How corals can actually benefit from climate change effects

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Justin Ries, an associate professor at the Marine Science Center, researches biogeochemical oceanic change over long time periods. Credit: Brooks Canaday/Northeastern University

Researchers from Northeastern University's Marine Science Center and the University of North Carolina at Chapel Hill have found that moderate ocean acidification and warming can actually enhance the growth rate of one reef-building coral species. Only under extreme acidification and thermal conditions did calcification decline.

Their work, which was published Wednesday in the journal *Proceedings of the Royal Society B: Biological Sciences*, is the first to show that some corals may benefit from moderate ocean acidification.

Justin Ries, an associate professor at Northeastern and one of the paper's co-authors, focuses his research on the biological impacts of rising atmospheric carbon dioxide levels, which has been increasing ocean acidity since the Industrial Revolution. One group of organisms that would be greatly affected by ocean acidification are those that build calcium carbonate shells and skeletons, such as coral, snails, and clams, which, he said, are already near the point of dissolving in some parts of the ocean.

The authors attribute the coral's positive response to moderately elevated carbon dioxide to the fertilization of photosynthesis within the coral's algal symbionts, which may provide the coral with more energy for calcification even though the seawater is more acidic. They propose that the eventual decline in coral calcification at the very high levels of carbon dioxide occurs when the beneficial effects of fertilizing photosynthesis are outweighed by the negative effects of acidification on the skeleton-forming process.

"The study showed that this species of coral (Siderastrea siderea) exhibited a peaked or parabolic response to both warming and acidification, that is, moderate acidification and warming actually enhanced coral calcification, with only extreme warming and acidification negatively impacting the corals," Ries said. "This was surprising given that most studies have shown that corals exhibit a more negative response to even moderate acidification."

Furthermore, their work indicates that ocean warming is likely to threaten this coral species more than acidification by the end of the century, based on projections from the Intergovernmental Panel on

Climate Change.

He noted that in the past 200 years, ocean pH level has dropped from 8.2 to 8.1 and is expected to fall even further to about 7.8 over the next one or two centuries. That is a significant decrease over a relatively short period of time, Ries said, when looking at the geologic history of ocean acidification.

"The amount of change that would typically occur in about 10 million years is being condensed into a 300-year period," Ries said. "It's not the just the magnitude of the change that matters to the organisms, but how quickly it is occurring."

In addition to publishing these findings, Ries has leveraged his research in this area to secure a prestigious fellowship from the Hanse Wissenschaftskolleg Institute for Advanced Study in Delmenhorst, Germany and a supporting research award from the National Science Foundation. He will spend 10 months over the next four years there working with researchers at three prominent German research institutions to use various tools such as microelectrodes, isotope ratios, and pH sensitive dyes to see how ocean acidification affects the organisms' internal calcifying processes that lead to the formation of their shells and skeletons.

"Acidification of the surrounding seawater is certainly important for marine organisms, but what is equally as important—perhaps even more important—is how the chemistry of their internal calcifying fluid responds to these changes in seawater chemistry," Ries said.

More information: The reef-building coral Siderastrea siderea exhibits parabolic responses to ocean acidification and warming, rspb.royalsocietypublishing.or … nt/281/1797/20141856

Provided by Northeastern University