Summer dead zones in Chesapeake Bay breaking up earlier

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A new study shows that dead zones in the lower Chesapeake Bay are beginning to break up earlier in the fall, which may be an indication that efforts to reduce nutrient pollution to the Bay are beginning to make an impact. Scientists from the University of Maryland Center for Environmental Science examined 30 years of data on dead zones and nutrient levels in the Chesapeake Bay. They found that dead zones in the lower part of the Chesapeake Bay, the saltier part from the Potomac River south, are getting smaller in the late summer thanks to a late-season replenishment of oxygen, a natural response to decreasing nutrient pollution.

"This study shows that water quality monitoring programs that have been in place for decades are beginning to reveal fundamental information on the nature of change associated with the Chesapeake Bay's dead zones," said Peter Goodwin, president of the University of Maryland Center for Environmental Science. "These areas are beginning to undergo recovery from eutrophication, and even more exciting, natural responses to cleaning the water are kicking in."

Dead zones, areas of low to no oxygen that choke off life in the Bay, typically start growing in late May and dissipate in the fall. Studies in the past decade have shown that the size of the dead zone changes throughout the summer, growing larger in June and smaller in August. Jeremy Testa and his team, including UMCES Professors Emeriti Walter Boynton and Michael Kemp, set out to understand what was happening late in the season. They found that a complex chemical process was

kicking in, allowing the Bay to begin cleaning itself.

"The size of low-oxygen water in the dead zone has been getting smaller at end of summer. Reoxygenation has allowed for a conversion of nitrogen in late summer to a form that is more amenable to being removed by natural processes," said Jeremy Testa, assistant professor at the University of Maryland Center for Environmental Science's Chesapeake Biological Laboratory. "We envision that this is how the Bay would've typically functioned before dead zones were such a severe problem."

In the spring and early summer, algae in the Chesapeake Bay feed on the nitrogen-rich runoff that comes off the land and typically reach high densities. Eventually these algae die and sink to the Bay's deep waters. As they decompose, a form of bioavailable nitrogen called ammonium is created. This ammonium accumulates in the bottom waters throughout the summer where there is little to no oxygen, in the so-called dead zones . When there is no oxygen around, ammonium persists and could feed more algae. However, if some oxygen begins to be added to the system, ammonium can undergo a process that eventually turns it into a form that can be converted to nitrogen gas and permanently removed from the Bay . While this process typically happens in the fall as storms and winds churn up the waters, this new analysis indicates that the process is happening earlier and at higher rates.

The research of Testa and his team supports previous studies that have shown late-summer dead zones to be getting smaller and breaking up earlier in the year. "This decline in the late summer hypoxic volumes corresponds to a long-term and modest nitrogen loading decline." said Testa. "The improved oxygen conditions appear to allow additional production of nitrogen forms that can be readily removed from the Bay, which we call a negative feedback. It's an important element of recovery."

More information: Jeremy M. Testa et al. Season-specific trends and linkages of nitrogen and oxygen cycles in Chesapeake Bay, *Limnology and Oceanography* (2018). DOI: 10.1002/lno.10823

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