

### Project Summary

The Great Barrier Reef experienced unprecedented back-to-back coral bleaching in 2016 and 2017. Despite extensive coral mortality, the consequences of bleaching on genetic diversity and adaptation are not yet known. To address this knowledge gap, this project will ask the questions:

- Has bleaching resulted in a loss of genetic diversity?
- Do survivors contain genetic signatures of bleaching adaptation?
- What is the prevalence of heat tolerant photo-symbionts within surviving corals and in the environmental pool?
- Are heat tolerant *Symbiodinium* communities and host genetic variants correlated with ambient environmental and recent bleaching conditions?

High throughput genomic sequence variant analysis will identify genes in corals and *Symbiodinium* types associated with bleaching tolerance. Correlations with environmental variables will develop a spatially explicit understanding of the distribution and abundance of stress tolerant coral genes and symbionts (*in hospite* and free-living) on the GBR.

#### Problem

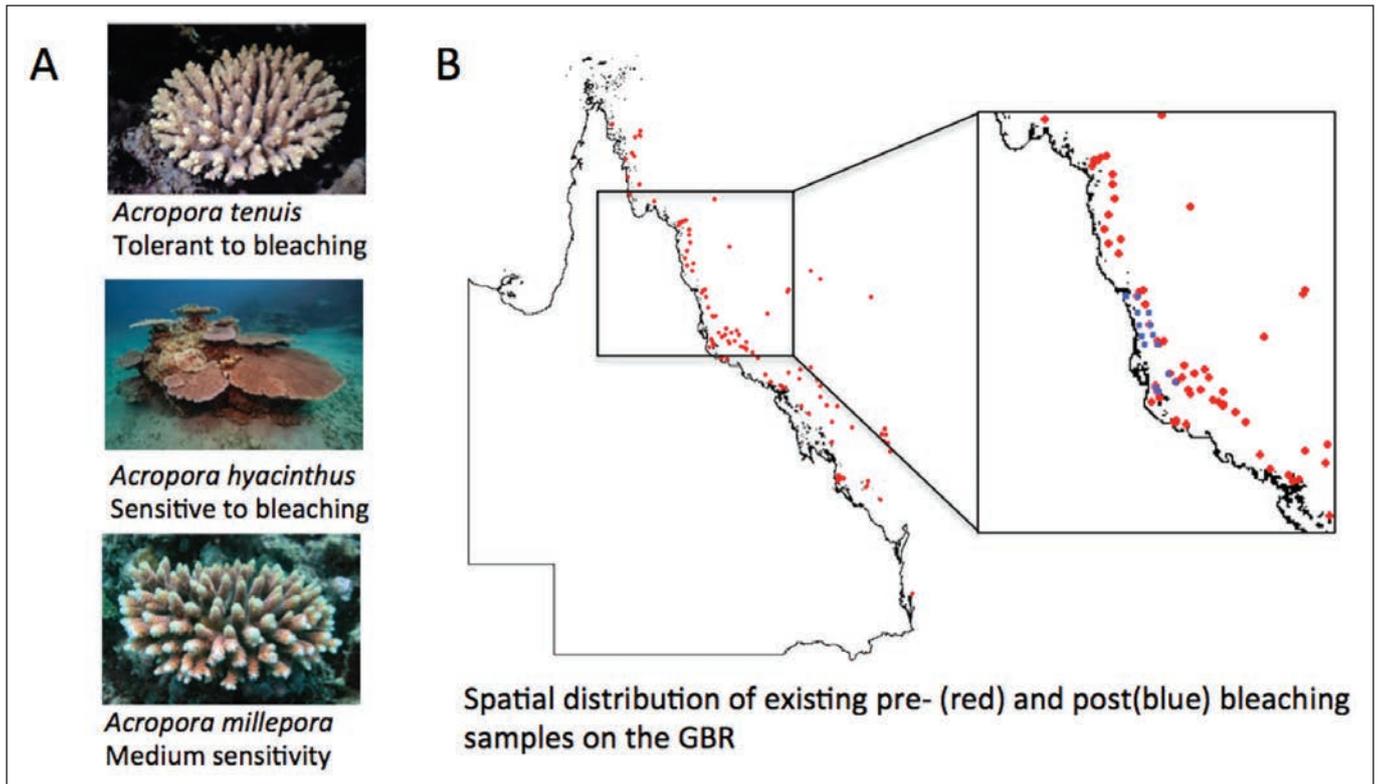
Corals are sensitive to elevated temperatures and ocean warming is widely recognized as the largest threat to reefs world-wide. Genetic variation underpins the scope for adaption of natural populations and its maintenance is a key objective for biodiversity conservation and management. Despite this, we have a poor understanding of how mass bleaching events that result in extensive coral mortality impacts genetic health and local adaptation of coral populations.

#### How Research Addresses Problem

This project delivers an increased understanding of how bleaching events affect the genetics and adaptability of natural coral populations. Heritable genetic variation associated with tolerance to higher temperatures exists in some populations, and supports the hypothesis that adaptation to changing environmental conditions is possible. This project will use genetic analyses to identify key coral populations for protection, key reefs for resilience management and potential breeding stock for use in reef restoration activities.



The extent of coral bleaching was recorded at the peak of the event in March 2018 by divers at Coates Reef in the Central Sector of the Great Barrier Reef. (17°11'52.3"S 146°22'37.0"E)



Surveys of coral populations in Dec 2017 revealed surviving coral species such as this *Acropora tenuis*, at Great Detached Reef in the Northern GBR (11°46'26.6"S 144°03'38.2"E).

A) Bleaching severity across target coral species B) Spatial distribution of pre- (red) and post (blue) bleaching samples on the GBR.

This project will develop a spatially explicit understanding of the distribution and abundance of stress tolerant corals and symbionts (*in hospite* and free-living). This will identify key hard coral populations for resilience management and potential breeding stock in future potential coral reef restoration activities.

We will examine if the survivors from natural bleaching events possess genetic markers that enable them to withstand higher temperatures. The health and stress tolerance of corals is also strongly influenced by the genetic identity of the photo-symbionts they host in their tissues. Hence, a key focus here is to describe *Symbiodinium* dynamics within corals and in the environment before, during and following bleaching.

### Approach

1. Identification of genetic variants that underpin bleaching susceptibility through genomic comparisons of corals sampled pre and post the 2016 – 17 bleaching event from the Central and Northern GBR 2017. This analysis will also yield estimates of total and adaptive genetic diversity.
2. A high sensitivity analysis of *Symbiodinium* communities in corals before, during and after mass bleaching, including highly abundant and background (i.e., rare) symbionts. We will also identify the composition of free-living sediment-associated *Symbiodinium* communities available for uptake by corals.
3. Environmental drivers of total and adaptive coral host genetic diversity, and *Symbiodinium* community structure across the GBR will be identified.

### Further information

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