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Study shows continued spread of 'dead zones'

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A global study led by Professor Robert Diaz of the Virginia Institute of Marine Science, College of William and Mary, shows that the number of "dead zones"—areas of seafloor with too little oxygen for most marine life—has increased by a third between 1995 and 2007.

Diaz and collaborator Rutger Rosenberg of the University of Gothenburg in Sweden say that dead zones are now "the key stressor on marine ecosystems" and "rank with over-fishing, habitat loss, and harmful algal blooms as global environmental problems."

The study, which appears in the August 15 issue of the journal *Science,* tallies 405 dead zones in coastal waters worldwide, affecting an area of 95,000 square miles, about the size of New Zealand. The largest dead zone in the U.S., at the mouth of the Mississippi, covers more than 8,500 square miles, roughly the size of New Jersey.

Diaz began studying dead zones in the mid-1980s after seeing their effect on bottom life in a tributary of Chesapeake Bay near Baltimore. His first review of dead zones in 1995 counted 305 worldwide. That was up from his count of 162 in the 1980s, 87 in the 1970s, and 49 in the 1960s. He first found scientific reports of dead zones in the 1910s, when there were 4. Worldwide, the number of dead zones has approximately doubled each decade since the 1960s.

Diaz and Rosenberg write "There is no other variable of such ecological importance to coastal marine ecosystems that has changed so drastically over such a short time as dissolved oxygen."

Dead zones occur when excess nutrients, primarily nitrogen and phosphorus, enter coastal waters and help fertilize blooms of algae. When these microscopic plants die and sink to the bottom, they provide a rich food source for bacteria, which in the act of decomposition consume dissolved oxygen from surrounding waters. Major nutrient sources include fertilizers and the burning of fossil fuels.

Geologic evidence shows that dead zones were not "a naturally recurring event" in Chesapeake Bay or most other estuarine ecosystems, says Diaz. "Dead zones were once rare. Now they're commonplace. There are more of them in more places." The first dead zone in Chesapeake Bay was reported in the 1930s.

Scientists refer to water with too little oxygen for fish and other active organisms as "hypoxic." Diaz says that many ecosystems experience a progression in which periodic hypoxic events become seasonal and then, if nutrient inputs continue to increase, persistent. Earth's largest dead zone, in the Baltic Sea, experiences hypoxia year-round. Chesapeake Bay experiences seasonal, summertime hypoxia through much of its main channel, occupying about 40% of its area and up to 5% of its volume.

Diaz and Rosenberg note that hypoxia tends to be overlooked until it starts to affect organisms that people eat. A possible indicator of hypoxia's adverse effects on an economically important finfish species in Chesapeake Bay is the purported link between oxygen-poor bottom waters and a chronic outbreak of a bacterial disease among striped bass.

Several Bay researchers, including VIMS fish pathologist Wolfgang Vogelbein, hypothesize that the prevalence of mycobacteriosis among Bay stripers (>75%) is due to the stress they encounter when development of the Bay's summertime dead zone forces them from the cooler bottom waters they prefer into warmer waters near the Bay surface.

Diaz and Rosenberg's also point out a more fundamental effect of hypoxia: the loss of energy from the Bay's food chain. By precluding or stunting the growth of bottom-dwellers such as clams and worms, hypoxia robs their predators of an important source of nutrition.

Diaz and VIMS colleague Linda Schaffner estimate that Chesapeake Bay now loses about 10,000 metric tons of carbon to hypoxia each year, 5% of the Bay's total production of food energy. The Baltic Sea has lost 30% of its food energy—a condition that has contributed to a significant decline in its fisheries yields.

Diaz and Rosenberg say the key to reducing dead zones is "to keep fertilizers on the land and out of the sea." Diaz says that goal is shared by farmers concerned with the high cost of buying and applying nitrogen to their crops. "They certainly don't want to see their dollars flowing off their fields into the Bay," says Diaz. "Scientists and farmers need to continue working together to develop farming methods that minimize the transfer of nutrients from land to sea."

Source: Virginia Institute of Marine Science

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