Shell-shocked: Ocean acidification likely hampers tiny shell builders in Southern Ocean

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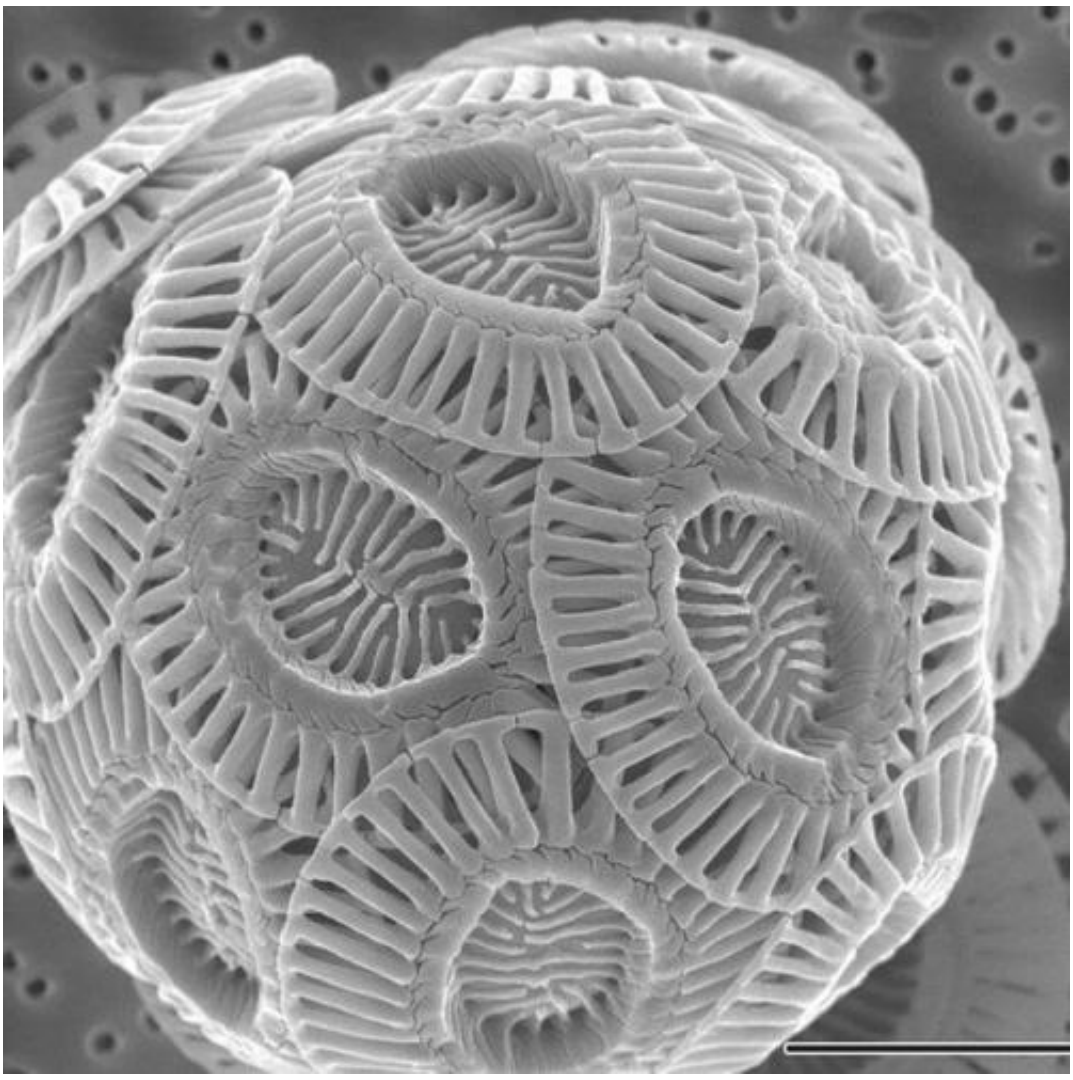

Microscopic coccolithophores like this species, *Emiliania huxleyi*, among the ocean's most common phytoplankton, appear to be declining in the Southern

Ocean, a possible result of a changing climate. Credit: Image courtesy Alison Taylor, University of North Carolina Wilmington Microscopy Facility/Wikimedia Commons

A University of Colorado Boulder study shows a ubiquitous type of phytoplankton—tiny organisms that are the base of the marine food web - appears to be suffering from the effects of ocean acidification caused by climate change.

According to the study authors, the single-celled organism under study is a type of "calcifying" plankton called a coccolithophore, which makes energy from sunlight and builds microscopic calcium carbonate shells, or plates, to produce a chalky suit of armor. The researchers used satellites tuned to observe the amount of calcium carbonate present in the surface of the Southern Ocean produced by *Emiliania huxleyi*, one of the most common species of coccolithophores in the region.

The coccolithophore *E. huxleyi* is important in the marine carbon cycle and is responsible for nearly half of all calcium carbonate production in the ocean, said lead study author Natalie Freeman, a doctoral student in the CU-Boulder's Department of Atmospheric and Oceanic Sciences (ATOC). The new study indicates there has been a 24 percent decline in the amount of calcium carbonate produced in large areas of the Southern Ocean over the past 17 years.

The researchers used satellite measurements and statistical methods to calculate the calcification rate - the amount of calcium carbonate these organisms produced per day in surface ocean waters. Across the entire Southern Ocean, which surrounds Antarctica, there was about a 4 percent reduction in calcification rate during the summer months from 1998 to 2014. In addition, the researchers found a 9 percent reduction in

calcification during that period in large regions of the Pacific and Indian sectors of the Southern Ocean.

"This is the first study to use satellites to measure the change in the amount of calcium carbonate and the calcification rates of the Southern Ocean," said Freeman. "Both have decreased in large portions of the Southern Ocean basin, which is what one might expect considering the ongoing acidification of the world's oceans."

A paper on the subject by Freeman and CU-Boulder Assistant Professor Nicole Lovenduski of ATOC was published online in *Geophysical Research Letters* (*GRL*). The National Science Foundation (NSF) and the National Oceanic and Atmospheric Administration (NOAA) funded the research.

The new study also includes data collected from ships to show that the observed decline in calcification occurs simultaneously with a loss in the amount of carbonate ions. Carbonate ions, a key ingredient in coccolithophore shells, are being significantly depleted via ocean acidification when the world's oceans absorb atmospheric CO2.

The Global Carbon Project, an international environmental organization, estimates roughly 3 billion tons of carbon dioxide from factories, cars, power plants and other human sources were absorbed in 2013 by the world's oceans. NOAA scientists have estimated that global oceans have become up to 30 percent more acidic since the Industrial Revolution.

"While we generally expect acidification to negatively impact coccolithophore calcification and growth, other environmental stressors such as warming may have influenced these processes," said Lovenduski. The two researchers, who also are affiliated with CU-Boulder's Institute of Arctic and Alpine Research, used data collected by the SeaWiFS and MODIS satellite instruments.

"These results suggest that large-scale shifts in the ocean carbon cycle are already occurring and highlight organism and marine ecosystem vulnerability in a changing climate," wrote the CU-Boulder researchers in GRL.

The Southern Ocean and the North Atlantic absorb more human sourced CO2 from the atmosphere than other oceans, and the Southern Ocean is particularly vulnerable to ocean acidification because of its naturally low numbers of carbonate ions. "This study has implications for how sensitive these coccolithophores are to a changing climate, and how their calcification might influence the marine carbon cycle."

In a changing climate, the response of these organisms and the ecosystems they support is still unknown. But all signs suggest that acidification will likely place these organisms under increased pressure, threatening them in different ways, including the ability of some cocolithophores to build and maintain a shell, according to the CU-Boulder researchers.

Provided by University of Colorado at Boulder

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