Rising carbon dioxide levels, ocean acidity may change crucial marine process

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Credit: Tiago Fioreze / Wikipedia

Climate change may be putting cyanobacteria that are crucial to the functioning of the ocean at risk as the amount of carbon dioxide in the atmosphere increases and the acidity of ocean water changes.

In a paper published Thursday in *Science*, a team of researchers from Florida State University, Xiamen University in China and Princeton

University argue that the acidification of seawater caused by rising carbon dioxide levels makes it difficult for a type of cyanobacteria to perform a process called nitrogen fixation.

Few people know much about a type of cyanobacteria called *Trichodesmium*, but this miniscule collection of cells is critical to the health of hundreds of species in the Earth's oceans. Through nitrogen fixation, *Trichodesmium* converts nitrogen gas into ammonia and other molecules that organisms are dependent on for survival.

Trichodesmium is thought to be responsible for about 50 percent of marine nitrogen fixation, so a decline in its ability could have a major ripple effect on marine ecosystems.

"This is one of the major sources of nitrogen for other organisms in the open ocean," said Sven Kranz, assistant professor of Earth, Ocean and Atmospheric Science at Florida State University and a co-author of this study. "If *Trichodesmium* responds negatively to the environmental changes forced upon the ocean by fossil fuel burning, it could have a large effect on our food web."

The effects of climate change on *Trichodesmium* have been studied extensively by scientists in labs across the globe but with widely different results. Some scientists found that increased carbon dioxide in ocean waters caused a decline in nitrogen fixation, while others saw huge increases. Because of the large role these bacteria play in the health of the Earth's oceans, Kranz and his colleagues sought to resolve the discrepancies.

Some of these discrepancies, they found, are based on the preparation of the water in which these organisms typically grow under laboratory conditions. For example, the researchers found contamination by elements such as ammonia or toxic elements like enhanced copper

concentration.

"Any slight differences in the specific ingredients of the water—in this case artificial seawater that scientists prepare—can have a huge effect on the outcome," Kranz said.

A slight contamination can throw a huge wrench in the process, yet using this artificial seawater is common because not every lab has access to clean ocean water.

The authors also found that increased carbon dioxide could sometimes stimulate nitrogen fixation but this was offset by the negative effects of the increased ocean acidity.

Kranz began studying how increased carbon dioxide affects cyanobacteria as a researcher in Germany and then as a postdoctoral researcher with François Morel and Dalin Shi at Princeton University. Shi is now at Xiamen University and led the study with his research group there.

For this study, Kranz focused on the preliminary data collections and how the cyanobacteria reacted to changing concentrations of iron and carbon dioxide. Shi's group in China conducted further studies including protein analysis and replicated this work in the field, conducting experiments in the South China Sea in May 2016.

More information: "The complex effects of ocean acidification on the prominent N2-fixing cyanobacterium Trichodesmium," *Science* (2017). science.sciencemag.org/lookup/ … 1126/science.aal2981

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