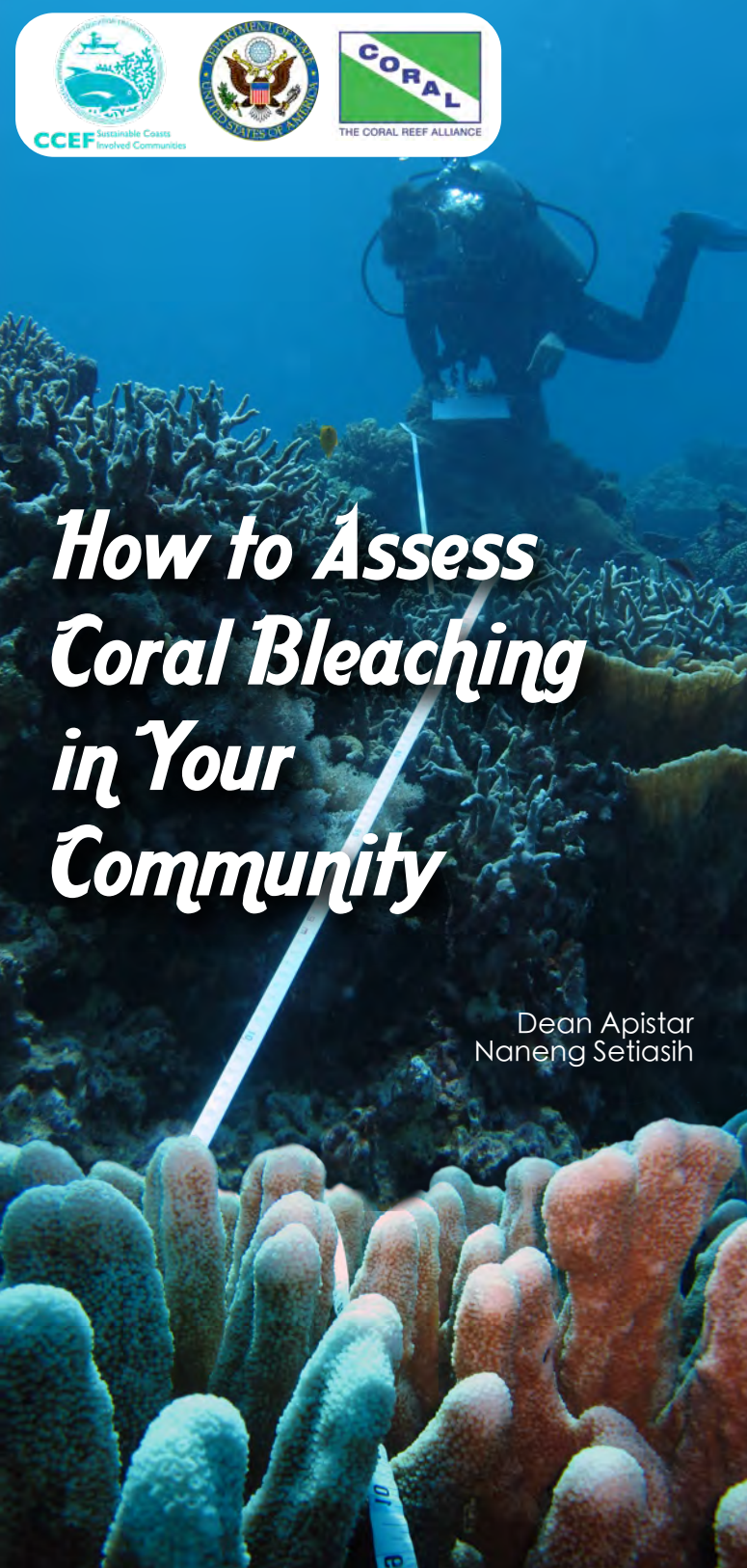

How to Assess Coral Bleaching in Your Community

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How to Assess Coral Bleaching in Your Community

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Cover photo:
A trained diver monitors the corals using Line Intercept Transect (LIT) method.

Introduction

What is coral bleaching?

Coral bleaching occurs when corals lose the single celled algae (*zooxanthellae*) that live within their tissues. These golden brown colored algae occur in varying densities in reef corals (and other reef invertebrates), giving them a pale to dark brown color.

When corals lose their *zooxanthellae*, the white skeleton can be seen through the transparent animal tissue, making the corals look bleached white (Figure 1).

Figure 1. Photo of a bleached coral

Figure 2. Close up photo of a bleached polyp

Sometimes coral polyps produce a kind of chemical compound to protect them from UV stress. This chemical produces a bright yellow, pink or green color and becomes very obvious without the zooxanthellae. Corals that have been bleached are not necessarily dead. On close inspection, it may be possible to see the transparent polyps and tentacles of bleached colonies (Figure 2). However, corals cannot remain bleached indefinitely (Oliver et. al., 2004).

What causes coral bleaching?

Bleaching is caused by various natural and anthropogenic factors:

At a local scale

Storms

Diseases

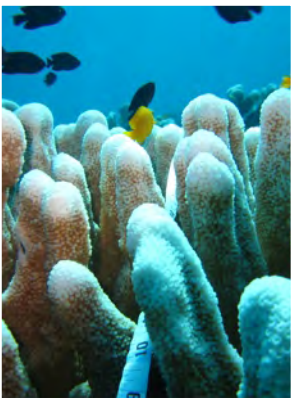
Sedimentation

Cyanide fishing

Herbicides

Heavy metals

Change in salinity



However, the primary cause of regional or mass bleaching events is **increased sea temperatures**. Sea temperature increases of 1-2 °C above the long term average maximum are all that are required to trigger mass coral bleaching (Marshall and Schuttenberg, 2006).

Stages of bleaching

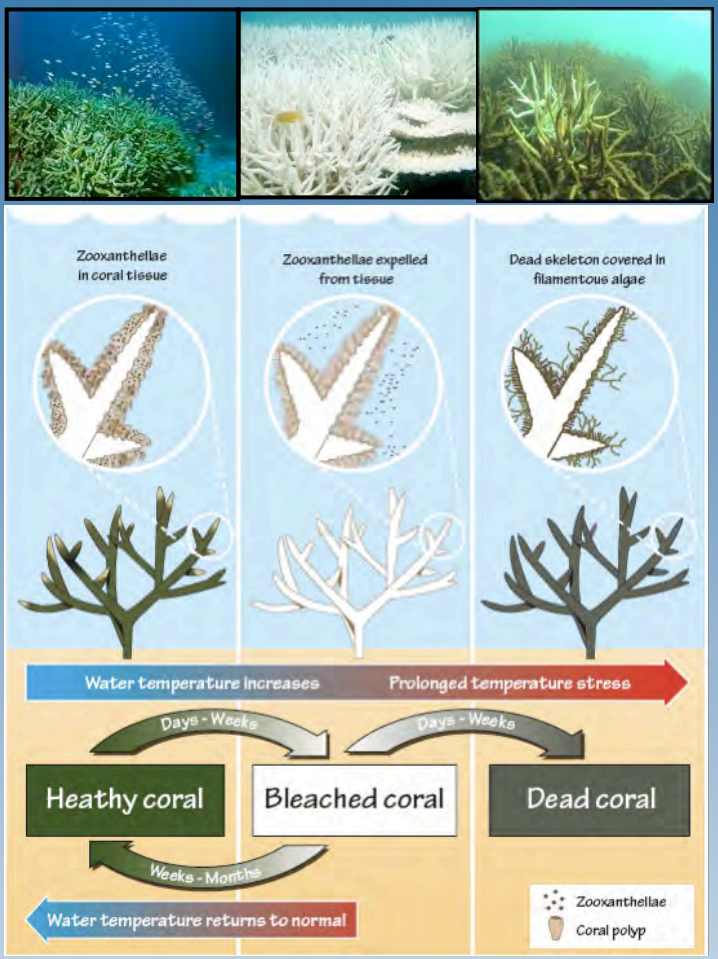


Figure 3. **Stages in Mass Coral Bleaching.** During mass coral bleaching, water temperature increases above the normal range, typically over a large area. Coral polyps begin to lose their single celled algae (zooxanthellae), and eventually appear white or 'bleached'. Nevertheless, the bleached coral polyps are still living and, if water temperature returns to normal soon enough, they can regain their zooxanthellae. However, should high temperature prolong, corals are likely to die. Where mass coral bleaching causes high levels of coral mortality, these ecosystems typically take years to decades to recover (Marshall and Schuttenberg, 2006).

Predicting mass coral bleaching

Sea temperature is the most reliable predictor of the occurrence and severity of large-scale coral bleaching events.

Reef managers may get a very useful indication of whether their region is likely to experience increased heating in coming months based on climate predictions.

- **Check climate forecasts.** One of the ways to predict possible heating of the oceans is through regional or local climate forecasts such as news of upcoming climate events (e.g. El Nino). This can tell you that an increase in sea temperature may likely happen in the coming months.

- **Observe the weather.** Another way of predicting possible coral bleaching is through observance of the weather in your area. Coral bleaching may likely occur during periods of calm wind and seas, lack of clouds and low water turbidity or currents (Figure 4). During this "bleaching weather", cloudless skies and calm seas that reduce turbidity allow more solar radiation to reach the water and increase temperatures. Normally, clouds reflect some of the solar radiation and reduce rising sea surface temperatures; wind causes the surface of the water to become rough, thus also reflecting the solar radiation; and currents induce mixing of the water column, further reducing the water temperature.

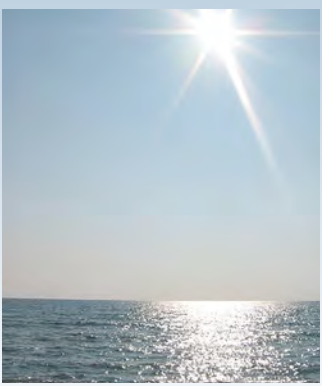


Figure 4. What bleaching weather may look like.

- **Check early warning systems on the web.** Other methods of predicting mass coral bleaching include early warning systems that are available on the web. The National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Watch Program provides current reef environment conditions to quickly identify areas at risk of coral bleaching using in-situ and remote sensing tools for near-real-time and long term monitoring and reporting of physical environmental conditions of coral reef ecosystems. Some of these products include graphs and figures of Sea Surface Temperatures (SST) in specific regions all over the world including the Philippines, as seen in Figure 5 below.

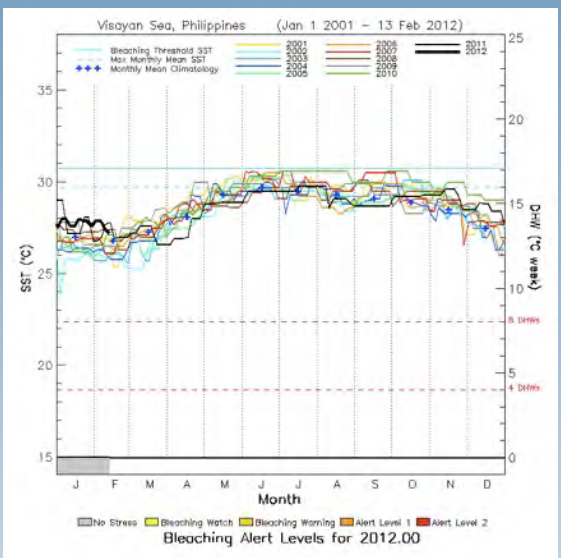


Figure 5. The SST in the Visayan Sea (N: 11.5, E: 123.5) using their Virtual Stations from January 1, 2001 to May 28, 2012, with its corresponding bleaching alert levels.

These levels are defined in terms of the HotSpot and Degree Heating Week (DHW) values. When low thermal stress is present at a reef site (0 °C < HotSpot < 1 °C), a Bleaching Watch is posted for the site. A Bleaching Warning is posted when the HotSpot is equal to or more than 1 °C.

At this point, DHWs begin accumulating. A DHW accumulation of 4 °C-weeks triggers a Bleaching Alert Level 1. At Bleaching Alert Level 1, bleaching is expected at the site within a few weeks of the alert. An accumulation of 8 °C-weeks triggers a Bleaching Alert Level 2, at which point widespread bleaching and some coral mortality are likely.

Stress Level	Definition	Effect
No Stress	HotSpot <= 0	
Bleaching Watch	0 < HotSpot < 1	
Bleaching Warning	1 <= HotSpot and 0 < DHW < 4	Possible Bleaching
Bleaching Alert Level 1	1 <= HotSpot and 4 <= DHW <8	Bleaching Likely
Bleaching Alert Level 2	1 <= HotSpot and 8 <= DHW	Mortality Likely

Table 1. Bleaching Alert Levels

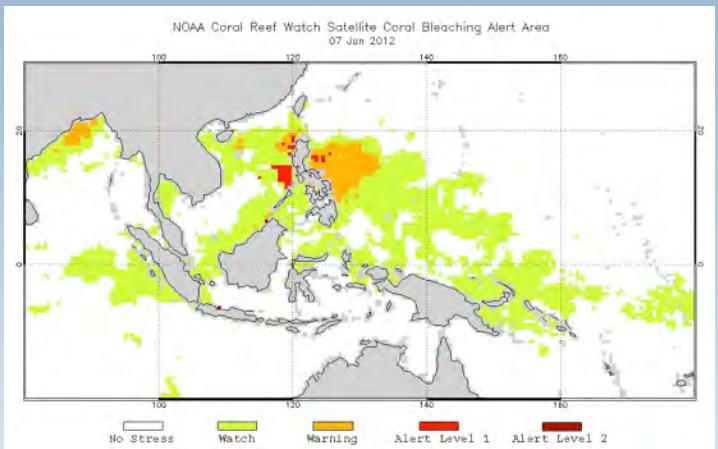


Figure 6. NOAA's Coral Reef Watch's current operational real-time twice weekly satellite coral bleaching Hot Spot alert in the Coral Triangle area. Data accessed June 7, 2012.

For a complete list of all sites and other information, you can visit NOAA's Coral Reef Watch Program at

http://coralreefwatch.noaa.gov/satellite/index.html)

Monitoring

What is monitoring and why should we monitor coral bleaching?

Monitoring is a standard method to observe one thing in one place over a period of time.

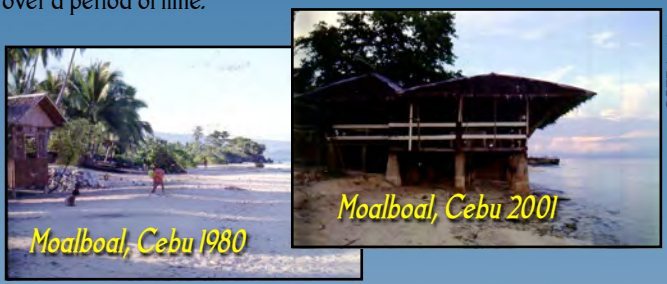


Figure 7. Photo of a same location in Moalboal twenty-one years apart.

Accurate estimates of the severity, timing and spatial patterns of coral bleaching and mortality are essential if we are to gauge the extent of the threat and to develop appropriate management actions to address the ecological and social impacts.

How do I measure or quantify coral bleaching?

The most common way to measure the level of bleaching is to first determine the percentage of the reef surface which is covered by hard and soft corals, and then to record the percentage of bleached coral.

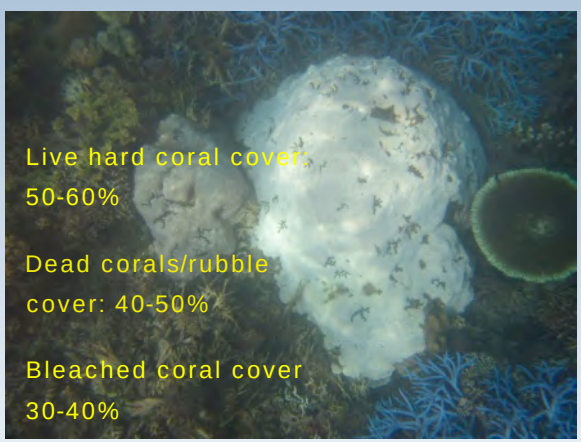


Figure 8. An example of how to estimate coral bleaching cover.

It is important to carry out some surveys prior to bleaching, so that specific 'before' and 'after' comparisons can be used to gauge ecological impacts.

How do I identify coral bleaching from other "white coral"?

Many people automatically spot white coral as coral bleaching. However, most of the time, it is not the case. This bleaching manual focuses on mass coral bleaching that is caused by an increase in sea surface temperature. Here are some notes that will help you identify coral bleaching:

1. If you see white coral (usually patchy) only in one or two sites, it is unlikely to be bleaching caused by increased sea surface temperature (SST). Increased SST would likely affect reefs in a vast area, if not the whole region.

2. If you see plenty of white corals, check for any presence of Crown of Thorns seastar (*Acanthaster plancii*) locally known as ***salanay*** or ***dap-ag***, or any other factors that may have caused it, like cyanide fishing and dynamite fishing in the area.

Figure 9. A Crown-of-Thorns seastar eating a massive coral.

3. If you see a white coral, look for a pattern within the colony. Many coral diseases also make corals white. The easiest way to identify disease is by locating a band. You can see the white area surrounded by a band (can be white, black or brown), which distinguishes them from the healthy part of the coral. Those who are "quite ill", will probably also have dead coral spots in them.

4. If you see white coral, check the life form. Mass coral bleaching tends to affect certain species or kind of corals before affecting others. There are a lot of exceptions, but the rule of thumb is that the branching corals will be affected before the massive corals. So, if you see a white massive corals surrounded by healthy branching corals, it is unlikely to be caused by increased SST.

5. Lastly, bleaching corals are still alive. Therefore, at closer look, you can still see the coral polyps (Fig.2, page 2).

Broad-scale synoptic surveys

Broad-scale surveys are an excellent way of getting a general overview on location and extent of bleaching. It requires very minimum equipment and can be performed by anyone. Some of these methods are discussed further below.

A. Questionnaire

One method in assessing coral bleaching that does not require extensive fieldwork is the questionnaire. Various groups and organizations around the world have created their own questionnaires that suit the specific situation of their area. One example of these is ReefBase and NOAA's Coral Bleaching Form (Appendix Ia and Ib). They have jointly developed a form which allows observers to record observations of coral bleaching in their area. The bleaching questionnaire fulfills two important functions. First, it provides information on the basic aspects of bleaching events. Second, it can be shared and distributed to other people in your area to gain additional information of the distribution, severity and basic characteristics of the bleaching events. Other forms of bleaching questionnaires are found in Appendix I. While these questionnaires may be different from each other, their purpose and content are similar.

B. Manta Tow Survey

(Uychiaoco et. al. 2001 and English et al. 1994)

This method is best for obtaining a general description of large reef areas or measuring broad change in abundance and distribution of organisms and large scale disturbances such as storm damages and crown of thorns infestations.

Requirements:

Geographic positioning system (GPS) or a compass

Map

Underwater slate board

Mask and snorkel

Manta board

Rope

Watch

Small boat and fuel

This method involves a snorkeler/observer being towed behind a boat at a constant speed with regular stops every two minutes.

Prior to actual survey, plan and mark the tow survey path along the reef area on the map.

When the observer (snorkeler) is ready and gives the "OK" signal, tow the observer parallel and over the reef edge, along the area to be surveyed.

Meanwhile, a person on the boat should keep track of the time as well as the observer's safety. The timer also then marks their current position using a GPS.

After two minutes of towing (approx. 100 to 150m), the "timer" on the boat should inform the boat operator and the observer to stop, in order for the observer to record his/her data on the manta board.

Repeat the whole procedure until the whole area planned to be surveyed is covered.

C. Timed-swim survey
(Oliver et. al. 2004)

Timed swim surveys provide accuracy since observers can spend more time in a particular area and get closer to the substrate to ensure optimal visual resolution.

Requirements:

Mask and snorkel

Underwater slate board

Watch

SCUBA equipment (Optional)

An observer should enter the water using SCUBA or snorkeling equipment. Closer distances should be used to verify coral condition when needed.

At each site, swim slowly along the reef, for a period of two minutes, keeping within the prescribed depth zone. Height above the substrate should be about 2 meters, depending on the visibility.

The observer should record all variables on the data sheet at the end of each two-minute period.

Finer-scale survey

Fine scale monitoring provides the greatest level of detailed data. It should only be used when there is a need to reliably detect small to moderate bleaching effects. However, this method requires certain level of training and equipment and should be conducted only by trained personnel.

A. Line intercept transect (LIT) method (English et. al., 1994)

The line intercept transect method is recommended as a suitable method for most purposes. It provides a measured value for cover and bleaching that is not possible from area assessments where the cover is estimated rather than directly measured.

Requirements:

SCUBA equipment

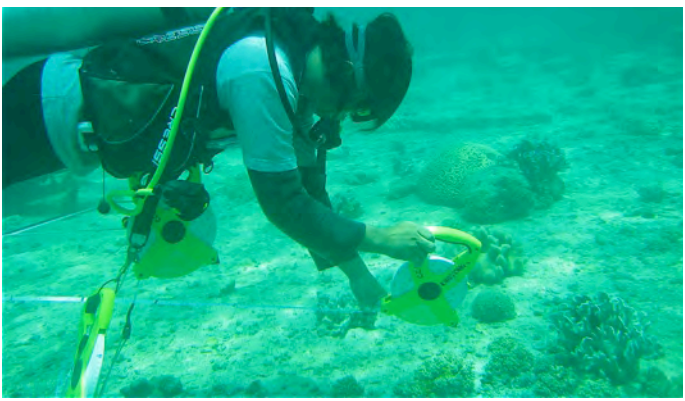
Transect tape (30-50m)

Underwater slate board

Small boat and fuel

Stations for LIT monitoring should be selected based on an analysis of the synoptic surveys. A minimum of three 25m transects should be laid haphazardly within the area. In cases where the coral habitat is patchy, it may be better to use a larger number (5) of shorter (10m) transects. Two depth zones (shallow and deep) should be sampled at each site whenever possible. Distance between transects should be at least 10 meters apart.

The first observer should lay the transect tape at a certain depth of the reef following the reef contour.



While the transect line is being laid out, the second observer can record details of the site, depth, etc., on the datasheet.

Once the transect line has been laid out, the second observer moves slowly along the transect, recording onto the data sheet the lifeforms (Figure 10) encountered under the tape.

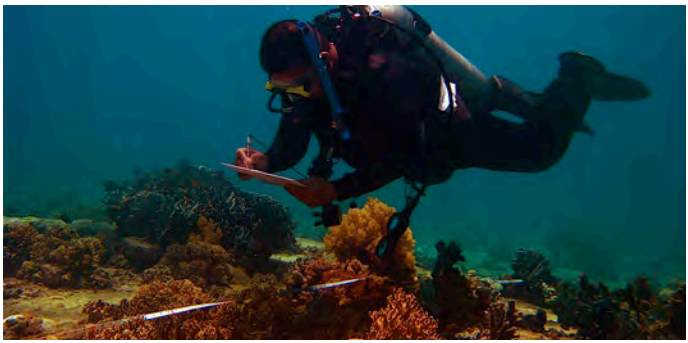


Figure 10. Sample of Life Forms datasheet

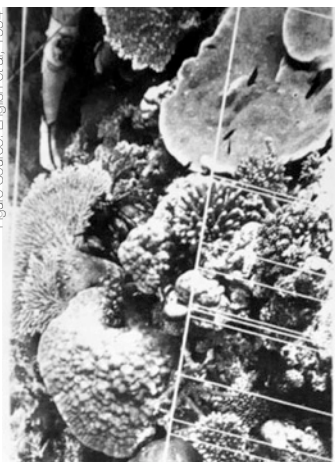


Figure Source: English et al. 1994

Transition	Category
57	CF
60	AA
80	ACD
89	AA
100	CM
102	AA
104	CM
122	A
136	ACB

Table 2. Lifeform categories and their corresponding codes

Lifeform	Code	Lifeform	Code
Acropora Encrusting	ACE	Soft Corals	SC
Acropora Branching	ACB	Other Animals	OT
Acropora Tabulate	ACT	Mushroom Corals	CMR
Acropora Digitate	ACD	*Millepora*	CME
Acropora Submassive	ACS	*Heliopora*	CHL
Coral Foliose	CF	*Halimida*	HA
Coral Encrusting	CE	*Zoanthids*	ZO
Coral Branching	CB	Sponges	SP
Coral Massive	CM	Turf Algae	TA
Coral Submassive	CS		

What can you do if you see bleaching?

There are plenty of ways you can help if you notice a bleaching event, including:

1. Inform your local officials about the event (e.g. municipal/city agricultural office, local environmental agencies in your area, environmental NGOs working in your area).

2. Report signs of coral bleaching in your area by emailing us at contactccef@gmail.com

   i. Tell us where, when, the depth and the category of bleaching (see appendix 4) that you observed.

   ii. If possible, get water temperature readings and take underwater photos or videos of corals and invertebrates that are bleached

   iii. Report other factors that may have caused bleaching

   iv. If you have conducted a survey (questionnaire, broad-scale and fine-scale surveys) in your area, send us your raw data. Your contributions will be greatly appreciated and properly acknowledged.

3. Visit Philippine Coral Bleaching Watch on the web (https://phcoralbleaching.crowdmap.com/main) and submit an online report form.

4. Log on to facebook and join the Philippine Coral Bleaching Watch Group. Provide them with the same information stated above.

5. Manage other stressors like destructive fishing methods, pollution, siltation, SCUBA diving related effects and other destructive factors to aid in the recovery after a coral bleaching event.

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Appendices

Appendix 1a. ReefBase/NOAA Coral Bleaching Form
Appendix 1b. Dr. Licuanan Coral Bleaching Report Form
Appendix 2. Manta Tow and Timed Swim Form (ReefBase/NOAA)
Appendix 3. Line Intercept Transect Form
Appendix 4. Site Bleaching Category (ReefBase/NOAA)

Index	Percent	Description	Visual Assessment
0	<1	No Bleaching	No bleaching observed, or only very occasional, scattered bleached colonies
1	1–10	Low or Mild Bleaching	Bleached colonies seen occasionally and are conspicuous, but vast majority of colonies not bleached
2	11–50	Moderate Bleaching	Bleached colonies frequent but less than half of all colonies
3	49–90	High Bleaching	Bleaching very frequent and conspicuous, most corals bleached all colonies
4	>90	Extreme Bleaching	Bleaching dominates the landscape, unbleached colonies not common; the whole reef looks white

APPENDIX 4

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