



COSPPac Ocean Portal About: Coral Bleaching

In Brief

Coral bleaching alerts are available in both **near real-time**, and **forecast** out to **4 weeks, 8 weeks, and 12 weeks** from NOAA Coral Reef Watch. The near real-time alerts are derived from satellite remote sensing of sea surface temperature (SST) and the forecast is based on the Climate Forecast System (CFS) computer model.

Introduction

Coral bleaching refers to the process whereby corals expel their symbiotic algae (zooxanthellae), leaving the white skeleton visible through the transparent coral tissue. Bleaching is a common stress response of corals, caused on broad scales by elevated sea temperatures. During periods of unusually high sea temperatures, corals can bleach and may eventually die if the heat stress is intense and sustained over several weeks. Aside from temperature, bleaching can also be caused by other stresses such as freshwater inflows, nutrient pollution and intense light.

Different species of coral have different responses and vulnerability to thermal stresses. For example, branching corals are more likely to experience bleaching at lower thermal stress levels than massive corals that are more resilient (Marshall and Baird, 2000).

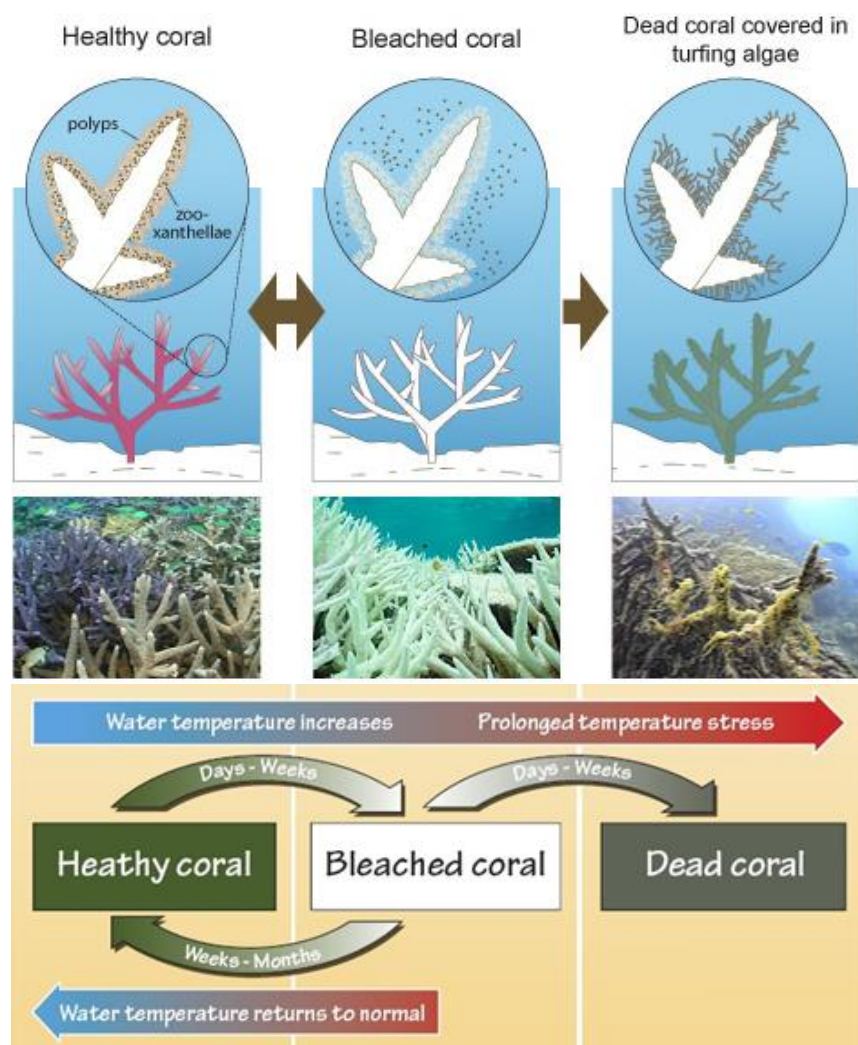


Figure 1. Coral bleaching process caused by elevated SST.
Source: Great Barrier Reef Marine Park Authority



The coral bleaching datasets in the ocean portal provide bleaching alerts that summarise the location, coverage, and potential risk level of the current coral bleaching thermal stress conditions. A set of thermal stress gauges reflect the highest observed bleaching alert level surrounding selected islands or countries, as seen in Figure 2.

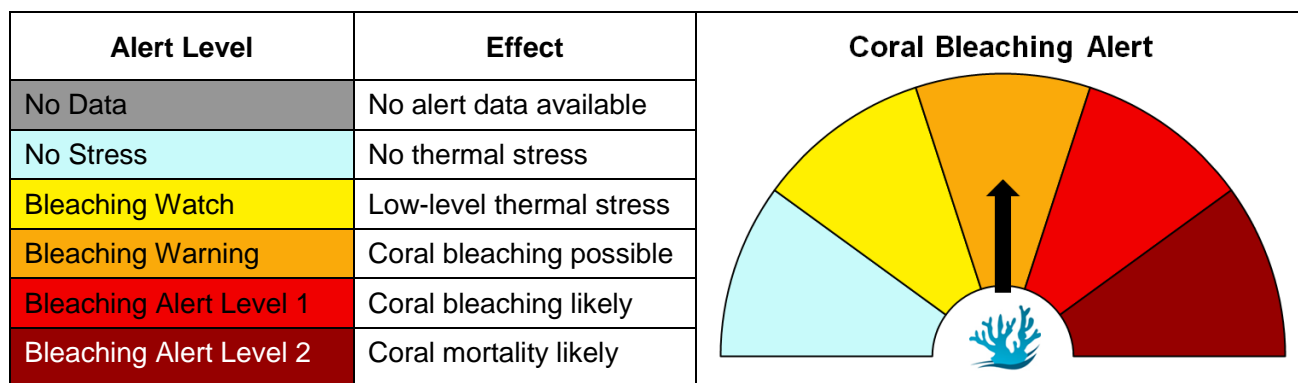


Figure 2. Bleaching alert level colours and the possible resulting effect, with an example alert dial.

Using the Portal

(1) For a regional view of a Pacific Nation's EEZ, select the country's name from this drop down box.

Country/Region Pacific Ocean

Variable Coral Bleaching Alert

Plot Type Surface Map

Period Daily

Date Click to open calendar

Dataset Coral Reef Watch

Submit

About Coral Reef Watch

(2) If "Coral Bleaching Alert" is selected, the next step is to select the date of interest from the pop-up calendar.

(3) Click the 'submit' button to produce your map.

Description of Parameters

Bleaching Alert:

Defined in the table below, the bleaching alert levels are based on current values of the coral bleaching HotSpot and Degree Heating Weeks (DHW) products. HotSpot is defined as the positive difference between the satellite-observed SST and the climatologically averaged temperature for the warmest month at that pixel. Degree Heating Weeks is the accumulated thermal stress, and is calculated as the sum of all values of HotSpot $\geq 1^{\circ}\text{C}$ during the past 12-week period at that pixel. In the Bleaching Alert Area product every pixel has an alert level defined and is color-coded (see Table 1). The alert reflects





the maximum thermal stress experienced in the prior seven days. The data are at 0.05 degree (5 km) resolution, updated daily.

Table 1. Coral bleaching thermal stress levels based on the [NOAA Coral Reef Watch 5-km Coral Bleaching HotSpots and DHW products](#).

Alert Level	Level Definition	Effect
No Stress	HotSpot ≤ 0.0	No thermal stress
Bleaching Watch	Watch $0.0 < \text{HotSpot} < 1.0$	Low-level thermal stress
Bleaching Warning	$1.0 \leq \text{HotSpot}$ and $0.0 < \text{DHW} < 4.0$	Coral bleaching possible
Bleaching Alert Level 1	$1.0 \leq \text{HotSpot}$ and $4.0 \leq \text{DHW} < 8.0$	Coral bleaching likely
Bleaching Alert Level 2	$1.0 \leq \text{HotSpot}$ and $8.0 \leq \text{DHW}$	Coral mortality likely

A status level of "Bleaching Watch" means that there is low-level thermal stress present at that location but not of sufficient magnitude to accumulate stress for corals, should they exist in that location. Previous thermal stress exposure may still have adverse impacts on the corals, although recovery may be underway. If SST at a location exceeds the bleaching threshold (maximum monthly mean climatology + 1°C, = HotSpot of 1°C) then a bleaching warning is issued. Alert Level 1 indicates that DHW has reached 4°C-weeks and coral bleaching is likely to occur for some coral species. Alert Level 2 indicates DHW has reached 8°C-weeks and both widespread bleaching and significant coral mortality are likely. The bleaching intensities given are representative of ecosystem impacts for most coral reef communities. Coral species more susceptible to thermal stress may experience bleaching during a Bleaching Warning, while resistant species may only bleach during Alert Level 2. A worked example of the bleaching alert calculation for one pixel location is show in Table 2.

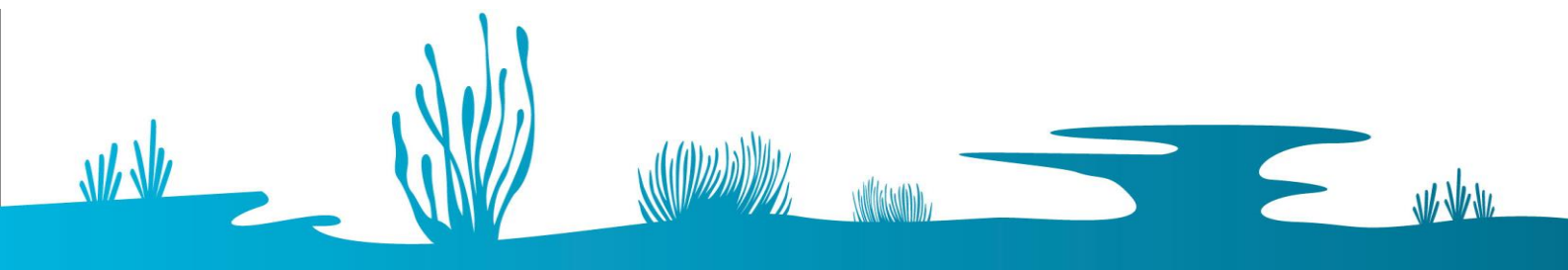
Table 2. Worked calculation over 22 weeks for the bleaching alert level, shown as colours.

	Week Number																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Observed SST	26	26	26	27	27	28	28	29	29	30	30	31	30	31	30	31	32	32	31	30	29	28
Average SST for warmest month	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1
Difference between obs & warmest month SST	-3.1	-3.1	-3.1	-2.1	-2.1	-1.1	-1.1	-0.1	-0.1	0.9	0.9	1.9	0.9	1.9	0.9	1.9	2.9	2.9	1.9	0.9	-0.1	-1.1
HotSpot	0	0	0	0	0	0	0	0	0	0.9	0.9	1.9	0.9	1.9	0.9	1.9	2.9	2.9	1.9	0.9	0	0
Degree Heating Weeks	-	-	-	-	-	-	-	-	-	-	-	-	1.9	1.9	3.8	3.8	5.7	8.6	11.5	13.4	13.4	13.4

Bleaching Outlooks:

The seasonal coral bleaching thermal stress outlook product has a 0.5°x0.5° spatial resolution and is based on sea surface temperature (SST) forecasts generated by an operational, dynamical, fully coupled ocean-land-atmosphere seasonal climate forecast model. The output is probabilistic, showing 60% chance of the thermal stress occurring. Alert forecasts are presented for 4 weeks, 8 weeks, and 12 weeks in the future.

In a normal year, the outlook forecasts no potential for bleaching. When the forecast SST exceeds bleaching thresholds over a long enough period to cause bleaching, the Outlook maps display the





bleaching potential. Actual conditions may vary due to model uncertainty, subsequent changes in the broad-scale climate, extreme localized variability, or weather patterns.

Examples of Applications

Bleaching Response & Management

When combined with the implementation of a management plan, advanced knowledge of potential bleaching events can reduce the severity of the bleaching event and aid in recovery. Following a bleaching event, coral recovery can be inhibited by opportunistic algae growth. Limiting fishing in the region can increase fish populations, which in turn maximises the consumption of plant growth and limits their impact on the corals. Corals are also impacted by poor water quality. Therefore, land management practices which reduce chemical and sediment runoff can also help coral recover in the event of bleaching.

The bleaching alerts serve as an early warning system. Once a potential bleaching event is detected, a management plan should be implemented to reduce the impacts of the bleaching. An example of a management plan based on basic resources is listed below (Marshall and Schuttenberg, 2006).

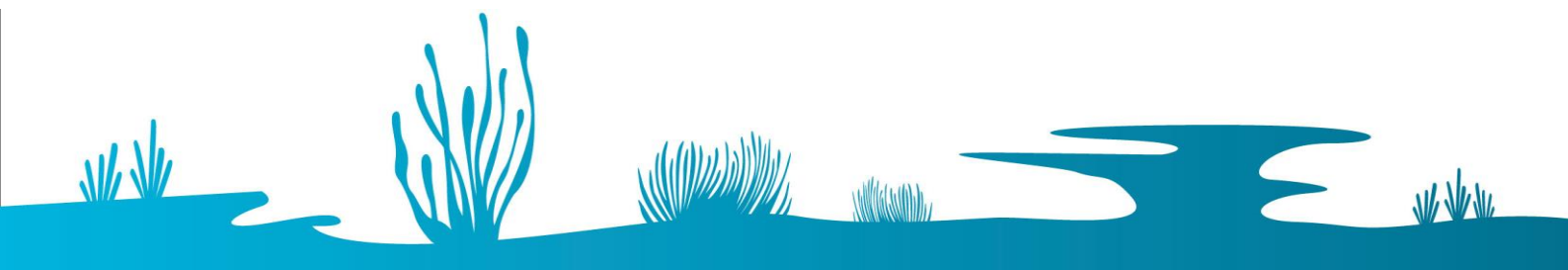
- Early Warning System
 - Identify potential bleaching event
 - Monitor the coral reef sites
- Impact Assessment
 - Assess severity of the bleaching
 - Identify coral types affected
 - Report bleaching event to ReefBase
(see Links section for online form; offline form is in Appendix A)
- Management Interventions
 - Protect herbivore populations through fishing regulations
 - Protect water quality by limiting harmful land-use practice
- Communication
 - Talk to local community and media about bleaching event
 - Brief senior decision makers
 - Meet with other key stakeholders

Data Source

The [Bleaching Alert Area data](#) are part of the NOAA [Coral Reef Watch](#) suite of products. The alerts are derived from SST measurements sourced from the NESDIS daily global 5-km geostationary-polar-orbiting (geo-polar) blended night-time-only SST analysis (Liu et al, 2014).

The [weekly 0.5-degree thermal stress outlooks](#) are derived from the NOAA/National Weather Service/National Centers for Environmental Prediction's (NCEP) Climate Forecast System (CFS). A detailed description of the CFS-based Seasonal Bleaching Outlook product is given in Eakin et al. (2012).

Links





NOAA Coral Reef Watch Home web page:

<http://coralreefwatch.noaa.gov/satellite/index.php>

ReefBase Bleaching Report

<http://www.reefbase.org/contribute/bleachingreport.aspx>

A Reef Manager's Guide to Coral Bleaching

http://www.gbrmpa.gov.au/_data/assets/pdf_file/0013/4450/Gbrmpa-ReefManagersGuidetoCoralBleaching.pdf

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References

Eakin, C.M., G. Liu, M. Chen, A. Kumar (2012). Ghost of bleaching future: Seasonal Outlooks from NOAA's Operational Climate Forecast System. Proceedings of the 12th International Coral Reef Symposium, Cairns, Australia, 9-13 July 2012. --- [Free download](#) from the conference website.

Liu, G, Heron SF, Eakin CM, Muller-Karger FE, Vega-Rodriguez M, Guild LS, De La Cour JL, Geiger EF, Skirving WJ, Burgess TFR, Strong AE, Harris A, Maturi E, Ignatov A, Sapper J, Li J, Lynds S (2014) Reef-scale Thermal Stress Monitoring of Coral Ecosystems: New 5-km Global Products from NOAA Coral Reef Watch. *Remote Sensing* 6(11): 11579-11606, doi:10.3390/rs61111579.

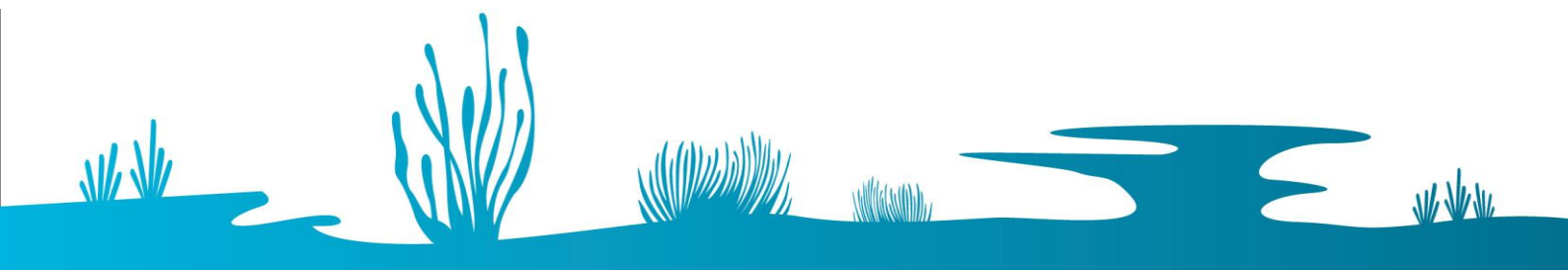
--- [Free download](#).

Marshall, P.A., Baird, A.H. (2000). Bleaching of corals on the Great Barrier Reef: differential susceptibilities among taxa. *Coral Reefs* 19: 155-163.

Marshall, P. and Schuttenberg, H., 2006. A Reef Manager's Guide to Coral Bleaching. Great Barrier Reef Marine Park Authority, Townsville. (see links section for free download)

Contact

For more information, please email cosppac_comp_unit@bom.gov.au





Appendix A: ReefBase Coral Bleaching Report Form

Coral bleaching, which occurs predominantly during periods of hot, calm weather, is a major threat to coral reef health and survival. Bleached corals appear white or extremely pale compared to their natural brownish color. If you have made any observations of coral bleaching, please provide details of your observation below, or submit an online report at <http://www.reefbase.org/contribute/bleachingreport.aspx>. Your contribution will be made available on the ReefBase web site for managers and researchers interested in managing the impacts of bleaching on coral reefs.

Name		Contact/Email	
Organization (if applicable)			
Country/Territory/State			
Reef or Site Name		Latitude and Longitude (if known)	
Date of observation			
Did you observe coral bleaching (pale or white colonies) on the reef during your visit?			
<input type="checkbox"/> No <input type="checkbox"/> Yes – If yes, please complete the rest of the form. If no, please send the form with only the site details above filled in.			
Approximate area surveyed (m ²)		Type of survey conducted (line transect, belt transect, quadrat, etc.)	
Number of surveyors		Skill level of surveyor(s): (beginner, intermediate, advanced, expert)	
Water temperature		Location in reef zone (slope/reef flat/ etc.)	
Type of Coral dominating the reef (List top 5 species or common names)			
Depth bleaching was observed		Date bleaching started (if known)	
Percentage of live coral cover on reef		Percentage of live coral that is bleached	
Type of live Coral bleached (List top 5 species or common names)			
Percentage of dead coral on reef			
Type of dead Coral (List top 5 species or common names)			
Other observations			

Please e-mail, mail, or fax this report to:

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