Coral Bleaching Report
Koh Tao – June 2010
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There's a lot of talk around the island recently about the widespread bleaching experienced on all of our reefs. Many people who have not dived for a couple of weeks (or months) are most surprised to see the rapid change in appearance of many of the corals.

Many questions have been posed regarding the mechanisms of bleaching and why neighbouring colonies will react differently under the stress of warmer seas. Many people have been wondering if all the corals are dead or whether they will recover to their former glory. I hope to answer a few of these questions here. I also plan to elaborate on what we can expect in the months to come.

Current Bleaching Conditions

With the 2009-2010 El Niño, the Indian Ocean has been experiencing significant coral bleaching thermal stress since the beginning of this year in a spatial pattern similar to that seen in 1998. Most of the northern Indian Ocean and Southeast Asia regions have been experiencing intensive thermal stress. Significant bleaching has been reported in Maldives, **both sides of the Thailand Peninsula (Andaman Sea and Gulf of Thailand),** Cambodia, Indonesia, and the Anilao region of the Philippines.

What is coral bleaching?
The great majority of corals live in a symbiotic relationship with zooxanthellae, a type of single-celled dinoflagellate algae. These microscopic algae live within the coral's tissues. Zooxanthellae produce energy-rich compounds through photosynthesis, providing a food source that is absorbed and used by the coral. In general, corals are highly dependent on this symbiotic relationship, receiving up to 90 per cent of their energy requirements in this way depending on the species.

Bleaching is a stress response that results when the coral-algae relationship breaks down. The term 'bleaching' describes the loss of colour that results when zooxanthellae are expelled from the coral hosts or when pigments within the algae are degraded. Because the photosynthetic pigments found in zooxanthellae give corals most of their colouration, the loss of zooxanthellae renders the tissue largely transparent. The white of the calcium carbonate skeleton is then clearly visible through the un-pigmented tissue, making the coral appear bright white or 'bleached'**. Bleaching also occurs in other animals** that are engaged in symbiotic relationships with zooxanthellae, **such as sponges, anemones and giant clams.**

Why are Some Corals Blue in Colour?
In some instances, coral bleaching will result in corals taking on a pastel shade of blue, yellow or pink rather than turning bright white. This is due to proteins produced by some corals, which tint the coral tissue and become the dominant pigment during bleaching, when zooxanthellae are absent.

The Causes of Coral Bleaching
The primary cause of mass coral bleaching is increased sea temperatures. Mass bleaching, however, affects reefs at regional to global scales and cannot be explained solely by localised stressors operating at small scales. Rather, a continuously expanding body of scientific evidence indicates that such mass bleaching events are closely associated with large-scale, anomalously high sea surface temperatures. Temperature

increases of only 1-2oC can trigger mass bleaching events because corals already live close to their maximum thermal limits.

Some Science - The role of temperature and light.
Increased temperatures cause bleaching by reducing the ability of the photosynthetic system in the zooxanthellae to process light. When temperatures exceed certain thresholds, incoming light overwhelms the photosynthetic apparatus, resulting in the production of reactive oxygen species that damage cellular structures. Corals cannot tolerate high levels of these toxic molecules, and they must expel the zooxanthellae to avoid tissue damage. Because of the low tolerance of the photosynthetic process to high temperatures, even normal levels of sunlight are enough to damage the photosynthetic system of the zooxanthellae when temperatures exceed certain levels. Furthermore, as light levels increase the amount of damage due to thermal stress increases as well.

The relationship between temperature and light in causing coral bleaching helps explain observations of reduced bleaching on shaded parts of coral colonies or in shaded reef areas. This has clearly been evident on many corals on Koh Tao this year.

It also explains why the corals of Thailand have had such a difficult time this year. We have experienced a long, hot, dry spell with intense sunlight. Add this to low tides and flat, calm seas and you can clearly see why our corals are stressed in 2010.

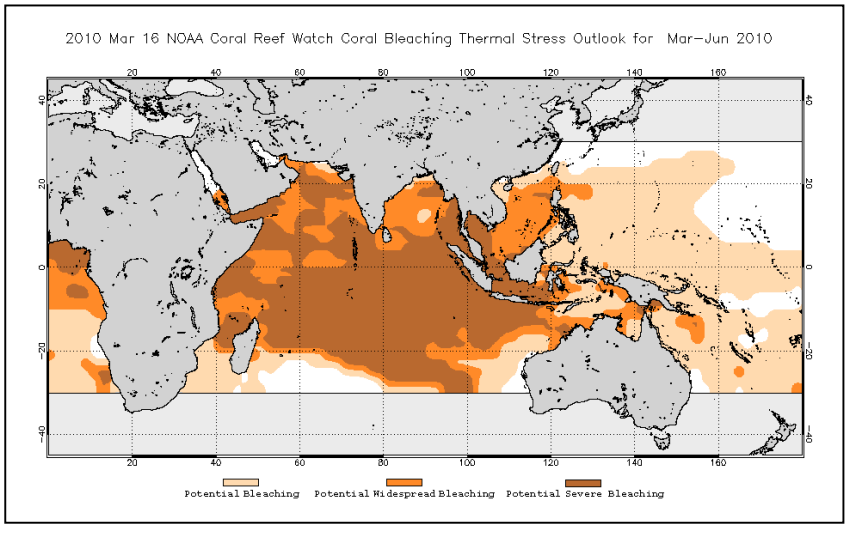
Why do some corals bleach and those nearby are fine?
Individual corals vary in their responses to heat and light stress. Variability in bleaching response has been observed ***within individual coral colonies***, among colonies of the same species, and between colonies of different species. These variations are further compounded with corals of the same species often showing different bleaching responses at different locations. *These patterns have been observed at scales ranging from* ***metres*** to thousands of kilometers.

At smaller scales, the ***microenvironment of corals can also vary***. Water currents and flow regimes increase water movement around corals, helping them to get rid of metabolic waste and toxic molecules, thereby potentially reducing their susceptibility to thermal stress.

Bleached Corals are not dead.
Bleached corals are still living, and if temperature stress subsides soon enough, most are capable of surviving the bleaching event and repopulating their tissues with zooxanthellae. Even a coral that appears much bleached to the human eye can still retain a large number of zooxanthellae.

While extreme temperature stress is almost certain to result in widespread coral mortality, the effects of more moderate temperature anomalies are highly variable. When temperatures do not greatly exceed bleaching thresholds, the coral loses its zooxanthellae, but its tissue may not be directly damaged. Whether mortality follows bleaching in these circumstances is thought to be largely dependent on the coral's ability to endure starvation, or to supplement its energy requirements from food particles captured from the water column.

Outlook for 2010



NOAA has provided detailed bleaching alerts related to sea surface temperatures and suggests that we should expect some relief soon. According to a recent report in early June, “thermal stress that has already been causing bleaching in the Indian Ocean and Southeast Asia are expected to dissipate in the next few weeks. Bleaching has been experienced in parts of the

Maldives, Thailand, Cambodia, Indonesia, and the Philippines. Both satellite observations and the outlook model show a decrease in thermal stress levels, bringing relief to stressed coral reefs."

"The thermal stress has persisted and even increased in the other areas in the northern Indian Ocean and Southeast Asia. The rainy season has just started and is expected to relieve the high thermal stress in these regions and promote the recovery of bleached corals." The 'rainy season' is relevant for the west coast but for us on Koh Tao we usually experience some carry over effects during June –August including increased winds and rain. Both of which will be beneficial for the reefs of Koh Tao.

Koh Tao has managed relatively well so far. Many species of coral have suffered severe bleaching. Some mortality has already been experienced but not on a widespread scale yet. Many species that were the first to bleach in April-May are still managing to withstand the onslaught. There have also been some examples of recovery. These admittedly have been few. But there are many positive signs.

We are still at a very crucial time with hot, calm conditions still prevailing for the most part. The next 2 – 4 weeks will be critical in determining whether many of Koh Tao's coral survive.

Recovery will take months and maybe years, so don't expect the rapid return to colour akin to the speed with the loss of colour over the past two months. It is a lot easier to 'break' something than to put it back together.

What Can We Do About it?
Our data collection using the Koh Tao EMP's & Reef Check surveys, Coralwatch surveys and other related eco activities are all vital for our understanding of this phenomena and the how we may better be able to deal with it in the future. So if you have a chance do a survey, take some photos, upload them to Eco Koh Tao…Educate yourself and those around you. All of these things will result in a brighter future for Koh Tao.

References:
A Reef Manager's Guide to Coral Bleaching. By Paul Marshall & Heidi Schuttenberg

NOAA's Coral Reef Watch Website
http://coralreefwatch.noaa.gov/satellite/index.html
Specifically:
http://coralreefwatch.noaa.gov/satellite/bleachingoutlook/outlook_messages/bleachingoutlook_20100608_for_2010junsep.html

Our Own Observations: www.ecokohtao.com