

## Low-oxygen events unprecedented, disrupt ocean ecosystem

by Dave Stauth

CORVALLIS, Ore. — A review of all available ocean data records concludes that the low-oxygen events that have plagued the Pacific Northwest coast since 2002 are unprecedented in the five decades prior to that, and may well be linked to the stronger, persistent winds that are expected to occur with global warming.

In a new study to be published Friday in the journal *Science*, researchers from Oregon State University outline a “potential for rapid reorganization” in basic marine ecosystems and the climatic forces that drive them and suggest that these low-oxygen, or “hypoxic” events are now more likely to be the rule rather than the exception.

“In this part of the marine environment, we may have crossed a tipping point,” said Jane Lubchenco, the Wayne and Gladys Valley Professor of Marine Biology at OSU, and the lead scientist for PISCO, the Partnership for Interdisciplinary Studies of Coastal Oceans.

“Levels of oxygen in the summertime have suddenly become much lower than levels in the previous 50 years,” Lubchenco said. “And 2006 broke all records, with parts of the shallow shelf actually becoming anoxic, meaning that they lacked oxygen altogether. We’ve never seen that before.”

The rapid and disturbing shift of ocean conditions in what has traditionally been one of the world’s more productive marine areas — what’s called the California Current Large Marine Ecosystem — has garnered much attention in recent years, also raising questions about whether it has happened before, and what is causing it.

“People keep asking us, ‘Is this situation really all that different or not?’” Lubchenco said. “Now we have the answer to that question, and it’s an unequivocal ‘yes.’ The low oxygen levels we’ve measured in the last six years are abnormally low for our system. We haven’t seen conditions like this in many, many decades, and now with varying intensity we’ve seen them in each of the last six summers.”

In these events, water oxygen levels have repeatedly reached hypoxic levels, below which most marine animals suffocate or are severely stressed if they cannot escape the area. If oxygen levels drop to zero, most animals die. The massive 2006 event covered at least 3,000 square kilometers, lasted for four months, and occupied up to 80 percent of the water column in shallow shelf areas, the report said. Fish either died or fled these areas, thousands of crabs died, and marine seafloor life that could not move faced almost total mortality. Recovery has been slow.

It's less certain why this is happening, but the events are completely consistent with global climate change, the OSU researchers say.

"There have always been unusual weather events, such as hurricanes, droughts, and changes in wind patterns," said Jack Barth, an OSU professor of physical oceanography and a lead scientist with PISCO. "So it's difficult to prove that any one event is caused by global warming. Having said that, we expect global warming to generally cause stronger and more persistent winds. These winds contribute to the hypoxic events by increasing plankton production and holding low-oxygen water on the continental shelf for longer periods.

"At this point," Barth added, "I'd be surprised if this trend towards hypoxic events didn't continue."

Francis Chan, a marine ecologist with OSU and PISCO, conducted a survey of all known records of oxygen levels on the Oregon continental shelf over the last 60 years, with measurements taken by research cruises and ocean-going vessels from more than 3,000 stations.

"The data make it pretty clear that the recent conditions are unprecedented during any period that has been measured," Chan said. "We're now seeing very low-oxygen water, lasting for long periods, and closer to shore than at any time in more than 50 years."

That long period of time included several El Niño and La Niña events, possible suspects in any change of Pacific Ocean conditions, and also shifts in the Pacific Decadal Oscillation, another player in near-term climate trends. None of those appeared to have any correlation to the hypoxic events.

Hypoxic conditions in ocean waters "often popularly called 'dead zones'" are usually associated with serious nitrate loads or other nutrient pollution, such as in the Gulf of Mexico or Chesapeake Bay. Pollution-caused hypoxic zones are found with much less frequency in regions where significant upwelling occurs "a process that is usually beneficial to productive marine food webs.

"Coastal upwelling ecosystems occupy only about 1 percent of the ocean surface area, but they produce about 20 percent of global fishery production," Lubchenco said. "These areas have historically been highly productive. The appearance or increase in severity of hypoxia in these ecosystems would be cause for concern."

Some other areas of the world bear more similarity to the recent situation off the Pacific Northwest, such as the Benguela Current off South Africa and Humboldt Current off Chile. They historically have had hypoxic

conditions before “ which may be getting worse.

“The Namibian system in the past decade seems to be seeing lower oxygen levels and more frequent hypoxic events than it had previously,” Barth said. “Historically it has even more extreme upwelling than we have in the Pacific Northwest, and more frequent marine life die-offs.”

A concern, researchers say, is whether that system is a harbinger of the future for the Pacific Northwest.

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