Another danger sign for coral reefs: Substitute symbiont falls short

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Credit: Oregon State University

For reef-building corals, not just any symbiotic algae will do, new research shows.

The findings are important because they amount to another danger sign for the world's coral reefs, which rely on a partnership with the millions of phototrophic algae they host to obtain food.

Global climate change is threatening the reefs in part because the symbionts, *dinoflagellates* of the genus *Symbiodinium*, can be stressed by

warming oceans to the point of dysbiosis - a collapse of the host-symbiont partnership, which results in a phenomenon known as coral bleaching.

Earlier studies had suggested the more heat-tolerant *Symbiodinium trenchii* might be able to take the place of other, more sensitive species of *Symbiodinium*.

But an international research group that included Virginia Weis, Eli Meyer and Camerron Crowder of Oregon State University found that likely won't be the case.

"Our research suggests that while *S. trenchii* might be able to establish a population in a host, it's not correct to say it will be a beneficial partnership for the coral," said Weis, professor of integrative biology in OSU's College of Science.

Findings were published today in the *Proceedings of the National Academy of Sciences*.

Weis and collaborators at Victoria University of Wellington in New Zealand, the University of Melbourne and Stanford University worked with the sea anemone *Exaiptasia pallida*, commonly called *Aiptasia*, an established model for studying the type of symbiosis upon which coral reefs rely.

"Corals are really hard to grow in a lab," Weis said. "They're very fussy, they're slow growing, and many of them are endangered. But this anemone grows very fast and is easy to manipulate."

Aiptasia anemones were colonized separately with S. trenchii and their native symbionts, *S. minutum*.*S. trenchii* has been observed to invade corals after bleaching - when the corals become stressed and lose their

algae.

"When we challenged Aiptasia with the regular symbiont, it went as expected," Weis said. "There was no immune system response, and there was productivity - we could see signs of the host getting sugars and nutrients from its symbiont."

But with the introduction of S. trenchii, it was a much different story.

"We got a completely different set of signals," she said. "The hosts' immune system went on alert, mounting a response to try to eject this invader, and we saw signs of catabolism - instead of growing and putting carbon away for a rainy day, the host was having to break down its own tissues because it wasn't getting enough food. So it was quite a dramatically different set of responses."

Understanding as much as possible about the symbiosis corals require, and the biology that underlies it, is a key to the "grave and existential threat" they face from climate change, Weis said.

"We're at the point now where coral reefs as we know them will in fact largely disappear, and what we're hoping is to get carbon emissions more under control and bring global temperatures back down so we can manage their reappearance as a dominant ecosystem," she said. "One approach to mitigate the problem would be to shift the host to a symbiont population that can develop corals that are more robust to climate change. One of the hopes had centered on S. trenchii, but what studies show in the model system is that it's unlikely that combination would result in an ecologically healthy partnership that could last. It's a cautionary tale to those who think we can willy-nilly make symbiont switches and have healthy corals be the result."

More information: Jennifer L. Matthews et al, Optimal nutrient

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exchange and immune responses operate in partner specificity in the cnidarian-dinoflagellate symbiosis, *Proceedings of the National Academy of Sciences* (2017). DOI: 10.1073/pnas.1710733114

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