Ocean acidification linked to larval oyster failure

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Four to six month old "spat" or oyster seed at the Hatfield Marine Science Center in Newport,Oregon. © Oregon State University

Researchers at Oregon State University have definitively linked an increase in ocean acidification to the collapse of oyster seed production at a commercial oyster hatchery in Oregon, where larval growth had declined to a level considered by the owners to be "non-economically viable."

A study by the researchers found that elevated seawater carbon dioxide

(CO2) levels, resulting in more corrosive ocean water, inhibited the larval oysters from developing their shells and growing at a pace that would make commercial production cost-effective. As atmospheric CO2 levels continue to rise, this may serve as the proverbial canary in the coal mine for other ocean acidification impacts on shellfish, the scientists say.

Results of the research have just been published in the journal, Limnology and Oceanography.

"This is one of the first times that we have been able to show how ocean acidification affects oyster larval development at a critical life stage," said Burke Hales, an OSU chemical oceanographer and co-author on the study. "The predicted rise of atmospheric CO2 in the next two to three decades may push oyster larval growth past the break-even point in terms of production."

The owners of Whiskey Creek Shellfish Hatchery at Oregon's Netarts Bay began experiencing a decline in oyster seed production several years ago, and looked at potential causes including low oxygen and pathogenic bacteria. Alan Barton, who works at the hatchery and is an author on the journal article, was able to eliminate those potential causes and shifted his focus to acidification.

Barton sent samples to OSU and the National Oceanic and Atmospheric Administration's Pacific Marine Environmental Laboratory for analysis. Their ensuing study clearly linked the production failures to the CO2 levels in the water in which the larval oysters are spawned and spend the first 24 hours of their lives, the critical time when they develop from fertilized eggs to swimming larvae, and build their initial shells.

"The early growth stage for oysters is particularly sensitive to the carbonate chemistry of the water," said George Waldbusser, a benthic

ecologist in OSU's College of Earth, Ocean, and Atmospheric Sciences. "As the water becomes more acidified, it affects the formation of calcium carbonate, the mineral of which the shell material consists. As the CO2 goes up, the mineral stability goes down, ultimately leading to reduced growth or mortality."

Commercial oyster production on the West Coast of North America generates more than $100 million in gross sales annually, generating economic activity of some $273 million. The industry has depended since the 1970s on oyster hatcheries for a steady supply of the seed used by growers. From 2007 to 2010, major hatcheries supplying the seed for West Coast oyster growers suffered persistent production failures.

The wild stocks of non-hatchery oysters simultaneously showed low recruitment, putting additional strain on limited seed supply.

Hales said Netarts Bay, where the Whiskey Creek hatchery is located, experiences a wide range of chemistry fluctuations. The OSU researchers say hatchery operators may be able to adapt their operations to take advantage of periods when water quality is at its highest.

"In addition to the impact of seasonal upwelling, the water chemistry changes with the tidal cycle, and with the time of day," Hales said. "Afternoon sunlight, for example, promotes photosynthesis in the bay and that production can absorb some of the carbon dioxide and lower the corrosiveness of the water."

A previous study co-authored by Hales found the water that is being upwelled in the Pacific Ocean off the Oregon coast has been kept at depth away from the surface for about 50 years – meaning it was last exposed to the atmosphere a half-century ago, when carbon dioxide levels were much lower. "Since atmospheric CO2 levels have risen significantly in the past half-century, it means that the water that will be

upwelled in the future will become increasingly be more corrosive," Hales said.

The OSU researchers also found that larval oysters showed delayed response to the water chemistry, which may cast new light on other experiments looking at the impacts of acidification on shellfish. In their study, they found that larval oysters raised in water that was acidic, but non-lethal, had significantly less growth in later stages of their life.

"The takeaway message here is that the response to poor water quality isn't always immediate," said Waldbusser. "In some cases, it took until three weeks after fertilization for the impact from the acidic water to become apparent. Short-term experiments of just a few days may not detect the damage."

Provided by Oregon State University

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