

Who Will Survive *The Dead Zone*?

A dead zone is an area that has little or no oxygen and cannot support marine life. One large dead zone (about the size of New Jersey) exists off the Gulf of Mexico. Similar dead zones exist in marine and fresh waters around the world (see photo below), though the one in the Gulf of Mexico is particularly significant due to its large size. A dead zone is one example of **eutrophication**, which means an ecological imbalance that occurs as a result of excess nutrients.

It was in August 1972 that scientists began investigating the dead zone in the Gulf of Mexico, finding severe oxygen depletion at shelf depths of 10-20 meters. Many studies since then have revealed dissolved oxygen (DO) levels lower than the normal seawater level of about 6 milligrams per liter (mg/L) (See Figure 2). Marine life needs DO to live. When conditions become **hypoxic** (this means DO is less than 2mg/L) shrimp, crabs, fish and other marine life suffocate and die. In some cases, there is no DO (0mg/L). When there is no DO, conditions are known as **anoxic**. As DO drops very low, large fish and marine mammals will quickly swim out of the area.

Several factors can cause a dead zone. Excess nutrient input to rivers and the ocean is a primary factor. Nutrients, such as nitrogen and phosphorus, are found in sources including fertilizers, animal wastes (pets and farms) and wastewater treatment. When it rains, these nutrients are flushed into rivers and the ocean. In the Gulf of Mexico, the Mississippi River is the primary source of freshwater and nutrient input. These nutrient sources can trigger and feed large algae or phytoplankton blooms. As the algae die from these blooms and fall to the bottom, bacteria begin to decompose them. Decomposition requires large amounts of DO. The more phytoplankton that bloom, the greater the number of phytoplankton that will die, and the more bacteria will use DO to decompose them. The end result after a bloom is water with little to no oxygen. Hypoxic and anoxic conditions can result in massive fish die-offs and long-lasting dead zones as we've seen in the Gulf of Mexico.

Phytoplankton blooms are sometimes visible in satellite imagery as swaths of blue and green. Blooms like those pictured below off the coast of Namibia (Africa, Nov 8, 2007) have caused dead zones in the Atlantic Ocean.

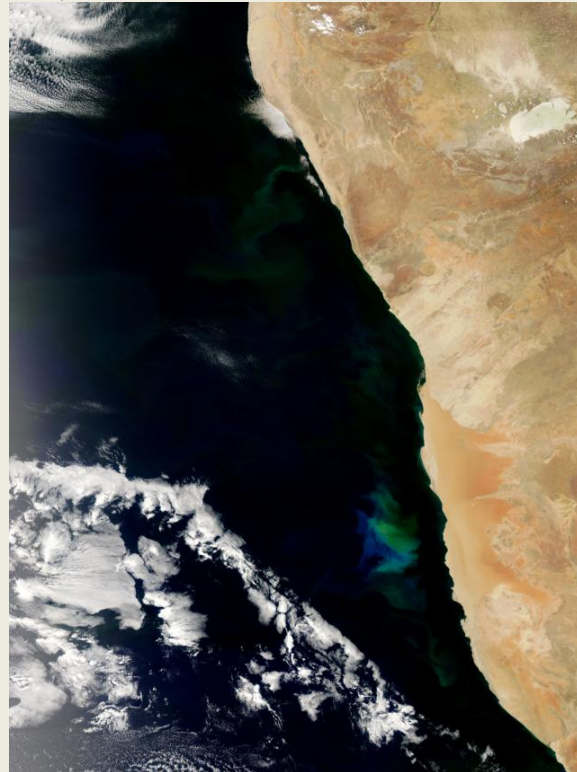


Photo: NOAA

Other physical factors can influence dead zone formation. DO content is related to water temperature: the cooler the water, the higher the solubility of DO (more O₂ dissolves into the water). Thus warmer water temperatures reduce the availability of DO. Also, water circulation influences dead zone formation. During the summer, water circulation tends to be lower which means that DO doesn't disperse very much.

Figure 1 shows the location of a DO monitoring site in the Gulf of Mexico and Figure 2 shows DO content readings from this station. Use these data to answer the questions below.

Questions:

1. Refer to Figure 2 for questions a-d:
 - a. Which month has the longest period of anoxic conditions?
 - b. Are there any months during which anoxic or hypoxic conditions don't exist?
 - c. Based on the graphs, when are low oxygen conditions (either hypoxic or anoxic) worse:
 - i. Spring (April-June)
 - ii. Summer (July-September)
 - iii. Fall (October-November)
 - d. Explain why you think the season you chose for (c) is likely to have the low oxygen conditions?

2. What does DO stand for? What are the common units for measurement of DO?

3. How are hypoxic conditions defined? Anoxic conditions?

4. What is a significant cause of dead zones?

5. What do you think are some economic impacts that could occur when dead zones occur, not only in the Gulf but in other locations around the world?

6. A shark, a crab and a shrimp find themselves in hypoxic conditions. Who do you think is most likely to survive a dead zone? Why?

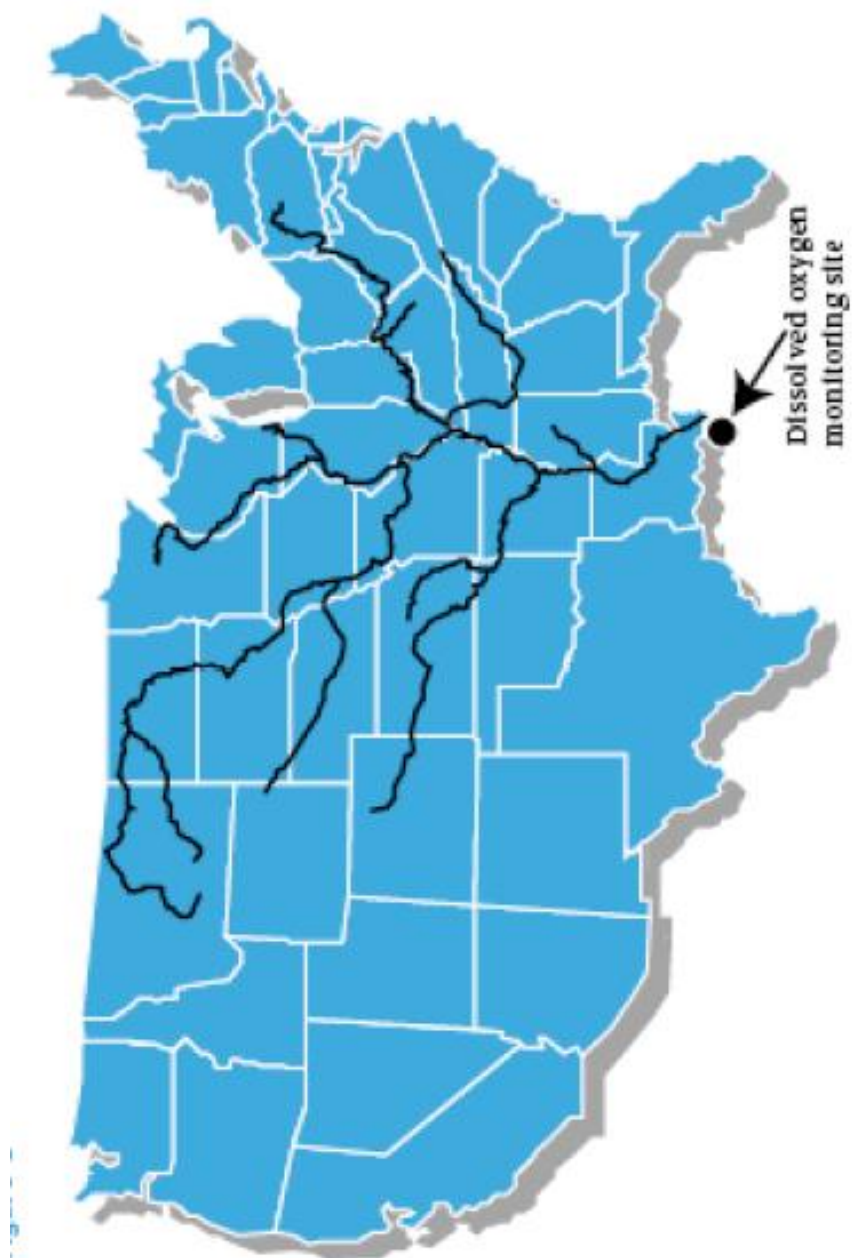


Figure 1. The location of the Gulf of Mexico dead zone DO monitoring site that collected samples in Figure 2.

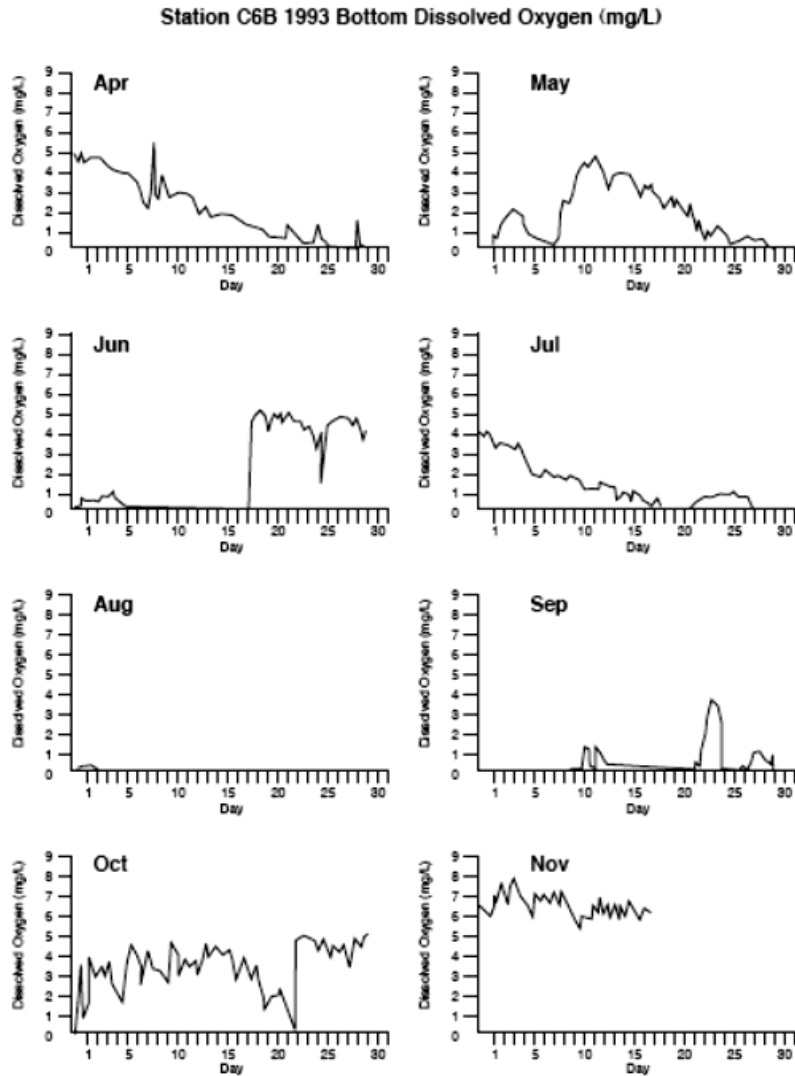


Figure 2. Station DO content readings (mg/L) in 1993 Aug-Nov.

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² Source: NOAA/NOS Lesson Plan on dead zones:
http://oceanservice.noaa.gov/education/classroom/lessons/13_ecoforecasting_deadzone.pdf