REPORT FROM 2020 SHELF-WIDE HYPOXIA CRUISE

LOUISIANA STATE UNIVERSITY
AND
LOUISIANA UNIVERSITIES MARINE CONSORTIUM

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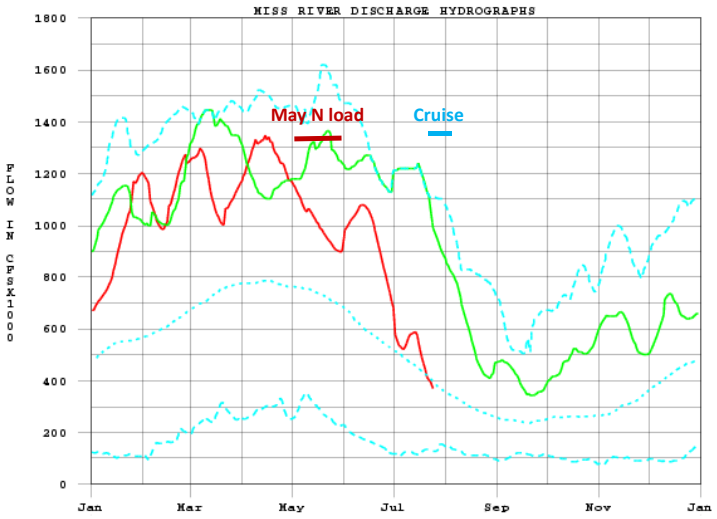
The bottom area of low oxygen in Louisiana coastal waters west of the Mississippi River, commonly known as the 'Dead Zone,' was mapped at a much smaller-than-average size this summer. The area was 2,117 square miles (5,048 square kilometers), larger than Rhode Island but smaller than Delaware, and well below the projected estimate of 7,769 square miles (20,121 square kilometers).



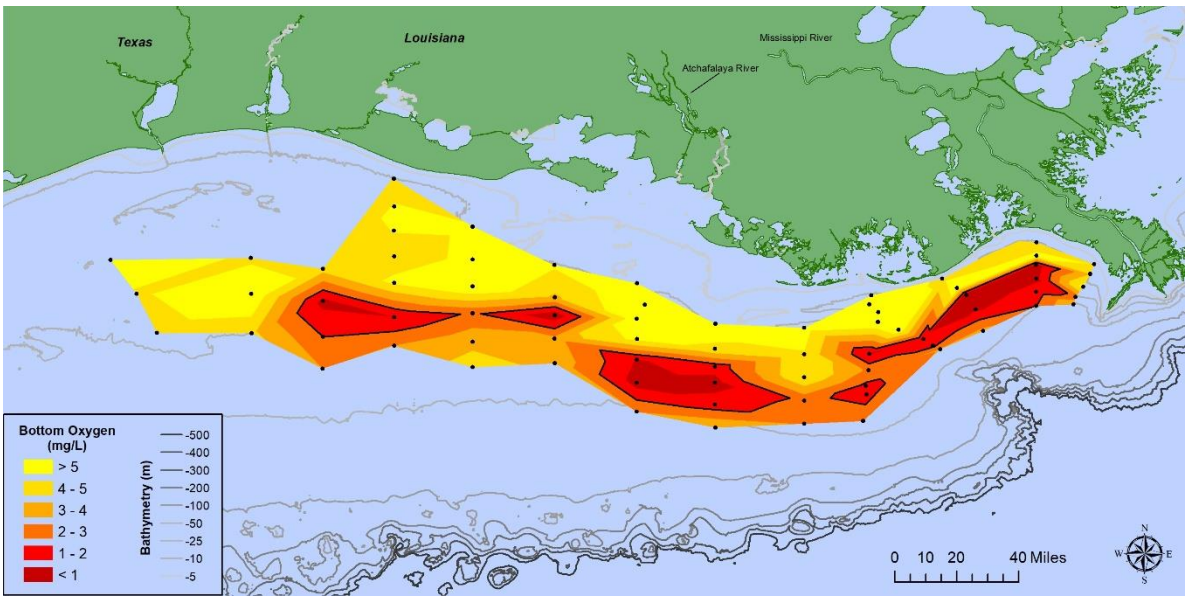
Mississippi River discharge and nitrogen loads were high in May, which led to a prediction of a large area of bottom-water hypoxia (estimated at 17,500 to 20,000 square kilometers) if no storms occurred.

This summer's Dead Zone size was the third smallest area since mapping began in 1985. The average hypoxic zone size over 2015 to 2020 is 5,407 square miles (14,000 square kilometers) (about three times the size of the Hypoxia Task Force five-year goal reduction of 1,930 square miles (5,000 square kilometers). This size of this summer's Dead Zone is close to the Task Force goal, but not because of a reduction in nitrogen loading, but because of weather conditions.

The LSU forecast on 2020 size (https://gulfhypoxia.net/research/shelfwide-cruise/?y=2020&p=hypoxia_fc) included a caveat about tropical storms or other wind and wave disturbances. If storms occur just before or during the cruise, then the predicted size was estimated to be 30% (i.e., reduced to 14,000 square kilometers).

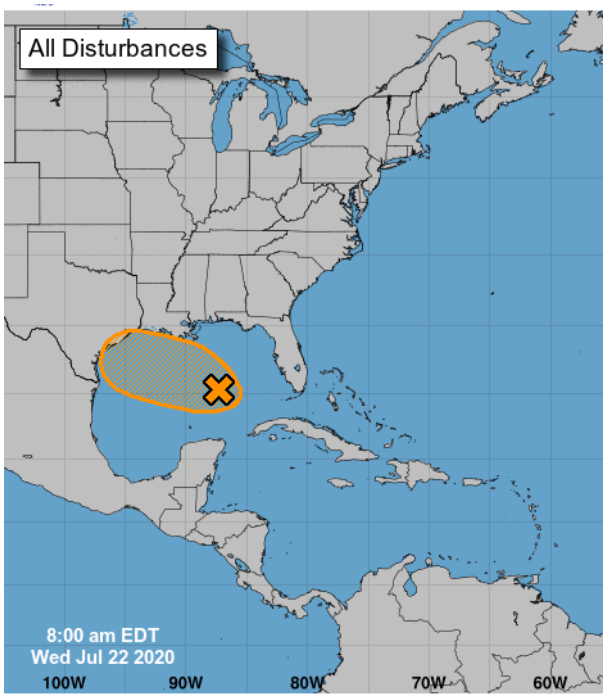
Tropical Storm/Hurricane Hanna moved from east to west across the central Gulf of Mexico and crossed the Texas shore as Hurricane Hanna on July 25, which was the beginning of the hypoxia cruise. Storm's high winds and waves affected all coastal Louisiana and disrupted hypoxia by mixing the water column from the surface down to

about 65 feet. The persistent winds from the south generated downwelling favorable conditions pushing what remained of the hypoxic water mass into deeper, offshore waters.



Map of bottom-water dissolved oxygen concentrations. The combined less than 2 mg l^{-1} and 1 mg l^{-1} are the darkest colors and outlined by the black line.

The nitrogen loading of the Mississippi River to offshore remains high. There are efforts, however, for states along the mainstem and others in the watershed to reach lower loads of excess nutrient (Mississippi River/Gulf of Mexico Hypoxia Task Force (https://www.epa.gov/ms-htf).

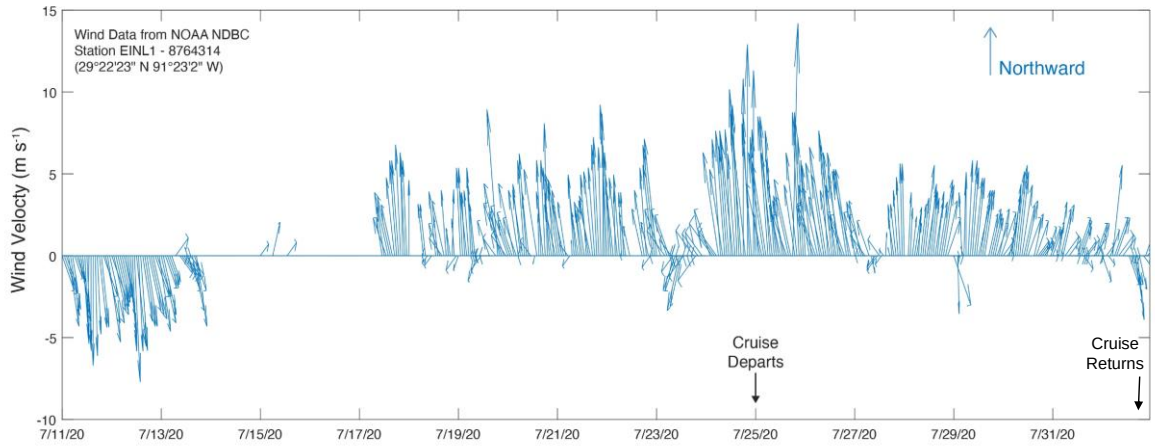


The science crew began measuring dissolved oxygen on July 25 as TS Hanna was crossing the northern Gulf and impinging on the Louisiana shoreline. The strongest winds that day were among the highest in the two weeks prior to the cruise and during the cruise.

There were high winds and waves at the beginning of the cruise in the area west of the Mississippi River delta near Barataria Pass. This mixed oxygen into shallower waters and reduced the size of the hypoxic zone there. The winds calmed towards the end of the 8-day cruise. The small size in 2020 was, therefore, directly caused by TS/H Hanna and not to any reduction of Mississippi nitrogen loading.

Five day Tropical Forecast on July 22, 2020

(National Hurricane Center

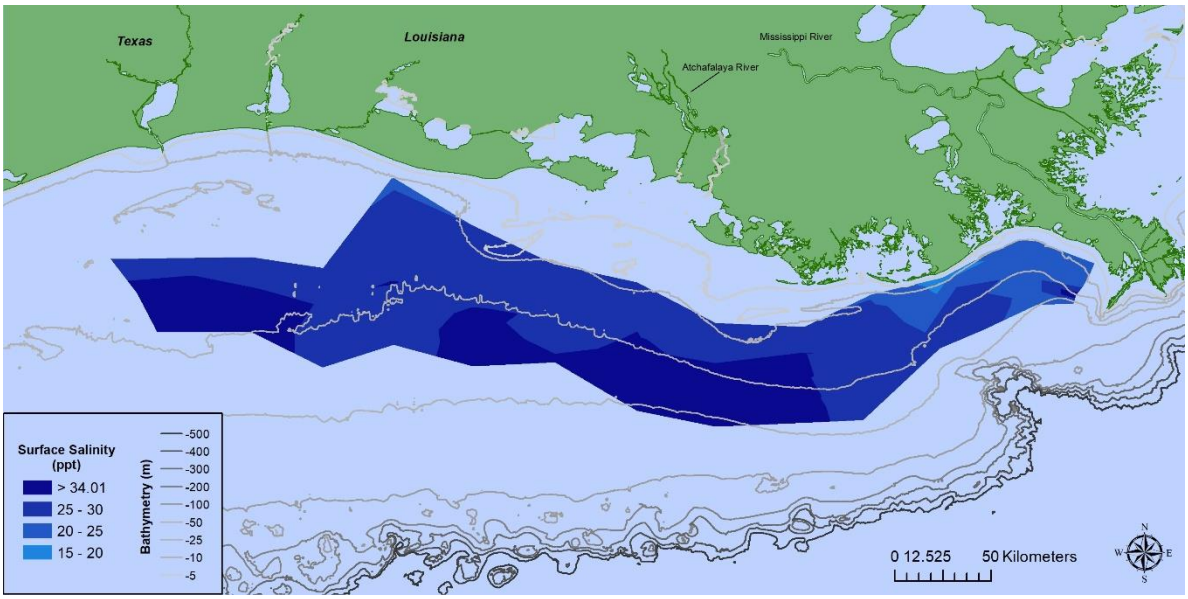


Wind speed (m s^{-1}) and direction at Eugene Island (the arrows indicate the direction to which the winds are directed). Evidence of the leading edge of TS Hanna as it passed the study area can be seen by the winds from the north to the south, then a switch with winds from the south to the north.

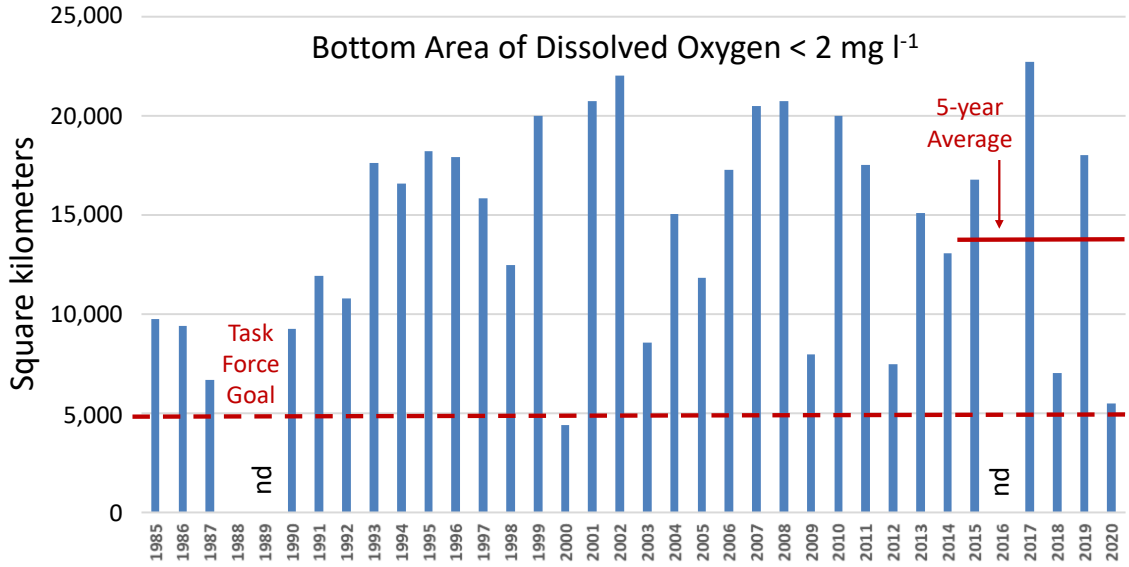
The scientists mapping the 2018 summer area of the 'Dead Zone' returned to dock after measuring bottom-water dissolved oxygen levels less than 2 milligrams per liter (equal to 2 ppm) at 18 of 75 stations from the Mississippi River west along the Louisiana coast to Lake Calcasieu at the Louisiana-Texas border.

Dr. Cassandra Glaspie LSU served as the Chief Scientist with Dr. Nancy Rabalais attending virtually. There were only three other science crew members on board because of COVID-19 and the need for social distancing. The cruise on the RV *Pelican* was considered a low risk operation because of the small science crew, closeness to a port, and room for quarantining. We are all looking forward to a 'normal' cruise next year.

Oher water quality and physical oceanographic data were collected along with the bottom-water dissolved oxygen values. The reduced flow of the Mississippi River at the time of the shelf-wide cruise and the deep mixing of the upper water column resulted in a fairly uniform salinity distribution at the surface and with depth. The lowest surface salinity values were nearest the Mississippi River delta.



Surface salinity values during July 25-31, 2020.



Area of bottom-water dissolved oxygen < 2 mg l^{-1} (nd – no data).

Current models used to predict hypoxia in the northern Gulf of Mexico are robust for long-term management purposes, but they are not optimized to predict the area for years where short-term weather patterns move water masses or mix up the water column. Field measurements, therefore, remain a necessity to understand the dynamics of hypoxia and contribute to accurate modeling of a changing ocean.

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

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

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