More acidic oceans may affect the sex of oysters

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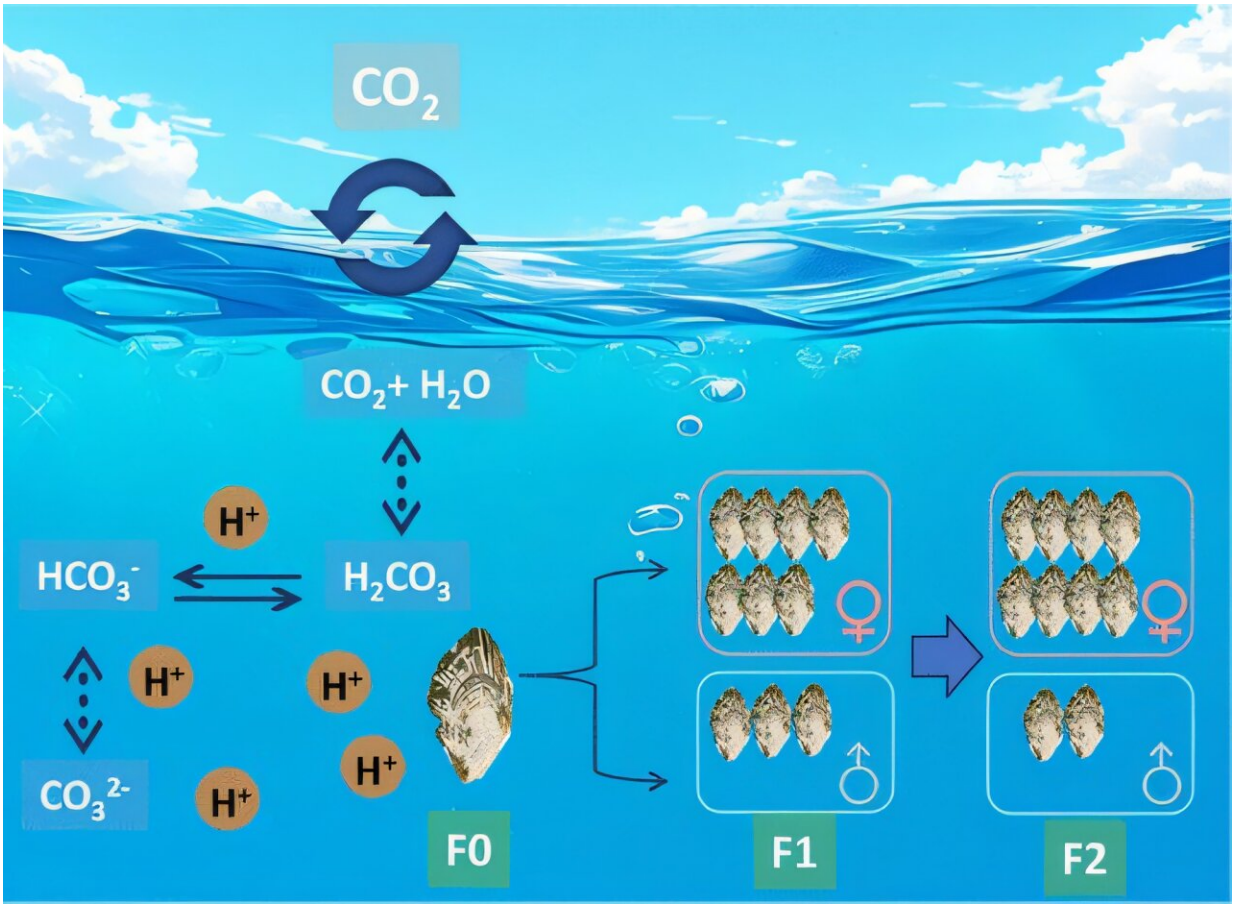

Credit: *Environmental Science & Technology* (2024). DOI: 10.1021/acs.est.4c07808

Rising carbon dioxide levels affect more than just the climate; they also

affect the chemistry of the oceans. When saltwater absorbs carbon dioxide, it becomes acidic, which alters the aquatic animal ecosystem.

But how exactly does ocean acidification impact animals whose genetic makeup can shift depending on environmental cues? A study published in *Environmental Science & Technology* addresses this question through the "eyes" of oysters.

Oysters, unlike mammals and birds, do not have chromosomes that dictate their sex at the point of fertilization. The bivalves rely on environmental factors to trigger genetic signals that determine whether they are male or female—a mechanism known as environmental sex determination.

Previous studies have explored how environmental signals such as temperature and food availability can change female-male ratios for aquatic animals, but shifting pH levels have been overlooked. Now a research team led by Xin Dang and Vengatesen Thiyagarajan has examined how ocean acidification could impact the sex ratio of oysters across generations, both in hatcheries and in the wild.

The researchers collected the study's first generation of oysters from the wild and housed them in two different tanks, one with a neutral pH and the other with slightly more acidic water to mimic ocean acidification. The wild oysters' offspring (second generation) in the acidic tank had a higher female-male ratio than those spawned in the neutral pH tank.

Next, the team transplanted the second-generation oysters from the acidic tank into two different natural habitats: one with a neutral pH and one with an acidic pH. The third-generation oysters had higher female-male ratios regardless of habitat pH, demonstrating that pH-mediated sex determination can be transgenerational for oysters.

Likewise, pH-mediated sex determination also occurred in the control-group offspring. When second-generation control-group oysters were transplanted into acidic natural habitats, their offspring had higher female-male ratios than control-group oysters transplanted into neutral pH natural habitats.

The team also explored the relationship between pH and sex determination through genetic analysis. The results indicated that a series of genes involved in female development turned on in response to acidic pH, whereas a different set of genes involved in male development shut down. These results uncover a new trigger for environmental sex determination in oysters.

"This study is the first to document a biased sex ratio over multiple generations towards females driven by exposure to low pH," says Dang. "The results expand our understanding of environmental sex determination and highlight the possible impact of future global changes on reproduction and population dynamics of mollusks and other marine organisms."

The researchers' next steps involve exploring this phenomenon in other marine animals, to better understand the genetic regulation in response to climate change and test the application of pH sex determination in oyster aquaculture.

More information: Xin Dang et al, Low pH Means More Female Offspring: A Multigenerational Plasticity in the Sex Ratio of Marine Bivalves, *Environmental Science & Technology* (2024). DOI: 10.1021/acs.est.4c07808

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