

STUDENT ABSTRACTS FOR POSTER PRESENTATIONS

OCEANIC/MARINE AND FISHERIES SCIENCES

(1)

OCCURRENCE OF SOME FISHES IN VARIOUS HABITATS IN THE VICINITY OF MISSISSIPPI SOUND. Sonya D. Barner¹, Sara E. LeCroy² and Chet F. Rakocinski².

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To generate museum records and document biodiversity in Mississippi coastal waters, fishes were collected from various habitats in Mississippi Sound and nearby Gulf of Mexico waters, ranging from Fort Bayou inshore waters to open waters near Horn and Chandaleur Islands. Samples were collected with seines and an otter trawl. Fishes were sorted, identified, catalogued and deposited in the fish museum at Gulf Coast Research Laboratory (GCRL). The GCRL Museum database was searched to provide additional information on the five most abundant species from each habitat in order to compare fish habitat preferences for the most common species collected. Forty species of fish were identified. The following families had the highest number of species: Carangidae (5), Fundulidae (5), Sciaenidae (5), Engraulidae (3) and Sparidae (3), followed by the Clupeidae (2), Gobiidae (2), Mugilidae (2), Synodontidae (2) and Syngnathidae (2). Of the seven species collected at the Fort Bayou station, *Menidia beryllina*, *Anchoa mitchilli*, and *Lucania parva* were the most abundant accounting for about 76% of the total catch. In the offshore areas of Barrier islands, eleven species were collected with *Anchoa hepsetus*, *A. mitchilli* and *Saurida brasiliensis* being the most abundant. Two different distribution patterns were evident based on our collections. Pelagic forage species such as *Anchoa mitchilli* and *Menidia beryllina* were widespread, showed no apparent habitat association and were euryhaline, occurring widely throughout the area. The second pattern was shown by species that were associated with one or two habitat types. These included *Sauridia brasiliensis*, *Eutremus teres*, and *Stenotomus caprinus*, which were collected only at the open water stations, *Gobiosoma bosc*, from low salinity mud bottoms, *Trachinotus carolinus* and *Menticirrhus americanus* from nearshore sand bottoms, and all three species of *Fundulus*, *Oligoplites saurus* and *Eucinostomus argenteus* from high salinity grassbeds.

(2)

PREDICTION OF SHRIMP BIOMASS FLUCTUATIONS AND CATCH RATES USING A BIOMASS DYNAMIC MODEL: A PRELIMINARY STUDY. Atanasio Brito¹, David

Die^{2,4}, Richard Gragg¹, Elijah Johnson¹, Jennifer Cherrier¹, Larry Robinson¹ and Brad Brown³.

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The Mozambique Sofala Bank (16°20'-21°00') shrimp fishery was over fished and the fishing effort was 30% greater than the effort that would produce the maximum sustainable yield for the year 2000. Recent introductions of powerful shrimping vessels, night time fishing and the constant upgrading of navigation systems such as Global Positioning System and Echo Sounder by commercial fleets have counteracted the management practices of seasonal closures, total allowable catches and limited entries. This work uses a biomass dynamic model to predict monthly biomass fluctuations of penaeid shrimp in Sofala Bank. The model can give managers a predictive capability in estimating monthly biomass fluctuations for the purpose of maintaining a sustainable shrimp fishery. A 9-year series (1991 to 1999) of a commercial fleet shrimping catch and effort statistics, for *Farfantepenaeus indicus* and *Metapenaeus monoceros*, were input into the biomass dynamic model. A reasonably good correlation between the estimated catch per unit of effort and the observed monthly catch per unit of effort for both species was observed in the model. The estimated catch per unit of effort, for *F. indicus*, following the all year recruitment pattern yielded an r-value of 0.7363. The harvestable biomass, from 1991-1999, of *F. indicus*, oscillated on a monthly basis between 34 and 415 tons. The catchability coefficient for the fleet is estimated to be 0.000085. While the annual growth biomass oscillated between 387 and 1083 tons. The estimated catch per unit of effort, for *M. monoceros*, fits the observed at an r-value equal to 0.5379 for a seven-month recruitment pattern. The model predicts that the harvestable biomass of *M. monoceros* oscillated between 83 and 783 tons. The catchability coefficient for this species was estimated to be 0.000026. The annual growth biomass oscillated between 593 and 1262 tons. This preliminary work has provided the key elements necessary for a definitive study. Future work will be more comprehensive, using data from all Sofala Bank shrimping fleets and the six shrimp species caught in the past 15 years.

(3)

FISHERY TROPHIC LINKAGES IN THE CHESAPEAKE BAY ECOSYSTEM. R.H.

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Annually, landings from the Chesapeake Bay ecosystem account for roughly 250,000 – 350,000 metric tonnes of total catch from U.S. fisheries. Collectively, over 50 species of finfish, crustaceans, and bivalves are caught in the Bay. The complexity of the bay ecosystem, along with effects that stem from the steadily increasing human population of its watershed, challenges fishery management. Modern fishery management calls for multi-species models and

approaches. Unlike single-species approaches, multi-species approaches treat stocks as part of an ecosystem, taking into account natural mortality, growth effects, and dynamics of the entire food web. In order to develop these approaches, a good understanding of trophic linkages under varying conditions is needed. This study serves to identify trophic linkages through the use of a combination of stomach content and C, N, and S stable isotope analysis. Samples represent important finfish, bivalve, and crab populations in oligohaline and mesohaline regions of the Bay. We seek to identify the trophic roles and connections of and among species and age classes spatially, temporally, and under varying water quality conditions.

(4)

A PRELIMINARY STUDY OF SUBSTRATE PREFERENCE BY HATCHERY PRODUCED JUVENILE RED SNAPPER (*LUTJANUS CAMPECHANUS*). Jomeka Johnson¹, Chigbu, P.¹ & Ogle, J.² ¹*Department of Biology, Jackson State University, Jackson, MS 39217;* ²*Institute of Marine Sciences, Gulf Coast Research Laboratory, University of Southern Mississippi, Ocean Springs, MS 39566.*

Substrate characteristics influence the distribution of benthic organisms, including fishes. Red snapper larvae settle out to the bottom of the Gulf of Mexico following a planktonic larval existence. A previous laboratory study using circular tanks suggested that 0+ red snapper collected from the wild preferred shell to sand substrate, perhaps because shells provide refuge to juvenile snapper from predation. However, hatchery-produced fish may differ from wild conspecifics in their behavior, for example, in habitat selection. This can increase the vulnerability of hatchery-produced fish or wild conspecifics to predation, and thus can potentially contribute to the failure of fish stock enhancement projects. We examined substrate preference by hatchery-produced 0+ red snapper using two raceways and two circular tanks. Each container was divided into two equal areas, the floor was covered with sand in one area and clam shells in the other half. Groups of four (n=6) fish < 92.0 mm in size were introduced into the experimental chambers and visually observed at various times from morning to night. On the average, more fish (75%) were observed in the areas of the tanks with sandy substrate than in the areas with shell (25%). Only in one case was there no apparent difference in substrate preference, as about 50% fish were on sand and 50% on shell. These results are inconsistent with a published study that suggested the wild caught juvenile red snapper preferred shell to sandy substrate. Further studies are planned to confirm this observation, to compare substrate selection by hatchery-produced and wild caught snapper, and to assess ontogenetic changes in substrate preference.

(5)

MARINE MAMMAL PROGRAMS AND ACTIVITIES AT THE SOUTHEAST FISHERIES SCIENCE CENTER, PANAMA CITY LABORATORY, FLORIDA. Wanda Jones, *University of Florida and National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City Laboratory*

The National Oceanic and Atmospheric Administration (NOAA) Fisheries, is mandated by the Marine Mammal Protection Act of 1972 and Amendments of 1994 to manage and conserve certain marine mammal species including all cetaceans, seals and sea lions. In the southeast region, the Southeast Fisheries Science Center (SEFSC) Protected Resources and Biodiversity Branch (PRBD) houses the Marine Mammal Investigation Group that participates in the Marine Mammal Stock Assessment and Marine Mammal Health and Stranding Response Program(s). In compliance with the act mandates, stranding programs, biomonitoring programs, and population surveys have been developed and implemented in the southeast region. The SEFSC programs oversee NMFS research conducted on marine mammal communities in three ecosystems: the Gulf of Mexico Shelf, the South Atlantic Shelf, and the US Caribbean Shelf. A number of cetacean (whale and dolphin) species, pinniped (seals) species, and sirenian (manatees) species inhabit these areas seasonally and year-round. Research conducted by the SEFSC is utilized by NMFS' Office of Protected Resources and Conservation and Recovery Programs in the management and enforcement branches to create, implement, mitigate, and enforce regulations supporting the Marine Mammal Protection Act of 1972.

Several SEFSC field laboratories within the southeast region conduct research and activities in keeping with the goals and mission of the Marine Mammal Programs. The Panama City Laboratory, Panama City Beach, Florida, in cooperation with the University of Florida, conducts marine mammal programs under the PRBD including stock assessment, mortality estimation, health assessment, life history, and behavioral research. Recently, from 1997-2000, Jones (in prep) conducted field research on bottlenose dolphins in Panama City and the surrounding areas. The work focused on stock assessment and the general behavioral ecology of pods and individual dolphins. Information collected included abundance estimates, residency status, habitat use, movement patterns, group associations, and the development of activity budgets for the various pods in northwest Florida marine and estuarine waters. In addition, a photoidentification catalog was created and continues to be updated for dolphins inhabiting the waters surrounding Panama City and neighboring cities, Destin and Port St. Joe. This catalog is a valuable asset in the identification of resident and transient dolphins, for behavioral studies, and for stock assessment goals. It is also useful in determining identification of individuals in unusual mortality events and those examined during the normal course of data collection for the Marine Mammal Health and Stranding Response Program (MMHSRP). Research and activities conducted for the MMHSRP include collaboration with the Southeast Region Stranding Network for marine mammal rescue, rehabilitation, health assessment, and necropsy for sample collection for the Biomonitoring Program including life history, genetic, morphometric, pathology, virology, and feeding ecology research.

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ABSENCE OF *MONOPYLEPHORUS RUBRONIVEUS* IN FISH FEEDING STUDIES.

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Tidal creeks serve as nursery and refuge habitats for many economically and ecologically important species of fish and crustaceans. During at least one stage of their lives, most of these fish and crustaceans feed upon the benthos living in the creeks. The tubificid oligochaete *Monopylephorus rubroniveus* is the numerically dominant macrobenthic organism found intertidally in southeastern tidal creeks. Oddly enough, *Monopylephorus* and similar organisms are rarely found during fish gut-content studies. We have performed a series of experiments in which we fed both oligochaetes and hard-bodied amphipods to a common estuarine fish, *Fundulus heteroclitus* and measured the state of digestion of each after 2, 15, 30, or 60 minutes in the gut. To evaluate the presence of food, items in the gut were assigned a score, 0- empty, 1- tissue (identified under a compound microscope) and 2- whole, based on the degree of digestion. Amphipods were easily identified to species at all four sampling times. After 2 minutes the oligochaete was still easily identified. At 15, 30, and 60 minutes the oligochaete was only recognizable as setae, if there were any remains left at all. It is our feeling that most fish diets, which are based upon typical gut-content analysis methods, underestimate the importance of oligochaetes and other soft-bodied organisms while overestimating the importance of hard-bodied organisms due to their quick digestion time in the gut of the fish.

(7)

ARCVIEW GIS UTILIZATION IN IDENTIFICATION AND QUANTIFICATION OF SHORE TYPE AND LAND USE IN AN URBANIZED SUBESTUARY OF THE CHESAPEAKE BAY.

Patrice Longshaw, *Marine and Environmental Science Undergraduate, Hampton University*

The technological advancements that have been made in mapping during the last few years allow for many statistical and database functions to be integrated into one program. One such program is the ArcView GIS program, distributed by Environmental SR Imaging. The Hampton River, a tributary of the James River adjacent to Hampton Roads, at the mouth of the Chesapeake Bay in Virginia, is an ideal location to utilize the capabilities of ArcView GIS to analyze land use and shoreline types. ArcView allows overlaying of digitized maps from various sources such as the City of Hampton. and USGS. Each of these layers, once applied to a basemap, can be shown, or hidden, as appropriate for the particular area being analyzed. This project is in progress, and will provide many opportunities for student research in the future. This will be an ongoing study to better quantify and assess effects of shore types and land usage on the Hampton River ecosystem.

(8)

INVESTIGATIONS OF THE HEALTH OF THE STRIPED BASS IN THE CHESAPEAKE BAY: MYCOBACTERIA INFECTIONS IN STRIPED BASS. Anthony S. Overton¹, Eric B. May¹, and F.J. Margraf². ¹*University of Maryland Eastern Shore, Maryland Cooperative Fish and Wildlife Research Unit 1120 Trigg Hall Princess Anne, Maryland 21853.* ²*Alaska Cooperative Fish and Wildlife Research Unit 210 Irving I Building P.O. Box 757020 University of Alaska Fairbanks Fairbanks, AK*

Several species of bacteria have been isolated from striped bass in the Chesapeake Bay. *Mycobacteria sp.* is of particular interest to scientists because of its association with large nodules (granulomas) or ulcers throughout many of their tissues. The resulting disease may be characterized by emaciation, inflammation of the skin, open lesions, and ulceration. We determined the extent of Mycobacteria infection in striped bass and provide evidence of decreased overall condition of fish affected by these bacteria. Almost 50% of the fish showed some sign of an external sore. Granulomas appeared in at least one organ in 53% of the fish in our samples regardless of the presence or absence of external sores. The Gran scores from the spleen and head kidney were significantly higher than either the heart and liver and appeared to be most closely associated with the presence of external sores. The condition factor was significantly higher for striped bass without sores (0.96) than those with sores (0.82). Condition factors involving all fish clearly shows a trend, with NGNS at 0.99, GNS at 0.92 and GS at 0.81. Slopes of the regression loge weight (g) and loge length (mm) for striped bass with sores was significantly higher than those fish without sores. However the weight at length were more variable (lower r²) in striped bass with sores than those fish without sores.

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THE HABITAT UTILIZATION OF JUVENILE HAWKSBILL SEA TURTLES (*ERETMOCHELYS IMBRICATA*) AT BUCK ISLAND REEF NATIONAL MONUMENT ST. CROIX U.S. VIRGIN ISLANDS. Roy A. Pemberton Jr. and John A. Musick, *College of William & Mary, Virginia Institute of Marine Science, Fisheries Science Lab., Gloucester Pt, VA 23062*

Juvenile hawksbill, *Eretmochelys imbricata*, and green, *Chelonia mydas*, sea turtles are found in waters of Buck Island Reef National Monument, St. Croix U.S. Virgin Islands. Sea turtle surveys were conducted at Buck Island in the summer of 1998 and winter of 1999. Green turtles were found in the southern area of the monument in blocks A through J and block R. These blocks were either adjacent to or near areas of large sea grass beds, which are the predominant foraging areas for green sea turtles. The majority of juvenile hawksbills sighted were along the north side of the monument in blocks J through N. There was a significant difference in the mean number of juvenile hawksbills sighted in blocks with low zoanthid (*Zoanthus sociatus*) cover and those with high zoanthid cover. More juvenile hawksbills were sighted in blocks with high zoanthid cover. Their habitat utilization around Buck Island reflects their foraging focus on zoanthids.

Radio and sonic telemetry was used to elucidate site philopatry of juvenile hawksbills at Buck Island. The hawksbills exhibited strong site philopatry for the North side of Buck Island.

Each turtle monitored had a relatively small home range ($\leq 2 \text{ km}^2$) which it occupied for at least several months. Turtles moved less than 1.09 km over a period of several months. Their ranges appeared to not be limited by the park boundaries but possibly by the distribution of zoanths in the habitat. Judging from tag recapture studies these animals may be resident in the habitat for periods of at least several years. Strong site philopatry was maintained by one juvenile hawksbill despite the passage of Hurricane Lenny in November of 1999.

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THE ECOLOGICAL IMPORTANCE OF CRINOIDS ON HECETA BANK, OREGON.

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Heceta Bank is a commercially important offshore rocky bank with depths of 80-400m. Surveys of Heceta Bank were completed yearly between 1988 and 1990 using the submersible Delta. Transects provided data on physical habitat, and fish and invertebrate diversity and abundance. These transects were revisited this past summer and will be visited again next year as part of a 2 year study. The use of the submersible Delta, as well as the remote operating vehicle ROPOS provided the opportunity to sample a greater variety of habitats on the bank. The crinoid *Florometra serratissima* is a common invertebrate associated with hard substrate throughout the bank. The goal of this study is to compare the abundance and distribution of past studies to current studies 10 years later. The patterns that emerge from this study can be used to understand the importance of crinoids to the deep-sea benthic community of the Northeast Pacific Ocean and the role these invertebrates, and other benthic organisms, may play in the life cycle of economically important groundfish.

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EFFECTS OF SALINITY ON FOOD CONVERSION AND GROWTH OF JUVENILE

RED SNAPPER (*LUTJANUS CAMPECHANUS*). ¹Pamela Riley-Daniels, ¹Himabindu Remata, Chigbu, P.¹, Ogle, J.², & Lotz, J.². ¹*Department of Biology, Jackson State University, Jackson, MS 39217;* ²*Institute of Marine Sciences, Gulf Coast Research Laboratory, University of Southern Mississippi, Ocean Springs, MS 39566.*

Salinity is an important factor affecting growth and distribution of marine organisms. In a recent study, "high value habitat" for juvenile red snapper was defined in the northwestern Gulf of Mexico, as areas with temperature of 24 – 26°C, dissolved oxygen level $\geq 5 \text{ mg/L}$ and salinity of about 35‰. Nevertheless, limited information is available on the response of red snapper to different levels of physico-chemical parameters. Defining salinity level for optimal growth of juvenile snapper is invaluable for its culture. It is also useful for predicting the response of snapper to changes in salinity in its natural environment. Juvenile red snapper produced at the University of Southern Mississippi-Gulf Coast Research Laboratory (USM-GCRL) were transported to JSU marine science laboratory and acclimated to laboratory conditions for one week. Fish were then randomly assigned to 10 gallon aquarium tanks containing 25ppt water. The salinity in the tanks was then gradually adjusted to 15ppt, 25ppt or 35ppt over a week period, after which the fish were anaesthetized, measured and weighed.

There were three or two fish per tank and four replicates for each salinity treatment. Fish were fed pre-counted, weighed pelleted food, *ad libitum*, twice daily. After 28 days the fish were measured and weighed. There were no significant differences in the mean relative growth ($P = 0.457$) and food conversion ratio ($P = 0.106$) among salinity treatments. Preliminary studies suggest that juvenile red snapper can survive for several days at lower (~7 ppt) and higher (~45 ppt) salinities.

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PREY PREFERENCE AND FUNCTIONAL RESPONSE OF ADULT BLUE CRABS *CALLINECTES SAPIDUS* TOWARDS TWO PREY SPECIES. Ariel Settles¹, Anson Hines², Livingston Marshall¹. ¹*Morgan State University, 1700 Coldspring Lane, Baltimore, Maryland 21251*, ²*Smithsonian Environmental Research Center, 647 Contees Wharf Road, Edgewater, Maryland USA*

Blue crabs are large epi-benthic predators that forage in diverse habitats along the Gulf and Atlantic coasts of the United States. Our previous research showed that predation by blue crabs regulates multiple prey abundance and distribution, but this work focused on density-dependent interactions with one prey species at a time to infer regulation of benthic community structure. In this study, we considered prey preference and functional responses of large (140 mm) blue crabs to varying combinations of two prey species simultaneously, juvenile blue crabs 30-70mm and Baltic clams *Macoma balthica* 20-30 mm, in large lab tanks. Preliminary results indicate that adult crabs preferred clams to juvenile crabs, and addition of a second prey species altered the predator's functional responses to the prey species from type II to type III for juvenile crabs, and from type III to type II for clams. These changes could have major implications for stability of prey populations, since type II responses destabilize while type III stabilize prey populations.

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PATHOLOGIC CHANGES OBSERVED IN PYGMY SPERM WHALES (*KOGIA BREVICEPS*) STRANDED ALONG THE FLORIDA COAST 1992-2000. Fred Williams III^{1,2} and Ruth Ewing¹. ¹*National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami Laboratory* and ²*Tuskegee University, College of Veterinary Medicine, Nursing, and Allied Health.*

Necropsy and histologic evaluations were performed in 20 pygmy sperm whales (*Kogia breviceps*) that had been stranded along the Florida coastline. The animals were attended to by the US Southeastern Marine Mammal Stranding Network volunteers as they responded to stranding notices. Their personnel performed the necropsies and collected the tissue samples evaluated in this study. The gross lesions included findings consistent with the cardiomyopathy reported in the species. The microscopic lesions primarily include cardiomyopathies characterized by cardiac atrophy and cardiomyocyte degeneration. These changes were observed with no sex bias, and were commonly accompanied by non-specific changes indicative of cardiovascular collapse or shock. No definitive cause for the lesions was identified. The histological reports of those cases were reviewed and are presented in a summarized format.

This collection of data may be used to further understand the mechanisms behind why these animals leave leave alone.

ENVIRONMENTAL SCIENCES

(14)

CUMULATIVE IMPACT OF PHOTOOXIDATION AND COMETABOLISM ON THE DEGRADATION OF PETROLEUM HYDROCARBONS BY INDIGENOUS

NEARSHORE BACTERIA. ¹Milton Clarke, ¹Xiaoling Ding, ¹Richard Gragg, ¹Jennifer Cherrier and ²Jeff Chanton, ¹*Environmental Sciences Institute, Florida A&M University*, ²*Department of Oceanography, Florida State University*

Photooxidation and co-metabolism have been shown to enhance the biodegradation of refractory organic compounds. Petroleum consists of a complex mixture of hydrocarbons, some of which are biologically refractory. A series of 90 day incubations, with bacteria from a nearshore oil-contaminated (NC) site and a nearshore pristine (NP) site were carried out to evaluate the cumulative impact of photooxidation and cometabolism on the biodegradation of petroleum hydrocarbons (PHCs). Crude oil was photooxidized by exposure to natural sunlight for 16 h. A parallel series of incubations were carried out using unphotooxidized oil as the experimental control. Ground pinfish powder, a labile substrate, was used as the co-metabolite. Bacterial respired CO₂ taken at various time points was used as an indicator for the degree of oil degradation. Our results showed that in NC incubations, the CO₂ concentrations were 5000, 6900, and 11600 ppm for unphotooxidized oil, pinfish, and pinfish plus oil, respectively. Correspondingly, those observed in the NP incubations were 1,500, 14500 and 17800 ppm, respectively. The biodegradation of photooxidized oil was completely inhibited, at both sites, even under the presence of labile pinfish (CO₂ concentrations were about 500 ppm, which was the same as the background). These findings indicate that bacteria at NC site more efficiently degrade unphotooxidized oil than bacteria at the NP site. Additionally bacteria at the NP site can more efficiently degrade labile substrate than bacteria at the NC site. The time required for reaching the steady-state of CO₂ respiration for oil amended with pinfish (a few days) was much shorter than that of oil alone (about 40 days) at both of these sites. Photoinduced inhibition of CO₂ respiration may be due to the fact that after photomodification, some PHCs are more toxic than their parent compounds. Our gas chromatographic analysis of photooxidized oil also showed that more PHCs dissolved in water, especially smaller fractions, compared to unphotooxidized oil, suggesting that bacteria were exposed to higher PHC concentration in photooxidized oil incubations. Further experiments will investigate the relationship between the extent of PHC photooxidation and PHC photoinduced inhibition or enhancement of bacterial CO₂ respiration.

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CHELATE-ASSISTED PHYTOEXTRACTION OF LEAD FROM CONTAMINATED SOILS USING WHEAT (*TRITICUM AESTIVUM* L.) B. Crudup, R. Warren, M.F.T.

Begonia, and G.B. Begonia, *Jackson State University, Jackson, MS 39217*

Preliminary studies indicated that wheat (*Triticum aestivum* L.) can tolerate and accumulate significant amounts of lead (Pb) in its shoots when grown in Pb-amended sand. To further evaluate the potential of wheat for phytoextraction, a study was conducted to determine whether the timing of ethylenediaminetetraacetic acid (EDTA) application and acetic acid amendment can further enhance the shoot uptake of Pb. Two seeds were planted in each 150 ml super cell containing top soil and peat (2:1, v:v) amended with various levels of Pb and EDTA. Results revealed that wheat plants can tolerate toxic Pb concentrations as evidenced by the non-significant differences in shoot and root biomass among treatments. An exception to this general observation was the root inhibition of plants grown in 2000 ppm Pb that was amended with EDTA and acetic acid one week before harvest. Generally, root and shoot Pb uptake increased with increasing concentrations of soil-applied Pb. When no EDTA was added to the growth medium, the majority of the Pb was retained in the roots. However, when EDTA was applied one week before harvest, there was an enhanced Pb translocation to the shoots. Application of acetic acid in conjunction with EDTA led to a tremendous increase in shoot Pb uptake.

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EFFECTS OF CHELATES ON THE BIOACCUMULATION OF LEAD FROM A CONTAMINATED SOIL USING COFFEEWEED (*SESBANIA EXALTATA* RAF.) E.

Dillon, O. Okuyiga-Ezem, T. Williams, M.F.T. Begonia, and G.B. Begonia, Jackson State University, Jackson, MS 39217

This study was conducted at the Jackson State University greenhouse to evaluate whether the addition of a synthetic chelate, ethylenediaminetetraacetic acid (EDTA), can further enhance the effectiveness of coffeeweed (*Sesbania exaltata* Raf.) as a phytoextraction species. Coffeeweed seeds were grown in various concentrations of lead (Pb) and EDTA mixed with a growing medium composed of sieved soil, peat, and sand (4:2:1, v:v:v). After six weeks of growth, the plants were harvested and their Pb contents were extracted using a modified nitric acid-hydrogen peroxide digestion technique. Lead concentrations were quantified by atomic absorption spectrophotometry. Results showed that coffeeweed can tolerate soil Pb levels up to 2000 ppm and that EDTA can significantly enhance the uptake of Pb by both the roots and the shoots. The results further demonstrated that pre-planting application of EDTA caused a greater Pb uptake by the plant compared to the untreated control and plants that were amended with EDTA one week before harvest.

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CYTOTOXIC EFFECTS OF PENTACHLOROPHENOL IN PRIMARY HEPATOCYTE CULTURES OBTAINED FROM CHANNEL CATFISH (*ICTALURUS PUNCTATUS*).

Waneene C. Dorsey, Paul B. Tchounwou, and Ali B. Ishaque, *Environmental Toxicology Research Laboratory, NIH-Center for Environmental Health School of Science and Technology, Jackson State University, 1400 Lynch Street, Box 18540, Jackson, MS 39217, USA*

Organochlorine residues are ubiquitous in the environment and have been found worldwide in soil, water, and air samples. Of particular interest are species of organochlorine compounds found in pesticides, because of their efficient biocidal activity against insects and microorganisms. An example of such pesticides is Pentachlorophenol (PCP), an organochlorine compound that has been used worldwide for many industrial and domestic applications. In this research, we investigated the acute toxicity of PCP to fish hepatocytes. The cytotoxicity of PCP was determined *in vitro*, using cultured primary hepatocytes from male channel catfish. The viability of cells, exposed for 2 days to PCP, was assessed by the fluorescein diacetate (FDA) method, using a Fluoroscan microplate reader. Study results indicated a linear relationship between cell survival and PCP toxicity. Upon 48 hrs of exposure, the NOAEL, LOAEL, LC₅₀ of PCP were 62.5 ± 10.3 , 125.0 ± 15.2 , and 2000.0 ± 9.6 ppm, respectively. Based on these preliminary results, further studies are underway to assess the estrogenic potency of PCP, as well as its ability to transcriptionally induce stress genes in liver cells.

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CELLULAR RESPONSE (CYTOTOXICITY AND P53 EXPRESSION) TO ARSENIC AND ATRAZINE BY HEPG2 CELL LINES.

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Atrazine and Arsenic-containing compounds are among the leading chemicals that are used in America for agricultural purposes. Atrazine is a man-made herbicide used for the control of broadleaf and grassy weeds. It is persistent in the environment and contaminates ground waters and surface waters that are sources for human consumption and recreation. Lifetime exposure to Atrazine, at levels above 0.003 mg/L, has the potential of causing cancer. Arsenic is a carcinogen not only for skin, but also for internal organs such as the lung and bladder. Health effects associated with arsenic exposure include diabetes, cardiovascular disease, hearing loss, and neurological and neurobehavioral effects. The maximum contaminant level for arsenic in drinking water is 50 ug/L. The goals of this project were: (1) to determine the toxicity of arsenic trioxide and atrazine using the lactate dehydrogenase (LDH) assay, and (2) to determine the cellular response mechanism of Arsenic and Atrazine in human hepatic carcinoma cell (HepG2) lines. To conduct this experiment, HepG2 cells were seeded at 1×10^6 cells/mL and exposed to the chemicals for 48 hours. LDH analysis was used to determine the lethal concentration at which 50-percent of the cell population (LC₅₀) dies. Total protein concentration was determined using the Bradford Assay, and Western Blot analysis evaluated p53 cellular protein expression. The results indicated that Atrazine alone was nontoxic to HepG2 cells in the concentration range

tested. The LC₅₀ value for arsenic trioxide was shown to be 12 ppm. The tumor suppressor gene product p53, which is a critical mediator of the cellular response to DNA damage, was expressed after treatment of HepG2 cells with 12ppm of Arsenic.

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THE INFLUENCE OF NITROGENOUS COMPOUNDS ON GROWTH AND SEXUALITY OF THREE MICROALGAL SPECIES. Eric J. Fisher¹, I. O. Farah, M. G. Hardy and H. S. Yang, *Jackson State University, Jackson, MS 39217*

Total growth, sexuality and utilization of various nitrogenous compounds by microalgae in 21-day batch culture media (Lewin's FW1 medium at 25°C within an illuminated growth chamber) were studied using microbiological, spectrophotometrical, microscopical and statistical techniques. Microalgae exhibit luxuriant growth in eutrophic ponds and lakes by metabolizing abundant nitrogen and phosphorous found in these areas. These abundant nutrients facilitate primary productivity and are reassembled in algal cells to become part of their biomass. Nitrogen is one of the most important inorganic/organic nutrients utilized by microorganisms. This microalgal ability may, however, produce an excellent source of quality nitrogen for various uses. Our objectives are (1) to determine if microalgae will grow and transform poor quality nitrogen into quality biomass by their response to different nitrogenous sources in the growth medium and (2) to determine if primary products accumulate in microalgae exposed to various concentrations of nitrogen and the influence on algal sexuality. Three microalgae; *Chlorella pyrenoidosa*, *Chlamydomonas reihardtii* and *Chlorococcum echinozygotum* were inoculated in media containing twenty different nitrogenous compounds (including various amino acids) at 1, 10, 100, 1,000 and 10,000 ppm. Results showed statistically significant differences ($p < 0.01$) among treatments. For the above algal species, mean and SD for total growth ranges were respectively as follows: 0.099 ± 0.001 - 1.07 ± 0.1 , 0.071 ± 0.03 - 1.13 ± 0.07 , 0.12 ± 0.016 - 1.642 ± 0.02 in OD units/ml. Mean sexuality (cell %/ml) ranges were respectively as follows: 10.8 ± 7.75 - 69.6 ± 3.10 , 8.0 ± 2.43 - 81.20 ± 2.71 , 3.33 ± 0.11 - 67.00 ± 2.00 . All three species showed significant growth at higher concentrations ($> 1,000$ ppm). Urea, asparagine, citrulline and uric acid showed the highest accumulation of organic material in algal cells. An inversely proportional relationship was found between zygotic cell counts and growth. Therefore, it was concluded that the concentrations to be used for the best primary productivity and sexuality is at least 1,000 ppm. This study points to the potential of using microalgae to transform low quality and cheap nitrogen into biomass, a condition that could be exploited to improve plant cell culture productivity under aquatic conditions.

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AXENIC LINES OF *SPARTINA ALTERNIFLORA* FROM SURFACE STERILIZED SEEDS. Alisa G. Harkins¹, Trenis D. Palmer¹, Marc E. Frisher² and Chandra I. Franklin¹.

¹*Marine Environmental Science and Biotechnology Research Center, Savannah State University, P.O. Box 20228, Savannah, GA 31410.* ²*Skidaway Institute of Oceanography, 10 Ocean Science Circle Savannah, GA 31411*

The smooth cordgrass (*Spartina alterniflora*) is a dominant plant species in saltmarshes of southeastern United States, and it can account for up to 90% of biomass production. In anthropogenically impacted saltmarshes, interactions between *S. alterniflora* and sediment microbial communities appear to influence the uptake, transformation, and ultimate removal of contaminants including hydrocarbons, heavy metals and xenobiotics. Axenic (microbe-free) lines of *S. alterniflora* are needed for conducting experiments to assess the individual roles of *S. alterniflora* and microbes. Under natural conditions, it is not feasible to conduct such experiments, because they cannot be physically separated. In this report, the methodology to produce axenic lines of *S. alterniflora* from seeds surface-sterilized using chlorine fumes is described. Due to the microbe-rich habitat of *S. alterniflora*, its seed surface appears to be heavily infested with fungal and bacterial population. Surface sterilization of seeds using conventional methods did not yield satisfactory results. Therefore, an alternate method using chlorine fumes generated by mixing commercial bleach (Clorox) and glacial acetic acid was used. Seeds were exposed to chlorine fumes for 10-90 min (in 5-10 min increments) and subsequently germinated on sterile nutrient medium (100 seeds/treatment). Ten days later, data on number of seeds showing microbial growth (contamination) were collected. Seeds exposed for 10-30 min showed 5-10% contamination. Seeds exposed for 35 min and above showed no contamination. As expected, prolonged exposure to chlorine fumes reduced seed viability. Ten minute exposure reduced seed viability by 13%, whereas 90 min exposure resulted in 60% reduction of seed viability. At 35 min, 29% reduction of seed viability was observed. Results from these studies indicate that 35 min exposure to chlorine fumes is optimal for surface sterilizing *S. alterniflora* seeds. Viable surface-sterilized seeds germinated into normal plants with well-established root and shoot systems with no signs of microbial growth in the nutrient medium.

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BIOCONCENTRATABLE POLYCYCLIC AROMATIC HYDROCARBONS & QUINONE PHOTOPRODUCTS IN EVERGLADES CANALS C-11 AND C-111. Haynes,

S.^{1,2}; Gragg, R.D.¹; Orazio, C.E.²; Lebo, J.A.²; R.²; Frederic Essien¹, Larry Robinson¹, and Maurice Eddington³. *Florida A & M University, ¹Environmental Sciences Institute, and the ³Department of Chemistry, Tallahassee, Florida; ²USGS, Columbia Environmental Research Center, Columbia, Missouri USA*

Urban runoff is a major source of polycyclic aromatic hydrocarbon (PAH) contamination in the Everglades. Solar ultraviolet radiation is a component of the Everglades temperate climate that has the potential to photo-modify some PAHs. Growing evidence suggests that the real hazards of PAHs to aquatic life may be due to the toxic effects of photooxidized PAH

photoproducts formed by PAH absorption of ultra-violet radiation in sunlight. PAHs are difficult to measure by conventional means of sampling and a means of sampling and measuring ultra-trace levels of PAH photoproducts in the aquatic environment has not been reported. In this investigation samples were collected from 2 sites in the Everglades: Canals C-11/S-9 and C-111/S-177. Bioavailable PAHs and quinone photoproducts in the water column were sequestered using a semipermeable membrane device (SPMD). These devices mimic the bioconcentration process of lipophilic compounds by aquatic organisms. After a 28-day sampling period, the SPMDs were retrieved, dialyzed and analyzed by GC-FID and HPLC/UV. A new method for measuring quinone photoproducts was developed without any post-dialysis cleanup by direct HPLC/UV analysis. The GC and HPLC methods, in conjunction with SPMD sampling, enable PAHs in the Everglades to be measured at levels as low as 10ng/ mL. The limit of quantitation for the photoproducts is estimated to be in the $\mu\text{g/mL}$ range by this method. Naphthalene, fluoranthene, and chrysene were detected in SPMDs at both sites. No quinone photoproducts were detected. In addition to the PAH related compounds, the SPMD samples were also screened for organochlorine pesticides (OCP). The highest concentration levels of OCP detected from both sites were trans-chlordane and cis-chlordane with concentrations ranging between 11.5-12.2 and 8.9-9.8 ng/mL, respectively. Endosulfan was highest in canal C-111/S-177 with a concentration of 348 ng/mL. Other pesticides detected in SPMD included DDT, DDE and dieldrin.

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PHYTOREMEDIATION OF LEAD-CONTAMINATED SOILS USING TALL FESCUE (*FESTUCA ARUNDINACEA* L.). M. Ighoavodha, A. Butler, M.F.T. Begonia, and G.B. Begonia, Jackson State University, Jackson, MS 39217

Tall fescue (*Festuca arundinacea* cv. 'Spirit') had been found to tolerate and accumulate substantial amounts of lead (Pb) in its shoots when grown in Pb amended sand. To further evaluate the suitability of tall fescue for phytoextraction, a study was conducted to determine whether the timing of ethylenediaminetetraacetic acid (EDTA) application and acetic acid amendment can further enhance the shoot uptake of Pb. Seeds were planted in 1.9 L plastic pots containing top soil, peat, and sand (4:2:1, v:v:v) amended with various levels of Pb and EDTA. Generally, root and shoot growth of tall fescue were not significantly affected at the two lower Pb levels, but were inhibited at the two higher Pb treatments with preplanting EDTA amendments. EDTA significantly increased shoot Pb uptake. However, there was no difference in Pb uptake whether EDTA was applied before planting or a week before harvest. Addition of acetic acid to the growing medium one week before harvest, further enhanced shoot and root Pb uptake only in plants grown at 1000 ppm Pb.

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A STUDY OF THE EFFECT OF ULTRA VIOLET LIGHT ON RESIDENTS IN MISSISSIPPI. Amalee Jayasinghe and Pao-Chiang Yuan, *Department of Technology, School of Science and Technology, Jackson State University, Jackson, MS 39217.*

The depletion of the ozone layer has increased the amount of harmful ultra violet rays reaching the earth. This results in damage to human health, plants and the ecosystem. Studies have shown that UV radiation causes skin cancer known as melanoma, suppresses the immune system and causes premature wrinkling. The object of this study was to determine whether UV radiation had any effect in the number of cases of skin cancer reported in Mississippi. Health statistics were obtained from the Department of Health along with measurements of UV radiation using ultra violet sensor scales. Based on data obtained, we can conclude that UV radiation does cause an increase in skin cancer. This study will prove helpful in educating residents about the risks and ways to prevent skin cancers.

(24)

TRANSIENT EXPRESSION OF THE REPORTER GENE BETA GLUCURONIDASE IN SPARTINA ALTERNIFLORA EXPLANTS. Whitney H. Palefsky, Alisa G. Harkins and Chandra I. Franklin. *Marine Environmental Science and Biotechnology Research Center, Savannah State University, P.O. Box 20228, Savannah, GA 31410.*

The smooth cordgrass (*Spartina alterniflora*) is a dominant plant species in saltmarshes of southeastern United States, and it can account for up to 90% of biomass production. In anthropogenically impacted saltmarshes, interactions between *S. alterniflora* and sediment microbial communities appear to influence the uptake, transformation, and ultimate removal of contaminants including hydrocarbons, heavy metals and xenobiotics. A gene transfer system is being developed in an effort to utilize transgenic technology to produce genetically engineered *S. alterniflora* that can be used as a biosensor for heavy metal contamination in saltmarshes. Published protocols for genetic transformation or regeneration of *S. alterniflora* are not currently available. Therefore, studies in this laboratory focus on developing a gene transfer system and a compatible tissue culture system for regenerating transgenic *S. alterniflora*. As *Agrobacterium* mediated DNA transfer is not practical with grasses, particle bombardment mediated DNA delivery is being used. In this report, results from studies to optimize DNA delivery to fleshy young shoot explants of *S. alterniflora* are presented. The efficiency of DNA delivery was assessed based on transient expression of the reporter gene beta-glucuronidase (*gus*) as measured by the number of *gus* expressing units [(GEU) - blue spots resulting from the GUS histochemical assay]. Particle bombardment parameters such as helium pressure, vacuum level in the particle delivery chamber, particle travel distance, and the plasmid concentration were optimized for efficient DNA delivery. Obviously, increasing the plasmid concentration resulted in higher GEUs, whereas physical parameters controlling the velocity of particles greatly influenced the DNA delivery even at higher plasmid concentrations. Results from this study indicate that 1550 psi helium pressure, 28 inches of Hg chamber vacuum, 85 mm of particle travel distance and a plasmid concentration $\geq 1\mu\text{g/delivery}$ are optimal for DNA transfer to *S. alterniflora* explants.

(25)

TEMPORAL PATTERNS IN THE ABUNDANCE OF FISHES IN THE NEARSHORE

AREAS OF THE ROSS BARNETT RESERVOIR. ¹Raymond Portis, ¹Crockett, R., ¹Chigbu, P., ²Holman, T. & ²Bull, L. ¹*Department of Biology, Jackson State University, Jackson, MS 39217;* ²*Institute of Marine Sciences, Gulf Coast Research Laboratory, University of Southern Mississippi, Ocean Springs, MS 39566.*

Information on spatio-temporal patterns in the abundance of prey and predators is important for assessing the extent of their spatial overlap and therefore the degree of predation pressure exerted on the prey. We conducted day time electroshocking in the Ross Barnett reservoir to assess spatial and temporal patterns in the abundance and size structure of fishes in the nearshore areas. Electroshocking was carried out, approximately bimonthly, from July 1999 to July 2000 in four areas of the reservoir. In each area we made three consecutive fifteen minute collections. All fish were placed on ice for later processing in the lab., or preserved immediately after collection in 10% formalin. In the lab. the fishes were identified, counted, measured and weighed. Eighteen (18) species of fish were captured. Threadfin shad (*Dorosoma petenense*) and gizzard shad (*Dorosoma cepedianum*), important prey of largemouth bass (*Micropterus salmoides*) were the most abundant. Other abundant fishes were silversides and bluegill sunfish (*Lepomis macrochirus*). Abundances of threadfin and gizzard shad, and that of their major predator, largemouth bass increased in the nearshore areas of the reservoir from summer to fall.

(26)

EFFECTS OF CADMIUM ON THE BIOLUMINESCENCE OF VIBRIO FISCHERI, AND THE GROWTH AND OXYGEN UPTAKE OF A HETEROGENEOUS POPULATION OF MICROORGANISMS.

Lamar Reed and Paul B. Tchounwou, *Environmental Toxicology Research Laboratory, NIH Center for Environmental Health, School of Science and Technology, Jackson State University, 1400 J.R. Lynch St., P.O.Box 18540, Jackson, MS.*

Bacterial In vitro assays such as the Microtox Assay have become an attractive alternative to traditional and costly fish and invertebrate methods for toxicological screening. In this research, we tested the toxic effects of cadmium against a marine bacterium (*Vibrio fischeri*), and a heterogeneous population of bacterium derived from the Pearl River in Jackson, Mississippi. Using the level of bioluminescence (*Vibrio fischeri*), and the kinetic of dissolved oxygen uptake and growth (mixed bacterial population) as measures of toxicity, cadmium concentrations effecting 50% reduction in these parameters (EC₅₀) were determined as toxic endpoints. The activity quotients were also computed to determine the degrees of toxicity. Bacterial bioluminescence was assessed using the Microtox Assay. Optical density (measure of growth) and oxygen uptake were measured over an extended period of time (20 hours). EC₅₀ values of 0.79±0.12, 4.50±0.04 and 5.00±0.42 mg/L were recorded for bioluminescence, growth and oxygen uptake, respectively. As expected, these results indicated that *V.fischeri* was about one order of magnitude (8.3 times) more sensitive to cadmium toxicity than the mixed

population of Pearl River microorganisms. Reductions in bioluminescence, growth, and oxygen uptake were directly correlated to cadmium concentration, with toxic levels ranging from slightly toxic in lower concentrations, to extremely toxic in higher ones. Upon 20 hours of exposure, a strong correlation ($r^2=0.98$) was found between the times required to produce 50% reduction in dissolved oxygen concentrations (T50s), and the concentrations of cadmium, indicating a time-response relationship with respect to cadmium toxicity.

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CYTOTOXICITY OF ARSENIC TRIOXIDE AND MSMA TO HUMAN LIVER CARCINOMA CELLS: COMPARATIVE STUDY OF TWO BIOASSAYS. Tanya

Robinson, Paul B. Tchounwou, Barbara A. Wilson, Ali B. Ishaque, *Environmental Toxicology Research Laboratory, NIH- Center for Environmental Health School of Science and Technology, Jackson State University, 1400 Lynch Street, Box 18540, Jackson, MS 39217, USA*

Arsenic is the 20th most abundant element. It is released to the environment as a result of natural phenomena. Several adverse health effects have been associated with the exposure of Arsenic and its toxicity depends on the chemical species involved. Cytotoxicity is the study of effect of acute (high) concentration of chemicals on living cells. Diphenyltetrazolium Bromide (MTT) and Fluorescein Diacetate (FDA) assays are among the most widely used methods to test the cytotoxicity of various environmental compounds. The objectives of this research were to find the concentration of Arsenic needed to kill 50% (LC₅₀) of HepG2 cells (cytotoxicity), to compare MTT and FDA methods used in evaluating cytotoxicity of Arsenic, and to compare the toxicity of Arsenic Trioxide (inorganic form) and MSMA (organic form). HepG2 cells were grown with DMEM medium in a CO₂ incubator until maximum growth, after which cells were washed and trypsinized. Next, fresh medium was added and centrifuged at 3,000 rpm for 10 minutes. 180- μ l of cells at a density of 300,000 cells/mL were seeded into each well of two 96-well tissue culture plates. Next, 20 μ l of serial dilution of Arsenic (0.2, 0.4, 0.8, 1.6, 3.1, 6.3, 12.5, 25, 50 and 100ppm) and MSMA (2, 4, 8, 16, 31, 63, 125, 250, 500 and 1000ppm) were added columnwise. The FDA assay was conducted by washing the plates once and adding 100 μ l of 10ppm Fluorescein Diacetate solution columnwise to each well and placing the plates in the CO₂ incubator for 30-60 minutes before reading the fluorescence with the Spectrofluorometer. The MTT assay was conducted by adding 50 μ l of the 5,000ppm MTT solution to each well columnwise and placing the plates in a CO₂ incubator for 30 minutes. The medium was carefully removed and 200 μ l of DMSO was added to each well. The plates were incubated for 10 minutes in a CO₂ incubator and optical density was read at 405nm. The results showed there were no significant differences between the FDA and MTT assays based on the LC₅₀ values obtained from both assays. It is concluded that Arsenic Trioxide (inorganic) is more toxic than MSMA (organic Arsenic). The two methods gave comparable results and the difference in LC₅₀ between the two bioassays for Arsenic was not significant.

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CYTOTOXICITY AND PROLIFERATION STUDIES WITH SODIUM ARSENITE IN SKIN DERMAL FIBROBLASTS, THP-1, AND JURKAT CELLS. Dwayne J. Sutton¹, Paul B. Tchounwou¹, and Hari H.P. Cohly². ¹*Molecular Toxicology Research Laboratory, NIH-Center for Environmental Health, School of Science and Technology, Jackson State University, 1400 Lynch Street, Box 18540, Jackson; MS 39217;* ²*Department of Plastic Surgery, University of Mississippi Medical Center, Jackson, MS 39216*

Ingestion of arsenic affects primarily the skin by causing keratotic lesions that may lead to cancer. Contamination of well water with arsenic leached from underground sediments leads to the formation of these pre-cancerous skin lesions due to arsenic ingestion. It has been proposed that the mechanism underlying the unique properties of arsenic involves changes in mitogenic signaling. Based on the hypothesis that arsenic exposure results in the modulation of both positive and negative regulators of cell proliferation, this study examined the acute cytotoxicity and proliferation of dermal fibroblasts, monocytes (THP-1) and T cells (Jurkat) in the presence of different concentrations of arsenic. Cytotoxicity was assessed by incubating THP-1 and JKT cells in RPMI 1640 and dermal fibroblasts in Iscove's DMEM with 10% fetal bovine serum, 1% streptomycin and penicillin for 96 hrs in 96-well microtiter plates, at 37°C in a 5% CO₂ incubator. Cell proliferation in 96-well plates was determined in cultured cells exposed for 24, 48, and 72 hours, using the MTT assay. The concentrations of sodium arsenite effecting 50% reduction in cell viability were found to range from 25 ppm to 50 ppm for all the cell-lines tested. The peak proliferation for Jurkat cells was 6 ppm and that for THP-1 and dermal fibroblasts was 1.5 ppm. These results show that arsenic affects proliferation at different concentrations for different cells.

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PHYSICO-CHEMICAL AND BACTERIOLOGICAL ASSESSMENT OF THE WATER QUALITY IN THE ROSS BARNETT RESERVOIR IN CENTRAL MISSISSIPPI. Paul B. Tchounwou, and Mike Warren. *Environmental Toxicology Research Laboratory, NIH-Center for Environmental Health, School of Science and Technology, Jackson State University, 1400 Lynch Street, Box 18540, Jackson, Mississippi 30217, USA.*

Ross Barnett Reservoir (RBR) serves as a source of water supply for the city of Jackson, Mississippi. It also constitutes an important site for recreational activities for many Mississippi counties' residents. A broad spectrum of illnesses have been associated with water-contact activities such as bathing, and swimming in recreational waters. In this research, we assessed the bacteriological quality of water in the RBR, and compared the bacteria levels to recommended criteria for public health protection. From 06/12/99 to 10/02/99, weekly water samples were collected from two different sites in the reservoir, and tested for a number of bacteriological parameters including: heterotrophic plate counts (HPC), total coliforms (TC), fecal coliforms (FC), and fecal streptococci (FS). Collected samples were also tested for basic physical and chemical characteristics of water. Study results indicated that the mean concentrations of bacteria at the two sampling sites were $5.6 \times 10^6 \pm 1.5 \times 10^6$, $4.5 \times 10^4 \pm 5.3 \times 10^4$, $5.0 \times 10^2 \pm 1.6 \times 10^2$, and $9.1 \times 10^1 \pm 7.3 \times 10^1$ colony forming units per 100 mL of water for HPC, TC, FC, and FS,

respectively. The values of physical and chemical parameters were at acceptable levels. However, bacterial densities often exceeded federal/state guidelines by several orders of magnitude, raising considerable public health concerns.

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INFLUENCE OF PLANT GROWTH REGULATOR LEVELS AND NITROGEN CONTENT ON CALLUS INDUCTION FROM *SPARTINA ALTERNIFLORA*

EXPLANTS. Laurie M. Thomas, Donna E. McDowell, Kashandra L. Jackson, Archie R. Hayes, Whitney H. Palefsky and Chandra I. Franklin. *Marine Environmental Science and Biotechnology Research Center, Savannah State University, P.O. Box 20228, Savannah, GA 31410.*

In saltmarshes of southeastern United States, smooth cordgrass (*Spartina alterniflora*) is a dominant plant species, and it can account for up to 90% of biomass production. Transgenic technology is being developed to genetically engineer *S. alterniflora* for use as a biosensor for heavy metal contamination in saltmarshes. An efficient tissue culture/regeneration system is needed for developing the transgenic technology. Callus induction is the initial response of explants cultured *in vitro*. In this report, results from studies to optimize plant growth regulator levels as well as nitrogen source and content of the tissue culture medium for callus induction are presented. Fleshy young shoot explants of *S. alterniflora* were cultured on medium containing various levels of a cytokinin [6-benzylaminopurine (BAP)] and an auxin [2,4-Dichlorophenoxy acetic acid (2,4-D)]. Similar explants were also cultured on medium containing organic or inorganic nitrogen source. Fleshy young shoots cultured on medium containing high levels of BAP (>5 μM) and 2,4-D (>20 μM) showed typical callus induction patterns. High levels of inorganic nitrogen content (20 mM ammonium 39.4 mM nitrate ions) in the culture medium caused necrosis and rapid death of explants, whereas explants cultured on medium containing low levels of inorganic nitrogen (7 mM ammonium and 28 mM nitrate ions) or an organic nitrogen source showed sustained growth. Results from these experiments indicate that organic nitrogen or low levels of inorganic nitrogen and high levels of a cytokinin and an auxin promote callus induction from young shoot explants of *S. alterniflora*.

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PM-2.5 MONITORING IN FLAGSTAFF DURING THE PRESCRIBED BURN AND RESIDENTIAL WOOD BURNING SEASONS.

Amanda Thompson and Marin Robinson, *Northern Arizona University, Flagstaff, Arizona.*

In 1997, the EPA passed a law to regulate fine particulate matter (PM-2.5), in addition to coarse particulate (PM-10), targeting particles with aerodynamic diameters $\leq 2.5 \mu\text{m}$. These regulations were promulgated due to concerns that fine particles can become lodged in the lungs and thereby contribute to pulmonary disease. In addition to health concerns, PM-2.5 contributes to visibility impairment and climate change, since small particles scatter visible light and increase albedo in cloud-free portions of the atmosphere. Major sources of PM-2.5 include fuel combustion, agricultural burning, and forest fires (natural or prescribed). Concomitant with the new PM-2.5 standards has been an expressed desire by Federal, tribal, and State land managers

to use prescribed fire as a method for restoring wildland ecosystems. The fire-suppression policy of the 20th century (1910-1990) has left national forests in an unhealthy state, characterized by dense undergrowth and heavy fuel loads, increasing the likelihood of catastrophic wildfire. The potential benefits of prescribed fire are great, yet the smoke generated by such fires may put public health and welfare at risk. Thus the need to speciate chemical components of wood smoke, and identify those components with greatest toxicity, is an issue of primary importance.

To address this concern, we initiated a pilot project to collect PM-2.5 from wood smoke in Flagstaff, AZ. Flagstaff is located in the Coconino National Forest, the largest continuous ponderosa pine forest in the United States. Ongoing and proposed ecological restoration initiatives for this forest include the combined use of mechanical thinning, pile burns, and broadcast burns. Four portable air monitors (AirMetrics) were located at selected sites in Flagstaff to collect 24-hour samples of PM-2.5 during the prescribed burn season (Summer-Fall 2000) and residential wood burning season (February-March 2001). Monitors were operated as saturation samplers, to determine if the EPA 24-hour standard ($65 \mu\text{g}/\text{m}^3$) had been exceeded. Monitoring results and plans for future PM-2.5 speciation studies during prescribed burns of the Coconino National Forest will be reported.

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EFFECTS OF SALINITY ON DEVELOPMENT OF *HYLA REGILLA* EMBRYOS. Ezra Yohannes, *Shaw University, Raleigh, NC and Vandergon, Davis, Brewster, Plank, Martin and Kats, Natural Sciences Division, Pepperdine University, Malibu, CA.*

Chemical contamination in fresh water streams and lakes may have detrimental affects on amphibian species. The affect of salinity (0-7 ppt) on embryonic development, growth and survival in the Pacific tree frog *Hyla regilla* was examined. *Hyla regilla* embryos exposed to < 4 ppt showed normal developmental rates and survivability, whereas embryos exposed to 5 ppt salt concentration showed decreased survival, slower development and abnormal growth. Embryos exposed to 6 or 7 ppt showed slow growth, abnormalities and did not survive to hatching.

ATMOSPHERIC SCIENCES

(33)

A STUDY OF TORNADO FORMATION AND ASSOCIATED TOPOGRAPHY IN ARKANSAS. Ashton Robinson Cook, *Jackson State University, Jackson, Mississippi 39217*

A study was performed on severe thunderstorm activity and tornado formation in Arkansas in relation to topography. On March 1, 1997, January 21, 1999, and February 24, 2001 mid latitude cyclones affected Arkansas by spawning tornado outbreaks. Some areas were affected multiple times by these outbreaks as tornadoes hit these areas. The study indicated that topographical difference plays a helpful role in the formation and development of tornadoes which increases the frequency of tornadoes occurring within the areas of topographical differences in Arkansas. More specifically, tornadoes can be focused in these areas where the

traits of the landscape change from Ozarks and Ouachita Mountains to the north and west to the flat lands and delta regions of the south and east. The study also illustrates that there is a correlation between this “tornado alley” and the frequency and strength by which these tornadoes exhibit as they propagate through these areas.

(34)

FAST-RESPONSE ENVIRONMENTAL TEMPERATURE SENSOR CALIBRATIONS.

Quentin Cowans, Thomas Smith, and Randal L. N. Mandock, *Morehouse College, Earth System Science Program, Clark Atlanta University, 223 James P. Brawley Dr., SW., Mail Stop 241, Atlanta, GA 30314.*

A number of methods have been devised over the years to measure the fluxes of sensible and latent heat near the air/land interface. Indirect methods include profile, Bowen-ratio, Priestley-Taylor, Penman-Monteith, bulk-transfer, gradient, structure function, and others. The direct method of surface flux measurement is referred to as eddy correlation, where fluxes are determined as covariances of the perturbations of meteorological variables. In the eddy correlation method, vertical kinematic sensible heat flux is simply $\langle w'T' \rangle$, and vertical kinematic latent heat flux is $\langle w'q' \rangle$, where w' represents the vertical component of the perturbation wind vector, T' is the perturbation dry bulb temperature, q' is the perturbation specific humidity, and $\langle \rangle$ represents an averaging operation. The Earth System Science Program at Clark Atlanta University (CAU) has begun to calibrate fast-response wind, temperature and humidity sensors for later deployment in eddy correlation measurements of evaporation, momentum, buoyancy, and sensible heat flux. Initial test data for calibration spectra, averages, and flux measurements are reported. These measurements were made on the roof of the Research Center for Science and Technology at CAU.

(35)

DETERMINATION OF THE OPTICAL EFFECTS OF ATMOSPHERIC AEROSOLS USING SUN PHOTOMETERS.

Adwoa K. Gyekye, *Clark Atlanta University, Department of Physics*

The Clark Atlanta University (CAU) Earth System Science program operates an Atmospheric Optics Observatory on the roof of the Research Center for Science and Technology. This observing facility provides a platform for instruments used to monitor the amount of solar energy reaching Earth's surface throughout the day. An Ascension Technology RSP (Rotating Shadowband Pyranometer) measures the global, direct, and diffuse radiation at the surface for visible wavelengths. In addition, a NOAA automated weather station operated at the observing site provides meteorological data on atmospheric pressure, temperature, humidity, wind speed, and wind direction. The ultimate goal of this project is to be able to model the effects of atmospheric haze (aerosol particles) and water vapor variations on the total amount of energy from the sun that reaches the surface. To improve our ability to interpret data obtained by the RSP and the meteorological instruments, CAU is developing a simple, inexpensive atmospheric haze sensor that uses an LED (light-emitting diode) as a narrow-band detector. Six different LED wavelengths are available, and data from such a device operated throughout the

day at multiple wavelengths can be used to determine the fraction of incident solar energy that has been lost due to the total amount of haze and water vapor in the atmosphere. Sun photometers have been built and operated for each of the different LED wavelengths. The sun photometer measurements are analyzed by plotting the natural logarithm of the solar radiances measured with the photometer versus the secant of the zenith angle of the sun at the time of each observation (Langley plots). The optical thickness of the atmosphere is obtained by measuring the slope of the plotted line. Results obtained with the CAU sun photometers will be presented.

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SODAR OBSERVATIONS OF THE ATLANTA URBAN BOUNDARY LAYER.

Ilomechina, Sochi and Randal L. N. Mandock, *Clark Atlanta University, Earth System Science Program, 223 James P. Brawley Dr., SW. Mail Stop 241, Atlanta, GA 30314*

An Aerovironment 300C monostatic sodar was installed on the roof of the Research Center for Science and Technology at Clark Atlanta University in summer 2000. The sodar is located about one mile west of downtown Atlanta, 22 meters above ground level, in a medium height and density urban environment.

The sodar is currently operating in the facsimile mode, but existing software is under revision to enable it to produce Doppler vertical wind speed and variance measurements early in 2001. Facsimile records showing meteorological phenomena such as fog and low cloud layers, frontal passage, rise and descent of the convective boundary layer, and nocturnal structure at the top of the boundary layer will be described and compared with meteorological data from our rooftop weather station.

(37)

INTER-COMPARISON OF REBS Q³7.1, PDS7.1, & THRDS7.1 RADIOMETERS'S PERFORMANCE CHARACTERISTICS.

Dwayne C. Joseph & J. Quentin Cowans, *Clark Atlanta University, 223 James P. Brawley Drive, Atlanta, GA 30314*

Radiometers are instruments used for detecting and measuring the intensity of radiant energy. With the use of net radiometer, total hemispherical radiometer, and a pyranometer these instruments will assist in studying the radiative balance within the atmospheric boundary layer in Atlanta. Furthermore, this research will take into account the role clouds and surface albedo partake in comprising the radiative balance.

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AN INTERCOMPARISON OF TWO ULTRASONIC ANEMOMETERS. Pierson, Bryant R. and Randal L. Mandock, *Clark Atlanta University, 304 Lakeside Village Dr., Atlanta, GA 30317*

A low cost R.M. Young Ultrasonic anemometer was intercompared with a more expensive Solent Research Ultrasonic anemometer. Mean and standard deviations, comparability, and bias of wind speed, wind direction, the vertical wind component, and the speed of sound were calculated. Also presented in this research are response characteristics of the sensors, computed accuracy, momentum and buoyancy flux, and virtual temperature.

(39)

GAS TRAPPING IN VAPOR DEPOSITED WATER-ICE FILMS (90-145 K). Brian Raymond and Marin Robinson, *Northern Arizona University, Flagstaff, Arizona*

Water-ice is abundant throughout the solar system and can influence both atmospheric chemistry and composition. One way in which ice influences composition is by trapping and transporting gases, such as with comets. As comets form, the amount of gas trapped depends, in part, on the phase of the condensing ice (amorphous or crystalline). As a comet approaches the Sun, amorphous ice crystallizes, releasing some of the trapped volatiles. Eventually the comet sublimates, releasing the rest. The purpose of this study was to investigate this process with CO₂, CH₄, CO, and N₂. In a high vacuum chamber, a thin film (375 nm) of amorphous (90-110 K) or crystalline (110-145 K) ice was co-deposited with a selected gas (10:1 gas: water) on a pre-cooled Al substrate. The film was annealed (1K/min) through the phase change (147-153 K) and sublimation of the ice film (162-183 K). The phase change was monitored using grazing-angle Fourier Transform Infrared-Reflection Absorption Spectroscopy, while the gas release was detected using integrated flux to a mass spectrometer. Results show that all four gases were trapped by ice. CO₂, and to some extent CH₄, were released during the phase change and sublimation; N₂ and CO were released only during sublimation. Amorphous ice trapped more CO₂ than crystalline ice, but roughly equal amounts of N₂, CH₄ and CO

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DIAGNOSING AND PREDICTING EXTREME PRECIPITATION EVENTS IN SOUTHEAST BRAZIL. Aisha C. Reed and Brant Liebmann. *NOAA Climate Diagnostic Center*

Extreme daily precipitation events that occurred in Sao Paulo, Brazil from 1979-1995 during the austral summer are examined to document the atmospheric conditions associated with their occurrences. In this study, events are studied in which 14% and 30% events of the average seasonal total rainfall fell in one day at, at least one station. Mean composites and anomalies are obtained for the 500-millibar heights, to make synoptic patterns, and outgoing longwave radiation (OLR), to observe convection, for the day of and days preceding and following the event. There is a stationary trough on the days preceding and the day of the event, and the OLR

indicates that convection is in the area at least one day before the event and begins to dissipate the day after an event.

(41)

RAINFALL ESTIMATES OVER WEST AND CENTRAL AFRICA FROM TRMM PR, TRMM MERGED, CMAP, GPCP AND SSM/I: A COMPARISON OF THE INTERANNUAL VARIABILITY FOR 1998 AND 1999. Andrea Sealy and Gregory Jenkins. *Department of Meteorology, Pennsylvania State University, 503 Walker Building, University Park, PA 16802.*

The accurate measurement of tropical rainfall is essential to understanding interannual variability, climate change, the hydrologic cycle and its link to the general circulation. There are numerous methods for estimating tropical precipitation including rainguages, the Special Sensor Microwave Imager (SSM/I) satellite, Outgoing Longwave Radiation (OLR) measurements and, more recently, the Tropical Rainfall Measuring Mission (TRMM) satellite which carries as one of its precipitation measuring instruments the first space-borne precipitation radar (TRMM PR). These data sources differ in their rainfall estimates over the tropics due to differences in horizontal resolution as well as spatial and temporal sampling. In this study I have compared the interannual variations in rainfall estimates for 1998 and 1999 during the West and Central Africa wet seasons from TRMM PR, TRMM Merged, CPC Merged Analysis of Precipitation (CMAP), Global Precipitation Climatology Project (GPCP) and SSM/I data. Previous results for West Africa have shown that the TRMM PR and TRMM Merged rainfall estimates differ in the intensity and occurrence of maximum rainfall during June-August 1998. The results from this study point to differences in the amount of rainfall estimated by the different datasets and the occurrence of maximum rainfall during the rainy season. The results also indicate differences in inter-annual variability of the rainfall estimates from the five datasets.

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A STUDY OF PREDICTIVE MODELS FOR FORECASTING TROPICAL CYCLONE AND HURRICANE ACTIVITY OVER THE GULF OF MEXICO. James Dacia Sims and R. Suseela Reddy. *Department of Physics, Atmospheric and General Sciences, Jackson State University, Jackson, MS*

Predictive models including a) a regression model and b) Hurricane Predictive Index (HPI) have been developed for predicting the origin and evolution of tropical cyclones and hurricanes over the Gulf of Mexico. These models describe the air-sea interactions and associated tropical cyclone and hurricane activity using NOAA GOES satellite data and data from buoys in the Gulf of Mexico. These models were tested for 1999 (August 18-25) Hurricane Bret, that was formed and developed in the Gulf of Mexico. The models simulated and predicted the air sea interactions and associated tropical cyclone/hurricane activity.

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CHARACTERIZATION OF FORTY-TWO YEARS OF RAINFALL DATA FOR EARLY COUNTY, GA. Monesa Watts¹ and Donald Perkey², ¹*Jackson State University, Jackson, MS;*

²*Global Hydrology and Climate Center, Huntsville, AL.*

Knowledge of water supply and demand associated with rural and agricultural communities may be greatly beneficial with regard to periods described by water deficit. One of the most important parameters associated with water deficit is the amount of rainfall. The purpose of this study was to determine the frequency of occurrence and intervals between rainfall amounts along with calculating the mean and standard deviation for Blakely, GA located in Early County. Daily precipitation totals along with the climatology for the region were obtained from the Southeast Regional Climate Center through the University of Georgia's Website. Excel was used to evaluate all collected data and to estimate the mean rainfall amount; the frequency of precipitation amounts were found to be greatest in March and decrease throughout the following months with a slight increase in July over the forty-two year period. Regarding intervals between daily rainfall, there were greater occurrences of consecutive days without rainfall than consecutive days with rainfall. Data Analysis of spectral distribution of precipitation, frequency of precipitation events, and intervals between precipitation days led to a characterization of precipitation for Early County, GA.

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SOME ASPECTS OF AIR-SEA INTERACTIONS AND ASSOCIATED TROPICAL CYCLONES OVER THE GULF OF MEXICO USING SATELLITE AND BUOY DATA.

Ashley Zachary and R. Reedy, *Dept. of Physics, Atmospheric Sciences and General Science, Jackson State University, MS 39217*

Under the NASA FAR program, a study has been undertaken for investigating some aspects of air-sea interactions and associated tropical cyclones over the Gulf of Mexico using satellite data. In the present study, we investigated the air-sea interactions for Hurricane Gordon and the related hurricane activity for the year 2000. NOAA satellite GOES imagery and buoy data from NDBC for sea surface temperature and other meteorological variables were used in the to calculate heat, momentum, and moisture fluxes during the formation and development of hurricanes. The study suggested that a) sea surface temperature was maximum (29°), b) a 3-5 day oscillation in the heat flux was noticed before the 3 days of the hurricane formation, and c) a strong correlation was noticed between heat fluxes and the sea level pressure.

ABSTRACTS FROM RESEARCHERS AND RESEARCH ORGANIZATIONS

OCEANIC/MARINE AND FISHERIES SCIENCES

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ATLANTIC COD AND HADDOCK EGGS ON GEORGES BANK, 1995 TO 1997; INTERANNUAL VARIATION IN DISTRIBUTION, ABUNDANCE AND MORTALITY RATES. Peter Berrien and John Sibunka, *NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands, NJ 07732*

GLOBEC Broadscale Surveys on Georges Bank were implemented to assess bank-wide features on a monthly basis during the first half of the calendar year. These surveys provide information on distribution and abundance and on biological rates such as mortality/survival and growth of planktonic life stages of target species. This bank-wide approach provides some of the 'big picture' examination of potential factors in the determination of recruitment rates, as compared to the more focused approach of 'process studies'. Analysis of egg collections of the two targeted fish species, Atlantic cod and haddock, provides the starting point in a 'life table' assessment. It is assumed that egg production rate parameters can be linked with those of larvae, and with the adult stocks that produced them. Additionally, because eggs are passive constituents of the plankton their fate can be strongly influenced by circulation patterns on the Bank.

(46)

A TRIBAL TRAINING AND DEMONSTRATION PROJECT ON SHELLFISH AQUACULTURE: A NORTHWEST INDIAN COLLEGE AND WASHINGTON STATE UNIVERSITY COLLABORATION. Gleyne E. Bledsoe, *Northwest Indian College, 2522 Kwina Rd., Bellingham, WA 98226*

The Northwest Indian College (NWIC), in collaboration with Washington State University (WSU), established a Tribal Shellfish Extension Training and Demonstration Facility at the campus of NWIC. The facility is used to train conventional NWIC students and Native American's who desire to establish their own shellfish farms or to work in shellfish aquaculture. It is administered as part of the NWIC/WSU Cooperative Extension Program serving the tribal and non-native communities within the states of Washington, Oregon, and Alaska. The facility also provides Washington State University with a marine aquaculture facility that is available to their Cooperative Extension and academic programs. Previously, WSU did not have such a facility.

An integral part of the project was the development of a shellfish demonstration area in which students can physically construct and experience several methods of shellfish aquaculture. Another function of the demonstration area is to conduct research into new methods of husbandry that improve shellfish growth, permit shellfish grow out in bottoms that are not otherwise suitable for such, and to reduce adverse impact to the environment. An example of this was the construction and maintenance of a modified post and longline system to grow Pacific Oysters (*Crassostrea gigas*) in an area plagued by severe wind/tidal damage that previously prevented successful grow out. In

addition, the area was the site of a sensitive eelgrass bed. The successful results of the project and information pertaining to the facility in general are presented.

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A PRELIMINARY ANALYSIS OF GROWTH DATA OF JUVENILE LOGGERHEAD (*CARETTA CARETTA*) SEA TURTLES FROM NORTH CAROLINA, U.S.A. Joanne Braun-McNeill¹, Sheryan P. Epperly², Larisa Avens³, and Samuel Sadove⁴. ¹NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort, North Carolina 28516; ²NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida 33149; ³NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort, North Carolina 28516; ⁴Long Island University, Southampton College, Southampton, New York 11968.

Determining the age at which sea turtles mature is vital to understanding sea turtle demography, thereby facilitating conservation management practices. However, as sea turtles cannot be aged based on external characteristics, it is only possible to estimate the age at maturity using indirect methods such as measuring the growth rates of wild, recaptured turtles. Previous studies have documented a higher rate of growth for wild, juvenile loggerhead (*Caretta caretta*) sea turtles in the southern Bahamas and Florida than in Virginia. The National Marine Fisheries Service sea turtle program in Beaufort, North Carolina has been conducting mark-recapture studies in Core and Pamlico Sounds, North Carolina since 1988, and has tagged a total of 978 loggerhead (*Caretta caretta*) sea turtles, most of which were incidentally captured in commercial pound nets. Data from the New York State Marine Turtle Project were also included in the analysis. Straight-line measurements of carapace length (notch-tip) taken for each turtle ranged from 41.4-103.0cm. External Inconel Style 681 tags applied to both rear flippers and internal passive integrated transponder (PIT) tags injected into the left front flipper enabled identification of recaptured turtles. Growth rates (Carapace length initial - Carapace length at recapture / Years at large) were assigned to a 10cm size class based on the mean of the initial and recapture length and averaged. Multiple t-tests were used to calculate differences in mean growth rates among the recaptured loggerheads from the different regions of the western Atlantic. To date, 29 loggerheads have been recaptured after being at large for 11 months or more, allowing for measurable growth. Similar to Virginia, North Carolina and New York had slower growth rates compared to Florida and the Bahamas although these differences were not always significant. Differences in growth rate have been attributed to the seasonal availability of food as well as the costs associated with seasonal migrations. Growth rates may also vary depending upon the genetic composition of the respective populations. This may have important ramifications for the management of the declining northern nesting population of loggerhead sea turtles.

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LARVAL HATCH FECUNDITY FOR A STOCK OF FRESHWATER PRAWNS RAISED IN ARIZONA. George B. Brooks, Jr., *Adjunct Assistant Professor, Wildlife and Fisheries Resources, University of Arizona, Tucson, AZ*

Successful prawn hatchery management requires a knowledge of the number of brood stock required to produce a defined number of postlarvae. In *Macrobrachium rosenbergii*, Larval Hatch Fecundity (LHF) is defined as the number of larvae released from the egg mass following incubation. In the literature there are two reported values for average LHF, 1,000 larvae per gram of female prawn weight and approximately 400 larvae per gram of female prawn weight. The research detailed in this paper explores the LHF for a stock of *M. rosenbergii* commonly available in the United States. The results suggest a LHF value close to 400 for this particular stock of prawns. This particular LHF value could be the result of a number of factors including environmental, genetic differences and differences in rearing technique.

(49)

AQUACULTURE AS A TOOL TO TEACH SCIENCE IN THE GILA RIVER INDIAN COMMUNITY. George B. Brooks, Jr. and Joyce Baldwin, *Department of Land and Water Resources, Gila River Indian Community, P.O. Box C, Sacaton, Arizona 85247*

An environmental/science education program designed to provide a fundamental understanding of biological and environmental science for K-12 students has been initiated in the Gila River Indian Community (GRIC) near Phoenix Arizona. As part of this program, aquaculture was used as a method for teaching the scientific method, cell biology, mathematics, development and ecology. This 9 school program was designed to prepare O'otham (Pima) and Pee Posh (Maricopa) students for careers in natural resource management or as preparation to enter college. The program included gaining experience in tilapia egg incubation and tilapia growth studies.

The breakthrough for the concept occurred in 1997 when students from Estrella school on the Community, took a 4th place with a tilapia culture project at the International Science fair. In 1999, students from Vechij Himdag MashchamakuD (New Pathways to Learning) alternative high and middle school on the Gila River Indian Community, competed in the 46th annual Central Arizona Regional Science and Engineering Fair and took home three awards. Most recently a pilot scale commercial fish farm at the GRIC Juvenile Detention and Rehabilitation facility has been added to the program.

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AN OVERVIEW OF THE TRIP INTERVIEW PROGRAM. Pamela Brown-Eyo, *NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149.*

NOAA- Fisheries, Southeast Fisheries Science Center maintains several fisheries statistical data collection programs. These programs collect information that is used to manage the marine fish stocks of the South Atlantic Ocean. One of those commercial fisheries databases

is the Trip Interview Program (TIP). The TIP program provides details such as size frequency for species landed. TIP sampling is conducted throughout the southeast states and Puerto Rico and the US Virgin Island. In each area a TIP Scientist monitors the local marine fishing activity. The Scientist interviews the fishermen and collects fish measurements and biological samples on individual fish from the fishing trip. These interviews provide specific information, such as, area fished, hours fished, species landed, the pounds landed, the length of the fish or the width of the crabs, the species sex and the otoliths for age determination. This data is used to evaluate the growth and health of the fish populations. Since 1985, the TIP program has interviewed 49,891 commercial fishing trips, collected data on 543 species of marine fish and shellfish, measured the length of 2,993,933 individual species, and removed 98,380 otoliths for aging studies. The TIP program continues to provide detailed data for the management of the Nation's marine resources.

(51)

PRELIMINARY INVESTIGATIONS OF CRAB PREDATION ON BAY SCALLOPS.

Joseph Choromanski and Sheila Stiles. *NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT 06460*

In the course of bay scallop aquaculture research conducted at the National Marine Fisheries Service Laboratory in Milford, CT, excess scallops were donated to Connecticut municipal shellfish commissions for free-planting in area waters. The practice of free-planting or tossing seed scallops (10 - 40 mm) directly into the water has come under scrutiny because of the observable decreasing return in the number of adults (>60 mm) caught by recreational fisherman in the towns that have such policies. Field studies of bay scallops have suggested a variety of causes for population fluctuations including habitat loss, genetic inbreeding depression, and predation. It is generally known that crab predation can be a major factor in survival and growth of bay scallops for reseeding or stock enhancement efforts, especially in sites devoid of eel grass which can serve as a refuge for small scallops.

To evaluate crab predation on scallops, an experimental study was conducted with green crabs (*Carcinus maenas*) in the laboratory. Six treatment aquaria with 10⁰ C flowing seawater were established with a single crab and 10 scallops. A seventh aquarium, with 10 scallops and no crab to check for non-predator related mortality, was used as a control. Four separate trials were run with scallops in each of the following size classes: 10, 20, 30 and 40 mm shell height. Trials were duplicated with a second set of crabs and scallops. Observations were made at 1, 6, 20, and 48 hours for each study. Results indicated that larger-sized scallops had higher survival rates, indicating some degree of refuge from predation by green crabs. In addition, damage to scallop shells was manifested in a characteristic appearance which could be used in identifying mortality by crab predation in the field.

A smaller scale project involved a comparison of bay scallop predation by Asian shore crabs (*Hemigrapsus sanguineus*) versus similar-sized green crabs. Six containers were set up for each crab species with fifteen scallops and one crab per container. The shell height of scallops ranged from 6-8 mm and the carapace width of crabs ranged from 18.0 to 25.3 mm. Observations were made after 48 hours when the experiment was terminated. The most notable difference was the number of scallops eaten by the male and female crabs. Generally, male

crabs ate all of the scallops in their containers, while the female crabs ate very few to none. This difference could be attributed to the larger size of the claw of the male crabs. There was a slight difference in the number of scallops eaten by the green crabs versus Asian shore crabs. These observations can be used for planning purposes when attempting to enhance or replenish scallop populations.

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POPULATION ENHANCEMENT EFFORTS FOR THE BAY SCALLOP, *ARGOPECTEN IRRADIANS*, IN THE NIAN TIC RIVER ESTUARY, CONNECTICUT, USA. Ronald Goldberg¹, Jose Pereira¹, Paul Clark¹, Bernard Faber², David Porter², Lorenz Rinek², Barbara Kanter², Eric Kanter² and Walter Lord². ¹NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT 06460; ²Waterford East-Lyme Shellfish Commission, 5 Rope Ferry Road, Waterford CT 06385

The Niantic River supports presently a small population of bay scallops, *Argopecten irradians*, that is harvested recreationally. Numbers of bay scallops have fluctuated greatly with a peak level estimated as high as 20 million animals in the 1940s (Marshall, 1960). Three potential enhancement strategies were evaluated: 1) collection of natural spatfall, 2) direct re-seeding, and 3) over-wintering of hatchery-reared stock for creation of spawner sanctuaries. Assessment of natural spatfall in 1997 indicated that peak spawning occurred in late July and that spat were dispersed widely, however, too few spat were available for enhancement activities. In direct re-seeding experiments, time of planting and the inferred predation intensity were major factors affecting survival, while planting density had no significant effect. The Waterford East- Lyme Shellfish Commission (WELSCO) held 26,000 bay scallops in suspension culture during the 1998 – 1999 winter, of which, 60 - 80 % survived and spawned during the summer of 1999 within mobile spawner sanctuaries (cages suspended on long-lines). This effort is being repeated during 1999 – 2000. An annual recreational harvest survey has been initiated to assess enhancement activities. The pro-active approach of WELSCO in using aquacultural methods for enhancement of bay scallop populations is appropriate when natural recruitment is poor and habitat and environmental conditions are not limiting.

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A CONTRIBUTION TO THE EARLY LIFE HISTORY OF DEEP-SEA SMELTS (FAMILY: BATHYLAGIDAE) IN THE GULF OF MEXICO. Alonzo N. Hamilton, Jr. and Joanne Lyczkowski-Shultz, NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula Facility, 3209 Frederic St., P.O. Drawer 1207, Pascagoula, MS 39568-1207

Five species in a single genus of deep-sea smelts occur in the central western Atlantic and among these the larvae of only three species have been described; *Bathylagus bericoides*, *B. longirostris*, and *B. compsus*, Southeast Area Monitoring and Assessment Program (SEAMAP) ichthyoplankton collections are taken in the deep ocean habitat of these fishes within the Gulf of Mexico only during April to June with infrequent observations during winter months. Under current SEAMAP protocols bathylagid larvae are initially identified to the family level y

scientists at the Polish Sorting and Identification Center in Szczecin, Poland. A recent synthesis of existing literature on the Bathylagidae uncovered numerous questions concerning their nomenclature, species validity and larval identification. Reexamination of archived bathylagid larvae from Gulfwide collections has allowed us to describe the distribution of the larvae of these fishes and to investigate their occurrence relative to oceanographic conditions and features in the deep Gulf.

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CONTINUING THE LEGACY OF MARINE EDUCATION AND RESEARCH PARTNERSHIP: THE SAVANNAH STATE UNIVERSITY/ NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION COOPERATIVE MARINE EDUCATION AND RESEARCH PROGRAM: (SSU/NOAA CMER). Dionne L. Hoskins, *NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Savannah State University, Savannah, Georgia 31404*

The Cooperative Marine Education and Research (CMER) Program was established on February 6, 1995 when a Memorandum of Understanding was signed between Savannah State University (SSU) and the National Oceanographic and Atmospheric Administration (NOAA). The relationship between NOAA and SSU is a long-standing one. NOAA has provided substantial guidance and support to Savannah State University for almost 30 years, beginning in the early 1970's when the university first began offering marine science courses and in 1979 when SSU formalized a Bachelor of Science degree in Marine Biology. NOAA has continued to provide vessels, dive training, student support and capacity-building assistance to Savannah State University while Savannah State University has offered research, education products, and information to NOAA through formal grants, contracts, and Memoranda of Understanding since 1981. The relationship between NOAA and SSU has now been expanded to provide for even more active cooperation in the advancement, organization, and operation of marine research, education, in-service training, and demonstration programs. In its first year, the CMER program has supported several coordinated research and education programs funded by Sea Grant and the Department of Education. These include internship opportunities that expose students to marine aquaculture and workshops in statistical analysis, research presentation and website design, and marine-related geographical information system (GIS) applications.

(55)

NOAA'S CENTER FOR COASTAL FISHERIES AND HABITAT RESEARCH: A JOINT NOAA FISHERIES AND NATIONAL OCEAN SERVICE FACILITY. Donald E. Hoss, *101 Pivers Island Road; Beaufort, NC 28516*

Founded in 1899, the laboratory has served under various government agencies since opening. Currently there are 75 +employees, plus port samplers, post-doctorate researchers, graduate and undergraduate students who staff the laboratory. Research topics are broad in scope and support NOAA's goals to build sustainable fisheries, sustain healthy coasts, and recover protected species.

Organizational structure of the Center consists of one research branch with 9 teams conducting research on environmental and fishery questions. Applied Spatial Ecology and Habitat Characterization, Coastal Ecosystem Research and Restoration, Fisheries Oceanography and Ecology, Plankton Ecology and Physiology, and South Florida Fish Ecology and Contaminants teams address environmental issues related to ecology of living marine resources in various habitats. Research projects involve ecological processes in salt marshes and seagrass beds and the fish and shellfish that utilize them in locations ranging from Virginia to south Florida to Louisiana, Texas, and California coasts. State of the art ecological, chemical, biochemical, and satellite imagery methodologies are used in the course of these studies. Fisheries focused investigations are conducted by the Fish Biology, Population Dynamics and Cetacean and Sea Turtle teams. The research is oriented toward understanding environmental and fishery factors that control the abundances of important fishery species, sea turtles, and marine mammals. The reef fish community of the SE U.S. continental shelf and menhaden resources of the Atlantic and Gulf of Mexico receive major attention by these teams. Population model development and evaluations of stock dynamics for fishery management in coastal fisheries as well as highly migratory species are conducted. Sea turtle studies focus on biology and dynamics of loggerhead, green, and Kemp's ridley in the NC coastal waters. Cetacean studies deal with all coastal marine mammals and with a concentration on the coastal bottlenosed dolphin stocks. The Information Technology and Spatial Analysis team provides statistical assistance, satellite imagery, and spatial data that are used by other research groups within the Laboratory, and they make the satellite data available to academic institutions and the private sector.

Researchers for these teams provide scientific and management advice to Fishery Management Councils along the Atlantic and Gulf coasts and to habitat managers in NOAA and other Federal and state agencies. Frequently staff are called upon to provide scientific information in instances where there has been environmental damage, and scientific advice is needed on the impacts as well as potential approaches to mitigate for impact and restore habitats to improve both damaged habitats and fisheries.

(56)

OVERVIEW OF FOOD WEB DYNAMICS IN THE NORTHWEST ATLANTIC: DETECTING CHANGES IN KEY PROCESSES AND PARAMETERS IN A MULTI-SPECIES CONTEXT. Jason S. Link, Frank P. Almeida, Cheryl G. Milliken, and Lance P. Garrison. *Food Web Dynamics Program, NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543*

The fish component of the northwest Atlantic continental shelf ecosystem has undergone well-documented changes over the past three decades. Particularly, gadids, flatfish, and other demersals are less abundant whereas smaller pelagics and elasmobranchs are more abundant than historical levels. In addition to abundance, we monitor several diet parameters including percent diet composition, percent prey frequency, total stomach contents, predator size, and prey size to estimate and assess major processes and rates for key fish in this ecosystem. Some of the major processes and rates we examine from these parameters are 1) trophic links and interaction strengths for multi-species models, 2) food web statistics, 3) M vs. F, 4) the partitioning of

energy, biomass, and yield, 5) recruitment bottlenecks, 6) essential fish habitat, and 7) consumption, predation, competition and production rates. Our time series extends for 25 years, contains more than 100 predators and 1200 prey items, ranges from Cape Hatteras to Nova Scotia, covers over 83,700 square nautical miles, and spans the period and locale of intense perturbation on the fish community of this ecosystem. Changes in these key processes and rates are not trivial to detect at these spatial and temporal scales, but if observed, as they have been in this ecosystem, allow quantification of the effects of over-exploitation and more importantly provide an assessment of the potential for recovery of economically important fish stocks. This example demonstrates the value and utility of maintaining long-term, broad-scale monitoring efforts.

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IS SIROLPIDIUM ZOOPHTHORUM THE ANIMAL EATER ITS NAME SUGGESTS? NEW EVIDENCE OF PARASITISM. Christopher Martin, NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT 06460

A phycomycetous fungus has been observed repeatedly in larvae of the bay scallop, *Argopecten irradians*, at the Milford Laboratory. This microorganism has been tentatively identified as *Sirolopidium zoophthorum* Vishniac, first observed at this laboratory by V.L. Loosanoff almost fifty years ago. The morphology and development of the fungus have been previously described. While apparently enzootic in scallop cultures at our laboratory, *S. zoophthorum* has not been tied directly to mass mortalities of this species. Loosanoff regarded it as parasitic in the bay scallop and in the larvae and juveniles of other bivalves. However, his evidence was largely circumstantial, i.e., conspicuous presence of “infected” larvae in cultures suffering high mortality.

Using pure cultures of *S. zoophthorum*, freshly isolated from affected scallop larvae, it has been possible to demonstrate that this fungus is one likely cause of observed mortality. Exposure of 72-hour scallop larvae to suspensions of recently emerged zoospores resulted in approximately 70% mortality in 4 days. Fungal thalli were detected in up to 88% of dead larvae. Untreated controls remained unaffected. *S. zoophthorum* was successfully reisolated from parasitized larvae, thus satisfying Koch’s Postulates.

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EFFECT OF HARMFUL ALGAE ON MARINE RESOURCES IN THE GULF OF MEXICO. Steve L. Morton, Kate Schaffer, Tina Mikulski, Steven Eaker, Mark Busman, Brad Mitchell, Nikki Wiggins and Peter Moeller. *Marine Biotxin Program, National Ocean Service/NOAA, Center for Coastal Environmental Health and Biomolecular Research, 219 Ft. Johnson Rd., Charleston, SC 29412.*

A number of species of microalgae commonly observed from the Gulf of Mexico produce bioactive compounds that have profound effects on marine resources. These biotoxins lead to mortality events of marine resources and human diseases after consumption of contaminated shellfish or finfish. The 1995 and 1996 manatee mortality events and the 1999 dolphin mortality event will be used as examples of biotoxins leading to loss of marine

resources. Human diseases caused by toxic algae known to be found along the Gulf Coast include Neurotoxic Shellfish Poisoning (NSP) and Ciguatera Fish Poisoning (CFP). The cause of the mortality events and human intoxications will be discussed. Current research conducted by the Marine Biotxin Program on new potential toxic algal species will also be presented.

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LABORATORY CULTURE OF LARVAL TAUTOG: RECENT UPDATES AND CHANGES. Dean M. Perry, David A. Nelson and Robin S. Katersky, *NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT 06460*

Adult field-captured tautog, *Tautoga onitis*, were spawned in the laboratory. Larvae were cultured according to standard laboratory procedures developed at the Milford laboratory using a recirculating system containing six 1140 L conical rearing tanks. During the summer of 2000, the following changes were made to our protocol which increased larval survival. These changes included increasing live feed density in the rearing system, extending the duration of rotifer feeding, and decreasing the initial larval stocking density. Larvae were fed an average of 9×10^6 rotifers per day, which is double the amount fed in previous years. They were also fed rotifers for a 25d period compared to 14d in prior years. With this increased larval survival we are currently monitoring growth rates of these juveniles under laboratory conditions. From December 14, 2000 to February 2, 2001, total length (mm) and biomass were measured and recorded biweekly. Specific growth rate was 0.30 mm d^{-1} and biomass increased at an average of 0.04 g d^{-1} .

(60)

AN ANALYSIS OF SIMILARITY COEFFICIENTS AND TAXONOMIC CLUSTERING METHODS FOR IDENTIFICATION OF BACTERIAL FISH PATHOGENS. Steven C. Pitchford and Richard A. Robohm, *NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford, Connecticut 06460*

Reliable classification of bacterial pathogens often poses a problem for those investigating the cause of fish disease. In the absence of sufficient DNA probes for fish pathogens, the most reliable identification method is numerical taxonomy based on bacterial phenotypic traits. A number of mathematical formulas exist for first producing similarity coefficients and then clustering organisms for construction of taxonomic trees. A systematic comparison of these approaches has not been published for cross family classification of bacteria.

We report here an evaluation of programs for similarity coefficients and clustering techniques that are available in the NTSYS-PC software package from Exeter Software (Setauket, NY). We tested 96 permutations of pairs of similarity coefficients and clustering techniques for their ability to produce correct taxonomic trees from representative bacteria (primarily fish pathogens) from six taxonomic families. Reliability was determined by looking for correct phylogenetic groupings after the programs were applied to a database of phenotypic characteristics for 28 known pathogenic species that we compiled from the literature and 30 that we isolated and identified through a consensus of five taxonomic schemes. A minimum of 40

and a maximum of 86 traits were compared between organisms depending upon the available data. A set of 10 semi-quantitative measures were established to evaluate the resulting taxonomic trees.

The most accurate permutation proved to be Kulczynski no. 2 (K2) association coefficient in combination with the Complete Linkage method. Use of this combination in conjunction with a sufficient database will help in classifying bacteria when family and genus are unknown.

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DISTRIBUTION OF BDELLOVIBRIO-LIKE BACTERIA IN ALASKA'S EASTERN BERING SEA (EBS) SHELF. DeLois M. Powell¹, Henry N. Williams, Ruby Singh and Andy Sneider², J. Frank Morado and Lisa Appesland³. ¹*Department of Natural and Physical Sciences, Shaw University, Raleigh, NC;* ²*University of Maryland at Baltimore;* ³*NOAA, National Marine Fisheries Service, Alaska Fisheries Science Center/RACE, Seattle, WA*

Scientists around the world are currently involved in ongoing studies to investigate the ecology of a unique predator in the marine environment, the endoparasitic bacterium, *Bdellovibrio* and to note its interaction with other organisms in the marine ecosystem. Previous studies about the distribution of *Bdellovibrio* in Alaskan waters did not exist. This project intended to determine if *Bdellovibrio* or *Bdellovibrio*-like bacteria occur in these waters and to add isolates to the collection that is currently being characterized and compared from other parts of the world. A Nissin bottle dropped from the deck of the NOAA trawl Fishing Vessel (F/V), Aldebaran collected subsurface water (from approximately 1-meter depth) of the Eastern Bering Sea (EBS) during July 1-23, 1999. Water, mud and fish and shellfish gut samples were collected with the intent to survey the diverse habitats of the EBS and to focus on near- and offshore areas in the Bristol Bay. A total of 30 samples were enriched for detection of *Bdellovibrio*-like bacteria (addition of *Vibrio parahaemolytica*) and analyzed in the NOAA laboratory, using a modified agar overlay technique. Seven of 19 samples tested were positive for *Bdellovibrio*-like bacteria. Thirty-six mud-gut samples were collected from EBS and 5 mud-gut samples were collected from Larrabee State Park. Of 15 samples assayed, one proved positive for *Bdellovibrio*-like bacteria. Two additional mud samples collected at H184 and H195 (haul designation number) were positive for *Bdellovibrio*-like bacteria. A modification of the membrane filter technique used to analyze water for fecal coliforms was employed to survey water samples for the presence of possible hosts. Preliminary colonial characterization of bacterial isolates indicated a diverse population of potential host organisms.

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THE TRAP POND PROGRAM: A SERVICE LEARNING PARTNERSHIP BETWEEN COLLEGES AND PARKS. Michael A. Reiter¹ and Jenna Luckenbaugh². ¹*Department of Agriculture and Natural Resources, 1200 N. DuPont Hwy., Dover, DE 19901-2277;* ²*Trap Pond State Park, RD2, Box 331, Laurel, DE 19956*

The Trap Pond Program (TPP) is a service-based teaching and research relationship between the Department of Agriculture and Natural Resources of Delaware State University and

Trap Pond State Park, DE. The park provides expertise and opens its lands for research and teaching programs in freshwater, wetland, terrestrial, and coastal ecology/environmental sciences, as well as interdisciplinary resource management, and in return the department works on topics relating to the management needs of the park. The university gains an extensive field site containing a wide variety of aquatic and terrestrial communities and a working relationship with the state's resource personnel. Students gain the ability to work on issues of present-day concern and access to the expertise that exists in the state's resource management agencies. At the same time, the TPP benefits the park directly and the State of Delaware indirectly by providing inexpensive manpower to study freshwater, terrestrial, and coastal questions impacting the park and its mission. The program also benefits the park and the state by encouraging students to develop an interest in the sciences while providing future employees and citizens trained in local environmental issues. The TPP is intended to be a model program for other state parks and institutions of higher learning (particularly small colleges and regional universities) both within Delaware and beyond.

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SELECTION STUDIES ON GROWTH AND SURVIVAL OF BAY SCALLOPS

(*ARGOPECTEN IRRADIANS*) FROM LONG ISLAND SOUND. Sheila Stiles, Joseph Choromanski, and Christopher Cooper. *USDOC, NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford, CT 06460*

Selection studies are underway to investigate genetic responses for improving growth and survival of bay scallops (*Argopecten irradians*) from Long Island Sound through breeding. Previous findings from early responses to selection for growth indicated variation among several lines, with some modest gains. Several reasons were given for the range in early responses, including stage and age of scallops at the time of selection, the selection differential, inbreeding, density and other culture factors.

Subsequent measurements on the growth and survival of scallops from the same lines at a later time in development demonstrated some, but less variability in the responses among the lines. Responses in the progeny are best measured at the same stage or age as when the parents were selected. Measurements also provided more definitive information that density-dependence was a critical factor in evaluating responses. Preliminary results from breeding the F₁ generation suggest that interaction with survival may be a more important factor in selecting scallop populations than selecting for growth alone. For example, mortality was observed among the smallest and the largest scallops of some lines, thus the mean size of the survivors in the groups or sublines was similar. This could be connected with genotype-related mortality which was suggested from genetic population analyses employing allozymes. Progeny of the next generation currently in early phases of growth should further elucidate responses to selection.

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POPULATION CHARACTERISTICS OF THE U.S. SOUTH ATLANTIC RED PORGY STOCK. Douglas S. Vaughan, *NOAA-CCFHR, National Marine Fisheries Service, 101 Pivers Island Road, Beaufort, NC 28516*

The age structure and status of the U.S. south Atlantic stock of red porgy is examined, using recorded and estimated landings and size frequencies of fish from commercial, recreational, and headboat fisheries from 1972-1997. Estimates of annual, age-specific population numbers and fishing mortality rates (F) were obtained by application of a calibrated virtual population analyses (VPA), using fishery-independent data from MARMAP hook-and-line and trap gears in the calibration procedure. Fishing mortality rates (F) increased from 0.05 in 1974 to 1.34 in 1997 for fully recruited ages (assumed 4+ throughout for comparative purposes) with $M = 0.28$, while spawning potential ratios declined from 90% to 32% based on mature female biomass and from 89% to 17% based on total mature (male and female) biomass. Recruits to age 1 declined from a peak of 7.6 million age-1 red porgy in 1973 to 12,000 age-1 red porgy in 1997; while total spawning stock (mature) biomass declined from a peak of 11,700 t in 1978 to 323 t in 1997. Long-term and severely declining recruitment to age 1, headboat CPUE, and MARMAP Survey CPUE raise concerns about overfishing. Generally static SPR has been at or below the South Atlantic Fishery Management Council's criteria for overfishing (SPR = 30%) since 1981. Keeping in mind the difference between thresholds and targets, it would appear that reducing F to a level at or below that equivalent to 40% static SPR is necessary for rebuilding the U.S. south Atlantic red porgy stock.

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GROWTH AND SURVIVAL OF BAY SCALLOPS, *ARGOPECTEN IRRADIANS* IRRADIANS, FED *TETRASELMIS CHUI* BY TWO METHODS. James C. Widman Jr. and David Veilleux, *NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT 06460*

Tetraselmis chui was grown using two different methods, carboy vs GRAMPS (Greenhouse Algal Mass Production System) and fed to bay scallops, *Argopecten irradians irradians* - growth and survival were monitored. Algae grown by the traditional Milford carboy method utilize artificial light and artificial seawater with the addition of various nutrients, trace elements and vitamins. GRAMPS-grown algae utilize sunlight and natural seawater from Milford CT harbor, which is UV treated and then enriched with a commercially available F/2 media. Current results indicate a slight growth advantage when using algae grown in the carboys. Increases in mean shell height ranged from 2.6 -3.1 mm for scallops fed with GRAMPS-grown algae, while scallops fed carboy-grown algae increased 3.6 - 4.1 mm. Most surprising was the decrease in survival when scallops were fed *Tetraselmis* grown using the GRAMPS method. Survival of scallops on the GRAMPS-grown *Tetraselmis* averaged 64%, and scallops fed carboy *Tetraselmis* averaged 89%. Additional research is needed to determine the cause of the growth and survival discrepancies observed between the two growing methods.

(66)

PUTTING OUR TECHNOLOGY TO WORK ON THE (FISH AND SHELLFISH) FARM.

Gary H. Wikfors, Barry C. Smith, Jennifer H. Alix, and Mark S. Dixon. *NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT 06460*

As part of our technology-transfer activities, we have organized an annual training session titled, "Growing Microalgal Feeds for Marine Aquaculture -- The Milford Workshop." Microalgae are cultured as feeds for molluscan shellfish (scallops, clams, and oysters) and as part of the live-food chain for marine finfish. Practical knowledge and skills required to culture microalgae successfully are diverse, ranging from microbiology to ecology, chemistry, engineering, physics, and hard-knocks lessons. The purpose of this annual Workshop is to organize and condense the diverse, practical information and skills needed to culture microalgae in a hatchery setting into a three-day crash-course integrating both lecture and hands-on laboratory sessions. The Workshop is offered at no cost, as part of the Milford Laboratory's ongoing efforts to support development of US aquaculture, with first preference given to commercial growers and extension personnel. Enrollment is limited to 16. The 2000 class included participants from commercial shellfish farms, state extension programs, academic research laboratories, and Native American Tribal groups on both Atlantic and Pacific coasts of the US.

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ENHANCING COASTAL MANAGEMENT THROUGH GEOSPATIAL ANALYSES.

Pace Wilber, *NOAA Coastal Services Center, 2234 Hobson Avenue, Charleston, SC 29405*

Working with partners from academia, non-governmental organizations, and state/local governments, the NOAA Coastal Services Center fosters the application of geographic information systems (GIS) and remote sensing in coastal management. Our remote sensing activities work with data streams from satellite, airborne, and *in-situ* sources to identify new or under-utilized remote sensing activities, such as LIDAR and acoustic sensors, that could assist coastal managers. GIS activities cover a broad range and include "rescuing" geospatial data from non-digital formats and customizing GIS applications to more effectively integrate remote sensing and other data to aid decisions in the coastal and marine environment. Distributing tools for developing metadata, providing training in development of metadata, and hosting applications that allow simultaneous searching of multiple geospatial archives fosters access to geospatial data and technologies. Through fellowships, internships, cooperative agreements, and traditional classroom settings, the Center also provides hand-on training in the use of these technologies and their practical application to coastal management issues.

ENVIRONMENTAL SCIENCES

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EFFECTIVE MOLECULAR MECHANISMS TO IDENTIFY MICROORGANISMS RESISTANT TO TOXIC METALS IN THE ENVIRONMENT. Raul Cuero, John Williams, Nnana Mogongwa, Felicia King, Alonso Sadberry, and Ashley Chatham. *Prairie View A&M University, PO BOX 685, Prairie View, Texas 77446*

Although many metals including Zn^{+2} , Cu^{+2} , Fe^{+2} and others, are essential to microbial metabolism, all are potentially toxic. However, microorganisms such as bacteria and fungi can develop mechanisms to accumulate these metals, thus making the microorganisms and/or their metabolic products ideal for metal recovery and/or environmental protection. Metals affect microbial metabolisms, enzymatic activity, membrane transport, and nucleic acid synthesis. Therefore, the aim of the present investigation, was to use fungal molecular structures and products such as RNA molecule and enzyme chitosanase, respectively, in relation to microbial growth, under different concentrations of toxic metals, thus identifying strains resistant to toxic metals that can be used for further decontamination of these toxic metals in the environment. Different fungal isolates and a bacteria strain were tested during the study. However, *Aspergillus flavus*, and *Fusarium graminearum*, were mainly used in every experiment. The fungal isolates were sequentially grown in agar media, then inoculated in sterile soil media containing sterile ground corn, and finally transferred to broth media. All the media contained 0-5 ppm concentrations of toxic metal ,including Zn^{+2} , Cu^{+2} , Fe^{+2} . Some cultures were amended with the natural polysaccharide chitosan to induce chitosanase production. The toxic metal-amended fungal cultures were incubated in replicates at room temperature. Agar and broth media were incubated for 3-6 days, while soil cultures were incubated 3-12 months. Soil cultures were always used as the primary inoculum for the sequential inoculation of the agar and broth media. Soil and liquid cultures were subjected to analysis for fungal growth; only liquid cultures were used for RNA yield (Cuero et al., 2000), while chitosanase production was assessed in chitosan-amended agar, for which a qualitative assay is reported based on an arbitrary scale (- = little enzyme production; ++ = medium enzyme production; +++ = abundant enzyme production; and ++++ = very abundant enzyme production) (Cuero, 1996). The results show that both copper and zinc either in single or combined treatment stimulated fungal growth 10 times (up to 0.45 gr. biomass) in liquid cultures. Similarly, fungal populations increased 4-12 times in soils treated with the metal ions (up to 1×10^6 CFU) as compared to non-treated fungal cultures, after 3 months. Stimulation of fungal growth corresponded with an increase in RNA yield and concentration, depending upon the fungal species. Growth and RNA production by *A. flavus* were stimulated more by zinc, while *F. graminearum* was stimulated more by copper. RNA and growth of the bacteria *Bacillus* spp., were markedly increased by zinc. Chitosanase production was also higher in fungal cultures amended with chitosan and toxic metals. The present results show an effective molecular approach to use RNA and/or enzymes to identify microorganisms with potential for removal of toxic metals from the environment.

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PETROLEUM HYDROCARBONS IN SEDIMENTS AND RIBBED MUSSELS FROM RESTORED, UNRESTORED, AND REFERENCE MARSHES IN THE ARTHUR KILL, NEW YORK / NEW JERSEY, USA. Ashok D. Deshpande, Bruce W. Dockum, and Amy M. Tesolin, NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center. James J. Howard Marine Sciences Laboratory at Sandy Hook, 74 Magruder Road, Highlands, New Jersey 07732

An underwater pipeline ruptured during January 1990, discharging about 567,000 gallons of No. 2 fuel oil into the Arthur Kill. The City of New York Parks and Recreation Department restored 2.6 hectares of the impacted marsh with *Spartina alterniflora*. We collected sediment and ribbed mussel samples from restored, unrestored, and reference sites over two collection periods to assess the functional effectiveness of the restoration efforts with respect to total petroleum hydrocarbons (TPHs). TPHs in sediments varied within and between sites, and within sections of the individual cores, with generally higher concentrations found in the deeper sections. TPHs in surface sediments ranged from less than the method detection limit (MDL, 181 mg/g wet weight) to 490 mg/g wet weight for a restored site, less than MDL to 7890 mg/g wet weight for an unrestored site, and less than MDL for a reference site. TPHs in ribbed mussels also varied within and between sites, with a range of less than MDL (54 mg/g wet weight) to 540 mg/g wet weight. There was no correlation between TPHs in mussels and TPHs in sediments. Another spill of about 50,000 gallons of No. 2 fuel oil occurred at one of the reference sites shortly after the last collection period. We collected additional samples of sediment and ribbed mussels at this site to study the petroleum hydrocarbon patterns before and after the spill. Hydrocarbon fingerprints, double ratio plots, and principal component analyses were used to examine if sediments and ribbed mussels were contaminated with the spilled oil.

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HIGH PERFORMANCE UV (HPUV) INACTIVATION OF *E. COLI*. Kurt A. Garrett, Cheryl M. Davis and De Lois M. Powell, Department of Natural and Physical Sciences, Shaw University, Raleigh, NC

The use of ultraviolet light for inactivation of microorganisms is well documented in the literature. Ultraviolet light used for inactivation is sometimes called germicidal UV or UV254 (the specific wavelength known to have the most lethal effect on bacteria, fungi and viruses). While this band of invisible light is part of the sun's spectral energy, artificial sources of germicidal UV come from manufacturers such as Sylvania and General Electric. The greatest users of germicidal UV lamps are wastewater treatment facilities seeking alternative methods of disinfection that reduce the need for chlorine and chlorine derivatives. The disinfection mechanism generally points to the disruption of the microorganism's DNA. In turn, the disruption of microbial DNA prevents replication and can cause 'death'. Early UV light inactivation research was set back when conventional ultraviolet lamps performed below expectations. This failure was traced to lamp design. While researchers sought intense high-energy germicidal UV light, manufacturers designed low-energy UV lamps, primarily used for wastewater disinfection. In research typical inactivation times, using conventional germicidal

UV lamps, range from 20 minutes to several days for virus and similar times for bacteria. Recently, we tested a new lamp system, High Performance Ultraviolet Light (HPUV; CSMO, Inc.) and found it to reduce 10^6 colonies of herpes simplex virus (HSV) in three seconds. We are proposing use of the HPUV for inactivation of *E. coli*. Our studies will measure inactivation initiation, inactivation optimum and hyper-inactivation. HPUV is expected to result in quicker inactivation times for *E. coli* than conventional UV lamps. This data will allow us to construct a response curve for *E. coli* when using HPUV inactivation. Future research will use these data to determine inactivation conditions that preserve important protein triggers of the cellular immune response.

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RESTORATION AND ASSESSMENT OF URBAN SALT MARSH HABITAT DAMAGED BY A SEVERE OIL SPILL. David Packer¹, Joe Vitaliano¹, & Carl Alderson².
¹NOAA, National Marine Fisheries Service, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands, NJ 07732; ²Salt Marsh Restoration Team, Natural Resources Group, New York City Parks, 200 Nevada Ave., Staten Island, NY 10306

Few scientific studies have focused on *restored* salt marshes (restored because of a severe environmental impact) as opposed to *created* or *constructed* marshes (created in response to mitigation). In 1990, a 576,000 gallon oil spill seriously damaged marshes of the Arthur Kill, the strait separating Staten Island, NY from NJ. The Salt Marsh Restoration Team of NYC Parks implemented a multi-year restoration and monitoring project to restore marshes directly impacted by the 1990 spill. To date, restoration activities included the successful reintroduction of over 9 acres of Arthur Kill-propagated salt marsh cordgrass, *Spartina alterniflora*. SMRT has been monitoring several parameters in oiled marshes that were replanted and oiled marshes left for natural recovery, including *Spartina* biomass/density, ribbed mussel (*Geukensia demissa*) density, fish abundance/diversity, frequency/duration of feeding of wading birds, and sediment total petroleum hydrocarbons (TPH) in replanted and unplanted sites. In 1996 the National Marine Fisheries Service's James J. Howard Marine Sciences Laboratory extended the study by characterizing and assessing the structure and function of replanted, unplanted, and reference marshes. Studies included sediment chemistry, contaminant analyses, macrobenthic surveys, and stomach content analyses of mummichogs (*Fundulus heteroclitus*). Results are presented from the two investigations. A quantitative assessment of these marshes may allow us to evaluate our ability to restore this habitat's functional attributes, and identify indicators of habitat and living resource health and recovery within a heavily urbanized and degraded estuary.

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THE EVOLUTION OF MTBE AS A POLLUTANT. Pao-Chiang Yuan, Doris McPherson and Youguo Xu, *Hazardous Materials Management Program, Department of Technology, School of Science and Technology, Jackson State University, Jackson, Mississippi*

We have learned a lot of lessons from the past. The famous materials we've used in the past are asbestos, PCB (polychlorinated biphenyl) transformer oils, freon, and lead in paint and

also in gasoline. They were wonderful useful materials that served their purposes for us until we found they have harmful health problems. Most of them cause chronic diseases and irreversible harm. Some materials have been used for thousands of years, such as asbestos, until two to three decades ago, when we stopped using it in this country, it is still being used by other countries. For most of these toxic materials, their substitutes have been found and they have been totally exclude from the United States market. MTBE is used as a fuel additive mixed into gasoline starting from about a decade ago, due to the Clean Air Act Amendment (CAAA) that required improvement in the air quality in some parts of the country, until scientist found MTBE in our water and ground water supply. This is a case of our efforts to control air pollution now threatening water quality. MTBE is a possible human carcinogen according to the US EPA (United States Environmental Protection Agency).

ATMOSPHERIC SCIENCES

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HPVCI - DISTANCE LEARNING. Paul Croft, Rafael Mahecha, R. Suseela Reddy, and Pat Fitzpatrick. *Meteorology Department, Jackson State University, Jackson, MS*

As a part of the High Performance Visualization Center Initiative (HPVCI) at Jackson State University, the JSU Meteorology Program (JSU MP) is developing a Distance Learning Initiative involving mesoscale modeling and products (MM5 and COAMPS) for college and professional users. Through computer visualizations of mesoscale model data and results, and their presentation and use in the classroom, both students and professionals will have the opportunity to learn and examine the nature of numerical weather prediction models. Visualization products will be available to the broader atmospheric and minority communities for education and training, particularly in an electronic classroom. Assisted directly by several undergraduates, three websites, including a developmental site (<http://www.angelfire.com/ms2/hpvc/index.html>), the JSU Meteorology Program's homepage (<http://weather.jsu.edu>), and a research platform site (<http://betsy.jsu.edu/~hafner/oper5.html>) are in development to address the needs of users. Ultimately all three sites will be linked and/or merged. Numerical model guidance and their output will be used to create class materials. Both models (MM5 and COAMPS), run in real-time, and will be used to explain the reasons for weather modeling, the need to do so, and the methodological approaches used. A study through beta testing is planned. Various target audiences will be selected to consider general and specific skills and knowledge that different users may, or may not have, to define their goals when visiting the websites. Users with various academic backgrounds, and levels of meteorological skills will be introduced to the sites, asked questions about it (e.g., how easy is it to navigate the site? Is labeling clear?), and asked for comments. Before final release, the sites should have a layout, information, products, and labels that are clear and easy to use (without losing technical quality) for all audiences. Suggested improvements to the sites include further explanation of products, less crowded maps, and "make-your-own" overlays. Upon completion the Jackson State University Meteorology Program's HPVCI websites will serve as a clearinghouse for model output and products.

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A NEW U.S. CLIMATE ATLAS. Marc S. Plantico¹, Lynn A. Goss¹, Liz Love-Brotak¹, Gregory Hammer¹, Christopher Daly², George Taylor³. ¹*National Climatic Data Center, Scientific Services Division, Asheville, NC 28801*; ²*Spatial Climate Analysis Service, Oregon State University, Corvallis, OR 97333*; ³*Oregon Climate Service, Oregon State University, Corvallis, OR 97333*

The National Climatic Data Center (NCDC) has developed a new, electronic Climate Atlas of the United States which is available on CD-ROM. The purpose of this Atlas is to depict the climate of the United States in terms of the distribution and variation of major climatic elements. The Climate Atlas is intended to meet the needs for climatic information from commercial, industrial, agricultural, research, and educational institutions, as well as from the general public. The new atlas replaces the previous Climatic Atlas of the United States which was published in 1968. Data used for the old publication were from the period 1931-1960 and the nearly 200 maps were hand contoured. The new atlas used innovative technology and easy to use Geographic Information Systems (GIS) to objectively generate many of the maps. The analytical model, PRISM (Parameter-elevation Regressions on Independent Slopes Model) which was developed at the Oregon Climate Service (OCS) at Oregon State University, was used to generate nearly 350 different map products. An additional 350 maps were generated at NCDC. Most atlas products are derived from the 1961-1990 period of record. This poster illustrates some of the map products that are contained in the new atlas.

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SOME ASPECTS OF AIR-SEA INTERACTIONS, HURRICANE PREDICTIVE MODELS AND VARIABILITY OF TROPICAL CYCLONES. R. Suseela Reddy¹ and Richard L. Miller². ¹*Jackson State University, Jackson, MS*; ²*Earth System Science, NASA Stennis Space Center*

Under the NASA research grants, we present the work established on (a) the air-sea interactions and associated tropical cyclones during their formation and evolution over the Gulf of Mexico, (b) the development of predictive models for hurricane activity, and (c) the variability of tropical cyclones over the North Atlantic. The studies suggested that, (a) a 3-5 day oscillation was noticed in the heat and momentum fluxes during the formation and evolution of hurricane activity, (b) Hurricane Predictive Index (HPI) was used for hurricane prediction, and (c) a long-term ~ 50-year oscillation was noticed in the tropical cyclone activity over the North Atlantic Ocean.

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MESOSCALE CIRCULATION OVER THE COMPLEX PHYSIOGRAPHY IN LOUISIANA-MISSISSIPPI (LA-MS) COASTAL REGION. R. Suseela Reddy, Paul Croft and Pat Fitzpatrick, *Jackson State University, Jackson, MS*

Mesoscale air flow in coastal regions is determined by land-sea temperature contrast (land-sea breeze) and by the shape of a coastline. In addition to topography, shape of coastline

has an effect on mesoscale wind flow, and thus, on various meteorological variables including cloudiness and air pollution. We present in this study an understanding of the mesoscale circulation in LA-MS coastal region and in particular the combined effect of the lake and shape of the coastline. The Penn State/NCAR Mesoscale Model (MM5 version 3.1) was used with several options including multiple nesting and several convective and boundary layer parameterizations, as a modeling tool to investigate mesoscale wind flow patterns in the study area. Two cases of mesoscale circulation during the summer of 1999 were selected for numerical simulations (24 July and 17 August). The study suggested that the MM5 model is suitable for numerical studies of sea-breeze circulations and it is capable to simulate diurnal variations of wind patterns and convective cloudiness. Results will be presented and discussed.

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TECHNOLOGICAL ADVANCES AT THE LOWER MISSISSIPPI RIVER FORECAST CENTER -USING GIS TECHNOLOGY. Keith Stellman , Amanda Roberts, and Dave Reed. *NOAA, National Weather Service, Lower Mississippi River Forecast Center, 62300 Airport Road, Slidell, LA 70460*

The National Weather Service (NWS) is responsible for supporting the nation's welfare and economy by issuing river and flood forecasts and warnings. To do this, the NWS has 13 River Forecast Centers (RFC) in the United States. The Lower Mississippi River Forecast Center (LMRFC), located in Slidell, LA, is responsible for issuing routine river and flood forecasts at over 170 locations daily and over 30 locations when rivers are expected to exceed flood stage at these locations. The NWS uses hydrologic computer models on state-of-the-art technology to prepare these forecasts.

The LMRFC collects, processes, and analyses a large amount of data. To keep its users informed, the LMRFC prepares a significant number of products using ArcView. These products are used internally at LMRFC and within the NWS and may be posted to the LMRFC webpage. Products prepared using ArcView include: precipitation estimates from the NWS WSR-88D Radar for time periods ranging from hourly to yearly; contoured observed precipitation for time periods ranging from daily to yearly; monthly normal precipitation maps and departure from normal; forecasted precipitation in 6-hour increments for 24 hours in the future including gridded model output; and maps displaying the status of river forecast locations to name a few. We will demonstrate this technology and how it is integrated into LMRFC products and services.

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REGIONAL CLIMATE MODELING IN THE SOUTHEASTERN UNITED STATES. Loren D. White, *Jackson State University, Jackson, MS*

Besides their application to long-term large-scale issues such as global warming, numerical "climate models" are increasingly being developed to study and predict anomalous conditions on seasonal and interannual timescales. A complex regional climate model developed at Florida State University (the FSU Nested Regional Spectral Model) has been used at Jackson State University to examine issues of climate predictability and forcing over the Southeastern

U.S. Most emphasis has been on the interrelationship between surface forcing from the ocean (e.g. El Nino) and from the land surface (e.g. soil moisture). Sensitivity of model results to specifics of the domain choice was also investigated in one set of winter season experiments. A unique approach to "ensemble" model forecasts has been explored by variation in the details of the initial soil moisture and temperature conditions. This technique provides a useful means of determining the degree to which model forecast uncertainties over specific regions may be attributable to uncertainties in the initial conditions of the land surface. Finally, experiments which vary the number of vegetation types modeled within the domain will be discussed. Especially at high horizontal resolutions, the question of how many vegetation types "need" to be recognized by a climate model is currently unknown and can most likely be resolved by many numerical experiments of this type.