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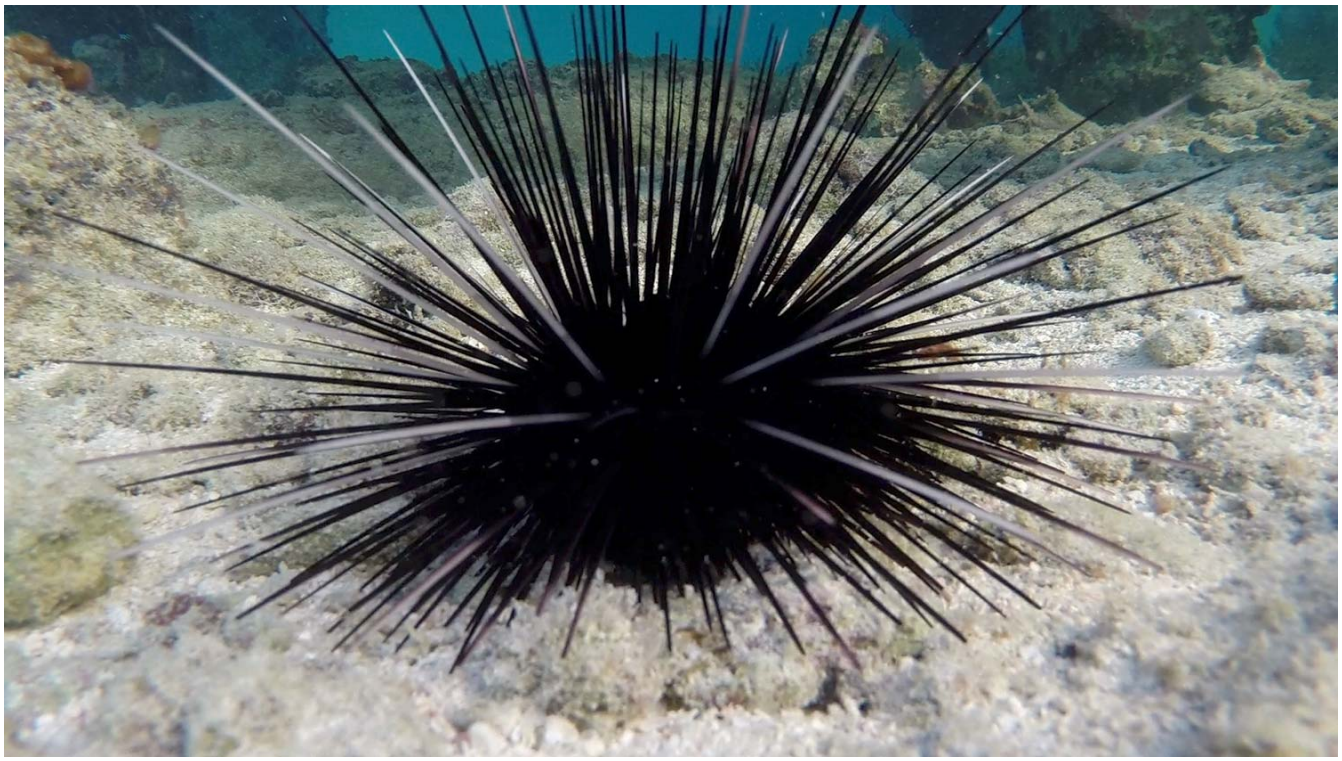
Rise of Aggressive Reef Predator From Overfishing May Impede Sea Urchin Recovery, Study Finds

Reef fossils help explain why algae-controlling urchins have not recovered following mysterious dieoff



Long-spined reef urchin

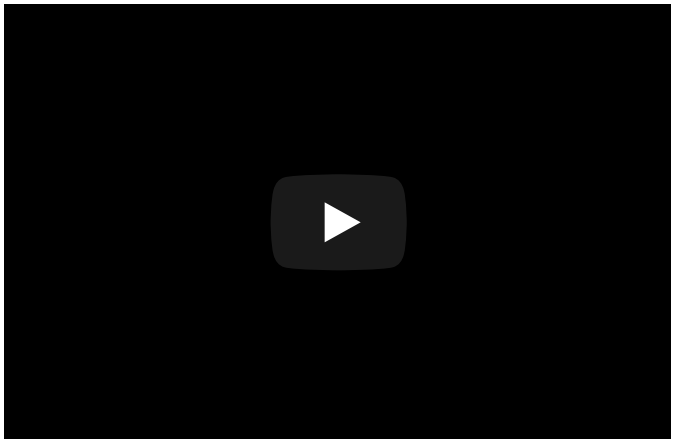
A new study suggests that an aggressive reef competitor—the Threespot Damselfish—may have impeded the recovery of Caribbean long-spined sea urchin populations after a mysterious disease outbreak caused a massive die-off of these animals over three decades ago.

The research led by Scripps Institution of Oceanography at the University of California San Diego scientists helps shine a light on the importance of curbing overfishing to protect coral reefs, which are in decline worldwide.

Threespot Damselfish populations have exploded in recent years due to overfishing of predatory fish such as groupers and snappers.

Long-spined sea urchins, known as *Diadema antillarum*, were once found everywhere on Caribbean reefs, until 1983, when an unknown pathogen rapidly spread throughout the region, killing 90 percent of the species within a year. These urchins are an important part of reef ecosystems since they eat algae that accumulate on corals. Many Caribbean reefs have become overgrown with algae since the die-off.

To understand why the long-spined urchins have not returned to the reef more than 30 years later, Scripps scientists Katie Cramer and Dick Norris analyzed the amount of fossilized urchin spines that accumulated in reef sediment layers over the past 3,000 years to paint a picture of life on the reef before it was altered from the disease outbreak and human activities such as fishing and pollution.



The researchers sorted the fossils out of the reef sediment to track the amount of long-spined and other urchin species over time. They then used a modeling approach developed by Scripps ecologist George Sugihara and colleagues to detect cause-and-effect relationships in ecological systems.

Cramer and Norris found that as one coral species, staghorn coral, increased in abundance, the long-spined urchin populations decreased. They theorized that this is due to the aggressive territorial activities of the Threespot Damselfish, a competitor of the long-spined urchin that takes refuge in the coral.

“These damselfish pick up urchins and move them off the coral with their mouths,” said Cramer, a postdoctoral scholar at Scripps and lead author of the study. “Damselfish populations appear to have grown recently as their predators have been overfished, which is one plausible explanation as to why long-spined urchin populations have failed to recover.”

Since urchins produce large numbers of eggs throughout the year, scientists initially expected that they would recover rapidly following the disease outbreak. Their failure to do so is a looming question among coral reef scientists. This issue has been hard to resolve since no

detailed scientific studies of Caribbean reefs were conducted prior to the outbreak to help researchers understand reef dynamics and what might impede their recovery.

“This study sheds light on the many surprising ways that fishing can alter reef ecosystems,” said Norris, a paleooceanographer in the Geosciences Research Division at Scripps and a co-author of the study. “Our findings suggest that these effects should be considered in the future management of Caribbean reefs.”

Algae-eating fish and corals once dominated Caribbean reefs. Important reef fish, such as parrotfish, that control these algae have largely disappeared on Caribbean reefs today due to overfishing.

In January, the Scripps researchers published a similar analysis of fossilized parrotfish teeth that showed when there are more algae-eating fish on a reef, it grows faster. They attributed the loss of parrotfish to overfishing as well.

This recent study’s findings were published in the journal *Ecography*. A Smithsonian Institution MarineGEO Postdoctoral Fellowship and UC San Diego Frontiers of Innovation Scholars Program Postdoctoral Fellowship supported Cramer’s work.

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