Dispersal strategies drive marine microbial diversity

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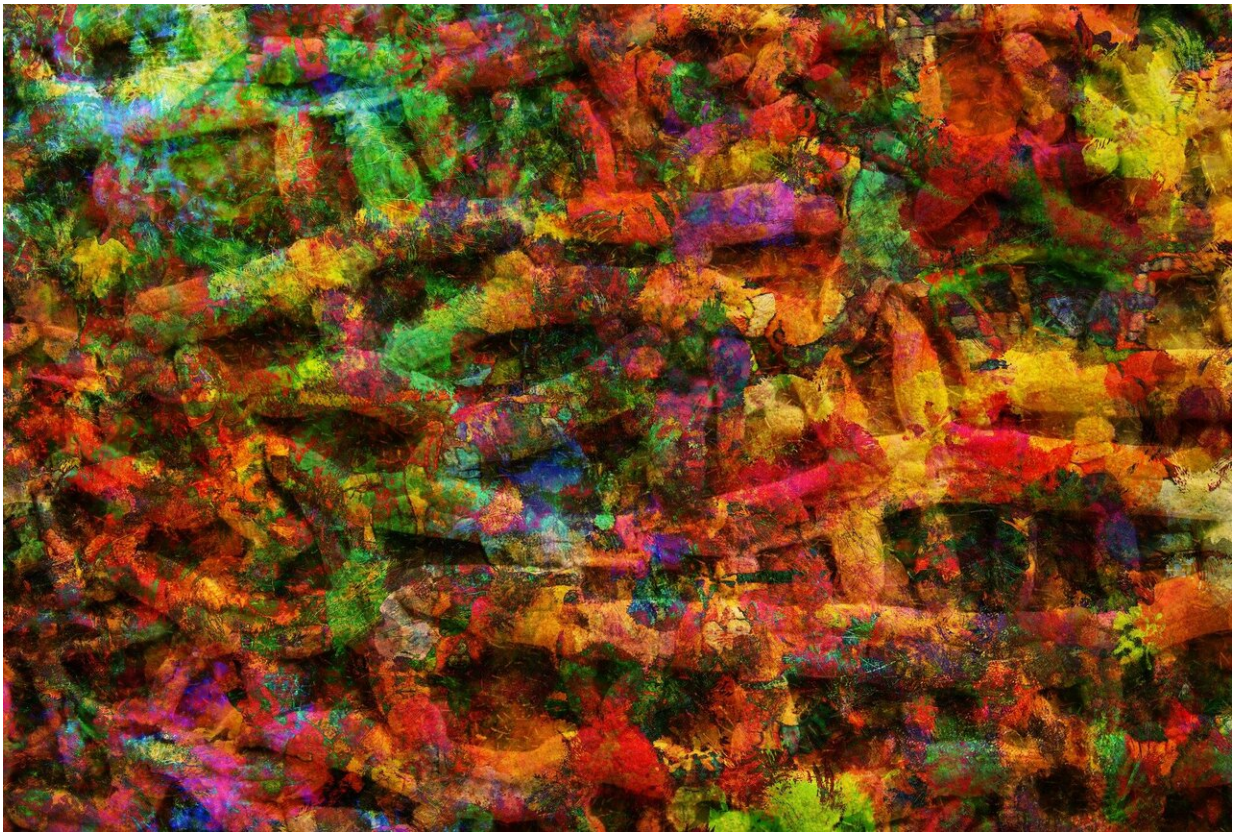

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Trade-offs between the benefit of colonizing new particles and the risk of being wiped out by predators allow diverse populations of marine microbes to exist together, shows a study published today in *eLife*.

The findings help explain how a vast array of diverse bacteria and microbes coexist on floating particle rafts in oceans.

Microbial foraging in patchy environments, where resources are fragmented into particles, plays a key role in natural environments. In oceans and freshwater systems, bacteria and microbes can interact with particle surfaces in different ways: some only colonize them for short periods, while others form long-lived, stable colonies.

Scientists have long puzzled over the greater-than-expected diversity of microscopic creatures in oceans, a phenomenon called the "plankton paradox." While researchers have begun to understand the factors that support so many different types of plankton, many questions remain about the more plentiful ocean microbes that live on floating particles.

"We wanted to study the role that dispersal strategies play in the successful coexistence of different microbes living on the same set of particles," says co-first author Ali Ebrahimi, who completed the study while he was a postdoctoral fellow at the Ralph M. Parsons Laboratory for Environmental Science and Engineering, Massachusetts Institute of Technology (MIT), Cambridge, US.

Ebrahimi and the team used mathematical modeling and computer simulations to test how different dispersal strategies may help marine microbes exist together in this way. They found that differently navigating the trade-offs between growth and survival can allow microbes to thrive together.

Their model showed that organisms which stay put on a single particle for longer have more opportunities to multiply. However, they face a higher risk of being wiped out by a virus or other predator capable of engulfing whole particles. On the other hand, microbes that more frequently hop between particles have less opportunity to multiply, but

also have a lower risk of facing a mass mortality event. The success of one strategy over another may depend on differing environmental conditions.

"When the particle supply is high, microbes that hop rapidly between them will have a greater chance of survival," explains co-first author Akshit Goyal, Physics of Living Systems Fellow at the MIT Department of Physics. "But when particles are harder to come by, the bacteria that stay put will have an advantage."

Additionally, the team found that coexistence can remain stable in the face of changing environmental conditions, such as algal blooms of particles, favoring growth, and changing numbers of predators, favoring mortality. Together, these differing factors significantly increase the likelihood that populations with diverse dispersal strategies can live together.

"Our work focused on the link between dispersal and mortality in the ocean, but there's plenty more going on in these environments," Goyal concludes. "Future research could provide important new insights on how environmental changes might impact these minuscule communities and, in turn, their wider marine ecosystem."

More information: Ali Ebrahimi et al, Particle foraging strategies promote microbial diversity in marine environments, *eLife* (2022). DOI: 10.7554/eLife.73948

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