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# Extreme ocean warming drives coral bleaching across WA

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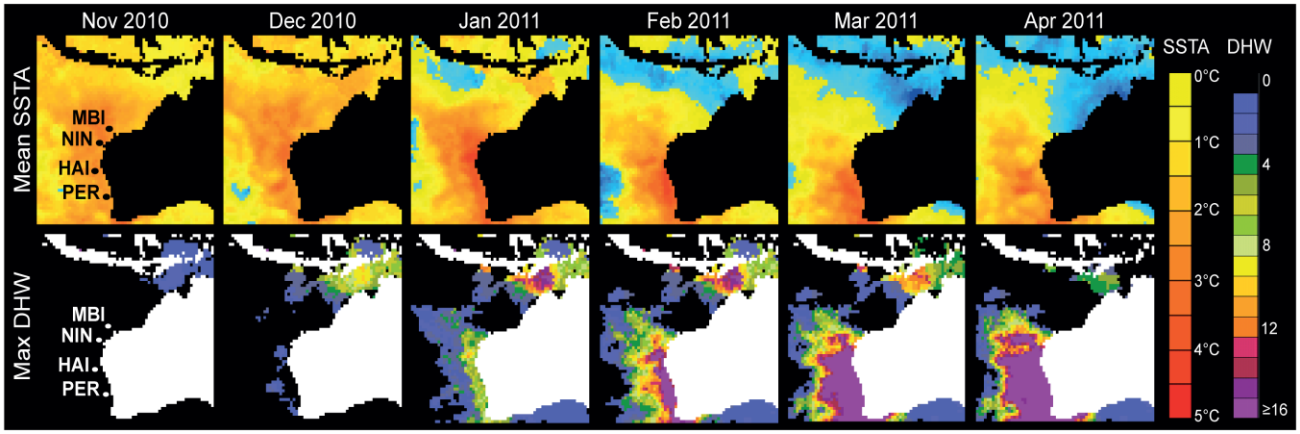
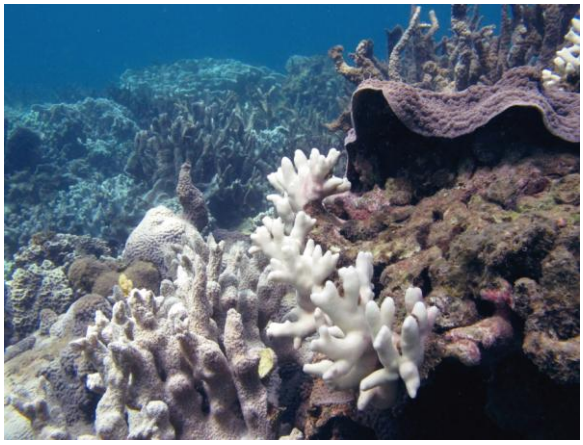
## Background

Record La-Niña conditions during the 2010-11 summer resulted in unprecedented levels of ocean warming spanning the coastline from the Pilbara in the tropical north to Albany in the temperate south. These anomalously high temperatures caused significant coral bleaching across coral communities spanning 12$^{o}$ of latitude from the Montebello and Barrow Islands in the north, to Rottnest Island in the south. Whilst large-scale or "mass" coral bleaching has been recorded in many coral regions of the world, this is the first time that this event has been recorded for WA. This has important implications for WA coral communities under climate change scenarios predicting continued increases in ocean temperature in future.




Progression of ocean warming throughout the 2010-2011 summer showing mean sea surface temperature anomalies (SSTA) and accumulation of thermal stress to corals measured as Degree Heating Weeks (DHW) [>16 DHWs indicates severe to extreme stress with widespread mortality likely] (Images courtesy of NOAA Coral Reef Watch http://coralreefwatch.noaa.gov/satellite/index.html)

### *Coral bleaching*



Barrow Island Shoals coral assemblage at various stages of bleaching: here *Echinopora* shows no visible loss of pigment (top right) whilst *Porites* shows substantial bleaching (foreground). (Photo: J. Moore)

The coral animal lives in a symbiotic relationship with microscopic single-celled algae, called zooxanthellae, which provide vital nutrients to the coral through photosynthesis. The concentrations of photosynthetic pigments in these algae are what typically give corals their unique colouration. Coral bleaching occurs when there is a disruption in the relationship between the coral hosts and their algal symbionts. Under stressful conditions, such as anomalously high temperatures over and above what corals would normally be accustomed to, corals become visibly paler in colour either through ejection of the algal symbionts, degrading of their pigments, or both. Whilst visibly dramatic, corals that are completely bleached still contain millions of viable zooxanthellae. Depending on the intensity and duration of temperature stress, corals may be able to persist through bleaching events and regain symbionts through reproduction and repopulation of existing cells or direct uptake from the surrounding water.

## Findings


Coral reefs of the Exmouth Gulf were some of the most highly impacted as shown in this time sequence from Bundegi (Photos: DEC)

- Water temperatures reached unprecedented highs across a large proportion of the WA coastline, peaking at up to 5°C above long-term averages. This was driven by highly anomalous conditions in the ocean and atmosphere as a result of a near-record strength La-Niña driving a very strong Leeuwin Current which transported the warm water as far south as Albany.
- Across all of our study sites, coral communities from the offshore Pilbara reefs in the Montebello/Barrow islands Marine Protected Areas, to Rottnest Island and Hall Bank just off Perth, were subjected to high to extreme levels of coral bleaching as a result of the high water temperatures. Significant coral bleaching was recorded, ranging from 17 to 95 per cent of all corals in our study area. The lowest bleaching was observed at Rottnest Island with the highest seen on the reefs adjacent to Exmouth at Bundegi in the Ningaloo Marine Park.
- The mortality of corals caused by bleaching was variable and ranged between <1 to 84 per cent of all corals at a site. The lowest loss of coral was observed in the Montebello and Barrow islands and the highest on the reefs of Bundegi where the highest levels of bleaching were also recorded. This is encouraging for coral communities across the state. Although we recorded very high temperatures and subsequent bleaching, the variable loss of coral suggests that, at least for some locations, coral communities are relatively resilient to large-scale thermal stress.
- Globally, mass coral bleaching events have been recorded for at least the past 20 years. To date, there has been no record of coral bleaching on similarly large-scales in WA and so this study provides an invaluable baseline as the impacts of climate change become increasingly frequent and severe.

## Management Implications

- This study is the first to show the impacts of large-scale disturbance events on WA coral reefs. Understanding the ways in which coral communities respond to these impacts directly empowers management actions that seek to improve the ability of coral communities to recover from these events by limiting, where possible, any additional stress caused by human use.
- Although direct impacts of coral bleaching were variable, our work shows that WA coral communities are susceptible to the impacts of rising global ocean temperatures. Under future climate change scenarios, it is likely that such events will become more commonplace. This study identifies key ‘at-risk’ areas and as such focuses monitoring and management efforts targeting areas of high priority for conservation.

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