REPORT FROM 2022 SHELF-WIDE HYPOXIA CRUISE

LOUISIANA STATE UNIVERSITY
AND
LOUISIANA UNIVERSITIES MARINE CONSORTIUM

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The bottom area of low oxygen in Louisiana coastal waters west of the Mississippi River, commonly known as the 'Dead Zone,' was mapped from July 25 – July 29, 2022, and was estimated to be 8,480 square kilometers (3,275 square miles) (Figure 1). The 2022 size is the eighth smallest in 36 years of coast wide hypoxia data. The size is about the size of the state of New Jersey, or just over 13 times the size of Lake Pontchartrain. The area is also over the size of the environmental goal for the Mississippi River/Hypoxia Task Force Action Plan of 5,000 square kilometers over a five-year running average. The area mapped is much smaller than the predicted area of approximately 15,200 square kilometers.

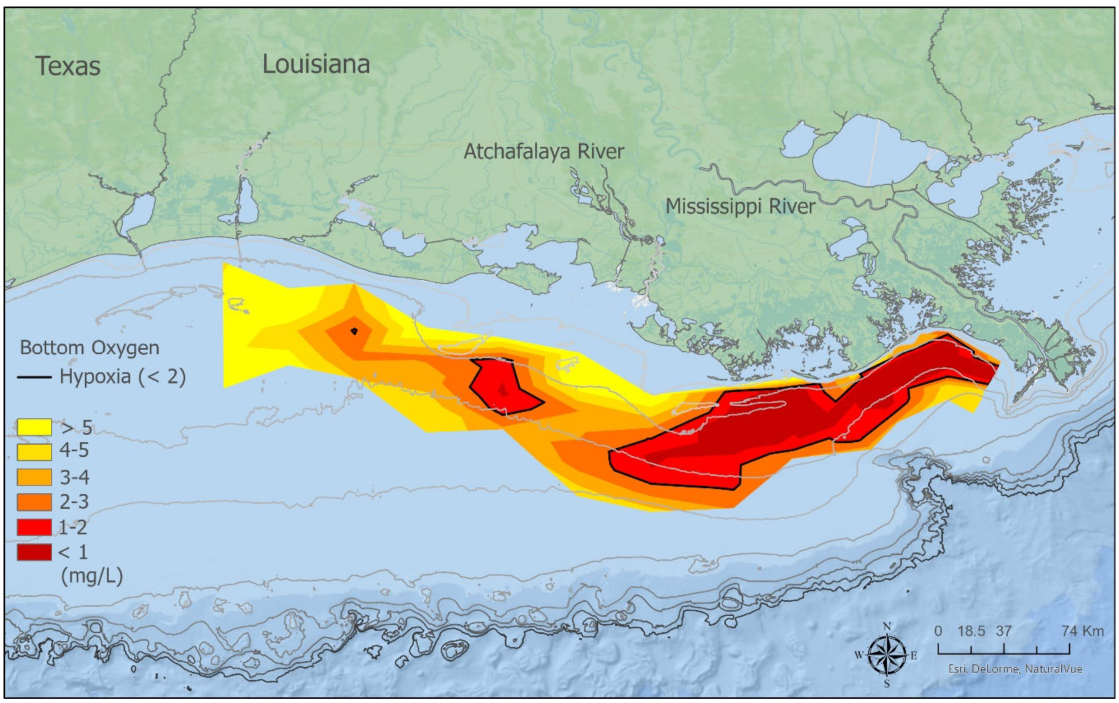

Figure 1. Distribution of bottom-water dissolved oxygen concentration for July 25-29, 2022. The combined area less than 2 mg l^{-1} and 1 mg l^{-1} are the darkest colors and outlined by the black line. Data source: NN Rabalais⁺, RE Turner* & C Glaspie*, *⁺Louisiana State University and Louisiana Universities Marine Consortium. Funding: National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science.*

The forecasted size was based on the nutrient loads of Nitrate+Nitrite-N, in the May preceding the hypoxia research cruise (Figure 2). The May 2022 river discharge and calculated nutrient loads indicated an 'average' year, and the estimates for the size of the low oxygen area were average.

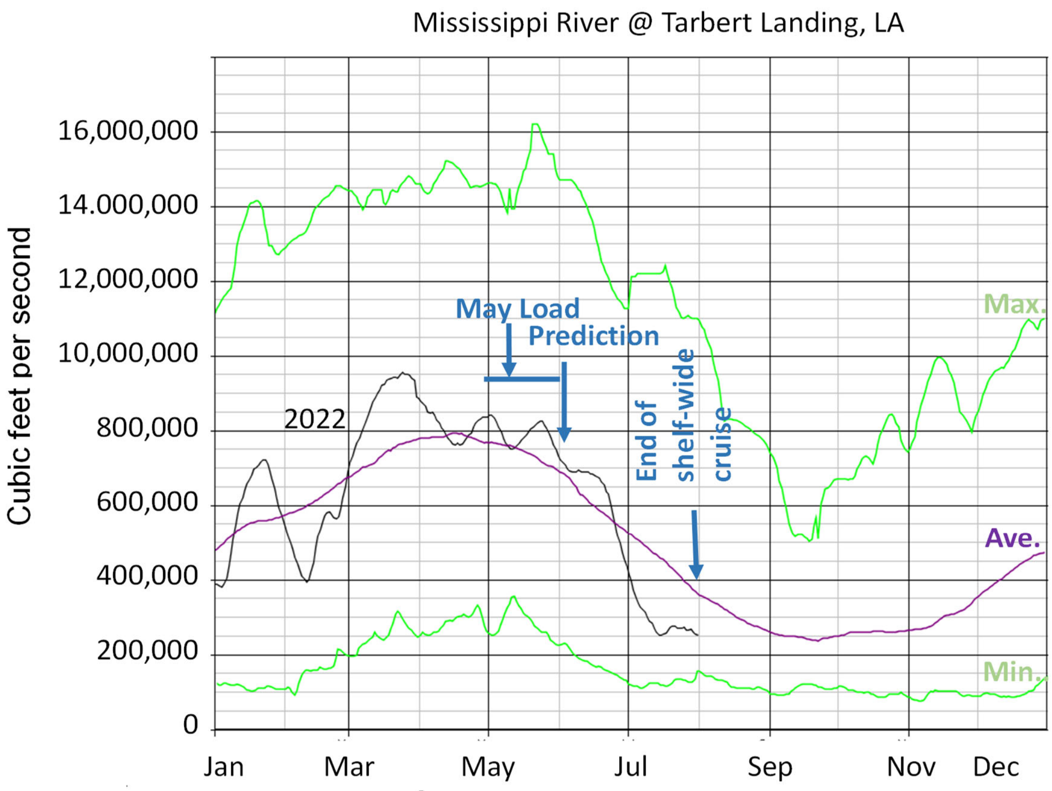

Figure 2. Mississippi River discharge at Tarbert Landing MS for 2022 through July 1. The nutrient load (discharge × nutrient concentration) in the month of May is used to predict the bottom-area size of the hypoxic zone in mid-summer. Last access on 7-31-2022
https://rivergages.mvr.usace.army.mil/WaterControl/Districts/MVN/RRLFlow.png

The delay from prediction of size in May to measurement of size during the cruise allows for growth of phytoplankton, followed by their eventual sinking to the bottom, and the loss of dissolved oxygen during bacterial respiration in a stratified water column.

Once the prediction was made, however, the daily flow of the Mississippi River decreased dramatically from mid-June to mid-July and remained well below average through the end of July. The shelfwide cruise timing corresponded to the below average summer flow of the Mississippi River. Less freshwater inflow meant less surface water salinity (Figure 3), substantially reduced stratification of the water column, and easier movement of dissolved oxygen from the surface to the bottom. The effect of the Mississippi River plume is indicated in the 20-30 psu (practical salinity unit) waters west of the delta. The same decreased freshwater content carried much lower nutrient concentrations, and chlorophyll biomass (an indicator of phytoplankton production) was minimal across the shelf (Figure 4).

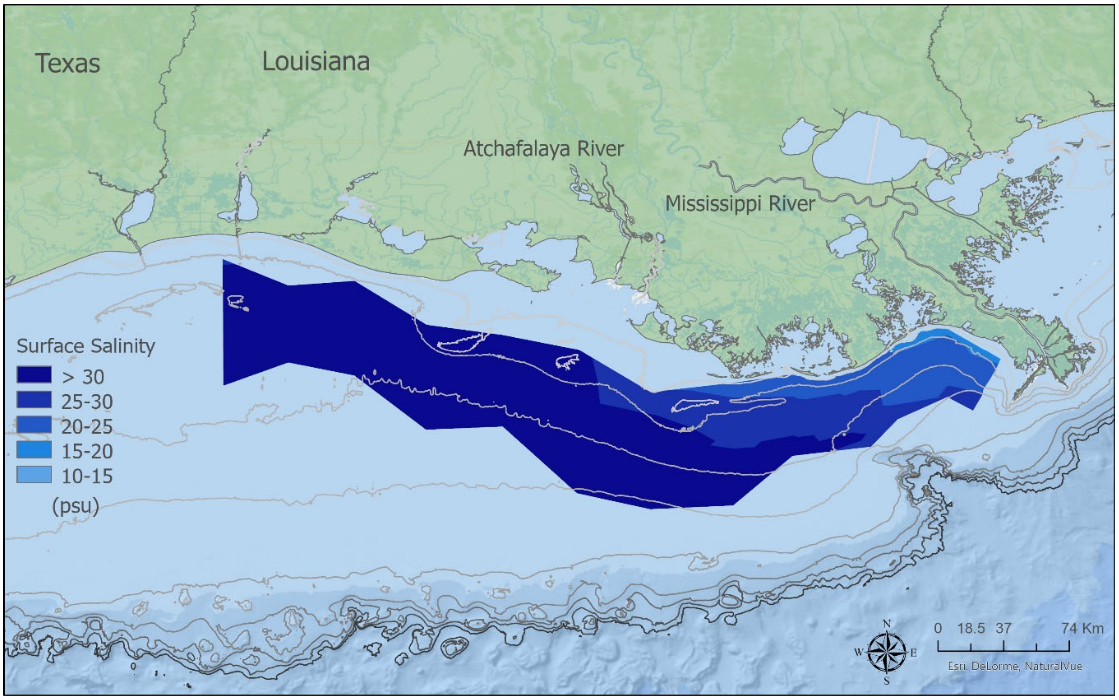

Figure 3. Distribution of surface water salinity July 25-29, 2022, while mapping bottom-water dissolved oxygen. Note the 20-30 psu salinity west of the Mississippi River delta and greater than 30 psu across the remainder of the shelf.

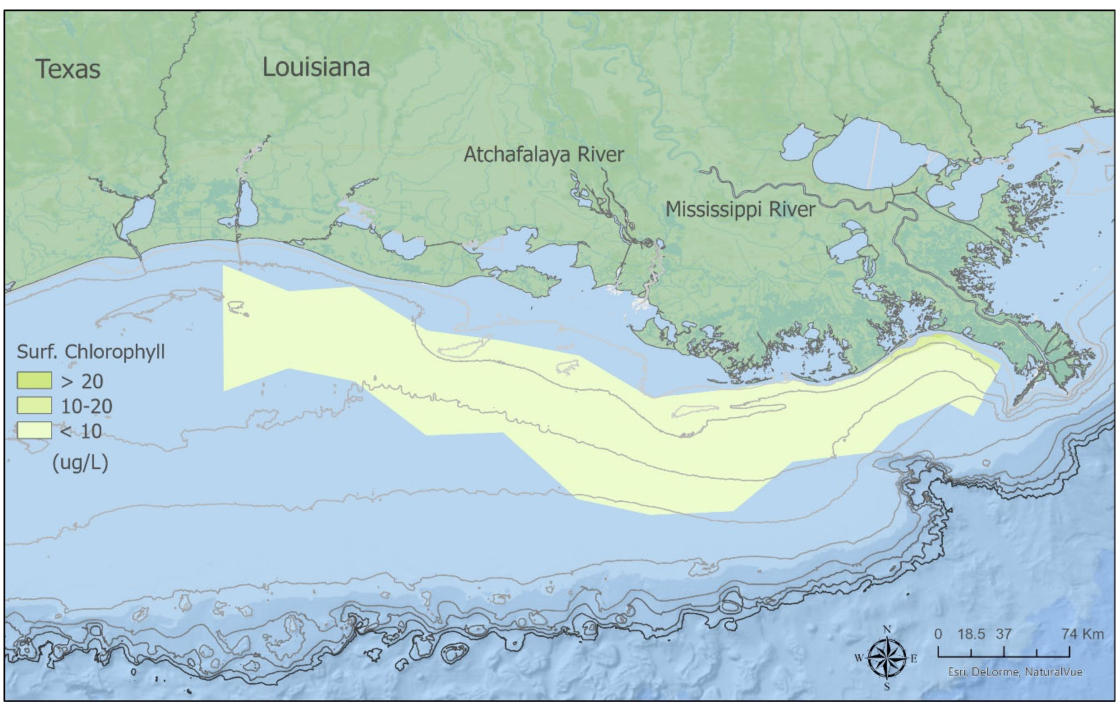

Figure 4. Distribution of surface water chlorophyll biomass (phytoplankton abundance (July 25-29, 2022, while mapping bottom-water dissolved oxygen. Chlorophyll biomass of 10-20 micrograms per liter was close to shore with most of the shelf with less than 10 micrograms per liter.

High salinity, low chlorophyll biomass, and hardly any suspended sediments resulted in crystal-clear waters for most of the research cruise. The vertical profiles for salinity, temperature, and dissolved oxygen were mostly uniform from surface to bottom on the western part of the surveyed area. There were some fluorescence increases in the bottom water in the same area.

The calmness of the winds during the cruise, much less than the two weeks before, also supported the further development of higher salinity, low chlorophyll, and relatively high bottom dissolved oxygen at most stations once the ship moved toward the Atchafalaya River and to the west (Figure 5).

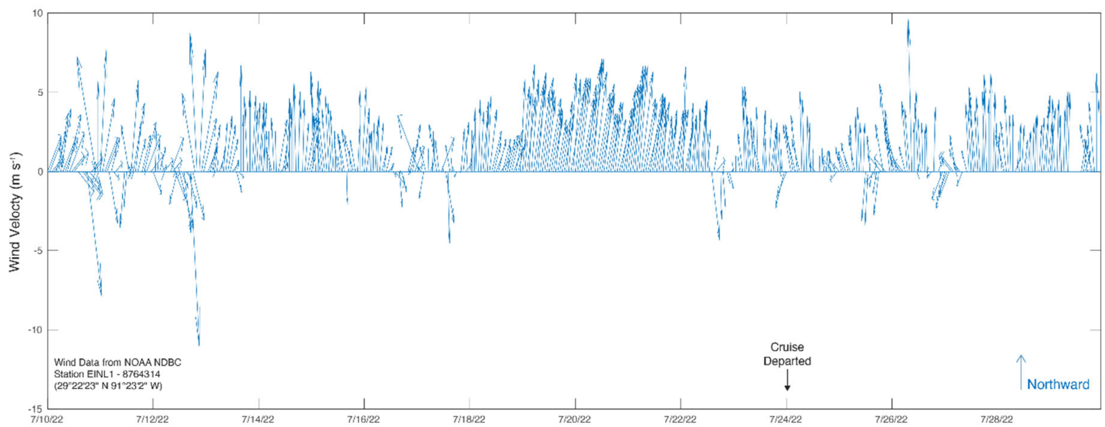

Figure 5. Wind speed (m s^{-1}) and direction at Burwood, LA for the two weeks before the shelfwide hypoxia cruise and during the cruise beginning on July 25, 2022. The arrows indicate the direction to which the winds were blowing. Wind speeds were unusually calm for the full mapping cruise.

The hypoxia research team from LUMCON, LSU, and many other scientists have been offshore studying hypoxia (with 36 successfully completed mappings of the full area). We have watched as the physics and biology interact to develop and maintain hypoxia over its seasonal development (Figure 6). We have also identified the effects of nutrient enrichment on the algal communities and abundances that contribute to the carbon loading that leads to hypoxia near and on the bottom.

The nitrogen loading of the Mississippi River to offshore remains as high as when the Hypoxia Action Plan was developed. There are efforts by states along the main stem and others in the watershed to reach lower loads of excess nutrients (Mississippi River/Gulf of Mexico Hypoxia Task Force, https://www.epa.gov/ms-htf). These efforts need to continue and intensify as we face many societal and environmental knowns and unknowns in both the watershed and in offshore waters. We, as citizens of the watershed, need to lessen our consumption of nitrogen-based products and reduce other activities that contribute to the amount of *reactive*-Nitrogen in the environment.

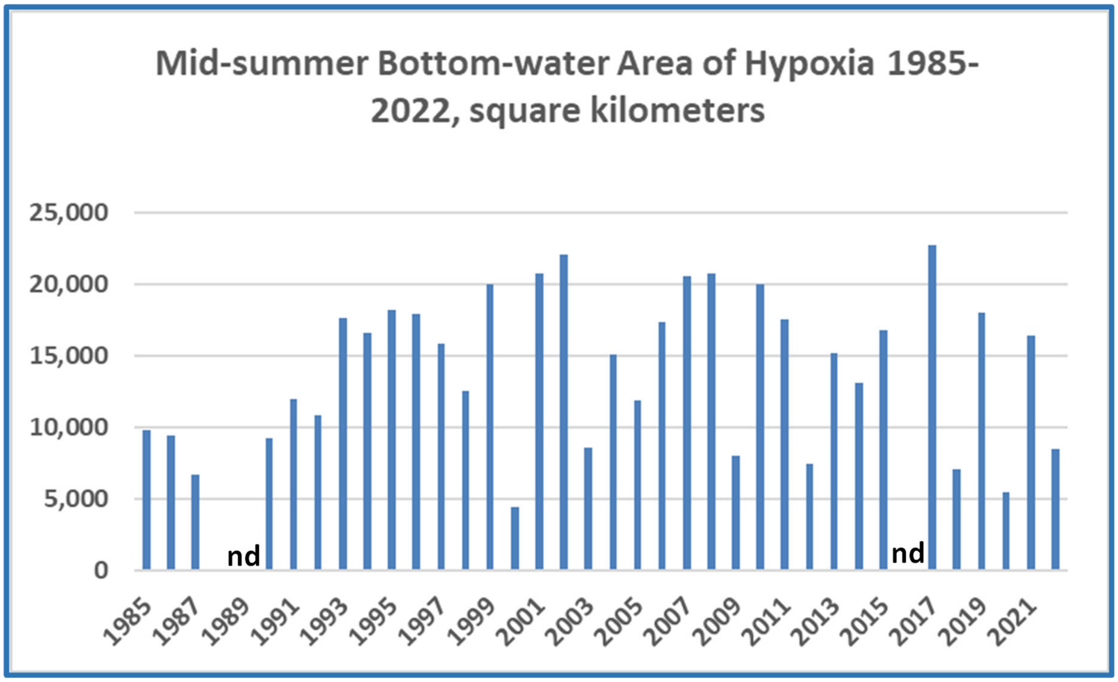

Figure 6. The size of the area of bottom-water hypoxia (dissolved oxygen less than 2 milligrams per liter) for 1985-2022. "nd" indicates 'no data'—a year without a completely mapped area or no mid-summer shelfwide cruise (1989 & 2016). In some years the full area was unable to be mapped. The area for 1988 is minimal and not visible on the graph.

Contacts for further information:
Nancy N. Rabalais, nrabal@lsu.edu, or
Cassandra Glaspie, cglaspie1@lsu.edu, or
R. E Turner, euturne@lsu.edu

Graphics by Leslie Smith, Your Ocean Consulting LLC, and Nancy Rabalais LSU & LUMCON

Visit the Gulf Hypoxia web site at https://www.gulfhypoxia.net for maps, additional graphics and more information concerning this summer's research cruise and previous cruises.

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https://www.noaa.gov/news-release/xxxxxxxx