Australian Government
Great Barrier Reef Marine Park Authority

EYE ON THE REEF®

Help protect the GREAT BARRIER REEF

TOURISM WEEKLY

Training Manual

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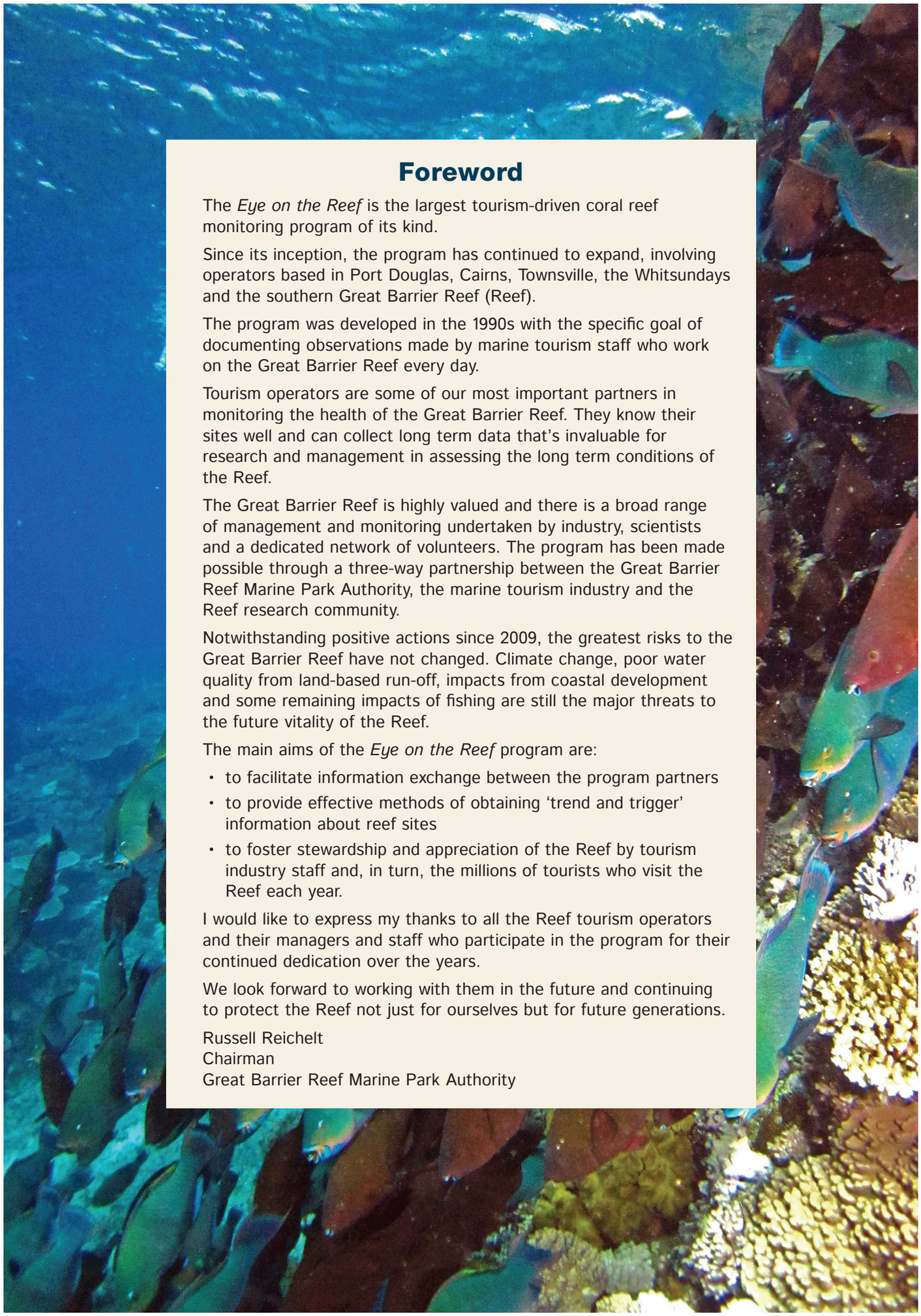


Foreword

The *Eye on the Reef* is the largest tourism-driven coral reef monitoring program of its kind.

Since its inception, the program has continued to expand, involving operators based in Port Douglas, Cairns, Townsville, the Whitsundays and the southern Great Barrier Reef (Reef).

The program was developed in the 1990s with the specific goal of documenting observations made by marine tourism staff who work on the Great Barrier Reef every day.

Tourism operators are some of our most important partners in monitoring the health of the Great Barrier Reef. They know their sites well and can collect long term data that's invaluable for research and management in assessing the long term conditions of the Reef.

The Great Barrier Reef is highly valued and there is a broad range of management and monitoring undertaken by industry, scientists and a dedicated network of volunteers. The program has been made possible through a three-way partnership between the Great Barrier Reef Marine Park Authority, the marine tourism industry and the Reef research community.

Notwithstanding positive actions since 2009, the greatest risks to the Great Barrier Reef have not changed. Climate change, poor water quality from land-based run-off, impacts from coastal development and some remaining impacts of fishing are still the major threats to the future vitality of the Reef.

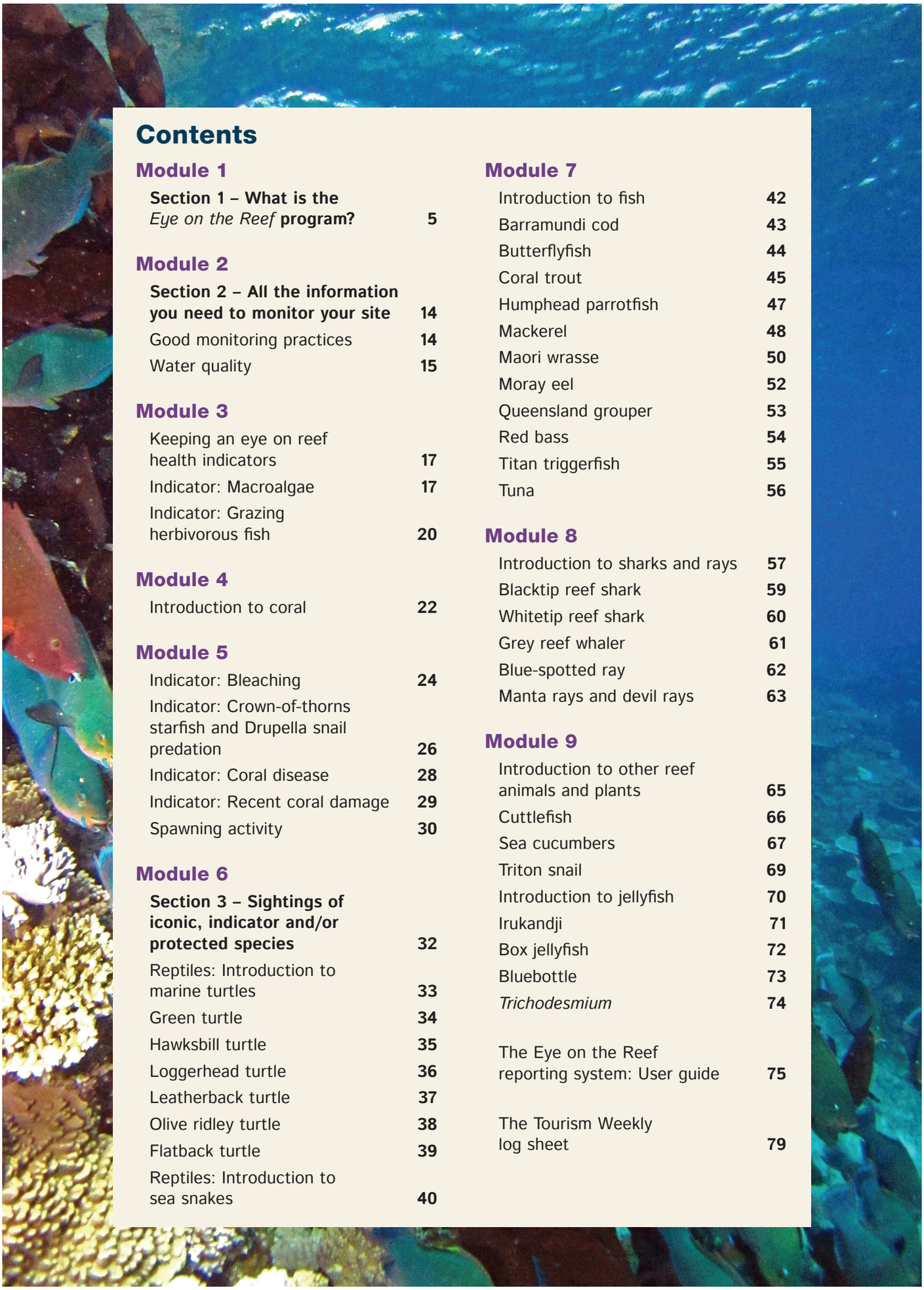
The main aims of the *Eye on the Reef* program are:

- to facilitate information exchange between the program partners
- to provide effective methods of obtaining 'trend and trigger' information about reef sites
- to foster stewardship and appreciation of the Reef by tourism industry staff and, in turn, the millions of tourists who visit the Reef each year.

I would like to express my thanks to all the Reef tourism operators and their managers and staff who participate in the program for their continued dedication over the years.

We look forward to working with them in the future and continuing to protect the Reef not just for ourselves but for future generations.

Russell Reichelt
Chairman
Great Barrier Reef Marine Park Authority



Contents

Section 1 What is the *Eye on the Reef* program?

Module 1

Eye on the Reef is an environmental management, monitoring and capacity-building stewardship program run by the Great Barrier Reef Marine Park Authority (GBRMPA). It involves a range of stakeholders, including tourism operators and staff, researchers, fishers and reef visitors.

In-water training

Under the umbrella of *Eye on the Reef* there are a number of monitoring programs that address various environmental and biological information needs, including Reef health, the presence and absence of protected and iconic species, water quality and incident reporting. These programs include:

- **Tourism Weekly Monitoring**
- **Sightings**
- **Rapid Monitoring**
- **Reef Health and Impact Surveys (RHIS)**

Information collected through *Eye on the Reef* contributes to a data management system that enables a wide range of Reef users, experts and managers to contribute to a Reef-wide picture of the ecosystem's health. It also helps assess the impact of environmental events such as floods, cyclones, coral bleaching and crown-of-thorns starfish (COTS) outbreaks.

> *Eye on the Reef gives me the information that allows me to share with passengers how vital environmental stewardship is to us as an operation, and to me as an individual. Conservation isn't "what we do," it's "who we are".*
>
> Russell Hosp,
> Passions of Paradise

Through this monitoring and reporting, GBRMPA can generate, assess and apply the best available information to improve our understanding of ecosystem resilience and risks to that resilience, and to develop response options. This will lead to better long-term understanding of Reef impacts and ecosystem function, and help us protect the Reef for the future.

Crown-of-thorns starfish and surveyor

Tourism staff participation in the monitoring rapidly increases staff knowledge of reef ecology. This builds the capacity of those staff to deliver experiences to guests and to provide valuable information to operation managers and owners.

The *Eye on the Reef Tourism Weekly Monitoring program (Tourism Weekly)* samples set sites for reef health indicators on a weekly basis.

The main aim of *Tourism Weekly* is to record indicators of reef health and the presence or absence of protected and iconic species, and then to share that information with program partners. As many tourism operators visit their sites daily or weekly, tourism staff are ideally placed to record observations about reef health and status. This program also seeks to foster stewardship of the Reef by tourism operators and their staff, and to provide opportunities to improve understanding of the natural processes of the Reef.

Why do we care?

The iconic majesty of the largest reef system on Earth has been recognised for its Outstanding Universal Value, being inscribed on the World Heritage List in 1981, and ranked the highest of all Australian icons.

However, the Great Barrier Reef is under increasing threat from:

- the declining quality of water entering the Great Barrier Reef
- degradation of coastal ecosystems
- climate change-related impacts, including sea temperature increase, ocean pH change, sea level rise and cyclone frequency
- direct use, including dredging, dredge material disposal, fishing, marine debris and oil spills
- coastal development and national industrialisation.

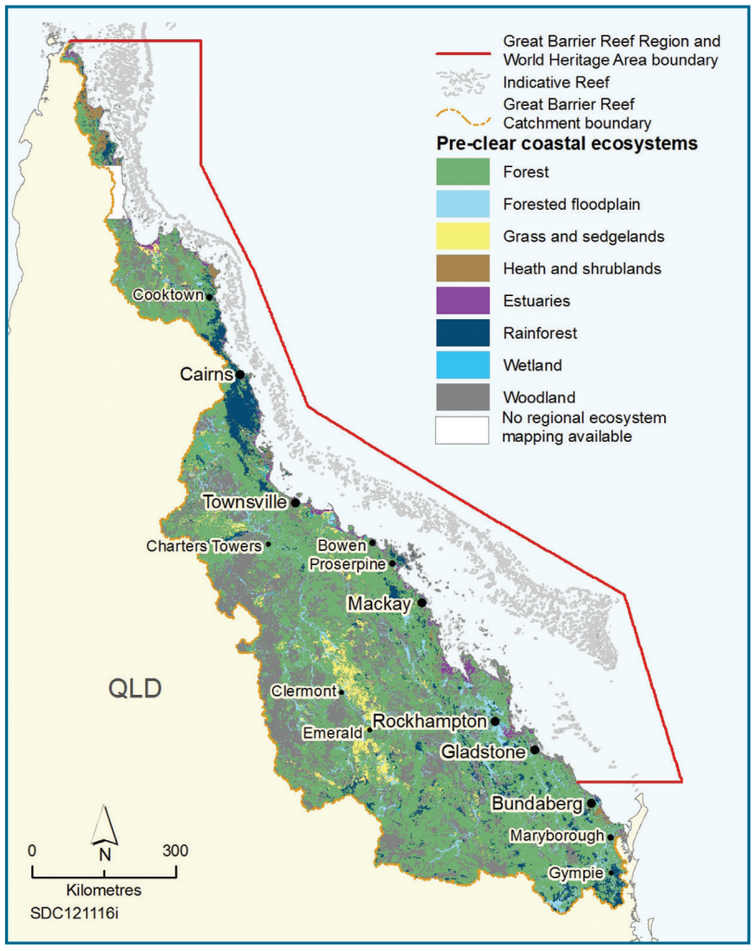
These threats have resulted in:

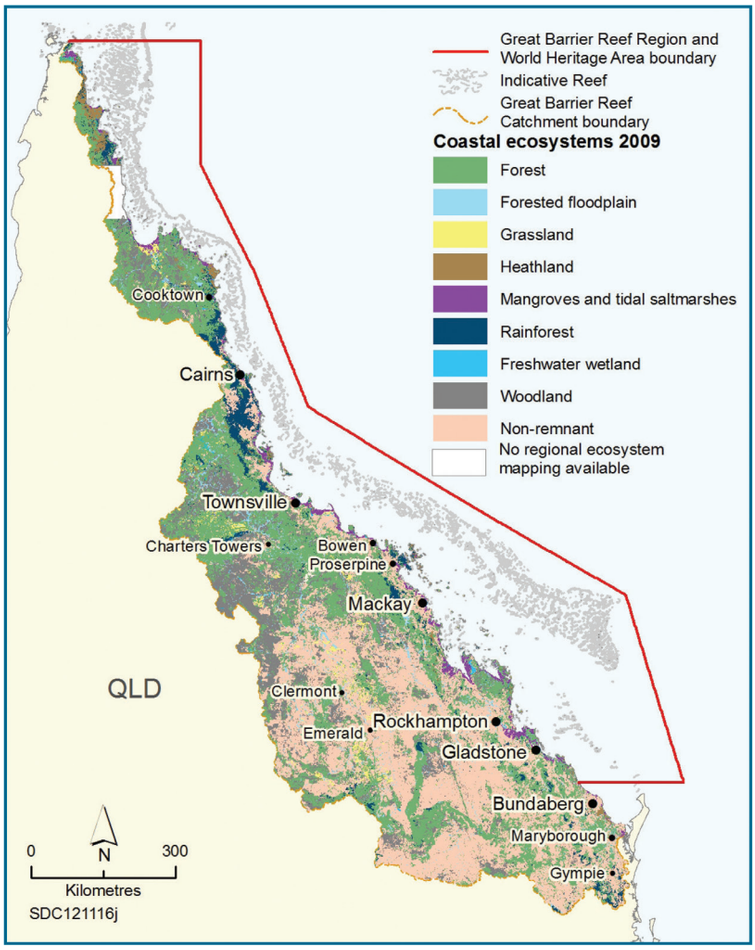
- inshore biodiversity decline, especially snubfin dolphins, dugongs and turtles
- an estimated coral cover decline of 50 per cent since the early 1980s
- the decline of seagrass meadows to an all-time low.

For these reasons alone, the tourism industry as a Reef user must be an active participant in reversing these trends.

Involvement with this program also brings benefits to tourism operators:

- monitoring helps conserve the Reef ecosystem that tourism businesses rely on
- having knowledgable staff improves the quality of the tourism experience
- communicating ecological processes to tourists increases awareness of threats to the Reef in the wider community.





Before European settlement there were extensive areas of forests, woodlands and forested floodplains across much of the catchment (top map). Much of the area's natural vegetation has now been modified (pink areas on the bottom map), particularly in the south of the catchment.

(page 6, *Great Barrier Reef Strategic Assessment in Brief*, 2014)

What gets monitored?

Tourism Weekly focuses on two key areas of data collection:

- **Great Barrier Reef health indicators** – This data includes levels of macroalgae, predators such as crown-of-thorn starfish, and coral bleaching and coral damage. It helps managers and researchers understand the health and condition of specific sites on the Reef, and provides an insight into the ecosystem as a whole.
- **Presence and abundance of iconic, indicator and/or protected species** – This data includes numbers of turtles, sharks and various kinds of fish. It helps managers and researchers understand how abundant and widely distributed specific types of organisms are in the Great Barrier Reef Marine Park. It also provides reef operators with valuable knowledge of the resident species at their sites.

Who does the weekly monitoring?

Many tourism staff are very knowledgeable about coral reefs, especially the site or sites they visit most. *Eye on the Reef* harnesses this knowledge by asking staff who undertake snorkelling and/or diving activities as part of their job to observe what is happening at their site on a weekly basis. These observations are made during a 30-minute swim and recorded on a Weekly Log Sheet.

While the observations are not difficult, they are extremely valuable. The strength of *Tourism Weekly* is its ability to frequently collect reef health indicator and presence and absence information simultaneously, across a wide range of sites, for sustained periods of time. This regular monitoring of change over time at specfic sites provides an unmatched level of spatial and temporal resolution which makes *Tourism Weekly* a very powerful monitoring tool.

Passionate staff – the core of the program

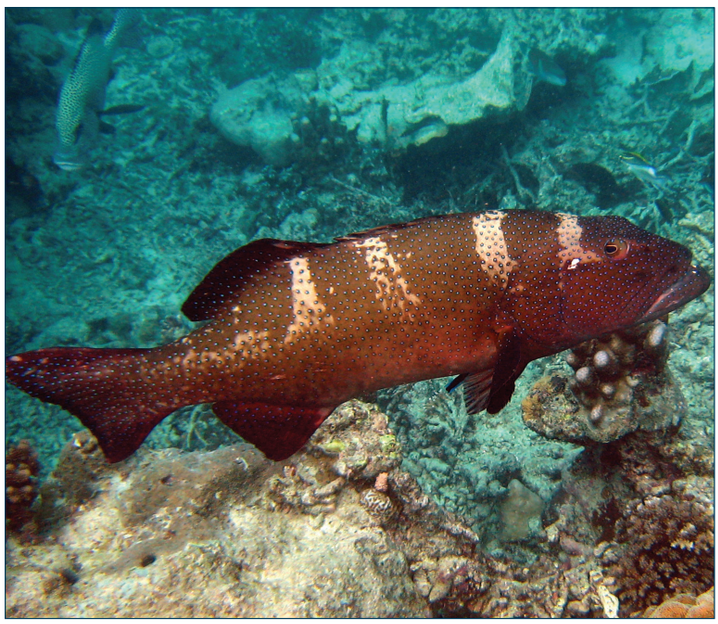
How can staff monitor their site with all the other jobs they have to do?

Tourism Weekly is designed so that data can be collected by tourism staff during normal diving/snorkelling activities, such as snorkelling tours and guided scuba dives. This means that participation in *Tourism Weekly* can be easily incorporated into staff members' normal professional duties.

As participating members of the program, operational managers agree to designate staff time to conduct the monitoring and to attend training sessions and workshops – making this part of the job description for specific tourism staff.

The Weekly Log Sheet is designed to be completed on-site, during or after snorkelling or diving activities at nominated site/s.

- Tourism staff collecting information **during** the snorkel/dive can take the Weekly Log Sheet 'slate' with them and fill it out as they go.



Reef health indicator species: coral trout.
Understanding the distribution and abundance of this species is an accurate indicator of the success of the 2004 Zoning Plan. Preliminary results have shown that 'no-take' zones have a higher abundance of coral trout, and more of the fish present are larger than the fish monitored in 'take zones'.

- Tourism staff filling out the Weekly Log Sheet **after** the snorkel/dive will have to remember what they see underwater and record it on the Weekly Log Sheet when they return to the vessel. This should be straightforward as the categories are clear and staff should know their sites well.

Each participating tourism operation must complete at least one Weekly Log Sheet each week. It is this regular sampling of the same location for the same length of time that makes this program so powerful.

How do tourism staff learn how to monitor their own site?

There are three ways to learn how to conduct *Tourism Weekly* surveys:

- complete the Tourism Weekly online training course
- attend in-water training sessions and workshops
- read the *Eye on the Reef Tourism Weekly Manual* (this document).

Tourism staff from participating tourism operations are trained to collect data by GBRMPA staff during in-water training sessions out on the Reef. These training sessions are scheduled at least once a year with a major gathering.

Training day on Green Island

Participating tourism staff are also required to attend workshops which often feature presentations by guest Reef researchers. At these presentations, researchers report and discuss their latest discoveries regarding coral reef biology, ecology, conservation and/or management. Workshops also provide an excellent opportunity for participants to meet one another and share knowledge and experiences.

The in-water training sessions, online training course and workshops are designed to assist tourism staff with their monitoring and identification skills.

By completing the online training course and using this training manual as a reference when at sea, tourism staff should have enough information to collect data. However, it is strongly recommended that staff attend the next available workshop or training session. They should also contact the *Eye on the Reef* coordinator (email: eyeonthereef@gbrmpa.gov.au) to register their contact details and ask any questions.

This training manual will be most useful to tourism staff new to *Tourism Weekly* or those who want to brush up on their monitoring and/or identification skills.

Training day

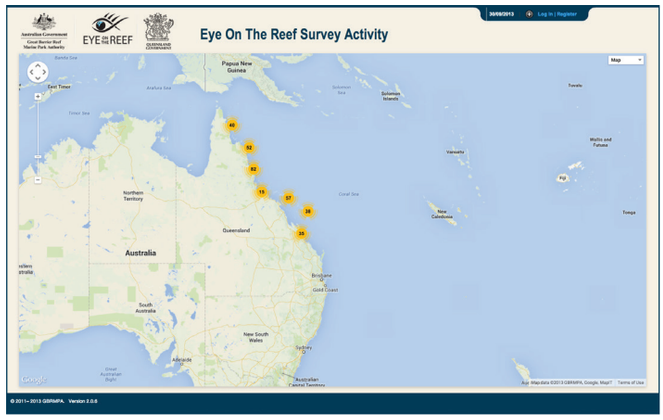
Where does all the data go?

Observations from the completed Weekly Log Sheets are entered and stored in the *Eye on the Reef* database system. Tourism operators can use their own logins to enter their Weekly Log Sheet data and conduct their own analysis of this data using their operation's nature diaries. The data is analysed by managers and different researchers, depending on their field of expertise or interest. For example, the coral bleaching data is available to coral bleaching experts, and sightings of manta rays are available to researchers who study these animals.

How is all this information used?

The *Tourism Weekly* categories, reporting and training methods have been aligned with other *Eye on the Reef* programs such as the Reef Health and Impact Surveys completed by Queensland Parks and Wildlife Service (QPWS) rangers and other experienced Reef visitors. *Tourism Weekly* is also aligned with the categories in the community-orientated Rapid Monitoring survey. This survey is completed by citizens and schools interested in contributing to our knowledge of reef health and diversity. This alignment enables reporting across all programs and increases the amount of information available to managers and researchers on Reef status, trends and impacts over a broad spatial scale.

The data is also automatically summarised by the system and is available at any time to each operator in the form of an online and printer-friendly nature diary. This report provides a summary of what has been observed at each site over that period of time. These summaries are created solely from the data collected by each operation, and are useful aids for staff inductions to the site, site management, interpretative activities and snorkel/dive briefs. Alternatively, staff can use their own login to summarise their data in a range of different ways which allows them to learn more about their site and track their monitoring activity.



Eye on the Reef reporting system login page

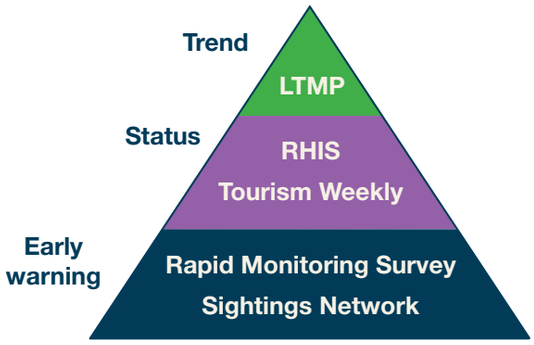
For more information about using the Eye on the Reef reporting system, see the user guide on page 75.

Surveyor on a 30-minute survey

Crown-of-thorns starfish and surveyor

How does Tourism Weekly fit into the broader Eye on the Reef program?

Tourism Weekly is now one component of a much larger system. Each component has different strengths.



The pyramid of knowledge types

There are many ways to sample the natural world and a coral reef is so complex and so variable, no single method can ever be completely adequate. *Eye on the Reef* is an integration of four methods designed to complement the Australian Institute of Marine Science (AIMS) Long-term Monitoring Program (LTMP).

With the Tourism Weekly component, the reef health indicators are not precise counts of variables. Instead, we categorise observations into groups such as '6–20 colonies'. This makes the method less precise but quick and easy enough to do weekly.

The Reef Health and Impact Survey (RHIS) component does make actual counts of the same reef health indicators and this method is precise.

The power of Tourism Weekly is the frequency of sample coupled with your intimate knowledge of the site. You have the knowledge to notice what has changed from one week to the next. By recording this, the accuracy of the information increases with time, despite the data not being precise counts. The more consistently your site is sampled, the more accurate the picture of what is truly happening to the Reef.

Accurate (correct) **Precise (consistent)** **Accurate and precise**

Integration of programs provides data that is both accurate and precise.

Trend

The **AIMS Long-term Monitoring Program (LTMP)** has been surveying 47 reefs in the Great Barrier Reef annually since 1993. This represents the longest continuous temporal record of change in reef communities on such a large scale.

A team of trained scientists survey fishes by underwater visual census and record corals and other benthic organisms along the same sections of reef at each visit. The data capture the natural variability of coral and fish populations and document the effects of disturbances like crown-of-thorns starfish (COTS), cyclones and bleaching events.

Status

The **Reef Health and Impact Survey (RHIS)** is used to evaluate coral reef health and the severity and extent of major impacts. For example, RHIS assessments are the primary source of information on the impacts of coral bleaching and cyclones on the Reef.

The **Tourism Weekly Monitoring program** relies on tourism staff collecting standardised biological information at frequently visited sites. The information is collected weekly at a large number of sites spread across a broad geographic area. Ananalysis of the data is reported to industry staff and reef managers.

Early warning

This system provides near real-time information on a whole-reef scale.

The **Sightings Network** is a community-based program for reporting observations of protected and iconic species or incidents such as injured animals and coral bleaching on the Great Barrier Reef. People also provide photos and videos of their observations using the *Eye on the Reef* smartphone app.

The **Rapid Monitoring Survey** is more detailed. This survey specifically seeks data on iconic and protected species, coral cover and impacts.

Can all tourism operations participate?

Unfortunately, not all tourism operations are able to participate in *Tourism Weekly* for logistical reasons. For example, some tourism operations do not visit reef sites regularly enough to collect the data, or others may not offer in-water activities that allow staff to collect the data. Table 1 describes the requirements tourism operations need to meet to participate in *Tourism Weekly*.

Table 1: Operator requirements for involvement in the Eye on the Reef Tourism Weekly Monitoring program

Weekly visitation to site
Visit the nominated monitoring site at least once a week for at least nine months of the year.
Designated staff time
Have designated staff time to manage *Eye on the Reef*, undertake the surveys and ensure that all data collected is either entered into the system or passed on to GBRMPA. Those staff who are collecting data must be in the water, snorkelling or diving.
Weekly log sheet completion and storage
Ensure Weekly Log Sheets are completed and entered into the online database or sent to GBRMPA.
Attend Eye on the Reef workshops
Ensure participating staff attend *Eye on the Reef* workshops.
Attend in-water training sessions
Ensure participating staff attend at least one in-water training session.
Complete the online training course
Support participating staff in completing the online training course by allowing computer time.
Include Eye on the Reef in interpretation programs
Encourage interpretive programs to relay participation in the program – and the outcomes (e.g. presentations, interpretive reef talks, dive/snorkel briefings).
Promote Eye on the Reef
Allow participating staff to wear *Eye on the Reef* logos, such as mask straps and rash shirts, as part of their uniform, where possible.
Sign a statement of commitment
The manager of the operation must sign a statement of commitment to the ongoing collection of data for *Eye on the Reef*, and commitment to staff time for workshops and training sessions.

What is expected of participating tourism operations?

The *Eye on the Reef* is an important monitoring program for increasing our understanding of the Reef now and into the future, so a high level of commitment and goodwill is needed from all program partners. It is important that participating tourism operations meet certain obligations. Table 2 describes the requirements for remaining in *Tourism Weekly*. Tourism operations that are unable to meet these ongoing obligations will miss out on the benefits that come with participating in the program.

Table 2: Operator commitment to Eye on the Reef Tourism Weekly Monitoring program

Weekly log sheet returns
A minimum of 40 weeks of Weekly Log Sheet returns per site per year (approximately 80 per cent) is required to gather useful trend information, therefore operators are encouraged to retain trained personnel within their operation at all times. • If log sheet returns drop below this level without reasonable cause, operations will be contacted and advised that they need to increase their level of participation. • If log sheet returns do not then improve, the operation may be removed from the program. • The operation may later apply to resume the program.
Ensure staff attendance at in-water training sessions
Ensure and support the operations manager and participating staff in attending in-water training sessions.
Attend workshops
Encourage all staff to attend the evening workshops.

Examples of responsible reef practices

- Follow correct mooring and anchoring procedures that do not damage the reef.
- Implement a 'no touch' policy to provide your guests with a message of respectful behaviour towards wildlife.
- Do not handle wildlife, especially protected species such as wrasse, as it sends a poor message.
- Implement ways of reducing the leaning, grabbing or kicking of coral, especially by novice divers and snorkellers.
- Fish feeding should only be done at the surface, when there are no guests in the water.

Training fun with GBRMPA staff

How do tourism operations benefit from Eye on the Reef?

Tourism operations who have participated in *Eye on the Reef* for the past 15 years think it is of great value. Not only is it good for their business and the future of the Reef, it also:

- plays an important role in staff training and development, and increasing customer satisfaction
- contributes to site management
- helps to maintain staff enthusiasm and staff retention
- augments interpretive programs within the operation with the latest science and site data
- increases understanding of the environmental processes of the Reef and particular sites
- assists in becoming Eco Certified which can lead to a 15-year permit.

GBRMPA also provides direct benefits to tourism operations for their participation in *Eye on the Reef*, listed in Table 3.

Table 3: Tourism operation benefits from participation in the Eye on the Reef Weekly Monitoring program

Augments interpretive programs
This is a major benefit of the program; informed and educated staff make a huge difference to the quality of the tourism experience.
Free staff training
Participating tourism staff will be trained in scientific monitoring methods, interpretative techniques and best practice site and visitor management strategies. They will also be kept up-to-date with the latest Marine Park management arrangements and research findings.
Free project kits
All participating operations will be provided with project kits that contain all the *Eye on the Reef* materials.
Free analysis and interpretation of data collected from your site
Through the nature diaries, participating operations can obtain detailed reports on the health, trends and status of their site, and the organisms that are regularly seen.
Operators can promote their status as partners in the largest tourism-driven spatial and temporal monitoring program in the world
Participating operations will form part of the largest tourism-driven spatial and temporal monitoring program in the world and will enter into an ongoing partnership with GBRMPA, the tourism industry and the Reef research community.
Use Eye on the Reef as a criterion for ECO Certification, which can lead to becoming a GBRMPA High Standard Operator
By taking part in the *Eye on the Reef Tourism Weekly Monitoring program*, operations fulfil one of the requirements for gaining ECO Certification. Once this is achieved, operations may become GBRMPA High Standard Operators and are then eligible for a 15-year Marine Parks permit.

Section 2 All the information you need to monitor your site

Module 2

Good monitoring practices

The first step in good Reef monitoring is to ensure that you are comfortable and competent in the water.

The second step is completion of the log sheet. This can be achieved by following a few simple steps, shown at the right.

To begin

To make sure we are recording the correct data for the correct site for the correct time period, you must complete the top section of the form. This asks for your details and the site details, including the tide at the time of monitoring.

These are the basic facts of who, where and when.

Steps for completing the log sheet

1. Complete as much of the log sheet as possible, providing as much detail as you can.
2. Check that you can read the log sheet after you complete it; chances are if you can't read it, no one else will be able to.
3. Do not spend a lot of time assessing one category. If you are unsure, take a photograph and email it to the program coordinator at eyeonthereef@gbrmpa.gov.au.
4. Not seeing something that you have looked for is just as important as seeing it, so remember to mark this on the log sheet.
5. If you did not look for a particular indicator, note this on the log sheet.
6. *Remember to enjoy what you are doing.*

Tourism Weekly Monitoring

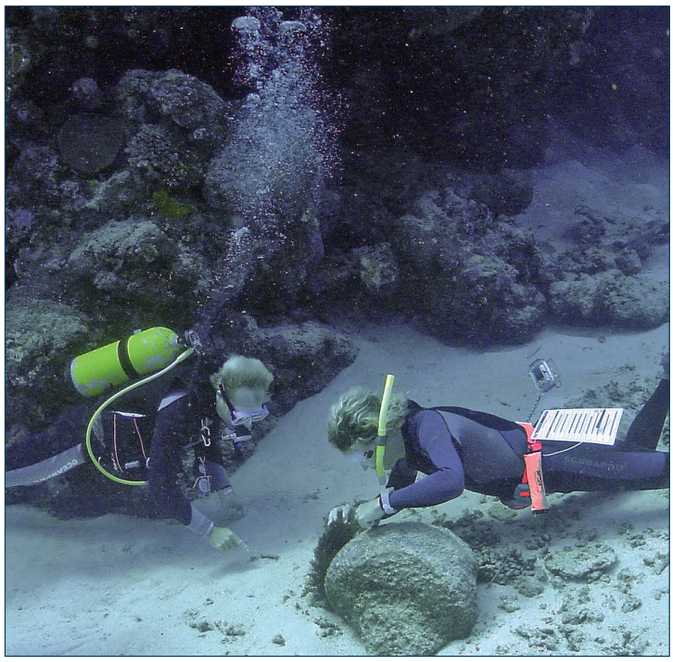
Australian Government Great Barrier Reef Marine Park Authority | EYE ON THE REEF | Queensland Government

Observer name:		Report date:	Time:
Operator:	Vessel:	Method (tick one): Snorkel ☐	Dive ☐
Reef name:		Site name:	
Tide on survey (tick one): Low ☐	Medium ☐	High ☐	
Water temperature (0–1 m depth): _____°C (to one decimal point)		Secchi disc visibility: _____ metres	

The 30-minute swim

Each tourism site typically has an established snorkel or dive path for visitors, so use this as your regular *Tourism Weekly* site. However, if your operation has several well-known dive/snorkel trails that cover multiple habitats, make sure you make the weekly observations in the same habitat each time.

Swim for 30 minutes, recording what you see as you go. You can use your underwater Weekly Log Sheet slate to tally the colonies affected and species seen, and total them once back on the boat or at the end of the monitoring swim. Be sure to look for overall presence and absence, and to be consistent.



Surveyor checking Tree/Bush-like macroalgae

Water quality

GBRMPA's *Outlook Report 09* identified reversible poor water quality (sediment and nutrients) as the key driver of coral decline on the Reef because it lowers the resilience of the Reef. This reduces the ability of the Reef to recover from factors such as crown-of-thorns starfish outbreaks, storm damage and bleaching, as well as future impacts.

This means that the most critical data you can collect is a measure of water temperature and turbidity (clarity). If you are unable to get in the water for some reason, at the very least complete the who, where, when and water quality sections of the log sheet.

Monitoring water temperature

Seawater temperature is closely linked to many natural environmental events, such as coral spawning, bleaching and increased algal growth.

Although sea surface water temperatures are available from other sources (e.g. the Bureau of Meteorology, Reef Temp), the water temperature at your specific site may vary by a few degrees, depending on its location on the Reef. Therefore it is essential for water temperature to be recorded at each *Eye on the Reef* site.

The supplied thermometer is not of a high grade or calibrated type. However, this lack of precision is compensated for by the number of operators using a device from the same manufacturer and the frequency of sampling, which enables the system to accurately detect temperature trends.

Use the thermometer provided in the *Eye on the Reef* project kit

Recording water temperature

- Consistency is the key. Always try to measure the water from the same place each time.
- Use the thermometer provided in the *Eye on the Reef* project kit – this is an essential part of consistency, so do not use any other device.
- Submerge the thermometer in water at a depth of 0–1 m for at least one minute.
- Make sure you do not take the measurement near areas of the vessel that may be warmer than the ambient water, for example near the engines or exhaust. We need the most natural reading possible.
- Read the temperature while the thermometer is in the water, if possible.
- Record the value to one decimal place, in the water temperature box on the log sheet.
- If you do not record the temperature for some reason, leave the box blank.

Monitoring water visibility

Poor water visibility on the Reef is a strong indicator that water quality has been compromised. There are many factors that affect water quality, such as temperature, salinity, nutrients, herbicides and suspended sediments. These in turn are influenced by tide and wave action which varies throughout the year. Temperature and salinity changes are both linked to climate change and are only reversible in the long term.

However, the addition of nutrients in fertiliser, suspended sediments and herbicides that are the direct result of human land use practices like agriculture, coastal development, deforestation and mining, are reversible in the short term. For decades these pollutants have been washed into the river catchments when flooding occurs, particularly during the wet season, and can travel in flood plumes up to 100 km offshore.

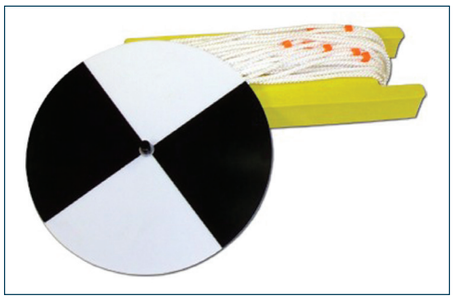
Flood plume

The key difference between water quality issues linked to climate change and those linked to pollution is that land-based pollution is reversible and the amounts of pollutants are within our control. Therefore, it is essential that water quality is monitored regularly across large areas of the Great Barrier Reef, and *Tourism Weekly* plays a role in this. Just by consistently and frequently measuring water visibility using the Secchi disc, you provide valuable data.

What is a Secchi disc?

Secchi discs have been used for many years to measure water clarity around the world. They are simple devices – a disc approximately 30 cm in diameter made of plastic or metal, divided into alternating black and white coloured quarters.

Secchi discs are used to measure *vertical* water visibility only, not horizontal visibility. The vertical visibility of water is directly related to what is within the water, including suspended solids like mud. It is also affected by the density of microscopic green life such as single-celled algae which themselves are proportional to the presence of nitrogen and phosphorus nutrient.



Secchi disc

How to record water visibility with the Secchi disc

- Consistency is the key. Always try and measure visibility from the same physical place each time, at the same tidal range, and never wear sunglasses.
- Lower the Secchi disc into the water, counting the metre marks on the rope at the waterline as the disc goes down.
- Use the rope measurements to record the depth at which the black sections of the Secchi disc disappear from sight.
- Record this depth in metres on the log sheet.
- If you hit bottom before the black sections of the disc disappear, put a '+' sign after your depth measurement.
- If your site is always clear enough to see the bottom, perform the measurement anyway as it is the perfect opportunity to discuss the issue of water quality with your guests.
- If you do not measure visibility for some reason, leave the box blank.

Note: Tides create large variation in water clarity. Resort and pontoon staff should collect Secchi data at high tide.

Module 3

Keeping an eye on reef health indicators

What are reef health indicators?

There are many ways to sample the natural world, and a coral reef is so complex and variable that no single method can ever monitor it all. There is always a trade-off between comprehensive surveying and practicality to make it quick and easy enough to be done frequently.

The solution is to choose things to monitor that – by their abundance or condition – indicate how healthy a reef is. By keeping an eye on these indicators, long-term trends in the health of the reef can be linked to activities causing those trends.

More importantly, the monitoring of these indicators provides an 'early warning system' – alerting reef managers and researchers to potential problems.

The *Tourism Weekly* program monitors these reef health indicators:

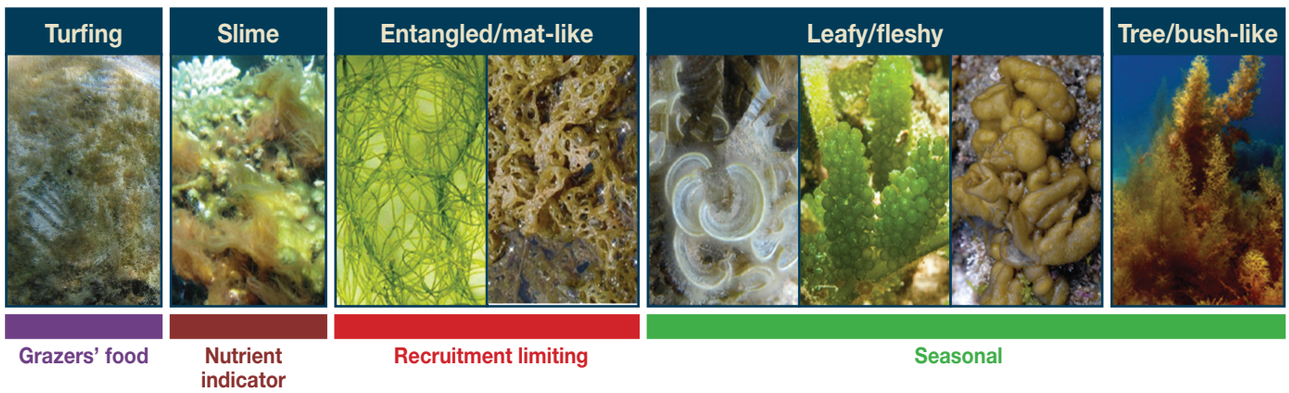
- **Macroalgae:** Algae that is visible to the human eye responds to increasing nutrients, competes with coral for space and is an important food source for many reef animals. Therefore, significant changes in the different populations can indicate a potential problem.
- **Grazing herbivorous fish:** These fish feed on macroalgae, giving coral a fighting chance – especially by keeping coral rock clean enough for coral larvae to settle and grow into new coral colonies.
- **Bleaching:** Bleaching, paling and fluorescence are all signs of stress which can progress to the death of the coral. Bleaching events are predicted to increase in frequency and severity.
- **Crown-of-thorns starfish and Drupella snails:** Outbreaks of these coral predators can rapidly devastate large areas of reef.
- **Disease:** Although diseases are a natural part of life, monitoring their spread and severity provides an indication of coral condition and health.
- **Recent coral damage**: As well as affecting ecological processes, coral damage can impact the aesthetic quality of the reef. Determining the cause might help prevent future damage.

Indicator: Macroalgae

Macroalgae is generally present naturally on all reefs. However, the abundance of macroalgae is a useful indicator of state of a reef and its environmental condition. For example, particular algal life forms can be used as indicators of poor water quality.

Macroalgae are highly diverse, but can be loosely grouped into five broad life form categories: **turfing, slime, entangled/mat-like, leafy/fleshy, tree/bush-like**.

Macroalgae as an indicator



Alga bloom

Cause: A macroalgal bloom is a sudden increase in the population of a certain type of algae. These blooms can be caused by:

- increased nutrients
- artificial or natural removal of herbivores
- the presence of new and available substrate to colonise after bleaching events, crown-of-thorns starfish or Drupella snail outbreaks, coral disease, severe storms, floods and other major environmental events.

For a typical coral reef, the natural state is to be a 'nutrient desert'. Increasing nutrient levels removes the competitive advantage that corals, with their symbiotic zooxanthellae, have over macroalgae.

Warning signs: Any of the causes listed above could be a precursor to an algal bloom. The presence of larger than normal stands of macroalgae should be monitored closely, as macroalgae can quickly out-compete and smother existing corals. Macroalgae can also cover surfaces that would otherwise be available for settlement by coral larvae.

Recovery: The severity of the event preceding a macroalgae bloom, the type of algae, and the number and diversity of herbivores at your site affect the rate of recovery. Recovery might be rapid, or very slow, if at all. Weekly monitoring of your site will determine the trend and provide insights into the drivers (such as numbers of grazing herbivores) of such trends.

Season: More frequent in summer due to warmer water temperatures.

Macroalgae:

- are plants
- are usually green, brown or red in colour
- are generally attached to the substrate (bottom).

The presence of macroalgae can be used as an indicator of certain environmental factors and the overall health of a coral reef.

Gardening damselfish

You may see large patches of algae appearing due to the gardening damselfish. This fish aggressively defends a patch of algae growing on the substrate from other grazers.

Turtle weed (*Chlorodesmis fastigiata*)

This is a commonly seen turfing macroalgae that grows in tufts on reefs. Although turtle weed does pose a threat to coral, **do not record it on your survey**. This is because turtle weed rarely becomes a large-scale problem due to an unusual relationship that bushy corals have with small fish called gobies. Turtle weed releases a noxious chemical that disrupts the photosynthetic algae (zooxanthellae) inside coral, ultimately leading to coral bleaching.

However, coral has its own defence in the form of help from coral gobies. When turtle weed makes contact with coral, the coral gets hit with chemicals from the noxious algae. It then releases its own chemical signal, an emergency call to the gobies. When the gobies receive the message, they swoop in to consume the turtle weed touching the coral. As well as saving the coral, the broad-barred goby (*Gobiodon histrio*), gets a boost to its own toxic defences. It produces poisonous mucus through its skin to deter predators. After eating the noxious turtle weed, this mucus becomes faster-acting.

This extraordinary relationship benefits both the corals and the gobies while keeping turtle weed in check. This is why it is not necessary to record this macroalgae on your survey.

Macroalgae by type

Turfing

- Thread-like, filamentous strands, similar to hair.
- Density: variable, but generally the substrate is visible.
- Height: usually 1–3 cm.
- Includes filamentous algae but do not include turtle weed.
- Almost always present, this is the algae that feeds many of the herbivorous fish at your site – which visitors often mistake for fish feeding on coral.

Slime

- Very delicate, will break apart. Slimy to touch.
- Density: variable but can cover large areas.
- Height: a few millimetres to 20 cm.
- Sometimes referred to as 'nutrient indicator algae', most slime algae is actually a colony of cyanobacteria (blue–green algae) such as *Lyngbya* sp.
- Some evidence of it causing coral death at a small scale.

Entangled/mat-like

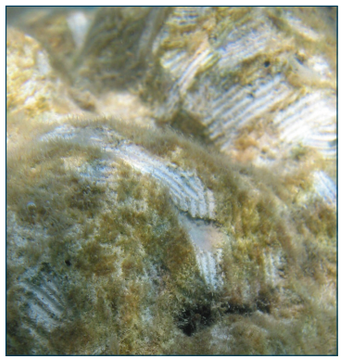
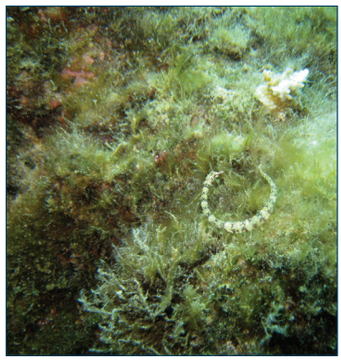
- Forms a complex mat, often made of different species.
- Trapped sediments should be visible.
- Very dense.
- Height: up to 10 cm.
- A good example is *Hydroclathrus* sp.
- This group can stop larval coral from settling.

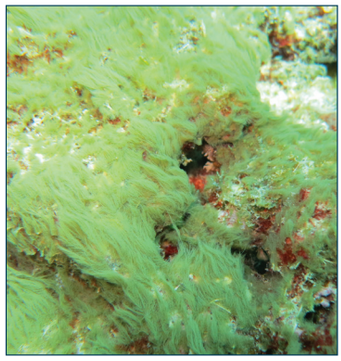
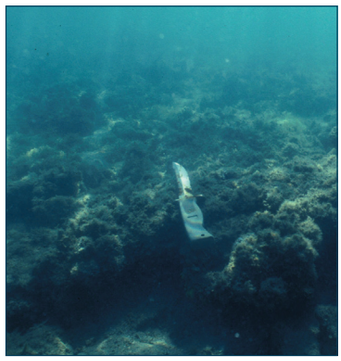
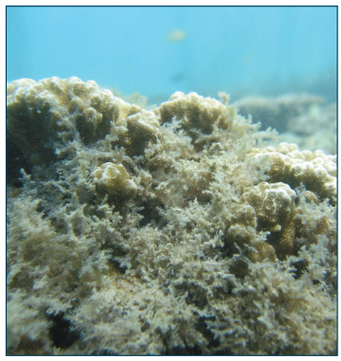
Leafy/fleshy

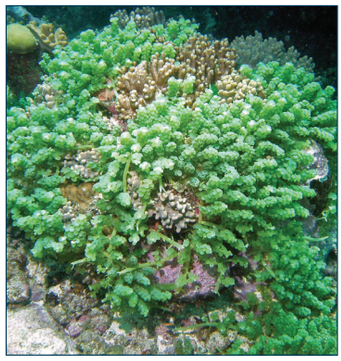
- Leaf-like structures are clearly visible.
- Density: variable, but you should be able to identify individual plants.
- Height: 5–20 cm.
- Common examples include *Caulerpa* sp. and *Podina* sp. (right). *Halimeda* sp., even though it is a calcareous algae, fits into this category.

Tree/bush-like

- Large robust plants, typical 'sea weed'.
- Density: can be quite separated at the substrate but look very dense from above.
- Height: usually over 10 cm, up to 3 m.
- A common example on reefs is *Sargassum* sp. Spadefish species are known to graze on and significantly reduce *Sargassum sp.*



Indicator: Grazing herbivorous fish

Just as herds of buffalo or gazelle roam the grassy plains in search of green grass, grazing herbivorous fish roam the coral reefs in search of algae. Many species of fish are known to consume algae, but a few species do so in large schools. The most common ones are species of parrotfish, surgeonfish and rabbitfish.

These fish are important algal grazers, which makes them essential to the health of the reef as they make sure everything is kept in balance. Monitoring populations at a site is an important indicator of the site's resilience to disturbance.

No species of grazing herbivorous fish are currently protected outside 'No Take' zones.

Grazing herbivorous fish:

- feed on macroalgae
- vary in size
- move in schools, slowly along the reef, grazing close to the coral reef substrate (bottom).

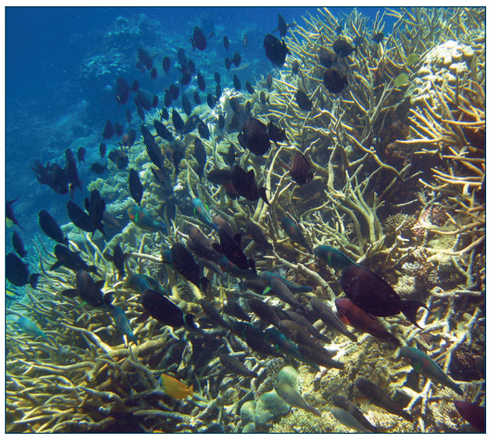
Mixed school of parrotfish, surgeonfish and rabbitfish

What to look (or listen) for

For this reef health indicator we are primarily interested in the size of the school and the average size of the fish within that school, rather than the species. This is because it is the **function of the school** that is important.

Schools of grazing herbivorous fish are usually found very close to the substrate, anywhere there is a good surface for algal growth – often the reef flat or back reef. Look for a school of fish that are similar in appearance and size, moving slowly along the reef. If parrotfish are associated with the group you can also expect to hear the scraping sound of the parrotfish's beak on the rock or coral surface.

While we call these schools of parrotfish, rabbitfish and surgeonfish 'grazing herbivores', most are actually feeding on the detritus caught in the algae strands. This cleans the algae to the point where it is suitable for true herbivores to feed on. However, because they all perform a part in the control of algae growth, we consider them nominal herbivores and include all three families of fishes in this category.



Mixed school of parrotfish, surgeonfish and rabbitfish

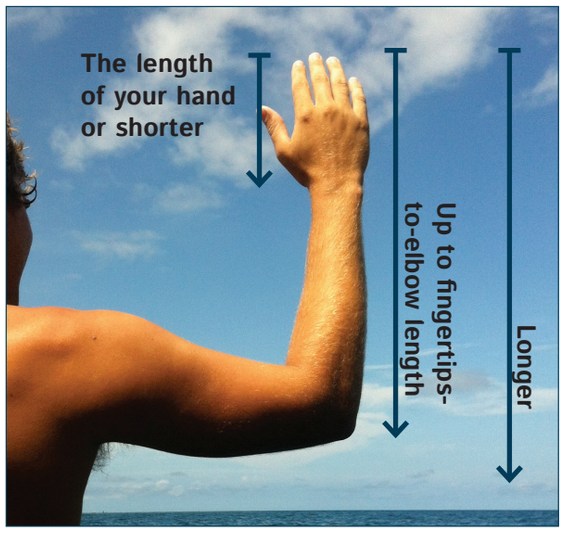
Numbers of fish in the school

Monitoring the number of fish within a school provides us with insight into a school's ability to keep things in balance – as you would expect, five fish consume less algae in one day than 20 fish of the same size. This is why the approximate number of fish observed within each school should be recorded during the survey.

Size of the fish in the school

Monitoring the size of the fish is just as important as the number of fish – 20 small fish could consume the same amount of algae as five big fish. Therefore it is essential for you to estimate an average length for the fish in each school. For this you need only your arm. Three simple length categories are provided for you to choose from:

- **the length of your hand or smaller**
- **up to fingertips-to-elbow length** – is the average fish longer than your hand, but shorter than the length from your fingertips to your elbow?
- **longer** – is the average fish longer than your fingertips-to-elbow length?



Schools of parrotfish (Family Scaridae)

Size: Varies; most schooling species are 20–40 cm.

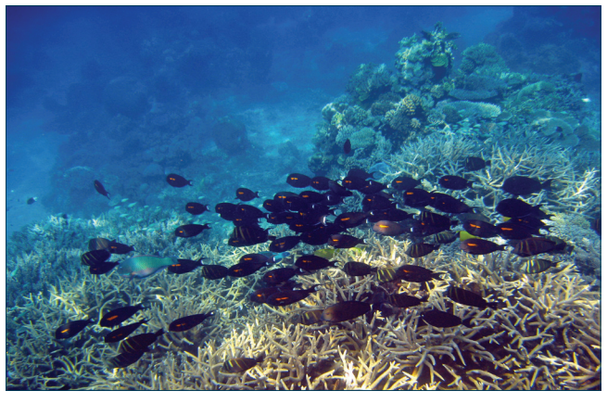
Colour: The males are very brightly coloured. The females, usually more numerous in a school, are often drab greens or browns.

Diet: Most species feed mainly on benthic algae which they scrape from dead coral rock, at the same time removing layers of limestone. They are regularly observed releasing the digested white carbonate in long white clouds.

Where to look: Very similar in range and habitat to schools of surgeonfish – reef flats and shallow areas; sometimes these fish are seen schooling together.

Please do not record humphead parrotfish (*Bolbometopon muricatum*) schools or individuals in this section – these spectacular animals do not graze on algae, but on coral. They have their own reporting category in the indicator, iconic and/or protected species section on the back of the log sheet.

Schools of surgeonfish (Family Acanthuridae)



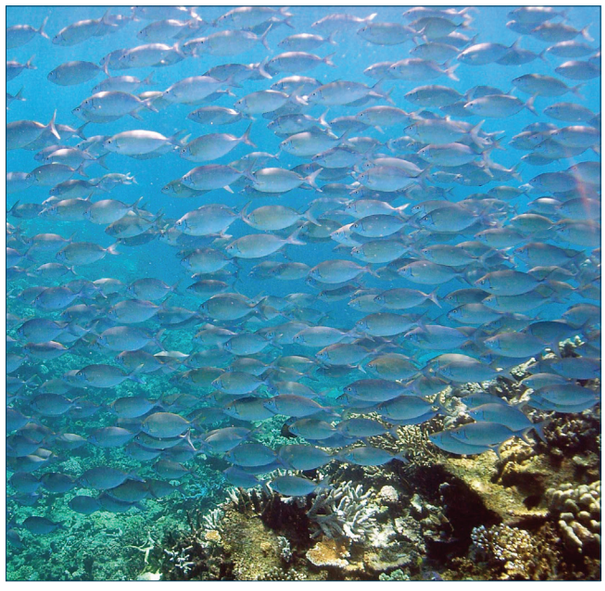
Size: Varies; many are 20–30 cm.

Colour: Varies between species, but are often brightly coloured.

Diet: Most feed on detritus that cleans the algae enough for parrotfish to graze on it.

Where to look: Often observed moving around the reef flat or in shallow areas, grazing en masse on the algae.

Schools of rabbitfish (Family Siganidae)



Size: Varies from 10–30 cm, large schools of thousands tend to be of the smallest species.

Colour: Variable, small species tend to be dull grey/blue but some have yellow patterns. Large species often have many stripes.

Diet: Most feed on detritus that cleans the algae enough for parrotfish to graze on it.

Where to look: Shallow sunlit waters where algae grows. Often school around reef flats though larger species can be found deeper when not feeding.

Module 4

Introduction to coral

The remaining reef health indicators are all related in some way to coral, the basis of a coral reef.

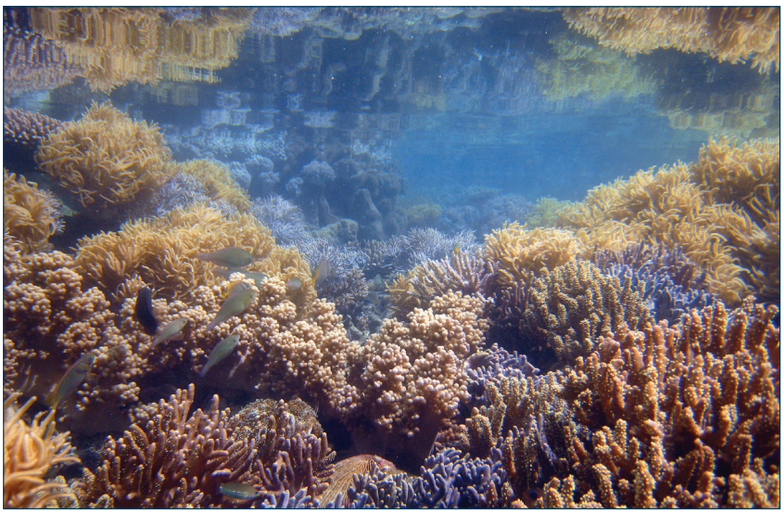
Coral types can be divided into eight categories: soft coral and seven hard coral categories (branching, bushy, plate/table, vase/foliose, encrusting, mushroom and massive). You need to know these coral types to complete the Weekly Log Sheet, but this is as much detail about corals as you will need to provide.

These are general categories. Because corals are species–diverse, not every coral on the reef will fit neatly into the eight defined live coral life form categories. And of course, not all life form categories will be present on every reef, just as certain categories will dominate certain reefs. But the majority of the common genera of corals should fit loosely into one of the categories outlined below.

Coral is a generic term for the group of animals that have polyps.

Soft corals have soft, flexible bodies with many polyps that always have eight tentacles. The polyps are often supported by tiny calcareous spines called spicules.

Hard corals vary in shape and have a rigid, stony skeleton. Their polyps have multiples of six tentacles.



Soft corals at low tide

Zooxanthellae are microscopic algae that live in the tissues of animals such as corals, anemones and giant clams.

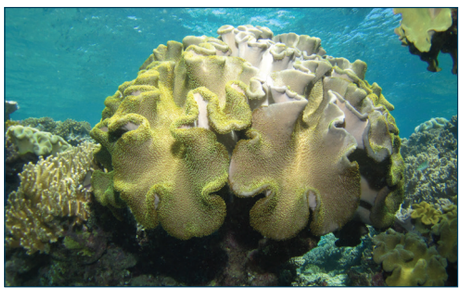
It is a mutually dependent relationship – the coral structure provides a place for zooxanthellae to live, while the algae serve as an energy source for corals.

Zooxanthellae photosynthesis generates enough food for both the algae and the coral, providing up to 95 per cent of the coral's energy.

Coral by type

Soft

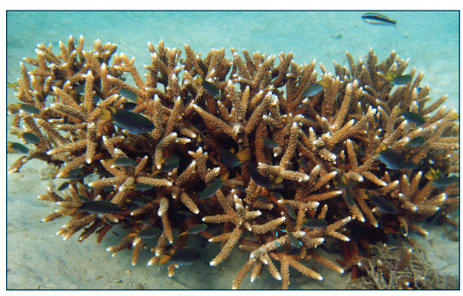
All soft corals.



Branching

All branching corals:

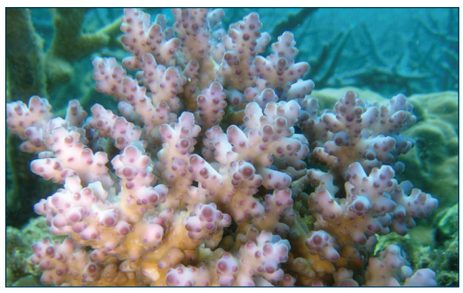
- staghorn



Bushy

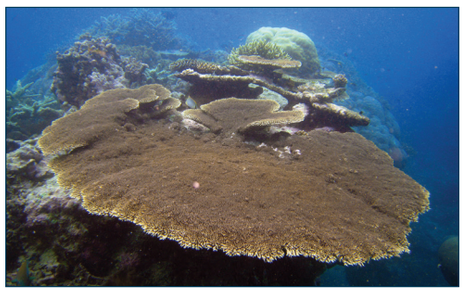
All bushy corals:

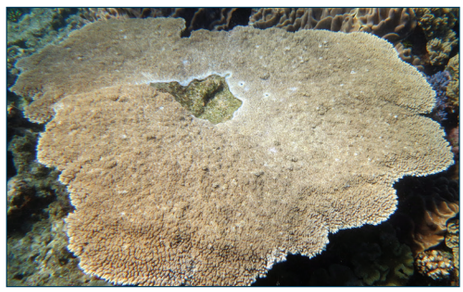
- digitate
- pillar
- knobbly
- finger



Plate/table

All horizontally flattened corals.

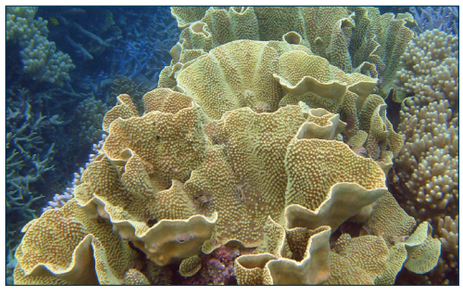




Vase/foliose

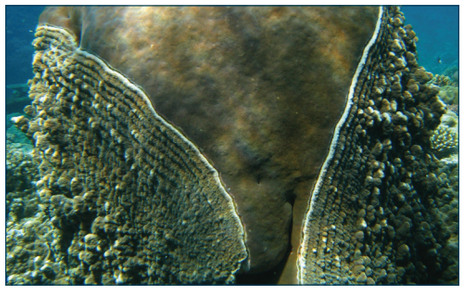
Corals with upright sheets that often form layered 'whorls':

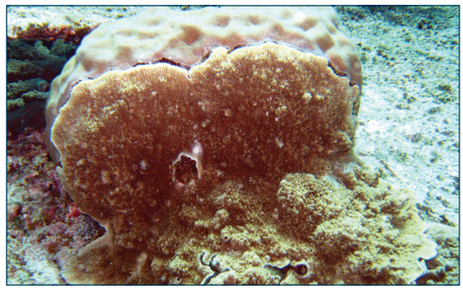
- cabbage
- foliaceous
- vase



Encrusting

Corals that form thin layers as they grow over the reef surface, often taking on the shape of whatever they overgrow.

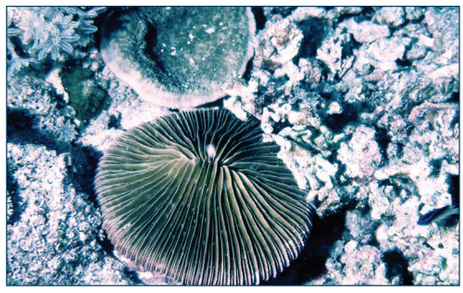




Mushroom

Corals that live on the bottom, unattached:

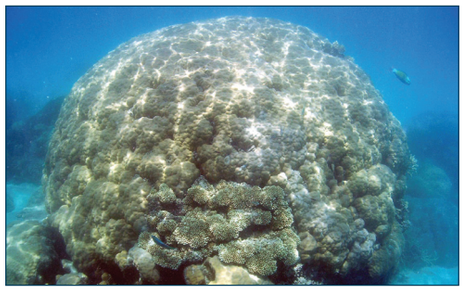
- mushroom
- slipper corals

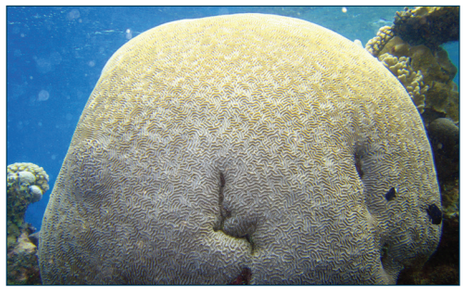


Massive

All massive/boulder corals:

- brain
- honeycomb
- star
- kidney (Porites)





Module 5

Indicator: Bleaching

Coral bleaching

Coral bleaching can result in severe degradation of coral and reef health – it is a direct indication of coral condition.

Cause: Environmental stresses – such as increased water temperatures, and changes in light levels, salinity, sedimentation, exposure to air and fresh water – cause coral to 'shed' their symbiotic algae (zooxanthellae).

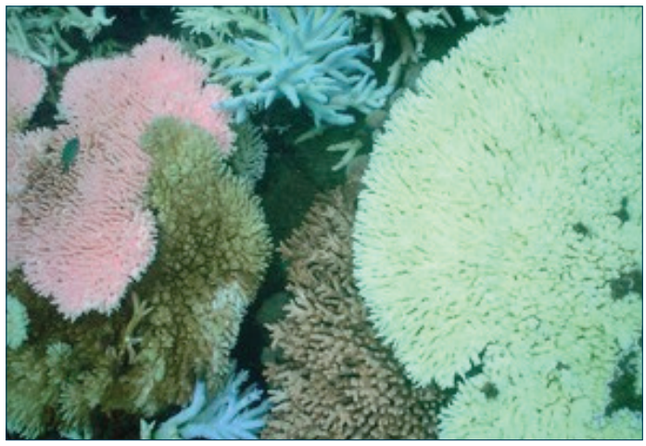
Warning signs: The normal colours of corals pale, sometimes looking fluorescent, until eventually they appear stark white. When no zooxanthellae are present, the coral's white skeleton is visible through its clear tissue. Note that some branching corals have naturally white tips.

Recovery: As long as the bleached corals are bright white, they are still alive – they are surviving by capturing food at night. If a coral colony can survive on this limited food source until the remaining zooxanthellae in its tissues reproduce asexually and start photosynthesising again, the colony has a chance at survival. Corals can also be recolonised by zooxanthellae from the water once conditions have improved. But coral that looks light green in colour and fuzzy has died – it is now just a coral skeleton with filamentous algae starting to grow over it.

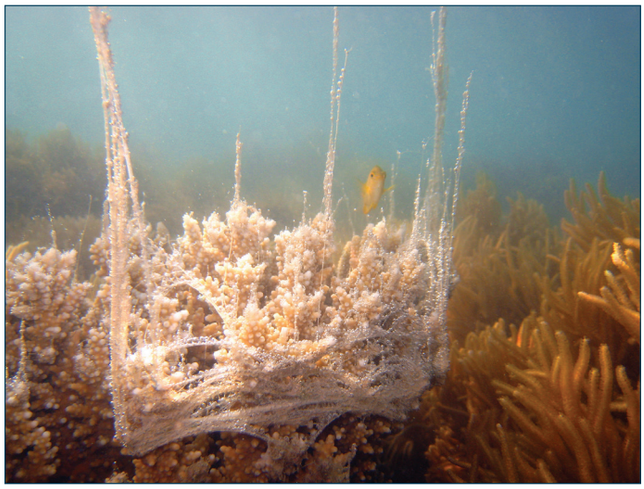
Progression of bleaching: Bleaching events can become widespread in a few days or weeks, so it is important to monitor them closely.

Season: More frequent in summer with warmer water temperatures and heavy rainfall.

Affected corals: All species of hard and soft corals. The chart below shows the relative susceptibility.



Fluorescence in corals due to thermal stress



Mucous response to exposure

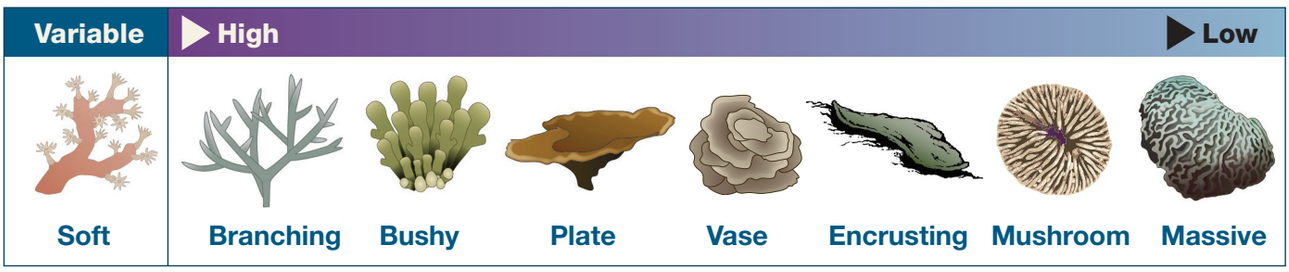
Coral bleaching is a result of environmental stress such as changes in temperature, salinity and light.

This stress causes corals to lose the symbiotic algae (zooxanthallae) that normally live inside the coral tissue, and provide the coral with its colour – hence the term 'coral bleaching'. This stress response may be limited to individual colonies, or affect entire reefs.

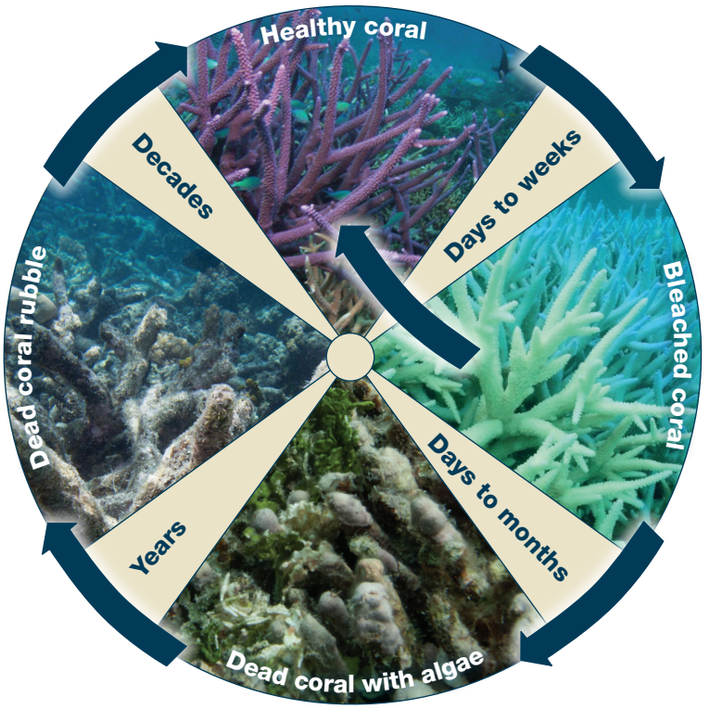
A 'bleached' coral colony still has its layer of live tissue, and therefore does not become covered with algae.

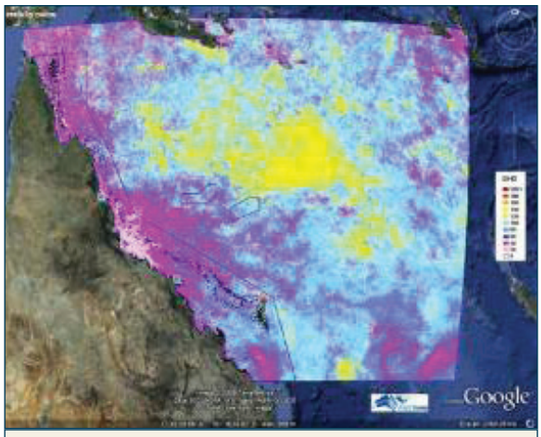
It is possible for corals to regain their zooxanthellae and recover from bleaching events, provided environmental conditions return to favourable levels within a few weeks.

Susceptibility to thermal bleaching



Progression of bleaching





ReefTemp now-cast: ReefTemp is a mapping product that provides information on coral bleaching risk for the Great Barrier Reef Region. It is a collaborative project between CSIRO Marine and Atmospheric Research, the Great Barrier Reef Marine Park Authority and the Bureau of Meteorology.

ReefTemp produces high-resolution now-casts of bleaching risk and provides an improved ability to monitor heat stress in the Great Barrier Reef. To view the most current ReefTemp image, go GBRMPA website, type 'ReefTemp' into the search window and follow the link. (Note: This link is to an external website.)

Clam bleaching

Contrary to popular belief, giant clams rely almost exclusively on the nutrients provided by their symbiotic zooxanthellae – not on plankton from the seawater. Clams pump water in and out for oxygen.

The same environmental stresses that trigger coral bleaching – high water temperatures, too much sunlight, drastic changes in salinity (flood plumes, torrential rains), heavy sedimentation, and prolonged exposure to air, can also cause clams to bleach.

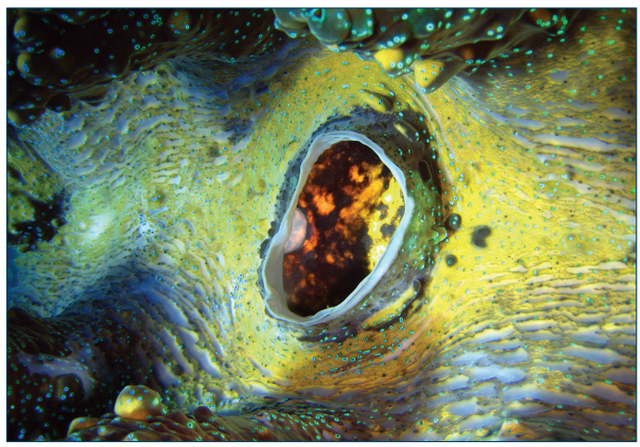
Cause: As with corals, giant clams shed their zooxanthellae, which leaves their tissues white.

Warning signs: White blotches on tissue (mantle) – starting off as small dots and spreading out until the entire mantle is bleached.

Recovery: Giant clams do not survive bleaching events as well as corals because they rely nearly entirely on food produced from the zooxanthellae that live within their tissues. They usually die within a few days of bleaching, so it is important to keep a very close eye on them.

Season: More frequent in summer, with warmer water temperatures. Can occur after freshwater inundation (e.g. after a large storm).

Bleached clam

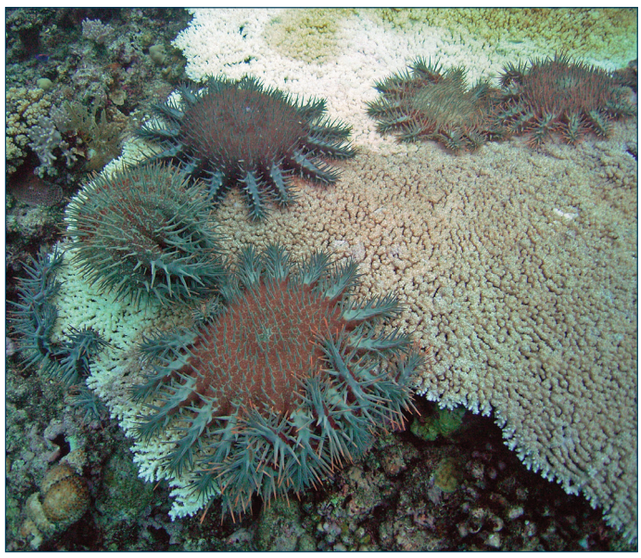


Healthy clam

Indicator: Crown-of-thorns starfish and Drupella snail predation

Organisms that consume live coral tissue can also cause severe impacts if they are present in high enough numbers. The devastation caused by crown-of-thorns starfish (COTS) outbreaks over the years has been well documented on the Reef. The Drupella snail is another predator that is much smaller but can also cause severe local damage, especially to plate and branching coral communities.

Keeping an eye on the numbers of these organisms and the scars they produce through feeding provides an indication of how much damage they can cause.



Seven COTS feeding on a plate coral

Crown-of-thorns starfish (*Acanthaster planci*)

Description: The body is less than 1 metre in diameter, covered in sharp venomous spines. It has 7–26 arms (usually 15) and up to 9 anuses.

Age and maturity: Sexually mature at 2–3 years, a female can produce 60–70 million eggs each breeding season.

Hiding places: During daylight, COTS usually hide under branching and plate corals; during an outbreak they can be seen feeding during the day.

Food: Prefer fast-growing corals (staghorns), but will eat nearly any type of coral when hungry.

Feeding method: The stomach is stuck out through the mouth to envelop prey. Digestive juices break down coral tissue into a 'soup' that the COTS 'slurp up'. They eat an area approximately as large as themselves every day. Feeding usually occurs from the colony edge (plate/table and massive coral types), exposing large areas of white skeleton.

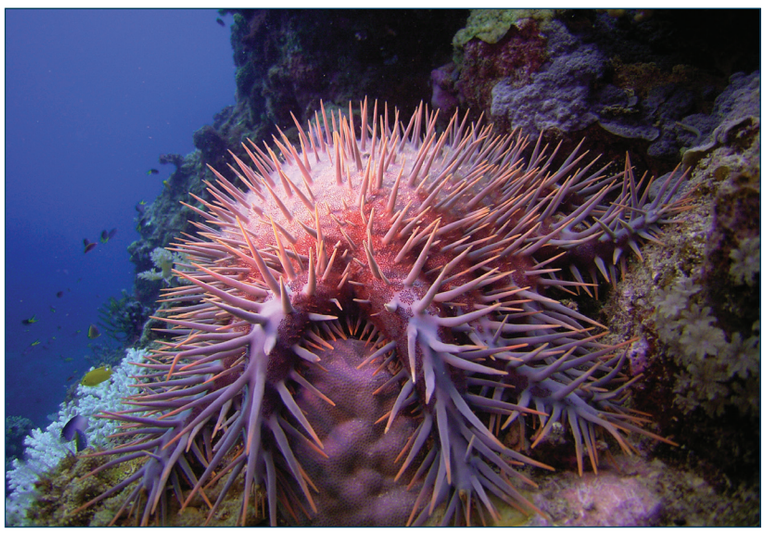
Feeding scars: When fresh, scars appear as white patches. They are clean of coral flesh (Drupella leave bits of tissue behind). If you touch the scar, there will be no mucus left on the coral. If the scar is still white, COTS are usually in the area either feeding or hiding under the colony – have a good look around. Older scars turn grey from turfing algal growth.

The four previous COTS outbreaks in the Lizard–Cairns region followed 2–5 years after early wet season floods exceeded 10 cubic kilometre flows from Burdekin to Daintree rivers.

Chlorophyll concentrations (suspended planktonic single-celled algae) in the region are positively correlated with estimates of aggregated river run-off and plume transport.

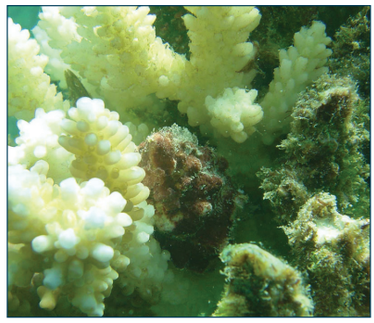
COTS larval survival is enhanced when chlorophyll concentrations exceed 0.45 micrograms per litre of seawater, which is now the nominal threshold for a COTS outbreak.

Chlorophyll concentrations vary approximately eight-fold over the range of run-off volumes experienced during wet season floods.



COTS feeding on a massive coral

Drupella snails



Drupella in bushy coral

Shell: Less than 5 cm long, roughly textured with bumps and ridges.

Colour: Juvenile shells are white with orange or white openings. As they mature, their shells become completely encrusted by coralline algae so they appear dark purple or pink in colour and are well camouflaged.

Hiding places: During daylight, Drupella snails usually hide among the bases of branching corals and underneath plate corals.

Food: Feed on live coral tissue, mostly branching and bushy corals.

Feeding method: Drupella feed using their radula (rasp-like tongue) to scrape the coral tissue, as they cannot cross live coral tissue.

Feeding scars: White in colour, and similar to those caused by juvenile COTS. Usually smaller than a 50 cent coin in size. (See comparison to 10 cent coin at right.) The scars can merge to form a larger area, which is sometimes hard to tell apart from COTS scars. If you look closely, you will see that bits and pieces of coral tissue remain within the scarred area – this is because Drupella scrape off the coral tissue; they do not digest it like COTS do.
If the scar is still white in colour, Drupella will usually be hiding at the base of the colony during the day, often clustered, and feeding at night. Older scars turn grey from turfing algal growth.

Size comparison of Drupella and 10 cent coin

A quick guide to telling them apart: COTS scars, Drupella snail scars and coral bleaching

It can be hard to differentiate between COTS scars, Drupella snail scars and coral bleaching. The following table is a quick guide to help tell these three things apart.

	Impact	Description	Feature
Drupella snail scar		White feeding scars are similar to juvenile COTS scars, but usually smaller than a 50 cent piece. Scars can merge to form a larger area – sometimes hard to tell apart from COTS scars. **Impact area:** a few square centimetres.	Look closely and you will see bits of coral tissue remaining – this is because Drupella snails use their tongues to scrape off the coral tissue – they do not digest it like COTS do.
COTS scar		Bright, white patches about the size of your hand. Old scars turn grey from turfing algae growth. Usually relatively round or scalloped in shape (on plate or boulder coral). **Impact area:** up to half a square metre for each COTS.	Clearly defined edges. Very clean – no obvious coral tissue remaining. If you touch it, there will be no mucus left on the coral.
Coral bleaching		All or part of a coral colony will be pale brown or white. Colour change is usually gradual over a few days to weeks. The part of the coral most exposed to the sun will usually bleach first. **Impact area:** usually many square metres over many coral colonies.	The white patch encompasses nearly all the coral. The edges between non-bleached and bleached coral are not very sharp. Mucus will come off on your fingers if you touch it.

Indicator: Coral disease

Diseases are a natural part of life in all populations, and are one cause of variation in population numbers.

Coral diseases can be difficult to identify, and you will need training and practice to develop an eye for distinguishing between the various diseases. Many coral diseases are more common during summer and can have significant effects on coral condition and health.

Monitoring the spread and severity of coral diseases provides researchers and managers with essential information about the impacts of these diseases on the Reef, and is again another indication of coral condition and health.

Typical position for assessing coral disease

White syndrome

Warning signs: Starts as a white spot near the centre of a coral colony. It becomes a distinct white band up to 1 cm wide, creating a border between the living coral and the dead white skeleton.

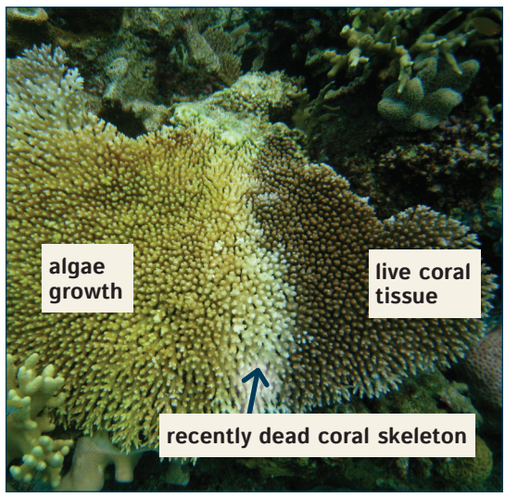
The dead skeleton may become overgrown by algae, turning it dull grey in colour. This results in a distinctive white band in front of progressively darker grey bands of algal cover.

Causes: Thought to be an algae or bacteria; what triggers an outbreak is unknown.

Spreading rate: Several millimetres per day.

Season: Common in summer, with warmer water temperatures.

Coral types: Mostly branching *Acropora* sp.



Black band disease (BBD)

Warning signs: Creates a distinctive black border, which can be 1–20 mm wide but is usually 3–4 mm, between living coral tissue and dead white skeleton. This border looks like a 'black mat', less than 1 mm thick, often with small bubbles coming out of it.

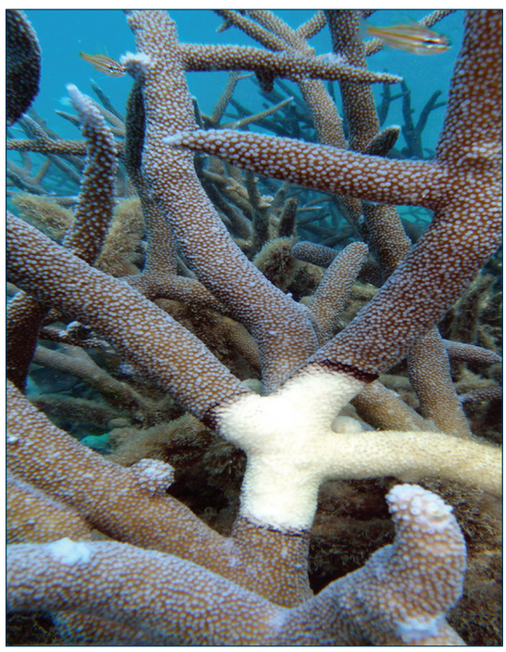
BBD moves over corals, consuming live tissue and leaving dead skeleton behind.

Causes: A collection of microbials including a blue-green algae (cyanobacteria: *Phormidium corallyticum*), other types of bacteria (filamentous bacteria: *Beggiatoa* sp.) and fungi. It is thought to be linked to increased nutrient levels (e.g. after heavy rainfall, in areas with sewage run-off or due to elevated nutrient levels at your site).

Spreading rate: Can spread over the surface of living coral at a rate of up to 2 cm per day, killing the entire colony.

Season: More commonly seen during the summer months.

Affected corals: Most corals, including staghorn, plate, table and massive. Corals with BBD are thought to die from suffocation rather than chemical toxins.



Brown band disease

Warning signs: Brown band disease creates a distinctive brown band between living coral tissue and dead white skeleton. Sometimes infected branching corals have a pigmentation response with unusual colouration either side of the disease.

Tissue loss may be rapid – it begins from the base of the branch but can spread to adjacent branches at contact points.

Causes: Consists of mobile ciliate bacteria infection which may contain zooxanthellae from consumed tissue, which gives the band its brown colour.

Spreading rate: Rapid rate of progression – approximately 20–100 mm every day.

Season: More commonly seen during the summer months.

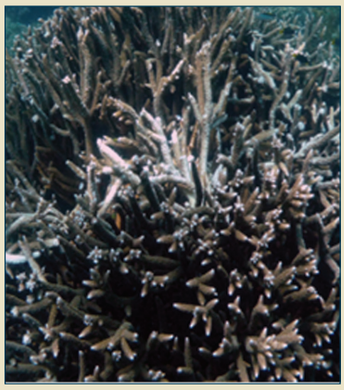
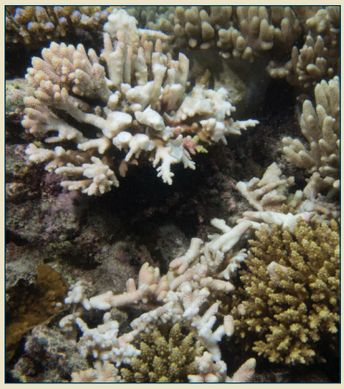
Affected corals: Most commonly affects branching *Acropora* sp.

Indicator: Recent coral damage

Physical damage to coral can be highly visible and dramatic. Breakage can result from natural events such as cyclones and storms or even resting turtles. It can also result from human carelessness in the form of boat groundings, anchor damage, fin contact and touching.

It is important to monitor the amount of broken coral at a site as it can impact the aesthetic quality of the site, as well as ecological processes. Determining the cause of damage could help with taking steps to prevent future damage.

Some simple rules to determine the cause of the coral breakage

Natural events	Human activities
Storm damage: Large areas of overturned whole colonies of massive and plate corals. 	**Anchor damage:** Severe localised damage (a few m^2) of all marine organisms, not just corals. 
Fish damage: Localised (less than 1 m^2) with individual coral branches bitten off, leaving clean breaks. For example, nest-building by titan triggerfish, buffalo wrasse feeding frenzy. 	**Fin damage:** Usually only one or two colonies damaged with the coral fractured into many pieces. 

Spawning activity

Coral spawning is the Reef's single most important mechanism for recovering coral cover lost through the previous impacts. The annual recruitment of juvenile corals from a larval stage is essential to the long term recovery of the Reef, so every year we record when, where and what types of coral were observed to successfully spawn. You can record this in the spawning section under Other and/or send in a special Sighting observation.

To help us fully understand the environmental cues and timing of coral and fish spawning events on the Reef, it is important to monitor and record the days on which spawning happens. Because many tourism operators visit the reef on a daily basis, they generally observe natural behaviour such as spawning far more frequently than the scientists who research it – so tourism operators are in a perfect position to record it.

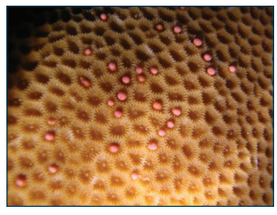
Bushy coral releasing eggs

Why release so many eggs?

Eggs released through spawning face many hazards before reaching adulthood. They must:

- avoid being eaten by predators before fertilisation
- be fertilised by sperm which is also floating in the water
- survive for hours or months as plankton, drifting in the ocean
- settle and grow into adults.

Generally, less than one per cent of the eggs released survive to spawn themselves. This may seem like a wasteful over-saturation of eggs at one time but it is actually a guarantee that at least some of the eggs will survive. Both coral and fish, among other types of marine animals, use this strategy.



Small massive corals releasing eggs at Hardy Reef

Coral spawning

Hard corals

When: Night, during slack tide (least water movement).

Season: Two to six nights after the full moon in October and/or November.

Eggs/sperm: The pink eggs range in size from very small (nearly invisible) to larger than a pin head. Sperm is white and milky and tends to spread in the water, making the area murky. When released, both eggs and sperm slowly float to the surface.

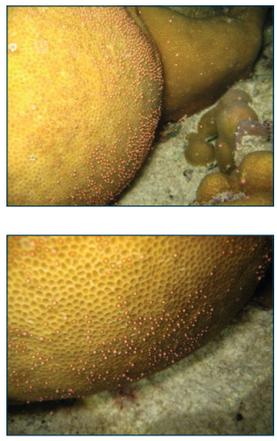
First sighting? Mass coral spawning on the Reef was first recorded by scientists in 1984 at Magnetic Island off Townsville, Queensland.

Soft corals

When: Afternoon and night, during slack tide (least water movement).

Season: Spring and summer.

Eggs/sperm: Eggs and sperm are released on mucous strands to prevent them from being washed away too quickly – this is particularly obvious in shallow reef areas.



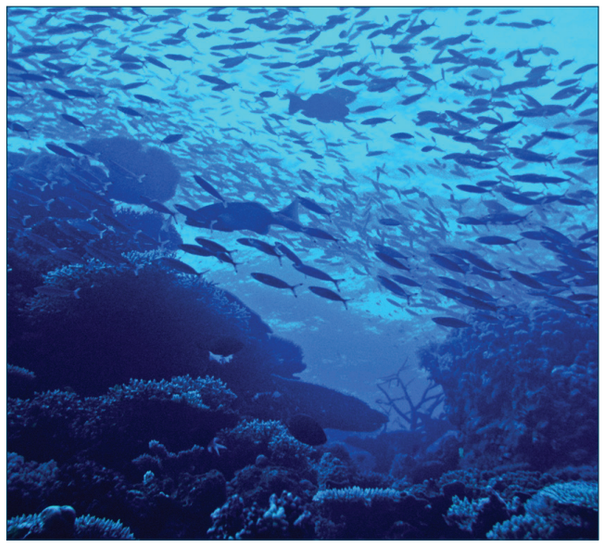
Sequential zoom showing the scale of colony to scale of egg bundles released.
Photos courtesy of Emily Smart

Fish spawning

Many reef fish can and do change sex at some point in their lives – but at any one time, they are either male or female. No known fish can self-fertilise; they all need to mate in some manner. Fish use many different ways to:

- get to know one another (courtship behaviour)
- have sex (mating and spawning)
- take care of the eggs and kids (parental care).

Fish spawning aggregation sites are critical locations for protection. Many were included in the 2004 GBRMP zoning schedule.



Getting to know one another

Courtship behaviour varies between species, but usually involves some form of 'dance' where the male approaches the female and puts on a show. Just before spawning, the male usually gives the female a nudge on the abdomen – this is thought to stimulate the release of eggs.

Having sex

Sharks and rays have external sex organs but bony fish do not. Instead, bony fish use **external fertilisation** or **spawning**, where eggs and sperm are released into the water.

One night stands and group orgies

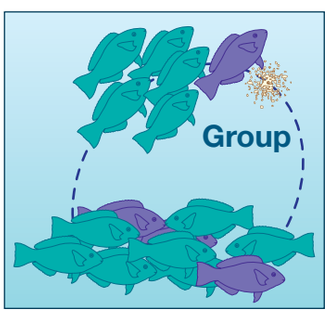
There are two types of spawning.

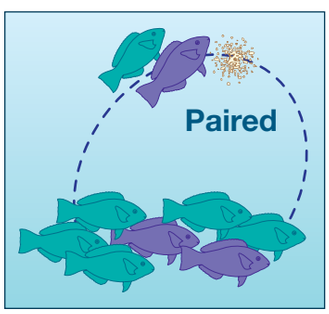
- **Demersal spawning:** Eggs are laid on the bottom or in a nest. A male swims over the eggs releasing sperm. Most demersal spawners show some form of parental care, with either the male or female watching over the eggs until they hatch.
- **Pelagic spawning:** Eggs and sperm are released into the water column when males and females (either in pairs or groups) swim towards the water surface. There is no parental care of the eggs.

Showing off

Spawning behaviour is quite distinctive. It starts as a calm gathering of fish, but as they prepare to spawn their excitement escalates. This excitement is transmitted to other fish in the immediate area through vibrations, movements, odours (yes, fish can smell under water) and chemical stimuli. Eventually the entire group or a small sub-group erupts off the seafloor into the water column. During this frenzy, females release eggs and the males follow with sperm. Spawning happens in either groups or pairs.

- **Group spawning:** A group of individuals, usually many males and one female, release eggs and sperm into the water column at the same time.
- **Paired spawning:** Instead of a group of fish exploding from a fish aggregation to spawn in the water column, only a single male and a single female break from the group to spawn.





Caring for the kids

Most reef fish do not protect or care for their offspring – they leave the survival of the eggs to chance. In fact, sometimes at spawning locations, clouds of damselfish or fusiliers stream into a fresh cloud of pelagic spawn to gorge themselves.

Some spawning fish do go to great lengths to ensure their eggs have a better chance of survival. Some attach eggs to a surface so they won't float away; others make nests for their eggs and stand guard until they hatch. A few types of fish even watch over the larvae until they are large enough to survive on their own.

Who's spawning? Who's not?

As a general rule, if you see fish:

- **rubbing together**
- **twisting around one another**
- **dashing to the surface in pairs or groups**
- **leaving a milky cloud behind**

assume they are spawning.

Section 3 Sightings of iconic, indicator and protected species

Module 6

Many different types of animals can be found on reef sites, but some are of greater interest to researchers because they are:

- **Iconic** – species that are of high or special value on the Reef, like the maori wrasse.
- **Indicator** – species that provide us with information about the health of the Reef, like coral trout.
- **Protected** – species that are protected by law and require special management, like the green turtle.

The species in *Tourism Weekly* fall into one or more of these classifications. The frequency of visits and the number of hours spent underwater make tourism staff perfect observers for the abundance of these species.

Surveyors in training

Recording observations of iconic, indicator and/or protected species

For each of the iconic, indicator and/or protected species, there are two things to record:

- How many did you see during the 30-minute swim?
- Did you observe any spawning or mating behaviour?

Surveyor finds an octopus

General tips

- *Tourism Weekly* surveys are conducted weekly in a 30 minute timed swim. If you see something iconic or special outside of this timed swim (from in the water or on the boat), please report it using the *Sightings* app or website.
- As a tourism operator, you are setting an example of best practice protocols for your guests. Guest safety is of utmost concern. Do not touch, disturb or harass any animals as this causes undue stress. Avoid excessive artificial lights during night tours as this alters the behaviour of fish and plankton.
- Remember that it is illegal to touch, take or possess any protected species.
- Implement environmentally-responsible business practices; your divers will expect that from you and your example will enhance visitor awareness, appreciation and understanding of the environment and foster a genuine commitment to conservation in your guests.

Surveyors in training

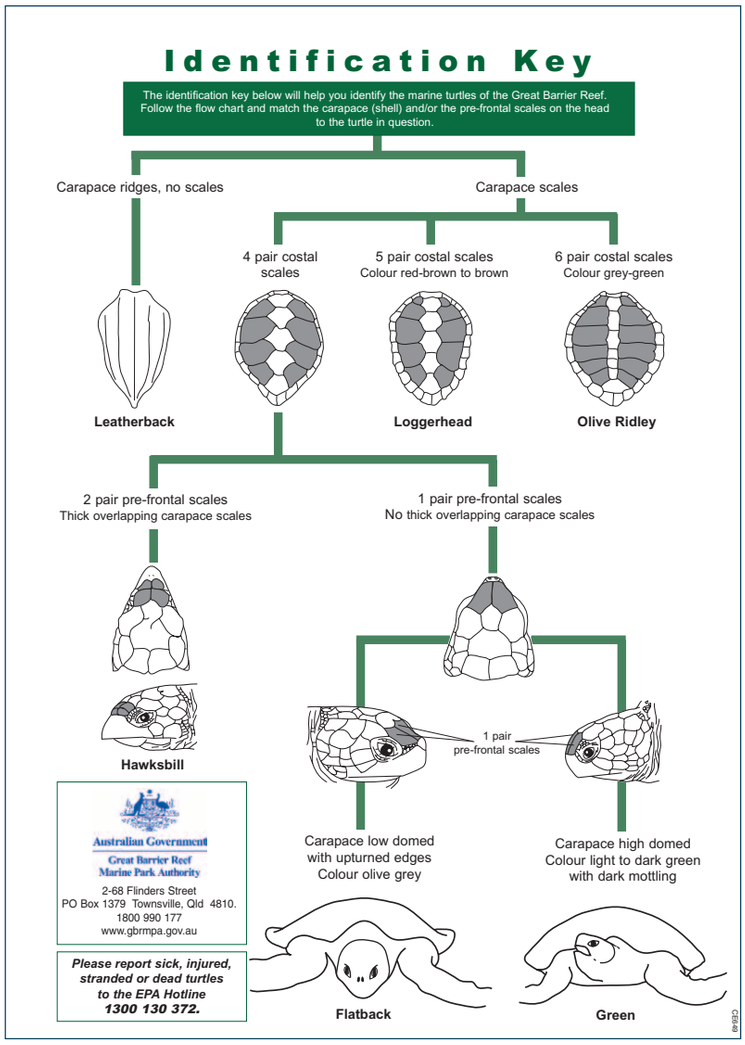
Reptiles: Introduction to marine turtles

Six of the world's seven species of marine turtle live in the Great Barrier Reef World Heritage Area and nest adjacent to the Reef: green turtles, hawksbill turtles, loggerhead turtles, flatback turtles, olive ridley turtles and leatherback turtles. All species of turtles are protected in Australia.

The green, hawksbill and loggerhead are seen often and have their own section on the log sheet. The olive ridley, flatback and leatherback are rarely seen but should also be recorded. You can write the species name in the 'Other' row of the reptile section of the log sheet.

Marine turtles are reptiles. They have evolved from land turtles and adapted to survive in the ocean. Although they live nearly entirely in the water, marine turtles have lungs not gills and must breathe air. They also need to return to land to lay their eggs.

You can use the Identification Key shown below to help you identify marine turtles by the carapace and pre-frontal scales on the head.



cool facts

Marine turtles are reptiles, which means they are cold-blooded and breathe air. Their need to surface to breathe makes them vulnerable to drowning in fishing nets and being hit by speeding boats.

Turtles need to rid their bodies of excess salt and often do this on land by 'crying' salty tears.

Sub-adult green turtle

Most turtles become sexually mature at 30–50 years and can live for up to 100 years. They can make breeding migrations of up to 3000 kilometres from their feeding grounds to nesting beaches.

Marine turtles lay 50–200 eggs per clutch. The temperature of the sand determines the sex of the offspring. Males result from cooler nests (<25°C) and females from warmer nests (>31°C). Both sexes result from nests 27–29°C.

Nearly 24,000 metric tons of plastic are dumped into the ocean each year. Turtles accidentally ingest a wide range of this floating debris, including bags, sheets, pellets and balloons as well as abandoned fishing line.

Tracks of hawksbill, green and flatback nesting turtles are distinguishable. Hawksbill flipper tracks alternate while green and flatback tracks are parallel. Green tracks are much wider than flatback tracks.

Turtles can rest or sleep underwater for several hours at a time on one breathe. When diving for food or escaping predators, their submergence time is much shorter. Breath-holding ability is affected by activity and stress, which is why turtles quickly drown in shrimp trawlers and other fishing gear.

Green turtle *(Chelonia mydas)*

Description

- Shell size up to 1.5 m with a high dome, weighs up to 400 kg.
- Carapace (upper shell) is olive green and nearly circular or heart-shaped. Usually variegated with brown, reddish-brown and black on the top, and whitish or cream underneath.
- There are four pairs of costal shields (shell plates located on either side of the mid-line) between the centre and outer margin of the upper shell
- Hatchlings are shiny black above and white below.

Species

- The green turtle (*Chelonia mydas)* has the widest distribution of all marine turtles. It is one of the most commonly seen marine turtles. They are carnivorous as juveniles and herbivores as adults eating seagrass and seaweeds.

Why do we care?

- Green turtle populations are considered vulnerable due to their migratory nature; conservation measures to protect them from illegal hunting can be particularly difficult. In order to monitor Australian populations, we need as much information about their distribution and abundance as possible. Green turtles are also iconic species to the Reef for visitors.

Where to look

- Green turtles can commonly be seen in subtidal and intertidal coral and rocky reefs and seagrass meadows of the continental shelf. Green turtles are common sights on the Reef. They can be seen moving between the surface, where they breathe, to the reef substrate where they rest and feed on algae. It is not uncommon to see the same green turtle at a site for long periods of time.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Vulnerable
- **IUCN:** Endangered

Best practice and best message

- In the water, keep your distance from turtles, allowing them to continue their normal activities. For the best experience, swim calmly and slowly, and position yourself to the side of the turtle. Never back into a ledge or interfere with their need to surface to breathe. While boating, look out for surfacing turtles in areas known to have them (such as shallow reef flats and seagrass beds). Travel slowly in these areas, with no wake, especially if you have sighted a turtle within 30 metres of your vessel.
- Do not light camp fires on turtle nesting beaches.

cool facts

Green turtles are mostly vegetarian, feeding on seagrass and algae mats, although occasionally they feed on mangroves, jellyfish and sponges.

Mature turtles often return to the exact beach from which they hatched. Turtle hatchling survival rates are not high. Only 1 in 1000 green turtles will survive to adulthood.

The green turtles' common name comes from the usually green fat found beneath its carapace.

The largest known green turtle weighed 395 kg and measured 153 cm in carapace length.

Hawksbill turtle *(Eretmochelys imbricata)*

Description

- The carapace (shell) is heart-shaped, domed and up to 1 m in length with serrated edges.
- The colour of the carapace is olive-green or brown with a complex pattern of light and dark streaks, and white underneath.
- Two pairs of nasal scales give the appearance of a hawk-like beak.
- There are four overlapping scutes (plates) on the edges of the carapace.
- Each front flipper has two claws.

Species

- The hawksbill turtle (*Eretmochelys imbricata*) is also called the 'tortoise-shell turtle' because its shell has been used for decorative purposes in many cultures. This turtle uses its hawk-like beak to cut through sponges, soft coral, sponges, sea urchins, molluscs, fish, jellyfish and algae.

Why do we care?

- Hawksbill turtle populations are critically endangered, the highest risk category assigned by the IUCN Red List for wild species. Critically endangered species face a very high risk of extinction in the wild. As much information as possible about this species is needed to better understand its future.

Where to look

- Usually found in tidal and subtidal coastal reefs, rocky areas, estuaries and lagoons. Often seen resting in caves and ledges in and around reefs during the day.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Vulnerable
- **IUCN:** Critically Endangered
- The Convention on International Trade in Endangered Species (CITES) outlaws the capture and trade of hawksbill turtles and the products made from them.

Best practice and best message

- In the water, keep your distance from turtles to allow them to continue their normal activities. For the best experience, swim calmly and slowly and position yourself to the side of the turtle. Never back them into a ledge or interfere with their need to surface to breathe. While boating, look out for surfacing turtles in areas such as shallow reef flats and seagrass beds. Travel slowly in these areas with no wake, especially if you have sighted a turtle within 30 m of your vessel.
- Do not light campfires on turtle-nesting beaches.

cool facts

Hawksbill turtle populations have declined more than 80 per cent in the last century, primarily due to the international trade in their beautiful carapace (shell), also referred to as 'tortoiseshell'. Hawksbills were hunted almost to extinction prior to the ban on the tortoiseshell trade.

Hawksbills primarily consume sponges, which contain toxic chemical compounds. These compounds accumulate in the flesh of the turtles. The consumption of their meat by humans may cause serious illness and, in extreme cases, death.

Hawksbills are important inhabitants of coral reefs. By consuming sponges, they play an important role in the reef community aiding coral growth. It's estimated that one hawksbill turtle consumes over 500 kilograms of sponges per year. Without this predation, sponges have the ability to overgrow corals and suffocate reefs.

Loggerhead turtle *(Caretta caretta)*

Description

- Grows up to 1 m in length and is longer than it is wide.
- The carapace (shell) is heart-shaped and red-brown to brown in colour.
- It has five pairs of costal plates that are dark brown in colour.
- Has a large head.

Species

- The loggerhead turtle (*Caretta caretta*) is the world's largest hard-shelled turtle. It is omnivorous, eating seaweed, jellyfish, crabs, sea urchins and giant clams.

Why do we care?

- Loggerhead nesting populations in eastern Australia have declined by 86 per cent since the 1970s and the species is in danger of becoming extinct. This is due to the numerous threats they face associated with human activity, such as incidental capture (bycatch) by fisheries; ingesting marine pollution such as plastics; nest destruction by feral animals such as wild dogs, pigs and foxes; loss of nesting beaches; and climate change. While these turtles are rarely seen on tourism sites, any observations of these animals are critical to our understanding of their immediate future.

cool facts

Loggerhead turtles get their name from their large square heads and strong jaws.

The loggerhead reaches sexual maturity within 17–33 years and has a lifespan of 47–67 years.

Like all turtles, loggerheads breathe air. Although they usually breathe every 15–30 minutes, they are capable of staying underwater for up to four hours.

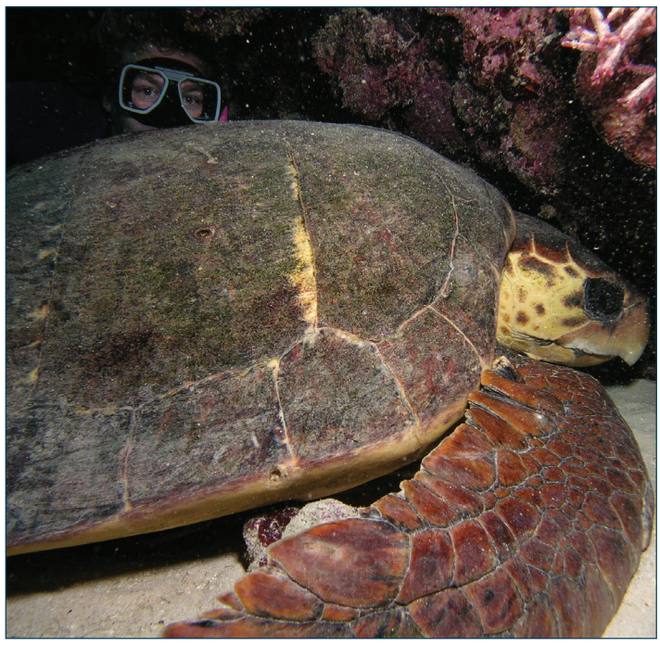
Loggerheads have been living on Earth for about 40 million years.

Where to look

- In Australia, the loggerhead turtle is found in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Vulnerable
- **IUCN:** Endangered



Best practice and best message

- Fishing gear is the biggest threat to these turtles as they often become entangled in long-lines or gillnets. They also become stuck in traps, pots, trawls and dredges. However, requiring turtle excluder devices for nets and other traps used on the Great Barrier Reef has been successful in reducing the number accidentally caught.
- The loggerhead turtle is protected. Do not touch, harass or attempt to ride.
- Loggerhead turtles were once intensively hunted for their meat and eggs. In the 1920s, there were many turtle soup canneries along the Great Barrier Reef. In one summer over 1000 turtles were taken.

Leatherback turtle *(Dermochelys coriacea)*

Description

- Grows to over 1.75 m long and weighs over 500 kg.
- The leatherback's tapering carapace (shell) has many small bones embedded in a tough, rubbery skin which has seven ridges running all the way down to its pointy posterior.
- The turtle is black in colour with light spots and a pale pink patch on top of its head.

Species

- The leatherback turtle (*Dermochelys coriacea*) is the largest of all marine turtles. It has no teeth – instead it uses special notches in its mouth to grip soft prey such as jellyfish and other squashy invertebrates.

Why do we care?

- The leatherback turtle is listed as critically endangered which means the species is on the brink of extinction. Crabs, seabirds and fish make a quick snack of hatchlings, but the main threat to the leatherback's survival is human activities. Like other marine turtle species, it drowns in trawl nets, gets tangled in fishing and lobster pot lines, and is struck by boats. Leatherbacks are also choked or strangled when they mistake plastic bags and other rubbish for their favourite food – jellyfish. In some countries their eggs are harvested.
- The leatherback grows slowly and takes decades to reach maturity.

Where to look

- Sightings of these turtles are extremely rare as there are no major breeding colonies in Australia. A few turtles nest at scattered sites in the Northern Territory and northern Queensland every two to four years, in December–January. Most turtles living in Australian waters migrate to breed in neighbouring countries such as Indonesia, Malaysia and Papua New Guinea. There has not been a record of a leatherback turtle nesting in Queensland for over 10 years.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Endangered
- **IUCN:** Critically Endangered

Best practice and best message

- These turtles are critically endangered and it is illegal to capture or kill them. Their global population has declined by over 70 per cent in 30 years. The main threats have been the harvest of their eggs and incidental capture by fishers. In some areas, egg harvesting and illegal poaching has removed more than 95 per cent of clutches – this has been recognised as the main cause for the collapse of the Malaysian population. If you see this animal outside of your survey, report it using the *Sightings Network*.

cool facts

Leatherback turtles are the fastest reptiles, with recorded speeds of over 35 kilometres per hour in the water.

These turtles are one of the deepest diving marine animals. They have been recorded diving to depths of 1280 metres.

Although all reptiles are cold-blooded and depend on the environment for their body temperature, leatherbacks are unique in that they can maintain high body temperatures using metabolically-generated heat – that is, by being active.

Scientists tracked a leatherback turtle that swam from Indonesia to the United States in an epic 20,000 km foraging journey over a period of 647 days.

Adult leatherback turtles subsist almost entirely on jellyfish. Their diet helps to control jellyfish populations.

An estimated one third of all adult leatherbacks have ingested plastic.

Leatherback turtles have existed in some form since the first true marine turtles evolved over 110 million years ago during the Cretaceous period.

Olive ridley turtle *(Lepidochelys olivacea)*

Description

- Smallest of the marine turtles, growing to approximately 62–70 cm and weighing 35–45 kg.
- The carapace (upper shell) is domed from the front, heart-shaped and grey to olive-grey and cream underneath.
- Hatchlings are black and have a light brown plastron (bottom of the shell).
- Nesting females have a unique habit of stamping down sand after a nest has been buried.

Species

- The olive ridley (*Lepidochelys olivacea*) is the smallest marine turtle and feeds in continental shelf waters on crabs, echinoderms, shellfish and gastropods.

Why do we care?

- Olive ridley turtles are uncommon in the Great Barrier Reef and have received little scientific attention. The long-term trend in the population of the species on the Reef is unknown. Data collected on sightings will help to establish estimates of abundance and distribution.

Where to look

- In Australia, they are found in soft-bottomed, shallow, protected waters from southern Queensland to northern Australia. Sightings of these turtles within the Marine Park are rare.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Vulnerable
- **IUCN:** Endangered

Best practice and best message

- Although not endangered as other marine turtles are, olive ridleys are vulnerable to egg harvest and incidental capture in oceanic fisheries. If you see one, approach it slowly, being careful not to stress the animal. If seen outside of your survey, report it using the *Sightings Network*.

cool facts

Olive ridley turtles nest both individually and in 'arribadas', which are large nesting aggregations. This is one of the most fascinating characteristics of this species. After laying her eggs, the female covers the eggs with sand, stamps down the sand with her plastron and then flings more sand about with her flippers to erase any signs of the nest.

Historically, the olive ridley turtle was considered the most abundant marine turtle in the world. More than one million were commercially harvested off the coasts of Mexico in 1968 alone.

Olive ridleys are the most carnivorous marine turtles, especially in immature stages of the life cycle. Common prey include jellyfish, tunicates, sea urchins, bryozoans, bivalves, snails, shrimp, crabs, rock lobsters and sipunculid worms. Captive studies have indicated a level of cannibalistic behaviour in this species.

Although the olive ridley has a long list of predators – such as caiman crocodiles, sharks, and killer whales – humans are the leading threat to their survival. People are responsible for unsustainable harvesting of adults at sea for the commercial sale of both the meat and the hides.

Flatback turtle *(Natator depressus)*

Description

- Grows to approximately 90 cm and weighs up to 73 kg.
- Has a distinct low-domed flat carapace (shell) with upturned edges covered by a thin skin. The plastron (bottom of shell) is white.
- Adults have olive-grey flippers and heads.
- Hatchlings are grey and have a white plastron.

Species

- The flatback turtle (*Natator depressus*) is unique among marine turtles in that it is the only species of turtle in the world to be exclusive (endemic) to Australia. They feed on soft corals, sea pens and jellyfish.

Why do we care?

- Numbers in the east coast flatback population in Queensland appear to be stable, but continued monitoring of their numbers will help to determine if they are declining. As the flatback turtle is endemic to Australia, conservation measures may be easier to enforce.

Where to look

- Flatback turtles are only found on the continental shelf of Australia. Although they feed around Papua New Guinea and Indonesia as well as within the Great Barrier Reef Marine Park, they nest only in Australia.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Vulnerable
- **IUCN:** Not yet assessed

Best practice and best message

- These turtles face a number of threats associated with human activities such as commercial and recreational fishing, coastal infrastructure and development (including industrial, residential and tourism development), Indigenous harvest, feral animal predation and climate change.
- If you see a flatback turtle, be careful not to stress the animal. If seen outside of your survey, report it using the *Sightings Network*.

cool facts

The flatback marine turtle is the only marine turtle endemic to Australian waters – they are not found anywhere else in the world. These turtles inhabit the coastal waters of western, northern and eastern Australia.

The most significant breeding site is Crab Island in the western Torres Strait. Breeding may also occur on the islands of the southern Great Barrier Reef and on mainland beaches and offshore islands north of Gladstone.

The flatback turtle is unusual in that it lays fewer but larger eggs than other marine turtle species.

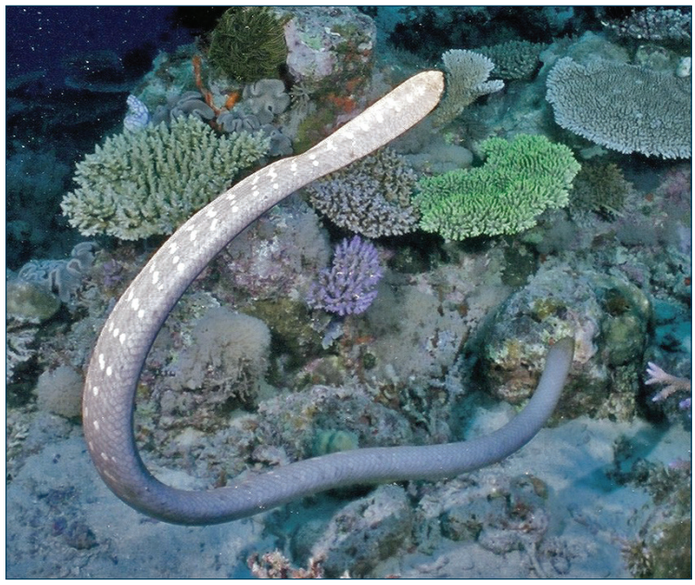
Flatback hatchlings are fairly large compared to other marine turtles. This size advantage may help to increase predation survival rates.

This species is considered vulnerable to extinction in Western Australia, but the Red List of the IUCN regards it as data deficient and has not assessed its status.

Reptiles: Introduction to sea snakes

Sea snakes can be found in Australian tropical waters. Sea snakes are real, air-breathing snakes with forked tongues and body scales that shed their skins, just like land snakes. Most sea snakes are highly venomous, but are usually no cause for concern. They are cold-blooded reptiles found primarily in the warm tropical waters of the Indo-West Pacific. They are not found in the Atlantic Ocean or Caribbean Sea.

Although there are various species of sea snakes on the Reef, the most common sea snake encounters involve the olive sea snake. Please report any sea snake you see even if you are unable to determine which species it is.



Olive sea snake

Description

- Look similar to land snakes and grow to 120–150 cm.
- Can be solid in colour or banded; the most common is olive green.
- Can be found on the surface, breathing.
- Paddle-like tail.
- Have nostrils on the top of the snout.
- Although highly venomous, they are considered non-aggressive.

Species

- There are over 70 species of sea snakes worldwide, with approximately 30 species on the Reef. The olive sea snake (*Aipysurus laevis*) is the one you are most likely to see. The diet of most sea snakes consists of fish and invertebrates, but a few species feed exclusively on fish eggs.

cool facts

Some species can dive to 100 metres or more, and remain submerged for up to 80 minutes. This may be partly due to the remarkable ability of some species to absorb part of the oxygen they need through their skins.

Their nostrils have valves that close when they are under the water.

Some fish species follow hunting sea snakes in the hopes of catching fleeing prey.

Why do we care?

- We know very little about sea snakes in terms of their abundance and distribution. As these animals need to surface to breath, they are vulnerable to drowning through entanglement in fishing gear and are often caught incidentally by prawn trawlers. Most of what we know about their distribution comes from fisheries by-catch data. More information on sightings will help us to understand how susceptible these animals are to by-catch.

Spine belly sea snake

Where to look

- Sea snakes can be found in shallow waters near land and around islands, especially in somewhat sheltered waters. They are also found near estuaries. Some species are pelagic and are found in drift lines and slicks of floating debris brought together by surface currents. All sea snakes are air-breathers, so can be spotted on the surface.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Listed
- **IUCN:** range from Least Concern to Critically Endangered

Best practice and best message

- Do not harass sea snakes. They are quite curious and may approach people, but you should never touch them. Although sea snakes are highly venomous, they are generally placid and rarely attack people unless provoked. Even if they do bite, which is very unlikely, they typically will not envenomate (release venom through their fangs).
- As sea snakes surface to breathe air, they can drown in fishing nets. By-catch reduction devices (BRD) inserted in fishing gear to allow the escape of non-target or endangered species such as seals, turtles and dolphins have been successful in the Great Barrier Reef in reducing the number of sea snakes caught as by-catch.
- Please keep an eye out for sea snakes when you're boating, as they are also vulnerable to boat strikes.

cool facts

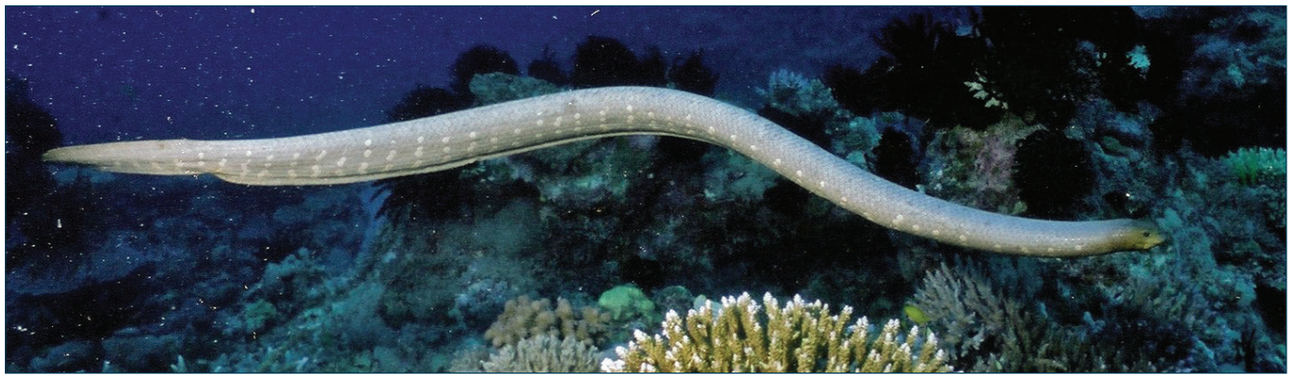
They may swim up rivers and have been reported as far as 160 km from the sea.

Sea snakes have been known to curl around divers' regulator hoses and limbs, especially during the breeding season.

Although they are highly venomous, only 20 per cent of bites result in significant symptoms or envenomation. The venom in injected by fangs. Most species fangs are not long enough to penetrate through a wetsuit. The venom is very potent and toxic.

Spine belly sea snake

Spine belly sea snake



Olive sea snake

Module 7

Coral reefs are some of the most diverse and valuable ecosystems on Earth. They support more species per unit area than any other marine environment, including about 4000 species of fish. Although coral reefs cover less than 0.1 per cent of the world's ocean surface, 25 per cent of all marine species can be found there.

The Great Barrier Reef fish exhibit a myriad of shapes, colours, behaviours and ecological functions. This diversity, combined with abundance, helps make this area unique and popular.

Coral reef fish perform a number of important ecological services, without which the reef could not function:

- **Predators** control populations of prey fish.
- **Herbivores** control the amounts of algae on reefs and thus the amount of space available for corals to occupy and grow.
- **Planktivores** are crucial in the role of energy transfer (in the form of food) from the pelagic to the reef habitat.
- **Corallivores** play an important role in limiting coral reef growth, halting or spreading coral disease and eroding the reef substrate.

A healthy coral reef has a delicate balance of these functional groups and therefore is extremely sensitive to overfishing, especially when certain species are targeted more than others.

The Reef also provides a haven for iconic species of fish such as the Maori wrasse which are not protected in other parts of the world. Monitoring such species is essential for our understanding of how their populations are responding to Marine Park management.

Parrotfish and surgeonfish grazing

cool facts

Scientists have explored only 1 per cent of the ocean depths. They believe millions of new kinds of animals and fish are down there, waiting to be discovered.

Fish were the first vertebrates with bony skeletons to appear on Earth. Unlike today's fish, early fish had no scales, fins or jawbone, but they did have dorsal fins.

Fish can form schools containing millions of individuals. They use their eyes and something called a lateral line to hold their places in the school. The lateral line is a row of pores running along a fish's sides from head to tail. Special hairs in the pores sense changes in water pressure from the movements of other fish or predators.

A fish's jaw is not attached to its skull, so many fish can project their mouths forward like a spring to catch startled prey.

Some fish, such as the grazing herbivorous fish, often lack jaw teeth but have tooth-like grinding mills in their throats called pharyngeal teeth.

Most fish can see in colour and use colours to camouflage themselves or defend themselves and their territory. Most fish have the best possible eyesight for their habitat and can certainly see you peering at them in a fish tank. Some fish can see polarised and ultraviolet light.

On average, flying fish can glide 50 m, but have been observed to glide as far as 200 m and reach heights up to 6 m.

An inflated porcupine pufferfish can reach a diameter of up to 90 cm. It puffs up by swallowing water and then storing it in its stomach. The stomach increases in size with more water.

The most venomous fish in the world is the stone fish. Its sting can cause shock, paralysis and even death if not treated within a few hours.

The fastest fish is the sailfish. It can swim as fast as a car travels on the highway, 110 km/h.

The slowest fish is a seahorse. One species, the dwarf seahorse, takes about one hour to travel 1.5 m.

The batfish plays dead when threatened. It floats motionless on its side, making it look like a dead leaf floating on the surface of the water.

Barramundi cod *(Cromileptes altivelis)*

Description

- Up to 70 cm in length and 3.5 kg in weight.
- Colour is greenish-white to light greenish-brown with scattered black spots on the body and fins.
- Concave dorsal head, with upturned mouth.
- Highly skilled at camouflaging against the reef, often hiding in holes.
- Juveniles have an identical shape, but are whiter in colour with large black spots.

Species

- Barramundi cod (*Cromileptes altivelis*) belong to the same family as cod and groupers (Serranidae). They differ from other cods and groupers by their distinct head shape (concave). They are carnivorous, eating small reef fish.

Why do we care?

- Barramundi cod were heavily overfished for both the commercial fish industry and the aquarium trade (mainly juveniles). As their numbers rapidly declined, they were designated a protected species in the Great Barrier Reef Marine Park in 2003. It is important to continually monitor their populations to ensure their recovery.

Where to look

- These fish are very secretive, hiding in holes in the reef or under plate corals. They are usually seen alone or in pairs in silty or dead-coral areas. A barramundi cod can often be seen lying with its body in a hole, with just the head sticking out to ambush passing prey. Juveniles swim with their heads towards the bottom, waving their pectoral fins. They are thought to do this in order to mimic toxic flatworms and thus avoid being eaten.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPCB:** Not listed
- **IUCN:** Vulnerable

Best practice and best message

- In Australia, this fish was granted protection on the GBR and this has increased their numbers in the Marine Park. As this is a protected species, do not harass or touch them. They can be easy to approach, especially in locations with high numbers of divers. Move slowly towards any barramundi cod and stay near the bottom.

cool facts

This fish is also called a humpback grouper. It is unique among the groupers due to the elongate, slender head that rises sharply at the nape of the neck, giving the species a distinctive 'humpback' appearance.

These fish begin life as females. Males are produced as necessary – the dominant females within a group change sex to male. When a male dies, the next dominant female will undergo a sex change to replace him.

Small juveniles are very attractive and commonly caught for the aquarium trade, and adults are a food fish.

Butterflyfish (Chaetodontidae)

Description

- The maximum length of most species is under 30 cm; typical length is around 20 cm.
- They have striking colour patterns of yellow, black and white with occasional blues and oranges. Their colours fade at night to allow them to blend in with the reef.
- Thin, disc-shaped body, usually with a long nose and a small mouth.
- Generally found in pairs that may stay together for periods ranging from weeks to life.

Species

- There are around 70 species of butterflyfish on the Great Barrier Reef and they are some of the most beautiful fish on coral reefs. Many feed on live coral polyps; others consume a mixed diet of benthic invertebrates and algae.

Saddled butterflyfish

Why do we care?

- More than one third of all butterflyfish are 'obligate corallivores' – they rely on live coral for food. This means that their presence on reefs can be an indicator of overall coral health.

Where to look

- Butterflyfish are usually found in pairs, in and around live coral in depths less than 20 metres, and are restricted to a relatively small area. They are most active during daylight hours as they forage for food.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Least Concern

Best practice and best message

- A high abundance of butterflyfish is usually related to high coral cover and a healthy reef. Butterflyfish are popular in the aquarium trade but most do not thrive in home aquariums because they require live coral for food. Butterflyfish are not fished commercially.

cool facts

Approximately 80 species of butterflyfish have developed their own language. They make sounds using tail slaps, fin flicks, grunts and jumps underwater. Their swim bladders are linked to their lateral line to detect and amplify these noises. These sounds are very quiet compared to the rest of the reef, and could be one reason pairs stick so close together – many butterflyfish mate for life.

Many species are corallivores, although some feed on a mixed diet of algae, small benthic invertebrates and even plankton.

The presence of this fish is an indicator of coral health and abundance, because many butterflyfish rely on a supply of healthy coral as their food source.

Most species are active by day and rest among corals or rocks during the night, and patrol a home range. At night, butterflyfish settle into dark crevices, and their brilliant colours and markings fade to blend with the reef background.

The function of the eyespot has long been thought to confuse predators; however, new studies suggest that eyespots are used for social communication with other members of their species.

Saddled and double-saddled butterflyfish

Coral trout *(Plectropomus sp.)*

Description

- Record numbers for two size classes: <38 cm (under legal catch size) and >38 cm (minimum legal catch size).
- Most grow up to 80 cm and up to 8 kg, except the blue-spot trout and footballer trout (*Plectropomus laevis*) which grow up to 120 cm and 25 kg. Minimum legal size is 50 cm for these fishes.
- Colour varies with species; identification is based on colour patterns and tail shapes.
- Torpedo-shaped body and large mouth.
- Gill covers with three spines.
- Generally, there is a paddle-shaped flat tail.

Common coral trout

Species

- The name 'coral trout' describes a number of different species, including:
  - » Common coral trout or leopard trout (*Plectropomus leopardus*) – reddish brown with small dark-edged blue spots on the head, body and fins (none on the underbelly) and a distinctive blue ring around the eye
  - » Blue-spot trout (*Plectropomus laevis*) – dark brown with blue spots and a dark, non-transparent pectoral fin (in contrast to other coral trouts)
  - » Footballer trout (*Plectropomus laevis*) – a different colour morph of blue-spot trout, yellow, black and white
  - » Bar-cheeked trout or island trout (*Plectropomus maculatus*) – rather than spots, it has bars on the side of the head
  - » Passionfruit trout or leopard trout *(Plectropomus areolatus*) – many medium, dark-edged, blue spots over the entire body, including the underbelly (in contrast to other coral trouts).
- Coral trout are voracious fish-eating predators (piscivores). Juveniles mostly eat crustaceans, especially prawns which live on or near the reef bottom. Adults feed on a diversity of reef fish but most commonly on damselfish (Family Pomacentridae). Adult coral trout also eat juvenile coral trout.

cool facts

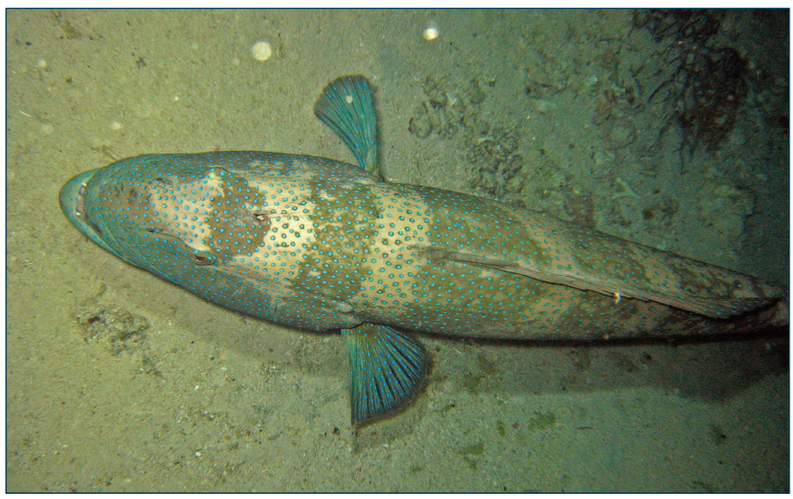
Coral trout aggregate for spawning. Males arrive first and fight to establish territories. When the females arrive, the males use elaborate courtship displays to entice females into their territory.

All coral trout mature as females and change sex to become males at approximately 42 cm. It is not known what triggers this sex change.

Active throughout the day, especially at dusk and dawn, and rest at night. Usually hunt alone.

Coral trout are fish-eating predators. Adult coral trout feed on a variety of reef fish, especially damselfish and parrotfish. They also eat juvenile coral trout.

Coral trout are territorial – research suggests that coral trout spend a great deal of their time moving within a single reef (within a 500 metre radius). These fish are extremely important in the food chain as high level predators.



Blue-spot trout

Why do we care?

- Coral trout are among the most heavily fished on the Reef, often caught and sent overseas alive for sale. Recreational fisherman also heavily target coral trout as their flesh is sweet and tender. Understanding the distribution and abundance of this species is an accurate indicator of the success of the introduction of the 2004 Zoning Plan. Preliminary results have shown that not only do 'no-take' zones have a higher abundance of coral trout, but more of the fish present are larger than the fish monitored in 'take zones'. This is why we monitor not only the presence of coral trout but also the size.

Where to look

- Coral trout are solitary coral reef predators, often seen hiding under coral ledges during the day or even above the coral network. They can also be seen at cleaning stations. They are most active during daylight hours (heightened activity during dusk and dawn) and have two modes of feeding: ambush (hide in the reef waiting to attack passing prey) and prowling (approach slowly and then attack at high speed).

Protection status

- **Great Barrier Reef Marine Park:** Not Protected – fishery target species.
- **EPBC:** Not listed
- **IUCN:** range from Least Concern to Vulnerable
- Coral trout are the main target species for reef line fishers along the Queensland coast from the eastern Torres Strait in the north to the Capricorn Bunkers area in the south. No species-specific protection exists for coral trout; however, a number of management strategies are in place. These strategies aim to protect coral trout from overfishing and include size and bag limits.

Best practice and best message

- These fish are vulnerable to overfishing; therefore compliance with fisheries guidelines is of utmost importance. No-take Marine Protected Areas (MPAs) are crucial for the sustainable harvest of these species. Over 80 per cent of fish larvae in MPAs are carried to Blue Zones (areas open to fishing). Therefore, MPAs act as a species bank, distributing the fish to fishing areas while protecting breeding stocks. Report any instances of non-compliance, such as fishing in Green Zones or illegal size catches (under 38 cm except for the blue-spot coral trout, which has a 50 cm size limit).
- Do not feed coral trout as they are well equipped to secure their own food.

Footballer trout (Blue-spot trout)

cool facts

Coral trout have been observed hunting cooperatively with moray eels. The coral trout uses body language to signal a hunting foray to the moray. As the grouper's bursts of speed make it deadly in open water and the moray's sinuous body can flush out prey in cracks and crevices, this cooperation leaves prey fish with nowhere to hide.

Coral trout only feed during daylight hours and most often at dusk and dawn. They also change the colour of their skin while feeding.

Coral trout have two different types of hunting methods: ambush and prowling. They use the ambush method to hunt fish that live among the coral on the reef bottom. The trout hides and remains very still and alert, ready to attack passing prey. The prowling method is used to hunt schooling fish higher up in the water. Here, the trout moves slowly (prowls) towards the prey and then attacks at great speed.

New research shows that coral trout can suffer from skin cancer lesions.

Common coral trout

Humphead parrotfish *(Bolbometopon muricatum)*

Description

- Largest of all parrotfish, up to 120 cm in length and 46 kg in weight.
- Green in colour with large scales and a paler head.
- Very prominent hump on the forehead, marked in white or pink.
- Large, parrot-like beak.
- Gregarious and sociable in nature; usually seen in small aggregations swimming on the reef flat.

Species

- The humphead parrotfish (*Bolbometopon muricatum*) has a distinctive appearance and is the largest of all parrotfish, usually over 1 metre in length. They are noisy eaters, munching on encrusting algae and live coral.
- This species is **not** a grazing herbivore, so do not include it in the benthic survey.

Why do we care?

- Humphead parrotfish play a critical role in ecosystem processes on the Great Barrier Reef as a bioeroder – a role which no other fish can perform. These fish literally turn carbonate rock into coral sand. Each individual removes an estimated five tonnes of carbonate every year. Without parrotfish there would be significantly less coral sand, which is essential for sand-dwelling animals such as sea cucumbers, molluscs and worms. They are irreplaceable in the reef ecosystem and vulnerable to overfishing, therefore important to Reef management.
- They have been heavily fished in most of their range, almost to the point of extinction in certain oceans. Marine Protected Areas (MPAs) have been vital in the protection of their numbers and humphead parrotfish can now be found near coral reefs across the Indian and Pacific oceans. The presence of these fish can be a useful indicator of coral reef health. The largest numbers of humphead parrotfish have been recorded on the Great Barrier Reef and in Malaysia and Micronesia.

Where to look

- Adults are found in clear outer lagoon and seaward reefs to depths of at least 30 m. They are usually found in small groups and they feed on benthic algae and live corals. Smaller wrasse often follow humphead parrotfish because their feeding activities dislodge worms and crustaceans from coral rock. At night, they can be found sleeping in the shallows, seeking shelter in wrecks and caverns.

Protection status

- **Great Barrier Reef Marine Park:** Not Protected
- **EPBC:** Not listed
- **IUCN:** Vulnerable

Best practice and best message

- You can often see humphead parrotfish in schools noisily munching on coral without paying any attention to the people in the water. Do not harass them or chase them away.

cool facts

Humphead parrotfish are slow-growing and live to about 40 years.

Each adult fish ingests over 5 tonnes of structural reef carbonates each year, significantly contributing to the bioerosion of reefs and creating up to 90 kg of sand annually.

The humphead parrotfish sleep in large groups, making them highly vulnerable to exploitation by spearfishers and netters at night.

Male parrotfish have been observed using their prominent humps to ram each other in territorial disputes.

These fish have pharyngeal jaws located in the back of the throat which grind the hard coral into a digestible paste. Any indigestible elements are passed out in the fish's faeces.

Mackerel (Scombridae)

Description

- Grow to lengths of 80 cm to 130 cm; the narrow-barred mackerel is the largest species.
- Silvery, long, torpedo-shaped body; sometimes yellowish-green with vertical stripes on the side of the body.
- Two distinct lateral lines on the sides.
- Deeply forked tail.

Species

- There are over 30 species of mackerel, belonging to the Scombrid family. Species of interest for this survey are listed below.
  - » Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – dark blue along the top, becoming silvery towards the centre and underneath. They have a banded pattern of narrow dark blue or black bars running vertically along the body, narrower than the bars on their relative the broad-barred Spanish mackerel.
  - » Broad-barred Spanish mackerel (*Scomberomorus semifasciatus*) – grey in colour with widely spaced bars.
  - » Shark mackerel (*Grammatorcynus bicarinatus*) also known as grey mackerel – smaller than spanish mackerel with an elongated body that is usually green on top and silver on the sides, with small black spots on the lower sides of its body. Distinguished from other mackerel by its 12 dorsal spines.
- Mackerels primarily feed on small fishes like anchovies, clupeids, carangids, squids and prawns.

Why do we care?

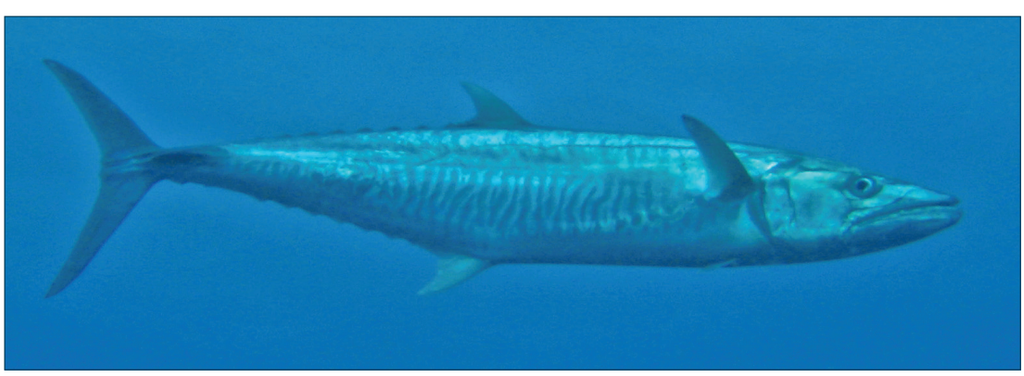
- Mackerel are very high on the food chain, which means they are important predators in their ecosystem. Their presence can be an indicator of reef health. Their abundance and distribution may vary over the year and surveys will help to determine these seasonal changes.
- This fish is high in omega-3 oils and is harvested by humans.

cool facts

Mackerel species are sometimes responsible for ciguatera fish poisoning. The flesh of mackerel spoils quickly especially in the tropics, and can cause scombroid food poisoning.

Mackerel are excellent swimmers and can retract their fins into grooves on their bodies for maximum swimming efficiency and manoeuvrability. They are one of the fastest fish, with top speeds of 33 kilometres per hour.

Spanish mackerel tend to spawn when the water temperatures are higher, as this provides optimal food availability for the rapid growth and development of the larvae.



Spanish mackerel

Where to look

- Mackerel are a free-roaming oceanic fish usually found schooling over offshore reefs and drop-offs, feeding on baitfish. The broad-barred spanish mackerel is often encountered inside major bays in the tropics. Larger fish are loners and smaller fish form dense schools.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** The narrow-barred spanish mackerel (*Somberomorus commerson*) is listed as 'Near Threatened'. Both the broad-barred spanish mackerel (*Scomberomorus semifasciatus*) and the shark mackerel (*Grammatorcynus bicarinatus*) are listed as 'Least Concern'

Best practice and best message

- Since the 1980s, the biomass of some mackerels has declined at least 40 per cent in eastern Australia. There are no known species-specific conservation measures for these mackerel species, except in Australia where there are minimum size limits (75 cm for spanish mackerel and 50 cm for shark mackerel) and bag limits (three for spanish mackerel and 10 for shark mackerel).

cool facts

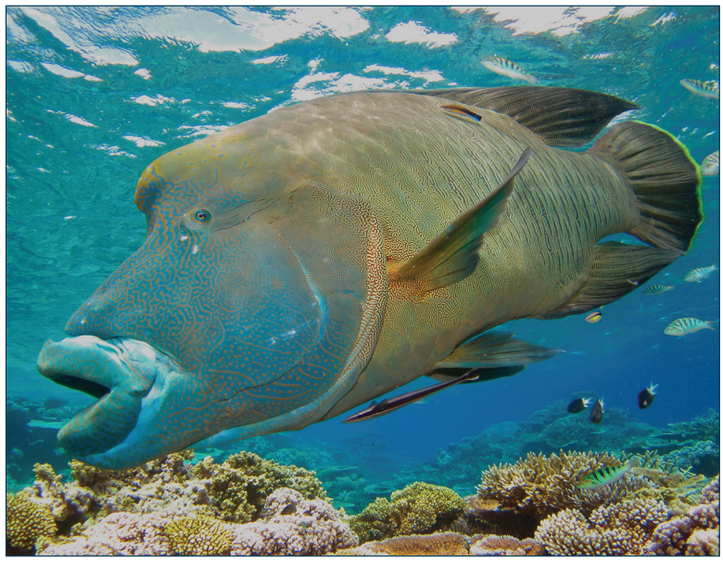
Mackerel are typically found in schools. In order to school efficiently, they need feedback mechanisms to help them align with adjacent fish, and match their speed. These fish have a reflex in their visual systems that is known as an optokinetic reflex, and it can be sensitive to moving stripes. Therefore, the stripes on a mackerel's body provides 'schooling marks' which signal changes in relative position.

These fish may have a lifespan of 15–22 years.

Maori wrasse *(Cheilinus undulatus)*

Description

- One of the largest reef fishes in the world – grows up to 2.3 m in length and 190 kg in weight.
- Males are usually blue and green in colour with dark markings near the eyes. The distinctive wavy lines leading away from the eyes gave this fish its name – these markings were thought to be similar to the traditional facial tattoos of the Maori people of New Zealand.
- Females are more bronze in colour with similar patterns and markings.
- Males have a prominent hump on the head, females usually do not.
- Big lips and intricate patterns on the head.



Mature male Maori wrasse

Species

- The Maori wrasse (*Cheilinus undulatus*) is the largest member of the wrasse family (Labridae). Their diet consists of molluscs (clams, snails and cuttlefish), fish (especially boxfish), crabs, sea urchins, crown-of-thorns starfish and other reef invertebrates.

cool facts

All Maori wrasse mature as females. Some change sex from female to male at approximately 9–15 years of age. When they do, the hump on their head becomes more prominent. Early stages of sex change can be reversed in order to avoid the aggression of larger males.

Males are generally solitary and most often seen alone. Sometimes they are accompanied by a harem of females. During spawning, a male often 'rounds up' females in a cave or protected area and defends his harem from other males.

Why do we care?

- The Maori wrasse is a protected species on the Reef and an iconic tourism species due to the amazing encounters it provides for visitors. It is also a known crown-of-thorns starfish predator, playing a vital role in the ecology of the reef.
- Little is known about the abundance and distribution of this species and how populations are responding to their total protection status since 2003.

Where to look

- Maori wrasse are found on many tourism sites. They are often extremely friendly and approach divers and snorkellers, usually in search of food. Their large size and conspicuous shape and colouration make them an easily recognisable reef fish. The same wrasse can usually be seen at a site for many years. Most spend the day around the reef and at night rest in caves or under ledges.

Female Maori wrasse

Maori wrasse *(Cheilinus undulatus)* continued

Protection status

- **Great Barrier Reef Marine Park:** Protected. You must not take or possess this species in the Marine Park.
- **EPBC:** Not listed
- **IUCN:** Endangered
- Highly valued in parts of Asia in the live reef fish food trade. This species has a long lifespan (up to 30 years) which limits its recovery to fishing pressure in parts of the world where they are not protected.

Best practice and best message

- You must not take or possess protected fish species in the Great Barrier Reef Marine Park unless you have a Marine Parks permit. **Note: 'Take' includes removing, gathering, killing, interfering with (touching and/or hand feeding), or attempting to take.**
- Do not harass or chase Maori wrasse.
- Do not touch any fish because they have a protective mucous coating that, when removed, makes them vulnerable to disease or infection.
- If you catch a Maori wrasse while fishing, please ensure that you use best practice methods to release it.

cool facts

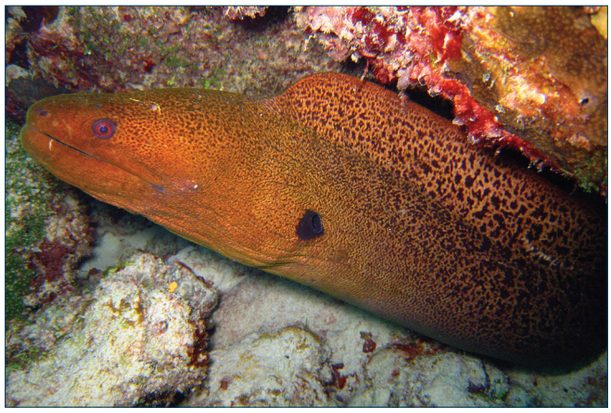
A carnivorous predator, feeding mainly on molluscs and a wide variety of invertebrates including crustaceans, sea urchins, brittle stars and starfish. They have a second set of jaws in their throat, called pharyngeal jaws, which can crush heavy trochus and other shells. Larger fish also take small fishes.

Maori wrasse have been seen turning over rubble to reach the animals beneath and crushing large chunks of coral rubble to feed on burrowing mussels and worms. It is one of the few predators of toxic animals such as the crown-of-thorns starfish, boxfishes and sea hares.

Moray eel *(Gymnothorax sp.)*

Description

- Up to 2 m in length.
- A range of colours, but commonly green or brown.
- Typical, long, eel-like body.
- The mouth gapes open to allow it to breathe.
- Nasal tubes on the end of the snout.
- Has no pectoral fins; the dorsal and anal fins are fused with the caudal fin.
- Solitary by nature.



Giant moray

Species

- There are over 200 species of moray eels worldwide. The giant moray eels (*Gymnothorax sp.*) are the most common coral reef inhabitants. They prey on small fish, octopus, shrimp and lobsters. Some can crush the hard shells of mussels, clams and crabs for food.

Why do we care?

- Moray eels live at the same site for many years – possibly for their entire lives. This makes them important to the tourism industry as a source of enjoyment to divers and snorkellers. However, we don't know a great deal about their abundance and distribution. It's important to gain a better understanding of the lives of these shy creatures.

Where to look

- Moray eels are generally found in lagoons and seaward reefs.
- They are solitary and most often seen with just their head poking out of a small hole in the coral network, usually around an isolated bommie. Each moray eel tends to have its own hiding spot, so the same one can often be found in the same place each day. If you are lucky, you may observe one free-swimming in search of food or another place to hide, in which case they will move between the corals in a true eel-type swimming style.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Listed as Least Concern

Best practice and best message

- Morays are site-specific, so regular divers can visit them again and again in the same location. They are shy and will only attack humans in self-defence.
- Attacks may be provoked by disturbing the animal's burrow or hand-feeding them. Morays have poor vision and rely mostly on their acute sense of smell – this makes it difficult for them to distinguish between fingers and held food. Hand-feeding of moray eels has been banned on the Great Barrier Reef.

cool facts

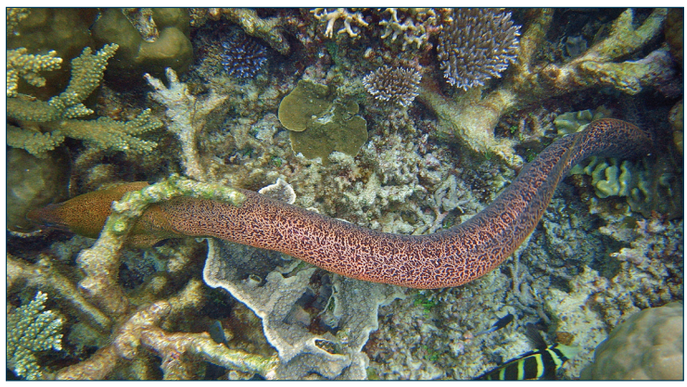
Moray eels are sometimes recruited by coral trout for hunting trips. The coral trout uses body language to signal a hunting foray to the moray. As the grouper's bursts of speed make it deadly in open water and the moray's sinuous body can flush out prey in cracks and crevices, this cooperation leaves prey fish with nowhere to hide.

Morays have a second set of jaws in their throat, called pharyngeal jaws, which can be launched forward to grasp prey.

Moray eels have to keep their mouths open to pass water over their gills. This often gives them a frightening appearance, although they are harmless when left undisturbed.

Once a moray eel bites something (including a human hand), it cannot release it due to the inward pointing teeth of its pharyngeal jaws. The animal must be manually pried off, and sadly, killed in the process.

Moray eels are top predators and often accumulate the poisonous ciguatoxin in their bodies, causing ciguatera poisoning if eaten by humans.

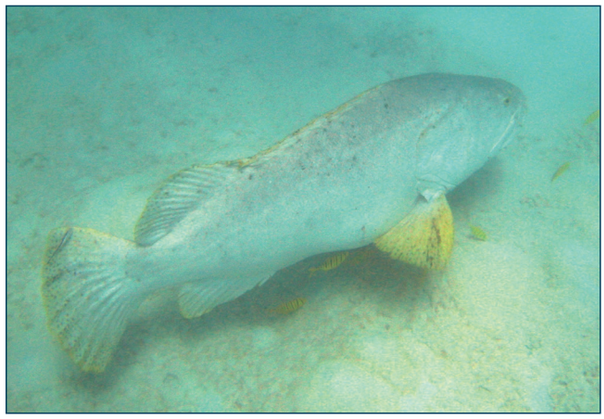


Giant moray swimming

QLD grouper (groper) *(Epinephelus lanceolatus)*

Description

- Largest Indo-Pacific reef fish, growing up 3 m in length and over 600 kg in weight.
- A mottled dark greyish-brown in colour.
- Stout, with a torpedo-shaped body.
- Large upturned mouth with big lips, protruding lower jaw and multiple rows of teeth.



Adult Queensland grouper, about 200 cm

Species

- The Queensland grouper (*Epinephelus lanceolatus*) is the largest bony fish in Australia and is an iconic reef species. This giant fish is a voracious predator, eating fish, sharks and crustaceans – spiny lobsters are their favourite meal. There are reports of these groupers stalking and attacking divers. There are even reports of them swallowing divers whole.

Why do we care?

- The Queensland grouper has been a prize catch to fishers for many years; not so much for their flesh, more for their sheer size.
- They are apex predators and very important to the ecosystem for their role in maintaining prey populations.
- Their extreme size means that these animals are not naturally abundant. This, combined with fishing pressure, is why this species was given protected status in 2003. Understanding their recovery from small populations is essential to their survival within the Reef.

cool facts

The Queensland grouper is the largest bony fish found on coral reefs.

Groupers are often resident on a particular reef for a long time. Some have been known at pontoon sites for over 20 years.

The majority of cods and groupers are predators. They feed on fish and invertebrates – mainly crustaceans, squid and octopus.

Groupers are ambush predators. They often appear to hover motionless under ledges or rest on the bottom where their colouration helps them blend in, waiting for prey to come to them.

Although many species are yet to be studied, it appears that most cods and groupers first mature as females. After spawning one or more times as females, they change sex and spawn as males.

Where to look

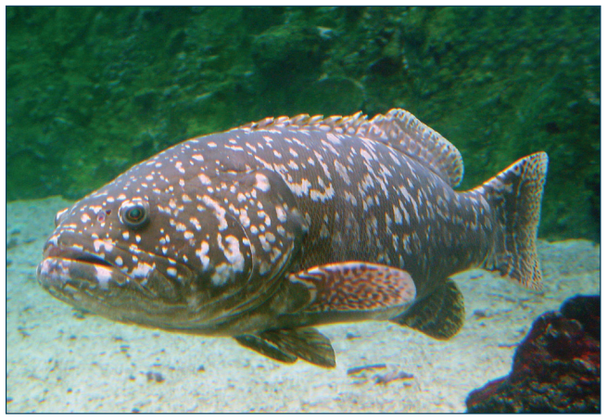
- At some sites these fish can be seen around pontoons. But generally they are a solitary reef-edge species that can be hard to observe. It usually stays within its home range (territory) most of the time. This means the same one is often seen at a site for many years.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Not listed
- **IUCN:** Vulnerable

Best practice and best message

- You must not take or possess protected fish species in the Great Barrier Reef Marine Park unless you have a Marine Parks permit. **Note: 'Take' includes removing, gathering, killing, interfering with (touching and/or hand feeding) or attempting to take.**
- Do not harass or chase Queensland groupers, or feed them when people are in the water. You must have a Marine Parks permit to feed fish as part of your tourism operation.
- Although not generally considered dangerous, large Queensland groupers should be treated with caution and should not be hand-fed.



Juvenile Queensland grouper, about 50 cm

Red bass *(Lutjanus bohar)*

Description

- Grow up to 80 cm in length, but commonly around 50 cm.
- Dark silvery red in colour with large yellow to orange eyes.
- Deep grooves run from the eyes to the nostrils.
- Obvious canine teeth.
- Wide, paddle-like tail.

Red bass in daylight

Species

- The red bass (*Lutjanus bohar*), also commonly called the two-spot red snapper, is one of the largest snapper species. They feed mainly on fishes but will also consume other prey such as crustaceans. This species is sometimes confused with Mangrove Jacks on in-shore reefs.

Why do we care?

- Red bass are important predators on coral reefs and are a protected species in the Great Barrier Reef Marine Park. It is therefore important to monitor their populations by recording abundances and distributions.

Where to look

- Red bass are commonly seen in open water, on the edge of reefs. They often form schools near the surface if fish-feeding activities are taking place. Red bass are avid hunters of small fish – take care when diving at night as anything illuminated can become prey to this opportunistic hunter.

cool facts

Red bass are one of the longest lived species on the reef, living up to 50 years of age.

The small juveniles mimic harmless damselfishes in order to get close to potential prey.

Red bass are known to cause ciguatera poisoning in humans when eaten.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Not listed
- **IUCN:** Not yet assessed

Best practice and best message

- Red bass are one of the longest lived fish on the reef with a lifespan of over 50 years. They grow slowly, reaching a maximum size of 80 cm. Long lifespans and slow growth rates make this species particularly vulnerable to fishing pressure – they may not be as efficient in replenishing their stock numbers as faster-growing species.
- As a top predator, the red bass is known to have high levels of ciguatoxin in its flesh, causing ciguatera poisoning in humans. Preventing people from consuming them is another reason for its protection on the Great Barrier Reef.

Red bass at night

Titan triggerfish *(Balistoides viridescens)*

Description

- Grows up to 75 cm in length and 7 kg in weight.
- Distinctively coloured; a black region with yellow spots covers the eyes and extends to the pectoral fin bases, and the dorsal and anal fins have black margins.
- Heavily scaled head and body.
- A deep groove in front of both eyes.
- Approximately five rows of spines on either side of the caudal peduncle (the area where the tail meets the body of the fish).
- Generally solitary or in pairs.
- Often seen head-down 'blowing' water into the sand to excavate food.

Titan triggerfish biting off coral to hunt

Species

- The titan triggerfish (*Balistoides viridescens*) is the largest of all triggerfish. They turn over coral rubble in search of sea urchins, coral, crustaceans (crabs, prawns and crayfish) and molluscs (clams and snails). It is also one of only a few predators of the crown-of-thorns starfish.

Why do we care?

- As a predator of crown-of-thorns starfish, it is important to understand the titan triggerfish's natural patterns of abundance and its role in the resilience of the reef to outbreaks of crown-of-thorns starfish.

Where to look

- Titan triggerfish are most commonly seen near the reef substrate or sandy bottom where they feed and nest. They are usually solitary and can be observed excavating and moving pieces of rubble in search of food. Typically, they have a 'feeding cave' littered with broken shells where they take prey for consumption.
- During nesting season, they can be seen either making or protecting deep conical nests in the sand. They can be quite aggressive and attack divers when protecting their territory during this season.

cool facts

Triggerfish get their name from the stout first dorsal spine which can be locked into position by a small second spine – the second spine is the 'trigger' because when it is pressed down, the first spine can be 'unlocked'. The fish use these triggers to wedge themselves into coral crevices at night and predators cannot dislodge them.

The strong titan triggerfish are the 'workers' of the reef and often surrounded by other fish feeding from their leftovers.

Titan triggerfish can be a menace to divers during nesting season; there is a record of three divers being attacked by a fish in a single dive.

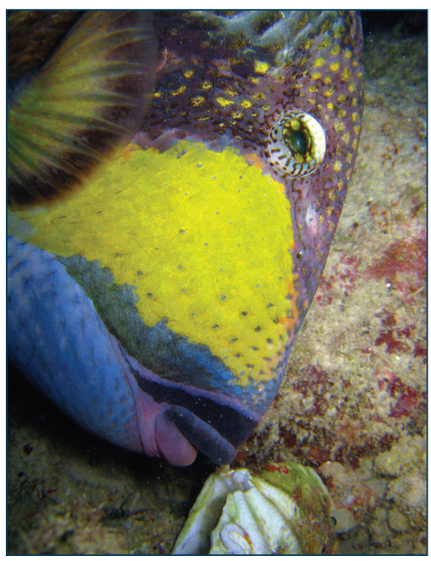
The genus name of this fish, Ballistoides, comes from the Latin ballista, meaning 'ancient war engine' or, more literally, 'a throwing machine'.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Not yet assessed

Best practice and best message

- These large fish are usually shy of divers, but can be aggressive when guarding nests. They are capable of delivering a nasty bite to anyone perceived to be a threat. Avoid getting too close, particularly during nesting season.
- These fish are known to cause ciguatera poisoning in humans when eaten.



Titan triggerfish in a feeding cave, opening a clam

Tuna (Scombridae family)

Description

- Size depends on species and ranges from 40 cm up to 240 cm and 200 kg in weight.
- Metallic silver body, torpedo-shaped and streamlined, stout in the middle and pointed at either end.
- Large eyes and large mouth with conical teeth in both jaws.
- Two closely spaced dorsal fins rise from its back – the first is depressible.
- The tail is lunate (curved like a crescent moon) and tapers to pointy tips.
- The caudal peduncle to which the tail is attached is very slender, with three stabilising keels on each side.
- Usually seen in groups.

Dogtooth tuna, about 150 cm

Species

- The dogtooth tuna (*Gymosarda unicolour*) is the largest tuna you are likely to see at a dive site. The dogtooth tuna has a distinctive wavy lateral line visible along the rear half of it body.
- Other species such as the yellowfin tuna (*Thunnus albacares*) are not commonly seen during a dive on the reef. Most species are only found in open waters.
- All tuna are carnivores, feeding on small fish.

Why do we care?

- As predators, tuna perform an important role in the pelagic system, structuring the abundance of prey species.
- They are targeted commercially both for domestic and international markets.
- Data collected from surveys helps to improve our understanding of their distribution and abundance throughout the year and monitor population numbers.

Where to look

- Most tuna are pelagic and not attached to sites on the reef. They are found in the open water, cruising reef walls or open channels. These fish are always on the move and can be seen in groups, usually with the biggest animal in the lead. However, the dogtooth tuna is reef-associated. It is generally solitary or in small schools of six or fewer.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Some species of tuna, such as the southern bluefin tuna (*Thunnus maccoyii*), are listed as 'Critically Endangered' but many other species occurring in Australian waters are listed as 'Least Concern'.

Best practice and best message

- While diving, a tuna sighting may be rare and brief as they are incredibly fast swimmers. As top predators, tuna are extremely important to ecological processes that affect reef health. Many species are in decline. Skipjack tuna (bonito) is the most sustainable tuna caught in Australia.

cool facts

Tuna are among the fastest fish in the sea with speeds of up to 75 kilometres per hour. They have a higher proportion of red muscle mass compared to white muscle mass – this allows them to sustain high speeds for long periods.

The distances travelled by tuna exceed those of any other fish; one tagging study reported a Pacific bluefin tuna swimming a distance of 10,790 km from the southeast of Japan to off Baja, California.

The heart of the tuna is about 10 times larger, relative to body weight, than in other fish. The blood pressure of tuna is about three times that of other fish, and their hearts pump blood at about triple the rate.

The gills of some tunas can absorb oxygen at similar levels to the lungs of mammals of comparable weight.

Tuna have complex circulatory systems which keep their body temperature several degrees warmer than the surrounding seawater.

Module 8

Sharks and rays are an essential part of the reef ecosystem. However, very little is known about their distribution and abundance on the Reef. Increasing our knowledge is critical to the management of certain species, particularly reef sharks. Sharks and rays also have an extremely high tourism value because so many visitors enjoy seeing them, and some travel exclusively to see them.

Populations of coral reef sharks in the Indo-Pacific, including the Great Barrier Reef, are severely depleted. Approximately 100 million sharks are killed globally each year by fishers. The East Coast Inshore Finfish Fishery takes more than 20 shark species, many of which can be found on the Great Barrier Reef.

Tiger shark

Sharks – likely to be seen around reef areas:

- Blacktip reef shark
- Whitetip reef shark
- Grey reef shark
- Silvertip shark
- Wobbegong
- Tawny nurse shark
- Epaulette shark
- Carpet shark
- Leopard shark
- Spot tail shark
- Lemon shark

Not common but you should know what they look like:

- Tiger shark
- Hammerhead shark
- Bull shark
- Pigeye shark

cool facts

Sharks are at the top of the food chain and help to regulate the populations of prey species and maintain an ecological balance.

When sharks have a problem tooth, it falls out and is replaced by a new one from the many rows of back-up teeth. A shark may go through 20,000 teeth in its lifetime.

Shark skin is made of tiny triangular teeth, with the pointy ends pointing towards the tail. This is why a shark feels smooth when rubbed from head to tail, and rough when rubbed the other way. Some fish use this rough surface to remove dead skin and parasites, swimming up behind the shark and rubbing along its flanks from tail to head.

The caudal (tail) fin of sharks varies in shape and size between different species.

If a shark can't stop swimming, how does it sleep? From research, we know that the 'central pattern generator' that coordinates swimming movements in sharks is not located in the brain, but in the spinal chord. This makes it possible for an unconscious shark to swim. Other research indicates that sharks may shut down different parts of their brain in sequence – they never fully switch off, merely 'zone out'.

Tawny nurse shark

Rays are also under threat from fishing, whether targeted or incidental. Manta rays are currently killed or captured for their gill rakers, and have been hunted in significant numbers in recent years. Manta rays are vulnerable due to their large size, slow swimming speed, aggregative behaviour, predictable habitat use, and lack of human avoidance. Like sharks, rays have a low growth rate, are long-lived and slow-breeding which makes their populations vulnerable to overfishing.

Sharks are top-level predators in the food chain and therefore extremely important to ocean and reef health. The ecological roles of rays are less understood. So little is known about the basic biology and life history of many ray species that little can be said about their importance from a scientific or ecological standpoint.

It can be argued that certain species, such as manta rays, are a highly valued tourism species because they are gentle and harmless to humans. As they are reliant upon plankton, their feeding activities can also map reef productivity. However, the manta ray's migratory nature and worldwide distribution makes conservation of this species difficult.

Many reef-associated sharks and rays are also under threat due to habitat destruction. Their reliance on the reef habitat makes them more susceptible to exploitation and changes in habitat quality than species which range broadly among habitats.

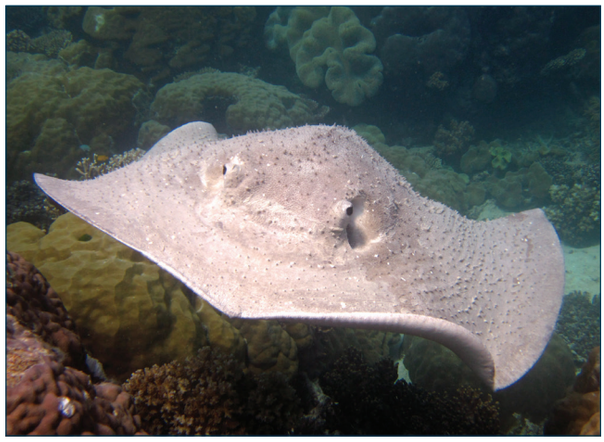
The next pages focus on whitetip, blacktip and grey reef sharks and the blue-spotted manta and devil rays.

Rays – likely to be seen around reef areas:

- Blue-spotted ray
- Manta ray
- Devil ray

Not common but you should know what they look like:

- Blotched fantail ray
- Eagle ray
- Kuhl's stingray
- Mangrove whipray
- Porcupine ray



Porcupine ray

cool facts

Like their shark relatives, rays have electrical sensors called 'ampullae of Lorenzini'. Located around the mouth, these organs sense the natural electrical charges of potential prey.

Many rays have jaw teeth that enable them to crush molluscs such as clams, oysters and mussels.

Most rays, including manta rays, are completely harmless but stingrays have one or more barbs on their tails that they use to defend themselves. If they are caught by fishers or feel threatened, they will sometimes eject their barb. The barb is venomous but stings are rarely fatal. Historically, people living in areas with stingrays used the spines to make weapons like daggers. Stingray venom remains deadly, even if extracted from a dead stingray.

Sharks have been evolving for about 400 million years. Some of the early sharks looked very different from the ones we see now. They have been around for much longer than rays. Paleontologists believe that rays evolved from flattened sharks about 200 million years ago.

Ancient Greek dentists used stingray venom as anaesthetic.

Stingrays are born fully developed; they look like miniature versions of adult animals and take care of themselves from the moment of birth.

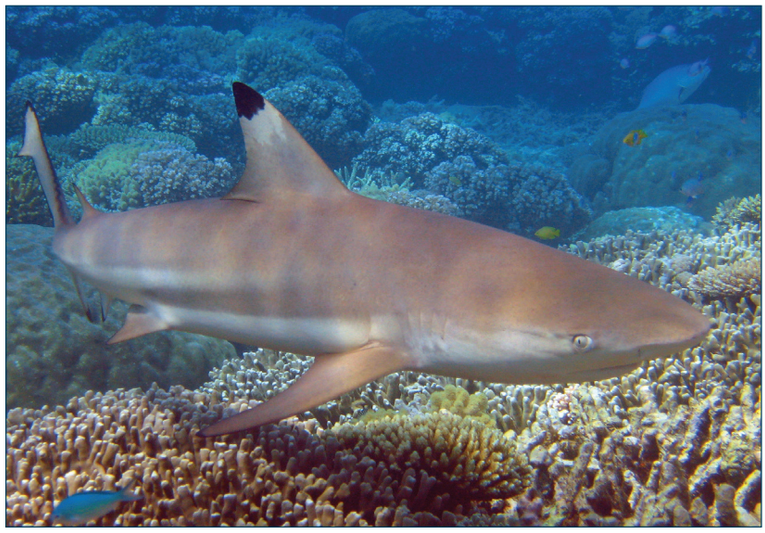
Spiracles are found in some sharks and in all rays. They are a pair of openings just behind the eyes that allow oxygenated water to be drawn in from above. The spiracles allow the fish to breathe even when lying on the ocean bottom or buried in sand.

Manta rays and devil rays are the only ray species that have evolved into filter feeders.

Blacktip reef shark *(Carcharinhus melanopterus)*

Description

- Grow up to 2 m in length but is usually around 1.8 m.
- Grey-brown dorsally in colour, with a lighter belly and black tips on all fins.
- A small shark with a short, bluntly rounded snout and oval eyes.



Species

- The blacktip reef shark (*Carcharinhus melanopterus*) is one of the most commonly seen sharks around coral reefs, and one of four species known as reef sharks. They belong to family of sharks commonly known as requiem sharks (which also includes the whitetip and grey reef sharks).
- Their diet consists mainly of small fishes – parrotfish are a favourite.

Why do we care?

- Like the whitetip reef shark, this species is heavily targeted by fishers. Monitoring the populations of blacktip reef sharks will provide essential data that will help to protect these animals.
- This shark is an important tourism species due to the high quality experiences they provide for tourists – they are seen frequently and are very attractive.

Where to look

- Blacktip reef sharks are very common on reef flats and in shallow lagoons, either alone or in small groups. They inhabit shallow water close inshore on coral reefs, reef flats and near reef drop-offs, and are most active at dusk and dawn.
- Juveniles are often found feeding in mangroves at high tide.

cool facts

While some bottom-dwelling sharks have specialised systems to keep water pumping through their gills, blacktip reef sharks belong to a group of pelagic (mid-water) sharks that can't stop swimming, or they will drown.

Blacktip reef sharks feed on a wide variety of small fish and invertebrates, including mullet, groupers, wrasses, cuttlefish, squid and shrimp.

Blacktip sharks are one of the first animals to re-enter lagoons at high tide. In depths of less than 50 cm, they can manoeuvre, hunt prey and avoid predators.

Females come inshore to pup and have three to six young. They stay in groups with other females until the pups are large enough to move offshore.

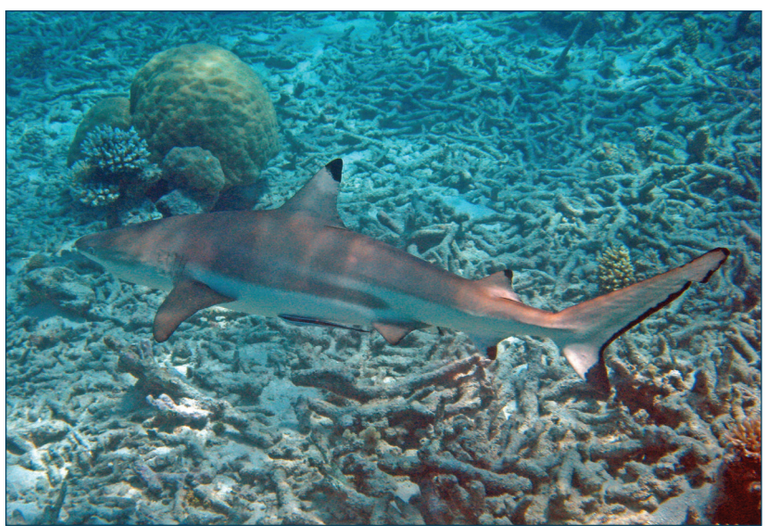
Tagging studies have found that the blacktip shark generally moves only short distances along the coastline and rarely enters offshore waters. However, some individuals have been recorded travelling longer distances – up to 1348 kilometres.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Near threatened

Best practice and best message

- Do not harass or chase sharks.
- If you catch a shark while fishing, please ensure that you use best practice methods to release it.
- Look for and record any mating scars you see on the animal.



Whitetip reef shark *(Triaenodon obsesus)*

Description

- Grows up to 2 m in length.
- Grey in colour with conspicuous white tips on the tail fins and the dorsal fin only (never on the pectoral: silvertip sharks have white tips on their pectorals).
- A small, slender shark with an extremely short, broad snout and oval eyes.

Whitetip reef shark eating a red bass

Species

- The whitetip reef shark (*Triaenodon obsesus*) is one of the most commonly seen sharks around coral reefs, and one of four species known as reef sharks. Their diet consists of fish, octopus, squid and crustaceans.

Why do we care?

- Recent research has shown that on the Great Barrier Reef, populations of whitetip reef sharks in fishing zones have been reduced by 80 per cent, compared to populations in no-take areas.
- Monitoring the populations of whitetip reef sharks will provide essential data that will help to protect these animals.
- This shark is an important tourism species due to the high quality experiences they provide for tourists – they are seen frequently and are very attractive.

cool facts

Unlike other requiem sharks which rely on ram ventilation and must constantly swim to breathe, this shark can pump water over its gills and lie still on the bottom.

Whitetip reef sharks readily try to steal catches from spear fishers – this has resulted in several fishers being bitten.

Whitetips often appear to 'walk' on their pectoral fins along the sandy bottom when disturbed.

Whitetips are skilled at squeezing into crevices to reach prey fish. They can fold down their dorsal fin to make their bodies more compact.

Where to look

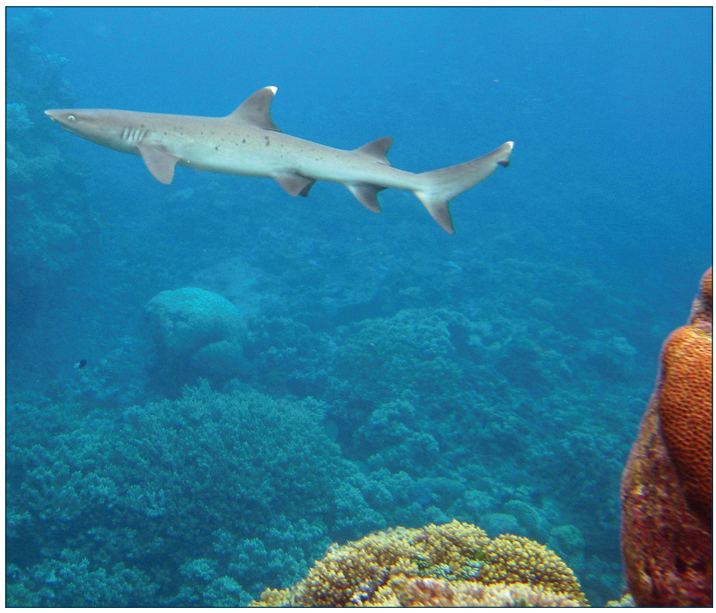
- These sharks can be seen almost anywhere on the reef and near the substrate, but are more likely to be found in back reef areas at depths of 10–40 metres. During the day they are conspicuous due to their habit of resting flat on the bottom. At night they are aggressive and active hunters.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Near threatened

Best practice and best message

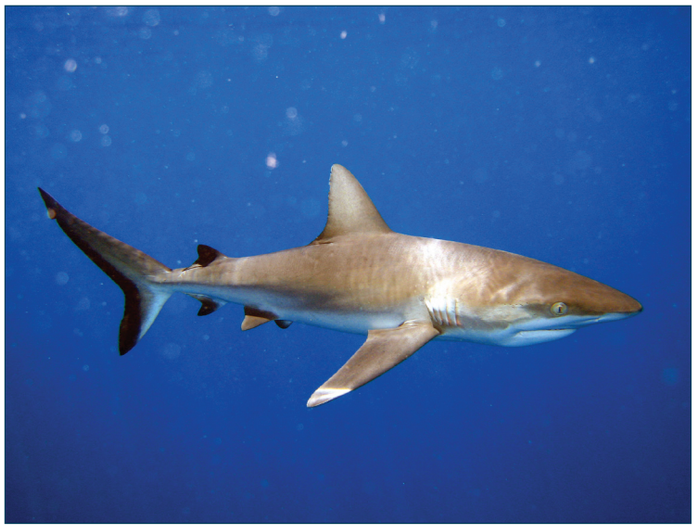
- These sharks usually sit on the sand or under ledges to rest during the day. Although non-aggressive and considered harmless to humans, they are easily disturbed from rest by divers who get too close. Do not harass or chase sharks.
- If you catch a shark while fishing, please ensure that you use best practice methods to release it.



Grey reef whaler *(Carcharhinus amblyrhynchos)*

Description

- Grows to up to 2.5 m in length but individuals over 1.8 m are uncommon.
- Bronze to grey in colour above and pale below with a black caudal fin margin.
- Typical shark body form.
- An indistinct stripe runs anteriorly from above the pelvic fins.



Immature grey reef shark, about 120 cm

Species

- The grey reef whaler (*Carcharhinus amblyrhynchos*), also called the grey reef shark, is one of four species known as reef sharks. It is a common species on coral reefs. This shark's diet consists of reef fishes, squids, cephalopods, crabs, lobsters and shrimps.

Why do we care?

- As these sharks are slow to mature and produce young, they are particularly susceptible to fishing pressure.
- These sharks are important predators in the Reef ecosystem and encounters with them are highly valued by divers and snorkellers.
- Data collected from surveys increases our understanding of their distribution and abundance, helping to monitor their numbers.

cool facts

Grey reef whalers mature at about 7–7.5 years and their expected lifespan is at least 25 years.

These sharks can form schools during daylight hours in aggregations of up to 100 individuals.

The grey reef whaler has a well-documented threat display that involves raising its head, arching its back, lowering its pectoral fins and swimming with exaggerated movements.

A grey reef whaler was photographed at 800 m by a submersible off Hawaii.

This shark has an inquisitive nature, often investigating disturbances and approaching divers.

Where to look

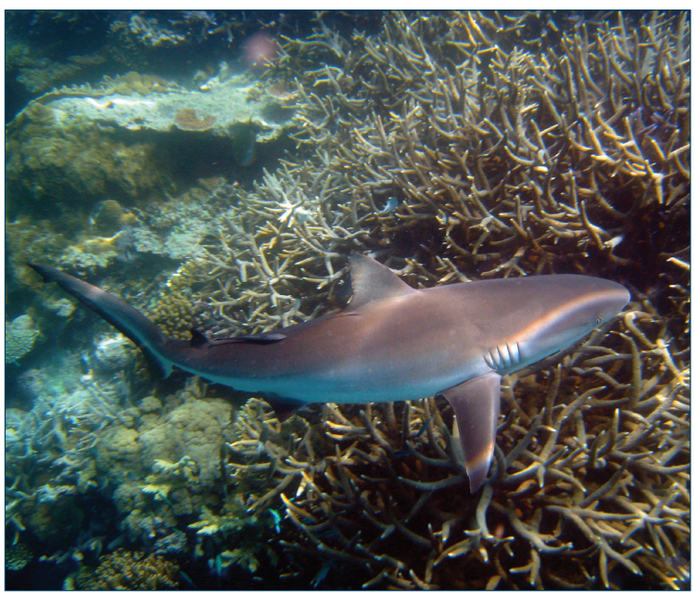
- In Australia, it has been observed from the central Western Australian coast, around the tropical north, to southern Queensland. It can be found from the surface down to depths of about 280 m, and is typically seen on steep outer slopes, drop-offs and channels, often in packs.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Near Threatened

Best practice and best message

- These sharks live on the same reefs for their entire lives. Local populations can be severely depleted by even slight fishing pressure. Massive declines in populations have been reported in other areas of the world.
- The species is regarded as potentially dangerous to humans. They tend to be aggressive under baited conditions and readily enter into an excited feeding frenzy. Do not feed or bait them.

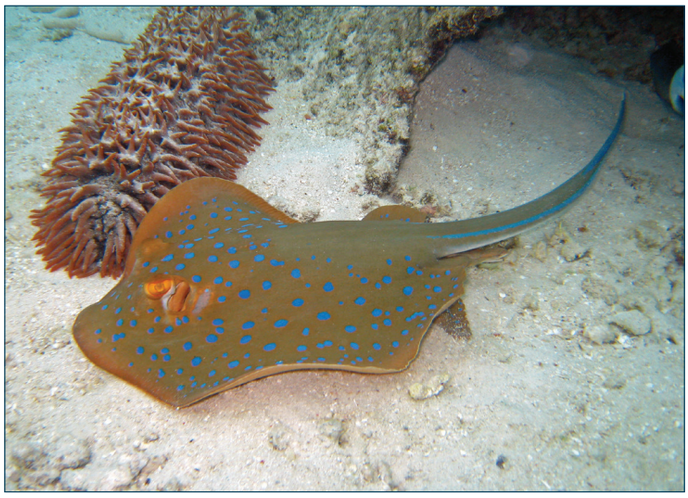


Mature female grey reef shark, about 200 cm

Blue-spotted ray *(Taeniura lymma)*

Description

- Grows up to 70 cm in length with a disc width of 30 cm.
- Greenish, beige or grey in colour with vivid blue spots and blue side-stripes along the tail.
- The snout is rounded and angular and the disc has broadly rounded outer corners.
- The short tapering tail is less than twice their body length when intact.
- Has 1–2 stinging spines or barbs, located near the back of the tail.
- Not to be confused with Kuhl's stingray which has a more diamond-shaped body.



Blue-spotted ray beside a pineapple trepang (sea-cucumber)

Species

- The blue-spotted ray (*Taeniura lymma*) is the ray you are most likely to see at a dive site. They are a relatively small ray. They mainly eat molluscs but also other invertebrates buried in the sand including worms, crabs and shrimps.

cool facts

The ray does not have teeth – instead, it has food-crushing plates on the sides of its mouth.

The stingray is very venomous and its barb is approximately 6 cm long.

The hammerhead shark frequently preys on the blue-spotted ray, and the killer whale generally preys on juvenile Kuhl's stingrays.

The stingray's eggs are retained in the female's body until they hatch and then are born as pups, with up to seven pups per litter.

Why do we care?

- Despite its relative abundance in some areas, almost no information is available on its life history parameters – age at maturity, longevity, average reproductive age, generation time and annual fecundity are all unknown. The lack of data makes management of this species difficult.
- As the ray most likely to be encountered, it is an extremely important tourism species.

Where to look

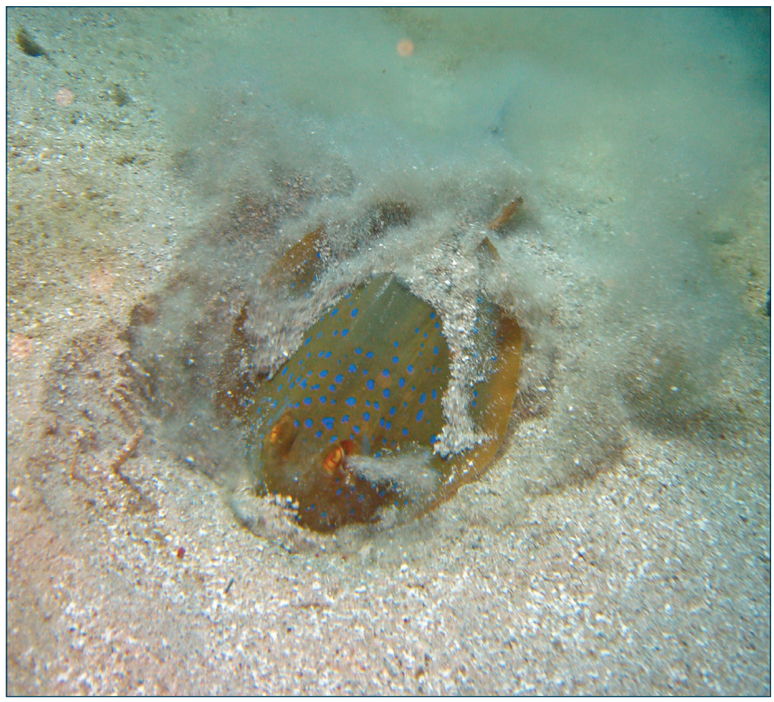
- The blue-spotted ray occurs in shallow tropical marine waters, usually on open sandy areas or in caves on the back reef and in channels.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Near threatened

Best practice and best message

- This ray is capable of injuring humans with its venomous tail spines, but prefers to flee if threatened. Do not harass or try to feed them.



Blue-spotted ray feeding

Manta *(Manta birostris* and *Manta alfredi)* & devil rays *(Mobula japanica)*

Description

- Manta rays grow up to 6.7 m in width and 1300 kg in weight, while devil rays are typically 2–3 m in width and up to 350 kg.
- Usually dark above and white below in colour, although all-black and all-white mantas are seen.
- The spot patterns are unique among individuals and can be used to identify them.
- Has a very broad mouth, on either side of which are prominent fleshy extensions called cephalic lobes.
- The smaller devil rays have rolled cephalic lobes, giving them the appearance of devil-like horns. They are generally 'pointier' than manta rays.

Reef manta ray

Species

- The giant or oceanic manta ray (*Manta birostris*) is the largest living ray, commonly 4 m wide, has a black mouth and is black on top and white below with grey edging. The related reef manta ray (*Manta alfredi*) is smaller with a pale mouth.
- Devil rays (*Mobula japanica*) differ from manta rays in these ways:
  - » Mantas have a large, broad head with the mouth positioned in front. Devil rays have a narrower and more apparent head with the mouth located under the 'chin'.
  - » The general body shape of devil rays looks 'sharper' than the manta's, with 'pointier' extremities.
  - » Devil rays are generally smaller than manta rays, up to 2–3 m in width.
  - » Manta rays don't have tail barbs while some species of devil rays do.
  - » Devil rays are sometimes spotted.
- They are all filter feeders, living off plankton.

cool facts

Although most individuals are seen swimming slowly, the manta ray is capable of swimming at rapid speed.

The manta ray has one of the highest brain-to-body mass ratios of all fish.

Manta rays are sometimes observed breaching: leaping out of the water.

The manta ray does not have teeth. It filters plankton from the water using its gills.

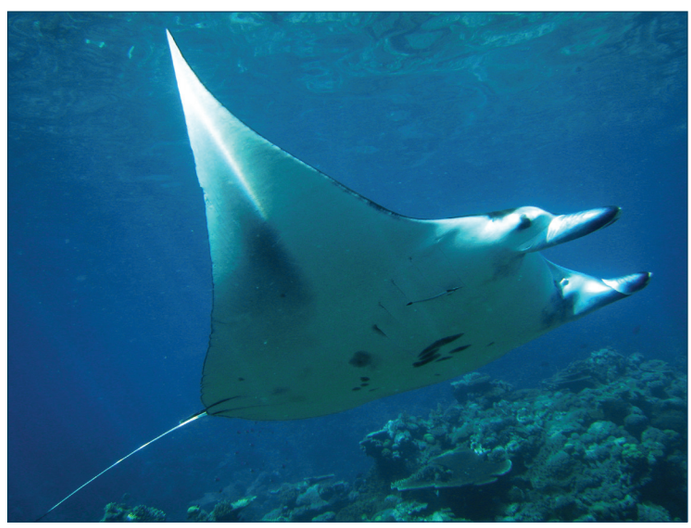
Manta rays swim by moving their wing-like pectoral fins and look like they are flying through the water.

Disc widths have been reliably measured up to 6.7 m, but manta rays possibly grow to 9.1 m.

Manta rays are long-lived, with an estimated lifespan of 40 years.

Why do we care?

- The main threat to these rays is fishing, whether targeted or incidental. Manta rays are currently killed or captured for their gill rakers.
- These rays are easy to target due to their large size, slow swimming speed, aggregative behaviour, predictable habitat use and lack of human avoidance.
- As they are gentle and harmless to people, they are a highly valued tourism species.



Reef manta ray

- Their feeding activities can map reef productivity because they rely on plankton.
- Their migratory nature and worldwide distribution makes conservation of this species difficult.

Where to look

- Manta rays and devil rays are often seen mid-water, on their own or in groups. The manta ray lives in tropical marine waters worldwide, but is also found occasionally in temperate seas. They are known to migrate around the world in search of plankton-rich waters.

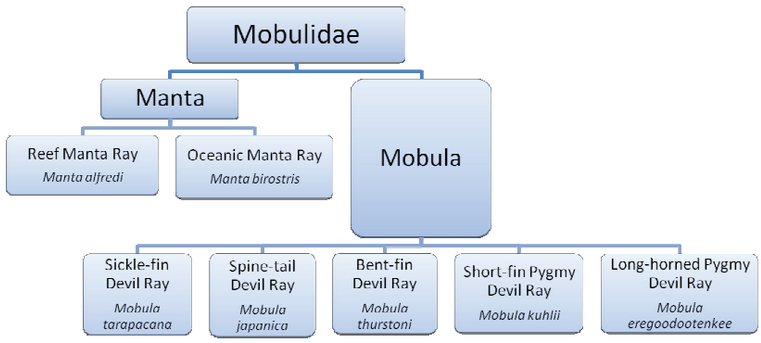
Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Near Threatened
- In 2013, manta rays received protection under the Convention on International Trade in Endangered Species (CITES): they must now be traded with CITES permits, and evidence that they are harvested sustainably and legally must be provided.

Best practice and best message

- These rays are gentle giants and are popular subjects for underwater photography as they are majestic, graceful swimmers and often move slowly. However, these traits also make them more vulnerable to harassment.
- Dive tourism involving this species is a growing industry and it has been demonstrated that sustainable tourism significantly enhances the economic value of this species much more so than the short-term gain of fishing.
- Project MANTA is a multidisciplinary study of manta rays established in 2007. It aims to provide much needed biological and ecological information about this species in eastern Australia. This research relies heavily on community support to provide information about and photographs of manta ray sightings. Photographs of the underside of a manta ray are used for identification and are integrated in a database of manta rays on the eastern Australian coast. Send any images of manta ray bellies through the *Sightings Network*.

Mobulid species of the Indo-West Pacific



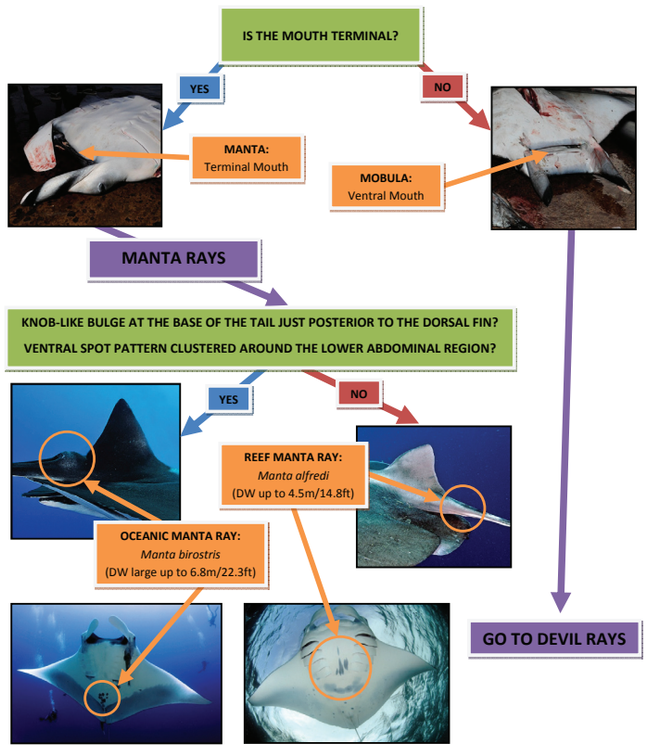
Courtesy of Manta Trust

cool facts

Devil rays in the Gulf of California (Sea of Cortez) have been reported to breach as high as 2 metres above the sea.

Devil rays have a disproportionately large, complex brain compared to other fish. The weight of their brains relative to their body weight is comparable to many mammals. These rays have been documented exhibiting 'un-fishlike' almost curious or playful behaviour with other rays as well as divers.

Key to the identification of mobulid rays (Mobulidae) in the Indo-West Pacific



Courtesy of Manta Trust

Module 9

There are many other important indicator organisms on the Reef and learning about their abundances is useful for management of the Great Barrier Reef.

These organisms don't fit into the previous categories and include invertebrates such as molluscs, echinoderms and cnidarians. Invertebrates are the largest contributors to coral reef biodiversity, with species estimates ranging from about 170,000 species to over nine million species. Most invertebrates are small and are not studied as frequently as fish and corals.

Invertebrates make up approximately 98 per cent of all animal species on earth. Similar to the insects of the rainforest, coral reef invertebrates are extremely diverse and are the engineers of coral reefs. They perform many vital ecological services such as water filtration, decomposition of dead and decaying material, cleaning corals and fish of parasites, keeping algal growth in check and nutrient cycling. They are also critical to both the pelagic and coral reef food webs.

One type of algae is also included in this section, the blue-green algae *Trichodesmium* sp. It differs from macroalgae in size, in where it is found and in ecological importance.

Five species are included in the 'Other' section of the *Tourism Weekly* log sheet: four types of invertebrates and one type of algae. Once you are familiar with the five main species and become more comfortable conducting your weekly timed swim, you may start noticing other animals that don't fit into the reptile/fish/shark categories. You can list these animals in the last row of the 'Other' section. Additional species could include giant clams, lobsters, squid, octopus, cleaner shrimp, egg cowrie, coral crabs, mantis shrimp, flatworms and sea slugs.

Polyclad flatworms mating
Photo courtesy of Emily Smart

cool facts

Giant clams are iconic coral reef invertebrates that play important ecological roles in water filtration, as a food source and as a substrate for reef-associated organisms. These clams clean nutrients from the water around the Reef, limiting the nutrients available to algal growth. A single giant clam can filter hundreds of litres of water each day, and only where there are giant clams do we see high coral abundance and biodiversity.

Cleaner shrimp and wrasse perform a vital ecological role on coral reefs by cleaning fish of their parasites. Often found in 'cleaning stations', these animals may 'service' hundreds of 'clients' per day and consume thousands of parasites from their hosts. Many fish visit the same cleaning stations each day.

Coral crabs are found in bushy corals. They live in pairs and protect their coral homes from predators, including the crown-of-thorns starfish. At least 50 times the size of its attacker, the crown-of-thorns starfish is repelled by the tiny crabs' aggressive tactics, including using their claws to snap off the starfish's thorny spines and tube feet. The crabs also clean their coral hosts of sediments and invading organisms, and their presence enhances the coral's growth rate.

The octopus is considered the most intelligent invertebrate and shows great skill at problem solving. They are the first invertebrates seen to use tools, such as using coconut shells to hide from potential predators and using rocks and jets of water in a way that could be classified as tool use. Recent research suggests that each of the eight arms of an octopus may have a mind of its own. Studies indicate that octopus arms have independent nervous systems. The brain may simply delegate orders, with the arm being responsible for deciding exactly how to execute the order.

Nudibranchs are small, colourful molluscs, often called sea slugs. Scientists were surprised to discover that one species of nudibranch has a 'disposable' penis. After mating, the male discards its penis, grows a new one within 24 hours and then mates again the next day. Scientists are still baffled about why this unique mating behaviour evolved.

Snapping shrimp, also known as pistol shrimp, have a specialised claw used for hunting prey. When the claw is snapped shut, it creates a cavitation bubble which travels quickly (97 km/h) towards the prey and releases a sound that reaches 218 decibels. The pressure is strong enough to kill small fish. The bubble then collapses, reaching temperatures of over 4700°C, nearly the temperature of the surface of the sun (5500°C). It has since been discovered that some species of mantis shrimp can also create cavitation bubbles with their club-like claws.

Cuttlefish (Sepiidae family)

Description

- Grow to 50 cm in length and 10 kg in weight.
- Colour is usually opaque white or mottled with varying degrees of browns, blacks and blues; but cuttlefish can change the colour and texture of their skin in an instant.
- The mantle is oval with crescent-shaped clubs.
- They have ten arms – two are retractable and sit in 'tentacular pockets'.

Species

- The reef cuttlefish, also known as the broadclub cuttlefish (*Sepia latimanus*), is the second largest cuttlefish and the one most often seen around the Reef. Please record any cuttlefish you see on your survey, no matter the species.
- They are formidable hunters – they use camouflage to sneak up on and confuse prey before projecting their two retractable arms to grasp and pull prey to their mouths. They usually hunt fish, shrimp and crustaceans.

Why do we care?

- Cuttlefish are elusive creatures, have a short lifespan, undergo natural mass death after breeding and are highly dependent on particular coral species for egg-laying. These characteristics make them vulnerable to large-scale coral disturbances; therefore keeping track of sightings is useful for monitoring and managing them.

Where to look

- Cuttlefish sightings usually occur in the later months of the year when they appear on reef sites to mate and nest. Males and females can be seen courting, with males defending a coral head where females will lay their eggs. Vibrant displays of flashing colours and skin textures take place. Keep a close eye on your site if you have stands of *Porites cylindrica* as it is a favoured coral species for cuttlefish egg-laying.
- Cuttlefish are usually seen mid-water, on their own or in groups.

Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Data deficient

Best practice and best message

- Cuttlefish are rarely seen and are masters of camouflage. They make brilliant photography subjects if you can get close enough. When stressed, they emit an ink cloud to confuse predators. Do not harass cuttlefish as inking is a high-stress response. Do not feed them.

cool facts

Cuttlefish have one of the largest brain-to-body size ratios of all invertebrates – they are one of the most intelligent invertebrates on Earth.

Although they can change the colour of their skin for camouflage, they are colour-blind. A cuttlefish placed on a checkerboard can imitate the pattern and baby cuttlefish often mimic mangrove leaves.

Cuttlefish tentacles eject and retract in the blink of an eye, at a speed of approximately 15 metres per second.

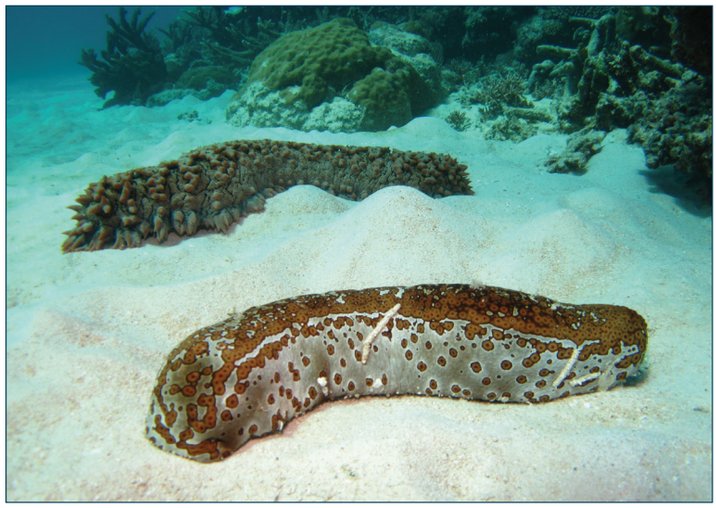
Cuttlefish are short-lived. They have a 2–3 year lifespan and die shortly after reproducing. They lay their eggs among branching hard corals to hide them from predators. Their eyes are thought to be fully developed while still in the egg – cuttlefish start observing their surroundings while waiting to hatch.

The blood of a cuttlefish is blue due to the copper-based hemocyanin used to carry oxygen instead of the red, iron-containing protein hemoglobin found in the blood of vertebrates.

Sea cucumbers (class Holothuroidea)

Description

- Some species can grow to 2 m but generally they are 50–60 cm in length.
- Colour varies from black to pink, green to brown; both solid colours and markings.
- Body is soft and cylindrical; most look like large worms or caterpillars. Their tough skin reduces predation.
- They have a distinct upper and lower surface with tube feet only on the lower surface.
- Move principally using their tube feet and rhythmic contractions of their large, fleshy bodies.
- Breathe by taking in water through the anus.
- Most are dull in colour, so shape is the most important feature for identification.



Pineapple trepang and leopard trepang

Species

- There are over 1500 species worldwide, with approximately 200 species in Australian waters. All species of sand-dwelling sea cucumbers are of interest because they consume dead and decaying organic material, algae and tiny plankton, filtering the sand for their food. However, we do not count the synaptid species as they feed on the surface detritus rather than filtering the sediment.

cool facts

When threatened, some species of sea cucumber can shoot their sticky respiratory organs (called cuvierian tubules) out their anus to entangle potential predators. The release of these organs can also be accompanied by the discharge of a toxic chemical which can kill any animal in the vicinity. These respiratory organs can regenerate in 1–5 weeks, depending on the species.

Sea cucumbers belong to a group of animals called echinoderms, which includes sea stars and urchins – all of which are able to regenerate lost or damaged body parts, including internal organs. Echinoderms can also regrow a whole individual from body fragments (asexual reproduction).

Why do we care?

- Sea cucumbers play a vital role in the reef ecosystem by virtually vacuuming the sea floor and removing excess nutrients – this limits algal growth.
- Sea cucumbers are commercially harvested for food, known as bêche-de-mer. In the far north of Queensland, Australia, sea cucumber harvest from the Great Barrier Reef and the Coral Sea is managed.

Where to look

- Almost always seen on sandy substrate, but sometimes on coral. Some burrow under sand and are difficult to spot. Look for a cylindrical shape.

Sea cucumber emerging from being buried

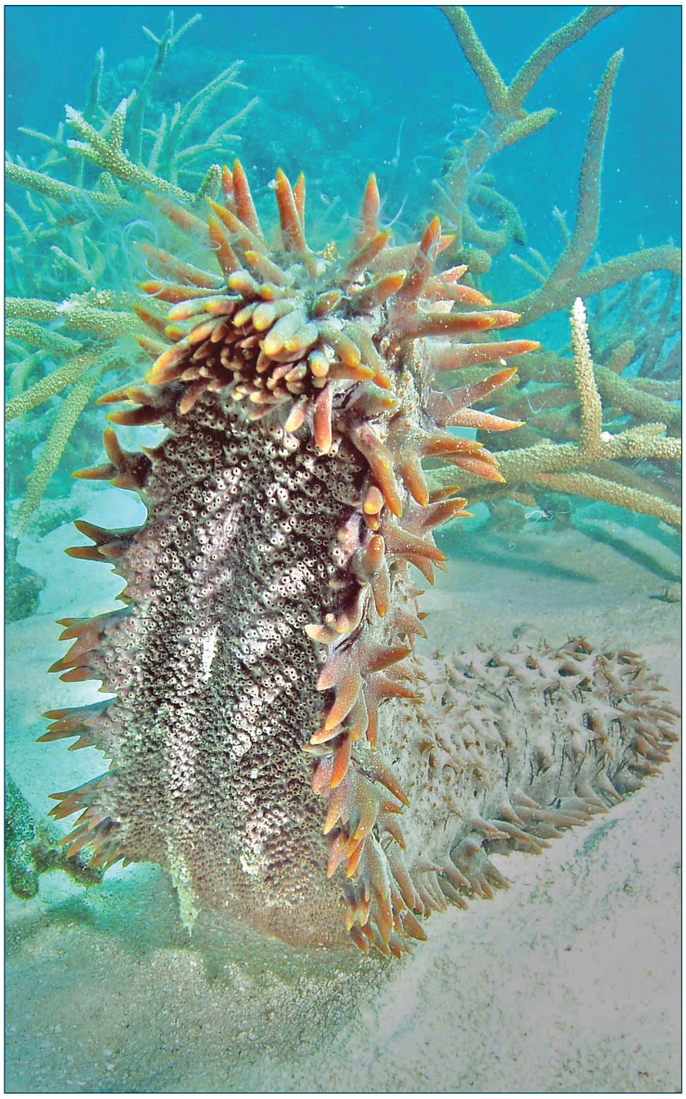
Protection status

- **Great Barrier Reef Marine Park:** Not protected
- **EPBC:** Not listed
- **IUCN:** Not yet assessed
- Endangered in many parts of the world. Sea cucumbers are heavily overfished in some areas because they are easy to catch and of relatively high value.

Best practice and best message

- Do not pick up sea cucumbers as you can severely compromise the health of these animals. When the animal is harassed or threatened, some species eject their viscera (internal organs) through the anus. Although able to regenerate their organs within two months, it costs them a great deal in terms of energy, and they are extremely vulnerable to predation during the regeneration process.

Leopard trepang



Pineapple trepang spawning

cool facts

The sea cucumber trade between the Macassan seafarers from Sulawesi in East Indonesia and the Indigenous Australians of Arnhem Land to supply the markets of southern China is the first recorded example of trade between Australians and our Asian neighbours. Estimates from the 1800s based on historical data indicate that annual catches of around 800 tonnes were common.

Sea cucumbers are gaining popularity in medicinal science as they have been found to contain a number of unique biological compounds that are effective against cancer, blood clots, high blood pressure, inflammation and bacterial infections.

Sea cucumbers occupy an ecological niche in the ocean similar to that of earthworms in terrestrial ecosystems. They filter food from the water column and sift through the sea floor to filter organic matter from the sand, helping to keep the seafloor clean.

When sea cucumbers digest sand, they produce ammonia waste which provides nutrients for coral growth. They dissolve calcium carbonate as part of their digestive process. This source of alkalinity could reduce the effects of increasing atmospheric carbon dioxide on coral growth.

Instead of gills, sea cucumbers breathe through a special organ called a respiratory tree which draws water in and out the rear end.

Some sea cucumbers have a small fish, called a pearl fish, which lives inside their intestines, entering and leaving via the anus.

Triton snail *(Charonia tritonis)*

Description

- Largest snail on the Great Barrier Reef – grows up to 46 cm in length.
- Mottled white and brown in colour.

Species

- The triton snail (*Charonia tritonis*) is the largest of all Australian triton shells. It takes only three years from hatching to reach adult size.
- Many marine snails belong to the class Gastropoda. Gastropods are found in diverse habitats all over the world, such as woodlands, deserts, mountains, rivers and lakes, estuaries, mudflats, the rocky intertidal, the sandy subtidal, coral reefs, and the abyssal depths of the oceans.

Triton snail with clean shell

Why do we care?

- The triton was greatly prized for its beautiful shell and heavily collected on the Reef for many years. Very few people in recent times have seen a live triton snail, and information about their distribution and abundance is poor. The triton is now completely protected.
- In addition to its beauty, the triton is also a known crown-of-thorns starfish predator.
- Only close monitoring of the triton snail will determine whether its protection can conserve the species.

cool facts

Tritons can be observed turning and giving chase when the scent of prey is detected.

The triton grips its prey with its muscular foot and uses its toothy radula (a serrated, scraping organ) to saw through its prey's skin and inject it with a paralysing saliva. Once subdued, the snail feeds on its prey at leisure.

Tritons will ingest whole animals, later spitting out any poisonous spines, shells or other unwanted parts.

The beautiful shell has been celebrated in art since the Renaissance.

Where to look

- These snails can be hard to spot due to the growth of algae on their shells which provides camouflage. They can be found under rocks or coral slabs.

Protection status

- **Great Barrier Reef Marine Park:** Protected
- **EPBC:** Not listed
- **IUCN:** Not yet assessed

Best practice and best message

- These animals are protected. Do not collect or touch them.
- Do not turn the shell upside down and leave it that way. Although most gastropods can right themselves if tipped over by waves, they are more vulnerable to predators when upside down.

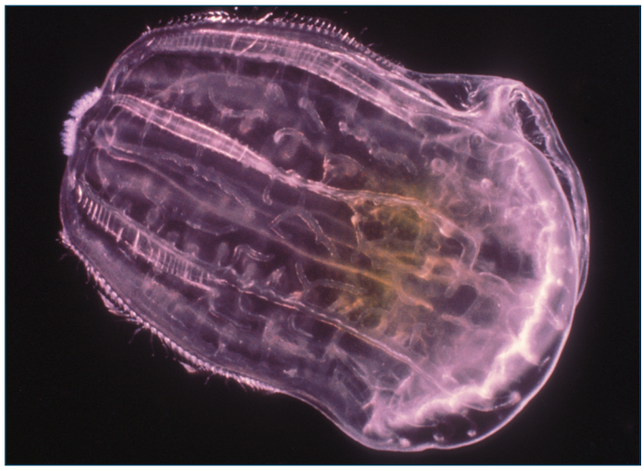
Triton snail eating COTS

Introduction to jellyfish

Jellyfish are closely related to corals and anemones, all of which have stinging tentacles. Most jellyfish have a bell-like structure with trailing tentacles that are used to capture food. They are carnivorous and feed on planktonic organisms such as small crustaceans and larval fish. Larger jellyfish also feed on adult fish.

Jellyfish are found in every ocean, from the surface to the deep sea. Jellyfish populations are known to have seasonal blooms. In 2005, it was estimated that the Sea of Japan contained an astounding 20 billion jellyfish.

Although jellyfish are a diverse group and include commonly seen species such as the moon jelly and comb jelly, there are three species of jellyfish we are particularly interested in understanding more about, simply because there is presently little data about them: Irukandji, box jellyfish and bluebottles. Also, these jellyfish can pose a significant threat to humans if contact is made. As they can deliver painful or even fatal stings, please be extremely careful when you see these animals.



Comb jelly

Lion's mane jellyfish

cool facts

Jellyfish have roamed the seas for at least 500 million years, and possibly 700 million years, making them the oldest known multi-organ animal.

Jellyfish are found in every ocean, from the surface to the deep sea. A few jellyfish even inhabit fresh water – the moon jellies in Jellyfish Lake, Palau, use photosynthetic algae to make their food instead of hunting with stinging tentacles.

A group of jellyfish is sometimes called a bloom or a swarm. Another collective name for a group of jellyfish is a smack.

Jellyfish do not need a respiratory system since their skin is thin enough for the body to be oxygenated by diffusion.

During their life cycle, most jellyfish progress from a polyp (a small planted stalk with a mouth that is ringed by upward-facing tentacles) to a medusa stage (the life stage which is most typically identified as a jellyfish). There are also several possible larval life-stages.

Jellyfish lifespans typically range from a few hours (in the case of some very small hydromedusae) to several months.

One species of jellyfish might be immortal due to its ability, under certain circumstances in the laboratory, to transform from the medusa stage back to the polyp stage, thereby escaping the death that typically awaits medusae after reproduction.

Jellyfish: Irukandji *(e.g. Carukia barnesi)*

Description

- Small jellyfish; 1–2 cm in length, cube-shaped.
- Colourless, transparent and often nearly invisible.
- Has one tentacle at each of the four 'corners'.
- Tentacles extend to over 1 m and contract to less than 5 cm.

Carukia barnesi

Species

- There are at least eight species of jellyfish that induce the 'Irukandji syndrome' in victims. The first confirmed species was *Carukia barnesi* in Australia, but the syndrome has been reported globally including locations such as Melbourne and Wales, and throughout the tropics.
- The irukandji jellyfish (*Carukia barnesi*) is a very small, cube-shaped jellyfish armed with a powerful sting that causes Irukandji syndrome. Symptoms of irukandji syndrome include severe headache, backache, muscle pains, chest and abdominal pain, nausea and vomiting, sweating, anxiety, hypertension, tachycardia and pulmonary oedema.
- The irukandji jellyfish feeds on fish and crustaceans and uses its strong toxin to paralyse prey.

Why do we care?

- This species of jellyfish can be extremely dangerous and even cause death. Collecting more data about its life history, including where and when irukandji are seen, is vital for understanding the species and managing human activity to minimise injury.

Where to look

- Irukandji are found swimming or floating in the water, offshore as well as along coastal beaches from Port Douglas in north Queensland to the Whitsunday Islands near Mackay. They are also found in the Cairns region and the Great Barrier Reef when northerly or north-easterly winds and currents carry them onshore.
- Irukandji can form swarms near the surface. Look for the appearance of 'crushed ice' on the surface and jelly buttons washing ashore. These are salps that appear during the same conditions so are a good indicator that caution is required.

Protection status

- No protection status exists.

Best practice and best message

- Always wear lycra stinger suits or wetsuits and preferably hoods as well when entering the water.
- These jellyfish are extremely dangerous. Do not swim in waters when they have been spotted (usually November–May).
- Report any sightings immediately. Stings require emergency care.

cool facts

Irukandji have image-forming eyes that respond to images, but they cannot process the visual information as they have no brain.

The initial sting of the jellyfish is usually not very painful. But about 5–45 minutes (usually 30 minutes) after being stung, the victim develops a severe backache or headache and shooting pains in their muscles, chest and abdomen. They may also feel nauseous, anxious and restless, and vomit. In rare cases, the victim suffers pulmonary oedema (fluid on the lungs) which can be fatal if not treated. Victims often report a feeling of overwhelming impending doom or a feeling of having something very wrong with their insides.

The irukandji jellyfish is both fast and agile while swimming, and does not just float around aimlessly.

The cause of irukandji syndrome used to be a mystery. In 1964, Dr Jack Barnes went on a mission in Cairns to determine the reason for Irukandji syndrome. He noticed the small jellyfish and captured it. He then stung himself, his 14 year old son and a surf life saver to find out if the jellyfish he had caught was responsible for irukandji syndrome. All three ended up in hospital but survived. The tiny jellyfish was later called *Carukia barnesi* after the very dedicated and slightly crazy Dr Barnes.

Jellyfish: Box jellyfish *(Chironex fleckeri)*

Description

- Large jellyfish; the bell reaches up to 30 cm in width while the tentacles can stretch up to 3 m.
- Clear, sometimes pale-blue bell, transparent and often nearly invisible.
- Has 15 tentacles at each of four 'corners' (60 in total).

Species

- The box jellyfish (*Chironex fleckeri*) is the largest of the cubozoan jellyfish. It feeds on fish and crustaceans, using its strong toxin to paralyse and kill prey.

Why do we care?

- These jellyfish are extremely dangerous to people in the water and can even cause death. Reports of where and when box jellyfish are seen are vital to human safety in order to manage human activity and minimise the risk of injury.

Where to look

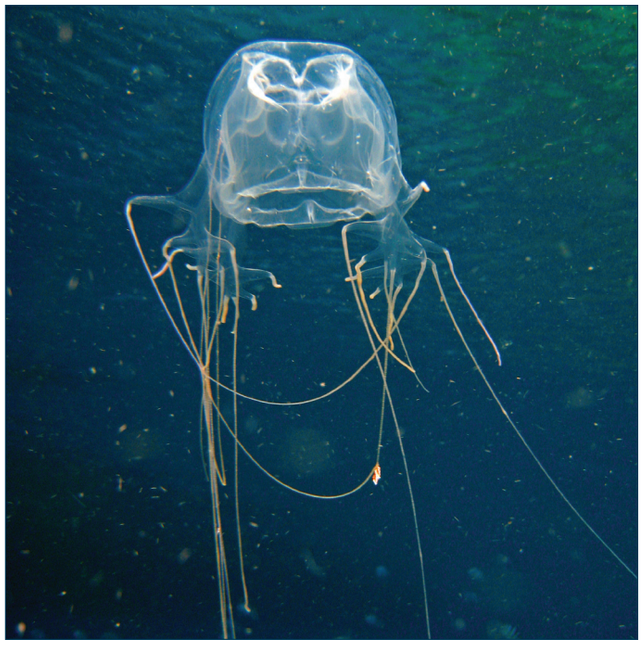
- Box jellyfish inhabit the shallow waters of the northern Australian coast. They are more numerous after local rain and in calm seas, especially near river and creek outlets and around boat ramps. They are more abundant during the summer months. They are believed to come near shore into estuaries to breed.

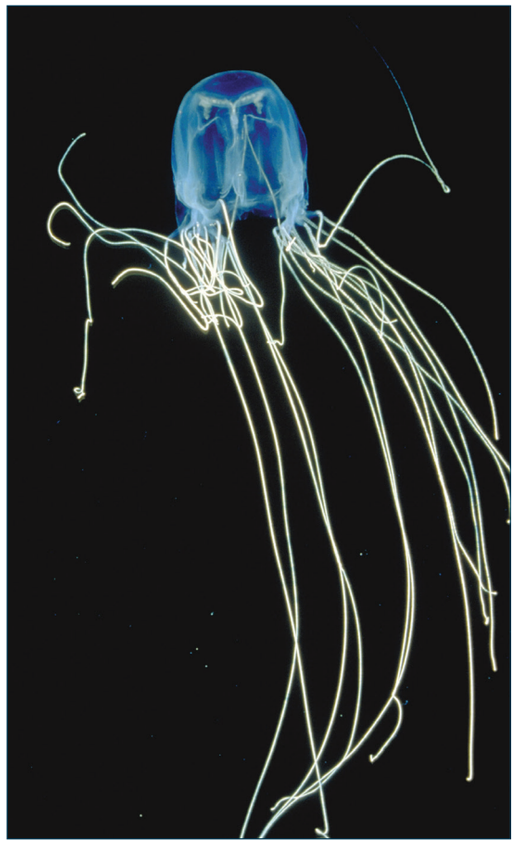
Protection status

- No protection status exists.

Best practice and best message

- Always wear lycra stinger suits or wetsuits and preferably hoods as well when entering the water.
- These jellyfish are extremely dangerous. Do not swim in waters when they have been spotted (usually November–May).
- Report any sightings immediately. Stings require emergency care.





cool facts

The box jellyfish is the most venomous creature known to science and is capable of killing a person within five minutes of stinging. However, while this is possible, hundreds of non-fatal stings occur across northern Australia every season

Box jellyfish have 24 eyes, consisting of four different types. The most primitive type is only light sensitive and cannot truly 'see'. However, one set of eyes is more sophisticated and can detect the colour and size of objects, in a way that is similar to human sight. Although they do not have a brain, they have four parallel information processing areas that act in competition, supposedly making it one of the few creatures to have a 360-degree view of its environment. This helps them to deliberately track and hunt prey.

Box jellyfish are very fast swimmers, capable of speeds over eight kilometres per hour – just under the speed of an Olympic swimmer – and move with purpose.

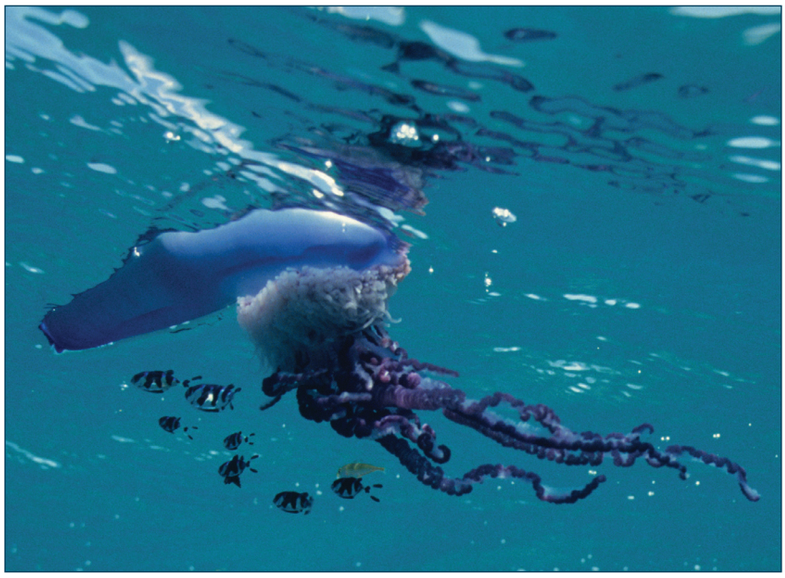
Box jellyfish have killed at least 67 people in Australia since records began in 1883.

Box jellyfish grow 2–3 mm every single night.

Jellyfish: Bluebottle *(Physalia physalis)*

Description

- Main body is 5–30 cm in length and stands up to 15 cm above water.
- Transparent, with a blueish-purple hue.
- Has coiled tentacles that can extend up to 50 m.
- A gas-filled float keeps the bluebottle on the surface.



Species

- The bluebottle (*Physalia physalis*) is not actually a jellyfish, but a colonial hydroid, made up of a colony of animals called polyps.
- It is also known as the Portuguese man o'war. They are carnivorous, feeding on small fish.

Why do we care?

- The specific season for this species is not fully understood. Recording the occurrence of bluebottles at tourism sites will provide a clearer picture of their habits. This is particularly important as bluebottles can cause a painful sting.

Where to look

- Bluebottles are most commonly seen in the open ocean. However, waves can direct them into shallow waters or wash them up on beaches. They can be found year-round along the Australian east coast.

Protection status

- No protection status exists.

Best practice and best message

- When entering the water, wear lycra stinger suits or wetsuits and preferably hoods as well. Do not touch them. Although no fatalities have been attributed to bluebottles, their sting can be quite painful, even if they are washed ashore and dead. They are hard to see from the surface. If you see them, let others in the water know straight away.

cool facts

The float of each individual is either right-sided or left-sided, which causes the bluebottle to drift 45 degrees to the right or left of the wind direction. This means that if one half of the population floats into predators or a current that washes them up on shore, the other half can survive.

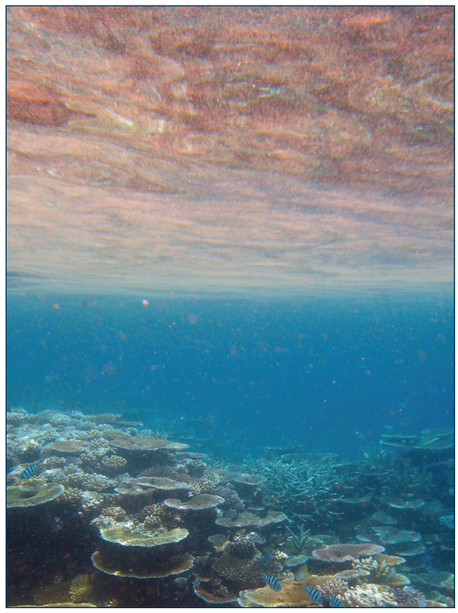
One predator of bluebottles is a small nudibranch which, after ingesting the bluebottle, diverts its venom undigested into finger-like projections of its own body, becoming more toxic than the bluebottle itself.

The sting remains potent even if the bluebottle is dead. The tentacles should not be touched.

The bluebottle's float is equipped with a siphon. In the event of a surface attack, the siphon can be deflated, allowing the bluebottle to briefly submerge.

Trichodesmium sp.

Description



- Tiny but found in large slicks on the surface of the water. They join together to form long filamentous strands.
- Brown to red in colour when floating. Blooms washing onshore can appear pink, green and livid purple as they decompose in shallow tidal pools. Often compared to sawdust (and called sea sawdust by early observers).
- Sometimes appear as a milky layer within the first 3 m of surface water.
- They give off an unpleasant smell.

Species

- *Trichodesmium erythraem* is a single-celled organism, a blue-green planktonic alga (also called cyanobacteria). As algae is the ocean's equivalent to a plant on the land, *Trichodesmium erythraem* creates its own food by photosynthesis – it requires sunlight to turn carbon dioxide into carbohydrates. This algae forms in clear, nutrient-poor water (oligotrophic) and its appearance on the surface is at the end of its life. The reddish-brown colour is due to the iron that it has accumulated.

Why do we care?

- *Trichodesmium erythraem* plays an important role in the ocean's chemical cycle – these chemicals support life and affect the global climate. *Trichodesmium erythraem* is a nitrogen-fixer like some terrestrial plants, so it provides vital nitrogen to other animals in the ocean. Perhaps more importantly, it converts carbon dioxide into organic carbon, pulling this greenhouse gas out of the atmosphere. Therefore, *Trichodesmium erythraem* may be an important indicator for water quality and climate change issues on the Reef. Recording the occurrence of *Trichodesmium erythraem* helps us monitor its frequency and range of appearances.
- Phytoplankton, such as *Trichodesmium erythraem*, is the base of marine food webs; it is the initial energy producer that sustains all other life in the ocean. Phytoplankton produces food through photosynthesis just like plants on land. It transfers this energy when it is eaten by larger zooplankton (tiny animals such as krill and baby fish) which are then eaten by larger animals, such as fish and filter-feeding whales, like blue and humpback whales. This means that the amount of phytoplankton available in the ocean actually limits how many animals can live in the ocean. Without phytoplankton, there would be no marine animals.

cool facts

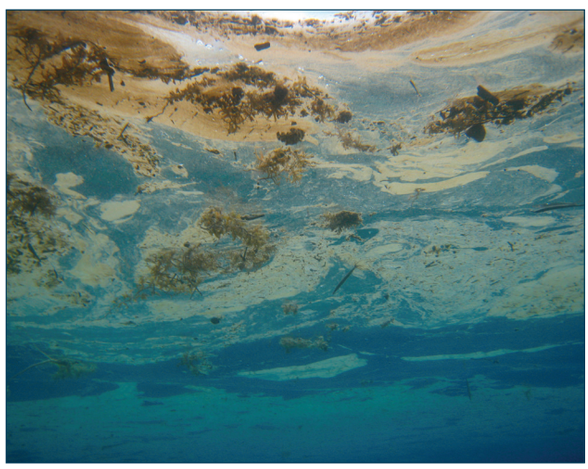
Vast blooms of *Trichodesmium erythraem* are visible from space and have been photographed by NASA.

Trichodesmium erythraem produces more nitrogen than any other macroscopic cyanobacteria. About half of the new nitrogen is used for primary production. This means that *Trichodesmium erythraem* can take nitrogen gas from air and 'fix' it in a form that can then be transferred into the food chain.

Trichodesmium erythraem was first recorded by Captain James Cook in 1770.

Where to look

- *Trichodesmium erythraem* starts growing in deep water. Gas spaces in the cells make the algae float to the surface, where it forms loose bundles that become the visible flecks and strands that we see. *Trichodesmium erythraem* 'blooms' look like oil slicks and/or a milky layer two to three metres deep. It can be found all year round, but tends to be more common in summer and more visible on calm days.



Protection status

- No protection status exists.

Best practice and best message

- Contact with blooms may cause skin irritation and if inhaled, lung irritation.

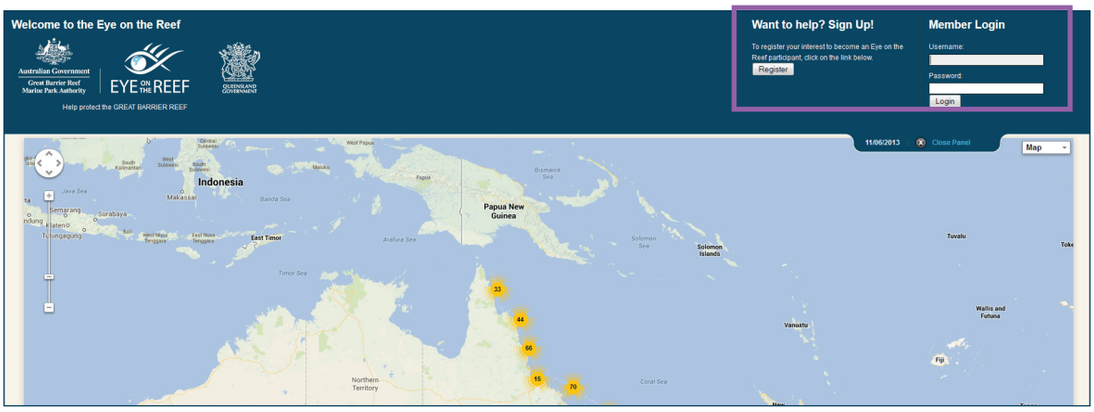
The Eye on the Reef reporting system: User guide

Step 1:

Follow this link/url: www.gbrmpa.gov.au/eye-on-the-reef

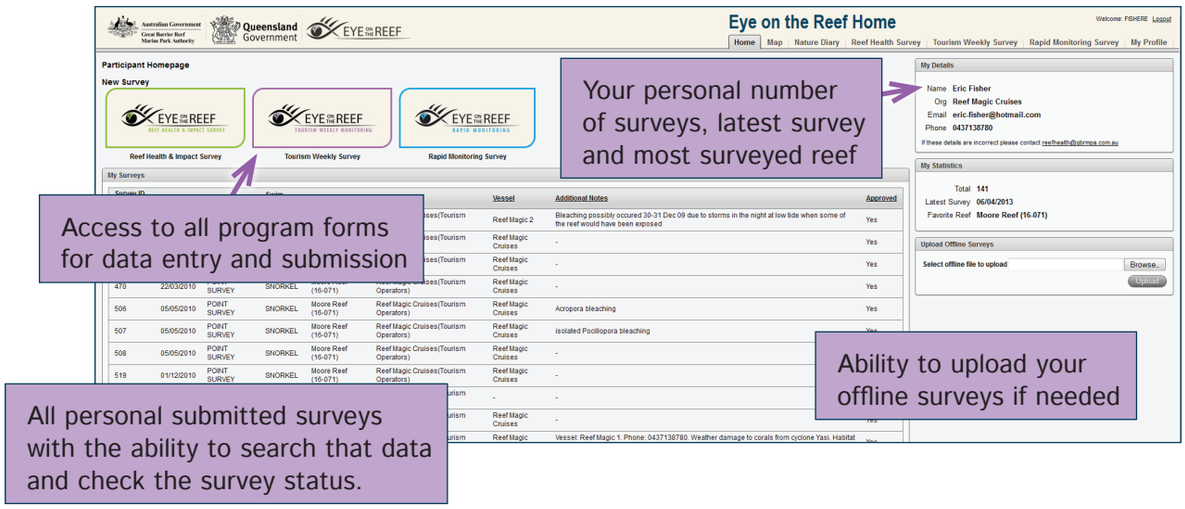
Step 2:

Log in.

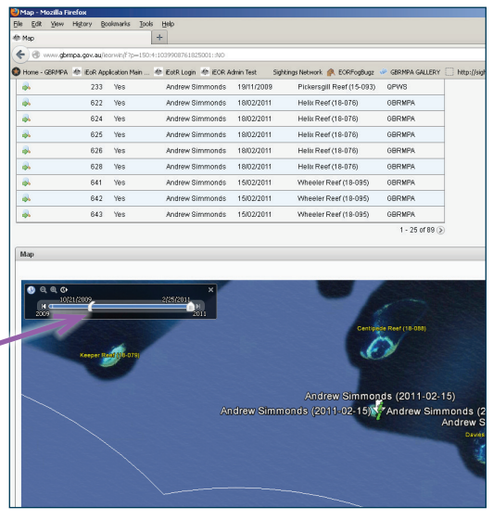


Step 3:

This is your usage screen. It displays a list of your surveys, a summary of your effort and access to the online forms for data entry

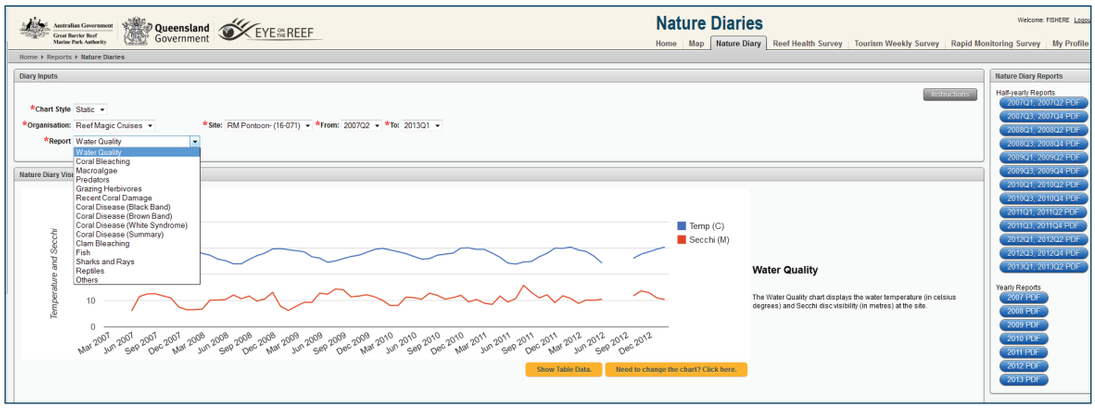


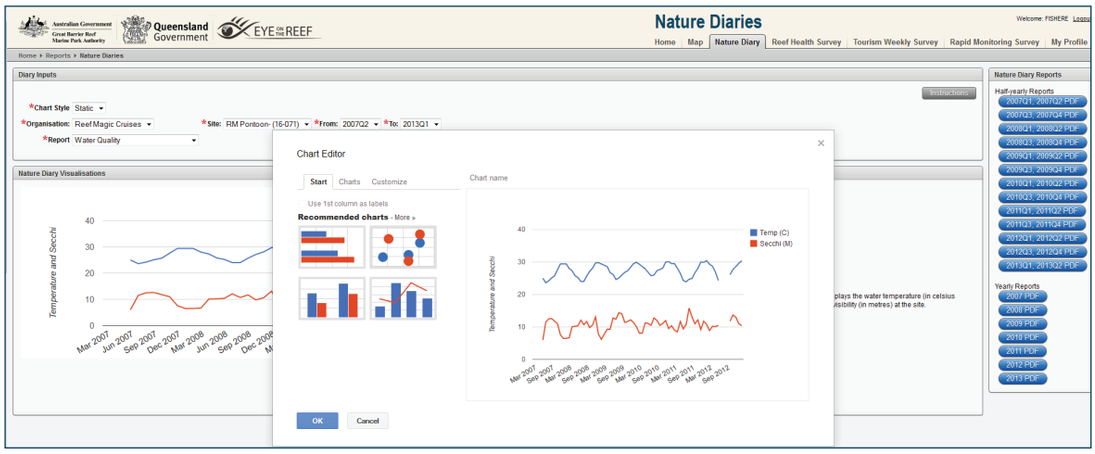
The Map tab displays your survey effort spatially in a downloadable KML.

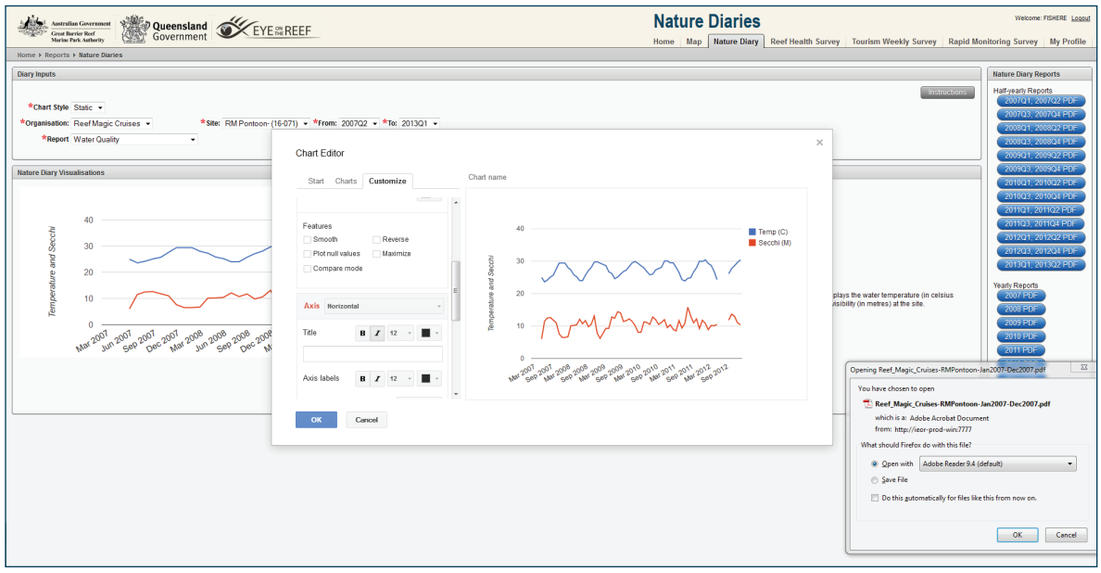


Step 4:

The Nature Diary tab gives you access to site reports and the ability to customise chart displays.

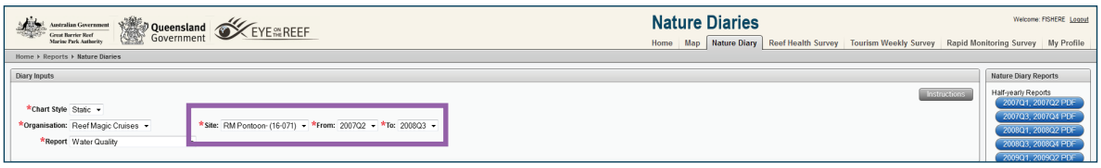




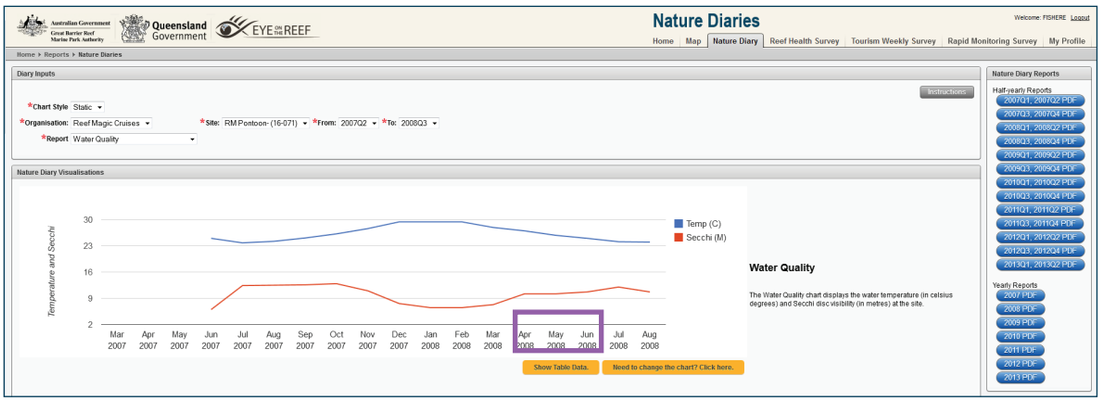


To export data to Excel

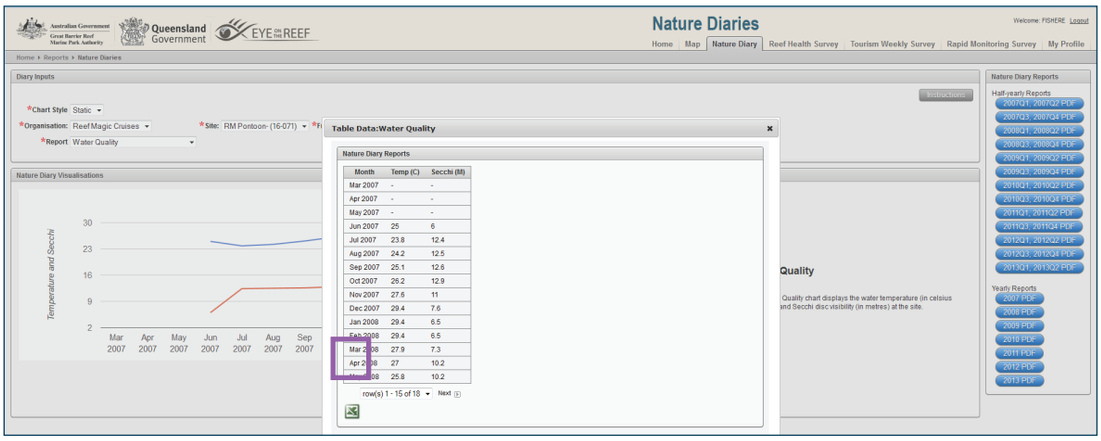
Under Nature Diary tab> Select date range:



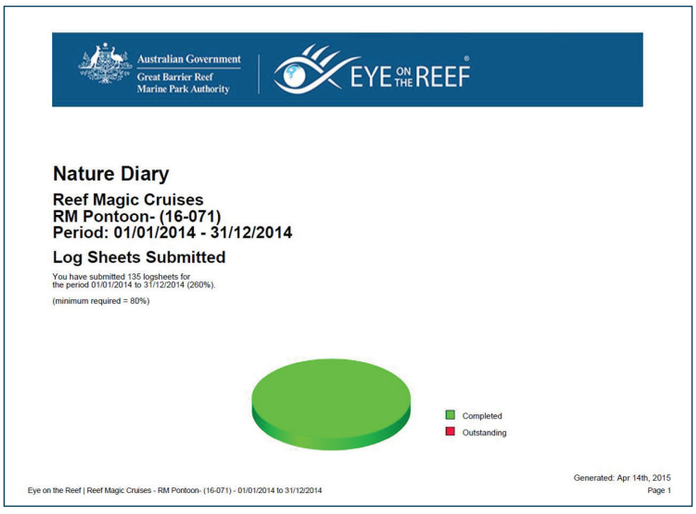
Select “Show Table Data” tab:



Click on the Excel icon:



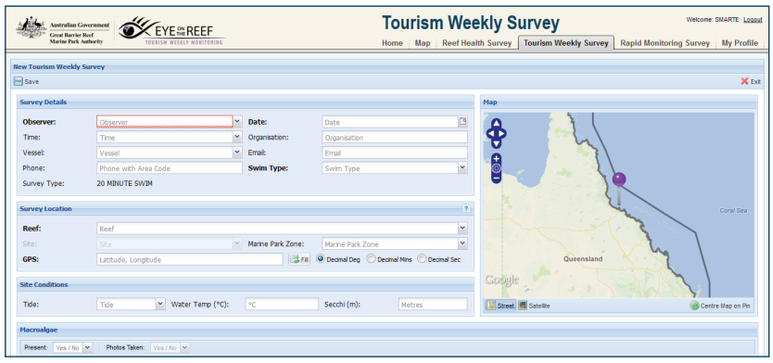
And download PDF reports in one step



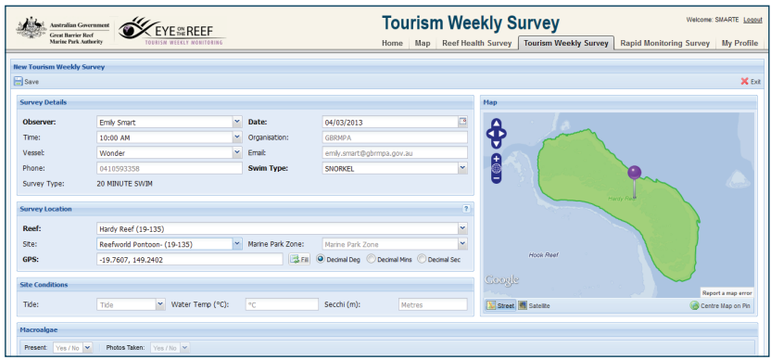
Step 5:

The Survey tabs give you access to online forms for data entry.

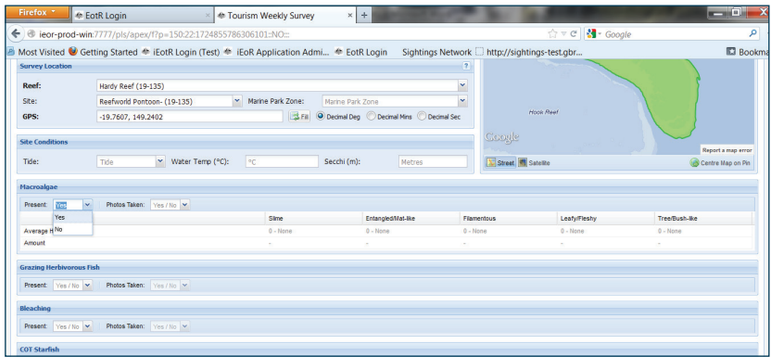
Select the log sheet you wish to enter online.



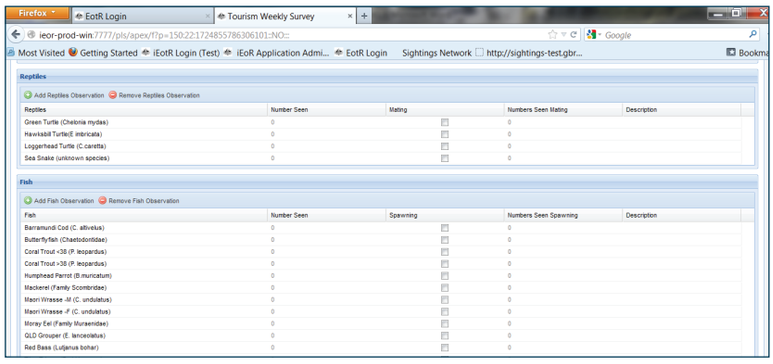
Enter forms online; select your name, organisation, vessel, reef name, site and move pin to actual site location.



Select Yes or No to represent present or absent (you looked) then populate each field and leave as is if didn't look.



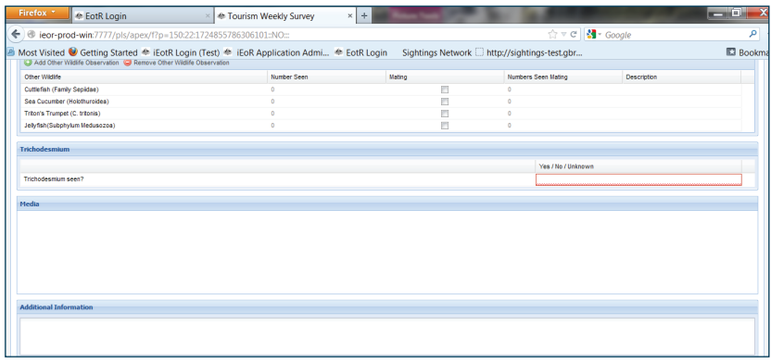
Place number or a zero in each box for each species and then select box if seen mating/spawning and provide description.



If you have any associated images or video, note the image number and when sent to eyeonthereef@gbrmpa.gov.au email.

Any additional information of interest can be added to the Additional Notes section.

Select Save and record the survey number given on the form, date entered and by whom and file hard copy log sheet.



For assistance email eyeonthereef@gbrmpa.gov.au

The Tourism Weekly log sheet 1

Tourism Weekly Monitoring

Australian Government | Great Barrier Reef Marine Park Authority | EYE ON THE REEF | Queensland Government

Observer name:		Report date:	Time:
Operator:	Vessel:	Method (tick one): Snorkel ☐	Dive ☐
Reef name:		Site name:	
Tide on survey (tick one): Low ☐	Medium ☐	High ☐	
Water temperature (0–1 m depth): _____°C (to one decimal point)		Secchi disc visibility: _____ metres	

REEF HEALTH INDICATORS

MACROALGAE — ☐ Present ☐ Absent ☐ Did not look

Algae type:	Slime	Entangled / mat-like	Turfing	Leafy / fleshy	Tree / bush-like
Average height:					
Insert code: **0** = None **1** = <3 cm **2** = >3–25 cm **3** = >25 cm					
Amount:					
Insert code: **N** = None **B** = Bits & pieces **L** = Large patches **E** = Everywhere					

GRAZING HERBIVORES — ☐ Present ☐ Absent ☐ Did not look

Length:	Size of hand or shorter	Up to fingertips-to-elbow length	Longer
Total number of fish:			
Insert code: **0** = None **1** = 1–10 **2** = 11–20 **3** = 21–40 **4** = >40			

BLEACHING — ☐ Present ☐ Absent ☐ Did not look

CORAL BLEACHING

Coral type:	Soft	Branching	Bushy	Plate / Table	Vase / Foliose	Encrusting	Mushroom	Massive
Amount affected:								
Insert code: **0** = None **1** = ⩽5 colonies **2** = 6–20 colonies **3** = ⩾21 colonies								

CLAM BLEACHING — Number of clams **partially bleached:** _____ Number of clams **totally bleached:** _____

COT STARFISH — ☐ Present ☐ Absent ☐ Did not look

Coral type:	Soft	Branching	Bushy	Plate / Table	Vase / Foliose	Encrusting	Mushroom	Massive
Amount scarred:								
Insert code: **0** = None **1** = ⩽5 colonies **2** = 6–20 colonies **3** = ⩾21 colonies								

COTS seen: Number of juveniles (size of hand): _____ Number of adults (larger than size of hand): _____

DRUPELLA — ☐ Present ☐ Absent ☐ Did not look

Coral type:	Soft	Branching	Bushy	Plate / Table	Vase / Foliose	Encrusting	Mushroom	Massive
Amount scarred:								
Insert code: **0** = None **1** = ⩽5 colonies **2** = 6–20 colonies **3** = ⩾21 colonies								

Drupella seen: Number of snails seen: _____

DISEASE — ☐ Present ☐ Absent ☐ Did not look

Coral type:	Soft	Branching	Bushy	Plate / Table	Vase / Foliose	Encrusting	Mushroom	Massive
Amount affected by **White syndrome:**								
Amount affected by **Black band disease:**								
Amount affected by **Brown band disease:**								
Insert code: **0** = None **1** = ⩽5 colonies **2** = 6–20 colonies **3** = ⩾21 colonies								

RECENT CORAL DAMAGE — ☐ Present ☐ Absent ☐ Did not look

Coral type:	Soft	Branching	Bushy	Plate / Table	Vase / Foliose	Encrusting	Mushroom	Massive
Amount affected:								
Insert code: **0** = None **1** = ⩽5 colonies **2** = 6–20 colonies **3** = ⩾21 colonies								
Severity:								
Insert code: **1** = Edge/tips **2** = Part / branches **3** = Whole colonies **4** = Structure								
Suspected cause:								
Insert code: **A** = Anchor **C** = Animal **D** = Divers **X** = Other **S** = Snorkellers **U** = Unknown **W** = Weather / storm **V** = Vessel								

Please return to: **Great Barrier Reef Marine Park Authority** | Reply Paid PO Box 1379 Townsville QLD 4810 | Fax (07) 4772 6093 | Ph (07) 4750 0700 | eyeonthereef@gbrmpa.gov.au

The Tourism Weekly log sheet 2

INDICATOR, ICONIC and/or PROTECTED SPECIES					
REPTILES		NUMBER SEEN	MATING (if applicable, Y or ✓)	NUMBER SEEN MATING	DESCRIPTION
Green turtle					
Hawksbill turtle					
Loggerhead turtle					
Sea snake	Sp:				
Other:					
FISH		NUMBER SEEN	SPAWNING (if applicable, Y or ✓)	NUMBER SEEN SPAWNING	DESCRIPTION
Barramundi cod					
Butterflyfish					
Coral trout	<38 cm				
	>38 cm				
Humphead parrotfish					
Mackerel					
Maori wrasse	Male				
	Female				
Moray eel					
QLD grouper					
Red bass					
Titan triggerfish					
Tuna					
Other:					
SHARKS / RAYS		NUMBER SEEN	MATING (if applicable, Y or ✓)	NUMBER SEEN MATING	DESCRIPTION
Blacktip reef shark					
Whitetip reef shark					
Grey reef whaler					
Blue-spotted ray					
Manta ray					
Other:					
OTHERS		NUMBER SEEN	SPAWNING (if applicable, Y or ✓)	NUMBER SEEN SPAWNING	DESCRIPTION
Cuttlefish					
Sea cucumber					
Triton snail					
Jellyfish	Type:				
Trichodesmium					
Other:					