World's oceans get an acid bath

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Credit: Chris Langdon | University of Miami

Among the repercussions of global climate change, the effect of ocean acidification on marine life is one of the least-understood variables.

The oceans have already absorbed about one-third of the 500 billion tons of carbon dioxide that human activity has added to the atmosphere since the industrial revolution. Absorbing carbon dioxide reduces the pH of seawater, indicating an increase in its acidity.

While more attention has been focused on the ecological fragility of coral reefs, cold-water life in other regions -- from urchins and sea-stars to tiny plankton-like copepods -- may be more at risk than their warmer-water counterparts, according to information presented at the American Association for the Advancement of Science annual meeting in

Vancouver.

Like many effects of climate change, the impacts of acidification can vary from place to place.

"Ocean warming-related issues that have economic punch will not be evenly spread around the globe," said Gretchen Hofmann , a professor of marine biology at the University of California, Santa Barbara. "They will be local, focal, and intense."

The physical mechanisms are clear: because cold water tends to hold more gas, the Arctic and Antarctic oceans already contain more carbon dioxide than other areas. In a world with oceans even more acidic than they are today, marine creatures that form shells or body structure from calcium carbonate may struggle to create their structures. Losing those species will negatively affect species that are higher up on the food chain, like herring.

Already, some oyster hatcheries in the Pacific Northwest recently failed to produce oysters because the water had become too acidic for the larvae to form shells, Hofmann said.

Scientists are just beginning to predict what will happen in the future with more acidic waters. Jason Hall-Spencer, of Plymouth University in the U.K., studies life at sites where natural carbon dioxide bubbles like a Jacuzzi from the ocean floor. He chooses places along the carbon-rich sea floor vents that mimic the effects of high acidity in the rest of the ocean's future -- a time machine for looking at hundreds of species in conditions that will exist 10 or 50 years down the road.

Hall-Spencer has studied volcanic vents in Italy, California and Papua New Guinea. All of them show similar effects. "What we see are dramatic shifts in ecosystems, with a tipping point predicted at end of this century," he said. That tipping point would spell out a 30% drop in biodiversity in everything from corals to fish, he added.

Hall-Spencer said that some organisms strain attempt to keep up with changing conditions. "It's like us panting for oxygen at high altitude - they're struggling," he said.

Hall-Spencer called the combination of warming and acidification "a deadly noxious cocktail." He said that worst-case scenarios predict that acidity will increase another 150 percent by 2050 -- and warming and acidification are a double-whammy.

Other researchers are studying the ability of microorganisms to adjust to new environmental conditions. Sinead Collins, a research fellow at the University of Edinburgh in the U.K., studies microevolution in phytoplankton -- the tiny ocean floaters who are responsible for half the photosynthesis on Earth.

Collins takes micro-algae and subjects them to a high-carbon-dioxide environment for hundreds of generations, watching how they evolve. She has seen them change.

"Some of them began to photosynthesize really quickly, but just spit carbon back out. Current algae are much more efficient at capturing carbon dioxide," said Collins.

Collins has found that the organisms are able to adapt, but their rate of change slows as the speed of environmental change speeds up.

"If you take an antibiotic and introduce it slowly, antibiotic resistance happens readily. But if you take it at a high dose, suddenly, resistance takes longer to evolve," explained Collins.

The studies are not meant to be an oracle to predict the exact future.

"Experimental evolution is not a crystal ball. It can’t replicate the glorious real world, but it lets you know the rules the real world plays by," said Collins.

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