West Coast study emphasizes challenges faced by marine organisms exposed to global change

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Washington's northwest coast. Credit: University of Washington

The Pacific Ocean along the West Coast serves as a model for how other areas of the ocean could respond in coming decades as the climate warms and emission of greenhouse gases like carbon dioxide increases.

This region—the coastal ocean stretching from British Columbia to Mexico—provides an early warning signal of what to expect as ocean acidification continues and as low-oxygen zones expand.

Now, a panel of scientists from California, Oregon and Washington has examined the dual impacts of ocean acidification and low-oxygen conditions, or hypoxia, on the physiology of fish and invertebrates. The study, published in the January edition of the journal *BioScience*, takes an in-depth look at how the effects of these stressors can impact organisms such as shellfish and their larvae, as well as organisms that have received less attention so far, including commercially valuable fish and squid.

The results show that ocean acidification and hypoxia combine with other factors, such as rising ocean temperatures, to create serious challenges for marine life. These multiple-stressor effects will likely only increase as ocean conditions worldwide begin resembling those off the West Coast, which naturally expose marine life to stronger low-oxygen and acidification stressors than most other regions of the seas.

"Our research recognizes that these climate change stressors will co-occur, essentially piling on top of one another," said co-author Terrie Klinger, professor and director of the University of Washington's School of Marine and Environmental Affairs.

"We know that along the West Coast temperature and acidity are increasing, and at the same time, hypoxia is spreading. Many organisms will be challenged to tolerate these simultaneous stressors, even though they might be able to tolerate individual stressors when they occur on their own."

Oceans around the world are increasing in acidity as they absorb about a quarter of the carbon dioxide released into the atmosphere each year. This changes the chemistry of the seawater and causes physiological stress to organisms, especially those with calcium carbonate shells or skeletons, such as oysters, mussels and corals.

Hypoxia, on the other hand, is a condition in which ocean waters have very low oxygen levels. At the extreme, hypoxia can result in "dead zones" where mass die-offs of fish and shellfish occur. The waters along the West Coast sometimes experience both ocean acidification and hypoxia simultaneously.

"Along this coast, we have relatively intensified conditions of ocean acidification compared with other places. And at the same time we have hypoxic events that can further stress marine organisms," Klinger said. "Conditions observed along our coast now are forecast for the global ocean decades in the future. Along the West Coast, it's as if the future is here now."

Klinger is co-director of the Washington Ocean Acidification Center based at the UW and served on the West Coast Ocean Acidification and Hypoxia Science Panel, which was convened two years ago to promote coast-wide collaboration and cooperation on science and policy related to these issues.

For this paper, the authors examined dozens of scientific publications that reported physiological responses among marine animals exposed to lower oxygen levels, elevated acidity and other stressors. The studies revealed how physiological changes in marine organisms can lead to changes in animal behavior, biogeography and ecosystem structure, all of which can contribute to broader-scale effects on the marine environment.

The tri-state panel has completed this phase of its work and will wrap things up in the coming months. Among the products already published or planned are a number of scientific publications—including this synthesis piece—as well as resources for policymakers and the general public describing ocean research priorities, monitoring needs and management strategies to sustain marine ecosystems in the face of ocean acidification and hypoxia.

The group's other papers and findings related to ocean acidification and hypoxia will soon be available on its website.

Provided by University of Washington

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