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Ripple Marks
The Story Behind the Story

BY CHERYL LYN DYBAS






Photo credits: Joseph Pawlik, University of North Carolina Wilmington

New Game in Town: The Sponges

Q: When is insult added to injury on a coral reef?

A: When overfishing removes predatory fish that feed on sponges.

Using the NOAA undersea habitat *Aquarius*—moored on Conch Reef off Key Largo, Florida—marine scientist Joseph Pawlik of the University of North Carolina Wilmington and colleagues found that these predatory fish are the same brightly colored angelfish and parrotfish that attract scuba divers and glass-bottom boat tourists. The results are published in the journal *PLoS ONE*.

The fish prey on sponges without chemical defenses—sponges missing what might be called the "yuck factor." "Sponges manufacturing metabolites that are distasteful to fish are largely left alone," says Pawlik.

"When overfishing by humans removes these predatory fish, reefs shift toward faster-growing sponges that can out-compete corals for space." With the decline of reef-building corals, sponges are becoming the main organisms on many reefs.

The findings provide important information, scientists say, about interactions between sponges and predatory fish in coral reef communities.

Previous research showed that Caribbean sponge communities were primarily structured by the availability of plankton rather than by predators.

But sponge growth experiments performed by Pawlik and colleagues—research that used cages to exclude predators—demonstrate the opposite.

"Overfished reefs that lack spongivores [sponge-eating fish] soon become dominated by faster growing, chemically undefended sponge species, which better compete for space with reef-building corals," says Pawlik.

Sponges are already overrunning certain coral reefs.

"As the effects of climate change and ocean acidification disrupt marine communities," he says, "it's likely that reef-building corals will suffer greater harm than sponges, which don't form the at-risk limestone skeletons that corals do."

Caribbean reefs of the future may be made up increasingly of sponges. Scuba divers and glass-bottom boat tourists might visit reefs not to view corals, but to see the new game in town: the sponges.

Antarctic Ice Shelf Disappears, Opens Underwater World of Glass

Larsen A, it was called, the smallest and most northerly of the three Larsen ice shelves that once extended from the eastern coast of the Antarctic Peninsula to the western Weddell Sea. An ice shelf is the continuation of a glacier that extends over and floats atop the sea. In January 1995, Larsen A collapsed during a storm. The 2,000 km^2 ice area fell into the sea.

Scientists had never seen an ice shelf disintegrate so quickly. It was the first time researchers realized that climate change could result in a complete loss of ice shelves.

An ice shelf's loss, however, turned out to be a glass sponge's gain.

To the surprise of scientist Claudio Richter of Germany's Alfred Wegener Institute for Polar and Marine Research, glass sponges in Antarctica are major beneficiaries of the ice shelf's disappearance. Between 2007 and 2011 alone, the density of glass sponges increased threefold in depths once covered by the ice—despite a low plankton food supply and water temperatures of –2°C. The sponges grew remarkably quickly, and knocked out their competitors for food.

The findings, reported in a paper by Richter and colleagues in the July 2013 issue of the journal *Current Biology*, show that marine animal communities at the bottom of the Weddell Sea can react quickly to climate change.

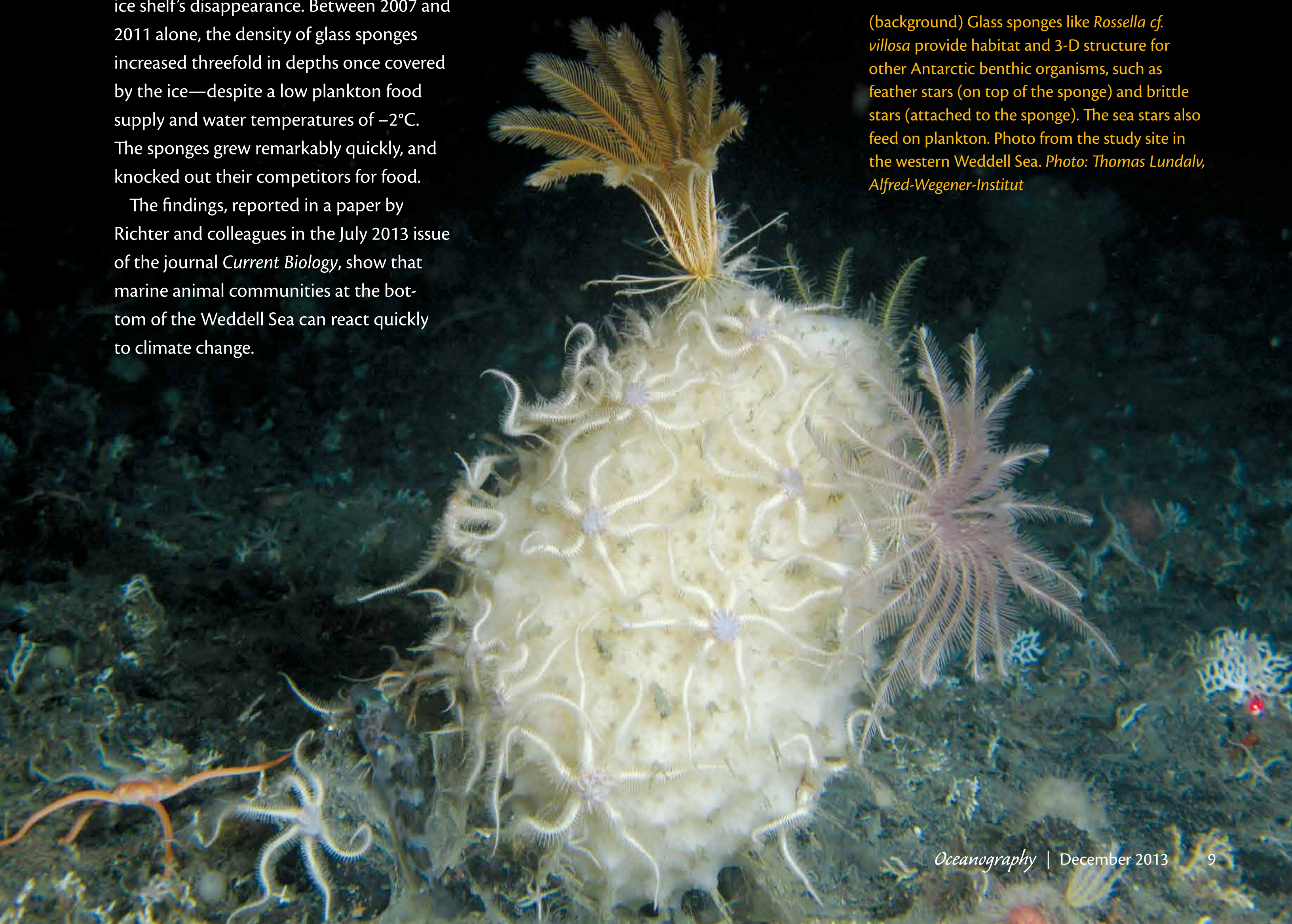
"We were surprised by what we saw on our video screens in 2011 when we lowered our remotely operated vehicle to the seabed," says Laura Fillinger, also of the Alfred Wegener Institute and a co-author of the *Current Biology* paper. "In an area with only occasional glass sponges during an expedition in 2007," she says, four years later there was a bonanza of sponges, including juveniles.

Until the discovery, scientists believed that communities on the Antarctic seafloor changed very slowly, a result of the cold waters and patchy food supply. "We now know otherwise: glass sponges can quickly colonize new habitats," says Richter.

Glass sponges feed on small plankton, which they filter from the water. The animals grow to a size of 2 m; their vase-like bodies provide places to hide and spawn for fish, invertebrates, and many other denizens of the deep. "Like corals," Richter says, "glass sponges create their own habitats. They're cities on the seabed. There's something going on wherever they are, and that attracts other ocean dwellers."

At the underwater city-of-glass beneath the former Larsen A, sunlight now allows plankton growth in surface waters and hence a snowfall of food particles to the seabed.

"To the organisms living there," says Richter, "the disappearance of the hundred-meter-thick ice shelf must have been like the heavens opening up above them."



(background) Glass sponges like *Rossella cf. villosa* provide habitat and 3-D structure for other Antarctic benthic organisms, such as feather stars (on top of the sponge) and brittle stars (attached to the sponge). The sea stars also feed on plankton. Photo from the study site in the western Weddell Sea. *Photo: Thomas Lundalv, Alfred-Wegener-Institut*

Caribbean Coral Mystery

Take one wastewater treatment plant and place it somewhere along the Caribbean coast. Then—by a means unknown to science—kill coral reefs near the plant.

"You'd have all the makings of a great mystery novel," says ecologist James Porter of the University of Georgia.

Except that, in this case, the story would be true.

Between 1996 and 2012, more than half of all corals in the Florida Keys alone had died. The greatest decline was in elkhorn coral (*Acropora palmata*). The species has disappeared from more than 90% of its former range.

Most elkhorn coral that perished in the Keys had signs of a disease known as white pox.

Hot on the white pox trail, Porter and other scientists ultimately identified sewage outflows as the source of a pathogen that causes the disease.

Along with colleagues Kathryn Sutherland of Rollins College and Erin Lipp of the University of Georgia, Porter discovered that the bacterium killing the coral, *Serratia marcescens*, is also found in humans.

But where was it coming from? From the land, it turned out, not the sea: in human waste. *Serratia marcescens* is in the gut of humans and in those of other terrestrial animals.

To trace the source, the researchers collected and analyzed samples from a wastewater treatment facility in Key West, then compared them with samples from animals such as deer and seagulls.

While *Serratia marcescens* showed up in these non-human animals, genetic analyses demonstrated that only a strain from people matched that found in white pox-diseased corals.

"The final piece of the puzzle," says Porter, "was to determine whether it was pathogenic to corals."

The scientists exposed fragments of elkhorn coral to the strain in humans to find out if it would cause the disease. The experiments were carried out in a lab in closed seawater tanks to eliminate any risk of infection to wild coral populations.

The results were positive: the disease-causing bacteria didn't come from the ocean. "They came," says Porter, "from us."

The movement of pathogens from wildlife to humans is well documented—in, for example, bird flu—but the transfer of disease-causing microbes from humans to marine invertebrates had never before been proved. The results are published in the journal *PLoS ONE*.

The good news, says Porter, is that the problem can be resolved with advanced wastewater treatment facilities.

The Florida Keys region is in the process of upgrading its wastewater treatment plants. The measure, scientists hope, will eliminate this source of the bacteria.

The story doesn't end there, however. Porter is working to identify another microbe that causes a white pox-like syndrome in elkhorn coral. "The new disease also may be linked with wastewater," he says. "And we're likely the culprits again this time."

Photo credits: James Porter, University of Georgia

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