CORALWATCH

A GUIDE TO USING THE CORAL HEALTH CHARTS

SUSTAINABLE TOURISM CRC

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

bright minds™

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The authors would like to thank the following people and organisations, because it is their knowledge, vision and skills that made this guide possible. Thank you.

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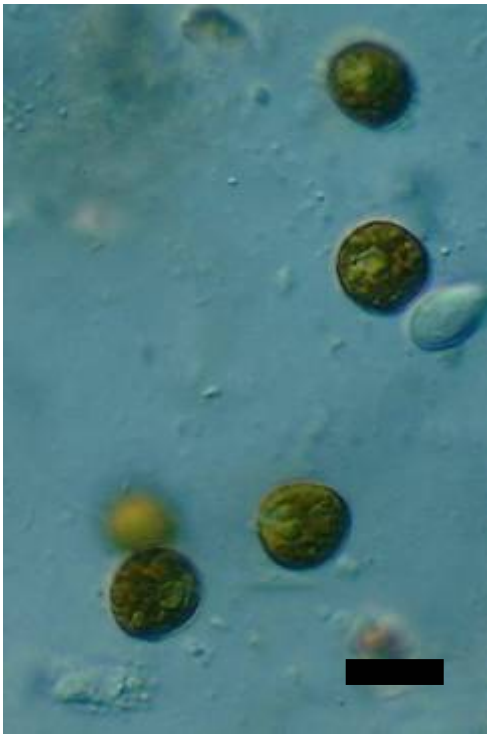
Table of contents

Introducing corals and coral reefs

The classification of corals has been long disputed, and they have previously been classified as plants, animals and minerals. Corals are in fact **animals** within the phylum **Cnidaria**, which also includes jelly fish.

Interestingly, reef-building (**hermatypic**) corals are also part-plant, because they contain single-celled algae called **dinoflagellates** or zooxanthellae within their cells. Hermatypic corals and the algae within their tissue have a very important mutualistic symbiotic relationship that facilitates the growth of a coral reef. A mutualistic symbiotic relationship is one in which both partners benefit.

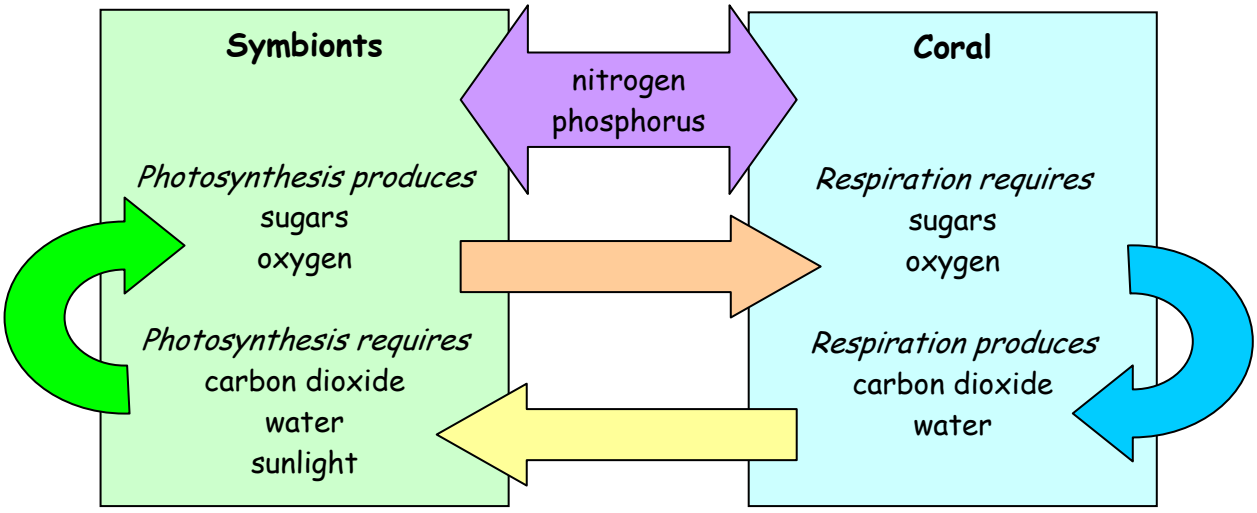


Light microscope image of isolated symbiotic dinoflagellates (symbionts). The symbionts have been blasted from the coral tissue using high pressure water. The green colouration is due to the presence of the photosynthetic pigment chlorophyll. Scale bar 10µm. Source: Ove Hoegh-Guldberg.

Symbiotic dinoflagellates (symbionts) use **sunlight**, **carbon dioxide**, **nitrogen**, and **phosphorus** to produce organic compounds during photosynthesis. The sugars they produce are a very important source of nutrients for the coral, providing as much as 98% of the coral's nutrition. It is the symbionts that provide the energy, which allows corals to

deposit a calcium carbonate skeleton at a rate facilitating **reef build-up**. During photosynthesis, the symbionts also produce **oxygen**, which is used by the coral to respire. Symbionts also contribute to the **colour of corals**, and hermatypic corals lacking symbionts are generally white in colour, i.e. bleached.

Corals produce **carbon dioxide** and **water** through respiration, and give off **nitrogen** and **phosphorus** as waste products. The coral waste products benefit the symbiont because they provide the materials required for photosynthesis. The hard skeleton and the stinging cells of the corals also help **protect** the symbionts from predators.



Schematic diagram illustrating the mutualistic symbiotic relationship between the symbionts and the coral. It is this tight coupling of materials that allows hermatypic corals to flourish in the nutrient poor coral reef environment, thereby laying down a calcium carbonate skeleton and allowing reef build-up. Respiration and photosynthesis are complex biological processes that involve many other materials, and have been simplified for the purpose of this diagram.

Coral bleaching

Coral bleaching occurs when corals change colour, generally from dark brown to a lighter shade of brown or white. The colour change is generally caused by a **loss of symbionts** from the coral's tissue, but can also be associated with a decrease in the concentration of photosynthetic pigments within the symbionts. Coral bleaching is a reaction to stress and can be caused by a variety of environmental factors including:

- elevated or decreased water temperatures
- changes in water salinity
- increased solar irradiance (both visible and ultraviolet)
- elevated exposure to chemical contaminants

It is important to distinguish that there are two distinctly different types of bleaching: localised and mass bleaching. **Localised bleaching** occurs over small geographical regions and can be caused by any of the above factors. **Mass bleaching** occurs over large geographical regions and is caused by increased water temperature over extended periods of time, together with increased levels of ultraviolet light. Sea temperatures are predicted to continue to rise and thus mass bleaching is expected to occur more frequently, and with greater intensity. This could lead to the death of large areas of coral reefs worldwide within a few decades.

Monitoring coral bleaching

Very little is known about trends of coral bleaching on a global scale. Current attempts to monitor bleaching often involve costly satellite-born technologies, require sampling of live tissue and are restricted to the few reefs that are regularly visited by scientists. There are many questions that need to be answered in order to build a greater understanding of our reefs. This is where you can help.

By collecting bleaching data using the **Coral Health Chart** you will be providing valuable data to researchers. With your support it will be possible to monitor coral bleaching throughout the year, not just during bleaching events, and also across the world rather than at selected locations. Your data will help researchers answer questions related to issues such as patterns of bleaching and recovery.

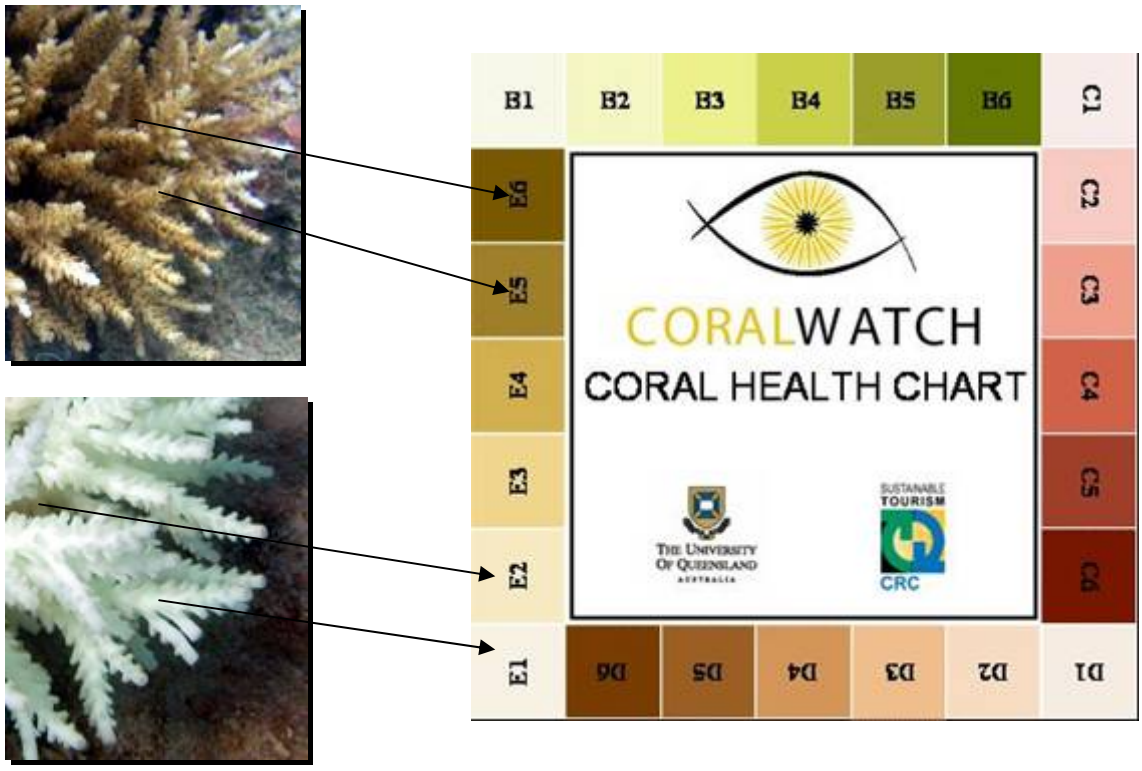
Bleaching is closely linked to **coral health.** However, it is important to remember that there are several other factors that affect the overall health of a coral or reef, such as:

- Physical damage caused by storms or human impact
- Coral diseases, e.g., black band and white spot
- Over-fishing, e.g., a reduced numbers of herbivorous fish provide the opportunity for algae to flourish, which can smother and kill corals
- Increased nutrient levels can also enhance algal growth
- Increased sedimentation can also smother corals
- Coral diversity

The Coral Health Chart

The colour charts are based on the actual colours of bleached and healthy corals. Each colour square corresponds to a concentration of symbionts contained in the coral tissue. The concentration of symbionts is directly linked to the health of the coral.

In the field, all you need to do is match the colour of the coral with one of the colours on the Coral Health Chart. You then record the lightest and darkest colour score for each coral on to the data sheet provided. The lighest and darkest colour is recorded to allow for the natural colour variation within a coral. The averaged value is used during the spreadsheet and website analyses.



Source: Justin Marshall

Waterproof data slates can be created by simply copying the data sheet onto a piece of PVC. Pre-printed waterproof slates can also be purchased through CoralWatch by emailing info@coralwatch.org.

If the chart is used below five metres you need to use a source of illumination, like a torch, to shine on both the chart and the coral. This is

to counteract the changing spectral properties of water with increased depth.

The Education Package contains two *Microsoft Excel* spreadsheets that provide a range of data collection and analysis options.

- **The Reef Fingerprint©** spreadsheet is designed to be used with randomly collected data. This spreadsheet provides a graphical and numerical summary of your data, showing information such as average coral colour scores, the percentage of different coral types and the overall colour of the reef. Detailed instructions can be found on the first page of the spreadsheet.

- **The Reef Transect©** spreadsheet is designed for data collected using belt or line transects, and requires additional information such as water temperature and depth. This spreadsheet therefore provides a more comprehensive analysis, e.g., information about the relationship between coral colour and water depth. Once again detailed instructions can be found on the first page of the spreadsheet.

Once you have collected your data please remember to forward it to CoralWatch. You can enter your data directly onto the website www.coralwatch.org or email your spreadsheet to info@coralwatch.org and we'll upload your data for you. The website also produces graphs for different reefs across the world – don't forget to check out your reef!

Coral classification

Classifying corals at the species level is very difficult, so **life forms** are often used when recording data about coral cover or general coral health. For this purpose, the basic life forms of coral colonies can be described in a simplified manner by shape.

The Coral Health Chart uses life forms to classify corals. **Branching** refers to any branching coral such as some *Acropora* species. **Boulder** refers to any massive or rock shaped corals such as some *Platygyra* and *Porites* species. **Plate** refers to any coral that forms a plate like formation such as tabular *Acropora* species, and the **soft** category refers to corals lacking a hard skeleton, such as the *Xenia* species.

Branching

Plate

Boulder

Soft

Source: Justin Marshall (branching, plate, boulder) and Craig Reid (soft)

Due to the dynamic nature of coral morphology, these categories are not strict and there are many forms that do not fit into these categories. Our aim is to keep the chart and survey as simple as possible, so if you're experiencing difficulties when classifying your corals, please simply choose the closest life form.

Coral classification activity

The aim of this activity is to observe and draw four of the most common types of coral life forms on the reef.

What to do:

- Spend about ten minutes with each type of coral to obtain an accurate picture of what is taking place on, in and around the coral.
- Sketch the coral.
- On the lines below your diagram, list any other marine organisms that you observe on, in or around the coral.

Branching	**Boulder**
Plate	**Soft**

Spreadsheet questions

The following questions relate to the data you have collected, and the results you have obtained from the spreadsheets.

1. Which coral type was the most abundant?

_____

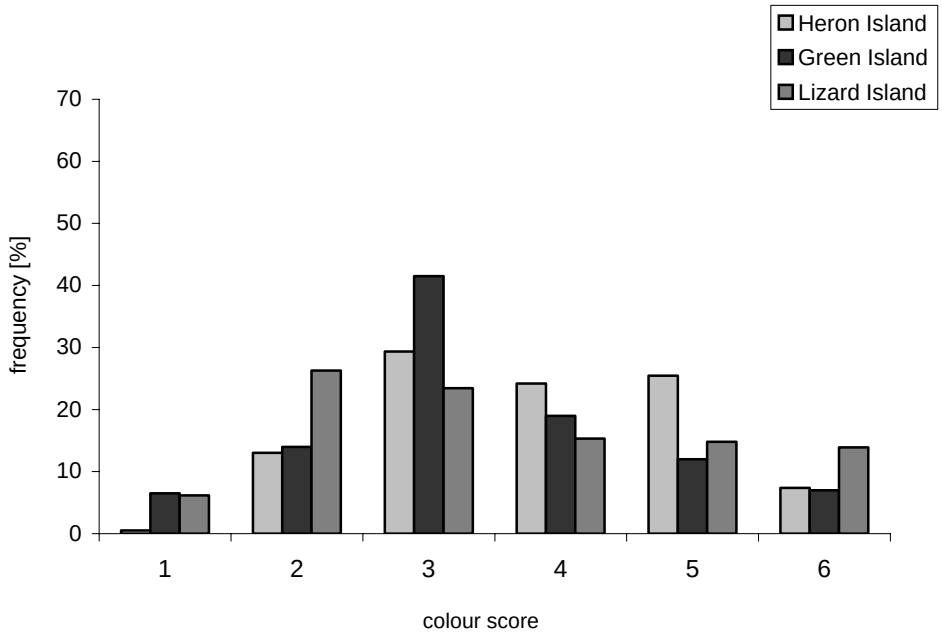
2. Which coral type was the least abundant?

_____

3. Which colour score had the highest frequency?

_____

4. A healthy reef would be expected to have a majority of corals with scores over 3, a few corals with scores of 2 and a very small number of corals with a colour score of 1. The distribution graph would be similar to the graph below.



Coral Health Chart surveys on Heron, Green and Lizard Island during July 2002.

How do your spreadsheet results compare with the coral colour scores obtained by researchers on Heron, Green and Lizard Island during July 2002?

Source: Ian Leiper

5. Do your spreadsheet results support what you observed in the field? If not, why?

6. Natural variation in coral colour occurs as a result of environmental conditions. For example, extended periods of elevated temperature and intense periods of rainfall can reduce a coral's symbiont concentration, thereby affecting its colour. Check what the weather conditions were like at your location before you arrived.

Have there been any unusual weather patterns experienced at your location recently? If yes, what were they, and what impact do you think they've had on the reef?

_____

_____

_____

_____

_____

7. What was the average colour score for each coral type?

Coral Type	Colour Score
Branching	
Boulder	
Plate	
Soft	

8. Based on the above table, which of the coral types appears to be more resilient to coral bleaching? Why do you think this is the case?

_____

_____

_____

_____

_____

Source: Justin Marshall

9. How would you rate the general health of the reef at this point in time, based on the data you have collected and analysed together with your general observations? Explain your reasoning.

10. How could your data help researchers get a more accurate picture of coral bleaching and reef health?

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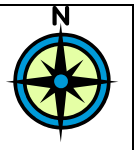
Source: Justin Marshall

11. What is a possible effect of bleaching on the future growth rate of the reef? Draw a diagram to assist you in your explanation.



One possible future

12. Assume that sea surface temperatures and coral bleaching will increase in frequency and intensity over the next 50 years. Describe the likely long term impacts on the marine life of the coral reefs.

Source: Justin Marshall

CORALWATCH data sheet

Group name: _____ Your name:_____

Email address: _____

Participation field: dive centre / scientist / environmental / school or university / tourist

Country of reef: _____ Reef name: _____

GPS if possible: _____ _____ Sea temperature:_____^{o}C

Date of survey: _____/_____/_____ Time collected: (ie.14:00 or 2pm) _____
Day Month Year

Weather: sunny / cloudy / raining Your activity: reef walking / snorkelling / diving

Coral Number	Colour Code L=Lightest D=Darkest		Coral Type Br=Branching Bo=Boulder Pl=Plate So=Soft			
example	*L: D2*	*D: E5*	*Br*	*Bo*	*Pl*	*So*
1	L:	D:	Br	Bo	Pl	So
2	L:	D:	Br	Bo	Pl	So
3	L:	D:	Br	Bo	Pl	So
4	L:	D:	Br	Bo	Pl	So
5	L:	D:	Br	Bo	Pl	So
6	L:	D:	Br	Bo	Pl	So
7	L:	D:	Br	Bo	Pl	So
8	L:	D:	Br	Bo	Pl	So
9	L:	D:	Br	Bo	Pl	So
10	L:	D:	Br	Bo	Pl	So
11	L:	D:	Br	Bo	Pl	So
12	L:	D:	Br	Bo	Pl	So
13	L:	D:	Br	Bo	Pl	So
14	L:	D:	Br	Bo	Pl	So
15	L:	D:	Br	Bo	Pl	So
16	L:	D:	Br	Bo	Pl	So
17	L:	D:	Br	Bo	Pl	So
18	L:	D:	Br	Bo	Pl	So
19	L:	D:	Br	Bo	Pl	So
20	L:	D:	Br	Bo	Pl	So

Any other relevant information, e.g. average diving depth, species of coral, pollution, long term weather such as drought, flood, heat-wave.

Any comments or enquiries.

Please use one of the following options to enter your data: i) directly onto the CoralWatch website (www.coralwatch.org), ii) by fax: +61 7 3365 4522 to the attention of Kylie McPherson, iii) by post: Kylie McPherson, VTHRC, University of Queensland, Brisbane Queensland 4072 Australia. Thank you very much for you participation! You have now contributed valuable information that will help scientists understand coral bleaching on a global scale. Check our website for survey results and global bleaching trends.

Student feedback

This is your chance to tell us what you thought about the the CoralWatch Reef Education Package and your trip to the reef.

Give the trip a rating of 1-5:

What did you like the best?

_____
_____
_____
_____

What was the worst aspect of the trip?

_____
_____
_____
_____

What component of the Reef Education Package did you like the best? For example, seeing how corals change over time in the Virtual Reef or using the Coral Health Chart in the field.

_____
_____
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_____

How do you think the Education Package could be improved?

_____
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_____
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_____

Teacher feedback

This is the first edition of the Reef Education Package. Please take the time to let us know us what you thought. WE VALUE YOUR FEEDBACK!

Your name and school (optional):

_____

_____

Where did you hold your field trip (if applicable)?

_____

Which component/s of the Reef Education Package did you use?

_____

_____

_____

How do you think these components could be improved?

_____

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Do you have any other comments or questions?

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Please send to: Kylie McPherson
By email: info@coralwatch.org
By mail: VTHRC, University of Queensland, Brisbane, Queensland 4072 Australia
By fax: +61 7 3365 4522
Please include any relevant Student Feedback sheets

This guide is part of the CoralWatch Reef Education Package, which also includes:

- Coral Health Charts
- Reef Fingerprint© and Reef Transect© *Microsoft Excel* spreadsheets
- Virtual Reef
- Virtual Lab
- Virtual Transect poster
- One sample data slate

The Charts are designed to be used in conjunction with this Guide and the spreadsheets. The virtual tools provide an opportunity to learn more about coral bleaching and the charts. They can be used to prepare for a reef field trip or as a valuable alternative to a field trip.

If you have any queries about the Education Package please contact info@coralwatch.org. Thank you for your support and participation!