REPORT FROM 2024 SHELFWIDE HYPOXIA CRUISE

LOUISIANA STATE UNIVERSITY

AUGUST 1, 2024

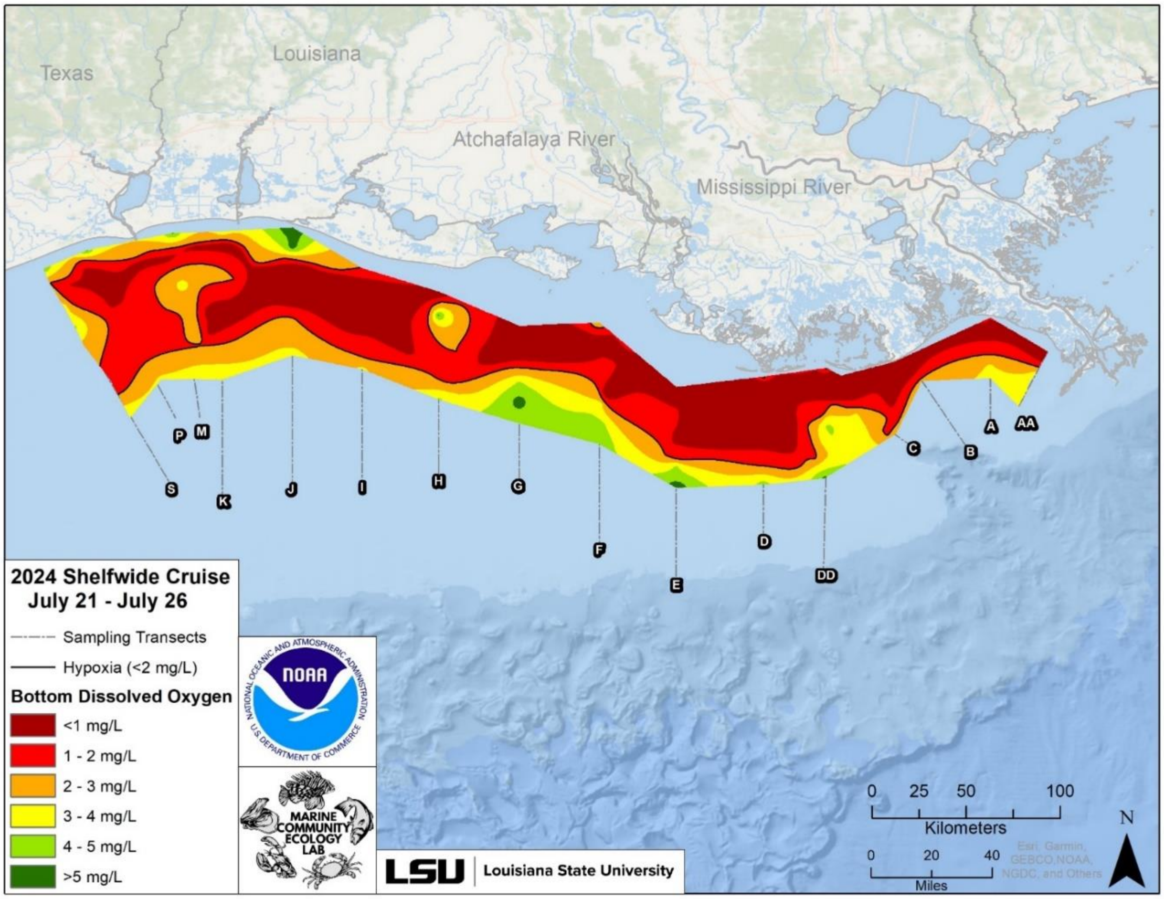

Figure 1. Distribution of bottom-water dissolved oxygen concentration for July 21-26, 2024. The combined area less than 2 mg l^{-1} and 1 mg l^{-1} are the darkest colors and outlined by the black line. Data source: CN Glaspie, NN Rabalais, and RE Turner, Louisiana State University. Funding: National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science, and Gulf of Mexico Alliance.

The bottom area of low oxygen waters west of the Mississippi River (often called the 'Dead Zone') was mapped July 21-26, 2024, in Louisiana/Texas offshore waters. The mapped area was calculated to be 17,360 square kilometers (6703 square miles) large and stretched from the Mississippi River across Louisiana coastal waters into Texas to the west (Figure 1). The 2024 size is about 1.3 times the average of the long-term 38-year record, 13,675 square kilometers (5280 square miles), and also 3.5 times higher than the environmental goal of 5000 square kilometers (1930 square mi) set by the Mississippi River Nutrient Task Force to reduce the size by the year 2025. It also exceeded the estimated size based on spring predicted Mississippi River nutrient loads (15,093 square kilometers, 5830 square miles). This means that much mitigation of excess nutrient loads from the Mississippi River basin to the northern Gulf of Mexico needs to occur before the Hypoxia Action Plan environmental goal is met.

The nutrient loads for the Mississippi River based on May data are composed primarily of dissolved nitrate plus nitrite, NO_3^- and NO_2^-). The Mississippi River discharge was lower for May 2024 [(a long-term predictor for hypoxic zone size in summer)] but higher than average in July (Figure 2).

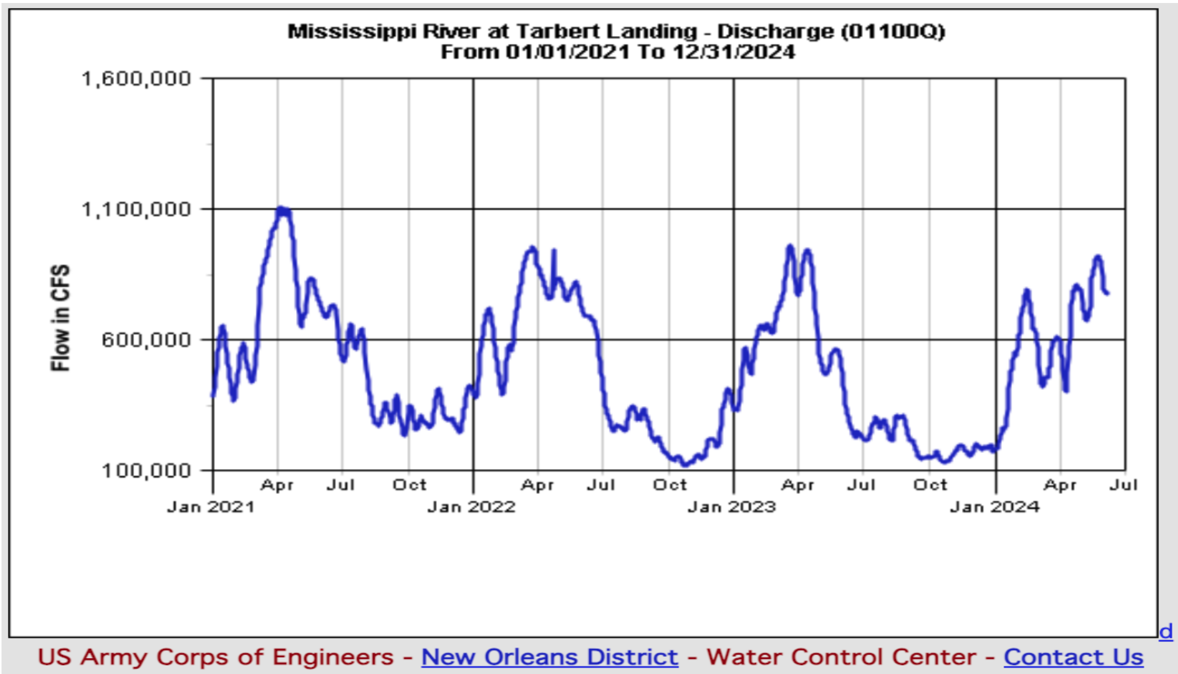

Figure 2. Discharge of the Mississippi River at Tarbert Landing for January 2021-June 2024.

The 2024 hypoxia cruise was characterized by mostly calm winds, except around pop-up thunderstorms. It was difficult to document any of the expected influence of the Mississippi and Atchafalaya River plumes. Suspended sediments were minimal, and Secchi disk depths (a measure of water clarity) in the area west of the Atchafalaya River were deep, indicating much less turbidity from suspended matter (including sediments and particulate organic carbon in the form of phytoplankton chlorophyll). The "Coastal and Marine Forecast" called for 2-ft seas for the cruise departure on July 21, but the predictions for calm winds and seas were interrupted by pop-up thunderstorms which often brought the seas to 6 feet.

The sea state was sufficient to maintain stratification, i.e., no water column mixing. The stratification of warmer oxygenated water in the upper water column over the cooler, saltier bottom water was sufficient to exclude dissolved oxygen from the overlying water from diffusing into the near-bottom hypoxic waters and, thus, low dissolved oxygen. Low oxygen waters were often extremely low and extended well up into the water column above the seabed by 2-3 meters, sometimes the lower 5 meters of the water column.

The surface salinity for most of the mapped area was higher than 25 psu (practical salinity units) approaching full salinity for the coastal waters of the northern Gulf of Mexico at 35-36 salinity (Figure 3).The water column salinity from the Mississippi River to the Atchafalaya River transitioned from around 30 psu at the surface to 36 psu at the bottom, maintaining strong stratification and resulting in low bottom-water dissolved oxygen.

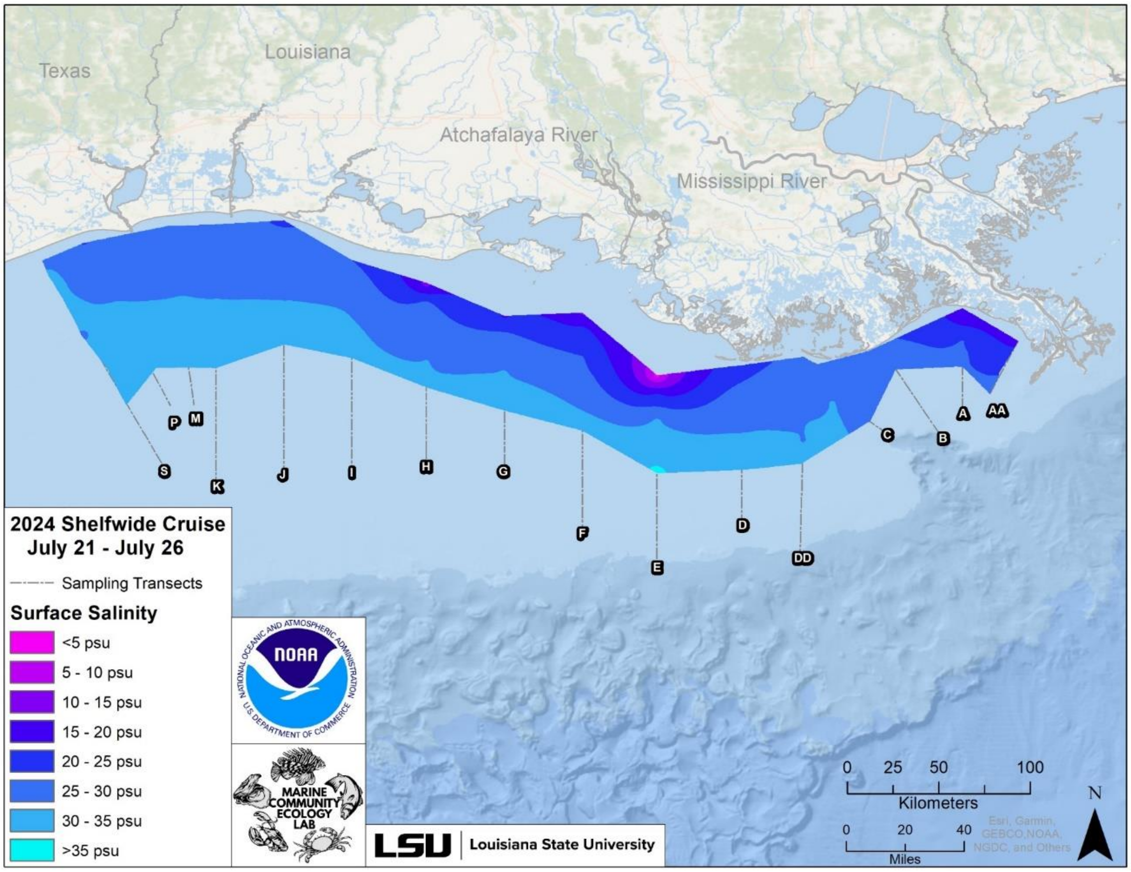

Figure 3. Surface water salinity for July 21 – July 26, 2024

With low discharge from the Mississippi River and the lower nutrients associated with it (not yet measured), one would expect limited phytoplankton production. Other than stations near the Mississippi River near Southwest Pass, the surface water surface chlorophyll concentrations were indicative of low phytoplankton biomass, less than 5 µg chlorophyll l^{-1} (Figure 4).

Still, there were sufficient quantities of organic matter from the springtime vertical flux of surface phytoplankton, decayed or decaying phytoplankton cells, and organic detritus that could be degraded by bacteria to consume oxygen. Other studies of surface water production and flux of organic matter on the northern Gulf of Mexico shelf west of the Mississippi River indicate that the spring organic matter production is coincidental with high nitrogen-rich discharge from the Mississippi River and is sufficient to carry over potential organic matter into the same year's summer and beyond through several summers.

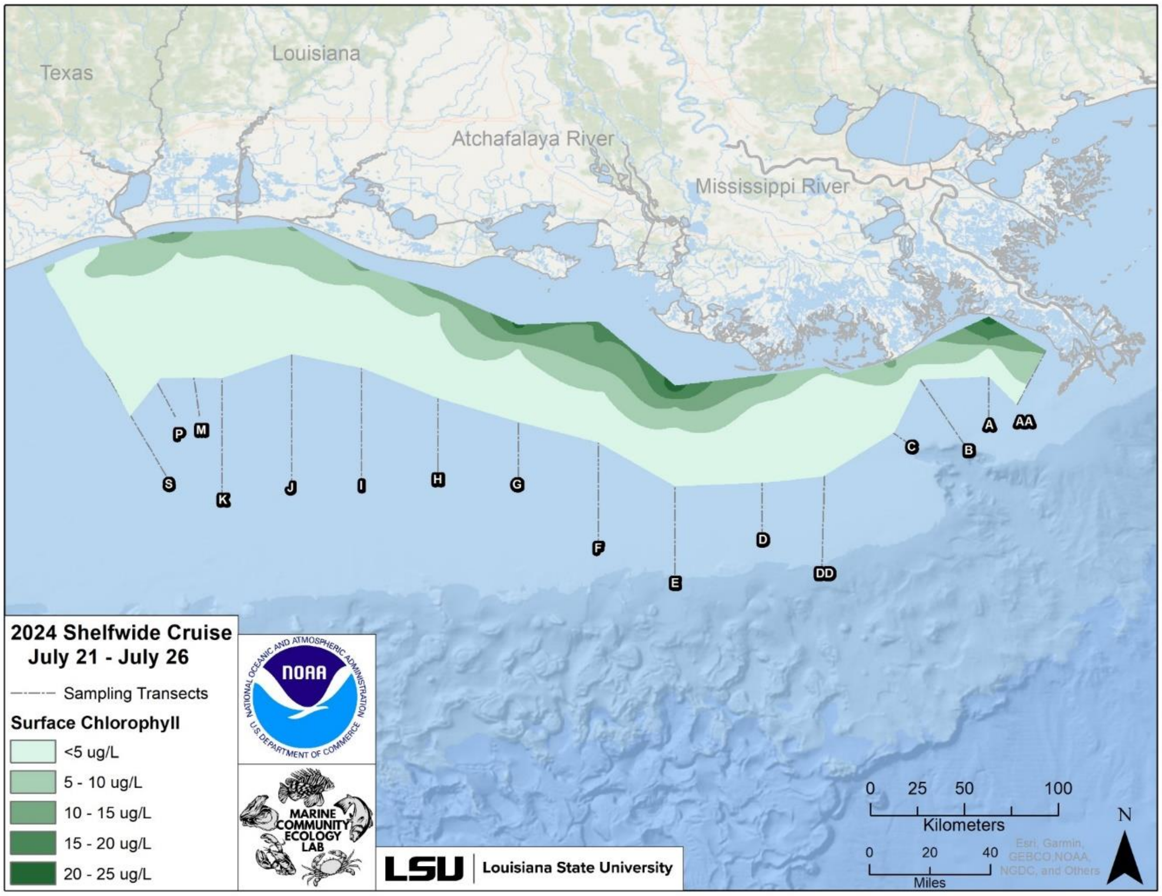

Figure 4. Surface water chlorophyll biomass (µg l^{-1}) for the period July 21-26, 2024.

While there was little evidence of phytoplankton in the surface waters except nearshore. the bottom waters had high concentrations of chlorophyll (up to 10 µg l^{-1}, as well as degraded chlorophyll (phaeopigments) in concentrations equal to or higher than the chlorophyll. These values indicate phytoplankton production in bottom waters and/or recently fluxed surface phytoplankton, along with substantial degraded phytoplankton. The organic matter near the bottom contributes to reduced dissolved oxygen through bacterial respiration.

The long-term nitrogen loading from the Mississippi River to the northern Gulf of Mexico has not decreased since the adoption of the Hypoxia Action Plan in 2001. There remains a need for nutrient reduction mitigation within the Mississippi River watershed for the environmental and human health within the watershed and for the reduction of low dissolved oxygen in the northern Gulf of Mexico.

The science crew also documented bottom-water hypoxia east of the Mississippi River with research funds from the Gulf of Mexico Alliance. The results from those stations will be provided shortly.

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