

# **FLORIDA INSTITUTE OF TECHNOLOGY/DAUPHIN ISLAND SEA LAB: EFFECTS OF A MAJOR OIL SPILL ON NEKTONIC ASSEMBLAGES OF SALT MARSHES AND ADJACENT SAV HABITATS IN FLORIDA AND ALABAMA**

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## **SCIENCE ACTIVITIES**

### 1) General Summary

Our work explored the effects of oil flow from the Deepwater Horizon (DWH) disaster on the recruitment of nektonic species that rely on coastal, vegetated environments for nursery habitat. The goal of this study was to identify and quantify the direct and indirect impacts of the oiling of salt-marsh and seagrass habitats on permanent and transient nekton in the Florida Panhandle and coastal Alabama. Emphasis was initially placed on comparing the dynamics of transient and resident species among control sites and those known to have experienced oiling. Our working hypotheses were as follows: (1) nekton (both transient and permanent residents) movement from oiled habitats will result in enhanced species abundance, diversity, and biomass in nearby, non-impacted habitats; (2) impacts to the offshore spawning stock of transient residents will result in reduced recruitment to coastal habitats relative to populations of permanent residents; and (3) a prolonged period of oiling (defined as the amount of time necessary to encompass one or more known species-specific spawning and recruitment events) will result in the decline of both transient- and permanent-resident populations. However, visible oiling was not observed during the study period and our assessments of polycyclic aromatic hydrocarbons (PAH) were not consistent with site-specific oil sightings by Natural Resource Damage Assessment (NRDA) teams in the months directly following the DWH disaster. Furthermore, our assessments of marsh- and seagrass-associated faunas at study sites in Grand Bay, AL or Big Lagoon, FL do not suggest significant impacts of the DWH spill. The data collected from this study will, nevertheless, serve as an invaluable time series of recruitment patterns for salt marshes and seagrass meadows in the northeastern Gulf of Mexico to compare with data derived from pre-spill monitoring programs.

### 2) Results and scientific highlights

The field sites used in this study were selected to integrate data sets from multiple collaborative efforts in coastal Alabama and Big Lagoon, Florida, collected in conjunction with colleagues at the Dauphin Island Sea Lab (DISL). The first of these collaborative efforts continued the sampling protocol of an ongoing study at three sites in Grand Bay, AL: Long Island, Marsh Island, and West Point-aux-Pins. The Grand Bay study, which began in August 2010, was funded by the Northern Gulf Institute and was led by PIs from DISL: Just Cebrian, Kenneth Heck, Jr., and Ryan Moody (who is co-PI of the present grant). Nekton were collected monthly from salt-marsh and seagrass habitats using a paired design. Samples from the fringing marsh and adjacent seagrass meadow were taken within the same tidal period at each site from August 2010 to May 2012. Salt-marsh associated nekton were collected using tidal fyke nets, designed to capture organisms as they exited the marsh on the outgoing tide. Seagrass-associated

organisms were sampled within the Grand Bay sites using otter trawls.

Marsh-associated nekton catches were dominated by resident grass shrimp, with abundances typically one to two orders of magnitude higher than all other species combined. A diverse assemblage of killifish represented the second largest component of resident organisms. The transient salt-marsh fauna was dominated by blue crabs and penaeid shrimp. The resident seagrass fauna was dominated by grass shrimp and silver perch, and the transient fauna was dominated by blue crabs, penaeid shrimp, bay anchovies and pinfish. In 2010 and 2011, total nekton abundance was highest during the late spring and summer for both salt-marsh and seagrass habitats. Although nekton abundance differed significantly among sites, expected seasonal trends, in terms of both seasonal means and maxima, were observed for both salt-marsh and seagrass-associated assemblages with no significant interannual differences related to the 2010 DWH spill.

Seasonal patterns of abundance of blue crabs and penaeid shrimp in the Grand Bay salt marshes corresponded to late-spring and late-summer recruitment events. Blue crabs and penaeid shrimp leave coastal vegetated habitats and move offshore into deeper water during the cold winter months. Blue crab and penaeid shrimp catches within the salt-marsh at each site were composed almost exclusively of juveniles. In contrast, collections of blue crabs from the adjacent seagrass beds consisted of subadult and adult size classes. Abundances of seagrass-associated penaeid shrimp were significantly lower than those collected within the marsh, but followed a similar seasonal pattern to that observed for salt-marsh associated shrimp.

Our second collaborative effort was focused on marsh and seagrass habitats within six sites in Big Lagoon and Perdido Bay, FL: Gongora, Big Lagoon State Park, Kee's Bayou, Joe's Site, Langley Point Inner, and Spanish Cove Inner. Previous work in this area focused on salt marsh and seagrass ecology, productivity, and nutrient cycling but lacked critical data on patterns of salt-marsh and seagrass-associated nekton. program is led by PI Just Cebrian of DISL and is funded by the Environmental Protection Agency (EPA) and National Oceanographic and Atmospheric Association (NOAA). We sampled nekton at these sites using a design identical to that for Grand Bay. Historical data, covering 2001 to present, are available on the dynamics and productivity of the marsh and seagrass communities at each of the six sites. Our nekton sampling in Big Lagoon and Perdido Bay will be coupled with these existing and ongoing data sets to assess the productivity and ecological health of the two bodies of water.

Faunal sampling within Big Lagoon and Perdido Bay was conducted once every two months from June 2011 to May 2012. Dominant, resident salt-marsh species included sailfin mollies, sheepshead minnows and a diverse assemblage of killifish. The transient fauna was dominated by blue crab, brown shrimp, and inland silversides. The numerically dominant, resident seagrass-associated species were grass shrimp and rainwater killifish. The transient seagrass fauna was dominated by pinfish, spot and penaeid shrimp. Although grass shrimp constituted a significant proportion of marsh catches, abundances were not as extreme as those within Grand Bay and were proportional to catches of other organisms. Total nekton abundances remained relatively constant throughout the late spring and summer within both marsh and seagrass habitats, and declined as water temperatures cooled in December 2011. Total nekton abundances were consistently higher within the marshes relative to the adjacent seagrass meadows. Abundances of penaeid shrimp and blue crabs were significantly lower seagrass habitats relative to fringing marshes in Big Lagoon and Perdido Bay. An increase in penaeid abundance in October for both salt-marsh and seagrass habitats coincides with a known fall recruitment period, although the

typical late spring recruitment pulse in 2012 was noticeably absent from seagrass samples.

Lastly, concentrations of polycyclic aromatic hydrocarbons (PAHs) were measured in August 2010 for the sediments and plants of the Grand Bay sites, as well as for Gongora, Big Lagoon State Park, and Kee's Bayou. The analyses were performed as part of a collaborative effort, led by PIs Gary Irvin and Mark Williams of Virginia Tech and funded by NGI. A single site in Grand Bay, West Point-aux-Pins, was found to have elevated sediment-PAH concentrations. Sporadic sightings of weathered tar balls by NRDA teams were reported in Grand Bay, specifically to the southwest of Long Island and along the southernmost tip of Point-aux-Pins prior to the start of the study but no oil was observed during the study period. Long Island and Marsh Island did not exhibit elevated PAH levels. Kee's Bayou and Gongora were found to have elevated sediment-PAH concentrations, and seagrasses at both Kee's Bayou and Big Lagoon State Park exhibited elevated PAH-levels. Reported sightings of tarballs by NRDA assessment teams were limited to an area near Spanish Cove, located near the eastern inlet of Big Lagoon, during summer and fall 2010. The observed elevations in PAH concentrations are, therefore, not consistent with early NRDA observations of shoreline oiling, nor do they correspond to site-specific variability in the abundances of resident or transient organisms within our study sites. We tentatively conclude that the observed PAH variability was likely associated with environmental inputs unrelated to the DWH spill.

Seasonal patterns of nekton abundance within Grand Bay, Big Lagoon and Perdido Bay are consistent with known patterns of recruitment for the region. No loss of salt-marsh vegetation or seagrasses, nor the structure they provide to juvenile nektonic species, was observed at any of the study sites, suggesting minimal impact to Grand Bay and Big Lagoon. The lack of large interannual variability in nekton abundances within both study areas and congruence of this data with that of sites for which pre-spill data are available suggests minimal, or negligible, impact of the DWH oil spill.

### 3) Cruises & field expeditions

All field work was conducted from an FIT-owned, 25-foot skiff. A schedule of sampling activities is provided in section 7.

- 4) Peer-reviewed publications, if planned (Note: a special section will focus on student and post-doctoral publications)
  - a. Published, peer-reviewed bibliography (Copies of the papers are requested)
  - b. Manuscripts submitted or in preparation (Please note target journal, and anticipated date of publication or submission)

We have begun preparing manuscripts based on the results of this study and we plan to submit one or more manuscripts for publication in peer-reviewed journals in 2013.

- 5) Presentations and posters, if planned (Please provide copies of each) (Note: a special section will focus on student presentations)

### **Northern Gulf Institute (NGI) Meeting, Mobile, AL; May 2011**

Moody, R. M., S. Kerner, L. K. Biermann, J. Howard, J. Cebrian, K. L. Heck and S. Powers. Deepwater Horizon and temporal dynamics of nekton abundance in coastal fringing marshes. Oral Presentation.

**Florida Institute of Oceanography BP/FIO Principal Investigator Coordination Workshop, Orlando, FL; September 2010**

Aronson, R. B. and R. M. Moody. Effects of a major oil spill on nektonic assemblages of salt marshes and adjacent SAV habitats in Florida and Alabama. Oral presentation.

**Collaborative Scientific Research Opportunities Relative to the Gulf Oil Spill (LA EPSCoR, LA Board of Regents, AL and MS EPSCoR, and NSF) Meeting, New Orleans, LA; October 2010.**

Moody, R. M., S. Kerner, L. Biermann, J. Cebrian and K. Heck Jr. The nursery role of fringing salt marshes and submerged aquatic vegetation in coastal Alabama. Poster.

6) Other products or deliverables

*Please list (for example: maps, models, tools) and indicate where they can be located/obtained.*

There are currently no deliverables other than reports (housed at FIO) and publications (in progress).

7) Data.

	Aug 2010	Sept 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	June 2011	July 2011	Aug 2011	Sept 2011	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	May 2012	
<u>Grand Bay, AL</u>																						
Fyke Nets: MARSH	X	X	X	X				X		X	X	X	X	X	X	X				X		X
Trawl/Seine: SEAGRASS	X	X	X	X				X		X	X	X	X	X	X	X				X		X
Environmental*	X	X	X	X				X		X	X	X	X	X	X	X				X		X
PAH Samples	X																					
<u>Big Lagoon, FL</u>																						
Fykes: MARSH											X		X		X		X	X		X		X
Trawl/Seine: SEAGRASS											X		X		X		X	X		X		X
Environmental*											X		X		X		X	X		X		X
PAH Samples									X		X											

\* Salinity, Water temperature, dissolved oxygen

## PARTICIPANTS AND COLLABORATORS

### 8) Project participants

*Please list the participants of your project, their role(s)\* and contact information. This includes some personal information that we will hold closely and for limited purposes. We ask for demographic data – relating to gender, race, and citizenship – so that we can: gauge whether the GoMRI program is fairly reaching and benefiting everyone regardless of demographic category; ensure that those in under-represented groups have the same knowledge of and access to programs, meetings, vacancies, and other research and educational opportunities as everyone else; and we can monitor involvement of international investigators. We will use the demographic data for statistical purposes only. Submission of demographic data is voluntary, but basic data such as name, contact information, and role in the project is required. No personal information will be released. **Note: Student/educational information will be collected elsewhere in this report.***

*\* We understand one person may fulfill more than one role; please list all applicable roles using the following standardized titles: Principal Investigator, Co-Principal Investigator, Scientific Participant, Technician, Lab Assistant, Administrative Support.*

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## MENTORING AND TRAINING

### 9) Student and post-doctoral participants

*Please list the student participants of your project, their educational role, and other information. This includes some personal information that we will hold closely and for limited purposes. We ask for demographic data – relating to gender, race, and citizenship – so that we can: gauge whether the GoMRI program is fairly reaching and benefiting everyone regardless of demographic category; ensure that those in under-represented groups have the same knowledge of and access to programs, meetings, vacancies, and other research and educational opportunities as everyone else; and we can*

*monitor involvement of international investigators and students. We will use the demographic data for statistical purposes only. Submission of demographic data is voluntary, but basic data such as name, contact information, and research area is required. No personal information will be released.*

First Name	Last Name	Post-doc / PhD / MS / BS	Thesis or research topic	Institution	Supervisor	Expected Completion year	Gender	Race	Citizen ship

There are no current students or post-docs; however, some of the participants are recent Bachelors (Reynolds, Macy, Gulbranson) and Masters graduates (Hemphill) from the Florida Institute of Technology. They are being trained and mentored in lab and field work in order to encourage and inspire them to pursue further degrees.

- 10) Student and post-doctoral publications, if planned
  - a. Published, peer-reviewed bibliography (Copies of the papers are requested)
  - b. Manuscripts submitted or in preparation (Please note target journal, and anticipated date of submission or publication)

See item 5.

- 11) Student and post-doctoral presentations and posters, if planned (Please provide copies of each)

Title	Presenter	Authors	Meeting or Audience	Abstract published (Y/N)	Date

See item 5.

- 12) Images
 

*Please attach high-resolution image and provide details including a description of the image, location, credit, date, etc. Of note: Image may be used in GoMRI promotions, make sure you have rights to use the image. Note: GoMRI will establish a Flickr site to share these images through the GoMRI website and with media and the public.*

See next page for photo. Image is from the project and may be used by GoMRI for promotion and other purposes. A high resolution image is also available.

Caption: Fyke nets for sampling salt-marsh nekton, Gulf Shores National Seashore, Perdido Key, Florida.

Credit: Jessica Gulbranson, Florida Institute of Technology

Date: December 2011

