Oceans Getting Too Hot to Handle?

by Jane J. Lee on 25 October 2012, 4:40 PM |

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Tropical marine grazers may face a decidedly limited menu in a warming world. With rising temperatures, the ranges of many species of phytoplankton—the microscopic, plantlike organisms the grazers feed on—will shift away from the tropics and toward the poles, according to a new study. Up to one-third of tropical phytoplankton could be pushed out of tropical latitudes by 2100, the authors estimate.

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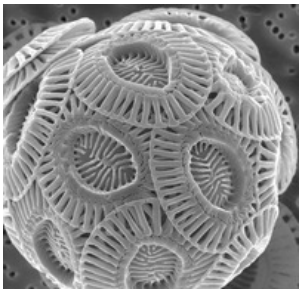

Beat the heat. Researchers are uncertain whether phytoplankton, such as this coccolithophore (*above*), can adapt quickly enough to rising ocean temperatures.

Credit: Alison R. Taylor/UNC Wilmington Microscopy Facility

Phytoplankton play key roles in several chemical and nutrient cycles, including taking up carbon dioxide from the atmosphere and either cycling it through food chains or sequestering it in the deep sea, says marine ecologist David Hutchins of the University of Southern California in Los Angeles, who wasn't involved in the current study. And, he adds, "We wouldn't have fish or mammals in the oceans without [them]."

But despite phytoplankton's central role in marine ecosystems, scientists don't understand their distribution in the ocean or how it may change in response to warming temperatures, says study co-author Colin Kremer, a theoretical ecology graduate student at Michigan State University's W. K. Kellogg Biological Station in Hickory Corners.

To find out, Kremer and colleagues gathered previously published data on how more than 130 phytoplankton species respond to changing temperatures. For each species, they estimated maximum growth rates, optimal growth temperatures, and the temperature ranges within which the species could grow.

The researchers found that phytoplankton in polar and temperate regions grow best at temperatures higher than the average annual temperatures of the oceans in which they live. (They intentionally set their models to consider just temperature effects, rather than other factors such as nutrient availability.) But tropical species of phytoplankton, the team found, grow best at temperatures either at or below current ocean temperatures in the tropics, they report online today in *Science*. This difference, the researchers say, suggests that tropical species may be more vulnerable to rising ocean temperatures than are temperate or polar species.

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Why tropical phytoplankton species lack that buffer against warming isn't clear. Hutchins speculates that perhaps tropical phytoplankton species simply haven't been able to adapt fast enough to the warming that's already occurred—but how quickly species of phytoplankton are able to adapt remains an open question.

Kremer and his colleagues then wanted to determine what would happen to phytoplankton distributions under future warming scenarios. After plugging their data into a species distribution model, they found poleward shifts in phytoplankton species' ranges, suggesting that as ocean waters warm, tropical species could be squeezed into smaller areas or disappear altogether.

"Naturally, we recognize that temperature is not the sole factor affecting phytoplankton," says study co-author

Mridul Thomas, a graduate student in phytoplankton ecology also at Michigan State University. But now that their work has set limits on possible phytoplankton distributions, additional environmental factors will only help to pinpoint species' ranges, he adds.

It's not all bad news, though. The study authors note that no one knows for sure how quickly phytoplankton will be able to adapt to changing temperatures. Kremer would love to figure out how fast that adaptation could happen.

"They're really doing a good job of thinking about what temperature changes mean [for phytoplankton]," Hutchins adds. But he says he'd be interested to see how multiple factors, including temperature, affect phytoplankton distributions.

"It's desperately difficult," to look at the effect of more than one environmental factor at a time, says biogeochemist Philip Boyd of the University of Otago in Dunedin, New Zealand, who was not involved in the study. But he agrees that the field needs to examine how multiple environmental factors interact and what that means for the future of phytoplankton.

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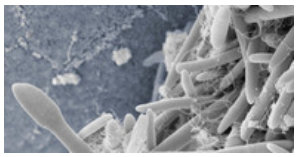

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