



Images from December 2014 (left) and February 2015 show coral bleaching in the Pacific waters around American Samoa.

ECOLOGY

El Niño's warmth devastating reefs worldwide

Recent aerial surveys of Australia's Great Barrier Reef find massive coral bleaching

By Dennis Normile

Even as recently as early March, Australian coral reef scientists still hoped that the legendary Great Barrier Reef (GBR) would get off lightly in the current El Niño, the climate phenomenon that brings unusually warm water to the equatorial Pacific, stressing and often killing corals. No such luck. On 20 March, the GBR Marine Park Authority in Townsville, Australia, reported that divers were finding extensive coral bleaching—the loss of symbiotic algae—in remote northern areas of the reef. Many sections were already dead.

Subsequent flyover surveys have confirmed an unfolding disaster: “Only four reefs out of 520 [observed] had no bleaching,” says Terry Hughes, director of the Australian Research Council Centre of Excellence for Coral Reef Studies in Townsville, who personally checked the northernmost 1000 kilometers of the 2300-kilometer reef system over 4 days last week. “It was the saddest reef trip of my career.”

The GBR joins a lengthening list of reefs bleached because of the El Niño that started in late 2014. It is now the longest bleaching event ever, and this El Niño, which helped make 2015 the planet's hottest year on record, “isn't even close to being over,” says Mark Eakin, a coral reef ecologist at the U.S. National Oceanic and Atmospheric

Administration (NOAA) in College Park, Maryland. Even though the El Niño is now weakening, its lingering effects could cause bleaching for another year, he adds.

Eakin says it is too early to tell whether this current event will match the infamous bleaching event of 1998, when 16% of reefs worldwide perished. But it is surely a sign of what's to come, he and others contend.

With global warming raising ocean temperatures, even relatively weak El Niños will be enough to make corals uncomfortably hot, Eakin warns. “If bleaching events continue to increase in both frequency and intensity, there will be a step-wise decline in the health of the reefs; the frequency of bleaching events can overwhelm the ability of the corals to recover,” says coral ecologist Alexandra Dempsey of the Khaled bin Sultan Living Oceans Foundation in Annapolis.

Ove Hoegh-Guldberg, director of the Global Change Institute at the University of Queensland, St. Lucia, in Brisbane, Australia, suggests that the world is on course to lose coral reefs entirely by 2040. “This is not in the future, it's happening right now,” he says.

Corals harbor colorful symbiotic algae

called zooxanthellae, which use photosynthesis to produce nutrients for themselves and their hosts. When the water gets too hot the corals expel the zooxanthellae and turn white, or bleach. If the water cools soon enough, the algae return. But prolonged bleaching can kill the corals—and much more. The loss of coral cover makes reefs less hospitable for many marine organisms and fish, leading to a dramatic loss of biodiversity.

Bleaching occurs occasionally because of local conditions—in 2002, for example, local hot weather drove widespread bleaching on the GBR. But an El Niño drives up temperatures all across the Pacific and influences waters and weather patterns worldwide. The record-setting 1998 bleaching resulted from a particularly powerful El Niño. A 2010 El Niño also caused extensive global bleaching.

In late 2014, NOAA's Eakin, who runs the agency's Coral Reef Watch, predicted a “global-scale bleaching event” because of the then-emerging El Niño. The reports started flowing in at the beginning of 2015. That April, Dempsey and other researchers reported extensive bleaching in the British Indian Ocean Territory, a speck of isles in the Indian Ocean halfway between Africa

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and Indonesia. "More than 50% of branching corals, some as large as 2 meters in diameter, were beginning to show the early onset of bleaching," says Dempsey, who was part of a team surveying the remote and rarely visited reefs.

Extensive bleaching hit Hawaii in November 2015 and then Fiji and New Caledonia in February of this year. "Bleaching is going on right now across half the globe in the Southern Hemisphere," Eakin says. "We expect the warming to continue its northward movement in the Indian Ocean, and the long-range outlook is calling for bleaching in the Caribbean this summer," he adds.

The fate of the GBR will be documented best, thanks to Australia's scientific resources. About 6 months ago, Hughes laid plans for a National Coral Bleaching Taskforce, which swung into action last week with aerial surveys and teams of divers. The team uses a zero-to-five scoring system, where zero is no bleaching, three is 30% to 60%, and four is more than 60% bleaching. Hughes notes that 95% of the reefs they checked were scored as three or four. For comparison, in 2002 only 18% of the reefs were bleached that badly. "Without a doubt, [the damage] is much more extreme than in 2002 or 1998," he says.

A tropical cyclone in early March cooled off the central and southern sections of the reef. But coral scientists don't know exactly how far south the bleaching extends; to find out, they plan more aerial surveys of the GBR this week.

It is not clear what percentage of the

bleached corals will die. But Hoegh-Guldberg was surprised by the bleaching at the GBR's pristine remote northern tip, which is least subject to fishing and tourism pressure. "We were feeling somehow that the northern end of the reef would be more robust," he says.

The optimistic view, Hughes notes, is that the pristine reefs "should bounce back faster, but the level of bleaching will take a decade to recover from."

Australian studies of this and the other major bleaching events, in 1998 and 2002, could yield clues about reef resilience. "Some lucky reefs haven't been hit and some have been clobbered three times," Hughes says. He and his colleagues will start looking for patterns, including how distant a particular reef is from the coast, its water quality, and the impacts of fishing and tourism, "to see if we can get some clues why some reefs are more vulnerable." If water quality proves to be a determining factor, "that would point to an obvious management imperative," Hughes says.

But improving water quality will have only a minor impact, given global warming. "The only way out of this bind is to rapidly contain further increases in global warming" by implementing the carbon dioxide emission cuts pledged at last year's Paris climate conference, Hoegh-Guldberg says. He is hopeful that the 500 million people worldwide who rely on reefs for their livelihoods will start making their voices heard. The damage to the GBR and other reefs, he adds, shows the "graphic alternative if we don't deal with this issue." ■



Aerial surveys in March of the Great Barrier Reef revealed extensive bleaching of corals (white).