PSA-089-RETURN OF THE "*DEAD ZONE*"

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For a Diver Every day is Ocean Day

RETURN OF THE "*DEAD ZONE*"

Here's what happened the last time the living things in our oceans and lakes died

Worth saving? (Reuters/Mark Blinch)
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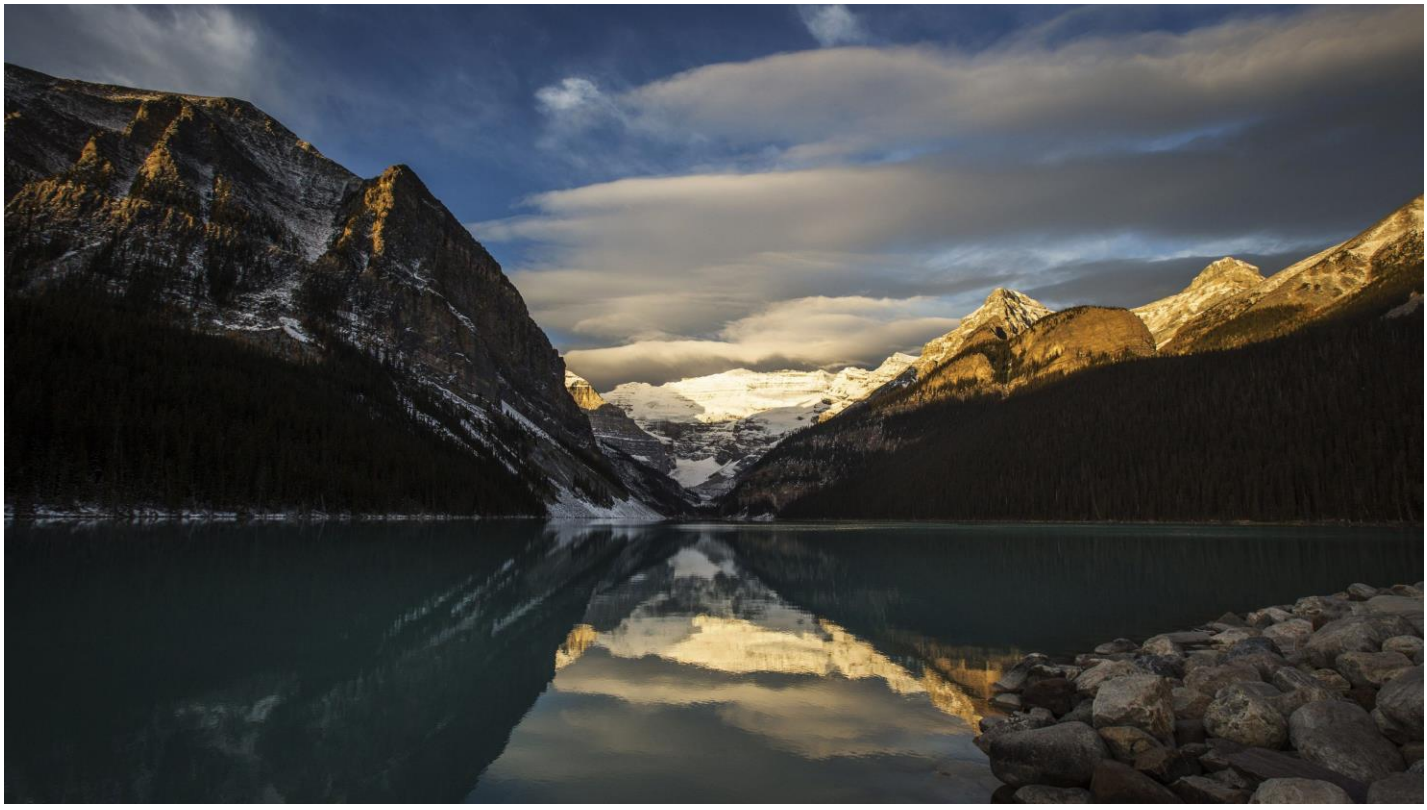

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On January 5, 2018, a paper published in the journal Science delivered a sobering message: The oxygenation of open oceans and coastal seas has been steadily declining during the past half century. The volume of ocean with no oxygen at all has quadrupled, and the volume where oxygen levels are falling dangerously low has increased even more.

We're seeing the same thing happen in major lakes.

The main culprits are warming and—especially in coastal seas and lakes—eutrophication caused by enhanced nutrient loads in runoff. The findings reaffirm that we urgently need to address global warming, and that we are in need of an updated Clean Water Act. We only need to look to the Mediterranean Sea and, more recently, the North American Great Lakes region for dramatic illustrations of what lies in store if we don't act now.

Around 8,000 years ago, the entire eastern half of the Mediterranean Sea became severely oxygen-starved between 300 and 1,500 meters, and lost all oxygen, or became 'anoxic,' below that. It wasn't warming that caused the oxygen decline then, as is happening in today's oceans, but the amplification of the African monsoon, which drove intense flooding of the Nile River, full of nutrients from decomposing organic matter. The freshwater itself inhibited deep-water formation, while its nutrient-load led to wild-growth of algae, cyanobacteria, and animals grazing on them. Upon their death, decomposition sapped oxygen from the water, rapidly turning it oxygen-starved, anoxic, and in extreme cases rendered it 'euxinic' (containing hydrogen sulfide, infamous for its rotten-eggs smell). The conditions wiped out virtually the entire ecosystem from a few hundred meters below the surface of the water to the seafloor. A devastating 4,000-year period of anoxic 'dead zone' conditions ensued, which all started within a century of the flooding.

Dead zone conditions are now expanding rapidly throughout shallow coastal seas and lakes. Anoxic events are not restricted to the oceans. Dead zone conditions are now expanding rapidly throughout shallow coastal seas and lakes, critical regions for fisheries, water provision, and recreation. The problems are arising because of warming, which speeds up the oxygen-consuming microbial processes of decomposition, and because human actions are increasing nutrient input via runoff. The particularly well-studied North American Great Lakes teach us very valuable lessons.

The Great Lakes were born of a massive climate change at the end of the last ice age, some 21,000 years ago. The Earth's orbit shifted, climate warmed, and the vast ice sheet that covered North America melted. A tremendous volume of melt-water flowed across the landscape, filled basins left by the receding ice, and created vast swampy marshes and wetlands around the lakes.

When settlers migrated along the southern shore of Lake Erie within the watersheds of the Maumee and Sandusky Rivers, they were confronted by a three-million-acre wetland: the Great Black Swamp. Thick mud and standing water surrounded clumps of giant Sycamore and Bur Oak trees. To the settlers, the trees blocked the light, while the standing water bred mosquitoes (which we now know carried malaria) and hid the farmland they needed to survive. So, the Great Black Swamp was drained, and some of the most fertile farmland in the U.S. arose.

But draining the Great Black Swamp profoundly impacted Lake Erie. The swamp was a natural filter that removed nutrients from its slow-moving streams before they could enter the lake. Cities expanded, and raw sewage was dumped into waterways, providing still more nutrients. The agricultural revolution that occurred following WWII added cheap commercial fertilizers to the mix, amplifying the problem. Lake Erie was in serious trouble.

By the 1960s and 1970s, eutrophication fuelled enormous blooms of cyanobacteria in the warm, shallow waters of Lake Erie's Western Basin. Winds and currents drove them eastward, into the Central Basin and Cleveland's suburban and urban sprawl. As the blooms died and sank, microbial decomposition released nutrients and consumed oxygen. It also made bottom waters more acidic, which caused a release of more nutrients back into the water from the sediments. This contributed to even larger blooms in subsequent years.

An ensuing cascade of environmental problems expanded the Central Basin anoxic dead zone, resulting in massive fish kills. Beaches were soiled with rotting cyanobacterial mats. The water stank of rotten eggs. Infamously, Lake Erie was declared dead in the newspapers and in Congressional testimony.

The stage was set for the formation of the Federal Environmental Protection Agency, the passage of the Clean Water Act, binational agreements through the International Joint Commission, and the growth of state environmental agencies. Huge efforts based on sound science led to enactment of policies to clean the lake—including targeting for removal as much as two-thirds of the phosphorous entering the lake. Phosphorus was removed from soaps and detergents. Pollution from raw sewage was reduced by stringent sewage-water treatment requirements. And the installation of phosphorous-scrubbing equipment was required in industrial smokestacks.

Lake Erie improved remarkably. Bottom-water oxygen levels increased, and water clarity improved. Fish kills decreased and sport fishing recovered. And, most evident, the large blooms of cyanobacteria had become a thing of past nightmares by the 1990s.

Alas, the good news would not last. Although the Clean Water Act strictly regulated point-source pollution, mandating sewage treatment standards, it did not similarly restrict more diffuse sources, such as nutrients delivered by agricultural and suburban runoff. By the mid-1990s, measurements showed that streamflow into Lake Erie was increasing, and that it contained higher phosphorus levels than before that continued to climb. The result was a dramatic increase in the nutrient load delivered to Lake Erie.

The lake's nutrient levels pushed back up to values not seen since the 1970s. Large cyanobacterial blooms have returned. Matters are even more urgent than before, because scientists have discovered that some cyanobacteria (*Microcystis* and *Planktothrix*, which dominate in the Western Basin and Sandusky Bay) produce liver toxins that the World Health Organization considers dangerous even in minute concentrations.

Alongside all the familiar environmental concerns, cyanobacterial blooms are now known to be potentially poisonous.

Only a wholesale change in our attitudes toward the environment can bring relief. The oceans are so vast that they can look infinite to many people. It is then tempting to presume that future dead zone development could not possibly reach a global extent — that it would be restricted to more limited areas of high sensitivity. But would such a hunch be realistic? How confident could we be? Humanity is pumping an enormous amount of artificial and human and animal waste derived nutrients into the oceans, and global warming is taking place 10 to 100 times faster than in recent geological history.

The *Science* study reveals that the problem has taken hold in the world's oceans already. Clearly, their vastness is no safeguard— which raises potent questions for the far-smaller, and more fragile inland lakes.

Detailed studies have now established that phosphorus levels would need to be decreased by about 40% to restore Lake Erie to mid-1990s conditions. Only a wholesale change in our attitudes toward the environment can bring relief, including committed conservation, re-establishment of natural filtration systems (wetlands and swamps), and relentless efforts to reduce runoff nutrient levels.

This cannot happen without an updated Clean Water Act.

This article was originally published on Undark. Read the original article.

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