Plankton communities' warm response to nutrient availability

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Xosé Morán (left) and Tamara Huete-Stauffer during one of their monthly sampling trips of planktonic microbes in the Red Sea; the KAUST campus can be seen in the background. Credit: Miguel Viegas

Microbial plankton communities will be boosted in productivity and biomass from warmer water temperatures provided sufficient nutrients are also readily available, suggest KAUST researchers.

The response of marine ecosystems to global warming depends on complex factors. The growth rates and activity of plankton communities are largely dictated by nutrient availability (bottom-up control), predation (top-down control) and changes in water temperature.

Warming will probably alter life in cold and temperate waters more dramatically than in the equatorial belt. Nutrients, which are necessary to enhance plankton growth, are generally more abundant in colder waters. If nutrient levels in the oceans drop due to rising temperatures, this will have a knock-on effect on aquatic lifeforms.

"We wanted to investigate the response to warming in three planktonic communities simultaneously—picophytoplankton, heterotrophic bacteria and heterotrophic nanoflagellates," says Tamara M. Huete-Stauffer, a postdoc in Xosé Anxelu G. Morán's group in KAUST's Red Sea Research Center. The two KAUST scientists collaborated with scientists in Spain and the United States to complete the work.

"These three communities represent different elements of the food web. Phytoplankton are the primary producers in the ocean, rather like plants in a terrestrial ecosystem. Bacteria process the dissolved organic matter released from phytoplankton and other organisms, while nanoflagellates are the major predators of bacteria and small phytoplankton," explains Huete-Stauffer.

The team collected samples in temperate waters off the northern coast of Spain every month for a year. They incubated samples atin situtemperature and at 3 degrees Celsius above and below. This allowed them to calculate activation energy values, which indicate how a rate, such as net growth or metabolism, might change in response to a change in temperature.

"Our results showed a beautifully synchronized coherence in the

temperature response of all three plankton communities although they play different roles in the ecosystem," says Morán. "Their synchronized sensitivity to temperature was largely driven by the availability of nutrients: if the organisms are strongly constrained by the availability of food or by their consumers, then future warming will have a very limited effect on enhancing their growth."

These results form the basis for a general conceptual model of the response of marine ecosystems to global warming. "We have since conducted four similar experiments in the coastal Red Sea, which will serve as a test of the generality of the model in some of the hottest marine waters on Earth," adds Morán.

More information: Xosé Anxelu G. Morán et al. Temperature sensitivities of microbial plankton net growth rates are seasonally coherent and linked to nutrient availability, *Environmental Microbiology* (2018). DOI: 10.1111/1462-2920.14393

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