

ECOSYSTEMS AT RISK

Coral bleaching events

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Climate change impacts on coral reef health and resilience through a range of associated and interconnected processes and feedbacks including sea level rise, ocean acidification, increased ocean temperatures and coral bleaching.

Impacts of climate change

Sea surface temperatures have been increasing by approximately 0.07°C per decade over the past century.

Cyclones, winds and storms are common natural stresses that impact on coral reefs, sometimes devastating whole reefs. The natural processes involved in breaking down dead organisms, ensures that a basis is provided for the growth of new polyp colonies. An increasing number and severity of extreme weather events are likely to impact coral reefs as a result of climate change.

Carbon dioxide from the atmosphere is absorbed by the ocean. This carbon dioxide reacts with the seawater to create carbonic acid. Coral reefs consist of accumulated skeletal fragments of calcium carbonate (limestone). Reefs grow on the surface of the limestone. When corals die the coral fragments are added to the limestone. A result of increased ocean acidity is that corals are unable to build their skeletons from calcium carbonate.

Climate change is likely to exacerbate the spread of invasive species, changing climatic restraints on the species and shifting their species distribution.

What is coral bleaching?

Corals rely on a relationship with zooxanthellae, the single celled organisms that photosynthesise and nourish the corals. Zooxanthellae also give the corals their colour. Warmer waters strip away the colourful photosynthesising algae that feed corals, as the corals that are under stress from high water temperatures expel their zooxanthellae. When corals expel the algae that grow within their body tissues they lose a significant source of food, become more vulnerable to disease and are more susceptible to erosion (National Oceanic and Atmospheric Administration. 2015).

Global bleaching events

We are currently experiencing a period of global coral bleaching as a result of a record El Nino event. This bleaching event is evident in all three ocean basins. Approximately 36% of the world's coral reefs have been affected by the current global coral bleaching event (Global Coral Bleaching. 2017). This global bleaching event is the longest ever recorded. Records indicate that the frequency of global bleaching events is increasing.

How coral bleaching occurs.



http://oceanservice.noaa.gov/facts/coral_bleach.html

Cook Islands

Annual temperatures in Rarotonga and Penhryn have increased and sea levels have increased as part of the global pattern of warming. Maximum temperatures in Rarotonga and Penhryn have increased at a rate of 0.09°C per decade. Sea levels have risen by 4mm per year since 1993 (Pacific-Australia Climate Change Science and Adaptation Planning Program Partners. 2017).

The northern coastline of the island of Rarotonga, was impacted by coral bleaching in 1997–8. More recently, Tongareva was affected by bleaching when sea surface

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Atuitaki Lagoon, Cook Islands.



Rarotonga, Cook Islands.

temperatures hit 32°C, and possibly as high as 35°C. Branching corals and puau (clams) were particularly affected. Large scale bleaching also occurred on the northern group atolls (Cook Islands News, 2016).

Micronesia

Reefs in Palua were impacted by coral bleaching during the 1998 global bleaching event. At this time, much of the coral was killed. In some reefs there was up to 90% coral mortality. Branching corals were particularly hard hit, with their branches disintegrating and turning to rubble (Bruckner, 2015). Palua reefs were also affected by two typhoons – Bopha (2012) and Haiyan (2013), however, they were largely unaffected by the 2016 bleaching event. Recovery of Palua's reefs has indicated high levels of reef resilience.

Great Barrier Reef

Coral bleaching events have been recorded since the 1980s. The Great Barrier Reef has been affected by bleaching events in 1998, 2002, 2016 and most recently 2017. The geographic distribution of coral bleaching is determined by temperatures of ocean currents at the time of each event.

Images below: Coral bleaching evident April 2016 at Fitzroy Island Great Barrier Reef



In 2016–17, record high temperatures resulted in coral bleaching episode that affected all tropical areas (known as pan-tropical). The 2016 bleaching event occurred during February and March 2016. During the 2016 bleaching event, only 7% of the Great Barrier Reef avoided bleaching. In the northern section of the GBR 81% of the reefs were severely affected by bleaching, while in the central section 33% were severely bleached. The 1000km region north of Port Douglas up to the Torres Strait is classified as having suffered extreme bleaching. Coral mortality north of Port Douglas is likely to be between 50% and 90%. Only 1% of the southern sector was severely bleached.

In the 2017 bleaching event, the central 500km section of the Great Barrier Reef has been severely damaged. In March 2017 it was reported that the southern offshore reefs of the Great Barrier Reef had escaped the impacts of the latest coral bleaching event, with no bleaching evident in 149 southern offshore reefs (Climate Council, 2016).

The impact of having two consecutive bleaching events on the GBR has reduced stress tolerances of the corals. The resilience of corals has been weakened by persistent, high temperatures. The northern sector of the GBR has suffered severe damage.

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South China Sea (Dongsha Atoll)

A 2015 bleaching event in Dongsha Atoll in the South China Sea was the most devastating to hit the area in over 40 years. In northern parts of the South China Sea, sea-surface temperatures reached 6°C above average. This killed 40% of the coral in Dongsha Atoll. Increased ocean temperatures as a result of climate change and a normal El Nino pattern were exacerbated by local climatic conditions (unusually low winds). The shallow water of the atoll heated more than surrounding areas. The lack of wind trapped the heat in and around the atoll.

Hawaii

The first coral bleaching event in Hawaii occurred in 1996, affecting the northern part of the mainland Hawaiian islands, with little impact on the Northwestern Hawaiian Islands. Coral bleaching then occurred again in 2002. Coral health in parts of Hawaii was also impacted by a freshwater “kill” event during July 2014. This particularly affected Kaneohe Bay where coral cover was reduced by 22.5% as a result of flooding. Extreme warming was reported during August-September 2014, resulting in large scale bleaching throughout Hawaii. As temperatures rose corals began to show signs of stress such as discolouration and contracted polyps. Bleaching of 80-100% of total coral cover was reported. The cumulative effect of the freshwater flooding and extreme high temperatures had a devastating effect on Hawaii's coral reefs (Keisha, et al 2015). Coral mortality was reported at 50% in the West Hawaii region in 2015.

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American Samoa coral bleaching event



CORAL BLEACHING - Essential Facts

Why do corals matter? A coral reef is like an oasis in a desert. Corals provide both food and shelter for a staggering amount of marine life. Although coral reef ecosystems represent less than 0.1% of the area of the ocean, approximately 25% of all marine species relies on them. They are especially important as a nursery for juvenile fish until they are large enough to venture into open-ocean. Losing a coral reef can have a dramatic impact on local food fisheries and livelihoods. About 500 million people globally depend on such fisheries.

What is coral bleaching? Coral bleaching is the process by which corals lose their colouration and turn a ghostly white. This happens when they become overly stressed especially when exposed to warmer than normal temperatures and excessive sunlight (normally over 4-6 weeks).

What happens when corals bleach? When corals bleach they are actually expelling the brown algae that they grow within their body tissues. Corals expel the algae because high temperatures cause the algae to produce toxic compounds. The expulsion of the algae makes the corals appear a brilliant white - which is due to skeletons being visible through their translucent coral tissue.

How often does coral bleaching occur? Bleaching is becoming increasingly common throughout the coral reef regions of the world as a direct result of warming oceans. Nowadays there is at least some limited coral bleaching reported each year especially during summer months, although the major global events that span multiple oceans are usually associated with natural variability (e.g. El Niño conditions) building on top of seas that are now warmer because of climate change.

What is the connection between bleaching and climate change? Coral bleaching is one of the most visual indicators of thermal stress due to climate change. It is a phenomenon caused by ocean warming. The oceans have absorbed 93% of the heat from climate change and are now significantly warmer than they were 50 years ago. The heat that is causing reefs to turn white represents the momentum of climate change - it will increasingly impact our weather, climate and rainfall for decades to come until a new equilibrium is reached. This hidden energy could also trigger runaway heating if the ocean's methane deposits are released. It is why coral reefs are often referred to as "the canary in the coalmine".

What is Mass or Global Coral Bleaching? Mass coral bleaching is where whole reef systems bleach and not just a few individual corals. This was first recorded in 1979. It is thought that a tipping point was reached around that time when the short-term temperatures that normally accompany El Niño events began to exceed the temperatures that corals could tolerate.

How damaging are mass bleaching events? Mass bleaching events can be extremely damaging. A reef can turn from a coral dominated reef to an algae dominated reef in the space of a few months - a process that can take decades or longer to reverse. The Galapagos Islands was one of the first places where mass bleaching and mortality was first documented. The reefs there lost over 95% of their coral during the 1982 event.

Why is coral bleaching associated with El Niño? El Niño events result in higher than normal ocean temperatures in large parts of the world. This causes higher levels of stress on coral reefs. During the warm season, the higher than normal ocean temperature, combined with additional seasonal heating and sunlight, is often enough to now cause corals to bleach.

Does bleaching only occur when there is an El Niño? Major global events have only happened in El Niño years to date, however the baseline temperature of the ocean is now high enough that we see some mass bleaching every year. It is now only a matter of time before we have a global event that is not triggered in an El Niño year.

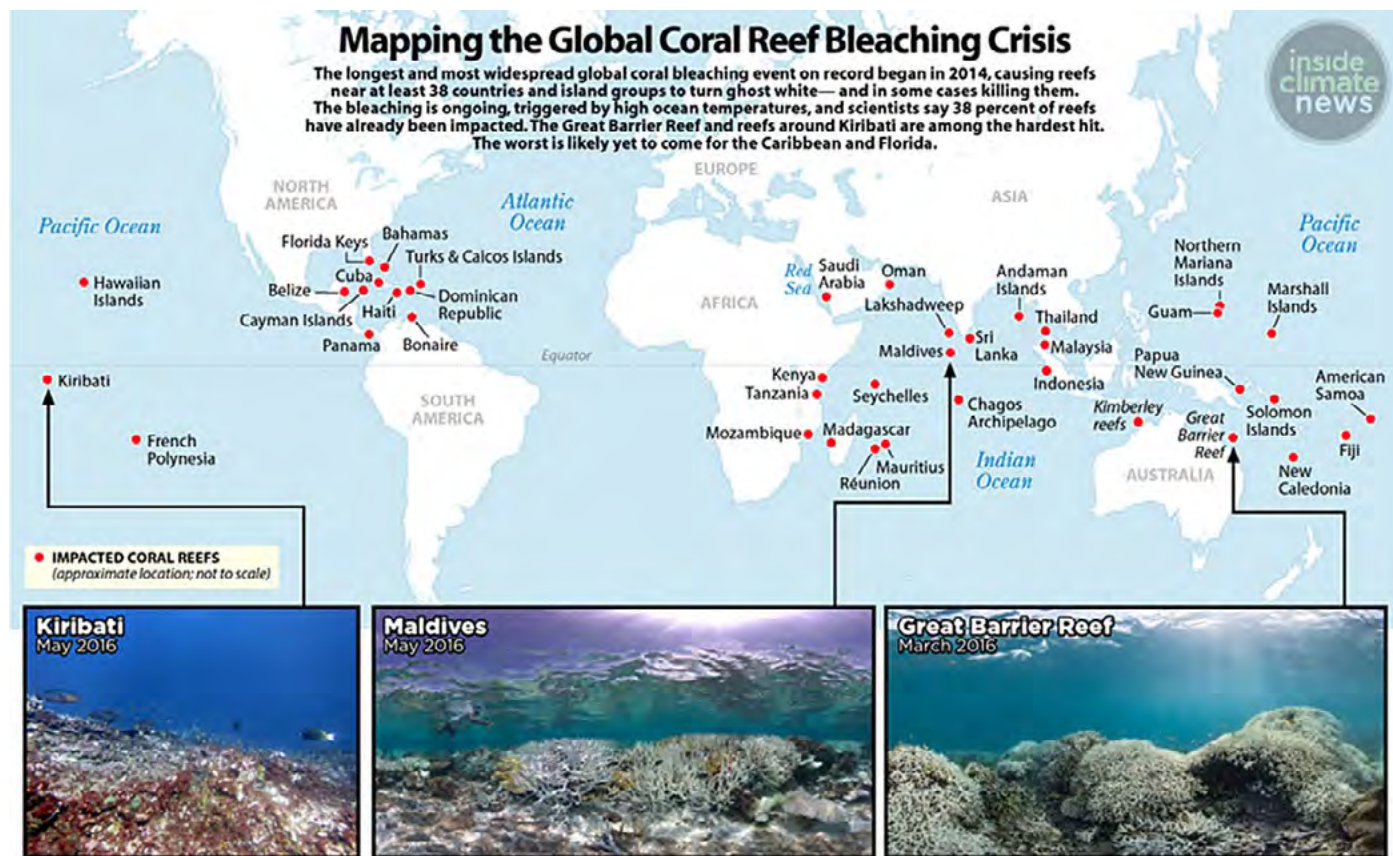
Can anything be done to reduce the risk of corals bleaching? The coral's ability to recover often depends on how healthy it was before the event. Coral reefs can be prepared for bleaching events by ensuring local stressors, such as overfishing and pollution, are minimised.

How does the XL Catlin Seaview Survey help? The XL Catlin Seaview Survey team is conducting the most extensive visual and scientific survey of the world's coral reefs. The Survey's images are available for expert insight and comment on corals, bleaching and ocean change.

The XL Catlin Seaview Survey team is conducting the most intensive visual and scientific survey of the world's coral reefs. Coral reefs worldwide are increasingly threatened by a combination of local and global impacts, including ocean warming and climate change. The prospect of many surviving beyond the middle of this century is not high. Our partners, NOAA and others predict that coral bleaching will occur widely across the world's oceans during 2015. If their prediction is realised, this would make it the third global coral bleaching, following previous events in 1998 and 2010. The Essential Guide To Coral Bleaching has been prepared as useful background information for journalists by Professor Ove Hoegh-Guldberg, XL Catlin Seaview Survey's Chief Scientist and Director of the Global Change Institute at the University of Queensland and colleagues working on our Survey. It is intended to be a desktop reference guide to keep to use when needed.



Source: <http://www.globalcoralbleaching.org/>



SOURCES: "Global Coral Bleaching 2014-2017" report by C.M. Eakin et al.; NOAA/Bernardo Vargas-Angel; XL Catlin Seaview Survey; InsideClimate News research

PAUL HORN / InsideClimate News

Source: <http://www.globalcoralbleaching.org/wp-content/uploads/2016/06/CoralReefsJeopardy1058px.png>

Understanding CORAL BLEACHING EVENTS

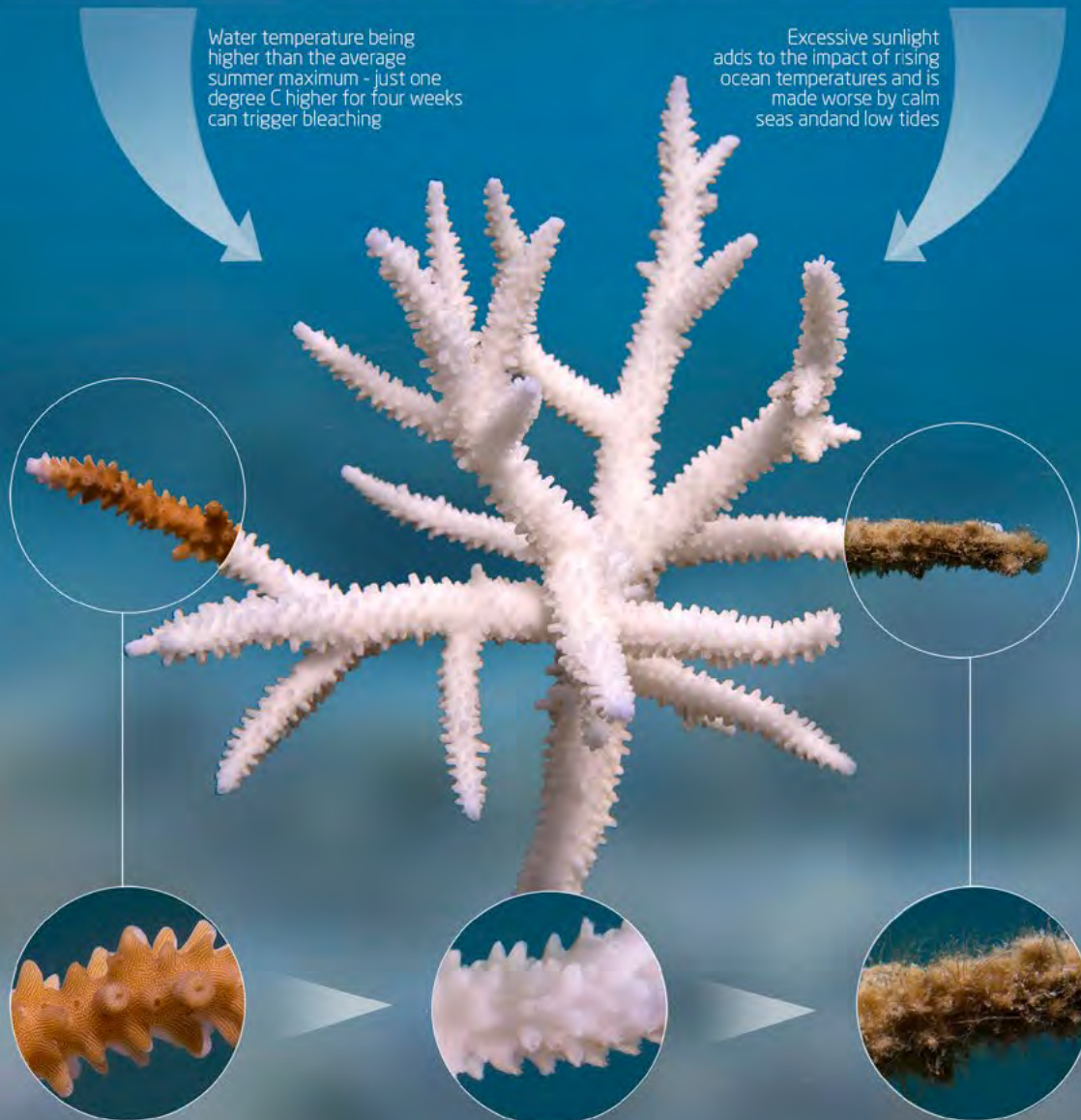
HOT WATER

WHAT CAUSES BLEACHING?

AND SUNSHINE

Water temperature being higher than the average summer maximum - just one degree C higher for four weeks can trigger bleaching

Excessive sunlight adds to the impact of rising ocean temperatures and is made worse by calm seas and low tides



HEALTHY

The colour of healthy coral colonies come from tiny plant-like cells that live inside the clear body tissue of the animal. These plant-like cells convert sunlight into food for the coral.

BLEACHED

The plant-like cells become toxic and are expelled by the coral during mass bleaching events. The coral's white skeleton is revealed through the coral's clear body tissue.

DEAD

Without enough plant cells to provide the coral with the food it needs, the coral soon starves or becomes diseased. Soon afterwards, the tissues of the coral disappear and the exposed skeleton gets covered with algae.

The history of global CORAL BLEACHING EVENTS

Why should we care?

Coral bleaching is a highly visual indicator of ocean warming. Most of the extra heat generated by climate change (93%) has been absorbed by the ocean, causing significant shifts in ocean temperature.

The resulting changes in ocean temperature will increasingly impact weather and climate for decades to come.

