Providing Key Information to Understand and Reduce the Impacts of Oxygen Depletion on Living Resources in the Gulf of Mexico

Occurrence of Oxygen Depletion and Associated Ecosystem Impacts in the Gulf of Mexico

The Gulf of Mexico contains almost half of the nation's coastal wetlands and supports approximately 20% of U.S. commercial fishery landings as well as important recreational fisheries. The vast majority of the Gulf's commercial fishery landings - almost $2.8 billion annually - come from the area directly affected by the Mississippi River. This northern portion of the Gulf of Mexico ecosystem has undergone profound changes over the past few decades due to increased nutrient enrichment from land-based sources that run into the Mississippi River. While a certain level of nutrients such as nitrogen and phosphorus are beneficial, excessive amounts can "over-enrich" coastal ecosystems and lead to adverse impacts. A common effect of nutrient over-enrichment is excessive algal production. When the algae die, sink, and decompose on the bottom of the waterbody, concentrations of dissolved oxygen are reduced, often causing bottom-dwelling organisms to become stressed or die.

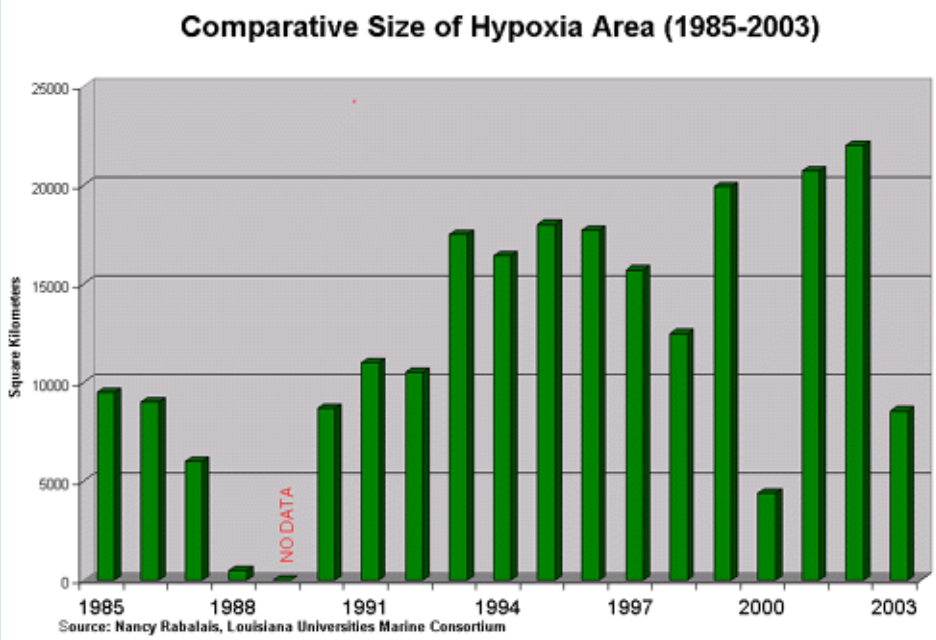
Uncertainty Regarding the 'Dead Zone'

Nutrient inputs into coastal ecosystems became a major issue in the mid to late 1980s as large areas of low oxygen (hypoxic) bottom water, known as the 'Dead Zone,' were a recurrent feature in the Gulf of Mexico each summer. The issue immediately became a focal point for considerable scientific and policy attention because of its enormous size and implications regarding management of the Mississippi River watershed which encompasses more than 40% of the continental U.S. The issue was further complicated by uncertainty about the causes of hypoxia and its impacts on marine resources. This uncertainty existed because of a lack of comprehensive scientific studies on the subject.

The Need for Interdisciplinary Research

In order to create the necessary scientific base with which to make informed policy decisions, the National

Oceanic and Atmospheric Administration initiated a major research effort called the Nutrient Enhanced Coastal Ocean Productivity (NECOP) Program. From 1990 to 1996, approximately 49 Federal and academic scientists from 18 institutions joined in this interdisciplinary investigation of hypoxia in the Gulf of Mexico. The NECOP Program was designed to investigate the causes and impacts of hypoxia in the Gulf and to monitor annual hypoxic episodes on the Texas and Louisiana Inner Shelf to determine their frequency and areal coverage. Additional research examining changes in the sediment was conducted to understand how the Mississippi River plume affects the productivity and extent of hypoxia within this critically important ecosystem. Research results documented the growing size of the hypoxic zone and produced considerable evidence that increased nutrient loading from the Mississippi River watershed into the Gulf of Mexico has been a major factor in the severity of hypoxia.



ing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico describes a national strategy to reduce the frequency, duration, size, and degree of hypoxia in the region. The Action Plan, derived from considerable stakeholder input, outlines the goal of reducing the five-year average size of the hypoxic zone to less than 5,000 km^2. To accomplish this goal, the states throughout the Mississippi River watershed endorsed a voluntary set of cost-effective actions. The Task Force is currently reassessing and updating the Action Plan.

Tribal, State, and Federal Organizations Respond to Growing Concerns

The results of these studies raised public interest and led to the call for an integrated assessment to be performed and the convening of the first Gulf of Mexico Hypoxia Management Conference in December 1995. In 1997, the U.S. Environmental Protection Agency led six Federal, seven state, and two tribal organizations in forming the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The National Centers for Coastal Ocean Science (NCCOS), in conjunction with the White House's National Science and Technology Council's Committee on Environment and Natural Resources, published six technical reports and the *Integrated Assessment of Hypoxia in the Northern Gulf of Mexico* using data and information from NECOP-sponsored studies. This final synthesis encompassed a two-year review and collaborative assembly of relevant research on the topic, providing a comprehensive report on the state of knowledge on the extent, characteristics, causes, and effects - both ecological and economic - of hypoxia in the northern Gulf of Mexico.

Efforts to Reduce Hypoxic Zone Take Shape

Based on the scientific consensus from the NECOP research and Integrated Assessment, the Task Force developed the first ever action plan regarding the Gulf's hypoxic zone. The *Action Plan for Reduc-*

Better Understanding of Hypoxic Zone through NCCOS Research

Knowledge gained through NCCOS' northern Gulf of Mexico hypoxia research program directly influences future management decisions in the Mississippi River watershed. Current NCCOS-sponsored field studies and computer modeling efforts, which build upon the NECOP Program findings, are helping to unravel the uncertainty regarding the factors influencing the size and duration of the hypoxic zone, and are leading to enhanced predictive models to forecast hypoxia and better understand its impacts on commercially and ecologically important species. From these long-term research investments, NCCOS now has the capability to provide accurate forecasts of the hypoxic zone and evaluate the expected impact and benefit of management strategies aimed at reducing the hypoxic zone. This capability was demonstrated with the successful forecast of the hypoxic zone last year. Future research investments will expand the ability to forecast hypoxia under a variety of conditions and determine its impact on living marine resources and associated coastal communities. By employing a combination of field, monitoring, and modeling studies within an ecosystem management framework, NCCOS-sponsored research has enabled NOAA to provide key information and tools to coastal managers which help them manage and mitigate the size and impact of the annual hypoxic zone and support the goals of the Gulf of Mexico Action Plan through recommendations on nitrogen fertilizer application amounts, assistance in developing vegetated buffers along streams, and other important actions.

National Centers for Coastal Ocean Science
1305 East West Highway, Room 8221, Silver Spring, MD 20910
Phone: (301) 713-3020 FAX: (301) 713-4353 Web site: www.coastalscience.noaa.gov
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