A Double Whammy for Corals

GLOBAL WARMING AND LOCAL WEATHER COMBINE TO CAUSE MASSIVE BLEACHING

by Evan Lubofsky

Tom DeCarlo, WHOI

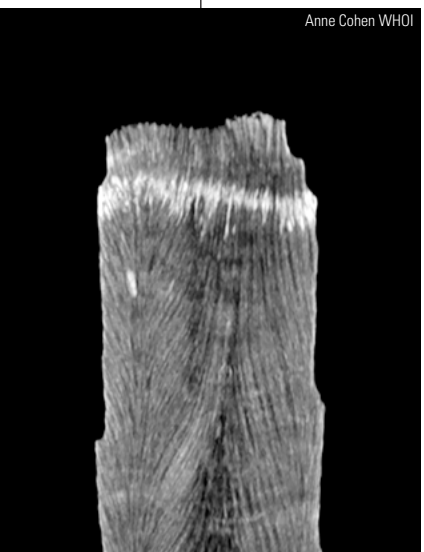
A 3.6° F rise in ocean temperatures, combined with a stretch of unusually calm weather, caused coral reefs in the South China Sea to bleach in 2015. About 40 percent of the corals died. Below, a CT scan image of a piece of skeleton cored from a coral reveals a bright white "stress" band that formed when ocean temperatures rose during an El Niño in 2009-10. The cores provide a record of past bleaching episodes.

Scientists know that gradually rising ocean temperatures can push corals past a threshold and cause them to bleach. But combine this chronic stress with an acute short-term weather shift, and the amplified impacts can be sudden and devastating.

That's what a research team led by Woods Hole Oceanographic Institution discovered in June 2015 on Dongsha Atoll, a circular coral reef surrounding a lagoon in the remote South China Sea.

The Dongsha corals were already feeling a 2° C (3.6° F) rise in ocean temperatures from global warming and from an El Niño—the phenomenon that occurs every few years and sends warm equatorial waters flowing westward toward the western Pacific and the South China Sea. But then prevailing winds near Dongsha unexpectedly died down.

Dongsha Atoll is typically hit in June with tropical storms and strong winds and waves that churn in seawater from the open ocean to help corals stay cool, said Tom DeCarlo, a graduate student in the MIT-WHOI Joint Program in Oceanography. "But in 2015, the weather in June was exceptionally calm. At one point, there was basically no wind and no waves. This had an amplifying effect on the water temperatures. The whole reef became a giant swimming pool that just sat there and baked in the sun."



Anne Cohen WHOI

After only a few days of calm, the reef lost its supply of cooler water from the open ocean. "We saw water temperatures surge to 36° C (97° F)—a full 6° C (10.8° F) above normal summertime temperatures," he said. "This caused 100 percent of the corals to bleach. We saw that all the corals had turned white, and 40 percent of them died."

The study—conducted with researchers from the University of California at Irvine, Old Dominion University, and National Sun Yat-Sen University—was published in March 2017 in *Scientific Reports*.

DeCarlo witnessed the start of the mass die-off with WHOI divemaster Pat Lohmann and WHOI scientist Anne Cohen, principal investigator on the project and DeCarlo's Ph.D. advisor.

"It's quite uncommon to be out there in such a remote place as a massive bleaching event is actually happening," Cohen said.

Bleaching occurs when warmer waters cause colorful symbiotic algae hosted in coral tissue to move out, revealing the corals' underlying white skeletons, Cohen said. The corals provide algae with a protected place to live and chemical compounds they need for photosynthesis. In exchange, the algae produce oxygen and organic materials that corals need to grow.

The team also drilled core samples from Dongsha corals and used computed tomography (CT) scans to reveal annual rings or "bands" that show when the corals experienced thermal stress. The scans showed that Dongsha corals had three previous bleaching events, each during El Niño years between 1983 and 2015, but none came close to the 100 percent bleaching in 2015.

"The current global climate models and prognosis for reefs are based on a 2° C warming scenario for the open ocean," DeCarlo said. "But when you have weather amplification events superimposed on top of carbon dioxide-driven ocean warming, that's when things can get really bad for corals."

"It's possible that coral reefs are in much more immediate danger than we have anticipated," Cohen said. ▲

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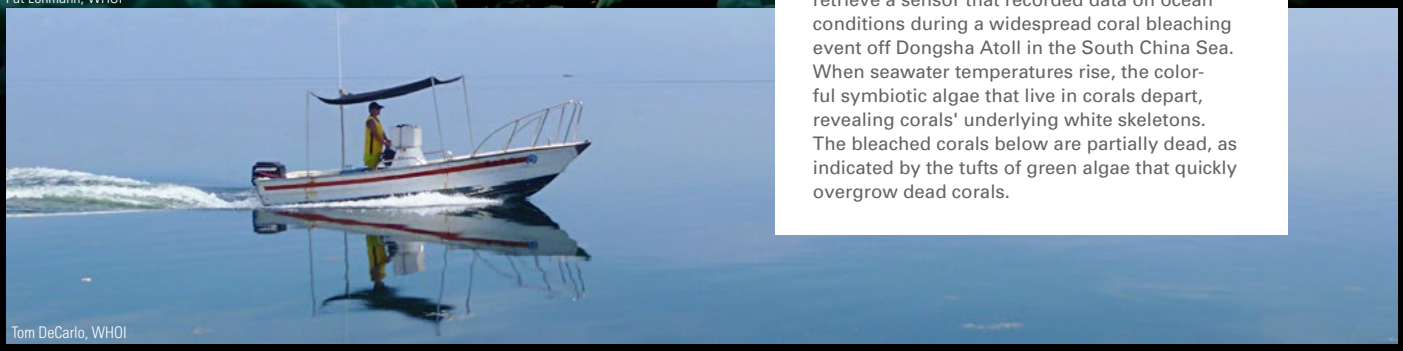
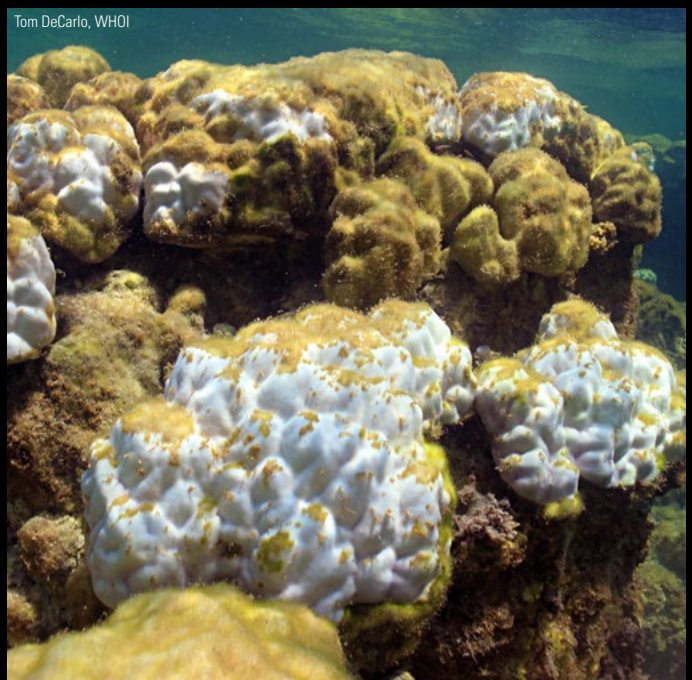
Pat Lohmann, WHOI

From a boat from the Dongsha Atoll Research Station, graduate student Tom DeCarlo dives to retrieve a sensor that recorded data on ocean conditions during a widespread coral bleaching event off Dongsha Atoll in the South China Sea. When seawater temperatures rise, the colorful symbiotic algae that live in corals depart, revealing corals' underlying white skeletons. The bleached corals below are partially dead, as indicated by the tufts of green algae that quickly overgrow dead corals.



Tom DeCarlo, WHOI



Tom DeCarlo, WHOI