

Submarine springs reveal how coral reefs respond to ocean acidification

June 17 2013



Plate coral (*Fungia* sp.). The picture was taken in Papua New Guinea. Credit: Wikipedia.

Ocean acidification due to rising carbon dioxide levels will reduce the density of coral skeletons, making coral reefs more vulnerable to disruption and erosion, according to a new study of corals growing where submarine springs naturally lower the pH of seawater.

The study, led by researchers at the University of California, Santa Cruz, and published in the *Proceedings of the National Academy of Sciences* (PNAS), is the first to show that corals are not able to fully acclimate to low [pH conditions](#) in nature.

"People have seen similar effects in laboratory experiments," said coauthor Adina Paytan, a research scientist in the Institute of Marine Sciences at UC Santa Cruz. "We looked in places where the corals are exposed to low pH for their entire life span. The good news is that they don't just die. They are able to grow and calcify, but they are not producing robust structures."

With [atmospheric carbon dioxide](#) rising steadily, the oceans are absorbing more carbon dioxide, which lowers the pH of the surface waters. Ocean acidification refers to changes in seawater chemistry that move it closer to the acidic range of the pH scale, although seawater is not expected to become literally acidic. Paytan's team studied [coral reefs](#) along the Caribbean coastline of Mexico's [Yucatan Peninsula](#) where submarine springs lower the pH of the surrounding seawater in a localized, natural setting. The effect is similar to the widespread ocean acidification that is occurring as the oceans absorb increasing amounts of carbon dioxide from the atmosphere.

Led by first author Elizabeth Crook, a graduate student in Paytan's lab, the researchers deployed instruments to monitor [seawater chemistry](#) around the springs and removed skeletal cores from colonies of *Porites astreoides*, an important Caribbean reef-building coral. They performed CT scans of the core samples to measure their densities and determine annual calcification rates in the laboratory of coauthor Anne Cohen at Woods Hole Oceanographic Institution.

The results showed that coral [calcification rates](#) decrease significantly along a natural gradient in seawater pH. Ocean acidification lowers the concentration of carbonate ions in seawater, making it more difficult for corals to build their calcium carbonate skeletons.

"Carbonate ions are the building blocks they need to grow their skeletons. When the pH is lower the corals have to use more energy to

accumulate these carbonate building blocks internally. As a result, the calcification rate is lower and they lay down less dense skeletons," Paytan said.

The reduced density of the [coral skeletons](#) makes them more vulnerable to mechanical erosion during storms, organisms that bore into corals, and parrotfish, which sometimes feed on corals. This could lead to a weakening of the reef framework and subsequent degradation of the complex coral reef ecosystem.

"There are likely to be major shifts in reef species and some loss of coral cover, but if ocean acidification is the only impact there won't be total destruction," Paytan said. "We need to protect corals from other stressors, such as pollution and overfishing. If we can control those, the impact of ocean acidification might not be as bad."

More information: Reduced calcification and lack of acclimatization by coral colonies growing in areas of persistent natural acidification , www.pnas.org/cgi/doi/10.1073/pnas.1301589110

Provided by University of California - Santa Cruz

Citation: Submarine springs reveal how coral reefs respond to ocean acidification (2013, June 17) retrieved 9 April 2024 from <https://phys.org/news/2013-06-submarine-reveal-coral-reefs-ocean.html>

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