As Coral Bleaching Goes Global, Scientists Fear Worst Is Yet to Come

Warm ocean temperatures are taking an unprecedented toll on reefs in all the world's tropical oceans, including in areas not affected by previous bleaching events.

BY BOB BERWYN AND ZAHRA HIRJI

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Bleached coral, like this in New Caledonia, has become a global phenomenon and a stark indicator of the impact of unabated climate change. Corals are crucial ocean nurseries, nurturing up to 25 percent of all marine species. Credit: XL Catlin Seaview Survey/March 2016

The longest and most widespread coral bleaching event on record has reached reefs near at least 38 countries and island groups, according to **the latest report from NOAA's Coral Reef Watch** and other research. Parts of many coral reefs have died, becoming ghostly underwater graveyards. They are perhaps the starkest reminders—like the melting Arctic—that a thickening blanket of greenhouse gases is irrevocably changing the face of the Earth.

Reefs are not only beautiful to behold, they also play a key role in ocean ecosystems. When the surrounding water gets too warm, corals start to expel symbiotic algae that helps keep them alive and gives them their color. Bleaching in popular tourist spots like the Maldives and Great Barrier Reef has grabbed recent headlines, but reefs in all the world's tropical oceans have been affected.

Coral mortality has reportedly been as high as 35 percent along previously healthy sections of Australia's Great Barrier Reef. There was even

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higher mortality around small islands in the central Pacific, in the pool of water overheated by the recent strong El Niño.

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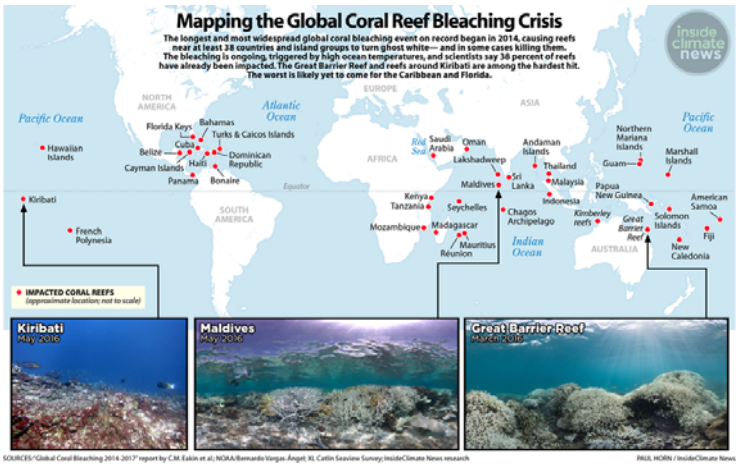

"There's even worse news ahead," said Mark Eakin, coordinator of the National Oceanic and Atmospheric Administration's Coral Reef Watch. "There are a lot of places with similar mortality rates. We've got bleaching going on from the east coast of Africa to French Polynesia. Right now, it's basically covering half the Southern Hemisphere." Eakin warned that if the wave of bleaching follows historic patterns, corals near Florida and in the Caribbean will be hit hard again this summer.

"The biggest story in terms of severity right now is in central equatorial Pacific," he said. "It's in the heart of the El Niño zone. That's why the heat stress is so high there. It's really extreme. Right now, we're really in a transitional season, where the equatorial region is getting hit the worst. We're likely to see more bleaching in the western Pacific, in **Micronesia** and the **Coral Triangle**."

Corals are crucial ocean nurseries, nurturing up

BY PHIL MCKENNA

to 25 percent of all marine species. According to the **United Nations Environmental Program**, a third of a square mile of healthy reef (about a quarter the size of New York's Central Park) can produce about 15 tons of fish and other seafood every year. About 850 million people live within 60 miles of coral reefs. And about 275 million people depend directly on reefs for livelihoods and sustenance. Coral reefs also protect shorelines from storm erosion and provide raw material for beaches as waves grind them to sand.

Scientists say the first signs of the latest mass bleaching (others occurred in 1998 and 2010) started in the middle of 2014 around Guam and the Marianas Islands in the eastern Pacific. It spread west to Malaysia and as far as Africa, south to Australia, the Coral Sea and Fiji and later as far as Panama, the Red Sea and the Caribbean. The **formal alarm** from the National Oceanic and Atmospheric Administration's **Coral Reef Watch** came last October, warning of the third global mass bleaching event.

During 2014 and 2015, **monthly global climate reports** showed record-warm readings from every ocean basin, priming the waters for a perfect storm of bleaching conditions. The average global temperature hit a new record in 2014 and again in 2015, and the coral watchers knew that El Niño-heated water along the equatorial Pacific was poised to send temperatures spiking even higher.

A reef in American Samoa is seen before, during, and after a coral bleaching event. Credit: XL Catlin Seaview Survey

The bleaching process starts when the ocean warms more than 1 degree Celsius above what corals are used to and remains warm for weeks or months. Some corals are more tolerant than others, so the exact threshold varies according to species or even genotypes within the same species. Coral is made up of individual polyps that grow together as a colony. Colonies of different coral species growing together, along with fish and other types of animals, form a coral reef ecosystem.

Corals can survive without their algae companions for a while and recover from moderate levels of bleaching. But each episode weakens coral and makes it more susceptible to other impacts, including disease and damage from pollution, storms, sediment, recreation and runoff from land areas. In the past two years, 38 percent of the world's coral reefs have been exposed to water temperatures above the critical threshold, about half at levels that can cause significant mortality, according to **an April bulletin** from NOAA.

Even with advance warning, some coral experts were stunned by the extent, duration and intensity of the current bleaching, which has already killed and damaged parts of reef

complexes in every tropical ocean basin. The bleaching generally hasn't been as severe as in 1998, but it has affected more reefs and has caused mass bleaching in several reefs that have never been affected before, according to Eakin.

Coral-threatening conditions are expected to continue and spread to new areas for the rest of the year and possibly into 2017. Parts of some reefs are likely to be wiped out. Others will be so damaged that they won't recover for decades, if ever. The planet's current warming trajectory puts half the world's corals at risk of dying by 2050 and 90 percent by 2100.

New observations from the past few weeks reinforce the warnings. Near Jarvis Island, part of the **Pacific Remote Islands Marine National Monument**, about 95 percent of the coral colonies have died, NOAA researchers recently reported. That came after a year of ocean temperatures running up to 4 degrees Celsius above average. More coral mortality is expected on other reefs in the months ahead.

"Bleaching events in Hawaii and Florida have now occurred for two boreal summers in a row. Back-to-back bleaching events in both of these places is unprecedented," said Ilsa Kuffner, a research scientist with the U.S. Geological Survey's Coastal and Marine Geology Program. "Adding a third bleaching event this summer would again take us into unknown territory."

Bleaching's New Era

Scientists say there have always been small coral bleaching episodes, but extended mass bleaching events are new and linked with global warming.

"We're thinking that in 1998 a new era started, where suddenly El Niños result in global mass bleaching," said Verena Schoepf, a coral researcher at the University of Western Australia in Perth. "We're not aware of severe widespread coral bleaching before that." If it did happen, then perhaps it was once every 50 or 100 years, which would give corals plenty of time to recover between episodes, she said.

"1998 was a benchmark for bleaching. During that event, we lost 16 percent of the world's coral reefs," Schoepf said. "This number contributed to a 2008 estimate that about 20 percent of the world's coral reefs have been lost, with another 15 percent expected to die in the next 15-20 years. Potentially by the year 2050, we'll lose 50 percent of the world's coral reefs."

Coral bleaching at Heron Island in February 2016, close to the southernmost point of the Great Barrier Reef. Credit: XL Catlin Seaview Survey

For Schoepf and many other researchers, there's little doubt that global warming is the culprit. The **Intergovernmental Panel on Climate Change** (IPCC), the world's leading climate change body, has spelled out the connection, and the outlook is grim, unless the world can quickly cut back on greenhouse gas emissions and limit warming to less than 2 degrees Celsius.

At the current rate of emissions, the average global temperature is expected to rise at least 2.5 degrees Celsius by 2100, a level that would be fatal to nearly all reefs.

"It's a very bleak picture, where 90 percent of coral reefs would already be at risk under 1.5 degrees by 2050 and almost 100 percent at 2 degrees," said Michiel Schaeffer, a climate scientist with **Climate Analytics**, a climate research institution based in Berlin.

But limiting warming to 1.5 degrees Celsius "offers some kind of a window for adaptation," Schaeffer said. "If coral resiliency is at the upper edge of current estimates, than coral reefs might hang out at many locations to the end of the century and beyond."

Scientists hope the current crisis has grabbed the public's attention enough to prompt a change in policies.

"Maybe events like this one make the public care," Schoepf said, suggesting that global policy changes and political action are the only things that will make a difference for reefs in the long run. "All we can do as scientists is to communicate what is happening."

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