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Refuges for Hope

First, the bad news: New data reveals that acidified ocean water is pervasive along the West Coast — and is likely to keep spreading.

So what's the good news? Persistent, less-acidic havens in some regions may be sheltering marine life from the harsher, low-pH conditions.

With the first-ever dataset measuring pH in the very nearshore regions of the ocean, a multi-institution research team including UC Santa Barbara biologists Carol Blanchette and Gretchen Hofmann found that the California current is more susceptible to ocean acidification than previously thought. The work, published in Scientific Reports, also documents "refuges" that offer hope.

"This is both good and bad news," said Blanchette, director of UCSB's Valentine Eastern Sierra Reserves, who collaborated on the study in her longtime role with research consortium PISCO (Partnership for Interdisciplinary Studies of Coastal Oceans). "The hotspots of acidification have very low pH, but the spatial structure is so persistent from year-to-year that the refuge areas — those with better pH, near Cape Mendocino, north of Point Conception and Monterey Bay — are likely to be refuges over time."

In a three-year survey of the California Current System along the West Coast, the scientists found persistent, highly acidified water throughout the ecologically critical nearshore habitat, with "hotspots" of pH measurements as low as any oceanic surface waters in the world. The research was conducted at several sites in the

region of Cape Mendocino, Bodega Bay, Monterey Bay and the coast just north of Point Conception.

With the increase in atmospheric carbon dioxide — the prime suspect in ocean acidification — low-pH conditions are likely to get worse, according to the scientists. That reality makes the discovery of safer havens equally important; these more moderate pH environments could be used as a resource for ecosystem management.

“This provides an opportunity for research to examine how organisms can adapt through evolutionary change if they have open populations that live in both higher and lower pH areas,” Blanchette said. “It also means that the ocean is not homogenous — there is a lot of spatial structure. And, importantly, it speaks for a network of marine protected areas as a conservation strategy for climate change, to allow populations to be large enough, in many different places, that organisms have time for evolution to work and provide genetic adaptation to climate impacts.”

Said lead author Francis Chan, a marine ecologist at Oregon State University, “The West Coast is very vulnerable. Ten years ago, we were focusing on the tropics with their coral reefs as the place most likely affected by ocean acidification. But the California Current System is getting hit with acidification earlier and more drastically than other locations around the world.”

The researchers developed a network of sensors to measure ocean acidification over a three-year period along more than 600 miles of the West Coast. They observed near-shore pH levels that fell well below the global mean pH of 8.1 for the surface ocean, and reached as low as 7.4 at the most acidified sites — among the lowest recorded values ever observed in surface waters.

The lower the pH level, the higher the acidity. Previous studies have documented a global decrease of 0.11 pH units in surface ocean waters since the beginning of the Industrial Revolution. That pH decrease represents an acidity increase of approximately 30 percent.

Highly acidified ocean water is potentially dangerous because many organisms are very sensitive to changes in pH. According to the scientists, negative impacts already are occurring in the California Current System, where planktonic pteropods — or small swimming snails — were documented with severe shell dissolution.

“This is about more than the loss of small snails,” said co-author Richard Feely, a senior scientist with the National Oceanic and Atmospheric Administration’s Pacific Marine Environmental Laboratory. “These pteropods are an important food source for herring, salmon and black cod, among other fish. They also may be the proverbial ‘canary in the coal mine’ signifying potential risk for other species, including Dungeness crabs, oysters, mussels, and many organisms that live in tidepools or other near-shore habitats.”

The team’s observations did not vary significantly over the three years — even with different conditions, including a moderate El Niño event — according to Chan

“The highly acidified water was remarkably persistent over the three years,” she said. “Hotspots stayed as hotspots, and refuges stayed as refuges. This highly acidified water is not in the middle of the Pacific Ocean; it is right off our shore. Fortunately, there are swaths of water that are more moderate in acidity and those should be our focus for developing adaptation strategies.”

UCSB marine scientist Libe Washburn was also a co-principal investigator on the project.

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