

2009

# Reef Check Australia South East Queensland Survey Season Summary



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Reef Check Foundation Ltd



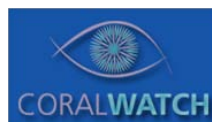
We greatly appreciate all of our supporters who helped to make this project a success: dedicated volunteers, generous dive operators, innovative collaborators and supportive funding agencies.

We would like to recognize the importance of the Australian Government's Envirofund and Coast Care funding and a generous donation from the Max Faber Foundation.

A special note of thanks to Dive Evolution, who provided the resources to help us collect data on ten sites in the Moreton Bay region.



**Australian Government**





## Table of Contents

<b>Introduction and summary results</b> .....	<b>1</b>
<b>New survey sites</b> .....	<b>5</b>
Currimundi Reef, Site 1 .....	5
Currimundi Reef, Site 2 .....	5
Flat Rock, Shark Gulley, Site 1 .....	6
Flinders Reef, The Nursery, Site 2 .....	6
Flinders Reef, The Nursery, Site 3 .....	7
Goat Island, Site 1 .....	8
Green Island, Site 1 .....	9
Hancock’s Shoal, Site 1 .....	9
Hancock’s Shoal, Site 2 .....	10
Inner Gneerings, The Caves, Site 1 .....	10
Jew Shoal, The Pin, Site 1 .....	11
Kings Beach, Site 1 .....	12
Macleay Island .....	13
Marietta Dal .....	13
Myora Reef .....	14
Palm Beach Reef, Site 2 .....	14
Peel Island, North, Site 1 .....	15
Peel Island South, Site 1 .....	15
Shag Rock, North, Site 1 .....	16
<b>Dive sites where coral cover increased</b> .....	<b>17</b>
Flat Rock, The Nursery, Site 1 .....	17
Flinders Reef, Aladdin’s Cave, Site 1 .....	18
Hutchinson’s Shoal, Site 1 .....	19
Shag Rock, South, Site 1 .....	20
<b>Dives sites where coral cover decreased</b> .....	<b>21</b>
Mudjimba Island, Site 1 .....	21
<b>Dive sites where coral cover fluctuated</b> .....	<b>22</b>
Flinders Reef, The Nursery, Site 1 .....	22
Palm Beach Reef, Site 1 .....	23
<b>Artificial Reef sites</b> .....	<b>24</b>
Gold Coast South West Wall, Site 1 .....	24
Narrowneck Artificial Reef .....	25
<b>Literature Cited</b> .....	<b>26</b>



## REEF CHECK AUSTRALIA South East Queensland Survey Season Report

### Overview

Reef Check Australia's (RCA) monitoring program acts as an early warning system for changes in the health of coral habitats. Annual surveys provide long-term data sets that can reveal important patterns over time. Quantitative data is collected about substrate cover as well as abundance of key invertebrate species and target fish species. RCA also documents natural and anthropogenic impacts that affect coral habitats.

Summary findings for surveys conducted in South East Queensland (SEQ) during the 2009 season are presented in this report. Teams of trained volunteers were able to monitor a total of 28 sites on 19 distinct coral habitats, including 9 existing survey sites and 19 new sites, ranging north to south from Noosa to Palm Beach.

### South East Queensland

SEQ represents the marginal edge of coral growth (Perry & Larcombe, 2003) and a transitional area where tropical, sub-tropical and temperate species mix. Coral communities in this area may receive larval recruitment from the southern Great Barrier Reef, but are generally limited from accreting reef structures by environmental factors such as light, temperature, aragonite availability and/or turbidity (Fellegara & Harrison,

2008 and Kleypas, McManus & Menez 1999). However, there are numerous coral communities with diverse and extensive coral growth in the area, including offshore sites like Flinders Reef with 119 recorded coral species. While coral communities inshore Moreton Bay may not contain such diversity (with 64 species found to date), there are many locations with considerable historical and existing coral cover (Wallace, Fellegara, Muir, & Harrison, 2009; Harrison, Harriot, Banks, & Holmes, 1998).

The SEQ area includes about seven percent of the State's coastline and 65 percent of its population (The State of Queensland. Environmental Protection Agency, August 2006). Immense population growth and development within the region increase pressures on the marine ecosystem, both directly and indirectly. Stresses such as sediment and nutrient runoff, habitat loss, boating and anchoring impacts, waste disposal, overfishing, aquarium trade collection and climate change all have the potential to impact coral habitats.

Despite the unique assemblage of marine species and recognized threats to coral habitat health in SEQ, there is limited monitoring of these habitats. With the habitat and species shifts that could potentially occur with climate change, as well as pressures from anthropogenic threats, this transitional area is gaining recognition as an important area to study and protect (Wallace, Fellegara, Muir, & Harrison, 2009). RCA aspires to make significant contributions to the available data set for coral health in SEQ.



Many SEQ surveys took place within the Moreton Bay Marine Park, encompassing 3400 km<sup>3</sup> from Caloundra to the Gold Coast. The Park underwent rezoning in March 2009, expanding Marine National Park (MNP) coverage from less than one to sixteen percent. RCA aims to collect information about varied coral habitats, including protected and non-protected areas, for the sake of comparison. During the 2009 SEQ season, 28 sites were monitored (Table 1) and eight of these were within MNP zones. RCA also surveyed in six Ramsar wetland sites.



Figure 1. Map of South East Queensland survey sites from Google Earth

Table 1. Table of all RCA monitoring locations in SEQ, including site number, location, depth, year of initial survey and site designation including four zones within the Moreton Bay Marine Park: Marine National Park (MNP), Conservation Park (CP), Habitat Protection (HP) or General Use (GU) zones as well as Ramsar Wetland site status (Ramsar)

Site	#	Location	Depth (m)	1st Survey	Site Designation
Currimundi Reef	1	Sunshine Coast	9	2009	n/a
Currimundi Reef	2	Sunshine Coast	9	2009	n/a
Flat Rock, Shark Gulley	1	Outer Moreton Bay	9	2009	MNP
Flat Rock, The Nursery	1	Outer Moreton Bay	7	2008	MNP
Flinders Reef, Aladdin's Cave	1	Outer Moreton Bay	10	2007	MNP
Flinders Reef, The Nursery	1	Outer Moreton Bay	6	2007	MNP
Flinders Reef, The Nursery	2	Outer Moreton Bay	6	2009	MNP
Flinders Reef, The Nursery	3	Outer Moreton Bay	6	2009	MNP
Goat Island	1	Inner Moreton Bay	2	2009	CP, Ramsar
Gold Coast, South West Wall	1	Gold Coast	6	2007	n/a
Green Island	1	Inner Moreton Bay	2	2010	HP, Ramsar
Hancock's Shoal	1	Sunshine Coast	11	2009	n/a
Hancock's Shoal	2	Sunshine Coast	11	2009	n/a
Hutchinson's Shoal	1	Outer Moreton Bay	11	2007	GU
Inner Gneerings, The Caves	1	Sunshine Coast	11	2009	n/a
Jew Shoal, The Pin	1	Sunshine Coast	10	2009	n/a
Kings Beach	1	Sunshine Coast	3	2009	HP
Macleay Island	1	Inner Moreton Bay	2	2009	HP, Ramsar
Marietta Dal	1	Outer Moreton Bay	10	2009	HP
Mudjimba Island	1	Sunshine Coast	5	2007	n/a
Myora Reef	1	Inner Moreton Bay	2	2009	MNP, Ramsar
Narrow Neck Artificial Reef	1	Gold Coast	5	2007	n/a
Palm Beach Reef	1	Gold Coast	10	2007	n/a
Palm Beach Reef	2	Gold Coast	10	2009	n/a
Peel Island, North	1	Inner Moreton Bay	2	2009	MNP, Ramsar
Peel Island, South	1	Inner Moreton Bay	3	2009	Ramsar
Shag Rock, North	1	Outer Moreton Bay	6	2009	HP
Shag Rock, South	1	Outer Moreton Bay	6	2008	HP



## Trends and Patterns 2009

Of the nine existing sites that were again surveyed this year, four sites had slightly increasing coral cover, one site had decreasing cover and three sites had fluctuating hard coral cover over the course of monitoring. The other two existing sites are artificial structures, where hard coral growth has never been recorded. Excluding these two artificial sites, hard coral cover ranged from six to 58 percent across all monitoring sites, with most sites averaging between 15 and 25 percent cover (Figure 2).

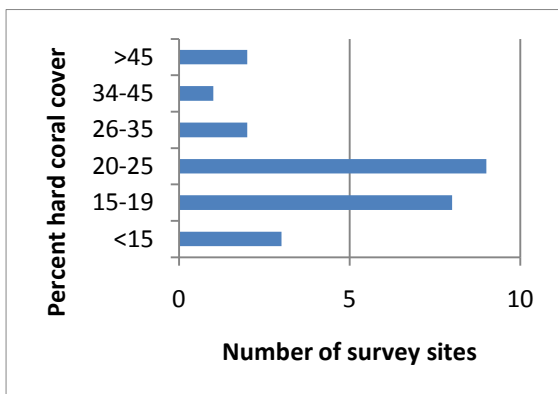


Figure 2. Percent cover of hard coral on all 28 sites monitored during 2009 survey season

The eight Sunshine Coast sites averaged 19 percent hard coral cover, ranging from 14 to 24 percent. The 10 sites offshore from Moreton Bay had an average of 26 percent hard coral cover, with sites as low as 15, but also sites with extensive hard coral cover (58%). The Gold Coast region only has one monitored reef, as many reefs in this area surpass RCA depth limits of 12m; the two research sites here average 15 percent hard coral cover.

RCA also monitored five inshore sites, located in Moreton Bay. These sites had higher potential for coastal impacts and often showed heavier siltation levels than off shore sites, but many inshore sites still had extensive coral cover. The inshore sites ranged from six to 46 percent cover, averaging 22 percent.

RCA also monitored two artificial reef structures on the Gold Coast. These were chosen due to heavy human impacts and high community interest. No hard coral cover has been reported on these sites, but there is other marine life found in these areas.

Throughout the season, nine sites reported coral bleaching. Many surveys were completed during the winter months (with reported water temperatures from 15 to 18°C), so some bleaching may be attributable to cold water stress. The maximum reported bleaching level was three percent of the hard coral community and most sites had less than one percent impact across the hard coral community.

Coral disease was reported on nine sites, with the highest reported incidence of two counts per 100m<sup>2</sup>. Many sightings appeared to be white syndrome.

*Drupella* sp. (coral eating snails) were recorded on thirteen sites, but generally in fairly low abundance (< 2/100m<sup>2</sup> on all transects). *Drupella* scarring was reported on seven sites (with just three scars maximum reported for a survey).



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Most surveys reported hard coral damage (n=20), some sites with as little as one incident and some sites averaging more than 3/100m<sup>2</sup>. Coral scarring from unknown causes was also relatively common and was reported on 16 sites, ranging from just one scar to as many as 16 total across the transect (4/100m<sup>2</sup>).

Discarded fishing line was reported on eleven sites, with maximum counts reaching a total of 20 on one survey (5/100m<sup>2</sup>). Other assorted rubbish was discovered on six survey sites, including items like bottles, fish cages and tyres.

Three sites, including Flat Rock (The Nursery), Hancock's Shoal (2) and Jew Shoal reported simultaneous bleaching, disease, *Drupella* snails, unknown damage and scarring.

Other features of note included high counts of *Diadema* sp. urchins at Flat Rock Shark Gulley, Myora Reef, Palm Beach Reef sites, and Shag Rock sites. High abundances of pencil urchins and anemones were found at Palm Beach Reef (much higher than any other SEQ site). Only one indicator sea cucumber was seen on RCA SEQ surveys (*Thelenota ananas* at Kings Beach Reef) and banded coral shrimp were only reported at Gold Coast Southwest Wall.

Butterfly fish and snapper were the most commonly recorded fish groups in SEQ, along with some parrotfish and sweetlips. Only one coral trout was sighted during the season.

## March 2009 Oil Spill Monitoring

On March 11, 2009 a container ship called the *Pacific Adventurer* spilled 270 tons of oil seven miles off the coast of Cape Moreton when 31 containers fell from the ship in bad weather. Due to severe storm conditions at the time, much of the oil was dispersed or washed past nearby coral communities (Department of Environment and Resource Management, July 2009). Major areas of oil accumulation included Moreton Island to Bribie Island and north to Point Arkwright on the Sunshine Coast.

RCA was awarded funds with the Sunshine Coast Regional Council through the SEQ Catchments Ltd. Oil Spill Recovery Grant to participate in marine monitoring on three sites after this event. RCA has monitored thirteen sites within the impacted area, including four established research sites with baseline data prior to the spill:

- Currimundi Reef Sites 1\* & 2\*
- Flinders Reef, The Nursery Sites 1\*-3
- Flinders Reef, Aladdin's Cave\*
- Hancock's Shoal Site 1 & 2
- Hutchinson's Shoal\*
- Inner Gneerings, The Caves\*
- Kings Beach
- Marietta Dal
- Mudjimba Island\*\*

\*These research sites were funded by SEQ Catchments Ltd, all other sites funded by the Australian Government's CoastCare.

\*\*RCA had existing baseline data before the March 2009 oil spill

## NEW SURVEY SITES

### *Currimundi Reef, Site 1*

This is a new research site in the Sunshine Coast region. It is an exposed rocky outcrop that is relatively unknown and not frequented by divers, fishers or boaters. Data indicated that hard coral cover was almost 18 percent (more than three quarters encrusting growth forms), with even higher soft coral coverage (23%), mostly leathery growth forms. All recorded sponges were encrusting. Most rock (75%) was covered with turf algae. Siltation levels were low.

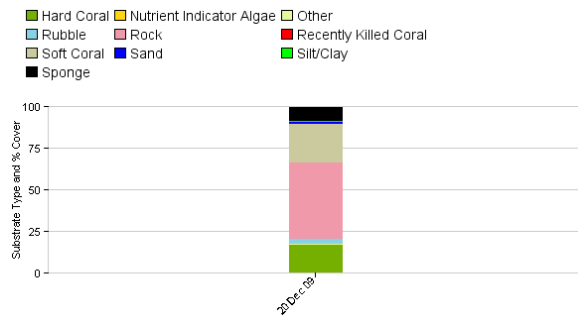


Figure 3: Substrate type and percent cover at Currimundi Reef medium: Site 1: Rocky outcrop

There was one coral scar on the entire transect. The only recorded invertebrates were three *Drupella* snails and one anemone. Less than one *Drupella* scar was reported per 100m<sup>2</sup>. No bleaching was seen but six incidents of coral disease were recorded. Fish abundance surveys were not undertaken.



### *Currimundi Reef, Site 2*

The second survey site at Currimundi Reef was dominated by mostly rocky substrate with 24 percent hard coral cover. Growth forms were generally encrusting (>75%). Soft coral accounted for 20 percent cover. A quarter of soft corals were leathery growth forms. Most rock was covered in turf algae, with less than 10 percent rock covered with calcareous algae. Siltation was low.

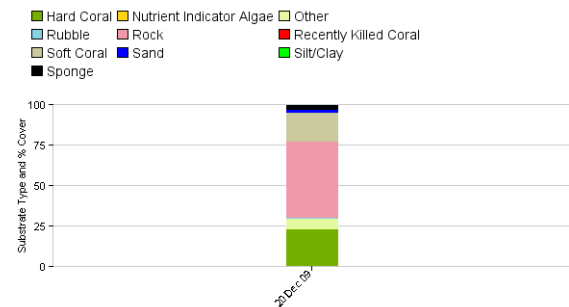


Figure 4: Substrate type and percent cover at Currimundi Reef deep: Site 2: Rocky outcrop

One *Drupella* was seen per 100m<sup>2</sup>, but less than one *Drupella* scar was recorded per 100m<sup>2</sup>. Two unknown scars were also recorded on the survey. No bleaching was recorded. Fish abundance surveys were not undertaken.



## Flat Rock, Shark Gulley, Site 1

This is a new site on the Southern side of Flat Rock. This site was recently declared a green zone in 2009 Park rezoning and is also a Grey Nurse Shark Protection Area. It is a popular local diving and boating location.

The hard coral cover is 15 percent with very little soft coral or sponge. More than half of the hard coral was branching. The majority of the remaining coral was encrusting, as were all sponges. A fair bit of macro algae, mostly *Lobophora* and *Asparagopsis*, was recorded (>6/100m<sup>2</sup>). Almost all rock surfaces were covered with turf algae.

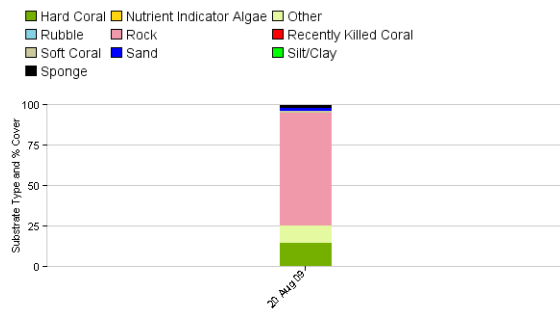


Figure 5: Substrate type and percent cover at Flat Rock Island: Shark Gulley: medium: Site 1: Fringing reef seaward

A few indicator invertebrates were recorded during the survey, including *Diadema* urchins (3/100m<sup>2</sup>), anemones (<1/100m<sup>2</sup>) and one giant clam. Less than there one incident of coral damage per 100m<sup>2</sup> was recorded and no coral bleaching was recorded. There were more than four butterfly fish per 100m<sup>2</sup> on average across the transect.



## Flinders Reef, Nursery, Site 2

This is a new site, which includes a large expanse of branching *Acropora* coral and a green turtle cleaning station. It is a popular dive site and may be exposed to damage from boat anchors and fishing. The site has been protected under Moreton Bay Marine Park rezoning and the reef itself is now a marine park green zone with no fishing activities allowed. The immediate surrounding area is a conservation park, where some fishing activities are allowed.

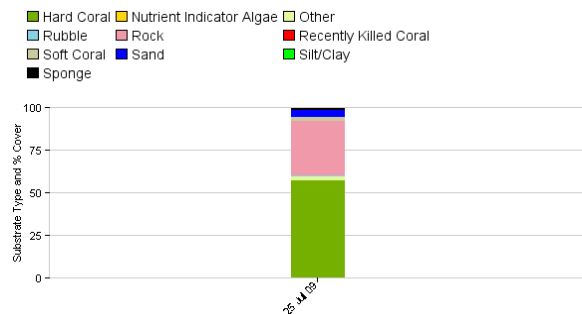


Figure 6: Substrate type and percent cover at Flinders Reef: Nursery: medium: Site 2: Fringing reef leeward

The extensive growth of branching coral at this site make hard coral cover quite high, with 58 percent cover recorded (made up of almost 100% branching coral). The rest of the transect area included mostly rock and sand with very little coverage of soft coral or sponge. There were two counts of macro algae per 100m<sup>2</sup> (assorted red algae).

Due to time constraints, neither invertebrate & impact nor fish surveys were completed for this transect.



## Flinders Reef, Nursery, Site 3

This site had 36 percent hard coral cover and a small amount of soft coral (5%). Most of the hard coral recorded was branching (>75%). Half of the rocky substrate was covered in turf algae and a small portion was covered in coralline algae (5%).

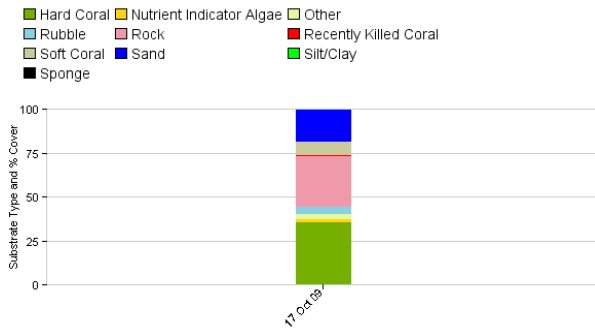


Figure 7: Substrate type and percent cover at Flinders Reef: Nursery: medium: Site 3: Fringing reef leeward

Invertebrates included one giant clam, three anemones, one collector urchin and two *Diadema* urchins in total. One egg cowrie was also recorded (Photo A).

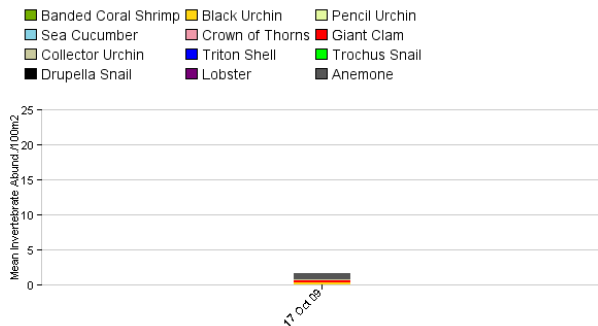


Figure 8: Mean abundance of invertebrates at Flinders Reef: Nursery: medium: Site 3: Fringing reef leeward



Photo A. Egg cowrie

Almost two scars per 100m<sup>2</sup> were recorded, as well as three incidents of coral damage per 100m<sup>2</sup>. One discarded fishing line was found. Two incidents of coral disease were recorded (Photo B).



Photo B. Coral disease

A variety of target fish species were seen, including butterfly fish (2/100m<sup>2</sup>), snapper (1/100m<sup>2</sup>), parrotfish (>2/100m<sup>2</sup>) one sweetlips and one coral trout. This was one of the most diverse fish assemblages recorded on a SEQ survey. One green turtle was sighted as well.

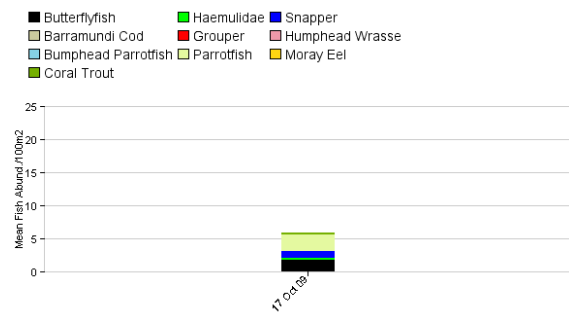


Figure 9: Mean abundance of fish at Flinders Reef: Nursery: medium: Site 3: Fringing reef leeward



## Goat Island, Site One

Goat Island is recognised as an important inshore site, with historical communities of diverse hard coral species (Fellegara, 2008). There is high boat traffic in the area and the ferries to North Stradbroke Island travel in close proximity to the island. Recreational fishing levels are considered mid-range. The transect area at Goat Island is a shallow, sheltered site fringing the Island.

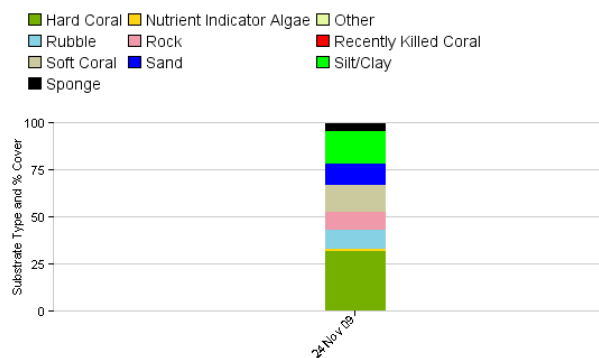


Figure 10: Substrate type and percent cover at Goat Island: Goat Island: shallow: Site 1: Fringing reef

Hard coral covers more than 32 percent of the transect area and soft coral makes up another 15 percent. Almost all recorded hard coral was plate growth formations. About half of the recorded soft coral was leathery. There were more than two counts of macro algae per 100m<sup>2</sup> across the transect (mostly *Padina*). There is heavy siltation at this site, accounting for almost 20 percent of the substrate surveyed and evidenced on top of many corals.



There was an average of three incidents of coral damage over each 100m<sup>2</sup>. Some bleaching was recorded (Photo C), representing slightly more than one percent of the population, impacting about 50 percent of the surface of each affected colony.



Photo C. Bleached hard coral

No RCA indicator invertebrates were recorded during the survey.

## Green Island, Site 1

Green Island is a new site located inshore Moreton Bay. It is of interest due to its historical coral community and close proximity to the mainland. The island itself is a high latitude subtropical, low-wooded island, a unique habitat. (Neil, 2000). The coral community has been impacted by limestone dredging that only stopped in 1997. Recreational fishing levels in this area are considered high and boat traffic is heavy. There are low levels of lobster harvesting and very low levels of diving/snorkelling.

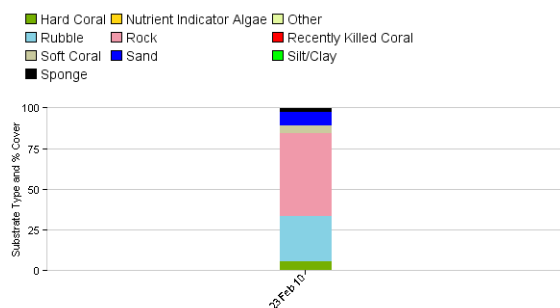


Figure 11: Substrate type and percent cover at Green Island: Green Island East: shallow: Site 1: Fringing reef

Coral coverage on this site is low (6% hard coral, 4% soft coral). Hard corals were scattered massive or RCA categorised hard coral (HC) growth forms. Most rock surfaces were covered with turf algae and macro algae counts were high (18/100m<sup>2</sup>). Evidence of numerous branching coral growth forms were seen in the rubble (27%), but there were few living colonies. Siltation levels were high.

No invertebrate/impact survey was completed.



## Hancock's Shoal, Site 1

This is a new site in the Sunshine Coast area. It is an exposed rocky outcrop with relatively low use by divers, fishers and boaters. Hard coral makes up 20 percent of surveyed substrate (75% encrusting, 25% foliose), while very little soft coral or sponge is found at this location. Rock with turf algae makes up more than half of recorded substrate. Macro algae counts across the transect totalled two. Silt loading levels were mid-range.

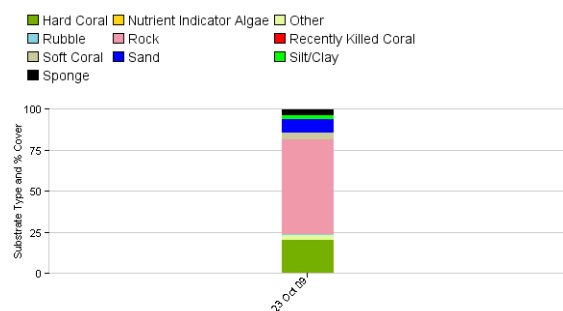


Figure 12: Substrate type and percent cover at Hancock's Shoal: Hancock's Shoal: medium: Site 1: Rocky outcrop

Very few invertebrates were found at this location, with only one *Diadema* urchin was recorded. Scarring was recorded slightly more than once per 100m<sup>2</sup> and less than one incidence of other damage was found over each 100m<sup>2</sup> on average. Bleaching was only recorded on five percent of one coral colony.

One octopus and one moray eel were recorded. This site demonstrated low target fish abundance, with less than one parrotfish seen per 100m<sup>2</sup>.



## Hancock's Shoal, Site 2

The second site at Hancock's Shoal had 23 percent was hard coral cover (almost all encrusting) and another fifty percent was rock (95% percent with turf algae). Only two counts of macro algae were recorded on the transect.

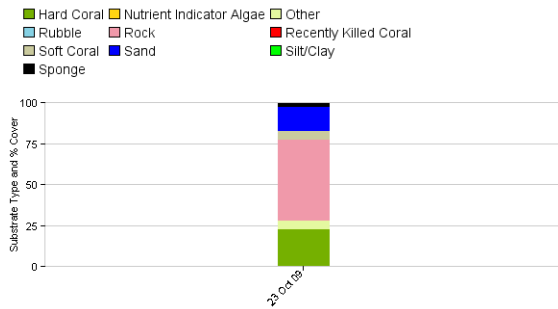


Figure 13: Substrate type and percent cover at Hancock's Shoal: Hancock's Shoal: medium: Site 2: Rocky outcrop

This site showed low invertebrate abundance, with only one *Drupella* snail sighted. Scarring was reported almost three times per 100m<sup>2</sup> and less than one incident of other damage was recorded per 100m<sup>2</sup>. A small amount of coral bleaching was recorded, affecting less than one percent of hard corals with colony surfaces bleached an average of twenty four percent.



## Inner Gneerings, The Caves, Site 1

This reef is located just off shore from Mooloolaba and covers an extensive area ranging in depths from 10 to 25m. The area is heavily used for boating and some recreational fishing.

The substrate survey showed 19 percent hard coral cover and 14 percent soft coral cover. Most hard coral was encrusting (75%) and all rock surfaces were covered in turf algae. No macro algae were recorded.

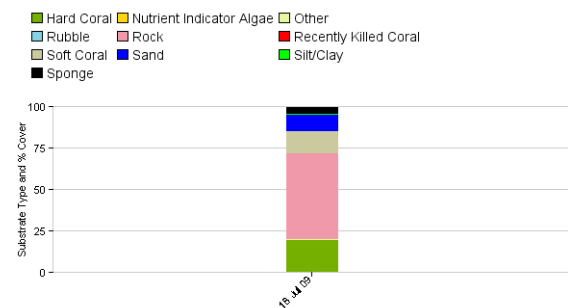


Figure 14: Substrate type and percent cover at Inner Gneerings: The Caves: medium: Site 1: Rocky outcrop

Several key invertebrates were recorded on this site. Two *Diadema* were found on the transect. *Drupella* snails averaged less than one per 100m<sup>2</sup>. One giant clam was sighted. One unknown scar was seen per 100m<sup>2</sup>, less than one instance of coral damage was reported per 100m<sup>2</sup>. No bleaching was reported. Two discarded fishing lines were found.



## Jew Shoal, Pinnacles, Site 1

This is a new site on the Sunshine Coast. Close to the Noosa River, the site consists of a large pinnacle with a wall along one edge. This is a major fishing site and a relatively popular boating location.

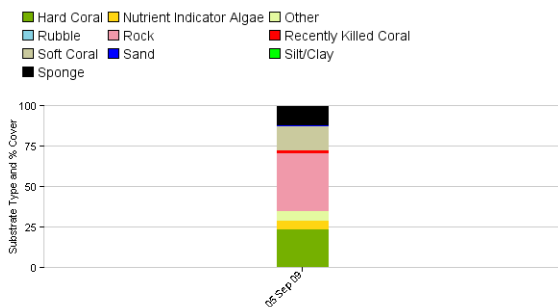
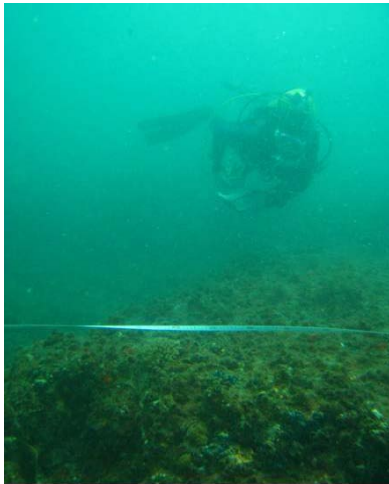


Figure 15: Substrate type and percent cover at Jew Shoal: The Pinnacles (The Pin): medium: Site 1: Rocky outcrop

The site had 24 percent hard coral cover, made up of 75 percent encrusting coral and 15 percent foliose. There was fifteen percent soft coral cover (65 percent leathery) and ten percent sponge, mostly encrusting. Almost all of the 35 percent rock substrate was covered with turf algae. No macro algae were recorded.

The only indicator invertebrates discovered on the site were *Drupella*, averaging slightly more than one per 100m<sup>2</sup>. An egg cowrie was also recorded.

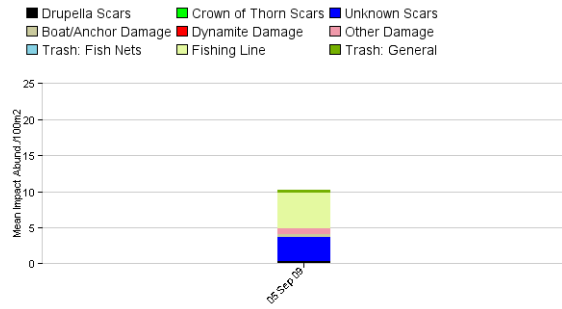


Figure 16: Mean abundance of impacts at Jew Shoal: The Pinnacles (The Pin): medium: Site 1: Rocky outcrop

The site had an average of three incidents of scarring per 100m<sup>2</sup> (Photo D). There were also recorded incidents of *Drupella* scars (n=2), anchor damage (n=2) and other coral damage (n=3). Bleaching was seen on less than one percent of colonies, impacting around thirty percent of each colony surface. Two accounts of coral disease were reported. Numerous discarded fishing lines were sighted (5/100m<sup>2</sup>, Photo E).

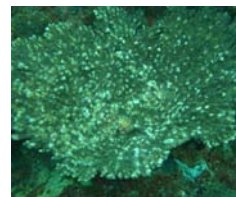


Photo D. Unknown scars



Photo E. Fishing line

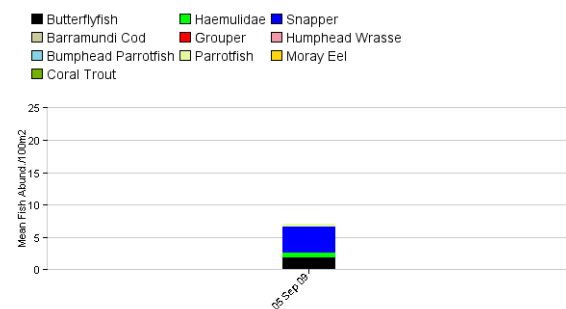


Figure 17: Mean abundance of fish at Jew Shoal: The Pinnacles (The Pin): medium: Site 1: Rocky outcrop

The site had snapper (>3/100m<sup>2</sup>), sweetlips (<1/100m<sup>2</sup>) and butterfly fish (2/100m<sup>2</sup>). A wobbegong, three eagle rays and a flathead fish were also seen.

## Kings Beach, Site 1

This is a new site on the Sunshine Coast that was chosen due to its heavy use and proximity to the coast. The site is located just a few hundred meters offshore, adjacent to a boat ramp. Spear fishers were observed during the survey and the site is heavily used overall.

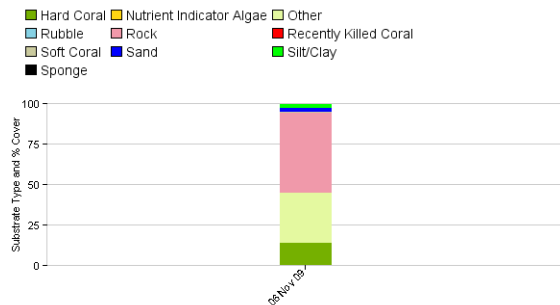


Figure 18: Substrate type and percent cover at Kings Beach: Kings Beach Reef: shallow: Site 1: Fringing reef seaward

Hard coral was recorded on fifteen percent of the transect. More than 50 percent of this was digitate growth forms in the general hard coral (HC) category (Photo F) and thirty percent encrusting. More than 25 percent of the transect was made up of the "other" substrate category (the vast majority of this being colonial ascidians, Photo F). Almost fifty percent of the transect recorded rock, more than 95 percent covered with turf algae. Total macro algae count was more than one count per 100m<sup>2</sup>.



Photo F. Hard coral and ascidians

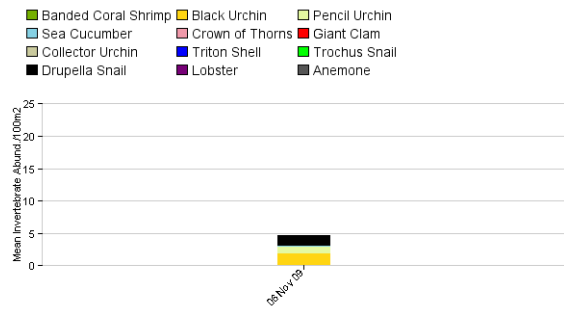


Figure 19: Mean abundance of invertebrates at Kings Beach: Kings Beach Reef: shallow: Site 1: Fringing reef seaward

Invertebrates included an average of three *Drupella* snails, two *Diadema* urchins and one pencil urchin over each 100m<sup>2</sup>. One incident of coral damage was seen on average over each 100m<sup>2</sup>. No coral bleaching was seen. Two discarded fishing lines were observed.



## Macleay Island, Site 1

This is a shallow fringing site inshore Moreton Bay. The site is close to a pier utilized for fishing but does not experience extensive boat traffic. More than twenty five percent of the substrate cover was soft coral, mostly ornate (80%). Fourteen percent of substrate at the site was hard coral; almost 75 percent of this consisted of massive coral growth forms. The average macro algae count was 3/100m<sup>2</sup> (mostly *Padina* and *Asparagopsis*). Forty percent of rock substrate was covered in turf algae. There is high siltation at this site.

Only a substrate survey was completed at this site due to low visibility.

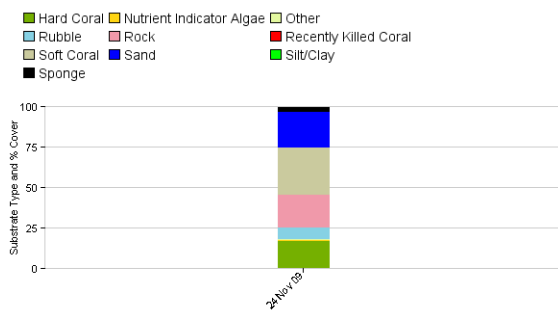


Figure 20: Substrate type and percent cover at Macleay Island: Macleay Island: shallow: Site 1: Fringing reef



## Marietta Dal, Site 1

This site is on the natural coral community adjacent to the wreck of the Marietta Dal, located just outside of Moreton Bay. This is one of the closest sites to the March 2009 oil spill. Due to its exposed nature, the site is not regularly visited by boats or divers.

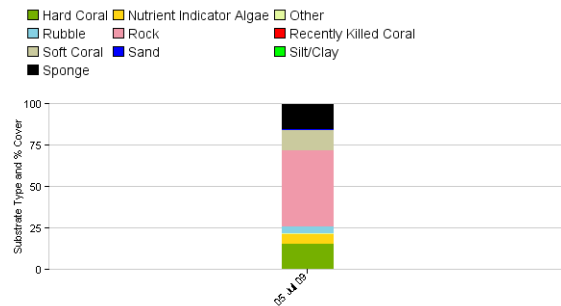


Figure 21: Substrate type and percent cover at Marietta Dal: Marietta Dal Reef: medium: Site 1: Fringing reef

The site had 15 percent hard coral cover, more than half of this was branching coral. Fifteen percent of substrate cover was sponge, 75 percent was encrusting growth. Soft coral accounted for ten percent cover, half of this made up of zooanthids. Average macro algae counts were 18/100m<sup>2</sup> (made up of both crustose and assorted red algae). Almost fifty percent of the substrate was rock and nearly all rock was covered in turf algae.

The only invertebrate recorded for this site was one collector urchin. An average of one scar and one account of coral damage were seen per 100m<sup>2</sup>. Three instances of coral disease were recorded. No bleaching was recorded. Four discarded fishing lines were found. Two butterfly fish were seen per 100m<sup>2</sup> and two sweetlips and one parrotfish were also seen.



## Myora Reef, Site 1

This is a shallow reef in Moreton Bay, close to North Stradbroke Island. There is 46 percent hard coral cover, mostly plate coral growth forms (*Acropora*). Eighty percent of rock surfaces were covered with turf algae. Macro algae was at low abundance (n=2). In March 2009, the area was established as a green zone.

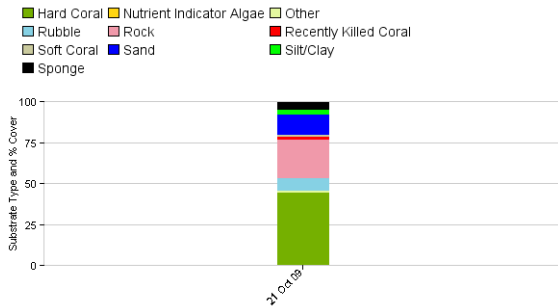


Figure 22: Substrate type and percent cover at Myora Reef: Myora Reef: shallow: Site 1: Fringing reef

*Diadema* was the most prevalent invertebrate, at an abundance of 4 per 100m<sup>2</sup>. *Drupella* snails were also found at counts of around one per 100m<sup>2</sup>.

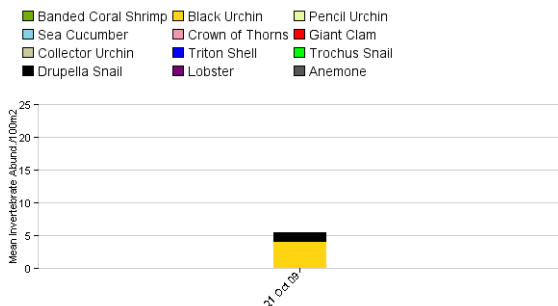


Figure 23: Mean abundance of invertebrates at Myora Reef: Myora Reef: shallow: Site 1: Fringing reef

Scarring was high at five scars per 100m<sup>2</sup>. No coral bleaching or disease was recorded. Two wobbegongs and a bamboo shark were sighted during the survey.



## Palm Beach Reef, Site 2

This is a new survey site at Palm Beach Reef. Hard coral cover was recorded at 10 percent, as was coverage of sponges. Almost half of the hard coral recorded was encrusting growth forms. There was no macro algae recorded but almost all rock surfaces were covered with turf algae. Siltation levels were high.

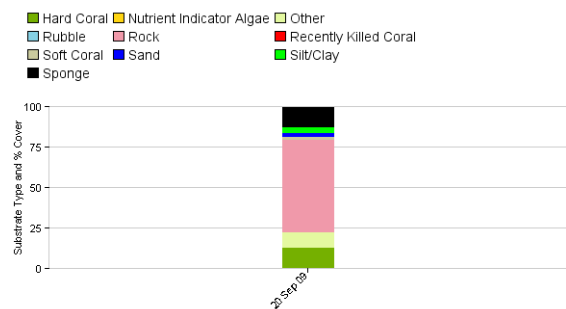


Figure 24: Substrate type and percent cover at Palm Beach Reef: Palm Beach Reef: medium: Site 2: Fringing reef seaward

Anemones were the most commonly recorded invertebrate (>26/100m<sup>2</sup>). *Diadema* (6/100m<sup>2</sup>) and pencil urchins (5/100m<sup>2</sup>) were also abundant. There was less than one account of damage and one incident of disease on average per 100m<sup>2</sup>. No RCA indicator fish were sighted. No coral bleaching was recorded.

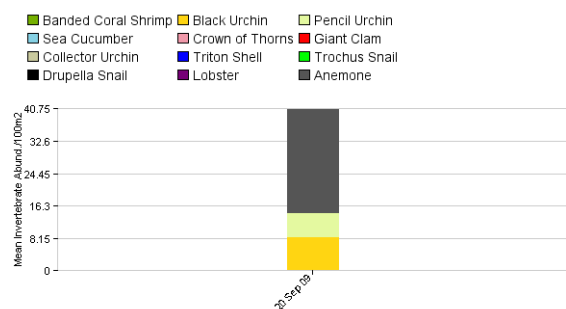


Figure 25: Mean abundance of invertebrates at Palm Beach Reef: Palm Beach Reef: medium: Site 2: Fringing reef seaward



## Peel Island North, Site 1

This is a new shallow inshore survey site. The northern area of Peel Island is an established green zone but it is an area with heavy boat traffic.

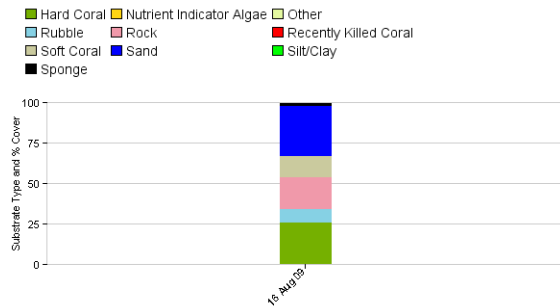


Figure 26: Substrate type and percent cover at Peel Island: North Peel: shallow: Site 1: Fringing reef

The site had 25 percent hard coral cover recorded, along with about ten percent soft coral. Hard coral fell mostly into the categories of massive, encrusting or general HC. Rock covered with turf algae made up around 20 percent of the transect. Macro algae counts averaged three per 100m<sup>2</sup> (mostly *Lobophora* and *Sargassum*). Siltation levels were mid-range and could be seen accumulating on macro algae surfaces.

Invertebrate counts were low; the only indicator species found was *Drupella* at average counts of one per 100m<sup>2</sup>. The only recorded impact was some marine debris, averaging less than one per 100m<sup>2</sup>. No bleaching or coral disease was sighted. Two discarded fishing lines and a tyre were observed on the site.



## Peel Island South, Site 1

This is a new shallow inshore site on the southeastern side of Peel Island. This area is a yellow zone and sees high boat traffic and fishing use.

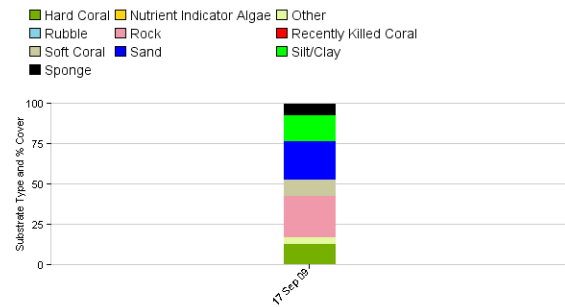


Figure 27: Substrate type and percent cover at Peel Island: South Peel: shallow: Site 1: Fringing reef

Hard coral cover on this side of Peel Island was not as abundant as the northern side, with 13 percent cover recorded. Coral growth forms were mostly encrusting and massive. There were low levels of both sponge (7%) and soft coral (9%) growth, with three quarters of soft coral being leathery growth forms. There is heavy siltation at this site, and silt accounted for more than 16 percent cover. Macro algae counts averaged more than 10 per 100m<sup>2</sup> and were mostly made up of *Sargassum*.



*Drupella* snails were the only indicator invertebrate recorded, found in abundances of more than one per 100m<sup>2</sup>.

Low levels of bleaching were seen, impacting 40 percent of each colony surface on average, but representing less than one percent of the overall population (Photo G). Discarded fishing line was found twice per 100m<sup>2</sup> (Photo H) and other rubbish was found in approximately the same abundance.



Photo G. Hard coral bleaching



Photo H. Fishing line

No indicator fish were sighted, but one file fish (Photo I) was recorded on the transect.



Photo I. Filefish

## Shag Rock North, Site 1

This is a new site on the northern, exposed side of Shag Rock. Fishing and boating are commonly observed at this site and divers visit regularly.

Nineteen percent hard coral cover was recorded, mostly branching coral. Siltation levels were high and represented a quarter of the survey transect. Macro algae counts totalled 12 (*Lobophora* and *Ulva*). Almost all rock surfaces were covered with turf algae.

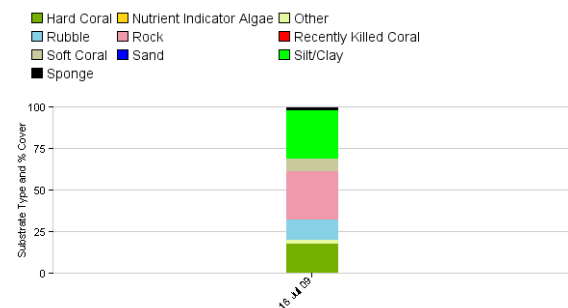


Figure 28: Substrate type and percent cover at Shag Rock North: Shag Rock North: medium: Site 2: Fringing reef

*Diadema* urchins were abundant (>13/100m<sup>2</sup>) but *Drupella* snails were the only other invertebrate seen (< 2/100m<sup>2</sup>).

Boat damage (2/100m<sup>2</sup>) and other unknown causes of coral damage (>1/100m<sup>2</sup>) were recorded. There was a low incidence of *Drupella* scarring (<1/100m<sup>2</sup>). No bleaching or coral disease were recorded. Snapper (1/100m<sup>2</sup>) and butterfly fish (<1/100m<sup>2</sup>) were recorded in slightly higher numbers than on the sheltered southern side of the island. Two wobbegongs were also spotted.



## INCREASING CORAL COVER

### Flat Rock, The Nursery Site 1

The island is surrounded by fringing coral and is a regular dive site for commercial operators. The area was rezoned in March 2009 and is now a green zone. It is also a Grey Nurse Shark Protection area.

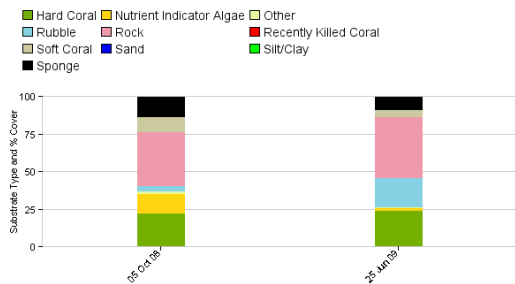


Figure 29: Substrate type and percent cover at Flat Rock: Nursery: medium: Site 1: Fringing reef

Hard coral cover at this site remained consistent, with coverage increasing just slightly from 23 to 24 percent. Rubble increased (3 to 19%), but nutrient indicator algae decreased (13 to 2%). Macro algae abundance decreased from ten total counts to three; this could be a seasonal difference as the previously survey was conducted in October 2008 and the 2009 survey took place in June. As recorded in previous surveys, most hard coral was encrusting (75%), but there was an increase in branching coral recorded on the transect and a slight decrease in plate coral and massive coral. Coralline algae was recorded for the first time, accounting for 10 percent of rock substrate. Of the low percent coverage of soft coral, zooanthids were recorded for the first time.



The number of recorded invertebrates decreased substantially from the last completed survey in 2008, with only one *Diadema* and one pencil urchin sighted. Less than one anemone was seen per 100 m<sup>2</sup> (Photo J). Recorded impacts included coral damage (>1/100m<sup>2</sup>, Photo K), coral scars (>2/ 100m<sup>2</sup>) and disease was reported for the first time at this site (2/100m<sup>2</sup>). Some cold-water bleaching was recorded; impacting 22 percent of each colony surface and three percent of the overall hard coral population.

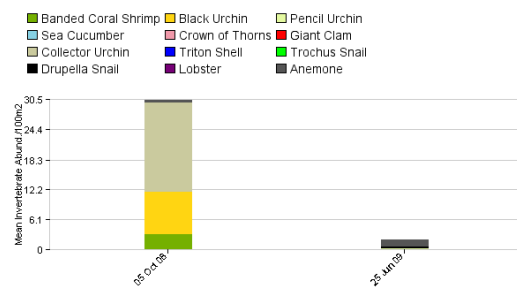


Figure 30: Mean abundance of invertebrates at Flat Rock: Nursery: medium: Site 1: Fringing reef



Photo J. Anemone & fish



Photo K. Anchor on coral

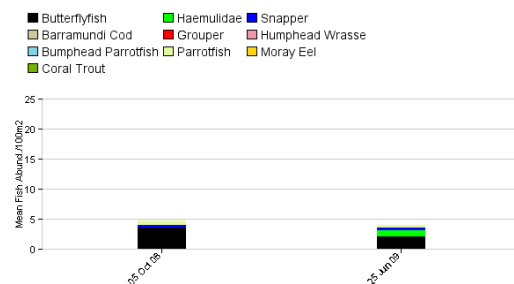


Figure 31: Mean abundance of fish at Flat Rock: Nursery: medium: Site 1: Fringing reef

Fish abundance at this site decreased, with a decline in butterfly fish (from more than 4/100m<sup>2</sup> to just more than 2/100m<sup>2</sup>), but an increase in sweetlips recorded (up from zero to 1/100m<sup>2</sup>).

## Flinders Reef, Aladdin's Cave, Site 1

Flinders Reef is a green zone, but is a frequented diving and boating location and there are reports of fishers utilising the area. The percent cover of hard coral cover increased since the last survey in 2008 (from 23% to 33%). On the same transect, nutrient indicator algae and bare rock decreased while soft coral increased. Soft coral category cover included a new presence of zooanthids not seen the year prior. Sponge cover also increased and almost all was encrusting. Rock substrate previously covered with turf algae decreased from 80 percent to 50 percent. Macro algae averaged more than 3/100m<sup>2</sup> across the transect (mostly *Asparagopsis*).

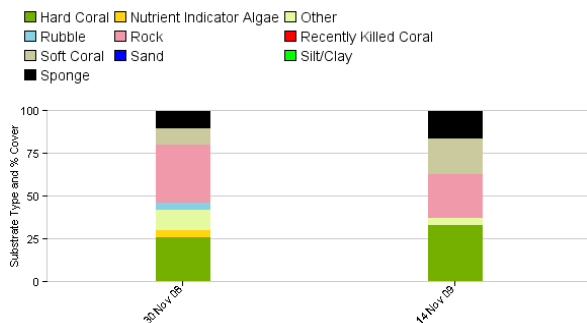


Figure 32: Substrate type and percent cover at Flinders Reef: Aladdin's Cave: medium: Site 1: Fringing reef seaward

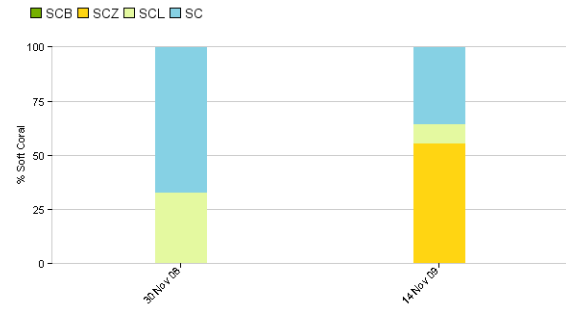


Figure 33: Soft coral type and percent cover at Flinders Reef: Aladdin's Cave: medium: Site 1: Fringing reef seaward

One anemone was seen per 100m<sup>2</sup> and two giant clams were recorded on the transect. There was an increased reporting of coral damage (>2/100 m<sup>2</sup>) and unknown scars (>1/100m<sup>2</sup>) on the site.

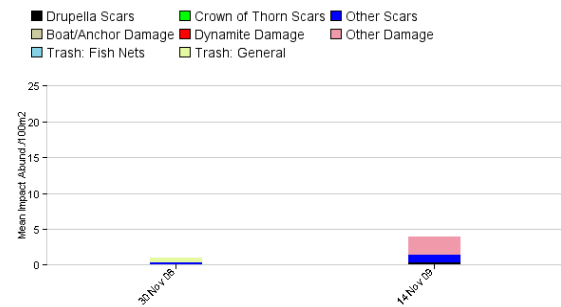


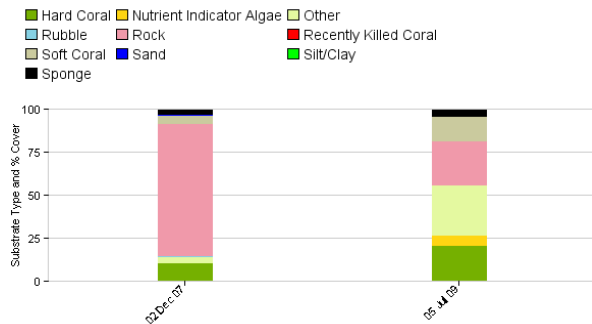
Figure 34: Mean abundance of impacts at Flinders Reef: Aladdin's Cave: medium: Site 1: Fringing reef seaward

Butterfly fish abundance has increased from less than one to four individuals per 100m<sup>2</sup>. Snappers were not seen this year, but sweetlips were spotted (<1/100m<sup>2</sup>). One green turtle was also sighted.



## Hutchinson's Shoal, Site 1

This is a relatively isolated reef located north of Flinders Reef. Due to its exposed location, it is not often visited by divers.



Hutchinson's Shoal was last surveyed in 2007. Since that time, hard coral coverage has increased on this site in that time from 11 to 19 percent, along with organisms such as zooanthids in the Other category, which have increased by almost 25 percent. Soft coral coverage has also increased from five to 13 percent. Nutrient indicator algae was also recorded this year (n=9). There was a total of 12 macro algae counts across the transects (mostly red algae, Photo L). This was less than 2007, but this may be a seasonal variation. Rock with turf algae has decreased from 100 percent to 75 percent on rock surfaces. Soft coral categories show an increase in zooanthids.

Figure 35: Substrate type and percent cover at Hutchinsons Shoal: Hutchinson's Shoal: medium: Site 1: Rocky outcrop



Photo L. Crinoid and algae (*Asparagopsis*)



Photo M. Fishing line

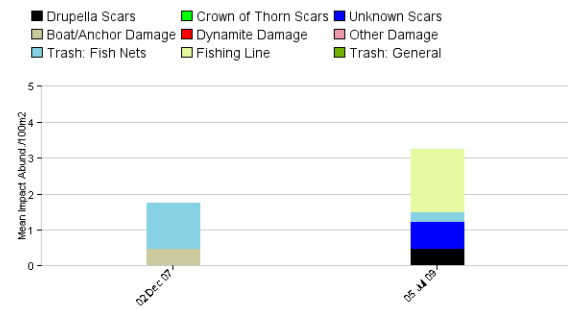


Figure 36: Mean abundance of impacts at Hutchinsons Shoal: Hutchinson's Shoal: medium: Site 1: Rocky outcrop

Two pieces of discarded fishing line/nets were found per 100m<sup>2</sup> (Photo M). Less than one scar was found per 100m<sup>2</sup>. Very low levels of bleaching (<1% of hard coral population, 70% of colony surface) and disease were recorded (n=1). On average, more than one *Drupella* snail was found per 100m<sup>2</sup>.

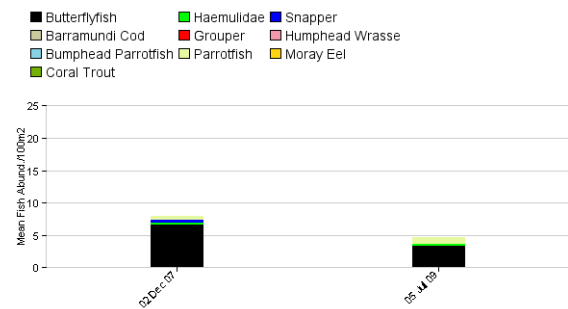
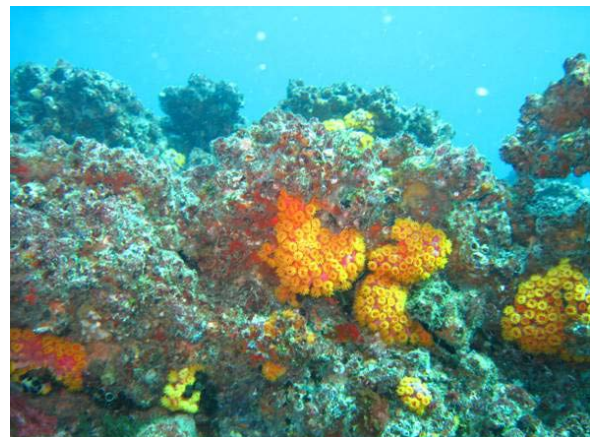


Figure 37: Mean abundance of fish at Hutchinsons Shoal: Hutchinson's Shoal: medium: Site 1: Rocky outcrop

Butterfly fish abundances have decreased from almost seven per 100m<sup>2</sup> to less than three per 100m<sup>2</sup> since the last survey in 2007.



## Shag Island South, Site 1

This site shows a slight increase in hard coral cover from 16 to 19 and soft coral from 3 to 11 percent (mostly zooanthids) since 2008. Hard coral includes mostly branching coral, encrusting coral and general hard coral categories. The category of 'other', which includes ascidians, corallimorphs etc has decreased substantially. Nutrient indicator algae have also decreased, leaving bare rock (75 percent covered with turf algae). This may be a seasonal variation as the 2008 survey was completed in December and the 2009 survey in July. Macro algae counts averaged 9/100m<sup>2</sup> for the transect (mostly *Lobophora*).

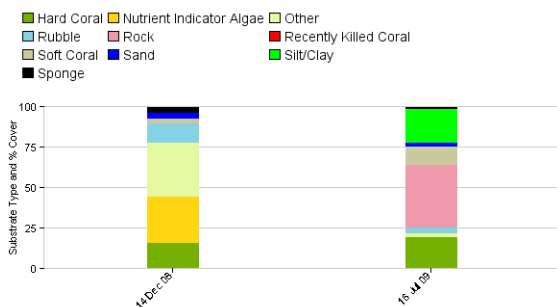


Figure 38: Substrate type and percent cover at Shag Rock Island: Shag Rock South: medium: Site 1: Fringing reef

*Diadema* abundance remained steady, at more than 11 per 100m<sup>2</sup>. Abundances of both pencil urchins (<7/100m<sup>2</sup>) and *Drupella* snails (1/100m<sup>2</sup>) seen in 2008 have decreased to zero in 2009. One giant clam was recorded (Photo N).

Unknown coral damage increased since the 2008 survey (>1/100m<sup>2</sup>) to almost three accounts per 100m<sup>2</sup> (Photo O). Two accounts of coral bleaching were recorded, affecting 20 percent of the colony surface on average and less than one percent of the population. There was less than one coral scar per 100m<sup>2</sup>. One account of coral disease was recorded.

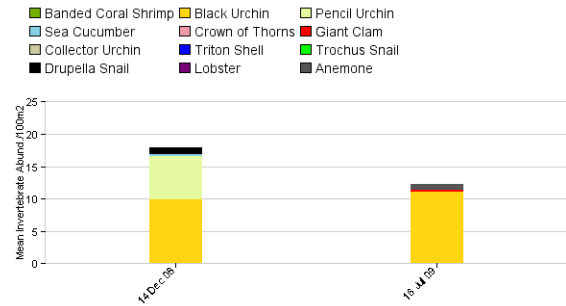


Figure 39: Mean abundance of invertebrates at Shag Rock Island: Shag Rock South: medium: Site 1: Fringing reef

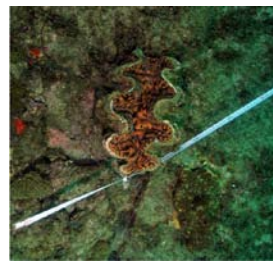


Photo N. Giant clam

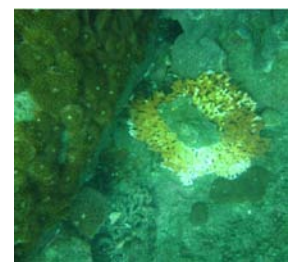


Photo O. Coral damage

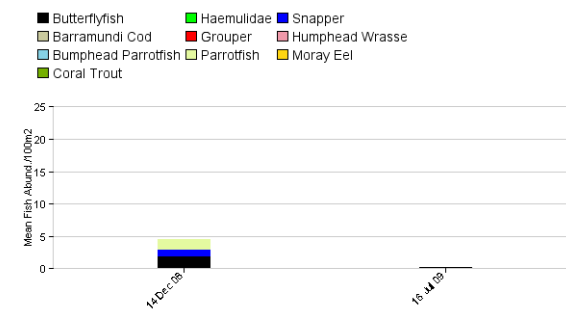


Figure 40: Mean abundance of fish at Shag Rock Island: Shag Rock South: medium: Site 1: Fringing reef

All previously recorded fish species decreased, the only sighting being a butterfly fish. One wobbegong and one hawksbill turtle were seen.

# DECREASING CORAL COVER

## Mudjimba Island, Site 1

The fringing reef around the island is close to the mainland and near the Mooloolah River mouth. The island has been deemed as a conservation zone for cultural reasons, although marine-based activities are not restricted.

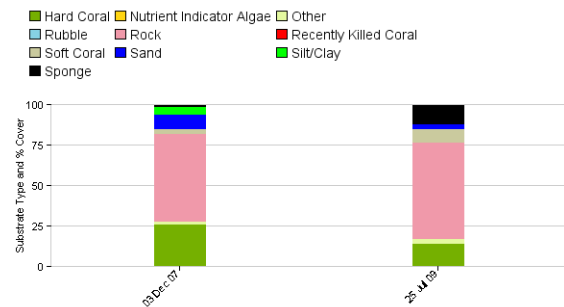


Figure 41: Substrate type and percent cover at Mudjimba Island: Mudjimba Island: medium: Site 1: Fringing reef leeward

Coral cover has decreased on this site since it was last surveyed two years ago in 2007 (from 24% down to 14%). The percentage of branching coral and plate coral increased, while massive growth forms decreased. Increases were seen in the cover of both sponge (up from <1% to 11%) and soft coral (up from 3% to 9%). Macro algae counts were substantially lower than in 2007 (down from a total of 10 counts to 1), but surveys were completed in different seasons. All rock surfaces were covered with turf algae. The percent cover of leathery soft coral and zooanthids increased, with the first accounts of zooanthids recorded at this site.

Few indicator invertebrates were recorded at this site, only less than one *Drupella* per 100m<sup>2</sup> and one anemone on the entire transect.

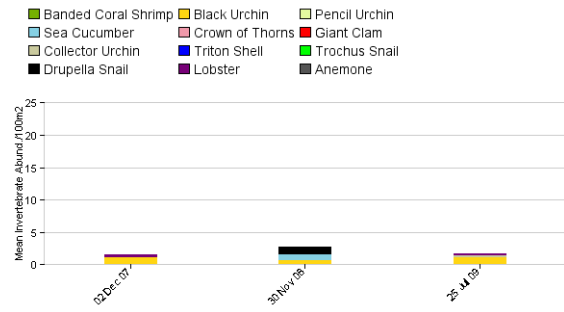


Figure 42: Mean abundance of invertebrates at Shag Rock Island: Shag Rock South: medium: Site 1: Fringing reef leeward

Incidents of fishing nets decreased from 2007, but both coral scars (>2/100<sup>2</sup>) and coral damage (n=2) increased. There was no report of bleaching. The site averaged one account of discarded fishing line on each replicate.

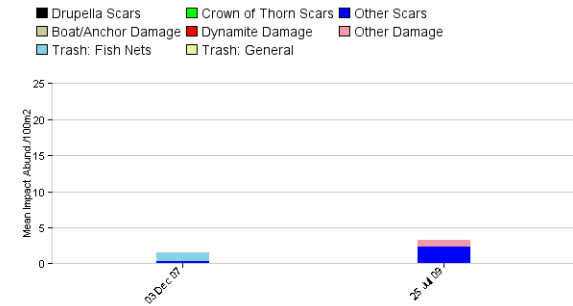


Figure 43: Mean abundance of impacts at Mudjimba Island: Mudjimba Island: medium: Site 1: Fringing reef leeward

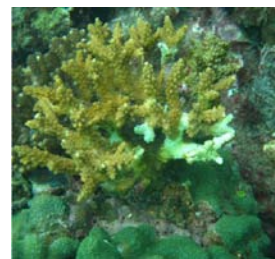


Photo P. Coral scar



Photo Q. Fishing line



# FLUCTUATING CORAL COVER

## Flinders Reef, The Nursery, Site 1

This site has been surveyed annually since 2007. Over this time hard coral cover has fluctuated, this year showing a slight decrease from 2008 levels, down from 23 to 19 percent, but overall showing an increase in coral cover since 2007 (12%). Branching coral forms have shown a decrease since 2007, although foliose and plate growth formations have increased. Sponge cover has increased from two to five percent. Nutrient indicator algae that were recorded in 2008 were not seen this year (possibly a seasonal variation). Soft coral cover has not varied drastically over the three years of monitoring. Macro algae levels have fluctuated over time, with this year showing the lowest recordings yet (2/100m<sup>2</sup> down from 9/100m<sup>2</sup> in 2008)—again potentially due to seasonal variation. Rock substrate is generally covered with turf algae.

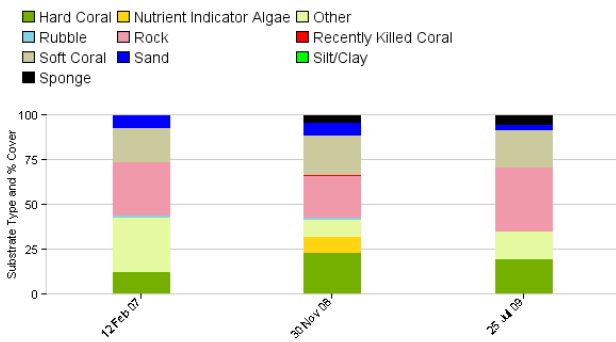


Figure 44: Substrate type and percent cover at Flinders Reef: Nursery: medium: Site 1: Fringing reef leeward



Photo R. Giant clam



Photo S. Colonial ascidians

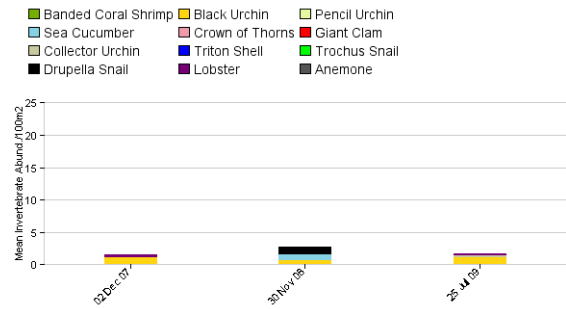


Figure 45: Mean abundance of invertebrates at Flinders Reef: Nursery: medium: Site 1: Fringing reef leeward

Invertebrate abundances have been generally low at the site over the three year monitoring period, with a few *Diadema* urchins (>1/100m<sup>2</sup>) and giant clams recorded this year (n=2). One lobster was sighted. As seen on the seaward side of Flinders Reef, there are more recorded accounts of coral damage (> 1/ 100m<sup>2</sup>) and coral scars (>3/100m<sup>2</sup>). No bleaching was recorded this year.

Butterfly fish show increased numbers since 2008 (increasing from <1/100m<sup>2</sup> to 6/100 m<sup>2</sup>). One wobbegong was sighted.

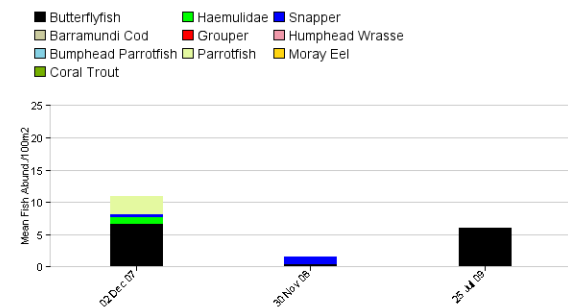


Figure 46: Mean abundance of fish at Flinders Reef: Nursery: medium: Site 1: Fringing reef leeward



## Palm Beach Reef, Site 1

This is an inshore reef with ridges and gullies close to the beach (800 to 1000m offshore). This site was first surveyed in 2007 and has shown fluctuations in hard coral cover over the three years of monitoring.

Hard coral cover decreased slightly from 2008 levels (down from 20% to 17%), but has increased from 2007 (8%). All recorded coral was encrusting or general hard coral (HC). All rock surfaces were covered with turf algae. Nutrient algae (1%) and rubble (2%) have consistently decreased. Organisms in the other category have consistently increased—at this site anemones made up the vast majority of this category (24%). Of note, hardly any of these anemones have resident anemone fish.

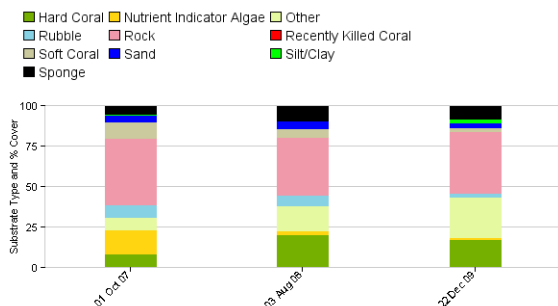


Figure 47: Substrate type and percent cover at Palm Beach Reef: Palm Beach Reef: medium: Site 1: Fringing reef seaward



Photo T. Anemones



Photo U. Pencil urchin

Both anemones (up from 0 to  $>50/100m^2$ ) and pencil urchins (up from  $16/100m^2$  to  $>23/100m^2$ ) have increased since 2007, while *Diadema* (down from  $>6/100m^2$  to  $<3/100m^2$ ) and *Drupella* (down from  $<4/100m^2$  to 0) have decreased.

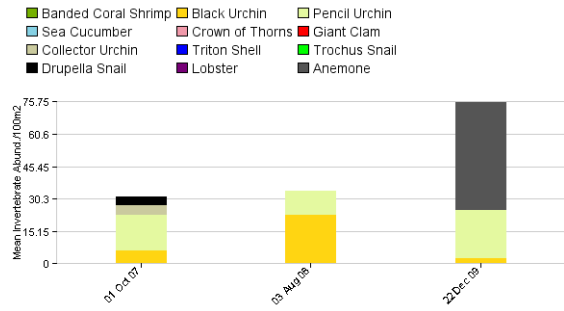


Figure 48: Mean abundance of invertebrates at Palm Beach Reef: Palm Beach Reef: medium: Site 1: Fringing reef seaward

The occurrence of coral scars has decreased to zero since 2008 when they were at their highest ( $>7/100m^2$ ). Other coral damage has increased slightly since the 2008 survey, but still remains less than one incident per  $100m^2$ . No bleaching or disease was recorded.

Butterfly fish abundance has fluctuated over the three years of monitoring, but were at their lowest this year ( $>1/100m^2$ ). Snapper abundance has increased each year ( $>1/100m^2$ ).

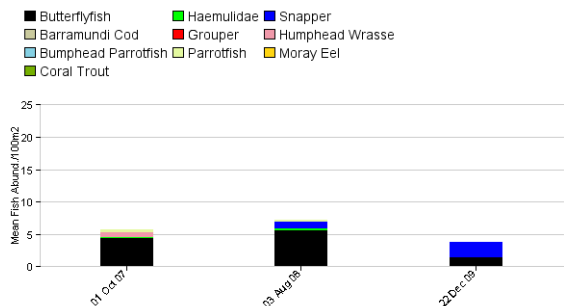
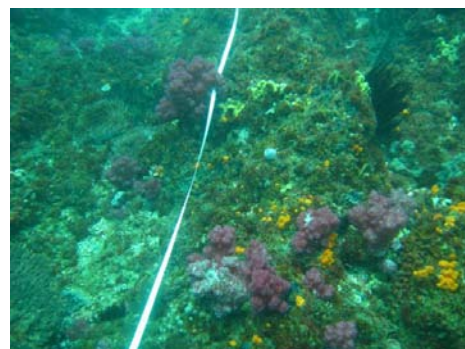


Figure 49: Mean abundance of fish at Palm Beach Reef: Palm Beach Reef: medium: Site 1: Fringing reef seaward



# ARTIFICIAL REEF STRUCTURES

## Gold Coast Seaway SouthWest Wall, Site 1

This is a shallow, sheltered site in The Gold Coast Seaway (built in 1971). Rocks on the constructed sea wall have created bare substrate for settlement. There is substantial silt loading but numerous unique marine species are reported by divers and it is a popular dive location. Boat traffic and urban influences are high.

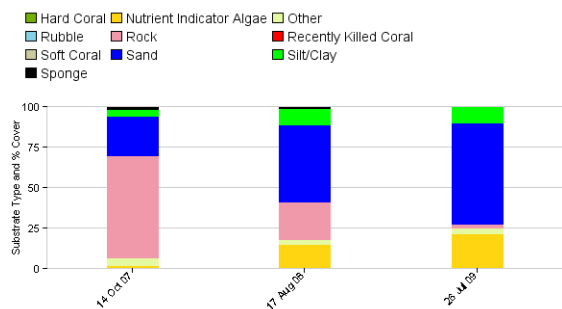


Figure 50: Substrate type and percent cover at Gold Coast Seaway Reefs: South-West Wall: medium: Site 1: artificial reef

No hard coral growth has ever been reported at this site. This site showed an increase in sand (24% to 62.5%), silt (4% to 10%) and nutrient indicator algae (2% to 22%) over the three years of monitoring since 2007. Macro algae decreased to less than one count per 100m<sup>2</sup> since 2008 when it was nine counts per 100m<sup>2</sup>. Siltation is high and all rock surfaces are covered with turf algae.

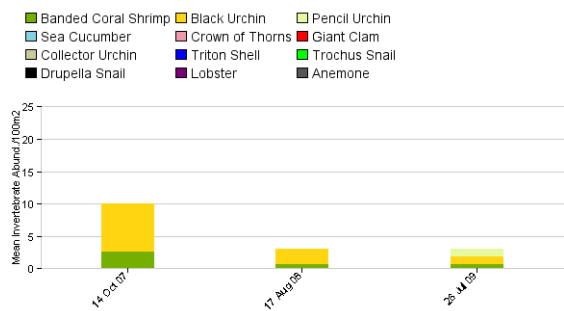


Figure 51: Mean abundance of invertebrates at Gold Coast Seaway Reefs: South-West Wall: medium: Site 1: Artificial reef

The mean abundance of *Diadema* (>1/100m<sup>2</sup>) and banded coral shrimp (<1/100m<sup>2</sup>) has decreased over the course of the three years. Collector urchins were found at an abundance of one per 100m<sup>2</sup> (Photo V). One octopus was sighted. More than two counts of discarded fishing line were recorded for each 100m<sup>2</sup>.

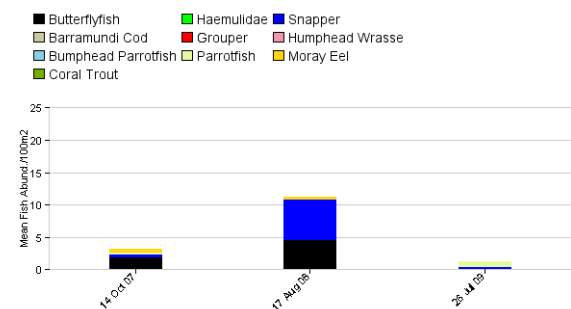


Figure 52: Mean abundance of fish at Gold Coast Seaway Reefs: South-West Wall: medium: Site 1: Artificial reef

Fish abundance has fluctuated over time, with a decrease in butterfly fish (>1/100m<sup>2</sup>) and snapper (>2/100m<sup>2</sup>) from the 2008 survey, both only recorded once on this survey. One sea horse was sighted (Photo W).

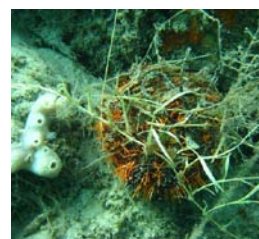


Photo V. Collector urchin



Photo W. Sea horse

## Narrowneck Artificial Reef, Site 1

This is an artificial reef only 300m offshore created from geotextile sand containers as a beach stabilization tool and surf break. The artificial reef averages about 5m in depth. Since its installation in the structure has reportedly grown numerous species of brown algae as well as hydroids, ascidians and crinoids (Edwards, 2003).

The site was not surveyed for substrate this year due to high surge, but visual surveys suggest that the majority of substrate consists of macro algae (including *Padina* and *Sargassum*) and ascidians. Also of note is that the material on the geotextile bags is becoming unattached in numerous locations (Photo X), creating loose substrate that is most free from growth, but also creating additional complexity in structure where many fish seemed to seek shelter. No indicator invertebrates or impacts were recorded during the survey.



Photo X. Detached textile material

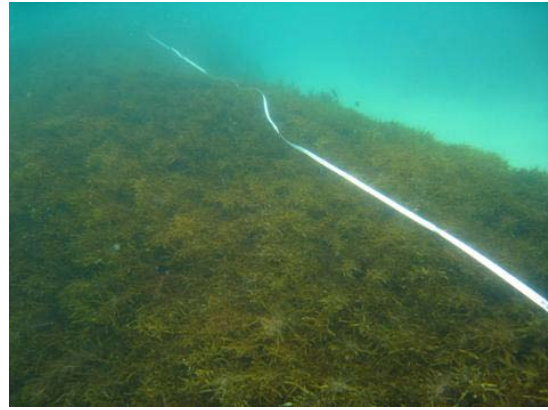


Photo Y. Algae covering sand container surface

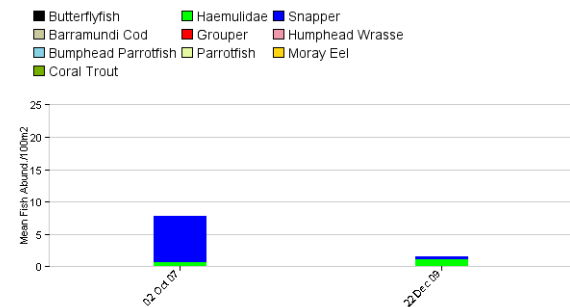


Figure 53: Mean abundance of fish at Narrowneck Reef: Narrowneck Artificial Reef: medium: Site 1: Artificial reef

The abundance of target fish species decreased from 2007, particularly snapper (1 sighted), although sweetlips were found in abundances of one per 100m<sup>2</sup> and numerous other non-target benthic fish species were sighted.



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