Can Florida's corals survive climate change? Fate of one small reef may hold the answer

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When marine scientist Ian Enochs jumped into the water at Cheeca Rocks, a small reef in the Florida Keys known for vibrantly colorful corals, what he saw shook him to the core.

"Literally everything was white," said Enochs, a research ecologist with the National Oceanic and Atmospheric Administration in Miami. "It does not look normal at all, it's just like a different reef."

It was July, still early in what would become the hottest summer on record in South Florida, and Enochs was witnessing a mass event bleaching—a telltale trouble sign that corals are struggling in abnormally hot ocean waters. Keys reefs have been hit periodically by bleaching over the decades and recovered, the corals weakened but still alive. But prolonged bleaching can prove fatal. To Enochs, this looked severe and potentially lethal.

"The flesh, the tissue (of the soft corals) were just falling off of them," Enochs said, "They were literally falling apart before our eyes."

Now, as ocean temperatures cool, teams of scientists are engaged in an unprecedented effort to assess not only the heat wave damage but the future of South Florida long-ailing reef tract.

Cheeca Rocks, Enochs' prime study spot for more than a decade, had been considered among the Keys' healthiest reefs. In the months and years ahead, it will serve as a living—or dying—laboratory. The fate of its corals will help tell scientists like Enochs how and if reefs can survive climate change, which is driving sea temperatures to new highs.

Record sea temperatures off South Florida

Summer 2023 set sea temperature marks up and down the Florida coast.

At Cheeca Rocks, Enochs' team from NOAA's Atlantic Oceanographic and Meteorological Laboratory on Virginia Key , recorded a temperature near 93 degrees Fahrenheit. In other parts of the Keys and up both Florida coasts, ocean surface temperature soared 4, 5 or more degrees

above historic averages. It approached 100 in the some shallow areas.

One sensor in the grass flats off Manatee Bay in Everglades National Park hit a staggering 101.1 degrees Fahrenheit. Consider that hot tubs typically range from 100 to 103 degrees.

"Globally, August 2023 set a record for the highest monthly sea surface temperature anomaly of any month in NOAA's 174-year record," the federal agency later reported.

Cheeca Rocks, a shallow nearshore reef popular with snorkelers, is particularly vulnerable to the hot weather and water. But much of the South Florida reef tract—which stretches from off Palm Beach County down to the Dry Tortugas—saw impacts.

It was starkly evident to scientists and divers who frequent South Florida reefs. During bleaching, coral shed the algae that give them their dazzling colors and provide them important nutrients. The bleaching victims, with all or swathes of their hard exoskeletons turned pale white, stand out like bones.

It may take a year to see how much recovers and to assess the final toll. But it's already clear that the record heat worsened what has been a precipitous decline for corals off South Florida. In just a half century, the undersea reefscape bordering the coast has profoundly and permanently changed.

Two species of large and spectacular branching corals, staghorn and elkhorn, once formed dense forests and served as the primary reef builders in South Florida. Since the 1970s, scientists estimate 90% of those have disappeared. Losses have been even higher in the Caribbean.

Diego Lirman, a University of Miami associate professor in marine

science, has monitored the region's reefs for 30 years. When he started working in the field of disturbance ecology—research focused on forces that can wipe out existing systems—the typical reef boasted about 20% coral cover. Now, hard coral survives on just about 5% of the bottom. Soft corals, algae and other marine life have moved in instead, altering the marine food chain and reducing the shelter and prey that reefs provide to an array of marine life.

The forces of destruction that Lirman and other scientists have identified are many. Over the decades, Florida's reefs have been hammered by humans with everything from pollution and dredging sediments to boat anchors, fishing lines and diver fins. In 1990, the 3,843-square-mile Florida Keys National Marine Sanctuary, which stretches from Biscayne National Park to the Dry Tortugas, was created to help protect reefs from continuing damage.

Anchor buoys were added and no fishing zones established around major reefs. Divers and snorkelers are taught not to touch corals and are typically now much more attuned to the fragility of the undersea world they have entered. Those steps have helped reduce coral damage loss from tourists, divers and anglers.

Breeding heat-resistent corals

But battling climate change is a whole other level of challenge. Scientists believe rising sea temps have driven the increasing impacts from invasive smothering algae and helped spread coral-damaging diseases, from black-band and white-band disease to white plague and stony coral disease. It's also made the ocean more acidic, which makes it harder for corals to built their hard skeletons. Weakened by repeated bouts of bleaching, some corals may not be healthy enough to survive all the mounting stressors..

One hope is to breed more resilient corals. Scientists have been growing coral in labs and underwater nurseries for years but newer tools like genetic sequencing have provided perhaps the latest and and maybe last chance for eventually reviving dying reefs. The hope is to pinpoint the most heat-tolerant genetic strains—ones that if cultivated, regrown and replanted on offshore reefs might have the best chance to survive and thrive.

The complication is that some coral strains may do better with hot water but might prove less resistant to disease or other issues. So it's essential to have a selection of strong corals for the future and threats to come, some of the perhaps still not identified.

"We know there is no such thing as a super coral," said Phanor Montoya-Maya, program manager for the Coral Restoration Foundation in Tavernier. "We need to ensure that every single genotype that is alive today has the chance to live beyond these conditions."

That's part of the mission at NOAA's Experimental Reef Laboratory on the campus of UM's Rosenstiel School of Marine, Atmospheric, and Earth Science. NOAA's Enochs and UM's Lirman co-lead the lab and $4.2 million project launched last month involving seven different academic and research institutions that amounts to an largest collaborative effort yet to assess the health and future of South Florida's reefs.

At the lab, scientists can manipulate conditions from temperature to water quality to assess the strength of samples of various species and genetic strains of corals. Those samples can be fragmented to grow as new individual corals. Then those small corals can be moved to nurseries in Biscayne Bay or elsewhere or eventually replanted on natural reefs.

"We watch them grow," Lirman said, "and we build our restoration

stocks."

Lab-grown corals alone can't replace all that has disappeared but, if they're hardy enough, they might be the seeds for stronger natural reefs.

Reef scientists turned emergency responders

The unprecedented summer sea temperatures turned many marine scientists into emergency reef responders, with an array of agencies and universities scrambling to save what they could. There was nothing to do about natural reefs but they could try to save the string of managed underwater coral nurseries all along the coast where researchers are growing thousands of coral fragments—the stock for future restoration efforts.

The staff at the Coral Restoration Foundation realized they had to move quickly to save their own four field nurseries, risking pulling them out of the ocean and moving them to land tanks with controlled temperatures—at least until the ocean waters returned to normal. Other groups did the same, pulling corals from offshore and putting them into tanks, creating a sort of Noah's Ark of genetic diversity to ride out the heat wave.

In one case in August, UM scientists also did the opposite—planting nursery and lab-grown corals on the seafloor two miles east of Key Biscayne. It was a study that boiled down to survival of the fittest. Those corals, previously collected from a range of reefs off South Florida, are being put to a critical real-world heat-stress test.

Some likely won't make it. But if some do, it could help identify coral types more likely to endure future climate change.

"We don't want to keep doing this just to watch our corals die," said

UM's Lirman. "We need to learn from the survivors."

As waters cooled in late November, Montoya-Maya and other foundation staffers were able to return about 1,500 to field nurseries in the waters off Tavernier.

They carefully transferred the corals from a tank into coolers on a boat After about a 30-minute boat ride, scientists jumped into the water to pass down the shelves bristling with nubs of healthy corals. The shelves, made out of PVC tubing and mesh, were then attached to nursery "trees" in waters from about 10 feet to 30 feet deep.

Overall, scientists say that it will be hard to tell how much coral will rebound and survive to next summer. They will have a better idea as they collect more data in the coming year. But if the losses at offshore nurseries are any indication, the toll could be severe. As the year came to a close, the Coral Restoration Foundation estimated they'd lost just over half their nursery corals.

Since this summer's heat wave, Enochs and his team have been back to Cheeca Rocks as often as possible. They are monitoring areas that are recovering, keeping an eye out for both outbreaks of disease among the weakened corals and natural pathways toward healing.

Was the biggest bleaching event perhaps ever the final nail in the coffin for the Keys' reefs? It's too soon to tell but at Cheeca, Enochs retains some hope.

"Things are not great, but they could be worse," said Enochs. "And the fact that they aren't worse means there's a way out of this."