



# 2011 ANNUAL REPORT

NORTHERN GULF INSTITUTE



**NGI**  
NORTHERN GULF INSTITUTE  
a NOAA cooperative institute

## VISION

NGI will be a regional leader providing integrative research and education to improve the resiliency and conservation of the Northern Gulf of Mexico.

## MISSION

NGI conducts high-impact research and education programs in the Northern Gulf of Mexico region focused on integration - integration of the land-coast-ocean-atmosphere continuum; integration of research to operations; and integration of individual organizational strengths into a holistic program. The program shall measurably contribute to the recovery and future health, safety, resilience and productivity of the region, through sustained research and applications in a geospatial and ecosystem context.



## MESSAGE FROM THE DIRECTOR

NGI enters a new phase in the fall of 2011. We've graduated from a new-start cooperative institute, performed well during a comprehensive science and administrative evaluation gaining an "Outstanding" rating, responded to the research coordination challenge presented by Deep-water Horizon, and adjusted to the tightest funding climate the country has faced in 80 years. NOAA's renewal of the NGI cooperative agreement establishes a collaborative framework for research and education in the Northern Gulf region for the next five years. The NGI mission to conduct research that builds an integrated, comprehensive understanding of natural and human impacts on Northern Gulf of Mexico ecosystems and economies to improve its management and the four NGI research themes are in lockstep with the NOAA mission.

When the founding team convened in the spring of 2006 to develop the plan that became NGI, the collaborative effort between the science leaders took root. Since then, the cooperative spirit has grown throughout the halls of the NGI member institutions, and resonates with the other important regional efforts addressing large issues in the Northern Gulf of Mexico ecosystem. The Gulf of Mexico Alliance, Sea Grant programs of the Gulf, the EPA Gulf of Mexico Program, and the NOAA Gulf of Mexico Regional Collaboration Team are just a few of the regional groups collaborating with NGI. These relationships have led to protocols and data and knowledge sharing that support the research, education and resource management of the Northern Gulf ecosystem.

During the summer of 2011, the NGI Council of Fellows adopted a new 10-year strategic plan. We have launched a redesigned NGI website with new focus using the latest information technologies and better serving our audiences. The NGI Program Office is moving into the new Mississippi State University Science and Technology Center at the Stennis Space Center, where other agencies will be co-located. If you are a stakeholder vested in a vital and healthy Northern Gulf of Mexico, I invite you to join us in realizing the goals of this long term plan. We look forward to working with you toward improving our understanding of how to be good stewards of the critical resources of the Northern Gulf of Mexico.

A handwritten signature in black ink that reads 'Robert Moorhead'.

Robert J. Moorhead, II  
Director and Endowed Professor

# RESEARCH LAND CO

## ECOSYSTEM BASED MANAGEMENT: GETTING THE WHOLE PICTURE

NOAA and NGI are working together to develop Integrated Ecosystem Assessments across the Northern Gulf of Mexico that provide: indicators that define ecosystem “states” for previously initiated IEAs of Perdido Bay, Mississippi Sound and Barataria Basin; a model framework to link state indicators to drivers and pressures; and a prototype coastal marine spatial planning system for the Northern Gulf that incorporates findings of these assessments.

With improved understanding of the drivers and pressures, resource managers can identify what actions on land and in the marine environment need to be changed, and focus their efforts and scarce resources towards those changes.

## UNDERSTANDING DRIVERS AND PRESSURES SUCH AS CHANGES FROM DIVERSION PROJECTS

New data on the impacts of Mississippi River diversions were analyzed to help budget what was happening to Mississippi River nitrate that was entering upper Breton Sound at Caernarvon, Louisiana. The data suggest that phytoplankton uptake is likely the major sink for nitrate at Caernarvon. The study demonstrated that nekton species biomass distributions changed significantly after the opening of the Caernarvon freshwater diversion in 1991. Nekton species richness, abundance and the proportion of smaller individuals increased, indicating increased nursery function. NGI supports researchers who analyzed data to investigate wetland loss patterns due to hurricane storm surge near the Caernarvon diversion. The biggest proportional changes are in the diversion area. The freshwater vegetation might be unable to withstand the shear stress from hurricane impacts on shallow low salinity root systems, leading researchers to believe freshwater vegetation is less hardy than its saline counterparts.



## SELECTING MOST COST EFFECTIVE BEST MANAGEMENT PRACTICES TO HELP PREVENT PRESSURES ON THE ECOSYSTEM



Polluted water from non-point sources such as mud escaping from construction sites is degrading water quality and habitats in the Northern Gulf ecosystem. Employing best management practices during construction is vital for the health of the Northern Gulf. Doing so in the most cost effective way is essential for the economic health of the region.

*“We’ve developed a simple model that developers can use to characterize the value of best management practices on commercial development.... We’re making the handoff from public-funded research to the private sector.”*

Wayne Wilkerson

By providing a tool that helps land developers assess costs of best management practices, they can more easily adopt the practices and help reduce non-point source pollution. The researchers are working with contractors, developers, municipal officials and other stakeholders in Jackson County, MS to help protect the Pascagoula River watershed and water quality of the Gulf of Mexico.

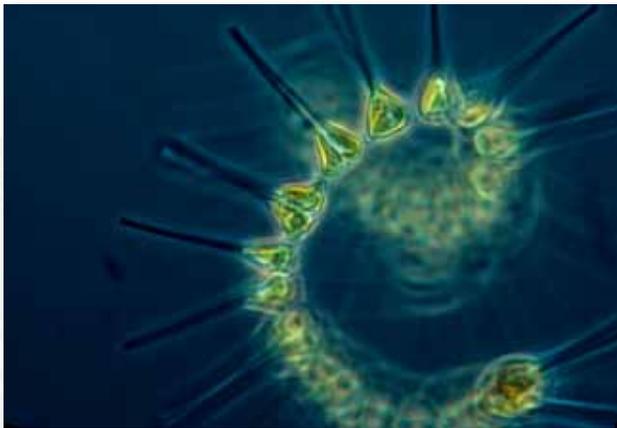
# COAST OCEAN ATMOSPHERE

## LEARNING MORE ABOUT HYPOXIA AND ITS IMPACTS

Hypoxia (oxygen levels too low to support marine life) has generally increased in the Northern Gulf and in the Mississippi Sound and Bight over the past 25 years. Recent NGI supported research by LSU and USM indicates that Barataria Bay estuary imports nitrogen and exports carbon to the coastal ocean. Compared to the lower Mississippi River, the Barataria estuary appears to be a very small source of Total Organic Carbon for the Northern Gulf of Mexico, and is therefore unlikely to have a significant influence on the development of Gulf hypoxia. Measurements show that hypoxia in the Mississippi Sound and Bight regions leads to nutrient flux out of the benthos, and enhanced surface productivity, which can then lead to enhanced bottom hypoxia. Better understanding of these connections helps us develop conservation tools to reduce the sources of hypoxia.



## DIFFERENT WAY OF LOOKING AT THE GULF – UP CLOSE



Analysis of previously neglected invertebrate zooplankton taxa revealed that the Gulf of Mexico is functionally designated as a single Large Marine Ecosystem. The Northern Gulf of Mexico can be divided into three Large Marine Ecosystem sub-units corresponding to i) west Florida inner shelf, ii) northern River-dominated shelf, and iii) oligotrophic Gulf-wide. Characterizing critical Large Marine Ecosystem sub-units based on the differences found will help improve specific ecosystem model parameterizations planned for managing Gulf resources. Researchers found seasonal association between worldwide oceanic-atmospheric modes of variability, meteorological and hydrological conditions and displacement volumes of zooplankton in the Northern Gulf of Mexico.

## RELATIONSHIP OF SALINITY AND PLANKTON

With climate change, we expect to see shifts in salinity levels. Observations demonstrated that freshwater pulse events in Breton Sound lowered *Vibrio* levels. Denitrification rates of the salt marsh soils in Breton Sound demonstrated a tolerance to salinity levels in the higher salinity range with no significant difference in mid-range. However, freshwater salinity treatment led to a dramatic decrease in denitrification rates for the salt marsh soil. This result has consequences for any proposed very large diversion which would be capable of discharging very large amounts of Mississippi River water. Consistent with the view that estuaries are generally highly productive systems, Breton Sound net productivity values are about ten times greater than average offshore values based on a model developed from averaging results from 24-hour incubations. As we see climate change impacts such as salinity levels increasing in more inland channels, this research helps us understand the vital need for wetlands restoration to prevent additional encroachment of higher salinity levels related to sea level rise.



# RESEARCH LAND C



## OBSERVING, UNDERSTANDING, AND TEACHING ABOUT HARMFUL ALGAL BLOOMS

Phycotoxins, including *Microcystis*, have now been detected in water samples in Breton Sound estuary, as well as primary and secondary consumers (chironomids, clams, blue crab and catfish), in two estuaries and coastal Louisiana illustrating the need for continued monitoring and research to discover the underlying factors that control toxin production. NGI supported researchers discovery of phycotoxins in the estuary illustrates the potential for harmful effects on consumers and the entire food web. Both field data and laboratory testing shows the major impacting factors in *Vibrio* proliferation. This helps us better understand harmful algal blooms and their threats to human health.

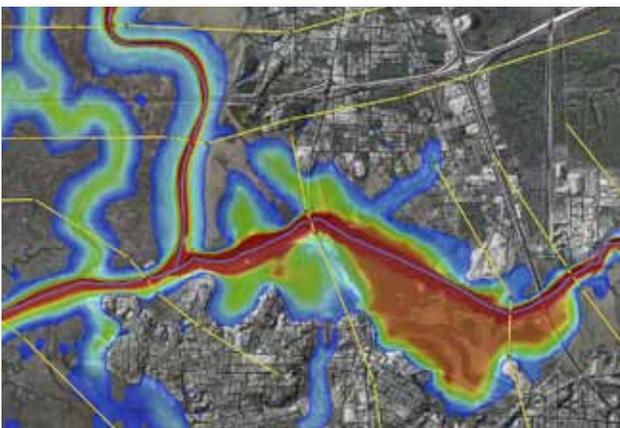
NGI provides a connection between research and outreach with support of the NOAA Phytoplankton Monitoring Network.

Members of the NGI staff work with NOAA to facilitate citizen scientists conducting regular sampling, identification and reporting of phytoplankton along the Northern Gulf coast as part of a national program to identify harmful algal blooms. This outreach effort not only helps members of the public better understand the ecosystem, it also helps the research resource management community monitor the Gulf.

## EDUCATION AND OUTREACH

Education and Outreach staff host two annual internship programs, facilitate student involvement on NGI research projects, distribute NGI research through numerous print and electronic media, conduct teacher workshops, and network with other professionals to promote science, technology, engineering and math skills in the Northern Gulf region.

NGI now has a Facebook page and a Twitter account and uses these forms of social media to relay and distribute information about workshops, seminars, scholarships, and even job opportunities.



## KEEPING COMMUNITIES SAFE FROM FLOODING RISKS

FloodViz is a new mapping product resulting from a joint project between NGI researchers at Mississippi State University and scientists at the NOAA National Weather Service's Lower Mississippi River Forecast Center. It has created new tools to help keep communities safe from flooding risk. Advances in computer technology have allowed researchers to rapidly create better maps which more accurately show areas likely to be affected by flooding. Massive flood threats during the late spring of 2011 showed the need for reliable information about areas at risk. FloodViz helps emergency management personnel plan ahead and pass information along to at-risk communities.

## INCREASING FISHERIES HABITATS WITH OYSTER REEFS

Using protocols gained from NCI-supported research at the Dauphin Island Sea Lab, The Nature Conservancy built 1.5 miles of oyster reef and created about 30 acres of marsh and submerged aquatic vegetation habitat. This effort is part of a larger 100 Miles/100 Acres project and was supported by NOAA and the American Recovery and Reinvestment Act of 2009. Over 600 volunteers placed 20,000 bags of oyster shells to create these reefs. The shoreline habitat restoration leads to many benefits including improved coastal resiliency, increased fisheries habitat, improved water quality and increased oyster reef resources.

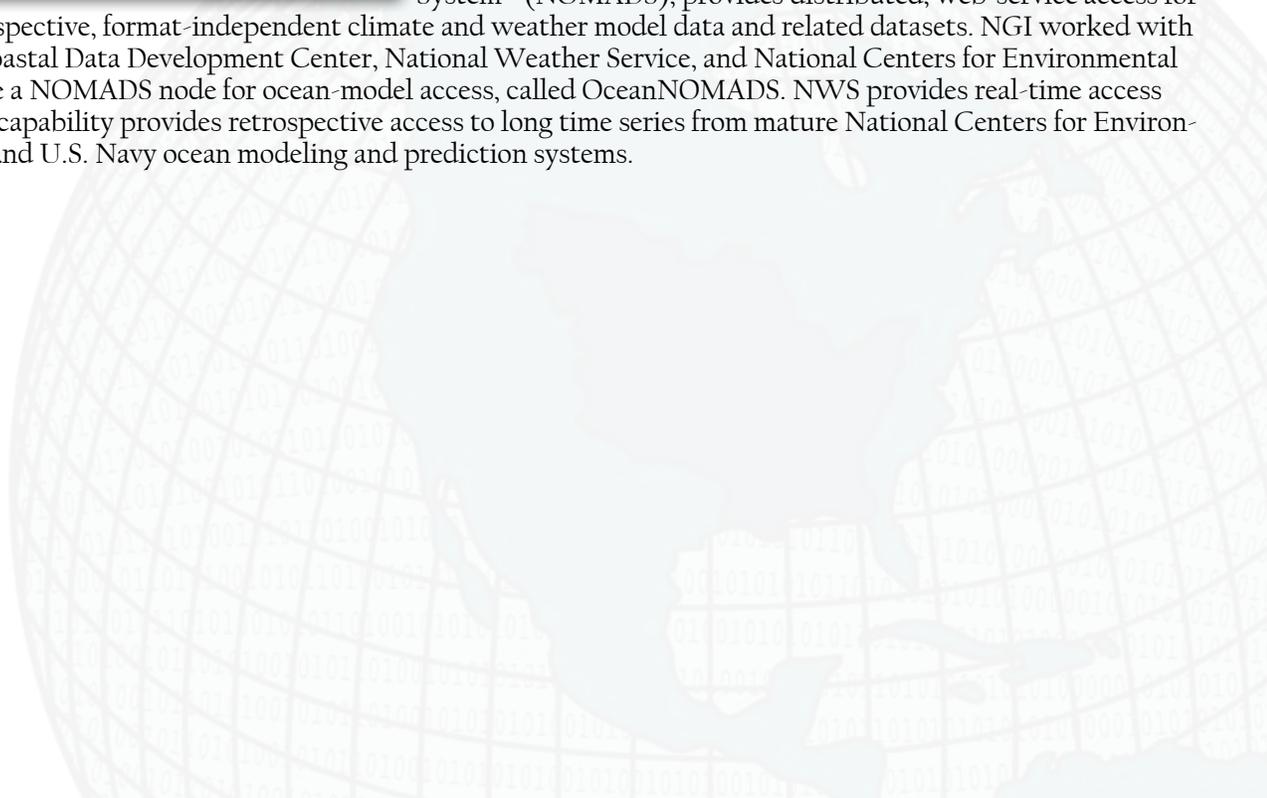


## FORECASTING HAZARDS TO HELP REDUCE IMPACTS

When Deepwater Horizon oil threatened the Northern Gulf, a NOAA/Navy/NGI partnership provided high-resolution, real-time and archived Gulf currents that NOAA responders and academic researchers used to track the daily movement of the oil.

When the damaged power plants from the Fukushima earthquake and tsunami released radioactive water into the Pacific Ocean, this partnership again provided access to models necessary to monitor this threat for both immediate response and later study. The NOAA Operational Model Archive and Distribution System - (NOMADS), provides distributed, web-service access for

real-time and retrospective, format-independent climate and weather model data and related datasets. NCI worked with NOAA National Coastal Data Development Center, National Weather Service, and National Centers for Environmental Prediction to create a NOMADS node for ocean-model access, called OceanNOMADS. NWS provides real-time access while the NCDDC capability provides retrospective access to long time series from mature National Centers for Environmental Prediction and U.S. Navy ocean modeling and prediction systems.



# NGI AWARDS BY FISCAL YEAR



Years	Total \$
2007	6,300,000
2008	5,326,925
2009	15,815,761*
2010	24,795,018*
2011	10,662,815

*\* Includes \$4,460,300 (2009) and \$4,495,500 (2010) for the Mississippi State University Science & Technology Center, which will house the Northern Gulf Institute Program Office and other organizations.*

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The Northern Gulf Institute (NGI), a National Oceanic & Atmospheric Administration Cooperative Institute, develops, operates, and maintains an increasingly integrated research and transition program focused on filling priority gaps and reducing limitations in current Northern Gulf of Mexico awareness, understanding and decision support.

The collaboration, led by Mississippi State University, includes the University of Southern Mississippi, Louisiana State University, Florida State University and the Dauphin Island Sea Lab.



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Scan this QR code with your smartphone to visit the NGI web site.



## ACADEMIC MEMBERS



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The Northern Gulf Institute is a member center of the High Performance Computing Collaboratory at Mississippi State University.