

Smithsonian Scientists Discover Coral's Best Defender Against an Army of Sea Stars

Guard-Crab Diversity Key to Coral Reef Survival in French Polynesia

Coral reefs face a suite of perilous threats in today's ocean. From overfishing and pollution to coastal development and climate change, fragile coral ecosystems are disappearing at unprecedented rates around the world. Despite this trend, some species of corals surrounding the island of Moorea in French Polynesia have a natural protector in their tropical environment: coral guard-crabs. New research from the [National Museum of Natural History's Smithsonian Marine Station](#) scientist [Seabird McKeon](#) and the museum's predoctoral fellow Jenna Moore of the Florida Museum of Natural History has helped unravel the complex symbiotic relationship between these crabs and the coral reefs they live in and defend. Details from this study are published in the Sept. 30 [issue](#) of the open-access journal, *PeerJ*.

The new research highlights the role of diversity in the healthy functioning of coral reef ecosystems and shows that guard-crab species and size classes offer different kinds of effective protection against various threats to coral reefs.

"We found that diversity in both species and size of coral guard-crabs is needed to adequately fend off coral predators," said McKeon. "It is an example of how biodiversity is crucial to conserving reef environments and the essential resources they provide for thousands of species, including humans."

Coral guard-crabs belong to the genus *Trapezia* and defend their habitat in coral reefs from predators called corallivores in exchange for shelter and nutrition. In 2008 and 2009, four species of coral guard-crabs known to protect coral from predator sea stars were studied in a series of experiments to examine the effectiveness of different species and various sizes of crabs at repelling multiple corallivores. At the time, [crown-of-thorns sea stars](#), which can grow to the size of a trashcan lid and decimate coral reefs, experienced a population boom on Moorea, threatening the entire reef community found there. In one trial, the research team selectively removed the largest species of coral guard-crab, [T. flavopunctata](#), from corals in the path of the army of sea stars and observed the effects. The results were dramatic; corals without guard-crabs, or with other species of guard-crab, were eaten—usually overnight.

"Seemingly small differences among crabs guarding their coral homes can have big effects on coral survival," said Moore. "Not only does the level of protection provided vary by species, but the smallest crabs were defending the coral from coral-eating snails, a threat that larger crabs ignored."

The team concluded that multiple lines of defense are a direct result of guard-crab diversity and will be necessary to keep coral reefs safe long-term. Additional surveys revealed that the host corals were not the only species that benefitted from the diverse guard-crab ecosystem. Small corals of other species sheltering in the shadow of the crab-coral symbiosis were also shielded from corallivore predation.

Coral reefs have long protected humans living in coastal areas, acting as barriers against storms, wave damage and erosion. They are also a rich source of food for people around the globe, providing habitat and nurseries for as much as one-quarter of all ocean species. As waters continue to warm and ocean acidification changes the chemistry of the Earth's marine systems, corals, and the incredible diversity of life they support, are at risk of vanishing.

The Smithsonian Marine Station in Ft. Pierce, Fla., is a research center specializing in marine biodiversity and ecosystems. The Marine Station, a facility of the National Museum of Natural History, draws scientists and students from the Smithsonian and collaborating institutions to investigate the plants, animals and physical processes in the ocean and Indian River Lagoon.

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IMAGES:



Title: Sea Star Predation

Credit: Jenna Moore

A predator crown-of-thorns sea star eats an undefended coral, leaving visible white scars of exposed coral skeleton where the tissue has been removed. In September 2014, Smithsonian

scientists Seabird McKeon and Jenna Moore published new research highlighting the role of diversity in the healthy functioning of coral reef ecosystems, showing that guard-crab species and size classes offer different kinds of effective protection against various threats to coral reefs.



Title: Coral Guard-Crab

Credit: Seabird McKeon

When scientists removed the largest species of the guard-crabs, *Trapezia flavopunctata*, from the path of an army of predator sea stars, the effects were dramatic; corals without guard-crabs, or with other species of guard-crab, were eaten—usually overnight. In September 2014, Smithsonian scientists Seabird McKeon and Jenna Moore published new research highlighting the role of diversity in the healthy functioning of coral reef ecosystems, showing that guard-crab species and size classes offer different kinds of effective protection against various threats to coral reefs.



Title: Sea Diving

Credit: Courtesy of Gary Cranitch.

Smithsonian scientist Seabird McKeon searches for coral guard-crabs on a coral reef, home to as many as one-quarter of all ocean species. In September 2014, McKeon and colleague Jenna Moore published new research highlighting the role of diversity in the healthy functioning of coral reef ecosystems, showing that guard-crab species and size classes offer different kinds of effective protection against various threats to coral reefs.

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Abstract (from the article):

Coral guard-crabs in the genus *Trapezia* are well-documented defenders of their pocilloporid coral hosts against coral predators such as the Crown-of-Thorns seastar (*Acanthaster planci* complex). The

objectives of this study were to examine the protective services of six species of *Trapezia* against corallivory, and the extent of functional diversity among these *Trapezia* species.

Studies conducted in Mo'orea, French Polynesia showed the *Trapezia*—coral mutualism protected the host corals from multiple predators through functional diversity in the assemblage of crab symbionts. Species differed in their defensive efficacy, but species within similar size classes shared similar abilities. Smaller size *Trapezia* species, which were previously thought to be ineffective guards, play important defensive roles against small corallivores.

We also measured the benefits of this mutualism to corals in the midst of an *Acanthaster* outbreak that reduced the live coral cover on the fore reef to less than 4%. The mutualism may positively affect the reef coral demography and potential for recovery during adverse predation events through shelter of multiple species of small corals near the host coral. Our results show that while functional diversity is supported within the genus, some *Trapezia* species may be functionally equivalent within the same size class, decreasing the threat of gaps in coral protection caused by absence or replacement of any single *Trapezia* species.