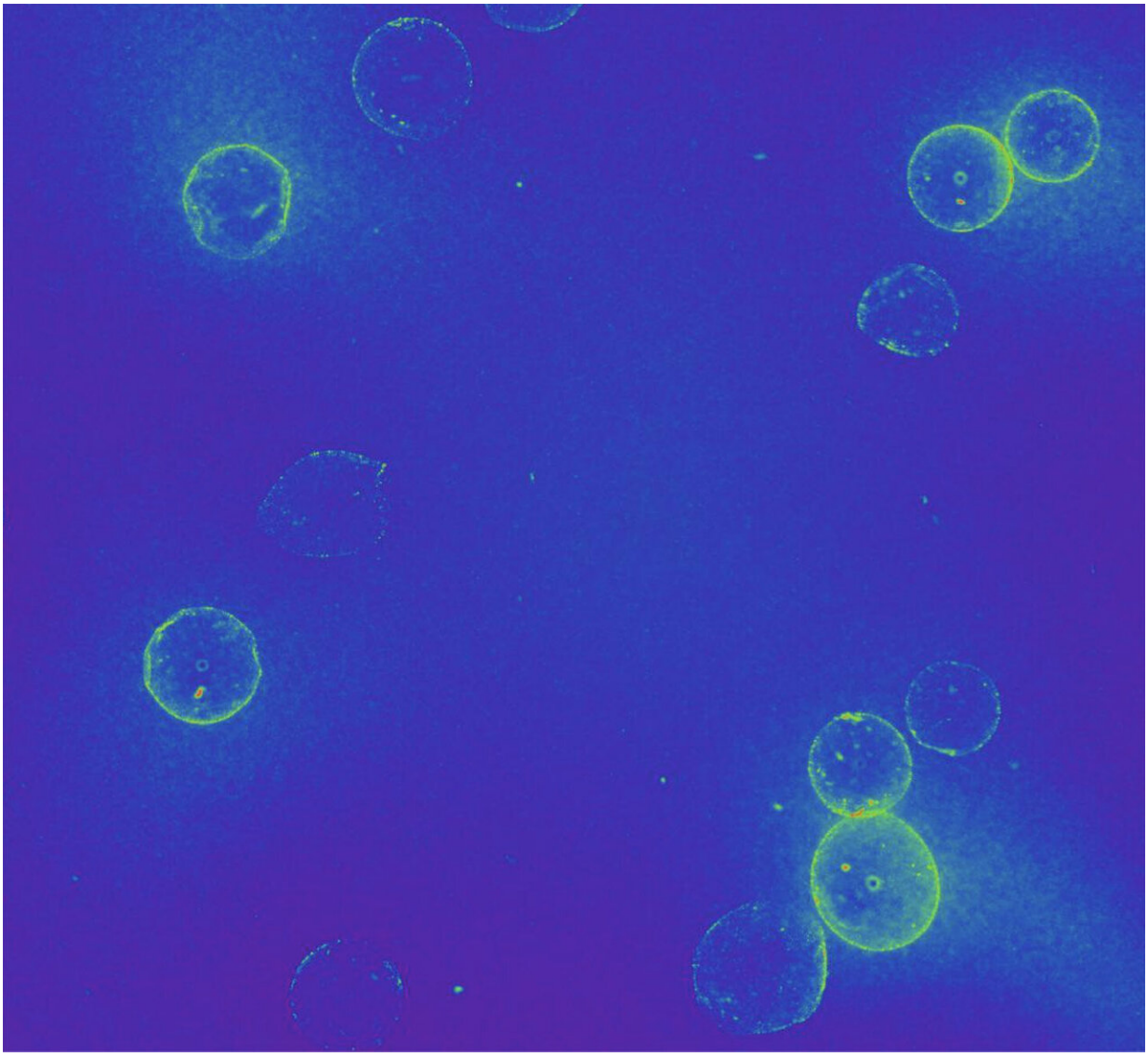
Marine bacteria shift between lifestyles to get the best resources

September 24 2020



Researchers from the University of Tsukuba and ETH Zurich find that marine bacteria forage optimally in seascapes of organic particles, switching between

attached and planktonic lifestyles. Credit: University of Tsukuba

To stay, or not to stay? When it comes to nutrient resource patches, researchers from Japan and Switzerland have discovered that marine bacteria have a knack for exploiting them efficiently, timing movements between patches to get the best resources.

In a study published this month in *Proceedings of the National Academy of Sciences*, researchers from the University of Tsukuba and ETH Zurich have revealed that marine bacteria optimize nutrient uptake by switching between dispersal and resource exploitation.

Heterotrophic bacteria (i.e., those that cannot produce their own food, instead obtaining nutrition from other sources of organic carbon, such as plant or animal matter) are the main recyclers of dissolved organic matter (DOM) in the ocean. Hotspots of DOM that are made up of particles, such as marine snow, are important to the global carbon cycle.

"Some groups of heterotrophic bacteria take advantage of these hotspots," says one of the lead authors of the study Assistant Professor Yutaka Yawata. "We used bacteria from one of these groups to look at whether optimal foraging theory is applicable to microbes, because their influence on the global carbon cycle ultimately depends on bacteria's ability to find and obtain nutrients from particles. Borrowing from the field of behavioral ecology, we referred to this process as foraging."

The researchers examined microbial foraging by studying the behavior of marine bacteria in seascapes of organic particles. They conducted experiments using single-cell tracking, where bacteria were video-recorded and the number of bacteria and the amount of time they spent on a surface was extracted and modeled.

"We found that foraging marine bacteria optimize nutrient uptake by rapidly switching between attached and planktonic lifestyles, and fine-tune the time spent on particles according to patch quality," explains Assistant Professor Yawata. "Bacteria stay longer on particles of higher quality, as predicted by patch use theory."

Patch use theory, which is part of optimal foraging theory, predicts that organisms foraging in a mixed-resource environment balance the time spent on a patch that yields diminishing returns with the costs of leaving that patch to find a fresh one. Until this study, the applicability of optimal foraging theory to microorganisms has been largely unknown.

Optimal foraging theory—and specifically patch use theory—provides a valuable framework for understanding microorganisms and their effects on ecosystems, such as quantifying and predicting the role of marine bacteria in the uptake and cycling of ocean nutrients.

More information: Constrained optimal foraging by marine bacterioplankton on particulate organic matter *Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.2012443117

Provided by University of Tsukuba