Biology trumps chemistry in open ocean

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Single-cell phytoplankton in the ocean are responsible for roughly half of global oxygen production, despite vast tracts of the open ocean that are devoid of life-sustaining nutrients. While phytoplankton's ability to adjust their physiology to exploit limited nutrients in the open ocean has been well documented, little is understood about how variations in microbial biodiversity—the number and variety of marine microbes - affects global ocean function.

In a paper published in *PNAS* on Monday November 24, scientists laid out a robust new framework based on in situ observations that will allow scientists to describe and understand how phytoplankton assimilate limited concentrations of phosphorus, a key nutrient, in the ocean in ways that better reflect what is actually occurring in the marine environment. This is an important advance because nutrient uptake is a central property of ocean biogeochemistry, and in many regions controls carbon dioxide fixation, which ultimately can play a role in mitigating climate change.

"Until now, our understanding of how phytoplankton assimilate nutrients in an extremely nutrient-limited environment was based on lab cultures that poorly represented what happens in natural populations," explained Michael Lomas of Bigelow Laboratory for Ocean Sciences, who co-led the study with Adam Martiny of University of California - Irvine, and Simon Levin and Juan Bonachela of Princeton University. "Now we can quantify how phytoplankton are taking up nutrients in the real world, which provides much more meaningful data that will ultimately improve our understanding of their role in global ocean function and climate regulation."

To address the knowledge gap about the globally-relevant ecosystem process of nutrient uptake, researchers worked to identify how different levels of microbial biodiversity influenced in situ phosphorus uptake in the Western Subtropical North Atlantic Ocean. Specifically, they focused on how different phytoplankton taxa assimilated phosphorus in the same region, and how phosphorus uptake by those individual taxa varied across regions with different phosphorus concentrations. They found that phytoplankton were much more efficient at assimilating vanishingly low phosphorus concentrations than would have been predicted from culture research. Moreover, individual phytoplankton continually optimized their ability to assimilate phosphorus as environmental phosphorus concentrations increased. This finding runs counter to the commonly held, and widely used, view that their ability to assimilate phosphorus saturates as concentrations increase.

"Prior climate models didn't take into account how natural phytoplankton populations vary in their ability to take up key nutrients, "said Martiny. "We were able to fill in this gap through fieldwork and advanced analytical techniques. The outcome is the first comprehensive in situ quantification of nutrient uptake capabilities among dominant phytoplankton groups in the North Atlantic Ocean that takes into account microbial biodiversity. "

More information: Impact of ocean phytoplankton diversity on phosphate uptake, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1420760111

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