REEF SNAPSHOT

SUMMER
2022–23

Australian Government
Great Barrier Reef Marine Park Authority

Australian Government
Australian Institute of Marine Science

CSIRO

Acknowledgement of Country

We acknowledge the continuing sea country management and custodianship of the Great Barrier Reef by Aboriginal and Torres Strait Islander Traditional Owners, whose rich cultures, heritage values, enduring connections and shared efforts protect the Reef for future generations.

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This snapshot draws on various types of information, including:
Climate time series data (http://www.bom.gov.au/climate/change)
Cyclone wave damage predictions (www.nature.com/articles/srep26009)
eReefs GBR1 rivers 2.0 model data (https://geonetwork.nci.org.au/geonetwork/srv/eng/catalog.search#/metadata/f9142_3105_0672_4156)
Eye on the Reef program data (www.gbrmpa.gov.au/our-work/eye-on-the-reef)
Long-Term Monitoring Program survey reports (https://apps.aims.gov.au/reef-monitoring/sector/list)
ReefTemp data (www.bom.gov.au/environment/activities/reeftemp/reeftemp.shtml)

About this snapshot

Summer is a critical time for the health of coral. This snapshot provides a summary of conditions on the Great Barrier Reef (the Reef) throughout summer, how these conditions impact coral and actions underway to help coral reefs. The snapshot focuses on coral. The health of other habitats or species is not assessed, although this may be added in future snapshots.

Each year, towards the end of summer, the snapshot is prepared by the three main Australian Government agencies responsible for Reef management and science: the Great Barrier Marine Park Authority (Reef Authority), Australian Institute of Marine Science (AIMS), and CSIRO.

This snapshot is based on the latest information available at the time of writing. It does not take the place of ongoing rigorous reporting by all agencies. It sets the scene for the more comprehensive reports released later in the year, such as the mid-year Long-Term Monitoring Program reports by AIMS, and reports from the Marine Monitoring Program managed by the Reef Authority.

Summary for 2022–23

- Compared to previous summers, cumulative impacts were low this summer.
- Slightly above average water temperatures led to minor coral bleaching on selected reefs in all regions.
- No cyclones crossed the Reef during the 2022–23 summer.
- Some rivers in the catchment reached major flood levels, with flood plumes reaching offshore reefs in the northern region and the Whitsunday Islands in the central region.
- Crown-of-thorns starfish remain at outbreak or potential outbreak levels in the Swain reefs. The Crown-of-thorns Starfish Control Program continues to work in all three regions to cull starfish down to non-outbreak levels.

Coral monitoring programs

AIMS has been monitoring the length and breadth of the Reef for more than 35 years.

The Long-Term Monitoring Program is the most comprehensive record of coral reef condition available for the Reef, with a focus on the long-term trends in coral decline and recovery. This summer 70 reefs with fixed sites were surveyed and 103 reefs were surveyed by manta tow, with more to be completed by the end of May.

A further 32 inshore reefs are monitored as part of the Reef Authority's Marine Monitoring Program.

Additional observations are gathered by the multiple organisations and people contributing to the Eye on the Reef program, including through the Reef Joint Field Management Program.

What has the Reef experienced?

Just like any natural system, the Reef goes through cycles of disturbance and recovery. Given the Reef is very large, disturbances affect it at a range of local and regional scales. This means conditions on the Reef can be variable across different locations.

During summer, no cyclones crossed the Reef. Elevated water temperatures were observed over winter, with spring being the hottest on record and the warmer waters continuing into early summer. This led to minor levels of coral bleaching across the Reef during summer.

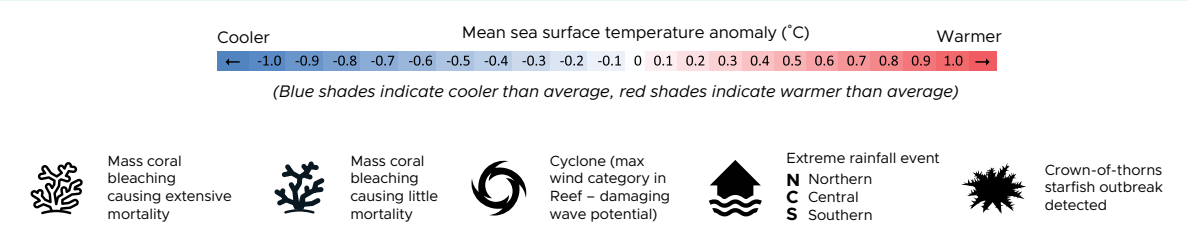
Low or moderately bleached corals have a higher likelihood of recovering, whereas severely bleached corals have higher mortality rates.

Climate change remains the greatest threat to the Reef. It influences weather patterns and the ocean's temperature, pH level and currents, as well as intensifying the effects of other threats. Climate change is escalating, and the Reef is already experiencing the consequences of this.

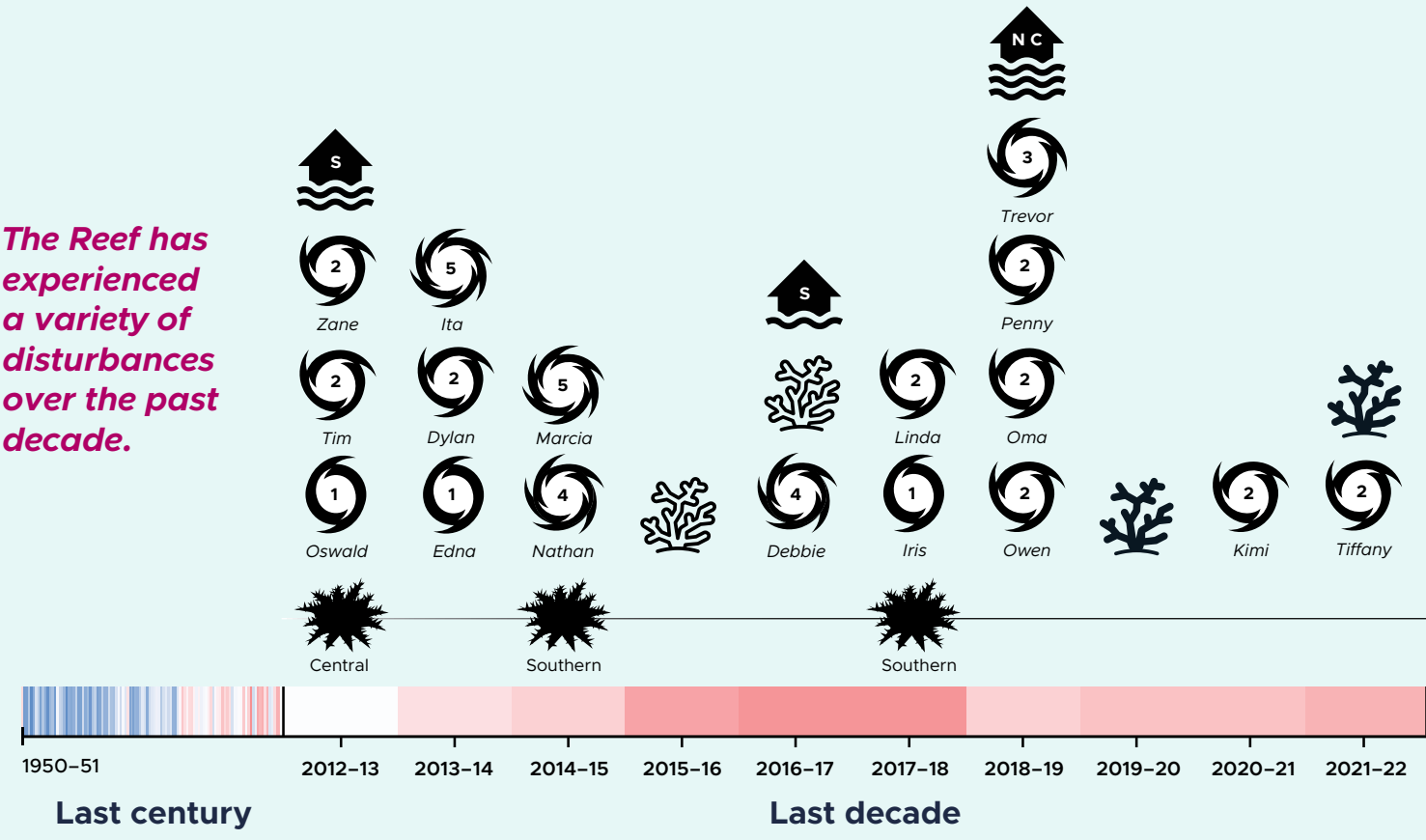
Unfortunately, the events that cause disturbances on the Reef are becoming more frequent, leaving less time for coral recovery.

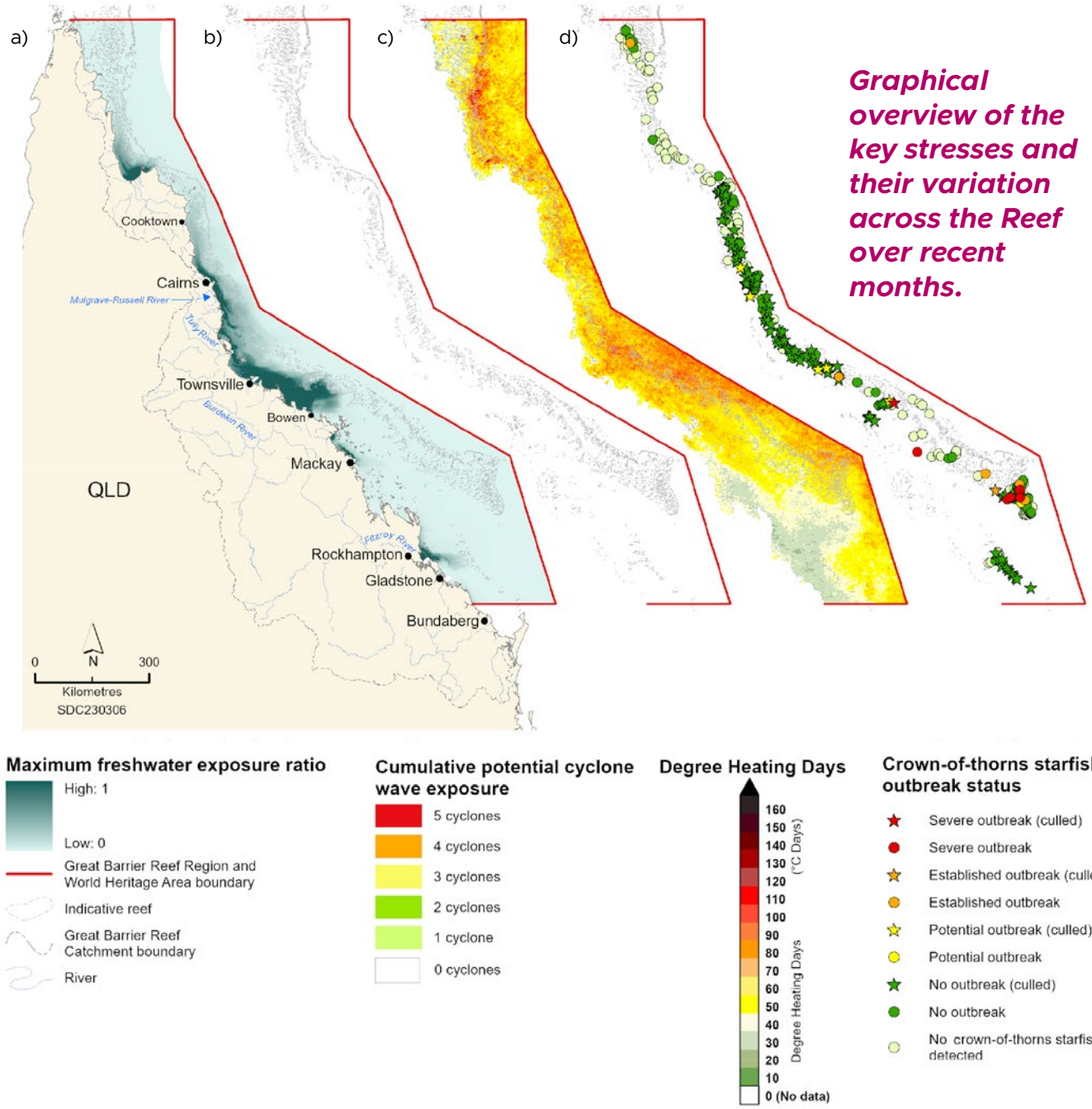
Four key stresses on coral reefs:

- **Above average sea temperatures**: An increase of only one degree Celsius above the average maximum sea temperature for six weeks can trigger coral bleaching.
- **Cyclones and storms**: Powerful waves generated during cyclones can seriously damage habitat, particularly coral reefs.
- **Flood plumes**: When large volumes of fresh, muddy water flow from the catchment into the ocean after intense or prolonged rainfall, it is called a flood plume. Flood plumes affect water quality, mainly by reducing clarity due to increased sediments and nutrients within the water. This can affect coral health and recruitment.
- **Crown-of-thorns starfish**: Crown-of-thorns starfish are a native coral predator, but when populations reach outbreak status (approximately 15 starfish per hectare), they eat coral tissue faster than corals can grow.



The Reef has experienced a variety of disturbances over the past decade.





Graphical overview of the key stresses and their variation across the Reef over recent months.

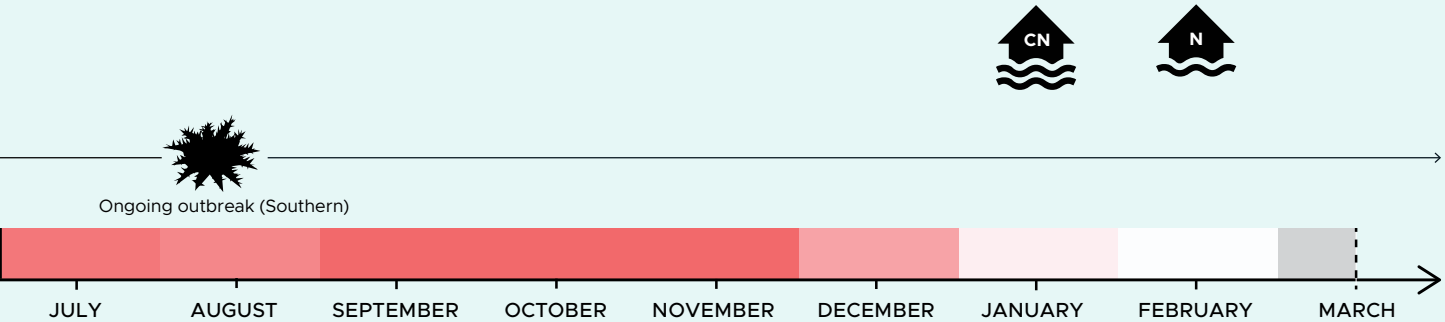
Recent conditions across the Reef

a) Maximum exposure to water from rivers on any single day between 1 October 2022 and 12 March 2023. Exposure values represent the ratio of freshwater to seawater at the sea surface, calculated using aggregated model data from the one-kilometre resolution eReefs hydrodynamic model version 2.0 (GBR1_H2p0). Data from CSIRO.

b) Estimated cumulative exposure to destructive waves (significant wave height of four metres or greater) from tropical cyclones between 1 July 2022 and 16 March 2023. Some outer shelf reefs potentially experienced big swells from Tropical Cyclone Gabrielle which tracked along the outside of the Reef. Data from AIMS.

c) Accumulated Degree Heating Days (DHD) as of 16 March 2023. The map shows 14-day DHD accumulated over the Reef during the period 1 December 2022 to 16 March 2023, based on the IMOS 2002-2011 climatology. This map is likely to be an overestimate of the actual heat stress because of constraints due to missing data from cloud cover. Data from the Bureau of Meteorology.

d) Crown-of-thorns starfish outbreak level observations between 1 July 2022 and 16 March 2023. Data from the Reef Authority and AIMS.



What does this mean for coral?

Between September and March surveys were conducted on the Great Barrier Reef to help us understand how corals have been faring in different regions during the summer. The information below summarises the current coral condition up to the middle of March 2023. It provides information regarding what has happened over summer and gives the long-term context for the new observations. More comprehensive analyses and summaries, including an update on the long-term effects of the 2022 mass coral bleaching, will be available later in the year and a timeline of key monitoring reports appears on the back page.

Northern

The northern region includes coral reefs from Cape York down to Lizard Island and Cape Tribulation.

In-water surveys (October to December):

Overall, hard coral cover within the northern region has stabilised after recovery from recent disturbances caused by cyclones, thermal stress and, at some sites, crown-of-thorns starfish. There have been declines in coral cover in Cape Grenville (4 per cent) and Princess Charlotte Bay areas (8 per cent), and a slight increase (6 per cent) in the Cooktown-Lizard Island area.

More than half of the reefs within the region increased in hard coral cover. The surveys conducted this summer found Reef-wide coral cover on individual reefs ranged between 20 and 60 per cent in the Cape Grenville and Princess Charlotte Bay areas. Hard coral cover on reefs in the Cooktown-Lizard Island area ranged between 10 to 40 per cent.

Crown-of-thorns starfish were detected at around 30 per cent of the sampled reefs within the Cooktown-Lizard Island area and were observed on two reefs in the Cape Grenville and none in Princess Charlotte Bay areas.

Minor bleaching was observed at isolated reefs across the northern region.

Central

The central region includes reefs from Cape Tribulation, down to the Whitsundays. This summer, some reefs off Cairns, Townsville, Innisfail, and the Whitsunday areas were sampled.

In-water surveys (November to March):

Coral cover ranged from 14 to 45 per cent within the Cairns area. No crown-of-thorns starfish were recorded, and minor levels of bleaching were observed on some reefs.

During surveys in March, coral cover on the five surveyed reefs in the Innisfail area ranged from 11 to 23 per cent and had increased on all reefs since last surveyed.

Surveys of reefs in the Townsville area are incomplete at the time of publication. Coral cover on the nine reefs surveyed prior to publication show coral cover from 22 to 66 per cent. One crown-of-thorns starfish was found at Kelso Reef and minor levels of bleaching were observed at all reefs.

Reefs in the Whitsunday area ranged from 11 to 62 per cent coral cover. Most reefs showed a decrease in coral cover. Bleaching was variable among reefs with only minor levels being recorded on several reefs during the March surveys.

Southern

The southern region includes reefs from south of the Whitsundays down to the Capricorn-Bunkers and out to the Swain Reefs.

In-water surveys (August to February):

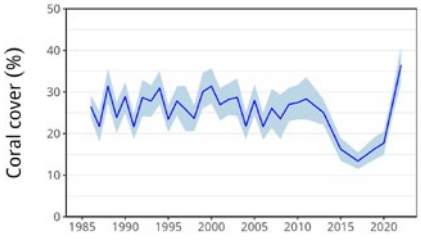
Reef-wide hard coral cover within the Capricorn-Bunker area ranged from 34 to 63 per cent, 13 to 62 per cent within the Pompey area and 9 to 17 per cent in the Swain Reefs area, although surveys in this region are incomplete.

Reefs in the Capricorn-Bunker area decreased in coral cover at all but one surveyed reef (since last visited). This was likely from swell generated by Tropical Cyclone Seth that passed outside of the Reef in December 2021-January 2022. Low densities of crown-of-thorns starfish were recorded at two surveyed reefs.

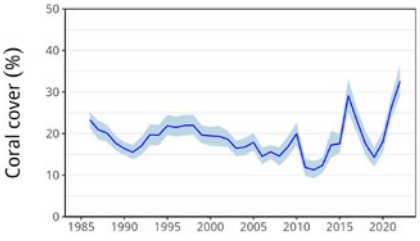
Eight out of nine reefs surveyed in the Pompey Reefs area increased in coral cover. A severe outbreak of crown-of-thorns starfish was recorded at Tern Islet, and an established level outbreak on Reef 21-187. No other surveyed reefs exhibited any signs of established, or potential outbreaks.

Crown-of-thorns starfish were found at all surveyed reefs in the Swain Reefs area, with two at established and one at severe outbreak level. Minor bleaching was observed at isolated reefs in the southern region.

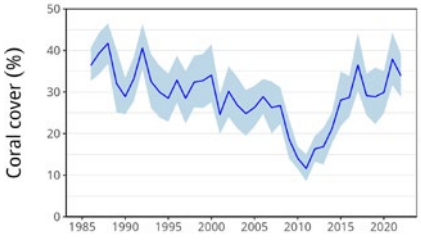
Northern: pre-summer



Central: pre-summer



Southern: pre-summer



Trend in coral cover for the northern, central and southern regions from 1985 to June 2022. At this time hard coral cover was at the highest ever recorded in the northern and central regions. Data from AIMS.

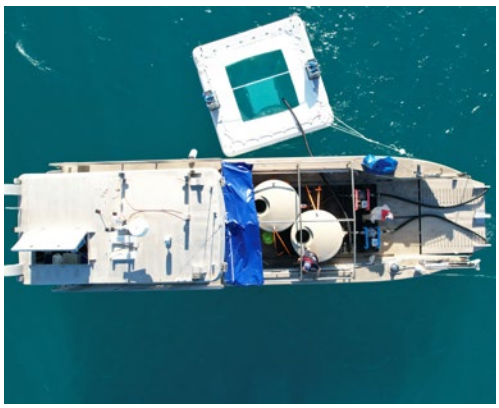
What are we doing to help coral?

Supporting coral reef resilience and recovery is vital. A combination of preventative and restorative actions, as well as ongoing research and management, are needed to protect coral and the species and communities that depend on it. Below are three examples of actions taken to help protect the Reef in the northern and central Great Barrier Reef.

Understanding the Reef

Researchers hit the water during the summer's coral spawning events to scale up the use of coral larvae for reef restoration. As part of the Reef Restoration and Adaptation Program (RRAP) Moving Corals subprogram, CSIRO, Southern Cross University, and Queensland University of Technology were testing a range of approaches for collecting wild coral spawn slicks, culturing these en masse, and delivering them to reefs at larger scales.

Two new technologies trialled included the collection and transfer of slicks using a 'coral spawn sucker', and the rapid delivery of cultured coral larvae to a 1.5 ha area of reefs from a moving vessel. The spawn sucker (pictured) features a custom-built intake for the transfer of coral spawn into large storage tanks. Rapid transfer can then take place from the tanks directly into culture pools. It took just 20 minutes to deliver more than 1.5 million larvae in 2,000 litres of water to the reefs.



The spawn sucker transfers slicks into the culture pool. A method of collecting coral spawn slicks means larvae can be transported anywhere across the Reef that has suffered major damage and does not have a natural supply of new larvae coming in.

Tourism eyes enrich data

Tourism operators along the length of the Reef contributed to the latest innovation in monitoring by simply uploading photographs of the Reef to the cloud. Thirteen operators methodically photographed the sites that they visit, and uploaded the images to the AIMS ReefCloud.ai platform, which uses artificial intelligence to analyse and extract data from the images.

ReefCloud information is used by the Reef Authority's Eye on the Reef program to monitor coral cover at these sites. The automation of photo analysis saves considerable time usually required to manually record and upload data, allowing more people to participate and help build an accurate record of changes in coral cover and diversity over time. This initiative is supported by the Queensland Government and follows a successful pilot program in Cairns where tourism operators collaborated with training and consulting company Marine Discoveries and the Reef Authority.

ReefCloud uses artificial intelligence (AI) to process coral reef images and estimate abundances of coral reef communities.

Tourism operators help to protect their patch

The Australian Government's $1.2 billion Reef protection package included a $15.1 million allocation provided to the Tourism Reef Protection Initiative (TRPI) to deliver reef protection and conservation at a range of locations in the Marine Park. The key focus of the Initiative is to support Reef protection services at more than 100 high value tourism sites through monitoring using Eye on the Reef surveys.

The monitoring services will be complemented by stewardship actions established through the site stewardship framework, which includes crown-of-thorns starfish mitigation, *Drupella* snail removal and additional assisted recovery actions where permitted. Also included in this initiative are on-country visits by Traditional Owners, as well as the Be A Marine Biologist for a Day program, which trains students and educators in citizen science.

Wavelength diver attaching a coral fragment to the reef rock.

What can you do?

See the Reef. Love the Reef. Protect the Reef.

The Reef is big, beautiful, and diverse and continues to support jobs and economies, and inspire people. Like all reefs around the world, the Reef faces challenges and is under pressure. Actions taken now, big or small, will matter. Regardless of where you live, you can make a difference at home and at work. Examples include reducing your electricity consumption, recycling, reusing plastics and reducing your emissions when getting around, such as walking or riding instead of driving. These all contribute to a healthy marine environment. We want you to be inspired by the Reef and tell others how they can help, as together, we can all make a difference. We ultimately want everyone to see the Reef, love the Reef and most importantly, protect the Reef.

Visit the Reef Authority for actions you can take to help love the Reef. www.gbrmpa.gov.au.

Understand and follow protection rules for the Reef.

Measures like zoning (e.g. access restrictions), permits, no anchoring areas, and extraction limits protect the Reef's biodiversity and long-term health. Before heading out to the Marine Park, ensure you know your zones by using tools such as the free Eye on the Reef app. By taking a little extra care when anchoring, and using moorings where available, you will help protect this delicate underwater landscape.

Reef health monitoring

Each year, data on the health of the Reef's corals are collected, analysed, and shared. The timing of data collection periods, report releases and related workshops are shown below.

<table>
<tr><th>Jul-Sep</th><th>Oct-Dec</th><th>Jan-Mar</th><th>Apr-Jun</th></tr>
<tr><td>Marine Monitoring Program surveys (inshore reefs)</td><td colspan="2">Long-Term Monitoring Program surveys (mainly mid and outer shelf reefs)</td><td>Marine Monitoring Program surveys (inshore reefs)</td></tr>
<tr><td colspan="4">Eye on the Reef (surveys/submissions)</td></tr>
<tr><td>Long-Term Monitoring Program Annual Summary Report on Coral Reef Condition</td><td>Pre-summer workshop</td><td></td><td>Reef Snapshot: Summer 2022-23</td></tr>
<tr><td>Marine Monitoring Program reports (annual)</td><td></td><td></td><td></td></tr>
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