



*Science, Industry, Community:  
Building Bridges to Coastal Health*

## **Proceedings**

Alabama Mississippi Bays and Bayous Symposium  
December 1-2, 2010  
Arthur R. Outlaw Convention Center  
Mobile, AL

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## **Conference Agenda**

### **Wednesday—December 1, 2010**

- 7:30 – 8:30 a.m.      **Registration – Concourse Lobby, Breakfast – West Ballroom**  
8:30 – 10:20 a.m.    **Welcome and Plenary Presentation – West Ballroom**  
John Hankinson, Executive Director, Gulf Coast Ecosystem Restoration Task Force  
Kerry St. Pé, Executive Director, Barataria-Terrebonne National Estuary Program
- 10:20 – 10:35 a.m.    **Break**
- 10:35 – 12:00 p.m.    **Concurrent Sessions**
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  - **Living Resources – Room 201B**
  - **Habitat Management – Room 201C**
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  - **Living Resources/Sustainable Communities II – Room 202C**
- 12:00 – 1:30 p.m.    **Lunch and Plenary Presentation – West Ballroom**  
Andreas Theuer, Head of Corporate Environmental Policies, ThyssenKrupp
- 1:30 – 2:50 p.m.      **Concurrent Sessions Continue**
- 2:50 – 3:10 p.m.      **Break**
- 3:10 – 4:30 p.m.      **Concurrent Sessions Continue**
- 4:30 – 5:30 p.m.      **Break**
- 5:30 – 7:00 p.m.      **Poster Presentation and Reception – Prefunction Area**
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“Hooked on the Gulf: A Life in Love with the Water,” Michael deGruy,  
underwater cinematographer, The Film Crew, Inc.

### **Thursday—December 2, 2010**

- 7:30 – 9:00 a.m.      **Registration – Concourse Lobby, Breakfast – East Ballroom**  
9:00 – 10:00 a.m.    **Welcome and Plenary Presentation – East Ballroom**  
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NATALIE R. ORTELL\*<sup>1,2</sup> AND ALICE C. ORTMANN<sup>1,2</sup>

**EVALUATION OF GROWTH AND SURVIVAL OF JUVENILE PACIFIC WHITE  
SHRIMP (*LITOPENAEUS VANNAMEI*) AND THE ATLANTIC WHITE SHRIMP  
(*LITOPENAEUS SETIFERUS*) AT DIFFERENT THERMAL AND SALINITY REGIMES**

MARTIN PEREZ-VELAZQUEZ, D. ALLEN DAVIS, XUEZHI ZHU, MAYRA L. GONZÁLEZ-FÉLIX, LUKE A. ROY\*

**ARE THERE 'BIG ONES' LEFT IN THE GULF OF MEXICO: EVIDENCE FROM FISHERY-DEPENDENT CATCH DATA AND INTER-GENERATIONAL PERCEPTIONS AMONG ANGLERS**

STEVEN B. SCYPHERS<sup>1,2\*</sup>, F. JOEL FODRIE<sup>3</sup>, SEAN P. POWERS<sup>1,2</sup>, GREGORY W. STUNZ<sup>4</sup>, FRANK J HERNANDEZ<sup>2,1</sup>  
AND ROBERT L. SHIPP<sup>1,2</sup>.

**THE NATURAL RESOURCE ADVISOR PROGRAM: AN INNOVATIVE APPROACH TO PROTECT NATURAL AND CULTURAL RESOURCES DURING THE DEEPWATER HORIZON OIL SPILL RESPONSE**

V. LYLE TRUMBULL<sup>1\*</sup>, WILL MEEKS<sup>2</sup>, MARK RAY<sup>1</sup>, STEVEN ALEXANDER<sup>2</sup>, RONALD CHIARELLO<sup>1</sup>, AL PFISTER<sup>2</sup>,  
LARRY MALIZZI<sup>3</sup>, JASON AYERS<sup>2</sup>, GRANT MATTHEWS<sup>1</sup>, ROBERT TAWES<sup>2</sup>, JASON KASE<sup>4</sup>, CALVIN DOUGLAS<sup>4</sup>, AND  
DON WENDT<sup>3</sup>

**VARIATION IN THE ABUNDANCE, DISTRIBUTION, AND HABITAT ASSOCIATIONS OF PASSERINES WINTERING IN SALT MARSHES OF THE GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE**

JAKE WALKER<sup>1\*</sup>, MARK S. WOODREY<sup>1,2</sup>, AND ROBERT J. COOPER<sup>3</sup>

**INTENSIVE OYSTER AQUACULTURE IN THE GULF OF MEXICO**

WILLIAM C. WALTON\*, F. SCOTT RIKARD, COURTNEY CODDINGTON, GLEN CHAPLIN AND TERRILL HANSON

**ANNUAL CHANGES IN SEAGRASS ASSEMBLAGES IN THE FENHOLLOWAY AND ECONFINA RIVER ESTUARIES, APALACHEE BAY, FLORIDA**

CARL M. WAY

**QUANTIFYING STRESS LEVELS OF SALT MARSH PLANTS FOR THE MISSISSIPPI GULF COAST: BASED ON THE STRUCTURAL CHANGE AND THE LOSS RATE OF MARSH PATCHES THROUGH MULTIPLE REMOTE SENSING METHODS**

JENNIFER FREY\* AND WEI WU

**CHANGES IN COASTAL FISH COMMUNITIES FOLLOWING DEEPWATER HORIZON OIL SPILL**

CHARLES W. MARTIN\*, SHANNA MADSEN AND JOHN VALENTINE

## **Habitat Management Session: Conservation and Restoration for Sustainable Ecosystems**

### **NOAA'S RESTORATION CENTER PROGRAMS, PARTNERSHIPS AND PROJECTS IN MISSISSIPPI AND ALABAMA**

MEG GOECKER

#### **SETTING THE STAGE FOR ALABAMA'S RECOVERY: 100 MILES OF OYSTER REEF, 1,000 ACRES OF MARSH**

JUDY HANER\*<sup>1</sup>, JEFF DEQUATTRO<sup>1</sup>, BETHANY KRAFT<sup>2</sup>, CASI CALLAWAY<sup>3</sup> AND BILL FINCH<sup>4</sup>

#### **THE ADCNR LITTLE BAY RESTORATION PROJECT: LARGE SCALE RESTORATION IN PRACTICE**

CARL FERRARO

#### **SHORELINE STABILIZATION AT DOG RIVER PARK: STABILIZING A SHORELINE AND CREATING HABITAT THROUGH A PUBLIC/PRIVATE PARTNERSHIP**

TOM HERDER

#### **RESTORING THE HYDROLOGY AND PLANT COMMUNITY OF A COASTAL BAYHEAD SWAMP ON OYSTER BAYOU IN BILOXI, HARRISON COUNTY, MISSISSIPPI**

JIM KELLY

#### **JUNCUS ROEMERIANUS MORPHOLOGY AND COLONIZATION IN TWO MARSH RESTORATION DESIGNS**

SPARKS, ERIC\*, JUST CEBRIAN, KATE SHEEHAN

#### **OYSTER REEFS AS NATURAL BREAKWATERS MITIGATE SHORELINE LOSS AND FACILITATE FISHERIES**

STEVEN B. SCYPHERS\*<sup>1,2</sup>, SEAN P. POWERS<sup>1,2</sup>, KENNETH L. HECK<sup>2,1</sup> AND DOROTHY BYRON<sup>2</sup>

#### **ALABAMA STATE PORT AUTHORITY CHOCTAW POINT TERMINAL PROJECT: YEAR 1 MITIGATION MONITORING**

TIM THIBAUT\* AND BOB HARRIS

### **COLLABORATIVE CONSERVATION PLANNING IN MOBILE BAY, AL**

HEIDI STILLER\*<sup>1</sup>, NOAA [COASTAL SERVICES CENTER](#)

#### **LIVING SHORELINES: A WORKSHOP PROVIDING SCIENCE BASED TRAINING TO DECISION-MAKERS AND ENVIRONMENTAL PROFESSIONALS ALONG THE GULF COAST**

MICHAEL SHELTON\*<sup>1</sup>, AMY GOHRES<sup>2</sup>, AVIA

<sup>1</sup>WEEKS BAY NERR; <sup>2</sup>WEEKS BAY FOUNDATION/GOMA; <sup>3</sup>

## **MISSISSIPPI COASTAL ROOTS SCHOOL SEEDLING NURSERY PROGRAM**

GARY R. BACHMAN\*, CHRIS A. BOYD AND CHRISTINE E.H. COKER

## **EDUCATING THROUGH EXPERIENCE: A DESIGN STUDY OF A GUM SWAMP EXHIBIT AT THE CROSBY ARBORETUM; PICAYUNE, MISSISSIPPI**

ROBERT F. BRZUSZEK\* AND TIMOTHY J. SCHAUWECKER

## **MANAGING MOBILE BAY SEDIMENT-HABITAT WITH A REGIONAL PERSPECTIVE**

W. H. MCANALLY\*<sup>1</sup>, L. E. PARSON<sup>2</sup>, J. H. CARTWRIGHT<sup>1</sup>, W. A. ROSS<sup>2</sup>, R. E. JACKSON<sup>1</sup>, N. D. CLIFTON<sup>3</sup>

## **USE OF LAND USE LAND COVER CHANGE MAPPING PRODUCTS IN AIDING COASTAL HABITAT CONSERVATION AND RESTORATION EFFORTS OF THE MOBILE BAY NEP**

JOE SPRUCE\*<sup>1</sup>, ROBERTA SWANN<sup>2</sup>, JAMES SMOOT<sup>1</sup>, AND JEAN ELLIS<sup>3</sup>

## **APPLICATION OF REMOTELY SENSED DATA AND MODELS TO EVALUATE THE EFFECTS OF LAND USE AND CLIMATE CHANGE ON SHALLOW AQUATIC ECOSYSTEMS AND INFORM CONSERVATION AND RESTORATION ACTIONS**

MAURICE ESTES JR. \*<sup>1</sup>, MOHAMMAD AL-HAMDAN<sup>1</sup>, RON THOM<sup>3</sup>, JEAN ELLIS<sup>4</sup>, DANA WOODRUFF<sup>3</sup>, CHAELI JUDD<sup>3</sup>, ROBERTA SWANN<sup>5</sup>, DALE QUATTROCHI<sup>2</sup>, HOYT JOHNSON III<sup>6</sup>, BRIAN WATSON<sup>7</sup>, AND HUGO RODRIQUEZ<sup>7</sup>

## **ASSESSING ENVIRONMENTAL CHANGE IN DAUPHIN ISLAND FROM 1972 TO PRESENT**

JOSH STODGHILL\*, AMANDA BILLIOT, ALYSON CEDERHOLM, JOSHUA PRITCHARD, VICTORIA CUNNINGHAM

## **USING MULTIPLE-SCENARIO CONTINGENT VALUATION DATA TO ESTIMATE WILLINGNESS TO PAY FOR RESTORATION OF MISSISSIPPI'S BARRIER ISLANDS**

GWANSEON KIM\*, DANIEL R. PETROLIA, MATTHEW INTERIS

## **CONTINUING EDUCATION CREDITS FOR ENVIRONMENTAL EDUCATION PROGRAMS**

CHRIS A. BOYD

## **TEACHING THE VALUE OF HABITAT RESTORATION**

JOAN TURNER\*, JENNY COOK, CARRIE DIXON AND TINA MILLER-WAY

## **COMMUNICATING THE VALUE OF CRITICAL HABITATS TO K-GRAY AUDIENCES IN ALABAMA**

JOANN MITCHELL\* AND TINA MILLER-WAY

## **CONSERVATION AND EDUCATION PROGRAM AT THE FOLEY GRAHAM CREEK NATURE PRESERVE**

LESLIE LASSITTER

**DOG RIVER SCENIC BLUEWAY: PROMOTING HABITAT REVITALIZATION  
THROUGH OUTDOOR RECREATION WHILE GROWING THE ECONOMIC  
RESILIENCE OF THE ENTIRE DOG RIVER WATERSHED THROUGH NATURE  
BASED TOURISM**

BJ SMITH\*<sup>1</sup>

**CITIZEN SCIENCE: ENGAGING VOLUNTEERS TO TAKE A PROACTIVE ROLE IN  
ASSESSING AND PROTECTING WATER QUALITY THROUGH SHORELINE  
ASSESSMENTS**

BETHANY KRAFT\*<sup>1</sup> AND CASI CALLAWAY<sup>2</sup>

**THE EFFECTS OF URBAN LAND-USE ON THE FUNCTIONAL CAPACITY OF HEADWATER SLOPE WETLANDS ON THE ALABAMA COASTAL PLAIN.**

W. FLYNT BARKSDALE\* AND CHRISTOPHER J. ANDERSON

**IMPACTS OF CLIMATE CHANGE ON OYSTER REEFS IN MOBILE BAY**

DANIELLE BOLTE\*, MAURICE ESTES JR, MOHAMMAD AL-HAMDAN

**CONSERVATION AND RESTORATION OF DOG RIVER AND THE DOG RIVER WATERSHED**

BRUCE COLDSMITH\*, JANET MILLER, THOMAS MILLER, ANN STEIN AND CLAIRE WILSON

**DEVELOPMENT OF A HABITAT-HEALTH ASSESSMENT TOOL FOR MANAGERS AND DECISION-MAKERS: A FOCUS ON WATERSHED DEVELOPMENT AND ITS IMPACTS ON ESTUARINE COMMUNITIES**

BRENNA EHME\*<sup>1</sup>, DANIEL GRIGAS<sup>2</sup>, THOMAS STRANGE<sup>1</sup>, WILLIAM UNDERWOOD<sup>1</sup>, JOHN LEHRTER<sup>3</sup>, YUSHUN CHEN<sup>2</sup>, JUST CEBRIAN<sup>4</sup>, AND MARK WOODREY<sup>1</sup>

**MERCURY DISTRIBUTION AND SPATIAL VARIABILITY IN SEDIMENTS FROM THE GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE, MISSISSIPPI**

HOWARD, BRANDON<sup>1</sup>, JOHN BRANCH, JR.<sup>1,2</sup>, CHRISTINA MOHRMAN\*<sup>2,3</sup>, ELIJAH JOHNSON<sup>1,2</sup>, RICHARD GRAGG<sup>1</sup>, AND CHARLES JAGOE<sup>1,2</sup>

**UTILIZATION OF COIR LOGS FOR LIVING SHORELINE ESTABLISHMENT AND STABILIZATION**

JULIUS B. MCILWAIN JR.\*, THOMAS P. STRANGE, WILLIAM V. UNDERWOOD

**MDMR WAVELAND WEATHER STATION**

JOHN MITCHELL

**USING BREAKWATERS TO RESTORE EMERGENT SALT MARSH AND SEA GRASS MEADOWS IN THE NORTHERN GULF OF MEXICO**

L. MOORE, K. WATSON, J. MCKEE, J. DEQUATTRO, K. HECK, S. POWERS, AND J. CEBRIAN,

**BALDWIN COUNTY GRASSES IN CLASSES PROGRAM: STUDENTS GROWING AND PLANTING NATIVE VEGETATION FOR COASTAL RESTORATION**

MARGARET H. SEDLECKY\* AND ANGELA S. UNDERWOOD

**POTENTIAL IMPACTS OF RESTORED OYSTER REEFS ON WATER QUALITY AND SUBMERGED AQUATIC VEGETATION**

S SHARMA\*, J. GOFF, D. BYRON, J. CEBRIAN, K. HECK, S. POWERS

**GIS ANALYSIS OF NESTING HABITAT FOR THE ENDANGERED MISSISSIPPI SANDHILL CRANE: POTENTIAL HABITAT SUITABILITY AND MANAGEMENT IMPLICATIONS FOR RESTORATION**

THOMAS P. STRANGE\* AND WILLIAM V. UNDERWOOD

**THE MOBILE BAY OYSTER GARDENING PROGRAM: BRINGING THE REEF TO THE PEOPLE**

P.J. WATERS



## **Sustainable Communities Session: Advancing Economic Viability and Hazard Resiliency**

### **NOAA COASTAL SERVICES CENTER: HELPING GULF COAST COMMUNITIES NAVIGATE CLIMATE CONSIDERATIONS**

MARIAN HANISKO\*, STEPHANIE FAUVER, DOUG MARCY

### **CLIMATE CHANGE AND COMMON LAW: A LOOK AT CLIMATE CHANGE LAWSUITS BY GULF COAST RESIDENTS AND BEYOND**

NIKI L. PACE\*

### **MITIGATING COASTAL HAZARDS THROUGH COMMUNITY EDUCATION/OUTREACH & PARTICIPATION IN NFIP'S COMMUNITY RATING SYSTEM – CHALLENGES, LESSONS LEARNED, REWARDS**

BETH OUSLEY\*

### **DEVELOPING A SUSTAINABLE WATERSHED HABITAT CORRIDOR: A COMMUNITY ACTION STRATEGY FOR LOW-IMPACT DEVELOPMENT, PUBLIC EDUCATION AND CITIZEN “BUY-IN” FOR AN URBAN WATERSHED PROJECT**

DON BLANCHER\*<sup>1</sup> AND YARROW ETHEREDGE<sup>2</sup>

### **MOBILE GREEN STREETS: LEVERAGING ECONOMICS, FLOOD REDUCTION AND AESTHETICS THROUGH INVENTIVE STORMWATER MANAGEMENT DESIGN**

CHARLENE M. LEBLEU, ASLA, AICP

### **EXTENSION PROGRAMMING FOR THE BUSINESS OF NATURE**

JOANNE McDONOUGH

### **BY-PRODUCT SYNERGY CENTRAL GULF COAST: IMPROVING MOBILE'S SUSTAINABILITY THROUGH INNOVATION, LEADERSHIP AND COLLABORATION**

JENNIFER DENSON\*

### **HISTORIC AND CONTEMPORARY CHALLENGES TO SUSTAINABILITY IN THE GULF COAST SHIPBUILDING AND FABRICATION INDUSTRY**

PREETAM PRAKASH

### **PRESERVING THE WORKING WATERFRONT IN COASTAL ALABAMA**

THOMPSON, JODY A.\* AND MARIE DYSON

### **MISSISSIPPI DEPARTMENT OF MARINE RESOURCES OYSTER STEWARDSHIP PROGRAM**

KRISTINA BROUSSARD

### **DAUPHIN ISLAND'S REVITALIZED CENTRAL BUSINESS DISTRICT**

MATTHEW CAPPS\* AND MICHAEL ROBINSON

## **NOAA'S CONSTITUENT ENGAGEMENT SURVEY**

LADON SWANN AND MATTHEW CAPPS\*

## **GULF OF MEXICO CLIMATE OUTREACH – BUILDING A COMMUNITY OF PRACTICE (COP) FOR LONG-TERM ENGAGEMENT WITH COASTAL COMMUNITIES**

KARL HAVENS<sup>1</sup>, BUCK SUTTER<sup>2</sup>, LADON SWANN<sup>3</sup>, HEIDI RECKSIEK<sup>4</sup> AND MATTHEW CAPPS\*<sup>3</sup>

## **NOAA'S GULF OF MEXICO CLIMATE AND RESILIENCY ENGAGEMENT PANEL**

BUCK SUTTER<sup>1</sup>, LADON SWANN<sup>2</sup> AND MATTHEW CAPPS\*

## **COMMUNITY ECONOMIC PREPAREDNESS: AN INDEX DESIGNED TO TEST THE ECONOMIC PREPAREDNESS OF RURAL COMMUNITIES**

RANDY Y. COKER, BENEDICT C. POSADAS, AMANDA SEYMOUR, SCOTT A. LANGLOIS, AND CHRISTINE E. COKER

## **CRISIS KNOWLEDGE AND PREPAREDNESS AFTER KATRINA AS A FUNCTION OF RACE**

RENEE EDWARDS\*<sup>1</sup>, ANDREA MILLER<sup>1</sup>, STEPHANIE HOUSTON GREY<sup>1</sup> AND DAVID P. BROWN<sup>2</sup>

## **OIL SPILLS AND THEIR EFFECT ON THE ENVIRONMENT**

ROBERT M. GLENN\* AND CIERRA D. MARTIN\*

## **SANDS - SEDIMENT ANALYSIS NETWORK FOR DECISION SUPPORT**

DANNY HARDIN\*<sup>1</sup>, SANDY EBERSOLE<sup>2</sup>, LAMAR HAWKINS<sup>1</sup> AND MATT HE<sup>1</sup>

## **IMPROVING NOAA ENGAGEMENT: UTILIZING EXTENSION, OUTREACH AND EDUCATION TO ENGAGE NOAA'S CONSTITUENTS**

L.D. HINESLEY\*, BUCK SUTTER AND LADON SWANN<sup>3</sup>

## **COMMUNITY DISASTER PREPAREDNESS: AN INDEX DESIGNED TO MEASURE THE DISASTER PREPAREDNESS OF RURAL COMMUNITIES**

SCOTT A. LANGLOIS\*, BENEDICT C. POSADAS, CHRISTINE E. COKER, AMANDA K. SEYMOUR AND RANDY Y. COKER

## **COMMUNITY ECONOMIC RECOVERY FOLLOWING NATURAL DISASTERS: A SUGGESTED MEASUREMENT APPROACH**

BENEDICT C. POSADAS\*, AMANDA K. SEYMOUR, SCOTT A. LANGLOIS, RANDY Y. COKER AND CHRISTINE E. COKER

## **SUSTAINABLE MARINE SHRIMP AQUACULTURE AT THE GULF COAST RESEARCH LABORATORY**

ANDREW J. RAY\*, JEFFREY M. LOTZ

## **UNCERTAINTY VISUALIZATION OF ENSEMBLE WEATHER FORECASTS**

JIBONANANDA SANYAL, SONG ZHANG, PHILIP AMBURN, JAMIE DYER, ANDREW MERCER, ROBERT MOORHEAD

## **RESPONDING TO THE 2010 DEEPWATER HORIZON OIL SPILL: MISSISSIPPI-ALABAMA SEA GRANT EXTENSION AND OUTREACH ACTIVITIES**

MELISSA SCHNEIDER\*, STEPHEN SEMPIER, DAVE BURRAGE, CHRISTIAN MILLER, NIKI PACE, TRACIE SEMPIER, STEPHANIE SHOWALTER, JODY THOMPSON, P.J. WATERS, LADON SWANN

## **IMPLEMENTATION AND EVALUATION OF THE COASTAL COMMUNITY RESILIENCE INDEX**

TRACIE SEMPIER\*, JODY THOMPSON, LADON SWANN, STEVE SEMPIER, MELISSA SCHNEIDER

## **POTENTIAL ECONOMIC IMPACTS OF THE GULF OF MEXICO OIL SPILL TO MISSISSIPPI, SECTOR BY SECTOR**

AMANDA SEYMOUR\*, BENEDICT POSADAS, RANDY COKER, SCOTT LANGLOIS AND CHRISTINE COKER

## **IMPROVING WAVE HEIGHT PREDICTION DURING BARRIER ISLAND OVERTOPPING**

BRET M. WEBB\*<sup>1</sup>, SPENCER ROGERS<sup>2</sup> AND ANDREW KENNEDY<sup>3</sup>

## **--LIVING RESOURCES/SUSTAINABLE COMMUNITIES II SESSION--**

### **(IN ORDER OF PROGRAM LISTING)**

## **A STUDY OF SEAGRASS BEDS AT GRAND BAY NATIONAL ESTUARINE RESEARCH RESERVE, MISSISSIPPI**

CRISTINA C. NICA\* AND HYUN J. CHO

## **A WATER-DEPTH CORRECTION ALGORITHM FOR SEAGRASS MAPPING USING HYPERSPECTRAL DATA**

MARVIN WASHINGTON\*<sup>1</sup>, DUANJUN LU<sup>2</sup> AND HYUN JUNG CHO<sup>3</sup>

## **IMPACTS OF ANTHROPOGENIC DEVELOPMENT ON THE NURSERY FUNCTION OF SALT MARSH HABITAT**

MICHAEL R. LOWE\*<sup>1</sup>, MARK S. PETERSON<sup>1</sup> AND BROCK C. HOUSTON<sup>2</sup>

## **THE SHORT-TERM IMPACT OF CRUDE OIL ON PHOTOSYNTHESIS OF SALT MARSH PLANTS**

WEI WU \*, PATRICK BIBER, JENNIFER FREY AND LINA FU.

## **TROPHIC PLASTICITY IN THE ATLANTIC SHARPNOSE SHARK (*RHIZOPRIONODON TERRAENOVAE*) FROM THE NORTH CENTRAL GULF OF MEXICO**

J. MARCUS DRYMON\*<sup>1</sup>, SEAN P. POWERS<sup>1,2</sup> AND RUTH H. CARMICHAEL<sup>1</sup>

## **OCCURRENCE, DISTRIBUTION, AND BEHAVIORAL PATTERNS OF BOTTLENOSE DOLPHINS, *TURSIOPS TRUNCATUS*, IN WOLF BAY, ALABAMA**

CLAIRE M. PABODY\*<sup>1</sup> AND KEITH MULLIN<sup>2</sup>

## **APPLE SNAIL (*POMACEA INSULARUM*) INVASION OF THE MOBILE-TENSAW DELTA: A RISK ASSESSMENT**

CHARLES W. MARTIN\* AND JOHN F. VALENTINE

## **EVALUATION OF A MECHANICAL GRADER FOR IMPROVING SHELL QUALITY AND REDUCING FOULING IN THE COMMERCIAL AQUACULTURE PRODUCTION OF OYSTERS, *CRASSOSTREA VIRGINICA*, IN THE GULF OF MEXICO**

COURTNEY H. CODDINGTON\*, WILLIAM C. WALTON, F. SCOTT RIKARD, AND GLEN CHAPLIN

*Bays and Bayous*  
*December 1-2, 2010*

## **MOBILE BAY: COASTAL APPLICATIONS OF GEOSPATIAL DATA AND MODELS**

RICHARD PATCHEN\*, ALLISON ALLEN, GALEN SCOTT, PATRICK FINK, TIMOTHY OSBORN AND DARREN WRIGHT

## **Living Resources/Sustainable Communities II Session**

### **IDENTIFYING KEY VARIABLES OF AN OIL SPILL**

JEFF ZANOTTI

### **NOAA'S REGIONAL ENGAGEMENT IN THE GULF OF MEXICO: LEVERAGING PARTNERSHIPS AND SCIENCE TO ADDRESS THE DEEPWATER HORIZON OIL SPILL**

BUCK SUTTER\* AND CATHY TORTORICI

### **EXAMPLES OF NASA DATA PRODUCTS USED IN THE NATIONAL RESPONSE TO THE DEEPWATER HORIZON OIL SPILL**

JASON B. JONES\*<sup>1</sup> AND JOSH STODGHILL<sup>2</sup>

### **OFFSHORE OIL AND THE DEEPWATER HORIZON: SOCIAL EFFECTS ON GULF COAST COMMUNITIES**

DIANE AUSTIN

### **ANALYZING THE SOCIAL AND ECONOMIC IMPACTS OF THE 2010 BP GULF OIL SPILL: A UNIFIED APPROACH**

DR DIANE HITE\*<sup>1</sup>, DR MICHELLE WOROSZ<sup>1</sup> AND DR TERRILL HANSON<sup>2</sup>  
<sup>1</sup>DEPARTMENT OF AGRICULTURAL

### **ASSESSING AND IMPROVING MESONET DATA FOR ADVANCED COASTAL DECISION MAKING**

MADHURI S. MULEKAR\*<sup>1</sup> AND SYTSKE K. KIMBALL<sup>2</sup>

### **THE UNIVERSITY OF SOUTH ALABAMA MESONET AND ITS PERFORMANCE DURING THE HEAVY RAINFALL EVENT OF HURRICANE IDA (2009)**

SYTSKE KIMBALL\*

### **UNDERSTANDING THE IMPACT OF DATA UNCERTAINTY ON METEOROLOGICAL AND OCEANOGRAPHIC FEATURES**

KEQIN WU\*, SONG ZHANG, AND R. J. MOORHEAD II

### **FINS, FISHES, AND FISHERIES: AN ENTHRALLING WEEK OF TEACHER EDUCATION!**

GREG GRAEBER\*, JENNY COOK, STEPHANIE WRIGHT, AND TINA MILLER-WAY

### **THE MOBILE COUNTY PUBLIC SCHOOLS ENVIRONMENTAL STUDIES CENTER – RAISING AWARENESS AND UNDERSTANDING OF COASTAL ALABAMA'S FLORA AND FAUNA**

LLOYD SCOTT\* AND DESIREE BISHOP\*

### **BOARDWALK TALKS: DIALOG BETWEEN THE SCIENCE COMMUNITY AND THE VISITORS OF THE DAUPHIN ISLAND SEA LAB**

MENDEL GRAEBER\* AND TINA MILLER-WAY

**--Water Quality Session: Assessing and Improving Water in a  
Changing Coastal Landscape --**

*(in order of program listing)*

## **The Influence of Mobile Bay on the Hydrographic Variability of the Inner Alabama Shelf**

Brian Dzwonkowski<sup>\*1</sup>, Kyeong Park<sup>1,2</sup>, Ho-Kyung Ha<sup>2</sup>, William M. Graham<sup>1,2</sup>, F.J. Hernandez<sup>1</sup> and Sean P. Powers<sup>1,2</sup>

<sup>1</sup>Dauphin Island Sea Lab, 101 Bienville Boulevard, Dauphin Island AL 36528, USA,

<sup>2</sup>Department of Marine Sciences, University of South Alabama, 5871 USA Drive N, Room 25, Mobile AL 36688, USA. [briandz@disl.org](mailto:briandz@disl.org)

Hydrographic variability on the Alabama shelf just outside of Mobile Bay, the second largest river discharge into the Gulf of Mexico, is examined using time series of water column temperature and surface and bottom salinity from a mooring site with a depth of 20 m in conjunction with a series of across-shelf CTD surveys. The time series data show variability in a range of time scales. The density variation is affected by both salinity and temperature, with its relatively strong annual signal mostly determined by temperature and its year to year variability mostly determined by salinity. Seasonal mean structures of temperature, salinity, and density show a transition from estuarine to shelf conditions in which three regions with distinct seasonal characteristics in their horizontal and vertical gradient structures are identified. Correlation analysis with available forcing functions demonstrated the influence of Mobile Bay on the variability at the mooring site. At low frequencies, river discharge from Mobile Bay has a varying influence on salinity, which is absent during the periods with unusually low discharge. At shorter synoptic time scales, both the estuarine response to the across-shelf wind stress and the shelf response to the along-shelf wind stress are significantly correlated with temperature/salinity variability: the former becoming important for the surface layer during winter whereas the latter for the bottom layer during both winter and summer. These forcing functions are important players in determining the estuarine-shelf exchange, which in turn are found to contribute to the shelf hydrographic structure. The forcing relationships highlight the strong connection between the estuary and shelf in this region and have significant biological implications for marine ecology.

## **Quantification of El Niño Southern Oscillation (ENSO) Impact on Precipitation and Stream Flows for Improved Management of Water Resources in Alabama**

Puneet Srivastava\*<sup>1</sup>, Vaishali Sharda<sup>1</sup>, Keith Ingram<sup>2</sup>, Muthuvel Chelliah<sup>3</sup> and Latif Kalin<sup>1</sup>

<sup>1</sup>Auburn University, Biosystems Engineering, 206 Tom E. Corley Building, Auburn AL 36849,

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Southeastern United States is a region of rapidly growing population which has resulted in increased pressure on water resources of the region. This is further exacerbated by the severe seasonal to inter-annual (SI) climate variability this region experiences. Most climate variability in this region has been attributed to the El Niño Southern Oscillation (ENSO) which influences temperature, precipitation and upper winds. Since precipitation is the main driver for number of hydrologic and water quality processes, understanding the regional impacts of ENSO on precipitation can provide valuable information to water resources managers in this region. It has also been reported that streamflow is sensitive to changes in temperature and evapotranspiration that are influenced by ENSO. Keeping this in mind, this study was undertaken to develop a clear picture of the effect of ENSO on observed precipitation anomalies and streamflow in Alabama to help water resource managers of the state in decision making. Effect of ENSO on precipitation at 49 stations in 8 climate divisions of Alabama was assessed. Mean monthly precipitation was compiled using the station data from NCDC website for 59 years (1950-2008). NOAA's Niño 3.4 index was used as an indicator of ENSO phase. Composite analysis was also performed on this dataset to obtain the conditional probabilities of ENSO events. The precipitation was analyzed for 3-month seasons of Jan-Feb-Mar, Apr-May-Jun and Oct-Nov-Dec. Since the wet season (Dec to Apr) and the growing season (April to Sep) are important for water supply and demand in Alabama, the analysis was also done for these periods along with correlation between seasonal precipitation and ENSO. Of interest was the occurrence of below normal precipitation in winter months during a strong La Nina signal which was found to be significant for climate divisions 8 and 7. A fairly strong relationship was also found during other months (JFM and AMJ). It was found that dry conditions during winter months in the southern climatic divisions (6, 7 and 8) tend to be associated with La Nina. Streamflows show a high variability and a strong positive correlation during winter months in the southern climate divisions. This analysis of precipitation and streamflow provides a basis for proceeding with the water management decisions that can be taken to deal with the climate variability associated with ENSO in this region. This seasonal variation in association with ENSO would give water managers a lead time for decision making.



## **Waters to the Sea: Discovering Alabama**

Allison Jenkins

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This presentation will introduce the audience to *Waters to the Sea: Discovering Alabama*, the newest addition to the internationally acclaimed, award winning *Waters to the Sea* CD ROM Series—the definitive watershed education tool for inspiring informed river stewardship in the next generation. The tool will engage young people (grades 3-12) in learning about the workings of the Continent's rivers as well as the history, culture and ecology of Alabama watersheds (and the shared watersheds of neighboring states). Through interactive storylines rich in images, sounds and ideas, students will engage in learning aimed to inspire river stewardship, while providing educators with cross curricular, standards-based education. And, since it will be available online by subject area, the tool will also offer information for the lay person interested in water quality issues in easy to understand language. Developed and produced in partnership by The Center for Global Environmental Education (CGEE) within Hamline University's Graduate School of Education (St. Paul, Minnesota) and the University of Alabama - Museum of Natural History's award winning *Discovering Alabama* PBS television series with Dr. Doug Phillips, project development is being coordinated by the Alabama Clean Water Partnership.

When complete the innovative educational CD will contain 12+ hours of interactive, interdisciplinary information combining ecology with a high tech virtual water quality lab and virtual river journeys hosted by historical guides telling the story of how humans have lived along the great waterways of Alabama (as well as in the neighboring states of Florida, Mississippi and Tennessee where watersheds are shared). Embedded in the program are interactive elements that challenge students while they learn, providing background information on ecology, watersheds and the water cycle, and water quality testing. The river journey explores, through a series of media-rich interactive modules, the human history of the watershed, the impact of primary land use activities on terrestrial and aquatic ecosystems and basic principals of river hydrology.

Examples of interactive modules to be included in *Waters to the Sea: Discovering Alabama* include:

1. An opportunity to operate a hydropower facility (mimics the various competing interests on impoundments including water supply, recreation, and power sources),
2. A look at the journey that water drop takes as it falls from the sky (nonpoint source pollution), and
3. An interactive opportunity to become a forestry foreman that must select the best way to harvest a timber from a specific site that has several potential stream crossings.

Check out the "Demo Version" at <http://cgee.hamline.edu/waters2thesea/DiscoveringAlabama>

## **Primary Productivity Distributions along the River-Influenced Shoreline of the Bay of Saint Louis, Mississippi**

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The relationship between photosynthesis and irradiance (P-E) was used to model potential primary production along the shoreline of the Bay of Saint Louis, MS (BSL) estuary. Monthly surface water samples were taken at six stations along the shoreline of the BSL estuary during incoming and outgoing tides to assess possible environmental influences on phytoplankton photosynthetic performance. Stations were located along the western shore of BSL to examine the influence of the Jourdan River on primary production and along the eastern shore to examine the influence of the Wolf River on primary production. Field sampling began in May 2010 and will continue through October 2010. Over the course of the study, two short-term experiments will examine the influence of atmospheric forcing (week), and tidal and irradiance effects (diurnal) on P-E parameters. Because the waters along the BSL shoreline are shallow and often turbid, preliminary results suggest that light availability may be the principle factor regulating phytoplankton production at selected stations along the BSL shoreline. The results from this study will provide the first estimates of primary production within the BSL system and will facilitate ecological research and monitoring efforts within regional estuaries.

## **Benthic Nitrogen Cycling in Weeks Bay, Alabama**

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We examined benthic nitrogen fluxes monthly over a one year period at two locations, Mid Bay and Magnolia River, in Weeks Bay, AL NERR site. Weeks Bay is a shallow sub-estuary of Mobile Bay, with an average depth of 1.5 m, and high inputs of nitrogen (N) supported by a predominately agricultural watershed. The objectives of the study were (1) to determine seasonal patterns in benthic nitrogen cycling and (2) identify factors controlling benthic N fluxes. Intact sediment cores were collected monthly by divers and incubated over a 24-hour period in a temperature controlled chamber at ambient water column temperature. Benthic N flux rates were determined in stirred sediment cores by measuring changes in overlying water column ammonium ( $\text{NH}_4^+$ ), nitrate ( $\text{NO}_3^-$ ), and dinitrogen gas ( $\text{N}_2$ ) concentrations. Net  $\text{N}_2$  flux was measured by membrane inlet mass spectrometry (MIMS). Although monthly benthic fluxes exhibited high variability, on an annual basis both sites exhibited similar patterns.  $\text{NH}_4^+$  fluxes from the sediment to the water column dominated the DIN fluxes and contributed  $2.1\text{--}2.8 \text{ mmol N m}^{-2} \text{ d}^{-1}$  to the water column. There was a small uptake of  $\text{NO}_3^-$  by the sediments of about  $0.7\text{--}0.8 \text{ mmol N m}^{-2} \text{ d}^{-1}$ . This uptake may be from denitrification or DNRA (dissimilatory nitrate reduction to ammonium). Denitrification is a microbially mediated form of anaerobic respiration in the sediments and a net sink of N. In contrast, DNRA transforms  $\text{NO}_3^-$  into  $\text{NH}_4^+$  which is the most reduced and thus most bioavailable form of N.  $\text{N}_2$  production was assumed to occur primarily via denitrification and an uptake by the sediments was assumed to occur via N fixation.  $\text{N}_2$  fluxes were variable and in general there was a small uptake into the sediments. The annual average  $\text{N}_2$  fluxes were  $-0.2 \text{ mmol N m}^{-2} \text{ d}^{-1}$  and  $-0.4 \text{ mmol N m}^{-2} \text{ d}^{-1}$ , Magnolia River and Mid Bay respectively. Recent studies have also reported net N fixation in Narragansett Bay and Corpus Christi Bay attributing these patterns to differences in  $\text{O}_2$  concentrations (normoxia = net fixation and hypoxia = net denitrification) and OM inputs (decrease in primary production leads to a reversal of  $\text{N}_2$  flux). With N inputs increasing in estuarine ecosystems worldwide, it is imperative to determine factors controlling N cycling in nearshore marine systems.

## **Carbon and Nutrient Speciation in River Waters along a Human Impact Gradient in the Louisiana-Mississippi Gulf Coast**

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Water samples were collected from several rivers along a human impact gradient in the Louisiana-Mississippi Gulf Coast. These river basins span from the Mississippi River (MR), a large and heavily human-influenced river, to the Pearl River (PR), a black water river with moderate human influence, and to the Jourdan River (JR) and Wolf River (WR), both are small forested, black water rivers with less anthropogenic influence. Water samples were measured for the concentrations of dissolved organic carbon (DOC), dissolved inorganic carbon (DIC), total dissolved nitrogen (TDN), dissolved inorganic phosphorus (DIP), dissolved organic phosphorus (DOP), and dissolved silicate to determine fluxes and speciation of carbon and nutrients and their relationship with hydrological cycle, human impacts and environmental change. Concentrations of DOC increased from the MR to PR and to JR/WR, whereas DIC concentration showed a contrast variation. The concentration of TDN was considerably higher in the MR compared to other three rivers. Similar to carbon species, concentrations of DIP also decreased from the MR to the PR and to the JR/WR, while DOP concentration increased from the MR to the PR and to the JR/WR, resulting in a predominance of DIC and DIP in anthropogenically influenced rivers and a DOC and DOP predominance in forested, black water rivers. Human influence, land use, and environmental change will likely enhance the river export of inorganic carbon and nutrients, but decrease the flux of organic species into the coastal marine environment. Therefore, changes in nutrient and carbon speciation in river waters may provide insights into understanding of impacts and consequence of climate and environmental changes in river basins.

## **The Importance of Stream Discharge and Land-use/Land-cover to Pensacola Bay Watershed Nutrient and Organic Matter Dynamics**

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Nutrients and organic matter were measured in the streams and rivers of the Pensacola Bay watershed over two annual cycles to assess how stream size and land-use/land-cover (LULC) relate to the speciation and concentrations of nutrients and organic matter. A watershed hydrology model, the Loading Simulation Program for C++ (LSPC) was used to estimate daily discharge and total nitrogen (N) and phosphorus (P) concentrations in watershed sub-basins. Stream discharge was shown to be a major factor dictating not only the magnitude of constituent concentrations but also the chemical speciation of the constituents that were present. Nitrate ( $\text{NO}_3^-$ ) concentrations were observed to have an inverse relationship with discharge. In contrast, dissolved organic matter increased with increasing discharge. Highly urbanized streams had significantly higher dissolved inorganic nitrogen, primarily  $\text{NO}_3^-$ , than streams and rivers draining forested watersheds, where nitrogen was predominately in the form of dissolved organic nitrogen (DON). Temporal trends in nutrient and organic matter over the two-year period indicated that constituents in the various sub-basins were generally in synchrony on seasonal scales but the magnitudes of seasonal change in constituent concentrations were variable. Finally, the nutrient speciations observed were used with the LSPC modeled TN and TP to estimate the seasonal fluxes of inorganic and organic nutrients to the Pensacola Bay estuary. The implications of these dynamics to eutrophication issues in the estuary will be discussed.

## **Water Quality Response to Changes in Land Use/Cover in the Fish River Watershed: A Modeling and Monitoring Synthesis**

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In this study we investigated how changing land use/cover (LULC) affects water quality in the Fish River watershed at both spatial and temporal domains. We relied on both using monitored water quality data and watershed modeling to understand the water quality dynamics in the watershed. The Fish River, in coastal Alabama, is of critical importance to the health of Weeks Bay, a designated Outstanding National Resource Water. The study took place across several subwatersheds within the Fish River watershed's boundaries. Dominant LULCs in the watershed include row-crop agriculture and medium density residential areas. Significant urbanization has occurred across all subwatersheds between 1995 and 2008. Grab samples and stormflow ISCO automated samples were taken and processed to determine the concentrations of ammonium + ammonia ( $\text{NH}_4+\text{NH}_3$ ), nitrate ( $\text{NO}_3\text{N}$ ), total phosphorus (TP) and total suspended sediment (TSS). Spatial comparisons between subwatersheds were linked to water quality. Data from previous studies in the mid-1990s were compared with this studies' collected data to determine changes in nutrient and sediment levels over time. Results showed that sites with large increases in urbanized land uses had substantially higher TSS concentrations and loads. Nitrate trends over time showed a general decrease, whilst TP concentrations and loads increased significantly between the two time periods. TSS concentrations and loads showed no significant changes over time throughout the watershed. The majority of changes in regards to nitrogen and phosphorus may be due to the introduction of peanut farming in the late 1990s. Peanut farming requires little addition of nitrogen fertilizer, but requires heavy additions of phosphorus. The watershed appears to have shifted from a phosphorous limited system to a nitrogen limited system. This may have very important implications as analysis at spatial domain showed that urbanization increases N loadings, therefore posing an increased threat of eutrophication.

We also assessed the Soil Water Assessment Tool (SWAT) in predicting the impacts of changes in LULC over time in the Fish River watershed. The model was first calibrated and validated for flow, total suspended solids (TSS), nitrate ( $\text{NO}_3^-$ ) and organic P (Org-P) using data collected from 1990 to 1998 along with LULC data representing 1992. The calibrated and validated model was then used to explore whether it can successfully predict flow and water quality conditions during 2008-2010 (post-validation) using a LULC data that was significantly different from the 1992 LULC data. Comparison of model simulated and observed flow and water quality data from the period 2008-2010 showed that SWAT can be a dependable tool in predicting the effect of LULC changes.

## **Numeric Nutrient Criteria for Streams to Protect Downstream Estuarine Waters: Scaling up Instream Retention and Loss**

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Eutrophication of estuaries due to nutrient enrichment is critical environmental issue in the northern Gulf region, as well as nationally. Environmental management efforts have often failed to improve water quality, or prevent further degradation, suggesting that more effective regulatory action is needed to protect water quality. A key problem for estuaries is the spatial displacement between nutrient sources in watersheds and downstream impacts in estuaries. Development of numeric nutrient criteria for streams to protect downstream estuaries is a potential solution. We call these criteria "downstream protection values," or DPVs. Challenges for developing DPVs include computing the fraction of nutrients transported in an upstream reach that ultimately reach the estuary. Using results from a SPARROW watershed model as well as a mechanistic watershed model, the Loading Simulation Program in C++ (LSPC) we illustrate how DPVs could be computed using Pensacola Bay and its watershed as an example. Model simulations predict that more than 50% of TN transported along the longest flow paths is likely lost to denitrification within the watershed, while >90% of TN transported in larger river channels and along shorter flow paths reaches estuarine waters. In contrast to TN, it is likely that little TP is stored. Simulations reveal the sensitivity of estimates to average stream velocity, stream geometry, nutrient speciation, and denitrification rates, indicating potentially useful avenues for further research in watersheds across the northern Gulf.

## **Decreasing Nitrate-N Loads to Coastal Ecosystems with Innovative Drainage Management Strategies in Agricultural Landscapes**

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The Mississippi River Basin (MRB) is home to some of the most productive agricultural land in the US, significant freshwater inflows into the Gulf of Mexico, and concomitant loads of nutrients. Nitrate-N specifically, is degrading downstream and coastal ecosystems resulting in hypoxic zones and loss of biological diversity which has a significant impact on coastal fisheries related economies. Tackling nutrient reduction needs to occur at the source of the pollution – i.e., the agricultural landscape. This research aims in quantifying the impact an innovative drainage management strategy has on nitrate concentration and load reductions in vegetated agricultural drainage ditches. Agricultural drainage ditches are ubiquitous features of the agricultural landscape, and enhanced controlled drainage within them will promote conducive biogeochemical conditions for nitrogen transformation. This controlled drainage will occur with the use of spatially orientated low-grade weirs: small impedance structures within the ditch that retain small volumes of water without reducing the function of the “drainage” ditch.. An experiment and field observation study has and is still taking place to quantify the results. An experiment was run at the Arkansas Agricultural Research Facility whereby two treatments, weir (W) and non-weir (NW), were compared against one another for nitrate-N reduction capability. Preliminary analysis shows that both weir and non-weir systems that are mature and well vegetated with wetland plants will significantly reduce nitrate-N concentrations from a simulated runoff event. Further analysis will aim to describe differences in load and concentration reduction between W and NW systems. Increasing in scale, field sampling of natural non-stormflow and stormflow events in a system that has had weirs installed is showing variable reductions of nitrate-N. Seasonality, flow rate, and maturity of the system seem to be factors that drive the potential of each system to reduce nitrate-N. The use of a spatially orientated water control structures are innovative drainage strategies as yet not established in drainage management literature, specifically in the context of landscape source nutrient reductions for coastal ecosystems. Thus it is vitally important that outreach activities will include a demonstration project at Newton MS, as well as on campus at Mississippi State University.



## **A Redfish Tale – Production of a Video to Educate about Nutrient Over-Enrichment along the Gulf Coast**

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In response to increasing concern about the health of the Gulf and its coastal watersheds related to excessive anthropogenic nutrient loading, the Mobile Bay National Estuary Program (MBNEP) has partnered with the Dauphin Island Sea Lab (DISL) and Hidden World Productions (HWP) to develop a touring video program, “A Redfish Tale.” This video presentation, targeted towards upper elementary- and middle school-aged students, is part of a bilingual, interactive touring exhibit in development with funding from a U. S. EPA/Gulf of Mexico Program grant. It uses animated redfish to explain the sources and impacts of excess nutrients in Gulf coastal waters and stimulate changes in behavior to reduce them.

The Redfish Tale was produced by MBNEP staff and Dr. Tina Miller-Way of DISL and directed by multiple Emmy Award-winner Lynn Rabren of HWP. The plot involves two high school students (played by Alabama School for Math and Science student actors), Zac, a scooter-riding slacker, and Kelsey, a motivated honor student, who have been assigned to partner in creation of a video concerning nutrient input in watersheds. While Kelsey works, Zac “slacks”, takes a fall from his scooter, and then encounters two animated redfish at the shoreline. Jimbo and Thibodeaux express their displeasure and enlighten him (and viewers) about nutrient over-enrichment, eutrophication, and hypoxia in the Gulf of Mexico. The presentation ends with a challenge to viewers to produce and submit their own short video programs to the MBNEP, who will provide the submitted library for access and viewing by internet browsers.

According to the Gulf of Mexico Alliance Governors’ Action Plan, education and outreach are essential to accomplish goals of improving water quality and reducing nutrient input to coastal ecosystems. Human activities on land add excess nutrients to coastal areas or compromise the ability of ecosystems to remove them either from landscapes or from waterways themselves. Nutrient over-enrichment underlies depletion of dissolved oxygen, habitat loss, harmful algal blooms and declines in populations of important marine organisms. This video production provides an innovating way to raise awareness about Gulf coast assets and motivate human behavior changes to stem negative impacts of human activities on ecosystem health. It will be circulated among Coastal Ecosystem Learning Centers, including Gulf Coast Exploreum, DISL Estuarium, J. L. Scott Marine Science Center, and other Gulf coast education venues.

## **Wastewater Reuse and Storm Water Recharge Pilot Studies**

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Maintaining the water quality of our coastal bays and estuaries is a challenging task for storm water and waste water managers on the Alabama Gulf Coast. Urban development of south Baldwin County has increased the volumes of waste water and storm water discharges requiring treatment and disposal. The dynamics of growth and its affect on storm water runoff, potable water demand and wastewater treatment requirements pose opportunities to investigate systems that integrate the handling of each of these infrastructures in a symbiotic fashion.

New and innovative solutions must be developed that will address the current and future disposal issues for both storm water runoff and wastewater discharges. These solutions must maintain the highest level of in-stream water quality with sustainable applications that address the changes inherent with coastal development. These changes include reduced pervious land areas that increase storm water runoff and reduce groundwater recharge, increase the potable water demand and require additional wastewater treatment facilities or increased capacities to existing facilities. The ability to maintain a high standard for water quality is vital to attract new residents and tourists to our coastal area.

Riviera Utilities and the City of Foley have initiated pilot projects to study alternatives for both storm water recharge and reuse treatment techniques for wastewater effluent. These projects are the major focus of an EPA sponsored special appropriations grant. The studies are designed to: 1.) Investigate possible alternatives that can provide reuse water from wastewater effluent to offset the irrigation demand on the potable water system, and 2.) Investigate groundwater recharge techniques to maintain a base flow condition in local streams that can mitigate saltwater wedge affects in the estuaries and saltwater intrusion of local wells.

The reuse water pilot study utilizes a wetland polishing system with subsequent surficial aquifer recharge. Down gradient production wells recover the polished wastewater and recycle it into the existing Riviera wastewater disposal system for monitoring. Water quality results from this pilot system are monitored so comparisons to reuse standards can be made in hopes of establishing reuse regulations in the State of Alabama.

Riviera Utilities and the City of Foley have also developed a storm water disposal pilot project utilizing an existing abandoned air strip (Barin Field) to capture rainfall/runoff. This storm water is collected in retention ponds and recharged into a shallow surficial aquifer that, in turn, base flows into a tributary of Wolf Bay. The study is designed to compare runoff volumes of existing detention techniques to a system with groundwater recharge capability for varying rain events.

Riviera Utilities and the City of Foley have involved the local stakeholders (Wolf Bay Watershed Watch) in all aspects of the planning, construction and operation of these projects. Ongoing operation of these waste water/storm water projects will allow Riviera Utilities to evaluate the effectiveness and potential for improving storm water and waste water treatment and disposal in its service area.

## **The Coastal Alabama Rain Barrel Project**

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Stormwater is considered the leading cause of water quality degradation by the U.S. Environmental Protection Agency. In the Mobile Bay area, which receives an average of 66 inches of rain annually, increases in stormwater runoff are exceeding existing infrastructure capacities and causing more frequent episodes of flooding, sedimentation, debris polluted waters, habitat destruction, and decreased aesthetics and property values. As it flows toward Mobile Bay, stormwater degrades and erodes streams and rivers that provide habitat for fish and wildlife. Stormwater runoff, if not managed to reduce its volume, velocity, and pollutant load, will deteriorate the quality of water in Mobile Bay, negatively impacting our economy, our coastal ecosystems, and most importantly our quality of life.

Recent and ongoing watershed planning Mobile and Baldwin Counties have indicated a need for a sustained outreach and education program focused on mitigating the impacts of residential stormwater runoff. The D'Olive Creek Watershed Management Plan recognized the contribution of residential parcels to stormwater runoff-related problems and specifically addressed the need for a pilot program in coastal Alabama to increase the visibility of rain barrels and to promote the use of this and other stormwater retention techniques by property owners. The goal of this project is to educate the citizens of Mobile and Baldwin Counties on the impacts of stormwater and the benefits of residential rainwater harvesting through rain barrel and Low Impact Development (LID) demonstrations and rain garden workshops.

The Coastal Alabama Rain Barrel Project provides guidance to property owners enabling them to individually retain stormwater on their property, reducing stormwater runoff flow and therefore the associated negative impacts on Mobile Bay. This educational effort combines LID demonstration sites and educational workshops which include information about stormwater, ground water recharge, water conservation, the use of garden-friendly harvested water, and the benefits of harvesting water for our streams and creeks by reducing residential stormwater inputs.

Upon completion of the rain barrel workshop, participants will exhibit increased knowledge of stormwater issues and the importance of adopting sustainable practices related to residential stormwater runoff. Workshop participants will also exhibit increased knowledge of the water cycle, ground water recharge, and residential stormwater management practices. Participants will receive a functional, high quality rain barrel which will be installed at their residence along with instruction on other methods to reduce residential stormwater impacts..

## **Watershed Management Plan for D'Olive Creek Watershed**

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D'Olive Creek drains a highly urbanized 7,700-acre watershed flowing into Mobile Bay from Baldwin County's Eastern Shore. Based on the intense growth this region has consistently experienced since the 1990s, there is a strong possibility the D'Olive Watershed could reach a 100% "build out" condition by 2020. This would result in the conversion of much of the remaining 45% of forest and agricultural lands to various urban uses, representing an increase in the watershed's Impervious Cover from the current 25% to approximately 38% by 2020. The significant consequences of urban development has been accelerated stormwater runoff; erosion rates that are 14 times greater than natural conditions; deteriorated stream and wetland habitats; and high sediment loading rates delivered to Mobile Bay. Much of the watershed's 23 miles of streams are included on Alabama's 303(d) list of impaired waters due to the sediment problems.

A coalition of federal, state, and local agencies; business interests; and "grass roots" organizations cooperated to develop the D'Olive Watershed Management Plan to reduce the sediment problems and to modify the land use conditions that influence stormwater management and the delivery of sediments to the watershed's streams. A principal goal of the Watershed Management Plan is the reduction of sediment loads into Mobile Bay. Among the secondary objectives of the Plan is the maintenance of Impervious Cover in the Watershed to no more than 25%.

The D'Olive Watershed Management Plan was completed in August 2010 and included 22 specific recommendations that are directed at (1) restoring the Watershed's hydrology to the extent feasible; (2) reducing sediment loads transported downstream to the Mobile Bay system; (3) removing the D'Olive Watershed streams from the State's 303(d) list of impaired streams; (4) contributing to maintaining quality of life issues within the D'Olive Watershed; (5) modification of the regulatory environment controlling and influencing development within the Watershed; and (6) reducing the amount of future public funds ultimately required to repair degraded streams in the D'Olive Watershed.

The Plan also outlined strategies to implement the recommendations. The strategies include: (1) establishment of an intergovernmental Watershed Restoration Task Force to focus prioritization and cooperation in the implementation of the recommended measures; (2) creation of a community outreach and public education program; (3) identification of potential funding sources to implement plan; and (4) description of a monitoring program to gage the success of the recommended management measures.

## **Rivers as Systems: Implications for Sustainable Policy and Management**

Mike Kensler

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Our understanding of the functioning of rivers as systems, including the importance of flow regime, connectivity to groundwater, floodplains, and between upstream and downstream segments, geomorphology, and other factors, has grown significantly over the past twenty years. At the same time, water policy and management have not evolved to match our growing scientific understanding of rivers as systems and their ecosystem services from which we benefit. The limits and liabilities of current approaches to water policy and management are becoming apparent throughout the Southeast and beyond as population growth and development place ever higher demands on limited water resources, and as ongoing land use changes further disrupt the functioning of ecosystems and the ecosystem services they provide.

This presentation will explore the disconnect between current policy and management practices and what we are learning about river systems, and identify opportunities for different, more sustainable approaches to land and water policy and management that better reflect our understanding of river ecosystems, and more accurately account for the beneficial services they provide.

## **Building Healthy and Sustainable Communities through Citizen Involvement, Community Partnerships and Utilization of Science**

Debra Love

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The Prichard Environmental Restoration Keepers (PERK) is a grass roots organization of citizens and businesses, committed to the preservation and restoration of the city's and surrounding area's natural and cultural environment. This community-based organization works very closely with the City of Prichard. Together, they have created partnerships with an array of private, governmental, and community organizations. Chief among these are strong and visible relationships with, local businesses, health organizations, Federal and State environmental agencies and educational institutions. Local community action agencies and housing authorities have played a pivotal role in furthering PERK's goal of establishing healthy sustainable communities. PERK, formed in April 2008, responded to critical environmental concerns of citizens regarding a plethora of environmental issues including air and water quality and the preservation and restoration of important habitat.

Prichard's undeveloped forested, wetland, and aquatic environment, is particularly fragile in light of existing environmental pressures and recent events on the Gulf Coast. Moreover, the waterways are surrounded by areas designated as floodways or floodplains, posing even greater environmental risks to a wider area.

The goal of PERK and its partners is to educate, inform and preserve the natural habitat within the City of Prichard and surrounding areas. This organization serves as one of the major partners in the City of Prichard's Community Action for a Renewed Environment (CARE) program which is funded by the Environmental Protection Agency (EPA). CARE endeavors to reduce exposures to toxic pollutants through collaborative action at the local level; help communities understand all potential sources of exposure to toxic pollutants; work with communities to set priorities for risk-reduction activities; and create self-sustaining, community-based partnerships that will continue to improve the local environment. Care partners include the Mobile Bay National Estuary Program and the Auburn University Marine Center. They are excellent partners that provide scientific resources for 8 Mile Creek and Gumtree Branch to deal with the sanitary sewer overflows, failing septic systems and urban runoff.

Employing a scientific brand that includes several scientists within the model helps to build public trust, improve the quality of human lives, establish a good reputation and create sustainable solutions. The diversity shown in the members of the partnership is a great model for creating the self-sustaining and community based partnerships that will continue to improve human health and the environment.

## Charismatic Phytoplankton of Fish River: Changes in Phytoplankton Composition and Abundance

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Microalgae are major contributors to global primary productivity and because they are at the bottom of the food chain, they impact the entire ecosystem. Both microalgae species composition and total biomass are determinants of ecosystem responses. The Weeks Bay watershed experienced several harmful algal blooms and hypoxic conditions in 2007. While these events were studied in detail, the critical knowledge of pre-bloom conditions was missing. The goal of this study was to describe long-term variability in phytoplankton community composition and to relate it to environmental variability. Phytoplankton species abundance at the mouth of Fish River was monitored every two weeks from 2008 to 2010. This site was selected based on the historical occurrence of phytoplankton blooms in this location. It is also the site of one of NOAA's SWMP data loggers that continuously records temperature, salinity, turbidity, pH, depth and dissolved oxygen levels. Chlorophyll *a* concentrations ranged from 2.2 to 160.5 µg/l and were correlated with concentrations of total N and P. The phytoplankton composition was very dynamic, oscillating between high abundances of cryptophytes, chlorophytes or cyanobacteria, interspersed with blooms of the raphidophyte *Heterosigma* spp., the dinoflagellates *Prorocentrum minimum* and *Heterocapsa triquetra*, and the diatoms *Synedropsis karsteteri* and *Cyclotella* spp. The temporal variation in phytoplankton composition was compared with environmental descriptors using an iterative non-parametric correlation analysis. The analysis suggests that discharge and temperature are important covariates of community composition.

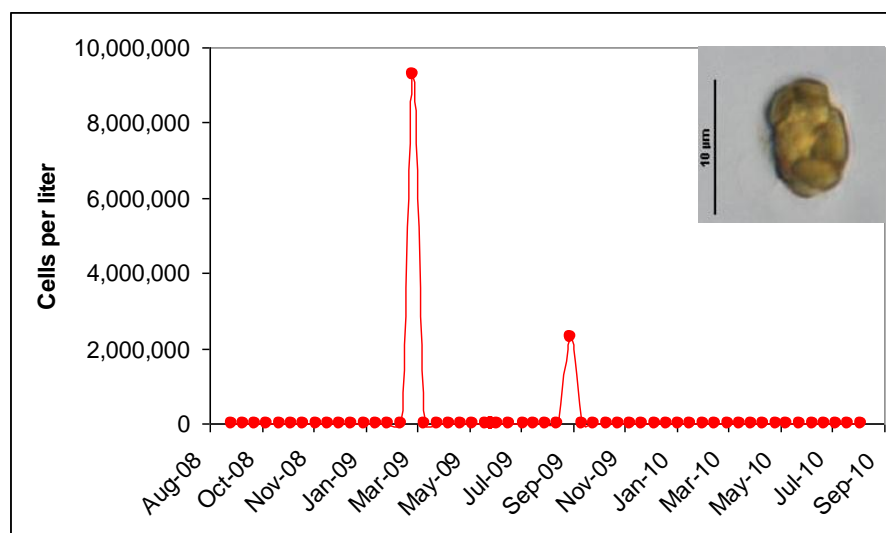


Figure 1. Abundance of the raphidophyte *Heterosigma akashiwo* during a period of 2 years. The frequency of sampling allows analysis of conditions before, during, and after the bloom.

**The Impact of Grazing on the Toxic Diatom *Pseudo-nitzschia* and the Phytoplankton Community in Little Lagoon, AL**

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Microzooplankton grazing has a strong influence on the abundance and composition of phytoplankton in many aquatic systems. The impacts of microzooplankton grazers on phytoplankton in Little Lagoon, a shallow, poorly-flushed coastal lagoon located in Baldwin Co, AL., were assessed through a series of 8 dilution grazing experiments carried out from April 2009 to August 2010. Little Lagoon has previously been shown to be a hot-spot for blooms of the potentially toxic diatom *Pseudo-nitzschia*, with bloom densities being correlated with discharge from the local aquifer. Microzooplankton grazing rates, the abundance and growth of microzooplankton, and intrinsic and potential growth rates of phytoplankton were determined in each experiment. Analysis of phytoplankton marker pigments was used to determine the selectivity of grazing by microzooplankton and its effect on the structure of the phytoplankton community. Phytoplankton identification and cell counts were also performed to assess selectivity of grazing on diatoms, including *Pseudo-nitzschia*. High grazing and high growth rates co-occurred and both processes were positively correlated with temperature. Selective grazing of the phytoplankton community was observed in some experiments, with diatoms and dinoflagellates appearing to be more negatively affected by increased grazing pressure. Small, chain-forming diatoms, including *Pseudo-nitzschia* appeared to experience heavier grazing within the diatom population.

Discharge events into poorly-flushed systems like Little Lagoon likely result in both an increase in available nutrients and a reduction in grazing intensity due to dilution. The results of these experiments indicate that a temporary reduction in grazing pressure in the presence of available nutrients will favor small, chain-forming diatoms and may help explain the association of *Pseudo-nitzschia* blooms with periods of high aquifer discharge. These results highlight the importance of top-down control in structuring phytoplankton communities and in the formation of harmful algal blooms..



## Developing Effective Nuclear Magnetic Resonance (NMR) Tools to Facilitate the Identification and Subsequent Remediation of Harmful Algal Blooms (HAB)

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HAB are a major financial, ecological, and human health problem worldwide. These events are typically associated with toxin production. The major problem in the isolation and identification of HAB toxins is the availability of compound and the limits of the current structural elucidation technologies. These problems have necessitated the creation of new technologies and the redesigning of established techniques to aid in the structural determination of HAB toxins. Understanding the structure and nature of the toxin is crucial to the design of remediation efforts. Identifying the exact species responsible for the aquatic devastation can be time consuming and almost impossible because blooms are generally complex mixtures of organisms. Quick identification of the toxic components is critical to the remediation efforts and essential to the avoidance of massive environmental and monetary consequences. Developing a relatively high-throughput screening method for the identification of crude HAB toxins will help to decrease response times and the devastating impacts HABs have on the global environment and economy.



Figure 1. Massive fish kill in Maryland in 1997 and 2001 due to HAB events.

As early as 1957, the dinoflagellate *Karlodinium veneficum* was reported to have high toxicity and has continually been associated with fish kills worldwide. Karlotoxins (KmTx) originate from this species; however, due to technological limitations the toxin structures were not elucidated until recently with the absolute configuration unresolved until 2010. These compounds show hemolytic, cytotoxic and ichthyotoxic activity. This project uses innovative NMR HSQC overlay experiments to determine the complex planar structures of 8 new KmTx molecules. The data gathered from this project will be utilized in the development of a screening method to identify the presence of KmTx at an HAB. The future of this project will be to expand the monitoring to include other HAB toxins and refine and develop this method along with a simple purification scheme to quickly identify the responsible toxin and enable prompt remediation. This methodology has the potential to be an effective and life saving tool for the aquaculture industry and environmental agencies during an HAB.

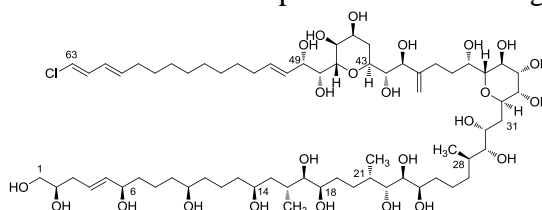


Figure 2. The absolute configuration of Karlotoxin 2 which is the most potent of the suite of toxins elucidated to date from *Karlodinium* blooms worldwide.

## **A Review of the Hydrographic Data Collected During the Response to the Deepwater Horizon Incident**

A. Rost Parsons\*<sup>1</sup>, Hernan E. Garcia<sup>2</sup>, Scott L. Cross<sup>1</sup>, Betsy Schenk-Gardner<sup>1</sup>, Julie A. Bosch<sup>1</sup> and Russell H. Beard<sup>1</sup>

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During the response to the Deepwater Horizon Oil Spill, over 1500 hydrographic profiles were collected to characterize both the environment and the signature of subsurface hydrocarbons released during the spill. Data was processed by NOAA's National Oceanographic Data Center (NODC) and provided to the National Incident Command's Joint Analysis Group (JAG) and the public.. In supporting the JAG, NODC contributed to the analysis of the profile data as well as comparisons to climatological or expected conditions. This presentation will review the regional oceanography derived from the data and significant analyses conducted by NODC. A finding confirmed by many monitoring and research efforts was that dissolved oxygen and chromophoric dissolved organic matter fluorescence data were key signatures of the subsurface hydrocarbons. Additionally, the subsurface indicators of hydrocarbons were correlated in the vertical with the potential density anomaly surface of  $27.71 \text{ kg m}^{-3}$ . A broad sampling was directed National Incident Command after the wellhead was capped on July 15, 2010 that found indicators of the subsurface hydrocarbons extending at least 400 km to the southwest of spill. NODC's analysis of the entire volume of dissolved oxygen data for the JAG confirmed that hypoxic conditions at depth were not observed. The authors wish to acknowledge their colleagues on the Joint Analysis Group and acknowledge the data collection of the scientists and crews of the research vessels involved in the response effort.

## **Influence of Oil and Dispersant on Optical Properties of Dissolved Organic Matter in the Mississippi Sound/Bight**

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Time-series water samples were collected at stations along a salinity gradient from the Mississippi Sound/Bight in the northern Gulf of Mexico. Flow-Field Flow Fractionation (FIFFF; a size fractionation technique), fluorescence excitation/emission matrix (fluoEEM), and UV-visible spectrometry were used to examine the effect of oil and dispersant on optical properties of seawater and size distribution of dissolved organic matter. Results of fluoEEM measurements and PARAFAC analysis show that the component of oil-signature in surface seawater increased with increasing salinity, ranging from 25% in near-shore to 31% in coastal waters, indicating a source of oil from offshore waters. However, the component of dispersant-signature doesn't seem to differ much between stations, with a general proportion of 36%. While bottom water at the offshore station (NGI-8) had a very low oil signature in May 2010 compared to its surface water counterpart, prominent oil signatures were observed in July, indicating the presence of oil in the bottom water. The size spectra show that signatures of both oil fluorescence and CDOM in seawater samples decreased rapidly with increasing size, with a predominant peak in the 1-4 nm.. In addition, seawater containing dispersant had a colloidal size spanning from 1 to 8 nm. This contrasts with the two major size species, 1-4 nm and 4-20 nm, measured for pure dispersant. More measurements are needed to quantify the effect of oil on size distribution of natural dissolved organic matter in the northern Gulf of Mexico..

## **The Impact of the Deepwater Horizon Oil Spill on Trace Element and Nutrient Distributions**

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In order to understand the impact of the Deepwater Horizon oil spill on the trace element and nutrient distributions, samples were collected from both oil contaminated and uncontaminated areas around oil rig explosion site during two cruises in May 2010. The spill could affect the distribution of trace elements by both direct and indirect means. Directly, some trace elements (e.g., nickel, vanadium, zinc) are enriched in crude oil, and could be released to the water column. Indirectly, the speciation, solubility, and chemical fluxes could be affected by how the spilled oil: a) affects the distribution of oxygen (e.g., oxygen depletion), b) increases dissolved phase complexers such as sulfur compounds and organics in the crude oil, and c) affects the surface of particles and sediments thereby altering dissolved/particulate partitioning. Although more detailed analyses are needed, preliminary results of analyses revealed little impact on the trace element and nutrient distributions. Ongoing studies will provide information for more elemental quantification (e.g., copper, zinc, nickel) and will be used to compare the distributions from before and after the oil spill.

## **Publicly Available Research-Quality Data from the Deepwater Horizon Response Effort**

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The response to the Deepwater Horizon disaster has generated a wealth of data that can fuel research on Gulf of Mexico physical and biogeochemical systems for years to come. Data used to track the extent and fate of deep subsurface hydrocarbons have been assembled by the National Oceanographic Data Center for the Joint Analysis Group (the JAG), an interagency group tasked with providing quick-look analysis of subsurface data to inform response efforts.. This dataset includes more than 1500 conductivity-temperature-depth (CTD) casts and corresponding Niskin bottle sample data for chemical analyses of hydrocarbon concentration as well as analyses of suspended particle size distribution and concentration. These data have undergone initial quality assurance/quality control (QA/QC) and are publicly available. The assembled dataset is hosted on a JAG website (<http://ecowatch.ncddc.noaa.gov/jag>) and is being archived at the NOAA National Oceanographic Data Center (<http://www.nodc.noaa.gov/General/DeepwaterHorizon/support.html>). This poster will describe the data collection effort in relation to the time-series of Deepwater Horizon spill events, the QA/QC procedure, and the available formats and access points.

## Isolation and Characterization of Pharmaceutical and Personal Care Product Degrading Bacteria from Weeks Bay, Alabama

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Pharmaceuticals, plasticizers, steroids and trace organics, both natural and anthropogenic, are a growing concern in aquatic ecosystems. Collectively these compounds are referred to as “pharmaceuticals and personal care products” (PPCPs). Some PPCPs have been shown to have detrimental effects such as endocrine disruption. As such they pose risks to human populations when present in finished drinking water and to aquatic biota when released into the natural environment. In order to understand the fate of these compounds in aquatic environments we isolated bacteria capable of degrading one of five model PPCPs: Bisphenol A, a component of polycarbonate plastics; N, N-Diethyl-*m*-toluamide (DEET), the active ingredient in most insect repellents; 5-Chloro-2-(2,4-dichlorophenoxy)phenol (Triclosan), an antibiotic found in many antibacterial consumer products; carbamazepine, an anticonvulsant and mood stabilizing drug; and naproxen, a non-steroidal anti-inflammatory drug. Enrichment cultures were established using sediments from the Weeks Bay National Estuarine Research Reserve and serially diluted onto agar plates with PPCP as the sole carbon and energy source in order to obtain pure PPCP degrading cultures. The 16S rRNA gene was amplified from each isolate and amplified ribosomal DNA restriction analysis (ARDRA) was performed to separate the bacteria into different phylogenetic groups. Over 100 PPCP degrading cultures were isolated, representing over 25 phylotypes. Representatives of each phylotype were then selected for sequencing of the 16S rRNA gene. Pseudomonads were the most numerous genus found in our collections of carbamazepine, naproxen, and triclosan degraders, accounting for 37, 52, and 62% of those collections respectively. In contrast, the DEET degrading culture collection was dominated by Gram positive bacteria. Actinobacteria accounted for 40% of DEET degraders and Firmicutes accounted for 28% of the DEET degrading isolates. A degenerate PCR approach was utilized to identify potential PPCP degraders in the culture collection. Primers targeting angular dioxygenase genes were used to screen the triclosan degrading cultures. One positive amplicon was obtained and is currently being sequenced and characterized. Primers for DEET hydrolase genes failed to amplify a product from the DEET degrading strains, suggesting that these isolates may utilize a different strategy for DEET degradation. Plasposon mutagenesis is currently being used to identify DEET degradation genes. Our results indicate that a wide variety of Weeks Bay bacteria are able to grow on PPCPs. In the long term, data from this study will be used to develop molecular tools to assess PPCP degradation in the environment by linking PPCP degradation potential to the presence or absence of microbial degradation genes.



## **Cooperative Monitoring, Informational Flow and Management of Water Quality in Little Lagoon, AL**

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Little Lagoon, Alabama, is the site of a collaborative effort by researchers and students from five universities and volunteers from Little Lagoon Preservation Society (LLPS) to assess water quality for science-based management. Water quality has been monitored bi-weekly at 4-5 sites in the lagoon since 2007 to describe and understand physical, chemical, and biological interactions. The effort, funded by the National Science Foundation (NSF), MS-AL Sea Grant, and Alabama Department of Conservation (ADCNR), has enabled researchers to pursue and test ideas generated from 3+ years of volunteer assisted research.

Lagoon volunteers, trained and supervised by academic partners, sample five sites along dominant gradients in water quality in the Lagoon. They measure DO, salinity, temperature, pH, fecal coliform bacteria (FCB), and phytoplankton community composition. Further samples are collected for analysis of nutrients and microalgal pigments (HPLC). Community composition is based on microscopic identification of net plankton as part of NOAA's Phytoplankton Monitoring Network (PMN). Volunteers enter the data into two publicly-accessible data bases. Physico-chemical and biological data are maintained by the Alabama Volunteer Phytoplankton Monitoring Network (ALPMN). Taxonomic data are also submitted to PMN. Data analysis and interpretation concerning the effort are presented by researchers to LLPS members, the public, government officials, elected officials, press and other stakeholders at quarterly LLPS membership meetings in Gulf Shores and in press releases. More detailed presentations by the researchers will be provided to all interested parties in yearly one-day workshops.

Stakeholder education and facilitation of prudent management of Little Lagoon are primary goals of this effort. Rapid response management to protect the Lagoon during the Discovery Horizon oil spill necessitated significant interaction between researchers, industry, community, and government. Two tidal passes that connect the Lagoon to the Gulf of Mexico were effectively closed by City of Gulf Shores and FWS officials for nearly 4 months by constructing and maintaining sand berms across both channels (paid for and approved by BP). The berms effectively prevented oil from entering Little Lagoon during oil landfall and were designed to facilitate both opening the pass to allow drainage during periods of high rainfall and rapid re-closure during oil-contaminated flood tides. Sampling interval was decreased from every two weeks to every week based on concern with periodic, anomalous, bacteria levels during this period. Data and discussion of water quality in the lagoon were regularly provided to the City of Gulf Shores and stakeholders by LLPS and researchers during the closure. The data, researcher interpretations, and stakeholder communications were instrumental in a final decision to re-open Callaway Pass to tidal exchange.

## Depth-induced Variations in Hyperspectral Reflectance for Optical Water Quality Studies

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Optical water quality measurements are important aspects in environmental quality assessments. Vertical diffuse attenuation coefficient ( $K_d$ ) is an optical measure for how incident light is attenuated by suspended inorganic and organic solids, phytoplankton, and dissolved colors as it travels downward in the water column. Suspended and dissolved water column constituents absorb and/or scatter available light within the water column, thus hinder various light-dependent biological processes including photosynthesis. We studied how turbidity affects light transmission through the water column by developing an algorithm that models light attenuation in water using spectral reflectance values measured over an in-door experimental tank. Spectral measurements were made using an Ocean Optics USB 2000 unit over the water tank at varying depths in a dark room. Dissolved color for water samples was induced using pine straws that were soaked in the water for several months. Turbidity for water samples was induced by adding known amounts of oven-dried sand/silt/dirt. The tank was painted with non glossy black paint to eliminate extraneous reflectance of light. Light source was provided by constant illumination from two 90 W halogen flood lamps above the water surface, and a black panel was manually operated through a pulley system to control water depth. Reflected spectral energy was measured at three levels of turbidity (5, 12, and 20 NTU) at varying water depths (5-60 cm, with 5 cm intervals). The Beer-Lambert law ( $I_{z,\lambda} = I_0 e^{-K_d(z,\lambda)z}$ ) was used to derive wavelength-dependent  $K_d$  by incorporating the measured intensity values  $I_0$  (light level at the water surface) and  $I_z$  (light remaining at a depth of  $Z$  m). The  $K_d$  values were then plotted against with the water depths, which appeared to be hyperbolic at all wavelengths that we tested (400-900 nm). The best-fit hyperbolic equations were used to extrapolate wavelength-dependent  $K_d$  values to unknown depths. The constants for the best-fit  $K_d$ -depth model changed as the turbidity levels changed. Our results showed  $K_d$  values decreased with increasing turbidity as expected. The  $K_d$  values at shallow depths (5, 10, 15 cm) at 5 NTU were lower (0.75, 0.36, 0.20) compared to those at 12 NTU (0.95, 0.60, 0.32) and at 20 NTU (0.95, 0.45, 0.34). The Pearson correlation indicated a strong negative correlation with -0.815(5NTU), -0.782 (12NTU) and -0.782 (20NTU) all were significant at 0.01 level (2-tailed).



## Harmful Algae, Hypoxia and Fecal Coliform Bacteria in Little Lagoon, Alabama

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Little Lagoon, Alabama, is a coastal lagoon connected to the Gulf of Mexico by a narrow pass. There are persistent physico-chemical gradients between the ends of the lagoon and the pass that are consistent with inputs mixing between groundwater and ocean water as the end-members. Water quality has been monitored bi-weekly at 4-5 sites in the lagoon since 2007, supplemented with more intensive sampling in surveys and moorings.

Microalgal abundance (as chlorophyll *a*) is correlated with total nitrogen and total phosphorus. These in turn are inversely correlated both with salinity along the salinity gradient and are correlated with temperature on seasonal scales. Mixing diagrams show non-conservative trends and the very high concentrations of N and P in sediments imply that benthic coupling is an important source. Dissolved oxygen concentrations were correlated with temperature over 3-year record and there was little evidence for hypoxia in the bi-weekly monitoring samples. These are surface water and are collected in the day. There were some instances of nocturnal hypoxia from moorings in the summer, when DO is lowest.

Microalgal community composition varies seasonally from domination by diatoms to domination by cyanobacteria and green algae. The transition occurs at 25 – 40 °C. Toxic diatoms in the genus *Pseudo-nitzschia* can dominate the microalgal community. Bloom density along the Fort Morgan Peninsula is correlated with discharge from the aquifer and the bloom dynamics in Little Lagoon are consistent with discharge being the ecological driver. Blooms inside Little Lagoon are toxic and production of domoic acid is correlated with reduced nutrient availability.

Numbers of fecal coliform bacteria are highly variable but the dynamics are not correlated with any of the water-quality parameters measured in parallel (temperature, salinity, nutrient concentrations etc.), nor are there systematic trends between sites. Numbers were consistently high at all sites during a period when Little Lagoon Pass was closed to prevent ingress of oil following the Deepwater Horizon oil spill.

## **Variations in the Partitioning of Carbohydrates between Dissolved and Particulate Phases in the Bay of St. Louis**

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Carbohydrates (CHO), including monosaccharides (MCHO), polysaccharides (PCHO) and particulate carbohydrates (p-CHO) are the major component of natural organic matter and play an important role in biogeochemical cycle of carbon and trace elements. The extracellular acid polysaccharide abundance may be used as a proxy for toxicant levels or low nutrient concentration in the water column. We have investigated the distribution of dissolved and particulate CHO in the Bay of St. Louis (BSL) using both field measurements and laboratory mixing experiments using waters collected from the Jourdan River (S=0) and the Gulf of Mexico (S=30.6). The results shows that DOC and total dissolved carbohydrate (TDCHO) decreased with increasing salinity for both the mixing experiment and also for the samples collected along the salinity gradient in the BSL and the Mississippi Sound. About 80% of the total CHO was in the dissolved phase and 20% in the p-CHO phase during mixing experiment. Among the dissolved CHO phase, MCHO was the predominant species (88%) with 12% measured in the PCHO, indicating the presence of highly degraded dissolved organic matter in the river and coastal waters. During mixing, no significant production of p-CHO was seen. The results from the field samples show that 70% of the total CHO was in the d-CHO and 30% in the p-CHO phase. In addition, MCHO was dominant in the d-CHO pool (76%) and p-CHO was 24% in early summer in the Mississippi Sound/Bight, whereas results from late summer samples show decrease in MCHO (50%) and increase in p-CHO (50%), likely due to the degradation of dissolved and particulate organic matter or the effect of oil contamination.

### Three Years of Alabama Volunteer Phytoplankton Monitoring Network (ALVPMN): “Pros and Cons”

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Alabama Volunteer Phytoplankton Monitoring Network (ALVPMN) is an outreach program that was established in 2007. Our main objectives are to monitor phytoplankton along the coast of Alabama, to identify general trends in harmful algal blooms (HABs), and to increase public awareness of phytoplankton related issues. Currently, our volunteers monitor phytoplankton composition and abundances at nine stations along the Alabama coastline. Volunteers sample one or more stations once every two weeks by towing a 20- $\mu$ m net, identifying and counting the phytoplankton under the microscope, and recording their findings online. Raw cell counts and supporting data (basic water quality) are archived online on our own website (<http://habs.disl.org/phytoplankton.html>) and summaries of cell counts are reported to NOAA's Phytoplankton Monitoring Network (<http://www.chbr.noaa.gov/pmn/default.aspx>) which provided training and sampling equipment. We work in close collaboration with colleagues at the Alabama Department of Public Health and ALVPMN is one component of *The Harmful Algal Bloom (HAB) Response Plan for Alabama* (Gulf of Mexico Alliance).

In the last three years, our volunteers have collected a total of 718 samples and successfully detected reoccurring blooms of four potentially-toxic organisms: *Prorocentrum minimum* and *Karlodinium veneficum* (dinoflagellate), *Pseudo-nitzschia* spp. (diatom) and *Chatonella* spp. (raphidophyte). Other toxic algae such as the dinoflagellates *Dinophysis* spp. and *Pyrodinium bahamense* and diverse cyanobacteria were detected in small numbers. Blooms of other non-toxic diatoms (*Chaetoceros* spp., *Skeletonema* spp., and *Nitzschia* spp.) and euglenoids were also recorded. Low oxygen conditions ( $<4$  mg l<sup>-1</sup>) were measured on 26 occasions.

An assessment of the pros and cons of maintaining ALVPMN shows that it is an asset in early detection of HABs. The volunteers live in a close proximity to the water bodies that they monitor, so are stakeholders who are personally invested in monitoring water quality. They are also able to collect, analyze and report on a sample very quickly.. Having “eyes and ears” along the coast line is an irreplaceable resource. The major drawback of the network is methodological: the phytoplankton counts are not quantitative. The 20-  $\mu$ m mesh size of the net excludes much of the biomass and many ecologically-important taxa and the sampling protocols are not quantitative. Consequently, the results are qualitative, making them impervious to statistical analysis and incomparable with counts from other methodologies.



Figure 1. Homepage of ALVPMN website with available links.

## **Fingerprinting *E. coli* Communities in Little Lagoon, AL to Understand Their Potential Sources**

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Since 2007 the number of fecal coliform bacteria (FCB) in the water column of Little Lagoon, AL has been monitored in a collaboration between the Little Lagoon Preservation Society (LLPS) and researchers at the Dauphin Island Sea Lab (DISL) and Dalhousie University (DU). Over this time period, the concentrations of FCB at five sites within the lagoon have varied, with some samples showing concentrations well above the regulatory threshold of 200 CFU l<sup>-1</sup>. The source of the FCB remains unknown, with no correlation between the concentration of FCB and any other measured parameter, including temperature, salinity, nutrients or microalgal community composition (see poster by MacIntyre *et al*). FCB may represent a threat to human health or the health of other organisms within the lagoon: however until the source of the FCB is determined, it is impossible to develop a long-term management plan (see poster by Hatfield *et al*).

Because FCB represents a wide range of different types of bacteria, including some that occur naturally within the environment, it is necessary to further identify the organisms present in the water column of Little Lagoon and link their identity to potential sources. One method of identifying bacteria is through the use of DNA fingerprinting. A combination PCR and denaturing gradient gel electrophoresis (DGGE) has been used to generate fingerprints which represent the specific *E. coli* community present in each sample. Samples were collected during a period when Little Lagoon Pass was closed, when high levels of FCB were detected, and after the pass was re-opened. (The pass was closed in response to oil from the Deepwater Horizon spill.) Three different genes in *E. coli* have been used for fingerprinting, giving us a clear measure of the diversity of the *E. coli* present within Little Lagoon. These fingerprints will be compared to fingerprints generated from potential sources of FCB contamination to identify which are the most likely sources of FCB in Little Lagoon.

## **The Gulf of Mexico Alliance (GOMA) Nutrient Reduction Campaign: Using Community Based Social Marketing to Educate Homeowners on Healthy Lawn Care Practices**

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Concern over the contribution of residential fertilizers to nutrient loading in waterways has spurred a recent focus on the impact that homeowners' lawn care practices have on local water resources. Research has shown that a properly managed yard can absorb nonpoint source pollution, help to stabilize soil quality, reduce ambient air temperatures, and promote a healthy ecosystem. However, fertilizer applied improperly or in excess may result in nutrient runoff to waterways, adding unhealthy levels of nitrogen and phosphorus to those water bodies. Nutrient runoff can lead to eutrophication and hypoxia, both of which negatively impact the Gulf of Mexico.

Based on the results of the Gulf of Mexico Alliance (GOMA) Environmental Awareness Campaign Social Marketing Plan produced by the University of South Florida's Center for Social Marketing, GOMA is conducting a nutrient reduction campaign aimed at reducing nutrient input into the Gulf of Mexico. The objective of this campaign is to elicit behavior change from homeowners regarding their lawn care practices; thereby improving the ecological health of the Gulf of Mexico by reducing the amount of residential nutrient runoff. The Social Marketing Plan identified Cooperative Extension Services as trusted agents in community education of lawn care and landscape practices. Subsequently, the GOMA Education and Nutrient PITs established a partnership with the United States Department of Agriculture (USDA) Cooperative Extension Service's Master Gardener Programs in the Gulf States. This partnership will utilize the skills and expertise of Master Gardeners to educate homeowners on proper lawn care practices.

Additionally, GOMA has established a partnership with the Scotts Miracle Gro Environmental Stewardship Department, and is consulting a professional social marketer to assist in development of appropriate social marketing messages for the campaign. Launch of the campaign is scheduled for spring 2011.

*Bays and Bayous*  
December 1-2, 2010

**--Living Resources Session: Understanding the Flora and Fauna of Coastal Ecosystems--**

*(in order of program listing)*

## Living on the Edge: Ecosystem Dynamics in Shallow Coastal Lagoons in the NW Gulf Of Mexico

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Although shallow lagoons are important components of coastal ecosystems, there are few data sets that focus on their long-term dynamics. Shallow lagoons are usually connected to estuaries and bays, but their metabolic rates and processes may differ significantly from the larger systems. Their limited depth and proximity to land make them particularly vulnerable to changes in the watershed, such as increased nutrient loading and excessive input of organic matter. These characteristics have important implications for monitoring. The effects of eutrophication are potentially easier to detect in a shallow lagoon than in the deeper parts of an estuary. This requires a good understanding of the ecosystem dynamics in these lagoons.

Here we report the results of an ongoing long-term study on ecosystem metabolism in three shallow lagoons with varying degrees of anthropogenic impact, located in Perdido Bay, Florida. For each of the lagoons, we related metabolic rates to producer biomass, secondary production, detrital biomass, water quality and environmental parameters. Our results indicate a long term decline in primary production in the seagrass beds, associated with a gradual decline in seagrass biomass. Benthic primary production in adjacent, unvegetated habitats exhibited seasonal fluctuations but remained constant over longer periods of time. The decline in biomass did not result in a reduction of the size of the seagrass beds as might be expected. On the contrary, in one of the lagoons, the seagrass bed increased in size. This was likely due to a change in the dominant seagrass species, from *Halodule wrightii* to *Ruppia maritima*.

## **The Identification of Critical Spotted Seatrout Spawning Habitat in Mississippi Coastal Waters Using Passive Acoustic Technology.**

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Spotted seatrout, *Cynoscion nebulosus*, is a highly prized saltwater recreational fish in the Gulf of Mexico. Given that they spawn in estuarine and nearshore waters and are highly exploited, a critical need for sustainability is to assess and protect spawning habitat. The objective of this study was to use passive acoustics to identify locations of spotted seatrout spawning aggregations based on male courtship sounds. The following environmental parameters were also measured at sampling sites and were used to evaluate spawning habitat: temperature, salinity, dissolved oxygen, depth, flow, and bottom type. The acoustic survey was conducted within two Mississippi estuaries: Grand Bay (a pristine bay included in the National Estuarine Research Reserve) and Biloxi Bay (a heavily impacted bay) from May to September 2008 and 2009. Seatrout aggregations were heard at nearly three times as many locations in Grand Bay (n=93) compared to Biloxi Bay (n=24). In Biloxi Bay, salinity (>22 ppt) was significantly higher in locations where spotted seatrout aggregations were present, and a positive association with artificial structure was observed. In Grand Bay, stations containing aggregations were in significantly deeper water (> 2.5 m) than stations without aggregations, and aggregations were often associated with sandy bottom habitat. Additionally, the majority of spotted seatrout spawning aggregations in both estuaries were within close proximity (< 0.4 km) to steep bathymetric relief (1-2 m). This research needs to be expanded throughout Mississippi coastal waters to gain a better understanding of critical spotted seatrout spawning habitat.



## **Characterizing the Demise and Recovery of the Macrobenthic Community at a Key Site Located in the Center of the 2008 Coastal Mississippi Hypoxic Zone**

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Adverse effects of coastal eutrophication cause major ecosystem disruption. Furthermore, population growth and climate change continue to exacerbate effects of eutrophication worldwide. Coastal resource managers need reliable coastal indicators. Macrobenthic communities offer effective indicators of biotic integrity, but their use for distinguishing anthropogenic from natural stress is tricky because coastal taxa are eurytolerant. Existing benthic indices based largely on taxonomic information are not equally sensitive to all types of stressors. Effective coastal management calls for benthic indicators that respond to specific stressors, apply across different habitats, and reflect ecosystem function. Organic enrichment followed by hypoxia engenders depauperate macrobenthic communities consisting of small short-lived opportunistic organisms. Thus, macrobenthic process metrics based on body-size descriptors should reflect ecosystem function and be useful for assessing the effects of eutrophication.

Coastal Mississippi experienced widespread and sustained hypoxia throughout summer 2008. Our site 6 located on the 10-m isobath in the center of the 2008 hypoxic zone served as a study area for examining effects of this event. Macrobenthic samples taken in 2008 and 2009 represented this site prior to hypoxia, during severe hypoxia, and following a return to normoxia. Production potential and total abundance decreased dramatically by about an order of magnitude after severe hypoxia, and steadily increased thereafter. Initial declines in mean size and community turnover rate were not nearly as pronounced, but still remained lower throughout the study period. Normalized biomass-size spectra (NBSS) varied markedly among months: prior to hypoxia in May 2008 the NBSS comprised high abundances of organisms distributed across a very broad range of size classes. During severe hypoxia abundances of all size classes were dramatically reduced or lacking, but some recovery of smaller size classes was evident upon a return to normoxia in November 2008. The NBSS had still not fully recovered by May 2009, after one year. The Benthic Index for the Gulf of Mexico developed by the USEPA for assessing estuarine health was not very useful for diagnosing the effects of hypoxia at this site on the Mississippi Bight. Prior to severe hypoxia, a diverse macrobenthic community comprised arthropods, bivalves, cnidarians, and various polychaetes. During hypoxia, the main survivors were three polychaete taxa. One of these, *Paraprionospio pinnata*, proved to be a superior opportunist following a return to normoxia. By May 2009, dominance by the acorn worm, *Balanoglossus*, indicated an advancing stage of succession.

## Nile Tilapia Establishment in Coastal Mississippi: Multi-Year Survival Confirmed by Otolith Ages

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Tolerance and adaptability to changing environmental parameters have made Nile tilapia (*Oreochromis niloticus*) a hardy and desirable aquaculture species. These traits have also enabled this fish to become a highly successful invasive species into temperate and subtropical aquatic environments. Otolith-based ages of Nile tilapia (41.3 - 400.0 mmTL, 1.34 - 1,293 g WW, n = 259) from a power plant cooling reservoir and the Pascagoula River proper in coastal Mississippi, USA, indicate that they may reach ages up to 4+ years old and confirm establishment. Marginal increment analysis along with sulcal groove length age estimation of the young-of-the-year tilapia indicated one annulus (opaque zone) per year was being deposited from April to August. In contrast, Nile tilapia deposit biannuli (two opaque zones) in their native African habitat in association with changes in water temperature due to wet/dry seasons. We believe this provides direct evidence for the seasonal formation of opaque zones in otoliths due to climatic temperature changes as opposed to increments induced as a result of biological processes such as feeding or reproduction. Additionally, the life history metrics we measured for Nile tilapia in coastal Mississippi are nearly identical to those reported from African environments, which indicates that they are flourishing in this non-native habitat.



Figure 1: Otoliths of non-native Nile Tilapia (*Oreochromis niloticus*) collected 27 October 2004 in Pt. Daniels cooling pond, Pascagoula, Mississippi. Tilapia A: 3+ yr, 393 mmTL, 1247 g WW; Tilapia B: 4+ yr, 371 mmTL, 1021 g WW

## Evaluating the Importance of Nearshore Waters for Coastal Sharks in the Northern Gulf of Mexico

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Several studies have suggested that populations of large sharks are declining worldwide (Myers et al. 2007 and others). Most sharks are long-lived, slow growing fishes that reach sexual maturity at a late age and large size; these traits, coupled with long gestation periods and low fecundity make these species especially vulnerable to over-harvest (Figure 1).



Figure 1. Photograph of a sandbar shark (*Carcharhinus plumbeus*).

It is important that adequate management for these fishes is implemented as declines in shark populations may be attributed to overharvesting, incidental bycatch and insufficient management. To that end, the National Marine Fisheries Service (NMFS) initiated an annual fisheries-independent bottom longline survey in 1995 to monitor the status of shark populations in the Gulf of Mexico. NMFS vessel limitations preclude sampling in shallow waters; therefore, in 2006 the Fisheries Ecology Laboratory at the Dauphin Island Sea Lab (DISL) initiated a fisheries-independent bottom longline monitoring program to evaluate fine scale patterns of shark abundance and distribution in the coastal waters of Alabama. In order to examine habitat utilization by sharks along the continental shelf (2-366m) data from the NMFS offshore survey were analyzed in combination with the nearshore data from the DISL survey (Figure 2). The combined data set (1995-2008) yielded 22 species of sharks with 12 species in the nearshore dataset (2006-2008) and 21 species in the offshore dataset (1995-2008). Multivariate analysis of the datasets revealed depth to be a determining factor in the community structure. Atlantic sharpnose (*Rhizoprionodon terraenovae*), blacknose (*Carcharhinus acronotus*) and blacktip (*Carcharhinus limbatus*) sharks were the most abundant species causing these differences in community structure. Blacktip shark CPUE was higher in shallow water (<10 m), while blacknose sharks had higher CPUE at mid-depth (10-30 m). Atlantic sharpnose

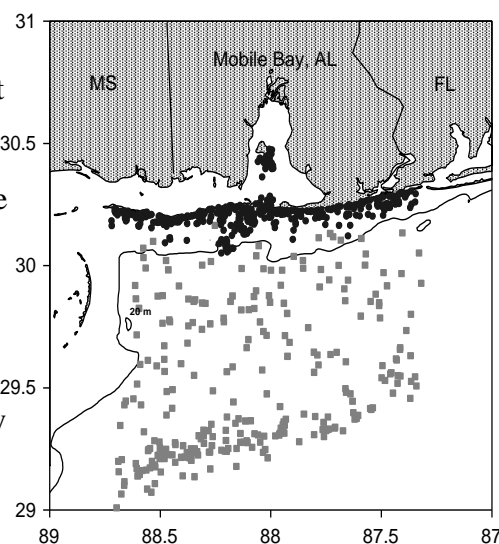


Figure 2: Map of survey area. Grey squares represent NMFS offshore stations and black squares represent DISL nearshore stations.

sharks were abundant in both shallow and mid-depth water. Analysis of sex ratio and length frequency data indicate that blacktip sharks use waters <10 m for parturition while blacknose and Atlantic sharpnose sharks likely use water greater than 30 m deep for parturition. These data comparisons illustrate the importance of sampling across the entirety of a species' depth utilization and surveys that fail to do this risk inaccurately reporting habitat use by these apex predators.

**A Spatially Explicit Bioenergetics Model of Habitat Suitability for Adult Striped Bass, *Morone saxatilis*, in the Biloxi Bay Estuary and Tributaries, Mississippi**

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A bioenergetics model is a useful tool to predict fish growth rate potential as an indicator of habitat quality. Growth rate potential is related to the fish's well-being and potential survival and is a useful metric for assessing spatial and seasonal variability in habitat suitability. The purpose of this study was to develop a bioenergetics model of habitat suitability for striped bass, *Morone saxatilis*, incorporating seasonal and spatial variability in temperature, salinity and dissolved oxygen (DO) in an index coastal river system along the Mississippi Gulf Coast. The Biloxi Bay estuary and tributaries were divided into three salinity regions; polyhaline, mesohaline and oligohaline-freshwater. One hundred random locations were selected monthly in each salinity region and environmental parameters (temperature, DO and salinity) were collected at 1-m increments from surface to bottom. Furthermore, habitat was evaluated during the spring-summer transition (31 March through 15 July) at 20 fixed locations in the study area. Environmental data were incorporated into a bioenergetics model and the predicted growth rates were analyzed by season and in a geographic information system (GIS) framework. Analyses demonstrated significant differences in growth rate patterns by season and by salinity zone. Analytical results indicate that habitat suitability is greatly reduced during the summer period and concentrated in specific parts of the river system suggesting there are habitat hotspots potentially important to population viability. Additional laboratory and ecological field studies on Gulf strain striped bass' environmental tolerances, habitat availability and habitat use are needed. This study is only the first step in understanding how striped bass may select habitat in a dynamic system.

## **Ecology of Barrier Island Salt Ponds in the Northern Gulf of Mexico: Fish and Avian Communities**

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Salt ponds are naturally forming bodies of water often found on barrier islands that vary greatly in size and persistence. These habitats are frequently lost or degraded as barrier islands are developed; in addition, tropical cyclones often reshape or destroy these ponds. The loss of barrier island salt ponds is detrimental to the animals that depend on them. To describe the ponds and their associated fauna, we conducted a three year survey on Dauphin Island, AL and Petit Bois, MS. The most common fish were *Fundulus majalis* (striped killifish) and *Cyprinodon variegatus* (sheepshead minnows), and the most abundant fish were *Mugil cephalus* (striped mullet) and *Menidia* spp. (silversides). Additional fish species that utilize the ponds include *Cynoscion nebulosus* (speckled trout), *Lutjanus griseus* (gray snapper), *L. synagris* (lane snapper), and *Megalops atlanticus* (tarpon). The fish assemblage varied seasonally with fishes being more abundant and diverse during spring and summer. Many bird species were observed gathered around the ponds. The avian assemblage showed no seasonal variation; however, marine birds such as *Larus atricilla* (Laughing gull) were more abundant in summer, whereas aquatic birds such as *Anas platyrhynchos* (Mallard) were more often seen during winter. Barrier island salt ponds are unique, dynamic habitats subject to natural and anthropogenic forces, and their conservation is essential for the continued functioning of coastal ecosystems.



**Addressing Critical Threats to the Future Survival of Diamondback Terrapins, *Malaclemys terrapin pileata*, in Alabama**

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Diamondback terrapins experienced a rich cultural history beginning in the eighteenth century through the first half of the twentieth century. In Alabama, the world's largest terrapin farm shipped thousands of turtles to the northeast markets for human consumption. However, numerous populations throughout its range have been decimated due to this historical exploitation and current threats. Surveys have indicated that crab trap mortality and nest predation are the two major threats to terrapin survival in Alabama. To address the crab trap mortality, the efficacy of by-catch reduction devices (BRD's) in crab traps was investigated. A side by side comparison of crab traps fitted with BRD's and those that were not fitted was conducted in Cedar Point Marsh in 2008 and 2009. Traps not fitted with BRD's caught significantly more terrapins, but there was no statistical significance in marketable crab capture. To counter the nest predation, a terrapin head starting program was initiated in 2008. Almost 300 eggs have been obtained from females nesting on the beach bordering Cedar Point Marsh. Both eggs and hatchlings were incubated and raised at U.A.B. To date, 50 head started juvenile terrapins have been released back into Cedar Point Marsh, and future monitoring will examine their survival. Head starting has the potential of significantly decreasing egg depredation, and potentially enhancing recruitment of terrapins into the breeding population. Additionally, our research indicates that the use of BRD's would also enhance recruitment by significantly decreasing mortality of terrapin in crab traps, with no impact on the crab industry. Implementation of conservation measures such as BRD's and head starting represent initial steps in the recovery program for the diamondback terrapin in Alabama.

**Seasonal Changes in Water Temperature Affect West Indian Manatee (*Trichechus manatus*) Movements in Alabama Coastal Waters**

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The West Indian manatee (*Trichechus manatus*) is a large aquatic mammal whose distribution is limited by physiological minimum water temperature requirements. Previous research has shown that manatees in Florida (FL) migrate from summer ranges to warm water sources after a sustained drop in coastal water temperatures to below 20°C. Less is known about manatees occupying fringe habitats in the northern Gulf of Mexico (nGOM) outside of FL, an area currently considered to be marginal habitat for the species due largely to seasonal cold temperatures. To determine the effects of water temperature on manatee presence or movement in nGOM fringe habitat, we compared Alabama (AL) manatee sighting reports with mean water temperatures over two-week periods for historical (1987-2006) and recent (2007-2009) datasets. Reported sightings decreased when water temperatures declined at the onset of winter, and increased in late spring as water temperatures increased, presumably indicating manatee migrations from and to AL waters. This finding was corroborated by the migration of one telemetry-monitored manatee out of AL waters in late 2009, and is consistent with what is known about FL manatees. However, manatees have been reported in AL in all months of the year, indicating possible local year-round habitat suitability or use of local habitat as a waypoint for late migrants. These data are the first of their kind to be collected for nGOM manatees and clarify previously understudied manatee movements in this area, which will in turn be useful to inform regional manatee management. These data may also help clarify this species' response to potential threats such as climate change and increasing loss of habitat in FL.

## Characterizing Individual and Spatial Variation in Tissue-Specific Stable Isotope Ratios of Spotted Sea Trout, *Cynoscion nebulosus*

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Analysis of stable isotope ratios (SIA) has become a common technique for delineating trophic pathways in aquatic ecosystems; as well as for examining dietary shifts in focal fish species. The application of SIA to trophic studies is rooted in the assumption that patterns in the isotopic ratio of key elements such as carbon and nitrogen follow specific patterns and are invariant at short temporal and spatial scales making SIA more informative about trophic relationships than more transient indices such as diet composition. However, many cases have been described in which variability in carbon and nitrogen stable isotope ratios changed between species, through time and space, or among tissue types. It is therefore important to characterize stable isotope variability in a species and ecosystem, prior to applying SIA to address broader questions. We examined the patterns in carbon and nitrogen stable isotope ratios in spotted seatrout, *Cynoscion nebulosus*, across multiple seasons and multiple sites in Mississippi Sound in order to characterize ambient variability. We also compared results for white muscle to those obtained from liver. A total of 187 individual *C. nebulosus* were captured in 2007 and 2008 from ten sites. All fish were captured between May and October with relatively even coverage across month. Fish ranged in size from 212 to 622 mm TL, but average TL by site was between 250-350 mm TL with the exception of fish collected near the Barrier Islands. The mean  $\delta^{13}\text{C}$  across all sites was -21.4 with a standard deviation of 1.6 suggesting a general trend towards feeding on carbon sources of a marine origin. The system wide standard deviation was generally similar to the within-site standard deviation, but close to the within-site maximum. The mean  $\delta^{15}\text{N}$  across all sites was 13.9 with a standard deviation of 1.1 suggesting *C. nebulosus* are feeding at a trophic level of 2-3. As with  $\delta^{13}\text{C}$  the overall standard deviation is within the range of within-site variability but towards the high end of the range. Significant differences were found in both C and N stable isotope ratios between sites but not between months. The trend is for a general enrichment of both isotopes in an inshore to offshore direction that is also confounded with increasing fish size. A comprehensive understanding of *C. nebulosus* position in the coastal food web will require sampling over a broad spatial and temporal scale, but patterns are detectable, so stable isotope data have utility for understanding trophic relationships in this species.



## Supply and Demand Characteristics of Marine Bait Markets in Mississippi and Alabama

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This presentation will report on research designed to characterize the sources, availability and quantities of marine bait supplied along the northern Gulf coast, as well as the quantities demanded by recreational anglers, the seasonality of demand, and the value of various bait species. The information has been collected for the purpose of determining the potential for producing marine baits in farm ponds.

All species of live baits used for angling were considered in the marketing study, including fish, shrimp, and crabs. From a marketing perspective, even dead baits and artificial lures are of interest as competing products. However, the main fish species being considered for aquaculture are bullminnows (*Fundulus grandis*), spot (*Leiostomus xanthurus*), pinfish (*Lagodon rhomboides*), mullet (*Mugil cephalus*), and croaker (*Micropogonias undulatus*). The shrimp species include white shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepenaeus aztecus*) and pink shrimp (*F. duorarum*).

Saltwater sportfishing is a multi-billion dollar industry on the Gulf Coast, with retail marine bait sales valued at about \$5 million in Alabama and \$3 million in Mississippi. Nevertheless, shortages of live bait are reported to be a common occurrence. If marine baits can be produced and distributed in sufficient quantities to be commercially successful, recreational anglers will benefit from the availability of this new source of supply, particularly if the products are consistently available, convenient, and hardy. As an additional benefit, raising marine bait on farms may help to reduce the pressure on bays and estuaries from the bait capture fishery. This, in turn, could enhance the sustainability of wild populations and reduce impact on by-catch species.

While our survey of bait dealers in Alabama and Mississippi revealed that there are times of significant shortfall in bait supplies, dealers could not confidently answer the hypothetical question of how much more bait they would buy if pond-raised sources were available. To address this problem, we developed an auction system for testing the latent demand for bait at any given time, and also used it to introduce new cultured species on a trial basis to potential buyers. Potential bidders were contacted by phone prior to each auction. A web-based auction site and a toll-free telephone messaging system were used to inform interested buyers of the types and quantities of bait available and to allow them to place multiple bids on desired quantities for that week (or even for the next season, in the case of one “advance auction”). Winners were contacted the following day about arrangements for picking up their bait. This method allowed a proactive marketing relationship to develop, which in turn offered us a far more comprehensive understanding of the bait market, including seasonal demand, price structures, delivery considerations, and markups.

## **Deepwater Horizon Oil Spill Results in Rapid Research Needs Assessment and Inventory**

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In September 2009 the Gulf of Mexico Research Plan (GMRP) was released. This plan was produced as a service to the research community and involved substantial stakeholder input including more than 1,200 survey responses and input from about 300 people at five workshops that were held in the region. The GMRP is coordinated by the Gulf of Mexico Sea Grant programs and guided by a Planning and Review Council. The plan has been used by at least fourteen different organizations for RFP's and/or in strategic plans. Priorities identified in the GMRP have been incorporated into RFP's that have funded millions of dollars of research. Due to the Deepwater Horizon Oil Spill there was a need to identify if new regional priorities emerged and if the existing priorities within the GMRP have shifted. This will be used to update the GMRP. Within a month after the spill a survey was released to a small sample of leaders in the region in order to identify oil spill research needs. The results of this survey and a synthesis of oil spill priorities identified at five workshops were used to develop a comprehensive survey. The comprehensive survey also included several questions that were in the original GMRP survey. This survey was widely advertised and more than 900 people completed at least a portion of the survey. Preliminary survey results will be presented.

A complimentary project was also initiated in the early days after the Deepwater Horizon oil spill. The National Sea Grant Office, Gulf of Mexico Sea Grant College Programs, and NOAA's National Coastal Data Development Center partnered to develop an online database of oil spill research, monitoring, and restoration activities. This database is available at: <http://gulfseagrant.tamu.edu/oilspill/database.htm>. The database allows people working on oil-spill related activities to enter their work via an online form. The database contains more than 165 activities and will assist the research, monitoring, and restoration community identify work that is being completed and where gaps may exist. The activities in the database will be compared with the research needs identified by the GMRP to identify research gaps. A brief overview of the database also will be presented.

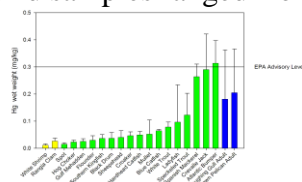
## Stable Isotope and Mercury Analysis in the Mobile Bay, Alabama Food Web

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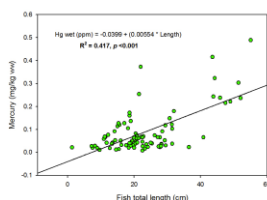
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Mercury (Hg) has been identified as a pollutant that poses a human health risk for people consuming contaminated seafood. Mercury enters the food web at the microbial level and is methylated and then biomagnified, through ingestion, to higher trophic levels. Brown Pelicans (*Pelecanus occidentalis*) and Laughing Gulls (*Larus atricilla*) represent species at possible risk for neurological effects of accumulation of mercury due to their trophic position in the Mobile Bay food web. This study examined various organisms inhabiting Mobile Bay (e.g., invertebrates, fish and birds) to track Hg concentrations. Stable isotopes (<sup>15</sup>N, <sup>13</sup>C, and <sup>34</sup>S) in combination with mercury was utilized to better understand the complex trophic dynamics and the transfer of metals through organisms within the food web. The relationship between biomagnification of mercury and stable isotope signatures will generate a model for examining the transfer of this neurotoxic metal through food webs and ultimately into food for human consumption.

Results suggest biomagnification of mercury from lower to higher trophic levels. Mean values for fishes ranged from 0.014 - 0.313 mg/kg, while bird samples ranged from 0.063 - 0.331 mg/kg (Fig 1). Birds accumulated mercury into their tissues, with the greatest accumulation whites of brown pelicans (mean = 0.331 mg/kg) followed by adult brown muscle tissues (mean = 0.205 mg/kg). Fishes exhibited mercury magnification with increasing total length ( $R^2 = 0.417$ ,  $p < 0.001$ ) (Fig. 2), supporting previous findings of size as an indicator of mercury contamination in fishes.



**Figure 1.** Mercury (Hg) wet weight (mg/kg) for all biota. Error bars represent standard deviation of mean values



**Figure 2.** Regression of total length (cm) of all fish species collected

Stable isotope analysis indicates reliance on a pelagic food web, based on in situ primary production, by Brown Pelicans. Laughing gulls exhibited highly variable diets, including a number of human derived materials, which makes determining food sources difficult. Reliance on pelagic food sources is generally associated with higher mercury burdens compared to more terrestrial, detritus based food webs. Further toxicity studies are needed on higher trophic-level species of Mobile Bay to better estimate the impact of mercury to this ecosystem.

## **Decoupled Effects (Positive to Negative) of Nutrient Enrichment on Seagrass Ecosystem Services**

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Eutrophication is a widespread phenomenon that disrupts natural ecosystems around the globe. Despite the general recognition that ecosystems provide many services and benefits to humans, little effort has been made to address how increasing anthropogenic eutrophication affects those services. We conducted a field experiment to determine the effects of nutrient enrichment on five ecological services provided by a model coastal system, a shallow seagrass community: (1) the provision of shelter for fauna; (2) the quality of food provided to first-order consumers; (3) quantity of food provision to first-order consumers and O<sub>2</sub>/CO<sub>2</sub> exchange; (4) producer carbon and nitrogen storage, and (5) water clarity. The results showed a severe negative impact on seagrass density and biomass, which greatly reduced the structural complexity of the community and provision of shelter to fauna. Water clarity and the standing stock of producer carbon were reduced in the fertilized in comparison with the control area. In contrast, nutrient addition did not affect in any consistent way the total quantity of food available for first-order consumers, the net exchange of O<sub>2</sub>/CO<sub>2</sub>, or the standing stock of producer nitrogen in the community. The nutritional quality of food available for first-order consumers increased with fertilization. These results show that the impacts of nutrient enrichment on the services provided by natural systems may be disparate, ranging from negative to positive. These findings suggest that management policies for anthropogenic eutrophication will depend on the specific service targeted. In the case of shallow seagrass beds, the loss of biogenic habitat and drastic impacts on commercially-important fauna may be sufficiently alarming to warrant rigorous control of coastal eutrophication.

## **Alteration of Salt-Marsh Floral Communities Induced by Shoreline Erosion**

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The loss of salt marshes in the northern Gulf of Mexico is proceeding at an alarming rate, resulting in the loss of ecosystem functioning and reduced connectivity with adjacent habitats. Shoreline erosion severely impedes the development and stability of salt-marsh habitats, resulting in the loss of floral diversity and the vital ecosystem services they provide. Salt marshes in the northern Gulf of Mexico typically exhibit compressed zonation patterns relative to their Atlantic-Coast counterparts resulting in narrow, fringing bands of emergent vegetation. The immediate result of shoreline erosion is the loss of seaward vegetation but it is unclear how, and at what temporal scale, upland marsh floral zones (defined here as the mid- to high-intertidal zone) respond to shoreline loss.

This study investigated the dynamics of species-specific floral zones in response to shoreline loss among three intertidal salt marshes that lie along a gradient of wave-generated disturbance. Site classifications were based on mean rates of shoreline erosion (range: 0.95–2.40m/yr) and mean escarpment height at the marsh edge (range: 0.15–0.55m). Floral community structure was characterized at each site in 2009 and 2010 using transect-based assessments of dominant floral zones. Changes in species cover were analyzed using both multivariate and univariate statistical approaches.

We identified three primary drivers of floral community change associated with the loss of shoreline vegetation: (1) an overall decline in the coverage of upland, monospecific species zones; (2) zonal compaction (i.e., encroachment of upland species zones and bare marsh surface by low-intertidal species); and (3) the replacement of climax communities by early colonizers. Sites that experienced high rates of shoreline erosion ( $>1.0\text{m/yr}$ ) exhibited a significant decline in the coverage of inland climax communities and high zonal compaction. The trajectories of community change in sites with intermediate rates of shoreline erosion ( $0.5\text{--}1.0\text{m/yr}$ ) were contingent on the degree of scarping. Sites with high escarpments exhibited stable zones of high-intertidal species, but experienced significant zonal compaction. Sites with low (or absent) escarpments experienced an overall decline in upland vegetation and increased coverage of mixed-species stands and early colonizers. Low-scarped sites did, however, exhibit low levels of zonal compaction. Sites that experienced shoreline loss rates of  $<0.5\text{m/yr}$  typically exhibited low scarps and maintained high floral diversities within the mid- and high-intertidal zone.

The effects of shoreline loss extend far beyond the marsh edge and drive changes in inland floral communities over very short temporal scales—one growing season for this study. The marsh edge not only provides vital habitat to a variety of aquatic species, many of which are commercially important, it also protects and maintains the integrity of upland vegetation zones. The incorporation of community indicators derived from this study into current monitoring schemes will fill a critical role in the early detection of stressed and degraded habitats in the northern Gulf of Mexico.

## **Hurricanes and Fire Interact to Control Plant Production and Vertical Accretion in a *Juncus roemerianus* Marsh**

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Coastal wetlands along the northern Gulf of Mexico are subject to both fire and hurricane disturbances, both of which are predicted to increase in frequency or intensity with climate change. These low-lying coastal areas are particularly vulnerable to sea-level rise, and must vertically adjust to rising seas, migrate inland, or risk local extinction. To understand the effects of these large-scale disturbances on processes important for vertical adjustment, we initiated a field experiment at the Grand Bay National Estuarine Research Reserve, MS, in which we examined effects of prescribed fire on a *Juncus roemerianus* dominated marsh. In July 2008, we established 18 plots along six transects, spanning low, mid and high marsh, from which we collected bimonthly measurements of accretion, plant biomass and porewater physicochemistry. In fall 2008, all study plots were inundated by storm surge from Hurricanes Gustav and Ike and in January 2009, half of the transects were also subjected to a low intensity prescribed burn (200-300°C). Vertical accretion was largely influenced by initial input of hurricane sediment, which resulted in  $15.4 \pm 2.4$  mm,  $5.3 \pm 1.8$  mm, and  $2.4 \pm 0.4$  mm of sediment deposition in the low, mid, and high marsh, respectively. This sediment pulse was sustained throughout the remainder of the study, with most of the change over time attributable to storms and not fire. These storms also moved wrack from the low marsh to the high marsh-pine island boundary, where it provided additional fuel for fire. The prescribed burn removed wrack from the study plots and significantly reduced aboveground biomass, which slowly recovered to pre-burn levels over the following year. Low marsh plots recovered faster than mid or high marsh plots, which experienced less tidal flushing, higher sulfide concentrations, and lower soil redox potentials than low marsh plots. The slow rate of recovery in burned high marsh locations, in which wrack accumulation from hurricanes was greatest, suggest that certain areas may be more vulnerable to fire than others, and that the occurrence of a hurricane or intense storm prior to a fire may alter fire behavior and intensity. The location and elevation within a marsh, as well as the presence of wrack along the potentially more vulnerable high marsh boundary, should be considered when developing management plans. As climate change contributes to further sea-level rise, understanding the effects of disturbances on biological and physical processes will be imperative for the long-term sustainability of these value coastal ecosystems.



## Effects of Deepwater Horizon Oil Spill on Community Respiration in the Intertidal Zone

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On April 20, 2010, the blow out and subsequent explosion on the Deepwater Horizon oil rig led to the release of about 4.9 million barrels of crude oil. Oil began washing up on Florida beaches in June 2010. Most of the oil was in the form of weathered mousse and tar balls. Hydrocarbon concentrations in the water and intertidal sand from Santa Rosa Island have been measured weekly since May 4, 2010. Alkane concentrations in sand were highest on Perdido Key beaches and ranged from 0.15 to 10.3 ppm between June and August. On Santa Rosa Island beaches, alkane concentrations in sand were usually below detection limits. Alkanes were detected in the surf zone on several occasions in July associated with floating mousse and tar balls. Analysis of polyaromatic hydrocarbons is ongoing.

Community respiration, nutrient, and chlorophyll concentrations in intertidal zone have been measured weekly between May 4 and September 6, 2010. Sand was collected from the intertidal, swash zone near Pensacola Pier and Navarre Pier. Average oxygen consumption in sand mixed with GF/F filtered seawater increased from 9.3 mmol/m<sup>2</sup>/d in May to 20.5 mmol/m<sup>2</sup>/d in August. Nitrate concentrations ranged from detection limits (0.2 µM) to 2.9 µM with higher concentrations at Navarre Pier than Pensacola Pier, particularly in May and June. Dissolved inorganic phosphate concentrations ranged from detection limits (0.2 µM) to 0.5 µM. Coincident with the arrival of oil, extensive blooms of “June grass”, the green macroalga *Cladophora*, occurred throughout July and August. Community respiration rates were affected by sources of organic carbon, both oil and macroalgae, as well as the benthic invertebrate community, particularly *Donax* spp. and *Emerita* spp.

## **Seasonal and Spatial Effects of Wastewater on Oysters in Mobile Bay, AL**

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We assessed the effects of wastewater treatment plant (WTP) effluent on growth and accumulation of microbial contaminants by oysters in Mobile Bay, AL. Effects were measured relative to distance from a major WTP outfall and season. Although seasonal conditions had a greater effect on chl *a* concentrations and oyster growth than distance from the outfall, oysters acquired wastewater-specific  $\delta^{15}\text{N}\text{‰}$  that reflected assimilated foods. Fecal coliform and male-specific bacteriophage concentrations were highest in water and oysters sampled near the WTP, with densities of each greater in the shellfish tissues than in water. During the winter/spring, fecal coliform levels were increased in the water and shellfish and were influenced by greater riverine inputs, another source of fecal contamination. In summer/ fall, however, when oysters were growing and riverine inputs were lower, concentrations of each indicator microorganism were significantly correlated with  $\delta^{15}\text{N}\text{‰}$  levels in oysters. These data verify that the levels of  $\delta^{15}\text{N}\text{‰}$  and microbes reflected wastewater exposure when traditional ecological measures (i.e., changes in food supply and oyster growth) were ineffective. This study demonstrates the utility of multiple indicators in tandem to differentiate the impact of pollution sources on shellfish growing areas. These data may be used to refine boundaries for safe harvest of shellfish while reducing the possibility of harvesting contaminated shellfish.



## **Fisheries Independent Sampling Program in the Northern Gulf of Mexico: Alabama's Reef Permit Zone**

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Red snapper (*Lutjanus campechanus*) is the most important commercial and recreational fishery in the Gulf of Mexico. However, the red snapper stock in the northern Gulf of Mexico is considered to be overfished and efforts to rebuild the stock have been in progress since 1984. The fishery management plan for red snapper continues to face challenges as identified in the latest SEDAR update assessment, which highlighted a lack of fisheries independent data from the eastern Gulf of Mexico and the need for better fishing mortality estimates. In response, the Dauphin Island Sea Lab and the Alabama Department of Conservation and Natural Resources developed a fisheries independent survey to sample the reef permit zone off Alabama. Surveys were based on a random sampling design, and took place before, during, and after the red snapper season. Our design included five gear types: sidescan sonar, ROV video, bottom trawl, bottom longline, and vertical longline. Bottom trawl caught the smallest fish (50 – 200 mm FL) and the largest fish were caught on the bottom longline (350 – 900 mm FL); however, the majority of red snapper were sampled with vertical longline gear. A total of 857 red snapper ranging in size from 200 – 850 mm FL were caught from 364 vertical longline sets during the spring and summer of 2010. During four survey periods (March, April, May, and August), red snapper in the 300 – 450 mm (FL) size range were the most commonly caught. CPUE values were highest in March and remained steady for the other three surveys, ranging from 0.23 – 0.33 fish / hook / 5 minute soak. Our experimental hook configurations suggest there is no difference between 3/0 and 8/0 hooks or 3/0 and 11/0 hooks, but 11/0 hooks caught larger fish than 8/0 hooks. Inclusion of more fisheries independent data in future stock assessments will likely improve management of this important species.

**Coastal Alabama Acoustic Monitoring Program (CAAMP): Tracking Elasmobranch Fauna in Mobile Bay.**

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The waters of coastal Alabama support a diverse assemblage of estuarine plants and animals; however, there is limited comprehension of how species of highly mobile elasmobranchs exploit the abundant resources of this region. Three such species, the bull shark (*Carcharhinus leucas*), the cownose ray (*Rhinoptera bonasus*), and bonnethead shark (*Sphyrna tiburo*) are hypothesized to exert a controlling influence over a number of the commercial species found in coastal Alabama. To document the habitat utilization and movement of these predatory species, an acoustic telemetry array was deployed at a number of migratory corridors (river mouths, inlets, and entrances to Mobile Bay and Mississippi Sound) in the area. Preliminary results from this effort suggest that the habitat utilization and movement patterns vary greatly among these three ecologically important species. The returns from the telemetry array show that smaller bull sharks are present in low salinity rivers while slightly larger individuals travel throughout coastal waters. Bonnethead sharks, in contrast, seem to exhibit higher site fidelity, with little movement detected away from higher saline barrier island waters. Cownose rays appear the most mobile of the three species, with a rapid migration that exploits a wide variety of disparate habitats. The tracking of these ecologically important species will enable the development of improved management strategies that will enhance the survivability of our coastal Alabama resources.

## **Evaluation of Harmful Interactions between Bottlenose Dolphins and Sport Fishing in Northwest Florida and Alabama**

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With the support of the Mississippi-Alabama Sea Grant Consortium, I conducted a study to assess the problem of harmful interactions between bottlenose dolphins (*Tursiops truncatus*) and the sport fishery along the Northwest Florida – Alabama Gulf Coast. Recreational anglers and boat operators have frequently reported dolphins removing hook-and-line catch and bait, and also scavenging on discarded catch. Many anglers were concerned the animals are learning dependency on incidental provisioning. Such interactions can result in dolphins being injured or even dying from entanglement in, or ingestion of, fishing gear while also having a possible economic impact on the sport fishing industry. The extent and frequency of these interactions had been unknown and were based primarily on anecdotal reports from for-hire captains and private anglers, which warranted this study.

I made observations on deep-sea sport fishing trips and used photo-identification of individual dolphins to characterize their persistence and frequency of engaging in fishing interactions. In addition, I monitored dolphin depredation activity at four Gulf fishing piers and conducted angler surveys to measure public attitudes. There is speculation that discard requirements for regulated sport fish plays a large role in exacerbating dolphin interactions since fishing boats and piers serve as relatively reliable sources of food for these animals. Overall during 76 deep-sea trips encompassing 378 separate reef fishing spots, dolphin interactions were noted at 16.7% of the spots. Of those interactions, scavenging of discarded fish was noted on 90.5% of the observations while depredation of caught fish occurred on 39.7%. During 99 visits to the Gulf fishing piers, dolphins were seen within 100 m of the piers on 42.4% of the visits. Fishery interactions involving depredation of caught fish was observed on 16.2% of the pier visits. Two cases of dolphins entangled in fishing gear were noted during the study. Numerous dolphins (N > 10%) that were identified on the offshore reefs were seen multiple times over a two-year period, and the majority of the dolphins that were photo identified around the Gulf fishing piers were known resident animals that frequent the nearby inlets and bays. This suggests that the populations involved are discrete, and that harmful impacts to dolphins on deep-sea reefs and at fishing piers may affect resident communities of animals in those respective areas.

Improving fish catch and release practices in order to 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. Our surveys indicate that recreational anglers generally enjoy observing dolphins in spite of interaction problems. In partnership with members of the recreational fishing community, we are exploring mitigation measures involving gear modifications, fish release practices, and fostering a shift toward embracing eco-tour principles by for-hire sport fishing operators.

## Understanding the Effects of Temporal Variations of Predation Risk on Prey Behavior: A Test of the Risk Allocation Hypothesis

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Species interactions are a significant factor in affecting population dynamics and community structure. While direct effects of predators on prey are well established, recent efforts to understand population dynamics and community structure have focused on how the indirect effects of predation risk affect the behavior of prey. However, all experimental studies of predator prey interactions have only examined the effects of the chronic presence or absence of predators in a system. Lacking in these experiments is the understanding of how prey respond to the temporal variation of predation risk as predator presence is a naturally dynamic process. The Risk Allocation Hypothesis (RAH) suggests that optimal prey behavior is dependent on the overall pattern of predation risk experienced by that animal over time. To test this hypothesis we designed a series of experiments using red drum (*Sciaenops ocellatus*) as the top predator, blue crabs (*Callinectes sapidus*) as an intermediate predator, and hard clam (*Mercenaria mercenaria*) as a base resource. Treatments included 0% risk (top predator never present), 33% risk (top predator present for four hours and absent for eight hours), 66% risk (top predator present for eight hours and absent for four hours), and 100% risk (top predator present entire time). The experiments were conducted for 48hrs. Acoustic transmitters were attached to all animals in the experiment and positions were tracked to analyze behavioral differences among the treatments. Results suggest that when intermediate predators, the blue crabs, experience infrequent pulses of predation risk (33% risk treatment), they reduce their foraging behavior and consume fewer clams, whereas exposure to increased risk (66% and 100% treatments) invokes a learned response leading to the continued consumption of clams. These results are not entirely consistent with behavior suggested by the Risk Allocation Hypothesis, however they do provide a unique and novel understanding of the effects of varying risk over time. The results from this study provide more insight into the behavior of blue crabs under more realistic conditions of varying predation risk.

## Submerged Aquatic Vegetation Mapping in Mobile Bay and Adjacent Waters of Coastal Alabama in 2008 and 2009

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Submerged aquatic vegetation was mapped in coastal Alabama (Mobile and Baldwin Counties), for the Mobile Bay National Estuary Program (MBNEP) and Alabama Department of Conservation and Natural Resources State Lands Division. Two seasonal surveys were performed based on aerial imagery obtained October 2008 and July and August 2009. The 2008 survey included only the southern portion of the MBNEP study area, whereas the entire area was surveyed in 2009. Digital ortho imagery was created from aerial imagery acquired with a digital mapping camera. Outlines of SAV signatures in the ortho imagery were digitized in a GIS environment, and digitized areas were field-verified. Spatial accuracy testing of polygon edges versus actual field boundaries found an average horizontal error of 3.17 m. Comparison of field cover type with corresponding polygon attributes determined a thematic accuracy of 90%. In both 2008 and 2009, SAV in the southern portion of the study area occurred as pure or mixed stands of shoal grass (*Halodule wrightii*) and widgeon grass (*Ruppia maritima*). Pure shoal grass acreage mostly occurred in the Perdido area of southern Baldwin County. Widgeon grass and widgeon grass-shoal grass beds occurred in Mississippi Sound. There were large changes in SAV acreage between the 2008 and 2009 surveys, with 438.8 fewer acres mapped in 2009. Between survey differences were primarily due to less acreage of widgeon grass in Mississippi Sound in 2009, particularly in the Grand Bay and Isle aux Herbes quadrangles. Compared to a 2002 baseline SAV survey, the southern portion of the study area had more acreage mapped in both 2008 and 2009. Areas with greater acreage in 2008-2009 compared to 2002 included the Orange Beach and Perdido Bay quadrangles in southern Baldwin County, and the Grand Bay, Petit Bois Pass, and Isle aux Herbes quadrangles in southern Mobile County. For the full study area survey in 2009, the lower Mobile-Tensaw Delta contained most of the total 5,248.7 acres mapped, particularly in the Bridgehead quadrangle (3,464 ac). Twenty-one vascular plant species representing eleven taxonomic families were recorded during the survey. Most habitat types occurred in northern Mobile Bay and the Delta. The most extensive habitat was a mixture of Eurasian watermilfoil (*Myriophyllum spicatum*), southern naiad (*Najas guadelupensis*), and wild celery (*Vallisneria spiralis*). Eurasian watermilfoil and wild celery were the most prevalent species in the survey overall, based on frequency of occurrence. Other common species included coon's tail (*Ceratophyllum demersum*), southern naiad, and water stargrass (*Heteranthera dubia*). There were 1,371.3 fewer acres mapped in 2009 than in the 2002 baseline survey, due to substantially less SAV acreage in the Mobile-Tensaw Delta. Causes of the recent decline of SAV acreage in the Delta are unknown. Future surveys may help identify the primary environmental forces responsible for interannual and seasonal variability in SAV distribution and species composition in the MBNEP study area.

## Impacts of Cownose Rays (*Rhinoptera Bonasus*) to the North-Central Gulf of Mexico: An Integrated Approach

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Increases in the abundance of cownose rays (*Rhinoptera bonasus*) may pose problems for fisheries management due to their consumption of exploitable shellfish species. Despite their reported abundance in the northern Gulf of Mexico there are no published studies on the spatial distribution and diet of *R. bonasus* from this region, and thus their impact to shellfisheries is currently unknown. We conducted an integrative study on the spatial and seasonal distribution, habitat use and foraging behavior of cownose rays across the coastal Alabama corridor. Adult cownose ray abundance was found to be highest in spring and fall along Gulf barrier islands, with highest densities observed west of Mobile Bay. Juvenile rays primarily exploited inshore estuarine waters (i.e., Mobile Bay) in summer, indicating this area may serve as a nursery ground during these warmer months. Significant ontogenetic (adult vs. immature) differences in diet were found, though these were primarily explained through differential habitat partitioning by life stages. Overall, cownose ray foraging behavior appeared habitat specific and did not include commercially important shellfish species (e.g., Eastern oyster *Crassostrea virginica*), though sustained targeted sampling in potential oyster seeding areas is still suggested. Ongoing telemetry work demonstrates connectivity between various regions of the Mobile Bay estuary and offshore shelf waters by these highly mobile rays.

## Wetland Recovery from the Deepwater Horizon Oil Spill in the Northern Gulf of Mexico

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In April 2010, the explosion of the BP oil rig Deepwater Horizon lead to the single largest oil spill in the Gulf of Mexico. As a result, there are long-term concerns regarding the environmental health of the northern Gulf of Mexico (GOM) region (the Florida Panhandle to Texas). An estimated one million hectares (ha) of salt marsh occur along the northern GOM coastline with most of it dominated by rooted perennial grasses and rushes, including: smooth cordgrass (*Spartina alterniflora*); salt meadow cordgrass (*Spartina patens*); salt grass (*Distichlis spicata*); and black needle-rush (*Juncus roemerianus*). Oil can impact plants physically (by coating plant and soil surfaces) and chemically because of its toxicity to plants. As a result of being coated in oil, marsh plants commonly experience a reduction in photosynthesis, transpiration, and capacity to regulate temperatures. If wetland exposure to oil is intense or prolonged, it can lead to widespread plant mortality and long term loss of marshlands.

To better understand the prospects for wetland recovery, we reviewed pertinent research and accounts related to wetland oil spills in the GOM and elsewhere. We identified factors that will likely determine the extent of wetland damage and recovery from the Deepwater Horizon spill. A common pattern of plants exposed to oil is the die off of aboveground biomass followed by a regeneration of biomass. As long as oil does not persist at the surface or in soils, plants are often capable of returning to pre-exposure conditions. More lasting damage, including plant mortality and marsh loss, occurs when oils persists at the surface or contaminates the rhizosphere. Although the general mechanisms for oil impacts on marsh plants are understood, it is often difficult to predict the eventual impact and recovery of marshes. This is because of the inherent differences between wetlands (vegetation, hydrodynamics, geomorphology), the variable nature of oil impacts (oil crude weight, exposure over time, and oil condition/weathering), and a range of potential remediation options that can be employed (flushing, fire, biostimulation, natural degradation).

Several factors specific to the Deepwater Horizon spill may contribute to the recovery of coastal marshes and support microbial oil degradation. Marsh plant species common along the GOM have proven to be resilient to oil exposure and, along with a warmer climate, tidal conditions, and high productivity, may contribute to an active microbial environment that supports natural oil degradation. Although several management options are available to actively remediate wetlands, more often the best strategy may be to rely on these natural degradation processes.



## Seasonal Times Series of Oyster Spat Settlement: Comparison of 2006-2007 Data with Historical Data from 1967

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The eastern oyster (*Crassostrea virginica*) has supported one of the most economically important and culturally rich fisheries in the Gulf of Mexico for over a century. In Alabama, oyster harvests have historically fluctuated until stabilizing in recent years at yields far below record highs (Figure 1). Oyster harvest is affected by many factors including population size, management effectiveness, storms, and water quality related closures. An important factor affecting adult oyster populations is the larval transport and subsequent spat settlement rate.

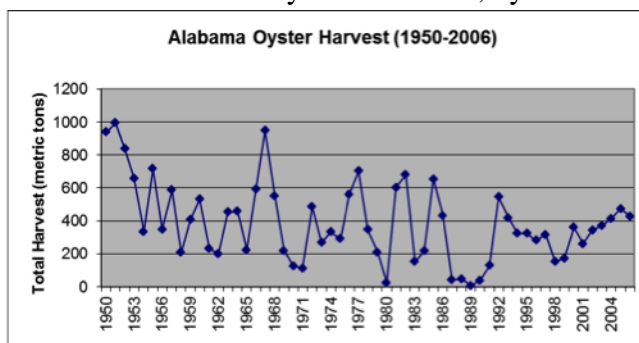


Figure 1. Historical oyster harvest in Alabama

Historical data from the 1960s revealed a persistent gradient of oyster spat settlement, with higher densities in the west (Mississippi Sound), and lower densities in the east (Bon Secour Bay and eastern Mobile Bay). During 2006-2007, we revisited the sites from the historical study and found the same east-west gradient from the 1960s is still evident 40 years later. Salinity patterns observed from both the present day and historical study can be tied to this east-west gradient seen with oyster spat settlement. The influence of the Mobile River system discharge in connection with tidal influences and their impact on salinity for the study area is apparent. Both the predictability of the study areas environmental factors influence on salinity and the persistent east west oyster spat settlement gradient over the past 40 years should be taken into consideration for present day and future management of the oyster fishery for the northern Gulf region stretching from Mississippi Sound to Mobile Bay.



## Using PAM to Detect Oil Stress in *Spartina Alterniflora*

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*Spartina alterniflora*, Smooth Cordgrass, is an important fringing species in saltmarshes of the northern Gulf coast. Saltmarshes provide numerous ecosystem services including nursery habitats, primary production, coastal protection and carbon storage. Threats to saltmarsh habitats include development, landscape alteration, pollutants, and sea-level rise.

In this study the impact of a pollutant, crude oil, which escaped the BP operated Macondo well during the spring and summer of 2010 was investigated. This particular crude oil is characterized by weathering to a sticky, tar-like substance. During Tropical Storm #2 on July 8, winds and storm surge combined to bring a patch of this weathered oil ashore on Marsh Point, Jackson County, Mississippi, heavily coating the fringing *Spartina* plants. Scientific investigators were able to access this site on July 21<sup>st</sup> to gather initial data on the impacts this oil had on plant photosynthesis. Because of the potentially toxic nature of this pollutant, investigators had to wear full body hazmat suits limiting the amount of time data could be collected due to the extreme summer heat.

To compare the stress posed by the oil, photosynthesis was measured on 10 replicate plants in 2 control (unoiled), 2 light-medium oiled, and 2 heavily oiled locations along less than 1 km length of shoreline. Sites were selected to be as similar as possible with respect to plant density and height, all plants were within 5 meters of open water. Pulse Amplitude Modulated (PAM) fluorescence was measured for 5 dark adapted leaves (minimum 10 minutes) and 10 light adapted leaves. Leaves were selected to be first or second fully mature leaves, with measurements made at about the midpoint along the leaf on the upper surface. Both Fv/Fm, F'/Fm', as well as Rapid Light Curves (RLC) were generated on each leaf. RLC measurements were made using the Walz Mini-Pam's highest actinic intensity setting, corresponding to PAR levels ranging from 55 to 1115  $\mu\text{mol photons/m}^2/\text{sec}$  approximately. Plant tissue samples, sediment core samples, and water samples were also collected at each site and returned on ice for later analysis of hydrocarbons.

Results of the photosynthesis study showed that the heavily oiled plants had significantly ( $p < 0.0001$ ) lower values than nearby control plants. Both light-adapted (F'/Fm') and dark-adapted (Fv/Fm) leaves showed very similar patterns with the highest yield (light mean = 0.740, dark mean = 0.810) in the control plants, intermediate in the medium oiled leaves (light mean = 0.330, dark mean = 0.600) and lowest in the heavily oiled plants (light mean = 0.120, dark mean = 0.180). Variability among leaves was highest in the medium oiled site, suggesting that degree of oiling had a strong impact on leaf stress. Heavily oiled leaves did not show as much variance, suggesting that there is a threshold impact on photosynthesis. The likely mechanism in this case was thick oil covering the leaves inhibiting light transmission and also possibly raising leaf temperatures above lethal levels due to substantial heat absorption by this black tar-like material under the hot summer conditions.

## Modeling Large-Scale Disturbance: The Effects of Hurricanes and Fire on Soil Building Processes in a Saltwater Marsh

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Coastal wetlands, as transitions from land to sea, provide important ecological and commercial services on which humans depend. These ecosystems are affected by regular disturbance from marine and terrestrial environments. In addition to this routine pulsation, coastal wetlands are adapted to infrequent, intense disturbances, or large-scale disturbances. These disturbances, such as hurricanes or fire, can have both stimulating and detrimental effects on ecosystem processes in coastal wetlands. In particular, disturbances can affect the biotic and abiotic processes of soil building, such as organic matter accumulation, baffling effects of plants, inorganic sediment deposition, and erosion. Soil building and the maintenance of marsh surface elevation are critical in coastal wetlands in order for them to adjust vertically and keep pace with sea-level rise. To better understand the effects of large-scale disturbances on elevation, we built a model focused on biotic and abiotic accretion in coastal marshes.

Incorporating above-ground biomass and inorganic sediment deposition, we simulated the effects of fires and hurricanes on accretion rate in a *Juncus roemerianus* marsh along the Gulf Coast. The model integrates the impacts of fire intensity and frequency on sediment baffling and biogenic accretion in the marsh.

To simulate the effects of hurricanes on accretion, we incorporated deposition of

inorganic sediment, damage to vegetation and

movement of wrack onto the marsh. These two disturbances can interact, when they both occur within the same year, by altering the wrack and baffling components of the model. With this model, we found that the impacts of a large-scale disturbance on coastal wetland ecosystems vary depending on the intensity, duration, frequency, timing, and type of the disturbance. In addition, pulses of inorganic sediment input associated with hurricanes increased the accretion rate and provided a more persistent stimulus to elevation than the effects of fire. These findings suggest that the influence of hurricane disturbance might play a greater role in the soil building processes of the marsh. When both fire and hurricane disturbance occurred within a year, the interaction amplified the disruption to the accretion rate. The combination of multiple disturbances can have unintended consequences for the long-term persistence of marsh ecosystems. Therefore, timing and season should be taken into consideration when planning a prescribed burn. The continued study of large-scale disturbances is important as coastal wetland ecosystems deal with climate change, and therefore the possible increase in the intensity and frequency of large-scale disturbances. We hope that this model stimulates research and discussion of soil building process and the future use of models by coastal wetland managers.

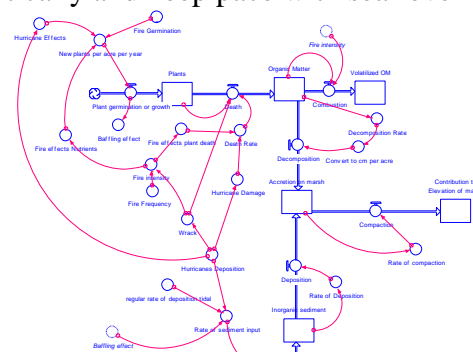


Diagram of model structure in STELLA (V. 9.0.2)

## **Aquatic Plants of Coastal Mississippi**

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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 and locating of the native, favorable species or the invasive, noxious species are: 1) required to understand species richness/dominance/diversity which can be used as an indicator of the habitat's health, complexity, stability, and status; and 2) the first step in habitat assessment for proper conservation and management. We have developed field guide resources for aquatic plants of coastal Mississippi. Shallow waters in main river channels and adjoining bayous, streams, inlets, lagoons, and bays of the Pascagoula River, Biloxi Back Bay, and Pearl River systems and estuaries were surveyed for aquatic plants from May 2008 to May 2010. The location of species of submerged aquatic vegetation (SAV), floating aquatic plants, and the shore emergent plants are presented in this paper. The survey area for each system extended from the river mouth to upstream areas where stream width became narrow and shore vegetation became tall trees which restricted SAV growth due to canopy shading. The catalogued information was 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 are available at the website, [jcho.masgc.org](http://jcho.masgc.org); and the similar species that can be easily confused will be discussed during the poster presentation.

## Alabama's Beach Mice and Coastal Dunes

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Figure 1. Alabama Beach Mouse. Photo: Matt Falcy

The Alabama beach mouse (ABM) (*Peromyscus polionotus ammobates*) was listed as a federally endangered species in 1985 under the Endangered Species Act (ESA) as a result of habitat loss and fragmentation from coastal development, recreational activities, feral cats, and recurring hurricanes. It is nocturnal, semi-fossorial (live part of their lives underground) and native to the coastal dune habitat between Fort Morgan and Perdido Pass. Coastal dunes are important buffers from storm surges and protect inland habitats. The ABM's current distribution is limited to about 2,500 ac and 15 miles of shoreline (44 % historic range) west of City of Gulf Shores and Gulf State Park (GSP). About 1,211 ac are designated as critical habitat for this species under the ESA.

ABM prefer open sandy habitats between the wet beach and inland oak/sand pine scrub dunes, and feeds on a variety of seeds, fruits and insects. Populations can fluctuate greatly, both spatially and temporally, due to normal life cycle events and habitat conditions, such as food availability, predation, and stochastic events (hurricanes, floods, droughts). Higher elevation tertiary dunes are used as storm refugia and are essential for the long-term survival of ABM. Only about 173 ac remain of this "refuge" habitat.

Coastal dunes' ability to function as buffers against storm surges and protect inland habitats depends, in part, on their locations, heights and resistance to erosion. Dune integrity can be affected by land use practices, especially development and recreation activities, as well as hurricanes. Dune restoration approaches have been developed and successfully used to rebuild dune habitats along Fort Morgan peninsula. The ABM's dependence on these coastal habitats for its survival and continuing development pressures have often resulted in conflicts between private landowners and federal law. Habitat Conservation Planning is one tool being used by private landowners to protect ABM and its habitat while developing their properties.

## **Differences in Herbivore Pressure across Northern Gulf of Mexico Salt Marsh Habitats**

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Herbivory is a common ecological process throughout salt marsh ecosystems. In some salt marshes, >50% of plants can be grazed by insect herbivores in the family Tettigoniida. As in many other habitats, herbivore pressure in salt marsh ecosystems increases as latitude decreases. However, to date, no studies have investigated how herbivore pressure varies across marshes within the same latitude. We have anecdotal observations suggesting salt marshes in Mississippi are heavily grazed by insect herbivores, while similar habitats in Florida remain relatively untouched. To address these observed differences and to examine potential reasons for differences, we have quantified the extent of herbivory at three salt marsh sites in the Grand Bay National Estuarine Research Reserve, Jackson Co., Mississippi and one salt marsh site at Big Lagoon State Park in Escambia Co., Florida. We will present preliminary results comparing differences in diversity and abundance of insect herbivores, plant densities, and intensity of herbivory across our study sites. Results of our research will provide a better understanding of factors controlling spatial variation in herbivory within a latitude and will contribute to data important to the development of coastal marsh modeling efforts investigating functioning of salt marsh food webs.

## Phytoplankton Abundance in Relation to Environmental Disturbances in the Western Mississippi Sound

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Phytoplankton form the base of the marine food web and, as such, play a critical role in supporting aquatic life in marine ecosystems. However, increasing levels of nutrient inputs associated with anthropogenic activities can lead to an overabundance of phytoplankton and result in deterioration of water quality. In addition to nutrient levels, phytoplankton abundance and productivity is also strongly influenced by environmental conditions including freshwater inputs, temperature, winds and their associated impacts on water column physical structure.

The western Mississippi Sound is a vital economic and ecological resource to the surrounding region. A large percentage of coastal residents between Bay St. Louis and Biloxi rely on the Sound for revenue from tourism and fisheries. At present, there is a limited understanding of the patterns of seasonal and spatial variation in phytoplankton abundance in the Sound. Here, we examine a time-series of observations of phytoplankton distributions in relation to nutrient concentrations and environmental conditions.

Phytoplankton abundances were determined through *in situ* fluorometric profiles of chlorophyll *a*. The data were acquired from a continuing monthly time-series (11/2007-Present). A series of stations were sampled extending from the mouth of Bay St. Louis to a location in the Mississippi Bight about 10 km south of Horn Island. A general decrease of phytoplankton abundance occurs as sampling moves away from the mainland. In addition, a seasonal increase in phytoplankton abundance was observed accompanying the onset of stratification in the spring and early summer, with a yearly maximum in occurring in August.

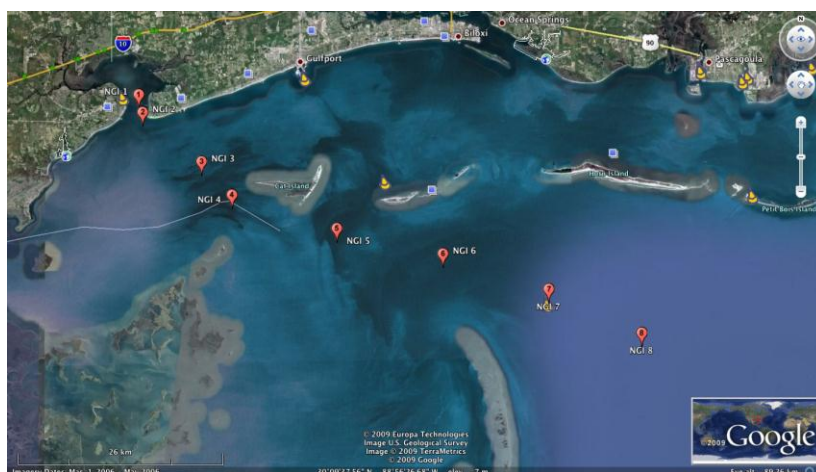


Figure 1: Time-series cruise stations 1-8 in the western Mississippi Sound (Google)



## **Abundance and Diversity of Macroinvertebrate and Finfish Assemblages in Shallow Coastal Embayments with Contrasting Seagrass Cover**

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Seagrass beds provide nursery habitat for a variety of vertebrate and macroinvertebrate species. These beds create a rich, complex habitat for resident macroinvertebrates that include blue crabs (*Callinectes sapidus*), brown shrimp (*Penaeus aztecus*) and smaller epifauna and infauna. In addition, many juvenile fisheries species preferentially recruit to seagrass beds, for example red drum (*Sciaenops ocellatus*) and grey snapper (*Lutjanus griseus*), along with fisheries prey species such as pinfish (*Lagodon rhomboides*). Anthropogenic impacts are currently degrading seagrass beds and reducing habitat availability, which may impact coastal fisheries deleteriously. As a basis to understand how seagrass decline may impact the diversity and abundance of associated assemblages of macroinvertebrates and finfish, we are carrying out field surveys in six coastal embayments with similar physical characteristics but which range widely in seagrass cover (from 0 to 80%). Predicted results are expected to show a decline in juvenile finfish and macroinvertebrate abundance and diversity with decreasing seagrass cover, which will be analyzed to quantitatively determine the associations between faunal assemblages and seagrass cover. This comparison will provide information as to how seagrass loss could affect the abundance of commercially and recreationally important species of macroinvertebrates and finfish.

## Landscape Features of Submerged Aquatic Vegetation Communities of Mississippi Coastal River Systems

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**Abstract:** Coastal submerged aquatic vegetation (SAV) abundance has declined globally due to the cumulative effects of habitat alteration and declines in environment quality. Such degradation along the Mississippi coast has resulted in substantial loss of SAV habitat for fish and wildlife and extirpation of some species of SAV. Subsequent recognition of the need for conservation of these habitats has lead to the development of several water quality/environmental models for seagrass/SAV habitat requirements for application by resource managers. These models were based on long-term data collection requiring extensive and consistent water quality monitoring. This demand on resources has restricted the usages of models to the limited number of areas with well monitored habitats; therefore, it is necessary to develop habitat indices that can be widely used to predict SAV occurrence and distribution in varying locations, habitats, and basin types. In order to develop a Habitat Suitability Index (HSI) for SAV via a decision-tree algorithm approach that utilizes landscape properties, SAV communities of shallow waters in channels, adjoining bayous, streams, inlets, and lagoons of the Pascagoula River, Back Bay of Biloxi, St. Louis Bay, and Pearl River systems of coastal Mississippi were surveyed from May 2008 to June 2010. The survey extended from the river mouth to upstream areas where stream width became narrow and shade from tall trees on the shore restricted SAV growth. The location and species was recorded of the SAV and the nearby floating aquatic and dominant shore vegetation. Survey methods included raking from a boat and wading in the water after SAV were observed to occur in a given location. GPS coordinates were recorded using a Trimble™ GeoXH handheld GPS unit and TerraSync™ software. The most salt-tolerant species *Ruppia maritima* occurred more frequently at sites closer to the Sound. *Potamogeton pusillus* and *Najas guadalupensis* occurred with *Ruppia*, but appeared to occur more frequently in the upper regions of the rivers where salinities remain fresh. *Najas guadalupensis* was nearly 3 times more likely to occur on sites with *Potamogeton pusillus* (0.64) than on sites without it (0.23). After we develop a tree-based algorithm for the index, its validation will be assessed using a separate set of field data. Application of the index will not be restricted to the well-protected and monitored areas because the index will use geographic, topographic, and shore vegetation parameters. The resultant HSI can be used to visualize potential SAV bed locations and to predict how coastal landscape alteration would affect their distribution and abundance.



## Measuring Dissolved Oxygen Stress in the Eastern Oyster, *Crassostrea virginica*

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Low oxygen events are increasing in location and intensity worldwide, creating stress on the organisms that inhabit affected waters. Mobile Bay, AL is known to have seasonal low oxygen events, “Jubilees,” which can affect the local oyster stocks. To understand the effect of low oxygen on oysters, hatchery reared oysters were placed in cages and deployed along with oxygen monitors (YSI 6600 data sondes) at two reefs in Mobile Bay, AL that typically differ in oxygen concentration. To detect and measure stress from low oxygen, protein analysis was performed on three oyster tissues (mantle, adductor muscle, and gill) and on two age classes. Because oysters are relatively tolerant of low oxygen events, these data can be used to quantify the sub-lethal stress response that traditional growth and survival measurements may not. Preliminary results show that protein expression differs between adults and juveniles, and also differs among different tissue types. Being able to understand and measure stress in oysters is important for managers who are restoring oyster reefs, and understanding oyster physiology and response to stress, including potential impacts from the recent oil spill.

## Age Distribution and Abundance Estimates of Adult Red Drum *Sciaenops ocellatus* in Offshore Waters of the North Central Gulf of Mexico

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The red drum (*Sciaenops ocellatus*) fishery in the Gulf of Mexico has been defined as overfished for the latter part of the 20<sup>th</sup> century. However, due to aggressive management of the species for the past twenty years, the stock is showing signs of recovery (Figure 1). The current status of the stock is undefined, and due to the cessation of the commercial fishery, there is a lack of quantitative data necessary to describe the health of the stock. To overcome this limitation, the Fisheries Ecology Lab at the University of South Alabama initiated a study to examine age distribution, abundance, and physical condition of red drum.



**Figure 1.** ROV snapshot of red drum school in the North Central Gulf of Mexico

Fish were collected by the Fisheries Ecology Lab longline survey, a monthly gillnet survey, and by hook and line. Many red drum were also collected at the 2009 Alabama Deep Sea Fishing Rodeo, an event that provides a valuable sampling opportunity to the scientific community.



**Figure 2.** Red drum otolith image

Quantifying the age composition of red drum is essential to determine if the stock is currently overfished. Age distribution of red drum is being determined by the use of otoliths. Otoliths are small calcium carbonate structures found in the heads of all bony fishes and used in sensory perception. They can be sectioned and analyzed to determine the age of a fish (Figure 2). In addition to using otoliths to obtain age, they can be used to quantify growth by measuring interannual distances between rings. These incremental measurements are used for back-calculation of length that can describe growth of the fish. A series of morphometric measurements are used to calculate gonadosomal and intraparetoneal fat indices, which are used to determine the health of each fish. Gonads and intraparetoneal fat are removed and weighed and compared to total weight of each fish to calculate these indices.

This study will provide an overview of the age distribution, condition and estimated abundance of the north central Gulf of Mexico red drum stock. These results will provide managers the quantitative information needed to best describe the current age structure of the red drum fishery, critical information for future stock assessments.

## Quantifying the Impact of the Gulf of Mexico Oil Spill on Salt Marshes

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**Abstract:** Salt marshes are the most vulnerable coastal environment (vulnerability index of 10 from a 1-10 scale) to be adversely affected by the oil spill, with the predicted residence times of over 10 years. Saline marshes generally have more oil-sensitive vegetation than freshwater marshes and oil impact on vegetation is most significant in highly organic soils of salt marshes. Cleaning activities such as skimming, oil collection, burning, flushing, use of dispersants, and plant cutting can also greatly damage marshes. In addition, the effects of oil spills vary with vegetation types and also with season. For example, *Spartina alterniflora* is more sensitive to oiling than *Juncus roemerianus*. Plants are more sensitive to oiling during the growing season than during the pre-dormancy or dormant season. Since the BP oil spill and cleaning up efforts occurring in summer, the growing season for *Spartina* spp., we hypothesize that short-term impacts of the spill on salt marshes will be detected. In order to quantify the short-term impact of the oil spill on the photosynthetic activity and physiological status of the coastal salt marshes, we initiated field surveys in Mississippi and Louisiana salt marshes to measure close-range hyperspectral reflectance, leaf chlorophyll contents, leaf area index, and above-ground biomass, and to take vertical digital camera photos at selected 2 m x 2 m plots. The measured values will be used to develop and validate remote sensing algorithms and protocol for mapping several biophysical characteristics of the marsh vegetation including Chlorophyll content, Green Leaf Area Index (GLAI), and Vegetation Fraction (VF).

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## Red Snapper (*Lutjanus campechanus*) and the DWH Oil Spill

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Red snapper (*Lutjanus campechanus*) is an important food fish in the Gulf of Mexico with stocks presently being managed as overfished across the entire U.S. gulf coast. However, the distribution of both adults and larvae is heavily biased toward the continental shelves west of the DeSoto Canyon. East of the canyon, red snapper are significantly less numerous and smaller in size. Previous research has shown that mid- to large-sized red snapper tend to use oil and gas platforms as preferred habitat. With over 4,000 platforms scattered over the continental shelf and slope west of the canyon, it seems evident that these structures play an important role in maintaining western stocks.

But oil platforms can produce deleterious effects as seen by the Deep Water Horizon explosion and subsequent oil discharge. Although oil can affect stocks in a highly complex manner by its indirect impact on food supply, predators and parasites, our study examines the potential direct impact on near-surface larvae. We use the distribution of larvae captured during ongoing fishery independent surveys, and the distribution of surface oil from the DWH spill as seen by NOAA satellite imagery to estimate the potential direct impact on the stocks (Figure 1). Since currents on the continental shelves are highly variable, we look at oil dispersion scenarios from climatological observed currents and from yearly scenarios using numerical model currents.

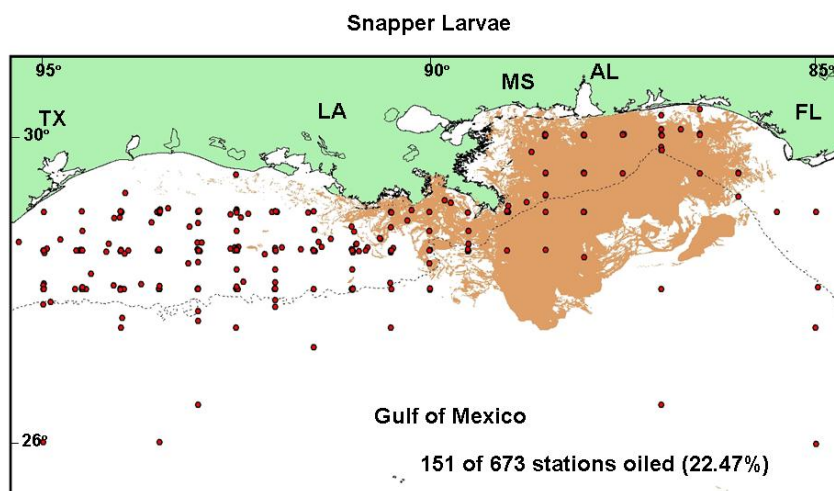


Figure 1: Surface oil from DWH (NOAA satellite image analysis) and sample stations where red snapper larvae were caught in previous surveys

## Differences in Breeding Ecology of Seaside Sparrows in Gulf and Atlantic Coastal Marsh Habitats

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Seaside Sparrows (SESP; *Ammodramus maritimus*) are passerines restricted to coastal salt marsh. They are considered a species of concern by the National Audubon Society, Partners in Flight, and the U.S. Fish and Wildlife Service due to current and projected habitat loss. The Gulf Coast Joint Venture (GCJV) Landbird Monitoring, Evaluation, and Research Team selected this species as an indicator of salt and brackish marsh health because its life history is tightly linked to this declining habitat. Unlike the Atlantic subspecies (*A. m. maritimus*, *A. m. macgillivraii*), little is known about the ecology of SESP along the northern Gulf Coast (*A. m. fisheri*). The current GCJV habitat model is based on assumptions based on the Atlantic Coast populations; however, marshes along the Atlantic are fundamentally different from those along the northern Gulf Coast. In this study we compared nesting data from coastal Mississippi to published data from Atlantic populations to test for differences in breeding habitat parameters. Preliminary analysis illustrates differences in multiple measures including nest location, nest survival rates, and causes of failure. This supports our initial hypothesis that significant differences exist between Gulf coast and Atlantic SESP populations and suggests that the GCJV model should be revised to consider data from the Gulf Coast subspecies.

## **A Decade of Mississippi-Alabama Sea Grant Consortium Research: The Big Picture**

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The past ten years have produced over 100 research projects for the Mississippi-Alabama Sea Grant Consortium (MASGC). These projects fall into one or more of Sea Grant's four focus areas, which are Healthy Coastal Ecosystems, Sustainable Coastal Development, Safe and Sustainable Seafood Supply and Hazard Resilience in Coastal Communities.

Examples of MASGC-funded research topics that have been funded over the past ten years categorized by focus areas include but are not limited to:

### Healthy Coastal Ecosystems

- Fish and invertebrates: life history, behavior, population/stock assessment and habitat management
- Trophic relationships in coastal ecosystems from primary producers to marcofauna
- Habitat: structure and function, quality, change, value, human-habitat interaction, marsh and seagrass communities, and restoration
- Pollution: nutrient input, water quality, pollution, hypoxia, algal blooms, chemical and metal pollution
- Invasive species

### Sustainable Coastal Development

- Stormwater and flood management
- Community supply water quality and availability
- Community development and structure
- Community heritage
- Ecotourism and local economies

### Safe and Sustainable Seafood Supply

- Oyster health and seafood safety
- Seafood processing methods and byproducts and economics of the industry
- Aquaculture: bait, sea urchins, oysters, red snapper, blue crabs and offshore

### Hazard Resilience in Coastal Communities

- Climate and sea level change: effects, planning and prediction
- Resiliency from storms and other disasters
- Structural Engineering

The MASGC funds research through several mechanisms including a core biennial research competition, program development funds, dolphin research program, coastal storms program, and biennial regional research programs.

This poster will highlight the MASGC research program and the types of projects that MASGC has funded over the past ten years.

## **Mycorrhizal Colonization of Native Salt Marsh Plants on Mississippi's Gulf Coast**

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Salt marshes in Mississippi are ecologically important areas, with high plant and animal species diversity. Until recently the fungal fauna has been largely over-looked. Nearly 98% of all terrestrial plants have a symbiotic relationship with fungi, called arbuscular mycorrhizal fungi (AMF). AMF translocate nutrients such as N, P, K, Ca, S, Cu, and Zn from the soil and enhance immobile nutrient uptake by increasing the absorptive surfaces of the root. They are also able to boost immunity by increasing P and Zn available to the plant. Saltmarsh plants have rarely been studied for AMF. The goals of this project were to determine if saltmarsh plants along the coast of Mississippi had mycorrhizal associations; and to determine if there were any seasonal variations in AMF colonization. *Juncus roemerianus*, *Spartina alterniflora*, and *Schoenoplectus americanus* plants were collected from multiple locations along the nearby coast. The plant, roots and the surrounding rhizosphere were collected. The roots of the plants were placed in bags and the plants were stored in a greenhouse and kept alive until the roots could be examined for AMF. The roots of the plants were examined for fungal colonization using an ink-vinegar stain. By determining the presence or absence of the AMF, a map was compiled showing the distribution and seasonal variations in AMF colonization were identified. The results show that the wild collected plants were colonized with AMF and showed seasonal variations with 100% of the plants being colonized in spring and approximately 70% being colonized in the fall. These results disproved previous assumptions that saltmarsh plants were not colonized with AMF.

## How does our Seagrass “Measure Up”? A Large-Scale Comparison of Morphological and Growth Attributes of the Seagrass *Thalassia testudinum*

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With increasing loss of seagrass beds worldwide due mainly to anthropogenic impacts, it has become important to document and understand seagrass growth under natural (i.e., undisturbed by human activities), yet highly variable, environmental conditions for efficient seagrass conservation and restoration. In this study, we examine morphological and growth characteristics of the seagrass *Thalassia testudinum* in three regions of the Gulf of Mexico with contrasting environmental conditions: Long Key, FL; Perdido, FL; and Corpus Christi, TX. Namely, these three regions differ largely in water light penetration, temperature, and salinity. The Florida Keys are distinguished as having greater water column light availability than Perdido and Corpus Christi as well as warmer average temperatures. Salinity is also more stable in Long Key than in the other sites. Shoots in Perdido had less photosynthetic area than shoots in Corpus Christi, which in turn had less photosynthetic area than in Long Key. These differences were mainly driven by similar contrasts in leaf width and length, however, not as much in the number of leaves per shoot. In addition, shoots in Perdido were, on average, younger than in the other two regions. Comparison of shoot age structure at the time of collection across the three regions suggested that shoots in Perdido turn over at a faster rate than in the other two regions. In all, these results show dramatic differences in the structure, morphology, and growth of *T. testudinum* among regions of the Northern Gulf of Mexico that are of interest for future restoration and conservation efforts. They also suggest that light availability and salinity are key drivers of *T. testudinum* performance in the Northern Gulf of Mexico, with depressed structure and growth in Perdido in relation to the other two regions possibly due to reduced light availability and widely oscillating salinity.



## **Phytoplankton Abundance and Pigment Taxonomy Composition in Coastal Mississippi Waters**

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Phytoplankton pigments from Coastal Mississippi waters were measured to determine the spatial and temporal distributions of phytoplankton communities. Concentration of phytoplankton pigments were analyzed using High Performance Liquid Chromatography (HPLC) and the changes in phytoplankton communities were determined with CHEMTAX. Surface water was collected for 2 years (September 2007-November 2009) at three sampling sites on a monthly basis. The stations were located in the Bay of St. Louis, the Mississippi Sound and the Mississippi Bight, following a salinity gradient. A time series of the observations documents variability of the different taxonomic groups in Mississippi waters. Diatoms were the major group in all stations and in all seasons. Cyanobacteria, Euglenophytes, Chrysophytes and Cryptophytes were present at the three sampling sites. Chlorophytes and Eustigmatophytes were present in the Bay of Saint Louis and in the Mississippi Sound but absent in the MS Bight. Prymnesiophytes increased their abundance in the MS Bight outside the Barrier Islands. Chlorophyll *a* (Chl *a*) concentration had a bimodal distribution with peaks in July 2008 and August 2009 and the highest concentration of (Chl *a*), was found in the Bay of Saint Louis (24µg L<sup>-1</sup>).

## **Distribution and Diversity of Coastal Archaea in Mobile Bay, AL**

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Archaea represent one of the three domains of life, along with Bacteria and Eukarya. Archaea were historically believed to be extremophiles, therefore, most research has focused on the methanogens, halophiles and thermophiles. Studies from the open ocean suggest that a large fraction of marine prokaryotic communities may be archaeal, however, little is known of archaeal populations in shallow coastal waters. Two main archaeal groups have been detected in the mesophilic marine environment; the Thaumarchaeota and Euryarchaeota. Most Thaumarchaeota are thought to be autotrophic nitrifiers, and are thus important to global carbon and nitrogen cycles. Marine Euryarchaeota are thought to be primarily heterotrophic, but no evidence has been found to support this hypothesis.

To better understand the role Archaea play in shallow marine ecosystems, this study examined the distribution and diversity of Thaumarchaeota, Euryarchaeota, and Bacteria in the Mobile Bay, AL region. Water Samples were collected monthly along with dissolved oxygen, salinity and temperature from sites surrounding Mobile Bay. The contribution of Archaea to the total prokaryote community was measured using fluorescent *in situ* hybridization (FISH), which used fluorescent probes to tag Thaumarchaeota, Euryarchaeota and Bacteria cells which were counted along with total cell counts via epifluorescent microscopy. The diversity of Bacteria and Archaea was determined in the same sample set using PCR and denaturing gradient gel electrophoresis (DGGE) to generate fingerprints of the 16S rRNA gene. Preliminary results indicate that a high diversity of Bacteria and Archaea exists in the Mobile Bay suggesting that Archaea may be important in estuarine nutrient cycling.

## **Evaluation of Growth and Survival of Juvenile Pacific White Shrimp (*Litopenaeus vannamei*) and the Atlantic White Shrimp (*Litopenaeus setiferus*) at Different Thermal and Salinity Regimes**

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Little information concerning the interaction of temperature and low salinity as it relates to survival and growth of juvenile shrimp is available in the literature. 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), in conjunction with low salinity and suboptimal ionic profiles, might be responsible for reduced survival and production of Pacific white shrimp (*Litopenaeus vannamei*) at harvest. Likewise, little information is available for commercial bait shrimp producers growing native shrimp or state agencies managing the fisheries concerning the interactions of temperature and salinity on survival and growth. In order to determine the influence of temperature and salinity on juvenile Pacific white shrimp and Atlantic white shrimp (*Litopenaeus setiferus*) a series of experiments were conducted to examine the effects of salinity (1 to 40 g L<sup>-1</sup>) on the biological performance of shrimp reared at temperatures of 20, 24, or 28°C. Poor growth and survival of *L. vannamei* was observed after 21-28 days of culture at low salinity (2 and 4 g L<sup>-1</sup>) at 20°C. Raising salinity to 8 and up to 32 g L<sup>-1</sup> significantly increased survival at this temperature. An improvement in the growth rate of *L. vannamei* was observed at 24°C, but it still was sub-optimal compared to results observed at 28°C. Irrespective of salinity, high survival rates were observed at both 24 and 28°C, but variable growth rates were recorded, indicating a combined influence of salinity and temperature. After 58 days of culture, shrimp reared at 32 g L<sup>-1</sup> at both temperatures had numerically greater weight gain values than shrimp held at lower salinities, detecting statistical differences with respect to shrimp at 8 g L<sup>-1</sup> at both temperatures, to shrimp at 16 g L<sup>-1</sup> at 24°C but not at 28°C, and not to shrimp held at 1 or 2 g L<sup>-1</sup> at either temperature. Contrary to *L. vannamei*, the Atlantic white shrimp which was reared for 28 days at 24°C only, had the best growth performance at 8 g L<sup>-1</sup>, as compared to those at 2, 16, and 32 g L<sup>-1</sup>. Under equal experimental conditions, *L. setiferus* had considerably lower weight gain and survival than *L. vannamei*. Data from these studies will be useful for inland low salinity shrimp farmers raising *L. vannamei* in west Alabama as well as coastal bait shrimp producers.

## Are There 'Big Ones' Left in the Gulf of Mexico: Evidence from Fishery-Dependent Catch Data and Inter-Generational Perceptions among Anglers

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The Alabama Deep Sea Fishing Rodeo (ADSFR) is the oldest saltwater tournament of its kind in the United States. Running for eight decades, the ADSFR has generated a unique, annual record for the maximum sizes of many harvested marine species available to fishermen in the northern Gulf of Mexico. While these long-term data should be of great interest to scientists and managers given the concerns of size-selective harvesting, we



were curious how these long-term trends

compare to the perceived trends of the recreational fishing community. To gauge the recreational community's perceptions of long-term patterns for the availability of large fish that they pursue, we surveyed 402 participants at the 2008 ADSFR. In addition to soliciting descriptive information on each interviewee (age, gender, experience level, size of boat used to fish, location of fishing effort), our survey asked fishermen to give their perceptions of long-term size trends of 16 nearshore/offshore, benthic/pelagic fish species typically caught using

recreational gear and included as categories in the ADSFR. Among these species were red snapper (*Lutjanus campechanus*), king mackerel (*Scomberomorus cavalla*), tarpon (*Megalops atlanticus*), yellowfin tuna (*Thunnus albacares*), and spotted seatrout (*Cynoscion nebulosus*). Possible responses from interviewees included: 1) a perceived long-term increase in sizes, 2) a perceived long-term



decrease in sizes, and 3) no change in sizes of fish caught perceived throughout the last century (among others). Our results strongly suggest that recreational fisherman exhibit a broad range of outlooks on the health of fish stocks (as defined by large fish availability): from optimistic to pessimistic.

Moreover, their perceptions on individual species patterns were dramatically influenced by how frequently they made fishing trips, as well as whether they fished nearshore or offshore. We hope these data can be used to open further lines of communication



*Bays and Bayous*  
*December 1-2, 2010*

with recreational fishermen, and move together toward addressing societal concerns about the health of coastal ocean ecosystems.

## **The Natural Resource Advisor Program: An Innovative Approach to Protect Natural and Cultural Resources during the Deepwater Horizon Oil Spill Response**

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The Deepwater Horizon (MC252) oil spill response required the removal of oil from the affected shorelines of Louisiana, Mississippi, Alabama, and Florida. Many of the shoreline cleanup activities had the potential to cause inadvertent but significant impacts to natural and cultural resources. As part of an emergency section 7 consultation, the USFWS developed a list of Best Management Practices (BMPs) to be implemented to minimize the impacts to federally listed species, designated critical habitat, and candidate species. Additional BMPs were developed to aid compliance with U.S. Army Corps of Engineers permits and conditions required by state natural and cultural resource agencies. Due to the size of the response area (~350 miles the Mobile Sector), it was difficult to implement agency BMPs from the Mobile Incident Command Center (MICC). The MICC (responsible for Mississippi, Alabama, and Florida Panhandle), in close coordination with the USFWS and the NPS, developed an innovative approach, the Natural Resource Advisor (NRA) program, to oversee compliance with agency BMPs and assist operations crews in minimizing potential injury to natural and cultural resources. The NRA program was comprised of 40 professional biologists distributed throughout the response area and imbedded within the field operations crews. NRA Team Leaders attended daily operations planning meetings and offered suggestions to maximize cleanup efficiency while minimizing resource impacts. NRAs delineated sensitive natural and cultural resources, directed cleanup crews and mechanized equipment away from these areas, and advised field operations on the least intrusive locations for staging and ingress/egress to the beach. Cleanup activities in sensitive habitats (wetlands, dunes, bird and turtle nesting areas, etc.) were continuously monitored. Where state or federal authorization was required, the NRAs took the lead in gathering the required permitting information. The NRA program was extremely successful and achieved the primary program goal of assisting field operations personnel with BMP compliance. It provided state and federal agency personnel with a single point of accountability for natural and cultural resource issues, collected data for the section 7 administrative record, reduced NRDA liability, and, most importantly, minimized impacts to the Gulf of Mexico shoreline during this historic response.

## **Variation in the Abundance, Distribution, and Habitat Associations of Passerines Wintering in Salt Marshes of the Grand Bay National Estuarine Research Reserve**

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Little is known about wintering marsh bird communities along the northern coast of the Gulf of Mexico. To document the abundance, distribution and habitat associations of wintering marsh birds, bi-weekly line-transect surveys were conducted using distance estimation along fifteen randomly selected transects ranging from 200 to 500 meters in length. Surveys were conducted December through March from 2004 to 2010 at the Grand Bay National Estuarine Research Reserve and National Wildlife Refuge. Marsh Wren (*Cistothorus palustris*), Nelson's Sparrow (*Ammodramus nelsoni*), and Seaside Sparrow (*Ammodramus maritimus*) were the three most commonly detected species, and were the species compared in our analyses. Preliminary analysis shows a positive relationship between vegetation diversity and species diversity. Species-specific habitat associations were examined for the three focal species of marsh birds. Relative abundance estimates of Marsh Wrens vary widely between years, while relative abundance estimates of Seaside Sparrows and Nelson's Sparrows remain similar from one year to the next. Temperature variation between winters and the timing of hurricanes and other flooding events were examined as explanations for the variability in Marsh Wren abundance between years.



## **Intensive Oyster Aquaculture in the Gulf of Mexico**

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Despite the dramatic growth of oyster farming across the US, in the Gulf of Mexico region, oysters have only been farmed extensively, on bottom leases with the vast majority of production concentrated in Louisiana. Subject to environmental variability, the supply and quality of extensively farmed oysters varies widely. In contrast, oyster farmers using intensive, off-bottom methods focus on producing a steady supply of consistently premium oysters for the lucrative half shell niche market. In parallel with other efforts to identify and overcome hurdles, it is essential to provide beginning and prospective oyster farmers concrete, locally-derived quantitative production and economic data to address the where, what and how of oyster farming.

The goal of this work, funded by the Mississippi-Alabama Sea Grant Consortium is to quantitatively compare oyster aquaculture practices at coastal sites in Alabama to determine the most viable combination of methods, providing guidance to current and prospective oyster farmers in the North Central Gulf of Mexico region. Specifically, working with three current Alabama oyster lease holders, we have begun to 1) identify optimal sites for the nursery culture of hatchery-reared oyster seed along the Alabama coastline by deploying oyster seed at different sites along the Alabama coast to measure average daily growth and mortality rates, 2) compare the performance of native triploid (putatively sterile) oysters to half-sibling diploid oysters at the three lease sites planted in the fall and spring over 11-16 month grow-out periods to analyze differences in growth, survival, yield and condition index, 3) test and compare the effect of four different types of commercially available oyster culture equipment on oyster growth, survival and yield to market size (and the interaction of gear with ploidy) with oysters deployed in the fall and spring, and 4) determine the costs of production of the various combinations of production strategies tested here, and identify the least cost approach to intensive farming of oysters for each lease holder and prospective oyster farmers in the region.



**Figure 2. View of demonstration commercial-scale oyster farm.**

This project relies on and promotes close collaboration with the industry participants and develops immediately applicable information (e.g., growth rates, mortality rates, costs of production, etc.) and 'hands on' experience. Additionally, the proposed project would create three working oyster farms along the Alabama coast, which can serve as demonstration sites for others in the region, supporting development of this industry broadly throughout the North Central Gulf of Mexico region.



## **Annual Changes in Seagrass Assemblages in the Fenholloway and Econfinia River Estuaries, Apalachee Bay, Florida**

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The Big Bend area contains the largest seagrass beds in the eastern GOM with coverage estimates of over 750,000 acres. The most abundant taxa in the northern GOM include *Thalassia testudinum*, *Syringodium filiforme*, *Halodule wrightii* and *Halophila* spp. Seagrasses can occur in both continuous coverage and patchy beds and provide critical and valued habitat functions. Excessive rainfall over extended periods has been shown to damage seagrass communities; high amounts of rainfall can result in decreased light availability along Florida's Gulf coast and a reduction in seagrass abundances. Seagrasses have been monitored over the growing season at ten stations in the Fenholloway River and Econfinia River estuaries during 2006 - 2010, as well as annual seagrass surveys in Apalachee Bay during 2005 - 2010. Data has shown that regional climatic factors, including seasonal rainfall and riverine discharge, affect the distribution and abundance of seagrasses in Apalachee Bay. There has been a gradual increase in the distribution and abundance of seagrasses from 2005 to 2010, coinciding with a decrease in both riverine discharge and water color and an increase in light availability.

## **Quantifying Stress Levels of Salt Marsh Plants for the Mississippi Gulf Coast: Based on the Structural Change and the Loss Rate of Marsh Patches through Multiple Remote Sensing Methods**

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Coastal wetlands are threatened by multiple upland and ocean based sources. The Mississippi's coastal wetlands in particular have faced increased stresses due to the Deepwater Horizon oil spill in the past months. The short term effects of oil on wetland plants ranges from reducing transpiration and carbon fixation to plant mortality and as plants perish, the wetland structure and functionality diminishes (DeLaune et al. 1979, Pezeshki and DeLaune 1993).



Figure 1. Photograph of Davis Bayou

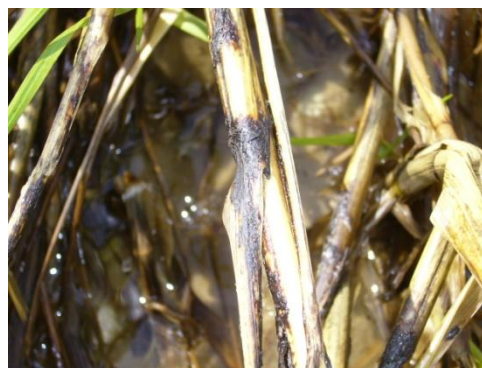


Figure 2. Photograph of *Spartina alterniflora* with dried oil

Our project seeks to evaluate the loss rates of the Mississippi Coast's saltwater marshes based on using two types of 1 meter resolution imagery for the years 2004 and 2009. We will perform land classifications using multiple methods including neural networks to texture and spectral information to determine the areas of three estuarine marsh types, emergent, forested and scrub. We will then calculate the areas of these wetland types to determine the loss rates among patches. Patches will be defined as relatively homogeneous marsh coverage not separated by water bodies. Accuracy assessments will be performed by applying a standard "confusion matrix" in which we relate the number of correctly classified units (or area) to the total number of units (or area) of the classifications (Story and Congalton 1986, Foody 2002). These changes in area between 2004 and 2009 for each marsh patch will be used as a proxy for stress levels. The loss rates will be classified to three stress levels. These rates will then be used in an ongoing photosynthesis project that will allow for a comparison of salt marsh stress levels as oil recovery efforts continue.

## **Changes in Coastal Fish Communities Following Deepwater Horizon Oil Spill**

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The April 20, 2010 explosion of the Deepwater Horizon (DWH) oil rig off the coast of Louisiana triggered expression of extreme concern from scientists, researchers, environmental managers, and conservationists. Because of public health concerns over seafood safety, state and federal authorities quickly closed many areas of the northern Gulf of Mexico to recreational and commercial fishing. What impacts the uncontrolled intrusions of oil from the accident site, and the cessation of fishing pressure on local resources, are currently unknown. Immediately after the catastrophic failure of the DWH, scientists at the Dauphin Island Sea Lab began collecting baseline data describing the composition and abundances of commercial and recreational fishes in waters around Mississippi and Alabama. In August, new funding provided by the Northern Gulf Institute allows us to begin assessments of acute impacts of the oil on our local fisheries. Here, we present preliminary results of a rapid response environmental assessment of changes in coastal and offshore fish communities. Specifically, we document changes in overall abundance and biomass by making comparisons of pre-impact trawling efforts (May 2010) to post-impact (September 2010) data.

Although more years of replication are needed to parse out the impacts of seasonal variability in these assemblages, initial results indicate surprisingly that the abundances and biomass of local fish assemblages are much higher than they were in May. We hypothesize that this increase could be due to indirect effects of the oil spill, primarily through the cessation of harvesting from the commercial and recreational industries.

**--Habitat Management Session: Conservation and Restoration for Sustainable  
Ecosystems--**

*(in order of program listing)*

## **NOAA's Restoration Center Programs, Partnerships and Projects in Mississippi and Alabama**

Meg Goecker

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NOAA's Restoration Center funds and supports marine and coastal habitat restoration through a diverse set of programs such as the Community-based Restoration Program (CRP) and the Damage Assessment, Remediation and Restoration Program (DARRP). The NOAA Restoration Center staff help to identify potential projects, strengthen the development and implementation of habitat restoration activities, and generate long-term national and regional partnerships to support restoration efforts across a wide geographic area.

The Community-based Restoration Program (CRP) applies a novel, grass-roots approach to restoration and is designed to actively engage communities in on-the-ground restoration of local habitats. The program also implements special initiatives to remove marine debris and re-open coastal river habitat to fish that migrate inland from the ocean. Through local and national partnerships with organizations such as the Gulf of Mexico Foundation, The Nature Conservancy, SeaGrant, and Fish America Foundation, numerous projects in Mississippi and Alabama have been funded. Current and past restoration projects in the Mississippi and Alabama include seagrass prop scar remediation, oyster reef restoration, living shoreline installation for shoreline stabilization, litter free waterway initiatives and derelict crab trap removal projects, and river passage and erosion remediation.

The Damage Assessment, Remediation, and Restoration Program (DARRP) works to restore marine resources that have been injured due oil spills, toxic releases, or ship groundings. Through the program, injuries are repaired when possible and the lost natural resources are replaced through restoration projects that focus on revitalizing and improving coastal and marine habitats. In the case of the Deepwater Horizon oil event, in coordination with federal and state agencies and the responsible parties, the NOAA team has been collecting data from pre-oiled and oiled natural resources. This information is critical to the natural resource damage assessment (NRDA) process. Data collected in the Gulf will help determine what natural resources have been injured and what human uses have been lost. Once the injuries and losses are known, NOAA works with its partners and the public to identify restoration projects that benefit a wide variety of habitats and biological resources.

## Setting the Stage for Alabama's Recovery: 100 Miles of Oyster Reef, 1,000 Acres of Marsh

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The Alabama Coastal Foundation, Mobile Baykeeper, The Nature Conservancy, The Ocean Foundation, local organizations, agencies, scientists and stakeholders, have formed the 100/1000 Partnership and together we are using the information gleaned from current and past projects to kickstart large-scale recovery efforts in Mobile Bay by building 100 miles of reef and promoting and planting 1000 acres of marsh/seagrass in Mobile Bay.

Spanning over 24,000 miles of shoreline in five southern states, the Gulf of Mexico is a true national treasure that makes up the United States' "third coast." Long seen as a major producer of seafood and energy, this 9<sup>th</sup> largest body of water on the planet is also home to globally important biological diversity. Warmed by subtropical waters and harboring a complex suite of habitats, the Gulf of Mexico is one of the most productive places on the planet.

Organizations and agencies have been trying to identify initial restoration activities that will make a meaningful difference in addressing the needs for recovery from impacts of the *Deepwater Horizon* Oil Spill, as well as the chronic issues of coastal Alabama and the northern Gulf of Mexico.

The Nature Conservancy has successfully implemented numerous pilot projects for oyster reef, seagrass and saltmarsh restoration in the Gulf of Mexico, from Texas to Florida, including several large-scale projects funded by the Estuary Restoration Act and the American Recovery and Reinvestment Act. In Alabama, TNC has been working with several partners to create more than a mile of new oyster reefs on the Alabama shoreline. While these projects are not fully complete, they have already provided valuable lessons that will enable the Conservancy to implement additional projects and help others to embark on restoration projects of similar or larger scales.

One hundred miles of new reefs will not only provide substrate for oyster spat settlement, it will also provide critical fish habitat, support seagrass beds, and significantly reduce shoreline erosion. Finfish and shellfish stocks will need as much new clean nursery habitat as possible to rapidly recover from the impacts of the *Deepwater Horizon* Oil Spill. Mobile Bay was relatively protected from worst aspects of the spill, primarily due to the freshwater inflows from the major tributaries to the bay, affording an excellent opportunity for this type of large-scale, partnership-based, initial restoration effort.

## **The ADCNR Little Bay Restoration Project: Large Scale Restoration in Practice**

Carl Ferraro

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Following Hurricane Katrina, the Alabama Department of Conservation and Natural Resources-State Lands Division (SLD) received NOAA-Fisheries Emergency Disaster Relief Programs (EDRP) funds to conduct finfish and shellfish nursery habitat restoration. The SLD targeted the majority of these funds towards a large scale restoration project at Little Bay in south Mobile County. This presentation will highlight the many aspects of this large scale restoration effort.

The Little Bay Restoration Project site is located just west of the mouth of Bayou la Batre on the north shore of Mississippi Sound in Mobile County, Alabama. This area has experienced significant long-term erosion, on the order of 5-10' per year. That objective of this project was to halt or slow this erosion and to restore the shoreline to its 1950 alignment, including sealing a breach in the peninsula which creates Little Bay. The project design included the placement of approximately 5,200 feet of permeable segmented breakwaters, the dredging and placement of approximately 130,000 cubic yards of sandy sediments and the planting of approximately 100,000 plugs of native vegetation. Project design and engineering commenced in 2007, construction commenced in November 2009 and was completed in July 2010. Planting was initiated in August 2010 and is scheduled to be completed in November 2010.

## **Shoreline Stabilization at Dog River Park: Stabilizing a Shoreline and Creating Habitat through a Public/Private Partnership**

Tom Herder

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Dog River Park (DRP) is a City of Mobile public facility with four ramps that provide the only public access for recreational boaters to Dog River. An approximately 340-foot shoreline that runs from concrete debris just south of existing ramps to the park's southernmost point has suffered chronic erosion caused largely by wakes from recreational boats. Stimulated by concerns of the Dog River Clearwater Revival and the City Parks and Recreation Department, the Mobile Bay National Estuary Program obtained \$26,000 through a NOAA-ANEP Community-based Restoration Partnership Grant to stabilize the shoreline using technologies that create or enhance riparian and intertidal habitat.

University of South Alabama (USA) Civil Engineering Professor Dr. Scott Douglass provided technical guidance and recommended installing a series of 20-foot pile-supported timber structures along the shoreline with 30-foot intermittent gaps. He advised placing clean sand fill landward of timber structures to create headlands and grading/excavating the four-foot escarpment in the gaps to create pocket beaches where emergent vegetation could be planted. He also advised placing riprap seaward of timber structures to prevent scouring and provide habitat for fish and invertebrates.

The lowest bid for construction of seven timber structures and placement of sand fill and riprap left little of the grant funds for purchase of sand, riprap, plants, or educational signage or for grading of gap escarpments. However, the Alabama State Port Authority (ASPA) donated 250 cubic yards of clean sand from their Rangeline Road storage site, leaving only the cost of transport to the site for placement. The City of Mobile, through a Memorandum of Agreement, provided and delivered 145 tons of #2 riprap for installation seaward of the timber structures and just offshore in gaps (to attenuate wave energy and protect plants). City Public Works Department employees used City equipment to grade gap escarpments and remove a large Chinese Tallow tree. 1,500 wetlands plants were purchased with a separate grant from the U. S. Fish and Wildlife Service (F&WS) and planted by volunteers with guidance and assistance by the vendor. Significant post-planting high water events compromised planting success in gaps, so Dauphin Island Sea Lab Discovery Hall Programs (DISL DHP) transplanted pickerel weed and duck potato from a Baldwin County pond to the DRP shoreline to supplement the earlier planting. Alabama Marine Police (AMP) extended and posted the "No Wake Zone" past the southern tip of the DRP shoreline. Educational signage was purchased with MBNEP funds and installed by City workers.

The completed project matched a \$37,300 Federal investment with over \$50,000 in local and in-kind match to stabilize a shoreline at a City park using technologies that publically demonstrate ecologically beneficial alternatives to traditional shoreline armoring. It was accomplished through a public/private partnership that included MBNEP, the City of Mobile, NOAA, EPA, F&WS, AMP, ASPA, USA, DISL DHP, and community volunteers.



## **Restoring the hydrology and plant community of a coastal bayhead swamp on Oyster Bayou in Biloxi, Harrison County, Mississippi**

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The project area is a reach of Oyster Bayou located in south Mississippi immediately north of US Highway 90 on the Mississippi Sound in Biloxi. The approximately 4.0 acre restoration site is part of the larger Beauvoir-Jefferson Davis Home complex. Oyster Bayou flows through the property and acts as the primary drainage for more than 350 acres of West Biloxi. The wetland forests in the north and east portions of the property were historically logged and some partially filled. The stream system flowing from northwest to southeast was channelized to move water more quickly off the site and into the nearby Mississippi Sound. On 29 August 2005, Hurricane Katrina made landfall less than 30 miles west of Beauvoir. The massive tidal surge deposited tons of debris, causing extensive damage to trees and extant native habitats. Additional collateral damage was inflicted while removing the mountains of construction debris and felled trees during the cleanup operation. This led to an invasion of exotic and ruderal plant species that threatened ecological integrity, challenged the biotic resilience of the system and required specific intervention in order to restore the native habitat. While extraordinarily destructive, the hurricanes of 2005 did help to raise the awareness of Gulf Coast residents as to the critical role that coastal wetlands play in floodwater attenuation and retention.

The ecosystem restored in Oyster Bayou is a forested wetland known as a *bayhead swamp*. These forests typically develop in broad, shallow braided drainageways, along creeks with little or no banks, or in deeper depressional areas of pine flatwoods. The hydrology is driven mostly by groundwater and the soil is frequently flooded, developing a relatively thick layer of highly organic muck or peat. Bayheads in south Mississippi are usually dominated by evergreen sweetbay and swamp bay with deciduous taxa such as red maple, pond cypress and swamp tupelo also occurring. The understory may contain a variety of hollies along with bayberry and fetterbush while the groundcover is usually dominated by an assortment of ferns including cinnamon, royal and chain. Coastal bayhead swamp communities would normally provide essential watershed functions related to floodwater storage, groundwater flow moderation, sediment removal, nutrient cycling and water purification. The diversity of trees, shrubs and herbaceous species offer unique habitats in which a wide variety of mammals, reptiles, amphibians and fish forage and reproduce. Vegetation along the stream helps stabilize banks, prevents soil erosion and filters out pollutants. Streamside vegetation also provides shade to maintain water temperature and reduce algal growth that might displace desirable aquatic flora and fauna. Many of these essential biological functions were corrupted or entirely absent at Oyster Bayou. Restoration techniques employed at Oyster Bayou and the site's current vegetative condition are presented. This is the first known restoration of a coastal bayhead swamp in Mississippi.

## ***Juncus roemerianus* Morphology and Colonization in Two Marsh Restoration Designs**

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Marshes play important roles in coastal systems, such as the prevention of shoreline erosion, buffering of flood waters, filtering of anthropogenic pollutants, and provision of habitat for a variety of organisms. Many of these roles that marshes play are not only ecologically important, but are also beneficial, thus economically valued, to humans and are termed “ecosystem services”. Marshes are being destroyed in many parts of the world due to human coastal development, and restoration is a common practice to palliate this loss. Few studies, however, have compared the success and cost-efficiency of different restoration designs. This is a pressing need for environmental managers, who often need to balance the target goals with the cost and effort required. Here we compare two designs for black needlerush (*Juncus roemerianus*) marsh restoration. Two density treatments (i.e. full and half density plots) were planted in Spring 2006 at the Bayou Heron boat launch in Grand Bay, MS. Most measurements were conducted seasonally from Summer 2006 to Summer 2010 in the restored marsh and in an adjacent natural marsh for comparison. Measurements included shoot growth rates, total shoot lengths (living and senesced), and shoot colonization rates for subsets of normal, interior colonizing, and periphery colonizing shoots. The results show that growth rates ( $p = 0.784$ ) and the ratio of living to dead shoot lengths ( $p = 0.112$ ) do not display large and consistent differences among treatments for normal shoots. Shoot lengths for normal shoots was significantly different among treatments throughout the duration of the experiment ( $p = 0.047$ ). However, shoot lengths did demonstrate an expected pattern of similar lengths among treatments directly after planting, followed by a divergence and convergence of lengths among treatments. Interior colonizing shoots and periphery colonizing shoots also showed an expected pattern with interior shoots being consistently longer than periphery shoots ( $p = 0.030$ ). Rates of shoot colonization from the plots outward were not significantly different between the two treatments ( $p = 0.380$ ). There was an evident pattern with marginally higher colonization rates in full density plots than in half density plots until Summer 2008 ( $p = 0.130$ ); however, after that date both types of plots showed similar rates of shoot outward colonization ( $p = 0.673$ ). The interior unplanted areas in half density plots filled in  $1285 (\pm 11.582)$  days, effectively becoming full density plots. These results point to half density plots as a preferred restoration design over full density plots, since similar results can be achieved over a few years with decreased effort and cost.

*Bays and Bayous*  
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## Oyster Reefs as Natural Breakwaters Mitigate Shoreline Loss and Facilitate Fisheries

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Estuarine and vegetated nearshore habitats comprise only 0.7 % of global biomes, yet they contribute \$7.9 trillion dollars or approximately 24% of the yearly total global ecosystem services. These benefits include disturbance resistance, nutrient cycling, habitat, food production, and recreation. Within estuaries, many of these benefits are concentrated along shorelines which are unfortunately among the most degraded and threatened habitats in the world because of their sensitivity to sea level rise, storms, and increased utilization by man. Efforts to restore shorelines and protect upland property have increased substantially. Unfortunately, many approaches put engineering ahead of ecology in determining mitigation and restoration efficacy.

The “engineering first” approach often utilizes vertical bulkheads, concrete and granite rip-rap, and seawalls that are often touted by coastal engineers because they are viewed as permanent and non-retreating structures. Unfortunately, little thought is given to the ecological, aesthetic, or socioeconomic impacts of these hardened structures. Although such structures may mitigate shoreline retreat, the ecological damages that result from their presence can be great in nearshore areas (Figure 1). The benthic setting adjacent many armored shores is generally absent of complex, structured habitats which are thought to function as nurseries for many finfish and shellfish species. Despite these known shortcomings, shoreline hardening has continued to increase primarily due to a lack of practical and ecologically responsible alternatives. Recently, initiatives for more sustainable development have produced innovative shoreline protection schemes that target the benefits of natural coastlines; however, the ecological benefits have not been explicitly tested.



Figure 1. Shoreline armoring can accelerate erosion on adjacent shorelines.



Figure 2. Construction of breakwater oyster reefs

In this study, we experimentally examined the efficacy of experimental breakwater oyster reefs and their potential impacts on nearshore fish and shellfish community structure along two different stretches of eroding shoreline in coastal Alabama (Figure 2). We documented oyster settlement and subsequent survival at both sites, with mean adult densities reaching more than eighty oysters  $m^{-2}$  at one site. We found the corridor between intertidal marsh and oyster reef breakwaters to support higher abundances and a different community of fishes than marsh inshore of control plots, and several economically important species were enhanced by the oyster habitat. Blue crabs were the most clearly enhanced (+297%) near breakwater reefs, while red drum (+108%), spotted seatrout (+88%) and flounder (+79%) also benefited. Our experimental breakwaters were an “ecology-first” approach and were successful in creating valuable habitat and mitigating shoreline retreat; however, the vertical relief of the breakwater reefs was reduced over the course of our three year study and this compromised their shoreline protection capacity. “Ecology-first” approaches, including breakwater reefs, that protect coastal uplands could provide a more ecologically-responsible alternative to traditional armoring and not only mitigate coastal erosion, but also enhance certain economically-valuable stocks. However, as our study demonstrated, efforts to sustainably and responsibly protect coastal shoreline habitats must balance both engineering and ecology.

## Alabama State Port Authority Choctaw Point Terminal Project: Year 1 Mitigation Monitoring

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This study provides environmental survey data for Year 1 of the 5-year mitigation-monitoring program for the Alabama State Port Authority Choctaw Point Terminal project. The Terminal project design includes 71.7 acres of fill in wetlands and water bottoms. To compensate for these impacts, emergent tidal marsh systems were created as mitigation. The mitigation marshes for Year 1 monitoring included the North Garrows Bend and McDuffie Island sites, which were prepared during the Fall 2006 and Winter 2007, respectively. These sites were created through excavation and removal of soils and sediments to achieve wetland elevations suitable for marsh plant species endemic to the upper reaches of Mobile Bay. Planting was completed at McDuffie Island in January 2007 and at North Garrows Bend in April 2007. These two sites comprise a total of 34 acres of created tidal marsh habitat. The reference marsh for the Year 1 study is a 34-acre site at Deer River, located approximately 10 miles south of the created mitigation marshes. Two seasonal surveys (June and November 2009) were conducted. Monitoring methodologies assessed the criteria for mitigation success stipulated in the environmental permit for port expansion. The percent cover of plant species and other ground cover categories was determined using standard a 1-m<sup>2</sup> quadrat and 100-ft linear transects. Macroinfauna were sampled in June using a 4-in diameter hand core. Nekton were sampled in lift nets (marsh surface) and seines (tidal creeks) during both the June and November surveys. Wet weight biomass was measured for lift net and seine sample contents. Total vegetated coverage in quadrats was 92% for McDuffie Island, 73% at Deer River, and 64% at North Garrows Bend. Total vegetated coverage along transects was 96% for McDuffie Island, 95% at Deer River, and 78% at North Garrows Bend. Annelid worms, particularly tubificid oligochaetes, were numerical dominants of the macroinfaunal community at both the mitigation and reference marshes. There were no statistically significant differences among the three study sites in macroinfaunal abundance, diversity, or species richness. Nekton abundance was generally greater in lift nets and seines at the mitigation marshes compared to the reference marsh, though numerically dominant taxa differed somewhat between the study sites. North Garrows Bend lift nets yielded the most individuals overall in both June and November. Cluster analysis resolved three groups of lift net stations, based on relatively low abundances of the fish *Fundulus* (McDuffie Island during both surveys), higher numbers of *Fundulus* along with blue crabs (North Garrows Bend in November), or the fish *Gobiosoma* along with *Fundulus* (North Garrows Bend and Deer River in June). Abundant taxa collected in seine samples included Gulf menhaden (*Brevoortia patronus*), mullet (*Mugil* spp.), and penaeid shrimps. Lift net and seine biomass values at both mitigation marshes equaled or exceeded values from the reference marsh during both surveys. The project is designed to recreate the essential structural features of tidal marsh systems, and is on a trajectory toward achieving a functional capacity comparable to that of nearby reference wetlands.



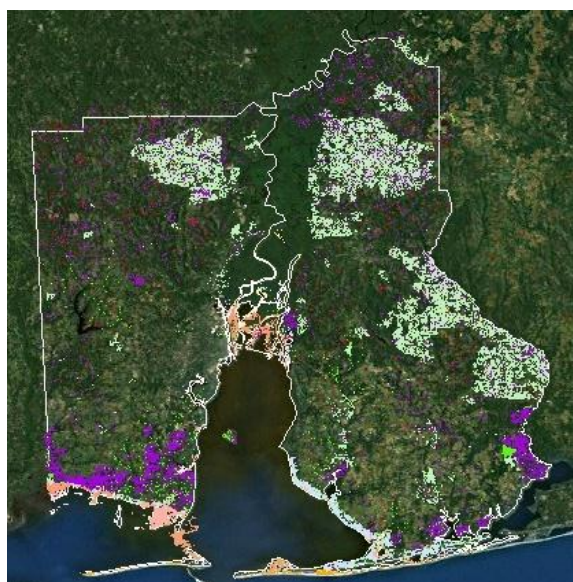
## **Collaborative Conservation Planning in Mobile Bay, AL**

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**Keywords:** conservation, coastal, conservation priorities, habitat protection, restoration, cooperative conservation, community-based

Habitat conservation, protection, and restoration are very much community concerns in coastal Alabama. In 2009, the Mobile Bay National Estuary Program (NEP), the National Oceanic Atmospheric Administration (NOAA) Coastal Services Center (Center), NOAA Office of Habitat Conservation (OHC), and The Nature Conservancy (TNC) got together with local stakeholders from the Coastal Habitats Coordinating Team (CHCT) to strategically identify priority habitats to guide conservation and restoration efforts in Baldwin and Mobile Counties, Alabama. The project brought together the local knowledge and expertise of more than sixty state and local entities concerned with habitat protection in coastal Alabama, together with the geospatial, ecoregional, and technical expertise of TNC, OHC, and the Center at the national level.

The project built upon an existing acquisition and restoration priorities atlas that was developed in 2004-2005 by the Mobile Bay NEP and TNC, in cooperation with a number of federal, state, and local stakeholders. The resulting report and static maps were revised using geospatial data, a Geographic Information System (GIS), and the Center's Habitat Priority Planner tool to strategically identify priority habitats for protection. The project also produced an interactive, online map viewer called the Alabama Habitat Mapper to make the priority habitat results accessible by stakeholder to guide habitat protection actions strategically at local and regional scales.



**Figure 1:** Alabama Habitat Mapper displaying priority habitat results

This presentation will highlight results of the project, including examples of how the Alabama Habitat Mapper has been used for habitat protection as well as for Deepwater Horizon oil spill response. It will also illustrate the challenges and accomplishments of collaborative partnerships that work across sectors and leverage tools, resources, and expertise. Such partnerships – motivated by local needs and grounded in holistic assessments of the ecological value of protected lands – serve as an important step in ecosystem-based approaches to coastal resource management. These partnerships aid communities in their efforts to make better use of existing capabilities, resources, and funding for achieving habitat goals.

**Living Shorelines: A Workshop Providing Science Based Training to Decision-makers and Environmental Professionals along the Gulf Coast**

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Coastal erosion is an issue of importance to the habitat restoration community throughout the United States, including the Gulf of Mexico. The Gulf of Mexico Alliance Regional Training Coordinator, in cooperation with the Coastal Training Coordinators from the five Gulf Coast National Estuarine Research Reserves, offered a total of five Living Shorelines workshops in four of the five Gulf States. Living shorelines use plants and other natural materials to stabilize the shoreline, minimize coastal erosion, and maintain coastal processes while enhancing the natural shoreline habitat for the benefit of property owners as well as fish and other wildlife. This regional living shorelines training effort was made possible through the framework of the Gulf of Mexico Alliance (GOMA) and allows priority issues of concern, such as coastal erosion, to be addressed on a regional scale. Attendees throughout the Gulf Coast were presented with detailed information about creating living shorelines projects and went on project site visits. Workshop development and implementation in the context of regional collaboration, as well as, participant feedback and lessons learned will be discussed.

## **Mississippi Coastal Roots School Seedling Nursery Program**

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Mississippi State University's Coastal Research and Extension Center initiated the Mississippi Coastal Roots School Seedling Nursery program in 2008. This program is modeled after and cooperates with the Louisiana State University Coastal Roots School Seedling Nursery Program for Habitat Restoration which was started 2000 in cooperation with Louisiana Sea Grant. The program enhances learning areas such as plant growth and development, wetland issues, conservation and hands-on habitat restoration. The program includes the installation of a small container nursery for production of native coastal plants at the participating schools. One school seedling nursery was established in 2009, Woolmarket Elementary School, and up to five more will be installed by the end of 2010. The program provides elementary and secondary educators the professional development opportunities to enhance teaching by example through hands-on demonstration which will supply students with real-world conservation and stewardship experience.



## **Educating through Experience: A Design Study of a Gum Swamp Exhibit at The Crosby Arboretum; Picayune, Mississippi**

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The mission of the Crosby Arboretum, Mississippi State University Extension (located in Picayune, MS) is to preserve, protect, and display plants and their communities in the Pearl River Drainage Basin. The Crosby Arboretum's nationally award-winning master plan has previously designated a portion of its facility for the creation of a gum swamp educational exhibit. Gum swamp forests are semi-permanently flooded forests that are predominated in species type and frequency by black gum (*Nyssa biflora*) and tupelo gum (*Nyssa aquatica*). As specified in Mississippi's Comprehensive Wildlife Conservation Strategy by the Mississippi Department of Wildlife and Fisheries (MDWF), Bald Cypress/Gum Swamp Forest Communities are considered vulnerable in the state of Mississippi. The proposed gum pond exhibit will address MDWF priorities through the construction and management of the exhibit; as well as providing a public venue for public education and experience for this vulnerable forest type.

The Crosby Arboretum Foundation was awarded a grant to create a gum pond wetland exhibit on approximately 2,023 meter<sup>2</sup> of Arboretum property for a gum pond wetland exhibit. Graduate students in the Department of Landscape Architecture at Mississippi State University utilized a semester-long class project in spring 2010 to research and design the proposed gum pond exhibit. Students conducted a literature search on gum ponds and related wetlands and visited several *in situ* natural gum swamps in Mississippi. Students recorded environmental data at the natural wetlands to inform the restoration design. Students also conducted an environmental inventory and analysis at the proposed exhibit site that recorded the site's hydrology patterns, plant species, soils, and other data. A design charrette (a collaborative session to determine solutions to the design problem) was conducted with wetland specialists and landscape architects to develop the preliminary design.

This presentation will discuss the method used to develop the exhibit design, and will present the drawings for the future gum pond. The resulting design was not strictly based upon a gum pond restoration *per se*, but instead was crafted to include a variety of program elements to enhance the educational and experiential nature of this exhibit. For example, plant community habitats found near natural gum ponds may include bayheads, shrub bogs, wet forests, and emergent wetland plants—all which can serve as teachable experiences for wetland education. Construction for the exhibit is slated to begin in Fall 2010.

## **Managing Mobile Bay Sediment-Habitat with a Regional Perspective**

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Excessive sediment erosion, transport, and deposition are estimated to cause damages of approximately \$16 billion annually in North America. Sediment overloading from land and stream erosion causes significant environmental and economic challenges – excessive sediment in rivers, reservoirs and estuaries may contribute to high turbidity and to sediment burial of sensitive habitats. Yet, a shortage of sediment causes coastal erosion and wetlands habitat loss. Regional Sediment Management (RSM) employs natural processes and human activities to ensure that water resources projects throughout a sediment region affect sediment in an economically and environmentally sustainable manner. It recognizes that the region and its ecosystems respond beyond the space and time scales of individual projects, and that a proactive regional approach can produce significant habitat protection and economic benefits.

A Regional Sediment Management framework is proposed for Mobile Bay, combining an active RSM program for the northern Gulf of Mexico coastal region from Apalachicola Bay, FL to Pearl River, MS with a proposed program for the Mobile Basin. Water in the upper-most reaches of the Mobile Basin makes its way to the Gulf of Mexico through Mobile Bay, transporting, eroding, and depositing sediments along the way. Understanding sedimentation processes from a regional perspective will aid in making informed management decisions relating to sedimentation and habitat management.

The draft Framework is based on experience with the coastal program and input from regional stakeholders through workshops and mailings. It is designed to address sediment issues in seven categories: Physical Environment; Biotic Environment; Economic and Social Environment; Human Activities; Data and Data Management; Laws, Policy, Regulation; and Communication & Education. The Physical Environment includes issues such as bank erosion and downstream deposition. The Biotic Environment includes habitat issues such as species' turbidity preferences and sediment suitability for benthic habitat. It connects these issues to sediment sources and sinks and attempts to determine actions and appropriate parties to accomplish those actions so as to achieve environmental and economic goals.

The Framework employs the Sulis Decision Support Toolkit to display regulatory and observed, data, including EPA 303d listed waters impaired by sediment or siltation, land uses and covers, sediment loads, and habitat maps, all in a light GIS map tool. It displays model results, including what-if scenarios for improved management practices. When complete, the Framework will provide a toolkit and a platform for resource managers to identify habitat problems, determine a course of action to remedy the problems, and work with others to achieve solutions.

## **Use of Land Use Land Cover Change Mapping Products in Aiding Coastal Habitat Conservation and Restoration Efforts of the Mobile Bay NEP**

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The Mobile Bay region has undergone significant land use land cover change (LULC) over the last 35 years, much of which is associated with urbanization. These changes have impacted the region's water quality and wildlife habitat availability. In addition, much of the region is low-lying and close to the Gulf, which makes the region vulnerable to hurricanes, climate change (e.g., sea level rise), and sometimes man-made disasters such as the Deepwater Horizon (DWH) oil spill. Land use land cover change information is needed to help coastal zone managers and planners to understand and mitigate the impacts of environmental change on the region. This presentation discusses selective results of a current NASA-funded project in which Landsat data over a 34-year period (1974-2008) is used to produce, validate, refine, and apply land use land cover change products to aid coastal habitat conservation and restoration needs of the Mobile Bay National Estuary Program (MB NEP). The project employed a user defined classification scheme to compute LULC change mapping products for the entire region, which includes the majority of Mobile and Baldwin counties. Additional LULC change products have been computed for select coastal HUC-12 sub-watersheds adjacent to either Mobile Bay or the Gulf of Mexico, as part of the MB NEP watershed profile assessments. This presentation will include results of additional analyses of LULC change for sub-watersheds that are currently high priority areas, as defined by MB NEP. Such priority sub-watersheds include those that are vulnerable to impacts from the DWH oil spill, as well as sub-watersheds undergoing urbanization. Results demonstrating the nature and permanence of LULC change trends for these higher priority sub-watersheds and results characterizing change for the entire 34-year period and at approximate 10-year intervals across this period will also be presented. Future work will include development of value-added coastal habitat quality assessment products that will be used by the MB NEP and its partners in the planning of coastal conservation and restoration activities.

## Application of Remotely Sensed Data and Models to Evaluate the Effects of Land Use and Climate Change on Shallow Aquatic Ecosystems and Inform Conservation and Restoration Actions

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Alabama coastal systems are subject to increasing pressure from a variety of influences including urban development and climate change. Land cover/land use (LCLU) and climate changes have a direct effect on the discharge of rivers that drain into Mobile Bay and adjacent coastal water bodies. The changes in streamflow affect water quality (temperature, salinity, and sediment concentrations) in the shallow aquatic areas and ecosystem functioning. Mobile Bay is a vital ecosystem that provides habitat for many species of fauna and flora. Historically, submerged aquatic vegetation (SAV) and seagrasses were found in this area of the northern Gulf of Mexico; however the extent of vegetation has significantly decreased over the last 60 years. The objectives of this research funded by the NASA Applied Sciences Program are to determine to what extent: (1) LCLU and climate changes affect runoff and water quality in the estuary, (2) how these changes will affect habitat suitability for SAV and seagrasses; and (3) how to best transition these data to benefit coastal policy and decision making. Our approach is to use watershed and hydrodynamic modelling to evaluate the impact of LCLU and climate change on shallow water aquatic ecosystems in Mobile Bay and adjacent areas of coastal Alabama (Figure 1). Under previous work, we used remotely sensed Landsat data for current LCLU model input and the Prescott Spatial Growth Model to generate future scenarios. Under current work we are using data from the *Intergovernmental Panel on Climate Change* (IPCC) on future temperature, precipitation, and sea level rise to create climate modelling scenarios. Model outputs will be used

to assess the impact on submerged aquatics and wetland species. The Mobile Bay National Estuary Program organized a Gulf coast stakeholder group to provide feedback to scientists on local conditions and policy concerns and to guide modelling assumptions and the transfer of data and results to coastal resource managers.

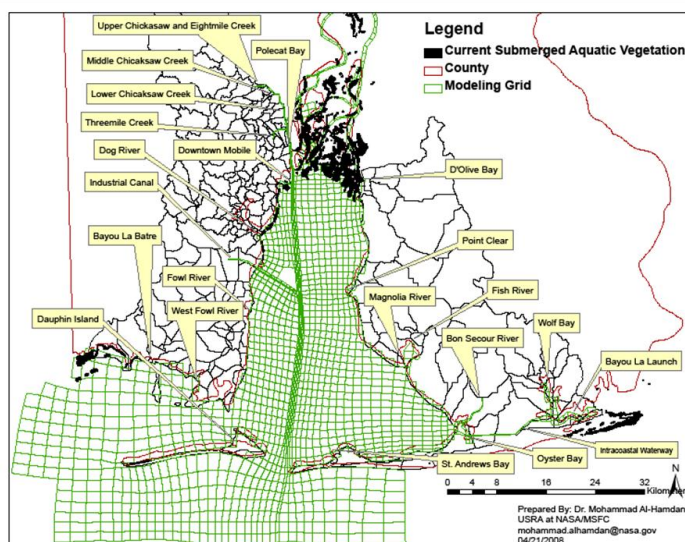


Figure 1. Hydrodynamic modelling grid, 22 discharge points, and SAV extent



## **Assessing Environmental Change in Dauphin Island from 1972 to Present**

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Dauphin Island is home to an Audubon Society bird sanctuary for multiple endangered species and supports a tourism industry that is a large contributor to the Mobile County economy. This barrier island is a buffer for southern Alabama during major hurricanes. Barrier islands are vulnerable to erosion because their location makes them susceptible to high wind and wave impacts from severe thunderstorms and tropical cyclones. Dauphin Island is considered a laterally regressive barrier island in a perpetual state of accretion and erosion due to changes in sea level and currents from the Gulf of Mexico. The east end of Dauphin Island includes large sand



**Figure 3** Map of Dauphin Island

dunes, while the beaches and dunes on the west end of the island have been eroding for the past three decades. The condition of island sand dunes is important to monitor because they help to protect coastal beaches and adjacent properties. Severe dune erosion destabilizes and erodes beaches, increases nearby inland flooding, and can lead to infiltration of salt water into surrounding fresh water estuaries. Community leaders require methodologies that will help them to improve responses to island geomorphologic and related vegetation change. To meet this need, students from NASA's DEVELOP National Program employed Landsat Thematic Mapper (TM) and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) imagery to investigate shoreline erosion, land loss, and vegetation change from 1972 to the present. With over 30 dates investigated, long term trends were assessed for the entire time series. We examined tidal variations as well as apparent effects of the Deepwater Horizon oil spill. LIDAR data was also used to quantify recent elevation change and sand dune erosion. The results demonstrate a steady decline in both land and vegetated area over the past three decades. The new information this project provides regarding the evolution of Dauphin Island can be used as a decision support tool by local community leaders and ultimately assist efforts to reduce erosion and protect the island's natural habitats and resources.

## **Using Multiple-Scenario Contingent Valuation Data to Estimate Willingness to Pay for Restoration of Mississippi's Barrier Islands**

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This research applies a novel method of nonmarket valuation to the case of barrier-island restoration in Mississippi. The objective is to estimate peoples' willingness to pay (WTP) for restoration to pre-Camille status by using the contingent valuation method because it is one of the standard approaches to measure the value of environmental goods or quality, and it is based on stated preference.

Data were collected by a mail-survey administered to 3,000 Mississippi households in February 2008. Petrolia and Kim (2009) measured Mississippi coastal residents' WTP for restoration of the Mississippi's barrier islands at three different scales: their current condition (Status-quo), their condition before Hurricane Camille (Pre-Camille), and their condition before 1900 (Pre-1900). They estimated the WTP for the three different scenarios separately using single-bounded data only, and did not include data on the level of uncertainty respondents had regarding their yes/no responses.

The single bounded model was conducted in order to compare the WTP from the similar concept of the double bounded model because the single bounded model often suffers from poor statistical efficiency. For the double-bounded dichotomous choice method to estimate WTP for the Pre-Camille option with other two scenarios, responses to the pre-1900 and Status-quo options could, in certain cases, be used as bounds on WTP for the Pre-Camille option. By incorporating additional information, the interval censored model could be adopted to estimate WTP more efficiently.

Additionally, we estimate our model of WTP incorporating respondent uncertainty. The uncertainty data were derived from a follow-up question where respondents were asked to indicate how sure they were about their stated WTP response. They choose from very sure, mostly sure, not very sure, and not at all. Uncertainty is incorporated in two different ways. In one specification, it is included as one of the independent variables; in the other, it is used as weights on the likelihood function.

Preliminary results indicate that the novel method introduced here results in both a higher WTP estimate and improves the efficiency of the estimates: WTP under the standard single-bounded model is \$128 with a 95% confidence interval between \$67 and \$190, whereas the novel approach yields a mean WTP of \$200 with a 95% confidence interval between \$186 and \$215.

## **Continuing Education Credits for Environmental Education Programs**

Chris A. Boyd

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Continuing Education Credits (CEU's) can be used to promote the Master Naturalist Program or other environmental education programs. Teachers, foresters, environmental consultants, city leaders and other interested participants can obtain CEU's or Continuing Forestry Education Credits for taking natural resources training. Typically one CEU credit is approved for every 10 hours of training. The Master Naturalist course teaches participants a wide variety of subjects in the class room and in the field. This type of natural resources training is unique and has limited class offering in many parts of the United States. These courses are taught by regional and local experts in the field of ornithology, water quality, native plants, habitats, wildlife, and other related subjects. An overview of the different types of education units offered, application process, and comparison of CEU credits obtained by a variety of environmental education programs will be discussed.

## **Teaching the Value of Habitat Restoration**

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Habitat restoration has become a significant focus of federal, state and local organizations and NGOs. Funding of research on effective restoration techniques as well as actual restoration projects has grown dramatically in the last decade. Many K-12 schools are now requiring or encouraging student participation in service activities. Restoration projects can provide an active, hands-on way to combine learning about habitats, organisms' requirements and ecosystems with students' desire to solve problems and 'do something'. However, many educators are unfamiliar with restoration science and have not explored this opportunity. Dauphin Island Sea Lab's Discovery Hall Programs created a new professional development opportunity to meet this need. Reefs, Rhizomes and Restoration (RRR), funded by Mississippi-Alabama Sea Grant (MASGC) from 2010-2013, is a workshop that focuses on restoration of oyster reefs, salt marsh and seagrass habitats.

The main objectives of the RRR workshop were to provide educators with 1) an introduction to restoration science, 2) a familiarity with the physical and biological requirements of three important coastal habitats, a seagrass bed, an oyster reef, and a salt marsh, 3) age-appropriate relevant classroom activities and 4) ideas for possible restoration student-focused service activities. These coastal habitats have been significantly affected by human activities and are critical to the health and productivity of coastal zones. Our approach was to combine lectures by restoration scientists with field excursions to restoration sites and explorations of several classroom-based activities. Additionally, we incorporated a small service project for workshop participants.

Formal and informal educators from four states (Alabama, Mississippi, Tennessee and Kentucky) participated in the four day 2010 RRR workshop. Teacher participants came from both math and science classrooms. In the classroom, general information about the specific habitats was shared, including their ecosystem services and then several age and subject appropriate hands-on activities for each habitat were introduced, conducted and discussed. For the summer of 2010, participants visited a MASGC salt marsh restoration site at Grand Bay National Estuarine Research Reserve, The Nature Conservancy's oyster reef restoration site in Mississippi Sound and a seagrass restoration site in Big Lagoon, FL. At each site, technicians, graduate students or others familiar with the project explained the design, construction and monitoring of the project. The teachers finished out the week by participating in a small restoration project, conducted in collaboration with the Mobile Bay National Estuary Program. They pulled pickerelweed from a homeowner's pond on the eastern shore of Mobile Bay and transplanted it along the shoreline in Dog River Park on the western shore of Mobile Bay to reduce shoreline erosion.



Figure 1. Teachers remove pickerelweed from a pond in Fairhope, AL.



## Communicating the Value of Critical Habitats to K-Gray Audiences in Alabama

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Researchers and educators at the Dauphin Island Sea Lab (DISL) and its Discovery Hall Programs (DHP) have developed an integrated research and education program for a large-scale oyster reef restoration study in Mobile Bay and Mississippi Sound. Oyster reefs provide critical ecosystem services, including improved water quality, shoreline stabilization and habitat and food for fish, birds and invertebrates. The purpose of this study, managed by The Nature Conservancy and funded through the National Oceanic and Atmospheric Administration, is to investigate the efficacy of different oyster reef restoration techniques in the establishment of living shorelines along the northern Gulf of Mexico.

A newly developed curriculum, including a lesson plan and associated activities and assessment, has been incorporated into our existing experiential education programs for school-age children and workshops for educators. Lesson content includes explorations of living shorelines, oyster biology, restoration science, and the ecology of oyster reefs, salt marshes and seagrass habitats. This curriculum was used in DHP's 2010 academic year and summer programs, including: (1) the residential *Marine Science* class for high school students; (2) *ArtSea Discovery camp*; (3) academic year class – *The Salt Marsh*; and (4) in a Mississippi-Alabama Sea Grant Consortium-sponsored teacher workshop titled *Reefs, Rhizomes and Restoration*. The curriculum includes the Alabama Course of Study Standards and Ocean Literacy Principles addressed. Modifications of the activities have also been used in several outreach events including Earth Day, Dauphin Island Community Day and Discovery Day, Dauphin Island Sea Lab's annual open house. We are continuing to update this unit and plan to develop new activities as the restoration project proceeds.



Figure 1. Children and adults learn about oyster reef restoration during Discovery Day.

We have also developed exhibits for the *Estuarium*, DISL-DHP's public aquarium which entertains and educates an average of 66,000 visitors per year. An outdoor exhibit has been constructed consisting of examples of each restoration technique being investigated, including a ReefBLK<sup>SM</sup>, Reef Balls, and unconsolidated oyster shell, along with permanent fiberglass interpretive signage. The signage highlights oyster biology, oyster reef habitat, ecosystem services provided by oyster reefs, and the potential benefits of using oyster reefs as living shorelines. An accompanying audio kiosk is under development. Inside the *Estuarium*, short videos describe reef design and construction, pre- and post-monitoring results and associated education activities.

## **Conservation and Education Program at the Foley Graham Creek Nature Preserve**

Leslie Lassitter

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The City of Foley, Alabama has been developing and implementing a conservation and educational program at the Foley Graham Creek Nature Preserve over the past two years. The goal of the Graham Creek Nature Preserve is to provide protection for the rare plant and animal species, the conservation and restoration of the unique habitats, and to provide an educational and a passive recreational experience for the community. Covering 484 acres, the Graham Creek Nature Preserve encompasses the headwaters and tributaries of Graham Creek, tidal marshes, pine savannas, and wetland and upland forests.

The educational programs initiated in 2009 with students participating in a longleaf pine restoration effort. Our Wonderful Wetlands was also founded in 2009. This educational program included two local schools teaching sixth grade students about wetlands including functions, types, and conservation practices. The students participated in field trips to the Graham Creek Nature Preserve where they learned about local wetland habitats. In 2010, the Our Wonderful Wetlands program will be expanded to include elementary and high school students visiting the Preserve and touring the unique habitats.

Graham Creek Nature Preserve currently boasts a canoe/kayak launch, picnic areas, a pavilion and several miles of trails. The preserve will foster environmental education through the use by the community, school groups, professional training courses and graduate level research projects conducted within the preserve. The trails and habitats will display interpretive signage for the identification of features, plant communities, habitats, flora and fauna. An environmental education center is projected to be constructed within the preserve for enhanced classroom activities and research facilities. Passive outdoor recreation will also be promoted within the preserve. Through the use of the canoe launch, the proposed disc golf course, and trails for walking, running, hiking, and biking, the public will benefit from the recreational attributes within the preserve. Bird watching and wildlife viewing areas will also be designated in areas within the preserve. The purpose of the Graham Creek Nature Preserve is to define the site as a local amenity with the potential for regional and national reverence.



Figure 1. White Topped Pitcher Plant Community

**Dog River Scenic Blueway: Promoting Habitat Revitalization through Outdoor Recreation while Growing the Economic Resilience of the Entire Dog River Watershed through Nature Based Tourism**

BJ Smith  
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The Dog River Scenic Blueway promotes stewardship of the Dog River Watershed, encourages cultural and historical awareness, and provides recreational opportunities for paddling enthusiasts and recreational boaters in Mobile's urban river and its tributaries.

Two goals of this project are to get more people on Dog River in order to raise awareness of the environmental issues affecting the Dog River Watershed and to bring locals and tourists into the businesses located along the river. Over the past year the National Park Service – Rivers, Trails & Assistance Program (RTCA) has assisted the Dog River Clearwater Revival in coordinating a partnership to produce a base map of the Dog River Scenic Blueway including current conditions and existing amenities of potential public access points along the blueway and documenting land ownership. The partnership also agreed on minimum standards for paddle launch sites.

Dog River and its tributaries drain most of the City of Mobile as well as function as an important recreational waterway. Many factors have severely degraded the quality of Dog River and its tributaries, including the destruction of wetlands, channelization of city storm-water drainage, and poor land development practices.

The Dog River tributaries range from relatively pristine streams to concrete lined drain ditches to sluggish, sediment choked, tidal channels. As the city itself spreads out into the upper reaches of the watershed, poorly managed construction and the replacement of natural vegetation with impermeable surfaces contribute to the deterioration of water quality in Dog River. Sediment, sewage and trash are the major issues. This urban watershed empties into Mobile Bay, a National Estuary.

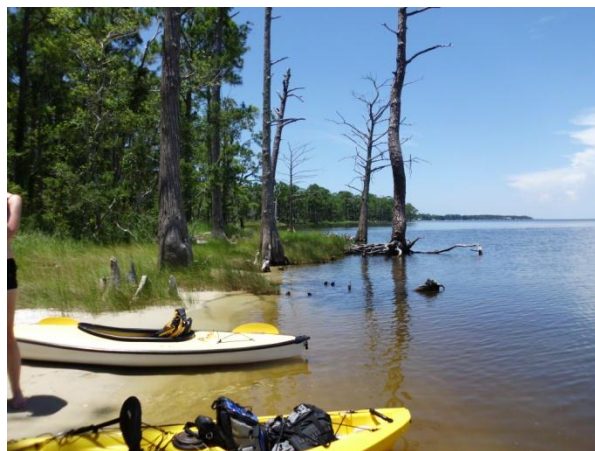
Taking a closer look at the population demographics of the watershed could potentially lead to new methods of reaching out to the community that has such a deep impact on the quality of Dog River and encouraging their participation in activities on the water. Over the next year, the partnership will engage youth in a 5 year strategic planning process for the Dog River Scenic Blueway and future greenways throughout the Dog River watershed.

## **Citizen Science: Engaging Volunteers to Take a Proactive Role in Assessing and Protecting Water Quality through Shoreline Assessments**

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The Shoreline Assessment Program (SAP) was developed and piloted in 2009 as a result of a grant from the Mobile Bay National Estuary program (MBNEP) for a study of the upper Fish River in Baldwin County, AL. Now in its second full year, the primary objectives of the SAP are to educate the public as well as community leaders about our watersheds and the pressures they face from nonpoint source pollution and to encourage citizens to take a proactive role in assessing and protecting water quality through citizen science and community involvement.



This large-scale volunteer project provides citizens the opportunity to make a solid connection to the environment and our natural resources. It reinforces the knowledge that the things we do have an impact on the watershed. Several parameters are evaluated in the course of the assessment, including: water quality, stream and bank characteristics, and the plant community in order to evaluate the overall health of the shoreline. The SAP also seeks to identify potential sources of pollution, including evidence of illegal dumping, sedimentation and erosion. All volunteers are trained prior to conducting an assessment.

The data can be used in the long-term to protect valuable habitat by identifying areas suitable for preservation, restoration or recreational use, and provides decision-makers the tools needed to make sound policy decisions regarding future growth and development in a watershed.

Most recently, we developed the Volunteer Field Observer Program in response to the Deepwater Horizon oil spill. Based on ACF's existing Shoreline Assessment Program, the VFOB Program uses trained volunteers to document shoreline conditions and identify impacted wildlife both pre- and post- oil impact. Over 270 individuals have been through the trainings, which began on June 1<sup>st</sup>.

The SAP highlights areas of concerns and underscores outreach and education needs that non-profits and agencies can work together to address once the assessment is complete. The adaptability of the SAP to a wide range of watersheds and data needs makes it an ideal program for watershed groups looking to engage citizens in an active learning project and collect valuable shoreline data.

## **The Effects of Urban Land-use on the Functional Capacity of Headwater Slope Wetlands on the Alabama Coastal Plain.**

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Wetlands provide crucial societal values due to their natural ability to provide water quality, flood control, and important habitat. These systems have not been extensively studied in relation to land use change and their values are often unrecognized by local landowners and planners. We present initial results from a study designed to define the impacts of urban land use on headwater slope wetlands in the southern Coastal Plain physiographic region of Baldwin County, Alabama. The objective of this study is to quantify how surrounding urban land use influences three main wetland functions: carbon cycling, vegetation type and form, and hydrology. We evaluated the functional capacity of 26 wetlands in southern Baldwin County using the *Hydrogeomorphic Approach to Assessing the Functions of Headwater Slope Wetlands on the Mississippi and Alabama Coastal Plains* (Noble et al 2007). Wetlands were selected to capture a range of surrounding urban land cover. For each wetland, an HGM functional capacity index score was determined for each pertinent function based on a variety of field and landscape measurements. The functional capacity of each wetland was then related to several metrics of urban land use in the contributing drainage catchment (e.g., percent land use cover, percent impervious surface).

Early indications suggest that increasing urban land use is correlated with declines in wetland function. Shifts in vegetation composition were observed as exotic species were more prevalent within urban wetlands. The increase in exotic/invasive species may partially be linked to urban sources (i.e., household landscaping). The capacity of wetlands to store water is expected to be related to the extent that these systems have become surface water driven (compared to groundwater driven as in their unaltered condition). We expect shifts in carbon cycling to also be related to changes in hydrology as decomposition is closely tied to wetland hydroperiod.

This project aims to provide planners with information necessary for maintaining healthy wetland systems within an urbanizing landscape. The study will provide crucial data to aid planners to better protect these important systems and minimize the negative effects of urbanization. We also plan to evaluate the HGM's ability to properly assess wetland environments and in the process provide information that may improve the methodology. We discuss plans to validate HGM functional capacity scores through field measures on these wetland functions.



# Impacts of Climate Change on Oyster Reefs in Mobile Bay

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The health and extent of oyster reefs around the world are declining rapidly, and although they haven't received as much attention as coral reefs, oyster reefs are just as important to their local ecosystems and economies. They provide habitats for many species of fishes, invertebrates, and crustaceans, as well as the next generations of oysters. Oysters are also harvested from many of these reefs and are an important segment of many local economies, including that of Mobile Bay, where oysters rank in the top five commercial marine species both by landed weight and by dollar value. This project seeks to evaluate the effects of climate change and on existing reefs and the impact that these changes may have on the economic and ecological health of Mobile



#### Figure 4 Proposed Locations for Reef Restoration by the Alabama Wildlife Federation

Bay. The habitat evaluation will be based on IPCC (Intergovernmental Panel on Climate Change) climate change scenarios and watershed and hydrodynamic model outputs that simulate the changes in water temperature, salinity, and clarity expected based on the climate change scenarios. These habitat changes contribute to the success or failure of oyster reef restoration projects and the long-term health of existing oyster reefs. The values from the models will be mapped for the water column in Mobile Bay using ArcGIS and the resulting habitat map will be evaluated for current rehabilitation sites to determine whether the future habitat will fall within the parameters necessary for healthy oyster reefs. The habitat map will also provide a basis for determining future restoration

sites where the habitat is likely to remain favorable. The results from this analysis will be used to determine the potential changes in current oyster reefs and the impact of these changes on the ecosystem and economy of Mobile Bay based on current economic data and research on the ecological benefits of oyster reefs. This data will be useful to the organizations and community groups that are seeking to preserve and rehabilitate oyster reefs in Mobile Bay.

## Conservation and Restoration of Dog River and the Dog River Watershed

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The conservation and restoration of Dog River and the Dog River Watershed is of vital importance to protect this in-city estuary for our environmental wellness, navigation, and recreational pursuits.

Studies have shown that siltation is the worst and most prevalent threat to Dog River. Siltation is closing the navigational channels thereby endangering the actual use of Dog River. The most significant alterations to the Watershed have been the loss of wetlands and of vegetated surfaces in general. In addition to the loss of Wragg Swamp (when the malls and I-65 were built), and many streamside (riparian) wetlands, Mobile's growth continues to replace vegetated surfaces with roads, houses, parking lots, and buildings. These surfaces are impermeable. When it rains, the water runs off quickly into man-made ditches that carry water to the nearest stream. Deposition of sediments occurs naturally in the lower part of a stream, which for the Watershed is Dog River.

In the Dog River Watershed, the steepest tributaries are in West Mobile. Unfortunately, that is also where development is rampant. Erosion increases when land is cleared, altered, or left unprotected. With an urban river most siltation occurs when the soil is disturbed by construction activity. When builders strip the vegetation from a construction site, the top soil is left vulnerable to wind and water erosion. The magnitude of damage depends on construction activities, climatic conditions, and site conditions. "Construction sites, if unprotected, can erode at rates in excess of one hundred times the natural background rate of erosion." *California Stormwater Quality Association Stormwater Best Management Practice Handbook*

The Dog River Watershed is composed of 95 square miles of a highly developed urban-suburban area. Fifty-six percent (56%) of the Dog River Watershed is located within the City of Mobile and forty-four percent (44%) in Mobile County. Many factors have severely degraded the water quality of Dog River, including the destruction of wetlands, channelization of the City's storm water drainage, and poor land development practices. Some other factors are an over-reliance on septic tanks, coupled with an outdated and severely overburdened City sewage system, as well as neglect by local businesses and citizens in the proper use and disposal of chemicals and trash.

DRCR has begun a program, and has been working with other local environmental agencies, to encourage builders to use best management practices (BMP) to reduce erosion, minimize the sediment in stormwater discharges, eliminate non-stormwater discharges, and to implement appropriate measures to reduce potential impacts on Dog River and the Dog River Watershed with a plan in place before construction with continuing assessments during and after construction projects. Construction projects are targeted for best management practices and, if not in place, talks will be held with the appropriate builders. If appropriate action is not taken, all available local and state resources will be contacted. Reducing the main threat of siltation would be the single largest benefit to protecting the water quality of Dog River, its navigable channels, and protecting our abundant recreational activities. For ourselves and future generations, we can strive for no less.



## **Development of a Habitat-Health Assessment Tool for Managers and Decision-Makers: A Focus on Watershed Development and Its Impacts on Estuarine Communities**

Brenna Ehmen<sup>\*1</sup>, Daniel Grigas<sup>2</sup>, Thomas Strange<sup>1</sup>, William Underwood<sup>1</sup>, John Lehrter<sup>3</sup>, Yushun Chen<sup>2</sup>, Just Cebrian<sup>4</sup>, and Mark Woodrey<sup>1</sup>

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About 50% of the U.S. population lives in or near coastal areas (Scavia et al. 2002), and estimates project up to 75% of the world population may settle in coastal areas by 2025 (Creel 2003). As coastal areas are developed to support human populations and their economies, the conservation and protection of coastal habitats and their associated ecosystems, which provide important benefits and services, becomes more challenging. Increased nutrient inputs, habitat degradation and loss, and over-exploitation of living natural resources reduce the capacity of coastal ecosystems to provide goods and services. The ability to predict the impact of watershed development on the health and function of coastal habitats and their associated resources represents a critical asset for decision-makers. The goal of this project is relate habitat health in terms of water quality, nutrient loads, and living resources back to the amount of human development in each bayou. As a result we will create an online tool which managers can use to help determine the effects of proposed development on nearby estuaries and aid in the permitting/approval process.

Three sub-estuaries with varying degrees of human development are the study sites for this project. The pristine site, Bayou Heron, and the moderately-impacted site, Bayou Cumbest, are located within the Grand Bay National Estuarine Research Reserve while Bayou Chico in Pascagoula serves as the heavily-impacted study site. The first step in this process was to delineate the watershed boundaries for the sub-estuaries. Using LiDAR imagery and ground-truthing, watershed boundaries were created for each bayou. Land characterizations will be carried out to quantify the percentage of land cover/land use in each bayou. Characterizations have been completed for Bayou Cumbest. Point-source discharge may prove an important source of nutrient input to the system, especially in Bayou Chico where the area is highly urbanized. Storm drains and pipes emptying into the bayou were mapped, with a sub-set selected for storm water monitoring. Pipes were divided into three size categories: 0-11 in, 12-21 in, and 22-72 in. Discharge rates were recorded and samples were taken during and after rain events in order to quantify nutrient loads and total suspended solids (TSS). Preliminary analysis shows that as flow curves peak and fall, TSS loading does the same. These results are most often due to increased build up of solids (sediments and other un-dissolvable materials) left in pipes from previous discharge and on roadways. Future work will provide nutrient loading for comparison with TSS loading and flow rates in order to observe how trends of nutrient concentrations compare with TSS from variable drainage area and pipe sizes as well as during varying rain intensity. Living resources such as nearshore fish communities and submerged aquatic vegetation communities will be sampled and assessed for biodiversity and abundance in each of the three bayous. Oysters will also be monitored for growth and survivorship.

## **Mercury Distribution and Spatial Variability in Sediments from the Grand Bay National Estuarine Research Reserve, Mississippi**

Howard, Brandon<sup>1</sup>, John Branch, Jr.<sup>1,2</sup>, Christina Mohrman\*<sup>2,3</sup>, Elijah Johnson<sup>1,2</sup>, Richard Gragg<sup>1</sup>, and Charles Jagoe<sup>1,2</sup>

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We measured sediment mercury at the Grand Bay National Estuarine Research Reserve, located in southeastern Mississippi, as part of a larger study on mercury deposition, cycling, and retention within the Reserve. To obtain baseline data, assess variability of sediment at multiple spatial scales (cm to km), and examine temporal variation, we collected 70 sediment grab samples at a depth of 1-10 cm from 14 transects across the Reserve. Transects spanned representative bottom types including unconsolidated mud, erosional marsh edge, seagrass beds, and sand. Sediments were collected seasonally, in March and August, 2010.

Three individual aliquots from each grab sample were collected and analyzed to assess microscale variability. Mercury was measured by EPA method 7473, and organic matter by loss on ignition. Approximately 20% of the samples run were blanks, spikes, standard materials or replicates for QA/QC purposes. Examination of histograms suggested that mercury distributions were lognormal; data were log transformed as necessary and analyzed by ANOVA, nested ANOVA, and regression.

Mercury concentrations ranged from 2 to 65 ng/g dry weight in March, and were similar in the August sample. These results are consistent with a relatively pristine area receiving atmospheric mercury input. Mercury content was significantly higher in air dried samples versus paired freeze dried samples, suggesting that a volatile form of mercury was lost during freeze drying. Mercury was positively related to organic matter content in sediments ( $r^2 = 0.20$ ). Mercury concentrations were significantly different among some transects. However, for most transects, variance components obtained by nested ANOVA showed that microscale variation (within a single grab) is comparable to variation among samples collected tens of meters apart. This implies that small inhomogeneities and patchiness on a scale of cm can influence sediment Hg measurements as much as differences across a scale of tens of meters. These data suggest variation at several spatial scales must be considered to accurately assess mercury in estuarine sediments at the landscape level.

## Utilization of Coir Logs for Living Shoreline Establishment and Stabilization

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As the human population grows and moves towards the coast, living shorelines are increasingly becoming at risk of erosion and development. Implementing a living shoreline is a management practice that addresses erosion by providing for long-term protection, restoration or enhancement of vegetated shoreline habitats. This is accomplished through the strategic placement of plants, stone, sand fill and other structural and organic materials.

In the winter of 2009, a volunteer group from Castlen Elementary in Grand Bay, AL assisted the Grand Bay NERR staff plant black needle rush (*Juncus roemerianus*) along the shoreline at the Bayou Heron boat ramp. To stabilize the shoreline eight coir logs were used. The coir logs consist of shredded coconut husks shaped into a log and wrapped with biodegradable twine. Before the volunteers arrived, the Stewardship staff prepared the site by installing the coir logs. Two three foot sections of non-treated 2x2" wooden posts were tied together with twine and then driven into the sediment on either side of the coir log for stabilization along the shoreline. The site was then backfilled with 14 yards of cleaned sand. Once the sand settled for several days, the students planted 300 black needle rush plants in less than four hours.

As the coir log biodegrades, the shoreline slope will decrease allowing for the accretion of sediments and natural recruitment of marsh plants. This demonstration site is photo-monitored on a regular basis to document change over time. Figure 1 is a photo taken immediately after marsh planting. Using biodegradable coir logs and native marsh plants to stabilize shorelines provides a cost effective and sustainable method for erosion control compared to traditional methods like bulkheading.



## **MDMR Waveland Weather Station**

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The Oyster reefs near Pass Christian are important to the Mississippi Gulf Coast both ecologically and economically. The reefs provide a thriving habitat for many inshore reef species as well as an important resource for Mississippi's commercial oyster fishermen. In the interest of public health, the waters that contain the most commercially important reefs are conditionally opened and closed to the harvest of oysters on the basis of rainfall amounts and/or river stages. The Mississippi Department of Marine Resources (MDMR) is currently in the process of constructing a Meteorological Monitoring Station for the observation of current weather patterns and events affecting the Mississippi Gulf Coast. The Waveland Weather Station, which will be located at the site of Hancock County Utility Authority's Waveland Wastewater Treatment Facility, will utilize state-of-the-art sensors and instruments to record meteorological data. Not only will the MDMR have the ability to monitor real time weather conditions, but the MDMR Shellfish Bureau will use the site as a rainfall gauge to follow the Oyster Area Management Plan. The rainfall gauge will allow managers to open and close the harvesting areas based on accurate and readily-available data. Following the installation of the Waveland Weather Station, the MDMR plans to construct several more monitoring sites. These sites will be placed in strategic locations across the Mississippi Gulf Coast. This assemblage of weather stations will be networked to create a meso-scale weather event monitoring network, also called a mesonet. In addition to providing the MDMR with live weather monitoring capability, the mesonet will catalog data for climatological and historical records. The capability to monitor live weather conditions and accurately measure rainfall will be a direct benefit to the management of the resource.

## **Using breakwaters to restore emergent salt marsh and sea grass meadows in the Northern Gulf of Mexico**

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The attrition along the coastal shorelines due to anthropogenic impacts such as loss of vegetation, reduced sediment deposition, and altered flow dynamics is a wide spread problem in the Gulf of Mexico. Emergent salt marsh and sea grass beds stabilize coastal shorelines by baffling wave energy through dense leaf canopies and by consolidating the sediment through entangled webs of underground stems and roots. Indeed, many reports have shown that coastlines suffer intense erosion shortly after their marshes and sea grass beds decline. It has been hypothesized that in eroding coastlines breakwaters can, other than baffling wave energy and reducing erosion by themselves, lead to improved conditions for enhanced sea grass and marsh growth, which could thereby retrofit the stabilizing effect of the breakwaters per se. To test this, we have distributed a total of 2250 meters of breakwaters along two eroding shorelines. The study sites are located at Alabama Port and Coffee Island. At each site we are comparing three different types of breakwaters (i.e. bagged oyster shell, reef balls, and ReefBlks, pronounced reef blocks) with control areas that have no breakwaters in them. The bagged oyster shell reefs are loose oyster shell in mesh bags stacked in a trapezoidal cross-section. The base of the trapezoid is 5.4m wide, the crest is 4m wide, and they are 70 centimeters tall. Each reef has five 17m long sections separated by 10m. The reef balls are 53.34cm tall, are a specially pH formulated cement, and are hollow. The ReefBlks are constructed of rebar, vex mesh, and oyster shells. They are a 5ft equilateral triangular prism and are two feet tall. We are documenting (1) the abundance and diversity of marsh plants on the shoreline across the breakwaters and control plots at each of the two sites and (2) the abundance and diversity of sea grass beds leeway of the breakwaters and edge of the control plots. Baseline measurements were taken before breakwater construction to evaluate the ambient differences among the areas being compared. We have been continuing our measurements quarterly (four times a year) after the deployment of the breakwaters (which took place in April 2010). Before breakwater deployment no sea grass beds were found and the marsh areas had similar values of plant abundance and diversity. These results have persisted after breakwater deployment; SAV has not yet appeared and the marsh plants are not more abundant or diverse in the areas protected by the breakwaters. More measurements expanding a longer time span are needed to evaluate the full impact of these breakwaters.



## **Baldwin County Grasses in Classes Program: Students Growing and Planting Native Vegetation for Coastal Restoration**

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The Baldwin County Grasses in Classes (*BCGIC*) program coordinates and sustains a network of teachers, students, restoration specialists, and other community members to plan and implement restoration of coastal environments (dunes, salt marshes, and longleaf pine) of Baldwin County, Alabama. With guidance and assistance from restoration specialists and teachers, students from 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 and black needle rush), and longleaf pine habitat plants (longleaf pine, wiregrass, big bluestem, little bluestem, lopsided indiagrass). 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 which they have grown. 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.

The *BCGIC* program is aggressively working on the restoration of Alabama's coastal environments with outstanding results (see photographs). Since 2005, students, teachers, parents and community members have contributed well over 3,500 volunteer hours and have planted approximately 40,000 native plants in coastal restoration projects in Baldwin County.

## **Potential Impacts of Restored Oyster Reefs on Water Quality and Submerged Aquatic Vegetation**

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Along with creating more habitat for commercially and recreationally-important species of crustaceans and fish, it has been hypothesized that restored oyster reefs could increase light availability for submerged aquatic vegetation (SAV) leeward from the reef through the filtration of particles floating in the water column and the reduction of sediment resuspension. In turn, healthier SAV stands could provide more habitat for crustaceans and fish, thereby retrofitting the habitat provided by the reefs. As part of a large oyster reef restoration project, we are in the process of collecting a suite of variables to test those hypotheses. Namely, we have been measuring water-column light extinction coefficients at mid-distance leeward of four 75m restored reefs constructed hundred meters away from the shoreline at about 1 meter depth (mean tidal depth) and adjacent four control plots (i.e. no reef constructed) before and after reef construction. We are also documenting the number and size (i.e. expansion or reduction) of the SAV patches leeward of the reefs or corresponding oyster-less edge of control plots, along with SAV morphological attributes (i.e. shoot density and leaf length and width). Measurements before reef construction expand 4 months and measurements after reef construction expands 12 months. Thus far we have not found a significant effect of the restored oyster reefs on light penetration through the water-column. Before construction of the reefs, reef-to-be locations and control locations did not show significantly different extinction coefficients and, after the construction of the reefs, that lack of differences persisted. Similarly we have not yet found any significant differences in the seagrass variables measured between reefs and controls either before or after reef construction. These results suggest that, in naturally murky waters such as in estuaries and marsh embayment of the Northern Gulf of Mexico, the impact of oyster reef restoration on water clarity and SAV growth may be limited. We may, however, need a longer time span to observe significant impacts in our study site.



## **GIS Analysis of Nesting Habitat for the Endangered Mississippi Sandhill Crane: Potential Habitat Suitability and Management Implications for Restoration**

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The Grand Bay Savanna in coastal Mississippi and Alabama constitutes one of the largest tracts of wet pine savanna remaining in the Gulf Coastal Plain. Historically, the Grand Bay Savanna was used as nesting and feeding territory for the federally endangered Mississippi sandhill crane. Management and restoration of this area is predicated on the controlled use of prescribed fire to set back succession and prevent the invasion of undesirable woody vegetation. Budget limitations, weather uncertainties, and the complexity of state, federal, and private ownerships within the savanna make the application of fire difficult. These factors, along with changes in land use patterns, have rendered some portions of the Grand Bay Savanna unsuitable as habitat for the Mississippi sandhill crane. In an attempt to better direct restoration and prioritize prescribed fire activities within the savanna, scientists from the Grand Bay National Estuarine Research Reserve have partnered with the Mississippi Sandhill Crane and Grand Bay National Wildlife Refuges. The unique collaboration will result in the development of GIS-based ecological niche models that will be used to predict the suitability of areas within the savanna for cranes to successfully nest. The modeling effort will use a two prong approach. Initially, relationships between sandhill crane nest-locations and a set of associated biophysical attributes will be quantified using Maximum Entropy and Nearest Neighbor techniques. This information will then be used with cadastral data (e.g. parcel ownership) and fire management information to create a fuzzy logic habitat suitability model to predict suitable locations for the reintroduction of crane breeding pairs. Additionally, the model will be used to prioritize the acquisition of real estate parcels in the area important for crane survival. This effort should result in a brighter future for the Mississippi sandhill crane as well as the threatened habitats protected under its conservation wings.

## **The Mobile Bay Oyster Gardening Program: Bringing the Reef to the People**

P.J. Waters

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The Mobile Bay Oyster Gardening Program (MBOGP) is a volunteer driven program focusing on education, restoration/enhancement and research. Gardeners are waterfront property owners who have an interest not only in the culinary attributes of the Eastern Oyster, *Crassostrea virginica*, but also its ecological value.

Each Gardener tends four (4) gardens, and produces an average of 1,000 oysters for restoration each season. Weekly maintenance expectations, predator recognition and introduction to ongoing regional research are addressed in training workshops prior to each season. Communication with Gardeners, Adopters and Sponsors is facilitated through the monthly MBOGP Newsletter, the MBOGP website ([www.oystergardening.org](http://www.oystergardening.org)) and site visits.

Area high school marine biology classes work closely with MBOGP, providing students hands on opportunities in their communities. A new Adopt a Garden program initiated for the 2010 season has created oyster gardening opportunities for stakeholders and students who live away from the coast, but recognize the critical role of the oyster in the Bay's ecology. The adoption fee supports one garden (~250 oysters) for one season for which the Adopter receives all the benefits (newsletters, speakers, tours, etc.) afforded a Gardener or Sponsor.

In spite of the oil spill disaster, MBOGP decided to continue preparations for the 2010 season, adopting modifications to the maintenance schedule. The modifications would allow continued maintenance while eliminating direct contact with the oysters by Gardeners in the event their area fell under advisories issued by the Alabama Department of Public Health. MBOGP was extremely fortunate that less than a week after Gardeners picked up their spat, the well cap was secured and a minimum amount of weathered oil penetrated the Bay.

**--Sustainable Communities Session: Advancing Economic Viability and  
Hazard Resiliency--**

*(in order of program listing)*

## **NOAA Coastal Services Center: Helping Gulf Coast Communities Navigate Climate Considerations**

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The NOAA Coastal Services Center (CSC) helps foster informed decisions about coastal issues by linking people with information, tools, and technology. One of the most challenging issues that coastal communities currently face is determining how to address the impact of climate change on a fragile landscape that is already stressed by development pressures, coastal storms, erosion and subsidence, invasive species, energy development, and other factors. Adding climate impacts to the realm of circumstances coastal managers consider when addressing issues such as mitigation for coastal hazards, land use planning, or conservation strategies is important because it helps create resilient communities that are better able to manage risk long term.

The CSC provides data, tools, training, technical assistance opportunities, and case study examples to help communities understand the impacts of climate change and take steps to plan for and adapt to these possibilities. The goal of this presentation will be to provide an overview of key resources including data and visualization tools such as Digital Coast, the Sea Level Rise Impacts Viewer, and the CanVis Simulation Tool; training products such as Road Map for Adapting to Coastal Risk, Planning for Climate Change, and Coastal Inundation Mapping; and compilations of case studies and adaptation strategies which can be found on the Coastal Climate Adaptation Website. This presentation will only brush the surface of the climate tools and resources that are available through the CSC. For more information on these products, please visit the following website: <http://www.csc.noaa.gov/climate>.

## **Climate Change and Common Law: A Look at Climate Change Lawsuits by Gulf Coast Residents and Beyond**

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As attempts to regulate climate change impacts at the federal level have repeatedly broken down, some individuals have turned to state common law actions in the court system for relief from climate change impacts. Two highly watched lawsuits currently working their way through the federal judicial system are *Connecticut v. American Electric Power* and *Comer v. Murphy Oil* (involving Mississippi Gulf Coast residents). In *Comer v. Murphy Oil*, local residents who suffered property damage during Hurricane Katrina filed a class action against numerous members of the energy, fossil fuel, and chemical industries. The residents argue that the greenhouse gas emissions from these industries contributed to climate change, increasing global surface temperatures causing sea level rise and contributing to the ferocity of Hurricane Katrina. According to the residents, these events culminated in the destruction of both private property and useable public property for which they seek damages. Since the initial court ruling, the case has undergone some unusual procedural twists. Likewise, in *Connecticut v. AEP*, a coalition of state attorney generals sued electric power producers to cap their emissions under common-law claims of public nuisance. This case is currently on appeal to the U.S. Supreme Court. Should either case advance to trial on the merits, the claimants will face substantial evidentiary hurdles when seeking to admit scientific evidence to prove that climate change caused their harms. This presentation will provide an overview of these two groundbreaking cases, with particular focus on the claims of the Mississippi Gulf Coast residents.

## **Mitigating Coastal Hazards through Community Education/Outreach & Participation in NFIP's Community Rating System – Challenges, Lessons Learned, Rewards**

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**Project Summary:** South Mississippi is exposed to natural and manmade coastal hazards that damage or destroy personal and public property. By improving the planning, response and recovery policies and procedures for a range of potential hazards, communities can develop more hazard resilience, utilize resources more effectively, and return to a normal way of life more quickly following a disaster. The District is working with jurisdictional officials to promote enhanced hazard-resilience and to assist with implementing the recommended activities of the Community Rating System. Education/outreach for the project targets floodplain managers and other floodplain staff, elected officials, and the general public.

**A Series of Challenges:** Challenges were encountered soon after project initiation. They included an unexpected restriction that prevented the PI's attendance at FEMA's EMI-CRS training course and the unavailability of alternate CRS training options; a mid-course correction necessitated by FEMA/ISO (Insurance Services Office) active involvement in guiding the regional CRS initiative following Hurricane Katrina; subsequent ISO staff changes and resulting communication difficulties. Further complications included a rather tepid response to attempts to engage floodplain officials from the inland and more rural jurisdictions. PI hosted a meeting of coastal floodplain officials as a special outreach presentation for their counterparts in those targeted communities; none attended. Participation by these officials has remained limited in subsequent workshops, meetings, and conferences. This is probably a symptom of an already overwhelming scope of work and/or limited budgets. These officials have certainly had full work schedules dealing with the aftermath of Hurricane Katrina, new FEMA requirements and oversight, and related challenges. One-on-one time in these jurisdictions is planned for the Fall.

**Barriers Identified:** One barrier is the cost to implement changes in floodplain management practices; a second is the CAV, or Community Assistance Visit. When a community expresses an interest in the CRS program, this triggers FEMA to order a CAV. The CAV is essentially an audit of all of a community's current conditions and existing policies and regulations. It can be a stringent and lengthy process and can result in mandated changes that carry extra costs.

**Other Education/Outreach Activities:** Association of Floodplain Managers of Mississippi (AFMM) Spring Conference; regional CRS training class; Building Resilient Communities Home Builder's Show; scholarship program for AFMM Fall Conference & CFM courses; CHOST meetings, and CHOST presentation to Harrison County Council of Governments.

**Successes:** Four counties have joined or are completing requirements to join the CRS Program. Six cities have achieved better ratings. Clearly, understanding of the benefits of CRS participation has been enhanced through outreach/education activities and this project.

## **Developing a Sustainable Watershed Habitat Corridor: A Community Action Strategy for Low-Impact Development, Public Education and Citizen “Buy-In” for an Urban Watershed Project**

Don Blancher\*<sup>1</sup> and Yarrow Etheredge<sup>2</sup>

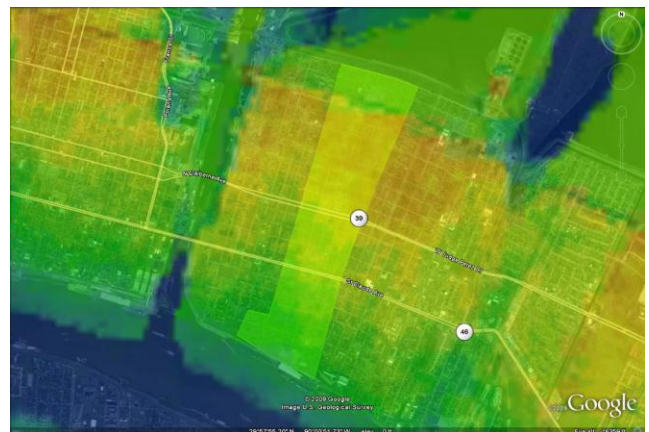
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Urban Infrastructure and development has multiple impacts on environmental systems, including habitat displacement and non-renewable energy utilization, and reduction of natural resource quality and quantity resulting from both. Water management is a major component of urban infrastructure development and maintenance, particularly in New Orleans, where parts of the metropolitan area are below sea level and the city as a whole is surrounded by a wetland system that is degraded and degrading further. Resiliency in such an environment requires learning to live with the water around us as a resource, rather than a waste, to be managed. In New Orleans, impermeable surfaces rob the groundwater of the opportunity to capture rainwater and recharge, and thereby contribute to subsidence as the peaty soil upon which the city was built compacts.

The purpose of this multi-partner project is to establish a Watershed/ Habitat corridor in the Lower 9<sup>th</sup> Ward of New Orleans, with a “Green Slice” that connects the Mississippi River to Bayou Bienvenue, anchored at Global Green’s Holy Cross Project and an industrial site at the terminus of Caffin Avenue (Figure 1). Such a corridor would nest existing and planned projects and programs that support green infrastructure and job training, skills building, and learning by coordinating and developing synergies within the corridor to leverage existing resources in order to secure additional investment, thereby enhancing existing community efforts to implement projects that increase storm resiliency and provide a human interface with nature in this fragile ecology.

The objective of the proposed green urban corridor is to reduce the ecological footprint of the area, incorporating greenways, gardens and green infrastructure to accomplish these goals, while increasing storm resilience by developing low-impact stormwater management systems. The corridor will include sustainable design components, i.e. systems where renewable energy sources (solar, rainfall, etc.) reduce ecological inputs and provide the greatest portion of the energy utilization in the area. The intent is to meld the urban infrastructure into a regional ecological system, creating contiguous habitat between the Mississippi River and Bayou Bienvenue that supports ecology and urban infrastructure, including jobs to support the people in the urban environment.

This presentation will describe the existing projects in the area, how they bring together several community action groups and the education and public works systems. It will also describe the current stage of development and how future developments will integrate local energies within the urban ecosystem.



**Figure 1. Location of the “Green Slice”, located in the lower ninth ward, New Orleans, Louisiana, overlain on a LIDAR image of the neighborhood.**



## **Mobile Green Streets: Leveraging economics, flood reduction and aesthetics through inventive stormwater management design**

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The inevitable population growth and economic development issues in the city of Mobile, Alabama and the Mobile Bay Watershed needs to be holistically and sensibly addressed by government officials, planners, academia, developers, land owners, and others, in ways that are environmentally protective and economically prudent. *Mobile Green Streets* addresses these issues by incorporating fundamental “*green street*” principals as tools to mitigate the impacts of nonpoint source pollution and flooding associated with suburban expansion. This presentation focuses on Best Management Practices for planning and design that test the feasibility of green street / green infrastructure/ low impact development practices within the city core of Mobile, AL. The BMPs will focus on protecting water quality by reducing overall polluted runoff flow volume and rates, but will concurrently address other economically viable and locally appropriate watershed livability, sustainability, development goals.

*Mobile Green Streets* speaks to discoveries and developments to improved methodologies that serve multiple benefits to the city including: the mitigation of impacts from coastal storm surges, remediation of stormwater runoff, urban ecological sustainability, and aesthetic enhancement to one of America’s most beautiful urban waterfront landscapes. Project objectives include: 1) Increase coastal urban sustainability through retention and remediation (bioretention) of stormwater including the reclamation of stormwater saved (diverted) by innovative science-based technologies; 2) Flood prevention enhancement through development of a green infrastructure plan to harness and utilize natural processes; and 3) Provide enhancement toward improving quality of life in the urban core, complementing the trend of residential population growth in the city center by reducing urban floods through inventive stormwater management designs. Leveraged benefits for the project’s civic hydrology outcomes include enhancement of the city’s pedestrian connectivity and accessibility, increased greenspace, and overall livability within a coastal-edge city.

Urban planning and design methods employed include: 1) an assessment of existing conditions, and case study analysis; 2) suitability analysis for economic development; 3) on-site design charrette to initiate public involvement; 4) design concepts, graphics and text deliverables that reflect design testing and feasibility analysis including scenario development and design overlays; 5) companion professional engineering studies including civil, water resources and environmental engineering; and 6) feasibility analysis and phasing plan for implementation with estimated funding requirements. This study is funded by Mississippi-Alabama Sea Grant Consortium and the National Oceanic and Atmospheric Administration.

**Keywords:** Green Street, flood prevention, green infrastructure, stormwater management, livability

## **Extension Programming for the Business of Nature**

Joanne McDonough

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Nature tourism is big business. If wildlife-related recreation were a company its revenue of \$45 billion, as stated in the USFWS 2006 National Survey, would place it on the Forbes Global 2000 list alongside some of the most influential companies in the world. Watching wildlife has moved beyond mere recreation to become a catalyst of economic growth.

Well planned and managed nature tourism businesses can provide income to local people, and by its reliance on healthy ecosystems, offer powerful incentives to conserve and protect biodiversity.

To be successful the nature tourism industry should be a collaborative effort between public and private entities and significant baseline issues should be addressed that will lead to a trained workforce for an expanded industry.

A Nature Tourism Initiative through extension and applied research programs has been launched to improve the economic return of existing businesses and facilitate the development of sustainable new businesses on the Alabama and Mississippi Gulf Coasts. This oral presentation will discuss:

- Addressing baseline issues
- Characterizing the existing nature tourism industry
- Analyzing the growth potential of the industry
- Building successful relationships
- Nature Tourism business planning programs
- Promotion and marketing techniques via the Internet
- Performance measures useful in evaluating the overall success of the program

## **By-Product Synergy Central Gulf Coast: Improving Mobile's Sustainability Through Innovation, Leadership and Collaboration**

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In May 2009, as part of its mission to promote a sustainable Alabama Gulf Coast, Partners for Environmental Progress (PEP) launched its By-Product Synergy Central Gulf Coast (BPS CGC) project to achieve significant economic benefits for participating companies while simultaneously advancing environmental protections. Using a process developed by the U.S. Business Council for Sustainable Development, PEP formed a diverse network of companies to actively seek opportunities to turn one company's waste or by-product into raw materials for another. This has resulted in "win-win" projects that will enhance the region's triple bottom line by providing economic, environmental and social benefits.

Local industry is committed to making a significant, positive impact on the region's sustainability. BPS CGC puts in place a system where businesses can constantly network and systematically review opportunities to reduce their environmental footprint. This type of innovation and collaboration can only help recruit the like-minded, environmentally progressive new industry.

BPS CGC is the practice of matching under-valued waste or by-product streams with potential users, helping to create new revenues or savings for the companies involved while simultaneously addressing social and environmental impacts. Synergies are not limited to material flows but can include energy, transportation services and best practices.

During the past year, the 12 participating entities met in a series of workshops to review and analyze product streams. An experienced technical team, headed by Dr. John Steadman, Dean of the College of Engineering, University of South Alabama, categorized, analyzed and helped identify priority potential synergies that would be commercially viable and environmentally significant. Action plans were developed to address technical, regulatory or other barriers.

The projects successful first year is a result of the leadership of PEP, the participation of a variety of local industry partners and the creativity of the engineers, operators and managers who came together seeking innovative solutions. The cumulative economic and environmental impacts of the BPS project, include, but are not limited to:

- \$1.6 million in company savings; \$3.2 million local economic impact;
- 8,200 tons of materials from landfills, wastewater treatment plants and other disposal sites; 5,300 tons of acid diverted from waste treatment plants; and
- More than 8,800 tons of CO<sub>2</sub> emissions were avoided.

## **Historic and Contemporary Challenges to Sustainability in the Gulf Coast Shipbuilding and Fabrication Industry**

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In many communities along the US Gulf Coast, businesses associated with the shipbuilding and fabrication industry rank among the most important sources of local employment. The industry's need for specialized infrastructure has often resulted in substantial construction and reconfiguration of local infrastructure and landscapes. At times the impacts of shipbuilding and fabrication along the Gulf Coast have stretched considerably farther than the local coastal communities in which they are based. The industry has historically attracted large numbers of people from the interior of coastal states and in some cases has spurred labor movement on a national scale. However, shipbuilding and fabrication has been and continues to be an industry characterized by high levels of fluctuation and uncertainty. This combination of factors has resulted in a number of challenges concerning economic and social sustainability. They have also structured the forms of resiliency that have evolved in this region over the years.

As with other Gulf Coast communities associated with shipbuilding and fabrication, the neighboring MS towns of Pascagoula and Moss Point have historically been subject to high levels of risk and uncertainty related to industry cycles. Additionally, as with the majority of other Gulf Coast communities the geographic locations of Pascagoula and Moss Point result in vulnerability to various environmental events, among which hurricanes figure as perhaps the most dramatic and destructive examples. Such events pose heavy potential risks to both the physical infrastructure and social networks which enable the shipbuilding and fabrication industry to function in these communities.

This presentation employs anthropological, historical, and economic data to illustrate the various challenges related to sustainability that have confronted the communities of Moss Point and Pascagoula. The data utilized are drawn from an ongoing long term study funded by the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) (previously MMS). I argue that in the case of Moss Point and Pascagoula as well as other Gulf Coast communities, the prospect of sustainable growth is called into question not only by the economic volatility of shipbuilding and fabrication, but also by social and physical transformations that have resulted from involvement with this industry, and by a geographic location sometimes vulnerable to catastrophic environmental events.

This presentation will first review the history of shipbuilding and fabrication in Moss Point and Pascagoula and surrounding areas. It will describe the infrastructural, demographic, and economic transformations that resulted from industry presence in light of broader local, regional, and national contexts. It will also examine the social and economic impacts on these communities of periodic industry downturns, and the relationships that have developed between shipbuilding and fabrication and other local industries. Issues that have historically plagued the industry such as labor shortages, lack of adequate training facilities, and a lack of diversification will be highlighted. Finally, the presentation will provide an overview of strategies of resiliency as they have evolved in various levels of the industry, ranging from individual workers to large corporate shipyards, and as they relate to the current Gulf oil spill.

## **Preserving the Working Waterfront in Coastal Alabama**

Thompson, Jody A.\* and Marie Dyson

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Traditionally, the coastal counties of Alabama have relied on access to the water for their livelihood. Generations of families, based in towns like Bayou La Batre and Orange Beach, Alabama, operate fishing boats, seafood processing facilities, boat yards, charter fishing operations, 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% white, 23% Vietnamese, 9.5% other Asian; approx. 1500 total residents).

Fisheries and other related activities have tremendous economic impacts. In coastal Alabama, impacts of commercial fishing have been estimated at:

- Dockside value of landings: \$36 million
- Estimated economic value: \$127 million
- Plant value of processed product: \$135 million
- Number of working shrimp boats: 240
- Number of other commercial fishing licenses: 1000
- Number of shipyards/annual revenue: 8/\$100 million
- Net makers, fuel docks, general suppliers: 14

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. Hurricane Katrina devastated 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, AUMERC and MASGC have organized workshops and stakeholders, provided technical information, facilitated discussions with the state legislative delegation, and funded an Inventory of Working Waterfront in Mobile County, Alabama. These actions resulted in the formation of a Water Access Study Committee for the state, lead by MASGC. In March 2010 the Committee submitted its final report to the Alabama Legislature detailing 13 recommendations of techniques and tools that, if implemented, would protect and preserve working waterfronts and water access throughout Alabama. This presentation will share case studies of activities related to preservation of working waterfronts in Alabama, and will update the audience on actions taken by the Alabama state legislature.

Bays and Bayous Symposium 2010  
ABSTRACT

**Mississippi Department of Marine Resources Oyster Stewardship Program**

Kristina Broussard

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The Mississippi Department of Marine Resources Shellfish Bureau developed the Oyster Stewardship Program to better inform and promote the active involvement of oyster industry members including oyster tongers, dredgers, dealers, and processors. The goal of the Stewardship Program is to encourage harvest practices and other techniques that can be used to assist resource managers in the judicious utilization of oyster resources of the state. Ideally, the Stewardship Program will have the harvesters and industry representatives heavily involved throughout the development and implementation process by way of meetings, surveys and individual contacts. Innovative methods of improving the resource potential will be investigated and implemented where feasible.

The following is a list of achievements of the Stewardship Program for 2009 and 2010:

- Shellfish Bureau has held 8 Stewardship meetings
- Provided 200 portable flushing toilets to licensed oyster harvesters to promote sanitary conditions of the oyster reefs
- Distributed first aid kits, t-shirts, folders, at each of the Stewardship meetings
- Mailed a newsletter hi-lighting the progress of the bureau to 611 licensed oyster harvesters. The newsletter included the 2008-09 oyster season harvest totals, spring shell cultch plant, oyster refrigeration standards, etc.
- The Oyster Task Force was developed in November 2009 and has met four times since

The work of the Oyster Stewardship Program continues with several upcoming meetings, giveaways, newsletters and brochures.

## **Dauphin Island's Revitalized Central Business District**

Matthew Capps\* and Michael Robinson

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Dauphin Island, Alabama by nature is a highly complex system. The environmental processes found on the island are dynamic and fragile. The island is strategically located at the western edge of Mobile Bay and the eastern edge of the Mississippi Sound and must be sustained to protect their vital estuaries. Dauphin Island is also a critical landfall habitat for migratory birds. Over the past 140 years, Dauphin Island has been directly affected by 41 severe storms. In the wake of these natural disasters, property owners and local officials make the decisions to rebuild homes, businesses and other local infrastructures in the same style and place. These early decisions to rebuild back to “normalcy” are impeding the opportunities to reshape the urban fabric, in a manner that will reduce the vulnerability and increase their survivability. A more resilient plan will allow for the use of green infrastructures. Such a plan will also integrate sustainable energy resources and utilize renewable fuels to strengthen the self sufficiency and ecological integrity of the island. Our goal was to setup a framework based on principals of sustainability and resiliency for the Town of Dauphin Island while still showcasing and preserving its coastal fishing and recreational community identity.

This project looks at alternative scenarios for developing greater urban resiliency on Dauphin Island through adaptive design. An adaptive design will increase their environmental, economical and social resiliency while improving their potential survivability in the face of natural disasters. This design is grounded foremost in the ways of sustainability and resilience in the shifting ecologies of a barrier island. Sustainable tourism is an emerging construct that attempts to balance environmental health, social justice and economic vitality with the disturbance that cultural recreation and tourism brings. This holistic approach of environmental awareness and respect will create positive experiences for both visitors and hosts. Through design we can create a holistic view between the built form and fragile and dynamic environmental systems of a barrier island. Communities that make smarter ecological decisions that respond to the challenges of climate change and storm events will increase their welfare and resiliency to natural disasters. By understanding these regional issues of resiliency and sustainability will allow communities to make cultural decisions that will minimize the effects on the fragile and dynamic landscape of barrier islands. Through the deployment of this adaptive design model and the use of best developmental practices, Dauphin Island will significantly reduce their vulnerability while inhabiting a shifting ecology. The proposal for the Town of Dauphin Island has a hotel conference with 110 rooms, 8,000 SF of conference, while offering guests 20,000 SF of spa and recreation, and two restaurants. 20 workforce housing units; mixed-use building will be used in the village district combining small scale retail with single family or duplex units. The working waterfront will have mixed-use buildings that will be based on commercial fishing, retail and entertainment and the design will propose a specialty grocery store to be located on the island.



## NOAA's Constituent Engagement Survey

LaDon Swann and Matthew Capps\*

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On August 9, 2007, President Bush signed legislation into law the America COMPETES Act (*America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science Act*, Public Law 110-69), which seeks to strengthen education and research related to science and technology. This legislation is significant for National Oceanic and Atmospheric Administration (NOAA), granting the agency a mandate to engage in agency-wide education and outreach efforts to all stakeholders. NOAA is charged with developing and promoting education and outreach activities at all levels for the purpose of heightening the public's current understanding of issues related to atmospheric science, the earth's environment and protecting life and property.

NOAA products, services and information are important to both the nation as a whole, and to the daily lives of United States citizens. NOAA's Science Advisory Board (SAB) identified a need for a more effective two-way communication between its programs and the customers and clients it serves. NOAA's Gulf of Mexico Extension, Outreach and Education (EOE) Engagement Pilot Program has a goal of improving the way the agency engages with its constituents. NOAA's Engagement Program is analyzing the way NOAA currently engages with its constituents and will provide recommendations to NOAA on ways to improve two-way communication with customers.

A survey instrument has been developed to assess NOAA's accessibility, responsiveness and respect for partners. These parameters are three of the seven parameters identified in the Kellogg Commission's report *Returning to our Roots: The Engaged Institution*, recommended by the SAB for NOAA's use in assessing constituent engagement. NOAA's Engagement Program has utilized the existing Office of Management and Budget approved survey questions and has developed a new survey instrument to collect responses from core groups of NOAA constituents. A workshop was held with members of NOAA's Gulf Coast Service Center, NOAA's Gulf of Mexico Regional Collaboration Team and Mississippi-Alabama Sea Grant Consortium to develop the survey questions and assist in assessing validity and reliability of the questions. The goal in creating the survey instrument is that it will ultimately become a standard NOAA tool for assessing how well NOAA engages with constituents throughout the nation. To achieve this goal, the survey has Office of Management and Budget approval and will be piloted in NOAA's Gulf of Mexico Region. The NOAA Engagement Program will collect responses and make recommendations of improving constituent engagement to the NOAA Line Offices.

## **Gulf of Mexico Climate Outreach – Building a Community of Practice (CoP) for Long-Term Engagement with Coastal Communities**

Karl Havens<sup>1</sup>, Buck Sutter<sup>2</sup>, LaDon Swann<sup>3</sup>, Heidi Recksiek<sup>4</sup> and Matthew Capps\*<sup>3</sup>

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The potential economic, social, and ecological impacts of sea level rise (SLR) around the Gulf of Mexico are tremendous. There is a need to provide decision makers with reliable information and science-based guidance regarding both the level of risk to their coastal communities and strategies they can promote to effectively adapt to rising sea level. These needs were addressed through a collaborative project that involved the four Gulf of Mexico Sea Grant Programs, NOAA capabilities, and other federal, state and local partners.

NOAA's Gulf of Mexico Regional Team and the Sea Grant Programs from the Gulf States hosted a workshop on building a Community of Practice for Long-Term Engagement with Coastal Communities on the topic of climate change. The initial workshop was held April 19-21, in St. Petersburg, Florida, which was focused on sea level rise. Facilitated by NOAA's Coastal Service Center, the workshop provided scientific information on sea level rise rates and impacts, as well as the perspectives of a panel of community leaders around the Gulf who are taking steps to understand and plan for sea level rise. The project brought together extension, outreach and education (EOE) experts from around the Gulf who are conducting EOE related to SLR in their respective communities. The initial workshop established a long-term community of practice among EOE professionals in the Gulf region that will ensure continued dialogue and information exchange on SLR and other climate change and coastal hazard related issues. The EOE professionals were provided with the latest information from technical experts on the projected rate of SLR, anticipated impacts to coastal natural and built resources, adaptation strategies, and practical tools for communicating risk and using community based social marketing. The workshop provided an opportunity to identify and discuss strategies and mechanisms for ongoing dialog, information sharing, and collaboration on climate change extension, outreach, and education. A 'toolkit' of existing resources was provided to attendees, and an online group was established for continued dialog and sharing of resources (see the Gulf of Mexico Climate Outreach Community of Practice group on <http://stormsmartconnect.org/>.) This Community of Practice identified an opportunity to work collaboratively by developing an outreach strategy which will provide guidance to local communities regarding SLR adaptation options.

## **NOAA's Gulf of Mexico Climate and Resiliency Engagement Panel**

Buck Sutter<sup>1</sup>, LaDon Swann<sup>2</sup> and Matthew Capps\*

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The NOAA Gulf of Mexico Regional Collaboration Team (GoMRCT) recognizes the need to identify priorities and improve NOAA's ability to engage its constituents to respond to local and regional climate and resiliency related priorities. The Climate and Resiliency Engagement Panel (C-REP) will serve as a transforming mechanism to obtain regional feedback on emerging issues in the Gulf of Mexico. Specifically, C-REP will play a vital role to the GoMRCT by providing input to address regionally relevant climate and resilience issues that impact the Gulf of Mexico's built and natural environment. The 35-member C-REP is comprised of individuals from the private sector, state agencies, academic institutions, federal agencies and non-profit organizations. These members represent each of the five Gulf of Mexico states. C-REP members have been asked to review and provide feedback on NOAA Climate and Resiliency programs in the region. These interactions include discussions of how to strengthen these programs through expanded constituent engagement, providing individual input that can help guide program managers and refine planned projects to better address regional needs.

### **Goals and Objectives of the C-REP:**

- Work with GoMRCT to improve the relevance of NOAA's climate and resilience work in the Gulf of Mexico.
- Serve as the transferring mechanism that links local and regional needs with NOAA products and services.
- Provide guidance to NOAA climate scientists and extension, outreach and education specialists on effective methods to locally implement climate and resiliency programming within regions.
- Interact with GoMRCT on a regular basis to develop new, collaborative opportunities and projects of direct benefit to coastal businesses, residents, and the environment.

An Annual meeting was held in August, 2010 at which panelists discussed current awareness, perceptions, beliefs and knowledge levels related to climate change in Gulf of Mexico communities recommendation to develop a consistent climate change message for the Gulf of Mexico. The meeting provided an opportunity to learn from each other's experiences and to identify and discuss strategies and mechanisms for ongoing dialog, information sharing, and collaboration on climate change and resiliency extension, outreach, and education.

## **Community Economic Preparedness: An Index Designed to Test the Economic Preparedness of Rural Communities**

Randy Y. Coker, Benedict C. Posadas, Amanda Seymour, Scott A. Langlois, and Christine E. Coker

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In 2010, the Mississippi State University, Center for Urban Rural Interface Studies (CURIS) conducted a research and outreach program on Community Economic Preparedness in the Gulf of Mexico Region. The overall goal of this project was to evaluate the overall community economic preparedness of rural counties and parishes. Community Economic Preparedness involves communities actively engaged in pursuing fundamental steps toward economic resilience and disaster management. Communities with local economies which are resilient to the effects of natural disaster will experience quick financial and physical recovery. The Community Economic Preparedness Index measures a county's or parish's economic preparedness level based on fifteen different categories:

economic development plan, effective zoning ordinances, industrial site capabilities, separate development organization, commercial development capabilities, small business development, community infrastructure, utilities capabilities, education access/quality, financial support available, strength of tourism boards, abilities/availability of labor force, natural disaster susceptibility, quality of life, and local government structure.

Each of these variables is then given a numeric value which is used to give each county or parish an overall economic preparedness score representing the current level of economic preparedness. The CURIS Region includes 20 counties and parishes in four of the five coastal states bordering the Gulf of Mexico: Louisiana, Mississippi, Alabama, and Florida. These 20 counties were used as the basis for distribution of the Community Economic Preparedness Index (CEPI) Survey. A total of 60 survey forms were mailed to these 20 counties and parishes. Three survey forms were mailed to the Chamber of Commerce, Board of Supervisors, and Economic Development Commission in each county or parish. A copy of the CEPI survey was mailed to each of the aforementioned sectors, along with instructions on how to complete it and a postage paid envelope to return the completed survey. A total of 2 mailings were sent out in May and June 2010. Of the 60 targeted CEPI survey participants, 17 completed surveys were returned, representing a response rate of 28.3%. The data from these completed surveys are being analyzed and interpretations will be provided to participating communities to assist in economic preparedness planning for the future.

## **Crisis Knowledge and Preparedness after Katrina as a Function of Race**

Renee Edwards<sup>\*1</sup>, Andrea Miller<sup>1</sup>, Stephanie Houston Grey<sup>1</sup> and David P. Brown<sup>2</sup>

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Disasters often unmask long-lingering issues of racial and economic inequality. Evacuation for Hurricane Andrew was lowest among minority populations. A disproportionate number of African-Americans were affected by Hurricane Katrina in terms of ability to evacuate, property damage, and even death. African Americans were less likely to evacuate because of beliefs that the hurricane would not be so disastrous.

Given the importance of race as a factor in past disasters, this project examined five hurricane-related issues. Hurricane planning refers to self-efficacy, an individual's belief that he or she has a plan for hurricane season and evacuation. Research on scientific literacy suggests many Americans are unable to pass a basic science test. Such knowledge concerning hurricanes seems essential for making good decisions. Information about hurricanes comes primarily from the mass media, although coastal residents may also turn to friends and family when a storm is approaching.

In the years since Katrina, state and federal governments have worked on improving hurricane protection systems such as levies and pumps. At issue is whether citizens know about and trust those systems. Finally, following Katrina, Louisiana launched a "Get a Game Plan" campaign. Public service messages encourage personal responsibility and protection in the face of hurricanes.

**Method:** A telephone survey of 519 residents in nine parishes in southeastern Louisiana was conducted in the fall of 2009 (effective response rate = 36%). Respondents were 67% female and 34% male; average age = 53; and 67% white and 23% African American. The survey included mostly closed-ended questions and took about 10 minutes to complete.

**Results:** 80% of the respondents have a hurricane plan in place, with no difference between racial groups. African Americans scored 77% on a test of hurricane knowledge, whereas whites scored 87% ( $t = -4.49, p < .001$ ). Although whites and African Americans find the mass media equally useful for hurricane information, African Americans evaluate information from friends and family as more useful ( $t_{(453.22)} = 4.3, p < .001$ ). Whites have more trust in hurricane protection systems than African Americans ( $t_{(400.14)} = -3.13, p < .01$ ). African Americans and whites are equally familiar with the "Get a Game Plan" campaign (40% yes).

**Implications:** The bad news for Louisiana is that 20% of coastal residents need plans for hurricane season, and 60% are not being reached by the state advertising campaign. The lack of trust may encourage planning for African-Americans. Hurricane literacy should be improved for all residents, and especially for African-Americans. Both mass media and interpersonal sources should be used to disseminate hurricane-related information.



## Oil Spills and Their Effect on the Environment

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With our oil-dependent life styles and catastrophes such as the Deepwater Horizon and Exxon Valdez oil spills, a plethora of environmental-minded scientists are needed for the future. The Mississippi-Alabama Sea Grant recognized that need when they recently awarded two high school students \$1500 scholarships to participate in an Ocean Science and Leadership Expedition in Cordova, Alaska. The scholarship recipients joined eight other students at the Prince William Sound Science Center for a program centered on leadership development, environmental ethics, marine science, marine debris and oil spills. The students will share what they learned, mainly focusing on the effects oil spills have on the environment. Topics include the chemical properties of oil, possible biota and environmental conditions, impacts the three have on each other, and human response. The two teens will also introduce the idea of forming a committee, similar to Cordova's Regional Citizen's Advisory Council, of community members and local business leaders to the Gulf Coast. The proposed committee would advise the federal, state and responsible party of ways to prevent and respond to oil-related accidents, as well as provide insight as to how individuals in the community are being affected. This plan would also include a monitory plan for coastal industries including the oil companies to ensure that proper safety methods are being followed to prevent future spills. The students are using their experience to educate the public, as well as further their own educations.



Above: Styrofoam is used to write "Save Our Seas" on 7 Mile Beach by OSLE students. Photo by Daniel Wall

Bottom Left: The looser sediments in Prince William Sound still contain oil.

Photo by Shelby Stoneburner

Bottom right: Dr. Rob Campbell teaches marine principles on a make-shift white board before students take part in a marine debris clean up. Photo by Cierra D. Martin



## **SANDS - Sediment Analysis Network for Decision Support**

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Since the year 2000, Eastern Louisiana, coastal Mississippi, Alabama, and the western Florida panhandle have been affected by 28 tropical storms, seven of which were hurricanes. These tropical cyclones have significantly altered normal coastal processes and characteristics in the Gulf region through sediment disturbance. Although tides, seasonality, and agricultural development influence suspended sediment and sediment deposition over periods of time, tropical storm activity has the capability of moving the largest sediment loads in the shortest periods of time for coastal areas. The SANDS project is also investigating the effects of sediment immersed oil from the Deepwater Horizon disaster in April 2010 which has the potential to resurface as a result of tropical storm activity.

The importance of sediments upon water quality, coastal erosion, habitats and nutrients has made their study and monitoring vital to decision makers in the region. Currently agencies such as United States Army Corps of Engineers (USACE), NASA, and Geological Survey of Alabama (GSA) are employing a variety of in-situ and airborne based measurements to assess and monitor sediment loading and deposition. These methods provide highly accurate information but are limited in geographic range, are not continuous over a region and, in the case of airborne LIDAR are expensive and do not recur on a regular basis. Multi-temporal and multi-spectral satellite imagery that shows tropical-storm-induced suspended sediment and storm-surge sediment deposits can provide decision makers with immediate and long-term information about the impacts of tropical storms and hurricanes. It can also be valuable for those conducting research and for projects related to coastal issues such as recovery, planning, management, and mitigation.

The Sediment Analysis Network for Decision Support has generated a number of decision support products derived from MODIS, Landsat and SeaWiFS instruments that potentially support resource management, planning, and decision making activities in the Gulf of Mexico. Specifically, these decision support products address the impacts of tropical storms and hurricanes on sediment disturbance, suspension, transport, and deposition in the north central Gulf of Mexico.

The products will be managed and accessed through the SANDS Portal, an on-line data repository with a user interface customized to provide data and information for specific storm based events. By making multi-spectral satellite products available for multiple common storm events, SANDS will provide end users the opportunity to better analyze, detect, and identify compositions and patterns of suspended sediment and sediment deposits.



## **Improving NOAA Engagement: Utilizing Extension, Outreach and Education to Engage NOAA's Constituents**

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A 2008 National Oceanic and Atmospheric Administration (NOAA) Science Advisory Board (SAB) report states that many United States citizens who might be served by NOAA products and services are not aware of NOAA. Because of this lack of public identity, a vast array of scientific information available through NOAA agencies and programs remains unused by potential NOAA constituents. The SAB report also identified extension, outreach and education (EOE) programs as a mechanism for NOAA to use to become more fully engaged and connected with its consumers and clients.

In response to the SAB report, the NOAA Gulf of Mexico Regional Collaboration Team established an Engagement Working Group (EWG) to help improve interaction between NOAA and Gulf of Mexico constituents. The EWG, which includes EOE program staff from both NOAA and NOAA's keystone partners, is tasked with recommending a regional coordinating structure for NOAA engagement that will better integrate and utilize existing EOE programs and personnel.

To achieve this task, the Engagement Working Group is collecting and analyzing information about current EOE activities in Gulf of Mexico programs. A survey to locate current extension, outreach and education employees and identify their specialties and best management practices for their programs was sent to the managers of a number of NOAA and keystone partner programs located within the Gulf of Mexico Region. These programs include: Bay-Watershed Education and Training Program, Coastal Zone Management Programs, National Coastal Data Development Center, National Estuarine Research Reserves, National Estuary Programs, National Marine Fisheries Service, National Marine Sanctuaries, National Weather Service, Northern Gulf Institute, Office of Coast Survey, and Sea Grant Programs.

The information gathered from the survey will be presented at Bays and Bayous and compiled into a report entitled "Roadmap for NOAA Engagement in the Gulf of Mexico," which will include recommendations to the Gulf of Mexico Regional Collaboration Team for improving engagement between NOAA and constituents.

## **Community Disaster Preparedness: An Index Designed to Measure the Disaster Preparedness of Rural Communities**

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Disaster preparedness can be defined as the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions. The coastal communities of the Northern Gulf of Mexico region stretching from Louisiana to Florida are predominantly rural and, as such, have the potential to not only be impacted directly by a variety of hazards in the region, but also indirectly due to their geographical association to the more populated urban areas to which they border. A better understanding of how these communities prepare for and respond to disasters may offer insight into factors which could be used to increase the resiliency of these communities before, during and after a disaster.

In early 2010, the Mississippi State University, Center for Urban Rural Interface Studies (CURIS) began an investigation into the development of a tool to measure how well prepared coastal communities were with regard to their ability to handle any type of natural hazard in the region. The goal of this project was to measure and compare the level of disaster preparedness of coastal communities along the CURIS region, which was defined as twenty counties and parishes in Louisiana, Mississippi, Alabama and Florida. Collection of disaster preparedness data was accomplished through the use of a mailed 52 question survey. Survey responses from sources which included emergency management, law enforcement, fire department and county/parish extension personnel were used to create a Community Disaster Preparedness Index (CDPI). The CDPI measures disaster preparedness based on nine variables: disaster preparedness plan, information, communication, security, transportation, sheltering, volunteer collaboration, utilities and critical infrastructure. Based on responses in each community, these variables are scored with a numeric value and form a basis for the CDPI representing the current level of disaster preparedness of the county/parish. Surveys were mailed to 83 targeted participants with completion instructions and included a postage paid envelope to return the completed survey. Over the course of several weeks, two complete CDPI survey mailings were performed with a total response of 29 surveys, yielding a response rate of 34.9%. The data from these completed surveys are being analyzed and results will be shared with participating communities in the hope that it will offer a positive impact to future disaster preparedness planning activities.

## **Community Economic Recovery Following Natural Disasters: A Suggested Measurement Approach**

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The Center for Urban Rural Interface Studies (CURIS) was established in 2005 to address sustainable development and disaster preparedness needs in rural communities. The CURIS Region includes 20 counties and parishes in four of the five coastal states bordering the Gulf of Mexico, Louisiana, Mississippi, Alabama, and Florida. Because of the location, these states experience a wide range of natural disasters from the more common, hurricanes and tornadoes, to the extremely rare, earthquakes along the New Madrid fault.

Natural disasters have caused serious damages to the nation's coastal communities, especially the recent hurricanes in the Gulf of Mexico, Ivan, Katrina, Rita, Gustav and Ike. The expedited path to economic recovery is foremost in the priorities among the local leadership and business sector of rural counties and parishes affected by recent natural disasters.

This poster presents a suggested approach in measuring community economic recovery following natural disasters. The economic variables to be used in measuring the economic recovery of counties and parishes will include variables describing the community human capital, economic output and tax revenues, business sector, and private construction. The sectoral economic variables and the sources of data included in the proposal are as follows:

Household sector:

- Population, labor force and graduation rates from the Bureau of Census
- Personal income from County Business Patterns
- Private building permits and valuations from the Bureau of Census

Government sector:

- Retail sales, tax collections from state tax commissions

Business sector:

- Number of business establishments from County Business Patterns
- Annual payroll and number of employees from County Business Patterns

## Sustainable Marine Shrimp Aquaculture at The Gulf Coast Research Laboratory

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Approximately 90% of the shrimp consumed in the US are imported from countries such as Thailand, Ecuador, China, and other Asian and Latin American countries. Most of those imported shrimp are grown in outdoor, extensive aquaculture ponds. The operation of these ponds typically involves exchanging large volumes of water with the natural environment to maintain pond water quality. This practice has resulted in disease exchange between both wild and captive shrimp populations, discharge of pollution and nutrients to the environment, escapement of exotic species, and large areas of habitat alteration to facilitate pond construction. In an effort to stem the US trade deficit with shrimp exporting countries, enhance economic competitiveness of the US agricultural sector, and overcome environmental hazards posed by irresponsible aquaculture, the Gulf Coast Research Laboratory is part of a group of research institutions investigating sustainable shrimp aquaculture technologies. We use intensive, recirculating aquaculture systems (RAS) that are contained under greenhouse structures. Marine shrimp (*Litopenaeus vannamei*) are cultured at high density, reducing the footprint of the systems and limiting the need for habitat alteration. Very little, if any water is exchanged which limits the impact that the systems have on natural ecosystems. Because of highly reduced water exchange rates and the tolerance of *L. vannamei* to low salinity conditions, these systems can be sited away from the coast. Positioning them only a short distance inland can help preserve delicate coastal ecosystems, moving farther inland can enable production of fresh marine shrimp near markets which otherwise would not have such a product. Because the systems are not reliant on marine waters, they are protected from potential environmental pollutants such as oil spills or agricultural runoff, helping to safeguard local marine shrimp production. Due to their small size, in comparison to ponds, these systems can be covered by a greenhouse or other building structures to contain heat, enabling year round shrimp production in regions such as the Northern Gulf of Mexico. Year round fresh supplies of marine shrimp produced in an environmentally conscious manner may create unique marketing opportunities and contribute to the economic and ecological sustainability of the region.

At the Gulf Coast Research Laboratory we have a pilot scale sustainable shrimp culture facility. Twelve 95 m<sup>2</sup> rectangular tanks are contained in six greenhouse structures, all connected to a building that serves as a central harvest basin. A water quality laboratory adjoins the building and during harvest water is diverted to one of two approximately 600 m<sup>3</sup> ponds to be held for reuse. Some of the specific issues under study at the facility are increasing growth rates and survival, managing particulate matter in the water column, year-round heating strategies, and nitrogen cycling dynamics. Developing these eco-friendly shrimp culture techniques may help to alleviate the US shrimp trade deficit, create employment opportunities, and strengthen and diversify economies along the Northern Gulf of Mexico.

## Uncertainty Visualization of Ensemble Weather Forecasts

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Ensemble forecasting is commonly used for numerical weather prediction. The ensembles are typically generated by repeatedly running the model with altered model parameterizations or slightly perturbed initial conditions, and sometimes both. Currently, these ensembles are interpreted by constructing spaghetti plots which are plots of a single midtroposphere pressure surface height contour.

In this poster, we describe two visualization techniques, interaction techniques, and a tool named “Noodles” that integrates these features for the visualization of uncertainty in a multi-member numeric weather ensembles. We also present a case study of the March 1993 “Superstorm”, also referred to as the “Storm of the Century”. The event was simulated using the Weather Research and Forecasting (WRF) model to create a 48-hour, 18 member parameterization ensemble. Three important weather variables: water-vapor mixing ratio, perturbation potential temperature, and perturbation pressure, and their uncertainty quantified by individual ensemble member standard deviation, inter-quartile range, and the width of the 95% confidence interval are visualized. Additionally, bootstrapping was employed to reduce the dependence on normality in the uncertainty metrics.

The tool presents a coordinated view of ribbon and glyph-based uncertainty visualization, spaghetti plots, iso-pressure colormaps, and data transect plots. Two meteorologists used the tool for assessing the uncertainty in the “Superstorm” simulation and found it useful in understanding the uncertainties in the simulation. They could identify the parameterizations that resulted in outliers in the ensemble. In addition, the meteorologists could identify spatial regions where the uncertainty was significantly high leading to an understanding of poorly simulated storm scenarios, and parameterizations that led to such scenarios.

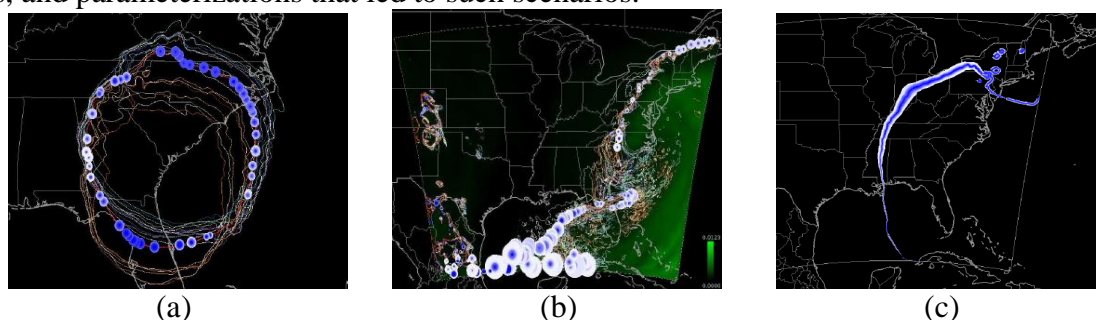


Fig (a) Graduated uncertainty glyphs with spaghetti plots for pressure perturbation. (b) Graduated uncertainty glyphs with spaghetti plots for water-vapor mixing ratio. (c) Uncertainty ribbon for pressure perturbation.

**Responding to the 2010 Deepwater Horizon Oil Spill: Mississippi-Alabama Sea Grant extension and outreach activities**

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Immediately following the Deepwater Horizon Oil Spill the Mississippi-Alabama Sea Grant Consortium (MASGC) began responding to the technical disaster on multiple fronts. MASGC worked closely with the Gulf of Mexico Sea Grant College Programs, National Oceanic and Atmospheric Administration, other federal agencies, state agencies, non-governmental organizations, universities and land grant cooperative extension services to identify and address oil-spill-related needs of Gulf Coast residents. Over a five-month period, MASGC led or provided substantial support for 25 oil-spill-related trainings, workshops and town hall meetings with more than 1,800 participants. Examples of these efforts include bringing experts from Alaska's Exxon Valdez oil spill to the region to discuss their oil-spill experiences, public forums for citizens to get answers from people leading the oil-spill response, workshops to address seafood safety concerns and educate people on the processes used to ensure seafood safety, peer listener training to assist people impacted by the spill and the mental health community, legal outreach to understand the complexities of the BP claims process and options to recover losses, and hazmat and waterfront property owner cleanup trainings. MASGC extension staff also worked directly with the seafood industry regarding fisheries closures, regulations and the re-opening process. In addition, the Gulf of Mexico Sea Grant College Programs developed a regional website that links to oil-spill-related resources and was often cited as one of the top Gulf of Mexico oil-spill website ([gulfseagrant.org](http://gulfseagrant.org)) resources during the early days after the spill. Finally, two regional outreach projects that support the research community were implemented. A database of oil-spill-related research, monitoring and restoration activities was developed in partnership with NOAA's National Coastal Development Data Center and an update to the regional research plan called the Gulf of Mexico Research Plan was initiated and is taking oil-spill research priorities into account.



## **Implementation and Evaluation of the Coastal Community Resilience Index**

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In 2008 the Coastal Community Resilience Index (RI) was introduced in the Gulf of Mexico in draft form. The RI has now been pilot tested in sixteen coastal communities in Louisiana, Mississippi, Alabama, Florida, and Texas. The input collected in the pilot tests was used to refine the tool. The final version of the RI will be shared with additional communities throughout the Gulf of Mexico through the implementation phase of the project. The goal of the implementation phase of the RI is to provide training to extension agents and others in all five Gulf states, equipping them to serve as a liaison to coastal communities and deliver the RI and other hazard related materials to local communities. Through this training, agents will learn how to facilitate the discussion surrounding the RI and to serve as a resource to communities as they strive to address vulnerable areas identified through the tool.

Results of pilot testing suggest the most effective means of implementation of this tool is in small, personal group settings where local managers, planners, and decision makers discuss issues covered by the RI while a facilitator such as an extension agent guides discussion. The process of completing the RI is as important as the score the community receives at the end. For this reason, it is important that the community make the index “their own” and have rich conversation regarding questions in the document. Having an outside, neutral party to facilitate this discussion is key to the success and usefulness of the RI within the community. Although the RI is a stepping stone to increase awareness and promote conversation regarding long term community resilience, it is an important first step in making contact with decision makers at the local level.

In addition to the assistance provided by extension agents, a mapping tool has been developed to help communities visualize the location of critical infrastructure and facilities, assisting them in answering questions on the RI. This tool is easily accessible via a web browser and compliments the RI.

Throughout the implementation phase, the Regional Outreach Coordinator will evaluate the effectiveness of using the RI to assist communities in their planning and efforts to improve their resilience. Effective evaluation of the RI will require follow-up with each community who has completed it. This information will be used to improve the next generation of the RI and continue to benefit the coastal communities throughout the Gulf.

The Resilience Index is a joint venture initiated by Louisiana Sea Grant and Mississippi-Alabama Sea Grant Consortium and has region-wide support through the NOAA Coastal Storms Program and the Gulf of Mexico Alliance Community Resilience Priority Issue Team.



## Potential Economic Impacts of the Gulf of Mexico Oil Spill to Mississippi, Sector by Sector

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On April 20, 2010, the BP Deepwater Horizon Oil Rig in the Gulf of Mexico exploded which resulted in over 4.9 million barrels of crude oil leaking and more than 1.8 million gallons of dispersants being poured into the Gulf. The Mississippi State University, Coastal Research and Extension Center (MSU-CREC) started building an economic inventory covering both prior and after the spill to ensure the most accurate economic impact assessment. One tool that is being developed for the purpose of the impact assessment is the MSU-CREC Gulf of Mexico Oil Spill (GOMOS) website (Figure 1).

The GOMOS website is a clearinghouse of long-term economic and socio-demographic data that will be used in modeling the economic impacts of GOMOS to affected economic sectors, households and communities. Not only does the website serve the purpose for CREC's economic impact assessment, but other institutions of higher learning as well as governmental agencies are using the information and data the project team gathered for their own research and outreach purposes.



Figure 1: MSU-CREC GOMOS Website, Home Page

The databases were compiled from both secondary and primary sources and are kept as current and up-to-date as possible. Some of the data sources include, but are not limited to: County Business Patterns, NOAA Fisheries, U.S. Bureau of Census, U.S. Fish and Wildlife, and the Mississippi Departments of Marine Resources, Revenues, and Employment Security.

The section on industrial impacts deals with baseline economic data on commercial seafood, coastal tourism, marine transportation and marine-related industries. These databases will be used to determine the economic impacts of GOMOS on the affected economic sectors.

The expected changes in the total flow of goods and services generated by the Gulf natural resources damaged by the oil spill will affect not only households but also the communities dependent on these natural resources. The section on household impacts compiles baseline databases on seafood prices, seafood consumption and household recreation. The section on community impacts compiles baseline databases on the levels of economic activity, levels of employment and personal income, and tax revenues among the affected communities.

## **Improving Wave Height Prediction During Barrier Island Overtopping**

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The results of damage assessments following recent hurricane events suggest that predictions of wave transformation across barrier islands during overtopping events are unreliable and, even worse, inaccurate. In many cases, inaccurate model predictions of wave heights in high hazard areas are translating into improper standards for “lowest structural member” elevations on residential and commercial structures. The substantive result of which is increased cost of construction, whether initial or replacement costs. The purpose of this project is to improve guidance on building elevations in high hazard flood plain areas where wave action is the primary structural damage mechanism. A number of novel, autonomous wave gauges will be temporarily mounted to fixed structures on Dauphin Island, Alabama in advance of an overtopping event during the 2010 hurricane season. Measured wave heights and water levels will provide an opportunity to characterize wave transformation across the barrier island; and when combined with surveyed building elevations, will identify critical building elevations that delineate survival and destruction.



Figure 5. Waves actively undermining a home foundation on Dauphin Island, Alabama, during a high tide event.

The practical results of research and analysis performed using the collected data are compelling: they may directly impact federal and state guidelines for construction methods and materials, building elevations, flood plain management, and insurance costs in coastal municipalities. Improved predictions of wave heights above the storm surge elevation will improve guidance provided in base flood elevation maps. When the wave transformation process is evaluated in tandem with ground surveys of structural damage, an opportunity for improving specifications and codes for foundation-floor joist-wall connections, and appropriate elevations of the “lowest structural member” will be realized. These results can lead to a reduction in repetitive losses, and more efficient construction.

**--Living Resources/Sustainable Communities II Session--**

*(in order of program listing)*

## A Study of Seagrass Beds at Grand Bay National Estuarine Research Reserve, Mississippi

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An important component of many marine ecosystems, seagrass beds have been declining globally due to the cumulative effects of alteration of natural habitats and deterioration in coastal environmental quality. Being one of the most productive ecosystems in the world, coastal seagrass beds perform a number of irreplaceable ecological functions in chemical cycling and physical modification of the water column and sediment, provide nursery and foraging habitats for marine life, help improve water clarity, help reduce coastal erosion, and buffer wave energy. Therefore, temporal changes in their distribution and abundance indirectly reflect changes in the habitat quality and environmental health status. In Mississippi Sound, seagrass beds have reportedly declined more than 50 percent since the 1969 Hurricane Camille. In addition, the more significant declines occurred in stable, climax community seagrasses such as Turtlegrass (*Thalassia testudinum* K.D. Koenig) and Manatee grass (*Syringodium filiforme* Kützinger), which have resulted in the increased relative abundance of opportunistic, pioneer species such as Wigeon grass (*Ruppia maritima* L.) and Shoal grass (*Halodule wrightii* Aschers) in estuaries and along barrier islands of the northern Gulf of Mexico. We have conducted bi-annual surveys at several seagrass beds at Grand Bay National Estuarine Research Reserve: 1) to identify the ecological requirements and limiting factors of the seagrass species (*R. maritima* and *H. wrightii*) at the reserve; and 2) to link the spatial and temporal variability in the seagrass structure/competitive advantage with key environmental factors. We hypothesized that there are significant spatial and short-term fluctuations in the coverage of *Ruppia*/*Halodule* beds. Seasonality was studied by comparing the data on the seagrass variables between summer (June and July) and the fall (October). Seagrass distribution and abundance were surveyed along water depth gradients and shoreline orientation. Our results indicate that the coverage and distribution of the beds dominated by *R. maritima* and the *Ruppia* – *Halodule* mixed beds of the tidal bay area (the estuarine area) in the reserve vary substantially, primarily due to changes in *R. maritima* abundance between summer and fall, and among years. According to the three –way ANOVA analysis, seagrass coverage was significantly different among the sites, season, years, water depths, and also for any two-, three-way effects of the fixed factors. The only exception was the *Halodule wrightii* coverage which has not changed significantly for a given season, at a given site. Our results on site variation in seagrass coverage suggest that shore orientation and wind-driven energy within the estuarine system may be contributing factors to the spatial difference in the shallow estuary. We also analyzed the biomass variation over one year period at three sites. The estuarine *Ruppia* population that grows in the shallow, high wave energy environment has an annual growth pattern: seedling growth in early spring, rapid vertical growth in April, producing abundant inflorescence and seeds in May and June, and senescence in the fall. Total biomass, below- and aboveground biomass were variable among the sites. At the mixed seagrass beds, the belowground biomass was substantial during winter months, due to *H. wrightii* which produces an overwintering rhizome mat.

## A Water-Depth Correction Algorithm for Seagrass Mapping Using Hyperspectral Data

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**Abstract:** The substantial difference between the reflectance values at the red and the near infrared (NIR) regions has been used to develop vegetation indices for remote sensing of green plants. These spectral indices, however, may not be effectively used for underwater plant detection due to numerous factors including the influence of the water column which interferes with reflected signals from the seafloor. We empirically differentiated the energy absorbed by water and scattered from the water column using an indoor water tank with hypothetical surfaces that either reflect or absorb all the incoming light. Using the experimental data, a function was developed to correct reflectance measured from a shallow water body for the water effects. When applied to independently measured reflectance of underwater vegetation; the algorithm significantly enhanced vegetation signals, especially in the NIR region. The experimental conditions were modified in order to reduce the errors associated with the effects of enhanced multi-path scattering, improve the algorithm using the new empirical data, and apply the algorithm to an airborne hyperspectral image data obtained over *Halodule wrightii* seagrass beds at Grand Bay National Estuarine Research Reserve, Mississippi. The water absorption and scattering factors ( $A_w$  and  $R_w$ ) were applied to the image data to obtain the reflectance that is attributed to the water bottom surface including bare sand and seagrass beds. The contrast between the dark *Halodule* patches and the bright sand increased in the bands between 500 and 800 nm after the correction. The correction algorithm also increased Normalized Difference Vegetation Index (NDVI) values for the seagrass pixels by restoring the upwelling signal in the near infrared. Therefore, this experimentally-driven algorithm has a potential to improve mapping capabilities of seagrass beds and invasive aquatics in shallow water bodies.

## Impacts of Anthropogenic Development on the Nursery Function of Salt Marsh Habitat

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In order to meet the demand of the growing population in Mississippi's coastal zone (up 85% since 1960), the coastal landscape is continually modified by the accumulation of man made structures and impervious surfaces. Though the cumulative impacts of such landscape-level changes are not always immediately apparent, an emergent property is the creation of a mosaic of smaller habitat patches nestled within a framework of inferior, man-made structures from what was once a homogenous landscape (i.e., fragmentation). Using a GIS-based approach (FRAGSTATS), we were able to identify replicates of three habitat-types along a gradient of alteration in both the Pascagoula River (PRE) and Biloxi Bay (BB) estuaries; completely fragmented (CF), partially fragmented (PF), and intact natural (IN) salt marsh habitats with tidal creeks of similar size and creek order. Though this project is still in the early stages, nekton (i.e. fish and decapods crustaceans) samples have been processed and some clear patterns are already apparent. While there were neither estuary or habitat-level difference in species richness or diversity (Inverse Simpson's Index), detailed multivariate analyses of the nekton assembles structure showed that while nekton communities were similar between estuaries they were markedly different among habitats. Intact natural and CF habitats were significantly different from each other and both were similar to PF. These habitat-specific differences were driven by spot (*Leiostomus xanthurus*), gulf menhaden (*Brevoortia patronus*), brown shrimp (*Farfantepenaeus aztecus*), and blue crab (*Callinectes sapidus*) being several times more abundant in IN habitats than either PF or CF habitats. Future directions for this project include 1) detailed analysis of the benthic community structure, biomass, and diversity, 2) quantitative description of spot, gulf killifish (*Fundulus grandis*), and southern flounder (*Paralichthys lethostigma*) diets, and 3) analysis of the trophic relationships in each habitat-type from primary producers through upper level consumers using carbon, oxygen, and sulphur isotopes.

## The Short-Term Impact of Crude Oil on Photosynthesis of Salt Marsh Plants

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Coastal wetlands are among the most productive ecosystems in the world. However, they are threatened by stresses at multiple spatial scales including crude oil contamination. The adverse effect from crude oil can exceed a threshold beyond which photosynthesis of wetland plants will no longer function normally, plants die, and consequently other wetland functions and structures will also begin collapsing.

In this research, we have assessed the short-term impact of crude oil on photosynthesis of salt-marsh dominated species on Mississippi Gulf Coast *Spartina alterniflora* in Davis Bayou in Mississippi (30.37° N, 88.39° W). We have not determined the crude oil came from Deepwater Horizon Oil Spill but the study will certainly provide insights how crude oil can affect carbon services of salt marshes. We measured the carbon exchange and fluorescence characteristics of the plant leaves impacted by oil at different levels using LI-6400 and *pulse* amplitude modulated (PAM) fluorometry immediately after the oil contamination (July, 2010) and one month after the contamination (August, 2010) when there were no signs of oil any more at the area. We applied a generalized linear model to study the impact of oil contamination levels (visualization) and light levels on carbon assimilation rates. The results showed that both oil levels and light levels significantly affected carbon assimilation rates although the oil range organic concentrations (32-68 ppm) in the sediments do not show much difference among the sites with different oil contamination. In details, there was no carbon fixation at the heavily contaminated oil site (heavy site) ( $n \geq 10$ ) immediately after the oil contamination, due to the oil films on leave surfaces which prevented stomata from exchanging gas with surrounding environment. The plants covered by oil at the site died after one month, and the photosynthesis rates of the new shoots were lower compared to the control site (no oil impact). The carbon exchange rates at the relatively lower contamination site (middle site) were generally 33% lower compared to the plants at the control site under the light levels between 400-1200  $\mu\text{mol m}^{-2} \text{s}^{-1}$  immediately after the oil contamination, the difference became very small with higher light levels of 1600-2000  $\mu\text{mol m}^{-2} \text{s}^{-1}$ . However, the photosynthesis at the site was still decreasing and there was no sign of recovery after one month. Potential photosynthesis rates measured by  $F_v/F_m$  on dark adapted leaves showed significant reduction at oil contaminated sites. The reduction ranged from 50% at the middle site to 80% at the heavy site compared to the control site.

The short-term assessment is the first step in building a hierarchical Bayesian model, which will be applied to get a better understanding of how selected functions of tidal marsh ecosystems degrade and recover in response to the factors at multiple spatial scales, including crude oil pollution.



## **Trophic Plasticity in the Atlantic Sharpnose Shark (*Rhizoprionodon Terraenovae*) from the North Central Gulf of Mexico**

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Quantifying the trophic role of sharks in coastal ecosystems is crucial for the construction of accurate ecosystem models. This is particularly important for wide-ranging species like the Atlantic sharpnose shark (*Rhizoprionodon terraenovae*), ubiquitous across the northern Gulf of Mexico. We applied gut content and stable isotope analyses to determine if differences in abundance of Atlantic sharpnose sharks in the waters around Mobile Bay, Alabama translated into differences in dietary sources or trophic position among sharks sampled east and west relative to the mouth of the bay. Gut content analysis suggested that Atlantic sharpnose sharks eat primarily teleost fish (%IRI > 80% across size classes). N stable isotope data from liver and muscle tissues indicated seasonal shifts in trophic position for Atlantic sharpnose sharks in the eastern region, which corresponded to seasonal shifts in biomass of potential prey. The lowest trophic position for Atlantic sharpnose sharks was estimated in the eastern region during the fall and corresponded with a seasonal peak in invertebrate biomass. Trophic levels for Atlantic sharpnose sharks were relatively high and constant year round in the western region, consistent with high teleost biomass in that region. Our results demonstrate trophic plasticity in Atlantic sharpnose sharks, findings that emphasize the importance of examining regional variation in trophic position when constructing coastal foodweb models.

**Occurrence, Distribution, and Behavioral Patterns of Bottlenose Dolphins, *Tursiops truncatus*, in Wolf Bay, Alabama**

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Bottlenose dolphins inhabit inshore waters throughout the north-central Gulf of Mexico (GOM), USA, but due to a paucity of research, knowledge of their site-specific ecology in this region is generally poor. This includes Wolf Bay, a small (25km<sup>2</sup>) estuarine system near the Alabama/Florida border, where increasing coastal development and the Intracoastal Canal Waterway exert considerable anthropogenic pressure on the bay system. I conducted photo-identification surveys in Wolf Bay over 16 months spanning 2006 & 2007 to gather baseline data on bottlenose dolphins in this previously unstudied area. Dolphins were sighted on all 41 surveys. Using Finbase, a photo-id catalog was compiled of 88 individuals with highly distinct dorsal fins. Fifty-nine percent of those 88 dolphins were seen >4 times & 23% were seen in ≥6 months & in all 4 seasons suggesting there is a resident population. Population estimates were highest in the winter (N = 131, SD = 32.0) & 18% of dolphins observed were calves & neonates. Dolphins showed a preference for specific areas within the study site. Average group size was small (4.1 dolphins/group, SD = 2.9) & groups with calves or neonates present were larger than average (5.5 dolphins/group, SD = 3.0). Over a third (34%) of all behavioral observations were of slow travel. Seasonal behavioral differences were apparent with observations of probable feeding behavior increasing in winter & social behavior increasing in summer. Some of my findings including percentage of calves observed & average group size, contrast with those from similar studies at different locales, highlighting the need to examine dolphins in every inshore habitat available in GOM waters for effective management of local stocks.

## **Apple Snail (*Pomacea insularum*) Invasion of the Mobile-Tensaw Delta: A Risk Assessment**

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Invasive species are regarded as one of the greatest threats to the structure and function of natural ecosystems. The proliferation of apple snails in Langan Park in Mobile, AL, and its subsequent colonization of its drainage has been hypothesized to place vegetation in the Mobile-Tensaw Delta (MTD) at risk. Recent surveys show apple snails persist in Three-Mile Creek less than a mile from the waters of the MTD. It remains unclear if these snails can successfully survive then proliferate in the saltier waters of the MTD. Here, we present results of a preliminary assessment to determine the potential for apple snail invasion into the MTD. Specifically, we document the height of eggs above the waterline and the impact of periodic inundation (tidal impacts) on hatching success as well as survival and growth of hatchlings and adults at salinities routinely observed in the MTD. Our work indicates that periodic inundation has little impact on hatching success and that snails can tolerate lower salinities found in the upper regions of the MTD.

## **Evaluation of a Mechanical Grader for Improving Shell Quality and Reducing Fouling in the Commercial Aquaculture Production of Oysters, *Crassostrea virginica*, in the Gulf of Mexico**

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The development of economical production techniques to increase the profitability of single shell oysters is key for advancing aquaculture in the Gulf of Mexico region. The goal of the presented research was to evaluate the shell altering capabilities of a labor-saving mechanical grader that could potentially increase the marketability and value of farmed oysters by enhancing product quality. The quality of oysters produced will be determined through physical measurements, quantitative sensory profiles and consumer response. When held in production cages, oysters are subject to fouling from a variety of aquatic organisms, algae and sediment that effect shell quality. Fouling affects growth rate, survival and potentially the marketability of cultivated oysters. The mechanical grader is typically used to separate the size variants of single shell oysters, but the tumbling action also breaks away and cleans bio-fouling from the oysters. In addition, the tumbling action prunes the growing edges of the oyster shell, potentially creating thicker shells with deeper cups. Since product quality is becoming important in the increasingly competitive half-shell markets, shell morphology and resulting consumer impressions serve as potentially valuable marketing tools.

Four types of commercially available oyster production gear were compared over the 2010 growing season (June-November): OysterGro™ Floating Cages, Floating Bags, LowPro™ Bottom Cages, and an Adjustable Longline Bag System from BST© in Australia. All gear types were stocked with oysters spawned in 2009 and subjected to three common treatments: no tumbling, monthly tumbling and monthly handling controls. In addition to the these three treatments, Floating Bags and OysterGro Cages were evaluated for weekly tumbling, biweekly tumbling, and seasonal tumbling with a handling control treatment for each interval. All gear was stocked with oysters and maintained according to the recommendations of commercial level production. Mortality, degree of fouling, growth rate, and product quality were evaluated.

Initial results indicate that weekly tumble treatments exhibited reduced shell height but displayed measurably “deeper cupped” shell width. This treatment also displayed a higher percentage of mortality associated from tumbling compared to handling stress alone. Also the high frequency of shell pruning will likely require a longer grow-out period to reach a target marketable size of three inches.

All tumbling treatments showed a reduction in fouling (sediment and barnacles) when compared to the non-tumbled treatments. However, over-set from oyster spat often remained, even throughout the most frequent tumbling regimes. Actual extrapolation for industry labor value has yet to be determined. Labor-hours saved as well as quality and sensory evaluations will be conducted following the conclusion of field trials in November, 2010.

## **Mobile Bay: Coastal Applications of Geospatial Data and Models**

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Coastal communities around the globe are facing the increasing challenges of human pressures, natural resource sustainability, and environmental/climate change. To successfully address these coastal challenges, NOAA is enhancing the geospatial infrastructure and using physical measurements to precisely model and forecast conditions in the environmentally sensitive area of Mobile Bay, Alabama and its environs. Input from users of these data and products is integral in determining how the products should be distributed, formatted, and used. The goal of this session is to ensure that the products of this survey are useful and available to potential end users.

**--Living Resources/Sustainable Communities II Session--**

*(in order of program listing)*

## **Identifying Key Variables of an Oil Spill**

Jeff Zanotti

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An off shore oil rig blowout results in millions of gallons of crude oil pumping into the waters of the Gulf of Mexico with little success in capping it. Scientists ponder the long term effects on the fishing industry and on the miles of beaches that oil is washing up on its shores. This is not the Deepwater Horizon disaster, but instead a description of the Ixtoc I oil spill in 1979 which originated 62 miles off the coast of Ciudad del Carmen, Mexico. Analyzing the Ixtoc I disaster as well as the infamous Valdez will help point out what defines the extent of an oil disaster ecologically.

Exploring these two historic oil spill disasters shows parallels, potential pitfalls, and also some guarded optimism in regards to the short and long term effects of the Deepwater Horizon blowout. The Ixtoc I was a bathypelagic oil spill like the Deepwater Horizon, though it was only at 165 feet below the surface instead of 5000 feet. It is estimated that 140 million gallons of crude oil escaped the well in the 290 days it took to plug the leak. Naturally the environmental impact was expected to be severe. Lower level food chain organisms were found to be reduced by 80% which confirmed scientists' pessimistic predictions. However, when the same areas were tested two and three years later these organisms had been found to have rebounded back to what they were prior to the spill. Marine biologists have credited the resiliency of the Gulf's ecosystem with this amazing bounce back but fear that over fishing in the last 30 years combined with newer form of dispersants used to break up the oil could paint a different picture this time around. The Valdez is a more widely known story for our generation but surprisingly the methods being used to aid in clean up are surprisingly similar. Agencies are still using booms, controlled burns, and dispersants. Although the technology has advanced clean up methods and new mitigation steps were put in place for large scale oil spills after the Valdez spill, it has not been enough to prevent a wide scale environmental debacle. Looking back after 20-30 years also lets us see that not all ecosystems are able to bounce back as well as the Gulf of Mexico did in the 1980's. Detailed research into the shore clean up methods have also revealed that the impact of an abrasive clean up strategy ended up doing more harm to lower level biota than the oil itself in certain areas.

This presentation will compare the Ixtoc I disaster to the Valdez in order to help identify key variables that define an oil disaster. Simple stats such as amount of oil and time uncapped do less to define an ecological disaster than weather, geography, and regional ecosystem do.



## **NOAA's Regional Engagement in the Gulf of Mexico: Leveraging Partnerships and Science to Address the Deepwater Horizon Oil spill**

Buck Sutter\* and Cathy Tortorici

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The Deepwater Horizon oil spill was one of the worst manmade environmental disasters experienced by the United States. The impact of it and response to it underscores the critical linkage between the environment and the economic health of the Gulf of Mexico. The oil spill also presented an unprecedented opportunity to focus the energy and expertise of NOAA's Gulf of Mexico Regional Functional Team, a group of research partners located in the Gulf Region on this critical response effort.

The Regional Functional Team is composed of members from all parts of NOAA (National Weather Service; National Environmental, Satellite, Data and Information Service; National Ocean Service; National Marine Fisheries Service; Office of Oceanic and Atmospheric Research). This provides an important cross-agency focus to leverage expertise and resources to assist with the oil spill response. Through their engagement with key stakeholders and the public, the Regional Functional Team provided an integrated approach to communicate NOAA's response to the oil spill, and support NOAA leadership's understanding of the public's "on-the-ground" needs to better target NOAA's efforts.

Through understanding stakeholder needs and NOAA's capabilities in the Region, the Regional Functional Team was able to quickly and nimbly communicate data and information to the public on fishery closures/openings, seafood safety testing protocols, human health and environmental impacts of oil and dispersants, the "oil budget," subsurface oil monitoring, as well as impacts to essential fish habitat, and endangered species. As the transition from response to restoration and recovery now begins, the Regional Functional Team is analyzing regional needs and capabilities into the nationally significant priorities to implement key initiatives like Coastal and Maine Spatial Planning and the "Mabus Report" for recovery of the Gulf of Mexico's environment, economy, and public health.

## **Examples of NASA Data Products Used in the National Response to the Deepwater Horizon Oil Spill**

Jason B. Jones\*<sup>1</sup> and Josh Stodghill<sup>2</sup>

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On April 20, 2010, an explosion aboard the Deepwater Horizon drilling rig in the Gulf of Mexico began one of the worst oil spill disasters in U.S. history. As the U.S. government established a unified command for responding to the spill, some of its most immediate needs were to track the movement of the surface oil slick, establish a baseline measurement of coastal ecosystem conditions for a natural resource damage assessment, and assess potential air quality hazards related to the spill and its mitigation. To help address these needs and assist the Federal response to the disaster, NASA deployed several of its airborne and satellite research sensors to collect an unprecedented amount of remotely sensed data over the Gulf of Mexico region. While some of these data were shared with the public via the media, much of the NASA data on the disaster is not well known to the nation's citizens. A need existed to inform the general public about these datasets and to make the data products more understandable to the public. In response, a project was begun by the NASA DEVELOP program to provide outreach to the public on NASA science data collected in response to the spill. The presentation provides an overview of how these remotely-sensed datasets are being used in oil spill response / recovery research activities. The presentation also discusses one facet of the DEVELOP project in which we developed and outreached value-added daily MODIS *Aqua* and *Terra* products to visualize the movement of the Gulf of Mexico oil slick in a form suitable for public consumption (Figure 1).

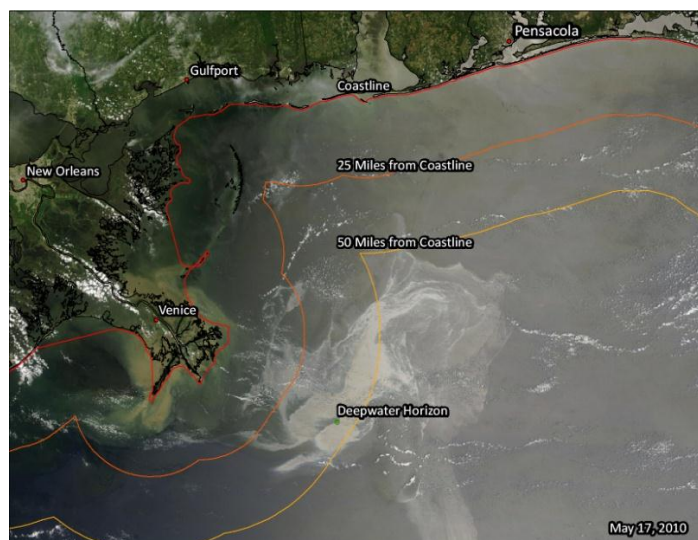


Figure 1: MODIS Image of Deepwater Horizon Oil Spill. May 17, 2010. Image Credit: NASA/GSFC, MODIS Rapid Response. Cartography Credit: NASA DEVELOP program.

## **Offshore Oil and the Deepwater Horizon: Social Effects on Gulf Coast Communities**

Diane Austin

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The Deepwater Horizon disaster has drawn attention from people and organizations across the globe. The explosion of the rig, the efforts to manage the flow of oil into the Gulf of Mexico, the effects of that oil on coastal ecosystems and communities, and the regulatory and technological changes that have occurred and will continue in the aftermath of this event have already begun to have ramifications worldwide, affecting both the practices and perceptions of the offshore petroleum industry. This presentation will outline and provide the initial results of a study that began in 2010 and will continue at least until 2013 to measure, document, and describe the social effects of this disaster, in the context of the offshore petroleum industry, on people and communities along the U.S. Gulf of Mexico.

The study uses a community-based participatory research approach and draws upon the expertise of community leaders and residents; university researchers; independent scholars; federal, state, and local government officials; business and industry representatives; and members of the not-for-profit sector. Led by researchers from the University of Arizona and Louisiana State University, the study will focus initially on southeast Mississippi (George, Harrison, Jackson, and Stone counties) and southwest Alabama (Mobile County), and on two regions in southeast Louisiana – (1) Assumption, Lafourche, St. Mary, and Terrebonne parishes; and (2) Jefferson, Orleans, Plaquemines, and St. Bernard parishes. This presentation will focus on the Mississippi and Alabama region but will bring in information from the other regions as appropriate.

## **Analyzing the Social and Economic Impacts of the 2010 BP Gulf Oil Spill: a Unified Approach**

Dr Diane Hite\*<sup>1</sup>, Dr Michelle Worosz<sup>1</sup> and Dr Terrill Hanson<sup>2</sup>

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Our presentation will present a framework for analyzing local and regional economic and social impacts of the BP Oil Disaster. We hope to receive feedback from other attendees of the conference, as well as from local community groups, such as the Working Waterfront Coalition and local Chambers of Commerce. In a disaster such as the one experienced in 2010, there are major disruptions of the ocean environment, causing a number of ripple effects throughout the economy. For example, food safety of Gulf seafood is an important concern, and this affects not only commercial fishing enterprises, but also seafood processing plants and water-based recreation providers. Further, previous research in Mobile County (Working Waterfront, 2007-2008) found that 86% of waterfront-related businesses had been negatively affected by Katrina, and 57% had not recovered fully or at all 2-3 years later. Since the quality of the Gulf fisheries was not affected by Katrina, we expect that short and long-run losses from the BP disaster will be of a much larger magnitude and scope compared to Katrina.

The approach to quantifying the impacts should be multi-pronged, including valuation surveys of the general populace of Alabama to measure negative impacts on Gulf tourism, and surveys of local businesses to examine effects on earnings and future outlook for coastal industries; a survey to assess consumer acceptance of Gulf seafood will also help to explore longer term market impacts. In addition, the already frail condition of the real estate market in the US will likely be exacerbated at the local level on the Gulf Coast. A well-known method, called the hedonic house price model, can be used to examine temporal impacts on house values resulting from the disaster, while also controlling for macroeconomic effects of housing market conditions.

In addition to the research aimed at consumers and businesses, we believe that a regional economic impact analysis should be conducted. Such analyses examine ‘multiplier’ effects of economic shocks throughout a region—in this case, we believe that the regional impact will not just be felt along the coast, but will also affect state level tax collections and the overall economic health of Alabama. Multipliers capture both direct and indirect effects of an economic shock; for example, if tourists avoid the Gulf region, expenditures on auxiliary items like gasoline and restaurants will drop, in addition to the impact on businesses like marinas. Such a model will enable us to isolate various economic sectors, such as commercial fishing, tourism, seafood processing and so on, in order to examine which of these sectors has the largest impact on local and regional losses. This will help policy makers develop the optimal responses to the needs of coastal communities.

## **Assessing and Improving Mesonet Data for Advanced Coastal Decision Making**

Madhuri S. Mulekar\*<sup>1</sup> and Sytske K. Kimball<sup>2</sup>

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A mesonet is a network of weather stations spaced between 10 and 100 km apart, that typically collect data every 1 to 5 minutes. With their fine spatial and temporal resolution, mesonets are a crucial tool for current day decision makers. Weather data impact a wide variety of aspects of our society including, but not limited to, weather forecasting, climate monitoring, studying renewable energy options (weather stations measure solar radiation and wind), ecosystem protection (aquatic life forms are sensitive to for example turbidity which can be caused by high winds and rainfall run-off), agricultural decision making (e.g. when to apply pesticide and fertilizer), and disaster response. The recent disasters, natural or otherwise, experienced by Gulf Coast communities certainly emphasize the urgency of the latter point.

In order to make accurate decisions tailored to the needs of Gulf Coast communities, data collected by local mesonets need to be of the highest quality. Given the fine temporal and spatial resolution at which data are collected, mesonets produce vast quantities of data every day. This makes manual quality control (QC) of mesonet data an unwieldy task. For this reason, automated QC systems are implemented. Auto-QC systems perform a wide variety of range, internal, temporal and spatial checks for data outliers. Flags are issued to allow users from a wide variety of disciplines to filter out bad data at a level suitable to their needs. The auto-QC system that is being implemented at the University of South Alabama Mesonet will be introduced and discussed.

## **The University of South Alabama Mesonet and its Performance during the Heavy Rainfall Event of Hurricane Ida (2009)**

Sytske Kimball\*

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The University of South Alabama (USA) Mesonet consists of 26 weather stations in coastal counties of Mississippi, Alabama, and Florida with an average spacing between stations of 30 km. Meteorological data collected include precipitation, temperature, surface skin temperature, relative humidity, wind speed and direction, solar radiation, and atmospheric pressure. Data are collected every minute and disseminated every 5 minutes all year round to serve a multitude of purposes including weather forecasting, education, and research. Near real-time, meta-, and archived data are available on our website: <http://chiliweb.southalabama.edu/> This data is crucial for the National Weather Service to issue timely and accurate severe weather and flood warnings to ensure the safety of Gulf Coast citizens. Additionally, mesonet data allows the Weather Service to analyze events after they occur and to assess the accuracy of their forecasts and warnings. An example of an extreme rainfall event that occurred recently is Hurricane Ida (2009).

In November 2009, Hurricane Ida made landfall in southwest Alabama. The storm produced more than 5 inches of rain in southern Baldwin county, AL. Two stations recorded rainfall rates of over 1 inch per hour. In this presentation, rainfall statistics and the storm's rainfall pattern and evolution will be discussed. The source of the rainfall maximum was a small warm front that moved onshore from the Gulf of Mexico. Overrunning over the cold air mass to the north caused large amount of precipitation to fall in south Baldwin County ahead of the approaching front.

Rainfall is measured by two tipping bucket rain gauges, a Hydrological Services TB3 tipping bucket rain gauge (TB3) and a Texas Electronics TE525 rain gauge (TE). Both gauges measure 0.254 mm of rainfall per bucket tip. The TB3 functions as the primary rain gauge as it includes a siphon tube (to deliver a preset volume of collected water to each bucket reducing under-catchment during heavy rainfall, e.g. Humphrey et al. 1997), a built-in level for more precise positioning, dual reed switches, and a sturdy tipping bucket made of synthetic ceramic coated brass. Dual rain gauges are used at USA Mesonet stations in case of damage due to severe weather or outage as a result of accumulated debris or nesting insects. The redundancy also allows for internal consistency checks (like-instrument tests) at each station for quality control (QC) purposes.



## Understanding the Impact of Data Uncertainty on Meteorological and Oceanographic Features

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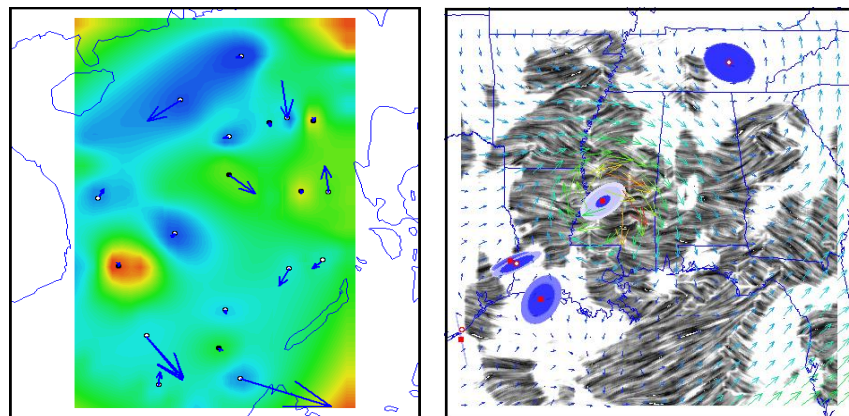


Figure 1. Left: The possible deviation of the temperature extrema indicated by arrow glyphs in an ocean surface. Right: The uncertainty of the vortices indicated by elliptical glyphs in a hurricane wind field

Analyzing and visualizing data uncertainty facilitate data analysis and decision making in various areas. Though many techniques have been proposed to visualize uncertainty, the relationship between the data uncertainty and its features is not well understood. The visualization community has long recognized two ways of expressing uncertainty: statistical methods such as estimated mean, standard deviation, error, etc. and scientific judgment such as experience and specifications. Both are not easily interpreted by the non-technical public. The current study on uncertainty visualization generally focuses on encoding uncertainty information into different graphics primitives to provide global insights into data uncertainty while the potential uncertainty related to the data features is hard to be assessed. However, the uncertainty of the data may result in significant positional and geometric deviations of its features and users need to be made aware of this kind of uncertainty.

We propose a feature-based uncertainty visualization which evaluates the impact of the data uncertainty on the data features. The framework of this approach consists of feature identification, feature mapping, and uncertainty representation. To correlate features among data from different simulation runs or modeling methods, various feature mapping schemes could be integrated into this framework. The current prototype of this framework is built upon the Feature Flow Field (FFF) which couples the topological features between vector fields through streamline integration. The deviation of a singularity within the FFF indicates its uncertainty. To evaluate the scalar features within FFF, the gradient fields of the scalar fields are used. Visual glyphs with both statistical meaning and real world metaphor are studied to represent the uncertainty of the features. Results demonstrate that visualizing feature-based uncertainty may provide better interpretation of the uncertainty and may be more desirable than the traditional uncertainty visualizations especially when the size and complexity of the uncertainty information increase.



## **Fins, Fishes, and Fisheries: An Enthralling Week of Teacher Education!**

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With concerns of fisheries stocks declining in many areas, apex ocean predators all but gone, and governments around the world looking to expand seafood harvests, the time to bring fisheries issues into the K-12 classroom is now. To tackle these issues head on, the Dauphin Island Sea Lab's (DISL) Discovery Hall Program (DHP) developed an educational and engaging week-long professional development opportunity for teachers titled, *Fins, Fishes & Fisheries* (FFF). Funded by Mississippi-Alabama Sea Grant Consortium (MASGC), this workshop combines content knowledge, field experiences and classroom activity explorations.

The main objectives of the FFF workshop were to introduce participants to the morphology of fishes, to the variety of ways that fishes are harvested and 'produced' and to discuss the information and approach currently used to manage fisheries in the United States. In the field, teachers used a variety of methods to catch target species including trawling, longlining, rod & reel, gill netting and pots. The highlight of the field experience for some was placing an acoustic monitoring tag inside an adult bonnethead shark (directed by a fisheries technician at DISL). Teachers will be able to follow the movements of this tagged individual by accessing a specific website. Participants were given opportunities to collect and preserve specimens for their own classroom collection. We also toured 2 local mariculture centers, Claude Petet Mariculture Center in



Figure 1: Teachers baiting shark longline in Mobile Bay

Gulf Shores, AL and the Auburn Shellfish Lab on Dauphin Island. In the laboratory, educators dissected fishes, learned how fish are aged, looked at ichthyoplankton, explored their understanding of fish shape vs habitat and wrote their own dichotomous keys. In the classroom, teachers learned about bycatch (and TEDs and BRDs), shifting baselines, the 'tragedy of the commons', Seafood Watch and fisheries models. Dr. Sean Powers, fisheries scientist at DISL and member of the Gulf of Mexico Fishery Management Council, spoke to participants about fisheries management in the Gulf and in the US. Various hands on and role-playing activities suitable for K-12 science and math classrooms were conducted and discussed.

The 17 educators attending the first of these workshops in the summer of 2010 were from Alabama, Mississippi, Georgia, and Tennessee. Their teaching situations included science classrooms at the high school (24%), middle school (6%), and K-4 levels (41%) as well as community college instructor (6%), pre-service teachers (12%) and informal educators (12%). Evaluations indicated that the teachers enjoyed and benefited most from the comparisons of various fishing techniques and the introduction to basic and functional morphology.

**The Mobile County Public Schools Environmental Studies Center – Raising Awareness and Understanding of Coastal Alabama’s Flora and Fauna**

Lloyd Scott\* and Desiree Bishop\*

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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 MS-AL Sea Grant Consortium and collaboration with the Dauphin Island Sea Lab, Auburn University Marine Extension 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 they face from natural forces and man. 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.

## **Boardwalk Talks: Dialog between the Science Community and the Visitors of the Dauphin Island Sea Lab**

Mendel Graeber\* and Tina Miller-Way

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Sponsored by the Northern Gulf Institute, the Boardwalk Talks program at DISL's Estuarium is a forum for communicating recent research directly and interactively to the public. The format is a half-hour, informal chat moderated by an educator who helps facilitate dialog among host and participants. Hosts are members of the Sea Lab's science community and have included researchers, graduate students, post docs, educators, aquarists, and technicians. Topics are wide-ranging and have included climate change, habitat restoration, hypoxia, sea level change, salt marshes, oyster reefs, sharks and the Deepwater Horizon oil spill, among others. If weather permits, talks are held outside, and hosts are advised that posters and slides are not well-suited. However, visual or tactile aids such as shells, nets, specimens or maps are encouraged. These measures help promote the spirit of informality that is the goal of the program.

The Boardwalk Talks program has many benefits in addition to the obvious benefit of introducing the public to recent research in the Gulf of Mexico. Foremost, it draws attention to the Gulf of Mexico region, enhancing environmental literacy. Additionally, it gives the public opportunities, not found in a lecture setting, for personal exchange with practicing scientists who are knowledgeable about topics of interest. For the hosts, these talks provide an on-campus, established framework that makes their participation easy and efficient. It gives hosts an opportunity to translate science for the general public, sharing their knowledge, expertise, and experience while fulfilling some broader impacts requirements. For less-experienced hosts such as graduate students and post-docs, the program offers a relaxed, low-pressure means to gain experience communicating with the public. Lastly, the Boardwalk Talks program provides an opportunity to reach out to those who support the operations of the lab: the taxpaying public, docents, staff, and the local community.

Since March 2010, the weekly Boardwalk Talks, which are free, have drawn approximately 670 participants in 30 talks – an average of 22 participants per talk. There have been 23 different hosts from around the Sea Lab. We have found that visitors are coming primarily or solely to participate in the Boardwalk Talks, and there are a few who return for multiple talks. Judging from the number of participants and the responses from participants and hosts, this program has provided a successful way for the scientific community to communicate with the local and visiting public.