Hypoxia in the Northern Gulf of Mexico

This is an environmental issue of national and even international significance.

Excess nitrogen and phosphorus present in the flow of the Mississippi and Atchafalaya Rivers contribute to depletion of oxygen from bottom water every summer in a large area of the northern Gulf of Mexico adjacent to Louisiana and east Texas.

In fact, the affected area is enormous, the largest such area in the western hemisphere. This water quality problem, known as *hypoxia*, reduces the ability of these highly productive coastal environments to fully support aquatic life, including shrimp and fish. Most commonly, marine life avoids areas where oxygen levels are too low, moving inshore, offshore, or upward into habitats with more dissolved oxygen. However, marine species that cannot move may not survive hypoxia. The absence of most marine life has led some to refer to the area affected by hypoxia as the "dead zone." While the term is applicable, those who travel to the area will find abundant marine life confined to the oxygen rich upper water column. The fact is that even though this coastal ecosystem is stressed by hypoxia, the regional fisheries are among the most valuable and productive in the United States.

What Causes Hypoxia?

Development and continuation of hypoxia, as occurs in the northern Gulf of Mexico, requires a convergence of several different ecological circumstances. First, the affected waters must be isolated from the supply of oxygen present in the atmosphere. This occurs in the northern Gulf principally as a result of freshwater–discharged from the major rivers–that creates a layer of buoyant, lower-salinity water on top of the denser marine waters, effectively isolating the bottom water. Secondly, a supply of reactive organic matter is needed to sustain oxygen consumption in the bottom water or the sediments. An increased rate of supply of organic matter, especially highly reactive organic

matter such as detritus derived from marine algae, promotes increased rates of oxygen consumption. In the appropriate physical context, oxygen can become depleted even with a "normal" level of organic matter input. On the other hand, an increased supply rate resulting from increased loadings of nutrients can increase the severity as well as the spatial and temporal extent of oxygen depletion. Although many details of the biological and physical oceanography of the process are still under investigation, there is broad scientific consensus that increased nutrient loading to the northern Gulf of Mexico from the Mississippi/Atchafalaya River basin contributes to the extensive hypoxia that has been documented.

Who should be concerned?

Hypoxia in the northern Gulf of Mexico is of concern to regional participants in commercial and recreational fishing, as well as to those who consume products of those fisheries or otherwise benefit from those industries. Those who value healthy coastal ecosystems also should be concerned. Efforts to mitigate the problem as part of a larger effort to improve water quality throughout the Mississippi/Atchafalaya River basin are gaining momentum. These efforts will create environmental benefits throughout the watershed, as well as regulatory implications that might ultimately affect almost everyone in some way. This is an environmental issue of national and even international significance.

What activities are in place to monitor and better understand Gulf hypoxia?

Gulf hypoxia is the subject of active monitoring, modeling, and research. To date, no fully coupled hydrodynamic water quality model has been validated and widely accepted as a tool for guiding water quality management.

Monitoring the Extent of Hypoxia. The extent of hypoxia in the northern Gulf of Mexico has been monitored by shipboard survey annually since 1985 by the Louisiana Universities Marine Consortium (LUMCON), largely funded by the National Oceanic and Atmospheric Administration (NOAA) after the first several years. Descriptions of the area of hypoxia are generally released to the media almost immediately after the survey. LUMCON also conducts monthly surveys on two transects off Louisiana and maintains several moorings collecting continuous data on weather, water quality, and physical circulation. Information is available at http://gulfhypoxia.net.

Monitoring Nutrient Loadings. Discharges of freshwater, nitrogen, and phosphorus from the Mississippi and Atchafalaya Rivers, known to contribute significantly to Gulf hypoxia, are monitored by the U.S. Geological Survey (USGS). Additionally, the USGS conducts essential modeling activities identifying the sources of nutrients within the watershed that are eventually discharged into the Gulf of Mexico. Information is available at http://toxics.usgs.gov/hypoxia.

Process-Oriented Research Addressing Gulf Hypoxia. The Center for Sponsored Coastal Ocean Research (CSCOR) at NOAA has funded research addressing the hypoxic zone since 1990 and continues to do so in 2010. Information on NOAA/CSCOR funded research within the NGOMEX program is available at http://www.cop.noaa.gov/stressors/pollution/current/gomex-factsheet.aspx. Many of the projects listed therein maintain their own internet presence. Additionally, the U.S. Environmental Protection Agency (EPA) is engaged in a research and modeling program on Gulf hypoxia, which began in 2003.

Planning for Management Programs. Plans for environmental management programs targeting nutrients in the Mississippi/ Atchafalaya River basin and Gulf hypoxia are assembled via the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, including both federal and state agencies and chaired by the U.S. EPA and are available at http://www.epa.gov/msbasin.