Tiny polyps gorge themselves to survive coral bleaching

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Certain species of coral have surprised researchers by showing an unexpectedly successful approach towards survival when seriously bleached. Their innovative strategy is gluttony.

The discovery, derived from experiments on coral reefs in Hawaii , provides new insights into how these tiny animals face a multitude of environmental threats. The report by Ohio State University researchers is published in the current issue of the British journal *Nature*.

During the past decade, reports have multiplied of major bleaching events that have damaged, if not destroyed, large portions of the world's fragile coral reefs. Scientists point to global warming as the cause and the victims are some of the tiniest creatures near the base of the undersea ecosystem.

Despite the apparent sturdiness of coral reefs, the creatures themselves are quite fragile. These tropical organisms survive in a narrow 4-to-6-degree C temperature range centered about 26 degrees C. While the exact temperatures vary with individual species from location to location throughout the tropics, they all must live within that tight range.

When the temperature climbs above that range, even by only two degrees, the result is a bleaching event. Within a two-year window during the 1997-98 El Nino event, 16 percent of the world's coral reefs sustained serious bleaching due to increases in seawater temperature and the animals died.

"If the rain forests were dying off at this rate, we would all be panicking," explained Andrea Grottoli, an assistant professor of geological sciences at Ohio State and lead author of the study.

"The problem is that now, with the planet's climate warming, coral are living closer and closer to their thermal threshold, so it takes less of a warming event than it did before to cause a catastrophe."

Coral are symbiontic organisms that host one-celled algae within their bodies for mutual benefit. The coral polyp, a relative of jellyfish and anemones, provides a safe home within its cells for the algae while the algae convert sunlight into energy for the polyp.

Grottoli said that when the temperature of the waters around a reef exceeds that upper limit and stays there for more than two weeks or so, it triggers a bleaching event. Once that happens, the symbiotic algae and the brown or green photosynthetic pigments inside are lost. The result is a "bleached" white coral.

"In most cases, corals get 100 percent of their daily metabolic energy needs from the algae. Once they are gone, the coral polyp is left with only two alternatives: Draw energy from stored fats within its body, or eat organic matter and plankton in the surrounding water," she said.

But what has puzzled Grottoli and other researchers is why in some bleaching events, some corals quickly died off while others close by were able to recover. To answer that, she returned to Hawaii Institute of Marine Biology where she has been studying corals for the past 13 years.

There, she and her collaborators focused on two types of common coral that thrived on the local reefs, Montipora capitata, or "rice" coral, and Porites compressa, "finger" coral. They collected samples of both types and placed them in sets of tanks supplied with natural seawater. Water from the reef was filtered to remove any plankton and flowed through the tanks in the same way it did through their natural environment. In one set of tanks, the water was heated, mimicking the rising temperatures leading to a bleaching event.

After a month, fragments of the coral were gathered from all of the tanks and put through a series of tests measuring energy reserves, photosynthetic rates and growth rates of the coral. The results showed that both Porites and Montipora used up their internal energy reserves. However, after a month of recovery on the reef (where plankton is naturally available) Porites continued to use up its reserves while Montipora had somehow managed to completely replenish them.

To explain that, Grottoli and colleagues closely examined the bleached and healthy corals of the two species on the reef.

"We let them feed for one hour," Grottoli said. "Then we harvested them all, dissected each polyp and counted how many zooplankton each had eaten, how big they were and what species. That told us how much the coral had eaten."

Surprisingly, the researchers discovered that while the bleached Porites fed at its normal rate, bleached Montipora had increased its rate of feeding more than five-fold, allowing it not only to survive and repair but also replenish its internal energy reserves.

"We think that this means that coral like Montipora can switch how it gets its food so that it can sustain itself in a bleached state much longer than can corals like Porites," she said. "While bleached Porites is limited by how much energy reserves it has, bleached Montipora is not.

That's good news for Montipora and corals like it as the frequency, duration and intensity of warming events increases globally. But Grottoli warns that Montipora's resilience doesn't diminish the threat that bleaching events hold for the world's coral reefs. While it might survive while other species may not, on a global scale it is unlikely to re-colonize areas where less-resilient species died.

"Recent projections suggest that with the current rate of warming, as much as 60 percent of the world's coral reefs could be lost within the next 10 to 30 years," she said. "We have a delicately balanced ecosystem that is already highly stressed. It is very much interconnected and so far, we have royally messed it up."

Source: Ohio State University