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Discovery

TROPICAL REEFS SURVIVING ENVIRONMENTAL STRESSES: CORALS' CHOICE OF SYMBIOTIC ALGAE MAY HOLD THE KEY

Corals that host fewer species of algae are less sensitive to disturbances

Coral known as *Acropora* on a fringing reef at NSF's Moorea Coral Reef LTER site.
Credit and Larger Version

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*The following is part ten in a series on the National Science Foundation's Long-Term Ecological Research (LTER) Network. Visit parts **one**, **two**, **three**, **four**, **five**, **six**, **seven**, **eight**, **nine**, **eleven**, **twelve** and **thirteen** in this series.*

Symbiodinium, it's technically called, but more popularly it's known as zooxanthellae.

Either way, these microscopic algae that live within a coral's tissues hold the key to a tropical reef's ability to withstand environmental stresses.

The effects on tropical corals of global warming, ocean acidification, pollution, coastal development and overfishing may all come down to how choosy the corals are about their algae tenants.

Reef corals are the sum of an animal and the single-celled algae that

The Moorea LTER site is also home to extensive lagoon reefs, like the one pictured here.
Credit and Larger Version

In Tahitian waters, *Porites* dominates the shallows: Shown here with Christmas tree worm.
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Porites coral bommie; Bommies are outcrops of coral or rock on a reef.
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Head of *Pocillopora* coral with small fish in a lagoon at the Moorea LTER site.

live inside its tissues. The animal is called the host and the algae are called endosymbionts.

It's a mutually beneficial arrangement. The corals provide the algae with protection in sunlit, shallow seas. The algae produce large amounts of energy through photosynthesis, which the corals use to survive and to build their skeletons.

The stability of this symbiotic relationship is critical to corals' survival. When corals lose their algae, they bleach out and often die.

Researchers at the University of Hawaii and other institutions have found that the more flexible corals are about their algal residents, the more sensitive they are to environmental changes.

"It's exactly the opposite of what we expected," says Hollie Putnam of the University of Hawaii and lead author of a paper published this week in the journal *Proceedings of the Royal Society B*.

"The finding was surprising; we thought that corals exploited the ability to host a variety of *Symbiodinium* to adapt to climate change."

But more is not always better, say Putnam and co-authors Michael Stat of the University of Western Australia and the Australian Institute of Marine Science; Xavier Pochon of the Cawthron Institute in Nelson, New Zealand; and Ruth Gates of the University of Hawaii.

"The relationship of corals to the algae that live within them is fundamental to their biology," says David Garrison, a program director in the National Science Foundation's (NSF) Division of Ocean Sciences, which funded the research.

"This study gives us an important new understanding of how corals are likely to respond to the stresses of environmental change."

The research was conducted at NSF's Moorea Coral Reef Long-Term Ecological Research (LTER) site, one of 26 such NSF LTER sites around the globe in ecosystems from deserts to freshwater lakes, and from forests to grasslands.

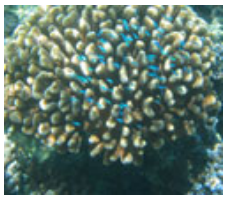
Putnam and colleagues took samples from 34 species of corals at the Moorea LTER site. By analyzing the DNA from the algae in the samples, they identified the specific species of *Symbiodinium*.

The findings reveal that some corals host a single *Symbiodinium* species. Others host many.

"We were able to link, for the first time, patterns in environmental performance of corals to the number and variety of endosymbionts they host," says Putnam.

The patterns show that corals termed generalists--those that are flexible in their choice of algae residents--are more environmentally sensitive.

Credit and Larger Version



Close-up view of *Pocillopora* coral with small fish darting in and out of the reef.
Credit and Larger Version

In contrast, environmentally resistant corals--termed specifists--associate with only one or a few specific species of *Symbiodinium*.

Generalists such as *Acropora* and *Pocillopora* are some of the most environmentally sensitive corals.

Conversely, specifists such as *Porites* harbor few *Symbiodinium* species and are environmentally resistant.

"Coral reefs are economically and ecologically important, providing homes for a high diversity of organisms and are necessary for food supplies, recreation and tourism in many countries," says Gates.

"The better we understand how corals respond to stress, the more capable we will be of forecasting and managing future reef communities."

It's likely that the reefs of tomorrow, say Putnam and co-authors, will be shaped by the coral-*Symbiodinium* assemblages of today.

In the roulette of coral species on a tropical reef, *Porites* may be the clear winner.

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Related Websites
NSF Moorea Coral Reef LTER Site: **http://mcr.lternet.edu/**
NSF LTER Network: **http://www.lternet.edu**
Trouble in Paradise: Ocean Acidification This Way Comes: **http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=122642&org=NSF**