MISSISSIPPI-ALABAMA

Bays & Bayous

SYMPOSIUM • 2008

Mississippi-Alabama Bays and Bayous Symposium Proceedings

October 28-29, 2008
Mississippi Coast Coliseum
and Convention Center
Biloxi, Mississippi

MASGP-08-037

Mississippi-Alabama Bays & Bayous Symposium

Sponsors

Without these organizations, this symposium would not be possible.

Acknowledgments

A symposium of this nature cannot succeed without the efforts and cooperation of a great number of individuals and their employers. We thank all presenters who submitted abstracts and made oral or poster presentations. This cutting-edge information will be of value to resource managers, policy makers, and citizens.

Planning and oversight for the symposium was provided by the symposium Steering Committee. We deeply appreciate the members' time and dedication to the final product.

Symposium Steering Committee:

- Dave Burrage – MSU Coastal Research & Extension Center and Mississippi-Alabama Sea Grant Extension Program
- Chris Boyd – MSU Coastal Research & Extension Center and Mississippi-Alabama Sea Grant Extension Program
- John Bowie – The Gulf of Mexico Program
- Mike Carron – Northern Gulf Institute
- Todd Davison – NOAA Gulf Coast Services Center
- John Dindo – Dauphin Island Sea Lab
- Martha Duvall – Gulf Coast Research Lab, The University of Southern Mississippi
- Jean Ellis – NASA Stennis Space Center
- Bill Hawkins – Gulf Coast Research Lab, The University of Southern Mississippi
- Tom Herder – Mobile Bay National Estuary Program
- Sharon Hodge – Northern Gulf Institute
- Amy King – ADCNR State Lands Division, Coastal Section
- John Mareska – Alabama Marine Resources Division
- Joanne McDonough – Alabama Gulf Coast Convention & Visitors Bureau and Auburn University Marine Extension Research Center
- Dave Ruple – Grand Bay National Estuarine Research Reserve
- Tina Sanchez – NOAA Gulf Coast Services Center
- Michael Shelton – Weeks Bay National Estuarine Research Reserve
- Stephanie Showalter – Mississippi-Alabama Sea Grant Legal Program
- Tina Shumate – Mississippi Department of Marine Resources
- Jody Thompson – Auburn University Marine Extension Research Center and Mississippi-Alabama Sea Grant Extension Program
- Bill Walker – Mississippi Department of Marine Resources
- Sharon Walker – The University of Southern Mississippi and Mississippi-Alabama Sea Grant Consortium

Special thanks to the following Mississippi-Alabama Sea Grant Consortium employees who served on the Symposium Steering Committee and worked tirelessly behind the scenes to make this event a success. They are: Kay Bruening, Devaney Cheramie, John Grigsby, Loretta Leist, Melissa Schneider, Steve Sempier, and Tracie Sempier.

Finally, we wish to thank the sponsors. Without these organizations, this symposium would not be possible.

LaDon Swann, Director
Mississippi-Alabama Sea Grant Consortium
Auburn University Marine Extension and Research Center

Preface

This meeting began in 1979 and was titled *Alabama's Bays, Bayous and Beaches Symposium*. In 1987, the symposium sought to update the findings of the 1979 symposium and widened the scope of papers to include the economic importance of coastal waters, educations programs and habitat restoration.

The 1995 symposium continued the tradition of scientific management reports while reaching out to local industry and governments. Water quality, watershed management, government cooperation and citizen involvement, government cooperation and citizen involvement were key topics addressed by a variety of papers. The stage was set for a new spirit of cooperation between Baldwin and Mobile counties in managing Alabama's coastal waters. Shortly after the symposium, Mobile Bay was approved for inclusion in the National Estuarine Program.

In 2006 it was decided that the meeting would be held every two years, rotating between Alabama and Mississippi, with the name rotating with each state (*Alabama-Mississippi Bays & Bayous Symposium* and *Mississippi-Alabama Bays & Bayous Symposium).* The 2006 meeting was held at the Mobile Convention Center in Mobile, AL, and drew more than 300 participants. There were 59 oral presentations and 37 poster presentations during the two concurrent sessions over the two-day period. Topics included water quality; living resources; habitat management; and natural hazards and coastal development.

We are pleased to host the 2008 Symposium at the Mississippi Coast Coliseum and Convention Center in Biloxi, MS. The two-day event will include three concurrent sessions with 91 oral presentations and 60 poster presentations. Topics will include coastal community action and stewardship; extension, outreach and education; natural hazards resiliency and the ocean's role in climate; water resources: supply and quality; living estuarine resources; and habitat management and restoration.

We hope you find the symposium interesting, educational and engaging and that you look forward to the next one in Alabama in 2010.

Keynote Speaker Biographies

Dr. Virginia Burkett
Chief Scientist for Global Change Research
U.S. Geological Survey

Dr. Virginia Burkett is the Chief Scientist for Global Change Research at the U.S. Geological Survey. She was formerly Chief of the Forest Ecology Branch at the National Wetlands Research Center and Associate Regional Chief Biologist for the USGS Central Region. Dr. Burkett has served as Director of the Louisiana Coastal Zone Management Program, Director of the Louisiana Department of Wildlife and Fisheries, and Assistant Director of the Louisiana Geological Survey. She has published extensively on the topics of global change and low-lying coastal zones. She was a Lead Author on the United Nation's IPCC Third and Fourth Assessment Reports (2001 and 2007) and an IPCC Technical Paper on Water (2007). She coordinated both the Coastal and Southeast synthesis chapters of the U.S. National Assessment of climate change and its impacts. During her career Dr. Burkett has been appointed to over 40 Commissions, Committees, Science Panels and Boards, and received a Nobel Prize in 2007 for work with the IPCC.

Dr. Steven Murawski
Director of Scientific Programs and Chief Science Advisor for NOAA Fisheries Service
National Oceanic and Atmospheric Administration (NOAA)

Dr. Steven Murawski is the Director of Scientific Programs and Chief Science Advisor for NOAA Fisheries Service, a position he has held since May of 2005. In addition to these duties, he was selected to be the NOAA Ecosystem Goal Team Lead in January 2006. As Goal Team Lead, Dr. Murawski is responsible for out-year strategic planning and budget development for all of NOAA's ecosystem activities which amount to $1.2 billion in 2008.

Currently, Dr. Murawski works to move forward ecosystem approaches to management both at NOAA and in conjunction with other federal agencies and international bodies. Prior to this, he was the Director of the NOAA Fisheries Office of Science and Technology. Dr. Murawski has considerable experience in the field of applied fisheries biology and quantitative fishery science and served as Chief Stock Assessment Scientist for the Northeast Fisheries Science Center in Woods Hole, Massachusetts (1990–2004).

His research background is in fisheries biology, population dynamics and stock assessment. He has published over 150 reports, articles and other documents, appearing several notable journals. During his career, Dr. Murawski has been a key representative on several committees and councils.

His current roles include official U.S. delegate to the International Council for the Exploration of the Sea (ICES), NOAA representative to the White House interagency Joint Sub-Committee on Science and Technology (JSOST), and member on the Global Ocean Ecosystems Dynamics (GLOBEC) Program Steering Committee. He received his Ph.D. from the University of Massachusetts–Amherst, in 1984.

Lunch Speaker Biographies

Dr. Bill Walker
Executive Director
Mississippi Department of Marine resources

Dr. Bill Walker is the Executive Director of the Mississippi Department of Marine Resources in Biloxi, MS. His research and teaching interests include: Fate and Effects of Pesticides/Toxins in Natural Environments; Bioassay Evaluations (Bioaccumulation, Food Chain Transfer, Sub-lethal Effects); and Toxic/Carcinogenic Responses in Small Fish Species.

Dr. Walker's grant history includes about $7.1 million over his career. Major funding agencies include U.S. Environmental Protection Agency, National Toxicology Program, National Biological Service, Department of the Army (DOD), National Cancer Institute (NIH), and private industry. He has over 40 peer-reviewed articles and over 100 national and regional presentations.

Dr. Walker earned his B.S. in Botany/Microbiology from Southeastern Louisiana University, and his M.S. and Ph.D. in Soil Microbiology/Biochemistry from Mississippi State University.

Mr. Stephen Sempier
Deputy Director
Mississippi-Alabama Sea Grant Consortium

Steve Sempier is Deputy Director at the Mississippi-Alabama Sea Grant Consortium and also serves as Sea Grant's Gulf of Mexico Regional Research Planning Coordinator. He is working with federal and state agencies, universities, and NGOs to develop a Gulf-wide plan that identifies and addresses regional research priorities and information needs. The four Gulf of Mexico Sea Grant College programs are leading this effort, and Steve works closes with each of these programs.

Steve has over ten years of professional marine science, aquaculture/fisheries, and teaching experience. Recent university employment includes working on a USDA aquaculture risk management project and working on a USAID program devoted to increasing food security in developing nations. He earned his B.S. in Marine Science/Biology at Eckerd College in St. Petersburg, Florida and an M.S. in Marine Resource Management/Fisheries Science at Oregon State University.

How to Use the Bays and Bayous CD-ROM

You will need Adobe Acrobat Reader to view the abstracts and most other documents on this CD. Acrobat Reader version 9.0 for Windows XP is provided on this CD for your convenience. A Macintosh version is also provided on the CD. Both versions are located in the folder called Reader.

Installing Adobe Acrobat Reader for Windows (PC)
Open the AdbeRdr90_en_us file on this CD.
Follow the onscreen instruction.
You will have to restart your computer to complete the installation.

Installing Adobe Acrobat Reader for Mac
Open the AdbeRdr812_en_US_i386.dmg file.
Follow instruction prompts to install the program.

Using the Table of Contents file
The abstracts for all presentations given at the 2008 Mississippi-Alabama Bays and Bayous Symposium are included on this CD. They are categorized by session topic: Coastal Community Action and Stewardship; Extension, Outreach and Education; Habitat Management and Restoration; Living Estuarine Resources; Natural Hazards Resiliency and the Ocean's Role in Climate; and Water Resources: Supply and Quality.

Oral and poster abstracts are listed in alphabetical order by title within each session. To view an abstract, find it on the Table of Contents and click on the title. A new window will open for every abstract selected.

Using keyword searches
To perform keyword searches, open the "Search Index" file on this disk. Enter one or more key words in the search box and then click search. A search window will display a list of documents that include your search criteria. To open a document, click the title.

MISSISSIPPI-ALABAMA

Bays & Bayous

SYMPOSIUM • 2008

Table of Contents

Coastal Community Action and Stewardship

Extension, Outreach and Education

Habitat Management and Restoration

Keynote and Guest Speakers

Living Estuarine Resources

Natural Hazards Resiliency and the Ocean's Role in Climate

Water Resources: Supply and Quality

Addendum

The Bays and Bayous Symposium took place Oct. 28-29, 2008, at the Mississippi Coast Coliseum and Convention Center in Biloxi, Miss.

ALABAMA VOLUNTEER PHYTOPLANKTON MONITORING NETWORK (ALVPMN)

Coastal Community Action and Stewardship
Poster Presentation
Lucie Novoveska* and Hugh L. MacIntyre
Dauphin Island Sea Lab and University of South Alabama
lnovoveska@disl.org

The Alabama Volunteer Phytoplankton Monitoring Network (ALVPMN) is an outreach program whose objectives are to monitor phytoplankton along the coast, identify trends and patterns in harmful algal blooms (HAB), and to increase awareness of phytoplankton related issues. Currently, we are establishing baseline of phytoplankton composition and abundances at nine stations along the Alabama coastline. Our volunteers sample one or more stations once every two weeks by towing a 20 μm net, identifying and counting the phytoplankton under the microscope, and recording their findings online. Nutrient and chlorophyll *a* analyses are provided for each of the samples by our lab, with funding from the Northern Gulf Institute and Alabama Department of Conservation and Natural Resources.

In the last year, volunteers have successfully detected blooms of three potentially toxic organisms: *Prorocentrum minimum* (dinoflagellate), *Pseudo-nitzschia spp.* (diatom), and the most recent bloom of *Chatonella spp*. (raphidophyte*).* Other toxic algae, such as the dinoflagellates *Dinophysis spp*. and *Pyrodinium bahamense*, the raphidophyte *Fibrocapsa spp*., and some filamentous cyanobacteria, were detected in small numbers, which emphasizes the importance of continuous monitoring. Our monitoring efforts failed to detect a bloom of red tide organism *Karenia brevis* in appropriate numbers due to the mesh size of the sampling nets. Blooms of other non-toxic diatoms (*Chaetoceros spp.*, *Skeletonema spp.*, *Nitzschia spp*, and *Rhizosolenia spp.*) were also recorded.

We work in close collaboration with colleagues at the Alabama Department of Public Health, and ALVPMN is identified as a component of The Harmful Algal Bloom (HAB) Response Plan for Alabama. Cell counts are archived online by the National Oceanic and Atmospheric Administration's Phytoplankton Monitoring Network (http://www.ncddc.noaa.gov/website/SEPMN/viewer.htm), which provided training and sampling equipment, and both cell counts and supporting data (physical hydrography, nutrient data, and chlorophyll concentrations) are archived on our own Web site (http://habs.disl.org/phytoplankton.html). Local outreach is achieved through talks to local citizens groups, such as Weeks Bay and Little Lagoon Preservation Society.

Figure 1. Photograph of *Pyrodinium bahamense* collected by volunteer Homer Singleton at Arnica Bay in February (left). Two cells of *Dinophysis caudata* collected by volunteer John Dismukes at Dauphin Island in April (right).

ASSESSING THE IMPACTS OF INDUSTRIAL ACTIVITY: ADDRESSING LOCAL NEEDS WITHIN A FEDERALLY-DRIVEN PROCESS

Coastal Community Action and Stewardship
Oral Presentation
Diane Austin*
Bureau of Applied Research in Anthropology, University of Arizona
daustin@u.arizona.edu

This presentation will provide a brief overview of offshore oil and gas exploration in the Gulf of Mexico and the involvement of people and communities from Alabama and Mississippi in this enterprise. It will then discuss an ongoing U.S. Minerals Management Service study of the social and economic impacts of this industry, and particularly the fabrication and shipbuilding sectors, on the coastal communities of these two states. It will describe the development and evolution of that study, the efforts to address local concerns within the study process, and the strengths and limitations of impact assessment in this context.

BUILDING WATERSHED PARTNERSHIPS
OLD FORT BAYOU BLUEWAY

Coastal Community Action and Stewardship
Oral Presentation
Judy Steckler*
Land Trust for the Mississippi Coastal Plain
judyltmcp@aol.com

In 2005, the Land Trust for the Mississippi Coastal Plain (LTMCP), with a grant from the Environmental Protection Agency (EPA) District IV, began development of community Watershed Partnerships in six watersheds that represented south Mississippi, both geographically and ecologically where LTMCP owns and manages lands, and in watersheds that demonstrated a need for restoration and protection.

One of the goals of the Watershed Partnerships was to facilitate community input to develop and implement a solution oriented action plan for protection and restoration and for public education. Within the Old Fort Bayou Watershed Partnership, the primary objective was to create a safe and beautiful Blueway for residents and visitors.

LTMCP, working with the National Park Service Rivers Trails and Conservation Assistance Program, City of Ocean Springs, and the Ocean Springs Chamber of Commerce, has designed an interpretive canoe and kayak trail that will improve public health and education by providing safe recreational access to Old Fort Bayou that links important conservation areas, historic properties, and parks along the route. The interpretive trail will incorporate a strong educational component into the overall design, trail map, interpretive signage, and brochure.

BUSINESS SENTIMENT TOWARDS RESIDENTIAL DEVELOPMENT IN SOUTHWEST ALABAMA

Coastal Community Action and Stewardship
Oral Presentation
Jennings Byrd*, Diane Hite, Luke Marzen, and Mac Martin
Department of Agricultural Economics and Rural Sociology, Auburn University
byrdwij@auburn.edu

A local survey of southwest Alabama working waterfront businesses is conducted. A primary objective is to identify business attitudes towards potential housing and condominium development. We develop a series of logit and ordered probit models to analyze this objective. We find that a variety of characteristics and needs present both a negative and positive relationship towards housing and condominium development. It is suggested that to secure the common property resource of accessible waterfronts, local governments, businesses, and developers should collaborate together to secure the necessary property rights to maintain accessible waterfronts for all.

THE CENTER FOR URBAN RURAL INTERFACE STUDIES AT MISSISSIPPI STATE UNIVERSITY: ADDRESSING "GROWING" NEEDS ACROSS THE NORTHERN GULF OF MEXICO

Coastal Community Action and Stewardship
Poster Presentation
Sidney Massey*
Center for Urban Rural Interface Studies
Mississippi State University/Coastal Research and Extension Center
skm15@msstate.edu

Population and land-use data, combined with abundant research on the science of watersheds, make it clear that land-use reforms are necessary to preserve coastal communities and ecosystems. Along I-10 corridor from Florida to Texas, coastal counties are growing exponentially. This trend of expansion into the hinterland is expected to increase because most of the available property on the immediate shoreline has already been developed. Urban sprawl affects not only the metropolitan areas from which it originates, but the surrounding communities onto which it infringes.

Each year, new developments appear in neighboring counties who benefit from the building and purchasing of new homes, but cannot afford the increased infrastructure required to support the new residents who work and play along the coast, which continues to benefit from commercial developments such as hotels and condominiums. Along with the increased pressure on the infrastructure of these rural counties comes the increased loss of jobs and land as traditional agricultural and forestry lands become developed into residential subdivisions and retail centers.

In an effort to reduce the effects of sprawl by educating communities on methods of sustainable development, the Mississippi State University Coastal Research and Extension Center in Biloxi established the Center for Urban Rural Interface Studies. The center serves as a resource for citizens, developers, stakeholders, and local officials. The regional scope of the Center consists of the coastal areas of Alabama, Louisiana, and Mississippi, and Florida.

THE CONTINUED RE-DEVELOPMENT OF THE WEST END OF DAUPHIN ISLAND, AL – A POLICY REVIEW

Coastal Community Action and Stewardship
Oral presentation
George F. Crozier*
Dauphin Island Sea Lab, Coastal Policy Center
gcrozier@disl.org

Dauphin Island is a barrier island at the mouth of Mobile Bay with a long history of human habitation and greatly expanded development over the past 50 years following the construction of the first bridge. Human occupation of the low western portion which is outside the protection of the ebb tidal delta southwest of the mouth of the Bay has been problematic since it began. Recently increased tropical activity and climate change has highlighted the inadequacy of our understanding of the role of these barrier features as well as the failure of public policy to properly manage them. The projections of extended and expanded storm impacts make this discussion imperative.

This presentation will chronicle the physical, economic, and sociological impacts of 30 years of storm impact. The reaction of the local community, state and federal programs, and the fiscal irresponsibility associated with continued redevelopment will be described, including comparisons of flood insurance compensations, Alabama vs. Dauphin Island. The role of the Stafford Act is pivotal in the management of these fragile ecosystems and will be reviewed. Sustainability of human occupation of these high-risk landforms is a major challenge and some alternatives will be reviewed.

THE ESTUARINE EDUCATION CENTER: PROMOTING ENVIRONMENTAL AWARENESS AND ECONOMIC DEVELOPMENT IN JACKSON COUNTY, MS

Coastal Community Action and Stewardship
Oral Presentation
Todd Adams* and Dr. Jason Pugh
Mississippi Gulf Coast Community College
todd.adams@mgccc.edu

The Estuarine Education Center (EEC) is located on the Jackson County campus of Mississippi Gulf Coast Community College. The waterfront is Mary Walker Bayou, a tributary of the Pascagoula River. This estuarine area is urban, with the headwater of Mary Walker Bayou starting in the City of Gautier, Mississippi. Runoff comes from streets, parking lots, residential areas, and the pine savannah of the Sandhill Crane refuge.

Figure 1. Aerial view of the EEC. Photo is oriented south. Photo credit: Doug Mansfield.

Encompassing 20 acres on the north end of campus, the Estuarine Education Center's architecture blends in with the environment. Special care was take to design the area with little disturbance to the natural environment and some LEED (Leadership in Energy and Environmental Design) concepts were used in the construction. Examples include pervious roads and parking areas to minimize stormwater runoff, limited clearing around building perimeters to protect native site features and vegetation, and low amounts or no volatile organic compounds in all building products.

The Estuarine Education Center will serve two purposes: education of college students and outreach to the community. Students preparing for a four-year degree in many natural/environmental sciences will find themselves utilizing the EEC for classroom lecture and laboratory space. While inside lab space is available, it is the dynamic outdoor lab which will engage the student in hands-on science. Students in the Outdoor Recreation Leadership program also share this open-air lab. The opportunity to hike, kayak, and canoe while learning "no-trace" techniques will prove to be invaluable to students in their future endeavors as professionals in their field.

The second purpose is community outreach. The facilities are available for governmental, educational, and corporate entities for conferences and workshops. An on-site ropes course helps build teamwork, confidence, and trust among community leaders and within their workplace. It is anticipated the exposure to the surrounding natural resources will help open minds and employ the communication process in regard to the environment. Mississippi Gulf Coast Community

College’s EEC looks forward to working with sister ecological organizations to promote environmental stewardship in addition to acting as an economic development tool in Jackson County to further re-enforce the idea that both the industrial and environmental communities can work together.

EVALUATING PROGRAM EFFORTS OF NON-GOVERNMENTAL ORGANIZATIONS FOR WATERSHEDS WITHIN THE NORTHERN GULF OF MEXICO

Coastal Community Action and Stewardship
Oral presentation
Robert F. Brzuszek *, Taze Fulford III, and Hall Roberts
Department of Landscape Architecture, Mississippi State University
rbrzuszek@lalc.msstate.edu

Non-governmental organizations (NGOs) are important entities in the education of the general public and the monitoring of water quality within regional ecosystems. Because of their independent nature, there can be a lack of coordination between individual NGO groups, state and federal agencies and a lack of comprehensive understanding of regional issues and efforts. This study developed a model to identify organizations working within selected watersheds of the northern Gulf of Mexico and categorized their efforts and programs. An analysis of this information could lead to focus areas for water quality issues within a region.

A survey questionnaire was developed that organized data into education and program categories. The survey questions included categories regarding drafting of water quality ordinances, managing land, wetland restoration projects, conservation easements, proposed development planning, monitoring water quality, and education programs. The survey also included questions on major issues of concern within watershed, water quality ordinance effectiveness, and challenges to enacting water quality ordinances. Twenty-two environmental organizations that directly work within four watersheds were identified, and they completed and submitted the survey information. Twenty-one were non-profit organizations, and there was one private corporation. Seven groups were surveyed in the Biloxi watershed (Mississippi); five within the Tchefuncte and Bogue Falaya rivers (Louisiana); five in the Fish River watershed (Alabama); and five in the New River (Florida).

This study revealed that environmental organizations are present and play an active and important role within each of the identified test watersheds of the Gulf Coast. These entities network with federal, state, and local governmental planning and environmental agencies, as well as other non-profit organizations; and are primarily concerned with conservation, enforcement, education, monitoring, and the drafting of water quality ordinances and standards. The results from the survey revealed that the efforts conducted within watersheds varied in programs resulting in gaps in critical water quality effectiveness. Multi-agency and non-profit organizations that are part of a larger comprehensive umbrella organization appear effective at being able to address multiple program areas and concerns. This method provides better avenues for missing program components and coordinates priority issues for watershed goals. The development of comparison models for NGOs could lead to better understanding for individual groups and their program development for regional water quality issues.

HOW SEA GRANT EXTENSION ENGAGES THE ASIAN-AMERICAN SECTOR OF THE GULF OF MEXICO COMMERCIAL FISHING INDUSTRY

Coastal Community Action and Stewardship
Oral Presentation
David Burrage*
Mississippi-Alabama Sea Grant Outreach Program
Mississippi State University Coastal Research and Extension Center
daveb@ext.msstate.edu

In past years, language and cultural barriers have prevented Extension from effectively engaging Vietnamese-Americans within the Gulf of Mexico fishing industry. The influx of many new Asian workers, primarily Vietnamese, into the northern Gulf of Mexico commercial fishing and seafood processing industries has required tactical change to more effectively reach these new constituents. In most instances, Asians have adapted quite well to working in the seafood industry. However, many of them do not speak or understand English well, which poses a communication problem, particularly in respect to compliance with regulations. As a group, the Asian community is very cooperative in sharing in their labor and finances, but they are also closed to outsiders they are not familiar with.

In the region's largest fishery, the shrimp fishery, most of the fishing power Gulf-wide is generated by Vietnamese-American owned and operated vessels. In 2006, 62 percent of the license sales in Mississippi for vessels greater than 45 feet in length went to people with Asian surnames. In Louisiana, Asians hold about 75 percent of the licenses for vessels greater than 50 feet in length. Similarly, about 65 percent of shrimp licenses in Alabama for vessels over 45 feet in length are held by Asians. As of October 2007, approximately one-third of Gulf of Mexico commercial boats with federal shrimp permits were owned and operated by Vietnamese-Americans.

The five Gulf of Mexico states each have various coastal areas where Vietnamese-American populations exist. Sea Grant Extension in each of the states have developed methods of engaging this constituency ranging from direct hires of bi-lingual personnel, collaboration with other agencies, and more traditional Extension programming, such as meetings and workshops; media outlets using newspaper columns, television news coverage, and press releases; event and aquaria displays; (informal) educational products; and a vast array of written materials including newsletters, reports, pamphlets, circulars, booklets, and books. Experience has shown what works and what doesn't when engaging this particular constituency.

LITTLE LAGOON PRESERVATION SOCIETY AND DAUPHIN ISLAND SEA LAB: A COLLABORATIVE EFFORT TO UNDERSTAND, PRESERVE, PROTECT, AND MANAGE ONE OF ALABAMA'S CROWN JEWELS

Coastal Community Action and Stewardship
Poster Presentation
James "Dennis" Hatfield*, H.L. MacIntyre, L. Novoveská, and J.D. Leifer
Little Lagoon Preservation Society – Gulf Shores, Alabama
scoopsinc@gulftel.com

Little Lagoon Preservation Society (LLPS) in Gulf Shores, Alabama, is a grassroots group that strives to preserve and improve the quality of life on and around Little Lagoon. The 8-mile-long, 1/2-mile-wide, E-W-oriented, shallow, saline lagoon is home to diverse and abundant flora and fauna. Spending quality time on Little Lagoon is a preferred activity for many of the 328 member families of LLPS, 6,000 residents of Gulf Shores, and 20,000 tourists who visit Gulf Shores on a peak summer day.

As part of our efforts to preserve and protect the Lagoon, LLPS has partnered with Dauphin Island Sea Lab (DISL) to monitor water quality and phytoplankton community composition. More than 15 trained (by DISL and SEPMN) LLPS volunteers and DISL researchers sample four locations in the Lagoon every two weeks. The team gathers field measurements and samples, prepares and analyzes samples, and enters and maintains observations in the SEPMN national data base and the DISL Water Chemistry and Phytoplankton database. Grant moneys from Alabama Department of Conservation and Natural Resources (ADCNR) and Mobile Bay National Estuary Program (MBNEP) support the nutrient analyses and have been used to supplement equipping our lab in Gulf Shores for the monitoring and research efforts, funding the LLPS Guest Speaker Initiative, and funding the LLPS Road and Park Sign Initiative.

Trend analysis of pigment and nutrient data suggest that groundwater inputs are a key driver of phytoplankton diversity and abundance. The abundance of phytoplankton is strongly correlated with nutrient concentrations in the lagoon, reflecting relatively slow flushing. The sampling has also documented blooms of the diatoms *Pseudo-nitzschia spp*. (potentially toxic) and *Skeletonema spp*. The potentially-toxic dinoflagellates *Karenia brevis* and *Dinophysis caudata* have also been detected in low numbers. Future hypothesis testing will focus on identifying significant groundwater inputs, quantifying their relative contribution to nutrient loads, and testing the relationships between discharge and the abundance and types of phytoplankton occurring in Little Lagoon.

In addition to support from ADCNR and MBNEP, our monitoring effort has been supported by the National Oceanic and Atmospheric Administration (NOAA) Southeastern Phytoplankton Monitoring Network (SEPMN), and by Alabama Department of Environmental Management (ADEM). These partnerships have facilitated LLPS gaining a reputation as a "cutting-edge" water-quality monitoring group with significant findings and credibility gains amongst our peer groups and with city, county, state and federal governments. City, county, and state officials/politicians regularly attend

our quarterly membership meetings, which have featured subject-matter experts from DISL, University of South Alabama, and The University of Alabama to date.

LIVIN' ON THE EDGE: MANATEES IN ALABAMA WATERS

Coastal Community Action and Stewardship
Oral Presentation
Claire M. Pabody*, Ruth H. Carmichael, and Lauren Waters
Dauphin Island Sea Lab
cpabody@disl.org

Once common throughout the Gulf of Mexico, West Indian manatees (*Trichechus manatus*) are now found primarily in Florida waters. Recently there has been an increase in the number of manatee sightings in areas west of Florida (e.g. AL, MS, LA, and TX), suggesting increased use of habitats at the outer margins of their range. Little is known about how manatees use extralimital habitats, and what is known has relied primarily on chance sightings.

Knowledge of manatee fringe populations and habitats may become increasingly important in coming years. Fringe habitats may experience more use if manatee recovery efforts increase populations in Florida, but habitat and food resources continue to decline from anthropogenic and natural pressures. Manatees utilizing fringe areas may be more susceptible to loss because of greater fluctuations in water temperature that cause cold stress and death. In addition, lack of community awareness of manatees in fringe habitats may result in detrimental human contact. Determining how and why manatees frequent extralimital locations is essential to guide development of management programs throughout their range.

Researchers at Dauphin Island Sea Lab in collaboration with Wildlife Trust in Florida initiated the first directed study of manatees in Alabama waters in 2007. Researchers compiled and analyzed historic records of manatee sightings in Alabama, established the first network to receive and track manatee sightings from the community, mapped reported sightings, and engaged in outreach activities to increase awareness of manatees in local waters. Mobile Manatees Sighting Network (MMSN) provided the community with a unified resource to report sightings. GIS maps of historic and 2007 sightings were made available online to show sighting locations and estimated habitat area. Press releases, presentations, flyers, and T-shirts served to alert citizens to MMSN and the presence of manatees in Alabama waters.

Historic data (1985-2006) showed an increase in manatee sightings in the past 20 years, with a significant increase in 2007 when MMSN was launched. It is as yet unclear whether increased sightings reflect increasing numbers of manatees in local waters or increased community awareness. Sightings were heavily distributed in rivers around Mobile Bay, however the greater number of residences on rivers may mean more people are likely to see and report manatees (as opposed to unpopulated areas such as the Delta).

The Mobile Manatees project has achieved several of its research and outreach goals. The network served as a contact for sightings from other southeastern states. Data provided by the project were responsible for Alabama Natural Heritage Program's decision to reclassify manatees from accidental to priority, recognizing them as seasonal residents in Alabama.

Thanks to continued funding, MMSN will continue to operate and expand. Continuation of MMSN will provide essential data about an ecologically important but understudied component of manatee populations in the United States. Standardization of publicity and outreach efforts will minimize the human factor influencing the number of reports. These data will be immediately useful to inform land-use planning and watersheet activities, reduce the chance of negative interactions between people and manatees, and allow both to share local waters. Longer-term, these data will help guide development of management and recovery programs for manatees in Alabama waters and provide a model for efforts in fringe habitats elsewhere.

MISSISSIPPI OYSTER STEWARDSHIP PROGRAM

Coastal Community Action and Stewardship
Oral Presentation
Bradley Randall*
Mississippi Department of Marine Resources Shellfish Bureau
bradley.randall@dmr.ms.gov

The Mississippi Oyster Stewardship Program brings together licensed commercial oyster fishermen, oyster processors, and others in the oyster business to explore ways to promote the wise use of oyster reefs.

Program participants share ideas about what they can voluntarily do in the process of running their commercial oyster businesses to improve the public oyster reefs. The DMR uses this program as a tool to help commercial oyster fishermen be more productive. Their input about this program and how to encourage other fishermen to participate by using best practices help make the program successful.

Major industries improve production by becoming more efficient. The oyster industry is made up of individual fishermen and small-business owners. The Mississippi Oyster Stewardship Program gives them a good mechanism to communicate information about smart oyster harvesting ideas. Many fishermen are participating in the program and adding input.

The DMR also provides information to educate those in the oyster industry and the public on the status of the resource. To ensure fishermen and the public receive accurate information about Mississippi Shellfish Bureau activities, the DMR has developed a newsletter and other materials.

MISSISSIPPI MASTER NATURALIST PROGRAM TRAINING AND CURRICULUM DEVELOPMENT

Coastal Community Action and Stewardship
Oral Presentation
Chris Boyd*
Coastal Research and Extension Center, Mississippi State University
cboyd@ext.msstate.edu

The Mississippi Master Naturalist Program training was conducted through the Mississippi State University Extension Service at the Coastal Research and Extension Center in Biloxi, Mississippi, from May 8 through June 26, 2008. To become a Certified Mississippi Master Naturalist, the trainee must complete a minimum of 40 hours of combined field and classroom instruction taught by regional experts, obtain a minimum of eight contact hours of approved advanced training, and complete a minimum of 40 hours of approved volunteer service. The classes and field trips included information about, ecology, soils, ecosystems, ornithology, plant science, entomology, water quality, weather and climate, geology, forest management, archaeology, native plants, forest ecology, fisheries, and wildlife management. The objective of the program is to improve public understanding of natural resource ecology and management by developing a pool of local knowledge about natural resource ecology. This pool of knowledge can be used to enhance education efforts within local communities and enhance existing natural resources education and outreach activities. Providing natural resources training at the local level develops a supply of dedicated and informed volunteers. The program also has the objective to expand the educational capabilities of extension efforts by the dissemination of natural resource management information to individuals and groups in the community.

The 26 participants included retirees, volunteer coordinators, nature tourism specialists, business owners, and extension agents. Curriculum development took more than 18 months. Curriculum modification will be based on participant's pre- and post-testing scores, course evaluations, and comments from the Mississippi Master Naturalist Curriculum Committee. The curriculum committee consists of Mississippi State University professors, extension county directors and extension agents. An increase in natural science knowledge of 42.5 ± 28.2 percent occurred based on the comparison of pre- and post-testing results. The program was a success based on class attendance (86.8 ± 5.2 percent) and evaluations. In the post-course evaluations, participants reported that the class was an overall success based on speaker expertise, diversity of topics covered, field trips, and networking opportunities. All responding participants found that the class increased their knowledge about natural resource management methods. Volunteer opportunities though working with the county extension directors, the United States Forest Service, National Oceanic and Atmospheric Administration, non-profit agencies, universities, 4-H programs, and other state and federal agencies is in development. A statewide program through the Mississippi State University Extension Service is being assessed.

OCEAN SPRINGS OUTDOORS*:* A BLUEWAY-GREENWAY PLAN THAT CAN BE USED AS A MODEL COMMUNITY CONSERVATION AND TOURISM PROJECT FOR GULF COAST COMMUNITIES

Coastal Community Action and Stewardship
Oral Presentation
Cynthia Ramseur* and Leah Bray*
Natural Capital Development
Cynthia@naturalcapitaldevelopment.com
Leah@naturalcapitaldevelopment.com

Ocean Springs Outdoors is a network of connected, safe trails, accessible to many user-groups. Our trails are visible, advertised, adopted and developed to enhance tourism and quality of life. Our blueway-greenway project promotes healthy physical outdoor activities and opportunities that will enable residents and visitors to:

- Safely explore the natural areas in and around Ocean Springs
- Learn about the ecosystems that surround Ocean Springs and how to protect them for future generations

Ocean Springs Outdoors will be released late August/early September 2008, the result of significant partnership efforts of the City of Ocean Springs' comprehensive planning process and the Ocean Springs Chamber of Commerce's blueway-greenway committee**.** This session will describe how the groundwork was accomplished and give an overview of the work yet to be complete. This presentation will provide information and a viable example for other coastal communities that are interested in providing high-quality adventures for tourists and outdoor recreation for residents.

In 2004, the Ocean Springs Chamber of Commerce, Visitors Bureau and Main Street began an effort to map and identify public access to the significant natural areas that surround the city: Gulf Islands National Seashore, Mississippi Sandhill Crane National Wildlife Refuge, Old Fort Bayou, Biloxi Bay, Davis Bayou, and the Mississippi Sound. Originally, the project was conceived to provide a companion marketing piece to the "Ocean Springs Shopping and Dining Guide." As discussion with state and federal owners of natural areas progressed, it became evident that more than a marketing piece was needed and wanted. We wanted a comprehensive plan to include a connected network of paddling, walking, birding, and biking trails.

A broad-based stakeholders meeting was scheduled for September 2005; obviously, project momentum was interrupted by the devastation of Hurricane Katrina. Even though Katrina was the worst natural disaster in American history, it also brought many opportunities to the region: an outpouring of private and public support from across the country brought experts from many fields and funding for rebuilding our coastal communities. In spring 2008, the Chamber of Commerce, in partnership with the City of Ocean Springs, re-convened the greenway-blueway committee to complete the work that was interrupted almost three years earlier.

The blueway-greenway project was built on information and concepts learned in the Nature Conservancy's Pascagoula River Ecotourism Study, funded by Jackson County Board of Supervisors and Coastal Impact Assistance Program. The blueway-greenway project was further informed by and built on results and lessons learned from Migration Discovery Festival (2002-2005) followed by Wild Wing River and Nature Festival (2005 and 2006).

Nature tourism creates important outdoor recreation opportunities for visitors and residents. It serves as a catalyst for economic growth and is a powerful incentive to conserve and protect natural ecosystems, biodiversity and scenic views. Healthy communities with access to unique, natural areas and outdoor recreational opportunities are well-positioned to compete internationally for job creation that depends on well-educated, adventurous, creative, and mobile young adults. Well-planned and managed nature tourism businesses can be an important component of regional tourism development, sustainable growth planning for cities and counties and conservation practices to protect natural resources for future generations.

RIVERS, TRAILS & CONSERVATION ASSISTANCE PROGRAM: THE COMMUNITY OUTREACH ARM OF THE NATIONAL PARK SERVICE ASSISTING GULF COAST COMMUNITIES IN CREATING A COASTWIDE NETWORK OF GREENWAYS AND BLUEWAYS

Coastal Community Action and Stewardship
Oral Presentation
Liz Smith-Incer*
National Park Service – Rivers, Trails & Conservation Assistance Program
liz_smith-incer@nps.gov

The Rivers, Trails & Conservation Assistance (RTCA) Program of the National Park Service (NPS) provides technical assistance to communities working to conserve rivers and open space and to establish trails and greenways.

The purpose of the Rivers and Trails Program is to empower local communities to achieve locally defined goals for natural resource conservation and outdoor recreation. In keeping with the NPS mission, "network" projects are encouraged – those that create physical connections in and between parks and communities and that contribute to local, regional, and state networks of parks, rivers, trails, greenways, and open spaces. The Rivers and Trails Program is particularly interested in projects that incorporate health and fitness goals as part of outdoor recreation planning.

Below is a brief synopsis of current RTCA projects, which will be discussed at the symposium:

Gulf Coast Heritage Trails of Jackson County
RTCA has convened stakeholders, identified planning goals, compiled information, and discussed and documented consensus-based strategies and priorities for bikeways, blueways, and walking trails in Jackson County, MS. It is anticipated that more than 50 miles of bikeways, blueways and walking trails, connecting natural, cultural, and historic sites along the Mississippi Gulf Coast will be created.

Gulf Coast Heritage Trails of Harrison County
Through meeting facilitation, RTCA has developed and built capacity of the Gulf Coast Heritage Trails Partnership. RTCA has collaboratively led the planning and implementation of a multiple-use recreational trail network made up of land-based and water-based trails in Harrison County, MS. It is anticipated that more than 100 miles of land-based and water-based trails, connecting natural, cultural, and historic sites along Mississippi Gulf Coast will be created.

Pascagoula River Basin Recreation Corridor
RTCA, in collaboration with partner agencies and conservation interests, has provided facilitation assistance in support of the creation of the Pascagoula River Basin Recreation Corridor. It is anticipated that 81 miles of water trail and more than 100 miles of multi-

use land-based trails will be created from the headwaters of the Pascagoula River, south, to its entrance into the Mississippi Sound.

Mississippi River Trail (MRT)

The MRT, once completed, will provide a 3,000-mile system of bicycle-friendly roads and multi-use pathways. There is significant impact in utilization of the MRT as an alternate transportation and recreation system that traverses the central United States. Impacting 20 million residents, connecting 400 communities in 123 counties in 10 states, linking 14 national parks and 14 U.S. Fish and Wildlife areas, the trail plays an important part in the public engagement with the river system. Working with MRT staff and city planners from Natchez and Vicksburg, RTCA has provided facilitation assistance in support of the development of segments of the MRT in Mississippi through MRT workshop planning.

SURVEYING AND MAPPING INVASIVE SPECIES TO IMPLEMENT BEST MANAGEMENT PRACTICES AT GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE

Coastal Community Action and Stewardship
Poster Presentation
Julius B. McIlwain*, Christopher A. May, Christina Mohrman, and Thomas Strange
Grand Bay National Estuarine Research Reserve
Mississippi Department of Marine Resources
jay.mcilwain@dmr.ms.gov

Invasive species can be found throughout a wide range of habitat within and adjacent to the Grand Bay National Estuarine Research Reserve's (Grand Bay NERR) boundary. According to Presidential Executive Order 13112 on invasive species, which was enacted in 1999, an invasive species is an "alien species" whose introduction does or is likely to cause economic or environmental harm or harm to human health. Since the arrival of the first known invasive species, land and natural resource managers have observed a significant loss of natural habitat and biodiversity. Without proper management, invasive species will continue to spread and displace native species through competition for nutrients and sunlight. Survey and mapping activities at Grand Bay NERR focus on the following known invasives: Cogongrass (*Imperata cylindrical*), Chinese Tallow (*Sapium sebiferum*), Chinese Privet (*Ligustrum sinense*), Japanese Climbing Fern (*Lygodium japonicum*), and Common Reed (*Phragmites australis*).

In order to effectively map invasive species, GPS and GIS technologies are utilized before, during, and after field surveys. With the use of ArcGIS, pre-surveying efforts include creating transects along predetermined locations and identifying disturbed areas such as trails, roads, power company rights-of-way, and waterways throughout the reserve. Field surveys are then conducted using a hand-held GPS to mark locations where invasives are found. A unique classification scheme that quantifies the area of infestation (Cogongrass) and the number of trees (Chinese Tallow) in an area is also used while ground-truthing. All GPS coordinates, unique classification schemes, other species present, and comments are recorded in a field notebook. Upon returning from the field, all data are entered into a spreadsheet and a distribution map is constructed to aid in future surveys and control methods. Future surveys will be conducted in order to map changes of the invasive species and to identify new areas of infestation. Grand Bay NERR will coordinate with other natural resource agencies in Jackson County, MS, and Mobile County, AL, to maintain current knowledge of preventive measures,

Figure 1. Photograph of Cogongrass surrounded by Chinese Tallows

invasion of new nonindigenous species or new invasions of known nonindigenous species in the area, and control and management techniques and actions. A combination of mechanical (mowing, discing, drum chopping) and chemical treatments (basal treatment, cut surface, foliar spray) will be implemented to properly treat, control, and, if possible, eradicate infested areas within the reserve.

WATERFRONT LAND USE COMPETITION IN SOUTHERN MOBILE COUNTY, ALABMAMA: A CASE FOR A GIS BASELINE INVENTORY

Coastal Community Action and Stewardship
Oral Presentation
Mac Martin*, Luke Marzen, Diane Hite, Jennings Byrd, and Nhuong Tran
Auburn University
martimw@auburn.edu

Concerns have been raised among owners of waterfront-dependent industries in the area relating to the threat of residential and condominium development along the waterfront of communities in south Mobile County. A culmination of events including Hurricane Katrina, high fuel and insurance costs, and a growing population in the area have stressed industries, such as seafood processors and shipbuilding operations, allowing more sanitized uses to move in. Waterfront-dependent business owners are concerned that such developments would price there businesses out of the market. They also claim that residential waterfront development would greatly decrease public accessibility along the waterfront. For this project, an inventory and mapping analysis in a GIS of waterfront-dependent businesses was taken in south Mobile County and the Mobile Causeway/Battleship Parkway in order to provide a baseline of the water-dependent business to help assess future change. Through fieldwork, coordinates were plotted for each business and were used to create building footprints. High resolution aerial photography was utilized to correctly locate and digitize business footprints, industrial waterfronts, and public access points along the water. The goal of this project was to better understand the economic and geospatial implications of the waterfront-dependent industries in the area.

BALDWIN COUNTY GRASSES IN CLASSES PROGRAM: GROWING NATIVE GRASSES FOR HABITAT RESTORATION

Extension, Education, and Outreach
Poster Presentation
Margaret H. Sedlecky* and Angela S. Underwood
Weeks Bay National Estuarine Research Reserve
weeksbay@gulftel.com

Healthy dune systems, marshes, and grass beds provide a number of environmental benefits including filtering pollution from run-off; reducing erosion; acting as buffers against storm surge and floods; serving as vital breeding and nursery grounds for most marine life; providing food and shelter for native wildlife; and acting as important recreational and commercial areas. After the hurricanes of 2005, almost all of Alabama's coastal habitats were severely damaged. Yet, those fragile habitats remain essential for the ongoing health of all the environs of south Alabama and for the quality of life of its residents. Therefore, it is essential that we protect and restore those ecosystems. The Baldwin County Grasses in Classes (BCGIC) program serves as a conduit to facilitate the restoration and protection of Alabama's coastal resources.

The BCGIC program coordinates and sustains a network of teachers, students, restoration specialists, and other community members to plan and implement restoration of the hurricane-ravaged coastal environments (dunes, salt marshes, longleaf pine, and freshwater emergent) of Baldwin County, Alabama. With guidance and assistance from restoration specialists and teachers, students from all seven public Baldwin County high schools grow native plants in outdoor nurseries they have constructed at their schools. Plants being grown include dune plants (sea oats, sea purslane, beach elder, bitter panicum, morning glory), salt marsh plants (smooth cordgrass, black needle rush, saltmeadow cordgrass), freshwater emergent plants (pickerelweed, hardstem bulrush, common rush, bulltongue arrowhead), and longleaf pine habitat plants (longleaf pine, wiregrass, big bluestem, little bluestem, lopsided indiangrass). By raising the plants to maturity in school nurseries, many expenses are curtailed and the cost of the planting project to government agencies is lowered significantly. During the school year, students work with environmental agency personnel to implement restoration projects on public lands, planting the native vegetation that they have grown. Since 2005, more than 1,000 students have participated in the BCGIC program and have planted approximately 21,000 native plants in coastal restoration projects in Baldwin County. The BCGIC program is aggressively working on the restoration of Alabama's coastal environments with outstanding results (Figures 1, 2, and 3).

Through participation in the BCGIC program, students learn the value of maintaining a healthy environment while participating in hands-on habitat restoration activities. The nurseries also provide an excellent educational resource for applying student learning to real world ecological and agricultural practices. The students become familiar with the life cycle of the plants they are growing and the importance of coastal ecosystems. This hands-on approach enhances education in schools as well as the health of Alabama's coastal environments.

Figure 1. Restoration April 2006 at Bon Secour National Wildlife Refuge. Sea oats and bitter panicum were planted behind sand fencing visible in the foreground.

Figure 2. Restoration April 2008 at Bon Secour National Wildlife Refuge. Sea oats and bitter panicum were planted in front of sand fencing. The sand fencing is no longer visible due to dune formation.

Figure 3. Monitoring July 2008 of restoration site at Bon Secour National Wildlife refuge. This picture is taken in front of the sand fencing which is no longer visible due to dune formation. Plants in front of the sand fencing have grown considerably since the April 2008 restoration.

BALDWIN COUNTY WATER FESTIVAL: RAISING AWARENESS OF FOURTH-GRADE STUDENTS ABOUT WATER AND WATERSHED PROTECTION

Extension, Outreach, and Education
Poster Presentation
Michael Shelton*
Weeks Bay Reserve, Alabama Department of Conservation and Natural Resources, Lands Division, Coastal Section
michael.shelton@dcnr.alabama.gov

Baldwin County has some of the most scenic streams, rivers, and bays along the Gulf Coast. Drinking water supplied in the county comes from groundwater sources. In a developing county, both resources are precious to area residents and necessary for a healthy quality of life for future generations. The functions and values of water resources and watershed protection need to be emphasized to area students. Started in 2004, the Baldwin County Water Festival educates fourth-grade students about water, related natural resources, and the responsibility that they and their families share in protecting water quality and quantity. Nearly 5,000 students and their teachers have participated in Water Festival, experiencing the activities which dramatically illustrate importance of water in their lives and the effects of human actions on the quality of water resources.

Figure 1. Students examine the behavior of sediment in water using the Pollutant Characterization activity.

Figure 2. Students use a spray bottle to simulate rain and to create runoff in the Model Watershed Activity.

Water Festival, which charges no fee to students, teachers, or schools, endeavors to instill in students a general environmental awareness and stewardship ethic. In turn, students can teach their peers and families about safeguarding ground and surface waters. During the event, each class participates in three dynamic, engaging, and hands-on activities, like building a watershed model to explore the causes of water runoff pollution and unwinding the coastal food web. Activities meet goals of the statewide fourth-grade science curriculum. The event is designed to be an educational, yet fun experience. Classes are kept together as a unit and rotated between rooms for the different activities. Following the activities, students are treated to an educational entertainment program. Also, teachers evaluate each year's event enabling event organizers to better meet student needs.

The people behind the Baldwin County Water Festival represent all parts of the local community: municipal staff, public water and utilities suppliers, concerned business people, Chambers of Commerce, environmental groups, and state agencies. A core group of these diverse individuals makes up the Water Festival Steering Committee and has been planning and hosting the event for the last five years. The Steering Committee has joined with the Baldwin County Board of Education to provide teachers with an exciting field trip opportunity. Trained volunteers perform instruction, as well as support roles: parking control, class guidance, cleanup, and all tasks that make Water Festival successful. Local businesses, utilities, volunteer groups, Baldwin County, and several state agencies provide support in the form of materials and donations. In its sixth year, the Baldwin County Water Festival remains a great experience for students and teachers.

BAYMOBILE: MARINE SCIENCE EDUCATION AND OUTREACH ROLLING THROUGH THE STATE OF ALABAMA

Extension, Outreach, and Education
Poster Presentation
Carrie Dixon*
Discovery Hall Programs, Dauphin Island Sea Lab
cdixon@disl.org

Fresh water from tributaries all over Alabama greatly influence the waters of Mobile Bay and the Gulf of Mexico every day. Though most Alabama residents do not live directly on the Gulf Coast, they have the ability to make a difference in the quality of Mobile Bay and Gulf Coast waters. The mission of BayMobile is to provide students, teachers, and communities in Alabama with a hands-on marine science experience to foster the development of better stewards of coastal resources.

Figure 1. Photograph of the DISL BayMobile. The truck travels throughout the state of Alabama providing marine science education and outreach programs.

BayMobile is the traveling outreach vehicle of Discovery Hall Programs at the Dauphin Island Sea Lab in Alabama. Its mission is to provide marine science outreach and education for communities and schools statewide. BayMobile targets a broad outreach audience including schools ranging from rural to inner-city communities. BayMobile targets the Ocean Literacy objectives focusing on the inextricable link between oceans and humans. By making the connection through the Mobile Bay watershed, students leave with a better grasp of the human and ocean connection. BayMobile brings preserved specimens from Mobile and the Gulf of Mexico and a watershed interactive model into classrooms for students to experience and touch up close. In our lessons, we stress the importance of watershed stewardship, showing the students how their local creeks and rivers reach the Gulf of Mexico and affect our coastal ecosystems. By giving communities and students the chance to touch the animals in our coastal waters, the message becomes very effective. In January of 2008 alone, all six marine educators at the Sea Lab were on the road visiting 32 different Alabama schools; more than 6,000 students in primary, middle, and high schools got to experience the BayMobile touch lab and learn about watershed stewardship.

BayMobile is a year-round education outreach program that travels throughout the state; however, the programs are not limited to the classroom. BayMobile is used as an outreach tool in public events, such as Gulf Coast Boat Shows, public venues, and a variety of festivals reaching highly diverse public audiences. The combination of BayMobile education outreach in Alabama classrooms and community outreach throughout the Gulf States reaches over 15,000 people each year.

“BRIDGING THE GAP” BETWEEN SCIENTISTS AND PRECOLLEGE TEACHERS, THEIR STUDENTS, AND THE PUBLIC CONCERNING COASTAL HAZARD RESILIENCY

Extension, Education, and Outreach
Oral Presentation
Sharon Walker*, Jessica Kastler, Mike Spranger, Dan Brook, and John Dindo
J.L. Scott Marine Education Center, The University of Southern Mississippi
sharon.walker@usm.edu

This presentation will focus on coastal hazard resiliency and the public’s need in being better prepared for these naturally or human-induced phenomena. The presenters will provide an overview concerning the manner in which content and activities are provided to K-12 teachers, their students, and members of the general public relative to coastal hazards. These hazards encompass hurricanes, tornadoes, tsunamis, earthquakes, flooding, erosion, harmful algal blooms, oil spills, and climate change — to include their impacts residents living along the ocean’s coasts and/or watersheds. This enhanced, coastal hazards awareness by these various groups will allow these coastal citizens to become more resilient for their personal safety, as well as their families, homes, property, pets, and household items. This presentation will culminate with a summary of the need and plans for implementing a national, public awareness campaign on a regional basis through increased coordination and collaborations through state and federal agencies, non-profit organizations, academia, and businesses and industry. Attendees will be provided coastal hazards materials on CD and in hard copy.

BRIDGING THE GAP: THE CHALLENGES OF INTEGRATING RESEARCH AND OUTREACH/EDUCATION ON SEA GRANT PROJECTS

Poster Presentation
Extension, Outreach, and Education
Loretta Leist*
Mississippi-Alabama Sea Grant Consortium
loretta.leist@usm.edu

Sea Grant's commitment to both supporting timely research and promoting the messages of that research is a unique and important part of its program. Research findings need to be translated into information that can be utilized by the general public and decision makers, applied by industries and possibly further developed on by other scientists in an efficient and effective manner.

The Mississippi-Alabama Sea Grant Consortium has approached this task by encouraging communication between its researchers and its extension, outreach and education staff and by requiring research proposals to address outreach and education activities as part of their research project. Both of these methods have worked in the past, but could be improved upon.

The National Sea Grant Office (NSGO) emphasizes the importance of this aspect of the Sea Grant College Programs. Efficient and innovative extension and outreach gives timely and accurate information to the end-users and decision makers. Open communication between researchers and extension staff allows the extension agents to combine the research messages and look at a larger picture of the problems and solutions. A "big-picture" message is often a stronger statement and will have more of an impact to the end-users. Additionally, in response to the encouragement from the NSGO, the Mississippi-Alabama Sea Grant Consortium doubled the percentage of evaluation points for the integration of education and outreach on research proposals from 10 percent to 20 percent in 2006 and, as a policy on supporting research only with research funds, no federal requested funding should be used for the outreach part of a research project.

Sea Grant research proposal writers are faced with the often daunting task of finding innovative ways to integrate their research with outreach and education. Researchers are not trained to do outreach and education and want to focus more on the scientific parts of their projects. Additionally, they are not well rewarded for these types of activities by their institutions. "Service" credits toward tenure and promotions are usually a small percentage and are not heavily weighted. Frustrated researchers often fail to adequately address this part of their proposal or default to using tired ideas. Unfortunately, this often demotes an otherwise good proposal.

In this presentation, I will present a few of the methods used by past and present researchers to address their outreach and education component and talk about current methods the Mississippi-Alabama Sea Grant Consortium uses to keep its extension and education staff up to date with the research projects. I hope this will initiate some

dialogue with the audience as to how to improve on the current methods we use to integrate extension and outreach and give future proposal writers ideas on how to strengthen their proposals.

THE BUSINESS OF NATURE

Extension, Outreach, and Education
Oral Presentation
Joanne McDonough*
Auburn University Marine Extension and Research Center, Mississippi-Alabama Sea Grant Consortium, Alabama Gulf Coast Convention and Visitors Bureau
jmcdonough@GulfShores.com

More than 71 million Americans 16 years and older participated in wildlife watching and spent over $45 billion on their activities, according to the latest wildlife-related recreation survey conducted by the U.S. Fish & Wildlife Service.

It is estimated that nearly 23 million visitors made Alabama their travel destination in 2007, contributing more than $9 billion to its economy and sustaining more than 170,000 jobs. Baldwin and Mobile counties attracted more than 7 million visitors who spent over $3 billion in the Gulf Coast region. A survey conducted by the Alabama Gulf Coast Convention & Visitors Bureau revealed that nearly 19 percent of visitors listed bird watching or wildlife-related recreation as activities they participated in, up from 8 percent in 2002. Visitor spending by this group increased from $37 million in 2002 to more than $100 million in 2006. The Alabama Coastal Birding Trail website has experienced a 91 percent increase in traffic since 2002.

Wildlife recreation is not only important as a leisure activity but also as a catalyst of economic growth, well-planned and managed nature tourism businesses can be a powerful incentive to conserve and protect biodiversity.

The Auburn University Marine Extension and Research Center, Mississippi-Alabama Sea Grant Consortium and the Alabama Gulf Coast Convention & Visitors Bureau launched a Nature Tourism Initiative in May 2007 to expedite the expansion of the coastal nature tourism industry. This unique partnership utilizes applied research programs, education, and marketing to improve the economic return of existing nature tourism businesses and to facilitate the development of sustainable new businesses.

COASTAL ENVIRONMENTAL EDUCATION OPPORTUNITIES FOR TEACHERS, STUDENTS, AND THE GENERAL PUBLIC AT THE MOBILE COUNTY PUBLIC SCHOOLS ENVIRONMENTAL STUDIES CENTER

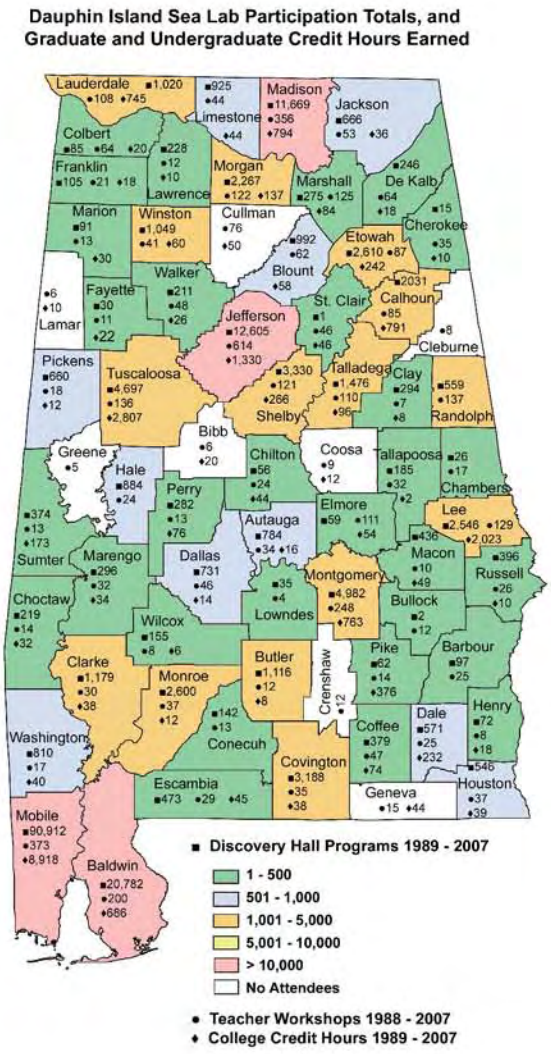
Extension, Outreach, and Education
Oral Presentation
Lloyd Scott* and Desiree Bishop*
Environmental Studies Center, Mobile County Public School System
dscott@mcpss.com, dvbishop@mcpss.com

Teachers, students, and the general public can access a variety of learning experiences dealing with wildlife conservation and related issues facing the environmental health of Alabama's coastal ecosystems. Through funding from the Mississippi-Alabama Sea Grant Consortium and collaboration with the Dauphin Island Sea Lab, Auburn University Marine Education and Research Center, and other state and local agencies, the Environmental Studies Center (ESC) engages over 22,000 visitors annually in hands-on study of the biological bounty of our coast and the pressures it faces from natural forces and man. The focus of the current Sea Grant funding is on public high school students. Project SEA ICE (Special Enrichment Activities In Coastal Ecology) is an ongoing project involving both teachers and students from 11 Mobile County public high schools in field study about wildlife and habitat diversity in coastal Alabama. Curriculum concepts and performance objectives identified in the project are aligned with National Science Education (NSES) Standards (1996) and the Alabama Science Course of Study. A cadre of 18 teachers, with course assignments in advanced biology (honors biology, Advanced Placement (AP) biology, and marine biology), participate in professional development activities designed to increase content knowledge, introduce innovative teaching strategies, and provide instructional resources for class use. Project teachers then engage their students in classroom and field experiences designed to: 1) identify coastal and marine species common to the northern Gulf of Mexico, 2) highlight examples of environment efforts to promote species recovery, 3) identify those populations currently classified as endangered, threatened, or of concern, and 4) promote positive behavioral changes regarding individual stewardship for the area's coastal wildlife resources. Each year, new professional development activities are provided to enhance teacher knowledge of coastal biology and current conditions influencing the successes and declines in species diversity. This presentation will cover the ESC's natural and man-made resources that enhance environmental study, the various programs that are available to area schools and the general public, and the partnerships that strengthen the ESC's on-site and outreach capability. It will also summarize Project SEA ICE, which is funded through a grant from the Mississippi-Alabama Sea Grant Consortium.

DAUPHIN ISLAND SEA LAB: DISCOVERY HALL PROGRAMS

Extension, Education, and Outreach
Oral Presentation
Greg Graeber*
Dauphin Island Sea Lab: Discovery Hall Programs
ggraeber@disl.org

The Discovery Hall Programs at the Dauphin Island Sea Lab offers field-based science education courses. The Sea Lab is an ideal site for educating K-12 students about the wonders of Mobile Bay and the northern Gulf of Mexico. Discovery Hall educates 11,000 to 12,000 students yearly from around the Southeast.



Schools travel to the island throughout the academic year and participate in a variety of field and lab-based courses. These courses are aligned with Ocean Literacy: Essential Principles and Fundamental Concepts, and State and National Science Standards.

The Touch Lab introduces a variety of marine creatures with a short "character sketch" of each animal's life cycle and place in the marine environment. For older students, the Phylum Mollusca is emphasized, and the anatomy of cephalopods is examined through a well-structured squid dissection. This course corresponds to Ocean Literacy: Fundamental Principle # 5, due to the diversity of vertebrates and invertebrates shown during the class.

The Beach Walk presents the topics of ever-changing barrier islands, beach zonation, maritime forest flora/fauna, coastal erosion, and ecology.

The Salt Marsh Ecology class introduces students to estuaries and the important concept of how the estuary is a nursery for marine animals. At the salt marsh, the group uses various sampling equipment to catch and then identify animals. A major component of

this course is aligned with Sea Grant's mission of environmental stewardship and responsible use of our coastal resources.

The Oceanography course comprises the physical and chemical aspects of the ocean. In the Gulf of Mexico, students measure wave crests, troughs, frequency, and the long shore current. They are provided tools to measure other parameters, such as wind speed, salinity, and air/water temperature. This course includes a classroom portion on tides, currents, and the ocean's influence on our coastal areas.

The group will board our research vessel and trawl in Mobile Bay and/or the Gulf of Mexico to collect and identify animals that inhabit our coastal waters. Students will have the opportunity to use scientific equipment to observe plankton and to measure physical parameters while at sea.

Students will learn about plankton and its role in the ocean ecosystem. The class teaches students how the tiniest of ocean life makes the earth habitable for everyone. The class will pull plankton nets in the Gulf and observe their samples under the microscope. The "What's in the Water?" class emphasizes environmental stewardship, the water cycle, and watersheds by showing the interconnectedness of students to their watery world. The class will use models to demonstrate point and non-point source pollution, and discuss how humans contribute to these and other water resource issues. Students will collect marine debris from the beach, and analyze it back in the classroom.

EDUCATION AND OUTREACH AT THE DAUPHIN ISLAND SEA LAB ESTUARIUM

Extension, Education, and Outreach
Oral Presentation
Mendel Graeber*
Dauphin Island Sea Lab
mgraeber@disl.org

The Estuarium is the public aquarium of the Dauphin Island Sea Lab (DISL), Alabama's marine education and research center. The 10,000-square-foot exhibit hall of the Estuarium is dedicated to showcasing four key habitats of coastal Alabama: the Mobile delta, the Mobile Bay estuary, barrier islands, and the Gulf of Mexico. Just outside the Estuarium, the Living Marsh Boardwalk leads visitors through a rebuilt salt marsh. The Estuarium has received more than 660,000 visitors since it opened in 1998, and is therefore a critical and effective venue for public outreach in marine science.

DISL has been a member of the Mississippi-Alabama Sea Grant Consortium for the past two decades. The education and outreach missions of both complement each other and enhance efforts undertaken by either organization. The support offered by Sea Grant can be seen directly in the Estuarium in our Underwater Exploration exhibit, signage on the mission of Sea Grant, and a new marine debris display on the boardwalk.

The Northern Gulf Institute (NGI) brings together five research institutions and is authorized by NOAA's Office of Oceanic and Atmospheric Research to develop and maintain a center of excellence in research relevant to the Northern Gulf of Mexico region. The goal of NGI is to develop and maintain a research and transition program that fills priority gaps or reduces limitations in current awareness, understanding, and decision support between upland-watershed systems and coastal waters, habitats, resources, and hazards.

Funding support from NGI has enabled the Estuarium to offer some exciting new things to visitors. Last August, there was an educator positioned in the Estuarium for the first time since its inception. Before then, visitors were engaged by a knowledgeable corps of docents, and to a limited extent, the aquarists. However, the educator has been able to add to the visitors' experience through direct interaction, support of the docent program, the revision of curricular materials, and the addition of new activities and exhibits. One of the ongoing projects is the revamping of the early-education Billy Goat Hole Room. In the works for this room, among other things, are a fishing game designed to teach about fishing regulations and sustainability, and a series of manipulative cloth habitat "puzzles," designed to teach about organisms' niches. This past summer, the Estuarium offered to the public several field excursions previously offered only to K-12 students and teachers. There were two different excursions offered, both led by the Estuarium educator, one through the maritime forest, dune field, and along the beach, and one to the salt marsh.

The Estuarium is an effective and dynamic tool for reaching the public. It is ever expanding its offerings. Some of the other new exhibits include a new oyster reef tank and a life-sized model of a mosasaur. Because it is part of DISL, a research facility with a 27-year history of quality K-

12 and teacher education, the Estuarium is uniquely positioned to offer the public a relevant and current marine education.

EDUCATIONAL PROGRAMS FOR DEVELOPERS AND REALTORS

Extension, Education, and Outreach
Oral Presentation
Emily H. Sommer* and Kevin D. White*
grassroots, inc.
sommeremily@bellsouth.net

Since 1997, *grassroots, inc.*, a 501©3 organization in Mobile, Alabama, has developed continuing education courses on responsible land use and brought them to Realtors, developers and elected officials. Courses on such topics as storm water management, preservation of wetlands as amenities, and low-impact site design have been enthusiastically received and repeatedly requested. The success of these programs proves that an effective balance between environmental concerns and residential development can be struck.

In 2005, the U.S. Environmental Protection Agency provided funds to develop an online version of "Water Runs Down Hill" (non-point source pollution), which has been achieved and distributed state-wide in Alabama in 2008. The National Association of Realtors has given a Smart Growth grant to a partnership of Mobile Area Association of Realtors and *grassroots, inc.* to develop an online program on flood plains and flood insurance, “Water Sometimes Rises.” This course is currently under final review.

Each course is taught by a cadre of four instructors: a marine biologist, a landscape architect, a civil engineer, and a Realtor. The information is lively, innovative and of interest to the general public.

The success of these programs with principal land-users, such as Realtors and developers, is based on several premises:

(1) These users are in private enterprise and do not get paid a salary for attending environmental seminars. Attendance at an educational program costs them money in lost revenue. Fees must be kept low and attendance time limited.

(2) Continuing education credit is an essential draw for these students.

(3) The environmental principles are presented as desirable and cost-effective elements of real estate development.

Each state requires continuing education courses for real estate license renewal. Alabama has a biannual renewal period. Mississippi and Louisiana have yearly renewal. There are 31 association/boards in Alabama with 17,000 members. Mississippi has 20 boards with 6,000 members, and Louisiana's 13 multi-parish boards have 20,000 members.

The g*rassroots, inc.* organization distributes these programs through the development of a unique system of profit-sharing partnerships with the autonomous real estate associations/boards. To our knowledge, this is the first time such an arrangement has been made.

“Water Sometimes Rises” presents facts on flood plains and flood insurance that are not widely known or appreciated by Realtors and developers or the general public. Changes in the watershed made by current development practices are illustrated and their costs in flooding are emphasized. The hydrology of creating flood maps is explained in lay terms and so is the fact that these maps should be taken as an estimate rather than a guarantee. Flood insurance costs and disaster loans are compared, and the Community Rating System for lowering insurance costs is explained.

Students receive a copy of “Navigating the National Flood Insurance Program,” a brochure developed by Mississippi-Alabama Sea Grant Consortium and Auburn University Marine Extension and Research Center.

ESTUARIES.GOV – AN E-TOOL FOR "EDGE"UCATORS AND "K THROUGH GRAY" LEARNERS

Extension, Education, and Outreach
Oral Presentation
Jennifer Buchanan* and Margaret Sedlecky*
Grand Bay and Weeks Bay National Estuarine Research Reserves
jen.buchanan@dmr.ms.gov
weeksbay@gulftel.com

Estuaries occur where the rivers meet the sea. They occur along the edges of our planet's one, big ocean. Estuaries.gov helps educators bring the beauty and the importance of these estuaries into classrooms and educational programs. This site provides, primarily, an avenue for elementary, middle and high school students, their teachers and other learners of all ages to learn more about estuaries, their resources and ongoing research and to explore the National Oceanic and Atmospheric Administration's (NOAA's) "living laboratories" – the National Estuarine Research Reserves.

Estuaries.gov delivers scientific information and real-time data in a meaningful form for anyone interested in estuaries – or simply in need of a reliable resource. It provides current information on a variety of educational and stewardship-related opportunities offered at local estuarine research reserves. It also provides the most recent research results of estuarine science. Volunteers working on coastal or estuarine-related issues; formal or informal educators; parents looking for supplementary materials; home-schoolers; students; representatives of non-profit, after-school programs, private conservation, or other community groups who are interested in estuarine and coastal issues are all among those who can benefit from the information presented on estuaries.gov.

Figure 1. A facsimile of a portion of the home page for the newly-updated and repopulated estuaries.gov Web site—Your source for learning and teaching about estuaries.

Estuaries.gov is the educational site for NOAA's National Estuarine Research Reserve System (NERRS) and is managed and maintained by NERRS education staff. The site is an important part of the NERRS efforts to communicate and advance ocean and estuarine literacy nationwide. It continues to be an interagency Website with partners such as NOAA's Chesapeake Bay Office and the Environmental Protection Agency's National Estuary Program.

GIVE THEM SOMETHING TO TALK ABOUT: STRATEGIES TO PUT YOUR WORK IN THE PUBLIC EYE

Extension, Outreach, and Education
Poster Presentation
Melissa Schneider*
Mississippi-Alabama Sea Grant Consortium
melissa.schneider@usm.edu

Scientists, educators and extension agents often have valuable and interesting information to share with members of the public, but sometimes the information doesn't reach them. This presentation will highlight how scientists, educators, extension agents and members of community action groups can get their newsworthy events covered by newspapers and television stations, as well as included in newsletters and on Web sites.

Universities, government organizations, and school districts often have a public relations office that can write press releases and articles about events, as well as pitch them to media outlets for placement. Making a visit or placing a phone call to your public relations office to tell them about your project can result in your work being introduced to the public through several outlets. The key is to let your public relations people know when you have a project to highlight or a story to tell.

Members of smaller organizations or educators that do not have a public relations staff can follow a few simple steps to get their events, meetings, and accomplishments noticed by media outlets. A clear, concise press release can open doors for news to be shared with their communities. This presentation will include basic tips on how to write a press release and will show that many news stories, listings, and similar information for dissemination, can come from a single press release.

GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE'S COASTAL TRAINING PROGRAM: UTILIZING FORMATIVE EVALUATION STRATEGIES TO ASSESS EMERGING RESOURCE MANAGEMENT PRIORITIES AND DESIGN MEANINGFUL TRAINING EXPERIENCES

Extension, Outreach, and Education
Poster Presentation
Marian Hanisko*
Grand Bay National Estuarine Research Reserve
marian.hanisko@dmr.ms.gov

The National Estuarine Research Reserves' (NERRs') Coastal Training Programs (CTPs) incorporate formative evaluation tools and strategies to stay informed of the emerging needs and interests of target audiences. This poster presentation will focus on the specific instruments that have enabled Grand Bay NERR's CTP to gauge the information needs and training priorities of its primary target audiences in a fluctuating climate, and it will illustrate how these tools have ultimately contributed to the viability and success of the program.

Grand Bay NERR's CTP conducts detailed market analysis and needs assessment studies every three years to evaluate the following: CTP's niche in the existing resource management training market, potential training partners, target audiences, and specific information needs of targeted audiences. The results of these detailed assessments are used to build a three-year program strategy. A successful strategy incorporates a degree of flexibility to allow for changes in the training priorities of target audiences. Emerging needs are routinely assessed through the use of formative evaluation measures including event evaluations and stakeholder input gathered through conversations with workshop participants, in-depth interviews with key members of the target audience community, and from the suggestions and advice of the CTP's multi-stakeholder representative advisory committee. Synthesis of data from these various sources enables the NERR to periodically review its training curriculum and make adjustments to offer practical, pertinent training opportunities that truly meet the educational needs of target audiences.

GULF OF MEXICO ALLIANCE ENVIRONMENTAL EDUCATION NETWORK

Extension, Education, and Outreach
Oral Presentation
Lee S. Yokel*
Dauphin Island Sea Lab/Gulf of Mexico Alliance
lyokel@disl.org

The Gulf of Mexico Alliance (GOMA) is a regional collaborative among federal, state, and other interests to address shared issues of coastal ecosystems. In March of 2006, the Governors' Action Plan for a Healthy and Resilient Coast was signed by all five Gulf of Mexico governors. The Action Plan identified five major, shared issues to address: Water Quality for Healthy Beaches and Shellfish Beds; Wetland and Coastal Conservation and Restoration; Identification and Characterization of Gulf Habitats; Reducing Nutrient Inputs to Coastal Ecosystems; and Environmental Education. A sixth issue, Community Coastal Resiliency, was added in 2008. Each of these areas identified goals, major actions, and partners with commitments to implement various sections of the plan within 36 months.

GOMA environmental education actions aim to contribute to building a Gulf stewardship ethic, strengthening the region's science literacy, and empowering a new generation of informed leaders. With these goals is the need to transfer successes among multiple audiences. The long-term Environmental Education Partnership Goals identified increasing awareness and stewardship of Gulf coastal resources.

To begin to address these issues, an Environmental Education Network (EEN) was initiated to bring together various educational interests around the Gulf. A Steering Committee was created. Volunteers have helped to establish a working group for Underserved and Underrepresented Populations, securing grants for pilot projects. Grants through the National Oceanic and Atmospheric Administration and the U.S. Environmental Protection Agency's Gulf of Mexico Program have supported the first steps of a public awareness campaign and extensive media relationships. The U.S. Geological Survey National Wetlands Research Center is developing an exhaustive database of educational resources that is available online. Networking within the Alliance continues to build new partnerships and relationships around the Gulf.

In 2008, GOMA began preparing the next action plan. Meetings were held around the five states to gather input from professionals for input on priorities of environmental education. Critical issues identified across all five states included: continued need for public awareness, expansion of underserved and underrepresented population pilot programs, experiential learning opportunities for K-12 audiences, addressing environmental education at various levels within individual state educational standards, the utilization of best available technology related to education and communication, and the always present need for continued funding of environmental education efforts.

This presentation will provide a brief overview of GOMA, the status of current education actions, plans for the future, and how educational professionals can participate in the Environmental Education Network.

HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP) TRAINING FOR THE SEAFOOD INDUSTRY AND REGULATORS IN MISSISSIPPI AND ALABAMA

Extension, Outreach, and Education
Oral Presentation
Robert Becker*
Mississippi-Alabama Sea Grant Consortium
Department of Fisheries and Allied Aquacultures, Auburn University
robertwbeckerjr@aol.com

The U.S. Food and Drug Administration (FDA) Seafood Hazard Analysis and Critical Control Points (HACCP) Regulation was enacted to control food safety hazards in the seafood industry. These include biological hazards like *Clostridium botulinum* and *Staphylococcus aureus*; chemical hazards like mercury, allergens, and histamines; and physical hazards like metal and glass fragments. A significant part of the regulation requires seafood processors to have HACCP-trained individuals involved in controlling their food safety hazards.

Since the inception of the Seafood HACCP Regulation, Sea Grant has been very involved in HACCP training for industry and regulatory individuals. This past year the Mississippi-Alabama Sea Grant conducted two three-day Seafood HACCP courses with a combined total of 32 students. FDA and state officials also assisted with these courses. Twenty-three of the students were seafood industry owners or representatives that will return to their processing facilities and assist with fulfilling their firm's HACCP responsibilities. Nine of the students were state regulatory officials who will be inspecting seafood processors in their respective states and evaluating compliance with the HACCP regulation. Because of the training made available by the Sea Grant program, the Seafood HACCP program can continue to support the seafood industry and help them provide clean and safe products to the general public.

The FDA's Seafood HACCP Regulation became effective in 1997. At that time a significant portion of the seafood industry did not have control of the food safety hazards associated with their particular seafood products. For example, there were no required controls for handling scombrotoxin species fish, no written records required for processing ready-to-eat seafood and no required sanitation records.

The Alabama crabmeat industry is a great example of a HACCP success story. Before the FDA Seafood HACCP Regulation became effective, there were about 25 crabmeat processors in southern Alabama, mostly small family-owned businesses. These firms first cook the live blue crabs, *Callinectes sapidus*, and then handle them extensively to produce ready-to-eat fresh picked crabmeat that is held under refrigeration until consumed by the general public. The opportunities for inadequate cooking, bacterial contamination and significant time/temperature abuse are great in this process. Of the 25 crabmeat processors, none had any cooking records, none had any written processing records and none had any written sanitation records. At one time or another, almost all of

them had samples analyzed by the state or FDA that were found to contain unacceptable levels of bacteria. Today all of the crabmeat processors maintain written cooking records, processing records and sanitation records on a daily basis and these records are routinely reviewed by a HACCP-trained individual to assure HACCP compliance. Today, like other seafood processors using HACCP controls, food safety hazards are being identified and controlled in a much more direct manner, the consuming public is much better protected, and the shelf-life of seafood products has increased significantly.

HIGH SCHOOL AQUACULTURE PROGRAMS:
A SUCCESS STORY AND MODEL FOR FUTURE PROGRAMS

Extension, Outreach, and Education
Oral Presentation
Phillip L. Waters, Jr.* and Julian Stewart
Auburn University Marine Extension and Research Center, Alabama Cooperative Extension System, Mississippi-Alabama Sea Grant Consortium
waterph@aces.edu

High school aquaculture programs have become an innovative method through which teachers can reach students using a hands-on method that promotes subject-based learning and character development. In the era of computers, game consoles, and television, teachers are competing not only for students' time, but also their attention. Students become bored in standard lecture classes, and though capable of performing well, disconnect early, and their performance suffers.

Aquaculture, when used as a teaching tool in high schools, allows teachers to reconnect students to the subject matter. Biology, chemistry, math, physics, and environmental sciences are only a few of the potential courses which can be taught through aquaculture. By engaging the students in hands-on applications, a teacher is able to maintain the attention of the student, who can then learn course material that may otherwise be lost in a standard lecture format.

Figure 1. Students inject Koi with carp pituitary to induce ovulation.

In addition to delivering course materials, teachers play a large role in the development of their students as responsible adults. Aquaculture programs aid in this by providing leadership opportunities, while requiring students to demonstrate life skills, including responsibility, team work, and problem solving.

Alma Bryant High School is an excellent example of the potential aquaculture can bring to the classroom. Located in southwest Alabama, this program has grown and adapted over several years to take advantage of a variety of opportunities while providing an outstanding educational opportunity to its students.

J.L. SCOTT MARINE EDUCATION CENTER: 2007-2008 ACADEMIC YEAR AND FUNDED PROJECTS FOR 2008-2010

Extension, Outreach and Education
Oral Presentation
Shelia A. Brown*
J.L. Scott Marine Education Center
Gulf Coast Research Laboratory
The University of Southern Mississippi
shelia.brown@usm.edu

The J.L. Scott Marine Education Center (MEC) is the education and outreach arm of the University of Southern Mississippi (USM) Gulf Coast Research Laboratory (GCRL). Research at GCRL focuses on sustainable coastal and marine resources, development of new marine technologies, and the education of future scientists and citizens. The MEC focuses on both formal and informal education. The MEC is one of the 10 Centers for Ocean Sciences Education Excellence (COSEE) in the U.S. COSEE Centers work to form partnerships between research scientists and educators, disseminate best practices in ocean sciences education, and promote ocean education as a charismatic, interdisciplinary vehicle for creating a more scientifically literate population. In the fall 2007, the MEC was designated as a Coastal Ecosystem Learning Center (CELC). The network of CELCs was established in 1996 by the Coastal America Partnership to combine the resources of federal agencies with marine education centers. Currently 20 CELCs exist in the United States. The goal of each Learning Center is to educate and involve the public in protecting our nation's coastal ecosystems.

The MEC conducts a variety of programs that emphasize a commitment to the ocean literacy principles and concepts and to fostering environmental stewardship values. Target audiences of the programs include K-12 students, pre-service and in-service teachers, and the general public. The student (K-12) components that are active post-Hurricane Katrina are the Coastal Sciences Camps, Coastal Sciences Investigation Camps, and Sea Camps. Summer Sea Camps and Coastal Science Investigation Camps are five-day, non-residential camps implemented during the summer. Both camps include kayaking, fishing, cast netting, field sampling, and specimen identification, as well as trips to Ship and Deer Islands, off the coast of Mississippi on one or more of the GCRL's fleet of boats, *R/V Tom McIlwain, R/V Hermes, and R/V Sea Explorer*. The camps include classes on beach and barrier island ecology and marsh and bog ecology. The Coastal Sciences Camps are held during the academic year (September-October and March to mid-May). These camps are field-oriented, residential camps lasting one to five days.

The teacher training workshops and summer institutes focus on various aspects of marine sciences and coastal biology. Teacher workshops are typically sponsored by local, state, and national agencies. Example agencies include Mississippi Department of Marine Resources, National Science Foundation, National Oceanic and Atmospheric Administration-Ocean Exploration, Environmental Protection Agency-Gulf of Mexico Program, and Mississippi-Alabama Sea Grant Consortium. For implementation of many of the teacher-oriented programs, partnerships have been developed with the Grand Bay National Estuarine Research Reserve

(GNDNEER), Gulf Islands National Seashore (GUIS) Davis Bayou, and Pennsylvania State University (PSU).

Public outreach programs include participation in local festivals (Wooden Boat Show, Peter Anderson Festival, Celebrate the Gulf, Mullet Festival, Earth Day [GUIS]) and public lectures. Presently the MEC is a cosponsor of Celebrate the Gulf.

All student and teacher programs are evaluated quantitatively and qualitatively. Pretest/posttest and Likert-scale data for the 2007-2008 academic year will be presented. Information on newly funded projects will also be presented.

LEARNING FROM TRAGEDY: BETTER SCIENCE COMMUNICATION THROUGH VISUALIZATION PRODUCTS

Extension, Education, and Outreach
Poster Presentation
Joseph Swaykos*, Christina Simoniello, Jessica Kastler, Sharon Walker, and Michael Spranger
The University of Southern Mississippi
joe.swaykos@usm.edu

Teachable moments often arise when least expected and from circumstances beyond our control. Taking advantage of and learning from these opportunities is an excellent way to educate citizens about the nature of science inquiry and to establish connections between personal behaviors and ecological outcomes. Using three case studies, the series of events from field observation, to scientific investigation, to management strategies, to education and outreach activities will be presented. Case studies will emphasize the use of archived and real-time coastal ocean observing system data to identify the causes of flounder die offs along the Grand Strand of the South Carolina coast, coral die offs in the Florida Keys, and grouper life histories in the Gulf of Mexico. Each case study addresses a current research priority area for the Gulf of Mexico. For example, hypoxia, harmful algal blooms and fisheries regulations will be discussed from both research, and outreach and education perspectives.

Tapping into the education potential of observing systems, the Gulf of Mexico Coastal Ocean Observing System (GCOOS) Education and Outreach Council (EOC) is in the process of developing education products for sea surface temperature, ocean currents, water level, and chlorophyll. The goal is to provide access to and understanding of oceanographic and meteorological information, in a way that emphasizes relevance to the lives of those living and working in the Gulf Coast States. Participants will get a view of the products under development by the GCOOS EOC, and an appreciation of the wealth of resources, collaborations, and leveraging taking place in the Gulf, all with the common goal of improving ocean literacy and promoting environmental stewardship.

MANAGING METADATA AND ARCHIVING DATASETS AT DAUPHIN ISLAND SEA LAB

Extension, Education, and Outreach
Oral Presentation
Rachel Nowlin* and Lei Hu
Dauphin Island Sea Lab
rnowlin@disl.org

The environmental and ecological data acquired from research at the Dauphin Island Sea Lab (DISL) is potentially valuable to researchers, managers, policy makers, the general public, and anyone seeking to understand changes in the atmosphere, water, and biota in the Gulf Coast area. Hence, creating metadata for research datasets and making these datasets readily accessible became a pressing issue, which greatly impacted DISL's capability to facilitate scientific studies, public education, and outreach.

In December 2007, the National Oceanic and Atmospheric Administration (NOAA) funded the project "Establishing a Data Management System at the Dauphin Island Sea Lab to Link with Northern Gulf Institute (NGI) Affiliated Programs: A Proposal to Enhance Data Retention, Metadata, Maintenance, and Faculty Participation." The goal of this project was to create a system to encourage and enhance research data retention at DISL and to use this system as a model for other institutions that have metadata retention needs. A data specialist was hired in December 2007 to begin this process. The data specialist met with faculty and support personnel to learn about the focus of each lab's research and resulting data. The project goal of the data specialist was to create and publish, to the National Coastal Data Development Center (NCDDC), at least one metadata record for each lab. The metadata records are then made searchable on the NCDDC Web site. To date, seven of the 12 labs at DISL have published metadata records.

In developing a metadata management system, we quickly identified two major hurdles that needed to be overcome for success. First, we needed to garner faculty participation, including obtaining copies of data. This task was challenging due to busy schedules, lack of knowledge about metadata and its usefulness and concern for proprietary rights of data. Second, we sought to establish an enduring system that would encourage independent metadata creation. This task is needed to establish a system that will function in perpetuity, even without data specialist oversight.

To encourage participation and facilitate independent metadata creation, DISL hosted two metadata training sessions that were taught by a metadata specialist from the NCDDC. Thirty-two participants attended this course. Training focused on learning to navigate and operate

MERMAid (Metadata Enterprise Resource Management Aid), a web-based metadata writing program compliant with the Federal Geographic Data Committee (FGDC) metadata standard. Following training, participants received MERMAid accounts that they could then use to create their own metadata records. Several graduate students have begun creating metadata records for their own research.

To help Web visitors easily access metadata and research datasets by originator or keyword, a Metadata Retention Center web page was created. The purpose of the Metadata Retention Center is not just to archive metadata, but to also facilitate scientific studies, public education, and outreach. To ensure that an accurate copy of data with its matching metadata is retained, DISL is evaluating the creation of a complementary Research Data Retention Center on a secure server for raw data.

OVERVIEW OF A STUDENT RIDE-ALONG: PERSPECTIVES AND OPPORTUNITIES

Extension, Education, and Outreach
Oral Presentation
David A. Rosenfield*
University of Southern Mississippi; Department of Marine Science
david.rosenfield@usm.edu

In September, I participated in what has been one of the most valuable experiences that I have had during my studies as a Ph.D. student, and the term “get my feet wet” has taken on a whole new meaning. I was a “student ride-along” assisting the crew of the National Oceanic and Atmospheric Administration (NOAA) ship Ka’Imimoana as they replaced moored ocean buoys in the Western Pacific Ocean. Regular maintenance cruises help the Tropical Atmosphere Ocean array continue to take measurements used to monitor the earth’s climate. Along the way, several researchers took advantage of ship time and collected physical and chemical oceanic data along the ship’s track.

Helping out on a research vessel was not only a first for me, but it also gave me an idea of the activities in which many oceanographers participate after graduation. When I wasn’t busy deploying sensors, connecting moorings, and building buoys, I had plenty of valuable interaction with senior oceanographers.

As a physical oceanographer who does all of his work from behind a computer, this experience helped keep me in touch with the data that I use daily and gave me a greater respect for the hard work required to gather remote oceanographic data.

Because my ship time was made available through NOAA as part of the Tropical Atmosphere Ocean project, and because I worked for them aboard the ship, the only funds that I had to raise were for the airfare and a few nights of hotel accommodations. The Mississippi-Alabama Sea Grant Consortium made these funds available to me, and I can’t thank them enough.

My oral presentation will focus on how easy it can be for educators to get a student aboard one of these scientific cruises. With a little perseverance and the ability to do their school work from a distance, this valuable experience can be acquired by almost any student.

OYSTER GARDENING IN MOBILE BAY

Extension, Outreach, and Education
Poster Presentation
Phillip L. Waters, Jr.*
Auburn University Marine Extension and Research Center, Alabama Cooperative Extension System, Mississippi-Alabama Sea Grant Consortium
waterph@aces.edu

The Oyster Gardening (OG) program of Mobile Bay was derived from the Chesapeake Bay program. Initiated in 2001, and depending largely on individual property owners who donate their time and pier space, the program aims to educate individuals on the importance of oysters in the ecosystem.

Each spring, new volunteers are recruited from around Mobile Bay. Specific conditions must be met for a volunteer to be eligible for the program. These are based on the classification system for commercial oystermen as set forth by the Alabama Department of Public Health (ADPH). Workshops are offered to volunteers for training purposes and to answer any questions they may have. In early summer, researchers from Auburn University Shellfish Laboratory (AUSL) spawn adult oysters to produce larvae. The larvae are then set on whole shell. The spat are grown to approximately 1.5 cm at which time they are taken to volunteers in late June or early July.

Figure 1. The Page Cage protects juvenile oysters from predation.

Volunteers care for the oysters which are hung from their pier in four “Page Cages.” These cages afford protection from predators. Hanging them off the bottom further protects oysters from oyster drills, a predacious snail. Volunteers clean and inspect their oysters weekly, remove any predators, and wash sediment and fouling organisms from the cages. Each volunteer will produce an average of 1,000 oysters that have grown to 2.0 inches.

In November, the oysters are collected from the volunteers and placed on restoration reef sites in Mobile Bay.

RESEARCHERS AND TEACHERS LEARNING FROM EACH OTHER TO IMPROVE SCIENCE TEACHING AND ENVIRONMENTAL STEWARDSHIP

Extension, Outreach, and Education
Oral Presentation
Jessica Kastler*, Mike Spranger, Shelia Brown, Sharon Walker, John Dindo, and Dan Brook
J.L. Scott Marine Education Center, Gulf Coast Research Laboratory, The University of Southern Mississippi
jessica.kastler@usm.edu

The J.L. Scott Marine Education Center hosts the Center for Ocean Sciences Education Excellence: Central Gulf of Mexico (COSEE:CGOM), a National Science Foundation sponsored project that catalyzes relationships among research scientists and science educators. As a way of addressing this goal, the COSEE:CGOM has implemented the Teacher/Scientist Institute since 2003 in Mississippi, Louisiana, Alabama, and Florida. This Institute places researchers and teachers side-by-side in classroom, laboratory, and field environments for one week to work and learn together about each other's professional experiences and the coastal science of the Gulf of Mexico. After the weeklong summer field session, teachers continue in the program and complete online presentations offered by six additional scientists on a variety of marine science topics.

Throughout both components of the Institute, teachers work to develop lesson plans that incorporate specific science content and process skills they have learned in their classroom activities. The best of these are being assembled on the COSEE:CGOM Web site (http://cosee-central-gom.org). Many of the activities developed by teachers incorporate stewardship, in fact, one of the online presentations of the 2003, 2004, and 2006 Teacher/Scientist Institutes was devoted to understanding stewardship, and therefore several lesson plans specifically addressed this topic.

Similarly, scientists make changes in their work to incorporate information they have learned from teachers. Sometimes scientists continue working with teachers, providing them with information based on research, field experiences, or a regular supply of fiddler crabs. Some scientists also continue working directly with classroom teachers by leading field trips or communicating about laboratory exercises. The activities to which scientists contribute frequently include some component of stewardship. For example, laboratory activities in fish biology and aquaculture might culminate in a release of endangered native fish fingerlings.

Whether or not it is called stewardship, many K-12 students, classroom teachers, and scientists share a desire to have a beneficial effect on threatened resources. The COSEE:CGOM Teacher/Scientist Institute provides teachers and scientists the opportunity, resources, and tools to turn this desire into reality through student learning and meaningful stewardship.

WEEKS BAY RESERVE COASTAL TRAINING PROGRAM: WETLANDS EDUCATION PATHS

Extension, Outreach, and Education
Oral Presentation
Michael Shelton*
Weeks Bay Reserve, Alabama Department of Conservation and Natural Resources, Lands Division, Coastal Section
michael.shelton@dcnr.alabama.gov

Weeks Bay Reserve Coastal Training Program (CTP) provides science-based information, tools, and skill-building opportunities to professionals whose decisions impact coastal resources. By building partnerships with other training organizations and routinely assessing the training needs of coastal decision makers, CTP at Weeks Bay Reserve develops training events resulting in the application of research science. Coordination with other training organizations ensures that training opportunities with recognized instructors are provided to the decision-maker audience. Key coastal issues addressed by CTP are land-use management practices, preservation of biodiversity, and protection of water resources.

Figure 1. Students examine soil color, a tool used in wetland delineation.

Most land-use questions facing elected official, planners, regulators, consultants, and real estate professionals involve wetlands. With several training partners, Weeks Bay CTP has hosted set of workshops for audiences with varying technical backgrounds but with distinct training needs. One training set contains highly technical courses directed at wetland professionals, managers, consultants, and regulatory staff. Expert instructors have conducted classes in identification, delineation, soils, invasive species ecology including practical control and functional assessment. Workshops include extensive field work using current implements and monitoring techniques. Another set of workshops targets primarily the regulated community and those individuals who advise this group. Instructors from state and federal agencies instruct real estate professionals and developers on current wetland rules and on the steps required to remain in compliance within the existing regulatory climate. The final set of workshops addresses wetland

Figure 2. Standing amongst pitcher plants, workshop participants discuss the hydrology supporting plant growth.

conservation under legal means like local ordinances and conservation easements. Writing local ordinances that are enforceable as well as defensible was paired with broader conservation planning workshop. Attorneys experienced in crafting local ordinances of this type in Alabama led the class. In addition, CTP and training partners conducted a program on land conservation and financial strategies for landowners, estate planners, and real estate professionals. The agenda included instruction on the application of permanent land conservation methods conserving ecology sensitive areas while upholding the owner's ability to gain financially. The principle instructor for the workshop participated in the writing of the IRS code concerning conservation easements and is nationally known for work in this field of law.

Weeks Bay CTP conducts workshops on wetland science and conservation using the most qualified instructors available. As an incentive and benefit to the training audience, appropriate continuing education awards are secured for courses. From elected officials to realtors, many vocations in coastal Alabama must deal with wetland issues. Weeks Bay CTP and a wealth of training partners that generously share support and expertise work together to meet wetland training needs.

AQUATIC PLANTS OF THE MISSISSIPPI COAST

Habitat Management and Restoration
Poster Presentation
Hyun Jung Cho*
Department of Biology, Jackson State University
Hyun.j.cho@jsums.edu

The extensive inland and coastal wetlands in Mississippi are a home for numerous aquatic plants. The state also contains one of the most well-preserved, unmodified river basins of the United States: the Pascagoula River Basin. Nevertheless, there are few aquatic plant guide materials that exclusively list and address the Mississippi aquatic plants and their habitats. The hydrophytes help improve water quality, stabilize sediment, and provide hunting grounds/nursery habitats for aquatic life. However, fast growing aquatics, especially submerged or floating plants of inland water bodies, can produce noxious conditions by forming surface canopies that prevent gas exchange, light penetration, navigation, and commercial/recreational activities. In either case, identification of the native, favorable species or the invasive, noxious species is the first step in habitat assessment for proper conservation and management. Plant identification is also required to understand species richness/dominance/diversity which can be used as an indicator of the habitat's health, complexity, stability, and status. Or, learning of aquatic plants, flowers, and their natural habitats would simply satisfy curious minds of wetland/waterway users including students, teachers, fishermen, hunters, and bird-watchers.

A project currently funded by Mississippi-Alabama Sea Grant Consortium is undertaken to develop field guide resources for aquatic plants of the Mississippi coast. The proposed field guide book will cover only obligate wetland vascular plants that occur in the MS coast and initially include up to 100 species in the field guide book. So far, surveys were conducted in and specimens were collected from areas of Pearl River, Biloxi River Marshes, Pascagoula River, and Grand Bay National Estuarine Research Reserve. Our plan is to cover the full range of the wetland habitat types. The catalogued information will again be sorted by habitat type (riparian wetland, freshwater swamp, freshwater marsh, tidal oligohaline marsh, tidal salt marsh, estuarine subtidal SAV beds, barrier island marshes and lagoons, and seagrass beds) and plant growth characteristic (free-floating, rootless submerged, rooted submerged, rooted with floating leaves, emergent, and trees). The photographs of the plants and their habitats will be presented; and the similar species that can be easily confused (Figure 1) will be discussed during the poster presentation.

Figure 1. Photographs of *Cabomba caroliniana*, *Ceratophyllum demersum*, and *Myriophyllum spicatum*.

COASTAL MARSH MONITORING FOR PERSISTENT SALTWATER INTRUSION

Habitat Management and Restoration
Oral Presentation
Callie M. Hall* and Maria T. Kalcic
NASA and Science Systems and Applications, Inc., Stennis Space Center
callie.m.hall@nasa.gov

Coastal freshwater and low-salinity marshes may experience periodic saltwater inundation from sporadic storm surge events. However, marsh inundation may last for prolonged periods after significant tropical storms and hurricanes, such as Hurricanes Katrina and Rita. Persistent flooding from storm surges and subsidence and the resulting increases in salinity produce both short- and long-term effects on marsh habitat and resiliency. Long-term effects include vegetative scour of plant substrate and alteration of marsh species composition. Persistent flooding and saltwater inundation increases the retention time of saltwater diffusion within interstitial sediment porewater. Evapotranspiration may further increase salinity within marsh porewaters in the absence of natural freshwater flushing. Dieback of freshwater marsh species and the succession by intermediate, brackish, or saline marsh grasses is not uncommon during extensive saltwater intrusion.

Collaborating with the United States Geological Survey (USGS) and the Louisiana Department of Natural Resources (LDNR), we assessed the feasibility of using NASA satellite data to monitor persistent saltwater intrusion in Louisiana coastal marshes, specifically those within the Coast-Wide Reference Monitoring System (CRMS) of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Program. We processed Moderate Resolution Imaging Spectrometer (MODIS), Landsat, Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), Hyperion, and Advanced Land Imager (ALI) data into products of Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), Normalized Difference Moisture Index (NDMI), and Normalized Difference Wetness Index (NDWI) to identify stressed vegetation and to determine if persistent flooding induces the stress. We explored the relationship between colored dissolved organic matter (CDOM) absorption and salinity in nearshore environments as a means of obtaining a proxy for salinity from satellite data. Previous research shows that CDOM absorption conservatively mixes with salinity in nearshore environments impacted by large rivers, e.g., the Mississippi-Atchafalaya River System. We employed a Time Series Product Tool (TSPT), developed at NASA Stennis Space Center, to analyze temporal trends of vegetation and moisture indices and sorted outcomes into one of three categories: 1) vegetation is (not) stressed, 2) vegetation is (not) stressed from persistent flooding, and 3) persistent flooding is fresh (saline). We computed cumulative NDVI, EVI, NDMI, and NDWI for 6- and 12-month periods and compared these results with in situ data from CRMS sites. CRMS in situ data used for validation of satellite-derived products include water level, surface salinity, vegetation cover, and species composition. Time series of NDVI, NDMI, NDWI, EVI, and a satellite-derived proxy for salinity indicate changes in marsh species composition due to persistently saline waters.

Ultimately, USGS and LDNR will use the time-series imagery produced from this effort to examine the relative persistence of high-salinity marsh porewater and to provide local projections of marsh species dieback and consequent shifts in species composition. This satellite-based approach will assist environmental planners with the design and execution of coastal restoration projects.

CONSERVING ALABAMA'S COASTAL HABITATS: STATUS OF THE ACQUISITION AND RESTORATION PRIORITIES OF MOBILE AND BALDWIN COUNTIES

Habitat Management and Restoration
Oral Presentation
Roberta Arena Swann* and Mary Austill Lott
Mobile Bay National Estuary Program
rswann@mobilebaynep.com

"Conserving Alabama's Coastal Habitats: Acquisition and Restoration Priorities of Mobile and Baldwin Counties" was produced in 2006 as a result of a partnership between the Mobile Bay National Estuary Program (MBNEP), The Nature Conservancy of Alabama (TNC), and the U.S. EPA Gulf of Mexico Program. Using an ecosystem-based process, MBNEP and TNC conducted a one-year conservation planning effort focused on the following conservation areas: Perdido River Corridor, the Gulf Islands, the Mobile Bay and Delta, and the Grand Bay. The need for strategic habitat assessment arose because of the many organizations, governments, and agencies actively pursuing habitat acquisition, preservation, restoration, and management activities in the Alabama coastal area. Through the strategic assessment process, the contributions of existing preservation and management programs and the capabilities of all agencies and organizations involved in these programs were coordinated and maximized. As a result, 17 priority acquisition sites (or other conservation options) and more than 30 other sites/habitat types where restoration and/or enhancement are considered viable and necessary were identified. These sites have been put in an "atlas" to be used by governments and other community organizations to more effectively guide resource management activities in coastal Alabama. Although long-term success will be judged on the degree to which identified sites are protected or restored, short-term results have been promising. Six of the sites identified in the atlas have been acquired and 11 have been or are currently undergoing restoration projects since 2006. Sites and areas identified in the habitat strategic assessment have also been included in the Mississippi-Alabama Habitat Restoration Database, which tracks ongoing coastal habitat restoration projects. During the fall of 2008, MBNEP and TNC will join together with the National Oceanic and Atmospheric Administration (NOAA) Office of Habitat Conservation (OHC) and the NOAA Coastal Services Center (CSC) to update and improve the spatial functionality of the atlas. The acquisition and restoration priorities will be assessed against additional data and regional and stakeholder priorities. Habitat conservation, protection and restoration are very much community concerns in coastal Alabama. The development of effective partnerships and tools such as these will aid communities in better utilizing and targeting existing capabilities, resources, and funding for achieving habitat goals.

EFFECTS OF NATIVE PLANTS AND LOW-IMPACT MANAGEMENT ON BEACH EROSION IN MISSISSIPPI

Habitat Management and Restoration
Oral Presentation
T.P. Cathcart* and P.O. Melby*
Ag. & Biol. Eng. Dept.
Landscape Architecture Dept.
Mississippi State University
tc@abe.msstate.edu

Erosion on the 42-km manmade beach between Biloxi and Pass Christian takes three forms. The southeast and southerly winds that prevail for much of the year blow sand over the seawall onto the highway bordering the beach to the north. Storm water from rain washes sand down the beach toward the Mississippi Sound to the south. Wave action and currents remove sand from the beach-water interface during high energy events. Current beach management practices appear to exacerbate the erosion process and shorten the time interval between renourishment projects. Raking and grooming the beach fluffs the sand, increasing its vulnerability to erosion caused by wind and storm water runoff. Heavy equipment compacts the sand beneath the fluffed layer. The ability of rainwater to infiltrate the compacted sub-sand is reduced, resulting in more water transport down-beach than would otherwise be the case, increasing sand transport with the runoff.

Use of native plant species on the beach represents an alternative to current management practices for much of the beach. This is true because the 42-km beach is “low energy,” which means that significant sand movement is mainly due to a relatively small number of high energy climatological events rather than the continuous sand reworking characteristic of higher energy beaches. Native plants are adapted to survive in the harsh conditions that are common in a beach environment. Native plantings appear able to inhibit or halt all three erosion processes, allowing renourishment projects to be delayed or avoided.

The native-plantings approach to beach management has two components. The use of native plants directly effects erosion by dissipating the energy of wind, runoff flow, and wave action and by holding the sand in place. The native plantings approach also, by necessity, precludes the use of mechanical grooming by heavy beach equipment. The absence of the heavy equipment appears to result in physical beach properties that further inhibit erosion. The presence of native plants and the absence of the equipment work together to make the beach more resilient in the face of erosive forces than would otherwise be the case.

Predictions of global warming and sea-level rise suggest that the rate of erosion on the world’s coastlines will increase. If this is true, then the approaches described above may become particularly useful in similar environments.

ENGINEERING PRINCIPLES FOR DESIGNING LIVING SHORELINES

Habitat Management and Restoration
Oral Presentation
Scott L. Douglass*, Larry Oliver, Caren Reid, and Christopher R. Oliver
Department of Civil Engineering, University of South Alabama
sdouglass@usouthal.edu

The principles of coastal engineering that have been successful on numerous bay and bayou shoreline projects in coastal Alabama (and the world) will be outlined for a general audience. These principles include general concepts of coastal geology, ecology, and oceanography including erosion and erosion control approaches. These principles also include specific approaches to the estimation and quantification of the physical processes (wave climate and attenuation, potential sand transport climate, equilibrium shoreline shape) required to design successful, cost-effective, and resilient living shoreline projects.

The application of these engineering principles to the design of successful projects in Alabama will be demonstrated. These shorelines are functioning, both ecologically and socially, much more naturally than a bulkhead or seawall would. They minimize the human impact while maximizing the stewardship of the bay shoreline habitat and resources. These projects vary from a thriving, emergent wetland on a busy urban bayou (Figure 1), to several small beaches on the bay, to a major recreational amenity beach along one of the most exposed shores in Mobile Bay (Figure 2), to a large wetland restoration project presently being designed with wave attenuation structures. Some of these projects have been in-place for over ten years and have survived three major hurricanes. One common aspect of these projects is that they were designed using the modern, state-of-the-art coastal engineering principles that will be summarized in this presentation. The presentation will be focused toward a general, non-engineering and non-academic audience.

Figure 1. Photograph of a constructed wetland behind a submerged breakwater (June 08)

Figure 2. Photograph of an artificial beach on Mobile Bay stabilized by headland breakwaters

EVALUATING THE IMPACT OF LAND USE CHANGE ON THE AQUATIC ECOSYSTEMS OF MOBILE BAY

Habitat Management and Restoration
Poster Presentation
Maurice G. Estes, Jr.*, Mohammad Al-Hamdan, Ron Thom, Dale Quattrochi, Jean Ellis, Dana Woodruff, Steve Davie, Brian Watson, Chaeli Judd, Hugo Rodriguez, Hoyt Johnson, and Jay Hodgson
National Space Science and Technology Center
maury.g.estes@nasa.gov

There is a continued need to understand how human activities along the northern Gulf of Mexico coast are impacting the natural ecosystems. Mobile Bay, AL, is a designated pilot region of the Gulf of Mexico Alliance (GOMA) and is the focus area of many current NASA and National Oceanic and Atmospheric Administration (NOAA) studies, for example. This is a critical region, both ecologically and economically to the entire United States because it has the fourth largest freshwater inflow in the continental USA, is a vital nursery habitat for commercially and recreational important fisheries, and houses a working waterfront and port that is expanding.

Watershed and hydrodynamic modeling has been performed for Mobile Bay to evaluate the impact of land use change in Mobile and Baldwin counties on the aquatic ecosystem. Watershed modeling using the Loading Simulation Package in C++ (LSPC) was performed for all watersheds contiguous to Mobile Bay for land use Scenarios in 1948, 1992, 2001, and 2030. The Prescott Spatial Growth Model was used to project the 2030 land use scenario based on observed trends. All land use scenarios were developed to a common land classification system developed by merging the 1992 and 2001 National Land Cover Data (NLCD). The LSPC model output provides changes in flow, temperature, and general water quality for 22 discharge points into the Bay. Theses results were inputted in the Environmental Fluid Dynamics Computer Code (EFDC) hydrodynamic model to generate data on changes in temperature, salinity, and sediment concentration on a grid with four vertical profiles throughout the Bay's aquatic ecosystems. Figure 1 shows the descriptive statistics of salinity differences between the baseline and future LCLU scenarios at those discharge points as an example.

The changes in the aquatic ecosystem were used to perform an ecological analysis to evaluate the impact of seagreasses and Submerged Aquatic Vegetation (SAV) habitat. This is the key product benefiting the Mobile Bay coastal environmental managers that integrates the influences of temperature, salinity, and sediment due to land use driven flow changes with the restoration potential of SAVs.

This project is a collaborative effort between NASA Marshall Space Flight Center, Universities Space Research Association, NASA Stennis Space Center, Battelle at the Pacific Northwest National Lab, Tetra Tech Engineering, Prescott College, and the University of Alabama.

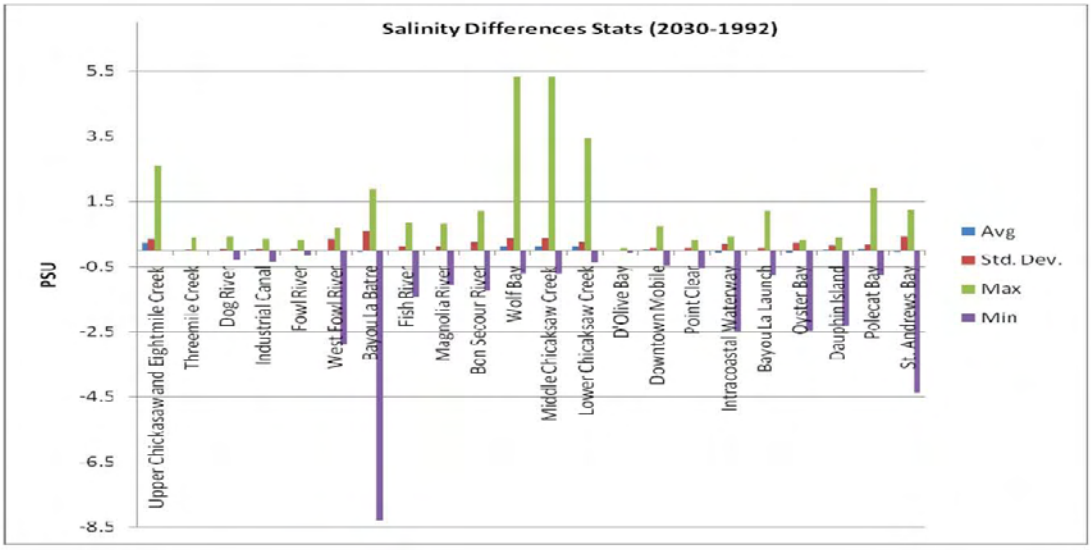


Figure 1. Descriptive statistics of salinity differences between the baseline (1992) and future (2030) LCLU scenarios.

HOW LONG CAN AN OYSTER HOLD ITS BREATH? USING BIOLOGICAL AND PHYSICAL DATA TO ESTIMATE REEF RESTORATION REQUIREMENTS IN HYPOXIA PRONE AREAS OF MOBILE BAY, AL

Habitat Management and Restoration
Oral Presentation
Matthew W. Johnson*, Sean P. Powers, Joseph Senne, and Keyong Park
Dauphin Island Sea Lab
mjohnson@disl.org

Oyster production is one of the largest fisheries in Mobile Bay; however, in the recent past there has been a loss in total productive reef area and a decline in oyster harvest. One of the primary reasons for this decline is an increase in the frequency of low oxygen events during the mid- to late-summer. Currently, it is proposed to restore parts of a large reef system (13 km in length) located in the central-western part of Mobile Bay to approximately 1 m in height. This design is based on the concept that the stratified, often hypoxic, waters rarely exceed more than 1 m off the bottom in this area. To test this proposed design, we deployed replicated oyster-covered panels at three historically productive sites that experience different patterns of hypoxia. The bottom waters of the northernmost site experience prolonged periods of hypoxia, the proposed restoration site experiences prolonged periods of moderate hypoxia, and the southernmost site experiences minimal hypoxia. Panels were placed at different depths (bottom, 1 m, and surface) and were monitored biweekly for survival and growth. Instantaneous oyster population growth was significantly different based on location but not depth. The least amount of population growth was in the north; moderate growth occurred at the central bay site, and the southernmost site had the greatest growth. At the southern site, the resulting oyster population was 3-4 times greater per panel than the other sites. Shell growth was also significantly different among the sites. The greatest growth was at the northern site, followed by the southern site, then the central bay site. These results may be due to reduced individual oyster growth at the southern site, resulting from space limitation, rather than exceptional growth at the northernmost site. Although oysters are thought to be extremely tolerant of moderate levels of hypoxia, our results suggest that extended periods of moderate hypoxia can be almost as detrimental as short bouts of severe hypoxia and a major hindrance to oyster restoration efforts. At the central bay site, a restored reef 1 m in height may not be adequate to ensure re-establishment and continued survival of oyster populations for this part of Mobile Bay.

THE IMPACT OF FRESHWAER INPUTS ON MIGRATION OF THE SALT MARSH AT MISSISIPPI PASCAGOULA BAY UNDER CHANGING CLIMATE

Habitat Management and Restoration
Oral Presentation
Wei Wu*
Department of Coastal Sciences
The University of Southern Mississippi
wei.wu@usm.edu

Unprecedented climate change put coastal regions on the front lines of its risks. One major concern is the loss of coastal marshes due to accelerating sea level rise, which could bring adverse impacts on storm surge and shoreline protection, flood control, water quality, and habitat conservation. For example, the coastal wetlands of Mississippi Sound, St. Louis Bay, Biloxi Bay, Pascagoula Bay, and the tidal Pascagoula River provide critical nursery areas for many species of fish and shellfish. The question of where the conservation efforts should focus on to achieve a cost-effective plan to protect these sensitive habitats is based on a reliable forecast tool how the salt marshes are going to migrate under climate change.

This study has applied a spatial explicit model – Sea Level Affecting Marshes Model (SLAMM) – to predict the potential impact of different scenarios of accelerating seal-level rise on migration pattern of the salt marsh at Pascagoula Bay in southeastern Mississippi Coast. The salt marsh receives considerable freshwater inputs all year long. The salinity regime, which is influenced by the direction and amount of the freshwater inflow, is key to determine the migration pattern under changing climate. Therefore, any regional changes in temperature or precipitation, which have potential to alter river discharge, will have a profound impact on the fate of the salt marsh at Pascagoula Bay in addition to the accelerating sea level rise. This study will provide a basis for more informed land planning, resource management, as well as fish and wildlife protection.

LAND-USE AND LAND-COVER CHANGE FROM 1974-2008 AROUND MOBILE BAY, AL

Habitat Management and Restoration
Poster Presentation
Jean Ellis*, Joseph Spruce, James Smoot, Kent Hilbert, and Roberta Swann
NASA Stennis Space Center
jean.t.ellis@nasa.gov

This project is a Gulf of Mexico Application Pilot in which NASA Stennis Space Center (SSC) is working within a regional collaboration network of the Gulf of Mexico Alliance (GOMA). The goal of this research is to produce unique multi-decadal time-series coastal land-use and land-cover (LULC) products that will be used by Mobile Bay National Estuary Program (NEP) to help them implement their goal to promote stewardship of the Mobile Bay estuarine system.

Landsat images were obtained for 1974, 1979, 1984, 1988, 1992, 1996, 2001, 2005, and 2008. We selected these years to target change resulting from Hurricanes Frederic (1979) and Ivan (2004) and to be synchronous to major pre-existing land-use and land-cover classification products (National Wetlands Inventory, NWI, 1979, 1988, and 2002; National Land Cover Database, NLCD, 1992 and 2002; and Coastal Change Analysis Program, C-CAP, 1996, 2001, and 2005). The products were classified according to: agriculture, barren, open water, upland forest, urban, non-woody wetlands, and woody wetlands. Areal extent of each class for the Mobile Bay region was calculated and change detection statistics were calculated for 1974-1979, 1974-1984, 1974-1988, 1974-1992, 1974-1996, 1974-2001, 1974-2005, 1984-1996, and 1996-2008. LULC map accuracy was completed – one method employed data obtained from NOAA Coastal Services Center relating to their C-CAP product. Overall classification accuracy for 2008, for example, is 89 percent. Areas of interest to Mobile Bay NEP (northern Mobile Bay, D'Olive Bay, Fish River, Three Mile Creek, Dauphin Island, and Big Creek watershed) were delineated and the extent of each class was calculated. Map products were produced to highlight the decadal-scale (1974-1984, 1984-1996, and 1996-2008) changes for urban land-use class.

Figure 1 shows example data products of the Landsat-derived land-use and land-cover data products for the two county region for 1974 (left) and 2008 (right). Table 1 reports the geospatial extent of each cover type for 1974 and 2008 corresponding to Figure 1. In the region shown in Figure 1, the satellite-based estimates indicate that during our 34-year study period urban areas increased from 96,688 to 150,227 acres, representing a 55.37 percent increase, or 1.63 percent per annum. Most urban expansion results from upland forest and agricultural conversion to urban cover types.

Figure 2 shows the northern portion of Mobile Bay, and therefore highlights the city of Mobile. A USGS DEM, where dark grays designate lower elevations and lighter grays and whites denote higher elevations, is shown in Figure 2A. Figure 2B is the urban cover-

type change from 1974-2008. Areas shown in yellow indicate urbanized landscapes for 1974 and 2008 and red areas indicate only the urban expansion between 1974 and 2008.

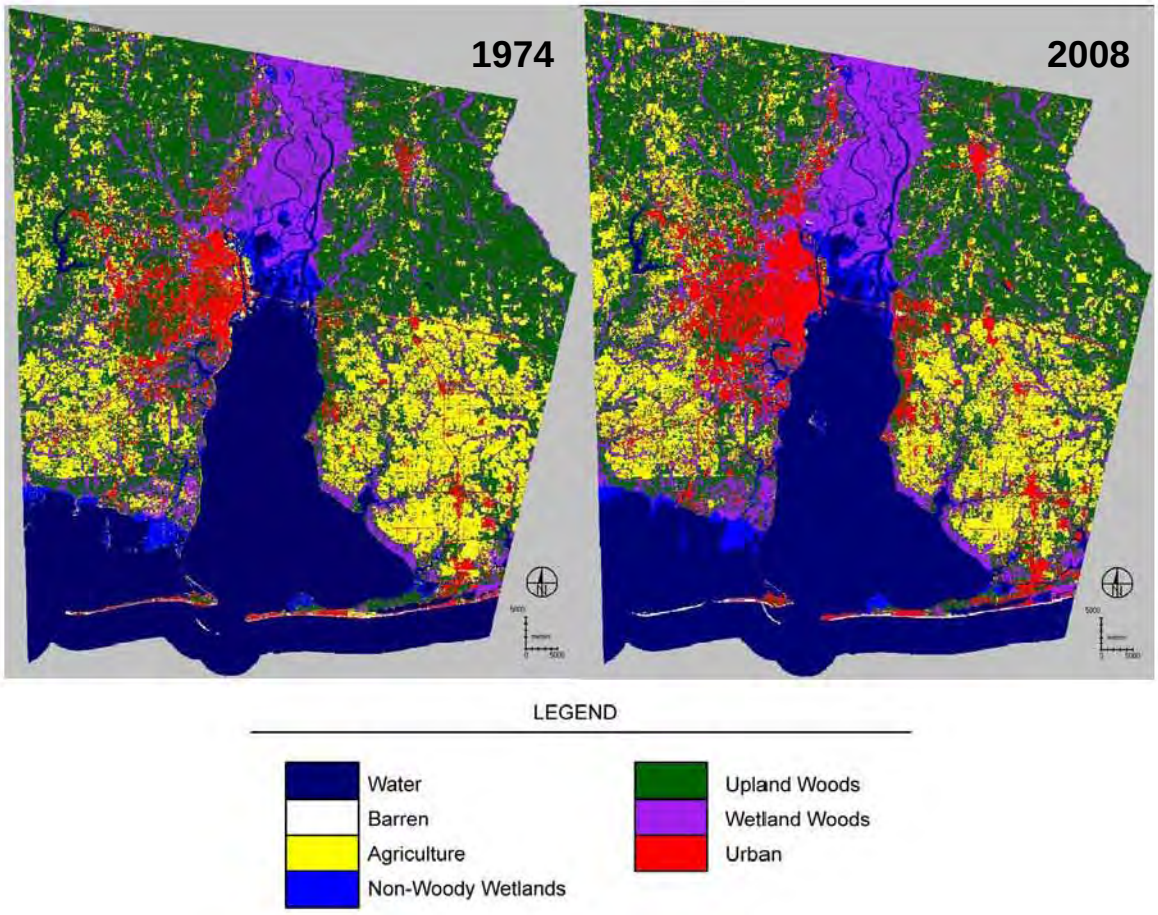


Figure 1: Land-use and land-cover change for the Mobile Bay region between 1974 (left) and 2008 (right).

Table 1: Land-use and land-cover change for the Mobile Bay region (shown in Figure 1) between 1974 and 2008.

	1974		2008	
Class	Total Acres	Percent	Total Acres	Percent
Open water	485,302	26.4	504,431	27.2
Barren	3,504	0.2	7,954	0.4
Agriculture	272,024	14.8	284,436	15.3
Non-woody wetland	38,631	2.1	39,964	2.2
Upland forest	674,298	36.6	586,523	31.6
Woody wetland	270,618	14.7	282,213	15.2
Urban	96,688	5.3	151,644	8.2
Total	1,841,065	100.0	1,857,165	100.0

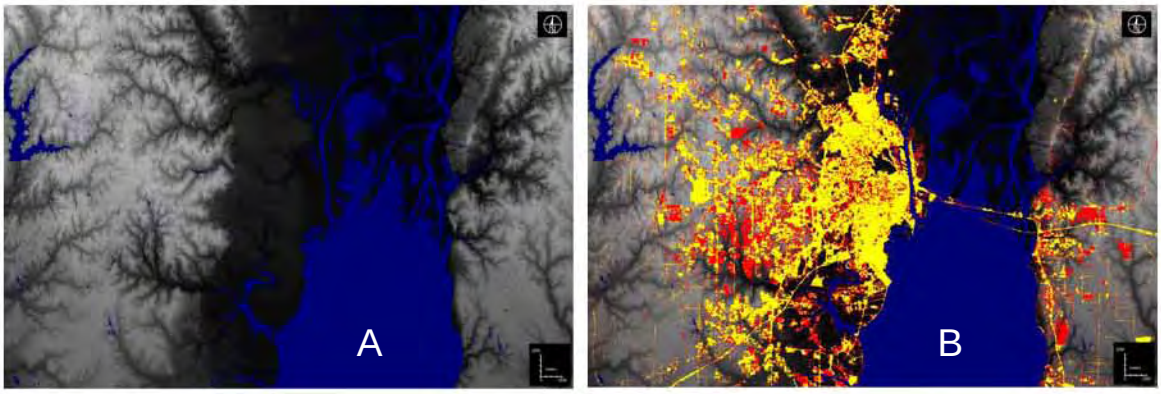


Figure 2: USGS DEM for the northern portions of Mobile Bay. Urban cover in 1974 and 2008 is in yellow, and red represents growth from 1974 to 2008.

LIVING SHORELINES: AN OPPORTUNITY TO PROTECT PROPERTY WHILE PRESERVING NEARSHORE HABITAT AND RESTORING OYSTERS IN COASTAL ALABAMA.

Habitat Management and Restoration
Poster Presentation
Mary Austill Lott*, Steven Scyphers, Sean P. Powers, and Kenneth L. Heck Jr.
The Nature Conservancy
mlott@tnc.org

The Nature Conservancy's (TNC) 2004 Conservation Area Plan identified nearshore habitat loss and coastal development to be the number one threat to the health of Mobile Bay. One of the predominant causes for the loss of nearshore habitat in Mobile Bay is the hard armoring (i.e. bulkheading) of shorelines employed by coastal property owners to protect their upland property. While sufficiently protecting uplands, the hardened shorelines are devastating to the ecology of the nearshore environment. There is sufficient need to develop alternatives to bulkheading that both maintain the biological processes of the nearshore environment and protect property. While a number of soft armoring alternatives have been developed, there are added advantages to using a substrate suitable for oyster recruitment including, increased sustainability and habitat value.

In the spring of 2008, TNC partnered with the Dauphin Island Sea Lab and the Alabama Department of Conservation and Natural Resources State Lands Division to implement a demonstration project aimed at testing two possible living shoreline alternatives to bulkheading along a section of heavily eroding state property on the west side of Mobile Bay. The project included four, 25-meter breakwater structures: two composed of bagged natural oyster shell and two composed of concrete reef domes. The treatments were modeled after the shorelines of private property owners in efforts to test the effectiveness of the living shoreline alternatives on a scale practicable for use by individual property owners. Reefs and controls will be monitored to evaluate the physical and ecological changes resulting from the restoration. Ichthyofauna surveys, including seining and gillnetting, will be used to evaluate the habitat value of each design of the restored reefs. In addition, oyster settlement will be monitored to evaluate each reef design as substrate for oyster spat recruitment, and changes in shoreline location and bathymetry will be mapped to determine the success of the reefs as breakwater structures.

The goal of this demonstration project is to provide the necessary data to begin to encourage agencies and private property owners alike to utilize living shoreline solutions as a more ecologically friendly erosion control mechanism, as well as restoring oyster populations to Mobile Bay.

MISSISSIPPI-ALABAMA NATIVE COASTAL PLANTS NURSERY

Habitat Management and Restoration
Poster Presentation
Patrick Biber*, John D. Caldwell, and Lindsey Singleton
Department of Coastal Sciences, The University of Southern Mississippi
patrick.biber@usm.edu

Saltmarshes and dune plants are important habitats in Mississippi and Alabama. Numerous restoration and mitigation projects are completed each year in these habitats. However, plants for these projects are not generally available locally, and hence are often imported from Florida or Louisiana sources. The impact of this anthropogenically mediated immigration of non-native genotypes into the local population is unknown, but has been shown to be undesirable in other areas. To reduce the need for this trans-state shipment of plants, we are growing many species from seeds or propagating local clones.

The species available for projects include: *Juncus roemerianus, Spartina alterniflora, Spartina patens, Schoenoplectus americanus,* and *Cladium jamaicense* for marsh habitats; and *Uniola paniculata, Panicum amarum* (both varieties), and *Ipomoea pes-caprae* for dunes; as well as *Thalassia testudinum, Halodule wrightii, Vallisneria americana,* and *Ruppia maritima* for seagrass and submerged aquatic vegetation restorations.

Plant seed collection and storage, as well as growing protocols, have been established for all of these species. Seeds range from recalcitrant (*S. alterniflora*) to those with long shelf lives (*J. roemerianus*) and are available on request. Two seed collection periods, in the late spring and through the fall, are targeted to collect the majority of these species. Germination is handled in temperature and light-controlled growth chambers to maximize seed viability. Seedlings are carefully raised to minimize mortality, and both indoor and greenhouse facilities are used to maximize growth success year-round. Fertilization regimes and mycorrhizal inoculants are active areas of ongoing research.

Our aim is to produce high-quality native species for all manner of coastal restoration projects through partnerships with locally operated commercial nurseries and educational Grasses in Classes programs. To achieve this goal, we propose to develop a multi-partner Center in Excellence for Germination, Growth and Ecosystems Restoration of coastal vegetation native to Mississippi and Alabama.

MOBILE BAY, ALABAMA: FIFTY YEARS OF HABITAT CHANGE

Habitat Management and Restoration
Oral Presentation
Handley, Lawrence R.*, Christopher Wells, Jason Dugas, Kelly L. Mouton, Brandy Winch, and Dennis Lichtenberg
U.S. Geological Survey, National Wetlands Research Center
larry_handley@usgs.gov

The Mobile Bay National Estuary Program area of study includes areas of Baldwin and Mobile Counties that surround Mobile Bay. This dynamic estuary is considered environmentally and economically important due to its biological diversity and productivity. It supports and serves as a nursery for fresh and saltwater species that are recreationally and economically important.

Mobile Bay habitat data was mapped utilizing aerial photography that spanned a fifty year period using the National Wetlands Inventory (NWI) as a hierarchical standardized classification system. Habitat data were derived from 1:20,000 scale, black and white, aerial photography acquired from 1953-1958. The 1979 and 1988 habitat data were derived from NASA 1:65,000 scale, color infrared, aerial photography. The 2001 Baldwin County habitat data were derived from 1:36,000 scale, color infrared, aerial photography. The 2002 Mobile County habitat data were derived from USGS NAPP 1:40,000 scale, color infrared, aerial photography. Each date of aerial photography was interpreted for wetland and upland habitats and 1:24,000 scale habitat maps were produced.

Habitat land/loss figures were tabulated for each data set. This mapping effort demonstrated the wetland loss that is occurring in Mobile Bay. In the fifty year period 17,548 acres of salt marsh has been lost. Fresh marsh habitat lost 25, 057 acres in the same fifty year period. Wetland scrub-shrub lost 9,481 acres. Wetland forest shows a 5,542 acre increase.

Upland habitats over this fifty year period saw a loss of agriculture and rangeland of 67,093 acres, while upland forested gained 21,662 acres, while the biggest gain occurred in urban development at 82,011 acres.

OYSTER REEF AND ESTUARINE LANDSCAPE RESTORATION

Habitat Management and Restoration
Oral Presentation
Kenneth L. Heck, Jr.*, Sean P. Powers, Steven Scyphers, and Dorothy Byron
Dauphin Island Sea Lab and University of South Alabama
kheck@disl.org

The dramatic decline and the economic loss of the oyster fishery in the Gulf of Mexico is striking and has historically been responsible for government actions to restore the fishery. More recently, recognition of the ecological benefits of oyster reef habitat has resulted in additional efforts to restore oyster reefs. Our project is designed to examine the potential benefits of restoring shallow subtidal oyster reefs on adjacent nearshore habitats. Specifically, we have created oyster reefs in shallow areas near shorelines with eroding marsh, and expect that the presence of this complex "biogenic breakwater" will reduce hydrodynamic disturbance behind the reef and thereby facilitate expansion of salt marsh on the eroding shoreline (Figure 1). The combination of adjacent shoreline marsh and oyster reef habitat should increase benthic prey resources and juvenile fish utilization, compared to nearby areas without oyster reefs. Finally, we believe that the combination of reduced hydrodynamic disturbance inshore of reef and reduced turbidity resulting from oyster filtration could facilitate the colonization of seagrass between the reef and the shoreline.

Our specific objectives are to: document changes in the physical and biological setting of study sites resulting from the addition of oyster reefs though shoreline mapping using GIS and marsh monitoring; quantify oyster recruitment and adult density in created nearshore oyster reefs; quantify primary and secondary producers within subtidal and intertidal habitats between created oyster reef and the shoreline; and quantify juvenile and adult fish and mobile invertebrate utilization of created oyster reefs and adjacent habitats.

In the spring and fall of 2007, we constructed two breakwater complexes (approximately 75 linear m of oyster reef added) along the southern portion of Mobile Bay (just south of Bayfront Park; 30°21.170", 87°07.098") and paralleling the southern point of Point aux Pines (30°22.237", 87°18.426"). Each complex was paired with a control location (no oyster reef added) chosen based on site similarities in depth, orientation, fetch, sediment type, and shoreline vegetation. Sampling along each breakwater and control location has occurred monthly and results to date are encouraging, showing substantially reduced erosion shoreward of the living breakwaters (especially at the Point aux Pins area) and a high degree of utilization of the reefs by

Figure 1: Photograph of one of the breakwater reef complex constructed near Bayfront Park, AL.

ecologically and economically important finfish. These promising results highlight the broader implications of our work, which will enhance the scientific understanding needed to rigorously establish whether the use of oyster reefs as living shorelines is an effective, ecologically-sound, and economical way to protect the increasing number of eroding shorelines and enhance nursery habitat.

OYSTER RESOURCE MAPPING AND RAPID CHARACTERIZATION AT THE GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE, MS

Habitat Management and Restoration
Poster Presentation
Thomas P. Strange*, Jay McIlwain, and Christopher A. May
Grand Bay National Estuarine Research Reserve
tom.strange@dmr.ms.gov

The eastern oyster (*Crassostrea virginica*) is an important economic resource to the state of Mississippi and provides many essential functions in the estuarine environment, such as water filtration and habitat structure for marine species. Substantial changes in eastern oyster populations have taken place throughout the Gulf of Mexico's coastal areas partly due to habitat loss, over-harvesting, and water quality degradation. A need exists to quantitatively and spatially describe current oyster populations so natural resource managers and researchers can document changes in reef location, health, and abundance over time. To date, few efforts have been made to map the spatial distribution and abundance of oyster reefs over large areas. Most of the efforts utilize remote sensing technology or side scan sonar to spatially describe oyster reefs. Although these techniques have been useful in other areas, they cannot be used at the Grand Bay National Estuarine Research Reserve (GNDNERR) due to very shallow water and small, patchy, intertidal oyster reefs.

In this study, we mapped and sampled oyster reefs, dead and alive, along the intertidal zones of bays, bayous, and lakes located within the boundary of the GNDNERR. Areas were mapped "in situ" by boating along waterways at low water conditions and transferring reef locations onto 6-inch high-resolution, true-color orthoimagery. The 6-inch resolution imagery provides accurate detail to map small oyster reefs. We assigned each segment of the intertidal area to a percent cover classification scheme. The oyster reef classifications and extents were then mapped using heads-up digitizing in ArcView 9.2 and feature attributes stored to describe information pertaining to the oyster resources. Random locations were generated by waterbody and percent cover classification level for biological sampling of the reefs. Areas were sampled for oyster age class, live vs. dead ratio, spat abundance, and biofouling using a 0.5 x 0.5 m quadrat at 10 locations per waterbody. Results indicate that approximately half of the shorelines surveyed are of low coverage (0-30 percent) with high coverage (71-100 percent) occurring more frequently in Bayou Cumbest, Bangs Bayou, and the North Rigolets. Rapid characterization of the oyster reefs through quadrat sampling reveal a much higher count of dead oyster versus live oysters, although spat growth is high in many areas. The majority of dead oysters were in size classes premature of harvestable size, but in the adult stages of life.

THE PARTNERSHIP APPROACH TO HABITAT CONSERVATION IN THE NATIONAL MARINE FISHERIES SERVICE, SOUTHEAST REGION

Habitat Management and Restoration
Poster Presentation
Miles M. Croom* and Buck Sutter
National Marine Fisheries Service
Southeast Region, Habitat Conservation Division
miles.croom@noaa.gov

Among its many missions, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) is charged with conserving healthy, self-sustaining coastal and marine habitats which support vital ecosystem functions. Healthy, abundant habitats produce harvestable stocks of living marine resources, contribute to recovery of protected species, and provide services for humans including coastal resiliency and aesthetic benefits. Over the past several decades, the challenge of conserving, protecting, and restoring coastal and marine habitats has grown significantly, and as populations continue to grow in the coastal areas of the United States, these challenges will increase. As the sense of urgency to conserve aquatic habitats has grown, it has become increasingly clear that solving these challenges requires a collaborative approach among government entities at multiple levels, the private sector, and the concerned public.

In the southeastern United States, the NMFS habitat conservation program is managed by the Southeast Region, Habitat Conservation Division (HCD). The NMFS Southeast Region includes the coastal states of Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, and North Carolina, as well as the U. S. Caribbean. The HCD conducts a broad spectrum of habitat conservation and protection efforts, using both statutory and voluntary approaches to promote the protection of existing habitat. By protecting and conserving existing aquatic habitat, ecosystem functions and services continue to provide ecological and economic benefits. The conservation approach helps foster habitat connectivity and prevents the continuing loss of ecosystem benefits where habitat could otherwise be lost or degraded as a result of human activities. The conservation approach also avoids the temporal loss of ecosystem services, thereby preserving existing habitat functions and benefits and avoiding the need for costly restoration and enhancement measures.

Historically, the HCD focused most of its attention on managing statutorily mandated programs. These programs include the essential fish habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act and the fish passage prescription authority provided by the Federal Power Act. However, these programs do not address the full spectrum of conservation problems, nor do these programs provide all the tools needed for comprehensive habitat conservation. A combination of declining budgets, increased demands on capabilities, and new conservation challenges (e.g., the effects of climate change and the prolonged drought in the southeastern United States and the need to build coastal resiliency) has led to a more partnership-based approach. This approach recognizes that HCD does not possess the capacity alone to achieve comprehensive habitat conservation and that we must engage the broader stewardship community. Existing and proposed federal authorities and budgets do not provide all the tools

needed to address habitat stewardship needs; the support of local, state, other federal agencies, non-governmental organizations, business and commercial interests, recreational interests, and the public at large must be mobilized to devise comprehensive, regionally focused, ecosystem-based solutions that work for all these interests.

PLAN FIRST, PLANT LATER: THE IMPORTANCE OF SITE SELECTION FOR SEAGRASS RESTORATION

Habitat Management and Restoration
Oral Presentation
Bart Christiaen*, Joshua Goff, Sybil Glenos, and Just Cebrian
Dauphin Island Sealab – Ecosystems Lab
Department of Marine Sciences, University of South Alabama
bchristiaen@disl.org

Seagrass beds provide many ecological services to coastal systems along the Gulf of Mexico. They supply food and refuge for numerous organisms, protect shorelines from erosion by reducing wave action, and improve water clarity through enhanced sediment stabilization. In the last century, many seagrass beds have disappeared because of increased anthropogenic disturbance. To reverse this trend we need to change current practices of watershed development, reduce physical damage and pollution by human activities, and improve the efficacy of restoration efforts. Restoration is carried out as a means to mitigate anthropogenic loss of seagrass beds, but it is often unsuccessful. One reason for the failure of restoration attempts is poor judgment in choosing the restoration site.

To ensure the success of an upcoming community-based restoration project that aims to restore ~900 m² of *Halodule wrightii* on the coast of Alabama, three possible restoration sites were chosen following published procedures of site selection. All three sites were located in the Bon Secour National Wildlife Refuge in Gulf Shores (AL). Phase 1 of the selection process involved the evaluation of key parameters like wave exposure, distance to natural beds, sediment quality, and water depth. During phase 2, a detailed assessment of the physical and biological characteristics was made and a transplant experiment was conducted at each site. For the transplant experiment, 162 plugs (15 cm in diameter) of *Halodule wrightii* were collected from healthy donor sites near Perdido Bay. Nine plugs were then planted in each of six plots per site. Half of these plots were protected against bioturbation with a sturdy metal mesh.

The sites showed contrasting physical characteristics. Mean light attenuation differed among sites, with attenuation being notably higher at sites 1 and 2. Site 1 also displayed large drops in salinity during periods of high rainfall. Preliminary results of the ongoing transplant experiment suggest that sites 1 and 2 are not good choices for seagrass restoration as, after three months, the planted plugs had died off. This finding was unexpected as the mean percentage of surface irradiation reaching the bottom in these two sites was above the published threshold for survival of *Halodule wrightii* (>18 percent). Additional stress from transplantation and bioturbation and large salinity oscillations in site 1 may have contributed to the observed plant mortality. At site 3, where water clarity was greatest, seagrass survival was 96.3 percent for the protected plots and 66.6 percent for the non-protected plots. These results illustrate the importance of applying site selection criteria, as well as guaranteeing adequate light availability and protection against bioturbation for successful restoration of seagrass in Alabama coastal waters.

POPULATION STUDY OF *Ruppia maritima* AT GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE

Habitat Management and Restoration
Poster Presentation
Brenna Ehmen*, Nicole Bulla*, Anne Boettcher, and Ashley Morris
Biology Department, University of South Alabama
behmen@jaguar1.usouthal.edu, anb606@jaguar1.usouthal.edu

Seagrass beds are an important part of the ocean's coastal zone, protecting the shoreline from erosion and supporting grazing and detrital food webs. They also serve as nursery grounds for many aquatic species, including commercially important fisheries. Seagrass populations have decreased dramatically due to human development, pollution, and eutrophication. Programs aimed at conserving and restoring this essential habitat have begun to consider genetic diversity as a key component in establishing and maintaining a successful seagrass population. The genetic structure of both the target restoration site and the donor material is important for the successful colonization of seagrass beds. Seagrass restoration using transplanted individuals is much more successful with donor plant material that is genetically diverse. Grand Bay National Estuarine Research Reserve has been conducting large-scale monitoring of seagrass habitat in the reserve and has noted a decline in its distribution over the past several decades. These seagrass beds are dominated by *Ruppia maritima*, a species for which little genetic research has been done. Initial investigation of the genetic diversity of *Ruppia maritima* in Grand Bay National Estuarine Research Reserve was carried out to supplement their submerged aquatic vegetation project. Samples were collected from various locations in the reserve and diversity within these populations was assessed using microsatellite markers. Additional samples from other locations along the Gulf Coast were also collected and used for comparison. Information regarding gene flow and any apparent patterns in genetic profiles of these locations will help lead researchers at Grand Bay National Estuarine Research Reserve in any future conservation or restoration projects.

PREDICTING SUITABLE SEAGRASS HABITAT AT GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE USING A BIO-OPTICAL MODEL

Habitat Management and Restoration
Poster Presentation
Brenna Ehmen*, Emily Goldman, Christopher May, Anne Boettcher, Deborah Gochfeld, Marc Slattery, and Hugh MacIntyre
Biology Department, University of South Alabama
behmen@jaguar1.usouthal.edu

Seagrass distributions are controlled by a variety of factors, with light availability, sediment characteristics, and wave action being key. These factors can vary based on both natural conditions and anthropogenic activities. Understanding how these characteristics vary in an environment is essential to designing successful resource management programs. A bio-optical model that predicts suitable seagrass habitat is being developed for Grand Bay National Estuarine Research Reserve (GBNERR). This reserve has inshore and offshore seagrass beds dominated by *Halodule wrightii* and *Ruppia maritima*. The amount of light reaching the sediment and thus available to seagrasses can be modeled using bio-optical data and depth. Spectrally resolved estimates of light scattering and absorption due to chromomorphic dissolved organic matter, phytoplankton, and particulate material were recorded along a GPS cruise track at GBNERR. Depth was also recorded at regular intervals. Attenuation of light was modeled using this information and the suitability of an area for seagrass growth was predicted according to photosynthetic requirements of *H. wrightii*. Classification of habitat suitability for seagrass was formulated using literature values for *H. wrightii* and the data collected from regions within the reserve that currently support seagrass populations, as well as those regions that do not currently support seagrass. The model's predictions of suitable habitat were a close representation of what is seen for seagrass distribution in the reserve. Using the recorded GPS locations, the habitat classifications can be merged with a GIS map of the reserve, making it easy for research scientists to locate possible restoration sites in the field. This type of model may prove to be an important tool for restoration programs looking to target appropriate areas that may be used to re-establish or initiate seagrass populations.

QUANTIFYING THE FISHERIES BENEFITS OF LANDSCAPE-SCALE OYSTER REEF RESTORATION: A TOOL FOR PROMOTING "LIVING-SHORELINES?"

Habitat Management and Restoration
Oral Presentation
Steven B. Scyphers*, Sean P. Powers, and Kenneth L. Heck Jr.
University of South Alabama, Department of Marine Sciences
Fisheries Ecology Lab, Dauphin Island Sea Lab
sscyphers@disl.org

Shorelines at the interface of marine and terrestrial biomes are one of the most degraded and threatened habitats in the coastal zone because of their sensitivity to sea level rise, storms, and increased utilization by man. Previous efforts to restore shorelines have largely involved introducing unnatural structures to dampen or deflect erosive wave energy. Two of the most common traditional methods are bulkheads and seawalls which have been shown to cause vertical erosion down the barrier, subsequent loss of intertidal zone, and even increased erosion on adjacent properties (Figure 1).

Figure 1. Substantially eroding shoreline, directly adjacent to a shoreline armored with a bulkhead and rip-rap.

The intertidal and nearshore zones are frequently comprised of marshes, oyster reefs, SAVs, and serve as habitat for many species of finfish and shellfish. Recently, some restoration efforts have shifted towards biogenic reefs, or "living shorelines." Beyond shoreline stabilization, living reefs may provide additional ecosystem services, such as habitat for resident species of shellfish and finfish, providing feeding resources for transient fishes, and improved water quality via the filter-feeding bivalves. Subtidal oyster reefs are one example of natural reefs within intrinsic habitat value that could be utilized for shoreline restoration efforts. Natural oyster reefs provide habitat for numerous species of infauna and epifauna, including baitfishes, worms, and crustaceans that serve as important prey items for larger fishes. Restored and created oyster reefs have been demonstrated to function at an equivalent or greater level, with decapods, crustaceans, and fish quickly colonizing the available substrate. Among the species with enhanced recruitment benefits from oyster reefs are several economically important species including: stone crab *(Menippe mercenaria)*, gray snapper *(Lutjanus griseus)*, gag grouper (*Mycterperca microlepis)*, and southern flounder *(Paralicthys lethostigma).*

Figure 2. Created subtidal oyster reefs near Alabama Port. These reefs provide complex 3-dimensional habitat for many fish and invertebrate species.

Currently, we are evaluating the fisheries benefits of multiple configurations and scales of breakwater oyster reef restoration projects in coastal Alabama (Figure 2). We hypothesized that over time the presence of eastern oyster (*Crassostrea virginica*) reefs could stabilize and possibly facilitate the expansion of shoreline marsh grass as well as provide habitat

for additional fishes. Our preliminary results support our hypothesis that created oyster reefs will be utilized by transient fishes and provide substrate for oyster reef recruitment. Results from this study and others could provide support for oyster reef and other living shoreline restoration practices.

RESTORATION OF LITTLE DAUPHIN ISLAND

Habitat Restoration and Management
Poster Presentation
Roberta Arena Swann*
Mobile Bay National Estuary Program
rswann@mobilebaynep.com

Little Dauphin Island serves as critical migratory bird habitat and protects a larger barrier island in Alabama from erosion caused by large storm events. It is a diverse assemblage of beach, coastal dunes, and associated uplands, salt marsh, and wetlands at the mouth of Mobile Bay. Hurricanes Ivan (2004) and Katrina (2005) significantly diminished the native vegetation on Little Dauphin Island, severely deforesting it, reducing vegetative habitat for migratory birds and compromising the island's role as a first line of storm surge protection for the larger Dauphin Island. In 2007, the Mobile Bay National Estuary Program in partnership with the U.S. Fish and Wildlife Service, the Bon Secour National Wildlife Refuge, and the Alabama Department of Conservation and Natural Resources established a comprehensive Re-vegetation Program for the island consisting of dune, shrub, and tree planting followed by an ongoing monitoring program to measure survival rates and direct subsequent planting activities. Twenty-five committed volunteers planted 1,100 dune species, such as sea oats, panic grass, and beach morning glory, in August 2007 along the eastern end of the island to stabilize the sand and promote increased shore accretion to support piping plover habitat. In December 2007, 40 volunteers planted 325 native trees to restore migratory bird habitat including sand live oaks and slash pines. These trees will not only provide habitat, they will also serve to stabilize this dynamic island landscape which protects the northern shore of Dauphin Island from the impact of storms and flooding. Volunteers continue their involvement by engaging in a monitoring program to evaluate survival rates, by checking on the trees once a month for a one year time period. Given the survival rates from the earlier plantings, another planting of 225 native trees and shrubs was completed in April 2008. MBNEP and Bon Secour National Wildlife Refuge will continue to work to identify additional planting opportunities at the Little Dauphin Island site.

RESTORATION OF TIDALLY-INFLUENCED SAWGRASS MARSH ON BENNETT BAYOU IN THE PASCAGOULA RIVER SYSTEM, JACKSON COUNTY, MS

Habitat Management and Restoration
Oral Presentation
Jim Kelly*
Eco-Logic Restoration Services, LLC
jkelly@ecologic-restoration.com

Sawgrass (*Cladium jamaicense*) is a large, rhizomatous sedge in the *Cyperaceae* family. It is most extensive in southern Florida but occurs in all the southeastern Coast and Gulf States from Virginia to Florida and west to southeastern Texas. Sawgrass marshes supply important habitat for a variety of fish and wildlife in addition to providing water quality functions like filtration, sediment capture, and erosion control. And if not well-known before, the hurricanes of 2005 helped raise the awareness of Gulf Coast residents as to the critical role that coastal marshes play in floodwater attenuation and retention.

Bennett Bayou is a tributary to the Pascagoula River in southeastern Jackson County, MS. A large canal was dredged through a sawgrass marsh in the headwaters of this bayou to provide direct river access for operation of a marina. Two large boat basins were also excavated. Dredged material was side-cast onto the adjacent marsh and graded for use as a parking area for boats and vehicles. Riprap used for erosion control along the banks of the canal and basins further degraded the ecological function of the area.

The Land Trust for the Mississippi Coastal Plain acquired the Bennett Bayou property in February 2006. Restoration of the 1.5 acre sawgrass marsh began in January 2007. Undisturbed marshlands lying adjacent to the project area on Department of Marine Resources Coastal Preserves were used as reference. Approximately 2,300 cubic yards of material was excavated to re-establish the site's historical elevation. Following a short consolidation period, more than 16,000 plants were installed by volunteers and contract labor. Once the herbaceous layer had become established, a few pond cypress trees were planted.

This is the first known restoration of tidally-influenced sawgrass marsh in Mississippi. It was made possible by funding and collaboration of numerous public and private entities. The Land Trust was presented with a Bronze Plaque Recognition Award from the U.S. Environmental Protection Agency's Five Star Restoration Program for this project. Restoration techniques employed at Bennett Bayou and the site's current vegetative composition are presented. Funding mechanisms used and public-private partnerships formed for the project are identified along with logistical considerations for planning such restorations in the future.

RESTORATION OF TROPHIC DYNAMICS IN CREATED SALT MARSHES ON THE NORTHERN GULF OF MEXICO

Habitat Management and Restoration
Oral Presentation
Moody, R.M.*, R.B. Aronson, Emmie Fulgham, and Andrew Lawrence
Department of Marine Sciences, University of South Alabama, Dauphin Island Sea Lab
rmoody@disl.org

Marsh restoration along the Atlantic and Gulf Coasts typically involves restoring the physical structure provided by the smooth cordgrass, *Spartina alterniflora*. The underlying assumption is that natural ecosystem function will follow the provision of structure, although this assumption has not generally been corroborated. We present the results of a three-year study to evaluate the development of trophic interactions and habitat utilization by key resident and transient species in restored salt marshes of the northern Gulf of Mexico.

The blue crab, *Callinectes sapidus*, is the dominant aquatic predator within salt marsh habitats along the northern Gulf Coast, and the primary predator of the marsh periwinkle, *Littoraria irrorata*. *Littoraria* is an abundant herbivore in *Spartina* marshes, and *Callinectes* controls *Littoraria* populations with cascading effects that can prevent the snails from overgrazing *Spartina*. We characterized the trophic linkage between *Callinectes* and *Littoraria*, using (1) tethering experiments, (2) estimates of the frequency of sublethal injury (repaired shell cracks) in *Littoraria* shells, and (3) multivariate descriptions of antipredatory shell morphologies. Field and laboratory experiments confirmed that among-site variations in shell morphology result from predator-induced plasticity by *Callinectes*, even in the absence of direct predator-prey contact. Furthermore, antipredatory defenses are differentially expressed among the sexes, with females producing thicker and more massive shells than those of males. These metrics of predation revealed distinct predation regimes over small spatial scales, correlated with the abundance of the predatory crabs, and persisted over multiple years. Integrated measures of predator activity (i.e., shell repairs and morphology) provided more stable among-site differences in predation over time than instantaneous rates of predation potential (i.e., tethering experiments).

The potential prey base for *Callinectes* was characterized using a combination of flume traps, standard quadrat surveys, and sediment cores. Assessments of transient nekton and demersal macrofauna were replicated over tidal cycles and assessments of resident epifauna and infauna were conducted seasonally. Although differences in community structure were detected among transient, resident, and infaunal assemblages, variability in diversity and abundance was not clearly associated with the age or restoration status (restored versus unaltered marshes) of study sites.

Although *Callinectes* and many of its prey species rapidly colonize restored marsh habitats, it is unclear whether or when quasi-natural trophic relationships become established. Conventional approaches to measuring ecosystem development, which are

rarely applied and yield inconsistent trajectories of ecosystem development, rely on indirect measures of biotic interactions that are costly and time-intensive. Metrics of the predator–prey relationship between *Callinectes* and *Littoraria* have the potential to provide inexpensive and time-efficient proxies for assessing the extent of habitat utilization by predators and the development of marsh function.

STATUS AND MONITORING OF *Pandion haliaetus* IN THE MISSISSIPPI DISTRICT OF GULF ISLANDS NATIONAL SEASHORE

Habitat Management and Restoration
Poster Presentation
Thomas Mohrman*, Gary Hopkins, Brett Patton, and Chris Story
National Park Service
Gulf Islands National Seashore
Thomas_mohrman@nps.gov

The Gulf Islands National Seashore routinely monitors and actively manages osprey that nest on the Mississippi barrier islands. Nests have been monitored for the past 10 years to identify the extent to which these islands are utilized for nesting and determine fledgling success. The 10-year trend shows fluctuations in both the nesting population size and relative fledgling success. Observations on this population and related data will be discussed. Additionally, current management techniques designed to mitigate anthropogenic disturbance to osprey will be described.

SUMMARY OF LOUISIANA COASTAL PROTECTION AND RESTORATION (LACPR) PLANNING UNIT 1 (PONTCHARTRAIN BASIN) ALTERNATIVES

Habitat Management and Restoration
Poster Presentation
Clint Padgett*
Engineering Research Development Center, Environmental Laboratory, Geospatial Data Analysis Facility
Clint.Padgett@us.army.mil

The objectives of the Louisiana Coastal Protection and Restoration (LACPR) effort are to reduce overall risk to people, economic assets, coastal resources, and cultural resources along the Louisiana coast from storm events. Storm risk reduction measures can be formulated in two ways: either by reducing the probability of adverse consequences from the occurrence, or by reducing exposure to the occurrence; thereby reducing the consequences themselves. No alternatives have been formulated that will provide absolute protection over the entire planning area against all potential storms. One assumption used is that hurricane risk reduction plans should rely on multiple lines of defense. This strategy involves using natural features such as barrier islands, marshes, and ridges to complement engineered structures such as highways, levees, and raised homes. Within the context of a multiple lines of defense or comprehensive system, numerous risk reduction measures can be combined to form alternative plans. Each type of measure provides unique opportunities to develop comprehensive solutions to the flooding and habitat loss problems of the Louisiana coast. These combined approaches produce a multiple lines of defense system against storm surge.

For the LACPR effort:

- Coastal restoration alternatives, consisting of hundreds of coastal restoration measures, are the foundation of every alternative, with exception to the no action alternative. Examples of coastal restoration measures include land/marsh-building river diversions, freshwater redistribution, mechanical marsh creation, barrier island/shoreline restoration, bank/shoreline stabilization, and ridge restoration.
- Structural measures and alternatives reduce flood risk using features that are designed to withstand the forces of storm events, such as surge-reduction weirs, floodgates, continuous earthen levees, floodwalls, and ring levees.
- Nonstructural measures and alternatives reduce the exposure to risk by removing vulnerable populations and assets from the threat through measures such as buyout of properties or raising structures in place. Additional nonstructural measures include wet and dry flood-proofing of critical facilities.
- Comprehensive alternatives (not to be confused with the comprehensive plan for the coast) refer to plans that contain all three types of risk reduction measures – nonstructural, structural, and coastal restoration – presenting a multiple lines of defense strategy, providing comparable levels of risk reduction to all economic assets in the surge impacted area.

TECHNIQUES FOR DETERMINING LAND COVER CHANGE IN A GRAND BAY SALTMARSH

Habitat Management and Restoration
Poster Presentation
Tami Wells*, Ashley Turton, Jonathan Powell, Steven Ethridge, Bradley Manning, Scott Peterman, Denise Runnels, and Anne Boettcher
University of South Alabama, Department of Marine Sciences
tmw502@jaguar1.usouthal.edu

Rate of change in land cover types were computed from historical aerial photography (from 1940 to 2006) combined with in situ line intercept vegetation analysis and post-classification maps for intervals between image time periods. The ancillary photographs and digital imagery were rectified, digitized and interpreted from both analog and digital file formats. Four matrices (*Juncus roemerianus* marsh, salt pan, water, and upland) were chosen for classification mapping of the study area. An accuracy assessment was performed on the rectified imagery by comparing randomly selected points within the study area to that of the individual land cover classes generated from each aerial image. An error matrix computed > 85 percent overall accuracy in land cover classification for each image. The change detection analyses revealed that most of the marsh remained marsh with the largest change occurring 1940-2002 where marsh converted to uplands and salt pan converted to marsh. Results indicate that comparison of aerial photography over time can provide insight into changing morphology of coastal marshes; however, the degree of accuracy is dependent on data collection and processing methodologies as well as spatial dynamics associated with the marsh system.

TRANSPORT AND RETENTION OF OYSTER LARVAE IN A SHALLOW AND WIDE ESTUARINE SYSTEM

Habitat Management and Restoration
Oral Presentation
Choong-Ki Kim*, Kyeong Park, and Sean P. Powers
Department of Marine Sciences, University of South Alabama
Dauphin Island Sea Lab
ckim@disl.org

As a part of a comprehensive oyster restoration program for coastal Alabama, a three-dimensional larval transport model has been developed to study the larval transport and retention of eastern oysters (*Crassostrea virginica*) in Mobile Bay and the adjacent eastern Mississippi Sound, Alabama. The simulated larval distribution showed a good agreement with oyster spat settlement observed in 2006 (Figure 1). The characteristics of larval transport in response to the variations in tide, wind, and river discharge were investigated by a series of scenario simulations. Variations in spawning time in relation to tidal phase result in little change in larval distribution, while variations in river discharge and winds play a significant role in the larval transport and retention inside the Bay and the Sound. Limited larval transport occurs between the west and east side of Mobile Bay regardless of tide, river, and wind conditions. The scenario simulations show that large spawning stocks in Cedar Point result in maximum larval supply into the southwest side of Mobile Bay and the eastern Mississippi Sound, suggesting that the differences in larval supply may be responsible for the persistent west-east gradient in oyster spat settlement over the past 40 years.

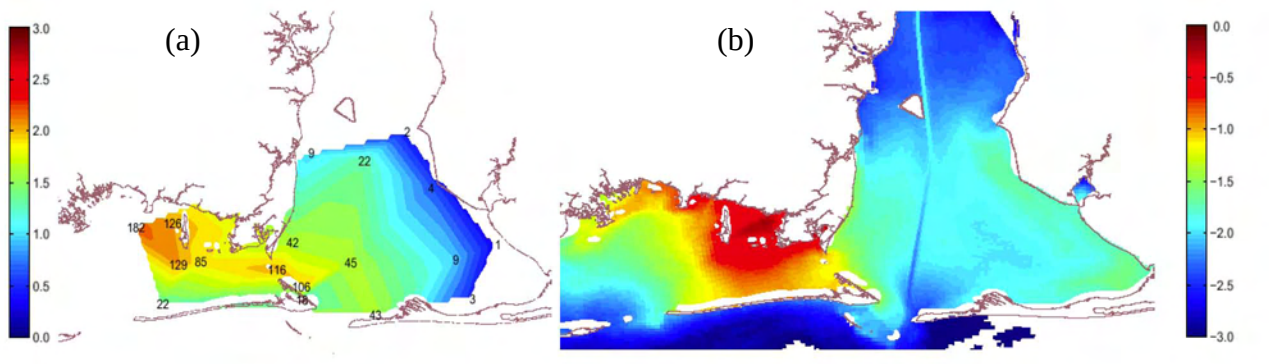


Figure 1. The observed oyster spat settlement in spat m^{-2} d^{-1} (a) and compared with the model results by physical transport only (b), averaged between May and October in 2006. Color bar indicates log10-transformed data and model results.

UNDERSTANDING ORGANIC DORMANCY AND GERMINATION OF SEEDS OF *Ruppia maritima* WITH IMPLICATIONS FOR SEAGRASS RESTORATION USING SEEDS AND SEEDLINGS

Habitat Management and Restoration
Oral Presentation
Philemon Kirui*, Inki Hong, and Hyun Jung Cho
Department of Biology, Jackson State University
Hyun.j.cho@jsums.edu

Seed broadcast and seedling propagation have been used in seagrass restoration projects elsewhere as a cost-effective alternative to whole-plant transplanting. Knowing presence, types, and timings of seed dormancy is suggested as one of the primary requirements for successful seedling propagation. *Ruppia maritima* L. is a cosmopolitan, euryhaline Submerged Aquatic Vegetation (SAV) that is highly dependent on sexual reproduction, producing numerous seeds that are protected by sturdy seed coats. *R. maritima* is the most abundant SAV species in marshes, bayous, and estuaries of Gulf of Mexico; and it is a pioneer species that can colonize and grow rapidly in bare habitat. Therefore, it is a good candidate species to initially re-vegetate areas with recent vegetation losses.

Figure 1. Seeds of *Ruppia maritime.*

We conducted a laboratory study to understand presence and types of organic dormancy (seed dormancy caused by seed characteristics, not by environmental factors) of the seeds of estuarine *R. maritima* to develop methods for long-term seed storage that can be employed for SAV propagation in coastal brackish habitat restoration projects. The following hypotheses were tested: (1) Newly matured *R. maritima* seeds are not in morphological dormancy; (2) *R. maritima* seeds are in a physical dormant state at time of maturation; (3) Desiccation does not reduce seed viability of *R. maritima*; and (4) Germination rates of dry-stored seeds do not differ among levels of salinity that naturally occur in local habitat. If mature seeds are in a physical dormancy, desiccation makes it easy to break the dormancy, and desiccation does not reduce seed viability, the seeds, if simply air dried, can be stored for an extended period and used later in SAV restoration projects. Our study results indicate that the brackish estuarine *Ruppia maritima* population produces seeds that do not have any noticeable initial morphological, physical, and physiological dormancy. Although dry stratification reduced seed viability (30 percent) and final germination rates (20-30 percent), drying seems to induce an earlier germination (Figure 2) in *R. maritima*.

Figure 2. Germinating *Ruppia maritima* seed

Desiccation also appears to induce an environmental dormancy that can be disrupted by exposure to water. Understanding requirements of an organically dormant period immediately after production, along with an understanding of environmental factors that disrupt or induce dormancy is the basic scientific information needed to develop inexpensive propagation methods

for SAV restoration. Further study on environmental dormancy is needed to provide information to develop methods for greenhouse seedling propagation.

USE OF ACOUSTIC BENTHIC SURVEY TECHNIQUES TO ASSESS ESTUARINE AND MARINE FISHERIES HABITATS ALONG COASTAL ALABAMA

Habitat Management and Restoration
Oral Presentation
George S. Bosarge*, Sean P. Powers, and Robert L. Shipp
University of South Alabama Department of Marine Sciences
Fisheries Ecology Lab, Dauphin Island Sea Lab
sbosarge@disl.org

Increased degradation of fisheries habitats, such as seagrass meadows, salt marshes, oyster reefs and shallow hard bottom reefs, as well as decreased abundance of many economically important fisheries, is known to be directly related to human utilization of coastal resources. With the realization that conservation of fisheries habitat requires assessment, characterization, and inventory of current fisheries habitat, comes the need to perform such assessments in a timely and effective manner. Acoustic benthic mapping technology, namely side-scan and single-beam sonar, allows for relatively large areas of bottom habitat to be surveyed and spatially characterized in a relatively short time period. Integrating these measurements into illustrated figures and maps provides a valuable tool to researchers, conservation groups, and resource managers. These survey techniques are currently being utilized as part of a comprehensive benthic habitat assessment program developed to support the University of South Alabama Oyster Reef and Fisheries Habitat Enhancement Program.

Presently, survey efforts are directed towards two habitat types within the Alabama coastal zone: subtidal oyster reefs located within Mobile Bay and Mississippi Sound, and offshore hard bottom (both natural and artificial) located within the Alabama artificial reef permit areas (Figures 1 and 2). A dual frequency (300 / 600 kHz) side-scan sonar provides broad swath coverage of seafloor habitats, providing two-dimensional, geo-referenced images from which areal extent of natural biogenic habitats or man-made submerged structures can be determined. A 200 kHz single-beam sonar deployed in tandem with the side-scan sonar system provides bathymetry for nearshore and offshore habitats, as well as bottom or surficial sediment classification of nearshore habitats. Data collected with both systems is currently being integrated into an ArcGIS database from which high-resolution bottom habitat characterization maps will be generated. The program represents a long-term investment in conservation

Figure 1. Side-scan mosaic of White House Reef (relic sub-tidal oyster reef). Blue lines represent borders of 1 km^2 survey grids.

and management of marine resources by the University of South Alabama. This talk will focus on the research plan and priorities of the first two years of this commitment.

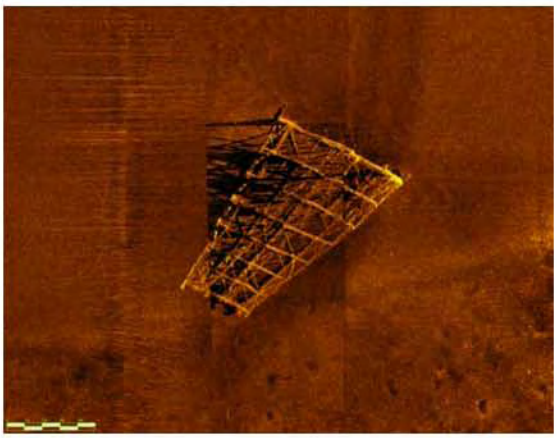


Figure 2. Toppled petroleum rig located in Hugh Swingle reef permit area. Yellow scale bar represents 50 meters.

USE OF AN INTEGRATED CONCEPTUAL MODEL FOR ECOLOGICAL RISK ASSESSMENT AT THE GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE, MISSISSIPPI

Habitat Management and Restoration
Poster Presentation

Mark S. Woodrey*, Michael A. Reiter, Mark A. Harwell, Paul B. Tchounwou, and Christina F. Watters
Mississippi State University Coastal Research and Extension Center/Grand Bay National Estuarine Research Reserve
msw103@ra.msstate.edu

Conceptual modeling methods such as Valued Ecosystem Component (VEC) modeling have provided resource managers with useful tools for evaluating cause-effect relationships and potential risks in an ecosystem. The growing interest in integrated assessment as a means of identifying environmental risks and developing management strategies has highlighted the need for a procedure that can combine scientific data, social and economic inputs, and management constraints so that they can be used to make management decisions. The National Oceanic and Atmospheric Administration-sponsored Environmental Cooperative Science Center (ECSC) has utilized conceptual modeling as the foundation of an integrated assessment and ecosystem management protocol (IAEMP) that allows coastal resource managers to move from a graphical picture of hypotheses for the behavior of the system of concern based on both scientific and non-scientific information to a series of forecast scenarios that can be analyzed for potential adherence to management goals. The subset of scenarios that fit management goals can then be evaluated based on management constraints in order to select the "best" scenario for developing a management action. The management action is implemented as part of an adaptive management process, allowing the manager to evaluate the management action and, if necessary, refine the action or the models (or both) in order to improve the outcome of future management actions and scenarios. In addition to scenario forecasting, the model can be used to identify data gaps, provide focus on VECs, prioritize research/monitoring needs, and allow for comparison with other management documents to highlight similarities and dissimilarities among evaluation tools.

The protocol will be discussed in reference to the development of a conceptual model for the Grand Bay National Estuarine Research Reserve (GBNERR) in southeast Jackson County, Mississippi. The conceptual model provides a

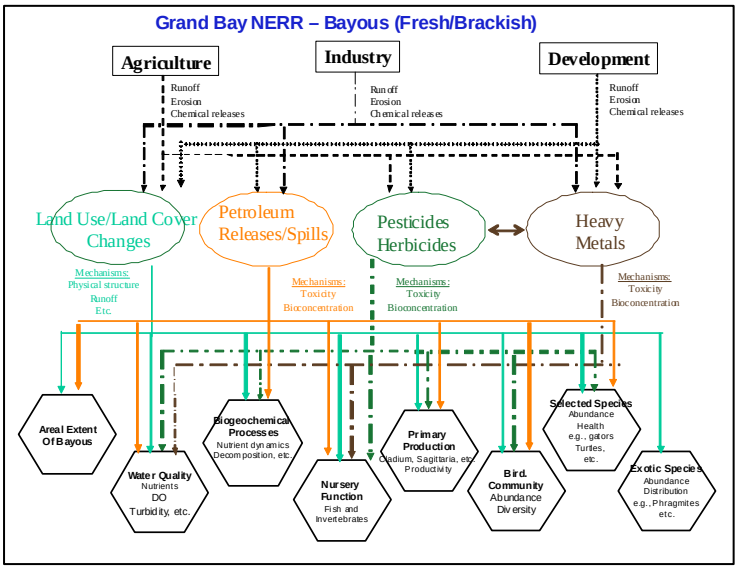


Figure 1. Sample schematic from the Grand Bay conceptual model.

framework for ecological risk assessment and management pertaining to the GBNERR. The model identifies key elements including significant drivers or sources of environmental stressors, specific environmental stressors as a result of natural phenomena or anthropogenic activities, the pathways of environmental exposure, and the potential human health and ecological effects. The model highlights valued ecological components in 19 key habitats of the GBNERR, as well as the most relevant assessment and measurement endpoints.

This modeling effort highlighted unanticipated insights into the function of the Grand Bay ecosystem. For example, unlike more classic riverine-dominated estuaries, discussions during the model development suggested this system is a marine-influenced system. Thus, stressors, such as climate change and sea-level rise, were hypothesized to have a greater impact on the long-term function of this system. This focus on the physio-chemical stressors the impacts of sea-level rise has directed NERR efforts toward monitoring VECs, such as the extent and health of emergent marsh vegetation, endemic terrestrial vertebrates, and the condition of tidal creek systems. The lack of fire, either natural or anthropogenic, was identified as the major stress of upland wet pine savanna habitats of the area, and restoration of these habitats is a major management focus of the Grand Bay NERR and Grand Bay National Wildlife Refuge.

USE OF PASSIVE ACOUSTICS TO IDENTIFY AND CHARACTERIZE SPOTTED SEATROUT SPAWNING HABITAT IN TWO MISSISSIPPI ESTUARIES: A PRELIMINARY ASSESSMENT

Habitat Management and Restoration
Poster Presentation
Eric R. Hoffmayer*, Jim S. Franks, Bruce H. Comyns, Jennifer A. McKinney, Susan K. Lowerre-Barbieri, Sarah L. Walters, and Joel W. Bickford
Center for Fisheries Research and Development, Gulf Coast Research Laboratory, The University of Southern Mississippi
eric.hoffmayer@usm.edu

Spotted seatrout, *Cynoscion nebulosus*, is one of the most sought-after saltwater recreational fish species in the southeastern United States and inhabits estuarine and nearshore Gulf of Mexico waters from the west coast of Florida to the Gulf of Campeche. Due to overfished spotted seatrout populations, as well as habitat loss and degradation as a result of post-Katrina coastal development, it is critical to identify and map spotted seatrout spawning habitat in Mississippi coastal waters. Two Mississippi estuaries were selected for study: Grand Bay (a pristine bay included in the National Estuarine Research Reserve) and Biloxi Bay (a heavily impacted bay). A passive acoustic survey designed to monitor male spotted seatrout courtship sound production was conducted in both estuaries from May to September 2008 to describe the habitat and environmental conditions associated with spawning spotted seatrout. Sample locations within each bay system were selected based on a stratified-random grid system. To ensure representative sampling, stations were distributed as evenly as possible over the available substrata. Each station was sampled for spotted seatrout courtship sounds using a hydrophone and digital recorder. In addition, water depth, salinity, temperature, dissolved oxygen, tidal and lunar stages, and GPS position were documented. To date, male spotted seatrout courtship sounds were detected in both estuarine systems. Preliminary results indicate that Grand Bay contains more suitable spotted seatrout spawning habitat than Biloxi Bay, based on the increased frequency of spotted seatrout courtship sounds identified. Preliminary findings suggest preferred spotted seatrout spawning habitat in the two bays to be oyster beds, artificial reefs, seagrass beds, and in depths greater than two meters. Continuing research will better define critical spawning habitat.

THE USE OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI TO ENHANCE NURSERY PRODUCTION OF SALTMARSH PLANTS *Juncus roemerianus, Spartina alterniflora,* AND *Scirpus sp.*

Habitat Management and Restoration
Oral Presentation
Melissa Pratt-Zossoungbo* and Patrick Biber
The University of Southern Mississippi
melissa.pzossoungbo@gmail.com

The value of salt marshes in reducing wave energy, enhancing sedimentation, stabilizing sediment, providing fisheries habitat, and serving as a food source for wildlife is well documented and widely recognized. From 1955-1978 12,700 ha of salt marshes were lost in the Northern Gulf of Mexico, the same land area as Rhode Island. Restoration efforts usually consist of whole plant harvesting from natural habitats. This imposes strong disturbances to the harvested areas, as well as plant availability being limited to the growing season. There is also potential disease transfer from the donor to the restoration location. Development and evaluation of ecologically sound and cost-effective restoration methods using nursery-grown marsh grasses will advance the current restoration science and improve restoration effectiveness in estuarine habitats.

The introduction of Vesicular-Arbuscular Mycorrhizal (VAM) fungi may have the potential to increase nursery production and the health of the plants produced. VAM are endomycorrhizae in which the fungal hyphae penetrate the plant cell wall. VAM grow intercellularly and intracellularly in the root cortex and form structures called arbuscules and vesicles. Generally, there is a benefit to both plant and fungi; the fungi obtain photosynthate from the host plant and the plant benefits from added surface area for nutrient uptake. Mycorrhizal infection may increase plant growth, improve water transport, increase resistance to pathogens, and mediate transplant shock of saltmarsh plants. VAM are also associated with enhanced plant survival in stressful environments including: water-stress, salinity stress, and low nutrient availability.

Figure 1: Photograph of a mycorrhizal infection in the root of a *Juncus roemerianus* plant. Under 100x magnification

Saltmarsh species *Juncus roemerianus, Spartina alterniflora, Scirpus robustus,* and *Scirpus americanus* plants of various ages were inoculated with commercial mycorrhizal innoculant containing a blend of eight types of endospores**.** Root samples were collected and the infection was assessed for all species using a staining technique. Infection rates

were monitored and plant growth and health were assed by morphological measurements including height, shoot counts and biomass.

These studies showed that species *Juncus roemerianus, Spartina alterniflora,* and *Scirpus americanus* are capable of acquiring a mycorrhizal infection, although the different species showed varying rates and durations of infection. In both the *Juncus roemerianus* seedlings and mature plants, plants were readily infected but showed little morphological differences between control and inoculated plants. There also seemed to be a peak of infection followed by a sharp decline. There was a difference in acquisition between seedlings and mature plants for *Scirpus* sp. *Scirpus robustus* seedlings showed significant differences in height and shoot numbers, while *Spartina alterniflora* seedlings showed significant difference in plant mortality between control and infected plants. More studies should be directed at determining favorable conditions for VAM infection and a more objective and less invasive method for determining infection in the roots.

CLIMATE CHANGE: PHYSICAL SCIENCE BASIS AND IMPACTS ON THE CENTRAL GULF COAST REGION

Natural Hazards Resiliency and the Ocean's Role in Climate
Oral Presentation
Virginia Burkett*
U.S. Geological Survey
virginia_burkett@usgs.gov

During the past 100 years the average temperature of the Earth's atmosphere has risen by 0.74º C, with the greatest increase in warming occurring in the northern hemisphere, during winter months, and at high latitudes. The rate of atmospheric and ocean surface warming over the past 50 years increased significantly over that of the past 100 years. Atmospheric warming alters water availability by increasing evapotranspiration rates. Warming also increases the moisture-holding capacity of the atmosphere and intensifies the hydrologic cycle. Annual precipitation has increased slightly, but significantly, in coastal Mississippi and Alabama since 1905. Although precipitation has generally increased across most of the reminder of North America, it is coming in the form of more heavy downpours. The number of days between rainfall events is increasing for most of the Northern Hemisphere and droughts have become more common in some regions. As ocean volume increases due to thermal expansion and a decline in land ice, low-lying coastal wetlands may be inundated and fresh water wetlands that fringe the coastline will tend to become more saline. The warming of the ocean surface, coupled with the increase in the moisture holding capacity of the atmosphere, portends an increase in the intensity of tropical cyclones globally. The relationships between warming and increased tropical storm intensity during recent decades are particularly strong in the main development region for hurricanes in the North Atlantic Ocean. Even if hurricanes do not increase in frequency or intensity, however, flooding is likely to increase along the low-lying Gulf of Mexico shoreline as sea level continues to rise.

The projected changes in climate for the 21st century by the Intergovernmental Panel on Climate Change portend a suite of environmental consequences that could place many coastal, wetland, and aquatic systems at risk in the central Gulf Coast region. Model results, climatic trends during the past century, and climate theory all suggest that extrapolation of the 20th century temperature record would likely underestimate the range of change that could occur in the next few decades along Mississippi/Alabama coastline. While there is still considerable uncertainty about the *rates* of change that can be expected, there is a fairly strong consensus regarding the direction of change for most of the climate variables that affect water levels, salinity, and disturbance regimes (storms, fires, drought), and habitats in the central Gulf Coast region. The large and growing pressures of human development, however, are responsible for most of the current stresses on Gulf Coast natural resources, which include: water quality and sediment pollution, drainage and filling of wetlands, human settlements along barrier island shorelines, dredging of natural rivers and engineered waterways, and flood-control levees have affected the amount of sediment delivered to the Gulf coastal zone. These and other human development activities could amplify the effects of climate change on coastal ecosystems.

THE GULF OF MEXICO RESEARCH PLAN: CONSTITUENT-DRIVEN RESEARCH PRIORITIES FOR THE REGION

Cross-cutting session
Oral Presentation
Stephen H. Sempier*, LaDon Swann, Karl Havens, Robert Stickney, and Charles Wilson
Mississippi-Alabama Sea Grant Consortium
stephen.sempier@usm.edu

There is an increasing need to identify regional research priorities as focus moves towards ecosystem-based management of natural resources that cross state and international boundaries. The Gulf of Mexico Research Plan (GMRP) is an effort to identify and address regional research priorities and information needs and uses the national Ocean Research Priorities Plan and Implementation Strategy (ORPP) as a framework to define and prioritize needs. The first step in this process was an analysis of over 100 strategic plans to identify the priorities that are being addressed by organizations that sponsor or conduct research in the Gulf of Mexico. Next, the GMRP collected input from constituents throughout the Gulf through surveys and workshops. Over 1,200 individuals rated the ORPP research priorities from a regional context through an online survey. Survey respondents were from federal, state, and local agencies, academia, non-governmental organizations, and businesses and included researchers, research administrators, and research users. In early 2008, approximately 300 people from more than 100 agency and university departments, non-governmental organizations, and businesses participated in workshops that were held in each Gulf of Mexico state. The workshops were used to identify specific high priority research topics for the Gulf. Over 250 topics were identified and prioritized at the workshops and the top 10 research topics from each workshop were used to develop the core portion of the plan. The ranking of each ORPP societal theme from the strategic plan analysis, survey, and workshops are included in Table 1. The two themes that were identified as highest priorities were “Improving Ecosystem Health” and “Stewardship of Natural and Cultural Resources.” However, specific research topics emerged as priorities within each of the ORPP societal themes. The draft plan has been circulated throughout the region for comment and the next phase of the project is to develop an implementation plan. The GMRP has contributed to regional efforts such as the Gulf of Mexico Alliance, Northern Gulf Institute, NASA’s Gulf of Mexico Coastal Program, NOAA’s Regional team and other efforts. The GMRP is sponsored by the four Gulf of Mexico Sea Grant College Programs (Texas, Louisiana, Mississippi-Alabama, and Florida) and the National Sea Grant Office. For more information about the GMRP access the project Web site at: http://masgc.org/gmrp.

Table 1. Ranking of Gulf of Mexico Priorities based on the Ocean Research Priority Plan Themes.

Theme	Survey Rank[a]	Workshop Rank[b]	Strategic Plan Rank[c]
Improving Ecosystem Health	1	1	1
Stewardship of Natural and Cultural Resources	2	2	2
Increase Resilience to Natural Hazards	4	3	3
The Ocean's Role in Climate	3	5	6
Enhancing Human Health	5	4	3
Enabling Marine Operations	6	5	5

[a] rank based on survey respondent’s average rating of research priorities within theme
[b] rank based on number of top 10 research topics defined at the workshop that matched theme
[c] rank based on number of research goals and priorities in strategic plans that matched theme

MYTHS AND REALITIES OF ECOSYSTEM-BASED MANAGEMENT

Habitat Management and Restoration
Oral presentation/keynote speaker
Steve Murawski*
NOAA Fisheries Service (Director of Scientific Programs and Chief Science Advisor)
steve.murawski@noaa.gov

Depending on the source, we are either behind the starting gate in implementing ecosystem-based management (EBM) of our oceans and coasts, or well into it, at least for a number of sectoral-based institutions. In reality, a number of our policy implementing institutions routinely consider some of the most-often articulated EBM principles, but the most elusive of EBM's tenets are those involving tradeoffs and allocation among competing use sectors. The chief impediments to implementing cross-sectoral decision making involve the asymmetric costs and benefits to individual use sectors perceived as accruing from EBM, and a consistent set of institutional frameworks and legal instruments supporting decision making. Science supporting the implementation of ecosystem-based principles chiefly requires information on species interactions, climate-species relationships, and habitat-species dependencies. Without such information, environmentalists urge precautionary management, while existing use sectors demand more specificity in the issues to be considered under the EBM rubric, as well as an accounting of how current management fails to address important issues. I will outline a number of current science and management "myths" regarding EBM, and my perceptions of "reality" regarding ecosystem policy. Additionally I will consider the value of incremental vs. paradigm-shifting change in our science approaches and management regimes for affecting EBM.

ADVANCEMENTS AND FUTURE STUDIES OF BLUE CRAB *Callinectes sapidus* AQUACULTURE IN MISSISSIPPI

Living Estuarine Resources
Poster Presentation
Christine Trigg*, Verlee Breland, Wayne Ferguson, Richard Fulford, Cindy Gavins, Dyan Gibson, Darcie Graham, Kirk Halstead, Adam Jackson, Anthony Johnson, Mike Mavar, Larry Nicholson, John Ogle, Harriet Perry, Matt Reudelhuber, Joe Roach, David Rose, Anthony Ryan, Kelly Schrader, and Joe Ziegler
The University of Southern Mississippi, Gulf Coast Research Laboratory, Center for Fisheries Research and Development
christine.trigg@usm.edu

In 2002, a comprehensive research program for the aquaculture of the blue crab was initiated at the Gulf Coast Research Laboratory (GCRL). Challenges of blue crab aquaculture include development of methodologies to address their complex larval life history, lengthy developmental period, cannibalism (megalopae and juveniles), nutrition, and disease. Current aquaculture practices at the GCRL include three phases: hatchery/nursery (eggs to megalopae), initial grow-out in re-circulating seawater systems (megalopae to juveniles about 20 mm CW), and pond culture of larger juveniles (greater than 20 mm CW).

In the hatchery/nursery phase, wild caught ovigerous females are held individually until they spawn. The newly-hatched zoeae are collected and transferred to 1400 L larval rearing tanks. Zoeae are stocked at 100 larvae per liter and reared through seven zoeal stages in these systems. Larvae are kept at ambient conditions (28 ppt salinity at 25ºC) for approximately 20 to 30 days until they molt to megalopae. The larval tanks are sampled daily to estimate survivorship and molt stage. Early zoeal stages are fed rotifers (*Brachionus plicatilis*) and algae. *Artemia salina* nauplii and Cyclop-eeze and added for later stage zoeae. Temperature, salinity, ammonia, nitrite, and nitrate levels are monitored in the rearing tanks. The crabs are harvested over a two- to three-day period when the systems contain 50 percent megalopae. Percent survival in these systems has varied; approximately 30 percent survival to megalopae was a typical recovery rate.

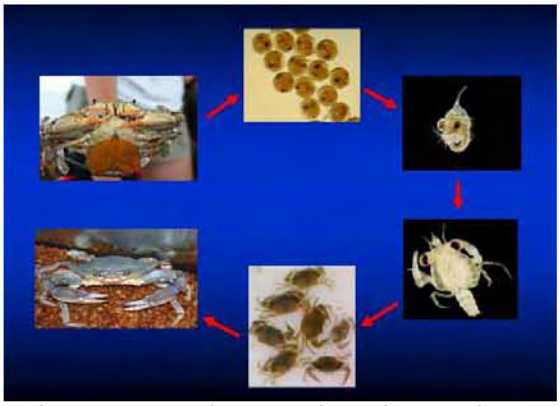


Figure 1. Blue crabs have been successfully reared through their entire life cycle at the GCRL.

Harvested megalopae are transferred to juvenile grow-out systems at the GCRL's Cedar Point Aquaculture Facility. Structure is added to the tanks to help reduce cannibalism. Daily feeding regimes included algae, *Artemia* nauplii and adults, Cyclop-eeze, and a variety of food pellets specially formulated to meet the nutritional requirements of crustaceans. Percent survival has

been as high as 10 percent over a six-week developmental period from megalopae to juvenile crab.

Cooperative studies with the Mississippi Department of Marine Resources (MDMR) are ongoing to test the feasibility and profitability of rearing juveniles in aquaculture ponds located at the MDMR Lyman Fish Hatchery in Gulfport, MS. Pond culture would allow for greater fishery production of high-value soft crabs without increased fishing pressure on natural stocks.

AMPHIBIAN RESPONSES TO HURRICANES IN SOUTHWEST ALABAMA

Living Estuarine Resources
Oral Presentation
Joel A. Borden*
Gulf Coast Geospatial Center
The University of Southern Mississippi
joel.borden@usm.edu

In 2005, the Atlantic Basin experienced a record-setting hurricane season. Twenty-eight named storms were spawned, seven of which were listed as major hurricanes (Category 3 or above). During this active storm period, an amphibian survey was under way to examine abundance, richness, and diversity in two upland habitats bordering the Mobile-Tensaw Delta in southwestern Alabama. Four named storms impacted the study area between June and late August: Arlene, Cindy, Dennis, and Katrina. While the objectives of the study were to examine community structures of amphibians, the four land-falling storms allowed for the examination of large-scale, random storm events on amphibian populations. Ten sites were randomly selected and sampled by using a single drift-fence array (composed of three arms) with six terrestrial funnels and three 19-liter pitfalls. Included in each array were 12 cryptozoan cover objects, five PVC tubes (tree frog refugia), visual transects, anuran (frog/toad) call monitoring, and hand captures. Twenty-one species of amphibians (N=2447) were encountered from February to December, the majority of these between April and September. Amphibians appeared to be positively impacted by the four storms. However, amphibian captures increased and remained high for several weeks after heavy rain events, independent of tropical storm activity. The hurricanes and tropical storms, while destructive to immediate coastal habitats, allowed amphibians in more protected inland areas to forage and breed at otherwise inhospitable periods.

ASSESSING STOCKS OF THE MISSISSIPPI BLUE CRAB FISHERY

Living Estuarine Resources
Poster Presentation
Darcie J. Graham*, Harriet Perry, Traci Floyd, and Bill Richardson
The University of Southern Mississippi, Gulf Coast Research Laboratory, Center for Fisheries Research and Development
darcie.graham@usm.edu

Assessing the status of the blue crab stocks in Mississippi is difficult due to the lack of fishery-dependent information. Changes in regulations over the years have restricted harvest of ovigerous females; thus, pounds of crabs landed does not reflect actual catch and more recent catch and effort data cannot be compared to historical information. A study of the fishery was initiated in the summer of 2005 to provide information on catch-per-unit-effort (CPUE), fishing effort, biological characterization of the catch, and disposition of the commercial harvest for the blue crab trap fishery. The initial study was severely compromised by Hurricane Katrina in August 2005. Although sampling resumed after the storm, data collection was inconsistent and did not produce comparable information from all participating fishermen. Using the same sampling methodology and protocols, a second study was initiated in May 2007. For the present study, each fisherman included additional traps equipped with a turtle excluder device (TED) in each funnel. Composition and CPUE of the catch from the traps with TEDs will be compared with traditional traps to determine the impact of the device on harvest.

Personnel accompanied three contracted crab fishermen aboard their vessels and recorded data on catch from each coastal county. Trips were made every other week. Number of blue crabs by sex and catch of ovigerous females were recorded for each trap.

Figure 1. Collecting data on blue crab catch in Jackson County.

Data on carapace width of crabs were collected from every other trap. Catch-per-unit-effort was calculated as pounds per trap, standardized to a 24-hour trap soak time. To calculate CPUE for standard and TED traps, values were determined as described above; however, the weight of the catch was determined based on the average weight of a crab from a representative sample multiplied by the number of crabs collected in the traps. In order to compare results with previous TED studies and to evaluate sex composition, additional CPUE values were calculated as the average number of crabs/trap day.

Values of CPUE fluctuate depending on season, with highest values found during the summer months. Overall, Jackson County had the highest average CPUE, followed by Hancock and Harrison counties. Females typically dominated the catch in all counties. In general, females were more abundant in traps in the summer and early fall; males became more abundant in the colder months. During peak spawning months, ovigerous females can make up more than 50

percent of the catch. On average, female crabs were larger than males in all counties and ovigerous females were larger than non-ovigerous females. Average CPUE and sex composition were similar between standard and TED traps, thus the TED appears to have little impact on harvest.

ASSESSMENT OF DEPREDATION BY BOTTLENOSE DOLPHINS IN THE NORTHWEST FLORIDA AND ALABAMA SPORT FISHERY

Living Estuarine Resources
Poster Presentation
Steve Shippee*, Jenn Latusek, Kelly Brinkman, Randall S. Wells, Claire Pabody, and Lori Schwacke
University of Central Florida, Biology Dept., Orlando, FL
shippee3@earthlink.net

We present our recently funded Mississippi-Alabama Sea Grant Consortium study to assess the problem of harmful interactions between bottlenose dolphins (*Tursiops truncatus*) and the sport fishery along the Northwest Florida – Alabama Gulf Coast. Sport anglers and boat operators report increasing incidences of dolphins stealing hook-and-line caught fish, regulatory discards, and bait. Aside from anecdotal information, little else is known about the extent and frequency of this problem, or of the consequence to dolphins that are injured or killed by fishing gear and the retributions of upset anglers. It is also unknown if some dolphins have become dependent on depredation as a principal feeding strategy, as has been suggested by some anglers.

The population status of bottlenose dolphins in the Northern Gulf is not well known, especially after recent hurricanes and toxic red tide blooms. Increased interactions with sport fishing may indicate a shift in dolphins' prey fish availability, suggesting ecological and habitat disturbance might underlie this problem. We speculate that discard requirements for undersized fish in the sport fishery also play a large role in exasperating dolphins' persistence to depredate since fishing boats and piers serve as easy prey sources. Presumably, the unintentional feeding of dolphins reinforces the interactions and promotes the problem as younger dolphins learn depredation behaviors from adults, which may have significant effects on juvenile survival.

Just in the past year, there have been two cases of dolphins being entangled in fishing gear in Destin, Florida (Figure 1), and there have been similar incidences in South Florida and Georgia. Dolphins depredate sport fisheries in the estuaries, at fishing piers, and at the near-shore reefs, and the occurrence of these interactions appear to be year-round. Improving fish release practices that reduce the incidental feeding of dolphins, along with increasing public awareness of this issue may be the best means to alleviate harmful dolphin-fishery interactions.

Figure 1. Juvenile dolphin entangled in fishing line, Destin, Fla., Feb 2008. *Photo: M. Ward*

Our project addresses four aspects of this issue: 1) examine the extent of the fishery depredation problem, 2) assess impacts on dolphins, 3) investigate mitigation approaches, and 4) develop and disseminate educational information on "dolphin-friendly fishing tips." Our objectives will be accomplished through direct observation of sport fishing, photo-identification of individual dolphins, angler surveys, and public outreach.

Our study sites are in Destin, FL, and Orange Beach, AL, where there are escalating dolphin interaction problems with sport fishing. We have partnered with members of the charter fishing fleets in both locations and are monitoring dolphin depredation activity at two Gulf fishing piers (Figure 2). As our study develops, we will be establishing community support for outreach opportunities. We look forward to reporting on our progress with this project in the coming year.

Figure 2. Adult dolphin patrolling the Okaloosa Island fishing pier at Fort Walton Beach Fla. *Photo: S. Shippee*

COLLECTION AND REAL-TIME PROCESSING OF ELECTRO-OPTICAL MULTISPECTRAL IMAGERY FOR ENVIRONMENTAL MONITORING APPLICATIONS

Living Estuarine Resources
Poster Presentation
Tami Wells*, Jon Schoonmaker, Denise Runnels, David Howell, Jonathan Powell, Chad Leflore, Scott Peterman, Bradley Manning, and Stephen Etheridge
University of South Alabama, Department of Marine Sciences
tami.wells@advanced-coherent.com

Coastal geomorphology and processes are complex where ecosystem dynamics change greatly in response to natural storms and anthropogenic influences. Multispectral passive sensors provide a non-destruct method for gathering information in sensitive ecosystems as well as urban microenvironments. A complete multispectral imaging system will provide coastal managers, researchers, and planners with a quick look visual assessment and various spatial and spectral indices for real-time computations regarding ecosystem function and many other coastal applications. Collaborating partners have developed a prototype, liquid cooled, rugged, multi-processor field system that can be configured to acquire and store sensor data and/or process the data for real-time monitoring of coastal ecosystems and detection of targeted aquatic and marine species. The multi-processor is coupled to a tunable 12 bit, four-band multispectral sensor to collect four synchronized frames at a rate of 17 hertz (Hz). Each frame consists of 1392 x 1024 pixels. When the system is set to processing mode the frame rate may be reduced as a function of the chosen processing solution complexity. This system is currently being engineered to fit a 5-inch turret for deployment from an unmanned aerial vehicle, deck of a research vessel, or fixed wing piloted aircraft. The results from research and development data collects have shown accuracy in detection of marine mammal species and mapping of numerous aquatic and marine habitats. Currently, biological researchers and computer scientists are working together to develop and test numerous algorithms for aquatic and marine applications.

THE CRUSTACEAN MOLT-INHIBITING HORMONE RECEPTOR AND INDUCTION OF MOLTING IN BLUE CRABS (*Callinectes sapidus*)

Living Estuarine Resources
Poster Presentation
R. Douglas Watson*, Junying Zheng, and Hsiang-Yin Chen
University of Alabama at Birmingham
Department of Biology
rdwatson@uab.edu

The soft crab industry is limited by a supply of premolt blue crabs (*Callinectes sapidus*) that is both seasonal and unpredictable. Steroid hormones termed ecdysteroids control cycles of growth and molting in crustaceans. Ecdysteroids are synthesized by paired endocrine glands, the Y-organs. The production of ecdysteroids by Y-organs is suppressed by molt-inhibiting hormone (MIH), a polypeptide neurohormone produced in eyestalk neural ganglia. Thus, it is hypothesized that MIH inhibits Y-organs during much of the molt cycle, and that a molting sequence is initiated when MIH secretion diminishes or stops. It follows that blocking the suppressive action of MIH will induce molting.

MIH suppresses ecdysteroid production by binding to a cell surface receptor on Y-organs. We have recently cloned from blue crab Y-organs a putative MIH receptor (a receptor guanylyl cyclase, CsGC-YO1). The results of preliminary experiments are consistent with the hypothesis that the cloned receptor is an authentic MIH receptor. First, as determined by real-time quantitative PCR, *CsGC-YO1* transcript abundance is elevated during intermolt (a time when MIH is hypothesized to suppress ecdysteroid production). Second, using antipeptide antibodies (anti-CsGC-YO1) raised against a portion of the ligand-binding domain of CsGC-YO1 as primary antibody, immunocytochemical studies indicate CsGC-YO1 is a membrane-associated protein. Third, preincubation of Y-organs with anti-CsGC-YO1 significantly diminishes the ability of MIH to suppress ecdysteroidogenesis *in vitro*. Although the above results are consistent with the notion that CsGC-YO1 is an MIH receptor, conclusive identification of the activating ligand for CsGC-YO1 will require studies designed to test the ability of MIH to bind and activate the receptor. In addition, the finding that anti-CsGC-YO1 blunts the action of MIH *in vitro* suggests anti-CsGC-YO1 can be used to block MIH action *in vivo* and thus induce molting.

The specific objectives of our future studies are to determine (1) whether MIH binds and activates the candidate MIH receptor, and (2) whether the anti-CsGC-YO1 can block the MIH receptor *in vivo* and effectively induce molting in blue crabs. Identification and characterization of the MIH receptor would constitute a significant contribution to the field of invertebrate endocrinology. Controlled induction of molting could provide an abundant and predictable supply of soft-shelled crabs, a benefit to the soft crab industry and to consumers of seafood.

DECADAL-SCALE ASSEMBLAGE CHANGES OF SEAGRASS-ASSOCIATED FISHES IN THE NORTHERN GULF OF MEXICO: ARE THEY CLIMATE RELATED?

Living Estuarine Resources
Oral Presentation
Joel Fodrie*, Ken Heck, Sean Powers, Monty Graham, and Kelly Robinson
Dauphin Island Sea Lab
jfodrie@disl.org

Global temperatures are on the rise and are expected to produce a poleward shift in the distribution of many organisms. We quantified changes in fish assemblages within seagrass meadows of the northern Gulf of Mexico between the 1970s and 2006-2007, and we observed changes consistent with this forecast. During 2006-2007, we sampled seagrass meadows using the same gears and methods previously employed by R. J. Livingston in coastal waters of northwest Florida throughout the 1970s. Comparisons between datasets revealed numerous additions to the fauna during 2006-2007 that were completely absent in the 1970s, including *Lutjanus synagris* (lane snapper), *Epinephelus morio* (red grouper), *Chaetodon ocellatus* (spotfin butterflyfish), *Mycteroperca sp.* (grouper), *Centropristis philadelphica* (rock sea bass), *Fistularia tabacaria* (bluespotted cornetfish), *Ocyurus chrysurus* (yellowtail snapper), *Thalassoma bifasciatum* (bluehead wrasse), *Abudefduf saxatilis* (sergeant major), Acanthuridae spp. (surgeonfishes), and *Sparisoma viride* (stoplight parrotfish). Several other species showed significant increases in abundance between 1979 and 2006, including *Mycteroperca microlepis* (gag grouper; up ~200x), *Lutjanus griseus* (gray snapper; up ~105x), and *Nicholsina usta* (emerald parrotfish; up ~22x). All of these are tropical or subtropical species that now make up a larger percentage of seagrass-associated fish assemblages in the northern Gulf of Mexico than in the past (Figure 1). Additionally, we documented regional increases in air and sea surface temperatures (>3ºC) during the ~30 years that separate Livingston's samples and ours (Figure 2). These temperature increases correlate with the northern shifts in the distribution of warm-water fishes. Documenting shifts in the distribution of fishes is a critical first step in investigating the consequences of global warming for endemic marine communities and fishery production in the northern Gulf of Mexico.

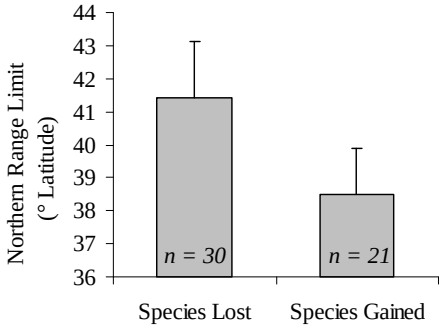


Figure 1. Northern range limits (mean +1 SE) of fishes collected only during the 1970s (species lost) or only during 2006-2007 (species gained) within northern Gulf of Mexico seagrass meadows.

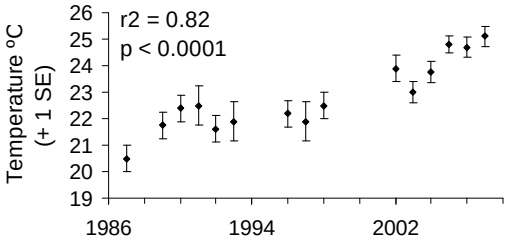


Figure 2. Daily minimum sea surface temperatures near Mobile Bay Inlet, AL, during fall (Sept.-Nov.) for the years 1987-2007 (mean ± 1 SE).

THE DYNAMICS OF MERCURY BIOACCUMULATION IN TWO SPORTFISH POPULATIONS IN THE MOBILE-TENSAW RIVER DELTA, ALABAMA

Living Estuarine Resources
Oral Presentation

Troy Farmer*, Dennis DeVries, Russell Wright, Joel Gagnon, and Brian Fryer
Department of Fisheries and Allied Aquacultures, Auburn University
farmetm@auburn.edu

Mercury is a harmful bioaccumulative heavy metal to which humans are exposed primarily through fish consumption. Several consumption advisories for mercury have been issued for fishes along the U,S. Atlantic and Gulf coasts, including the Mobile-Tensaw River Delta in coastal Alabama. Mercury cycling in estuaries is complex and little is known about the extent of mercury bioaccumulation in the ecologically diverse fishes in coastal areas such as the Mobile-Tensaw Delta, Alabama. Using traditional tissue analysis techniques combined with otolith microchemistry and diet analyses, we investigated seasonal and spatial trends of mercury accumulation in largemouth bass, *Micropterus salmoides*, and southern flounder, *Paralichthys lethostigma*, inhabiting the Delta.

Largemouth bass and southern flounder were collected in spring and fall of 2005 and 2006 from seven sites across a 50-km seasonal salinity gradient in the Mobile Delta (Figure 1). Tissue samples from filets of both species were processed for total mercury (Hg) and methylmercury (MeHg).

Methylmercury accounted for 80±12% of the total Hg in largemouth bass (N=18) and 87±20% in southern flounder (N=10). Given this, we viewed Hg as an acceptable surrogate for MeHg for both species. Tissue samples from 197 largemouth bass and 40 southern flounder were processed for Hg.

Most largemouth bass (~70%) processed for Hg exceeded the Alabama Department of Public Health (ADPH) minimum advisory level (0.3 ppm Hg), including some individuals from each site. Above this level no consumption is advised for women of childbearing age and children 15 years old and younger. However, few largemouth bass sampled (~3%) exceeded the more stringent 1 ppm advisory level. Mercury

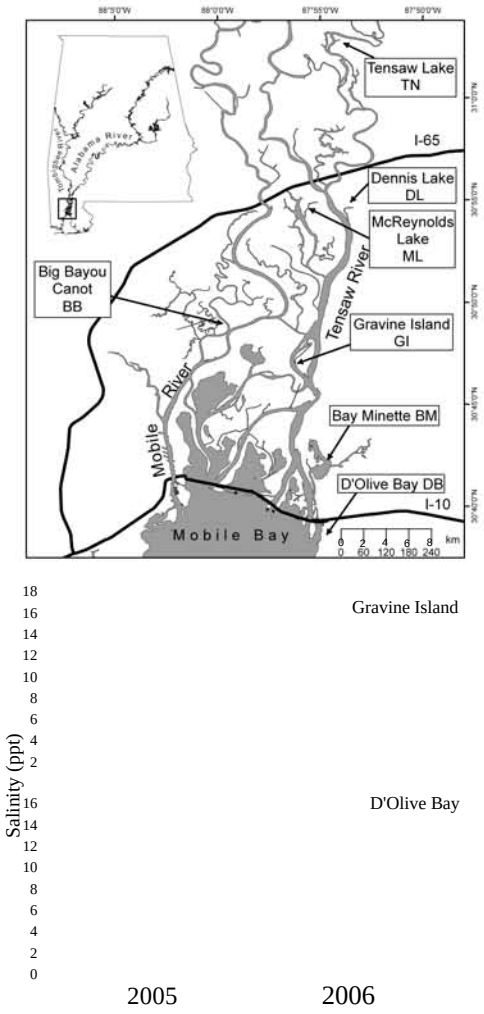


Figure 1. Map of the Mobile-Tensaw River Delta, Alabama with locations, names and abbreviations of seven sampling sites and locations of salinity loggers ( ). Salinity values (ppt) recorded every 0.5 hours at these loggers are shown in the bottom panels.

concentrations in largemouth bass were found to be size-dependent, with age being the best predictor. Within the Mobile Delta, size-standardized largemouth bass Hg levels were significantly (~20-30%) higher at upstream freshwater sites than at downstream seasonally brackish sites. This reduced largemouth bass Hg downstream correlated with two key factors that were associated with salinity: increased foraging on invertebrate (blue crab and shrimp) prey and faster growth early in life.

Southern flounder Hg concentrations were uniformly low across the Mobile Delta and no individuals exceeded the minimum ADPH advisory level. Mercury concentrations in southern flounder increased slightly with age, but even the largest southern flounder (18-19”) we processed were still below the minimum advisory level. Bioenergetics simulations indicated that faster growth rates in southern flounder (~1.5 g/day) compared to largemouth bass (~0.5 g/day) were largely responsible for differences in Hg between the two species. In addition, otolith microchemistry results indicate that southern flounder move throughout the Delta, while largemouth bass appear to not move, even in the face of increased salinity, further contributing to species differences.

Given largemouth bass Hg concentrations in the Mobile Delta, minimum length limits should be discouraged from a human health perspective, given that they would likely reduce the number of legal largemouth bass that are below the minimum Hg advisory level. Interestingly, increased salinity due to drought could yield lower largemouth bass Hg concentrations; however, if this occurs in the spring, year-class failure could result.

EARLY LIFE HISTORY OF THE THREE KINGFISH (*Menticirrhus*) SPECIES FOUND IN COASTAL WATERS OF THE NORTHERN GULF OF MEXICO

Living Estuarine Resources
Poster Presentation
E. John Anderson*, Bruce Comyns, Harriet Perry, Chet Rakocinski, Joanne Lyczkowski-Shultz
Gulf Coast Research Laboratory
Department of Coastal Science, The University of Southern Mississippi
evan.anderson@usm.edu

The southern kingfish (*Menticirrhus americanus*), the northern kingfish (*M. saxatilis*), and the gulf kingfish (*M. littoralis*) are members of the drum family (Sciaenidae) and are found in the northern Gulf of Mexico (GOM). Studies of growth and feeding have been conducted for the early life-stages of many sciaenids, but little is known about the life history of young *Menticirrhus* species. The purpose of this study is to further our understanding of the life-history of the early life-stages of the three *Menticirrhus* species in coastal Mississippi. In 2005 and 2006, beam plankton trawls (BPLs) and seines were used to collect specimens from four different shoreline habitats: surf zones of a barrier island, grass beds of a barrier island, mainland marsh edges, and mainland sandy shorelines (Figure 1). A total of 567 *Menticirrhus* were collected during this study, with over 85 percent of the specimens being collected in 2006. All three species are reported to spawn offshore from late spring to early fall; however, densities of young northern kingfish were highest in April from surf zones indicating a more extended spawning period. Young northern kingfish were also collected along sandy shorelines. Densities of young southern kingfish were highest along sandy shorelines in June of 2005 and September of 2006, but several were also found at surf zones and along marsh edges. Densities of young gulf kingfish were highest at surf zones in June of 2005 and September of 2006. Previous studies have indicated that young gulf kingfish are restricted to surf zone habitat, but several specimens were also collected along sandy shorelines during this study. No *Menticirrhus* were collected from grass beds; however, a few *M. americanus* and *M. saxatilis* have been collected from grass beds in 2004 and 2007 from opportunistic sampling.

Figure 1. Photograph of seining at a surf zone habitat.

Menticirrhus age and growth analyses indicate increased growth rate with increasing size and warmer water temperature for all three species. The growth rates increased from approximately 0.3mm/day at 4mm standard length (SL) to 1.2mm/day at 59mm SL for *M. americanus*, 0.3mm/day at 7mm SL to 1.2mm/day at 57mm SL for *M. littoralis*, and 0.2mm/day at 5mm SL to 1.1mm/day at 56mm SL for *M. saxatilis*. An analysis of covariance was used to compare linear regression slopes of age (daily increment number) to SL for species, year, season and habitat. The growth rate for *M. littoralis* was significantly greater than for *M. americanus* ($p= 0.003$) and *M. saxatilis* ($p<0.001$).

When comparing individual species from 2005 to 2006, *M. americanus* from sandy shoreline ($p<0.001$) and *M. littoralis* ($p=0.009$) from the surf zone had significantly faster growth rates in 2006 than in 2005. Growth rates for all species were slower during the spring than during the summer ($p<0.001$) or fall ($p<0.001$). *Menticirrhus americanus* collected in 2005 from the marsh edge had significantly higher growth than specimens collected along the sandy shoreline ($p=0.006$), and *M. saxatilis* collected in 2006 from the surf zone had significantly greater growth than specimens collected along the sandy shorelines ($p=0.004$).

EARLY ONSET OF HYPOXIA IN THE MISSISSIPPI BIGHT

Living Estuarine Resources
Poster Presentation
Kevin Dillon*, Stephan Howden, Kjell Gundersen, Kevin Martin, and Charlotte Brunner
Department of Coastal Sciences, The University of Southern Mississippi
kevin.dillon@usm.edu

Seasonal hypoxia exists in the bottom waters of many coastal areas around the world and has becoming more prevalent in recent years. Previous work in the Mississippi Bight (MSB) has shown that seasonal hypoxia may develop in bottom waters during the late summer. Over the years, sporadic measurements of seafloor hypoxia have been detected seaward of the barrier islands in the MSB. A study of foraminifera composition in core tops in the MSB suggested that hypoxia has been a reoccurring phenomenon in the region since at least the early 1950s. In 2006, the first field campaign designed to map the extent of an hypoxic event was conducted, and the hypoxic region was confined to the area south of the barrier islands (Horn and Petit Bois Islands) mainly along the 10 m isobath and never extended beyond a few meters off the bottom sediments. In 2008, hypoxia was detected as early as in May and lasted at least through mid-July. During June, the hypoxic region comprised an area 3-4 times larger than previous years and extended south along the Chandeleur Islands. The hypoxic region this year extended from the shallow waters surrounding the barrier islands (e.g. Cat Island) down to the 20 m isobath and had a maximum thickness above the bottom of approximately 10 m. Data from June and July suggests that the hypoxic area is dynamic, either changing in size or shifting in response to local currents and tidal cycles. Depth profiles and contours of this year's hypoxic event will be presented along with other chemical and biological parameters that were recently investigated.

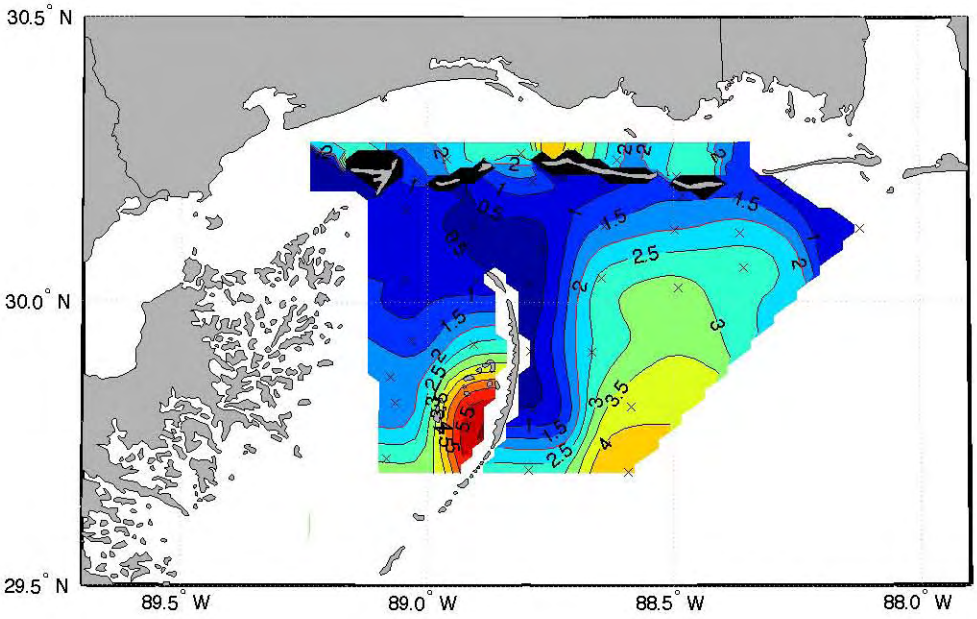


Figure 1. Contour plot showing bottom water oxygen concentrations (mg/L) in Mississippi Bight during June 2008. Sampling stations are denoted by the "×" symbols.

THE EFFECTS OF SHORT-TERM SHADING AND SEDIMENT NUTRIENT ENRICHMENT ON SHOALGRASS (HALODULE WRIGHTII) GROWTH DYNAMICS

Living Estuarine Resources
Oral Presentation
Just Cebrian *, Kelsey Pickard, and Todd Clardy
Dauphin Island Sea Lab, Department of Marine Sciences, University of South Alabama

jcebrian@disl.org

Few studies have simultaneously addressed the effects of reduced light availability and increased sediment nutrient availability on seagrass growth. Here we examine the short-term effects of reduced light availability (i.e. 45 and 90 percent reduction) and increased sediment nutrient availability on the growth dynamics of shoalgrass (*Halodule wrightii*) in shallow beds (i.e. 1 meter as mean depth) in Big Lagoon (Perdido Bay, Florida, USA). In all three experiments (summer 2000, fall 2001, and summer 2006), sediment fertilization did not affect shoalgrass leaf growth rates. In contrast, reduced light availability caused severe declines in shoalgrass leaf growth rates. Such declines could occur as early as one week after starting the experiment (fall 2001), and, for the summer 2006 experiment, they were irrespective of sediment fertilization. We also measured turtlegrass (*Thalassia testudinum*) leaf growth rates during the summer 2006 experiment and found similar results; reduced light availability had severe and fast impacts, whereas sediment nutrient enrichment was inconsequential. Our results demonstrate that man-made structures deployed above shallow, well-lit seagrass beds may have large detrimental impacts on the seagrass even though they are only deployed for a short period (i.e. a few months) and only reduce light availability moderately.

EFFECTS OF WATER DEPTH AND TURBIDITY ON SPECTRAL SIGNATURE OF SUBMERGED AQUATIC VEGETATION

Living Estuarine Resources
Poster Presentation
Harene Natarajan* and Hyun Jung Cho
Jackson State University
Harene.natarajan@gmail.com, Hyun.j.cho@jsums.edu

Remote sensing of terrestrial vegetation has been successful thanks to the unique spectral characteristics of green vegetation, low reflectance in red and high reflectance in Near-InfraRed (NIR). These spectral characteristics were used to develop vegetation indices, including Normalized Difference Vegetation Index (NDVI). However, the NIR absorption by water and light scattering from suspended particles reduces the practical application of such indices in Submerged Aquatic Vegetation (SAV) studies. We experimentally tested if NDVI can be used to depict canopy-forming SAV and to better understand the effects of water depth and turbidity on remote detection of SAV. A 100-gallon outdoor tank was lined with black pond liners, *Myriophyllum aquaticum* shoots were mounted on the bottom, and the tank was filled with water up to 0.5 m. We used a GER 1500 spectroradiometer to collect spectral data over the tank at every 1 cm depth change while water was constantly siphoned out. The measured upwelling radiance was converted to percent reflectance; and we integrated the hyperspectral reflectance to match the Red and NIR bands of three satellite sensors: Landsat 7 ETM, SPOT 5 HRG, and ASTER. NDVI values ranged 0.6-0.65 when the SAV canopy was at the water level, then they decreased linearly (slope of 0.013 NDVI/meter) with water depth increases in clear water. The values were lower (<0.35) in turbid water even in shallow depth (<10cm). The NIR region that appears as a high plateau in terrestrial plants became two peaks at approximately 710-720 nm and 810-820 nm in the submerged plants. Incorporation of these unique NIR reflectance peaks of submerged plants appears to improve the use of hyperspectral aerial photographs in locating and estimating aerial covers of canopy-forming aquatic vegetation beds. We currently test if these unique NIR patterns would improve SAV detection using hyperspectral aerial images.

EFFECT OF TEMPERATURE AND SALINITY ON GROWTH AND SURVIVAL OF POST-LARVAL AND JUVENILE NATIVE AND NON-NATIVE SHRIMP IN ALABAMA

Living Estuarine Resources
Poster Presentation
Luke A. Roy*, D. Allen Davis, Herbert E. Quintero, Jessica Jacquay, Patricio Paz, and Daranee Sookying
Department of Fisheries & Allied Aquacultures, Auburn University
royluke@auburn.edu

Very little is known about the interaction of temperature and low salinity as it relates to survival and growth of post-larval and juvenile shrimp. Both temperature and salinity are known to influence the growth potential and survival of shrimp. In west Alabama, farmers suspect low water temperatures (in spring and fall), in conjunction with low salinity and suboptimal ionic profiles, might be responsible for reduced survival and production at harvest. Likewise, the modeling of growth of native shrimp species either in the wild or under aquaculture conditions cannot be predicted as there is also limited data on these species. In order to determine the influence of temperature and salinity on post-larval and juvenile *L. vannamei* and *F. duorarum*, a series of bioassays were conducted at the E.W. Shell Fisheries Research Station (EWS) in Auburn, Alabama, and Claude Peteet Mariculture Center (CPMC) in Gulf Shores, Alabama. *Litopenaeus vannamei* were obtained from Shrimp Improvement Systems in the Florida Keys, Florida, and held at EWS and CPMC until the commencement of the bioassays. At EWS 15 post-larvae (PL_{13} and PL_{20}) were placed in 20 buckets containing 2 Liters of water with an initial salinity of 12 ppt and a constant temperature of 19.3°C (PL_{13}) and 19.6°C (PL_{20}) Using a drip irrigation system, freshwater was added to each bucket at a rate of approximately 1 gallon per hour. Each bucket was equipped with an airstone supplied with aeration from a regenerative blower. The target salinities for both bioassays were 12(control), 4, 2, 1, 0.5, and 0.2 ppt. Salinity was reduced at a rate of 4 ppt per hour until 4 ppt. After reaching 4 ppt the rate of salinity reduction was reduced to 1 ppt per hour until 1 ppt. After reaching 1 ppt, one hour was allowed to reach 0.5 ppt and another hour to reach 0.2 ppt. Survivals of PL_{13} shrimp (48 hour) were not significantly different among 12, 4, and 2 ppt treatments (83.3-91.7%). However, 1, 0.5, and 0.2 ppt treatments had significantly lower ($P < 0.05$) survivals (0-18.3%) when compared to 12, 4, and 2 ppt. Survivals of PL_{20} shrimp (48 hour) were not significantly different among 12, 4, 2, and 1 ppt treatments (95-100%). However 0.5 and 0.2 ppt treatments had significantly lower ($P < 0.05$) survivals (0-41.4%) when compared to 12, 4, 2, and 1 ppt. The differences in survivals among PL_{13} and PL_{20} shrimp indicate an age effect with respect to salinity tolerance following a 48 hour acclimation. The same bioassays were repeated with *L. vannamei* at CPMC using PL_{11} (22.6°C constant temperature) and PL_{20} (17.7°C constant temperature) with similar target salinities (30, 4, 2, 1, 0.5, 0.2 ppt). Shrimp were stocked into 15 buckets (3 replicates per treatment). Survivals were similar to the bioassays conducted at E.W. Shell. Similar experiments were also conducted using *F. duorarum* at both EWS and CPMC. Results indicate that age is an important factor to consider when acclimating post-larval shrimp to low salinities.

ESTIMATING MISSING HIGH RESOLUTION WATER QUALITY DATA

Living Estuarine Resources
Poster Presentation
James Weston* and Sohrab Gordji
University of Mississippi, Dept. of Biology and ETRP
jweston@olemiss.edu

Common issues with automated high resolution monitoring stations are gaps in recorded data limiting their usefulness to assess temporal trends at multiple scales. In 2005, at the Grand Bay National Estuarine Research Reserve (GNDNERR), MS, high resolution water quality data (depth, temperature, salinity, pH, dissolved oxygen, and turbidity) was recorded every 30 minutes by YSI 6600 data sondes and used to assess the effects of storms on water quality responses at three permanent locations (Bangs Lake, BL; Bayou Cumbest, BC; and Bayou Heron, BH) in the reserve. Missing 2005 water quality data at GNDNERR ranged from a low of 7 percent to a high of 29 percent, which equates to about 577 to 2,526 hours of data. At the BL location the summer months had the fewest water quality data recorded, ranging from 5 to 40 percent missing data. During the spring BH and BC had the highest missing percentage of data with ranges of 16 to 32 percent and 19 to 22 percent, respectively. During the summer of 2005 there were four named storms (tropical storm Arlene and Hurricanes Cindy, Dennis, and Katrina) and in the spring there were three heavy rain events. Water quality data related to these storm periods was typically available with many parameters missing no data. However, of the six water quality parameters evaluated turbidity and dissolved oxygen had the highest percentage of missing data, up to 100 percent. Completing data sets by estimating missing values will improve our assessment of water quality responses to storm events and in general will enable temporal trends of water quality parameters to be evaluated at multiple scales throughout GNDNERR.

EVALUATING THE CURRENT STATUS OF MISSISSIPPI DIAMONDBACK TERRAPIN (*Malaclemys terrapin pileata*) POPULATIONS IN ALABAMA AND DEVELOPING AN EFFECTIVE RECOVERY PROGRAM

Living Estuarine Resources
Oral Presentation
Andrew T. Coleman*, Thane Wibbels, Ken Marion, David Nelson, Joel Borden, Gabe Langford, and John Dindo
University of Alabama at Birmingham
colemana@uab.edu

Historically, Alabama populations of the Mississippi diamondback terrapin experienced both commercial and local demands as a food resource. This exploitation along with other threats has decimated terrapins to such a degree as to warrant state protection, although true understanding of the existing threats remains unknown. The current study conducted a number of ecological surveys in numerous salt marshes and tidal creeks in Alabama from 2004 to the present to gather baseline data to effectively evaluate present terrapin abundance. Head surveys were completed in which terrapins were counted as they surfaced to breathe. Surveys were also done on potential nesting beaches surrounding these salt marshes to look for depredated nests. Based on survey data, trapping in salt marshes and nesting beaches was performed in areas around Dauphin Island, AL. Cedar Point Marsh represents the strongest aggregation of terrapins in Alabama. A number of terrapins have been caught and tagged in Cedar Point Marsh; however, it is dwarfed by numbers caught in other areas along the terrapin's range.

To better characterize threats facing terrapins in Alabama, a comparison of modified crab traps fitted with By-catch Reduction Devices (BRDs) to traps without BRDs was done to examine the efficacy of this tool to prevent terrapin mortality yet still allow crab capture. In 2007, there was no significant difference between the trap types in crab capture, and the results of 2008 will be discussed. Also, wildlife cameras were employed on the nesting beach surrounding Cedar Point Marsh in an attempt to discover the type and abundance of nest predators. In addition, in 2008, several clutches were obtained from adult females captured in pitfall traps that were inserted into the nesting beach surrounding Cedar Point Marsh. The females were injected with an appropriate dose of oxytocin, and the eggs incubated. The hatchlings will be released back into Cedar Point Marsh to increase local abundance. These terrapins will also offer an opportunity to study a variety of physiological and ecological topics regarding the species, including sex determination and multiple paternity.

EXPERIMENTAL APPROACH TO CLASSIFY SHALLOW ESTUARINE WATERS USING HYPERSPECTRAL DATA

Living Estuarine Resources
Oral Presentation
Melissa Larmer* and Hyun Jung Cho
Jackson State University
Larmer02@gmail.com

Remote sensing has become a widely used tool in studies of terrestrial and floating aquatic vegetation due to their unique light-reflecting/absorbing properties. However, remote detection of submerged aquatic vegetation (SAV) has proven more challenging because of water absorption of Near Infrared (NIR) and light-scattering from suspended particles. SAV beds play critical roles in aquatic ecosystems by absorbing excessive nutrients, buffering wave energy, holding sediment, and serving as critical habitat to aquatic life. Monitoring these beds using field-based sampling is a time-consuming and costly process; and aerial photography provides useful information only when the water is clear and shallow and there are solid SAV beds.

Using an experimental approach to better understand the reflectance pattern of submerged vegetation, we identified unique spectral regions of the SAV and classified hyperspectral, aerial data over areas known to contain SAV. This has the potential for improving the remote detection of submerged vegetation in turbid, coastal waters. Detailed characteristic reflectance curves for SAV at different water depths and at different water turbidity were generated through controlled experiments and three key spectral wavelengths (bands) were selected to reduce redundancy of the data. The covariance among the spectral reflectance at varying depths was studied in order to find the three key wave bands.

Airborne data were obtained in October 2003 over Grand Bay National Estuarine Research Reserve, Mississippi. The data were obtained by the AISA Eagle hyperspectral sensor and pre-processed for atmospheric and geographic corrections through University of Nebraska at Lincoln. The data contained 20 hyperspectral bands within a range from 435 to 950 nm. Spectral Angle Mapping (SAM) was used to classify the AISA data. Only the three AISA bands whose centers were closest to the three key wavelength regions (561nm, 710nm, and 819 nm) were used in SAM classification. Regions of Interests (ROIs) were selected as polygons to represent un-vegetated deep water, shallow-water SAV, marsh, and bare sand. The three AISA bands were used to create an ENVI file in ENVI 4.1, which was then used for classification.

The classified image (Figure 1) was imported into ArcGIS 9.2 and re-projected into Universal Transverse Mercator (UTM) zone 16 (datum WGS 84) to be overlaid with SAV survey data. Compared to the original 20-band image, use of the NIR bands made chlorophyll-containing objects, both SAV beds and areas with high phytoplankton, more distinguishable. Although the shallow areas near the shore were correctly classified as SAV, the overall accuracy for the SAV class was less than 20 percent when compared with our field transect SAV distribution data. Possible explanations for low detection accuracy of SAV in the shallow bay include varying depth and high-suspended particles, which diminish signals from the substrates. Phytoplankton

with similar spectral signals to those of vascular plants may also have introduced sources for the misclassifications.

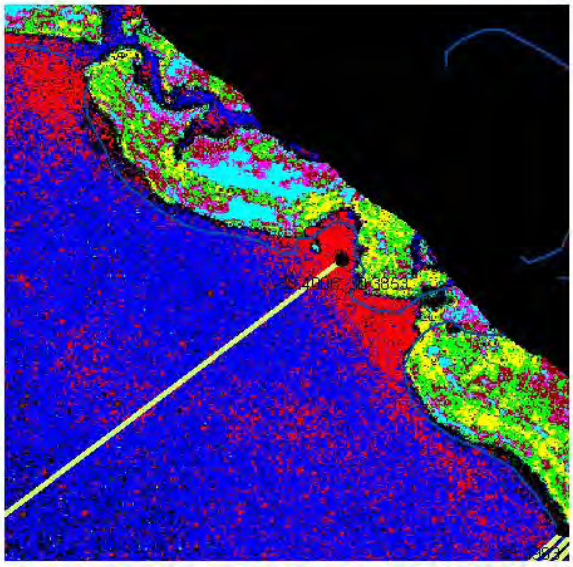


Figure 1. SAM classified the AISA image of Middle Bay, Grand Bay National Estuarine Research Reserve.

GRAY TRIGGERFISH, *Balistes capriscus*, REPRODUCTIVE BEHAVIOR, EARLY LIFE HISTORY, AND COMPETITIVE INTERACTIONS WITH RED SNAPPER, *Lutjanus campechanus,* IN THE NORTHERN GULF OF MEXICO

Living Estuarine Resources
Oral Presentation
Carrie MacKichan Simmons* and Stephen T. Szedlmayer
Marine Fish Laboratory
Department of Fisheries and Allied Aquacultures, Auburn University
szedlst@auburn.edu

Gray triggerfish, *Balistes capriscus*, is a widely distributed species, important to both commercial and recreational fisheries. Other species of Balistidae display atypical behaviors, such as demersal spawning and unusually long periods in the plankton as juveniles, compared to most other marine fishes. However, for gray triggerfish there is limited documentation on spawning behavior, early life history, and interactions with other species. To examine these aspects of gray triggerfish, we recorded spawning behaviors in June and July 2004 to 2007 on artificial reefs in the northern Gulf of Mexico by SCUBA diver observation and unattended remote video. A single male gray triggerfish established a territory around a reef, built 1 to 13 demersal nests in the sand, and attracted one to five female gray triggerfish to spawn. Eggs were collected from 13 of the 28 active nests and mean clutch size was 772,415 eggs. Based on male-to-female sex ratios, gray triggerfish displayed harem spawning behavior, with a single dominant male who attracted up to five spawning-condition females. We described gray triggerfish larval development from laboratory-reared fish up to 6 d post hatching. Photographs of live larvae (N = 10) were taken daily to document development. We examined recruitment of age-0 gray triggerfish to benthic artificial reefs by diver surveys from 2003 to 2007. Divers counted and estimated sizes of all gray triggerfish that recruited to three types of artificial reefs ranging in area from 1.2 to 4.0 m^2. Peak recruitment of age-0 gray triggerfish occurred from September through December 2003-2007. We also examined competitive interactions between gray triggerfish and red snapper in field removal and laboratory growth experiments. In the field removal experiments, size frequency distributions of red snapper were significantly different between triggerfish removed and triggerfish not removed. In laboratory growth rate experiments, red snapper showed a significantly slower growth rate when mixed with gray triggerfish compared to red snapper alone.

These studies showed a unique spawning behavior where gray triggerfish formed harem groups and showed extensive parental care. Our descriptions of early stage laboratory-reared gray triggerfish will aid in the identification of wild-caught larvae. The recruitment studies showed that gray triggerfish spend long periods in the pelagic environment and recruit in the fall to benthic habitat in the northern Gulf of Mexico. We showed competitive interactions between red snapper and gray triggerfish in field removal and laboratory growth experiments. These competitive interactions could lead to negative effects on red snapper on artificial reefs that have aggressive gray triggerfish.

GULF STATES UNITING TO IMPROVE THE GULF OF MEXICO

Living Estuarine Resources
Poster Presentation
Kimberly S. Caviness* and Natalie Guedon Segrest
Mississippi Department of Environmental Quality
kim_caviness@deq.state.ms.us

The Gulf of Mexico Alliance (GOMA) is a partnership, initiated in 2004, of the states of Alabama, Florida, Louisiana, Mississippi, and Texas, intent on significantly increasing regional collaboration to enhance the ecological and economic health of the Gulf of Mexico. Originally, the Alliance identified five priority areas that are regionally significant and can be effectively addressed through increased collaboration at the local, state, and federal levels. These areas include: water quality for healthy beaches and shellfish beds; wetland and coastal conservation and restoration; environmental education; identification and characterization of Gulf habitats; and reductions in nutrient inputs to coastal ecosystems.

In March 2006, GOMA published the Governors' Action Plan which included 73 discrete action items that were identified by the five priority issue teams (PITs). The Governors' Action Plan outlines a three-year plan in which the 73 action items should be completed by March 2009. The efforts of this group have been extremely successful and have received national recognition. At present, all action items identified are on schedule to be completed by the deadline. The Alliance has not only been successful at completing its action item goals, but it has made tremendous progress at increasing collaboration across the five states, which share the Gulf of Mexico as a common water body.

Due to the overwhelming success of this group and the original Governors' Action Plan, GOMA is currently in the process of developing Action Plan 2. At this time, each team is identifying new priorities and actions that will be completed in a five year timeframe. Action Plan 2 is scheduled to be released in March 2009 and will continue the efforts initiated through the original Action Plan.

GOMA team activities span a wide range of interest areas including: coastal resiliency, sensitive habitat identification, coordination of water quality monitoring and activities, characterization and impacts of nutrients, ecological assessments, wetlands restoration, and educational outreach. In order to maintain the momentum that GOMA has established through the original Action Plan, new collaborators and partners are vital to accomplish the goals of Action Plan 2 and continue working to achieve a healthy Gulf of Mexico.

THE IMPACT OF HYPOXIA ON FORAMINIFERS IN THE NORTHERN MISSISSIPPI BIGHT

Living Estuarine Resources
Poster Presentation
Valerie Hartmann*, Jennifer Kuykendall, and Charlotte Brunner
Department of Marine Science, The University of Southern Mississippi
valerie.hartmann@usm.edu

Hypoxia was measured in bottom water of the northern Mississippi Bight in August 2006 and July 2008. The area covered approximately 200 km^2, extending along the 10-m isobath from Horn Island to the eastern end of Petit Bois Island and southward to the USM buoy near the 20-m isobath. Seasonal hypoxia has been found annually in the bottom waters of the Louisiana continental shelf, and more recently researchers have become concerned about recurrent, seasonal hypoxia on the Mississippi shelf. Because hypoxia in the Mississippi Bight is smaller and shorter than seasonal hypoxia in the Louisiana bight, research was focused on assessing whether or not these events affect the benthic meiofauna, in this instance, the benthic foraminifers.

Benthic foraminifers were collected in cores within the area of known hypoxia in June when bottom waters were well oxygenated and in July and August when conditions were hypoxic. For comparison, core samples were also collected east of the area of known hypoxia. Notably, in this study replicate cores were taken for each site in order to improve the confidence of the data. The cores were sliced into 1-cm slabs from the top to 10 cm depth in core, stained with rose Bengal to detect living specimens, and sieved to the >63 μm fraction. Live specimens were picked from each 1-cm depth interval proceeding from the surface downcore until 95% of the living specimens were collected. Specimens were identified to genus or species level.

The assemblage of living foraminifers in normally oxygenated conditions consisted of ten species whose distribution was equitably divided, in addition to at least ten rare species. Only ~45% of the specimens at the surface (top 0-1 cm of the core) were hypoxia-tolerant species, and the density of living foraminifers was 600 specimens/10 mL. In contrast, the live assemblage from the hypoxic period was dominated by two hypoxia-tolerant species, *Nonionella basiloba* and *Bolivina lowmani*, comprising 93±3% of the fauna at the surface. The density of living foraminifers ranged from 1200-2300 specimens/10 mL at the surface (0-1 cm), at least double the surface density of the normally oxygenated core samples. At a site known to be intermittently hypoxic, where bottom waters were at that time oxic, an apparent fluid mud had moved into the area covering the seafloor. This fluid mud was observed in the top two centimeters of the diver core. The sample was dominated by the hypoxia-tolerant species, *Nonionella basiloba*, 79±7% of the fauna at the surface were hypoxia-tolerant, and the density of living specimens in the fluid mud was 2900-3500 specimens/10 mL. The depths below the fluid mud bore distinctly fewer living hypoxia-tolerant species (24 percent). Based on these results, it is concluded that the meiofauna represented by benthic foraminifers responds to the late summer hypoxia with higher densities of living specimens and dominance of hypoxia-tolerant species.

THE INVASION OF EURASIAN MILFOIL (*Myriophyllum spicatum*) IN MOBILE BAY: DOES A REDUCTION IN DISTURBANCE INTENSITY FACILITATE INVASION SUCCESS?

Living Estuarine Resources
Oral Presentation

Charles W. Martin*, John F. Valentine, Katy Blankenhorn, and Susan Sklenar
Department of Marine Science, University of South Alabama, and Dauphin Island Sea Lab
cmartin@disl.org

Biological invasions are among the most pervasive yet least understood consequences of the urbanization of our estuarine ecosystems. In Mobile Bay (Figure 1), urbanization has led to the construction of the Highway 90 causeway, which has been hypothesized to have created a "vacant niche" allowing invasive species to gain a foothold throughout the area. Here, we provide the results of a test designed to determine if this "vacant niche" allowed the establishment of invasive Eurasian milfoil.

Figure 1. The Mobile-Tensaw Delta in Upper Mobile Bay, AL.

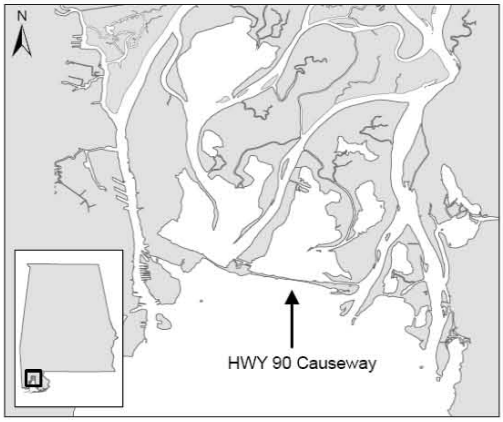


Figure 2. The growth of milfoil at 0, 5, and 15psu (p=0.566).

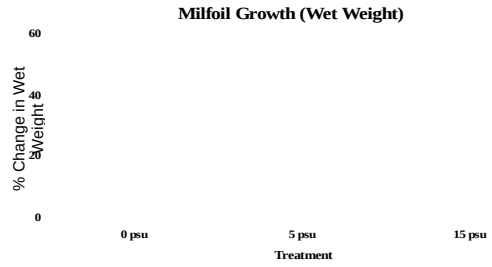
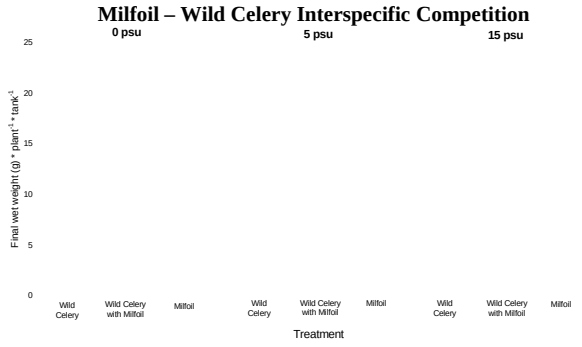


Figure 3. The growth of wild celery with and without milfoil addition (p=0.427) and at varying salinities (p<0.001).



Results from a field survey indicated that community composition varies greatly along the causeway, with submerged aquatic vegetation (SAV) south of the causeway being dominated by wild celery and milfoil to the north. Salinity was consistently lower north of the causeway than to the south. We performed an experiment which documented milfoil growth across a range of salinities recorded at the study site. Results suggest that salinity has no effect on milfoil growth (Figure 2). A subsequent experiment showed that milfoil cannot competitively exclude wild celery either (Figure 3). While we have yet to identify how milfoil became established, reanalysis of the field data suggests that an unconsidered factor, wave action, could limit milfoil proliferation to quiescent embayments north of the causeway. Based on ongoing field experiments, we argue that the causeway provides a vacant niche through reduced physical disturbance.

JUVENILE TARPON (*Megalops atlanticus)* IN MISSISSIPPI COASTAL WATERS: SHORT-TERM EVENT OR LONG-TERM TREND

Living Estuarine Resources
Oral Presentation
James S. Franks*, Paul O. Grammer, James R. Ballard, Gary J. Gray, and Michael V. Buchanan
Center for Fisheries Research and Development, Gulf Coast Research Laboratory, The University of Southern Mississippi
jim.franks@usm.edu

Tarpon, *Megalops atlanticus*, are large, migratory, elopomorphic fish that inhabit tropical and subtropical waters of the Western Central Atlantic Ocean, including the Gulf of Mexico. Adult tarpon seasonally occur in Mississippi offshore waters during summer months, and although presumably associated with a southern Gulf migratory group, nothing is known of their biology, habitat preferences or behavior while in local waters. Since the Gulf tarpon stock is documented to spawn (May – August) only off the coasts of south Florida and Yucatan, Mexico, the northern Gulf is believed to serve as an adult tarpon feeding ground. The Gulf stock has declined dramatically since the 1950s, attributable in part to over-fishing and depletion of tarpon nursery grounds (mangrove and marsh habitats) in south Florida and along the Yucatan coast.

Juvenile tarpon are rarely reported from Mississippi coastal waters (only 10 specimens documented prior to 2006). Since the Mississippi coast is not acknowledged as a tarpon nursery ground, recent occurrences (2006 – 2008) of young tarpon in Mississippi estuaries prompted "opportunistic" investigations. Juvenile tarpon (N = 129, 50 - 840 mm FL) were collected from Back Bay Biloxi and tidal sloughs in Jackson County. A few specimens were sacrificed to collect otoliths, stomach contents, and DNA tissue, but most were measured and released or placed in aquaculture systems for observation and study. Questions related to recent occurrences of the young fish include point of origin, age, abundance, food, ability to survive in local estuarine habitats, and over-wintering capability. Responses to those questions and an overview of preliminary study findings are presented.

MARINE FUNGI AS INDICATORS OF OCEAN HEALTH ALONG MISSISSIPPI GULF COAST BEACHES

Living Estuarine Resources
Poster Presentation

Allison Walker* and Jinx Campbell
Department of Coastal Sciences, University of Southern Mississippi
a.k.walker@usm.edu

Marine fungi are principally found in intertidal habitats such as sandy beaches where they play an important role in nutrient cycling via decomposition. Human impact can drastically change a coastal environment and because fungi are sensitive to anthropogenic influence, they may have utility as indicators of ocean health. The purpose of this project was to investigate differences in marine fungal communities found on barrier island beaches compared to those found on Mississippi Gulf Coast beaches variously impacted by human activity. Substrates including driftwood, algae, sand, and saltmarsh detritus were collected from pristine and disturbed beaches, incubated, and examined for the presence of marine fungi using morphological techniques. Marine fungal species richness, density, and community composition were compared among beaches and the effects of salinity, pH, water temperature, and beach disturbance level were assessed.

MARINE FUNGI ON SEAGRASSES FROM PERDIDO KEY

Living Estuarine Resources
Poster Presentation
Linda Collier*, Juan L. Mata, Just Cebrian, and Jinx Campbell
Department of Biology, University of South Alabama
lac309@jaguar1.usouthal.edu

Coastal plant and animal communities have been extensively studied for many years, but their mycological component has been largely neglected or poorly studied until recently. The discipline of marine mycology received only sporadic interest from researchers until the late 1940s. Since then, a total of 444 species have been described worldwide, only a small number of which have been documented for the Gulf Coast of the United States. Because of restricted sampling in this region, it is unclear how much variation there is in fungal presence between seagrass beds. It is also unknown how marine fungi populations respond to anthropogenic changes in the environment. Species composition data from more sites is needed as well as studies aimed at examining the ecological importance of marine fungi. The data presented here are from preliminary surveys from two seagrass beds in the North-Central Gulf Coast. One seagrass bed is approximately pristine while the other is highly impacted from wastewater and runoff from nearby homes and a roadway. So far, four species of ascomycete fungi have been recovered directly from plant material from the pristine site. The hyphomycete *Cumulospora marina* represents a new report on *Halodule wrightii*. These results are part of an ongoing graduate research project that aims to document the diversity and abundance of marine fungi associated with seagrass beds.

MICROHABITAT ASSOCIATIONS OF DIAMONDBACK TERRAPIN (*Malaclemys terrapin pileata*) NESTS AT THE GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE, MISSISSIPPI

Living Estuarine Resources
Oral Presentation
Christina F. Watters*, Mark S. Woodrey, and Christopher A. May
Environmental Cooperative Science Center, Florida A&M University
christina.watters@dmr.ms.gov

Diamondback terrapins (*Malaclemys terrapin*) are a species of small turtle endemic to salt marshes along the Atlantic and Gulf coasts of the United States. It is the only species of turtle that lives exclusively in brackish water. Terrapins are well adapted to their highly aquatic lifestyle; key morphological features include: a hydrodynamic shell, webbed limbs, lacrimal (salt-secreting) glands, and powerful jaws for crushing prey. Terrapins are one of the top predators in salt marsh ecosystems feeding on marsh grazers including snails and crabs. In addition, terrapins may also serve as an indicator species for contamination of estuarine ecosystems.

Mississippi diamondback terrapins (*Malaclemys terrapin pileata*) are found along the Gulf Coast from the Florida panhandle to western Louisiana. The Grand Bay National Estuarine Research Reserve (Grand Bay NERR) is located in Jackson County, Mississippi, near the center of the Mississippi diamondback terrapin's range. While populations of some terrapin subspecies are well studied, information is severely lacking for the Gulf Coast. The last Mississippi coastwide surveys for diamondback terrapins were conducted in the mid-1990s. At that time, some of the largest estimated populations of diamondback terrapins were located within the Grand Bay NERR. In Mississippi, the terrapin is currently listed as "imperiled because of rarity or factor(s) making it vulnerable to extirpation."

During the 2007 nesting season, we initiated a pilot study to identify nesting beaches and microhabitats along the Grand Battures, a headland with small, natural beaches located within the Grand Bay NERR. We conducted periodic surveys during the nesting season and documented approximately 180 nests depredated by raccoons (*Procyon lotor*). Depredated nests were used as a proxy for intact nests because freshly laid nests are cryptic and very difficult to locate.

In 2008, we conducted weekly surveys along three beach segments on the Grand Battures identified as important terrapin nesting areas during the 2007 surveys. Two-meter-wide transects were established along the length of each beach segment (total lengths = 100, 200, and 300 meters). We documented over 200 depredated nests during the nesting season (April–August). For each nest, we recorded the following information: GPS location, estimated number of eggshells, and percent cover of vegetation in a 0.25 m^2 and 1.0 m^2 area surrounding the nest. In addition, we deployed 22 temperature loggers to record soil temperature at nest depth in vegetated and open beach areas.

Terrapins are one of many turtle species with temperature-dependent sex determination (incubation temperature determines the sex of offspring); therefore, nest microhabitat selection is an important factor in controlling the sex of offspring produced. Our data suggest that local terrapins are nesting in vegetated microhabitats more frequently than has been observed in populations along the Atlantic coast. Average soil temperatures recorded in vegetated areas are lower and less variable than temperatures in areas of open sand. Terrapins may be utilizing vegetated areas of nesting beach in order to better regulate favorable nest temperatures and increase the survival of eggs laid.

A MID TROPHIC LEVEL LOOK AT THE SPECIES-AREA RELATIONSHIP AND SPECIES-ABUNDANCE DISTRIBUTIONS USING BARRIER ISLAND SALT PONDS

Living Estuarine Resources
Poster Presentation
Glenn A. Miller* and Sean P. Powers
Department of Marine Sciences
University of South Alabama
Dauphin Island Sea Lab
gamiller@disl.org

The fish assemblage of salt ponds on Dauphin Island, AL, and Petit Bois, MS, was sampled monthly to examine the species-area relationship and species-abundance distributions of mid trophic level organisms in coastal habitats. Salt ponds are natural features of many barrier islands. Their area can range over three orders of magnitude from a few hundred to tens of thousands of square meters. In addition, they have clearly defined boundaries which greatly simplify sampling and obtaining robust measurements of species richness and abundances. The ponds support a surprisingly diverse community. The fish assemblage of a single pond can be comprised of as many as 30 species of mid trophic level omnivores and planktivores. These characteristics make barrier island salt ponds a good candidate to examine the species-area relationship, as well as species-abundance distributions. The species-area relationship, where more species are found in larger habitats, is one of the most consist trends in ecology. The ponds display a clear, significant increase in species richness with pond area further emphasizing the ubiquity of the species-area relationship; in addition, ponds of a similar size have similar fish assemblages. Species-abundance distributions, however, do not display any clear trends with the fish assemblage not conforming to log series, log normal, or zero sum distributions. These species-abundance distributions do not seem to apply to habitats with limited species richness.

POPULATION TRENDS OF SELECTED DEMERSAL SPECIES IN COASTAL WATERS OF MISSISSIPPI AND ALABAMA

Living Estuarine Resources
Oral Presentation
Harriet Perry*, Ralf Riedel, Guillermo Sanchez, Leslie Hartman, and Stevens Heath
Center for Fisheries Research and Development
Gulf Coast Research Laboratory
University of Southern Mississippi
harriet.perry@usm.edu

The Gulf of Mexico (GOM) encompasses over 2 million hectares of wetlands, which support a vast array of fisheries. At one time, the GOM was considered too vast to be affected by contaminants, and fisheries resources were thought to be inexhaustible. Recent environmental trends, however, suggest that serious problems exist in the GOM with the potential to affect fisheries production. According to the U.S. Environmental Protection Agency, approximately 13 million pounds of toxic substances reach estuarine waters of the GOM each year. Combined with habitat damage from tropical storms, environmental perturbations associated with growth and development in the coastal zone, and economic overcapitalization in many fisheries, it is surprising that productivity has remained relatively stable in most fisheries. Recent analysis of fishery-independent data on population abundances of juvenile fishes and crustaceans in Mississippi, Alabama, and Louisiana suggest that current levels of productivity may not be sustainable in some fisheries in the near future.

Long-term, fishery-independent data were used to examine trends in abundance for selected species taken in otter trawls in coastal waters of Mississippi and Alabama. Dissolved oxygen, temperature, and salinity were collected with biological data at all sites. Both states use similar, standardized sampling methodologies. The data for both Alabama and Mississippi show very robust indications of declines for some species. White trout (*Cynoscion arenarius)*, lesser blue crab (*Callinectes similis)*, blue crab (*Callinectes sapidus)*, brown shrimp (*Farfantepenaeus aztecus)*, and white shrimp (*Litopenaeus setiferus)* showed decreasing trends in abundance in Mississippi. In Alabama, there were declining trends in white trout, blue crab, and white shrimp. No discernable trends in abundance were noted for pink shrimp (*F. duorarum*), brief squid (*Lolliguncula brevis*), spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), butterfish (*Peprilus burti*), and bay anchovy (*Anchoa mitchilli*). No trends in community structure through time were observed in the Alabama and Mississippi data. There was no evidence of recruitment failure based on catches of early stage juveniles in seines and beam plankton nets in either Mississippi or Alabama.

Consistency in field and laboratory protocols facilitated and simplified analysis of data. Similarity of results from both states provides evidence that broad-scale environmental processes are operating to regulate population levels in some estuarine species.

QUANTIFICATION OF NILE TILAPIA'S ABILITY TO SURVIVE, GROW, AND REPRODUCE IN ESTUARINE WATERS OF COASTAL MISSISSIPPI

Living Estuarine Resources
Oral Presentation
Michael R. Lowe*, Mark S. Peterson, Nancy J. Brown-Peterson, Pamela J. Schofield, Denise R. Gregoire, Jacqueline N. Langston, and William T. Slack
Department of Coastal Sciences, The University of Southern Mississippi
michael.lowe@usm.edu

The escape of Nile tilapia, *Oreochromis niloticus,* from aquaculture facilities has led to its establishment in several drainages in coastal Mississippi. Though the species' ability to overwinter at temperate latitudes has been the focal point for the majority of published research, salinity can also have profound effects on its survival and growth. In this study, we quantified survival and both somatic and gonad production for Nile tilapia exposed to salinities ranging from 0 to 70 ppt (10 ppt increments) at both summer (30°C) and winter (15°C) temperatures. During summer conditions, survival was greater than 80 percent in salinities up to 40 ppt. Male tilapia grew equally well up to 50 ppt and gonad development did not differ among salinity treatments. Female tilapia, on the other hand, showed negative growth at salinities > 30 ppt. Both ovary weight and gonadosomatic index, adjusted for body weight, decreased with increasing salinity and were significantly reduced above 20 ppt. The production of vitellogenic oocytes (eggs ≥ 1mm diameter) was also reduced above 20 ppt. Under winter conditions, complete mortality was observed in all salinity treatments ≥ 20 ppt; however, Nile tilapia survived exposure to 0 ppt and 10 ppt for 51.5 (± 41.4 SD) and 85.6 (± 7.2 SD) days, respectively. Negative growth was observed across all salinity treatments and with the exception of a few larger individuals, none of the fish had significant gonad production and only one individual produced vitellogenic oocytes. Our results suggest that Nile tilapia is not limited solely to coastal draining rivers and streams. In fact, the species appears capable of surviving and producing viable offspring in salinity as high as 20 ppt during summer conditions and that low salinity habitats may provide a thermal refuge during the winter for some individuals.

SEASONAL ABUNDANCE AND FEEDING ECOLOGY OF COWNOSE RAYS (*Rhinoptera bonasus*) FROM THE NORTHERN GULF OF MEXICO

Living Estuarine Resources
Oral Presentation
Matthew J. Ajemian* and Sean P. Powers
Dauphin Island Sea Lab
Department of Marine Sciences, University of South Alabama
majemian@disl.org

Increases in the abundance of myliobatid rays may pose problems for fisheries management due to the presence of exploitable shellfish species in the diets of these fishes. The cownose ray (*Rhinoptera bonasus*) is a myliobatid ray common to the northern Gulf of Mexico (NGOM). Cownose rays have been shown to play an integral role in controlling oyster and scallop populations in estuaries of the east coast of the United States. Off North Carolina, cownose rays enter estuaries during warmer summer months and consume scallops clustered in high density areas, resulting in a population sink. This has led resource managers of some states to consider utilization of fishing and exclusion devices to prevent predation on commercially valuable harvests by cownose rays. Despite their common occurrence in the Mississippi Sound, Mobile Bay and east to northwest Florida estuaries, no such actions have taken place in the NGOM, an area characterized by productive oyster and bay scallop fisheries. Past aerial surveys have shown that NGOM cownose rays are capable of forming aggregations of tens of thousands of individuals in Mississippi Sound, and these schools are often seen generating sediment plumes characteristic of ray foraging. These large cownose ray aggregations have been confirmed recently through continued aerial surveys and standardized gillnet sampling (Figure 1). Such observations encourage evaluating the ability of this predator to exert top-down control on benthic communities of the NGOM, especially due to this species' history of negatively impacting shellfish resources elsewhere.

Figure 1. An aggregation of cownose rays (*Rhinoptera bonasus*) photographed from an aerial survey off Dauphin Island, Alabama. (photo: J. Dindo)

We assessed cownose ray seasonal abundance over a one-year period (2007-2008) with random depth-stratified gillnet sampling (4.0 – 6.0" mesh size) in 6 blocks incorporating Mississippi Sound, Mobile Bay and Perdido Bay. Catch-per-unit-effort (CPUE) was calculated as rays per net per hour. Select individuals collected from gillnet sampling were sacrificed and examined for gut contents. Prey items were classified down to the lowest taxonomic level possible and then analyzed for frequency of occurrence, percent composition by number, percent composition by weight, and percent composition by volume. These data were then used to develop an index of relative importance (IRI) for each prey group. Finally, Shannon-Weiner diversity indices were utilized to quantify heterogeneity of diets across individuals. We compare our feeding ecology data to published studies on cownose ray diets from different regions of the Atlantic.

SEASONAL ABUNDANCE AND SIZE DISTRIBUTION OF ADULT AMERICAN HORSESHOE CRABS (*Limulus polyphemus*) ON MISSISSIPPI BARRIER ISLANDS

Living Estuarine Resources
Poster Presentation
Rebecca Haehn* and Richard S. Fulford
The University of Southern Mississippi Gulf Coast Research Laboratory
Department of Coastal Sciences
Rebecca.Haehn@usm.edu

The American Horseshoe crab, *Limulus polyphemus* (Phylum Arthropoda) is the sole species of the subclass Xiphosura inhabiting North America. Horseshoe crabs inhabit the continental shelf and estuaries from the Maine to the central Gulf Coast and the Yucatán Peninsula. However, the distribution is patchy within this range and growth rates, spawning behavior, and migration patterns differ between populations along the Atlantic coast. Although the presence of horseshoe crabs in southern Mississippi, there is limited data specific to the area and population. Investigating the relative population abundance and preferred habitat of adults will allow a better understanding of the biology and ecology of horseshoe crabs at the southwestern extreme of their habitat range. The continued existence of horseshoe crabs in Mississippi appears tied to their preference of barrier island beaches as spawning and nursery habitat. Measuring the physical characteristics of these beaches will provide critical habitat criteria and baseline information relative to future actions concerning island restoration, modification, and conservation.

Data will be gathered by counting horseshoe crabs on the northern shores of Horn Island and West Ship Island along a 1 km distance with randomly selected starting points for each date. Parameters collected for each animal include sex, prosomal width, state (pair, single, dead, or molt), water depth where they are found, and distance from shore. Other concurrent efforts include a tag and release program sponsored by the Fish and Wildlife Service that began in July 2008 (Figure 1).

On the Mississippi Gulf Coast horseshoe crabs begin to arrive as early as April and are consistently present through September/ October. The adult male:female ratio is 7:1. The mean prosomal width for horseshoe crabs located on West Ship and Horn Island for females and males is 221 mm (n= 41, SD=3.61) and 179 mm (n= 287; SD= 1.46), respectively. These observed means are between those found in Massachusetts (118 mm and 158 mm for females) and

Figure 1: Male horseshoe crab with tag.

North Carolina (232 mm and 327 mm for females). There was a significant difference between male and female prosomal width ($t(326) = 13.702$, $p<0.001$) with males being smaller.

The data collected will provide a critical overview of demographic data including sex and age distribution for a horseshoe crab population inhabiting one of their outer geographical extremes on the northwestern coast of the Gulf of Mexico.

THE SEA URCHIN *Lytechinus variegatus* IN THE NORTHERN GULF OF MEXICO: AN ECOLOGICAL AND ECONOMIC RESOURCE

Living Estuarine Resources
Oral Presentation
Stephen A. Watts*, John M. Lawrence, Mickie L. Powell, James B. McClintock,
and Addison L. Lawrence
Department of Biology, The University of Alabama at Birmingham
sawatts@uab.edu

One of the most conspicuous macroinvertebrates in nearshore marine benthic habitats of the Northern Gulf of Mexico is the sea urchin. The most common, *Lytechinus variegatus*, occurs in a variety of habitats, including beds of the seagrasses *Thalassia testudinum*, *Syringodium filiforme*, *Halodule wrightii*, and *Halimeda sp*., and on hard bottoms covered with algae, rock rubble, shell hash or sand. Population densities are variable, normally ranging from 0 to 40 ind·m^{-2} and may be habitat specific. Densities of up to 636 were reported in a sea urchin front off Dixie County in west-central Florida; however, high density populations are episodic and transient.

The life history characteristics of *L. variegatus* are a short life span, rapid growth rate and high production, and high reproductive rate. Individuals can grow up to 40 mm diameter within one year. Definitive spring and summer peaks of spawning have been observed in several populations in the northern Gulf of Mexico, corresponding generally to peaks in gonad indices. Temperature may be the most important factors influencing the distribution and abundance of *L. variegatus*. Individuals survive sea water temperatures from at least 11 to 35 °C in St. Joseph Bay, Florida. *Lytechinus variegatus* does not survive well at low salinities (<20 ppt). Mass mortality events were recorded in 1998 in St. Andrews Bay, Florida, following tropical storms that decreased nearshore salinities to 19 ppt.

Limited information exists on the effects of pollutants on *L. variegatus*. Individuals exposed to domestic and industrial wastes had irregular growth and a large number of deformities. Organic and inorganic phosphates can negatively impact behavior, feeding, absorption efficiency, nutrient allocation, gonad production, and spawning in *L. variegatus* as well as cause abnormal development in embryonic and early larval development. In terms of biological disturbance, mortality of *L. variegatus* off the central Florida gulf coast in 1996 and again in the summer of 2005 was associated with the occurrence of toxic red tides.

In terms of their ecological impact, most studies have examined the role of *L. variegatus* in regulating seagrass production. Field densities of 10 to 40 ind·m^{-2} impact the abundance of turtlegrass from fall to spring, but not in the summer, at St. Joseph Bay in the northeast Gulf of Mexico. Resultant community-level effects of massive grazing fronts of *L. variegatus* can effectively eradicate large-scale sea grass communities, including their associated animal communities.

Though the role of *L. variegatus* is important in nearshore marine benthic communities, it is also an important species in environmental and developmental research. *Lytechinus variegatus* are collected by a number of live specimen vendors and are often sold to research laboratories for basic developmental research on their eggs and embryos. Additionally, the gametes and larvae of this species are used widely

as a bioassay in tests conducted by EPA and USGS laboratories, and are a popular education tool in many K-12 classrooms.

Lytechinus variegatus are consumed by several island communities in the Caribbean and in Brazil, but they are not harvested commercially for roe. The negative consequences of even a controlled harvest might be substantial as sea urchins are routinely overfished beyond their carrying capacity. With the development of dry formulated feed (funded by Sea Grant) the potential of producing *L. variegatus* commercially for biomedical research, ecotoxicological evaluation and education is very feasible.

SHARKY CHEMISTRY: USING STABLE ISOTOPES TO EVALUATE TROPHIC DYNAMICS OF SHARKS IN THE NORTHERN GULF OF MEXICO

Living Estuarine Resources
Poster Presentation
Andrea Kroetz*, J. Marcus Drymon, and Sean Powers
University of South Alabama, Department of Marine Sciences
Fisheries Ecology Lab, Dauphin Island Sea Lab
akroetz2@gmail.com

A directive of the United States Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) is incorporation of ecosystem principles into future stock assessment. Ecopath/Ecosim models are a common way to represent such ecosystem effects, but rely on detailed biological data for model inputs. Modelers often lump sharks and other predatory fishes into a single group of apex predators, when in reality this apex predatory role is likely species and region specific. To investigate the trophic role of sharks in the north central Gulf of Mexico, monthly longline surveys were conducted to assess fine scale patterns of shark abundance and distribution (Figure 1). This survey straddles an area where disjunctive shark abundances have historically been shown.

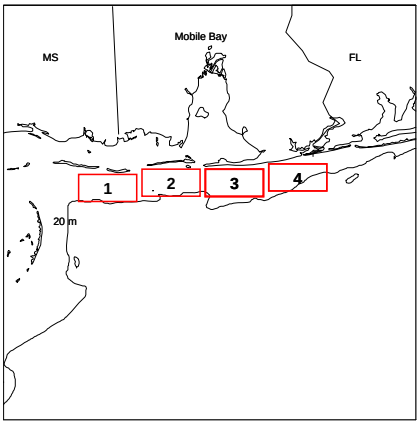


Figure 1. Sampling area for the current survey.

Multivariate analysis of 2007 data indicate adjacent areas within the Gulf of Mexico ecosystem show differences in shark community structure as revealed by non-metric multi-dimensional scaling and ANOSIM routines.

Stable isotopes are becoming a standard tool that allows researchers to assess both an organisms' dietary source and trophic position. In order to investigate the mechanism driving the patterns of abundance and distribution seen among these sharks, stable isotope analysis of liver and muscle tissue is currently being pursued to test the hypothesis that sharks in the region are responding to differences in the abundance of their prey. If this is the case, sharks may be functioning in different trophic roles throughout the extent of their range, something that carries consequences for future ecosystem based fishery management plans.

STIMULUS OF BACTERIAL PRODUCTION RATES IN TWO DON RICH NORTHERN GULF OF MEXICO ESTUARIES

Living Estuarine Resources
Oral Presentation
Katie Carpenter* and Kevin Dillon
University of Southern Mississippi
Department of Coastal Sciences
katie.carpenter@usm.edu

Bacterial growth, production and oxygen uptake of heterotrophic bacterial incubations were measured in Apalachicola Bay, FL (AB) and Mississippi Sound (MS) to determine biogeochemical limitations on bacterial production and what effect amendments of nutrients and organic matter would have on bacterial production rates (BPR, ug C L^{-1} d^{-1}), oxygen utilization rates (OUR, ug O_2 $L^{-1}d^{-1}$), and growth efficiencies (GE). AB is a N limited system while bacterial nutrient limitation is not well understood in MS. Both are characterized by high concentrations of dissolved organic nitrogen (DON). BPR in controls ranged from 0 to 76 in AB and 1 to 37 in MS. Controls OURs were 0 to 76 in AB while MS had OURs over 800. At AB, oak/elm amendments had BPRs of 7.9-28.4 and OURs of 0–114 with the highest GE. Vallisnaria extract stimulated bacterial metabolism (BPR=49-167, OUR=125-650) and had intermediate GEs while phytoplankton extract had the largest effect (BPR=252-520, OUR=5506–5718) with the lowest GE. In MS, ammonium and phosphate stimulated BPR; however, OURs were similar between control and amendments while BPRs increased to 103 and 127 with a significantly greater effect from PO_4. In AB, it appears that BGEs are highest in the river and deceases into the Bay. In MS, results suggest that PO_4 allow bacterial to access a portion of the DON pool. BGE in AB are much greater than in MS suggesting different controls on bacterial metabolism in these two systems.

STRIPED BASS (*Morone saxatilis*) IN MISSISSIPPI COASTAL WATERS

Living Estuarine Resources
Poster Presentation
Larry C. Nicholson*, Jay Dietrich, Wayne Ferguson, Richard Fulford, Adam Jackson, Anthony Johnson, Joe Roach, David Rose, and Joe Ziegler
USM, Gulf Coast Research Laboratory, Center for Fisheries Research and Development
larry.nicholson@usm.edu

The Striped Bass Technical Task Force of the Gulf States Marine Fisheries Commission developed a striped bass fisheries management plan for the five states bordering the Gulf of Mexico. The plan established the objective of restoring a viable reproducing population of gulf race striped bass (*Morone saxatilis*) in the Pearl and Pascagoula rivers. These two rivers supported an indigenous population of striped bass until the late 1950s. Since then the resident population has declined or has been eliminated from both rivers as well as from the river systems along the northern Gulf of Mexico. The Anadromous Fish Program at the Gulf Coast Research Laboratory (GCRL) has released approximately 12 million striped bass in coastal tributaries of Mississippi as part of an ongoing effort to restore populations. The project annually stocks striped bass, tracks population changes, and monitors all life stages of striped bass in coastal tributaries. The physical, chemical, and biological suitability of the rivers to sustain striped bass is also being evaluated.

Figure 1. Striped bass aquaculture pond at the MDMR Lyman Fish Hatchery.

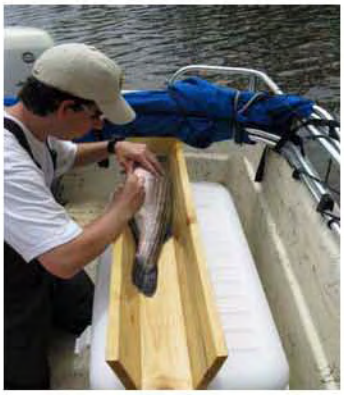


Figure 2. Tagging striped bass for tagging studies

The GCRL facilities for rearing striped bass were destroyed by Hurricane Katrina. In 2007, the GCRL Anadromous Fish Program partnered with the Mississippi Department of Marine Resources (MDMR) to re-direct culture efforts to the Lyman Fish Hatchery. Striped bass are currently being reared in aquaculture ponds instead of land-based re-circulating systems. Personnel from GCRL and MDMR are working cooperatively to improve existing culture techniques and to develop new methodologies for fish grow-out. In 2008, approximately 500,000 fry were stocked in ponds with about 250,000 fish released to local rivers.

SYMBIONT DISTRIBUTION, PREVALENCE, AND ASSEMBLAGES OF THE GRASS SHRIMP, *PALAEMONETES PUGIO,* IN SOUTHWESTERN ALABAMA

Living Estuarine Resources
Oral Presentation
Kate L. Sheehan*, Jack O'Brien, and Just Cebrian
Department of Marine Sciences, University of South Alabama, Dauphin Island Sea Lab
ksheehan@disl.org

As ecological concepts and experiments have become more sophisticated, investigators have gained a greater understanding and appreciation for factors that influence trophic and environmental interactions within estuarine systems, such as symbiotic and parasitic associations. Ecological, toxicological, and behavioral studies all require life history and distribution information; however, the baseline data needed are often incomplete or non-existent. Here, we provide observational data collected over a 21-month period describing the regional, spatial, and seasonal distribution of the macro-parasite assemblage of a cosmopolitan shrimp species along the Alabama Gulf Coast.

The common grass shrimp, *Palaemonetes pugio*, can be host to a number of symbionts/parasites within its North American range. We document the distribution and seasonality of four species that use *P. pugio* as a host in coastal Alabama. Twenty-two sampling sites (Figure 1) were visited in January, May, and September of 2007. These sites included islands within the Mississippi Sound, Mobile Bay, and Gulf of Mexico, as well as mainland sites of the Mississippi Sound, western and eastern Mobile Bay, and northern Mobile Bay in the Mobile-Tensaw Delta.

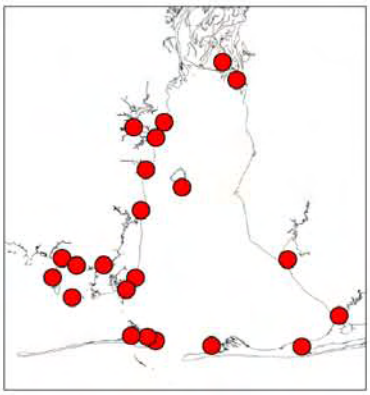


Figure 1. Sites from 2007 surveys.

Overall, the most common parasite is the microphallid trematode *Microphallid turgidus*. The haplosporidian hyperparasite *Urosporidium crescens* and the loricate ciliate *Lagenophrys lunatus* were also found consistently throughout the region. In contrast, the bopyrid isopod *Probopyrus pandalicola* was rare. The distributions of three of the four symbionts (all but bopyrid isopods) overlapped in a single geographic area (Mon Louis Island, AL) in all three seasons; however, multiple infections on individual hosts were seldom. The assemblages of symbionts for sites along the perimeter of Mon Louis Island were significantly different from sites in all other parts of the region (i.e. eastern Mobile Bay, Mobile-Tensaw Delta, and all island sites). At two sites where shrimp were surveyed more frequently (monthly for 21 months), microphallid trematode prevalence oscillated seasonally; however, relative prevalences between these sites remained consistent regardless of season. These data define the distribution of *P. pugio* and its symbionts within southern Alabama and provide baseline information for additional ecological studies on the spatial and temporal dynamics of these symbiont-host associations. Ongoing and future research is aimed at elucidating the factors that influence the distribution patterns found here,

and will include analyses of habitat (i.e. quantity/quality of host habitat available) and water quality (i.e. nutrient enrichment, biogeochemical conditions, and anoxia).

TIDAL CREEK ECOSYSTEMS: ARE THEY SENTINEL HABITATS FOR ASSESSING THE CONSEQUENCES OF RAPID DEVELOPMENT IN THE GULF OF MEXICO?

Living Estuarine Resources
Poster Presentation

Mark Woodrey*, Scott Phipps, Guy DiDonato, Denise Sanger, Gretchen Grammer, Christina Watters, and Susan White
Coastal Research and Extension Center - Mississippi State University and
Grand Bay National Estuarine Research Reserve
msw103@ra.msstate.edu

In many parts of the Southeast and Gulf of Mexico (GoM), the rate of land use consumption associated with coastal development far exceeds coastal population growth. This rapid development or urban sprawl, including the large amounts of impervious surfaces that are created, threaten the integrity of tidal creek and marsh ecosystems and ultimately human health and well-being of coastal populations.

Estuarine ecosystems, and the networks of tidal creeks that form them, are characterized by high biological productivity, great ecological value, complex environmental gradients, and many interconnected processes. River and tidal creek networks are the primary hydrologic link between estuaries and land based activities. The economic and ecological value, as well as the degree of human interaction with tidal creek habitats, is disproportionate to their area.

A conceptual model linking coastal watershed development to the environmental quality and human health and well-being of tidal creeks has been developed for the Southeast (Figure 1). This model links human population growth to changes in the physiochemical environment and ultimately ecosystem and human responses. In the Southeast, adverse changes in the physical and chemical environment were measured when impervious cover exceeded 10-20 percent. Ecological processes were impaired when impervious cover exceeded 20-30 percent. Estimates of threshold values for societal and human responses are currently being determined but it is clear that changes in the volume and rate of runoff associated with stormwater runoff makes coastal communities more vulnerable to flooding during large rainfall events and less resilient to coastal storms.

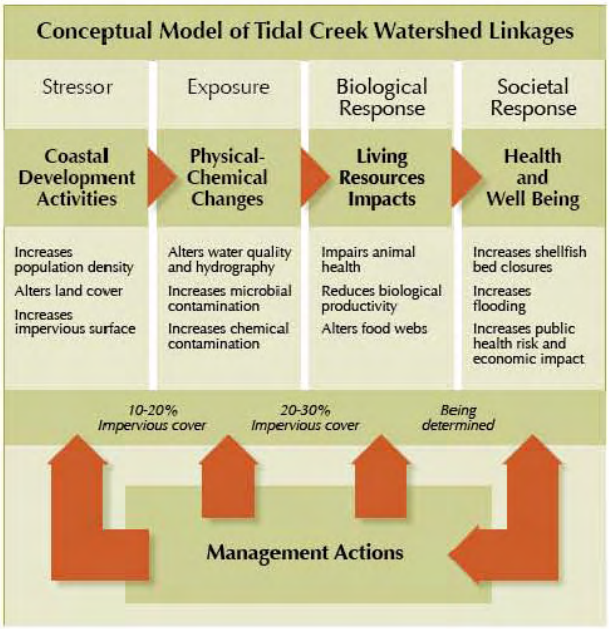


Figure 1. Conceptual model identifying linkages between development of the upland and the ecological and human well-being of southeastern tidal creeks.

The tidal creek conceptual model and classification framework have been explored and validated for much of the Southeast (SC, GA, NC) and are currently being evaluated in the Gulf of Mexico (GoM) with its smaller tidal regimes. Our proposed research combine

a watershed-level study integrating ecological, public health and human dimension attributes with watershed-level land use data. The primary objective of this work is to define clearly the relationships between coastal development with its concomitant land use changes and non-point source pollution loading and the ecological and human health and well-being status of tidal creek ecosystems. The approach used for this research is a comparative watershed and ecosystem approach that samples tidal creek networks draining developed watersheds (e.g., suburban, urban, and industrial) and nearby undeveloped sites, such as the National Estuarine Research Reserves (NERRs).

This research is being conducted collaboratively with the National Oceanic and Atmospheric Administration's Hollings Marine Laboratory and the Grand Bay (MS) and Weeks Bay (AL) NERRs. Creeks within and nearby these NERR sites were sampled for a wide range of indicators including water quality (e.g., dissolved oxygen concentration, salinity, nutrients, chlorophyll-a levels), sediment quality (e.g., characteristics, contaminants levels including emerging contaminants), pathogen and viral indicators, and abundance and genetic responses of biological resources (e.g., macrobenthic and nektonic communities, shellfish tissue contaminants, oyster microarray responses). Initial water quality and pathogen results from the 2008 sampling event will be presented.

UNDERSTANDING THE SLOW-GROWTH, HIGH-CONDITION PARADOX OF LARGEMOUTH BASS IN THE MOBILE-TENSAW RIVER DELTA, AL: INTEGRATING BIOENERGETIC MODELING, LIFE-HISTORY THEORY, AND GENETICS

Living Estuarine Resources
Poster Presentation
David C. Glover*, Dennis R. DeVries, Russell A. Wright, Alicia J. Norris, Troy M. Farmer, Huseyin Kucuktas, Zhanjiang Liu, and Rex A. Dunham
Department of Fisheries and Allied Aquacultures, Auburn University
glovedc@auburn.edu

Compared with those found in freshwater, estuarine populations of largemouth bass (*Micropterus salmoides*) often exhibit substantially different vital rates. Largemouth bass found in Alabama's Mobile-Tensaw River Delta (MTRD) are characterized by slow growth, high condition, and low annual survival as is the case with many coastal populations. To determine why these populations exhibit such different characteristics, we have examined 1) movement relative to salinity, 2) diet along a salinity gradient, 3) age- and sex-specific energy partitioning among somatic growth, reproduction, and mesenteric fat reserves, and 4) genetic differentiation using microsatellite markers.

An initial hypothesis to explain the slow growth of largemouth bass in the MTRD was that as salinity increases, adult largemouth bass migrate upstream to freshwater areas already occupied by other bass, resulting in overcrowding and reduced growth. However, telemetry, external tagging, and otolith microchemistry results indicate that largemouth bass move little in response to changes in salinity. Further, high largemouth bass body condition in the MTRD are inconsistent with expectations of limited forage.

Diet analyses revealed that largemouth bass consume mostly fish (i.e., sunfish species) in the upstream region of the MTRD, whereas those downstream had higher proportions of invertebrates (e.g., crabs and shrimp). Despite these differences, growth beyond age-1 did not differ between downstream and upstream. In addition, somatic energy density was 22 percent higher for coastal versus freshwater largemouth bass, indicating that greater consumption is required to obtain growth rates comparable to freshwater populations. Further, largemouth bass (both male and female) throughout the MTRD maintain high mesenteric fat reserves throughout the year, likely contributing to high body condition factors. Abundant fat reserves may provide resources to compensate for periodic stressful salinity levels; however, high caloric density reduces the somatic scope for growth in weight. A portion of the population spawned as early as age-1, possibly as an adaptive strategy to overcome high mortality rates, while reducing somatic growth. Thus, somatic growth may be reduced in favor of allocating energy towards processes enhancing survival and reproduction, thereby increasing their lifetime fitness.

Previous genetic investigations using a number of polymorphic allozymes indicated that MTRD largemouth bass were similar to their northern counterpart. However, recent evidence from genetic analyses using seven microsatellite markers suggests that largemouth bass within the MTRD may be genetically different from both northern strain and Florida strain largemouth

bass. Therefore, observed differences in largemouth bass vital rates in the MTRD versus inland populations may also have a genetic component in combination to environmental influences.

Our next step is to combine bioenergetics modeling with these life-history results, allowing us to determine how these freshwater fish adapt to a dynamic estuarine environment. Ultimately, our results will help fisheries managers to determine the extent to which this important resource can be enhanced, and whether angler expectations of a potential trophy bass fishery in the Mobile-Delta are realistic.

USE OF OTOLITH MICROCHEMISTRY OF SPOTTED SEATROUT TO IDENTIFY STOCK SOURCE-AREAS, REVEAL POPULATION MOVEMENTS, AND DETERMINE INTERANNUAL VARIABILITY IN REGIONAL PATTERNS OF OTOLITH SIGNATURES IN MISSISSIPPI COASTAL WATERS

Living Estuarine Resources
Oral Presentation
Bruce Comyns*, Chet Rakocinski, Mark Peterson, Alan Shiller, and Paul Grammer
Department of Coastal Sciences
University of Southern Mississippi
bruce.comyns@usm.edu

At the 2006 Alabama-Mississippi Bays and Bayous Symposium, we reported that we were able to use otolith microchemistry to correctly classify about 90 percent of juvenile spotted seatrout (n=199) with respect to the region (n=9) along the Mississippi (MS) coast from which they were collected in 2001. The suite of otolith microchemical variables included element/Ca ratios of Ba, Li, Mg, Mn, Sr, as well as $\delta^{13}C$ and $\delta^{18}O$. In addition, by analyzing the inner portion of otoliths from older fish (same year class) we found that fish originating as juveniles in Grand Bay occurred across much of the MS coastline in subsequent years, indicating that this reserve may serve as an important source area for spotted seatrout. In the second phase of this Sea Grant-funded study, we examined interannual differences between 2001 and 2006 in regional patterns of otolith microchemistry of juvenile spotted seatrout from the same nine regions of coastal MS. We also continued tracking the 2001 year class with respect to the region from which fish originated. In 2006, juveniles (n=201) were correctly classified at a similarly high rate of 93 percent success using a canonical discrimination function analysis. Misclassified specimens were mostly from adjacent regions. Interannual differences in regional otolith microchemistry patterns between 2001 and 2006 advise caution when attempting to track more than one year class based on the otolith microchemistry pattern for a particular year. About 20 percent of 2- and 3-year-old fish collected across the MS coast in 2004 were predicted to have come from Grand Bay. In contrast, no 3-year-olds and only 3 percent of the 2-year-olds were identified as having come from either the Pearl River region or the Biloxi (Louisiana) marshes for any of the other sampling areas in MS. This does not diminish the importance of these two regions as habitat for juveniles, as evidenced by the significant population of spotted seatrout that they support. It is also quite possible that these areas are important source areas of fish for more westerly areas. A general east-west movement of adults was also inferred by differences between where fish were captured and where they supposedly originated. Frequency distributions of 105 adults were aggregated into three major east-west regions across the MS coast: East (Grand Bay, Pascagoula River, Horn Island); Central (Biloxi Bay, Chandeleur Islands, Cat Island), and West (Saint Louis Bay, Pearl River, Biloxi marsh). A contingency test of the difference between where fish were captured and where they supposedly originated confirmed that the supply of fish was disproportionate across the three major regions. Fish were markedly better represented by eastern fish than western fish. Coastal MS is currently undergoing extensive coastal development, and the ability to determine spotted seatrout source regions is essential for justifying the conservation of key regions containing valuable nursery habitat.

USING MACROBENTHIC FUNCTIONAL METRICS AS INDICATORS OF ORGANIC ENRICHMENT AND HYPOXIA

Living Estuarine Resources
Oral Presentation
Chet F. Rakocinski*
Gulf Coast Research Laboratory
Department of Coastal Sciences, The University of Southern Mississippi
chet.rakocinski@usm.edu

Organic enrichment and hypoxia are major water quality concerns in estuaries of the U.S. Gulf of Mexico. Furthermore, population growth and climate change are exacerbating effects of eutrophication worldwide. Thus, there is a pressing need to develop and validate estuarine indicators with known links to eutrophication and other stressors that impede ecosystem function. Macrobenthic functional metrics are potentially useful for diagnosing effects of nutrient loading, organic enrichment, and hypoxia, because the macrofauna mediates trophic function by affecting rates, directions, and pathways of exchange and transformation between the water column and the sediment. However, macrobenthic functional metrics have not been widely used as ecological indicators of eutrophication and hypoxia. Moreover, existing macrobenthic functional metrics are not usually considered jointly as a suite of interrelated measures.

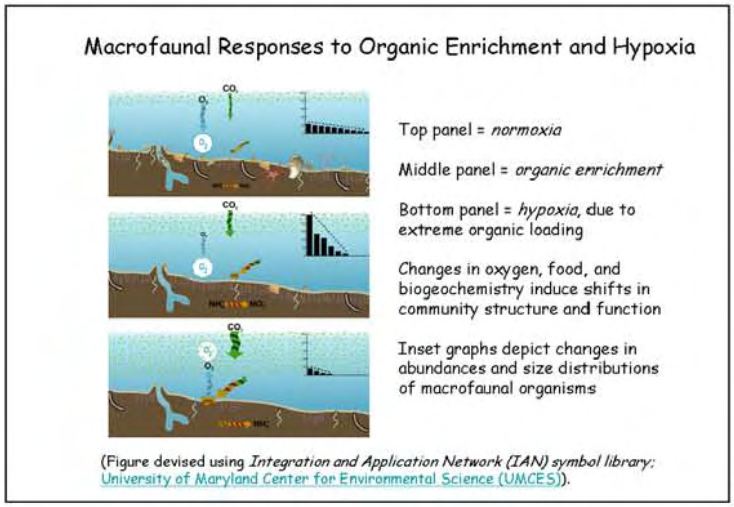


Figure 1. Macrofaunal responses to organic enrichment and hypoxia

The purpose of this U.S. Environmental Protection Agency (EPA) funded study was to: (1) examine relationships among a suite of macrobenthic functional metrics; (2) explore relationships between macrobenthic indicators and environmental variables; and (3) compare the Benthic Index for the Gulf of Mexico with macrobenthic indicators in terms of their environmental relationships. One hundred and thirty-three sampling events during the 4-year study period represented 29 sites within three central Gulf of Mexico (GoM) estuarine systems. Practical methods of estimating macrobenthic functional metrics were employed using a combination of image analysis, data conversions, and allometric scaling relationships. Constituent macrobenthic functional metrics included production potential, faunal turnover rate, mean body size, total biomass, total abundance, as well as slopes, intercepts, and residuals of normalized biomass size-spectra (NBSS). The suite of functional macrobenthic metrics comprised two orthogonal benthic indicator functions: BF1 reflected community maturity and BF2 represented a production-based macrobenthic indicator. Benthic indicator functions

generally showed stronger relationships with functional environmental variables than did the Benthic Index (BI), a reliable standard indicator of estuarine condition; and moreover, BF2 was strongly related to a DO-driven environmental factor. A hypothetical nonlinear response in benthic function to organic loading and decreasing DO was confirmed: BF2 values were highest at high levels of organic loading and moderate levels of DO; and lowest when both sediment organic and DO levels were correspondingly low. The indicator of community maturity, BF1, correlated significantly with the BI; whereas the production-based BF2 was completely unrelated to the BI. Joint consideration of the two orthogonal BF indicators enabled finer distinctions of estuarine condition: shallow subtidal sites exemplified the highest values for both indicator functions; whereas deep subtidal habitats often displayed the lowest scores on BF2. Deep sites often experienced chronic hypoxia in summer. Highly productive tidal marsh macrofaunal communities typically consisted of superabundant small-bodied organisms with short life spans. Recent funding through the National Oceanic and Atmospheric Administration Northern Gulf Institute (NGI) will enable extended sampling of macrobenthic functional indicators from deeper stations located at the Mississippi Bight.

USING MODIS AQUA AND IN SITU DATA FOR HAB PREDICTION IN THE NORTHERN GULF OF MEXICO: DECISION TREE ANALYSIS AND MODELING OF ECOLOGICAL CONDITIONS

Living Estuarine Resources
Oral Presentation
Dan Holiday*, Greg Carter, Rick Gould, and Hugh MacIntyre
Gulf Coast Geospatial Center
University of Southern Mississippi
dan.holiday@usm.edu

To date, 13 potential Harmful Algal Bloom (HAB) species have been detected in coastal waters of Mississippi and Alabama, including representatives of the diatom genera *Pseudo-nitzschia* and *Chaetoceros,* and dinoflagellate genera *Karenia*, *Karlodinium, Gonyaulax*, and *Prorocentrum*. This study investigates the potential of satellite remote sensing (MODIS Aqua) to predict environmental conditions leading to the formation of HABs in these turbid coastal waters. Phytoplankton populations and water quality were monitored in situ at 3 to 6 week intervals and 17 locations in Mobile Bay and the Mississippi Sound from July, 2005 through June, 2006. MODIS Aqua imagery corresponding with in situ collections was acquired. Non-parametric multivariate analyses determined relationships between phytoplankton cell counts and in situ or satellite-derived water properties, including surface temperature, salinity, concentrations of chlorophyll-a, total suspended solids, colored dissolved organic material, and nutrient levels. This paper will describe an expert system decision tree analysis approach to prediction of ecological conditions necessary for the formation of HABs. The model assumes unique ranges of remote sensing reflectance, chla, total suspended solids, and sea surface temperature must exist in order to allow the formation of HABs.

Vibrio IN THE NORTHERN GULF OF MEXICO: ECOLOGICAL SIGNALS, REMOTE SENSING, AND DISEASE

Living Estuarine Resources
Poster Presentation
Adrienne R. Flowers*, Crystal N. Johnson, Nicholas F. Noriea III, Gregory A. Carter, John C. Bowers, and D. Jay Grimes
Gulf Coast Research Laboratory, The University of Southern Mississippi
Adrienne.R.Flowers@usm.edu

Vibrio parahaemolyticus (*Vp*) and *V. vulnificus* (*Vv*) are Gram-negative, halophilic bacteria that can cause gastroenteritis, wound infections, and bacteremia. Infections are most frequently associated with the consumption of (raw) molluscan shellfish and wound exposure to seawater; particularly among immune-compromised individuals. *Vp* and *Vv* are naturally occurring in marine and estuarine environments, and their abundance has been shown to be influenced by a number of environmental factors, particularly water temperature and salinity. *Vibrio* densities are higher during warmer months, but outbreaks can occur during colder periods as well, suggesting that water temperature alone does not fully explain the variation in *Vibrio* densities It seems likely that the variation unexplained by temperature and salinity may be significantly correlated with other environmental parameters such as turbidity, chlorophyll, or plankton. To gain further insight into the relationship of these other factors to *Vibrio* abundance, we monitored environmental parameters in situ (water temperature, salinity, turbidity, chlorophyll-*a*, plankton) and densities of two vibrio species in water, oysters, and sediment at sampling sites in the Northern Gulf of Mexico from May 2005 through August 2007. *Vibrio* measurements involved direct plating-colony hybridization of environmental samples with alkaline phosphatase labeled portions of the *tlh* gene (thermolabile hemolysin) for *Vp* and *vvh* gene (*V. vulnificus* hemolysin) for *Vv*. Density estimates based on these observations were compared to in situ environmental data to identify the magnitude of correlations between bacterial densities, water temperature, salinity, turbidity, chlorophyll-*a*, and plankton densities. By using environmental parameters that can be measured remotely, it may be possible to monitor and even predict trends in *Vp* and *Vv* abundance and distribution regionally and globally, not just locally. When remotely sensed parameters correlate strongly with in situ measurements, then remotely-sensed indicators of *Vibrio* population levels can be described, offering an additional tool for ecological research and disease prevention.

COASTAL RESILIENCY INDEX: A COMMUNITY SELF-ASSESSMENT

Natural Hazards Resiliency and the Ocean's Role in Climate
Oral Presentation
Tracie T. Sempier*, Rod Emmer, Tina Sanchez, Melissa Schneider, Stephen Sempier, and LaDon Swann
Mississippi-Alabama Sea Grant Consortium
tracie.sempier@usm.edu

The Coastal Storms Program (CSP) is a nationwide effort to help coastal residents reduce the impacts storms have on their families, communities, property, and environment. The program has a history of providing a broad array of tools and services, which have included improved observing systems, forecast models, decision support tools, outreach and extension activities, and enhanced community resilience.

Locally, the Gulf of Mexico Coastal Storms Program (GoMEX CSP) is one of four national project areas, established to serve Alabama, Mississippi, and eastern Louisiana. The goal of the GoMEX project is to provide financial and technical assistance to improve communications, awareness, and understanding of issues surrounding land use development and how planning decisions affect hazard impacts through education and product transition, specifically with regard to:

- Ecological impacts of coastal storms on aquatic ecosystems
- Hazard and climate mitigation and adaptation, evacuation, etc.
- Community best practices in mitigating hazard impacts and related problems (evacuation, runoff, etc.)

One of the tools currently being piloted in the GoMEX CSP is a coastal resiliency index, which was initially developed by the Louisiana Sea Grant College Program and Mississippi-Alabama Sea Grant Consortium. The purpose of this self-assessment is to provide community leaders with a simple and inexpensive method of predicting if their community will reach and maintain an acceptable level of functioning and structure after a disaster. Using existing sources of information, experienced local planners, engineers, floodplain managers, or administrators can complete the self-assessment.

This presentation will highlight the key indicators included in the index and describe the pilot process on the Gulf Coast. Copies of the index will be distributed with contact information for communities that wish to participate.

GULF COAST FOREST DAMAGE DETECTION AND CARBON FLUX ESTIMATION USING ICESAT GLAS AND LANDSAT TM

Natural Hazards Resiliency and the Ocean's Role in Climate
Oral Presentation
Jason Jones, Lauren Childs*, Matt Batina, Aaron Brooks, Maddie Brozen*, Jenn Frey, Angie Maki, Chris Chappell, and Kenton Ross
NASA DEVELOP
Jason.b.jones@nasa.gov

Tropical storms and hurricanes annually cause defoliation and deforestation along the Gulf Coast. Following severe storms, there is an urgent need to assess the impact on timber growth so resources can be targeted to assist in recovery efforts. It is also important to identify these damaged areas due to their increased risk of fire, heightened susceptibility to invasive species, and fluctuations in carbon storage capacity. Current methods of detection involve assessment through ground-based field surveys, aerial surveys, computer modeling, space-borne remote sensing, and Forest Inventory and Analysis field plots. This project focuses on a need for methods that are at once more synoptic than field surveys and more closely linked to the phenomenology of tree loss and damage than passive remote sensing methods.

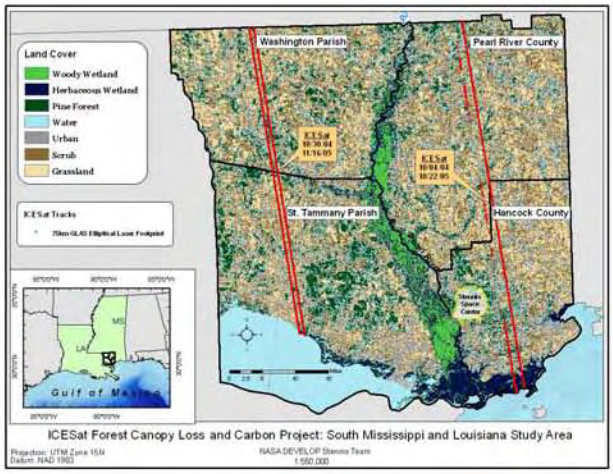


Figure 1. Map of the ICESat study area that covers Pearl River County, Hancock County, St. Tammany Parish, and Washington Parish

The primary concentration of the project is on the utilization of Ice, Cloud, and land Elevation Satellite (ICESat) data products to detect changes in forest canopy height as an indicator of post-hurricane forest disturbances, and the use of Landsat TM imagery to create forest fuel type land classifications and estimations of carbon loss due to storms. ICESat is a LIDAR mission for measuring ice sheet mass balance, cloud and aerosol heights, as well as land topography and vegetation characteristics. ICESat's Geoscience Laser Altimeter System (GLAS) instrument was used to measure topography over land, focusing on coastal forest canopy heights.

By analyzing ICESat and Landsat data over areas in Pearl River County, Hancock County, St. Tammany Parish, and Washington Parish affected by Hurricane Katrina, this study demonstrates that ICESat may serve as an indicator of a storm's direct effects on coastal forests as well as its long term consequences, while Landsat TM can be useful in estimating carbon flux over time.

HURRICANE SURGE FORECASTING FOR THE PASCAGOULA RIVER

Natural Hazards Resiliency and the Ocean's Role in Climate
Oral Presentation
Dave A. Ramirez* and David Welch
National Oceanic and Atmospheric Administration
Lower Mississippi River Forecast Center
dave.ramirez@noaa.gov

The National Weather Service (NWS) Lower Mississippi River Forecast Center (LMRFC) is responsible for providing stage forecasts for the lower Mississippi River and its tributaries, including streams draining to the Mississippi and Louisiana Gulf coasts. This responsibility includes river and flood forecasts regardless of their origin; heavy rainfall events, dam/levee failures, or elevated water levels in the Gulf of Mexico from high winds and tides or from hurricane storm surges. The scope of this analysis is focused on the efforts by the LMRFC to dynamically model the effects of storm surge or elevated astronomical tides on the Pascagoula River watershed in southeastern Mississippi including the main river reach of the Pascagoula running from Merrill, MS, to the Gulf of Mexico. The major tributaries included in the analysis have upstream boundaries at the following locations: Black Creek near Wiggins, MS, Red Creek at Vestry, MS, Escatawpa River near Agricola, MS, and Big Creek at Big Creek Dam, AL.

LMRFC will model the lower Pascagoula River using the unsteady state 1-D hydrodynamic model Hydrologic Engineering Center's River Analysis System (HEC-RAS) developed by the U.S. Army Corps of Engineers. The upstream boundaries of the river model will be generated from the National Weather Services River Forecast System (NWSRFS), a hydrologic model that produces stream flow and stage hydrographs for headwater and downstream basins. The downstream boundaries will be stage hydrographs generated from either a two-dimensional, coupled river/estuary/ocean model developed by the Coastal Hydroscience Analysis, Modeling & Predictive Simulations (CHAMPS) Laboratory at the University of Central Florida (UCF) or the National Oceanic and Atmospheric Administration (NOAA) Sea, Lake, Overland Surge Heights (SLOSH) Model, which is used during tropical events.

Only a sparse amount of channel survey data was available for the upper reaches of the study area. Data from the United States Geological Survey (USGS), the Corps of Engineers Mobile District, and past Federal Emergency Management Agency studies were available. Digital elevation model (DEM) data was merged with existing channel bathymetry in order to represent the river floodplain areas. Using this data, UCF developed a single digital terrain model (DTM) for the Pascagoula. This DTM was used by LMRFC to create river channel cross sections for all river reaches within the study area. UCF will also use this DEM to develop the ocean grid needed to complete the coastal modeling.

This model will be used by the LMRFC to forecast river stages incorporating rainfall and flows from upstream and the effects of observed tide with future National Ocean Service

astronomical tides and extra tropical storm surge derived from a global meteorological model. The model will also be set up to ingest the UCF - CHAMPS laboratory ocean model generated storm surge hydrographs and NOAA SLOSH model when the Pascagoula River is threatened by a tropical storm or hurricane.

INTERNET MAP SERVING THE HURRICANE KATRINA MAXIMUM STORM TIDE IN ALABAMA, MISSISSIPPI, AND LOUISIANA

Natural Hazards Resiliency and Ocean's Role in Climate
Oral Presentation
D. Phil Turnipseed, K. Van Wilson*, James E. Hathorn, Dean Tyler, Jason Stoker, and Robert R. Mason, Jr.
U.S. Geological Survey Mississippi Water Science Center
kvwilson@usgs.gov

In the months that followed the Hurricane Katrina devastation in the Central Gulf of Mexico region of the United States, the U.S. Geological Survey (USGS), in cooperation with the U.S. Army Corps of Engineers (USACE), developed an Internet Map Server (IMS) that enables a user to determine flood depths above the North American Vertical Datum of 1988 (NAVD88) for the Hurricane Katrina maximum storm tide in the affected states. The server includes a comprehensive geospatial information system allowing free access to many digital layers and GIS tools for this region which includes:

- Pre-Katrina Light Detection and Ranging (LiDAR) digital elevation model (DEM) with 1/9th arc-second (3-meter) grid resolution served as the base for the mapping furnished by USGS; FEMA; USACE; Baldwin and Mobile Counties, Alabama; and others;
- GIS layer with 842 high-water marks (HWMs) that were used to generate the maximum storm tide surface;
- Katrina Maximum Storm Tide Surface generated from the HWMs for areas outside of the New Orleans, Louisiana, levees to approximate the maximum storm tide that approached the levees;
- Cultural boundaries;
- Hydrography;
- Transportation;
- Orthoimagery;
- Land cover/use;
- Elevation Query Tool; and
- Elevation Profile Comparison Tool

The seamless DEM across the coastal areas of Alabama, Mississippi, and Louisiana was created from LiDAR data that were obtained from multiple sources and were collected independently in various file formats, projections, and levels of processing. The task of producing a seamless DEM, used as the map base for projecting the Katrina maximum storm tide in the affected coastal region, required extensive research, coordination, and revision.

The 842 HWMs used to generate the IMS representing the Katrina maximum storm tide were processed and filtered from more than 1,500 HWMs that were flagged, surveyed, and documented by teams representing the Federal Emergency Management Agency (FEMA), USGS, USACE, and others. The maximum storm tide elevations of about 29 feet were documented near Bay St. Louis, Mississippi, confirming that Katrina was more than 4 feet greater than storm tide caused in 1969 by Hurricane Camille (highest previously known storm tide to inundate the region).

The Web site is available to the public at http://gisdata.usgs.gov/website/gulf/.

LIVING SHORELINES AS AN ALTERNATIVE FOR SHORELINE PROTECTION FOR HOMEOWNERS

Natural Hazards Resiliency and the Ocean's Role in Climate
Oral Presentation
Chris A. Boyd*
Coastal Research and Extension Center, Mississippi State University
cboyd@ext.msstate.edu

The coastal shorelines and marine habitats of the Gulf of Mexico contain some of the most productive and diverse flora and fauna in the United States. Residential and commercial properties in the coastal region are located on beaches, bays, lagoons, peninsulas, tidal creeks, and rivers. In order to preserve and maintain the natural functions of these beautiful and ecological valuable habitats, we as a society must change some of our developmental practices. This is especially true because of the intense growth that is occurring in the coastal region today. This can start by learning about more natural ways to control shoreline erosion to preserve salt marshes, submerged aquatic vegetation, wetlands, and beaches that help to buffer the land during storm events and to protect water quality.

If your property is located where erosion is occurring, you should protect your property by reducing or stopping erosion. The current trend in the Gulf of Mexico and around the nation is to build seawalls or bulkheads to protect coastal properties. In Mobile Bay, more than 30 percent of shoreline has been armored. Since 1994, shoreline armoring has been permitted at the rate of 18 miles/year in Virginia. In other areas, the amount of shoreline that has been armored in heavily populated counties in California is greater than 75 percent, more than 50 percent of shoreline has been armored along South River in Maryland, and 45 percent of Florida's developed east and west shore has been armored with some type of hard structure. With a decline in fisheries in the Gulf of Mexico already occurring because of water pollution, loss of habitat and over fishing, we need to take pride in our remaining coastal property and try to develop it in a more environmentally sustainable way. Not only do hard structures reduce habitat through loss of the land and water interface, they reflect waves to areas that are not protected, and scourer the land underneath the seawall making the water body deeper and the edge steeper.

Property owners need to be aware that there are other structural alternatives that can address erosion that might be more economical, aesthetically pleasing, and environmentally sound. Seawalls could be the best alternative in a medium to high erosional setting, but in lower erosional environments, other soft or non-structural stabilization alternatives could be the most economical choice. In medium wave energy environments, hybrid structures that combine vegetative planting with hard structural control, such as low-profile rock sills or breakwaters, may be a good choice. A non-structural alternative, such as a living shoreline created from vegetative plantings or a combination of seagrasses and a rock sill, can be a very viable means of erosion control. Living shorelines are a more natural approach to stabilize shorelines while maintaining

coastal processes and natural habitats. They preserve access for aquatic and terrestrial wildlife and provide nursery habitat for many marine species.

NOAA'S NATIONAL OCEAN SERVICE PROMOTES HAZARD RESILIENCY THROUGH REAL TIME WATER LEVEL OBSERVATION IN MISSISSIPPI AND ALABAMA

Natural Hazards Resiliency and the Ocean's Role in Climate
Oral Presentation
Carolyn F. Lindley*, Allison L. Allen, and Kristen A. Tronvig
NOAA National Ocean Service
Center for Operational Oceanographic Products and Services
Carolyn.Lindley@noaa.gov

The northern Gulf of Mexico is highly susceptible to a range of coastal hazards, including hurricanes and coastal storms, land subsidence, relative sea-level rise, shoreline erosion, and loss of coastal wetlands. To mitigate these hazards, real-time water level must be available, as well as long-term water level trends, extreme storm information, and a good understanding of the land-water interface and its changes over time. Forecasting and assessing natural hazard occurrence and impact in order to protect life and property along all U.S. coasts is an essential application of the National Oceanic and Atmospheric Administration's (NOAA's) Center for Operational Oceanographic Products and Services (CO-OPS). CO-OPS operates and maintains the National Water Level Observation Network (NWLON), a network of long-term coastal water level stations, and a critical backbone of the National Water Level Program. As part of the NWLON, NOAA Sentinels of the Coast are real-time water level stations which have been strengthened to withstand severe coastal events, specifically Category 4 hurricanes. The NOAA Sentinels hardening effort was borne out of recognizing the critical need for accurate data at the height of storms.

CO-OPS developed PORTS® to meet the specific needs of the local maritime community by measuring, integrating, and disseminating observations of water levels, currents, salinity, wind, and bridge clearance, all of which help mariners successfully guide ships into and out of the Nation's seaports.

In addition to long-term water level stations, at which climate impacts can be observed through relative sea level trends, CO-OPS operates a series of subordinate, or shorter-term tide stations, in support of a wide range of specific projects and applications, including hydrographic surveys, marine boundary delineation, shoreline mapping, emergency management, and habitat restoration. Real-time water levels are observed and disseminated serving as a tool for the monitoring of inundation due to coastal storm surge and flood events, and evacuation decision-making. Water level information, when combined with knowledge of local tidal currents and waves, allows coastal managers to properly analyze beach erosion rates so that protective measures can be taken and where necessary, restoration can be designed properly.

Accurate geodetic information coupled with water level information is critical for hydrographic surveys in the Gulf. Accurate water level and geodetic information is critical in identifying and quantifying land subsidence and resultant long-term relative sea-level rise, as well as present shoreline and shoreline change. A tide station is currently being operated in the Weeks Bay

National Estuarine Research Reserve to support ongoing restoration and monitoring efforts, as well as observing the ecological effects of climate change.

OCEANIC-ATMOSPHERIC MODES OF VARIABILITY AND THEIR EFFECTS ON RIVER FLOW AND BLUE CRAB (*Callinectes sapidus*) ABUNDANCE IN THE NORTH CENTRAL GULF OF MEXICO

Natural Hazards Resiliency and the Ocean's Role in Climate
Poster Presentation
Guillermo Sanchez-Rubio*, Harriet M. Perry, and Patricia M. Biesiot
Center for Fisheries Research and Development
Gulf Coast Research Laboratory, The University of Southern Mississippi
guillermo.sanchez@usm.edu

Oceanic-atmospheric modes of variability occur on interdecadal, multidecadal, and decadal timescales, and their influence on climate around the world has been confirmed. The present study investigates Mississippi River and Pascagoula River flows in response to the influence of one or more of the three oceanic-atmospheric modes of variability: the Pacific Decadal Oscillation (PDO), the Atlantic Multidecadal Oscillation (AMO), and the North Atlantic Oscillation (NAO). These modes of variability are present in two phases: PDO warm (PDOw) and cold (PDOc), AMO warm (AMOw) and cold (AMOc), and NAO positive (NAOp) and negative (NAOn).

Four long-term climatic phases (PDOc/AMOc/NAOn, PDOc/AMOc/NAOp, PDOw/AMOc/NAOp, and PDOw/AMO w/NAOp and n) were identified from 1967 to 2005. High Mississippi River mean flow was associated with the PDOw, AMOc, and NAOp phases, with low river flow linked to their opposite phases. High Pascagoula River mean flow was related to the AMOc and NAOp phases, with low river flow linked to their opposite phases. Blue crab data on abundance were taken from fishery-independent trawl survey programs conducted by the Gulf Coast Research Laboratory and the Louisiana Department of Wildlife and Fisheries in coastal waters of Mississippi and Louisiana, respectively. Long-term climatic phases overlapped with four distinct periods of annual blue crab abundance that were identified using hierarchical agglomerative clustering and non-metric, non-parametric multi-dimensional scaling techniques. The following abundance periods were delineated: period I (1967-1970), period II (1971-1980), period III (1981-1998), and period IV (1999-2004). For all but three years (1991, 1995, 2005) the overall abundance of blue crabs fell into chronological sequences under climatic phases. A single year (1990) did not group with any of the four abundance periods. Periods II and III were characterized by high numbers of crabs and increased river flow. Blue crab abundance was related to long-term hydrological conditions across the Mississippi and Pascagoula River basins with 23 percent of the variability explained by climatic phases (AMO, NAO), salinity, and frequency of southeast winds. These factors may favor blue crab productivity by increasing marsh edge habitat, decreasing predation, and facilitating shoreward transport of megalopae. The majority of the variability in crab abundance was not explained by the factors investigated in this study. Because climate is operating on an ever-changing coastal environment, prediction cannot be based on climatic factors alone. Recent studies emphasize the importance of biotic factors associated with quality of habitat as refuge and the inability to quantify sources contributing to natural mortality of young crabs makes prediction based on current knowledge difficult. Years of lowest abundance (period IV) occurred at a time of unprecedented change in habitat associated with catastrophic storms, the cumulative

consequences of man-made alterations to coastal wetlands, and an unfavorable climatic regime. In fact, there has been a downward trend in abundance from periods II to IV, with catch in period III (highly favorable climatic phase) significantly lower than period II, a phase of less favorable conditions. Whether a shift to a more favorable climatic regime would increase abundance is unknown.

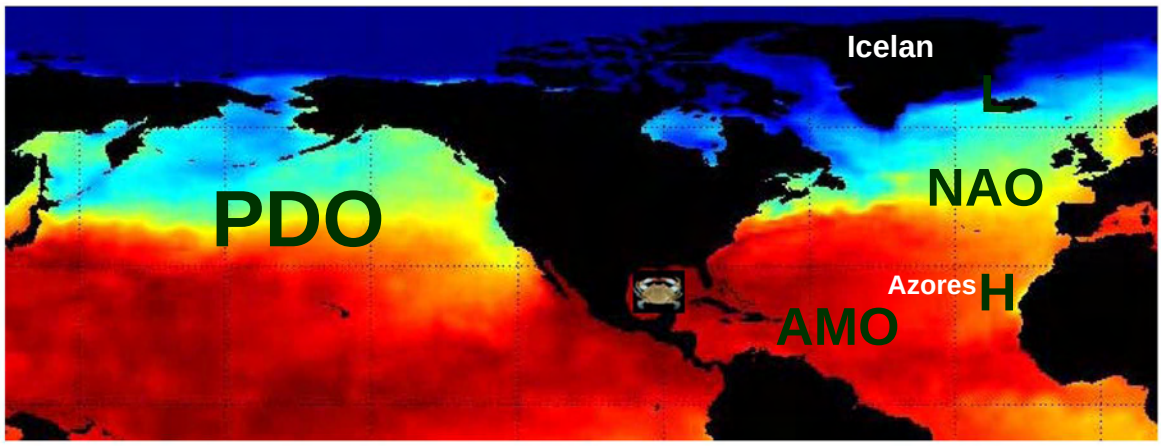


Figure 1. Oceanic-atmospheric modes of variability associated with river flows and periods of blue crab abundance.

POST-KATRINA RESILIENCY OF THE MISSISSIPPI-ALABAMA BARRIER ISLANDS

Natural Hazards Resiliency and the Ocean's Role in Climate
Oral Presentation
Gregory A. Carter*, Ervin G. Otvos, G. Alan Criss, and Kelly L. Lucas
Gulf Coast Geospatial Center, The University of Southern Mississippi
greg.carter@usm.edu

The Mississippi-Alabama barrier islands, which from west to east include Cat, West Ship, East Ship, Horn, Petit Bois, and Dauphin, were impacted dramatically by Hurricane Katrina in August, 2005. Satellite (IKONOS, QuickBird) and aerial LIDAR data acquired before Katrina (2004-2005) and within 5 months afterward were used in determining immediate storm impact on land area, elevation and vegetation cover (Figure 1). The smallest islands, W. Ship and E. Ship, were reduced to 85 percent and 23 percent, respectively, of their pre-storm land area. On Horn, the largest island, LIDAR indicated an unprecedented degradation of even the highest (3-7 m) island ridges. Immediate loss in vegetation cover, which was greatest on Horn (about 136 ha), was caused primarily by erosive shore retreat, washover erosion, and burial by sand sheets and washover lobes. While marsh habitat recovered quickly, field and remote sensing surveys of woodland habitats indicated tree mortalities of 80 percent on Horn and approximately 100 percent on E. Ship and Petit Bois that resulted from physical damage, saltwater flooding, and a severe post-Katrina drought.

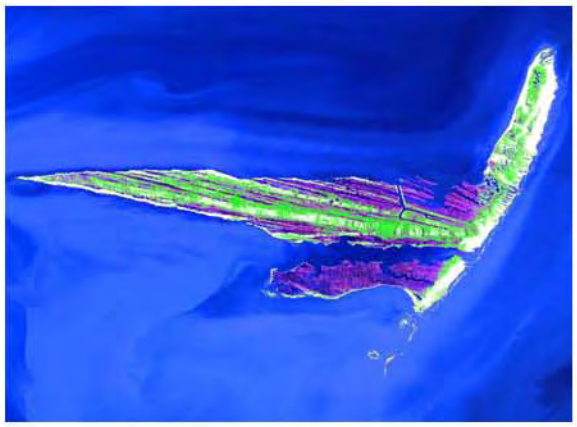


Figure 1. False-color image of Cat Island produced from IKONOS data acquired nine days after impact by Hurricane Katrina. The storm temporarily eliminated the southeastern barrier spit (bottom right).

Additional data acquired in 2006-2008 confirmed significant re-building of the islands through natural accretion. Vegetation cover continued to decline initially during this period as plants that survived the immediate impact of Katrina succumbed to storm-induced stress and drought. By November, 2007, Cat, W. Ship, E. Ship, Horn and Petit Bois had recovered to 96 percent, 94 percent, 32 percent, 100 percent and 104 percent, respectively, of their pre-Katrina land areas. Field observations and remote sensing indicated rapid vegetation recovery, including the establishment of numerous young slash pines. Results to date show an impressive resiliency of the Mississippi-Alabama barrier islands to the impact of Hurricane Katrina.

PREDICTIVE MODELING OF STORM-GENERATED MARINE DEBRIS

Natural Hazards Resiliency and the Ocean's Role in Climate
Poster Presentation
Zachary Nixon*
Research Planning, Inc.
znixon@researchplanning.com

During the 2005 hurricane season, Hurricane Katrina inflicted severe damage on the Gulf of Mexico (GOM) coastal region and deposited large amounts of debris over wide areas of the Gulf Coast. The National Oceanic and Atmospheric Administration (NOAA) Office of Coast Survey and Office of Response and Restoration were tasked with carrying out and disseminating the results of large scale side-scan sonar surveys to assess and verify debris locations. The data collected by this project make up one of the largest systematically collected, post-storm investigations of marine debris in existence.

Given the cost of side-scan sonar surveys, knowing where high densities of marine debris are likely to be found would greatly assist in developing survey priorities and in planning for debris removal after future storm events. As such, a statistical model was constructed by the GOM Marine Debris Project (GOMMDP) to characterize spatial differences in the distribution of relatively large, storm-mobilized and deposited, anthropogenic marine debris objects across the nearshore seafloor so as to help prioritize these areas for survey. Previous efforts at quantitatively modeling debris generated by hurricanes have largely focused on terrestrial debris.

The model relates a number of simple, commonly available predictor variables derived from Geographic Information System (GIS) data layers to debris presence/absence via logistic regression. Storm surge, wind speed, and bathymetry were evaluated as predictor variables related to debris-generating storm energy. Distance to shoreline, distance to waterways, nearby onshore structure damage, and offshore oil and gas infrastructure density were evaluated as predictor variables related to potential debris sources. All analyses were carried out on a grid of 100 m x 100 m. The model was implemented in the open-source statistical computing language R coupled to the commercial ArcGIS 9.2 software package. The model was found to perform well. While the ability of the model to generalize to other areas and storm events is still unclear, it is currently being evaluated in other areas of the GOM affected by hurricanes Katrina and Rita as new data are being collected.

STORM HARDENING USGS NEAR-SHORE COASTAL MONITORING STATIONS

Natural Hazards Resiliency and the Ocean's Role in Climate
Oral Presentation
Michael S. Runner*
U.S. Geological Survey Mississippi WSC
msrunner@usgs.gov

The U.S. Geological Survey, Mississippi Water Science Center, in cooperation with the Mississippi Department of Marine Resources, has been collecting continuous water-level and water-quality data at hydrologic monitoring stations in Mississippi Sound and its estuaries since August 1998. Near-shore monitoring stations have in the past been located on existing navigational structures consisting of four wooden piles driven in the ocean bed with a wooden deck ranging in size from 6 feet to 10 feet square, approximately 10 feet above mean water levels. Although sufficient most of the time, these structures are susceptible to damages from even small tropical events. Storm surge and wave action exceeding the deck elevation can submerge or damaged the monitoring equipment.

Since 1998 several monitoring stations have been damaged or destroyed altogether as a result of storm surge or wave action. Hurricane Georges in 1998 and Tropical Storm Isidore in 2001 are two examples. Damages are costly in lost equipment, but more significantly, in the lost opportunities to collect valuable hydrologic and water-quality data during these events. These incidents of damaged equipment generally are confined to an area local to the immediate storm track, but with Hurricane Katrina, every monitoring station in Mississippi south of Interstate 10 was damaged to some extent and became inoperable. Damage from storm surge and wave action ranged from electronic equipment failures to total loss of equipment and structural platforms.

As a result of this comprehensive network failure, which spanned the Gulf Coast from Louisiana to Alabama, it was determined that it was in everyone's interest, from the scientific community to emergency managers, to strengthen our network of monitoring stations to withstand a much higher level of storm event. Working in conjunction with personnel from National Oceanic Atmospheric Administration and the U.S. Army Corps of Engineers, a structure design was chosen and sites were selected. The structures consist of 36-inch diameter pipes that will be driven 50 feet in the ocean bed, and the platforms will be approximately 30 feet above the mean water level. Equipment at the stations is being upgraded to 1-hour transmissions, and meteorological sensors are being added. Data collected at these sites will include water level, water temperature, specific conductance, wind speed and direction, air temperature, relative humidity, barometric pressure, and rainfall.

Sites were selected based on cooperator preference and the location of proposed structures of other agencies to ensure that there would be adequate spatial distribution across the Louisiana and Mississippi coasts. Construction began on the structures in summer 2008 and is expected be completed before the end of the 2008 hurricane season.

SUMMARY OF CONTINUOUS STREAMFLOW MEASURED FOR COMPLETE TIDAL CYCLES IN THE PASCAGOULA, ESCATAWPA, PEARL, BILOXI, AND JOURDAN RIVER BASINS NEAR THE MISSISSIPPI GULF COAST

Natural Hazards Resiliency and Ocean's Role in Climate
Poster Presentation
K. Van Wilson*
U.S. Geological Survey Mississippi Water Science Center
kvwilson@usgs.gov

Continuous streamflow was measured for complete (25 hours) tidal cycles in the Pascagoula, Escatawpa, Pearl, Biloxi, and Jourdan River Basins during the month of September in 1996, 2000, and 2001 near the Mississippi Gulf Coast. A boat-mounted Acoustic Doppler Current Profiler was used to measure streamflow in order to document tidal-flow hydraulics of these estuaries, which previously could only be approximated with conventional streamflow measuring techniques. Streamflow was measured continuously during low-flow conditions so that streamflow would be mostly controlled by the tides and allow documentation of full-downstream flow, bi-directional flow, and full-upstream flow conditions during the tidal cycle. Streamflow extremes of all of the measured sites were observed at the Pascagoula and West Pascagoula Rivers combined flow at U.S. Highway 90, where as much as 44,900 cubic feet per second was flowing upstream, and 60,400 cubic feet per second was flowing downstream towards the Gulf during a tidal range of only 1.7 feet. The tidal cycle measurements were also used with mapped storm-tide inundation areas for hurricanes to estimate the stage-storage volume relation inland of each measuring site. The stage-storage volume relations can then be used with hurricane storm-tide hydrographs to estimate streamflows that could adversely affect bridges.

THE UNIVERSITY OF SOUTH ALABAMA CENTER FOR HURRICANE INTENSIFICATION AND LANDFALL INVESTIGATION (CHILI)

Natural Hazards Resiliency and the Ocean's Role in Climate
Oral Presentation
Sytske Kimball*
The University of South Alabama
skimball@usouthal.edu

The University of South Alabama (USA) Center for Hurricane Intensification and Landfall Investigation (CHILI) was made possible thanks to funding from the National Oceanic and Atmospheric Administration (NOAA). The center was started in September 2006 under direction of Dr. Sytske Kimball, Associate Professor of Earth Sciences/Meteorology at the University of South Alabama. The primary goal of CHILI is to advance understanding of the physical processes involved in hurricane landfall and to assist NOAA in improving hurricane landfall forecasting. In order to achieve these goals, the center utilizes elaborate data collection facilities as well as a state-of-the-art high performance compute cluster (HPCC). Data is collected via a mesonet of stationary weather stations, as well as intricate sensors observing ocean currents and waves from the bottom of the ocean. These Acoustic Doppler Current Profilers (ADCPs) are deployed in the Gulf of Mexico south of Mobile Bay at the beginning of each hurricane season and retrieved when the season ends in collaboration with NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML). Mesonet sites collect data every minute, and half-hourly updates are available from chili.disl.org. Archives and meta-data will soon be added to the site. CHILI is physically located at USA's Research and Technology Park in Mobile, Alabama. The first four of our mesonet sites were funded by the National Science Foundation (NSF).

Data collected includes 10 m and 2 m wind speed and direction, temperature and moisture at 10, 9.5, 2, and 1.5 m, atmospheric radiation, atmospheric pressure, surface temperature, and precipitation. Some sites also include soils temperature and moisture at 5 depths. Data archives includes 1-minute data, hourly summaries, and daily (7 a.m. and midnight) summaries. Each data set contains several derived variables, such as maximum wind speed, accumulated precipitation, and so on.

Apart from hurricane research, the data collected by the USA mesonet serve a myriad of purposes. The Mobile Weather Forecasting Office (WFO) uses the data to assist with daily forecasting responsibilities. Several of CHILI's mesonet sites are located on public school campuses throughout southern Alabama (including two sites in Mississippi) in order to foster outreach and to enhance understanding of hurricanes and weather forecasting amongst school children and the general public. Weather station data also are used by schools to enhance their science curriculum. The data are used at USA for forecasting and student training. Anyone interested in using the data for education, research, or other purposes is free to do so.

In this oral presentation at the Bays and Bayous symposium, the mesonet and its data will be described in greater detail as will some of the other facilities that CHILI has to offer. A poster presentation will show the results of some of the weather station data analyses that have been performed.

THE UNIVERSITY OF SOUTH ALABAMA MESONET: STATISTICAL ANALYSES, CLIMOGRAPHS, AND METEOROLOGICAL CASE STUDIES

Natural Hazards Resiliency and the Ocean's Role in Climate
Poster Presentation
Sytske Kimball*, Madhuri Mulekar, and Sean Huber
The University of South Alabama
skimball@usouthal.edu

The University of South Alabama (USA) Mesonet has owned and operated weather stations since 2005. Data has been archived and analyzed using various techniques ranging from statistical analysis to meteorological case studies. A cross-section of the results will be displayed on this poster at the Bays and Bayous symposium.

With the aid of statistical techniques, annual and diurnal cycles in soil and atmospheric temperatures at different sites were analyzed and compared. It was found that daily maximum soil temperatures from July 2006 until February 2008 were higher at Pascagoula than Agricola. Larger differences between daily maximum and minimum temperatures were observed at Pascagoula than at Agricola. The difference in daily maximum and minimum soil temperature decreased deeper into the soil at both sites. Both sites displayed a strong correlation between soil surface and soil 5 cm temperature and the slope of the regression lines were similar. In both cases, the 5 cm soil temperature was usually slightly warmer than the soil surface temperature. The soil surface temperature at Pascagoula responded differently to the low-level air temperature than that at Agricola. At all depths, diurnal soil temperature ranges were larger at Pascagoula than at Agricola. At both locations, the amplitude of the diurnal cycles (i.e. the diurnal temperature range) decreased with depth. Both sites displayed changes in the diurnal range with season. At 5 cm depth, Pascagoula's largest diurnal range occurred in the fall, while Agricola's occurred in spring. Deeper down, the maximum diurnal range occurred in spring at both sites. The smallest diurnal range occurred in winter at both sites and all depths. The above clearly indicates that different soil types have an impact on soil temperature behavior. This could be important to the planning of agricultural activities at both locations.

Using hourly and daily summaries of temperature and rainfall data, diurnal and annual climographs will be compared for all eight existing mesonet sites. Differences will be highlighted and related to station location and differences in physical environments. A case study of a frontal passage in the Mobile/Baldwin county area will be presented using mesonet, Acoustic Doppler Current Profilers (ADCPs), and radar data. Typical frontal features will be identified and signals in the different data sets will be compared and explained.

WETLAND AND LEVEE IMPACT ON STORM SURGE, AND A PROPOSED NEW SAFFIR-SIMPSON SCALE

Natural Hazard's Resiliency and the Ocean's Role in Climate
Oral Presentation
Pat Fitzpatrick*, Yee Lau, Jim Corbin, Nam Tran, Yongzuo Li, and Chris Hill
Northern Gulf Institute, Mississippi State University
fitz@ngi.mssate.edu

Katrina generated a U.S.-record storm surge, which impacted a wide region from Grand Isle, LA, to Mobile Bay, AL, and killed about 1,350 people with hundreds still missing. While Katrina's large wind field mostly caused the surge, an open question remained: whether the Mississippi River levees or Louisiana's eroded wetlands also contributed to the record surge.

Two storm surge models are used to examine these questions: The Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model and the Advanced CIRCulation (ADCIRC) model. Both are hydrodynamic models which solve the depth- integrated equations of motion and continuity equation, but have different grids. SLOSH is a finite difference grid with increasing resolution toward the coastline on a telescoping polar grid mesh. ADCIRC is a finite element grid with increasing resolution near the coastline and within the estuaries.

Simulations examined the impact of the Mississippi River levee system in enhancing Katrina's storm surge. In simulations with no river levees, land elevation is reduced to 4 feet to mimic the natural ridge along the river system and allow surge overflow into Barataria Basin. Simulations with both ADCIRC and SLOSH are summarized below:

- Katrina's surge was 2-3 feet higher east of river within 15 miles of levees due to the Mississippi River levee system.

- Katrina's surge was 1-3 feet lower west of river due to levees (north of landfall) due to the Mississippi River levee system. The surge also arrives later.

- SLOSH suggests less overtopping (no overtopping) of parish levees if river levees did not exist. ADCIRC contradicts this result.

- The Louisiana levee system did not alter the surge impact on the Mississippi coast

Katrina simulations were also conducted to examine wetland issues. Western Plaquemines Parish around Empire and Buras, which has experienced severe erosion the last 70 years, was the study area. A grid was generated which mimics its marsh for 1930 and 2000. The 2000 grid includes the impact of wetland loss and sea level rise. The simulations show 2 feet reduction in surge every 3 miles of wetlands (twice as much as other research suggests). But near levees, where water becomes trapped, wetland erosion does not reduce surge, although it may arrive sooner without wetlands.

We are conducting similar simulations for Hurricane Rita. Wetland attenuation of storm surge is also being examined in observations from Hurricane Rita, Lili, Isidore, and Georges. These results will be reported at the conference.

A revised Saffir-Simpson scale based on tropical cyclone size, intensity, storm speed, and continental shelf slope/depth is underway. There is some potential that Integrated Kinetic Energy can be used which combines storm size and intensity. These results will be reported at the conference.

ABUNDANCE AND DISTRIBUTIONS OF CARBOHYDRATES IN THE BAY OF SAINT LOUIS ESTUARY, MS

Water Resources: Supply and Quality
Oral Presentation
Xuri Wang*, Yihua Cai, Laodong Guo, and Allison Mojzis
Department of Marine Science, The University of Southern Mississippi
xuri.wang@usm.edu

Carbohydrates are a major component of marine dissolved organic matter and play an important role in energy storage and transportation for heterotrophic organisms in aquatic environments. Certain forms of carbohydrates, such as acid polysaccharides, may be used as an indicator of environmental and water quality and nutrient and pollutant stresses in estuarine environments. However, there is no report so far on carbohydrates and dissolved organic carbon (DOC) in the Bay of Saint Louis (BSL). In order to study the abundance, distributions, and estuarine mixing behaviors of carbohydrates and DOC in the estuarine mixing zone, water samples were collected from nine stations (Figure 1A) in the BLS during 2006 and 2007. DOC, total dissolved carbohydrates (TCHO), monosaccharides (MCHO), and polysaccharides (PCHO) were measured along a salinity gradient from the Jourdan and Wolf rivers extending to the mouth of BLS. Concentrations of DOC decreased from the highest 782 μM-C (at station 1) near the river mouth decreasing to the lowest 273 μM-C (at station 9) in the mouth of the Bay, with an average of 430 ± 92 μM-C (Figure 1B). Concentrations of TCHO, MCHO, and PCHO also showed the similar trends, with means of 81 ± 29 μM-C, 55 ± 23 μM-C and 33 ± 9 μM-C, respectively. The percentages of TCHO in the bulk DOC pool ranged from 11.6 percent to 28.6 percent, showing a decrease with decreasing salinity. MCHO was the dominant species in the carbohydrates pool in the low salinity area, accounting for as high as 80.7 percent of TCHO. MCHO concentrations also exhibited a removal behavior along the salinity transect, indicating that MCHO was preferentially utilized by bacteria during the estuarine mixing process (Figure 1C). In contrast, the percentages of PCHO in TCHO gradually increased as increasing salinity (Figure 1D) and PCHO became the dominant CHO species outside the mouth of the Bay, indicating that other in situ sources (phytoplankton excretion, degradation of debris) could contribute to the increase in PCHO fraction. Our results demonstrate that biopolymers and their ratios, such as MCHO/DOC, MCHO/TCHO and PCHO/TCHO, could be a powerful vehicle to investigate the biogeochemical cycles of organic matter in the estuarine environment. Further studies are needed to investigate other biopolymers such as acid polysaccharides and their relationship with nutrient, bacterial and phytoplankton biomass, and water chemistry to explore the use of biopolymer as a proxy for water quality and ecosystem health.

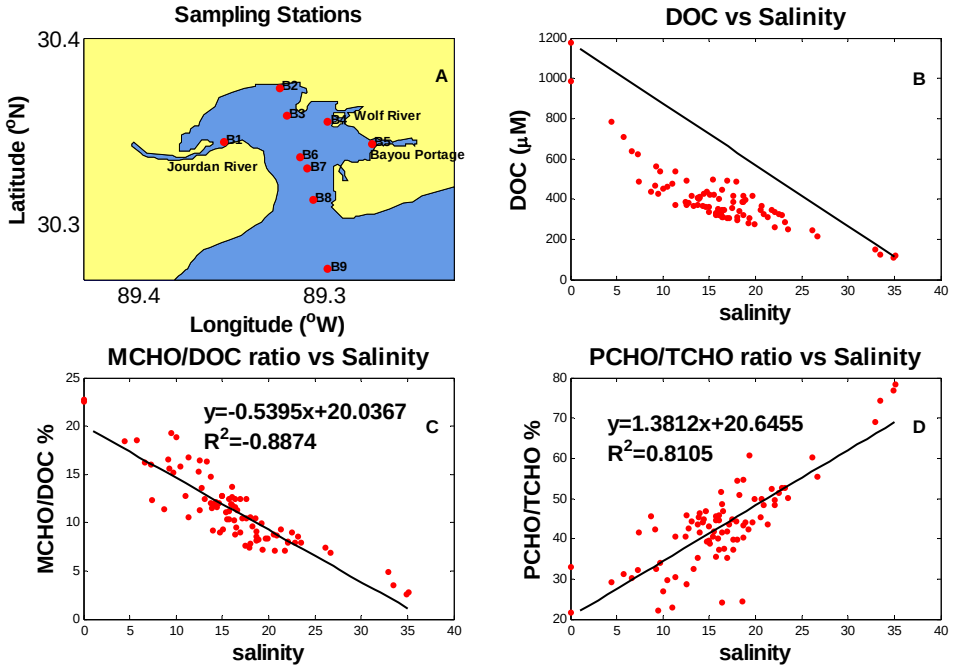


Figure 1. (A) Sampling stations at the BSL, MS. (B) Relationship between DOC and salinity. (C) Relationship between MCHO/DOC ratio and salinity. (D) Relationship between PCHO/TCHO and salinity.

ABUNDANCE AND TOXICITY OF A *Karlodinium veneficum* BLOOM IN WEEKS BAY NATIONAL ESTUARINE RESEARCH RESERVE, AL

Water Resources: Supply and Quality
Oral Presentation
Lucie Novoveska*, William W. Smith, Allen R. Place, and Hugh L. MacIntyre
Dauphin Island Sea Lab and University of South Alabama
lnovoveska@disl.org

Weeks Bay National Estuarine Research Reserve (NERR) experienced multiple dinoflagellate blooms in 2007. The phytoplankton community was dominated by a bloom of *Prorocentrum minimum* in February followed by *Kryptoperidinium foliaceum* and *Karlodinium veneficum* in July – October. Night time anoxia was recorded in February and in August. Five fish kills occurred within Weeks Bay and its tributaries during the summer. Analyses of the water and the dead fish indicated that karlotoxin contributed to these. We mapped phytoplankton community structure, toxin levels, and a range of environmental and optical variables repeatedly during the *Karlodinium* bloom. *Karlodinium* formed spatially localized peaks of cell density and cell toxicity. The highest abundance was 120 million cells perliter (466 µg l^{-1} Chla) in the upper reach of the estuary. High cell densities reflected elevated nutrient loading. The first 2 PCs in a principle components analysis explained 67 percent of the variability in the environmental data (T, S, DIN, DIP and kd). Per-cell toxin concentration was highly correlated with PC2, which was in turn correlated ($p<0.05$) with DIP ($R = 0.91$) and kd ($R = 0.81$): toxicity was highest at low DIP/high water clarity.

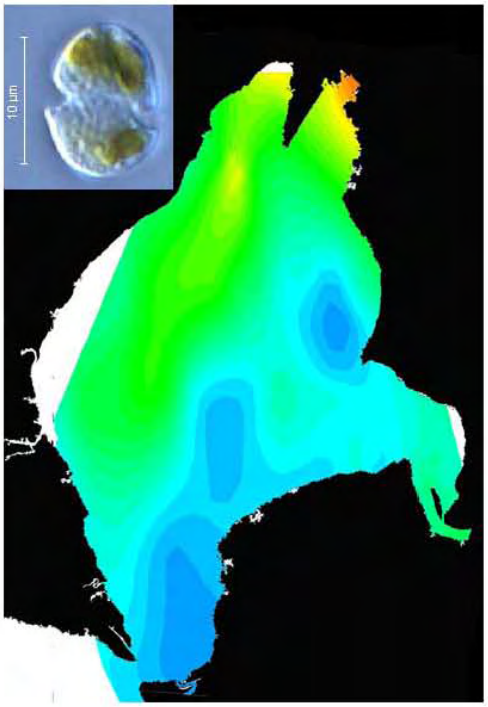


Figure 1. Modeled chlorophyll *a* concentrations in Weeks Bay on August 10, 2007 during the *Karlodinium veneficum* bloom (warmer colors = more chlorophyll *a*). The bloom was concentrated in the northern part of Weeks Bay, reaching a chlorophyll *a* concentration of 184 µg l^{-1}.

BACTERIOPLANKTON ABUNDANCES IN THE BAY OF ST. LOUIS, MS, RELATIVE TO ENVIRONMENTAL WATER QUALITY

Water Resources: Supply and Quality
Oral Presentation
Allison K. Mojzis*, Donald G. Redalje, Laodong Guo, Yihua Cai, and Xuri Wang
The University of Southern Mississippi, Department of Marine Science, Stennis Space Center, MS
allison.mojzis@usm.edu

The Bay of St. Louis is an important shallow estuary for communities on the Gulf Coast of Mississippi. The Hollywood casino, DuPont titanium dioxide plant, and sewage treatment plants on the shoreline contribute to the poor water quality. Bacterioplankton concentrations were used as a proxy for water quality throughout the Bay of St. Louis. Nine stations were sampled during outgoing tidal cycles. Stations included the mouths of two rivers and a bayou. Other stations were located along a north-south transect out of the bay to the adjacent Mississippi Sound. Water samples were taken monthly for seven months (March 2007 to September 2007). In situ environmental parameters (temperature, salinity, dissolved oxygen, and turbidity) were also measured. Preliminary results from two months in 2006 have shown that bacterioplankton abundances were positively correlated with turbidity. Attached bacteria, cells that were removed from organic particles and debris, were found in the range of 2.65×10^9 cells/L to 2.61×10^9 cells/L. Free-living bacteria, cells that were free-floating and not associated with particles, were found in a higher concentration (3.13×10^{10} cells/L to 9.72×10^{11} cells/L). Results from 2007 are currently being analyzed. Further work includes comparison of bacterial counts with chlorophyll *a*, nutrients (ammonia, nitrite, nitrate, and phosphate), dissolved organic carbon, poly- and mono-saccharides, and various weather parameters (rainfall, stream flow, gage height, wind speed and direction, and air temperature). All of these results will be compared to pre-Katrina conditions to determine the storm's effect, if any, on water quality.

CONVERSION OF SEAFOOD PROCESSING WASTE INTO TRIGLYCERIDES A BIODIESEL FEEDSTOCK

Water Resources: Supply and Quality
Poster Presentation
Todd French*, Rafael Hernandez, Guochang Zhang, Maria Parachivescu, and Earl Alley
Mississippi State University, Dave C. Swalm School of Chemical Engineering
french@che.msstate.edu

Rising diesel cost have recently had a significant impact on most American's lives. That is because diesel is the liquid fuel used most often to harvest and transport products. The shrimp producing industry is no exception. Diesel is used in the harvesting and transportation of shrimp and other seafood products. Biodiesel is a displacement fuel for traditional petroleum-derived diesel. Unfortunately, biodiesel is an expensive fuel due in large part to the high cost of the oil from which it is derived. Currently the majority of this country's biodiesel is derived from soybean oil which is selling for $4.52/gal. Conversion of this oil into biodiesel requires an additional $0.40 and produces a final product for ~$5.00 without profit or taxes factored in to the cost. Therefore, a biodiesel derived from inexpensive oil is needed to compete with petroleum-derived diesel. Oils derived from byproducts with no value could potentially be a cheap source of biodiesel. The byproducts from shrimp processing are heads and shells which contain a wealth of carbon in the form of proteins, chitin, fat, etc. While only the fat in this material could be converted into biodiesel as is, the other materials such as protein, chitin, etc., could be converted into oils via microorganisms. There is a group of microorganisms that possesses the ability to covert carbon substrates into triacylglycerides and store this material intracellularly. In fact, they have been shown to accumulate oil as high as 50 percent of their dry weight and have been labeled as oleaginous microorganisms. The objective of this investigation is to determine the feasibility of using oleaginous microorganisms to convert the shrimp byproducts into oil.

Initial experiments were conducted using the oleaginous microorganism *Rhodotorula glutinis* which is a yeast that has been shown by MSU and others to accumulate greater than 50 percent of its dry weight as oil (Figure 1). These experiments were initially conducted using *n*-acetyl glucosamine at a concentration of 50 g/L. There was an initial increase of 0.7 g/L of cell mass but slowed when pH of the medium increased to ~7.1 from 5.2, which is the optimal range of for growth for this yeast. Dry oil content in the yeast increased from 2 to 4 percent. Since the metabolism of *n*-acetyl glucosamine appears to increase the pH of the medium, an oleaginous microorganisms that likes higher pH will be evaluated. *Rhodococcus opacus* is the oleaginous microorganisms that will be tested in future experiments.

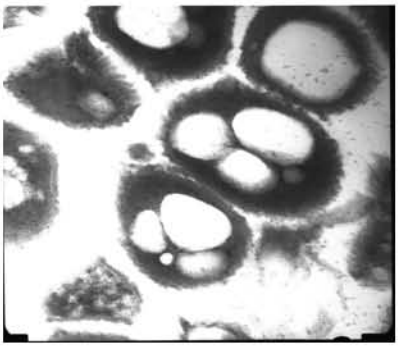


Figure 1. Transmission electron micrograph of *Rhodotorula glutinis* taken following oil accumulation (clear zones inside the cells). Photo courtesy of Jaclyn Hall, Ph.D. student, Dave C. Swalm School of Chemical Engineering

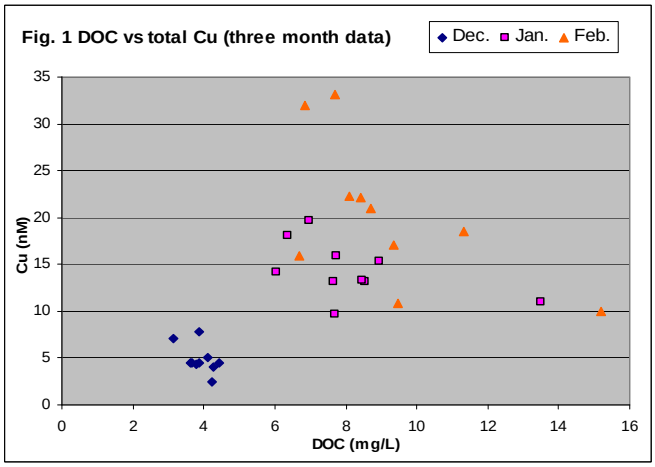
COPPER SPECIATION IN THE LOWER PEARL RIVER AND ITS FLOODPLAIN WATERS, MISSISSIPPI

Water Resources: Supply and Quality
Oral Presentation
Hailong Huang*, Moojoon Shim, and Alan Shiller
Department of Marine Science, The University of Southern Mississippi
Hailong.Huang@usm.edu

Floodplains potentially play an important role in trace element speciation and transport. Copper (Cu) is a particularly interesting trace metal because its concentration and physical-chemical speciation can render it either a trace nutrient or a toxic substance. The Pearl River is 490 kilometers long, has a moderate discharge rate and is periodically disturbed by seasonal storms. Marshes and wetlands areas comprise approximately 10 percent of the land area of this basin and are distributed all along the river corridor. The Pearl River is a relatively small fluvial system, whose bayous easily interact with nearby river waters during flood season. This aspect makes the Pearl River a good place to investigate floodplain effects on trace metal speciation and transport.

Trace element data are sparse for this area and Cu, because of its association with organic matter, is one of the trace elements that is expected to be affected by floodplain interactions. The increasing utilization of Pearl River water, as well as anthropogenic discharges and storm runoff, make the floodplain more important than ever as a buffer zone from upstream pollution. As with most trace elements, the labile form of Cu is much more critical to aquatic biota than its total concentration.

In order to understand the relationship between the Pearl River floodplain and copper speciation, various parameters were monitored for several months at 10 sites along the river from Bogalusa, LA, to Stennis Space Center, MS. Dissolved organic carbon (DOC), pH, temperature, chlorophyll-a, and discharge were recorded, as well as total Cu concentrations measured with inductively coupled plasma mass spectroscopy (ICP-MS). Total Cu concentrations ranged from 2 nM to 33 nM (Figure 1). Copper-binding ligand concentration (7 nM - 38 nM) and the Cu-organic binding constant (logK' = 8.6 - 9.3) were also determined. Comparing Cu speciation with all other parameters, we found Cu was correlated with DOC as well as ligand concentration. During low discharge (Dec. 2007), the water has low Cu, DOC, and ligand concentrations. During high discharge (Feb. 2008), large amounts of DOC were flushed downstream. Spatially, the Bogalusa site had the lowest DOC but the highest Cu and chlorophyll-a concentrations, which suggests that "fresh" plant-produced DOC has high ligand concentration but low binding strength. In contrast, bayou sites (e.g. Mikes River) generally had high DOC content and affinity for Cu (logK'), but low chlorophyll-a and low Cu concentration. This suggests that the bayou/floodplain DOC was mainly microbial in origin. As the DOC export



changed, our results show that the ligand strength from these three months changed too. Thus, floodplain organic matter sources cause the overall binding of Cu to organic matter to change.

DID HURRICANE KATRINA ALTER WATER QUALITY IN THE EAST PEARL RIVER?

Water Resources: Supply and Quality
Oral Presentation
Moo-Joon Shim*, Yihua Cai, Shuiwang Duan, Richard W. Smith, Laodong Guo, Thomas S. Bianchi, and Alan Shiller
Department of Marine Science, The University of Southern Mississippi
Moo-joon.shim@usm.edu

Extreme events like hurricanes can substantially alter the landscape and destroy vegetation in river basins. For instance, Hurricane Katrina brought strong winds to the Pearl River valley in southern Mississippi, causing significant numbers of trees to fall. This study examines the question of whether this physical impact on the landscape affected the biogeochemistry of the East Pearl River.

Hurricane Katrina caused the destruction of vegetation and modification of landscape through the Pearl River basin, which may have enhanced in the input of organic matter and suspended solids. The input of organic matter could, in turn, cause an increase in dissolved concentrations of certain trace elements because of metal-organic complexation. Alternatively, the rate of decomposition of the woody debris felled by Hurricane Katrina may be slow enough to not cause an observable effect. For this study, a time series analysis of dissolved trace elements, dissolved organic carbon (DOC), particulate organic carbon (POC), suspended particulate matter (SPM), and lignins was conducted from Nov. 2005 to Oct. 2007. Water samples also had been collected monthly at Stennis Space Center from Aug. 2001 to July 2003, prior Hurricane Katrina. The data from the recent time series were compared with the previous data collected before Hurricane Katrina.

Based on plots of dissolved trace elements versus river discharge, the dissolved trace element concentrations did not increase after Hurricane Katrina. Likewise, DOC, POC, SPM, and dissolved nutrient concentrations did not show significant changes before and after Katrina. Lignins, a biomarker for vascular plants, also did not change in DOC after Katrina. Lignin oxidation products (LOP) have been used to identify inputs of different terrestrial vegetation types (e.g., woody, non-woody angiosperms and gymnosperms) in natural waters. Post-Katrina samples had the same LOP signal as the previous lignin samples collected before Hurricane Katrina. This reflects a similar source input of terrestrial organic matter to the Pearl River both prior to and following Katrina. Furthermore, the LOP acid/aldehyde ratio, which has been used to characterize diagenetic alteration, also did not change. This further suggests that lignin in DOC remained diagenetically unaltered in the Pearl River after the storm. Thus, despite significant changes in the abundance of fallen trees after Katrina, there remains a lag in the input of lignin to the DOC pool.

In conclusion, Hurricane Katrina did not have a discernable impact on dissolved trace elements, organic matter, suspended load, nutrients, or LOP behavior in the East Pearl River in spite of major disturbances to the trees and other lower vegetation throughout the basin. This is likely explained by slow decay dynamics of woody vascular tissues and/or slow transport of organic

materials from the soils to the river after the storm. Thus, beyond an immediate storm surge impact near the coast, Hurricane Katrina made little discernable impact on water quality in the East Pearl River.

EFFECT OF DISCHARGE FROM A FISHERIES RESEARCH FACILITY ON WATER QUALITY IN A SMALL STREAM

Water Resources: Supply and Quality
Oral Presentation
Suthira Soongsawang*
Department of Fisheries and Allied Aquacultures Auburn University
soongsu@auburn.edu

The Lower Station of the E.W. Shell Fisheries Center at Auburn University (Figure 1) consists of 235 ponds, comprising approximately 90 hectares of water surface area on a 380-hectare catchment. Water supply for the facility is runoff from watersheds of the catchment. The research ponds are supplied by water from reservoirs filled from a small stream, and the Lower Station discharges into this stream. A study was conducted to evaluate effects of discharge from the Lower Station through seepage, overflow, and pond draining on water quality of the small stream. The study also compared water quality in the final reach of the small stream (Lower Station outfall) with that of Saugahatchee Creek, into which it discharges. Water quality data also were collected from three nearby reference streams that do not receive effluents.

Figure 1. The Lower Station of the E.W. Shell Fisheries Center at Auburn University

Over a 24-month period, the average concentrations of 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), total ammonia nitrogen (TAN), total nitrogen (TN), and total phosphorus (TP) were greater at a sampling station below the Lower Station than at one above it (Table 1). Increases in concentrations of water quality variables resulted from relatively high concentration the variables in station discharge as a result of fertilizer and feed application to the research ponds. Moreover, station discharge had higher specific conductance and greater concentrations of total hardness and total alkalinity than the stream above because of use of agricultural limestone in the ponds.

Stream water at the Lower Station outfall was higher in concentrations of BOD_5, TSS, TP, and several other variables than the three reference streams. However, Saugahatchee Creek, into which the Lower Station discharges, is polluted by industrial and municipal effluents and had greater concentrations of most variables than were found at the outfall of the Lower Station.

This study suggests that the Lower Station and associated fish culture and research activities cause a moderate decline in water quality in the small stream. However, this stream discharges better quality water than occurs in the Saugahatchee Creek.

Table 1. Average concentrations of selected water quality variables for sampling stations at or near the Lower Station of the E.W. Shell Fisheries Center at Auburn University.

	BOD_5 (mg/L)	TSS (mg/L)	TAN (mg/L)	TN (mg/L)	TP (mg/L)
Small stream above Lower Station	1.3	19.8	0.109	0.402	0.138
Small stream below Lower Station (outfall)	1.7	20.1	0.142	0.878	0.136
Saugahatchee Creek above outfall	2.7	20.1	0.513	4.276	0.583
Reference streams	1.3	7.8	0.147	0.680	0.113

EFFECT OF THE LOWER PEARL RIVER FLOODPLAIN ON TRACE ELEMENT AND NUTRIENT TRANSPORT IN THE PEARL RIVER, MISSISSIPPI (MS)

Water Resources: Supply and Quality
Poster Presentation
MooJoon Shim*, Yihua Cai, Laodong Guo, and Alan Shiller
Department of Marine Science, University of Southern Mississippi
Moo-joon.shim@usm.edu

Interaction of river waters with the surrounding floodplain has the potential to affect fluvial transport of dissolved and particulate materials and thereby affect the flux of these materials to the coastal zone. In this study, we examined how the floodplain and surrounding marshes of the lower Pearl River affects the behavior of trace elements and nutrients. This study is a first step in constructing a budget of trace elements and nutrients to the local coastal environment. The main objective of this work is to determine the role of the floodplain as an importer or an exporter of dissolved trace metals and nutrients.

Marshy and swampy areas are distributed all along the lower Pearl River floodplain. These areas are likely to affect trace element and nutrient transport via their high plant productivity and the reducing nature of their pore fluids. Hydrological stage will determine the extent of interaction of river waters with the floodplain and may also affect the redox status. For this study, a comparison of elemental concentrations in bayous and tributaries between Bogalusa and Stennis Space Center (SSC) was conducted. The water samples have been collected monthly since November 2007. Spatial changes in concentrations as the water flows through the floodplain, as well as temporal changes between high and low water, allow us to examine the floodplain's impact on dissolved trace element and nutrient behavior.

During high water (Feb. 08 - Mar. 08), the main source of water at SSC was from Bogalusa (as opposed to low water when Hobolochitto Creek is a dominant source). Concentrations of dissolved Fe, Zn, and DOC were higher at SSC than Bogalusa during high water. In contrast, concentrations of V, Re, and nutrients decreased in this river reach. The trace element behavior is compatible with interaction with a reducing environment and the nutrient reduction likely reflects uptake in the productive swamps and marshes. We also observe some of the surrounding bayous to have trace element and nutrient concentrations reflective of these effects.

In conclusion, during high water, the floodplain along the East Pearl River exported Fe, Zn, and DOC, but served as a sink for V, Re, and nutrients. This work is continuing with studies of the effects of the lower estuarine regions of the Pearl River on elemental transport.

AN EVALUATION OF CPC+, A NEW MEDIUM FOR ISOLATION OF *Vibrio vulnificus* FROM U.S. MARKET OYSTERS

Water Resources: Supply and Quality
Poster Presentation
Jeffrey Krantz*,Jessica Jones, John Bowers, and Andy DePaola
FDA/CFSAN/DSST, Gulf Coast Seafood Laboratory, Dauphin Island, Alabama
Jeffrey.Krantz@FDA.HHS.GOV

A new selective medium, cellobiose-polymyxin B-colistin (CPC+), was recently developed for the isolation and enumeration of *Vibrio vulnificus* (Vv) by direct plating of environmental samples. CPC+ is reported to allow equivalent recovery of all strains of Vv, regardless of their genotype. For risk assessment it is important to obtain an accurate estimation of the abundance of virulent genotypes of Vv. Market oysters were collected in nine states from February to November of 2007 and analyzed for Vv levels by direct plating of oyster homogenate on CPC+ and on *Vibrio vulnificus* Agar (VVA) as recommended by the Bacteriological Analytical Manual (BAM). Suspect colonies were confirmed using the DNA colony hybridization procedure described in the BAM. The mean levels of Vv detected using VVA and CPC+ were 2.69 and 2.54 $\log_{10}$ cfu/g, respectively. Statistical evaluation for equivalency using a line of identity, resulted in no significant difference in recovery between media ($P>0.05$). In addition to direct plating, a comparison using MPN enrichment in APW followed by isolation on mCPC (BAM method) and CPC+ was performed. The mean levels of Vv detected using mCPC were 2.06 $\log_{10}$ MPN/g, compared to 2.28 $\log_{10}$ MPN/g on CPC+, resulting in no significant difference in the line of identity between these media ($P>0.05$). In order to evaluate the genotype bias of each medium, confirmed Vv isolates from direct plating and MPN isolation were analyzed by real-time PCR to determine the 16S rRNA type (type B is mainly associated with clinical isolates). From direct plating, 14 percent of isolates from VVA and 0 percent of isolates from CPC+ were type B. After enrichment, 16 percent of isolates from mCPC and 14 percent from CPC+ were type B. Although relatively few isolates were examined, these data suggest no substantial difference in recovery of Vv using current BAM methods versus CPC+, or in the recovery of 16S type B. Additionally, the data are in agreement with previous reports that virulent strains (16S type B) represent a minority of the Vv population in oysters.

GROUNDWATER-DRIVEN SUPPLY OF NUTRIENTS AND HARMFUL ALAGAL BLOOMS IN COASTAL ALABAMA WATERS

Water Resources: Supply and Quality
Oral Presentation
Hugh L. MacIntyre*, L. Novoveská, A.K. Canion, J. D. Liefer, W.W. Smith, and C. Dorsey
Dauphin Island Sea Lab
hmacintyre@disl.org

A connection between nutrient loading and the incidence of harmful algal blooms (HABs) has been demonstrated repeatedly worldwide. Prediction of HAB events is still in its infancy, though, and blooms can not be forecast from nutrient concentrations. We show that the rate of delivery of nutrients is likely to be a critical factor in HAB development in Alabama's coastal waters. Weeks Bay and Little Lagoon, both in Baldwin County, AL, have experienced significant HABs that have resulted in toxic and hypoxic fish-kills. These are correlated with highs and lows of discharge from the A1 aquifer in Baldwin County.

The response of the microalgal community can be considered in terms of two well-developed ecological models, the Intermediate Disturbance Hypothesis and the C-S-R stress/disturbance model. Submarine discharge occurs in response to rainfall in the recharge zone and the groundwater can be nutrient-rich. High discharge is considered as a disturbance as it flushes the receiving waters but not as a stressor, as it is likely to be nutrient-rich. The very high temperatures characteristic of shallow waters in the summer can be considered a stress for many if not most microalgae. High-discharge periods (disturbance) favor blooms of the fast-growing and opportunistic diatom *Pseudo-nitzschia spp*., while high temperatures (stress) favor growth of cyanobacteria instead. *Pseudo-nitzschia spp*., is found in relatively high-salinity waters such as Little Lagoon. Conversely, low discharge periods favor blooms of the relatively slow-growing dinoflagellates, under conditions where their diverse nutrient-acquisition mechanisms allow them to out-compete other groups. *Prorocentrum minimum* blooms at relatively low temperature and *Karlodinium veneficum*, *Akashiwo sanguinea* and *Kryptoperidinium foliaceum* bloom at relatively high temperatures. All are found in mesohaline waters such as Weeks Bay.

If this model proves to be robust, it has several implications for management. The first is that groundwater is a non-point-source of nutrients and the residence time in the A1 aquifer is estimated at about 35 years (Dowling et al., 2004, Ground Water 42: 401-417). This complicates any effort to manage nutrient inputs and means that there may be a long lag between any change in nutrient application (e.g. fertilizer use) and nutrient delivery into receiving waters. The second is that blooms are likely to occur under both high-discharge and low-discharge conditions, albeit blooms of different organisms in different locations. As climate-change forecasts include predictions of both more drought (low discharge) and more severe storms (higher episodic discharge events), blooms may become more intense in the future.

HOW GOOD IS WATER IN THE DOG RIVER WATERSHED?

Water Resources: Supply and Quality
Oral Presentation
Madhuri Mulekar*, Steven Richardson, and Mirium Fearn
The University of South Alabama
mmulekar@jaguar1.usouthal.edu

Since the Clean Water Act of 1972, each state is required to regulate all bodies of water to ensure they meet minimum criteria for water quality as determined by individual states. For the last several years many locations in the Dog River Watershed in Mobile, Alabama, were on the 303(d) list for quality issues. This watershed is focus of research because it drains more than 90 square miles in Mobile County into northwestern Mobile Bay. Water quality data was collected by Barry A. Vittor and Associates for Mobile Area Water and Sewer Systems (MAWSS) from 2003 to 2006 from over 30 locations in Dog River Watershed. Sites were sampled every fortnight using a YSI multiprobe. Data on rainfall and flow obtained from the Williams Wastewater Treatment Plant were also incorporated.

Seven sites in this watershed (Stations 5, 6, 12, 16, 20, 24, and 25) were selected for further analysis to examine differences in quality for each location and to determine existence of relationships among water quality variables including fecal coliform, dissolved oxygen, pH, and salinity. Each water quality variable has an impact on the aquatic environment. Fish cannot tolerate changes in temperature and must relocate. Aquatic wildlife and plants require dissolved oxygen in the water to survive. Deviation of pH from its normal range can cause physical damage to a fish's skin. High levels of fecal coliform can reduce dissolved oxygen levels and are potentially hazardous to human contact.

Significant relationships were found between all variables and fecal coliform. Water quality differed from station to station. Levels of fecal coliform were higher more often at stations 6, 12, and 16. Salinity was much higher at station 12 than any other station, and a few times, the dissolved oxygen was at poor level at stations 6, 12, and 20. Results from Dog River watershed agreed with many results from other watershed areas in the United States. Some stations did not meet the criteria for fecal coliform. Most stations failed the single sample criteria for fecal coliform at least once during the study period. Stations 6 and 16 failed the geometric means criteria for fecal coliform levels for the month of September 2003. Station 12 was the only station with fecal coliform levels well above the acceptable level throughout the period of this study.

AN INTERDISCIPLINARY ASSESSMENT OF POPULATION GROWTH AND DEVELOPMENT IMPACTS ON THE *Fish River Basin* COASTAL COMMUNITY

Water Resources: Supply and Quality
Oral Presentation
Latif Kalin*, Charlene LeBLeu, Rebecca Retzlaff, and Susan Pan
School of Forestry and Wildlife Sciences, Auburn University
latif@auburn.edu

Weeks Bay, one of only three designated Outstanding National Resource Waters in the state of Alabama, is under stress due to population growth and urbanization in its watersheds. High proportions of impervious surface, typical consequence of urbanization, can lead to increased nutrient and sediment loading into streams. Urban developments have also shown to increase heavy metals, bacteria loadings, and stream temperatures. The assessment of the impact of land use/cover LULC changes and build out on the quality of its major water supplier, the Fish River, is therefore of paramount importance for the future management of the Bay area.

In this research project we implement an interdisciplinary approach to quantify the impact of (LULC) changes on the water quality parameters, Nitrate (N), Phosphorous (P), and total suspended solids (TSS) in the Fish River Basin, and disseminate this knowledge to local community and decision makers through outreach activities to preserve and improve the environmental and ecosystem health of the Weeks Bay area. Past, present, and future water quality of the Fish River watershed is assessed through regression techniques and complex watershed-scale modeling that utilizes past observed data, as well as new data that we recently started collecting. This project involves adding several innovative steps to traditional water quality analysis and modeling in the Fish River Watershed. These innovations include linking longitudinal water quality analysis to geographic analysis of land-use and socio-economic changes, analyzing and demonstrating land-use practices that can be used by citizens, and policies that can be used by government agencies to address water quality problems. Finally, we demonstrate how a community-based, citizen-led approach to addressing water quality can create positive change for the coastal community.

A watershed scale water quality model (SWAT) is constructed for the study area and is being calibrated/validated by utilizing data collected more than 10 years ago. The water quality data we are currently collecting will be used in post-validating the SWAT model, i.e. testing its predictive power in estimating changes in N, P, and TSS owing to LULC alterations. We will develop future LULC scenarios for the watershed based on Baldwin County Planning Commission's population projections and zoning maps for the year 2020 to appraise the future water quality of the area which could lay a ground for science based decision making for the local authorities. Best practices that can be used by both citizens and governments to address the water quality impacts will be identified. The information obtained from the water quality/modeling and best practice analysis will be used to inform a demonstration Master Plan, and will be assessed through evaluations of a charrette and an educational workshop.

NUTRIENT ANALYSES OF MISSISSIPPI SOUND IN RESPONSE TO THE BONNET CARRE SPILLWAY OPENING IN APRIL 2008

Water Resources: Supply and Quality
Poster Presentation
Adam Boyette*, Donald Redalje, Steven Lohrenz, Stephan Howden, Kjell Gundersen, and Kevin Martin
The University of Southern Mississippi Department of Marine Science
adam.boyette@usm.edu

On April 11, 2008, the Bonnet Carre Spillway (BCS) in St. Charles Parish, Louisiana, was opened for one month in response to high discharge flow rates in the Mississippi River. The purpose of the current study was to observe and assess the freshwater impacts on the Mississippi Sound resulting from the spillway's opening. This project also provided a unique opportunity to monitor significant large-scale water column changes from a short-term hydrological event.

Beginning April 14, monthly surface water samples were taken at five stations (St. 1-5) along a transect extending westward from Bay of St. Louis to near the mouth of the Pearl River. Surface water samples were also obtained for later use in pigment analysis. Additional water column parameters determined salinity, temperature, dissolved oxygen concentrations (DO), colored dissolved organic matter (CDOM), total suspended matter (TSM), and particulate absorption. Salinity data from the spillway samples were lower than those taken as part of the ongoing NOAA sponsored Northern Gulf Institute Monitoring and Assessment of Coastal and Marine Ecosystems in the Northern Gulf project. Recent data from the aforementioned project indicated a zone of hypoxia just south of Ship Island in late June, which may have resulted from the freshwater intrusion associated with the opening of the BCS. Current monitoring of the BCS was conducted as a mutual effort through the Northern Gulf Institute's Coastal and Marine Assessment Program that monitors water quality in the northern Gulf of Mexico's coastal and estuarine habitats.

The data obtained from the BCS monitoring will help describe the freshwater impact on primary productivity and nutrient cycling in the Mississippi Sound and will provide a better understanding of the role that hydrologic influences have on carbon cycling within the coastal zone.

REMOTE DETECTION AND ASSESSMENT OF ALGAL BLOOM EVENTS IN THE NORTHERN GULF OF MEXICO USING AUTONOMOUS GLIDERS AND HYPERSPECTRAL RADIOMETRY

Water Resources: Supply and Quality
Poster Presentation
Steven Lohrenz*, Xiaogang Chen, Kevin Martin, Vernon Asper, and Gary Kirkpatrick
Department of Marine Science, The University of Southern Mississippi
Steven.Lohrenz@usm.edu

Harmful algal blooms or "red tides" represent a significant and expanding threat to human health and fisheries resources. Given their potential to negatively impact public health, local tourism, and fisheries, new methods to detect, monitor, and mitigate red tide phenomena are required. Satellite ocean color has been useful in aiding ground based surveys of known algal blooms, although the ability to detect and monitor blooms remotely has been limited primarily to statistically-based approaches that flag areas of anomalously high chlorophyll. Optically complex waters, such as those of the northern Gulf of Mexico, pose a challenge for satellite-based approaches are less effective for inland waters. Such methods may be enhanced by augmenting satellite-based efforts with high spectral resolution (hyperspectral) sensors. Another limitation of satellite-based monitoring is a lack of the ability to detect or track subsurface bloom features. Recent efforts off west Florida have made effective use of relatively low-cost autonomous underwater vehicles equipped with sensors that provide information about algal bloom distributions. However, such technology has not yet been evaluated in the more optically complex northern Gulf of Mexico coastal environment. Here, we examine the utility of autonomous glider-based assessments and underway hyperspectral above-water radiometry for discrimination and mapping of algal bloom phenomena and other optically distinct features in complex coastal waters. Findings from this project will enhance both prediction as well as monitoring of HAB development in northern Gulf of Mexico waters. Future efforts will focus on providing products that would be a useful addition to the National Oceanic and Atmospheric Administration’s Harmful Algal Bloom Mapping System and Bulletin.

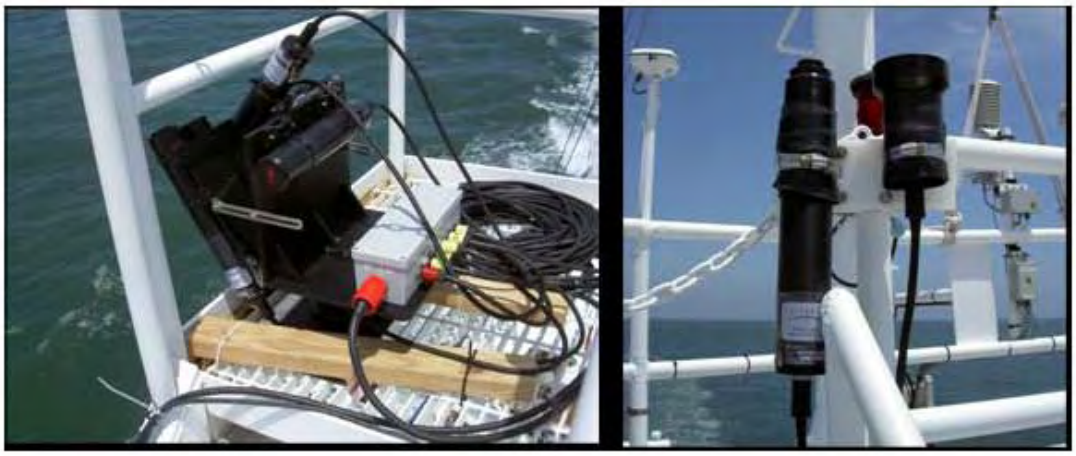


Figure 1. Photographs of HyperSAS-UV hyperspectral radiometry system, manufactured by Satlantic, Inc. as deployed aboard the *R/V Pelican* in April 2006.

SATELLITE ESTIMATION OF SUSPENDED PARTICULATES IN THE MOBILE BAY REGION

Water Resources: Supply and Quality
Poster Presentation
Regina D. Smith*, Rick W. Gould, Jr., Paul M. Martinolich, and Jean T. Ellis
Naval Research Laboratory
Regina.Smith.ctr@nrlssc.navy.mil

Mobile Bay, Alabama, is the fourth largest estuary in the United States encompassing 413 square miles, with an average discharge of 2245 m^3 s^{-1}. About 15 percent of the discharge flows west into Mississippi Sound through Pass aux Herons, and the remainder empties into the northern Gulf of Mexico, resulting in the formation of a buoyant plume located just south of the bay mouth between Dauphin Island and Fort Morgan (Figure 1).

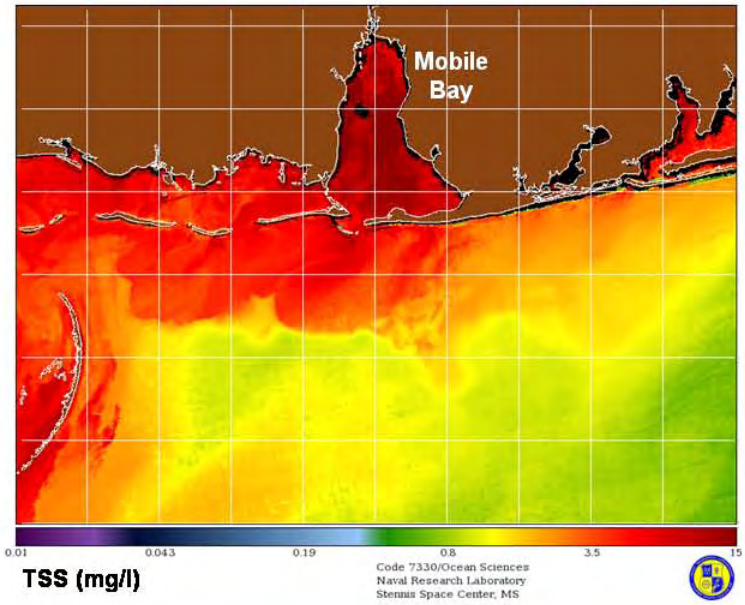


Figure 1. Concentration of total suspended solids (TSS), in and around Mobile Bay Alabama. MODIS image from 20 March 2008, at 250m spatial resolution.

The plume can carry high concentrations of suspended particulates (both organic and inorganic matter), which reduce water clarity (light transmission) and thereby impact primary production and subsequently dissolved oxygen levels. We examine the spatial and temporal variability of the total suspended particulate load of the Mobile Bay plume, using both field measurements and ocean color satellite imagery, for a one-year time period from 10/01/07 – 9/30/08.

Each month, in situ data were collected along transects both inside Mobile Bay and in the plume waters outside the bay, via small boat surveys. Vertical profiles of dissolved oxygen, salinity, chlorophyll, light, and turbidity were collected. Discrete water samples were also collected and analyses included total suspended solids (TSS), dissolved organic carbon (DOC), chlorophyll, particulate carbon, and particulate nitrogen. Daily satellite ocean color images over the region of interest at 250m spatial resolution were collected by the NASA Moderate Resolution Imaging Spectrometer (MODIS) and ingested into an automated processing system at the Naval Research Laboratory at Stennis Space Center, MS. Estimates of TSS (partitioned into organic and inorganic components) were derived from the satellite imagery using new bio-optical algorithms, and the satellite-retrieved

values are compared with the in situ measurements. In addition to the daily image products, we produced weekly composite averages to reduce the effects of cloud cover. We characterize the variability of the Mobile Bay plume and present a time-series analysis of the suspended sediment particulate load in the plume over a one-year period.

SEDIMENT AND WATER BUDGET TOOLS

Water Resources: Supply and Quality
Oral Presentation
William McAnally*, Jeremy Sharp, and Jared McKee
Department of Civil and Environmental Engineering, Mississippi State University
mcanally@cee.msstate.edu

The purpose of this project is to demonstrate the application of a set methodology for a Sediment Budget Template (SBT) and a Water Budget Tool. The SBT is demonstrated at the Aberdeen Pool on the Tennessee-Tombigbee Waterway and at Weeks Bay, Alabama. The Water Budget Tool demonstration site is the Tennessee-Tombigbee Waterway. Both tools are designed for robustness, repeatability, and application to basins draining to the coast.

The SBT is an outline that examines the total amount of sediment entering and leaving the system. The SBT uses sediment rating curves based on collected field data from the U.S. Geological Survey (USGS) to define the influent and effluent sediment flux. Once the sediment behavior is defined a sediment flux can be calculated using historic flow discharges. The SBT uses annual peak flood flow to construct a conceptual sediment budget; which is critical in determining the fundamental behavior of the system i.e. depositional or erosional. Upon validation of the conceptual sediment budget, daily flow data is used for a more exact solution and a second calculation. Finally, for a third calculation the Corps of Engineers HEC-RAS Sediment Impact Analysis Methods is implemented for further model refinement and validation. All three solutions are compared and used in conjunction to target the actual value and make final comments and recommendations.

The Water Budget Tool is demonstrated for the Tombigbee River-Tennessee-Tombigbee Waterway. Although the primary authorized purpose for the Waterway is navigation, now it is being looked to for surface water supply for current and future water demands in Northeast Mississippi. Before watershed managers can make well-informed decisions about permitting withdrawals, the amount of water available must be quantified – a water budget. This was attempted through the compilation of data into a spreadsheet schematic of the Tombigbee River and Tenn-Tom Waterway. Data were acquired through various methods and sources including Geographical Information Systems, USGS stream flow Data, Mississippi Department of Environmental Quality and Corps of Engineers personal communication, and the MDEQ EnSearch Engine. A meld of these data into the spreadsheet format transforms them into the volumetric discharges for different flow situations at locations along the river and waterway.

SPATIAL AND TEMPORAL VARIABILITY IN ABUNDANCE OF THE DIATOM *Pseudo-nitzschia spp*. IN COASTAL ALABAMA WATERS

Water Resources: Supply and Quality
Poster Presentation
Justin D. Liefer*, W.W. Smith, C. Dorsey, and H.L. MacIntyre
Dauphin Island Sea Lab and University of South Alabama
jdl602@jaguar1.usouthal.edu

The potentially-toxic diatom *Pseudo-nitzschia* is common in the northern Gulf of Mexico. In coastal Alabama, its abundance is monitored by the departments of Public Health (ADPH) and Environmental Management (ADEM) and the Dauphin Island Sea Lab. Seven sites along the Alabama Gulf Coast are monitored weekly to bi-weekly for potentially-toxic microalgae in the BEACH program. *Pseudo-nitzshia* was detected at densities up to 10^6 per liter in 380 of 606 routine samples (63 percent) taken between November, 2003, and May, 2007. A cluster analysis of the frequency distributions of abundance at the sites showed that the site of Little Lagoon Pass had a strong dissimilarity compared to other sites. This was due to a higher frequency of bloom densities and a lower frequency of absences, indicating that it is a regional "hot-spot" for *Pseudo-nitzshia*. Distributions showed no apparent relationship with temperature, over the range 10 – 34^{o}C. There was a weak positive relationship between salinity and abundance, over the range 3 – 35 PSU. *Pseudo-nitzschia* was absent more frequently from brackish sites. Peaks in abundance occurred in April-May, with secondary peaks in fall. Analysis of field surveys within Little Lagoon shows a positive relationship between groundwater level and *Pseudo-nitzschia* abundance at this site.

A STANDARDIZED REMOTE SENSING PRODUCT FOR WATER CLARITY ESTIMATION WITHIN GULF OF MEXICO COASTAL WATERS

Water Resources: Supply and Quality
Oral Presentation
DeNeice Guest*, Jean Ellis, Slawomir Blonski, and Callie Hall
SSAI, Stennis Space Center
dcguest@mac.com

A standardized remote sensing data product for estimating water clarity in the Northern Gulf of Mexico (NGOM) is currently being developed. Preliminary work revealed the feasibility of a satellite-based data product for water clarity was possible for coastal waters and estuaries of the NGOM. The first stage of this project concentrated on assessing in situ water quality data and 250-m MODIS (Moderate Resolution Imaging Spectroradiometer) products from Mobile Bay, Alabama. The in situ datasets ranging from the years 2000-2008 were converted and formatted. The MODIS datasets coincident to the in situ data were processed using SeaWiFS Data Analysis System (SeaDAS) software to apply atmospheric correction (NIR/SWIR switching method, simple dark pixel subtraction) and to assess data quality (clouds, sun glint, satellite viewing angle). MATLAB® was used for comparing in situ suspended particulate matter (SPM) measurements with 250-m MODIS band 1 data (~645 nm, Red). Several published MODIS SPM algorithms and approximately 200-300 match-up points generated from the data were evaluated. A reasonable correlation between the MODIS data and the in situ data was observed. Additional in situ datasets have been collected in other parts of the NGOM and will be used during the next phase of this project.

The development of a standardized data product that may be simply translated into water clarity parameters would be useful for regulatory agencies and/or would be routinely used by the Gulf States (e.g., SPM, turbidity, diffuse attenuation coefficient, or Secchi depth). The derivation of SPM concentration from satellite data has been extensively published, and SPM satellite algorithms are currently in use for the NGOM. This project will also survey the types of water clarity parameters routinely measured across the NGOM to determine which water quality variable should be selected for data product standardization. The objective of this project is to create a product that will enhance the quality of Gulf of Mexico data, through the use of NASA Earth science observations and research, by addressing the needs identified by the Gulf of Mexico Alliance (GOMA).

Participation in this work by Science Systems and Applications, Inc., was supported by NASA under Task Order NNS04AB54T at the John C. Stennis Space Center, Mississippi

WATER HARVESTING FROM SMALL WATERSHEDS: AN "ENVIRONMENTAL-FRIENDLY" APPROACH TO INCREASING WATER SUPPLY

Water Resources: Supply and Quality
Oral Presentation
Claude E. Boyd*, Samuel R. Fowler, and E. W. Shell
Department of Fisheries and Allied Aquacultures, Auburn University
boydce1@auburn.edu

Rainfall is abundant in Alabama and Mississippi, but it is not normally distributed throughout the year. Moreover, there are especially dry years resulting in severe drought. Some cities and towns already experience water supply deficiencies during periods of low rainfall. This problem will increase in frequency and severity in response to increasing demand for water by the growing population. Climate change also could exacerbate the water supply dilemma.

Sources of water supply are groundwater from wells, streams, and large reservoirs on streams. Some areas are not underlain by aquifers capable of supplying large volumes of water. Although about 40 percent of rainfall in these two states enters streams, flow normally declines during summer and fall and decreases drastically during droughts. Many streams have been impounded to provide water for consumptive use, generation of electricity, and flood control. Large reservoirs are distant from many municipalities and industries that need more water and conveyance would be too expensive. Large reservoirs may reduce stream flow leading to serious environmental consequences downstream – extending even into coastal areas. Because of environmental concerns, it is unlikely that construction of more large reservoirs will be an acceptable solution to the looming water supply crisis.

An alternative is water harvesting schemes consisting of series of small impoundments one above the other on watersheds in headwaters of stream catchments (Figure 1). These impoundments would fill from diffused rainfall over upland typography managed for quality water collection during winter and spring, thus reducing the requirement for extensive water treatment often necessary for water from larger downstream reservoirs subject to greater non-point source pollution. Water for consumptive use could be withdrawn from the lowermost impoundment in a series, and water could be released into this impoundment as needed from impoundments above. Seepage from impoundments would raise the local water table and increase base flow to maintain stream flow. When necessary, water could be released directly from impoundments to prevent negative environmental impacts of excessively low stream flow. Where water from harvesting systems is not polluted by use, it may

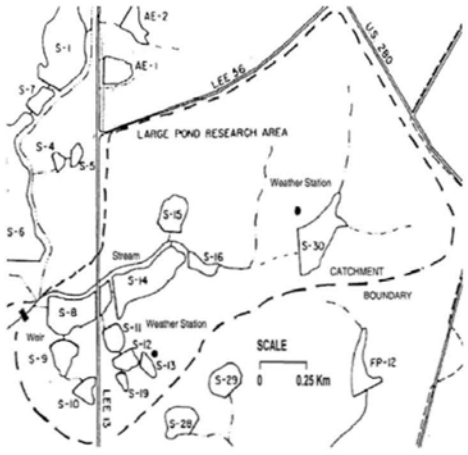


Figure 1. Water harvesting scheme.

be possible to reuse it by pumping it back into the uppermost catchments. A water harvesting scheme at Auburn University (Figure 1) is described. Principles used to supply water for these research ponds could be used to develop series of small impoundments for municipal and industrial water supply.

Water harvesting would normally be superimposed on privately-owned, rural watersheds and collaboration among stakeholders would be required for successful implementation. Incentives would have to be provided to assure participation of rural land owners who would provide catchment facilities and maintain the quality of catchment watersheds. Water harvesting on small, rural watersheds could increase water supply for nearby municipalities and industries and benefit the rural economy.

WATER QUALITY MODELING IN MOBILE BAY, AL

Water Resources: Supply and Quality
Oral Presentation
Yi (Frank) Xiong* and James L. Martin
Department of Civil Engineering, Mississippi State University
yx49@msstate.edu

A management-oriented model of water quality, including mercury, for Mobile Bay and the major tributaries to the Bay, is under development.

The study first synthesizes available data in order to obtain mass budget estimates for water and sediments. Mathematic models previously applied to the system are refocused, and/or converted, to simulation of sediments and mercury. The models, along with available data and analysis tools, are used in the assessment of factors impacting the fate and transport of mercury in the bay.

Development and testing of models for the Tenn-Tom waterway are being utilized to estimate flows and loadings to Mobile Bay and for the assessment of model algorithms for hydrodynamics, sediments, and water quality. Two parallel efforts are underway including development of 3-D hydrodynamic and sediment transport model for Aberdeen Pool and development of a 1-D hydraulic model of the Aberdeen Pool and the remaining Tenn-Tom waterway using the U.S. Army Corps of Engineers HEC-RAS model. This model was set-up and tested during this period and used to support the sediment budget calculations. 3-D efforts continued with the collection of data to support and set-up the 3-D Environmental Fluid Dynamics Code (EFDC) on Aberdeen Pool.

To obtain quantitative knowledge about mercury fate and transport in Mobile Bay as represented in Figure 1, a water quality modeling system based on a linked environmental Water Quality Analysis Simulation Program (WASP) and environmental fluid dynamics code (EFDC) for mercury modeling framework is under development. EFDC is used to simulate 10-year hydrodynamic, temperature, and sediment in the Mobile Bay, and the resulting flow information is incorporated into WASP to simulate the fate and transport of Mercury. As the NGI project continues and more Mobile Bay Mercury data is collected, the model will be modified as needed.

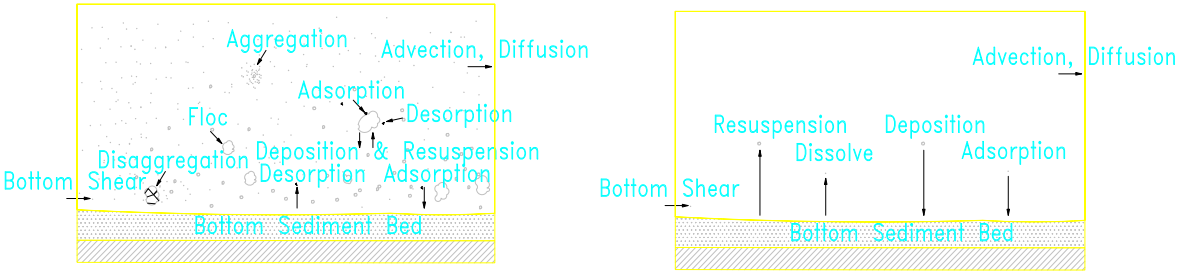


Figure 1. Mercury Conceptual Model (Left: Mercury Fate and Transport in Water Column; Right: Exchange of Bottom Sediments and Water)

Addendum to Mississippi-Alabama Bays and Bayous Symposium Proceedings

These three abstracts and were inadvertently left out of the original printing of the 2008 Mississippi-Alabama Bays and Bayous Symposium Proceedings CD Table of Contents. They can be viewed by opening the “Search Index” file on the proceedings CD and performing a keyword search, such as author’s last name.

The Fate of Working Waterfronts After Hurricane Katrina: The Alabama Experience

Jody A. Thompson, Auburn University Marine Extension & Research Center and Mississippi-Alabama Sea Grant Consortium

Morphometric Measurements of Oyster Aggregates in Grand Bay National Estuarine Research Reserve, MS

James Weston, Jay McIlwain and Thomas P. Strange. *University of Mississippi, Department of Biology and ETRP.*

Pollution and Dilution: How Do Processing and Proximity Affect Wastewater Assimilation By Local Biota?

Allen Aven, Peter Biancani, and Ruth Carmichael. *Dauphin Island Sea Lab and University of South Alabama*

THE FATE OF WORKING WATERFRONTS AFTER HURRICANE KATRINA: THE ALABAMA EXPERIENCE

Extension, Education, and Outreach
Oral Presentation
Jody A. Thompson*
Auburn University Marine Extension & Research Center/Mississippi-Alabama Sea Grant Consortium
jody.thompson@auburn.edu

Traditionally, the coastal counties of Alabama and Mississippi have relied on access to the water for their livelihood. Generations of families, based in towns like Bayou La Batre, Alabama, operate fishing boats, seafood processing facilities, boat yards, and support industries. These water-dependent industries have tremendous economic impacts both on the county and the state. Water-dependent interests in the area are wide-ranging, including commercial fishermen and shipbuilding facilities, a large charter fishing fleet, and heavy industrial shipping, with a large demand for recreational access in addition. These traditional fishing villages involve large participation from Vietnamese and Laotian communities (Bayou La Batre, AL: 51.7 percent white, 23 percent Vietnamese, 9.5 percent other Asian; approx. 1,500 total residents).

Fisheries and other related activities have tremendous economic impacts. According to the University of South Alabama, the economic expenditures related to fishing and non-consumptive activities (water-related tourism, charter fishing, birding, etc.) around Mobile Bay, AL, equals $3 billion per year.

On August 29, 2005, Hurricane Katrina devastated coastal Mississippi and traditional fishing areas of coastal Alabama. According to the University of South Alabama, the economic losses to the commercial fishing industry in Bayou La Batre, AL, alone totaled $112.25 million.

In response to constituent concerns, the Mississippi-Alabama Sea Grant Consortium held workshops in Biloxi, Mississippi, and Bayou La Batre, Alabama, in October 2006 to inform and discuss working waterfront issues. Attendees included business, industry, political leaders, and fishing representatives. MASGC continued to help organize groups in both Mississippi and Alabama of water-dependent businesses and other stakeholders, especially along the Alabama coast. Involved interests have included commercial fishing and related industries, charter fishing, recreational fishing, tourism, environmental groups, and heavy industry.

In Alabama, over 40 stakeholders from a wide range of interests have formed the Alabama Working Waterfront Coalition. MASGC provides the group with technical support and facilitates the group. To meet the needs of the stakeholders, MASGC produced a fact sheet and Web site, facilitated discussions with the state legislative delegation, provided press contacts through local and national media outlets, and acted as a liaison to local and national actions and potential partners. To meet additional needs identified by the stakeholders, MASGC funded an Inventory of Working Waterfront in Mobile County, Alabama.

Produced by Auburn University, the inventory of the current working waterfront in Mobile County, Alabama, was completed in January 2008. Along with mapping the working waterfront as a baseline study, the inventory included a survey of working waterfront businesses. The results from the study serve the dual purpose of a baseline for progress and an educational tool.

Future actions include broadening Alabama Working Waterfront Coalition membership, increasing community involvement and awareness, the formation of a state-level working waterfront committee and the proposal of current use legislation for working waterfronts in Alabama.

MORPHOMETRIC MEASUREMENTS OF OYSTER AGGREGATES IN GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE, MS

Living Estuarine Resources
Poster Presentation
James Weston*, Jay McIlwain, and Thomas P. Strange
University of Mississippi, Dept. of Biology and ETRP
jweston@olemiss.edu

As part of a larger study eastern oyster, *Crasssostrea virginica*, morphometric measurements from aggregates located throughout Grand Bay National Estuarine Research Reserve (GNDNERR) are being compared. Any observed biological differences might correspond to different local habitat conditions which can be used to guide future studies evaluating natural or anthropogenic stressors. This project is in progress and results reported here represent seven months of data (December 2007 through June 2008). Monthly samples were collected from two sites within each of five locations (Bangs Lake, Bayou Cumbest, Crooked Bayou, North Rigolets and Bayou Heron) in the GNDNERR; five oysters (> 4 cm) were collected from each site. Oysters were separated from clumps, scrubbed clean, transported and stored on ice until the following measurements were made: shell height and length and whole oyster, shell and tissue wet weights. The following parameters were calculated from measured values: shell area (shell height x shell length x ½) and volume (whole oyster wet weight – shell wet weight), condition index (tissue wet weight/shell volume x 100), percent wet weight shell, tissue and water; shell height/length ratio and shell/tissue wet weight ratio. Oyster morphometric measurements were used to assess spatial and temporal variability throughout GNDNERR. Even though within location variability was high, the three locations Bangs Lake, North Rigolets and Bayou Heron had morphometric measurements that differed significantly from the rest of the reserve. Condition index and percent tissue (34.5 and 8.1, respectively) in March were higher than pooled monthly data (30.15 and 7.1, respectively) and were lower in June (24.8 and 5.8, respectively). High and low condition index and percent tissue values suggest periods of gonad ripening and spawning. For most morphometric measurements evaluated Bayou Cumbest had the greatest amount of within variability while Bayou Heron had the least. This is further illustrated by between site comparisons within each location; in Bayou Cumbest the site closest to the mouth of the bayou usually had higher morphometric values.

This project provides a starting point to assess natural and anthropogenic factors which are responsible for the observed spatial and temporal variability in oyster morphometric measurements. Future studies can utilize less destructive sampling because our study is developing relationships between various morphometric measurements. For example, by measuring the shell height and length, shell area can be calculated and whole oyster, shell and tissue wet weights can be estimated because of the strong correlation with shell area ($0.83 \geq r \leq 0.87$). Better estimates of shell and tissue wet weights ($r = 1.0$ and 0.91, respectively) can be made by measuring whole oyster wet weight. Estimates of shell and tissue wet weight allows condition index to be estimated. Besides the immediate usefulness of oyster size demographics in GNDNERR our study provides a baseline for future non-destructive evaluations of oysters and their habitats.

POLLUTION AND DILUTION: HOW DO PROCESSING AND PROXIMITY AFFECT WASTEWATER ASSIMILATION BY LOCAL BIOTA?

Living Estuarine Resources
Poster Presentation
Allen Aven*, Peter Biancani, and Ruth Carmichael
Dauphin Island Sea Lab and University of South Alabama
aaven@disl.org

Wastewater is an increasingly important source of dissolved inorganic nutrients, particularly nitrogen (N), to coastal waters world-wide. Since N is the primary limiting nutrient in coastal waters, N inputs stimulate production of microalgae and other vegetation that support local food webs. Consumers, in turn, assimilate wastewater-derived N and carbon (C) from these foods and reflect the unique stable isotope ratios of nearby wastewater sources. Hence, stable isotope ratios are useful to define local food webs and trace wastewater influence on local organisms. Past studies have found stable isotope ratios varied among raw sewage, septic and wastewater treatment inputs, suggesting stable isotope ratios may vary in predictable ways with level of wastewater processing. These studies, however, were conducted across a wide range of temporal and spatial scales, which may shift stable isotope ratios and make it difficult to apply these data to identify and trace different wastewater sources. To better understand and trace wastewater treatment plant influence on coastal systems or inform management, it is essential to quantify these sources of variation in stable isotope data.

In this study, we defined the magnitude and spatial scale at which wastewater processing affects assimilation of wastewater-derived N and C by local organisms. To do this, we sampled N and C stable isotope ratios in influent and effluent from four WTPs (two in Mobile Bay and two in Mississippi Sound), which differ in level of processing. We compared these values to stable isotope ratios in water (suspended particulate matter), sediments, and biota at each outfall and at 200m to 400m away from each WTP outfall. We also sampled sites further from the outfalls to determine stable isotope ratios in surrounding Bay and Gulf waters and identify sources of dilution.

To determine the ecological significance of spatial variation and define the unique stable isotope signature of each WTP, we compared stable isotope ratios of biota within and among sites, taking into account the mobility and trophic level of each species sampled. These data are important to understand the effects of WTP-derived nutrient enrichment on estuarine environments, such as Mobile Bay and open waters like Mississippi Sound, which are home to commercially and recreationally important fisheries and valued by thousands of local residents.

MASGP-08-037

This publication was supported by the National Sea Grant College Program of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration under NOAA Grant NA06OAR4170078, the Mississippi-Alabama Sea Grant Consortium, Chevron Pascagoula Refinery, Alabama Department of Conservation and Natural Resources State Lands Division, Mobile Bay National Estuary Program, NOAA Coastal Services Center, Northern Gulf Institute, The Forum, Mississippi Department of Marine Resources, U.S. Environmental Protection Agency's Gulf of Mexico Program, NASA, Alabama State Port Authority and Volkert & Associates, Inc., Mississippi State University Extension Service, Dauphin Island Sea Lab, The University of Southern Mississippi Gulf Coast Research Laboratory, Alabama Marine Resources Division, Weeks Bay National Estuarine Research Reserve, Grand Bay National Estuarine Research Reserve, Mississippi-Alabama Sea Grant Legal Program, Alabama Department of Conservation and Natural Resources, Gulf of Mexico Alliance, Alabama Gulf Coast Convention & Visitors Bureau and Auburn University Marine Extension and Research Center.