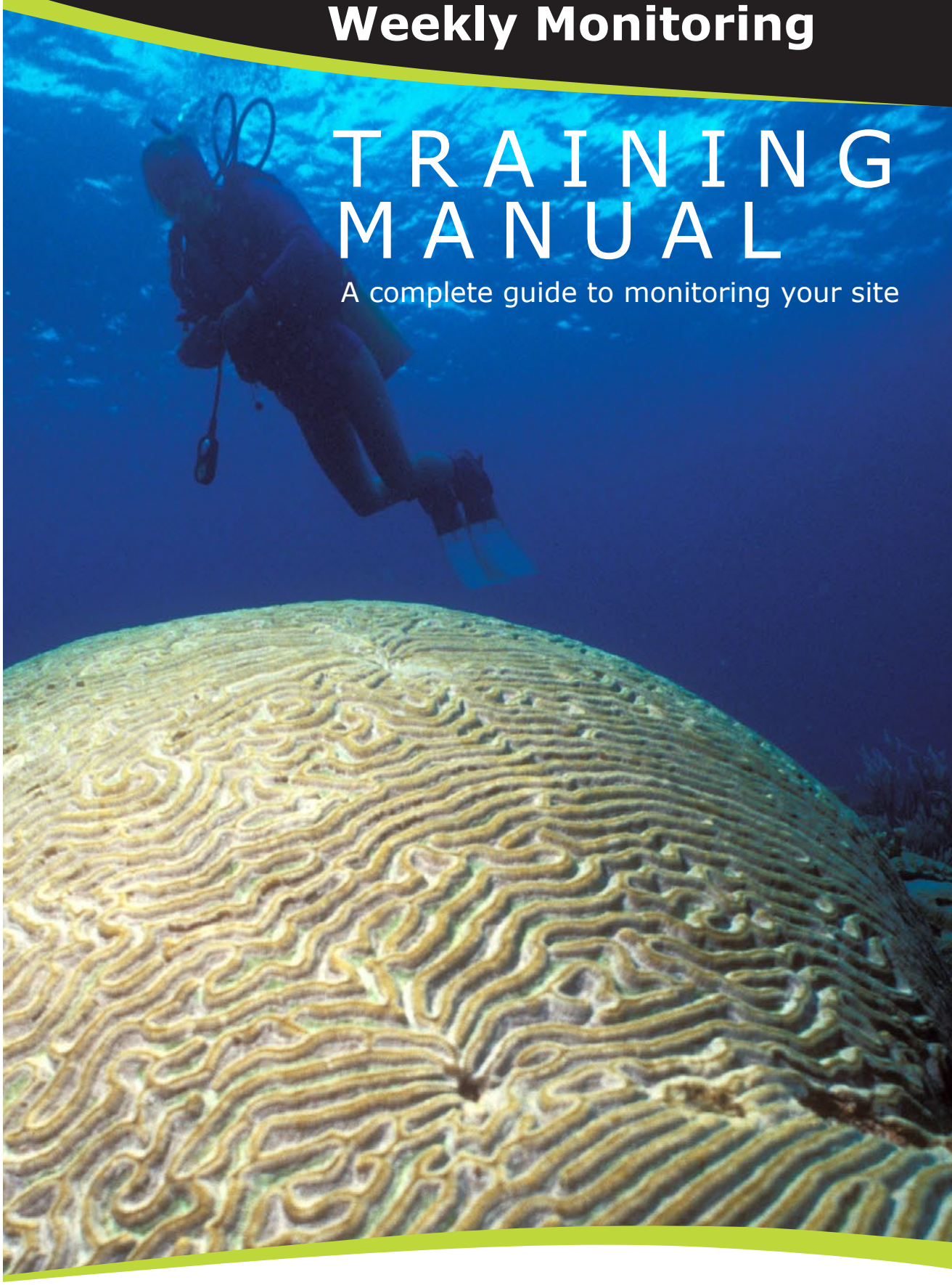
Eye on the Reef

Australian Government
Great Barrier Reef Marine Park Authority

Weekly Monitoring

TRAINING MANUAL

A complete guide to monitoring your site



Working together today for a healthier Reef tomorrow

Australian Government

Great Barrier Reef
Marine Park Authority

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Australian Government

Great Barrier Reef Marine Park Authority

Director, Communication and Knowledge Management Group
2-68 Flinders Street
PO Box 1379
TOWNSVILLE QLD 4810
Australia
Phone: (07) 4750 0700
Fax: (07) 4772 6093
info@gbrmpa.gov.au

Comments and inquiries on this document are welcome and should be addressed to:

Director Tourism and Recreation
tourism@gbrmpa.gov.au

www.gbrmpa.gov.au

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 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 Reef every day.

Tourism operators are some of our most important partners in monitoring the health of the Great Barrier Reef Marine Park. 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 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. This program is vital at a time when the Reef's health is under pressure from threats such as declining water quality and climate change.

The main aims of the *Eye on the Reef Program* continue to be:

- 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 that visit the Reef each year.

I would like to express my thanks to all the managers and staff of the Reef tourism operations who participate in the program for their continued dedication and professionalism to the *Eye on the Reef Program* 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

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SECTION 1 - What is the *Eye on the Reef Program*?

Eye on the Reef is an environmental monitoring, education and stewardship program between the Great Barrier Reef Marine Park Authority (GBRMPA) and a range of stakeholders, including tourism operators, researchers, fishers, and other members of the community.

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 *Eye on the Reef* weekly and rapid monitoring sytems, the *Sightings Network*, *Reef Health Impact Surveys* (RHIS) and *Eyes and Ears Incident Reporting*.

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.

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

The main aim of the *Eye on the Reef Weekly Monitoring Program* is to monitor indicators of reef health, water quality and the presence or absence of protected and iconic species and 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. The program also seeks to foster stewardship of the Reef by tourism operators and their staff, as well as provide opportunities to better understand the natural processes of the Reef.

What gets monitored?

The *Eye on the Reef Weekly Monitoring Program* focuses on two key areas of data collection.

These are:

- *Great Barrier Reef health indicators* – This data 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; and
- *Presence and abundance of iconic, indicator and/or protected species* – This data helps managers and researchers understand how abundant and widely distributed specific types of organisms are in the Great Barrier Reef Marine Park, and how effectively particular management arrangements are working to protect and preserve them.

Who does the weekly monitoring?

Many tourism staff who visit reef sites as part of their jobs are very knowledgeable about coral reefs, especially the site or sites they visit the most. *Eye on the Reef* harnesses this knowledge by asking staff that 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 recorded on a *Weekly Log Sheet*.

While the observations recorded on the *Weekly Log Sheet* are not onerous, the strength of *Eye on the Reef Weekly Monitoring* 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 provides an unmatched level of spatial and temporal resolution making the *Eye on the Reef Weekly Monitoring Program* a very powerful monitoring tool, and the largest marine tourism-driven monitoring program of its kind in the world.

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

The *Eye on the Reef Weekly Monitoring Program* has been designed so data can be collected by tourism staff during normal diving/snorkelling activities (e.g. snorkelling tours, guided SCUBA dives and resort SCUBA dives). This means participating in the *Eye on the Reef Weekly Monitoring* does not interfere with the staff's normal professional duties. In addition, as a participating member of the program, operational managers agree to designate staff time to conduct the *Eye on the Reef Weekly Monitoring* and attend training sessions and workshops - making this part of the job description for specific tourism staff.

The *Weekly Log Sheet* has been designed to be completed on site, during or after snorkelling/diving activities at nominated site/s. The exact procedures will vary depending on how each operation works.

- For those tourism staff that collect information *during* the snorkel/dive, they can take the *Eye on the Reef Weekly Log Sheet* 'slate' with them and fill it out as they go.

- For tourism staff filling out the *Weekly Log Sheet after* the snorkel/dive, they will have to remember what they see when underwater and record it on the *Eye on the Reef Weekly Log Sheet* once they return to the vessel. This should be straightforward as the categories are not difficult and staff should know their site well.

Each participating tourism operation is required to undertake a minimum of one survey snorkel/dive per week.

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

There are two ways to learn how to conduct the *Eye on the Reef Weekly Monitoring*:

- Attend in-water training sessions and workshops; and/or
- Read the *Eye on the Reef Training Manual*.

Tourism staff from participating tourism operations are trained to collect *Eye on the Reef Weekly Monitoring* data by GBRMPA staff during in-water training sessions out on the Reef. These training sessions are scheduled once a year.

Tourism staff from participating tourism operations are also required to attend workshops, which feature presentations by guest Reef researchers. These presentations enable researchers to report and discuss their latest scientific discoveries regarding coral reef biology, ecology, conservation and/or management. It also provides an excellent opportunity for participants to meet one another and share knowledge and experiences.

Both the in-water training sessions and the workshops are designed to help tourism staff develop their interpretative skills and methods, and assist with assessments of both site and visitor management strategies for their tourism operation.

By reading this training manual, tourism staff should have enough information to collect *Eye on the Reef Weekly Monitoring* data, however it is strongly recommended they attend the next available workshop or training session. They should also contact the *Eye on the Reef* coordinator (email: eyeonthereef.gov.au) to register their contact details and ask any questions they may have.

This training manual will be most useful to tourism staff new to *Eye on the Reef Weekly Monitoring*, or those that want to brush up on their monitoring and/or identification skills of *Eye on the Reef Weekly Monitoring* categories.

Where does all the data go?

Data from the completed *Weekly Log Sheets* is entered and stored in the *Eye on the Reef* database system. 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, whilst sightings of manta rays are available to researchers that study these animals.

How is all this information used?

The *Eye on the Reef Weekly Monitoring* categories, reporting and training methods have been aligned with Queensland Parks and Wildlife Service (QPWS) and GBRMPA Reef Health Impact Surveys completed by Rangers and other experienced Reef visitors and *Bleachwatch*, the coral bleaching program, completed by a broad range of Reef visitors including tourism staff. This enables reporting across programs and it strengthens knowledge for managers and researchers on Reef status, trends and impacts over a broad spacial scale.

The data is also analysed by GBRMPA and returned to each operator in the form of *Nature Diaries* every six months. These provide 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 crew inductions to the site, site management, interpretative activities and snorkel/dive briefs.

Can all tourism operations participate?

Unfortunately, not all tourism operations are able to participate in the *Eye on the Reef Weekly Monitoring Program* 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 would allow staff to collect the data. Table 1 describes the requirements tourism operations need to meet to participate in the *Eye on the Reef Weekly Monitoring*.

TABLE 1 Operator requirements for involvement in the *Eye on the Reef 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 passed on to the GBRMPA. Those staff who are collecting data must be in the water snorkelling or diving. The operations manager should be supportive of staff undertaking these roles.
***Weekly Log Sheet* completion and storage**	Ensure *Weekly Log Sheets* are completed and sent to the GBRMPA or stored for collection by GBRMPA staff at the next workshop.
Attend *Eye on the Reef* workshops	Ensure participating staff attend *Eye on the Reef* workshops.
Attend in-water training sessions	Support participating staff to attend in-water training sessions.
Support staff in attending the *Reef Discovery Course*	Support staff in attending the *Reef Discovery Course*.
Include *Eye on the Reef* in interpretation programs	Ensure that interpretive programs relay participation in, and the outcomes of, the program (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, as part of the crew uniform.
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.

If operators are unable to fulfil the requirements of the *Weekly Monitoring Program,* the *Eye on the Reef Rapid Monitoring Program* is an introductory step to Reef monitoring and is suitable for those who would like to contribute valuable information on the Reef to managers and researchers. Please contact the *Eye on the Reef* Coordinator for more information on *Rapid Monitoring*.

What is expected of participating tourism operations?

As the *Eye on the Reef* is an important monitoring program for increasing our understanding of the Reef now and into the future, there is a high level of commitment and goodwill needed from all program partners. Therefore, it is important that participating tourism operations meet certain obligations. Table 2 describes what participating tourism operations need to demonstrate to remain in the *Eye on the Reef Weekly Monitoring Program*. Tourism operations that are unable to meet these ongoing obligations may be asked to leave the *Eye on the Reef Weekly Monitoring Program* until they are able to meet the requirements.

TABLE 2 Operator requirements to remain in the *Eye on the Reef Weekly Monitoring Program*

***Weekly Log Sheet* returns**	Have a minimum of 40 weeks of *Weekly Log Sheet* returns per site per year (approx 80%). • *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 improve after the operation has been contacted, the operation may be removed from the program.* • *The operation may reapply to resume the program later or try the Rapid Monitoring Program.*
Ensure staff attendance at in-water training sessions	Ensure and support the operations manager and participating staff in attending in-water training sessions. • *If no attendance is recorded without reasonable cause, operations will be contacted and advised that they need to increase their level of participation.* • *If attendance does not improve after the operation has been contacted, the operation may be removed from the program.* • *The operation may reapply to resume the program later.*
Attend workshops	Support the operations manager and as many tourism staff in attending *Eye on the Reef* workshops. • *If no attendance is recorded without reasonable cause, operations will be contacted and advised that they need to increase their level of participation.* • *If attendance does not improve after the operation has been contacted, the operation may be removed from the program.* • *The operation may reapply to resume the program later.*

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, but it also:

- Plays an important role in crew training and development,
- Contributes to site management,
- Helps to maintain crew enthusiasm,
- Augments interpretive programs within the operation,
- Assists the understanding of the environmental processes of the Reef and particular sites,
- Assists in gaining Eco Certification accreditation which can lead to a 15 year permit.

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

TABLE 3 Tourism operation benefits from participation in *Eye on the Reef*

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, best practice site and visitor management strategies and 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 *Eye on the Reef* materials and act as a one-stop-shop for all information on *Eye on the Reef.*
Free analysis and interpretation of data collected from your site	Through the *Nature Diaries*, participating operations will be provided with detailed reports on the health, trends and status of their site, and organisms that are regularly seen.
Operators can promote being 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 between the GBRMPA, the tourism industry and the Reef research community.
Use *Eye on the Reef* as criterion for ECO Certification, which can lead to becoming a GBRMPA High Standard Operator	By taking part in the *Eye on the Reef Weekly Monitoring Program*, operations fulfil one of the requirements for gaining ECO Certification through Ecotourism Australia. Once this is achieved, operations may become GBRMPA High Standard Operators and are then eligible for 15 year Marine Park permits.

SECTION 2 - All the information you need to monitor your site

Good monitoring practices

The first step to good Reef monitoring is ensuring you are comfortable and competent in the water. The second step is through thorough completion of the monitoring form. This can be achieved by following a few simple steps;

1. Complete as much of the form as possible, providing as much detail as possible,
2. Check you can read the form after you complete it; chances are if you cannot read it no one else can either,
3. Do not spend a lot of time assessing one category, if 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 place 0's in the appropriate places,
5. If you did not look for a particular indicator then leave it blank, and
6. ***Remember to enjoy what you are doing!***

To begin

To ensure we are recording the correct data for the correct site and over the right time period it is compulsory that you complete the top section of the form which asks for your details and site details, including the tide at the time of monitoring.

Once you have an established snorkel or dive path use this as your regular *Eye on the Reef Weekly Monitoring* site. Include habitat from the back of the boat or from the shoreline of the beach to ensure you are capturing data from the seabed and surrounding reef habitats.

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 or fish seen and then 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 be consistent.

Water Quality

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 upon location on the reef. It is important, therefore, that water temperature is recorded at each of the *Eye on the Reef* sites.

How to record water temperature:

- Consistency is the key. Always try and measure the water from the same place each time.
- Use the thermometer provided in the *Eye on the Reef* project kit.
- Submerge thermometer in water between 0 and 1m for at least one minute. Be careful not to take a measurement near areas of the vessel that may be warmer than the ambient water, like near the engines or exhaust for instance. You want the most natural reading possible.
- Read temperature while the thermometer is in the water if possible.
- Record 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

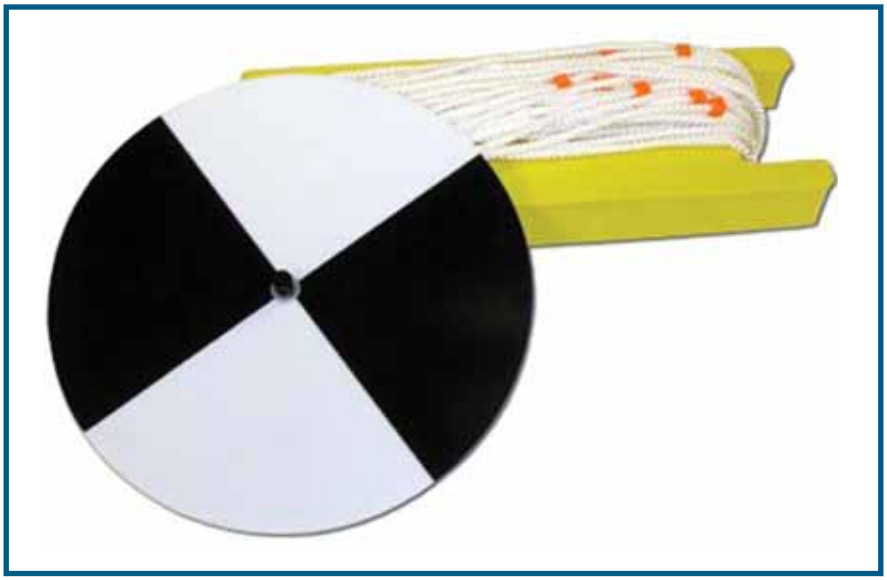
Underwater visibility, like water temperature, varies greatly from site to site. It can also change dramatically from day to day, or even with the tide. There are many different causes for poor water visibility, ranging from planktonic algal blooms to suspended sediments from wave action. It is one aim of the *Eye on the Reef Weekly Monitoring Progra*m to monitor water visibility over time to document seasonal fluctuations. *How do we do this? – using a Secchi Disc of course!*

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 30cm 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.

How to record water visibility with the Secchi Disc:

- Consistency is the key. Always try and measure visibility from the same place each time.
- Lower the Secchi Disc into the water counting the metre marks on the rope at the waterline as the disc goes down.
- Record the depth from the rope measurements at which the black sections of the Secchi Disc disappear from sight.
- Record the depth in metres on the log sheet.
- If the water is too clear, and you hit bottom before the black sections disappear, be sure to put a "+" sign after your measurement on the *Weekly Log Sheet*.
- If you do not measure visibility for some reason, leave the box blank.



Keeping an eye on reef health indicators

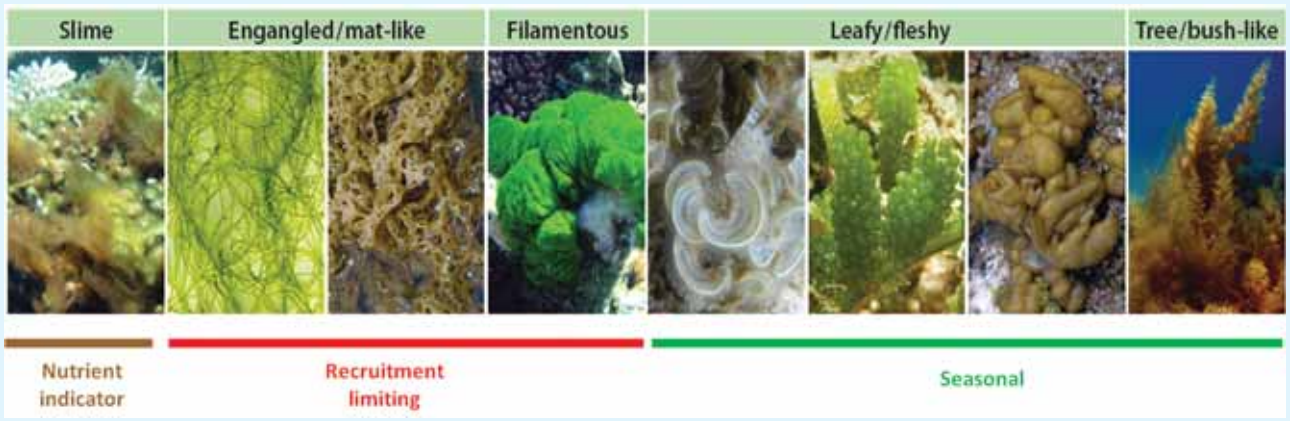
What are reef health indicators? There are several different environmental parameters we can monitor as indicators of reef health. Monitoring these can help determine reef-wide trends and establish links with changes in weather patterns or water quality for example.

More importantly, these indicators serve as an 'early warning system' - alerting reef managers and researchers to potential problems, which in turn can trigger appropriate responses to help preserve specific sites or larger areas, or initiate research for greater understanding.

Macroalgae types

Macroalgae is generally present on all reefs but the abundance of macroalgae is a useful indicator of reef state and environmental condition. For example, particular algal life forms can be used as indicators of poor water quality. Macroalgae are highly diverse but they can be loosely grouped into 5 broad life form categories – ***slime, entangled/mat-like, filamentous, leafy/fleshy, tree/bush-like.***

FIGURE 1 Macroalgae as an indicator



Cause:

Macroalgal blooms can be caused through increased nutrients, artificial or natural removal of herbivores, or because there is new and available substrate to colonise after bleaching events, severe storms, COTS or *Drupella* outbreaks, coral disease, flood and other major environmental events.

Warning signs:

Any of the above mentioned causes could be precursors 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 or recruiting corals. There are five major groupings of macroalgae that will help you detect an increase in algal biomass, outlined in Figures 1 and 2.

Recovery:

Depending on the severity of the event preceding a bloom, the type of algae, and the number and diversity of herbivores at your site, recovery might be rapid, or alternatively very slow, if at all.

Season:

More frequent in summer, with warmer water temperatures.

FIGURE 2 Macroalgae types

Slime
- Very delicate – will break apart. Slimy to touch.
- Density – variable but can cover large areas.
- Height – few mm to 20cm.

Entangled / mat-like
- Forming complex mat, often made of different species.
- Should be able to see trapped sediments.
- Very dense.
- Height – up to 10cm.
- A good example is *Hydroclathrus*.

Turfing
- Threadlike filamentous strands, similar to hair.
- Density – variable, but you should be able to see the substrate.
- Height – usually between one and three cm.
- Also includes turtle weed (*Chlorodesmis*) and other filamentous algae.

Leafy / fleshy
- Leaf-like structures clearly visible.
- Density – variable, but should be able to identify individual plants.
- Height – between five and 20cm.
- Common examples include *Caulerpa* and *Podina* (right); *Halimeda* (even though it is a calcareous algae) would fit 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 10cm and up to three metres.
- A common example on reefs is *Sargassum*.

Schools of grazing herbivores

Just like herds of buffalo or gazelle roam the grassy plains in search of green grass, so do the grazing herbivorous fish on coral reefs in search of algae. While many species of fish are known to consume algae, a few do so in large schools with the most common types being species of parrotfish, surgeonfish and rabbitfish.

Being important algal grazers, these fish are essential for the health of the reef and making sure everything is kept in balance. Monitoring populations at a site will be an important indicator of its resilience to disturbance.

What to look for (or listen for):

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

Schools of grazing herbivores are usually found very close to the substrate, and can be found anywhere there is a good surface for algal growth. This often means the reef flat or back reef. Look for a school of similar looking and sized fish moving slowly along the reef. If parrotfish are associated with the group you can also expect to hear a scraping sound as the parrotfish's beak scrapes at the rock or coral surface.

Please do not record schools of Humphead Parrotfish (Bolbometopon muricatum) in this section, as these spectacular animals have their own reporting category under the indicator, iconic and/or protected species section.

Often grazing schools are associated with other species, like some types of wrasse for instance, as these take advantage of all the organic matter being disturbed by the school but are not strictly herbivores.

Numbers of fish in the school:

Understanding the number of fish within a school will give us an insight to its ability to keep things in balance. As one would expect, five fish will consume less algae in one day than 20 fish of the same size. Therefore you should provide an approximate number of fish observed within the school.

Size of the fish in the school:

Understanding the size of the fish is equally as important as the number of fish. Just imagine that 20 small fish might consume the same amount of algae as five big fish. Therefore it is essential that you provide an average size of the fish in the school. For this you need only your arm. *What?*

To estimate the size of the fish we have three simple categories for you to pick from. These are:

- *The size of your hand or smaller* – Are the fish in the school the size of your hand or smaller?
- *The size of your fingertips to your elbow* – Are the fish in the school bigger than the size of your hand, but no bigger than the distance between your fingertips and your elbow?
- *Bigger* – Are the fish in the school bigger than the distance between your fingertips and your elbow (except Bumphead Parrotfish).

Schools of parrotfish (members of the family *Scaridae*)

Size: Parrotfish range in size, but most schooling species reach around 20-40cm.

Colour: The males of the species are very brightly coloured, while the females (usually the 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. Parrotfish 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, and sometimes these two types of fish can be seen schooling together.

Schools of surgeonfish (members of the family *Acanthuridae*)

Size: Surgeon fish range in size, but many are around 20-30cm.

Colour: Varies between species, but can often be brightly coloured.

Diet: Most graze on benthic algae.

Where to look: Schools of surgeonfish will often be observed moving around the reef flat, or in shallow areas, grazing en masse on the algae.

Coral Types

The remaining reef health indicators you will be looking for are related in some way to corals. Figure 3 shows the coral types you will need to know in order to fill out the *Weekly Log sheet* properly, and for the purposes of the survey, this will be as much detail as you will need to provide.

The coral types can be divided into one soft coral and seven hard coral life-form categories (branching, bushy, plate/table, vase/foliose, encrusting, mushroom and massive).

Not all life-form categories are necessarily represented on every reef, and certain life-form categories may dominate certain reefs. These are general life-form categories and you will be well aware that corals are fairly species diverse, and as such not every coral on the reef may fit easily into the eight defined live coral life-form categories. However, the majority of the common genera of corals on the reef should loosely fit into one of these categories.

FIGURE 3 Coral types

Soft
Includes all soft corals.

Branching
Includes all branching corals:
- staghorn.

Bushy
Includes all bushy corals:
- digitate
- pillar
- knobbly
- finger.

Plate / table
Includes all horizontally flattened corals.

Vase / foliose
Includes corals which have upright sheets which often form layered whorls:
- cabbage
- foliaceous
- vase.

Encrusting
Corals that form thin layers as they grow over the reef surface. They'll often take on the shape of whatever they overgrow.

Mushroom
Includes corals that live on the bottom unattached:
- mushroom
- slipper corals.

Massive
Includes all massive/boulder corals:
- brain
- honeycomb
- star
- kidney (*Porites*).

So what are the indicators?

Bleaching

Coral Bleaching

Coral bleaching can result in severe degradation of the reef and coral health, and therefore is a direct indication of coral condition.

Cause:

Environmental stresses (e.g. increased water temperatures, light levels, salinity, sedimentation, exposure to air and freshwater) cause coral to 'shed' their symbiotic algae (zooxanthellae).

Warning signs:

The normal colours of corals pale, sometimes looking almost fluorescent, until eventually they appear stark white. With no zooxanthellae, the coral's white skeleton is visible through its clear tissue.

Recovery:

During bleaching events, as long as the corals are bright white, they are still alive. They are surviving by capturing food at night. If they can survive on this limited food source until the remaining zooxanthellae in their tissues reproduce asexually and start photosynthesising again, the colonies have a chance at surviving.

Progression of bleaching:

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

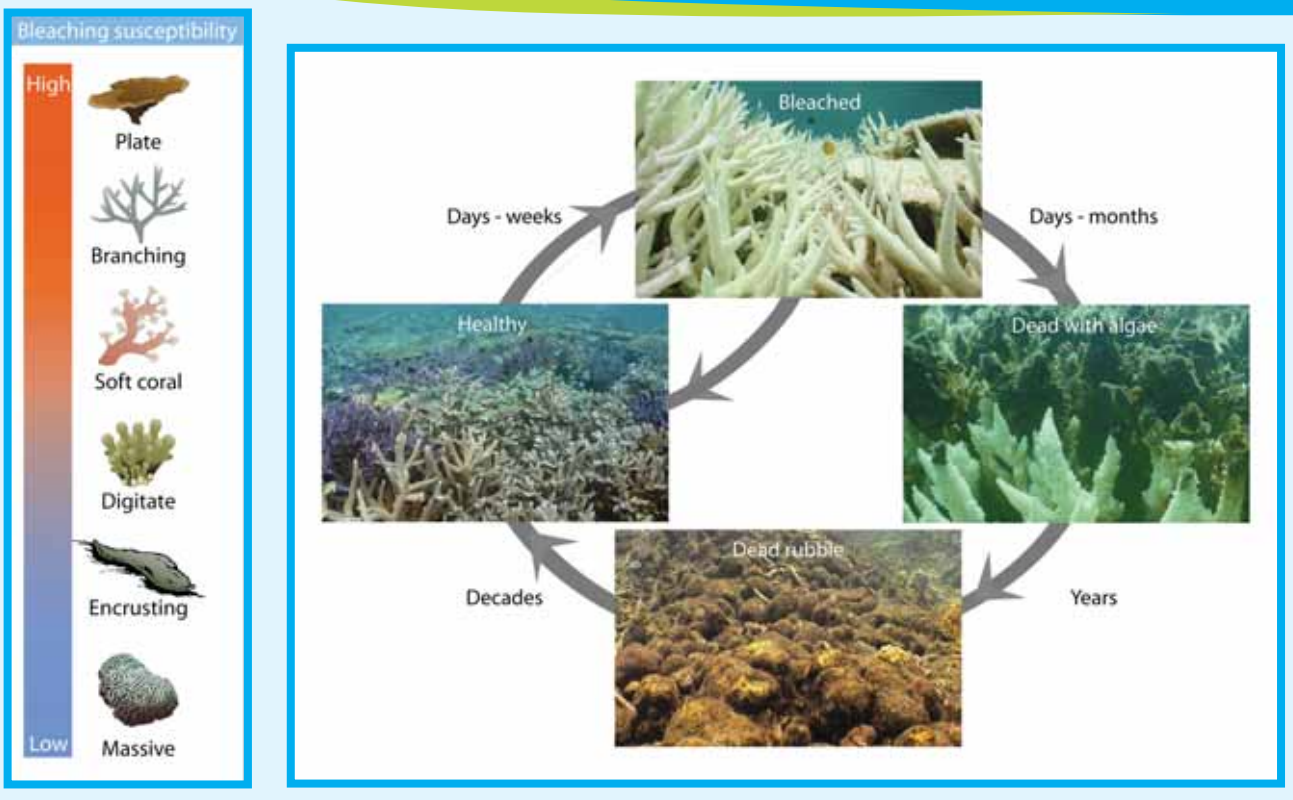
Season:

More frequent in summer with warmer water temperatures.

Affected corals:

All species of hard and soft corals – however Figure 4 shows which are most susceptible.

FIGURE 4 Susceptibility to bleaching and progression of bleaching



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).

Coral Predators

Organisms that consume live coral tissue can also cause severe impacts if present in high enough numbers. The devastation caused by COTS outbreaks has been well documented over the years on the Reef. Another, much smaller predator, called the *Drupella* snail can also cause severe local damage, especially to plate and branching coral communities. Keeping an eye on both the number of these organisms and the scars they produce through feeding activities gives an indication of the amount of damage they may cause.

Crown-of-thorns Starfish (*acanthaster planci*) / scars

Body:

- Less than one metre diameter, covered in sharp poisonous spines.

Arms:

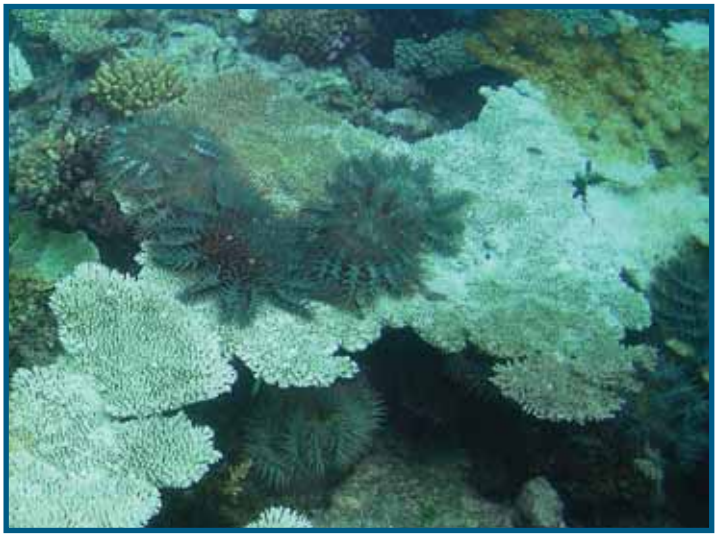
- Seven to 26 arms (usually 15 arms)
- Up to nine anuses.

Age and maturity:

- Sexually mature at two to three years, producing up to 60-70 million eggs each breeding season.

Hiding places:

- During daylight, COTS mostly hide under branching and plate corals, however during an outbreak can be seen feeding during the day.



Food:
- Fast growing corals (staghorns) are preferred, but they will eat nearly any type of coral when hungry.

Feeding method:
- 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, massive, tabular coral types), exposing large areas of white skeleton.

Feeding scars:
- White patches when fresh. Scars are clean of coral flesh (*Drupella* leave bits of tissue behind).
- If you touch the scar, there will be NO mucous left on the coral.
- If scar is still white COTS are usually in the vicinity either feeding or hiding under the colony; have a good look around.
- Older scars turn grey from turfing algal growth.

Drupella Snails / scars

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

Colour:
- Juvenile shells are white with orange or white openings. As these snails mature, their shells become completely encrusted by coralline algae making them dark purple/pink and well camouflaged.

Hiding places:
- During daylight, these snails mostly hide amongst bases of branching corals and underneath plate corals.

Food:
These animals feed on live coral tissue, mostly plates.

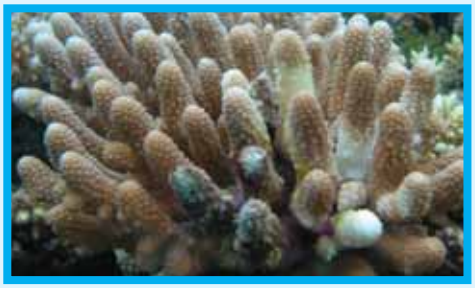
Feeding method:
- Drupella feed using their radula, or rasp-like tongue to scrape the coral tissue as they cannot cross live coral tissue.

Feeding scars:
- White feeding scars, similar to juvenile COTS scars, are usually smaller than a 50 cent piece. They can merge together to form a larger area - sometimes hard to tell from COTS scars. If you look closely you will see bits and pieces of coral tissue remaining - this is because *Drupella* scrape off the coral tissue. They do not digest it like COTS.
- If scar is still white, *Drupella* will usually be hiding at the base of the colony during the day, often clustered, or feeding at night.

FIGURE 5 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.

CAUSE	DESCRIPTION	FEATURE
COTS scar		
 courtesy U.Engelhardt	• Bright white patches about the size of your hand. • Old scars turn grey from turfing algae growth. • Usually relatively round or scalloped in shape (if on plate coral or boulder coral).	• Clearly defined edges. • Very clean – no obvious coral tissue remaining. • If you touch it, there will be NO mucous left on the coral.
***Drupella* snail scar**		
 courtesy U.Engelhardt	• White feeding scars are similar to juvenile COTS scars, but are usually smaller than a 50 cent piece. • They can merge together to form a larger area - sometimes hard to tell from COTS scars.	• If you look closely you will see bits of coral tissue remaining - this is because *Drupella* snails use a radula to scrape off the coral tissue – they do not digest it like COTS.
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. • Part of the coral most exposed to the sun will usually bleach first.	• White patch incorporates nearly all the coral. • Edges between bleached and non-bleached coral not very sharp. • Mucous will come off on your fingers if you touch it.

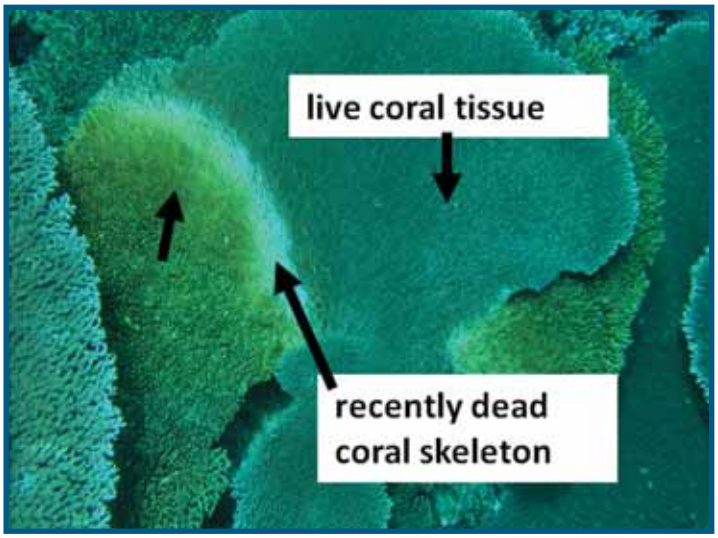
Coral diseases

Diseases are a natural aspect of all populations, and are a mechanism by which population numbers are kept in check.

Coral diseases can be difficult to identify, and people must be well trained to develop an eye for differentiating between the various diseases. Many coral diseases are more common during summer and can have significant effects on coral condition and health.

Detecting the onset of coral diseases can provide researchers and managers with essential information on how widespread and severe the diseases can be, and is again an indication of coral condition and health.

White syndrome



Warning signs:

- White syndrome starts as a white spot near the centre of a coral colony and becomes a distinct white band (up to one cm wide), creating a border between the living coral and dead white skeleton.
- The dead skeleton may be secondarily overgrown by algae, turning it dull grey.
- The result is 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 mm per day.

Season:

- Common in summer, with warmer water temperatures.

Coral types:

- Mostly branching *Acropora* species.

Black Band Disease (BBD)

Warning signs:

- BBD creates a distinctive black border, one to 20mm wide (but usually three to four mm wide), between living coral tissue and dead white skeleton.
- It looks like a ‘black mat’, less than one 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*) and fungi. It is thought to be linked to increased nutrient levels (e.g. after heavy rainfall, in areas with sewage runoff or elevated nutrient levels).

Spreading rate:

- Can spread over the surface of living coral at a rate of up to two 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. Corals with BBD are thought to die from suffocation, rather than from chemical toxins.

Brown Band Disease

Warning signs:
- Brown band disease creates a discrete brown band between live tissue and exposed skeleton.
- The exposed skeleton is white behind the band.
- Tissue loss may be rapid and begins from the branch base but may spread to adjacent branches at contact points.

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

Spreading rate:
- Rapid rate of progression (~20-100mm a day).

Season:
- More commonly seen during the summer months.

Affected corals:
- Most commonly affects branching *Acropora* species.

Recent Coral Breakage

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 such as boat groundings, fin contact, touching and anchor damage.

It is important to monitor the amount of broken coral at a site as this may impact the aesthetic quality as well as ecological processes. Determining the cause of damage may help to take steps to prevent further damage in some cases (Figure 6).

Figure 6: How to tell the difference

FIGURE 6 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 (e.g. nest building of titan triggerfish, feeding frenzy of buffalo wrasse) Localised damage (less than a m^2) with individual coral branches bitten off leaving clean breaks. 	**Fin Damage** Usually only one or two colonies damaged with the coral fractured into many pieces. 

Spawning activity

In an attempt to fully understand the timing and environmental cues of coral and fish spawning events on the Reef, it is important to monitor and record the days in which this happens. Because many tourism operators visit the reef on a daily basis, they are in a perfect position to be able to witness and record this.

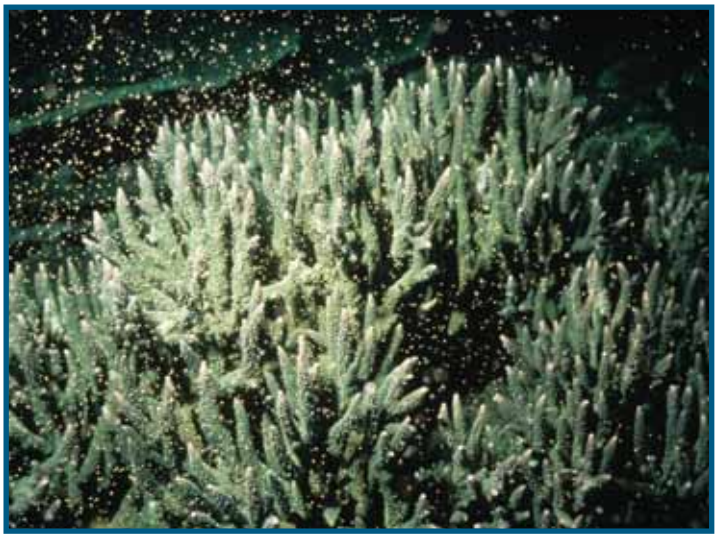
Why release so many eggs?

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

- Avoid getting eaten by predators before fertilisation,
- Be fertilised by sperm which is also floating in the water,
- Survive hours to months as plankton, drifting in the ocean,
- Settle and grow into adults.

Generally, less than one per cent of eggs released will survive to spawn themselves. What may seem like wasteful over-saturation of the eggs at one time 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.

Coral spawning



Hard Corals

When:

- Night time, 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, they 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 time, during slack tide (least water movement).

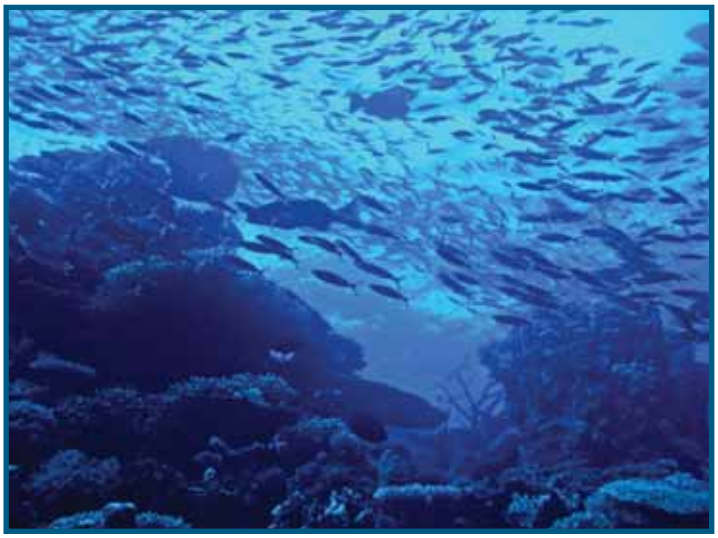
Season:

- Spring and summer.

Eggs/sperm:

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

Fish spawning



Although many reef fish can, and do, change sex at some point during their lives, at any one time they are either male or female. No known fish can self-fertilize - 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) and,
- Take care of the eggs and kids (parental care).

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 will usually give the female a nudge on the abdomen - this is thought to stimulate the release of eggs.

Having sex

Sharks and rays use internal fertilisation. They are the only ocean fish to use this method, although there are several freshwater fish (e.g. guppies and mollies) that give birth to live young.

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

One night stands & group orgies

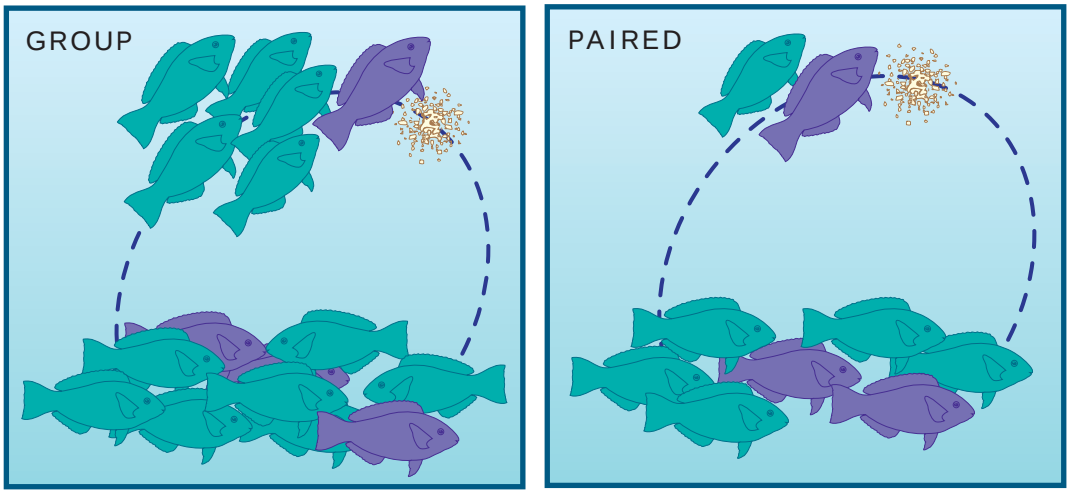
There are two types of spawning:

- 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 off 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 underwater) 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. Some however, go to great lengths to help assure 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???

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.

Sightings of Iconic, Indicator, and/or Protected species

While there are many different types of animals that can be found on reef sites, some are of greater interest to researchers because they are either:

- Iconic – species that are of high or special value on the Reef – example: Maori Wrasse.
- Indicator – species that provide us with information about the health of the Reef – example: Coral Trout.
- Protected – species are protected by law and require special management – example: Green Turtle.

Some of the species in the *Eye on the Reef Weekly Monitoring Program* may fall into one or more of these classifications.

Recording observations of Iconic, Indicator, and/or Protected species

For each of the iconic, indicator and/or protected species, there are two types of information of interest. These are:

- How many did you see on the day of the survey?
- Did you observe any spawning/mating behaviour on the day of the survey?

Reptiles

Sea Turtles

Of the world's seven species of sea turtles, six nest adjacent to the Reef. All species of turtles are protected in Australia. Sea turtles are reptiles. They have evolved from land turtles, adapting to survival within the ocean. Although they live nearly entirely in the water, sea turtles have lungs (not gills) and must breathe air. They also need to return to land to lay eggs.

Green Turtle (*Chelonia mydas*)

Size: Shell to one metre, high domed.

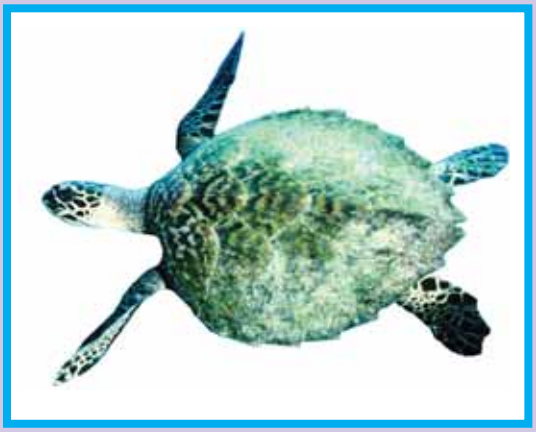
Colour: Light to dark green with dark mottling.

Diet: Carnivorous as juveniles, herbivores as adults (seagrasses and seaweeds).

Where to look: Coral reefs, inshore seagrass beds. 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. If approached slowly, divers and snorkelers can usually get very close and observe these animals. It is not uncommon to see the same Green turtle at a site for long periods of time.

Status: Vulnerable (EPBC Act 1999), Protected (GBRMP).

Why do we care? Green Turtle populations are considered vulnerable and so we need as much information about the distribution and abundance as possible. Green Turtles are also iconic species to the Reef for visitors.



Hawksbill Turtle (*Eretmochelys imbricata*)

Size: Size: Shell to one metre, low domed with upturned edges.

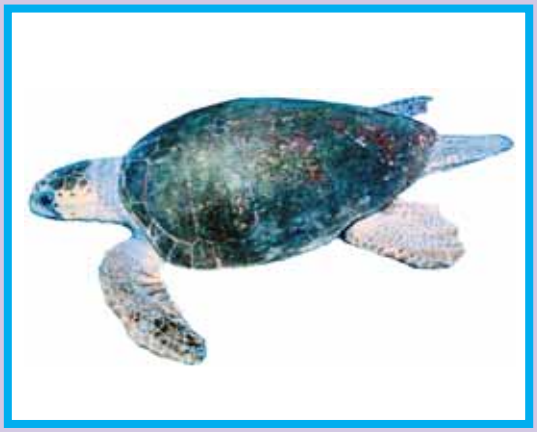
Colour: Olive grey, streaked with amber, brown and black.

Diet: Mainly sponges, but also soft corals, crabs, clams, snails, tunicates (sea squirts), seagrasses and algae.

Where to look: Coral reef flats, reef fronts and rocky areas.

Status: Vulnerable (EPBC Act 1999), Protected (GBRMP).

Why do we care? Hawksbill Turtle populations are also considered vulnerable and are somewhat less numerous than Green Turtles on the Reef. As much information as can be collected is needed to better understand the future of this species.



Loggerhead Turtle (*Caretta caretta*)

Size: Shell to one metre, longer than wide.

Colour: Red-brown to brown.

Diet: Jellyfish, crabs, sea urchins, giant clams.

Where to look: Coral reefs, bays and estuaries.

Status: Endangered (EPBC Act 1999), Protected (GBRMP).

Why do we care? Loggerheads are considered endangered, or in other words in danger of extinction. While these turtles are rarely seen on tourism sites, any observations of these animals are critical to our understanding of their immediate future.

Sea Snakes

Sea snakes can be found in Australian tropical waters. Sea snakes are real, air-breathing snakes with forked tongues and body scales and shed their skins, just like land snakes. Most are highly venomous, but are usually no cause for alarm. They are cold-blooded reptiles and are found primarily in warm tropical waters of the Indo-West Pacific. They are not found in the Atlantic Ocean or Caribbean Sea. The Reef has 14 species of sea snake; however the most common sea snake you are likely to see is the Olive Sea Snake.

Olive Sea Snake (*Aipysurus laevis*)

Size: Up to 150cm.

Colour: Olive green to light brown.

Diet: Fish and invertebrates.

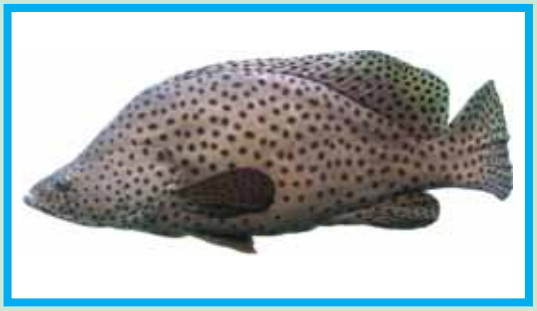
Where to look: Sea snakes can often be seen moving between the water surface, where they breathe, and the coral structures where they hunt and rest. They can often be quite inquisitive and approach divers. Sea snakes can often be seen from the surface.

Status: EPBC (listed species), Protected (GBRMP).

Why do we care? Very little is known about the abundance and distribution of sea snakes on the Reef other than from trawl catch data from the commercial fishing industry.

Fish

There are over 1,500 species of reef fish showing a myriad of shapes, colours and behaviours. This diversity, combined with abundance, helps make the Reef famous. The Reef is also famous because it provides protection for particular species of fish, such as the Maori Wrasse, that are not protected in other parts of the world, making the Reef a haven for these species. Monitoring such species is essential for us to understand how their populations are responding to management arrangements.



Barramundi Cod (*Cromileptes altivelis*)

Size: Up to 70cm, 3.5kg.

Colour: Greenish-white to light greenish-brown with scattered large round black spots. Very good at camouflaging amongst the reef.

Diet: Small reef fish.

Where to look: Very secretive, hiding in holes in the reef, or under plate corals. Usually seen alone or in pairs. Can often be seen lying with body in hole with only head sticking out to ambush passing prey. Juveniles, who look identical to the adults, swim with their heads towards the bottom, waving their pectoral fins to mimic feeding coral polyps.

Status: Protected (GBRMP).

Why do we care? The Barramundi Cod was a prize fish to fisherman, but was at threat of being overfished until they were declared a protected species in the GBRMP in 2003. Therefore, it is important to monitor the populations of this species on the GBRMP to ensure the management arrangements are suitable.

Butterflyfish (All species)

Size: Most species' maximum length is under 30cm, most around 20cm.

Colour: Famous for their striking colour patterns. Deep, compressed bodies and small protractile mouths with brush-like teeth.

Diet: Many feed on live coral polyps, others consume a mixed diet of benthic invertebrates and algae.

Where to look: Usually active during daylight hours foraging for food. Most found in depths less than 20 metres and are restricted to a relatively small area of the reef.

Status: Not protected.

Why do we care? As many butterflyfish species rely on healthy coral they can be an indicator of overall coral health.

Coral Trout (*Plectropomus leopardus*)

Record for two size classes <38cm and >38cm

Size: Up to 65 - 70cm, 4 - 4.5kg.

Colour: Reddish brown/orange red upper body with paler red underbelly, small dark-edged blue spots on head, body and fins (none on underbelly). More than 10 spots on cheeks. Distinctive blue ring around eye.

Diet: Small reef fish (mainly damselfish, fusiliers, parrotfish and juvenile coral trout).

Where to look: Very much a solitary coral reef predator often seen hiding under coral ledges during the day, or even above the coral network. Can also be seen at cleaning stations. Most active during daylight hours (heightened activity during dusk and dawn). Have two modes of feeding - ambush (hide amongst reef waiting to attack passing prey) and prowling (approach slowly, and then attack at high speed).

Status: Not Protected – fishery target species.

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 these fish are considered to be larger than fish monitored in 'take zones'. Therefore, we would like to monitor not only the presence of Coral Trout but also the size.

Humphead Parrotfish

(*Bolbometopon muricatum*)

Size: Up to 120cm, 46kg. The largest of all parrotfish with very prominent white flat hump on its forehead.

Colour: Dull, drab green with front of head pale yellowish to pink. Have very large scales.

Diet: Encrusting algae and live coral.

Where to look: Usually seen in small aggregations swimming on the reef flat, or among deeper sections. These fish graze on corals during the day, and sleep in crevices at night.

Status: Not Protected.

Why do we care? Because of their large size and dependence on live coral, understanding the population dynamics of these fish might be a very early indicator of coral reef health and function after large disturbance events.

Mackerel (Narrow-barred Spanish Mackerel (*Scomberomorus commerson*) and Broad-barred Spanish Mackerel (*Scomberomorus semifasciatus*), Shark Mackerel (*Grammatorcynus bicarinatus*)

Size: 80cm is common length, 110cm maximum length. Narrow-barred Mackerel is largest of the mackerels.

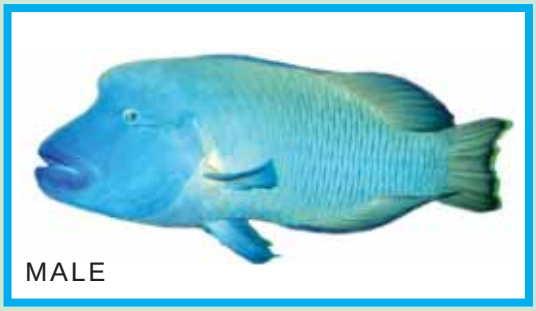
Colour: Yellowish-green back and brassy silver belly, frequently have small dark spots along central surface of the body with two distinct lateral lines on the sides.

Diet: Food consists mainly of small fishes with lesser quantities of shrimp and squid.

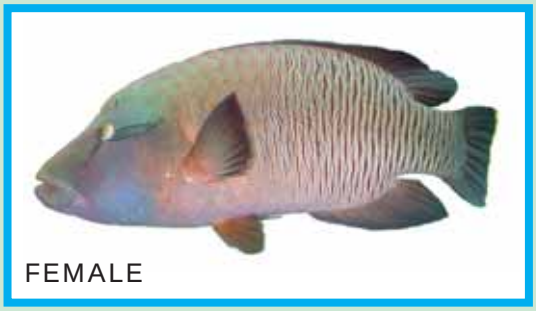
Where to look: Mackerel are a free-roaming oceanic fish usually found schooling over offshore reefs and drop-offs feeding on baitfish. The Broad-barred Spanish Mackerel is often encountered inside major bays in the tropics. Larger fish are loners whilst smaller fish form dense schools.

Status: Not protected.

Why do we care? Given that mackerel are very high on the food chain; this species is a key indicator of reef health processes. Data collected will help us better understand their distribution throughout the year. Spawning times for Spanish Mackerel tend to be associated with higher water temperatures that promote optimal food availability for the rapid growth and development of the larvae.



MALE



FEMALE

Maori Wrasse (*Cheilinus undulatus*)

Size: Largest of all wrasses - up to 225cm and 190kg. Only the larger ones are males, with very pronounced humps on their heads. All Maori wrasse begin life as females.

Colour: Males distinguished by colour of green/blue body with dark squiggly markings near eyes and the females are a brown colour. The distinctive wavy lines leading away from the eyes give this fish its name - because they look like the traditional facial tattoos of the native Maori people of New Zealand.

Diet: Molluscs (clams & snails), fish (especially boxfish), crabs, sea urchins, COTS and other reef invertebrates.

Where to look: Maori Wrasse are found on many tourism sites, and are often very friendly and approach divers and snorkelers, usually in search of food. Their large size, and conspicuous shape and colouration make them an easily recognisable fish on a reef. The same wrasse/s can usually be seen at a site for many years.

Status: Protected (GBRMP).

Why do we care? Not only is the Maori Wrasse a protected species on the Reef, and an important tourism species due the amazing experiences it provides visitors when encountered, it is also a known COTS predator, playing a vital role in the ecology of the reef. There is little known about the abundance and distribution of this species, and how well populations are responding to their total protection in 2003.

Moray Eel (*Gymnothorax sp.*)

Size: Up to two metres.

Colour: Moray eels can come in a range of different colours depending on the species, but most common are green or brown morays.

Diet: Small fish, octopus, shrimp and lobsters. Some can eat and crush hard shells of mussels, clams and crabs.

Where to look: Moray eels are solitary and most often seen with just their head poking out of small holes in the coral network, usually around isolated bommies. Each moray is usually specific to a hiding spot, and so the same ones can often be found in the same places each day. If you are lucky though, 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.

Status: Not protected.

Why do we care? Not a great deal is known about the distribution and abundance of these animals. Given their high value to the tourism industry because of the enjoyment that divers and snorkelers get from observing them, plus the fact the same morays can live at a site for many years, it is important we understand more about them.

Giant Queensland Grouper
(*Epinephelus lanceolatus*)

Size: Largest Indo-pacific reef fish. Up to three metres, and over 400kg.

Colour: Mottled dark greyish/brown.

Diet: 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.

Where to look: At some sites these fish can be seen around pontoons! But generally a solitary reef edge species that can be hard to observe and usually stay within their home range (territory) most of the time. This means the same one will often be seen at a site for many years.

Status: Protected (GBRMP).

Why do we care? The Giant Queensland Grouper has been a prize catch to fisherman for many years, not so much for their flesh, but more for their sheer size. Their extreme size also means these animals are not naturally abundant. Combine this with fishing pressure, and you can see why there was a need to protect this species in 2003. Understanding their recovery from small populations is essential to their survival as a species within the Reef.

Red Bass (*Lutjanus bohar*)

Size: To 75cm. Said to be one of the oldest fish on the reef living up to 50 years of age.

Colour: Dark silvery red with large yellow eyes and obvious canine teeth.

Diet: Feeds mainly on fishes but will also consume other prey such as crustaceans.

Where to look: Open water, often in schools near the surface if fish feeding activities take place.

Status: Protected (GBRMP).

Why do we care? Given that Red Bass are a protected species, it is important to monitor their populations, as with all protected species on the Reef.

Titan Triggerfish (*Balistoides viridescens*)

Size: Largest triggerfish - to 75cm and seven kg.

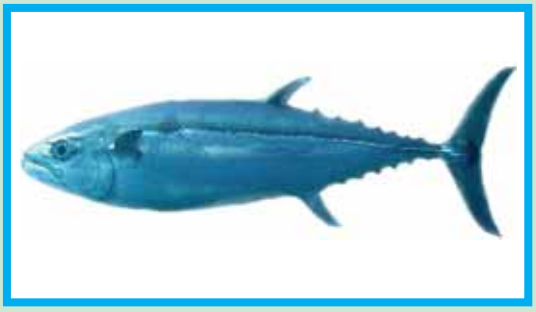
Colour: Body is blackish/grey with yellow spots, tail yellowish.

Diet: These fish turn over coral rubble in search of sea urchins, coral, crustaceans (crabs, prawns and crayfish), molluscs (clams & snails) and COTS.

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. During nesting season can be seen either making or protecting deep conical nests in the sand, and can sometimes be quite aggressive and attack divers when protecting their territory.

Status: Not protected.

Why do we care? Titan Triggerfish are a known COTS predator, so understanding more about their populations is essential to understanding more about reef resilience.



Tuna (*All species*)

Size: The largest tuna you are likely to see at your site will be the Dogtooth Tuna (*Gymnosarda unicolour*) – up to 180cm and 131kg.

Colour: While there are slight differences between species of tuna, the general colour will be metallic silver, sometimes with darker counter-shading on the upper surface of the body. Look for a torpedo shaped animal with a very large eyes and a streamlined body for high-speed swimming.

Diet: Prey on smaller fish like fusiliers.

Where to look: 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 taking the lead.

Status: Not protected.

Why do we care? Given that tuna are very high on the food chain, this species is a key indicator of reef health processes. Data collected will help us better understand their distribution throughout the year.

Sharks and Rays

Sharks and rays are an essential and important part of the reef ecosystem, however very little is known about their distribution and abundance on the Reef. Such knowledge is critical to our management of certain species, particularly the reef sharks. In addition to this, sharks and rays have an extremely high tourism value because so many visitors enjoy seeing them, and in some cases will travel exclusively just to see them.

Sharks and rays are particularly vulnerable to overfishing due to their late maturity, small litter sizes and slow growth rates.

Blacktip Reef Shark
(*Carcharinhus melanopterus*)

Size: Up to 1.8 metres.

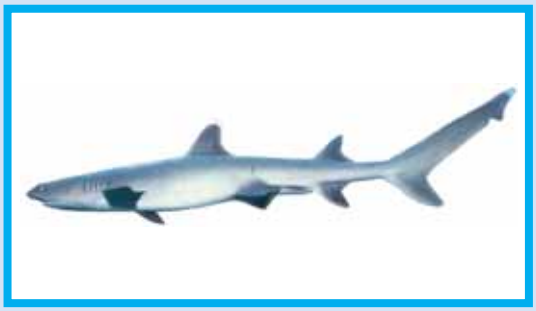
Colour: Tan to grey above, paler below. Black fin tips.

Diet: Mainly small fishes - parrotfish is a favourite.

Where to look: Very common on reef flats and in shallow lagoons, solitary or in small groups.

Status: Not protected.

Why do we care? Just as the Whitetip Reef Shark, this species is heavily targeted by fishers. Much needed data on the Blacktip Reef Shark population is essential for their protection. An important tourism species due to the high quality experiences they provide for tourists, mainly because they can often be seen and are a very attractive species.



Whitetip Reef Shark
(*Triaenodon obsesus*)

Size: Up to 2.1 metres.

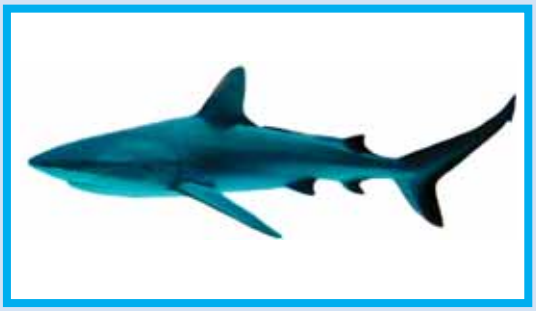
Colour: Brown to grey with white tip on dorsal fin only - NOT on pectorals (Silvertip Sharks have white tips on their pectorals).

Diet: Fish, octopus, squid and crustaceans.

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. During the day, they are conspicuous due to their habit of resting flat on the bottom, and at night are aggressive and active hunters.

Status: Not protected.

Why do we care? Recent research has shown that populations of Whitetip Reef Sharks are under serious threat from overfishing. Monitoring their populations will provide much needed data to protect these animals. They are also known to be very attractive to Reef visitors.



Grey Reef Whaler
(*Carcharhinus amblyrhynchos*)

Size: Up to 2.5 metres

Colour: Grey body with distinctive black trailing edge of tail.

Diet: Small fish, squid and octopus.

Where to look: Steep outer slopes, drop-offs and channels, often in packs.

Status: Not protected.

Why do we care? For the same reasons as the Blacktip Reef Shark.

Blue-Spotted Stingray (*Taeniura lymma*)

Size: Up to 2.4 metres.

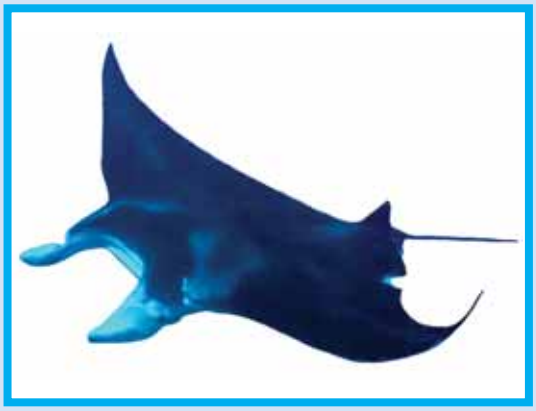
Colour: Greenish to beige to grey with bright blue spots.

Diet: Invertebrates buried beneath the sand - including worms, crabs, shrimp, snails and clams.

Where to look: Open sandy areas, usually on the back reef and in channels.

Status: Not protected.

Why do we care? A highly important tourism species as in most cases this will be the species of ray that visitors see at a site. Not to be confused with Kuhl's Stingray which has a more diamond shape body. It's distribution and abundance is poorly understood.



Manta Ray (*Manta birostris*)

Size: Up to 6.7 metres wide, and over 1,300kg.

Colour: Usually dark above and white below, although all black and all white mantas are seen. The distribution of spots underneath the manta is unique, just like a fingerprint, and so individuals can be identified.

Diet: Plankton.

Where to look: Mid-water, on their own or in groups.

Status: Not protected.

Why do we care? An extremely important tourism species, and also an indicator to the health of the reef. A species that relies solely on plankton so provides us with an insight into reef productivity.

Others

There are many more ‘other’ important indicators on the Reef. 'Others' in this instance represent all other organisms that don’t fit into the previous categories, and include crustaceans, cnidarians, echinoderms, molluscs and sponges.

Cuttlefish (*Sepia latimanus*)

Size: The largest Reef cuttlefish. Up to 50cm in length.

Colour: These animals have an amazing ability to rapidly change the colour and texture of their skin. However, usually seen with an opaque white skin with varying degrees of browns, blacks and blue colour variations.

Diet: Small fish and crustaceans.

Where to look: These animals are usually seen only around the later months of the year when they appear on reef sites to mate and nest. Males and females will 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*, a favoured coral species for egg laying.

Status: Not protected.

Why do we care? Given we know virtually nothing about these animals such as where they go as juveniles or after laying eggs, and combine this with the fact they are highly dependent on particular coral species to lay their eggs, these animals might be particularly affected by large scale coral disturbances, and thus an indicator of reef process health.

Sea Cucumbers (All species)

Size: Some species can reach up to two metres but generally around the 50-60cm size.

Colour: There are a range of sea cucumbers that you are likely to encounter. Most cannot be mistaken for any other sea creature, although some are completely alien looking. Most are dull in colour, so shape in this case is most important for identification.

Diet: Dead and decaying organic material, algae and tiny plankton. Most species filter the sand for their food.

Where to look: Almost always seen on sandy substrate, but can sometimes be observed on coral as well.

Status: Not protected.

Why do we care? Sea cucumbers play a vital role in the reef ecosystem by virtually vacuuming the sea floor and removing excess nutrients which limits algal growth. Sea cucumbers are commercially harvested and are known as bêche-de-mer, and over-harvesting can easily occur. How this fishery will impact on reef sites and the ecosystem as a whole is not at all clear.

Triton Shell (*Charonia tritonis*)

Size: Largest of Australian triton shells, reaching 46cm. It takes only three years from hatching to reach adult size.

Colour: Mottled white and brown.

Diet: Echinoderms - starfish, sea urchins and sea cucumbers. Will eat COTS, but only if there are no other starfish (especially Blue Linckia and pin cushion starfish) to eat.

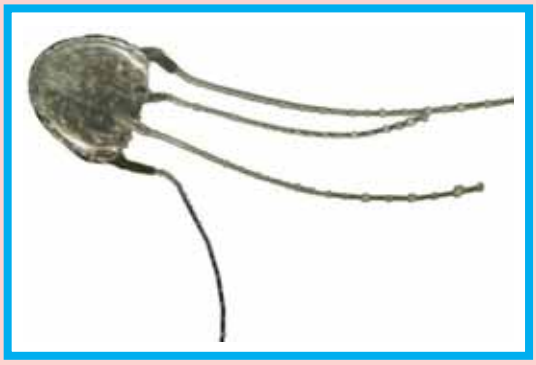
Where to look: Under rocks or coral slabs.

Status: Protected (GBRMP).

Why do we care? The Triton is greatly prized for its beautiful shell, and was heavily collected on the Reef for many years. Very few people in recent times have seen a live Triton Shell, and information about their distribution and abundance is poor. The Triton is now completely protected. In addition to having a beautiful shell, the Triton is also a known COTS predator, yet in such small numbers is likely to have little impact during an outbreak. Only close monitoring of this species will determine if its protection will conserve the species.

Jellyfish

There are several jellyfish we are interested in understanding more about, simply because presently there is poor data for these, and also because they can pose a significant threat to humans if contact is made. Please be extremely careful if approaching these animals.



Irukandji (*Carukia barnesi*)

Size: 1-2 cm long, box-shaped with one tentacle at each of the four 'corners'. Tentacles extend to over one metre, and contract to less than five cm.

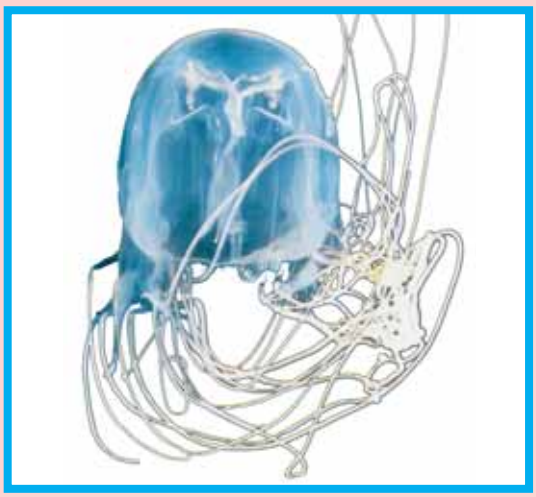
Colour: Transparent - nearly invisible.

Diet: Small fish and prawns.

Where to look: Most common in summer, but may be present all year. Can form swarms near surface.

Status: Not protected.

Why do we care? This species of jellyfish can be extremely dangerous and even cause death. Understanding more about its life history, such as where and when it is seen, is vital information to understand the species and manage human activity to minimise injury.



Box Jellyfish (*Chironex fleckeri*)

Size: Box shaped, can reach 20cm high or the size of a four litre ice-cream container.

Colour: Clear, transparent bell.

Diet: Mostly fish and prawns found in coastal areas.

Where to look: Most common in summer and usually found around turbid coastal waters sometimes in high numbers.

Status: Not protected.

Why do we care? For the same reasons as the Irukandji.

Bluebottle (*Physalia physalis*) – Not a Jellyfish, but a colonial hydroid.

Size: 5-30 cm long, up to 15cm tall.

Colour: Transparent purple/blue.

Diet: Small fish.

Where to look: Found all year round along the east coast of Australia. Are exclusively a surface species, and can be found in large numbers.

Status: Not protected.

Why do we care? The specific season for this species is not fully understood. By having tourism operators recording the occurrence of these at tourism sites, we will have a clearer picture of their habits. This is particularly important as Bluebottles can cause a painful sting, making them an unwanted guest at tourism sites.

Trichodesmium (*Trichodesmium erythraem*) Blue-green planktonic algae

Size: Minute, but found in large slicks on the surface of the water.

Colour: Dull orange/brown – red pigments in the cells make the blue-green colour.

Diet: Sunlight.

Where to look: *Trichodesmium* 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* 'blooms' look like oil slicks, and/or a milky layer two to three metres deep.

This algae can be found all year round, but tends to be more common in summer and more visible on calm days.

Status: Not protected.

Why do we care? *Trichodesmium* might prove to be an indicator for water quality and climate change issues on the Reef, and thus as much information as possible is needed on its frequency and range of appearances.

Australian Government

Great Barrier Reef Marine Park Authority

2-68 Flinders Street
PO Box 1379
TOWNSVILLE QLD 4810
Australia
Phone: (07) 4750 0700
Fax: (07) 4772 6093
info@gbrmpa.gov.au

www.gbrmpa.gov.au