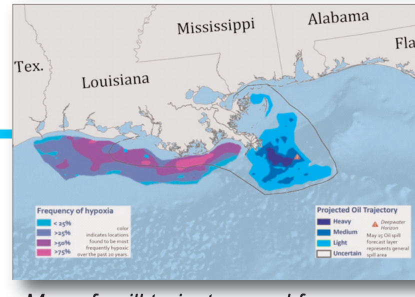
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

NOAA's Oil Spill Response

Links Between Gulf Hypoxia and the Oil Spill



Map of spill trajectory and frequency of Gulf hypoxia over the past 20 years.

Where is the hypoxic zone (dead zone) found?

Hypoxia, or low oxygen, develops near the mouth of the Mississippi River every summer as a result of excess nutrients that are introduced principally via the Mississippi River. These excess nutrients trigger algal blooms that are eventually decomposed by oxygen-consuming bacteria. As a result, oxygen in the bottom waters of the Gulf, below about 25-30 feet, drops to stressful and sometimes lethal levels.

Low oxygen waters have already been recorded this year but the full geographic extent of the affected area will not be known until later in the summer. In addition to the hypoxia that develops to the west of the Mississippi Delta, hypoxia has also developed periodically to the east of the delta in the Mississippi Bight. Winds, currents and storms also affect oxygen conditions in Gulf waters. The area affected can spread from the mouth of the Mississippi west towards Texas covering, on average for past five years, about 7,000 square miles of the continental shelf.

What are the repercussions of the oil spill on Dead Zone development this year; and ultimately how will the combination of these environmental threats affect the Gulf ecosystem?

NOAA-supported monitoring cruises conducted by the Louisiana Universities Marine Consortium have already detected some low-oxygen zones. Recent oil flow trajectories have oil approaching sites where Mississippi River outflow occurs. It is likely that water containing oil will intersect with this outflow and influence the dead zone formation. Heavy use of dispersants means that much of the oil is probably in the water column and may be moving closer to the region where the hypoxic zone typically forms than the surface accumulation might suggest.

According to researchers who have been studying hypoxia for decades, oil could exacerbate this year's dead zone. For example, oil on the surface of the water could restrict the normal process of atmospheric oxygen mixing into and replenishing the water column concentrations. In addition, microbes in the water that break down oil and dispersant also consume oxygen; this could lead to further oxygen depletion. It is also possible that the microscopic animal grazers of algae, or zooplankton, could be affected, thus allowing more of the hypoxia-fueling algae to grow.

There are factors related to the oil spill that could lessen the severity or extent of the hypoxic zone. For example, the large, near-surface algal blooms that ultimately fuel the bottom water decomposition that produces hypoxic conditions could be reduced if the oil or dispersant are toxic to the algae or reduce the light penetration required for algal growth. If such a reduction in algal growth occurs on a large enough scale, it is possible that this process could reduce the size and/or

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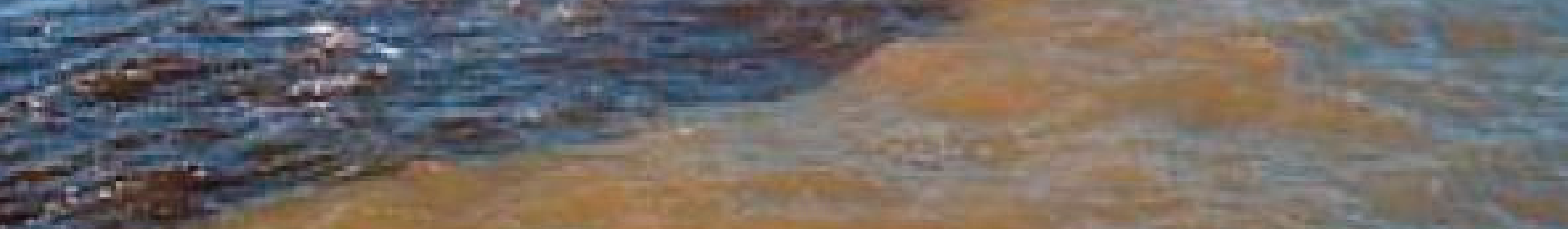

severity of the hypoxic zone. It is important to recognize that oil-related impacts could, in many cases, exacerbate the effects of hypoxia. For example, hypoxia can damage the health of organisms such as shrimp and fish, affecting their growth and reproductive potential.

Oil also can have sublethal effects on the eggs, larva, and early life stages of fish, so there is the potential that these stressors can be additive, and each stressor may increase the susceptibility to the harmful effects of the other. In fact, brown shrimp exposed to polycyclic aromatic hydrocarbons (PAHs), a common pollutant associated with oil, has been shown to induce stress at a higher level of dissolved oxygen relative to clean environments.

As part of NOAA's longstanding and ongoing research into the causes and effect of the Northern Gulf of Mexico Hypoxic Zone, efforts will be made this year to further evaluate the complex interactions between hypoxia and the oil spill.

Has the annual occurrence and expansion of the dead zone weakened the health of the food web over time, and has this made the ecosystem more susceptible to the harmful effects of the oil spill?

Hypoxia has clearly stressed or killed some organisms in the Gulf off Louisiana. This existing stress, therefore, likely makes the food web more susceptible to impacts from other stresses such as the oil spill. Some examples of this are provided in the prior question. However, since these food web effects may be subtle, even though potentially widespread and damaging, it is difficult to address this question definitively without substantial additional research.

Have NOAA sponsored research studies on the Dead Zone helped in the understanding of how the oil spill might affect the ecosystem?

Through NOAA research funding directed at the hypoxic zone and other NOAA programs over the past 30 years, a significant data base has been established that includes the benthic community, phytoplankton, zooplankton, shrimp, fish, and chemical constituents. These data can be used as a baseline to address impacts related to the oil spill. The hypoxia research programs also have recently supported the development of sophisticated biogeochemical mathematical models that could be used, with certain modifications, to understand and quantify the impacts from the oil spill and help to definitively link causes and effects.

How will hypoxia research efforts be affected by the oil spill?

NOAA is funding (through the NGOMEX hypoxia program) a number of research cruises this spring and summer that are designed to collect data on essential physical, chemical, and biological properties in the waters west of the Mississippi River.

There is a possibility that oil residues in the area of the hypoxic zone will disrupt this sampling of near-surface and deeper waters. Researchers studying hypoxia need to deploy expensive sampling equipment. Water column sampling equipment has very sensitive probes that could be ruined if deployed in oil contaminated water. It is not clear how to avoid complications posed by the presence of the oil if studies of hypoxia are to be conducted this year. Water also is collected for experiments to determine the role of nutrients and other factors in causing algal blooms that lead to hypoxia. How the presence of the oil will affect these experiments is unclear.

In recent years, NOAA has issued a late spring forecast of the hypoxic zone size and later in the summer releases the measured size. Given the many complexities and uncertainties surrounding the impact of the oil spill on processes that affect hypoxia, NOAA will not be able to account for the effects of the oil spill in the models used to forecast the size of this year's hypoxic zone. However, a summary of the latest understanding on potential influences will be provided along with the model forecasts.

NGOMEX Program: http://www.cop.noaa.gov/stressors/pollution/current/gomex-factsheet.aspx

Learn more about NOAA's response to the BP oil spill at http://response.restoration.noaa.gov/deepwaterhorizon.

To learn more about NOAA, visit http://www.noaa.gov.