

Sea urchin die-off threatens reefs from Florida to Caribbean: Scientists hope to revive them

April 10 2023, by Alex Harris



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These days, long-spined sea urchins are known as the gardeners of the sea. They tend the algae on the coral reefs they call home, making sure it

never overwhelms their hosts. Spotting one on the Florida reef tract is a good sign that nearby corals are doing OK.

Decades ago, their reputation was a little different. They were viewed as damaging nuisances—to divers and to reefs.

The first time marine scientist Don Levitan saw the reefs near the U.S. Virgin Islands, they were blanketed in black—the coral covered by thousands of urchins spiked with sharp, poisonous spines.

"It was so dense it looked like a reef of sea urchins," said Levitan, a professor at Florida State University. "You couldn't even walk into the water."

That was in 1983, six months before a mysterious disease all but wiped out the population that reached throughout the Caribbean, including Florida's reef tract. The average mortality rate across the Caribbean, he said, was 95%. In the following years, it would become clear that too few urchins would turn out to be worse for reefs than too many of them.

Now, after decades of gradual recovery, the population of this specific type of sea urchin, known formally as *Diadema antillarum*, has dramatically declined again. A recent paper led by Levitan, published in the journal of the *Proceedings of the National Academy of Sciences*, found that a [die-off that began in early 2022](#) was equally devastating: 98% of the *Diadema* population was wiped out, once again.

That looms as another blow to struggling [coral reefs](#) across the entire region, including Florida.

Diadema are known as the "billy goats of the sea." Their favorite food is the macroalgae that can clump along coral, cutting off the oxygen it needs to survive. *Diadema* are prolific grazers, and if there are enough of

them around, they create little algae-free zones— also called halos—around coral that help them survive.

The corals also give back to the urchins. They provide nooks and crannies to hide from hungry predators like triggerfish or hogfish.

But Florida's corals aren't in great shape these days. Climate change has made ocean water hotter and more acidic, causing coral bleaching. The widespread and devastating stony coral tissue loss disease has weakened scores of once-strong reefs. And plumes of pollution from leaky septic tanks and sewage spills are choking out coral with too many nutrients.

That's why, Levitan said, they need all the help they can get from *Diadema*. But unlike other spots in the Caribbean, Florida saw some of the slowest recovery between the first die-off in the 1980s and the second recent one, so the natural population is nearly nonexistent.

"Places like Florida, if you went diving or snorkeling in the Florida Keys between these two mortality events you just didn't see many *Diadema* at all," he said.

A collaboration of Florida scientists has been working to change that. It's been a long, slow process without much success or funding, scientists say, but some recent wins have given new hope to the mission of reviving this species.

Diadema nursery

The first hurdle is trying to get the darn things to reproduce—and grow up—in an aquarium.

"Some of the best aquaculturists I know have been dabbling with these things for years," said Ken Nedimeyer, technical director of Reef

Rescue U.S.. "Most other urchins are easy to breed and raise, so easy, but *Diadema* are so hard."

And the first few attempts to release those painstakingly raised *Diadema* into the wild didn't exactly go well. Nedimeyer remembers one try 20 years ago where researchers loosed the urchins on a patch of restored reef. Within 24 hours, they were all gone.

It's taken scientists a while to figure out exactly what went wrong there, but the biggest culprit was likely the other neighbors on the reefs.

"They're kind of like chocolate-covered peanuts. Everybody likes to eat them on the reef. Fish like em, crabs like em," Nedimeyer said. "They just can't seem to get past the gauntlet of all the fish mouths trying to eat them."

Scientists have tried all sorts of things to fix that, including providing urchins with tiny undersea houses made of concrete or turned-over terracotta pots. In one experiment, researchers even tied fishing lines to the released urchins to track whether having a hiding spot nearby helped them avoid predators. (It did.)

After watching several ill-fated releases, scientists like Nedimeyer realized there was another factor at play. The urchins raised in captivity didn't behave like their wild cousins, and they were less equipped to survive.

"In the aquarium, they feed them squishy algae, like romaine lettuce for a manatee. We have to teach them to chew," Nedimeyer said. "In the process of chewing the algae off the rock, they consume some calcium carbonate from the rock that strengthens their spines."

Nedimeyer's lab is currently working on that part of the equation, using a

batch of aquarium-raised *Diadema* from Joshua Patterson, a University Florida researcher based at the Florida Aquarium who leads the state in raising the urchins. Reef Rescue is trying to turn the pea-sized urchins into "reef competent" juveniles it can one day release into the wild.

"These are one of the most important critters out there. They're critical for the Caribbean," Nedimeyer said.

At last, success

Some of the most recent advances are happening in Miami's backyard, at the University of Miami's Rosenstiel School of Marine, Atmospheric and Earth Science. Inside, rows of lit aquarium tanks hold dozens of baby urchins, their black spines waving in the current.

Diego Lirman, an associate professor within UM's marine biology and fisheries division, said his team has released two batches of lab-spawned *Diadema* from Patterson's lab to test sites near Miami Beach, with a third release planned for the summer.

Scientists are tracking the urchins to see if they stay on the reefs and survive, or if they're gobbled up by hungry predators instead.

While those results won't be ready for some time, Lirman said he's heartened by the results of the latest paper he worked on, which was published recently in the journal of the International Coral Reef Society. In it, a team of researchers showed that their efforts to drop adult *Diadema* on five reef spots near Key Biscayne were successful.

Those sites saw a nearly 30% drop in algae cover after three months, and after nine months, about 40 of the original 200 urchins transplanted from Port Everglades and Government Cut remained at the Key Biscayne reefs.

"We've shown that they will stay for us, which is promising," Lirman said.

However, the eventual goal is not to just move the urchins around but grow them in tanks and release them wherever they're needed. At this point, Lirman said, scientists are just trying to use *Diadema* to help the struggling reefs. They're not attempting to resurrect the species.

"The goal is not to get them to spawn, the goal is to get them to stay and clean the [reef](#) so our coral restoration can be successful," he said. "At some point it would be nice to dump millions of competent larvae—that's a pipe dream right now."

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Citation: Sea urchin die-off threatens reefs from Florida to Caribbean: Scientists hope to revive them (2023, April 10) retrieved 17 May 2024 from <https://phys.org/news/2023-04-sea-urchin-die-off-threatens-reefs.html>

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