Acid test: Study reveals both losers and winners of CO2-induced ocean acidification

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The effect of different CO2 levels on an American lobster.

(PhysOrg.com) -- As the world's seawater becomes more acidic due to rising atmospheric carbon dioxide, some shelled marine creatures may actually become bigger and stronger, according to a new study.

The finding, based on research by University of North Carolina at Chapel Hill marine scientist Justin Ries, could have important implications for ocean food webs and the multi-billion dollar global market for shellfish and crustaceans.

Previous research has shown that ocean acidification - the term for falling pH levels in the Earth's oceans as they absorb increasing amounts of carbon dioxide (CO2) from the atmosphere - is likely to slow the growth or even dissolve the shells of such creatures.

However, the new study, published in the December issue of the journal *Geology*, suggests that sediment-dwelling marine organisms may exhibit a wider range of responses to CO2-induced acidification than previously thought: some may get weaker while others become stronger.

Researchers also found that creatures whose shells grew the most, such as crabs, tend to prey on those whose shells weakened the most, such as clams.

Such changes could have serious ramifications for predator and prey relationships that have evolved over hundreds of millions of years, said Ries, Ph.D., assistant professor of marine sciences in the UNC College of Arts and Sciences.

“There is no magic formula to predict how different species will respond, but one thing you can be sure of is that ecosystems as a whole will change because of these varied individual responses,” Ries said.

The effect of different CO2 levels on a blue crab.

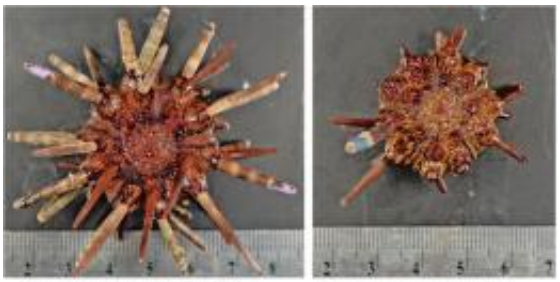
Researchers grew 18 different species of economically and ecologically important marine calcifiers (creatures that make their shells out of

calcium carbonate) at various levels of CO2 predicted to occur over the next several centuries. When CO2 combines with water, it produces carbonic acid, raising the overall amount of carbon in seawater but reducing the amount of the carbonate ion used by organisms in their calcification.

Seven species (crabs, lobsters, shrimp, red and green calcifying algae, limpets and temperate urchins) showed a positive response, meaning they calcified at a higher rate and increased in mass under elevated CO2. Ten types of organisms (including oysters, scallops, temperate corals and tube worms) had reduced calcification under elevated CO2, with several (hard and soft clams, conchs, periwinkles, whelks and tropical urchins) seeing their shells dissolve. One species (mussels) showed no response.

“Shelled marine organisms need carbonate ions to build their shells that protect them from the intense predation that defines everyday life on the shallow sea floor,” Ries said. “The organisms that responded positively to higher CO2 levels are apparently more adept at converting the elevated dissolved inorganic carbon in the seawater, which results from elevated atmospheric CO2, back into a form that they can use directly in their calcification. The others, however, appear to be less adept at manipulating dissolved inorganic carbon.”

Ries said the varied responses may reflect differences in organisms’ ability to regulate pH levels at their sites of calcification; their ability to generate a protective organic layer that limits their exposure to surrounding seawater; whether they use more soluble forms of calcium carbonate in their shells; and their ability to utilize CO2 directly via photosynthesis.



Pencil urchin under normal CO2

Pencil urchin under high CO2 (2850 ppm) showing dissolution of spines

The effect of different CO2 levels on a sea urchin.

Provided by University of North Carolina at Chapel Hill

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