

Hypoxia off the Pacific Northwest Coast

What is hypoxia?

Hypoxia means low-oxygen. It is a scientific term that refers to times when oxygen levels in seawater drop to levels that are too low to support most fishes, crabs and other marine life. Seawater is hypoxic if the amount of oxygen is less than 1.4 milliliters of oxygen per liter (ml/l) of seawater. Hypoxic areas are also commonly termed “dead zones”, because most animals avoid low-oxygen areas or suffocate due to lack of oxygen.

Since 2002, hypoxia has occurred off the Oregon coast each summer, to varying degrees. The map below shows the known extent of hypoxia in 2006 and 2007.

For seven years in a row, a dead zone of low-oxygen water has formed in the Pacific Northwest, killing crabs, fishes, and other marine life. The size, duration, and severity of these dead zones have varied from year to year. The most severe event occurred in the summer of 2006 when oxygen levels dropped to historic lows and hypoxic water could be found in large areas along the Washington and Oregon coasts.



Dungeness crabs that washed up along the Oregon coast after succumbing to low-oxygen conditions.
Photo: Elizabeth Gates, 2004.

Why is the dead zone occurring off the Pacific Northwest coast?

The repeated hypoxic events of recent years suggest a fundamental shift in ocean conditions off the Pacific Northwest coast.

These changes are complex and may include either oceanic or atmospheric changes or both. New results from other researchers show slight but wide-spread depletion of oxygen content in oceanic waters, most likely due to climate change. A small decrease in the overall oxygen levels has probably primed the pump for hypoxia in the Pacific Northwest. The other major factors contributing to Pacific Northwest hypoxia are changes in winds or ocean circulation. We have evidence for both. These changes underscore the need for long-term scientific monitoring and research in coastal and open waters. These observations can enable scientists to better forecast where and when future low oxygen zones are likely to take place.

The geographic extent of known hypoxia in 2006 and 2007. Light blue shows the extent of hypoxia (<1.4 ml/l) and purple shows the region of severe hypoxia (<0.5 ml/l). Waters closest to the shore remain high in oxygen due to breaking waves. Dots represent sampling sites. Data made available by PISCO and NOAA-Fisheries, NWFS.



What is unusual about hypoxia on the Oregon coast?

It is normal to find naturally low-oxygen conditions in deep, offshore waters, e.g., at the edge of the continental shelf and slope. However, the occurrence of low-oxygen water close to shore (the inner shelf, less than 50 m (165') of water) is highly unusual and had not been reported prior to 2002 despite over 50 years of scientific observations along the Oregon coast. Moreover, the appearance of anoxia, or zero-oxygen conditions, in 2006 was unprecedented and resulted in mass die-offs of long-lived marine animals such as seastars and sea cucumbers. The presence of long-lived species on the seafloor, with some individuals likely decades old, suggests that such low-oxygen conditions are not normal in this system.

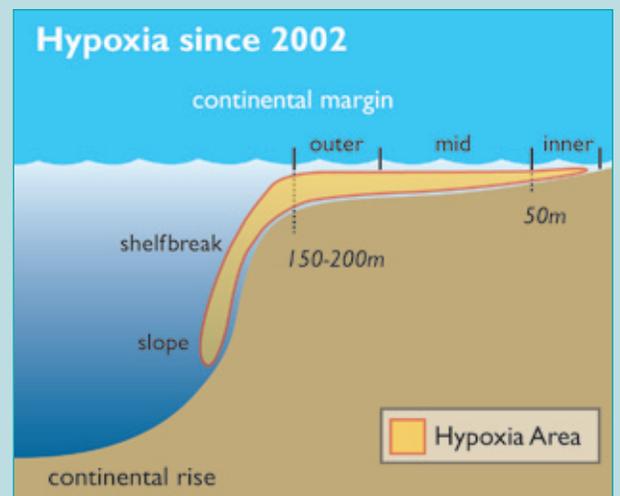
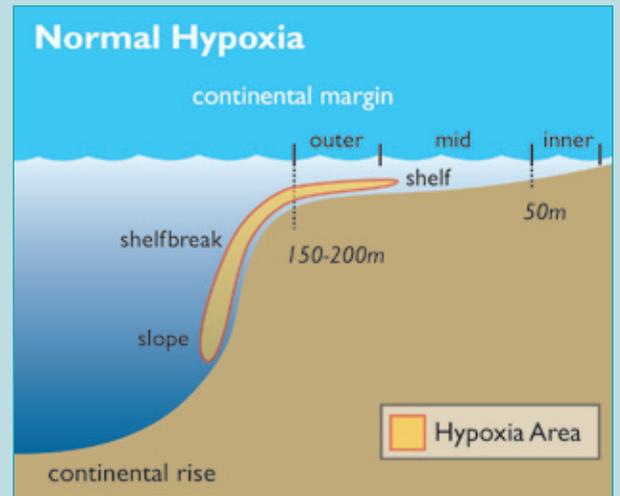
Is the dead zone caused by climate change?

The evidence that climate change is causing the dead zone is getting stronger. Lower oxygen content of seawater, changes in ocean circulation, and changes in wind patterns are all expected under a changing climate and all are happening. The changes in oceanic and atmospheric conditions that are causing the dead zone are thus consistent with predictions of climate change. That is not the same thing, however, as saying that climate change is definitely causing the dead zone.

How do scientists study hypoxia?

Scientists on the PISCO team at Oregon State University initially identified hypoxia as the cause of dead crabs and fishes and other anomalies reported in 2002. Research on hypoxic zones in the Pacific Northwest now involves collaborations between many partners, including the PISCO team, the Oregon Department of Fish and Wildlife (ODFW), the College of Oceanic and Atmospheric Sciences (COAS) at OSU, the Oregon Coastal Ocean Observing System (OrCOOS) and the National Oceanic and Atmospheric Administration (NOAA).

Scientists at OSU and their partners work together to study and monitor the conditions off the coast throughout the year. This work involves extensive shipboard sampling, testing the water for oxygen levels and other changes in the ecosystem. ODFW uses a Remotely Operated Vehicle (ROV) that allows scientists to view the bottom of the sea, which is critical for assessing biological impacts.



Dr. Francis Chan (PISCO-OSU) recovering an oxygen-sensing instrument and water samples along the Oregon coast during the height of the 2006 low-oxygen event. Photo: Jane Lubchenco

This summary was prepared by PISCO at Oregon State University. PISCO (Partnership for Interdisciplinary Studies of Coastal Oceans) is a research & outreach collaboration of universities along the west coast.

For information, contact hypoxia@science.oregonstate.edu, or visit <http://www.piscoweb.org/outreach/topics/hypoxia>.

