Oceans' rising acidity a threat to shellfish and humans

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Peering into the microscope, Alan Barton thought the baby oysters looked normal, except for one thing: They were dead.

Slide after slide, the results were the same. The entire batch of 100 million larvae at the Whiskey Creek Shellfish Hatchery had perished.

It took several years for the Oregon oyster breeder and a team of scientists to find the culprit: a radical change in ocean acidity.

The acid levels rose so high that the larvae could not form their protective shells, according to a study published this year. The free-swimming baby oysters would struggle for days, then fall exhausted to the floor of the tank.

"There's no debating it," said Barton, who manages Whiskey Creek, which supplies three-quarters of the oyster seed to independent shellfish farms from Washington to California. "We're changing the chemistry of the oceans."

Rising acidity doesn't just imperil the West Coast's $110 million oyster industry. It ultimately will threaten other marine animals, the seafood industry and even the health of humans who eat affected shellfish, scientists say.

The world's oceans have become 30 percent more acidic since the Industrial Revolution began more than two centuries ago. In that time, the seas have absorbed 500 billion tons of carbon dioxide that has built up in the atmosphere, primarily from the burning of fossil fuels.

By taking in that amount - more than one-quarter of the greenhouse gas that has accumulated in the atmosphere - the oceans have buffered the full effects of climate change, scientists say: Temperatures have not risen as much as they would have otherwise, glaciers haven't melted as fast. Yet the benefits are coming at a cost to marine life, especially oysters, clams and corals that rely on the minerals in alkaline seawater to build their protective shells and exoskeletons. The ill effects of the changing chemistry only add to the oceans' problems, which include warming temperatures and expanding low-oxygen "dead zones."

By the end of the century, said French biological oceanographer Jean-Pierre Gattuso, "The oceans will become hot, sour and breathless."

He was one of 540 scientists from 37 countries who gathered last month in Monterey, Calif., to discuss their findings on oceans in a "high-C02 world."

The full brunt of ocean acidification won't hit for decades. But scientists say the only sure way to avoid the worst is to significantly reduce carbon emissions. Some also have been exploring ways to restore the ocean's alkalinity through artificial means, such as spreading vast amounts of limestone or other minerals on the ocean surface. It's not yet clear whether either approach is realistic.

The West Coast provides a jarring glimpse of what lies ahead if trends continue, said Richard A. Feely, a chemical oceanographer for the National Oceanic and Atmospheric Administration.

Feely and a team of scientists have been tracking particularly acidic waters as they well up from the deep ocean and slosh onto the continental shelf off California, Oregon and Washington. "We found corrosive water everywhere we looked, particularly off California and Oregon," he said.

The cold, nutrient-laden waters from the deep sea are naturally more acidic than surface waters. Human contributions of CO2 only add to that acidity.

A few years ago, the shellfish industry became alarmed that 80 percent of oyster larvae at hatcheries were not surviving. Initially, they blamed an aggressive strain of bacteria.

But after Feely found evidence of corrosive waters reaching the West Coast, industry officials asked him and other scientists if there might be a connection to the die-offs. Sure enough, scientists found a link by studying the Whiskey Creek hatchery at Netarts Bay, Ore., whose larvae were bathed in acidic waters drawn in by intake pipes.

Oyster larvae are particularly sensitive in their first few days of life. As acidity rises in the ocean, the abundance of calcium carbonate - a mineral they need to build their shells - is gradually reduced. At extremely high levels of acidity, laboratory experiments show, seawater no longer provides this material and indeed can cause existing shells of corals, snails and other animals to dissolve.

Now, the Whiskey Creek hatchery tries to balance the acidity of its waters by adding soda ash. Costs have increased and production has never fully recovered. "We're limping along and manipulating the water to stay in business," Barton said.

Ocean acidification, once an obscure area of scientific inquiry, has quickly become of much wider interest. Because colder water can hold more CO2, scientists expect to see the first major changes in northern waters, where increasing acidity could melt away the bottom rungs of the food chain, such as pteropods, the button-sized marine snails that nourish salmon and other fish.

The chemical changes are then projected to spread to temperate waters.

Scientists have been doing experiments to determine if certain animals are more adaptable. Gretchen Hofmann, a University of California, Santa Barbara, ecologist, has found that purple sea urchins, for instance, are far better at tolerating higher acidity than are commercially grown Pacific oysters. Seafood should remain abundant, she said, if people are willing to eat urchin gonads, sold in sushi bars as uni.

Algae, bacteria and other primitive life forms tend to either be unaffected or to thrive in acidic waters, scientists report - which can create additional problems.

Dave Hutchins, a USC oceanographer, has found that harmful algae, common off the California coast, "like high C02 conditions." Experiments in his lab reveal that acidified waters trigger these microscopic plants to produce more toxins that contaminate clams and mussels. These shellfish, in turn, can sicken or kill humans who eat them.

Later this century, the rising acidity is projected to reach tropical waters. That will put coral reefs, already in peril, under even more pressure.

Katharina Fabricius, an ecologist from the Australian Institute of Marine Science, has been studying a particular coral reef off Papua New Guinea because, she said, "We can see what will happen by the end of the century."

These reefs, formed by the exoskeletons of small animals, are exposed to abnormally high levels of acidity because of carbon dioxide bubbling up from undersea volcanic vents. In areas with slightly elevated acidity, elkhorn, tabletop and other branching corals disappear. In areas with higher levels, even the sturdier mounding corals give way to fields of seaweed.

For island nations, the disappearance of coral reefs could prove disastrous.

Stephen Palumbi, director of Stanford's Hopkins Marine Laboratory, said that such reefs are nature's "sea walls," protecting islands from sea-level rise and storm waves.

Laboratory experiments show that rising acidity is toxic to some fish larvae and can bring on bizarre behavior. It scrambles the senses of the orange-and-white clown fish, featured in the animated film "Finding Nemo," making them leave their protective hiding places inside corals or sea anemones. Studies show they become deaf to the sound of predators and even attracted to the predators' scent.

The result: quick and certain death.