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Gulf Estuarine Research Society Spring 1998 Meeting Abstracts

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GULF ESTUARINE RESEARCH SOCIETY

SPRING 1998 MEETING

The Spring 1998 meeting of the Gulf Estuarine Research Society (GERS) is to be held from Thursday, March 26 through Saturday, March 28, 1998, in Galveston, Texas. Meeting sessions will be held at the HOLIDAY INN ON THE BEACH located at 5002 Seawall Blvd. The meeting is being hosted by the National Marine Fisheries Service Galveston Laboratory. Local contacts for the meeting are Lawrence Rozas (409-766-3532; lawrence.rozas@noaa.gov) and Pete Sheridan (409-766-3524; pete.sheridan@noaa.gov).

Tentative Schedule

Thursday, March 26	4:00 pm - 8:00 pm	Registration at Holiday Inn (HI)
	7:00 pm - 9:00 pm	Reception at NMFS Lab
Friday, March 27	8:30 am - 11:45 am	Registration and Sessions at HI
	1:00 pm - 4:30 pm	Sessions
	5:00 pm - 6:30 pm	Poster Session at HI
	7:00 pm - 12:00 pm	BBQ Bash - Knights of Columbus
Saturday, March 28	8:30 am - 11:00 am	Sessions at HI
	11:00 am - 12:30 pm	Student Awards and Business

Abstracts

The following abstracts were received by January 5, 1998; and these papers will be presented at the meeting by authors whose names are underlined. Special presentations also will be given by Harold Stevenson (Publishing and the Editorial Process of *Estuaries*), Chris D'Elia (Federal Budgeting and Success in the Grant Process), and Gene Turner (Estuarine Signatures for the Gulf of Mexico).

Cannon, Andrea Caron. National Marine Fisheries Service, Galveston, TX. **SEA TURTLE STRANDINGS AND CAPTURES FROM GALVESTON BAY.** Since 1991, four of the five species of sea turtles found in the Gulf of Mexico (Kemp's ridley, loggerhead, green, and hawksbill) have been reported in Galveston Bay. All turtles that are reported to the Sea Turtle Stranding and Salvage Network (STSSN) are documented. Dead turtles are recovered and necropsied, while live turtles are brought to the National Marine Fisheries Service Sea Turtle Research and Rehabilitation Facility for rehabilitation. Dead strandings make up the majority of the reports (85%). Due to the condition of the carcasses, a definitive cause of death is rarely determined. These carcasses are still important sources of life history data (sex ratios, food sources and feeding habits). Few of the reported turtles are alive (15%). Generally it is known why the turtle stranded alive (cold stunned, caught on power plant intake screen, injured post hatchlings, or caught by recreational hook-and-line); however, there are still unknown causes.

Childers, Daniel L.[1], Nicholas J. Oehm[1], Frank Parker[1], and Christopher Madden[2]. [1] Southeast Environmental Research Program & Department of Biological Sciences, Florida International University, Miami, FL, and [2]Everglades Systems Research Division, South Florida Water Management District, West Palm Beach, FL. **HOW FRESHWATER EVERGLADES WETLANDS MEDIATE CHANGES IN WATER FLOW AND NUTRIENT LOADINGS TO THE FLORIDA BAY ESTUARY.** Everglades restoration efforts are focusing on large-scale changes in water delivery to Everglades wetlands. These changes include increased water inputs, and associated changes in nutrient regimes, in a freshwater-estuarine system that we are currently studying in eastern Everglades National Park (ENP). In 1997, a levee was removed from along the major drainage canal that delineates the northern boundary of this ENP Panhandle region in order to increase sheetflow through these wetlands and to Florida Bay. Between this canal and the estuary, wetlands range from sawgrass marsh to mixed *Cladium-Rhizophora* wetland to scrub red mangrove forest, respectively. Our ENP Panhandle sampling began in Fall 1997, at which point over half of the levee had already been removed. We established a wetland transect roughly normal to the canal and behind the remaining levee. Throughout the remaining 1997 wet season, we sampled water overlying the sawgrass marsh along this transect both intensively (every 3 hours for 48 hours) and extensively (every 2 days continuously). Approximately halfway through our sampling, levee removal was completed. Our water chemistry data from before and after levee removal show that nutrient concentrations in wetland surface water more than doubled after removal of the levee, from about 0.2 to 0.4 5M TP and from about 45 to 140 5M TN. When combined with the large increase in wetland sheetflow from the new inputs of canal water, this represents a significant increase in nutrient loading to the ENP Panhandle wetlands and perhaps even to the Florida Bay estuary. However, the sawgrass marsh within 3 km of the canal appears to be removing much of this nutrient load. Interestingly, this wetland uptake phenomenon did not immediately show up as increased porewater nutrients in these wetlands. Furthermore, cores taken before and after levee removal show an inhibition of C mineralization (via aerobic respiration, sulfate reduction, and methanogenesis) in wetland soils receiving increased canal inflows; this in spite of the fact that C decompositional processes in Everglades wetland soils are strongly phosphorus limited. We have not yet observed any changes in soil porewater salinities or sawgrass productivity since the levee was removed and sheetflow increased, but we would anticipate a significant lag in response by such parameters—and levee removal was only completed in late October 1997. We will continue to quantify these parameters over the next 3 years, along 2 parallel transects. Additionally, we will extend our transects through the mangrove wetland zone and to the Florida Bay confluence, and we will construct and sample replicate flumes immediately adjacent to the canal edge, to more accurately quantify nutrient uptake and transformations by the sawgrass marsh. Thus, our research will continue to quantify how freshwater wetlands in the ENP Panhandle region are mediating the quantity and quality of additional water inflow that reaches the Florida Bay estuary, in response to Everglades restoration efforts.

Davis, Stephen E., III and Daniel L. Childers. Department of Biological Sciences / Southeast Environmental Research Program, Florida International University, University Park Campus, Miami, FL. **SEASONAL VARIATION IN CONCENTRATION AND FLUXES OF CARBON, NITROGEN, AND PHOSPHORUS IN TWO SOUTH FLORIDA MANGROVE FORESTS.** Since August 1996, we have been conducting quarterly sampling studies to determine the flux of carbon (C), nitrogen (N), and phosphorus (P) between dwarf and fringe red mangrove (*Rhizophora mangle* L.) wetlands and their associated water column along Taylor River in Everglades

National Park. We constructed modified, duplicate, in-channel flumes and triplicate, dwarf mangrove island enclosures (3-5 m in diam.) to determine these wetland-water column interactions. Total N, TP, TOC, and DOC concentrations were highest in the early wet season while dissolved inorganic N (DIN) concentrations peaked during the transition from wet season to dry season. Soluble reactive P concentrations fluctuated greatly (0.01-0.1 μM) both during and between samplings and were usually highest in the dwarf zone. Dwarf mangrove islands have shown a consistent pattern of DIN export (2-50 μmoles m-2 hr-1) for all samplings except August (NOX import) and November 1996 (NOX export and NH4 import). Control enclosures—which contain no mangroves—reflected this DIN release in May 1997 but showed significant uptake of both NOX and NH4 in August 1997. The fringe mangrove has shown a pattern of DIN uptake for nearly every sampling. We observed a significant release of SRP during the wet season of 1996 (0.1-3.8 μmoles m-2 hr-1) and release of TP in November 1996 and May and August 1997 (0.1-2.1 μmoles m-2 hr-1). There was no clear pattern of P flux in the fringe forest. Organic C fluxes were greatest of all constituents (+/- 3500 μmoles m-2 hr-1). Although DOC makes up roughly 95% of TOC in our system, we observed different flux behaviors for each of these constituents. The fringe forest appeared to take up organic C (especially DOC) during most of the samplings. The dwarf forest imported TOC during the dry season (100-1250 m-2 hr-1) and then exported it during the wet season (50-3300 μmoles m-2 hr-1). The dwarf forest imported TN in both August (early wet season) samplings (20-500 μmoles m-2 hr-1) and exported TN in May 1997. The fringe forest showed a pattern of TN uptake for all samplings. Additional data to be analyzed will come from November 1997 and January 1998 samplings. This project is part of a larger study looking at the importance of water source: freshwater (Everglades) vs. marine (Florida Bay) in controlling nutrient flux in the microtidal mangroves of the SE Everglades. During the wet season, direct precipitation and the freshwater marshes to the north are the major sources of water and nutrients, and during the dry season, Florida Bay is the source. Our data suggest a seasonal trend in both the concentrations and fluxes of these water-column constituents.

Devlin, Donna J. Department of Biology, University of Southwestern Louisiana, Lafayette, LA. **A FIELD EXPERIMENT OF PREDATOR STRATEGIES AND MANGROVE RESISTANCE: THE RELATIONSHIP BETWEEN THE RED MANGROVE (*RHIZOPHORA MANGLE*) AND THE SCOLYTID BEETLE *COCOTRYPES RHIZOPHORAE*.** Predation on propagules and seedlings is an important biological factor affecting the mix of mangrove seedlings on the forest floor and may partially determine which individuals recruit into the canopy. Unlike in the Indo-Pacific and parts of the Caribbean where many species of Grapsid crabs are important seedling predators on red mangroves (*Rhizophora mangle* L.), the primary *Rhizophora* propagule and seedling predator in Florida is the scolytid beetle *Cocotrypes rhizophorae*. This beetle is a borer and excavates extensive brood chambers in the seedlings. Eggs are laid within and all life history stages of the beetle exist together in the seedling. *C. rhizophorae* requires red mangrove seedlings or occasionally adult aerial root tips for completion of its life cycle. In a field experiment in southwestern Florida, I studied two important questions about this predator-prey relationship. First, does the predator mainly employ a *colonization strategy* by infesting *R. mangle* propagules before they drop from the parent tree, thereby ensuring that they could use the floating propagules as a vector to establish new populations; or, a *stay-at-home strategy* by infesting propagules after they strand and root in a forest, and thus ensure an environment relatively safe from being washed out to sea? Second, are propagules from some parent trees more susceptible to predation and mortality than those from other trees. This, along with the species-specific nature of the infestation, could affect the mix of species and genotypes of *R. mangle* in the seedling population and potentially influence recruitment of trees into the canopy. The experiment involved assigning propagules collected from 20 parent trees to both the canopy and forest floor under 15 recipient trees. At 2 weeks infestation was much greater on the ground than in the canopy (chi square test, $p=0.001$). Using randomization techniques, I determined that there were also among-parent tree differences in seedling survival of infestation ($p=0.01$). Therefore the beetle may be affecting the genetic diversity of *R. mangle* populations in forests where beetle densities are high.

Engelhard, Tannika and Kim Withers. Center for Coastal Studies, Texas A&M University-Corpus Christi, Corpus Christi, TX. **BIOLOGICAL EFFECTS OF MECHANICAL BEACH RAKING IN THE UPPER INTERTIDAL ZONE ON PADRE ISLAND NATIONAL SEASHORE, TEXAS.** During late spring and summer, beaches on Padre Island National Seashore (PINS) receive large quantities of stranded macrophytic algae, primarily *Sargassum* spp. (Phaeophyta, Fucales). PINS employs mechanical raking as a public-use management practice for removal of beach wrack to improve the aesthetic and recreational quality of the beach for visitors. This study was undertaken to determine

biological effects of mechanical raking in the upper intertidal zone and to make recommendations concerning the use of mechanical raking for wrack removal. Four sites along Malaquite Beach on PINS were systematically sampled from May through September 1997. Two treatments were applied, weekly and biweekly raking. Samples were collected on Day 3, 7, 10 and 14 following raking (Day 0). Avian abundance, macrofaunal abundance and biomass and sediment parameters (Chlorophyll , %TOC and % water) were determined for raked and unraked areas and analyzed using a two factor ANOVA. Results indicated that the dominant invertebrate macrofauna could be grouped into benthic organisms (*Haustorius* sp. and polychaetes) and organisms associated with wrack material (*Orchestia grillus* and insects). Both groups were affected by mechanical raking to some extent. The greatest differences between raked and unraked sites occurred within three days following raking with mean density and biomass significantly higher in unraked areas for all macrofauna. On Day 7 and 10, mean density and biomass was significantly lower at raked sites only for *O. grillus* and polychaetes. No significant differences existed between raked and unraked areas on Day 14. Sediment parameters exhibited no significant differences between sites for any days. Since differences in sediment conditions can be excluded as the primary source of variation, it was concluded that macrofaunal density and biomass decreased due to raking either by direct removal or as a result of vertical migration into the sand column in response to disturbance caused by raking. Bird abundance was not significantly different between raked and unraked sites during the study. Management recommendations were made based on the effects of raking on macrofaunal abundance, avian use and public visitation trends.

Engelhaupt, Erika[1], Thomas S. Bianchi[1], Matt Tarr[2], and Robert G. Wetzel[3]. [1] Department of EEO Biology, Tulane University, New Orleans, LA, [2] Chemistry Department, University of New Orleans, New Orleans, LA, and [3] Department of Biological Sciences, University of Alabama, Tuscaloosa, AL. **EFFECTS OF ULTRAVIOLET RADIATION ON THE COMPOSITION AND MICROBIAL UTILIZATION OF DISSOLVED ORGANIC CARBON (DOC) IN BAYOU TREPAGNIER, LA.** Light, particularly ultraviolet radiation, is known to release biologically available organic substrates from refractory materials such as humic substances. For example, Wetzel et al. (1995) found that in dissolved organic matter (DOM) released from senescent littoral aquatic plants, exposure to natural UV radiation resulted in the release of many small fatty acids. Furthermore, these fatty acids were readily metabolized by bacteria and resulted in increased bacterial protein productivity. However, few studies of photolysis of DOM have examined this process in the field, partly due to restrictions such as finding a site with a consistent hydrologic regime but varying light regime, where direct comparisons of the effects of UV can be made. The long hydraulic residence time, variable light regime, and high DOC concentrations of Bayou Trepagnier make it an ideal location to study UV photolysis of dissolved organic carbon (DOC) in a natural system. DOC values range from 15-100 mg L^{-1}, much higher than typical riverine or estuarine concentrations. Light values range seasonally from 68 to 150 mmol m^2 s^{-1} in a shaded site dominated by *Lemna minor* cover, while values at a non-shaded site range from 605 to 1650 mmol m^2 s^{-1}. A significant percentage of DOC is represented by colloidal organic carbon (COC; < 0.2 microns and > 1 kDa), ranging from an average of 27% in August to 56% in November 1997. COC is collected seasonally using cross-flow ultrafiltration from both field sites and irradiated in a solar simulator for 24 hours (the equivalent of about 4 sunny summer days) with both UV-A (315-400 nm) and UV-B (280-315 nm) light. To determine changes in functional groups of COC after irradiation, both irradiated and non-irradiated samples from both sites are compared using ^{13}C NMR spectroscopy. Preliminary analyses of ^{13}C NMR spectra of COC indicate relative abundances of aromatic and carboxylic/carbonyl functional groups of 40 – 60% and 20 – 25%, respectively. In addition, further work will include field measurements of bacterial protein productivity using ^{3}H leucine incorporation and bacterial abundance by direct counts.

Garber, Nikola M., Walter D. Grater, and Kenneth C. Stuck. Institute of Marine Sciences, Gulf Coast Research Laboratory, Ocean Springs, MS. **APPLICATION OF THE MITOCHONDRIAL DNA CONTROL REGION IN POPULATION STRUCTURE STUDIES OF GREY MULLET (*MUGIL CEPHALUS*) IN NORTH AMERICA.** In animal eukaryotic cells, a small amount of DNA is found outside the nucleus within the mitochondria. This mitochondrial DNA (mtDNA) evolves independently and at a faster overall rate than nuclear DNA. Specific genes and the non-coding control region within the mtDNA also evolve at different rates and can therefore be used in phylogenetic, systematic, and population level genetic studies. The non-coding control region is the most rapidly evolving segment in mtDNA and been used to distinguish populations of marine fish. Grey mullet, *Mugil cephalus*, has a worldwide distribution and is common

in coastal waters of the continental United States and Hawaii. Because of declining numbers, a program has been implemented in Hawaii to enhance natural mullet populations through release of cultured stocks. Similar enhancement efforts have been proposed in Mississippi. Therefore, studies have been initiated to determine the population structure of grey mullet in North America and Hawaii using direct sequence analysis of the mtDNA control region. Polymerase chain reaction (PCR) and universal primers to conserved regions of the mtDNA which flank the control region were used to produce a 2000bp fragment. The fragment has been cloned and sequenced, and internal primers have been designed to amplify the hypervariable portion of the control region. These procedures, which have been developed in the initial phase of this study, will be used to conduct future population genetic studies with mullet.

Gorham-Test, Cynthia. U. S. Environmental Protection Agency, Region 6 (6WQ-EW), Dallas, TX. **THE 1993 REGIONAL ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM (R-EMAP) STUDY OF GALVESTON BAY, TEXAS.** The Regional Environmental Monitoring and Assessment Program (R-EMAP) Study of Galveston Bay, Texas addresses the ecological health of this estuary by identifying benthic community structure, measuring toxicity of sediments, and measuring concentrations of various pollutants in the sediments. The Sediment Quality Triad approach was used in this study to differentiate between degraded sites and undegraded sites. For comparison of the main body of Galveston Bay with other systems and the Louisianian Province as a whole, twenty-nine randomly selected sites were chosen to represent 1305 km^2 of the Galveston Bay System. Random sites are located in Galveston Bay, Trinity Bay, East Bay and West Bay. In addition, a sample was taken for each of four important small bays associated with Galveston Bay, and for five marinas. This study does not include an analysis of the upper Houston Ship Channel, the Trinity River, or any other major tributaries. The Benthic Index, the Benthic Diversity Index, and abundance of Amphipods at each site proved useful in demonstrating that communities living in contaminated sediments had a community structure indicating poor conditions. The proportions of the two indices in the Galveston Bay area were similar to the proportions reported for the Louisianian Province in the 1993 EMAP Study. In contrast, amphipod occurrence in Galveston Bay sediments was significantly lower than in the entire Louisianian Province sediments. A degraded Benthic Component was found at 7 of 29 randomly sampled sites in Galveston Bay and 8 of 9 Small Bay & Marina Sites. Toxicity was seen when using amphipods as a test organism, but toxicity was not reported when using mysid shrimp. Toxicity results reveal a low occurrence of acute toxicity in Galveston Bay sediments. In Galveston Bay, arsenic, copper, lead, nickel, and zinc exceed the ERL but not the ERM criteria at one or more sites sampled. Sites with the most metals contamination include Offatt's Bayou, Clear Lake, Moses Lake/Dollar Bay, and two Marina sites. All of these sites are "Small Bay and Marina sites", which were chosen, not randomly selected, so they are not included in comparisons of Galveston Bay with the Louisianian Province 1993 EMAP sampling area. However, several of the randomly sampled sites in Galveston Bay did have exceedences for arsenic, chromium, nickel, and zinc. Exceedences of chromium, copper, lead, nickel, and zinc for each site were almost always due to anthropogenic inputs and not natural sources. Heavy metal concentrations greatly influenced the determination of degraded sites for the Sediment Chemistry Component of the Triad. TBT concentrations are higher in Galveston Bay sediments than expected with values greater than 1 ppb occurring in 52% of the area, compared to 31% of the total Louisianian Province area. A significant relationship exists between butyltin concentrations in the sediments and butyltin concentrations in the water column. Sites with high Dieldrin and Endrin concentrations in the sediments are located in upper Galveston Bay, Clear Lake, and upper Trinity Bay. PAHs exceeding ERL values in Galveston Bay include only C3-fluorene at one site in Trinity Bay where several active oil wells are located. Distributions of PAHs for Galveston Bay show that three sites, one site in Trinity Bay and two sites near Texas City in West Bay, have PAHs that are considerably higher than at the other sites in the Galveston Bay. The major variables used to determine degraded sediment chemistry in Galveston Bay include metals, butyltins, PAHs, pesticides other than DDTs, and silt-clay content. These variables were compressed into one factor (PPPMO) using Principal Components Analysis. Most of the degraded sites were "Small Bay & Marina sites" which were not randomly selected and which were near areas of high human activity. Most of the open bay area sites were in a marginal or healthy condition. The most degraded areas in the Galveston Bay Complex include seven Small Bay and Marina sites and five randomly chosen sites in the open bay: Offatt's Bayou, Clear Lake and its marina sites, Lafayette Landing and South Shore, Upper Galveston Bay at the Houston Yacht Club, Moses Lake/Dollar Bay and Trinity Bay near the river mouth, and mid-East Galveston Bay. Major tributaries, such as the Upper Houston Ship Channel and the Trinity River, were not sampled in this study.

Henderson, Christine. Texas A & M University at Galveston, Marine Laboratory, and National Marine Fisheries Service, Galveston, TX. **FACTORS AFFECTING THE COMMUNITY COMPOSITION OF EPIBENTHIC AND INFAUNAL INVERTEBRATES OF NEWLY PLANTED SEAGRASS BEDS.** Epibenthic and infaunal organisms represent an important link between macrofauna and the seagrass beds they utilize. For this reason, benthic organisms should be considered when a comparison is made of the structural and functional equivalency of planted beds and natural seagrass beds. Three *Halodule wrightii* beds were planted during May 1994 in western Galveston Bay, Texas. The experimental design allowed for evaluation of water depth, planting density, and distance to edge on benthic community composition. Bare sand adjacent to the planted sites and a natural seagrass bed 15 km southwest of the planted sites were used for comparison. Monthly cores 10 cm diameter by 5 cm deep were taken for 16 months after beds were planted. Excluding decapods, invertebrates were identified to species when possible. Although species richness and abundance within the planted seagrass beds increased relative to adjacent sands, epibenthic and infaunal communities did not closely emulate those of the naturally occurring seagrass bed. Preliminary data indicate planting density had a positive effect on faunal densities, while water depth and distance to edge had no effect. Planted seagrass beds often take 2-3 years to reach shoot and root densities comparable to those of naturally occurring beds. Benthic communities in planted beds probably take at least as long to reach structural equivalence with those in natural seagrasses.

Lambert, C. D. [1], T. S. Bianchi [1], G. C. Flowers [2], and G. L. McPherson [3]. [1] Department of EEO Biology, [2] Department of Geology, [3] Department of Chemistry, Tulane University, New Orleans, LA. **THE EFFECTS OF COLLOIDAL ORGANIC CARBON (COC) ON THE FATE AND TRANSPORT OF HEAVY METALS IN BAYOU TREPAGNIER, LOUISIANA.** Cycling dynamics of dissolved organic carbon (DOC) were examined in Bayou Trepagnier, Louisiana, in relation to its role in the partitioning of heavy metals (Pb, Cr, Zn, and Cu). Bayou Trepagnier is part of the Lake Pontchartrain estuarine system and is influenced by changes in lake water levels from tidal and wind forcing. Bayous, which are low energy systems with long hydraulic residence times, are common in the southern regions of the United States and are unique, in that they act as "chemostats" for the breakdown of natural organic matter in sediments and soils. DOC concentrations ranged from 5 to 100 mg C/liter with highest concentrations following the diversion of the Mississippi River to the Lake Pontchartrain estuary. The percentage of DOC represented by COC (< 0.2 microns and > 1 kDa) ranged from 20 to 60% in the water column; pore water DOC concentrations ranged from 65 to 200 mg C/liter with COC comprising 40 to 80 % of the DOC in pore waters. Preliminary analyses of C-13 NMR in COC showed a relatively high abundance of aromatic (40 to 60%) and carboxylic/carbonyl (20 to 25%) functional groups which have been shown to be influential in the partitioning of heavy metals onto colloidal particles. Seasonal profiles of functional groups common in natural organic matter will be discussed. Metal concentrations of Pb, Cr, Zn, and Cu ranged from 0.5 to 10 ppb, 0.8 to 10 ppb, 2 to 40 ppb, and 0.4 to 70 ppb, in the particulate phase, respectively, while metal concentrations in the colloidal phase ranged from 0.6 to 18 ppb, 0.5 to 9 ppb, 2 to 25 ppb, and 0.2 to 3.6 for Pb, Cr, Zn, and Cu, respectively. High metal concentrations in the colloidal phase suggested that DOC and COC plays an active role in the partitioning of metals, especially in regions where DOC is extraordinarily high.

Miller-Way, Tina [1] and Robert R. Twilley [2]. [1] University of Mobile, Mobile, AL and [2] University of Southwestern Louisiana, Lafayette, LA. **OXYGEN AND NUTRIENT METABOLISM OF A CARIBBEAN MANGROVE PROP ROOT COMMUNITY.** Fringe mangrove communities are highly productive despite low nutrient concentrations in surrounding waters. As in coral reef communities, high rates of production may be maintained by intense rates of nutrient recycling. This study determined nutrient exchange and oxygen consumption rates for the dominant heterotrophic members of the mangrove prop root communities of Twin Cays, Belize. Rates were measured using closed system incubation techniques under in situ conditions. Water column nutrient concentrations were determined for sites near and far from prop root communities to corroborate microcosm results. Three of the 6 species examined (*Tedania ignis*, a sponge, *Distaplia corolla*, a tunicate, and the mangrove oyster, *Isognomon alatus*) were significant sources of NH4 to surrounding waters (1.32 - 22.47 µmols g dry wt-1 hr-1). In contrast, the sponges, *Ulosa rutzleri* and *Lissodendoryx isodictyalis* released no NH4 but were a significant source of NO3 to surrounding waters (0.15 - 14.78 µmols g dry wt-1 hr-1), probably due to symbiotic associations with nitrifying bacteria. Stoichiometric ratios and transect data indicate that this 'new' nitrogen is not lost from the system through denitrification. The sponge, *Tedania ignis*, was also a source of PO4 to surrounding

waters (0.06 - 0.21 µmols g dry wt-1 hr-1). The anemone, *Aiptasia pallida*, was not a significant source or sink for oxygen or nutrients within the community but this pattern may be misleading due to the presence of zooxanthellae within its tissues. Considering their high weight specific rates and high biomass, sponges are responsible for most of the oxygen consumption of the mangrove prop root community. These data suggest that the prop root community may be a metabolic 'hot spot' for nutrient regeneration and oxygen consumption within the fringe mangrove ecosystem.

Mitra, S. [1] **and R. M. Dickhut** [2]**.** [1] **Department of EEO Biology, Tulane University, New Orleans, LA, and** [2] **School of Marine Science, Virginia Institute of Marine Science, Gloucester Point, VA.** **POLYCYCLIC AROMATIC HYDROCARBON (PAH) DISTRIBUTION COEFFICIENTS IN SEDIMENTS FROM AN URBAN ESTUARY: THE ROLE OF PAH SOURCE AND SEDIMENT GEOCHEMISTRY.** Sediments and pore waters from two sites (Site 1 & Site 2) in the urbanized Elizabeth River, VA were sampled for levels of polycyclic aromatic hydrocarbons (PAHs) as well as several geochemical variables. Pore water PAH concentrations were similar between both sites, despite an order of magnitude higher sediment PAH concentrations at Site 2. Organic-carbon normalized distribution coefficients (K'OCs) for all PAHs were also higher at Site 2 compared to Site 1, but decreased substantially with depth in the sediments at Site 1. Dilute sedimentary soot carbon, and other geochemical factors potentially affecting PAH distributions, including sediment age, grain size, particle surface area both before and after organic digestion, concentrations of lignin/phenols, and organic carbon / nitrogen ratios were also analyzed. Different factors were determined to control particle surface area at each site offering the most insight to explaining observed PAH K'OCs. At Site 1, increased mineral surface area is related to overall lower K'OCs and sediment PAH concentrations, and decreased downcore PAH K'OCs. We hypothesize that sediment organic matter becomes increasingly inaccessible with depth at this site. At Site 2, large and invariant K'OCs appear to be the result of sediments comprised of woody debris coated with natural dissolved organic matter or creosote, sequestering PAHs within the particle matrix. PAH isomer concentration ratios, indicators of differential PAH sources, mirrored trends in PAH distribution coefficients lending support to these arguments. Our results indicate there is significant heterogeneity in PAH distribution coefficients in estuarine sediments, which may be attributable to localized PAH sources and sediment geochemistry.

Moncreiff, C. A., T. A. Randall, J. D. Caldwell, R. K. McCall and B. R. Blackburn. University of Southern Mississippi, Institute of Marine Sciences, Gulf Coast Research Laboratory, Ocean Springs, MS. ***GYMNODINIUM BREVE*** **IN MISSISSIPPI SOUND:** A PATTERN FOR PREDICTION? *Gymnodinium breve* was first observed in water samples collected in Mississippi Sound north of Petit Bois Island on 31 October 1996. Blooms spread north from the barrier islands to oystering areas, forcing reef closures. A combined drop in surface salinities and water temperatures ended the event. Detection and monitoring of this species began with charter boat operators, who reported unusual fish behavior south of the barrier islands on 26 October 1996 and collected a water sample; microscopic examination confirmed the presence of this species, first in this sample from south of the barrier islands, and then in additional samples collected as the bloom progressed from the vicinity of barrier islands to waters overlying actively harvested oyster reefs. Subsequent analyses of oyster tissues confirmed the presence of brevetoxins at significant levels. *Gymnodinium breve* is reported to bloom at somewhat higher salinities than those observed during this event, which suggests that the hypothetical "salinity barrier" for this species may be lower than studies have previously suggested. Suspended sediments may also inhibit bloom development. Seasonally collected turbidity and salinity data indicated that the former of these two parameters was significantly different in 1996 when compared to similar data for 1994 and 1995, which may have contributed to conditions conducive to the spread and development of this toxic algal species within Mississippi Sound. Examination of surface water temperatures via data buoy records showed the arrival of a warm water mass in the northern Gulf of Mexico in early October, which may have contained sufficient *G. breve* cells for bloom initiation and development. Surface water movements in October and November of 1996 as tracked through Minerals Management Service's Drifter program also provides a mechanism for delivery of this toxic bloom species to the northern Gulf from the west coast of Florida. Red tides are a natural occurrence, and are an integral component of the estuarine ecosystem and its cycles that we are still trying to understand. Human impacts on the environment, such as increased levels of nutrients in coastal waters, may be related to an increase in the number of these blooms of algae as a whole, but is apparently unrelated to this particular occurrence of *Gymnodinium breve*.

Osborn, Timothy [1], Erik Zobrist [1], Rickey Ruebsamen [1], and Van Cook [2]. [1] National Marine Fisheries Service and [2] Louisiana Department of Natural Resources. **WETLANDS CREATION AND LARGE WETLANDS RESTORATION EFFORTS OF THE NATIONAL MARINE FISHERIES SERVICE WITHIN THE COASTAL WETLANDS PLANNING, PROTECTION AND RESTORATION ACT PROGRAM IN COASTAL LOUISIANA.** Within the Coastal Wetlands, Planning, Protection and Restoration Act (CWPPRA), the National Marine Fisheries Service (NMFS) and the Louisiana Department of Natural Resources (DNR) have forged a Federal/State partnership to plan and implement a significant number of large wetland restoration projects spanning the state's coastal zone. Each project was competitively evaluated within the CWPPRA Task Force in the annual Priority Project Selection process. In describing the CWPPRA program and the NMFS/DNR partnership, a case study is instructive. The following is a synopsis of the Big Island Restoration Project. The Big Island project, sponsored by the National Marine Fisheries Service, is located in Atchafalaya Bay about 18 miles southwest of Morgan City, Louisiana. It is in the western half of the lower Atchafalaya River delta and encompasses the shallow bay area to the north and west of Big Island. Natural expansion of the Atchafalaya River delta (Atchafalaya Bay about 18 miles southwest of Morgan City, Louisiana) has been hampered by the deposition of material dredged from the Federal navigation channel. The Big Island project will restore freshwater and sediment delivery processes to the northwestern portion of the delta. Project implementation will create nearly 500 acres of deltaic wetlands and allow natural delta growth which, over 20 years, is expected to create an additional 1,300 acres of wetland habitat. The project entails the construction of distributary channels having a combined length of about 24,000 feet, extending from the Atchafalaya River into the shallow waters west of Big Island. Dredged material will be placed in a pattern to mimic natural delta lobes and to create conditions conducive to trapping of riverine sediments and deltaic expansion. In addition to this, implementation of the Atchafalaya Sediment Delivery project, on the eastern side of the Federal Navigation channel, will restore freshwater and sediment delivery processes to the northeastern portion of the delta. Project implementation will create nearly 300 acres of deltaic wetlands and allow natural delta growth which, over 20 years, is expected to create an additional 1,700 acres of emergent and submergent wetland habitat. The project entails the construction of two distributary channels having a combined length of about 11,000 feet, extending from the East Pass channel, through Natal Channel and Radcliffe Pass, and into the shallow waters east of the existing delta. Dredged material will be placed in a pattern to mimic natural delta lobes and to create conditions conducive to trapping of riverine sediments and deltaic expansion. Presently, approximately twelve projects within the CWPPRA program are sponsored by the NMFS with a cumulative project area in excess of 70,000 acres. With the hopeful continuation of the program, the NMFS will continue to develop and implement additional projects benefitting Louisiana and the nation.

Proffitt[1], C. E. and D. J. Devlin[2]. [1] Louisiana Environmental Research Center, McNeese State University, Lafayette, LA and [2] Department of Biology, University of Southwestern Louisiana, Lafayette, LA. **SURVIVAL, GROWTH, AND SUCCESSION IN A RESTORED MANGROVE STAND IN SOUTHWESTERN FLORIDA.** In 1982, fill was removed from three dredge spoil mounds at the Windstar development in Naples and the sites were planted with red mangrove (*Rhizophora mangle*) propagules on 1 m centers. In 1989, 84.6% of the area of the northern site was covered by mangroves. Most of this was a relatively tall (>2 m) thicket ("tall mangrove" plots) and the rest was sparsely populated with shorter (<1.5 m), scrubby mangroves ("scrub plots"). In 1989, the site was dominated by white mangroves (*Laguncularia racemosa*) with density range of 2.1±1.6 to 12.9±1.4 trees/m^2. Black mangroves (*Avicennia germinans*) had colonized at low densities (greatest densities: 1.4±0.6 trees/m^2). Densities of *R. mangle* were 0.7±0.7 to 2.9±1.4 trees/m^2 and, along with the spatial pattern, indicated these trees originated from the propagules planted in 1982 with little subsequent colonization. During 6 mo. in spring and summer of 1989, total stem growth of marked stems was significantly greater in scrub plots than in tall mangrove plots for both *R. mangle* (means: Scrub plots 180.0 mm; tall plots 15.7-46.0 mm) and *L. racemosa* (means: Scrub 182.7 mm; tall 38.0-59.4 mm) There was no significant difference among plots in total stem growth of *A. germinans*. Combining scrub and tall mangrove plots, stem growth was greatest, although highly variable, in *A. germinans* (219.3±352.4 mm) relative to *R. mangle* (69.9±147.7 mm) and *L. racemosa* (92.3± 146.7 mm). Leaf production showed the same general patterns. Beginning in 1995, many *L. racemosa* in tall mangrove plots died and others showed signs of stress. Mortality was the greatest where starting *L. racemosa* densities had been the highest with these plots showing a 78% decrease in *L. racemosa* live trees and concomitant increases in standing dead trees in 1996. This was correlated with decreasing light penetration as the canopy became more closed. Prior to 1989, growth in scrub plots had obviously been slow and survival reduced. However, from 1989-1996 all 3 species showed greatest growth in height and trunk

diameter in scrub plots, and, by 1996 canopy heights in scrub plots were not significantly different from those in tall mangrove plots. In scrub plots, this accelerated tree growth was accompanied by colonization and increased densities of saplings and trees of *R. mangle* and *L. racemosa*. This may have been due to decreases in adverse environmental conditions with increasing tree size and canopy cover.

Powers, Sean P. Texas A&M University at Galveston, Marine Laboratory, Galveston, TX. **SUPPLY-SETTLEMENT RELATIONSHIPS IN AN ESTUARINE FOULING COMMUNITY.** Understanding the processes which are responsible for species distribution and abundance is a central goal of community ecology. Over the last 15 years, researchers of marine benthic systems have increasingly focused on the potential role of water column supply of new recruits and settlement (*e.g.* "recruitment limitation" and "supply-side ecology") in determining species distribution and abundance. The majority of this research has been conducted in temperate rocky intertidal areas or tropical reef systems; few studies have examined this question in sub-tropical encrusting communities. For a 9 month period in 1993-94, I monitored supply, settlement, and recruitment of six species of invertebrates in the fouling community of a tidal lagoon on Galveston Island, Texas. Water column supply of new recruits was monitored using passive plankton collectors and settlement/recruitment was monitored using 100 cm^2 gray PVC panels. Each collector consisted of a 0.75 m^2 concrete base with three pieces of reinforcing rod (rebar) placed at the corners. A 60 cm long, 5 cm diameter plastic tube was attached to each rod. The tube had an internal formalin layer which allowed *in situ* preservation of particles deposited in the trap. The tube provides a measure of the flux of passive particles passing over the opening; increases in either the horizontal advection or concentration of particles results in increase flux. Three stations were established in the center of East Lagoon along a gradient of decreasing water flow, i.e. station 1 > station 2 > station 3. From June 1993 to February 1994, three tube samples and two settlement panels were collected at each station every two-three weeks. Larvae and juveniles from the tube samples and settlement panels were identified to the lowest practical taxa and counted. In order to answer the question of whether the supply and or settlement of each taxon varied over space or time, abundances of new recruits in the water column (collectors) and settlers (panels) for each of the six species were analyzed using a two factor ANOVA with date and station location as effects. Second, I used correlation analyses to determine if supply and settlement showed any relationship. Finally, regression analysis was used to examine the relationship between settlement and the biomass of the panel (a surrogate measurement for structure). The strength of the relationship between supply and settlement varied among the taxa examined. Water column supply of larvae was a good predictor of settlement and recruitment for only one species, *Balanus eberneus*. Correlation coefficients of the supply/settlement relationship for *B. eberneus* ranged from 0.77 to 0.92 during the study. Correlation coefficients for the other five taxa examined were below 0.5. For the polychaete *Polydora ligni* and nematodes, the amount of suitable structure available appeared to be the limiting factor in explaining settlement. A strong positive relationship (r^2 > 0.72) was found between settlement and the biomass of barnacles on the panels. For other taxa, *i.e.* the amphipod *Corophium sp.*, the polychaetes *Hydroides dianthus* and *Neanthes succinea*, and the flatworm *Stylochus frontalis*, neither factor showed a strong relationship with settlement. The processes which determine recruitment success for communities are highly taxa specific and involve both pre and post-settlement factors. While larval supply can be an important determinant of settlement in some taxa (e.g. barnacles), the amount of suitable structure can be equally important in others (e.g. *Polydora ligni* and nematodes). Still in some taxa, neither appears to be the determining factor in recruitment into the community. Clearly, multiple processes are needed to explain recruitment in many multi-species assemblages.

Randall, T. A., C. A. Moncreiff, J. D. Caldwell, and R. K. McCall. University of Southern Mississippi, Institute of Marine Sciences, Gulf Coast Research Laboratory, 703 East Beach Drive, Ocean Springs, MS 39566-7000 **SEAGRASS RESOURCES IN MISSISSIPPI SOUND: PAST AND PRESENT.** The current and historical distributions of seagrasses in Mississippi Sound were mapped to provide a usable form of baseline information for this valuable marine resource. Seagrass distributions from a 1969 Gulf of Mexico estuarine inventory were used as a source of historical documentation, while data from a 1992 National Biological Survey aerial imagery study were ground truthed to provide recent distribution patterns. Potential seagrass habitat was also identified using a 2 meter critical depth limit, previously established by others and one of the authors (CAM) in a National Park Service seagrass monitoring project. The continued survival and growth of seagrasses may be threatened by the cumulative effects of anthropogenic activities in the coastal marine environment, which include commercial and recreational

use of seagrass habitat, in addition to a number of other uses which may directly or indirectly impact seagrasses. The primary vector for the disappearance of seagrasses is presently thought to be an overall decline in water quality, which may have a deleterious effect on certain species of seagrasses. Detailed maps of extant seagrasses and potential seagrass habitat are critical because of their importance as nursery habitat for larval and juvenile stages of fish and invertebrates, many of which are economically important. Because seagrassses and their associated microalgae function as both habitat and food for better-known organisms such as penaeid shrimp and blue crabs, in addition to many non-commercial species that often directly or indirectly support commercial fisheries, it is imperative that we elucidate how these critical habitats function. The maps generated from this study will be used to compare the historical extent of the seagrass communities with present day coverage. This baseline information will aid resource managers and scientists in recognizing and interpreting the effects of potential degrading impacts on the seagrasses and will lead to informed decisions regarding the management of this marine resource.

Rozas, Lawrence P. and Thomas J. Minello. National Marine Fisheries Service, Galveston, TX. **RELATIONSHIPS BETWEEN SEDIMENT HYDROCARBON CONCENTRATION AND SALT MARSH HABITAT USE IN GALVESTON BAY.** We sampled nekton, benthic infauna, and sediments in salt marsh habitats at ten locations in upper Galveston Bay, Texas to examine relationships between habitat use and sediment hydrocarbon concentration. Sample locations included marshes heavily oiled in the past as well as areas that were relatively clean. We estimated nekton densities in fall 1995 and spring 1996 by collecting five samples at each location using a 1-m^2 drop sampler. We estimated benthic infaunal densities at each sample site from three pooled 5-cm diameter cores. We also measured salinity, water temperature, dissolved oxygen concentration, water depth, marsh elevation, distance to marsh edge, plant stem density, and turbidity at each site; and sediments at each site were analyzed for grain size, organic content, and petroleum hydrocarbon concentration. Total petroleum hydrocarbon (TPH) and TPH fractions (i.e., "medium" (MPH) and "heavy" HPH) were determined by the Institute for Environmental Studies at Louisiana State University using gas chromatography/ mass spectrometry. We tested the null hypothesis that there is no relationship between sediment hydrocarbon concentration and use of the marsh surface by nekton and infauna using two types of analyses. We examined potential relationships between animal abundance and sediment hydrocarbons by simple linear regressions of organism densities against sediment TPH and MPH concentrations. We further explored potential relationships between animal density and sediment hydrocarbon concentrations by including ten independent variables (environmental parameters measured at each site) in addition to either TPH or MPH in a Stepwise Multiple Regression Analysis. Although most marsh sediment samples were contaminated with oil, most samples contained relatively low concentrations of weathered petroleum hydrocarbons. We found potential relationships between animal density and TPH concentration for very few animals. Of 63 abundant taxa (31 nekton and 32 infauna) examined, only six showed a significant negative relationship with sediment TPH levels. As evident from the low R^2's for the models in each case, petroleum hydrocarbon levels in sediment could account for only a small portion of the variability in animal densities for these taxa. In Stepwise Multiple Regression Analyses, hydrocarbon concentration did not contribute significantly to the models for most taxa; and in most cases where TPH or MPH were important variables, the relationship was positive (i.e., animal densities increased with TPH values). The low hydrocarbon concentrations in the sediments of upper Galveston Bay marshes could have contributed to our results either because levels were too low to be toxic or levels were toxic but too low to be detected by most organisms. Our study provides essential baseline data on sediment TPH and animal densities in shoreline marshes of upper Galveston Bay that have a high probability of being impacted by oil spills in the future. The data from our study will be useful in assessing the impact of any future spills in this part of Galveston Bay.

Salter, Michelle R., L. Harold Stevenson and C. E. Proffitt. Louisiana Environmental Research Center, McNeese State University, Lake Charles, LA. **LABORATORY MICROCOSM FOR TESTING MICROBIAL DEGRADATION OF VENEZUELAN CRUDE OIL.** Oil exploration, production, transportation, and refining along the Gulf Coast present the potential for pollution problems in sensitive estuarine habitats. Bioremediation represents a viable strategy for the mitigation of the damage done by the release of petroleum hydrocarbons in these areas. The usefulness of 10 cm X 17.5 cm, 1 L sediment columns as microcosms to test variables associated with bioremediation was examined in a series of laboratory experiments. To be useful, microcosms must meet several criteria. First, the design for the microcosm must allow for the collection of samples for studies of both redox potential and microbial populations. Second, the columns must serve as replicates within the experimental design showing no statistically significant

differences between columns used in the same treatment. Third, microcosms must be sustainable without either algae productivity or oxygen diffusion from the surface disrupting anaerobic conditions within the column. Fourth, redox potentials within the columns should mimic that of the natural environment. Each of the above expectations was tested in a separate mini-experiment to determine the feasibility of the use of columns in future bioremediation studies. Data were analyzed using one and two way ANOVA as appropriate. The final design did allow for the easy collection of samples. The individual microcosms showed no significant difference ($p = 0.098$) when most probable numbers of bacteria were compared, allowing the columns to be used as replicates. Over a fifteen day period there was no significant difference between elutant portions of the column ($p = 0.749$) which allowed different samples taken from the same column to also be used as replicates. There was, however, a significant decrease in Eh ($p = 0.0005$) showing that algae growth and oxygen diffusion from the surface was minimal if taking place at all. A redox potential at or near 50 mV was aimed for in order to mimic a natural Louisiana brackish marsh. This was obtained with the addition of 3% ammonium sulfate and sodium acetate solution ($p = 0.0005$). Therefor, the conclusion was made that the developed microcosm was a useful tool for testing variables associated with bioremediation in a laboratory environment.

Scott-Denton, Elizabeth. National Marine Fisheries Service, Galveston, TX. **UTILIZATION OF SUBMERGED AQUATIC VEGETATION HABITATS BY FISHES AND DECAPODS IN THE GALVESTON BAY ECOSYSTEM, TEXAS.** Fish and decapod densities in shoalgrass, *Halodule wrightii*, wigeongrass, *Ruppia maritima,* and adjacent non-vegetated sand or mud habitats in Galveston Bay, Texas were compared to determine the relative value of each habitat in terms of faunal utilization and species richness. Physical, environmental and other biological variables for each habitat were examined in relation to faunal density. Fish and decapod densities were quantitatively sampled during fall, spring and summer using a 1 m^2 throw trap. Totals of 48 taxa and 8,163 individuals were collected from 204 m^2 throw trap samples (equally divided between vegetated and non-vegetated habitats) taken during the period 30 September 1993 to 28 November 1994. Vegetated habitat (*Halodule* and *Ruppia)* contained 89% of the total fauna by number (83% decapods; 17% fishes), with non-vegetated substrate (sand and mud) containing 11% (55% decapods; 45% fishes). The dominant species in vegetated habitats were daggerblade grass shrimp, *Palaemonetes pugio*, 40%; blue crab, *Callinectes sapidus*, 15%; and white shrimp, *Penaeus setiferus*, 12%. Dominants in non-vegetated habitats included *Penaeus setiferus*, 21%; *Callinectes sapidus*, 16%; and gulf menhaden, *Brevoortia patronus,* 14%. The amount of submerged aquatic vegetation (SAV) cover appeared to be the most important variable related to total fish and decapod densities. Significant differences in faunal densities indicated that SAV habitat was more valuable to fishes and decapods than non-vegetated substrate. Non-vegetated substrate adjacent to SAV, however, was utilized by some species including commercially important *Penaeus setiferus*. Total faunal densities were similar between *Halodule* and *Ruppia* each season, but there were seasonal variations in use of each habitat at the species level, particularly by some commercial and recreational species. *Halodule* and *Ruppia* appear to function as "essential fishery habitat", as defined by the Magnuson-Stevens Fishery Conservation Act of 1996, and should be conserved to maintain fishery productivity.

Sheridan, Pete. National Marine Fisheries Service, Galveston, TX. **TRAJECTORY FOR STRUCTURAL EQUIVALENCE OF RESTORED AND NATURAL *HALODULE WRIGHTII* BEDS IN TEXAS.** Habitat restoration seeks to promote disturbed habitats toward structural and functional equivalency with natural areas. We examined several components of seagrass beds to determine the time needed to reach structural similarity. Flora, fauna, and sediments of five restored *Halodule* beds were compared to those in adjacent natural beds over several years. Tests of functional equivalency were not conducted but are needed both here and elsewhere. Seagrass beds (< 1 m depth) were located near Corpus Christi or Galveston, Texas and had been restored between 1988 and 1994. Three beds were spoil island scrape-downs that were transplanted, one was a scrape-down that re-vegetated naturally, and one was a shoreline transplant. Beds were examined 2 to 6 times each to derive patterns for ages 0.25 to 8.1 yr. Synoptic estimates of seagrass coverage (using quadrats or transects) were made only during the first 1 to 4 years post-restoration, as required and recorded by the permitting agency (Texas General Land Office). Quantitative sampling gear was used to estimate seagrass shoot and root/rhizome biomass, root : shoot ratios, sediment organics, sand : silt : clay ratios, and densities of fishes, decapods and benthos. Ten replicate samples with each type of gear were collected from each bed pair during each visit. Seagrass coverage in restored beds usually exceeded 60% in < 2 yr but may never reach that of natural beds due to construction anomalies. Planners left berms and channels (not found in natural seagrass beds) that trap debris and prevent seagrass expansion. There is some variation in coverage speed, in that one site had not reached the legal requirement of 70% after almost 3.5

yr. Seagrass biomasses in restored beds, both above- and below-ground, began to equal or exceed those of natural beds after 3 yr, but declined relative to natural beds after 6.5 yr. It is unknown whether this is an artifact or represents other factors such as nutrient limitation or genetic effects. Root : shoot ratios initially were higher in restored beds but were similar to those of natural beds after 3 yr. Sediment organics in restored beds were typically lower than those observed in natural beds. Seasonal variations and patchiness in deposition of detritus likely overrode any cumulative signature. Sand : silt : clay ratios indicated higher sand contents in restored beds but hinted at the slow increase in fine silts and clays over time. The build-up of fines is important for nutrient regeneration within the restored bed and for fueling the detritus-based food web from bacteria up to fishes. Fish and decapod densities remained low in restored beds for the first 3 yr relative to natural beds, then equaled or exceeded those in natural beds in following years. The lag period was similar to that observed for seagrass coverage. The superabundance of organisms may have been related to construction aspects that created protected shorelines or limited the access of predators. Dominant macrofaunal species were similar between restored and natural seagrasses during most sampling periods. Benthic communities are still under investigation, but preliminary data indicate similar numbers in each habitat after 3 to 4 yr. We do not know how long it will take benthic communities in restored beds to resemble those found in natural beds, but it has been suggested in previous studies that > 15 yr may be needed. This may be related to accumulation of fine materials in the sediments. Restored *Halodule* beds in Texas appear to need at least 3 to 4 yr to structurally resemble adjacent natural seagrasses. Some components have not reached equivalence even after 8 yr. Unfortunately, the state of knowledge concerning functional equivalence (energy flow, biogeochemical cycling, trophic relationships, etc.) remains poor here and elsewhere.

Smith, Daniel L., and C. Edward Proffitt. Louisiana Environmental Research Center, McNeese State University, Lake Charles, LA. **AMONG CLONE DIFFERENCES IN *SPARTINA ALTERNIFLORA* L. IN RESPONSE TO EXPERIMENTAL TREATMENTS OF CRUDE OIL AND REMEDIATION BURNING.** The potential for variation among different genets in plant responses to oil spills and remediation burning of oil has received little attention. We performed a greenhouse experiment using ramets from three genets collected from spatially-distinct clonal patches of the salt marsh grass *Spartina alterniflora* Loisel in a restoration site at the Sabine National Wildlife refuge. At the refuge, patches were located approximately the same distance from open water and were growing at similar elevations on sediments that were relatively homogeneous due to mixing during the dredging process. These factors greatly reduced the potential for between-clone differences in environmental growing conditions. Experiment main effects were oil-only (levels 0, 4, 8, 16 and 24 L/square meter) and oiled-and-burned (levels: unburned or burned) applied to the 3 clones (3 ramets/pot and 10 replicate pots in each treatment) in a fully-crossed design. Unweathered Venezuelan crude oil was applied to the water saturated sediment surface of potted plants. In burn treatments, crude oil was ignited with a butane torch. Plants in which all above-ground biomass was burned away with a butane torch served as a burn control. Burning proved effective in removing up to 40% of the oil from the sediment and the percent of oil removed by burning did not vary with the oil concentration applied. For biological variables such as culm density, shoot height and plant biomass there was a significant effect of oiling and burning, and evidence for "successful" remediation of oil effects by burning at an intermediate oil concentration, and in the oiled-and-burned plants there was among clone-differences in survival, culm density, shoot height and plant biomass. In general, the percent survival of plants that were oiled and burned decreased with increasing oil concentrations and was much lower than that of the oil-only treatments. There was no effect on culm density and shoot height at oil applications up to 8 L/square meter. Vegetation that was oiled and burned grew back rapidly at oil concentrations up to 16 L/square meter, but at the higher oil applications, burning lasted longer and the negative effects of oil were exacerbated. Flowering occurred more frequently in the oil-only than the oil and burn treatments, but in both cases flowering decreased with increasing oil concentrations. The data suggest that genetic variation may be affected by oil spills and/or remediation burning. Burning appears to be an effective remediation tool at oil concentrations of 16 L/square meter.

Sutula, M. [1], B. Perez [1], E. Reyes [1], J. W. Day [1], D. Childers [2], and N. Oehm [2]. [1] Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA and [2] Southeast Environmental Research Program, Florida International University, Miami, FL. **ANNUAL NUTRIENT EXCHANGE BETWEEN NE FLORIDA BAY AND A MANGROVE CREEK IN THE SOUTHERN EVERGLADES.** Hydrological restoration of the Everglades will result in increased freshwater flow to Florida Bay. The exchange of nutrients between Taylor River and NE Florida Bay was measured to establish baseline estimates of nutrient flux before restoration work begins. Specifically,

the objectives were to quantify the annual flux of nutrients from Taylor River and determine the importance of relative effect of freshwater flow, rainfall, wind-driven and tidal forcing on water exchange and nutrient concentration at the mouth of the creek. Five 10-day intensive studies were conducted during the months of May, August, November 1996, January and May 1997 to determine the flux of dissolved inorganic and total N and P. A daily record of TN and TP flux was generated from daily water samples taken from May 1, 1996 through April 31, 1997, and flow was recorded at the creek mouth in 15-minute intervals through out this period. There was an annual export of TP and TN of magnitude of 7998 moles yr^{-1} and 1,521,163 moles yr^{-1} respectively. Water exchange was influenced to a greater extent by freshwater flow and wind than by tide or local rainfall. Organic N and P dominated total nutrient flux during the five sampling periods (89 - 94%). Peak TP and TN export occurred during the beginning of the rainy season coincident with heavy rainfall in the watershed, while peak import was associated with wind-driven forcing. TN concentration was highly correlated with freshwater flow, while rainfall may be an important source of TP.

Turner, Jason P. and Graham A. J. Worthy. Physiological Ecology and Bioenergetics Lab, Texas A&M University at Galveston, Galveston, TX. **DIFFERENTIATING POPULATIONS OF BOTTLENOSE DOLPHINS (*TURSIOPS TRUNCATUS*) IN THE GULF OF MEXICO USING SKULL MORPHOMETRICS.** The current taxonomic status of the bottlenose dolphin in the Gulf of Mexico is that of a single species, *Tursiops truncatus*, although significant variability has been described on global and local scales. One hypothesis explaining this phenomenon is that the species is locally divided into both coastal populations comprised of small, elongate animals, and offshore populations made up of large, robust animals. A single morphometric study of bottlenose dolphin skulls in the Atlantic found that separation did occur between inshore and offshore animals, however, no such studies have been conducted in the Gulf of Mexico. To test this hypothesis in the Gulf of Mexico, 220 skulls were collected from stranded animals encompassing Mississippi (n=1), Louisiana (n=9), Florida (n=59), and six stranding areas from Texas (n=151). Data on standard length, sex, location of stranding, and a sample of teeth for aging were collected. While the specimens were obtained from stranding situations, and therefore of unknown origin, 37 animals were taken from known inshore communities. The inshore sample was comprised of specimens collected from coastal gillnets (n=3), strandings of photo-identified animals (n=16), and from die-off events within local bay communities (n=18). Thirty-five cranial measurements, from Perrin (1975) and Walker (1981), were examined along with age, sex, standard length, skull maturity, and geographic location of stranding. Characters were grouped based upon functionality and used to compare groups from Texas and Florida, belonging to known inshore populations and stranded animals from unknown populations. Cluster analysis identified a small group of animals (n=5) that were significantly different from the rest of the dolphins. Due to the shape and size of the characters exhibited by the skulls of these animals, they were hypothesized to be "offshore" animals. Discriminate analysis determined that traits defining skull length, feeding musculature, and nares shape identified separation between Texas inshore and Texas "offshore" populations, while traits defining width of rostrum and internal nares identified separation between Texas and Florida populations. Further investigation found that separation between the inshore and offshore dolphin populations could be determined by as few as three skull characters, consistent with findings from populations in the Atlantic Ocean. Future research will attempt to correlate these traits with feeding ecology and to develop a standard suite of measurements ranges which could be used to identify animals within managed areas.

Turner, R. Eugene. Coastal Ecology Institute, Louisiana State University, Baton Rouge, LA. **ESTUARINE SIGNATURES FOR THE GULF OF MEXICO.** The large variability among US estuaries both reflects and disguises underlying relationships between the physics and biology of estuaries. Important parameters of estuarine variability include morphology, flushing times, nutrient loading rates and wetland:water ratios, to name a few. The Gulf of Mexico (GOM) estuaries have 28% and 41% of the US estuarine wetlands and open water, respectively, and vary by 100 Xs within the GOM. The average freshwater turnover time appears to be faster (shorter residence time) in the Gulf of Mexico estuaries, compared to all others (average 184 days). Within the GOM, estuarine nitrogen, phosphorus and suspended matter loading varies over 2 orders of magnitude. This regional variability demonstrates a pattern of higher wetland:open water ratios with increasing suspended loading rates, but a distinct cluster of northeast estuaries that is separate from all others. Anoxic estuarine events tend to be those with slow freshwater turnover and high nitrogen loading.

VanderKooy, Kathy E., Chet F. Rakocinski, and Richard W. Heard. The University of Southern Mississippi, Institute of Marine Sciences, Gulf Coast Research Laboratory, Ocean Springs, MS. **TROPHIC RELATIONSHIPS OF THREE *LEPOMIS* SPP. LIVING IN AN ESTUARINE BAYOU.** By studying feeding patterns and habitat use among three co-occurring sunfishes, we can gain a better understanding of their associations in estuarine submerged vegetation. *Lepomis miniatus* (redspotted sunfish), *L. microlophus* (redear sunfish), and *L. macrochirus* (bluegill) were collected from an oligo-mesohaline bayou in Ocean Springs, Mississippi. Fish and prey availability samples were taken from March 1994 - January 1995. A total of 609 stomachs were examined from fishes representing three size classes. Based on diet composition, some degree of spatial segregation in feeding habitat occurred among the species. However, a high degree of trophic overlap existed among small size classes of all three species. Submerged aquatic vegetation (SAV) was an important feeding habitat for all sunfishes, and also provided an important refuge area for juvenile sunfishes. But trophic overlap among species was reduced by the use of forage areas other than SAV. Diet composition and use of feeding habitats changed seasonally. During spring and summer, fishes utilized SAV and sediment for feeding habitats. However, during autumn, all fishes increased their use of SAV for feeding. This increased use of SAV habitat for feeding coincided with declining SAV coverage, suggesting that competition during autumn was greater than in other seasons.

Withers, Kim and Jace W. Tunnell. Center for Coastal Studies, Texas A&M University - Corpus Christi, Corpus Christi, TX. **FAUNAL SUCCESSION IN BRACKISH, EPHEMERAL PONDS IN A HIGH MARSH ON THE CENTRAL TEXAS COAST.** Three brackish, ephemeral ponds located in a high marsh near Chiltipin Creek in San Patricio County, Texas were studied between October 1992 and October 1995 to determine if faunal abundances were affected by in situ burning used to clean up an oil spill caused by a ruptured pipeline. Two "treatment" and one "control" ponds were studied. Thirty-six invertebrate and four fish species were collected throughout the study. Of the invertebrates, four phyla were represented (Nematoda, Annelida, Arthropoda, Mollusca). Arthropods, primarily insects in the orders Hemiptera and Coleoptera, dominated collections during all three years. There was little pattern to the occurrence or abundance of taxa found in ponds except as a function of the filling and drying of ponds. However, the striking resemblance of Year 1 and Year 3 faunas (in terms of overall relative abundances) suggests that there may be multi-year cycles of succession and population abundance superimposed on the short-term succession required by the ephemeral nature of these ponds. There was no evidence that the oil spill and/or subsequent burn impacted the fauna inhabiting the ponds.

Williams, Patrick R.[1] and Richard E. Condrey[2]. [1] Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge, LA and [2] Coastal Fisheries Institute, Louisiana State University, Baton Rouge, LA. **PRELIMINARY ASSESSMENT OF NEKTON ASSEMBLAGES ASSOCIATED WITH THE BARRIER ISLAND AQUATIC HABITATS OF EAST TIMBALIER ISLAND, LOUISIANA.** The rapid deterioration of barrier islands is cause for national concern because these islands provide substantial biogeomorphic and socio-economic functions. Evaluation of fisheries habitat provided by barrier islands is essential in resource management to help resolve utilization and preservation conflicts and to examine the success of habitat protection and restoration efforts. A total of 71,841 specimens representing 87 nekton species were collected from tidal creek, surf zone, lagoon, tidal channel, sandflat, and vegetated edge habitats on East Timbalier Island, Louisiana by bag seine, otter trawl, and hand trawl during February to August, 1997. Principal components analysis identified seven assemblages accounting for approximately 30% of the total variance. Of these principal components, all had significant differences between months and four exhibited differences between habitats. Species diversity, richness, and eveness were also evaluated. These data will be used to identify which habitats are most important to fisheries resources, for use in future habitat restoration and creation projects.

Young, Jennifer S. and C. Edward Proffitt. Louisiana Environmental Research Center, McNeese State University, Lake Charles, LA. **COMPARISONS OF PLANT COMMUNITY DEVELOPMENT IN RESTORED AND NATURAL COASTAL MARSHES.** Growth and structure of marsh plant communities colonizing large flats of dredged sediments is being studied at the Sabine National Wildlife Refuge in southwestern Louisiana. Three created sites (ages 1.5, 5 and 15 years) are being studied as are two natural reference marshes. All sites were dominated by smooth cordgrass, *Spartina alterniflora*. The 15 year old site was populated by an apparent short form and the other sites were characterized by tall form *S. alterniflora*. We measured growth, density, biomass and environmental conditions at marsh edge and interior locations. The 1.5 and 5 year old sites have numerous circular clones some of which were marked for clonal growth studies. Clones were separated by bare ground or lawns of *Salicornia bigelovii*. Patches of *S. patens* and *Distichlis spicata*

also occurred in higher elevations but at very low percent cover. Salinities of ground and surface water are similar to that measured in the nearby Hog Island Gully canal (range: 0 - 32 mg/L). Temperatures in summer were significantly lower under *S. alterniflora* canopy ($P<0.05$). Within a marsh, there were no significant differences in height of *S. alterniflora* at marsh edge and interior locations, however, heights were significantly less in the 15 year old marsh ($P<0.0005$). Ramet densities and above ground biomass were greatest in the oldest restored marsh, and edge and interior locations did not show differences in ramet densities. The oldest created marsh has cover and biomass of *S. alterniflora* comparable to the natural reference marshes. In higher elevations in the 5 year old marsh, *S. alterniflora* clones (some >7 m in radius) were serving as nodes for colonization by several other species including *Baccharis halimifolia* and *Iva frutescens*. Neither of these species colonized bare ground, but only clones of *S. alterniflora*.

Zobrist, Erik C. **National Marine Fisheries Service, Habitat Restoration Division, Silver Spring, MD.** **CORAL REEF RESTORATION AND PROTECTION FROM VESSEL GROUNDINGS.** Major vessel groundings in the Florida Keys National Marine Sanctuary such as the M/V *Alec Owen Maitland* (Carysfort Reef), the M/V *Elpis* (The Elbow reef) in 1989 and the R/V *Iselin* in 1994 (Looe Key) have demonstrated the need for quick response when restoring injured coral reef habitat. The *Maitland* and *Elpis* sites were not restored until 1995. During the intervening period, waves and currents enlarged the injury and required major physical reconstruction of the reefs. While highly successful, the value of quick response was learned. While under litigation with the *Iselin* Potential Responsible Party (PRP), NOAA directed an operation which removed several hundred tons of loose coral rubble which threatened adjacent undisturbed coral habitat within a year of the grounding. Recently, NOAA had the opportunity to take actions to restore injured coral reef habitat quickly. The 600-foot Contship *Houston* ran aground near Key West in February, 1997. Coral heads were toppled and scattered on the sea floor generating a large volume of loose rubble. NOAA and the State of Florida were able to work with a cooperative PRP and completed an emergency restoration phase in Spring, 1997 which reattached live coral heads and fragments. Five rubble berms were stabilize with a non-toxic marine epoxy. Two large rubble berms were stabilized with flexible concrete mats and 2-3' diameter boulders while two other sites were stabilized with just boulders. In July, 1997, the 325-foot M/V *Fortuna Reefer* container ship ran hard aground near Mona Island, Puerto Rico. The vessel injured about 6,400 square meters of coral reef dominated by elkhorn coral, *Acropora palmata*. As a result of an expedited settlement between the trustees and the PRP, NOAA initiated emergency restoration of 1,857 broken elkhorn coral branches in September and complete the effort in mid-October. The objectives of the emergency restoration were to reverse the major impacts of the grounding by reestablishing the physical structure of the coral reef community and reduce coral mortality by removing the largest broken pieces of branching elkhorn coral from the seafloor and re-attaching them before they succumb to winter-storm damage. Through NOAA's Damage Assessment and Restoration Program, a solid scientific and strong legal case can facilitate either a cooperative relationship between the trustees and the PRP or encourage a timely settlement. These two cases demonstrate two means by which State and Federal trustees can restore coral reef habitat quickly, cost-effectively and without prolonged legal proceedings.