Wanted: Reef Cleaners

Can spiny housekeepers save beleaguered Caribbean corals?

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For millennia, hordes of delicate, nocturnal sea urchins grazed the Caribbean sea floor. By dining on shag carpets known as turf algae, these spiny herbivorous urchins, often referred to as lawn mowers, kept most area corals clean as a whistle.

Bleached coral is vulnerable to the algal overgrowth affecting its neighbors.
G. Ostrander

That all ended in 1983 with the arrival of a mysterious plague.

Over the course of 13 months or so, a still-unidentified germ swept through the Caribbean basin, beginning at the Atlantic side of the Panama Canal. It proved lethal to just one species—*Diadema antillarum*, the corals' primary housekeeper. Infected urchins lost spines, grew lethargic, and exuded mucus. Any reef hit by the epidemic would be devoid of living *Diadema* within 2 weeks.

Hammering the entire Caribbean and tropical West Atlantic—more than 3.5 million square kilometers—this die-off was "the most extensive ever reported for any marine animal," notes Haris Lessios of the Smithsonian Tropical Research Institute in Balboa, Panama. Overall, more than 97 percent of the area's *Diadema* perished, he says.

The loss triggered an immediate and drastic change in the regional environment—from a diverse coral culture to one increasingly dominated by algae. Now, 18 years later, largely unmowed blankets of greenery cover most of the Caribbean's hard surfaces, including its largely dead corals. Unless this dense algal cover is cropped, larval corals can't resettle and reclaim reefs built by their dead and dying progenitors.

That's why things look grim.

Wild adult Diadema collected and transplanted off Florida this summer.
A. Szmant

The abundance of living coral in the Caribbean appears to be at its lowest point since the epoch when these creatures originally colonized the area, according to reef ecologists. As things stand, "within another

10 years, there won't be any corals left to recover," Lessios maintains.....

Yet even a rebound of *Diadema* populations, many scientists worry, would amount to a band-aid gesture. The urchin die-off and the choking algal communities that resulted are symptoms of more fundamental environmental stresses, these researchers argue. The most injurious of these, they say, is the centuries-long practice of overfishing the finned vegetarians that had once helped keep the area's greenery in check.

Wall-to-wall urchins

Before its die-off, *Diadema* had been ubiquitous throughout its range. In any square meter, one might encounter close to a dozen specimens, some as much as 30 centimeters across. Plenty of spots even harbored smaller, wall-to-wall urchins—up to 70 per square meter, notes Terence P. Hughes of James Cook University in Townsville, Australia.

At those densities, the urchins were practically starving, he notes. In search of algae, they scraped clean any available surface, often to the point of eroding reefs. Their thoroughness even killed off some larval corals.

Heavy overfishing of finned grazers, like this parrot fish, left a dearth of backup species to take over coral cleaning after an epidemic killed the urchins.
G. Ostrander

Several biologists have speculated that this urchin's dominance reflected an overfishing not only of other reef grazers—predominantly parrot fish and surgeon fish—but also of *Diadema*'s many predators, which included toad fish and queen triggerfish.

Yet until the 1983 die-off, no one appreciated how dependent the ecosystem had become upon just one species of urchins....

Though *Diadema* hasn't gone extinct, it remains rare throughout most of its range. "I can [scuba] dive 16 times in a week and maybe see just three," Gary K. Ostrander of Johns Hopkins University in Baltimore told *Science News*.

One reason, Hughes suspects, is that most surviving members of this species now live too far apart. Adults release their eggs or sperm—perhaps millions of gametes—into the water. If the spawners are more than a meter apart, Hughes notes, fertilization doesn't occur.

Coral health

The prevailing rarity of *Diadema* has had grave repercussions. Hughes monitored coral health along some 250 kilometers of Jamaican coastlines throughout the decade ending in 1993. During that period, local corals suffered a major bleaching caused largely by a stretch of unseasonably warm water there. In

response, many of the overheated corals expelled the symbiotic algae that had not only given them color but also helped them to survive.

Ordinarily, some bleached reef heads would have recovered as larval corals reseeded them. But without masses of *Diadema* present, algae moved in first. They blanketed the bleached reefs and preventing larval coral from getting access to the hard surfaces that they need to set up housekeeping.

In several instances, Hughes witnessed "a smothering of established [live] corals" by large, weedy algal blooms in *Diadema*-free regions. He now suspects that hurricane damage and the runoff of nutrient-rich pollution from land fostered these blooms.

In the end, live-coral cover at the sites Hughes studied declined from about 60 percent of the reef area to just 5 percent. Since many of these species grow slowly, "it may take a century for these corals to come back," he notes.

Last year, Ostrander and his colleagues reported a similar trend at sites they had studied since the mid -1990s in relatively pristine waters off San Salvador Island in the Bahamas.

In 1994, the seafloor and reef were covered by about equal areas of live corals and algae. Then came a January 1995 bleaching event. It launched "a rapid decline in coral abundance and a significant increase in [large seaweed]," the researchers reported in the May 9, 2000 *Proceedings of the National Academy of Sciences*.

By 1998, live coral accounted for just 5.2 percent of the studied area. That was about a third of the live coverage seen 4 years earlier. Meanwhile, algal cover climbed to nearly 45 percent—more than 2.5 times the territory it swathed when the study began.

The ecological story was the same: Once a coral died, algal squatters rushed to cover it, all but eliminating any chance of natural recovery through the recolonization of reefs by larval coral.

When Ostrander returned to his study sites about 10 weeks ago, he says, "things appeared to have gotten a little worse."

An ecological rebound

....."Reintroducing sea urchins to start clearing off coral-reef rock is radical and exciting," says Elliott Norse of the Marine Conservation Biology Institute in Redmond, Wash. Short of sending in squads of divers to scrape corals free of algae, there are few other options available right now to reverse the continuing decline of corals, he says....

He favors the siting of new marine reserves that are off-limits to fishing (SN: 4/28/01, p. 264) so they would enable recovery of the parrot fish and surgeon fish that formerly backed up urchins in algae management.

Crisis management

The growing need for crisis management in the Caribbean and other marine environments should serve as "a wake-up call" that there can be high costs of paring down the food web, says marine ecologist Jeremy B.C. Jackson of the Scripps Institution of Oceanography in La Jolla, Calif. Underlying many marine plagues today, he argues, has been the common practice of mining aquatic systems of desirable fauna until only one species remains to hold the food web together. When something knocks this species out, Jackson notes, "the whole system inevitably collapses....."

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