National Centers for Coastal Ocean Science

ACCOMPLISHMENTS

2006

CONTENTS

MESSAGE FROM THE DIRECTOR

As we compile the year's major accomplishments of the National Centers for Coastal Ocean Science (NCCOS), I realize that this is quite an accomplishment in itself. Highlighting a year's worth of major accomplishments in one place, as in this fiscal year 2004 Accomplishments Report, underscores the extraordinary breadth and depth of our organization's coastal and ocean scientific activities. And each year we build upon the enormous body of scientific research from our previous years' work.

NCCOS research in fiscal year 2004 (October 1, 2003 – September 30, 2004) focused on the potential impacts of climate change on coastal ecosystems, risks posed by harmful algal blooms and invasive species, improved management of coastal pollution, and adverse impacts of extreme events on our coastal resources and populations.

One commitment that has remained constant since NCCOS was established by the National Oceanic and Atmospheric Administration in 1999 is our determination to work with our partners and customers, especially coastal resource managers, and provide them with practical and useful scientific resources and information. This commitment is reflected by NCCOS' motto of producing science that serves coastal communities.

I am delighted to share the progress and accomplishments of the women and men who continue to make NCCOS a vital resource in coastal ocean science. The dynamic and multidisciplinary research outlined in this Accomplishments Report only hints of the progress we expect to make next year and in the future. We encourage your comments, questions, and involvement in our scientific endeavors which support local, regional, state, national, and international efforts to ensure the sustainability of our coastal communities. Come join us in our ongoing scientific work by learning more about us at http://www.coastalscience.noaa.gov.

Gary C. Matlock

Gary C. Matlock, Ph.D.

ABOUT NCCOS

The National Oceanic and Atmospheric Administration (NOAA) formed the National Centers for Coastal Ocean Science (NCCOS) in February 1999 as the focal point for NOAA's coastal ocean science efforts. NCCOS research programs provide coastal managers with scientific information and tools to protect marine and coastal resources and public health, preserve valued habitats, and improve the way communities interact with surrounding ecosystems.

Successfully managing human activities requires a sound scientific basis and an understanding of what ecosystem functions are important to society. While humans benefit from coastal ecosystems, human activities can also adversely impact the functioning of ecosystem components. By better understanding societal expectations, economic costs and benefits, and the marine and coastal resources themselves,

NCCOS strives to assist decision-makers in evaluating alternative management options to allow the best selection of management alternatives.

Research Focus

NCCOS focuses its research on four broadly defined ecosystems that are managed by NOAA and its partners _coral reefs; National Marine Sanctuaries; estuaries, including the National Estuarine Research Reserves; and coastal oceans. For each of these ecosystems, NCCOS works with experts and stakeholders to understand their practical needs regarding the management and protection of these ecosystems. NCCOS has identified five categories of stressors that impact these ecosystems - climate change, extreme natural events, pollution, invasive species, and land and resource use - and is committed to understanding the implications of these stressors individually and in combination.

Core Principles

NCCOS envisions science guiding coastal stewardship decisions to maximize societal benefits. To ensure that all NCCOS endeavors reflect and strive to achieve this vision, the organization follows a set of core principles:

- Deliver high quality science in a timely and consistent manner using productive and strong partnerships;
- Develop and maintain relevant research, long-term data collection and analyses, and forecasting capabilities in support of its customers, stakeholders, and partners;

- Build capacity in the private, local, state, and tribal sectors by transferring technology, and by providing technical assistance and knowledge to its customers and partners;

- Conduct the anticipatory science necessary for managing the potential impacts of multiple stressors on coastal ecosystems; and

- Provide the best possible work environment for each employee by treating each individual with fairness, respect, and recognition, and with adequate training in the safest facilities and with the most current equipment possible.

Reaching Out to Communities

NCCOS researchers shared their work and expertise in authoritative peer-reviewed publications, at professional symposia and workshops, at "town hall" and local citizen group meetings, on the Web, and in numerous other settings. NCCOS scientists trained local volunteers to assist in coastal monitoring activities and conducted workshops for state and local agency staff working to protect the Nation's seafood supplies. NCCOS researchers used Web technology to relay their day-to-day activities while on research cruises at sea, thereby providing a real-time view of scientific research as well as question-and-answer sessions via e-mail.

NCCOS scientists worked with students in both laboratory and classroom settings. They engaged young scientists in field exercises, and encouraged students to consider marine science careers. As part of its education mission, NCCOS benefits from talented undergraduates who assist with field studies every summer. Ongoing outreach programs with universities nationwide assist students with directed training, allowing them to gain practical research experience to complete their degrees, become more familiar with NOAA and NCCOS, and build careers in scientific fields. Working with NOAA's Educational Partnership Program, NCCOS established innovative partnerships with minority-serving educational institutions. Through these partnerships, NCCOS provided financial assistance to these institutions to support the research and training of students from minority population groups in the coastal ocean sciences.

It was hands-on lab work for Brian Tawney, a junior at Easton High School in Maryland, as he completed a project at the NCCOS Cooperative Oxford Laboratory during the winter semester. Brian helped analyze mortality in blue crabs infected with a parasitic dinoflagellate. He learned how to monitor water quality parameters, bleed crabs, stain diagnostic analyses, and test hematological parameters in fish. In addition to assisting NCCOS, Brian received school credit for his work.

NCCOS also worked with industry and community groups to increase public awareness of environmental issues and encourage behaviors that help sustain the environment. NCCOS' public awareness campaigns for recreational boaters, for example, provided tips on how to avoid spreading invasive species from one body of water to another. In collaboration with the Association of Marina Industries and other partners, NCCOS sponsored a tournament to "round up" the invasive snakehead fish, helping call public attention to the economic and environmental threats posed by this species.

In Carteret County, North Carolina, NCCOS and its partner institutions in the Marine Science and Education Partnership (MSEP) contributed $127 million and 3,162 jobs to the local economy.

"If MSEP were a single entity, it would likely rank among the largest, most diverse, and most comprehensive of marine research complexes in the U.S." – 2004 MSEP economic analysis.

Meeting the Needs of Coastal Managers through New Technologies

As a research organization, NCCOS transferred its research results to users – notably coastal managers - as tools and techniques to make more rapid and reliable decisions; as models to forecast environmental conditions; and as improved knowledge to strengthen analyses of environmental conditions and steps to ensure resource sustainability. NCCOS' use and development of new technologies to assist coastal managers are reflected in the following ongoing efforts and fiscal year 2004 accomplishments:

- NCCOS scientists are using cutting-edge genetic techniques and nuclear magnetic resonance instruments to research the relationships between the health of coastal oceans and humans. Coastal ocean scientists will use the NCCOS findings to better understand metabolic responses to stimuli, such as chemicals, which will help advance the knowledge base of contaminant chemistry. By continuing to develop fundamental knowledge about the sublethal impacts of contaminants and other stressors on marine organisms, management decisions concerning the assessment and mitigation of these impacts will be improved.

- NCCOS forecasting tools are helping to predict the results of habitat restoration efforts, anticipate habitat impacts from different types of human activities, and support NOAA Fisheries models to predict resource sustainability.

- NCCOS' ecological forecasts - which predict how physical, chemical, and human-induced ecosystem changes will affect coastal ecosystems - have been instrumental in successfully predicting lower than normal spring pink shrimp harvest in North Carolina and the areal extent of the hypoxic zone in the Gulf of Mexico. These forecasts help local fishers in North Carolina more effectively target their time and resources, and assist Gulf of Mexico resource managers develop monitoring and modeling activities, as well as management strategies.

- By combining technologies such as satellite imagery, geographical information systems (GIS), and advanced detection methods, NCCOS provides advance warnings of harmful algal bloom (HAB) events to coastal managers, which allows for increased protection of fisheries, human health, and local economies. Thirty-four HAB Bulletins were issued in fiscal year 2004 in the Gulf of Mexico and provided coastal managers with critical lead-time for their resource management activities. NCCOS is also researching the use of autonomous underwater vehicles (AUVs) to complement data from satellites, buoys, and towed instruments in an effort to provide more advance warning to coastal managers of potential HAB events.

"You just can't have people out on boats all the time looking for these early stages of blooms," says Gary Kirkpatrick, AUV study partner from the Mote Marine Laboratory in Sarasota, Florida. "But we can, conceivably, have AUVs out there almost all the time looking for them."

- NCCOS is developing a prototype system called "EcoGIS" which will enable fishery managers and scientists to visualize multiple data sets at once. This GIS will help them evaluate fishery management alternatives and predict the effects of fishery closures on fish stocks.

- NCCOS and National Marine Sanctuary scientists are using underwater acoustics equipment to efficiently and non-intrusively examine distributions of pelagic fishes and estimate fish biomass in a Sanctuary along the Georgia coastline. This data will support Sanctuary managers in their assessment of seasonal and long-term changes in fish abundance. The use of active and passive acoustic equipment to estimate fish abundance and listen to sound-producing spawning aggregations, respectively, will help managers better understand fish spawning within the Sanctuary.

- NCCOS researchers partnered with a Massachusetts regulatory agency to use GIS technology and data acquired from remote sensors to rapidly and accurately locate illegally-altered wetland areas, thereby assisting coastal managers in collecting $280,000 of fines.

- NCCOS is researching new methods to detect a neurotoxin produced by algae within one hour at levels 10 times below those that elicit symptoms, which will help coastal managers make time-sensitive decisions as to whether to close shellfish beds and public beaches.

- NCCOS scientists are using GIS to "map" entanglement wounds on whales and other marine mammals to identify types of gear and activities contributing to marine mammal deaths. This information will help coastal managers identify which fisheries may be impacting marine mammal populations and determine whether modifications to fishery procedures are necessary.

- NCCOS is providing resource managers in the Dry Tortugas - a marine reserve - with the best remotely-sensed images for that area which are produced from high-resolution satellites and aerial photographs. The images will help the resource managers update the only available map of the area's submerged resources, evaluate changes in essential fish habitat since the reserve was established, and determine the success of resource protection from the reserve status.

- Submersible vessels are exploring underwater depths to 2,000 feet in the Dry Tortugas, providing resource managers with a unique glimpse of the seafloor and insights into seafloor types and areal extents.

Benefitting Partners Internationally

NCCOS partnered with the Smithsonian Institution's laboratory in Belize on developing techniques to examine field samples for a toxic dinoflagellate species suspected of causing ciguatera fish poisoning throughout the Carribbean.

Scientists investigating humpback whale deaths in Peru consulted with NCCOS researchers about a suspected harmful algal bloom connection.

NCCOS continues to support large-scale international ocean research activities, such as the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Program and International Ocean Biogeographic Information System (OBIS). GEOHAB coordinates and builds on related national, regional, and international efforts in HAB research within an ecological and oceanographic context. As the information component of the independent and multinational Census of Marine Life, OBIS is a growing network of researchers in more than 45 nations engaged in a 10-year initiative to assess and explain the diversity, distribution, and abundance of life in the oceans.

RESEARCHING COASTAL ECOSYSTEMS

NCCOS concentrates its scientific endeavors in four ecosystems that are directly or indirectly managed by NOAA and its partners:

- Coral reefs;
- National Marine Sanctuaries;
- Estuaries, including the National Estuarine Research Reserves; and
- Coastal oceans.

Coral Reefs

U.S. coral reef ecosystems are among the most diverse and productive ecosystems on Earth, rich in biological diversity and cultural heritage. They attract tourists, support fisheries production and human sustenance, and protect shorelines from storm damage. However, coral reefs in the U.S. and internationally are under stress from a combination of human activities and natural causes.

NCCOS is working to understand these problems by gathering data and developing models to help coastal managers predict impacts of alternative management decisions regarding marine protected areas, fishing regulations, recreational uses, pollutants, and coastal development. NCCOS and its partners also perform inventories, develop maps, and monitor coral reef ecosystems using innovative computer and remote sensing technologies to reduce management costs and improve speed and accuracy. Using these emerging technologies, NCCOS is leading a partnership effort to systematically produce baseline digital benthic habitat maps for all shallow water U.S. coral reef ecosystems by 2010. NCCOS also sponsors the Hawaii Coral Reef Initiative Research Program, Caribbean Coral Reef Institute, and National Coral Reef Institute and is the main partner in the U.S. Coral Reef Task Force's Coral Disease and Health Consortium.

National Marine Sanctuaries

National Marine Sanctuaries are areas that have been set aside to maintain the integrity of unique natural and cultural resources. The 13 Sanctuaries - located in the Pacific and Atlantic Oceans, off the coast of American Samoa, and in the Great Lakes - include deep-ocean "gardens," nearshore coral reefs, whale migration corridors, deep sea canyons, and underwater archeological sites. They range in size from one-quarter square mile in Fagatele Bay, American Samoa, to more than 5,300 square miles in Monterey Bay, California, one of the largest marine protected areas in the world. While some activities are regulated or prohibited in Sanctuaries to protect resources, multiple uses such as recreation, commercial fishing, and shipping are accommodated.

NCCOS scientists partner with Sanctuary managers to determine the status of the Sanctuaries, examine alternative management strategies, and achieve preservation goals. NCCOS monitors environmental changes and natural events within the Sanctuaries by developing benthic habitat maps, researching the amounts and sources of contaminants, and performing other scientific activities in the Sanctuaries.

Estuaries, including the National Estuarine Research Reserves

Accounting for more than 4.5 million acres of U.S. coastline, estuaries are semi-enclosed bodies of water where fresh water and ocean tides connect. Temperatures, water levels, and nutrient concentrations in estuaries differ markedly from those in the open ocean, making estuaries some of the most biologically productive ecosystems on Earth. However, many estuarine systems have been experiencing declines in productivity.

Through physical observation and use of technologies such as remote sensors and autonomous underwater vehicles, NCCOS scientists are examining the link between human activities and the increasing number of ecological disturbances observed within estuarine environments. NCCOS research focuses on assessing habitat health, modeling the structure and function of estuarine ecosystem components, and identifying the effects of management actions on estuarine habitats. NCCOS monitors sediment toxicity in estuaries through the National Status and Trends Program, the longest continuously running monitoring program in the world.

The National Estuarine Research Reserve System (NERRS) is a network of 26 protected areas established by Congress in 1972 for long-term research, education, and stewardship through partnerships between NOAA and coastal states. The nature of the NERRS sites provides reference sites for NCCOS to conduct comparative studies.

Coastal Oceans

The coastal oceans that form the U.S. Exclusive Economic Zone extend 200 miles offshore and encompass a broad range of saltwater ecosystems, including estuaries, coral reefs, rocky shores, gravel shores, sandy shores, mud flats, marshes, and mangrove forests. At least two-thirds of the nation's commercial fish and shellfish use these ecosystems for spawning grounds and nurseries. Coastal oceans also provide many recreational opportunities that contribute to the economic well-being of local communities.

NCCOS' research is directed at helping to understand large-scale processes affecting marine resources to improve management of these resources. NCCOS provides coastal managers with the tools needed to protect public health, restore damaged habitats, and improve the way communities interact with surrounding ecosystems.

RESEARCHING ENVIRONMENTAL STRESSORS THAT IMPACT COASTAL ECOSYSTEMS

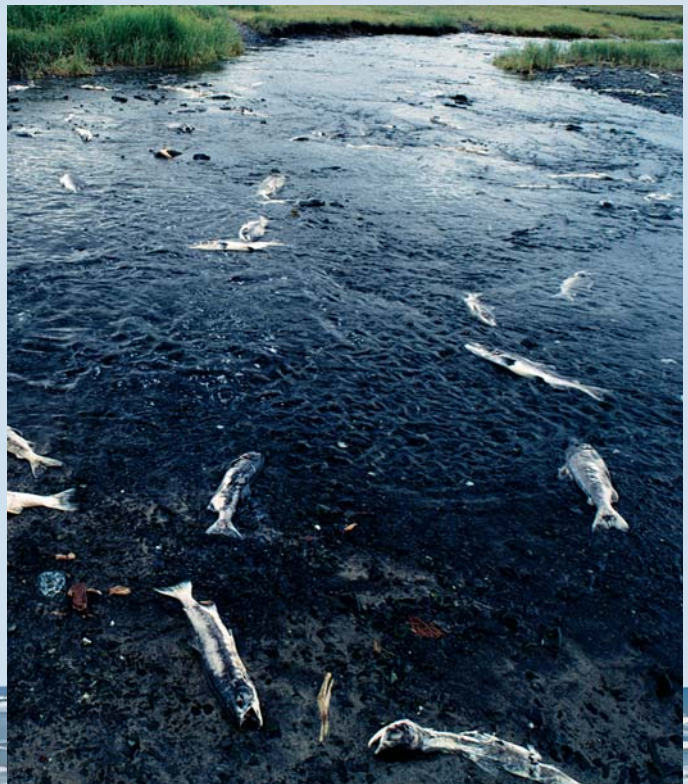
NCCOS examines the impacts of variable conditions or events known as "stressors" on coastal ecosystems. These stressors fall into five categories:

- Climate change;
- Extreme natural events;
- Pollution;
- Invasive species; and
- Land and resource use.

Climate Change: Overview

While scientists worldwide still have much to learn about natural and anthropogenic climate variability and the full implications of climate change, there is a consensus that the air and oceans are warming and that sea level will rise in the coming century. While there is presently no clear evidence to clearly establish that severe storms are on the increase, many scientists believe that storms will be more violent and unpredictable in the future. Corals, wetlands, and estuaries are already stressed from the combined effects of higher temperatures, rising sea levels, and human activities. There is evidence that some marine species have begun to migrate to cooler regions. Less mobile species that lack the capacity to move quickly enough could face extinction. Much uncertainty remains about the degree of warming and how coastal zones and marine life will respond to these changes. As current conditions offer useful insights into potential longer-term impacts of climate change and climate variability, NCCOS is conducting multidisciplinary research to examine:

- Changes in relative sea level and impacts of coastal storms on the sustainability of coastal communities and wetlands;
- Changes in precipitation and freshwater flow, resulting changes in nutrient delivery and salinity, and implications for management of coastal eutrophication and coastal resources; and
- Changes in ocean temperature and circulation and carbon dioxide as they might affect the sustainability of coral ecosystems and other sensitive environments and affect species composition in coastal areas.



Climate Change: Accomplishments

Program Established to Explore Ecological Effects of Sea Level Rise

NCCOS' new Ecological Effects of Sea Level Rise Program aims to develop a management-oriented predictive model capable of mapping interactions among sea level, shoreline, bathymetry, coastal habitats, and ecosystem effects. With ecological impacts of sea level rise likely to increase along the U.S. coastline, planners need to understand these future impacts when making land use decisions, especially in vulnerable shallow nearshore environments including coastal wetlands, which provide important habitat for a number of commercially valuable fish and shellfish. This NCCOS program will provide managers with ecological forecasting tools to help them predict likely impacts on ecologically and economically threatened natural resources. A February 2004 NCCOS-sponsored workshop on ecological effects of sea level rise is leading to the design of a pilot program to research the effects of sea level rise in the Pamlico and Bogue Sounds and the Neuse River in North Carolina.

Severe Deep-Water Hypoxia and Fish Kills on Oregon Shelf Linked to Climate Patterns

Researchers in the Global Ocean Ecosystem Dynamics (GLOBEC) Program funded by NCCOS and the National Science Foundation found severe low oxygen levels, or hypoxia, in bottom waters off the Oregon coast, with marked effects on fish and invertebrate populations. Massive fish and crab kills were documented by underwater video surveys, fishery data, and scuba divers, and large numbers of dead fish and invertebrates washed ashore. A recently published study in the international science journal *Nature* by these researchers explains that the hypoxic formation was caused by anomalous large-scale wind patterns over the northern Pacific Ocean and the incursion of cold, nutrient-rich waters from the sub-Arctic. These high-nutrient waters fueled huge algal blooms in surface waters, causing hypoxic conditions when the algae sank to the bottom and decayed. This deep-water mechanism is unlike the more well-studied estuarine and nearshore hypoxic events caused by land-based nutrient inputs, and it illustrates how large-scale oceanographic and climatic changes can cause abrupt and severe impacts on ocean ecosystems.

NCCOS-sponsored Research Dominates American Geophysical Union Meeting

NCCOS' GLOBEC Program supported more than 120 scientific papers presented at the American Geophysical Union's biennial Ocean Sciences meeting from January 26-30, 2004. The meeting, entitled "Understanding the Physical and Biological Coupling of Marine Population Dynamics," included 12 sessions devoted to research results from the GLOBEC programs in the Northwest Atlantic, Northeast Pacific, and Southern Oceans. U.S. GLOBEC is a research program to address how global climate change may affect the abundance and production of animals in the sea. For resource managers, the research findings shed critical light on climate change impacts to distribution, abundance, and production of marine animal populations in areas important to regional and national economies.

In the Bering Sea, which accounts for 50% of U.S. fish landings by weight, data from a NCCOS-supported biophysical oceanographic mooring maintained since 1995 show warming trends. Such conditions, NCCOS researchers explain, could favor species such as Pollock over benthic species such as crab, and create a northward shift in sub-Arctic species, thereby displacing Arctic species and affecting commercial and subsidence fishing harvests.

Weather Changes Shown to Trigger Algal Blooms as a Result of Increased Nutrient Inputs

NCCOS research suggested that the conditions favoring algal blooms along the North Carolina coastline by a non-toxic dinoflagellate can provide managers with insights into factors that may trigger blooms of harmful algae. *Heterocapsa triquetra*, a common, bloom-forming dinoflagellate found throughout the world, can form winter blooms in shallow tidally-mixed estuaries. Blooms seem to be triggered by low pressure atmospheric systems, where watershed runoff from rain supplies inorganic nutrients necessary for blooms to begin and develop. Runoff also creates a zone of intermediate salinity in the middle portion of the estuary with conditions favorable for *Heterocapsa* growth. This salinity allows the algae to overcome temperature-limited growth, short day lengths, and periods of low winter light. In a four- to six-week winter bloom, this single species can provide more than half of the production of phytoplankton in a temperate estuary.

Photo courtesy of W. Bennett, U.S. Geological Survey.

Organic Molecule Linked to Global Climate Change

NCCOS scientists successfully coupled information on the importance of the organic molecule dimethylsulfide (DMS) in cloud formation and global climate regulation with a provocative new mechanistic model to describe the biological function and production of DMS in marine phytoplankton. Published in the journal *Nature*, their research findings make it possible to better understand these interactions and the role that oceanic phytoplankton will play in influencing global climate change.

Research on Combined Effects of Climate Change and Pollution on Larval Fish Published

A new book edited by a NCCOS researcher and partially funded by NCCOS examines the question of how young, developing fishes meet, or fail to meet, the challenges posed by the combined environmental stressors of global climate change (temperature) and pollution (hypoxia). The book, entitled *The Development of Form and Function in Fishes and the Question of Larval Adaptation*, is a result of a 2002 symposium entitled "The Morphological Development and Physiological Function in Fishes" held in Bergen, Norway. Although the interplay of temperature, oxygen, and fish development is not well understood, slower growth and development means that developing fishes' larval stages are lengthened, making them more vulnerable and increasing their mortality rates. This book provides new information and encourages further research on this issue.

Extreme Natural Events: Overview

Extreme natural events such as hurricanes, coastal storms, floods, droughts, and harmful algal blooms (HABs) can profoundly affect coastal ecosystems and the people living and working nearby. The fall 2004 hurricane season brought winds, waves, and flooding along the southeast Atlantic and Gulf Coasts that degraded coastal habitats by altering freshwater flow and nutrient concentrations and increasing pollution runoff from populated areas and agricultural fields. For some coastal areas, HABs are seasonal events, wreaking havoc on tourism and local economies and threatening human health. These events occur in waters of nearly every coastal and Great Lakes state, and they have been responsible for an estimated $1 billion in economic losses – including reductions in tourism and real estate values – over the past few decades. The blooms, which can be toxic, can kill fish in large numbers and are thought to be responsible for more than half of marine mammal mortalities based on analyses of stranded animals. Seasonal fish harvesting bans along the East and Gulf Coasts and in the Pacific Northwest are sometimes required to protect the public from ingesting toxins from affected shellfish.

NCCOS uses and enhances NOAA's predictive capabilities to lessen environmental and social impacts of extreme natural events. NCCOS research responds to emergencies and strengthens long-term planning efforts aimed at mitigating future adverse impacts. NCCOS' ecological forecasting research and tools provide coastal managers with information necessary to manage coastal resources and protect public health and local economies.

Extreme Natural Events: Accomplishments

Severe Storm Impacts on Estuarine Food Web Assessed

As estuaries are large productive ecosystems that serve as vital food sources for migratory birds and provide important fish spawning and nursery habitat, scientists are trying to better understand how these areas recover from stress

When a massive algal bloom formed off the coast of Louisiana in early May 2004, NCCOS scientists used satellite imagery to provide critical information to state coastal managers on the timing and extent of the event, allowing them to more effectively focus their response and sampling strategies.

imposed by severe storms. NCCOS scientists examined how three hurricanes that rocked the Carolinas in late summer 1999 affected the estuarine food web in the Pamlico-Albemarle Sound, which accounts for more than 73 percent of North Carolina's total inshore commercial catch value. Within four months, chlorophyll biomass distribution across the basin had returned to pre-flood levels, which reflected ecosystem stability, although concentrations overall remained higher for about six months after the storms. They concluded that the region was remarkably resilient to the storm events, and that it had recovered quickly. After Hurricane Isabel in fall 2003, NCCOS scientists again monitored the Sound using airborne laser instruments to compare the chlorophyll and colored dissolved organic matter signals to determine the amount of change. They concluded that although post-hurricane chlorophyll concentrations return to pre-hurricane levels within a short time, chlorophyll concentrations vary markedly for more than a year after the events.

Advanced Warning of Harmful Algal Bloom in Maine Prevents Unnecessary Economic Costs and Public Health Concerns

In the summer of 2004, the NCCOS-supported Monitoring and Event Response for Harmful Algal Blooms (MERHAB) Program used a combination of new technologies to provide advance warning to State of Maine officials of an approaching harmful algal bloom. Based on observations from shipboard sensors, satellites, and buoys, as well as advanced molecular identification techniques, NCCOS-funded researchers located and mapped a patch of the toxic algae. Simultaneously, wind, current, and other ocean condition data received from offshore buoys were used to forecast where the toxic algae patch was headed using a computer model. NCCOS' prediction of the approaching bloom was confirmed by high toxin levels in shellfish recorded by the state monitoring program. As a result, vulnerable shellfish beds in Casco Bay were closed to public harvesting to assure that the seafood poisoned by the toxic bloom did not become a public health threat.

Dolphin Mortality Event Leads to Identification of New Toxin Transfer Route and Persistence in Food Web

In March and April 2004, 107 dead bottlenose dolphins were found in St. Josephs Bay, Florida. Unlike previous dolphin mortality events, the toxic dinoflagellate, *Karenia brevis,* was not apparent in the water, but high concentrations of the domoic acid-producing diatom *Pseudo-nitzschia* were present. NCCOS assisted NOAA Fisheries and Florida state agencies in the investigation of this dolphin mortality event by providing satellite imagery and funds to survey offshore waters for blooms, and analyzed more than 100 dolphin, fish, and water samples. Despite the absence of a harmful algal bloom, high levels of a neurotoxin produced by algae were found in fish and in the stomachs of stranded dolphins. Those findings suggest that these toxins, called brevetoxins, can persist in the ecosystem beyond the duration of a bloom, pointing to fish as a route of transfer to bottlenose dolphins. This finding raises the potential that fish can be vectors of brevetoxin also to humans. Though domoic acid was found in some dolphins, the levels were much lower than those found to cause marine mammal deaths on the West Coast. Although domoic acid may not have played a significant role in this event, this was the first marine mortality event in the Gulf of Mexico food web

NCCOS scientists responded quickly to a whale mortality event in the Gulf of Maine, providing local experts with information they needed to better understand how the event may relate to algal toxin exposure and how best to manage such events in the future.

at which domoic acid was identified, indicating a potential for multiple factors in marine mortality events.

System to Forecast Harmful Algal Blooms Goes Operational

Since 1999, NCCOS, in collaboration with other NOAA offices and Gulf of Mexico agencies, has been developing an informational tool using sophisticated satellite imagery to help coastal agencies manage harmful algal blooms (HABs). On October 1, 2004, NCCOS completed the successful transition of this new ecological forecasting system from a research to an operational product. The system produces information daily, and forecasts at least twice weekly, that are used to determine the current and future location and intensity of HABs and their likely impacts on humans, marine mammals, and fish. NCCOS scientists synthesize and interpret the data to determine current and future locations and intensities of *Karenia brevis* blooms, and also to assess potential HABs impacts on the environment. This information is published in HAB Bulletins. With advance notice, officials are better able to protect human health and mobilize clean-up efforts.

"The NCCOS (HAB) Bulletin gives us a reliable guide as to places to do sampling," says Earnest Truby, Ph.D., with the Florida Marine Research Institute. "Without the interpretive analysis NCCOS provides, the chlorophyll images just aren't that helpful at all. By comparing current levels to previous months' averages, the Bulletins can pretty much tell you what is going to be a red tide and what isn't."

In the northern Gulf of Mexico, early results from a NCCOS-funded study find that hypoxic conditions can adversely affect the growth of brown shrimp – the most economically valuable fishery in the region – and may help to explain size declines in shrimp catches observed in recent years.

Pollution: Overview

Progress has been made in reducing water pollution from "point sources" - industrial and municipal facilities, as well as oil spills and sediment residues from past contamination – since the passage of the Federal Clean Water Act in 1972, although coastal ecosystems still face substantial impacts from pollution. Marine organisms can accumulate contaminants in their tissues from water, sediments, and food, and may experience adverse biological effects even from extremely low concentrations of contaminants.

Nonpoint pollution sources – particularly excess nitrogen from agricultural and suburban runoff and atmospheric deposition of automobile and industrial emissions – remain a particular concern, and can pose significant stresses on coastal ecosystems. Estuaries have always received nutrients from natural watershed sources and the ocean, but in recent decades, population growth and related activities have increased nutrient inputs well beyond levels that occur naturally. Scientific committees, such as the National Research Council, consistently rank nutrient enrichment and overenrichment as leading problems for U.S. estuaries. Increased nutrient loadings carried by the Mississippi River have led to excessive production of algae in the northern Gulf of Mexico, reducing oxygen concentrations in bottom waters as a result of decomposition of these plants. Such hypoxic (low oxygen level) zones can kill animals living in these waters.

NCCOS has compiled extensive historical data on contaminant levels in many estuaries in the U.S. and is researching how best to address chemical contaminants in coastal watersheds. These efforts have resulted in new methods to assess pesticide concentrations in water and assess risks from pesticides in runoff after large coastal storms, along with improved ways to analyze the chemical content of sediments. New predictive models developed by NCCOS and NCCOS-supported scientists are used to assess risks to marine species from exposures to pollutants such as organochlorines and mercury. NCCOS develops annual forecasts of the Gulf of Mexico hypoxic zone and works to improve its annual

forecasts based on monitoring of the area as well as research to better understand impacts of this event on fisheries.

Pollution: Accomplishments

"Mesocosms" Found to Closely Simulate Real World Natural Ecosystems

NCCOS scientists use mesocosms - self-contained and self-supporting systems termed by the late Eugene Odom, often described as the father of modern ecology - to simulate estuarine ecosystems as they exist in nature. Over the past six years, NCCOS scientists have used mesocosms primarily to simulate releases and runoff events of numerous pesticides as they naturally occur following rain events. The researchers have found that the mesocosm results closely track actual field responses, providing results closely comparable to what happens with acute field runoffs, with high mortality rates for a range of commercially important invertebrate and fish populations as well as estuarine organisms. In a 2004 article in *Environmental Pollution*, NCCOS researchers reported that their mesocosm studies showed the pesticide fipronil (used to control various pests such as termites, fire ants, and mole crickets) to be highly toxic to estuarine crustaceans. After testing exposure levels for various estuarine species, the study team found the pronounced response to firponil exposures in grass shrimp.

Eutrophication Assessment Update Helps Managers Target Limited Resources

NOAA scientists are updating the 1999 landmark national assessment of eutrophication that helped pave the way to a better understanding of estuary conditions nationwide. The 1999 National Estuarine Eutrophication Assessment by NCCOS and NOAA's Special Projects Office was the first comprehensive assessment of estuarine conditions across the U.S. It provides a basis for determining a sound nutrient management strategy for the nation's estuaries, as well as a monitoring and research program to provide data for understudied systems. The updated assessment will help managers allocate resources to have the most impact and determine whether systems projected to deteriorate have done so. In the past five years, the study results have informed public policy decisions domestically and abroad. Water quality officials in Portugal have used NCCOS-developed methods to assess their estuaries, summarizing their results in a European Union report on management of nutrient overenrichment. The use of NCCOS' methods by members of the European Union establishes NCCOS as a leader in the global effort to evaluate and manage nutrient-related coastal water quality.

> "Eutrophication models," says NCCOS scientist Suzanne Brickner, Ph.D., "must include the ability to distinguish between situations which are naturally occurring and cannot be managed operationally, and where management measures can affect change, for example, by early and timely fisheries closures in the case of harmful algal blooms."

In fiscal year 2004, NCCOS provided the largest geographical assessment of the extent and severity of sediment contamination in the Chesapeake Bay by releasing information on chemical contaminant levels, toxicity test results, and information on benthic fauna distribution. NCCOS is continuing its research in the Chesapeake Bay, testing for the presence of pharmaceuticals, such as widely prescribed antibiotics, antidepressants, and blood pressure medications.

Copper Concentrations are Increasing in Areas of High Vessel Activity

NCCOS' review of national data collected through the Mussel Watch Project – the longest continuous monitoring program in U.S. coastal waters – shows that sampling sites near areas of high Naval or recreational activity have copper concentrations that are consistently high or are increasing. U.S. Naval vessels and many recreational vessels use copper as the active antifoulant in hull paint. The issue of whether the antifoulant source of copper is evident in the environment is important because the International Anti-Fouling Systems treaty will soon ban the use of tributyltin on large commercial vessels, leaving alternatives that leach copper.

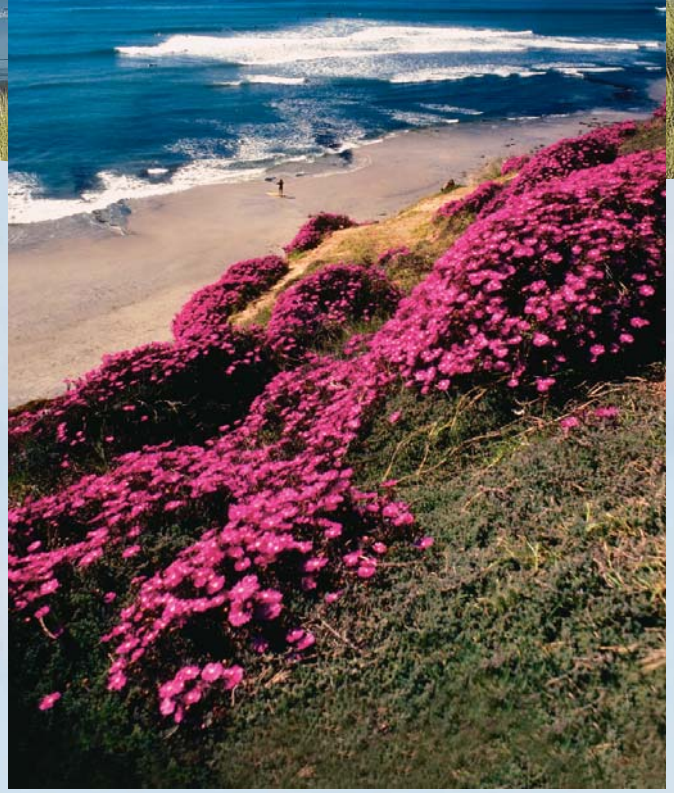
Long-term Monitoring Data Suggest Environmental Pollutants Reduce Male Shrimp Population

Data from more than 18 years of monthly monitoring suggest that environmental pollutants such as pesticides significantly reduce the percentage of male grass shrimp at chronically polluted sites. Laboratory toxicity testing results performed by NCCOS indicate that males are more than twice as sensitive as females in acute exposures to lipophyllic compounds such as the organochlorine pesticide endosulfan. Having fewer male grass shrimp to copulate reduces the percentage of females that reproduce. Pollution levels also appear to cause a reduction in female egg production.

Great Lakes Managers Track Toxic Contaminants using NCCOS, NOAA Information

Water quality in the Great Lakes region has improved overall since the 1970s, but hazardous chemical sediments remain on the bottom of rivers, bays, and nearshore waters in the region. The Episodic Events-Great Lakes Study (EEGLE) Project - a partnership between NCCOS, other NOAA offices, and the National Science Foundation - is providing coastal managers along Lake Michigan with information about the redistribution of toxic chemical contaminants deposited over the past few decades. Based on EEGLE Project data, the scientists have concluded that a variety of toxins, including cesium 137, PCBs, and lead, are stirred-up from bottom sediments by major late winter storms after surface ice melts. The resulting turbidity plume, which includes toxins and associated suspended sedimentary material, often extends over more than 10 km offshore and 200 km along the southern coastline of the lake. Prior to the EEGLE Project, the magnitude and episodic nature of the movement of this massive plume had not been well understood. EEGLE Project products include a coupled hydrodynamic-sediment transport-ecological model and resource management-oriented information.

"You can still find high levels of PCBs in fish, though PCBs were banned 20 years ago. We knew it was happening, we just didn't know how." -- EEGLE lead scientist Brian Eadie, quoted in a *Chicago Tribune* article as the EEGLE Project was getting under way.



Invasive Species: Overview

Exotic plants and animals brought to the U.S. from other countries, or moved to new areas from within the U.S., can damage native plants and animals, change native community structure, and cost millions of dollars to manage and control. U.S. marine and coastal environments, already under stress from other factors, are particularly susceptible to risks posed by the introduction of non-native species. The resulting changes in species composition can be dramatic and difficult to predict.

The invasive species research and monitoring activities performed by NCCOS provides technical assistance and complex data analyses to a growing network of partners. These activities provide a "heads up" about emerging invasions so coastal managers can develop effective local strategies for prevention and control.

Invasive Species: Accomplishments

American Fisheries Society Partners with NCCOS on Invasive Species Inventory

The American Fisheries Society (AFS) is partnering with NCCOS to help build the Hawaiian Pilot Inventory of Aquatic Species and an electronic network for early detection of invasive species. AFS' database of U.S. and Canadian fishes and invertebrates is the basis for the inventory, and NCCOS is working with more than 100 AFS taxonomists and scientists to peer-review regional lists of species.

Industry, Agencies, and Local Citizens "Roundup" Snakeheads on Potomac

On July 30, 2004, the Association of Marina Industries (AMI) and the National Marine Manufacturers Association partnered with state and Federal agencies, including NCCOS, for a fishing tournament to capture the northern snakehead fish, a non-native species recently found in the Potomac River. The snakehead is believed to have been introduced through live seafood industry imports and poses risks to native fish populations and recreational fishing. Challenged by murky water resulting from a recent rainfall, no snakeheads were caught, but one participant claimed to have spotted two of them. The snakehead "roundup" was successful, however, in calling attention to this economic and environmental threat, and in serving as an example of joint projects between NOAA and AMI, which encompasses nearly 950 marinas and 250,000 boaters.

Due to a dramatic decline in Diporeia amphipods - an important prey which supports multi-million dollar recreational and commercial fisheries in the Great Lakes – since 1990, NCCOS researchers assessed the role of disease in the population's pronounced decline. They found the amphipods suffering from a variety of diseases capable of causing mortality or otherwise impairing amphipod health. The NCCOS study showed the important role that disease plays in marine and freshwater ecosystems, helping to establish an important benchmark against which future disease assessments can be measured.

June 16, 2004 marked the launch of a major nationwide public awareness program entitled "A Living Reef Gives Our Islands Life." As part of the NCCOS-funded Hawaii Coral Reef Initiative Research Program at the University of Hawaii, the outreach program prompts community organizations to partner with public and private agencies to stay informed of environmental and economic issues affecting Hawaii's coral reefs, including invasive species.

Scientists Fight to Eradicate Invasive "Snowflake" Coral

Scientists from the NCCOS-funded Hawaii Coral Reef Initiative Research Program, University of Hawaii, and Hawaii Division of Aquatic Resources dove off South Kauai to try to eradicate a deadly, invasive coral species that threatens Hawaii's $30-million-per-year black coral industry and poses risks to NOAA's Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. The snowflake coral (*Carijoa riisei*) has been found in the waters off most of the other Main Hawaiian Islands. In Maui County, it has overtaken deeper black coral beds, which are harvested to make popular jewelry sold in Hawaii and throughout the world. The snowflake coral is believed to have been introduced more than 30 years ago from the bottoms of ships or as larvae in a vessel's ballast water. Unchecked, it could decimate black coral by covering it, removing its rust-colored or red-colored tissue, and leaving a skeletal frame. Ongoing NCCOS research is being conducted to help avoid that outcome.

Lionfish Studies Yield New Insights on Reef Community Impacts

Pterois volitans and *Pterois miles*, commonly called lionfish, are popular saltwater aquarium fish whose venomous spines contain poison that can cause severe pain, numbness, and paralysis. In recent years, NCCOS divers have spotted them in growing numbers off the coast of the Carolinas, where they are invasive. As with other invasive species, key questions involve whether they will thrive and reproduce in this new environment, how they will interact with other species, and the extent to which they may spread. As no basic data existed on the reproductive strategies of the lionfish, NCCOS is providing new information on fecundity (estimates of egg output), age of maturation, and spawning seasonality of the lionfish. Similarly, little was known about how other reef species in the lionfish's adopted environment would fare against them. Preliminary NCCOS observations suggest that lionfish may lead to increased mortalities of some species in important communities and that they may compete for food resources.

Land and Resource Use: Overview

Increasing domestic and international demands for food, fiber, and space are accelerating changes in land and resource use, resulting in exhausted fisheries, loss of habitat, degraded water quality, and increased chemical and sediment runoff. These conditions are found throughout the coastal U.S. and are among the most challenging problems facing coastal managers. Increased understanding of the consequences of human uses of land and resources will allow for better balancing of economic demands with environmental sustainability. NCCOS conducts and supports research on specific causes and effects of land and resource use on coastal ecosystems. Of particular concern to NCCOS are land and resource issues within those ecosystems managed directly and indirectly by NOAA.

Land and Resource Use: Accomplishments

Coastal Habitats Improved through Science-Based Restoration Monitoring Manual

Collaborating with Federal and state agencies, universities, private industry, and nongovernmental organizations, NCCOS compiled a comprehensive manual on how to plan and conduct monitoring of coastal habitat restoration projects. The resulting two-volume set, *Science-Based Restoration Monitoring of Coastal Habitats*, provides tools and information for the development and implementation of restoration monitoring projects for 13 types of coastal habitats found in the U.S. and its territories – from tropical coral reefs to Arctic rocky shorelines. Over 35,000 copies of Volume One have been requested, and demand for Volume Two is anticipated to be even greater. Over 30 governmental, nonprofit, private, and international organizations have referenced and recommended Volume One. This is one of the first comprehensive technical

The highly successful 2004 recreational razor clam dig on Washington's Olympic Coast beaches benefited enormously from coastal managers' access to improved shellfish monitoring data resulting from NCCOS research. Having access to timely data on shellfish toxin levels gave them the confidence to close only the affected beaches and ensure that Northern Pacific tribes could safely conduct their important clam digs on unaffected beaches. Such early detection tools developed by NCCOS are protecting the human health of tribes and coastal communities, and are helping states protect the annual $20 million shellfish industry.

Twenty years of NOAA-funded research, monitoring, and modeling – including major efforts by NCCOS – paid off in July 2004, when NCCOS made the first accurate prediction of the size of the Gulf of Mexico hypoxic (low oxygen) zone, a forecast subsequently confirmed by NOS-supported ship-based mapping. A report released by the Mississippi River/Gulf of Mexico Nutrient Task Force in September 2004 confirmed that long-term research, modeling, and monitoring are essential to the management of the Mississippi River watershed, which encompasses over 40% of the continental U.S.

publications that incorporated socioeconomic and scientific issues, and considered equipment, training, and cost issues. The manual fulfills a legislative mandate of the Federal Estuary Restoration Act and will help NOAA achieve its goal of becoming the global leader in integrated management of the ocean as these methods are being used internationally.

New Ecosystem Model Developed to Predict Consequences of Everglades Restoration

NCCOS-supported scientists developed a high resolution, three-dimensional hydrodynamic model to predict the consequences of the Florida Everglades restoration on the region surrounding Florida Bay and the Florida peninsula. The model simulations show the influence of Mississippi River water and provide a true simulation of eddy passages derived from the Gulf of Mexico Loop Current-Florida Current-Gulf Stream system, information critical for understanding and predicting environmental impacts of restoration on the Florida Keys National Marine Sanctuary, a complex marine ecosystem protected by NOAA to stem threats to the health and ecological future of this complex marine ecosystem. The model is also useful in clarifying mechanisms responsible for larvae recruitment, information critical to sanctuary planners and fisheries resource managers.

Assessment of National Marine Sanctuaries in California Helps Shape Management Plans

NCCOS, in collaboration with NOAA's National Marine Sanctuary Program (NMSP), completed a biogeographic assessment to support the review of management plans for the Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries in California. The assessment is improving understanding of the ecosystems off north/central California and providing additional tools and information to the NMSP for management, research, and education activities. Based on the assessment, NCCOS and NMSP scientists developed a report on physical and biological characteristics of the region, including key ecosystems and species in the

estuarine and marine waters of central and northern California as well as linkages among them. The report also describes biogeographic patterns and processes of the area. The NMSP is using the assessment to develop an environmental impact statement addressing its management plans.

Corals Found in Unusual Location by NCCOS and Partners

While corals are often associated with shallow tropical waters, NCCOS and its partners found them in deeper, cold-water habitats in both northern and southern latitudes. Because of slow recovery rates, deepwater corals and associated fauna may be especially vulnerable to environmental disturbances. In a June 2004 survey using a remotely operated vehicle, scientists documented deepwater corals in offshore waters of the Olympic Coast National Marine Sanctuary off Washington State's rugged and rocky coastline. They observed a dense field of stony coral (*Lophelia pertusa*), which is commonly found in the North Atlantic, on a rock ledge 271 meters below the surface. Many of the observed corals consisted of dead and broken skeletal remains, including a broken soft coral (Gorgonian) nearby. Trawl marks in sediment and derelict fishing gear were also observed. Preliminary results also suggest that these areas are important reservoirs of marine biodiversity and that they are valuable fish habitat. The survey was conducted on the NOAA ship *McArthur-II* and involved scientists from NCCOS, the Sanctuary, and several western state, academic, private, and tribal research institutions. Additional studies will document the spatial extent of these coral assemblages. The survey results have highlighted potential fishing/harvest effects and the need to consider more protective zoning in such critical habitats within the Sanctuary.

Efficacy of Protected Areas for Aquarium Fish Species Validated

Research funded by the NCCOS-sponsored Hawaii Coral Reef Initiative Research Program clearly demonstrated the effectiveness of protected areas along the west Hawaiian coast in bolstering populations of reef fish species targeted by the aquarium fishery. The West Hawaii Aquarium Project illustrated how marine managed areas can promote recovery of fish stocks depleted by fishing pressures in Hawaii, help to reduce conflicts between collectors and other users,

As members of a multi-agency team, NCCOS scientists are researching the potential impacts of introducing the non-native Asian oyster (Crassostrea ariakensis) on the Chesapeake Bay's ecosystem and the Bay's oyster industry. Introducing the non-native oyster is being considered as an alternative to restoring the Bay's naturally occurring oyster species, Crassostrea virginica, which has been decimated by decades of over-harvesting and disease. NCCOS scientists also provided invited testimony to the U.S. Congress and National Academy of Science.

help promote a sustainable fishery, and enhance aquarium fish populations. Populations of most popular aquarium fish species increased in experimental "no-take" zones on the west coast of Hawaii during the study. These findings were presented to the State of Hawaii's Department of Land and Natural Resources - Division of Aquatic Resources to help them implement a state law that established the West Hawaii Regional Fisheries Management Area which includes a network of nine fish replenishment areas to regulate impacts of aquarium fish-collecting along the west Hawaiian coast. The success of these fish replenishment areas is likely to increase as aquarium fishes grow and mature within these protected areas and as they further replenish nearshore reefs.

Special Scientific Journal Issue on Restoration Completed

At the request of Restore America's Estuaries and in partnership with NOAA Fisheries and the U.S. Environmental Protection Agency, NCCOS research encompassed a special issue of the *Journal of Coastal Research* entitled "Coastal Restoration: Where Have We Been, Where Are We Now, and Where Should We Be Going?" Academic, Federal, and state experts came together to explore restoration goals, efforts to restore fish and wildlife habitat, the role of restoration in maintaining coastal habitats, and uses of adaptive management approaches in coastal restoration. This collection of papers presented during four technical sessions at the April 2003 National Conference on Coastal and Estuarine Habitat Restoration represents an initial effort to document progress in restoring coastal habitats over the past 15 years. It also

provides guideposts for scientists and managers as they move forward, and highlights the need to include social scientists in the restoration process. The work presented in the special issue demonstrates the value of science in managing the Nation's resources and confirms the potential of restoration efforts in repairing damaged ecosystems.

Baseline Characterizations and Inventories of U.S. Virgin Islands Resources Established for Evaluation of Protected Area Effectiveness

NCCOS researchers, in collaboration with the National Park Service (NPS) and other partners, completed a seafloor characterization and biological resource inventory of nearshore and deepwater habitats of the Buck Island Reef National Monument and Virgin Islands National Coral Reef Monument, NPS-managed areas within the U.S. Virgin Islands. Data from these efforts will be used in producing maps of the seafloor topography, identifying and delineating seafloor habitats, and preparing spatially-explicit models of how fish species use habitats. The baseline information will also be used to update nautical charts of the U.S. Virgin Islands and help NOAA meet its commitment to the U.S. Coral Reef Task Force to map coral reef ecosystems. The Buck Island Reef National Monument, which is a no-take marine protected area, allows researchers a unique opportunity to study the ecosystems and determine baseline conditions against which future changes can be measured. This approach will allow them to determine the effectiveness of the protected area status once regulations are enforced. The Virgin Islands National Park Superintendent characterized this NCCOS research as "invaluable."

Protection Status of Tortugas Ecological Reserve Evaluated

NCCOS scientists are seeking to better understand the "real world" impacts of the landmark July 2001 designation of a 151-square mile "no take" ecological reserve in a remote area west of the Florida Keys National Marine Sanctuary. The Tortugas (Spanish for "turtle") are widely recognized as home to some of the most productive and unique marine resources in the entire Sanctuary. The goal of the 2001 ecological reserve designation is to protect critical coral reef ecosystem of the remote Tortugas, important spawning areas for snapper and grouper, and the deep-water habitats essential for other commercial species. After spending the equivalent of nearly four months at sea over a three-year timeframe, NCCOS researchers express cautious optimism that the area's reserve status endows it with tremendous downstream spillover and larval export potential for Florida reef habitats.

CONTACTING NCCOS

NCCOS Headquarters (NCCOS HQ) is located along with its parent organization, NOAA's National Ocean Service. Headquarters operations include professional, financial, and administrative management and coordination of the activities conducted at the NCCOS centers and laboratories.

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NCCOS' Center for Coastal Monitoring and Assessment (CCMA) monitors, surveys, and assesses coastal environmental quality, habitats, and resource distribution. CCMA manages the National Status and Trends Program, which performs long-term contaminant monitoring at more than 350 estuarine and coastal sites. CCMA's monitoring and assessment studies determine how contaminant exposure and changes in coastal habitats affect the distribution and abundance of living marine resources. In addition, CCMA uses remote-sensing technology to evaluate estuarine and coastal environmental problems, track harmful algal blooms, and determine coastal habitat changes over time.

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NCCOS' Center for Sponsored Coastal Ocean Research (CSCOR) administers a Federal-academic partnership to develop predictive capabilities for managing coastal ecosystems. These partnerships support long-term multidisciplinary projects to evaluate ecological effects of multiple stressors; develop forecasting tools; respond to the combined public health, economic, and ecosystem threats from harmful algal blooms; and transition successful research into NOAA operations. Major CSCOR research areas address coastal fisheries ecosystems, cumulative coastal impacts, and harmful algal blooms/eutrophication.

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NCCOS' Center for Coastal Fisheries and Habitat Research (CCFHR) conducts research to understand and forecast the ecological effects of coastal habitat and resource change. CCFHR laboratory and field research is concerned with estuarine processes, biological productivity of nearshore and ocean ecosystems, dynamics of coastal and reef fishery resources, and effects of human influences on resource productivity. The CCFHR-affiliated Kasitsna Bay Laboratory, located on a small bay in the Kachemak Bay system in Alaska, focuses on the impacts of land and resource use on relatively pristine coastal ecosystems.

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NCCOS' Center for Coastal Environmental Health and Biomolecular Research (CCEHBR) conducts interdisciplinary research on issues related to coastal ecosystem health, environmental quality, and related public health impacts. CCEHBR conducts chemical, biomolecular, microbiological, and histological research pertaining to human influences on marine and estuarine habitats. The CCEHBR-affiliated Cooperative Oxford Laboratory located in Oxford, Maryland specializes in the pathology of marine organisms and habitat restoration research.

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The **Hollings Marine Laboratory (HML)**, a NOAA facility on state-owned land in Charleston, South Carolina, will house a new NCCOS research center. Named after former U.S. Senator Ernest F. Hollings of South Carolina, the multi-institutional, multidisciplinary laboratory focuses on the relationship between the coastal ocean ecosystem and human health by integrating medical and marine expertise among the Federal, state, and academic partners at HML. As a newly designated NOAA Center of Excellence for Oceans and Human Health, the HML facility uses state-of-the-art technologies to develop genetic techniques for evaluating molecular-level responses of oysters and shrimp to multiple stressors, explore the susceptibility and conditions under which marine organisms become vectors for human pathogens, analyze the nutritional value of cultured versus wild seafood, and develop better techniques to track sources of pathogenic microorganisms that can pose human health risks.

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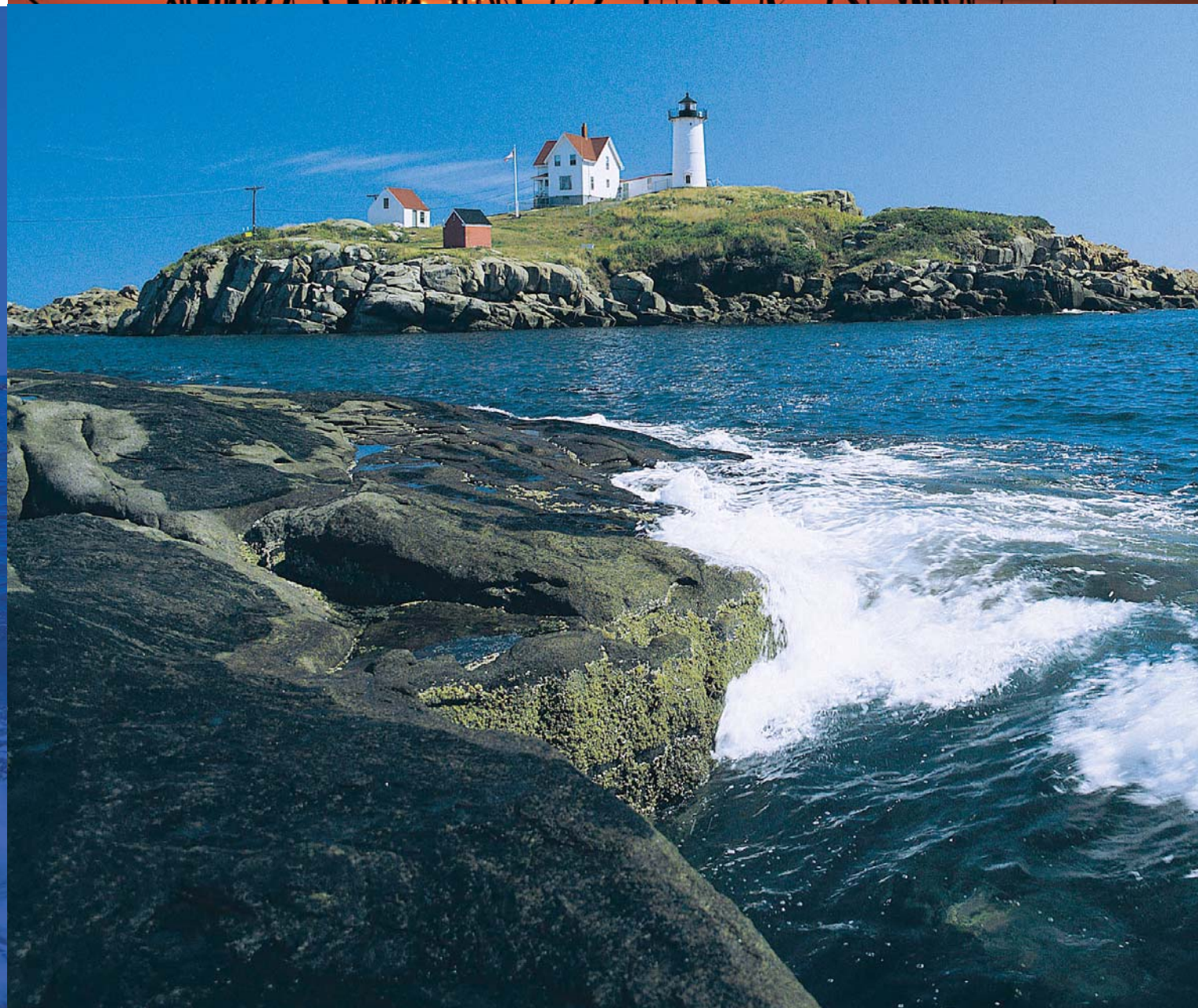

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