

SNAPSHOT

Snow white coral

Coral bleaching is a stark sign of climate change and although large-scale bleaching events (on both regional and global scales) seem to be common occurrences, they are actually a recent phenomenon. “1983 was really the first time we had widespread bleaching” notes Mark Eakin, coordinator of the Coral Reef Watch programme of the National Oceanic and Atmospheric Administration. Fifteen years later, the first (and largest) global event occurred in 1998, associated with extreme El Niño conditions. In 2010, a second global bleaching event took place, during less powerful El Niño conditions, and right now we are in the midst of the third confirmed worldwide event, which is expected to last at least another six months. “The baseline temperature is going up and if you superimpose El Niño spikes on it, you get these bleaching events” says Terry Hughes, convenor of the Australian National Bleaching Taskforce and Director of the Australian Research Council Centre of Excellence for Coral Reef Studies at James Cook University, Queensland.

What exactly is coral bleaching? Terry Hughes explains: “bleaching is a stress response ... Corals bleach once they have sat in very hot water for a number of weeks ... A heavily bleached coral is a sick coral.” The corals lose their colour as they expel zooxanthellae, the colourful symbiotic algae that live in the coral and provide energy through photosynthesis. If the bleaching is severe then corals will die, with the 1998 event resulting in the mortality of 16% of corals worldwide. The mortality from the current bleaching event will not be known for some time as it is still continuing, even in regions where the water has cooled “it takes a period of a couple of months for very sick corals to either recover or die”, states Hughes.

The current bleaching began back in June 2014 as a predicted Godzilla El Niño event was building (M. J. McPhaden, *Nature Clim. Change* **5**, 791–795; 2015). Although the expected strong El Niño conditions did not develop, coral bleaching was seen in locations across the Pacific — such as Guam, the Northern Mariana Islands, the western Pacific Ocean and Hawaii — and spread to the Caribbean. In 2015, when the El Niño event eventually arrived, widespread coral bleaching was



already underway; Eakin confirms that “even though El Niño was just ramping up [in 2015], we were already well on the way to a global bleaching event, and the really big year for a global bleaching event is the second year of an El Niño”.

The northern third of the Great Barrier Reef, located off the northeast coast of Queensland, Australia, has been severely affected by the current bleaching. The northern end of the Great Barrier Reef is better positioned to recover from bleaching events — it is isolated from further stressors such as pollution and overfishing that hinder recovery — although the extent of this event will determine the ability of the reef to bounce back. If too many of the herbivorous fish have been caught, a bleached reef can become overgrown with seaweed, also preventing the recovery of the corals. Recovery for healthy reefs takes at least 10–15 years, although that does not apply to all species; slow-growing corals, which are often more thermally resilient to moderate bleaching, take longer to return — if at all. Bleaching events can also alter the composition of reefs by reducing the species diversity. People often ask Hughes if there will still be a Great Barrier Reef in 30 or 50 years: “the answer is yes, but it is going to look very different.”

Model projections published in 1999 (O. Hoegh-Guldberg, *Mar. Freshwater Res.* **50**, 839–866; 1999) suggested that coral bleaching to the extent of the major 1998 event is likely to occur annually by 2040, with some reefs being exposed to temperatures high enough to cause bleaching on a

near-annual basis by 2020. This current event is approaching the two-year mark, and when it will end is not yet known. Both Eakin and Hughes are concerned for the future of corals with continuing warming. “As far as coral reefs are concerned 2 °C is way too high, 1.5 °C is about as much as reefs are generally going to be able to tolerate” notes Eakin, however he was “flooded” and happy to see the 1.5 °C target was included in the Paris Agreement at the twenty-first Conference of the Parties (COP21). Hughes, who will be closely monitoring the Great Barrier Reef in the coming months to determine the full extent of this bleaching event (as well as the mortalities associated with it) is concerned as “if the return period [of bleaching events] gets shorter through time then corals will be bleaching faster than they can recover ... the lesson is that we have a closing window of opportunity to tackle greenhouse gas emissions globally if we want to protect not just the Great Barrier Reef, but all coral reefs”.

Our best hope to preserve the diversity and extent of coral reefs worldwide is to manage the reefs — to improve water quality and prevent overfishing — allowing them the best chance to recover when these events occur. Simultaneously working towards lowering emissions, reducing atmospheric concentrations and keeping below the agreed temperature targets will protect against such events occurring more frequently.

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