



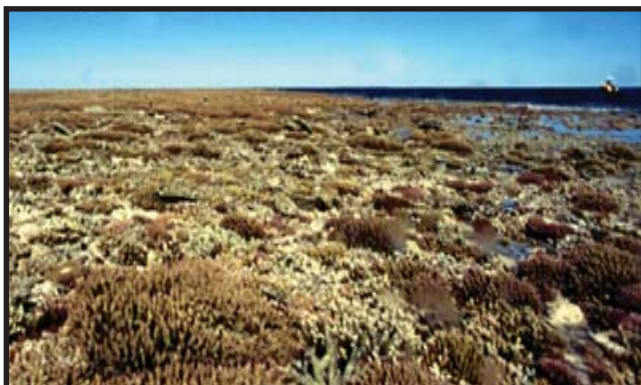
CORALWATCH



Do It Yourself CORAL HEALTH MONITORING KIT

Why do corals change colour?

During the early months of 1998, 2002 & 2004 many corals on the Great Barrier Reef, Australia and many other reefs in the world changed their colouration from brown to a brilliant white, purple or green. This 'whitening' of the coral is called coral bleaching and is due to a loss of the symbiotic dinoflagellates (algae) living within the tissue of the coral. In a healthy coral the algae supply the coral with energy (sugars and amino acids) and in turn receive products essential to their own survival (ammonia and phosphate).



During a bleaching event the brownish algae disappear from the tissue of the corals leading to the observed colour change. This loss of the 'nutrient factory' in corals may lead to the death of the coral or the coral may slowly recover. The mass coral bleaching event of 1998 is considered to be the most severe on record and about one-sixth of the world's coral colonies died!

Many stressful environmental conditions can lead to bleaching, however, elevated water temperatures due to global warming appears to be the major cause of the mass bleaching events observed in recent years. As the sea temperatures cool during winter, corals that have not starved may recover their symbionts and survive the bleaching event. However, even if they survive, the reproductive capacity of the coral is reduced and this can lead to long-term damage of reef systems.

Sea temperatures are predicted to continue to rise and thus bleaching is expected to occur more frequently and with greater intensity, leading to the death of large areas of coral reefs worldwide within a few decades!

Reef flat of Heron Island, Australia in March 2002 (top) and May 2002 (bottom) showing the extent of the bleaching during the mass bleaching event (top).

Do It Yourself CORAL HEALTH

Our aims

At the University of Queensland, Australia, we have recently developed a method to monitor coral bleaching which uses simple colour charts, like paint colour matching charts. The colour chart is a result of the unusual union between world leading vision and colour experts at the Vision, Touch and Hearing Research Centre (VTHRC) and world leading coral experts at the Centre for Marine Studies (CMS).

Current attempts to monitor coral bleaching often involve costly satellite-born technologies, are restricted to locations that researchers are working and often require sampling of live tissue for physiological analysis. Our coral reef monitoring approach using colour charts is the first attempt to provide useful data on a relatively large scale with the help of an inexpensive, 'user friendly' and non-invasive device.

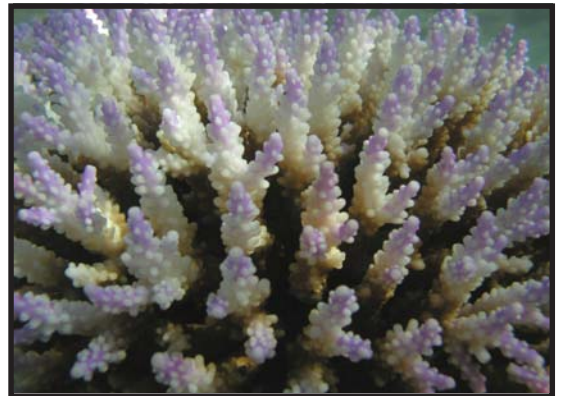
The Coral Health Charts can be used by anyone - scientists, school children, tourists and politicians. Importantly, the opportunity for everyone to participate in a global reef monitoring project removes the sense of hopelessness felt by many in the face of outcomes predicted from global warming. With this monitoring program we also aim to educate the public about coral bleaching and its devastating effect on coral reefs.



Simply match the colour of the coral with a colour on the Coral Health Chart. This healthy brain coral is dark brown and has an average colour score of E6.

This is how it works

The Charts are based on the actual colours of bleached and healthy corals. Each colour square corresponds to a concentration of symbiotic dinoflagellates (symbionts) contained in the coral tissue. The concentration of symbionts is directly linked to the health of the coral. All you have to do is match the colour of the coral with one of the colours on the chart. You then record the matching colour codes, along with coral type (species if possible), on your data sheet and subsequently on the CoralWatch website www.coralwatch.org.



The branches of this coral have lost most of their symbiont, leading to a colour change from the healthy brown (as seen at the base of the branches) to purple and white. The Chart cannot be used to assess purple or blue corals because the colouration is due to coral pigments, rather than symbionts, and the relationship between pigments and temperature is different to that between symbionts and temperature.

Why we need your help

Very little is known about trends of coral bleaching on a global scale. Currently coral health monitoring mainly occurs around a few reefs that are regularly visited by scientists. There are many questions that will have to be answered in order to try and save the reefs. This is where **you** can help! If many people around the world, like you, participate in the monitoring program we will be able to answer questions such as:

Large- and small-scale patterns of coral bleaching

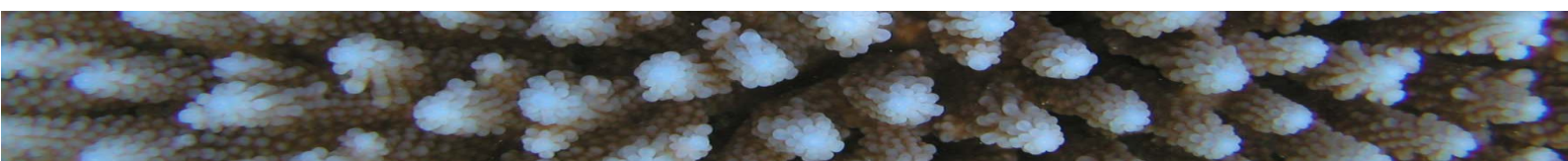
Based on water temperature measurements and knowledge of currents, it is possible to predict which areas will be affected by bleaching. We hope to answer several questions within this. Do all reefs bleach during every El Niño event, or are there some reefs or zones of reef that never bleach? Do the same areas bleach every time?

Duration and severity of coral bleaching

For what period of time are different reefs affected by bleaching events? How severely are different reefs around the world affected? Is the severity and duration dependent on previous bleaching events? Does the overall health of the reef deteriorate from one bleaching event to another?

Large- and small-scale pattern of recovery

To date, most research has concentrated on the onset of bleaching rather than recovery. With your help it will be possible to measure recovery. How long after the drop in water temperature does it take for a coral or reef to recover? Is recovery variable between different reefs and different coral types?



HEALTH MONITORING KIT

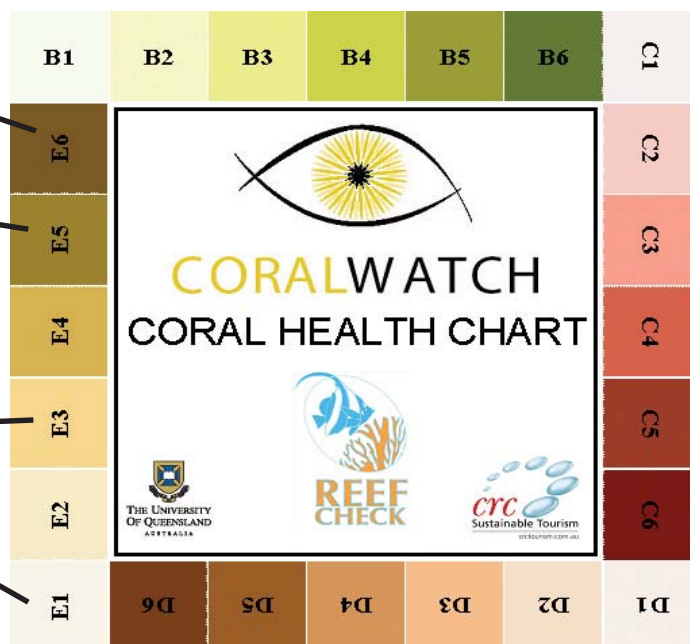
Staghorn coral after recovery in May 2002



Staghorn coral during bleaching in March 2002

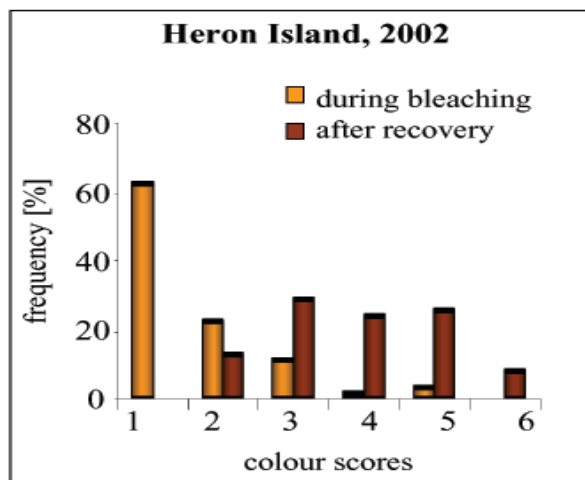


The lightest and darkest score are recorded to allow for natural colour variation across the coral. The average score is used during the website analysis.



The results

The CoralWatch website produces graphical results like that shown to the left. This graph highlights the different colour scores obtained for a bleached reef (predominately 1-3) and a healthy, brown-coloured reef (predominately 3-5).



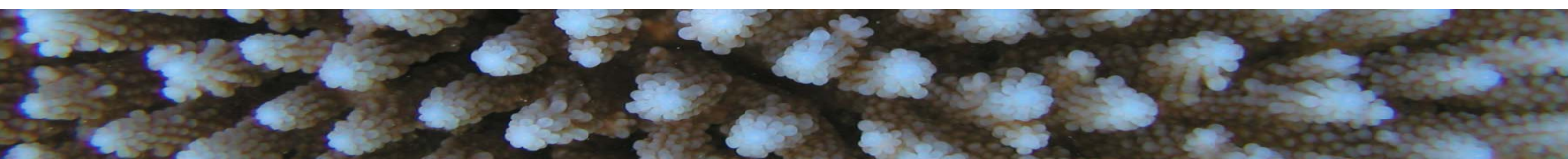
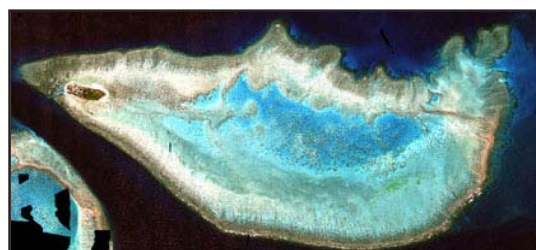
All submitted data is analysed and made available on the CoralWatch website. With your help, data will be available for different regions of the world. This will make it possible to compare the condition of many different reefs at any one point in time, as well as the condition of a single reef over time. With the help of the Charts, anyone in the world can monitor the health of their local reef or any that they visit.

Please remember to enter your data onto the website, alternatively please email or post it to us and we will enter it on your behalf.

Other events that lead to bleaching

With your help it will be possible to monitor coral health throughout the year, not just during bleaching events. It is important to measure the small natural fluctuations in the coloration of healthy corals, which do happen seasonally, so that we can immediately identify if there is a colour change outside the normal range. In this way it will be possible to find out if there are other factors that may influence coral health throughout the year.

The results from this project will be both supported by and provide information for a parallel project, which uses the complex technologies of remote sensing, vision biology and coral health. Website: <http://www.vthrc.uq.edu.au/ecovis> follow the links to 'Prawns in Space'.





Suit your own needs

There is no strict protocol that you must follow when using the Coral Health Charts. We encourage you to develop your own methodology and incorporate the Charts to suit your needs – be it research, education, or mere curiosity. Use the Charts to measure coral bleaching while on a relaxing dive, to regularly monitor corals along permanent transects for a science project, or simply to assess the current status of your local reef. Please let us know what you are doing with the Charts!



Groups using the Charts include:

Oceanway Corporation Limited is incorporating the Coral Health Charts into their Reef Check surveys to determine and monitor the status of corals in Hong Kong. Additionally, they are using the charts to monitor the health of coral areas currently being impacted by nearby marine works such as dredging. Preliminary results suggest that temporal monitoring of tagged colonies is very good for detecting small shifts in coral health and may be useful in calculating sustainable 'rates of work' and subsequent 'rest periods' required for recovery. Recommendations based on research using the Chart have been submitted with the Hong Kong government.

Numerous **Reef Check** groups, operating in countries such as Vanuatu, Malaysia and Australia, are incorporating the Charts into their regular surveys to provide an additional layer of information that will help monitor reef condition.

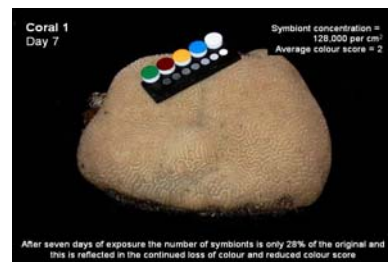
Voyages' Heron Island Resort, Great Barrier Reef, Australia, has supported the CoralWatch program since its conception. They have raised the project's profile by including the Charts in their popular educational reef walks and encouraging guests to donate a little of their holiday time to monitor coral bleaching. Coral bleaching is often the first topic of query by many visitors, and the Coral Health Chart provides a simple, practical and effective answer to the common question "What can I do to help?"

Reef Education Package

After 12 months of collaborative development between the University of Queensland and local marine educators, the Reef Education Package is now available for order.

The Package includes:

- Class set (30) of Coral Health Charts
- A Guide to Using the Coral Health Chart
 - A 22-page document outlining how you can use the charts in a 'classroom' setting
- CD containing the Guide (for editing and printing as required), Reef Fingerprint® and Reef Transect® *Microsoft Excel* spreadsheets for data analysis, Virtual Reef and Virtual Lab
- Virtual Transect poster (140 x 60cm)
- Hard copy of all images in the Virtual Reef and Virtual Lab
- Sample dive/snorkel data slate



An image from the Virtual Lab, which is a *Microsoft Powerpoint* presentation showing how the Charts were created. The Virtual Lab shows you how increased temperature affects the concentration of symbionts, and consequently the colour of the corals.



Further reading

Siebeck, U.E., Marshall, N.J., Kluter, A. & Hoegh-Guldberg, O. in prep. Fine scale monitoring of coral bleaching using a reference card.

Hoegh-Guldberg, O. 1999: Climate change, coral bleaching and the future of the world's coral reefs. *Marine and Freshwater Research* 50: 839-866.

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