Research Supporting Coastal & Ocean Management: Gulf of Mexico 2005-2006

POLLUTION

Florida Bay Characteristics Used to Predict Mercury Bioaccumulation Hotspots in the Gulf of Mexico and Florida

NCCOS is developing methods to identify coastal areas with high mercury concentrations in fish. This will allow coastal managers to take remedial action and limit consumption that endangers human health. NCCOS research has documented the high mercury concentrations in fish from eastern Florida Bay. Effective mercury methylation, oligotrophy, shallow depth, and limited physical flushing were identified as important characteristics contributing to high mercury concentrations. Initial application of data from NOAA's National Estuarine Eutrophication Assessment identified several estuaries likely to have high mercury concentrations because of their shallow depth and poor flushing. Efforts are underway to incorporate measures of oligotrophy and mercury methylation potential in this predictive model. Existing data from NOAA's National Status and Trends Program and EPA's database "The Occurrence of Mercury in the Fishery Resources of the Gulf of Mexico" (http://www.epa.gov/gmpo/mercury.html) are being employed to test these predictions. For more information contact David.W.Evans@noaa.gov.

Toxicity Evaluation Finds Mosquito Insecticide May be Toxic to Important Salt Marsh Species

NCCOS experiments indicate that the mosquito control insecticide 'Scourge' is highly toxic to grass shrimp, an ecologically important species in salt marsh ecosystems. Adult and larval grass shrimp (*Palaemonetes pugio*) were affected by Scourge concentrations that may exist after spray applications; larvae were more sensitive than the adults. The scientists also found, however, that Scourge degraded rapidly in water and that the presence of sediments reduced its toxicity. These findings will be helpful in assessing the relative risk associated with different mosquito control insecticides applied in estuaries. This research was recently published in *the Journal of Environmental Science and Health*. For more information, contact Pete.Key@noaa.gov.

NCCOS Research Helps Drive EPA Water Quality Criteria

NCCOS, EPA, and other scientists assessed the state of science regarding the fate and effect of nutrients in large rivers in the Mississippi River Basin to better understand how excessive nutrients impact large rivers. NCCOS-sponsored research included an assessment of the potential for seasonal phosphorus limitation on the Louisiana shelf, and ecological forecasting results from a new 3D hydrodynamic model used to study the effects of bottom oxygen demand in controlling the structure of hypoxia in the Gulf of Mexico. This research is part of NCCOS efforts to predict the size of this hypoxic zone under various environmental and management scenarios, and to understand the impacts of hypoxia on the Gulf of Mexico ecosystem. In 2006 NOAA and EPA will co-sponsor a symposium to assess the current scientific understanding of the processes regulating the development, persistence and aerial extent of the hypoxic waters; critical information which will be used by the Mississippi River Gulf of Mexico Watershed Nutrient Task Force to inform the ongoing reassessment of the Gulf of Mexico Action Plan. For more information contact Alan.Lewitus@noaa.gov.

HARMFUL ALGAL BLOOMS

Expanded Harmful Algal Bloom Forecasting Capabilities in the Gulf of Mexico

Closures of shell fishing areas, the occurrence of neurotoxic shellfish poisoning, fish kills, marine mammal deaths, and losses to local economies are caused by *Karenia brevis* blooms. In 2000, all Texas bays were closed to shell fishing due to *K. brevis* blooms and, in December 2001 Mexican coastal waters closed to shell fishing. These events opened an avenue for cooperative research and a request to expand geographic coverage of remote bloom monitoring in the GOM. The Harmful Algal Bloom Forecast, currently distributed by

CO-OPS and for the eastern GOM, is scheduled to begin in late 2006 in Texas and the western GOM including Mexico. For more information contact Richard.Stumpf@noaa.gov or http://www.csc.noaa.gov/crs/habf/.

More Accurate Detection of Harmful Algae in the Western Gulf of Mexico Enables Improved Monitoring and Decision-Making

Identifying HABs along the Texas coast has been problematic because of the frequent disturbance of harmless benthic algae by cold fronts. A new technique developed by an NCCOS scientist identifies increased concentrations of algae that result from resuspension, providing better identification of harmful blooms in that area. This method will reduce false positives (calling a bloom a HAB when it is not), increasing the likelihood of successful operational monitoring of HABs in the western Gulf of Mexico. The method should aid in identifying all algal blooms in areas subject to resuspension. Better HABs detection and data allows for improved decision-making by coastal mangers and public health professionals. For more information contact Timothy.Wynne@noaa.gov.

MERHAB Research Supports Automated Detection Methods for *Karenia brevis*

The ability to detect and quantify *Karenia* remotely and at low concentrations is important for early detection and real-time bloom monitoring. The first independently powered real-time *in situ* imaging system uses flow cytometry and imaging technology to identify and count cells. A new semi-automated sandwich hybridization assay can molecularly detect *Karenia* at low concentrations and be incorporated into deployed devices. The integration of such instrument packages with regional components of Integrated Ocean Observing Systems (IOOS) will provide the basis for real-time early warning systems for HABs. For more information contact Marc.Suddleson@noaa.gov.

Rapid Analysis of Phytoplankton Composition Improved for Southeastern US Estuaries

An NCCOS funded project isolated algae from southeastern US estuaries, determined their pigment composition, and used the pigment ratios to calibrate analyses of phytoplankton composition in the region. The best way to determine phytoplankton composition is by counting cells, but this is a very time consuming process that requires a high level of taxonomic expertise. More recently High Pressure Liquid Chromatography (HPLC) has been used as a fast method to distinguish major phytoplankton groups that can be used to indicate changing environmental quality. This calibration will increase the utility of pigment HPLC for monitoring water quality in southeastern US estuaries. For further information contact Quay.Dortch@noaa.gov.

Flower Garden Banks National Marine Sanctuary Coral Disease Outbreak Investigated

Flower Garden Banks National Marine Sanctuary scientists reported a highly unusual disease outbreak affecting several coral species in an area approximately 50 meters in diameter. This is the first documented report of such a wide-spread occurrence of disease in the FGBNMS. The disease signs are consistent with white plague that is caused by a bacterial pathogen, but will require laboratory confirmation. The Coral Disease and Health Consortium assembled a rapid response team consisting of coral disease experts to determine the extent, cause and short-term impacts of the disease outbreak. For more information contact Cheryl.Woodley@noaa.gov.

HURRICANE RESPONSE

Mussel Watch Project Data and Analyses Aid Hurricane Katrina and Rita Contamination Assessments

NCCOS' National Status and Trends Program conducted contamination assessments in Louisiana, Mississippi and Alabama to assist in addressing environmental and health impacts from Hurricanes Katrina and Rita. Scientists are monitoring and assessing chemical contaminant concentrations (of conventional pesticides, Fipropinl, metals, PAHs, PCBs, and PBDEs) in oysters, coastal waters and sediments at twenty coastal Mussel Watch project sites, and are performing toxicity tests on the sediment samples. In addition, the sediment and water samples are being analyzed for bacterial and viral indicators of human or animal fecal contamination, and oyster samples are being collected for the Food and Drug Administration, which will assess chemical and microbial indicators of seafood safety. The Mussel Watch project has a 20-year series of data for over 300 sites and 120 contaminants nationwide which serve as baseline data; data collected in September and data from the standard January collection period will be compared against this baseline to assess impacts from the hurricanes. Once the analyses are completed, the results will be shared with local, state, regional and federal decision makers to support environmental and public health recovery and restoration efforts. For more information contact John.Christensen@noaa.gov

NCCOS Contributes to Interagency Response to Hurricanes Katrina and Rita
The EPA, NOAA, FDA, and USGS are coordinating an environmental impact assessment of Hurricanes Katrina and Rita in coastal waters and wetlands throughout the affected areas of Louisiana, Mississippi and Alabama. This effort integrates response activities of agency scientists aboard EPA's OSV *Bold*, NOAA's R/V *Nancy Foster*, FDA small boat teams and numerous field teams. The interagency response includes six major projects to assess coastal ecosystems, including biological conditions, fisheries, water and sediment quality, seafood safety, and human-health risks. NCCOS plays a key role in interagency coordination and planning, and NCCOS scientists are monitoring and assessing current and longer term concentrations of human pathogens and chemical contaminants in fish, shellfish and sediments. Project results will be used to support environmental and public health recovery and restoration efforts. For more information contact Russell.Callender@noaa.gov.

NCCOS Activity Books Entertain Children in Louisiana Shelters, Teach about Marine Life
NCCOS responded to a third request for marine activity books for children displaced by Hurricane Katrina by sending 125 books to a shelter in Louisiana. The books introduce children (grades K-5) to coastal animals and ecology and include regional information, fun facts, drawings to color, connect the dots, find a word games, matching, etc. NCCOS created activity books on Coastal North Carolina, the Salish Sea, Mobile Bay, and the Chesapeake Bay as part of its efforts to foster ocean stewardship. Activity books are a fun and non-threatening way of introducing young children to marine science facts and concepts. These books begin the process of forming an environmentally aware citizen population, and may encourage future careers in marine sciences. NCCOS has contributed over 2,500 books to organizations working with children displaced by the hurricane. For more information contact Susan.Baker@noaa.gov.

HYPOXIA

"Dead Zone" Impacts Shrimp in the Gulf of Mexico
Northern Gulf of Mexico researchers have determined that the seasonal hypoxic zone in the Gulf of Mexico has negatively impacted the health and size of brown shrimp, the Gulf's highest-valued commercial species. Although shrimp can escape low oxygen waters, their movement away from the hypoxic zone may come at a price. PI's Kevin Craig and Larry Crowder found that shrimp avoidance of the hypoxic zone causes them to aggregate on the periphery of the zone, where temperatures are suboptimal for growth. They estimated that the hypoxic zone has resulted in a 25% habitat loss for shrimp, a 5-20% decrease in shrimp growth rate, lower lipid levels and energy content, and smaller body size. For more information contact Alan.Lewitus@noaa.gov.

Direct Effects of Hypoxia on Young Fish Revealed
Joint NCCOS-Duke research suggests that hypoxic water directly effects fish eggs and larvae. Developing fishes are incapable of significant horizontal movement, and are therefore more vulnerable in hypoxic waters because they cannot seek oxygenated water. Hypoxic waters can kill immobile marine animals and displace mobile animals from their preferred habitats. The scientists discovered that young fish handle oxygen differently because of differences in egg and larval development, including blood development. As a consequence, differences in the tolerance of hypoxic water are probable. For more information contact Jeff.Govoni@noaa.gov.

NCCOS Researchers Identifying Genes that Predict and Assess Hypoxia
Identifying genes that respond to hypoxia will support prediction and assessment of the onset, duration, and severity of chronic and intermittent hypoxia and its effect on organisms. NCCOS-sponsored researchers have isolated, cloned, and expressed potential hypoxia-response genes in grass shrimp, and found that specific genes mapped the organism's exposure to hypoxia, as the genes tried to increase the organism's oxygen uptake during hypoxic conditions. Genetic responses to hypoxia will be studied in sheepshead minnows. For more information contact Carol.Auer@noaa.gov.

Gulf of Mexico Survey Provides Key Information for Managers and Scientists
The annual NCCOS-sponsored Louisiana Universities Marine Consortium survey of the northern Gulf of Mexico found low oxygen levels over 11,840 square kilometers. The size of this year's hypoxic zone, extending from the Mississippi River to the Louisiana/Texas border, was slightly smaller than the long-term average, despite the influence of a hurricane and tropical storm which had recently passed through the area. These surveys, which have occurred for 20 years, represent a unique dataset for understanding how the size of the "dead zone" responds to changes in nutrient loading and oceanographic conditions, and for gauging progress in

implementing the goals of the 2001 Gulf of Mexico Action Plan which calls for a voluntary actions to reduce the hypoxic zone to less than 5,000 square kilometers. This research is part of a larger NCCOS effort to predict the size of the hypoxic zone under various environmental and management scenarios and to understand the impacts of hypoxia on the Gulf of Mexico ecosystem. For more information contact David.Scheurer@noaa.gov.

Gulf of Mexico "Dead Zone" Forecasted to be Smaller than Past Years
NCCOS scientists predicted that in 2005 the "dead zone" off the coast of Louisiana and Texas would be less than 1,400 square miles. This forecast is significantly smaller than the average summer hypoxic zone which has been approximately 4,900 square miles since 1990. The smaller predicted size is due to lower than normal riverine nutrient loads, which were probably caused by lower than usual precipitation across the Gulf of Mexico watershed. The forecast is based on U.S. Geological Survey data of May and June nutrient loads from the Mississippi and Atchafalaya Rivers. For more information contact Dave.Whitall@noaa.gov.

NCCOS Funds $2.5 million Study of Effects from Toxic Chemicals, Hypoxia on Fish
In light of the increasingly common problems of polycyclic aromatic hydrocarbons (PAHs) and hypoxia in coastal waters, and a lack of knowledge about their effects on fish, NCCOS is funding a research team to study the effects of PAHs and hypoxia on embryonic and early larval development stages of fish. Researchers from the University of Southern Mississippi and Texas State University were awarded $2.5 million to develop a library of approximately 8,000 genes and examine genomic responses to hypoxia and PAHs, which can cause cancer in humans. They will assess physiology, morphology, and gene/protein expression in embryonic and larval fish exposed to the environmental stresses alone and in combination. For more information contact Carol.Auer@noaa.gov.

INVASIVE SPECIES

Indo-Pacific Lionfish Study Finds Increasing Density and Distribution
NCCOS researchers in collaboration with NMFS in Panama City, observed a continuous distribution of lionfish from Northern Florida to Cape Hatteras, NC, in water depths of 90 to 260 feet, during both diver and remotely operated vehicle surveys. Diver surveys also suggest that lionfish density may be increasing off the coast of North Carolina, but that cool bottom water temperatures in winter may limit lionfish distribution. Lionfish may be restricted to water depths of 90 to 260 feet because these waters are close to the Gulf Stream and stay relatively warm through the winter. More research is necessary to determine the impact lionfish may have on native communities in the Atlantic. For more information contact Paula.Whitfield@noaa.gov.