To protect corals from heat waves, we should help their microbial symbionts evolve heat tolerance, researchers say

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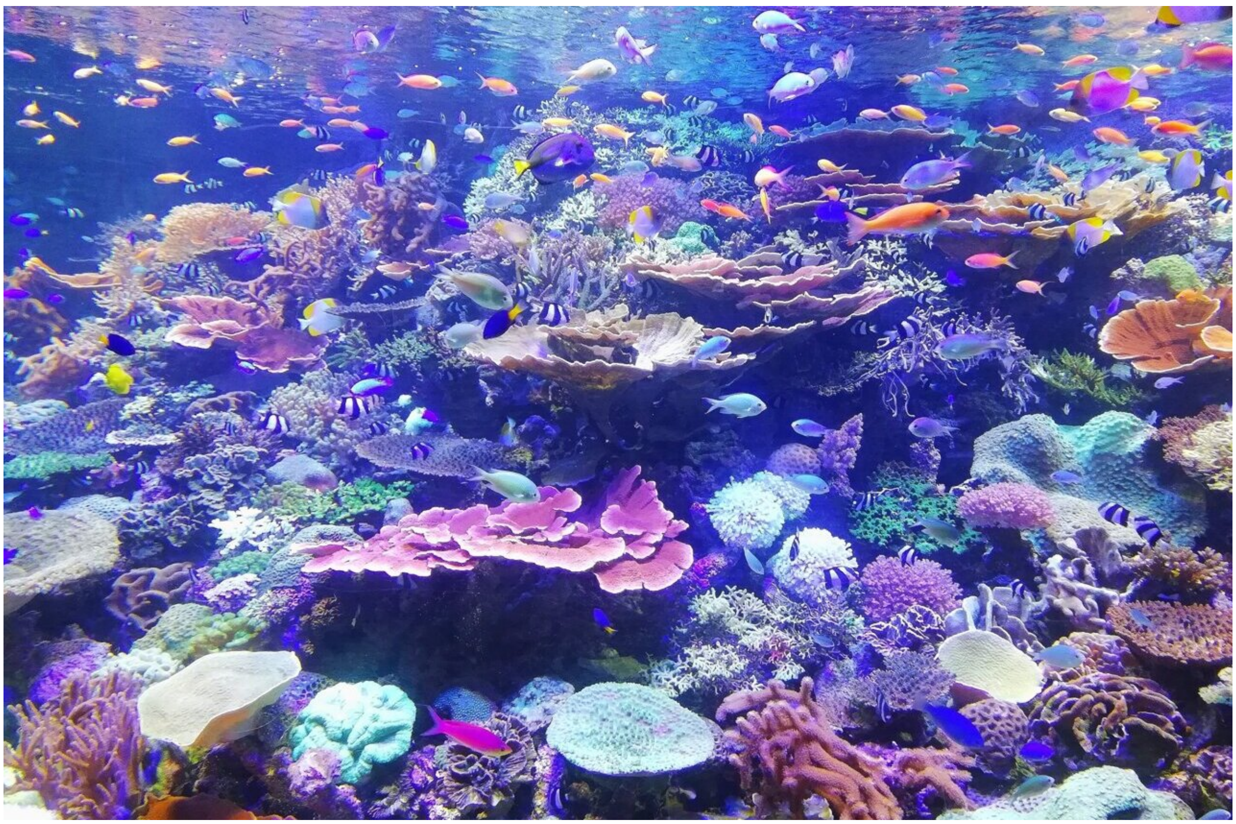

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Most coral reef restoration efforts involve restocking reefs with nursery-grown corals. However, if these corals are of the same stock as their wild counterparts, they will be equally vulnerable to the heat stress that caused the bleaching event in the first place.

In a review publishing June 27 in the journal *Trends in Microbiology*, researchers discuss the potential of improving corals' chances by inducing the evolution of heat tolerance in their symbionts—the mutualistic microbes that provide corals with nutrients in exchange for shelter and that are expelled during coral bleaching.

"Although heat-tolerant and -sensitive symbiont species occur in nature, even corals that harbor naturally tolerant symbionts have been observed to bleach during summer heat waves," write the authors, a team of marine scientists and bioengineers from Australia and New Zealand, including senior author Madeleine van Oppen of the Australian Institute of Marine Science and the University of Melbourne.

"Experimental evolution of Symbiodiniaceae offers a means to shift their thermal tolerance limit upward, increasing host resistance to bleaching."

To induce the evolution of heat-tolerance, researchers culture coral symbionts in the lab and expose successive generations to gradually increasing temperature, which maintains a selective pressure, so with each new generation, more heat-tolerant individuals are more likely to survive and reproduce.

"A critical decision about the efficacy of this intervention will revolve around determining whether field-deployed corals inoculated with heat-evolved symbionts exhibit greater tolerance to summer heat waves compared with their native counterparts because all observations so far have been made in the lab," they write.

Methods for culturing the symbionts will also need to be scaled up dramatically if this strategy is to be used at the necessary scale. "Research cultures are typically in the milliliter to liter volumes, yet thousands of liters would be required to inoculate millions of coral recruits reared from multiple reefs or regions," the authors write.

The authors note that researchers may fine tune culture conditions for mass production of Symbiodiniaceae by taking inspiration from large-scale culturing of microalgae for biotechnological applications (while preventing yield loss).

Experimental evolution of Symbiodiniaceae would be most effective in coral restoration efforts if used in conjunction with other measures, such as assisted gene flow, managed breeding of corals, and manipulation of coral-associated bacteria.

"All these interventions will be critical in maximizing the likelihood that coral reefs persist into the future, but it is imperative that these occur in tandem with significant emissions reductions and science-based reef management," they write.

More information: The use of experimentally evolved coral photosymbionts for reef restoration, *Trends in Microbiology* (2024). DOI: 10.1016/j.tim.2024.05.008

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