Recognising Coral Bleaching

How do I recognise bleached corals?

A healthy coral reef usually appears green-brown in colour (Figure 9). Bleached corals appear pale or bone white because they have lost all or most of their symbiotic algae. In the early stages of bleaching, some corals may exhibit bright pastel colours (Figure 3). Bleached soft corals often appear fluorescent.

Figure 9: Healthy coral reef.

What is NOT coral bleaching?

Growing Tips

Some corals, especially branching corals, exhibit pale or white tips when they are actively growing. This can sometimes be confused with bleaching (Figure 10). Branching corals affected by bleaching are distinguished by extensive whitening covering most of the branches.

Figure 10: Acropora growth tips.

Crown-of-Thorns Starfish

Although bleached corals appear similar to corals that have been eaten by crown-of-thorns starfish (COTS), there are subtle differences. On close inspection of bleached corals, it is possible to see the transparent tissue and tentacles covering the skeleton, while COTS digests the coral tissue leaving only the skeleton. Often, COTS feeding scars have very distinct edges and can be seen as an irregular patch of white on part of a coral (Figure 11).

Figure 11: COTS feeding scar.

Disease and <u>Drupella</u>

There are a number of coral diseases that can result in a coral having a bleached appearance. However, coral disease usually appears in small irregular patches or bands (Figure 12). Corals which have been eaten by *drupella* (a coral eating snail) are usually affected from the centre outwards and the coral tissue may appear shredded.

Figure 12: Diseased coral.

While it is sometimes difficult to distinguish the effects of COTS or disease from low levels of coral bleaching, mass coral bleaching events are easily recognised. During a mass bleaching event, large areas of reef will be dominated by bright white corals (Figure 13), whereas the effects of COTS or disease are usually indicated by patches of white or damaged coral.

Figure 13: Bleached reefscape.

Coral bleaching: the facts

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A single coral colony is made up of thousands of individual coral polyps. The tissue of each polyp contains high densities of microscopic algae called zooxanthellae (Figure 1). Like all plants, zooxanthellae photosynthesise to produce energy-rich compounds. This provides up to 90 percent of the coral's energy supply.

The photosynthetic pigments of the microscopic algae give corals their characteristic brown and green colour, although corals may also be blue and pink due to pigments in the coral tissue.

Why and how do corals bleach?

Bleaching is a stress response in corals that results when the coral / algal relationship breaks down. The term 'bleaching' describes the loss of colour leading to a bright white appearance that results when zooxanthellae densities are substantially decreased in the coral tissue, or when pigments within the algae are degraded (Figure 2). Temperature is a primary cause of coral bleaching as corals live close to their maximum thermal limits. When temperatures exceed these thermal limits, the photosynthetic process is altered and produces toxins as a by-product. As a result, the coral expels its zooxanthellae.

Coral and algal symbiotic relationship

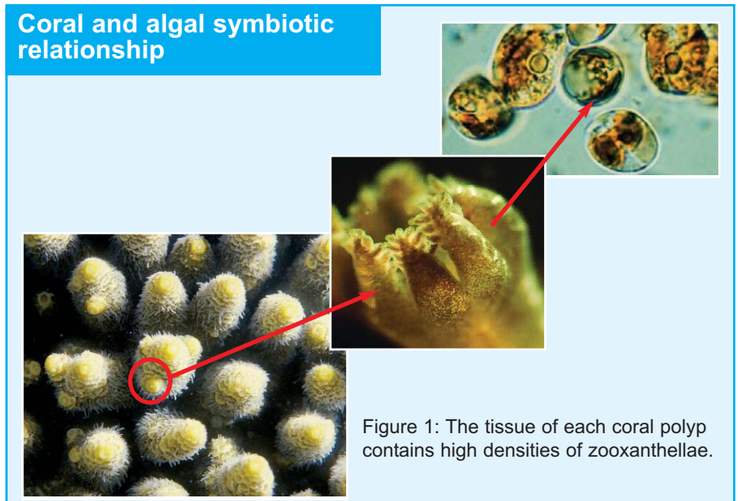

Figure 1: The tissue of each coral polyp contains high densities of zooxanthellae.

At a local scale, other factors - including disease, sedimentation, cyanide fishing, pollutants and changes in salinity - may also cause corals to bleach.

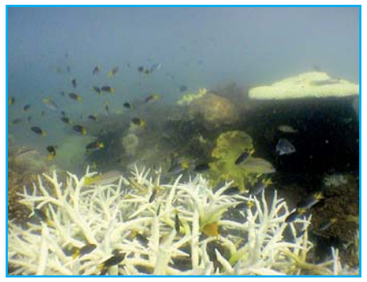

Figure 2: Bleached branching and plate corals.

In some instances, coral bleaching results in corals becoming a pastel shade of blue, yellow or pink rather than turning bright white (Figure 3).

Figure 3: Pastel shades of bleached corals. (Photo courtesy of AIMS).

Bleaching also occurs in other animals that have symbiotic relationships with zooxanthellae, such as foraminifera, sponges, anemones and giant clams (Figure 4).

Figure 4: Bleached anemone.

What is mass coral bleaching?

Mass bleaching affects reefs at regional to global scales and cannot be explained solely by localised stressors operating at small scales.

Scientific evidence indicates the primary cause of mass coral bleaching is increased sea temperatures coupled with high light levels.

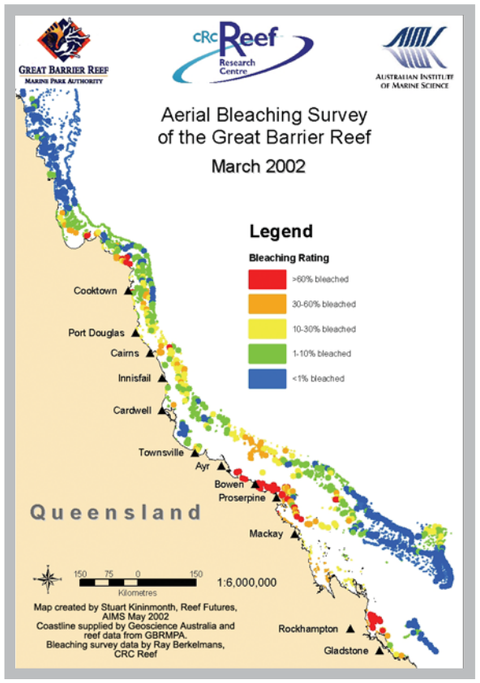

Figure 5: Results from 2002 aerial survey of the Great Barrier Reef illustrating the extent of bleaching.

Importantly, above average temperatures of only 1-2°C, particularly when prolonged, can trigger mass bleaching.

How have bleaching events affected the Great Barrier Reef?

The Great Barrier Reef has experienced mass bleaching events in the past, with the two most recent events being in 1998 and 2002. The mass bleaching event that occurred in the summer of 2002 affected between 60 percent and 95 percent of the reefs in the Great Barrier Reef Marine Park (Figure 5).

This was the worst bleaching event ever recorded for the Great Barrier Reef. While most reefs surveyed survived with relatively low levels of coral death, some locations suffered severe damage and up to 90 percent of corals were killed. During each of the last two major bleaching events, approximately five percent of reefs on the Great Barrier Reef were severely damaged, including the inshore reefs near Bowen and Mackay, as well as some reefs in the Coral Sea. These badly damaged reefs may take decades to fully recover.

Are all corals affected by bleaching in the same way?

Not all corals are affected by bleaching in the same way. Different species and growth forms of corals have different susceptibilities to bleaching. Faster growing branching and plate corals (especially *Acroporids* and *Pocilloporids*) are generally more likely to bleach than many of the slower growing massive or boulder corals. The mix of coral types that makes up reef communities can strongly influence how much bleaching occurs at a site (Figure 6).

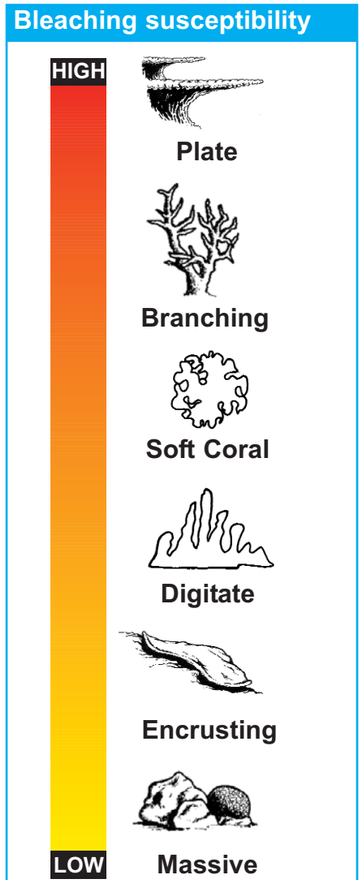

Figure 6: Generalised bleaching susceptibility gradient.

Can coral reefs recover from bleaching?

Bleached corals are still alive and, if they are not severely stressed, can regain zooxanthellae and return to a normal colour (7a). However, bleached corals will die if stresses are extreme or persistent (7b). Bleaching has led to mass mortality (7c) in many places around the world.

In the bleached state, a coral's health is likely to decline because of the loss of energy that normally comes from the zooxanthellae. Corals are able to compensate to some extent by feeding on plankton and organic matter in the water column. However, many corals have only limited ability to obtain energy requirements without the zooxanthellae. Corals that survive bleaching may suffer decreased growth rates, reduced reproductive output and be more susceptible to disease.

In situations where coral bleaching causes extensive death of corals, recovery is dependent on new coral recruits settling and growing on the reef. This is a time-consuming process, even on relatively healthy reefs. Regrowth of reefs that have been severely damaged by bleaching will take many years, or even decades, and the new reef may be significantly different from the reef that existed before bleaching.

If a recovering reef is affected by another bleaching event or other stress before it has fully recovered, it may persist in a degraded state for much longer. In locations suffering from pollution or other chronic pressures, recovery can be particularly slow or prevented altogether (Figure 8).

Figure 8: A degraded reef after severe bleaching.

The bleached coral checklist:

Bleached corals exhibit some or all of these characteristics:

- Transparent coral tissue
- White skeleton visible through the tissue
- Pale colouration
- Fluorescent appearance
- A bleached reef is dominated by bright white corals
- Bright pastel colours mixed amongst white.

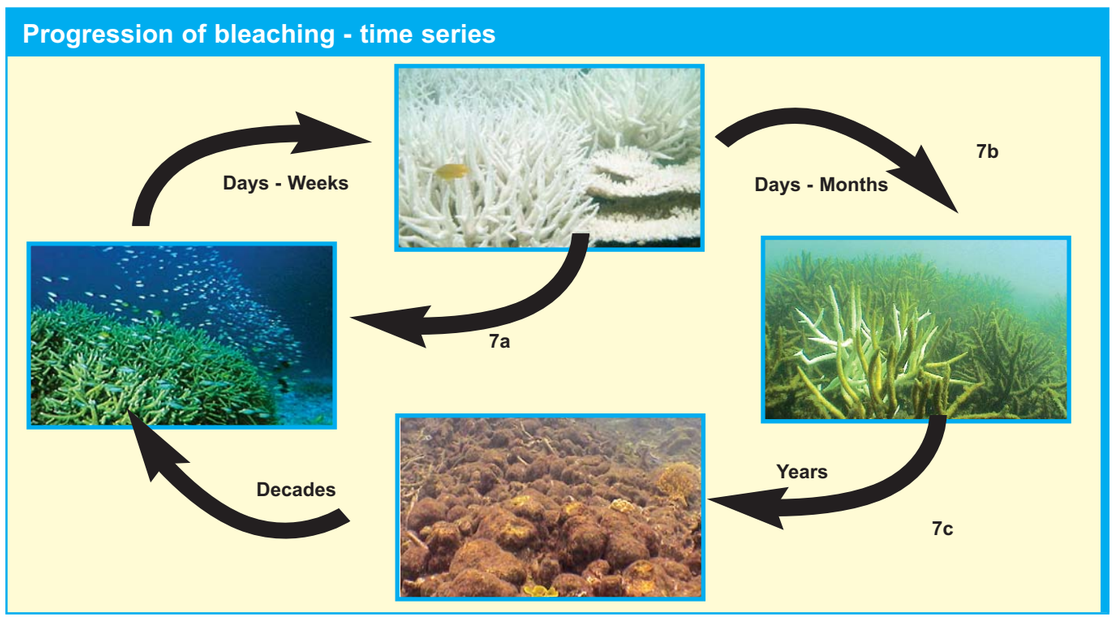

Figure 7: Progression of bleaching.