# CAN-152-Stony coral tissue loss disease in Florida Keys

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For a Diver Every day is Ocean Day

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A research diver looks for signs of stony coral tissue loss disease in Florida Keys National Marine Sanctuary. JIM ABERNETHY

## As Disease Ravages Coral Reefs, Scientists Scramble for Solutions

As oceans warm, coral reefs are suffering not only from bleaching but from deadly outbreaks of disease. Researchers are developing remedies, but the key question is whether these solutions can work on a large-enough scale to save vast reef systems from Florida to Australia.

BY RET TALBOT • JANUARY 10, 2019

In September 2014, William Precht received an alarming phone call. “I’m seeing something funky out on the reef,” a colleague reported. “It looks like disease.” At the time, Precht, a marine biologist and environmental consultant

working in coral reef restoration, had been monitoring a Port of Miami dredging project to ensure preservation of the nearby ecosystem. When Precht donned his scuba gear and dove to the site to investigate a few weeks later he couldn't believe what he found. "The whole reef was lit up in disease," he recounts. There were more than 30 coral colonies (each 4 to 16 inches across) with white bands and lines on them, and other corals were entirely white. "You could see this line of mortality moving across the reef — I was blown away."

Precht was witnessing the early signs of a new and rapidly spreading coral disease outbreak sweeping along the Florida coastline, threatening the third-largest reef ecosystem in the world. The outbreak first appeared in pockets of diseased coral near Miami. Four years later, it covers 96,000 acres of reef extending about 275 miles from West Palm Beach to the lower Florida Keys. By some estimates, as much as 35 percent of the coral population has been lost. Several species have nearly vanished, including majestic colonies of pillar corals (Dendrogyra cylindrus), a threatened species that can reach heights from 6 to nearly 10 feet. The few surviving colonies are now known as "the last unicorns."

Around the globe, coral disease outbreaks are becoming more frequent, severe, and widespread. Many factors are contributing to the problem, including pollution and nitrogen runoff from fertilizers and coastal sewer and septic systems. But scientists say a key culprit is steadily increasing ocean temperatures, which have risen at least 1.3 degrees Fahrenheit in the past century and could increase several more degrees by 2100. Elevated water temperatures can cause coral polyps to expel the algae that provide them with nutrition and spectacular color, leaving the corals bleached. With sufficient time, corals can recover from bleaching, but global climate models indicate that severe bleaching may happen annually by mid-century.

In Australia, scientists estimate that disease has wiped out at least six percent of the corals on the Great Barrier Reef.

Scientists say that bleaching makes corals more susceptible to illness. In the Caribbean, a disease hotspot, roughly 80 percent of coral cover has disappeared, largely from outbreaks of "white band disease," so named for the white band of dead tissue that forms in affected corals. Two of the dominant reef-building species, elkhorn and staghorn, are now nearing extinction.

In Australia, scientists estimate that disease outbreaks have wiped out at least 6 percent of the corals on the Great Barrier Reef. Researchers have found that diseases were more prevalent in areas where corals were damaged by fishing and other human activity, as wounded coral provides an entry point for pathogens and bacteria. These disease outbreaks also have occurred as extreme coral bleaching in 2016 and 2017 killed or badly damaged about half of the corals on the Great Barrier Reef.

In the face of climate change and mounting outbreaks, scientists are scrambling for solutions to stave off catastrophe. Some are assisting the migration of robust corals with higher tolerance to disease and temperature spikes to areas where those threats are likely to strike in the future. Others are speeding up evolution by breeding so-called "super corals," which are genetically designed to weather warm waters and lethal pathogens. In some locations, scientists are separating healthy coral tissues in the colony from infected ones by creating shallow

trenches treated with chlorine or antibiotics. However, some scientists question whether such attempts to intervene in the coming disaster can be used on a wide enough scale to really make a difference.


Stony coral tissue loss disease progresses rapidly, taking just weeks to severely damage a coral once it is infected. BRIAN RECKENBEIL/FWC

Florida is proving an important case study. Precht, who wrote the first scientific paper describing the Florida outbreak, says it is one of the deadliest in world history because of the number of afflicted species, the long duration, and the high mortality rate. Four years and millions of dollars later, researchers are still working to determine the exact pathogens causing the problem or whether one disease or several is behind the outbreak.

Biologists are making progress, with the state identifying a key ailment as “stony coral tissue loss disease.” Abigail Clark, a coral disease expert at the Mote Marine Laboratory in the Keys, says a coral infected with the disease loses tissue either in patches or in a band that usually extends upward from its base. “The disease is very fast acting,” she explains. “Once we see it in a colony, it will kill that colony within days, weeks, or months depending on the species. It affects over 20 species here in Florida, and there have been reports of it spreading into the Caribbean.”

Researchers are working to understand how to better protect corals and make them more resistant to disease and rising water temperatures. Stephen Palumbi — director of Stanford’s Hopkins Marine Station in Pacific Grove, California and the chair of an international committee studying the situation — says one important clue has been the discovery that some corals are apparently more resistant to bleaching events. Efforts to move, or assist the migration, of corals into restoration areas — ramping up genetic diversity, improving levels of heat tolerance, and bolstering population numbers — have shown promising results in early field tests and are ready to be used on larger scales, he says.

Researchers in Hawaii are taking a more radical approach by breeding ‘super corals’ capable of surviving future conditions.

The Mote laboratory is one of several organizations undertaking a restoration effort to plant a diverse mix of 70,000 endemic corals — seemingly more resilient to disease and warmer water temperatures — on 130 acres of

degraded reef in the next three years. With additional project funding, Clark says, “there is no reason why the entire Florida Reef Tract can’t be restored.”

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As ocean waters heat up, a quest to create 'super corals.' Read more.
In Hawaii, researchers are taking a more radical approach, attempting to speed up evolution by breeding “super corals” capable of surviving future conditions, including warmer ocean temperatures and more virulent disease. The Coral Assisted Evolution Project at the Gates Coral Lab at the Hawaii Institute of Marine Biology further conditions some of those corals to stressful conditions so that they might be even hardier. As Ruth Gates, the founder of the Gates lab who died last year, said, “Creating super corals is taking something that could happen in nature and making sure it happens.”

In Australia, scientists are attempting what is essentially coral in-vitro fertilization (IVF) by collecting eggs and sperm during spawning and fertilizing them in the lab to grow into larvae that can be redistributed on the reef by the millions. Late last year, Peter Harrison, a biologist at Southern Cross University, increased the scale of the project, capturing millions of eggs and sperm and then growing them in floating booms on the reef for about a week before releasing the larvae in a several hundred meter area. His team’s goal is to increase the project area to a square kilometer within the next few years.

WATCH: Scientists sample a coral microbiome to study disease resistance. (Courtesy of Shady Amin)
Shady Amin, a biology professor at New York University-Abu Dhabi is working with a group of researchers in the United Arab Emirates focused on better understanding the microbiome of two coral species that have evolved in the Persian Gulf’s warm waters. Their research is focused on identifying and cataloging the community of microscopic organisms — the microbiome — that live on a coral’s surface. Like the role the gut microbiome plays in humans, a healthy surface microbiome makes corals more resistant to disease. Amin and his colleagues discovered corals secrete chemicals that may play an essential role in both organizing the microbiome and attracting beneficial bacteria while fighting back against pathogens. In addition, the study suggests that researchers can sample the water around a coral and, based on the type of compounds present, predict the coral’s health. “This is the first glimpse we have of what corals do in their immediate surroundings to adapt to their environment,” Amin says. “If we understand the types of molecules corals need to maintain a healthy surface microbiome, we may be able to predict when diseases and bleaching occur and perhaps even prevent them.”

In Florida, Karen Neely, a marine biologist at Nova Southeastern University, is working to save the last remaining high-density stand of pillar coral at a reef ominously named Coffins Patch. If scientists don’t intervene, these highly infected corals are likely to disappear from the region. Neely is mixing the antibiotic amoxicillin, the common treatment for bronchitis, into a silicone-based paste and packing it into a shallow trench cut close to the margin of diseased corals, similar to how firefighters use firebreaks.

“These are time-consuming treatments and we can’t treat every diseased coral,” Neely says. Thus her team is prioritizing corals that are naturally resilient, highly reproductive, and particularly important to the ecosystem. By combining this approach with others, she’s hopeful that “we can have the material we need to rebuild once [the disease] stabilizes.”

“We mustn’t promise communities that we’re going to save their reefs with super corals next year or even in 10 years,” says one expert.

Some researchers worry that headline-grabbing interventions like super corals may never succeed at saving coral reefs, particularly given the massive scale of protecting or rejuvenating vast reef areas. “Those are pie-in-the-sky for now,” says David Obura, director of CORDIO East Africa, an organization committed to sustainable management of the region’s coral reefs. “We should certainly support research, as without it we’ll never know what may be possible, but we mustn’t promise some poor island or community we’re going to save their reefs and their lives with super corals next year or even in 10 years.” The main focus, Obura says, must be on “addressing the causes, not the symptoms. In many cases, the costs of all these things might be better spent on primary interventions upstream.” Obura points to mitigation of such common environmental threats as agricultural runoff, wastewater outflows, poor fisheries management — and of course delays in reducing carbon dioxide emissions. In other words, he says, “remove the sources of stress, rather than putting on Band-Aids.”

Precht, the Florida reef expert, says it will likely take an all-of-the-above approach to preserve reefs, including responding rapidly when a disease strikes. Last February, he experienced déjà vu when he received another phone call, this time from Cayman Island Department of Environment’s Tammi Warrender, who was working on a famous dive site off Grand Cayman called Killer Pillar. Warrender reported that the site’s large pillar corals were showing signs of disease similar to that described in Florida. Precht told her they might not be able to stop the spread, but that they could take steps to save individual corals. Warrender and her team salvaged the healthy parts of coral by sawing them off and transplanting them on other reefs. They used chlorinated epoxy to try to stop the spread of the disease and treated healthy tissue fragments with a povidone iodine and seawater solution before moving them to a nursery in hopes of preserving them.

Biologist Abigail Clark collects tissue from diseased coral in Florida. Since 2014, the state's coral disease outbreak has spread to 96,000 acres of reef.RAY BANISTER

Preliminary results of the Killer Pillar intervention have been promising. Two months after treatment, the epoxy application had resulted in no signs of active disease on two individual pillars, Precht says. All the fragments kept in the nursery have survived thus far, and roughly 80 percent of healthy fragments transplanted to new locations away from the disease remain alive.

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"We didn't have time to wait for answers from the lab because if we did we would have seen exactly what happened in Florida," Precht says. "We would have watched whole pillar coral colonies die while we waited for answers." By reacting quickly, Precht says they were able to salvage some of the large colonies. "Hopefully they will live and fight another day."

Ret Talbot is a Maine-based freelance journalist who covers fisheries and the intersection of science and sustainability. His reporting has taken him across the globe, from the developing island nations of the Pacific to the Gulf of Maine. He has written for National Geographic, Mongabay, Discover, and other publications. MOREABOUT RET TALBOT →

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