Pacific Northwest Dead Zones Linked to Climate Change

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Noreen Parks

Throughout the world's seas, scientists have now identified more than 400 oxygen-depleted (hypoxic or "dead") zones, the vast majority linked to pollution. However, in the coastal waters of the US Pacific Northwest, where dead zones have occurred annually since 2002, researchers suspect another culprit: climate change.

Hypoxic zones generally form where rivers dump nutrients (think fertilizers and sewage) into offshore waters, triggering phytoplankton blooms. The plants are essential to marine food chains, but as they sink down, their microbial decomposers suck oxygen from the water. When oxygen depletion becomes excessive, organisms unable to escape suffer severe stress, or die. The Pacific Northwest coast has no major sources of riverine nutrients; however, a deep pool of low-oxygen water exists offshore, along the continental slope. Northerly summer winds typically push near-shore, oxygen-rich surface water seaward, allowing the low-oxygen (but nutrient-rich) deep water to well up, triggering phytoplankton blooms that support rich fisheries. Eventually, southerly winds develop and reverse the entire process.

E Gates/ PISCO

Birds feast on dead crabs washed up on the beach after suffocating in the dead zone.

Over the past seven summers, the cycle has gone off-kilter. Underwater surveys by Jack Barth of Oregon State University (Corvallis, OR) and colleagues have revealed that the hypoxic zone has expanded shoreward, with oxygen levels considerably lower than those in the continental slope zone. In 2006, the researchers witnessed an unusually intense episode: upwelling went into overdrive, and a 1200-square-mile area, devoid of oxygen, hugged the central Oregon shoreline for 4 months. "A teeming habitat was transformed into a fish-free zone, carpeted with dead and severely stressed animals", Barth recalls.

Since then, seasonal hypoxia has recurred, to varying degrees. Hunting for possible explanations, the researchers reviewed 50 years of regional oxygen measurements. "There was no evidence that the patterns fit with cyclical changes, such as El Niño events, but low oxygen has become more prevalent in recent years", explains Barth. Furthermore, the new patterns *do* fit with regional climate models that predict stronger, more persistent coastal winds that reinforce upwelling. "Also, as the ocean surface continues to warm, colder, deep water becomes increasingly insulated from the atmosphere, driving oxygen decline". Only time will tell whether the changes are irreversible, Barth concludes. ■

Emissions-reducing crops

Mike Faden

An agricultural method, recently approved by the UN, of reducing greenhouse-gas (GHG) emissions by using nitrogen-fixing bacteria instead of synthetic fertilizers is entering field trials in several countries. Using this approach, farmers in developing nations inoculate soybeans and other legume crops with commercially produced bacteria that can fix nitrogen, even in acidic soil conditions. This reduces the need for urea fertilizer, thus offsetting atmospheric CO_2 emissions.

"The manufacture of nitrogen fertilizer is energy intensive and releases GHGs", says Peg Armstrong-Gustafson, founder of consulting firm Amson Technology (Des Moines, IA), and a co-developer of the methodology. "By eliminating the application of synthetic nitrogen fertilizer on legume crops, we can avoid CO_2 emissions by permanently reducing the amount of nitrogen fertilizer produced."

Legumes have the ability to fix nitrogen through symbiotic relationships with nitrogen-fixing bacteria. In theory, this can eliminate the need to add synthetic fertilizer. However, "because they are acidic, many soils do not have the natural abundance of rhizobium bacteria to interact with legume crops", explains Armstrong-Gustafson. "As a result, many farmers apply synthetic nitrogen."

The new method was created by Amson, Perspectives GmbH (Hamburg, Germany) and Becker Underwood (Ames, IA); the latter produces the commercial inoculants, designed to produce high crop yields even in acidic soils. The methodology was approved this year, for use under the UN Clean Development Mechanism (CDM), which provides a way for businesses in industrialized nations to offset carbon emissions by creating GHG-reduction projects in developing nations. The companies claim this is the first agricultural crop methodology approved under the CDM.

Small-scale field trials have now begun in Burkina Faso and Niger. Previous research has suggested that farmers should see 15–50% greater crop yields, without having to add fertilizer, Armstrong-Gustafson continues. If the trials confirm these results, larger projects of perhaps 2500 ha will be established. Farmers will receive the inoculant free of charge, or at a reduced rate, while the companies are granted carbon credits based on the reductions in fertilizer use. The companies can then resell the carbon credits, currently valued at about €10 per ton.

The companies predict that other emissions-reducing agricultural methods are likely to follow. "We believe the world will rethink how it produces everything, including our food, in order to reduce CO_2 emissions", concludes Armstrong-Gustafson. ■