

Research Supporting Coastal & Ocean Management: North Carolina & South Carolina 2005-2006

SEA LEVEL RISE AND CLIMATE CHANGE

Study of Effects of Coastal Development on Salt Marsh Response to Sea Level Rise Demonstrates that Sediment Accretion can be Managed

A key challenge to forecasting the consequences of sea level rise on coastal marshes is determining the effect of natural and anthropogenic factors on their ability to ameliorate rising water levels via sediment accretion. NCCOS scientists have demonstrated that reference shoreline marshes in North Carolina were able to accrete sediments at approximately the same rate as local sea level rise, while rates were doubled in transplanted marshes behind stone sills constructed to reduce erosion. In contrast, a marsh bordering the Intra Coastal Waterway and exposed to boat wakes was eroding. These findings demonstrate that sediment accretion can be managed and that further long-term study of the persistence of salt marshes in a variety of natural and developed settings is justified. For more information contact Carolyn.currin@noaa.gov.

North Carolina Managers May Benefit from the Development of a Tool to Predict Impacts of Sea Level Rise in Salt Marsh Rush Meadows

With the rate of sea level rise in the 21st century projected to be two to four times the rate observed over the 20th century, coastal managers will need tools to forecast the effect of inundation on plant and animal communities in areas with low lying topography. In response to this need, CSCOR has awarded the University of South Carolina, East Carolina State and Vanderbilt University over \$575,000 to develop a two-dimensional model to predict changes in plant community composition, sediment accretion, and geomorphology in response to tidal forcing and sea level rise. Specifically, the model will predict how salt marsh rush meadows (*Juncus roemerianus*), commonly found in areas of low tidal inundation, respond to sea level rise. This project is part of Ecological Effects of Sea Level Rise a NOAA research program with the goal of developing high resolution mapping and modeling tools for the Pamlico Sound and nearby waterways in North Carolina. For more information contact Carol.Auer@noaa.gov.

State Permitting Procedures and Use of Shoreline Stabilization Structures May Be Improved

In an effort to help the NC Coastal Resources Commission (CRC) revise its permitting procedures for shoreline stabilization structures (e.g., vertical bulkheads, riprap, and breakwaters) and respond to an increasing demand for shoreline stabilization structures to prevent shoreline erosion, NCCOS provided information on adverse environmental impacts of artificial shoreline structures. NCCOS scientists shared ongoing research on the effectiveness and habitat value of alternative shoreline stabilization structures, including salt marshes and oyster reef habitat, at several study sites in eastern NC. Shoreline erosion is due to rising sea level, coastal storms, and an increase in boat wakes. For more information contact Carolyn.Currin@noaa.gov.

NCCOS Developing a GIS Tool to Predict Impacts of Sea Level rise in NC

The rate of sea level rise in the 21st century is two to four times the rate observed over the 20th century and will result in beach erosion, inundation of low lying areas, salt water intrusion into aquifers, and increased flooding. Scientists at East Carolina University are using remotely sensed observations and sediment cores, in addition to already available datasets, to determine vulnerability to rising water level and storms. Results will be incorporated into a GIS tool that predicts ecosystem modification due to sea level rise in North Carolina. The tool should be available in 2008. For more information Carol.Auer@noaa.gov.

20-Year NCCOS Data Set Used to Link Fisheries Data with Global Climate Change

Data on larval fish entrance (ingress) into the Beaufort Inlet, NC has been used to identify decadal correlation with climate level events, specifically variation in the [El Niño Southern Oscillation](#) of the Pacific Ocean and the [North Atlantic Oscillation](#). NCCOS has monitored the ingress of larval fish into the inlet to assess adult population abundance, environmental condition, and decadal scale variation in climate, and recently identified

the correlations between larval fish ingress and climate events. For more information, contact Harvey.Walsh@noaa.gov.

Tropical Species of Fish, a Sponge, and a Toxic Dinoflagellate in North Carolina Reefs may be Sentinels of a Warming Trend of Concern to Coastal Management

Tropical species are well represented in the reef communities in coastal North Carolina where numerous tropical fish species occur and thrive. Diver observations of previously absent species and increasing abundances of tropical reef fish have been reported since 1977. NCCOS studies show the invasive tropical lionfish is growing and reproducing and the identity of a pan-tropical dinoflagellate species responsible for ciguatera fish poisoning, a disease that has been occasionally reported regionally for many years, has been confirmed. These changes, along with the discovery of a tropical sponge previously unreported in North Carolina reefs, have co-occurred with minimum winter bottom water temperatures increases of 1 to 6 degrees C. Changes in species composition warn of a possible warming trend of winter bottom temperatures. This has strong implications to habitat managers, particularly in regards to the persistence and spread of lionfish and possible increase in occurrence of ciguatera fish disease in the region. For more information Pat.Tester@noaa.gov.

POLLUTION

Database Provides CZ Managers Easy Access to Nutrient and Coliform Loading Information

NCCOS researchers have released a web-accessible, searchable nutrient and coliform loading database. Concentrations of nutrients and fecal bacteria are among the most commonly cited causes of degraded water quality throughout the US. As a result of this free website, coastal managers and researchers can better estimate loading from mixtures of different land cover classes. NCCOS began compiling the database when researchers realized many of their citations were difficult to obtain. The database contains 1739 bacteria and nutrient loading records, and also includes runoff values for other contaminants within the same reference. The database is searchable by both bacterial and nutrient loading by land cover class, and bacteria by animal species. Bibliographic references are provided for users to obtain additional information about each record. NCCOS will continually update the data as more are identified or become available. For more information Tom.Siewicki@noaa.gov or visit the database at <http://www.chbr.noaa.gov/ncl/>.

Coastal Managers to Control Microbial Contaminant Sources using NCCOS Research Results

NCCOS scientists are examining the sources and distribution of microbial pathogens in the estuarine environment to will assist managers in identifying and applying best measures to control pathogen sources in coastal waters. One NCCOS study found that levels of a bacterial pathogen harmful to certain at-risk groups of oyster consumers were low in both surface water and oyster samples, probably due to high salinities in the estuary. A second study used statistical approaches to identify pathogen sources in estuaries based on various gene-sequenced libraries of bacteria. Another investigation used genetic profiling of bacteria in water to determine that raccoons and cattle, not humans, were the dominant sources of coliform bacteria in the South Carolina watersheds sampled. For more information contact Jan.Gooch@noaa.gov.

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

NCCOS toxicity 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.

Bacteria Resistant to Multiple Antibiotics Found in Wild Dolphin Populations

NCCOS scientists found antibiotic-resistant *Escherichia coli* bacteria in wild dolphin populations in the Indian River Lagoon, FL and Charleston Harbor, SC. Dolphins harboring multiple antibiotic drug resistant *E. coli* were isolated from wild captured dolphins. *E. coli* from 20% of the FL dolphins and 70% of SC dolphins exhibited resistance to one or more of 26 antibiotics evaluated. This study, part of NCCOS' larger Dolphin Health and Risk Assessment Project assessing dolphin health relative to environmental factors, furthers understanding of

the transfer and potential impacts of antibiotic resistance in coastal dolphins. For more information contact John.Bemiss@noaa.gov.

HARMFUL ALGAL BLOOMS

NCCOS Finding Attributing Most Estuarine Fish Lesions to a Water Mold Helps Managers in NC and FL Allay Public Fears Concerning Lesion Events

Estuarine fish along the east coast of the United States experience seasonal epidemics of deep, aggressive skin ulcers often coincident with large fish kill events that have raised public concern about water quality and toxic algae. NCCOS scientists developed molecular assays and helped the NC Division of Water Quality to show that the water mold *Aphanomyces invadans*, a species that is not indicative of environmental pollution or toxicity, caused most observed ulcers in the Neuse and Pamlico Rivers. NCCOS scientists are also helping The Florida Fish and Wildlife Commission in their evaluation of fish lesions thus helping environmental managers to provide the public with timely and accurate information to help allay fears concerning lesion events. The assay is reported in a paper in press in Applied and Environmental Microbiology. For more information contact Mark.W.Vandersea@noaa.gov.

NC Dinoflagellate Confirmed to be the Pantropical Species Responsible for Ciguatera Fish Poisoning

NCCOS genetic analyses of dinoflagellate cultures isolated from reef communities at water depths of 100-140 feet in coastal North Carolina confirm the species to be *Gambierdiscus toxicus*, which is pantropical species of the Pacific and Caribbean. The discovery of this toxic tropical dinoflagellate adds a new facet to the tropical nature of NC reef ecosystems and raises the possibility of ciguatera fish poisoning of humans, a potential concern to habitat managers. For more information contact Wayne Litaker@noaa.gov.

Rapid Analysis of Phytoplankton Composition Improved for Southeastern US Estuaries

An NCCOS funded project isolated algae from southeastern 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.

Volunteer Monitoring Group Identifies First Recorded Bloom of a Toxic *Pseudo-nitzschia* species in North Carolina Waters

In 2005 the Southeastern Phytoplankton Monitoring Network (SEPMN) increased sampling sites to include 14 groups in NC. Within the first month of sampling, a bloom of *Pseudo-nitzschia* was observed by students of First Flight High School in Kill Devil Hills, NC. Preserved samples were positively identified using scanning electron microscopy as *Pseudo-nitzschia pseudodelicatissima*, a known producer of the toxin, domoic acid. SEPMN is a NCCOS sponsored community program that increases HAB awareness and directly involves volunteers in coastal stewardship. The identification of *P. pseudodelicatissima* in North Carolina's waters is another example where a volunteer monitoring program is useful in developing a species list and record of distribution patterns, as well as alerting scientists to the presence of potentially harmful species. For further information contact Steve.Morton@noaa.gov.

LAND AND RESOURCE USE AND MANAGEMENT

New Skin Lesion Molecular Probes Improve Fish Management

NCCOS researchers have developed molecular probes to screen large numbers of environmental samples for the pathogenic water mold *Aphanomyces invadans*, thought to be responsible for skin lesions and fish kills in fall the spring and fall in estuaries of the southeastern US. Identification of infection sources and the conditions that promote growth and transmission of this pathogen will help resource managers forecast when lesion events are likely to occur and perhaps to develop mitigation strategies. Examinations of fish in estuaries of North Carolina and Florida last summer detected the water mold in most of the skin lesions sampled. An important question yet to be answered concerning *A. invadans* pathogenesis is how natural infections are initiated. For more information contact Wayne.Litaker@noaa.gov.

NCCOS Research to Assist Coastal Managers in Fisheries Habitat and Stock Restoration

NCCOS is studying how habitat conditions affect the physiology and behavior of cultured fish to help coastal managers improve habitat and stock restoration initiatives. Recent testing of feeding and shelter-seeking behaviors show that fish reared in culture systems with a structurally complex environment outperform fish reared in conventional, structurally simple rearing systems. Ongoing NCCOS experiments will determine if stress in response to crowding observed in simple systems affects neural development as well as behavioral development. The work is being conducted jointly with researchers at North Carolina State University. For more information, contact John Burke (CCFHR) at (252) 728-8602 or John.Burke@noaa.gov. [02F00013]

Study Examines the Role of Crab Pot Ropes in Dolphin Entanglement

The crab pot industry is the highest source of fishery-related mortality of bottlenose dolphins in South Carolina, but the reasons for such a high rate of mortality and entanglements of dolphins in this fishery are poorly understood. NCCOS scientists conducted a two week pilot study of crab pot ropes in Charleston, SC to determine what lengths of rope would reduce the risk of dolphin entanglement. The study examined types and lengths of rope at different tidal stages, current strengths, and water depths – the ideal rope would reduce the risk of entanglement by lying flat and straight on the bottom. Results indicated that lead-core rope of all lengths tended to bend and loop off the bottom unless in a strong current in deep water. Braided nylon ropes typically used by crab fishers showed variable results with different rope lengths in varying water depths and currents. It is anticipated that this pilot study will produce recommendations to NOAA Fisheries for the crab pot industry to reduce the risk of bottlenose dolphin entanglement. For more information contact Wayne.McFee@noaa.gov.

Long-term Monitoring of Gray's Reef National Marine Sanctuary Supports Sanctuary Management

In 2000, a baseline assessment of benthic fauna and concentrations of chemical contaminants at the Grays Reef National Marine Sanctuary suggested that the sanctuary was in "good health". However, trace concentrations of pesticides, PCBs and PAHs in both sediments and biota demonstrated that chemical substances originating from human activities are capable of reaching the offshore sanctuary environment. In 2005 NCCOS reevaluated sediment quality and condition of resident benthic fauna to provide a means for tracking potential long-term changes in the environmental quality of the sanctuary based on such indicators, as well as a basis for mitigating any future problems. For more information contact Jeff.Hyland@noaa.gov.

Disease and Contaminants Impact Dolphins Health in FL and SC Respectively

From 2003-2005, over 200 dolphins have been captured near Charleston, SC and in Indian River Lagoon, FL to assess their health and identify health threats and links to possible environmental stressors. Data indicate that dolphins from Indian River Lagoon exhibit high incidence of infectious diseases such as lobomycosis and papilloma virus, while Charleston dolphins exhibit elevated body burdens of contaminants. For more information contact Pat.Fair@noaa.gov.

INVASIVE SPECIES

Indo-Pacific Lionfish Density and Distribution Increasing

A continuous distribution of lionfish were observed 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.

NCCOS Initiates Study of Aquaculture and Human Health Concerns of the Asian Oyster, a Potential Invasive Species

The proposed introduction of the non-native Suminoe (Asian) oyster, *Crassostrea ariakensis*, by Virginia, Maryland, and North Carolina, is an important issue in aquaculture, invasive species, and human health research. NCCOS will assess potential environmental and human health concerns by comparing bacterial uptake and natural cleansing rates of the Asian and native eastern oysters this summer, when estuarine bacterial levels are seasonally high. Thirty Americans die each year from the consumption of shellfish containing

the toxic bacterium, *Vibrio vulnificus*. Additional health risks derive from oysters contaminated with fecal pathogens such as *Escherichia coli*. For more information contact James.Morris@noaa.gov.

Lionfish Model Will Support Risk Assessments for Invasive Marine Finfish in the Western Atlantic

NCCOS scientists have completed a stage-based matrix population model to understand population dynamics of introduced marine finfish and are applying the model to lionfish. Recent results from field and laboratory lionfish reproduction studies indicate that juvenile mortality could play a key role in controlling lionfish population growth and size in the western Atlantic. Ongoing research will determine if juvenile lionfish are venomous, and if native reef fishes are capable of feeding on lionfish. These modeling efforts provide the framework for future risk assessments and eco-forecasts of impacts of marine finfish introductions along the East Coast. For more information contact James Morris at (252)728-8782 or James.Morris@noaa.gov.

Invasive Tropical Lionfish Thrive During Winter in Reefs off North Carolina

Since the summer of 2000, NCCOS researchers have documented the rapid spread of lionfish in relatively warm (>15° C year round), deeper (>115 ft) water reefs that are in close proximity to the Gulf Stream where the lionfish are established year round. In an unprecedented effort, researchers and divers from NCCOS and NOAA's Undersea Research Center braved winter waters offshore of North Carolina to determine if lionfish over-winter there. The poisonous tropical invaders were found at all five reefs divers visited, at water depths ranging from 115 to 135 feet and bottom temperatures as low as 15 C°. The persistent lionfish demonstrated behavior and abundances similar to those observed last summer and fall by scientists, when the water was warmer. Samples of the lionfish were collected to learn more about their reproductive status, diet, genetics, age, and growth; this data may enable resource managers to determine management strategies for this non-native, invasive species. For more information contact Paula.Whitfield@noaa.gov.

Capture of an Adult Lionfish by Hook and Line in Shallow Waters of North Carolina Indicates Continued Spread of this Invasive Species

First reported in the Atlantic in 2000, lionfish, a tropical, non-indigenous, poison-spine species are now widespread along the continental shelf of the U.S. in water depths greater than 100 feet. NCCOS research indicates that minimum temperature tolerance of 50°F (10°C) will limit the northern and shoreward expansion of this species. The November 8, 2005 capture of the adult lionfish by a fisherman at the Cape Lookout Jetty near Beaufort, North Carolina, represents the shallowest water depth, less than 25 feet, reported for an adult lionfish north of Florida. A shift to a more tropical reef faunal composition is occurring in water on the outer continental shelf off North Carolina, attributed to an increase in winter bottom water temperature. Shallow water encounters should remain limited, however, to warm water seasons. For more information contact Paula.Whitfield@noaa.gov.