

2010

Reef Check Australia  
Great Barrier Reef  
Survey Season Summary



**REEF CHECK**  
**AUSTRALIA**



# REEF CHECK AUSTRALIA

## 2010 Survey Season Report

P. Markey and M-L Schäppy

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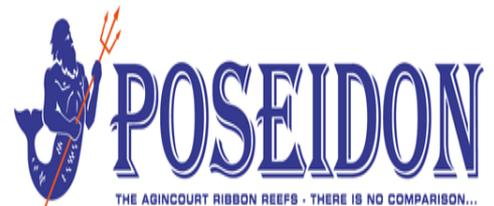


**Australian Government**

Great Barrier Reef  
Marine Park Authority



GREAT BARRIER REEF



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## A. Summary results

The Reef Check Australia (RCA) community volunteers led by our full-time project officer, Paul Markey, have surveyed 35 research sites, on 18 dive sites (Figure 1), including 11 reefs of the Great Barrier Reef. The percent coral cover on most sites surveyed by RCA, using the point intercept method (See [2008 Site Report](#)), has been either consistently increasing (21%) or fluctuating (55%) since the initial RCA surveys were carried out (Table 1). The percent coral cover of 17% of reefs surveyed have been largely stable. The minority of reefs surveyed (07%) in 2010 have declined in coral cover (Table 1). When the 2010 coral cover data was compared to the previous survey (of any year), at a particular site, 38% of sites showed an increase in coral cover while 24% decreased and 38% showed to be stable (Table 2a). When coral cover in 2010 was compared to the coral cover in 2009, 38% of the sites showed an increase in coral cover, 20% showed a decrease and 42% remained stable (Table 2b). In summary, percent coral cover on the dive sites surveyed by RCA has predominantly fluctuated or increased rather than remained stable or decreased. Coral bleaching and coral disease impacts were present on 40% and 51% of dive sites respectively and occurred in low numbers of incidences (Table 3).

During the course of the survey season two major coral damaging storms, Cyclones Olga and Ului, caused noticeable damage to reefs surveyed by RCA volunteers. Cyclone Ului impacted the Airlie Beach region crossing the coast on 21/03/2010. Cyclone Olga, which crossed the coast just north of Port Douglas on 24/01/2010, was exacerbated by the overlapping king tides causing damage to surrounding reefs.

- ▼ Agincourt Reef
  - ▶ Agincourt 3D (Pontoon)
  - ▶ Phil's Reef
  - ▶ Turtle Bay
- ▼ Hardy Reef
  - ▶ Hardy Reef
- ▼ Hastings Reef
  - ▶ North Hastings A
- ▼ Hayman Island Reef:
  - ▶ Blue Pearl Bay
- ▼ Knuckle Reef
  - ▶ Knuckle Reef,
- ▼ Low Isles Reef
  - ▶ Low Isles
- ▼ Moore Reef
  - ▶ Reef Magic Pontoon
  - ▶ Sunlover cruises pontoon
- ▼ Norman Reef
  - ▶ Norman Reef South
- ▼ Opal Reef
  - ▶ Bashful Bommie
  - ▶ SNO (South North Opal)
  - ▶ Split Bommie
  - ▶ The Wedge
  - ▶ Two Tone
- ▼ Saxon Reef
  - ▶ Saxon Reef
- ▼ Wheeler Reef
  - ▶ The Mooring

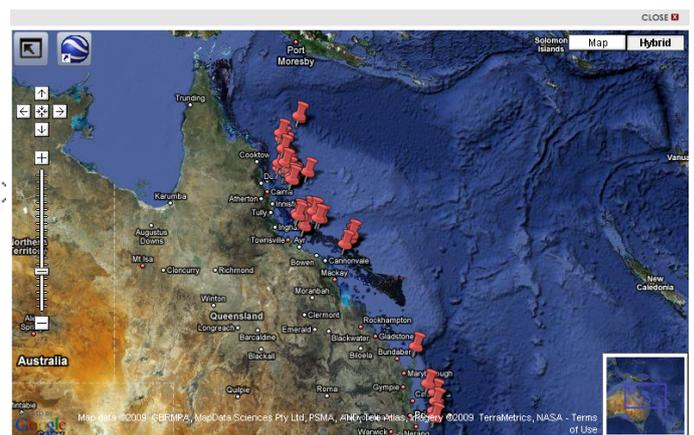


Figure 2: Map of RCA survey sites

Figure 1: List of surveyed dive sites with a map showing the location on the Australian coast (from RCA database)

Table 1: Coral cover through all survey years at sites surveyed more than once

Coral cover through time:	% surveys
Increased	21
Fluctuated	55
Remained stable	17
Decreased	07

Table 2: Comparison of coral cover between a) any previous surveys b) only the sites surveyed in 2009

Coral cover	a) % last survey-2010	b) % 2009-2010
Increased	38	38
Remained stable	38	42
Decreased	24	20

Impacts recorded in 2010 in the belt survey (2.5m either side of the transect line) included Crown-of-thorns starfish (COTS), coral disease, bleaching and *Drupella* sp. snails (Table 3).

Table 3: Percentage of sites where impacts were recorded in 2010

Impacts 2010	% of dive sites
COTS	.03
Coral Disease	51
Bleaching (line transect)	40
<i>Drupella</i> sp. snails	20

## B. Dive sites where coral cover increased

### Hardy Reef, site 2

Hard coral cover at Hardy reef site 2 has increased from our initial survey in 2009 (Figure 3a). Increased amounts of recently killed coral and rubble could be attributed to Cyclone Ului. The dominant hard coral lifeforms were mainly branching and encrusting. Both recently killed coral and rock substrates were mainly covered in turf algae. Invertebrate sightings included banded coral shrimp and high numbers of *Trochus* sp. snails (Figure 3b).

This dive location is a reef wall site with steep walls and overhangs and areas of shallower slopes. A moderate northerly current along the wall towards Reef World 1 frequently occurs at this site.

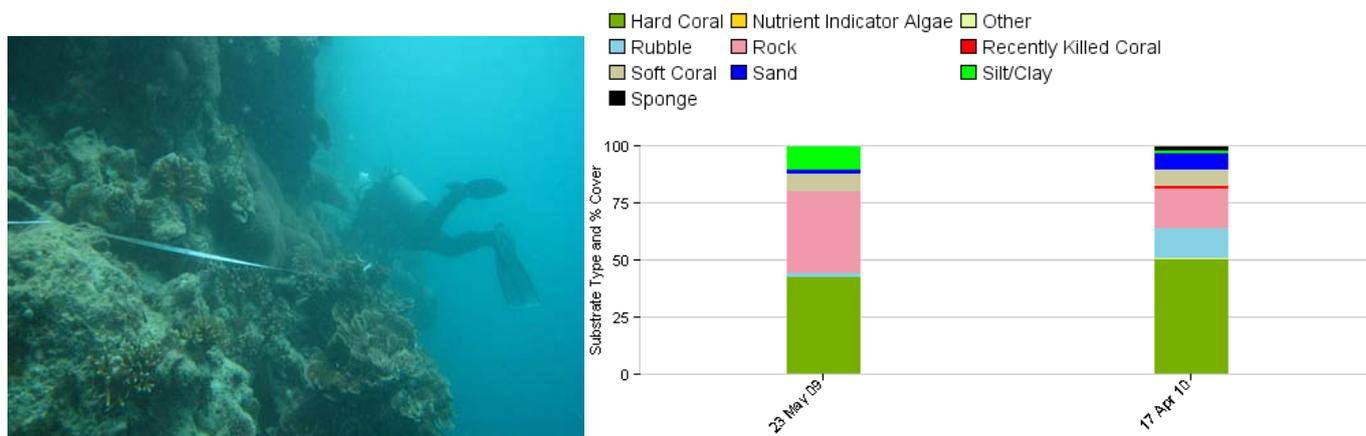


Figure 3a: Substrate type and percent cover at Hardy Reef: Hardy Reef: shallow: Site 2: Back reef wall

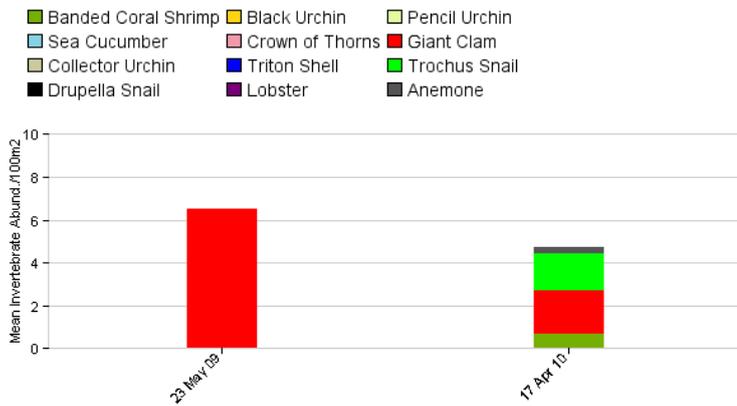


Figure 3b: Mean abundance of invertebrates at Hardy Reef: Hardy Reef: shallow: Site 2: Back reef wall

### Hastings Reef, North Hastings A, site 1 (Lagoon)

Hard coral cover in the lagoon shows a slight increase between our 2009 and 2010 surveys, and stable levels of nutrient indicator algae (NIA) and soft coral (Figure 4). Over 80% of hard coral cover was branching with marginal amounts of other lifeforms. Impacts included low levels of hard coral bleaching and levels of other coral damage, an impact category, similar to the previous year's data. Surveyors recorded a rare sighting of a bleached anemone with two spine-cheek anemone fish inhabitants.

This shallow sandy lagoon at North Hastings is dominated by massive boulder corals and is surrounded by sloping reefs. There are dense colonies of *Acropora* sp. throughout the area and several large giant clams. Surveyors remarked that the visibility was considerably better inside the protected lagoon.

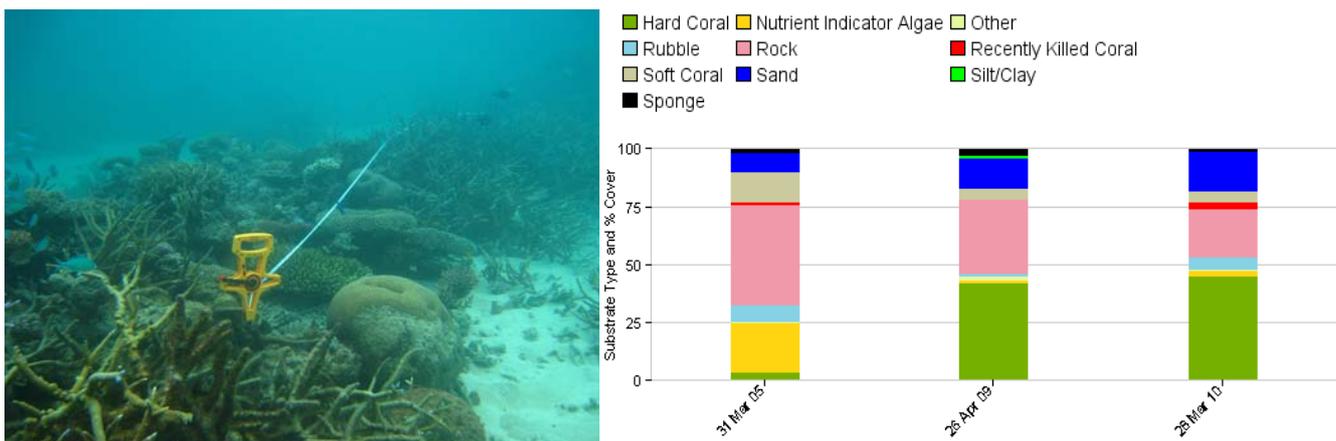


Figure 4: Substrate type and percent cover at Hastings Reef: North Hastings A: shallow: Site 1: Lagoon

### Moore Reef, Reef Magic Pontoon, site 1, medium

Hard coral cover has increased 10% after two years of remaining largely stable (Figure 5). Soft coral cover has also increased since our last survey and looks similar to 2005's data. Sponges and other substrate, mainly sea whips and gorgonians, are recorded in low levels at this wall-like site. Incidences of coral disease and other coral damage were recorded in 2010; these impacts were not described in previous years.

Site 1 at Reef Magic Pontoon was characterised by a sloping wall site which quickly dropped off to a sandy bottom around 16 metres. The transect start was easily identifiable as marked by a group of soft coral sea whips. Surveyors observed much diversity in sponges, soft corals, and gorgonians growing along the wall and a magnificent anemone near the beginning of transect 1.

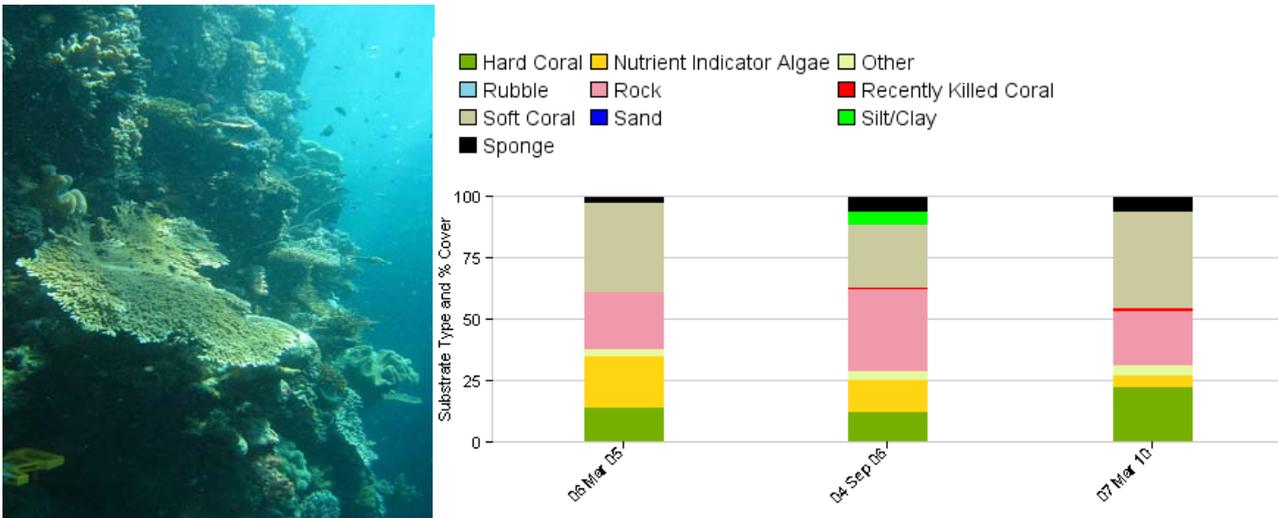


Figure 5: Substrate type and percent cover at Moore Reef: Moore Reef: medium: Site 1: Back reef slope

### Moore Reef, Reef Magic Pontoon, site 2, medium

Hard and soft coral cover increased since our first survey of site 2 on Moore reef in 2009 (Figure 6). Site 2 showed mainly branching and encrusting hard corals with even levels of other lifeforms. A decrease in leathery soft corals resulted in mainly non-leathery types for 2010. The 2010 surveyors recorded lower amounts of other coral damage than the previous year and less coral bleaching.

Also known as “Big Bommie” RCA’s medium wall site at Reef Magic Pontoon follows the dramatic drop-off of the north wall. Astounding coral cover and high visibility made this site a favourite among surveyors. A grey reef shark was observed patrolling the wall half way through the survey.

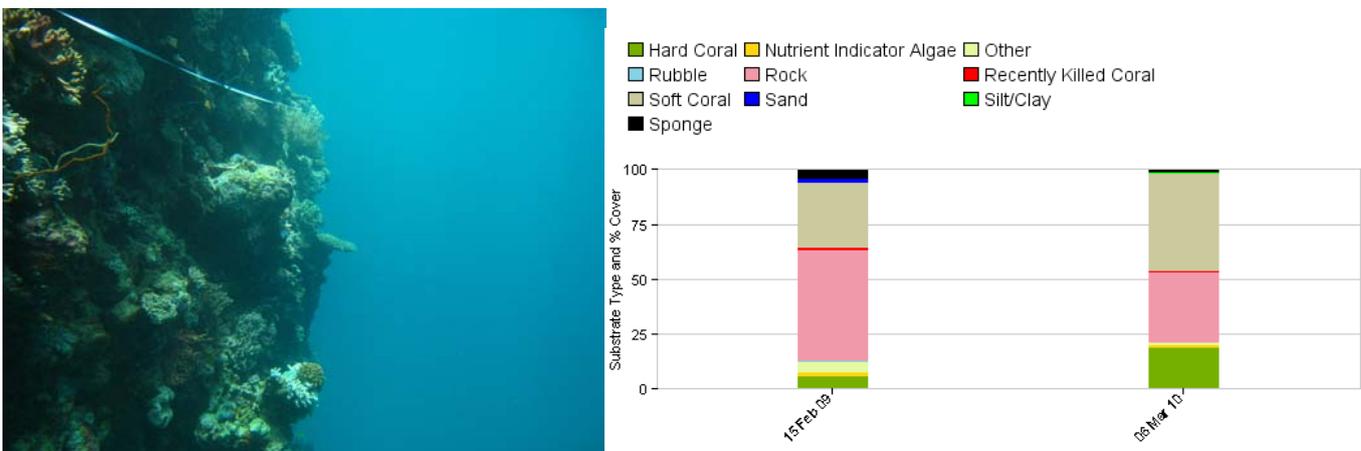


Figure 6: Substrate type and percent cover at Moore Reef: Moore Reef: medium: Site 2: Back reef slope

### Norman Reef South, site 1

Hard coral cover at Norman Reef South has increased 20% from our initial survey in 2006 (Figure 7a). Levels of rock decreased compared to the 2008 survey. While fine differences in transect re-deployment may be the cause of this difference, it is also possible that the bare substrate has been colonized by new coral growth. Hard corals show great diversity and near even distribution of each lifeform (Figure 7b). 2010 invertebrate report showed a decrease in *Drupella* sp. snails and increased numbers of giant clams in addition to 2 *Trochus* sp. snails. Fish surveyors recorded high numbers of parrotfish and butterflyfish as well as a few coral trout and snapper (Figure 7c).

Norman Reef South is a picturesque site marked by an ancient *Porites* sp. Bommie, or outcrop of rock and coral, rising from 12 to 15 metres. Site 1 has a high diversity of corals (Figure 7b) with some plates as big as 2m across. Surveyors reported seeing 2 whitetip reef sharks and a giant trevally.

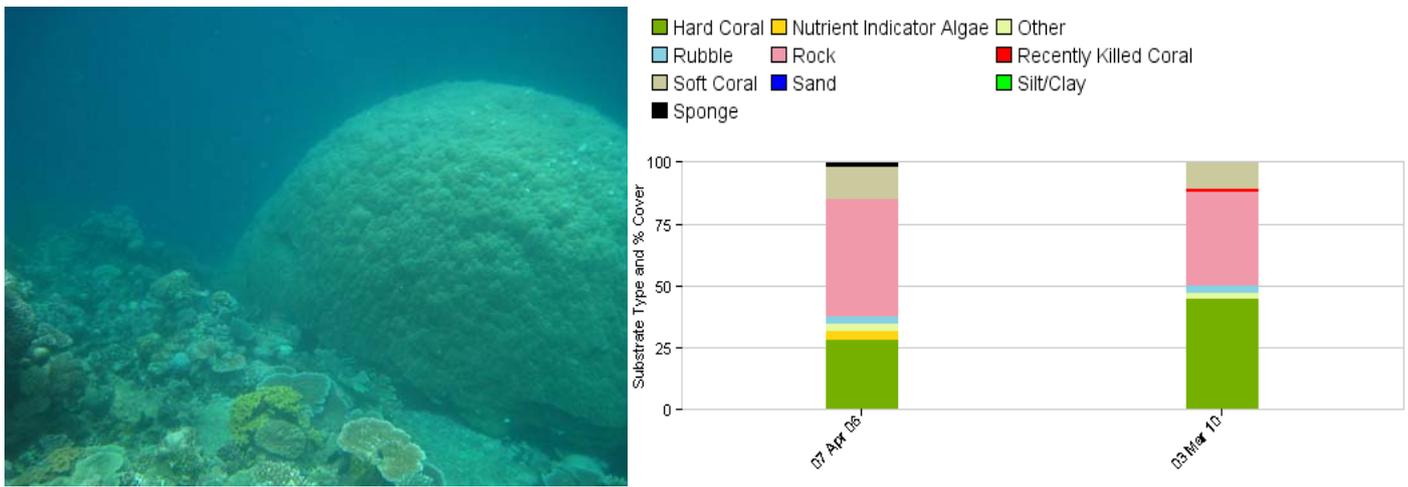


Figure 7a: Substrate type and percent cover at Norman Reef: Norman Reef South: shallow: Site 1: Back reef slope

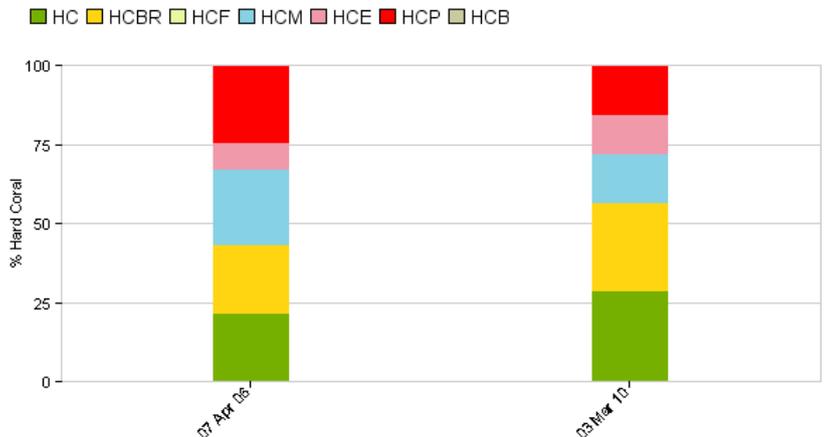


Figure 7b: Hard coral lifeforms and percent cover at Norman Reef: Norman Reef South: shallow: Site 1: Back reef slope

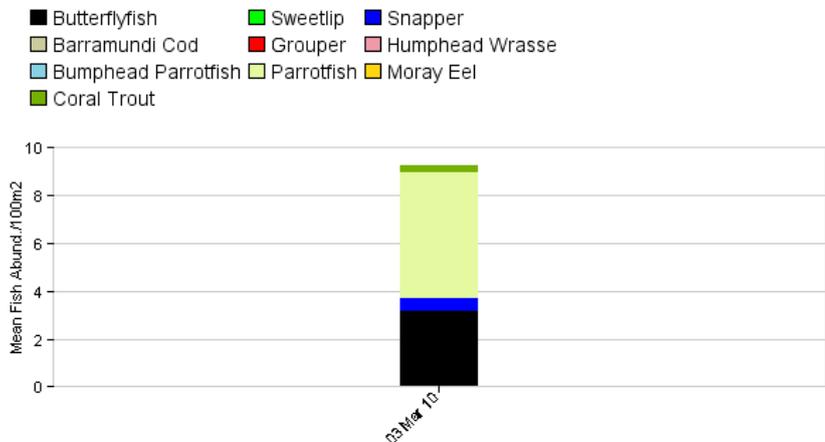


Figure 7c: Mean abundance of fish at Norman Reef: Norman Reef South: shallow: Site 1: Back reef slope

### Saxon Reef, site 2

Coral cover has steadily increased throughout our data set and appears to have stabilized at 40% (Table 8a). Coral growth forms show high diversity with a majority of branching and massive lifeforms. Turf algae have been the dominant algae type throughout this site's study and a small percentage of recently killed coral was recorded in 2010. The impacts show that other coral damage declined from 2009 to 2010 as well as fewer coral disease incidences (Table 8b).

Site 2 at Saxon Reef is a shallow sloping reef with several large *Porites* sp. bommies amid branching hard corals and leathery soft corals. Surveyors spotted a hawksbill turtle happily eating algae off rocky substrate and possibly adding "unknown scars" to our survey data.

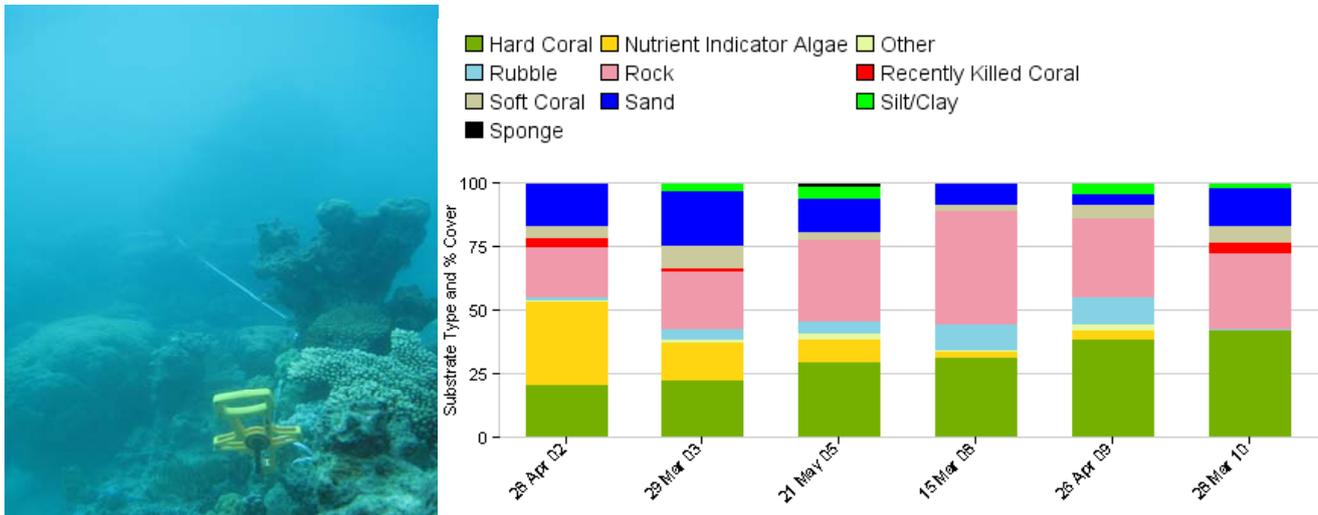


Figure 8a: Substrate type and percent cover at Saxon Reef: Saxon Reef: shallow: Site 2: Back reef slope

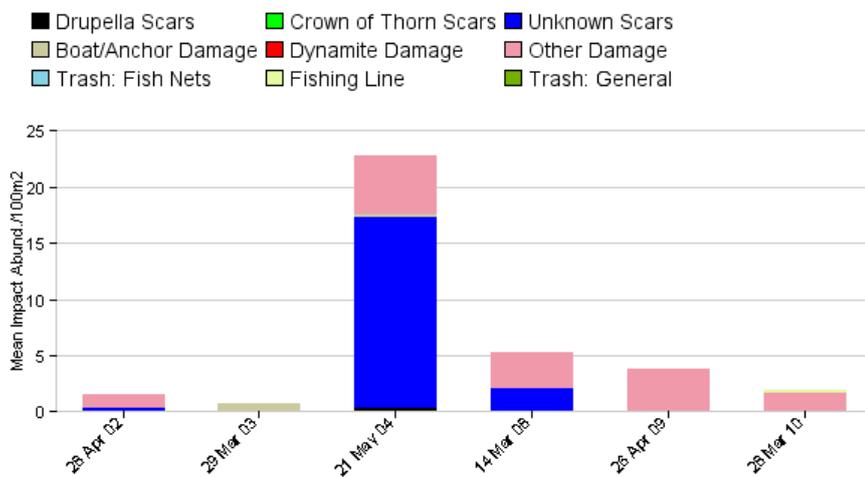


Figure 8b: Mean abundance of impacts at Saxon Reef: Saxon Reef: shallow: Site 2: Back reef slope

## C. Dive sites where coral cover decreased

### *Agincourt Reef, Turtle Bay*

The coral cover at Turtle Bay has decreased since our initial survey in 2009 (Figure 9a). Decreased coral cover and increased sand substrate could be due to the transect being laid over more sand patches in 2010. High amounts of nutrient indicator algae were also present in 2010's data. Turtle bay is dominated by branching hard corals with massive being the second most abundant formation. Some other coral damage was reported this year whereas none was recorded previously. The level of coral bleaching has decreased from the previous year. The fish report shows mainly butterflyfish with sightings of parrotfish, humphead wrasse, and snapper (Figure 9b).

This shallow reef site falls upon many patches of bommies and corals with a sandy bottom. The presence of gullies and reef outcrops made the re-deployment of the transect tape in the same place as last year difficult and some variation in the coral cover data is to be expected.

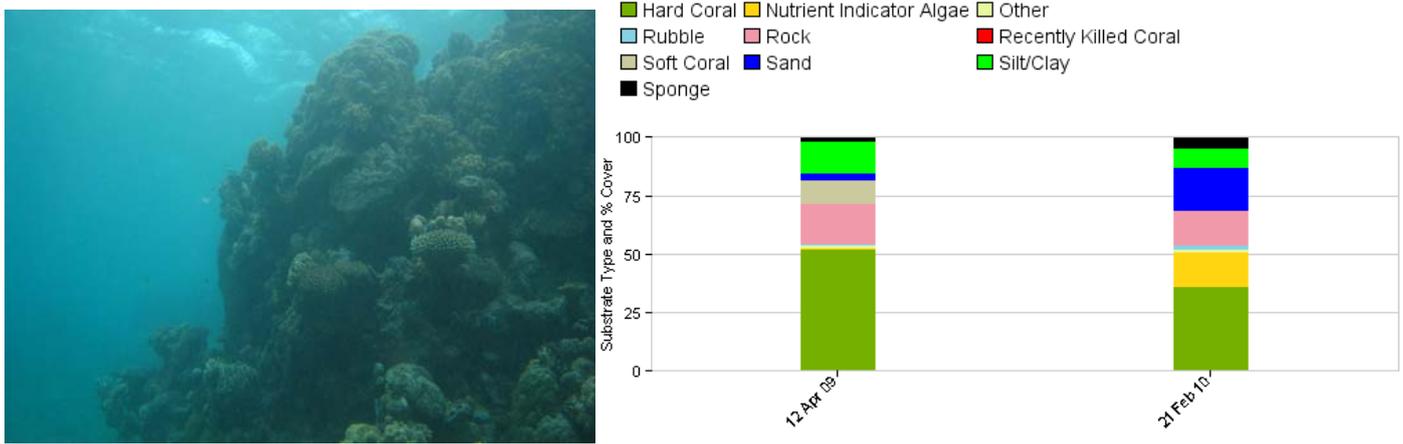


Figure 9a: Substrate type and percent cover at Agincourt Reef: Turtle Bay: shallow: Site 1: Back reef wall

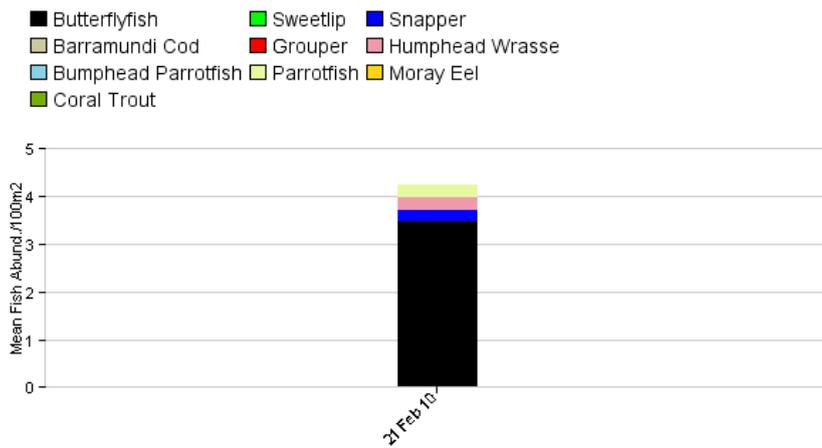


Figure 9b: Mean density of fish at Agincourt Reef: Turtle Bay: shallow: Site 1: Back reef wall

### Opal Reef, Split Bommie

The trend of decreasing coral cover and increasing rock substratum continues into 2010's data (Figure 10). The substrate survey also shows an increasing amount of sponge, 95% of which is encrusting. The only impacts recorded in 2010 were a small amount of bleaching. The surveyors reported "a large patch of dead bushy *Acropora* sp. in the saddle connecting the two bommies."

Split bommie, on Opal reef, is formed by two giant coral towers rising from 18 metres to the surface; large enough that two 100 metre transects could be laid around each tower. RCA's shallow transect at split bommie follows the gradual slope near the top of the bommie. Surveyors described split bommie as a stunning site and remarked on several types of nudibranchs observed during the survey.

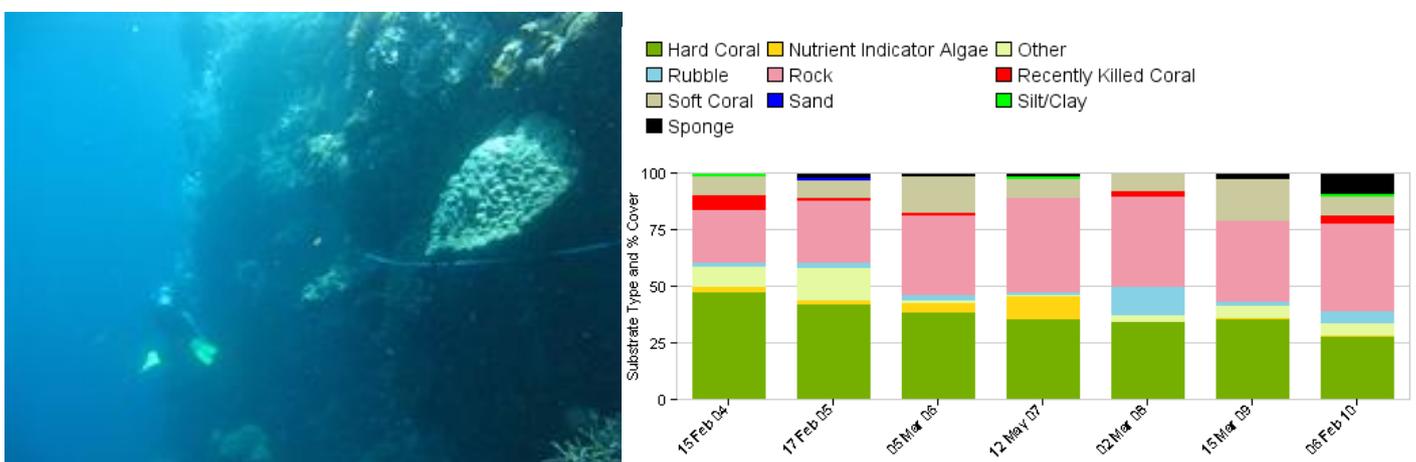


Figure 10: Substrate type and percent cover at Opal Reef: Split Bommie: shallow: Site 1: Back reef wall

## D. Dive sites where coral cover fluctuated

### *Agincourt Reef, Agincourt 3D Pontoon, site 1*

The overall trend shows hard coral cover fluctuating, although an increase can be observed in data collected in 2009 and 2010 (Figure 11a). Nutrient indicator algae are marginal and no recently killed corals were observed in 2010. Impacts in the form of coral bleaching and other coral damage decreased from the previous year's data (Figure 11b).

This dive site is characterised by a gentle slope from the reef flat, dispersed bommies scattered on the sand, and offering a diversified seascape.

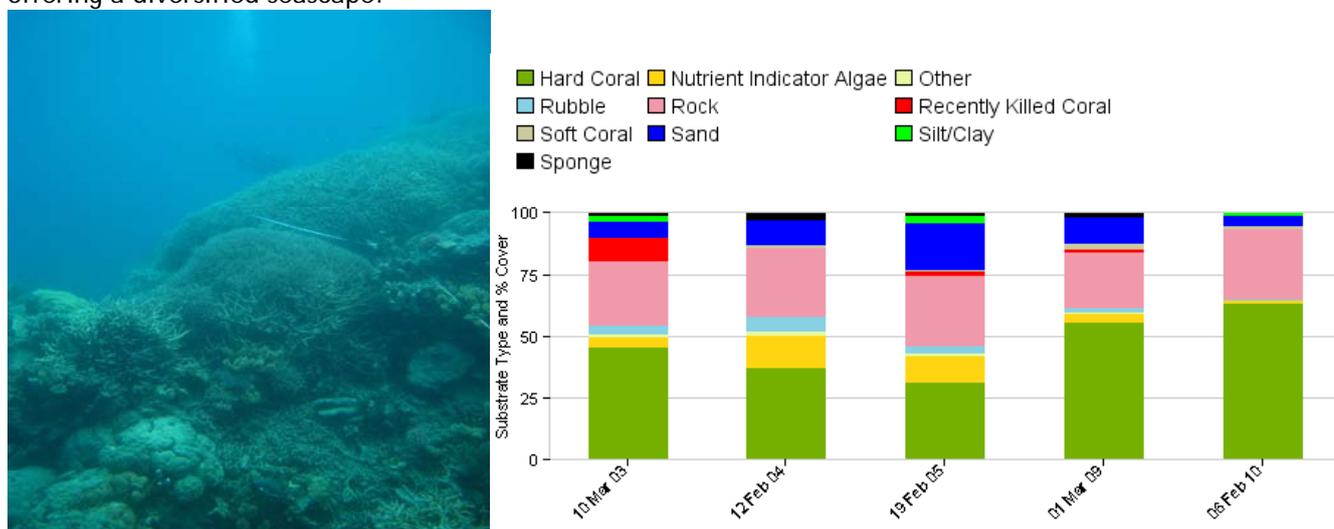


Figure 11a: Substrate type and percent cover at Agincourt Reef: Agincourt 3D (Pontoon): shallow: Site 1: Back reef slope

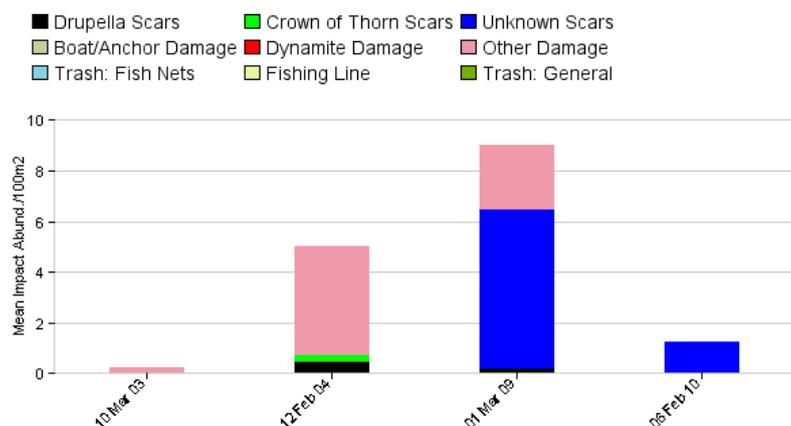


Figure 11b: Mean abundance of impacts at Agincourt Reef: Agincourt 3D (Pontoon): shallow: Site 1: Back reef slope

### *Agincourt Reef, Agincourt 3D Pontoon, site 2*

Nutrient indicator algae increased from 2009 to 2010 showing similar trend as in 2005. This could be due to seasonal algae blooms (Figure 12a). The coral cover declined from 2009 to 2010 with an increase in nutrient indicator algae over this period. Hard coral lifeforms were predominantly branching throughout our four year data set. The dominant algae type remains turf algae with some bare rock substrate recorded. Giant clams were the most common invertebrate, with stable numbers from 2004 to 2010 (Figure 12b). Impacts in 2010 include other damage and unknown scars; records show a substantial decrease in damage from the previous year's data (Figure 12c).

This site was characterised by a varied seascape on a gentle slope from the reef flat. Several small bays were encountered while laying the transect tape but the habitat remained the same and the transect tape could be laid without interruption.

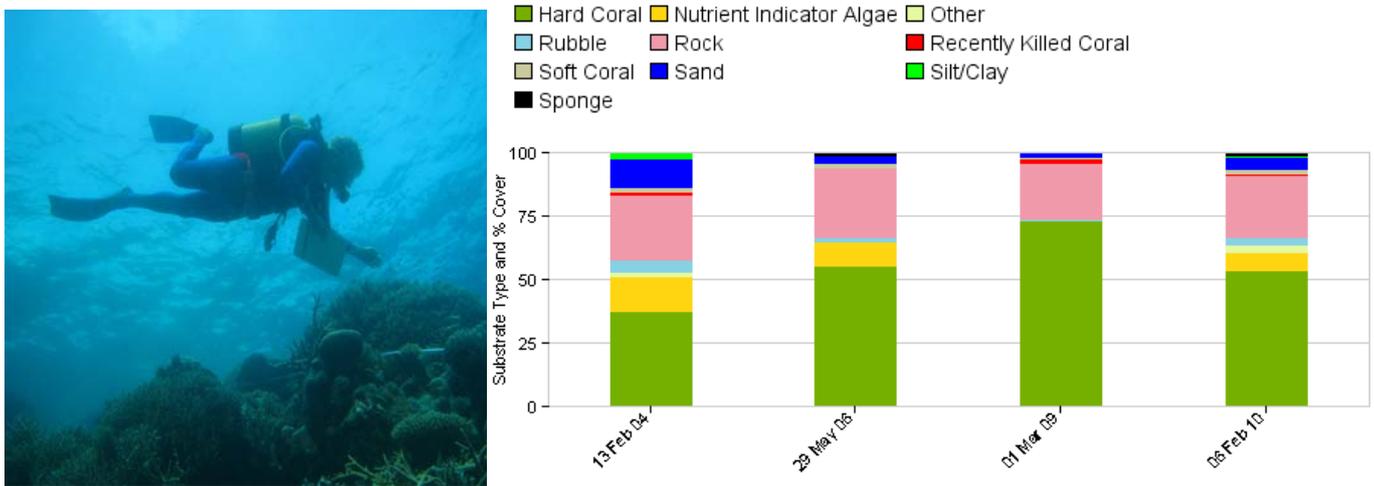


Figure 12a: Substrate type and percent cover at Agincourt Reef: Agincourt 3D (Pontoon): shallow: Site 2: Back reef slope

NOTE: Individual clam size distributions may not be recorded.

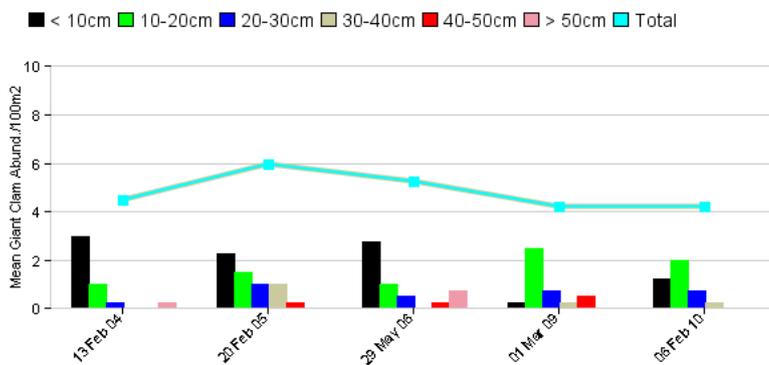


Figure 12b: Mean abundance of giant clam size classes at Agincourt Reef: Agincourt 3D (Pontoon): shallow: Site 2: Back reef slope

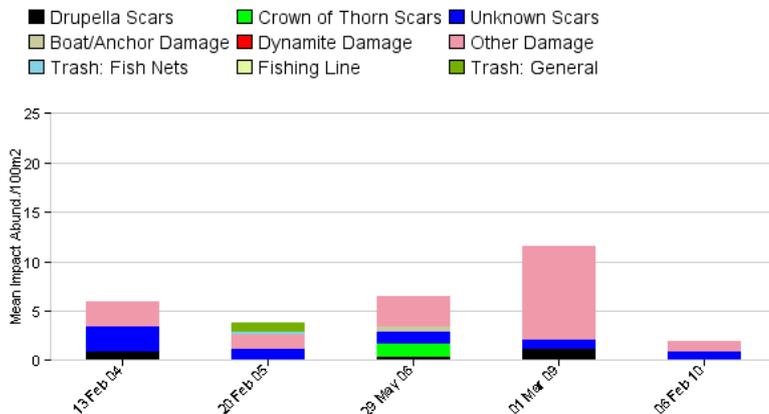


Figure 12c: Mean abundance of impacts at Agincourt Reef: Agincourt 3D (Pontoon): shallow: Site 2: Back reef slope

## Agincourt Reef, Phil's

Coral cover increased from 2003 to 2009, but has shown a substantial decrease in 2010 (Figure 13a). Hard coral cover and nutrient indicator algae amounts in 2010 are similar to 2003's data, and could be the result of a seasonal algae bloom. Surveyors described the site as "healthy with a high percentage of coral cover." "Nutrient indicator algae are present in massive expanses at the base of bushy *Acropora* sp.," which could explain the resulting high NIA levels. Surveyors reported a decrease in other damage from 2009 to 2010 and low levels of bleaching. Fish data shows mainly butterflyfish with fewer numbers of snapper and parrotfish (Figure 13b).

Phil's Reef is marked by high coral cover composed of expansive fields of bushy *Acropora* sp. surrounding large coral bommies. Three juvenile whitetip reef sharks were found resting under a plate coral ledge between transects 2 and 3.

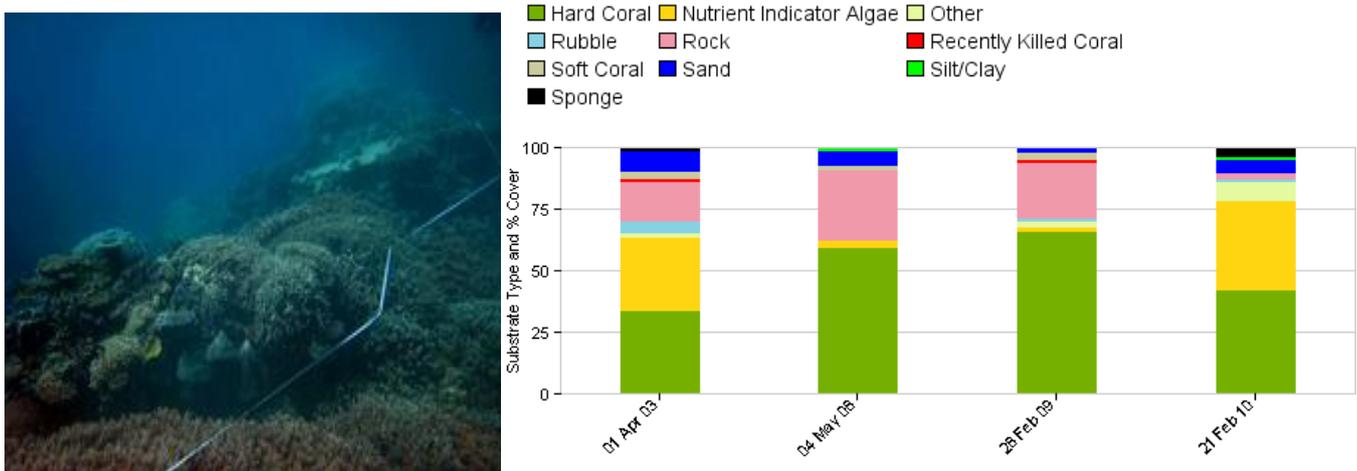


Figure 13a: Substrate type and percent cover at Agincourt Reef: Phil's Reef: shallow: Site 1: Back reef slope

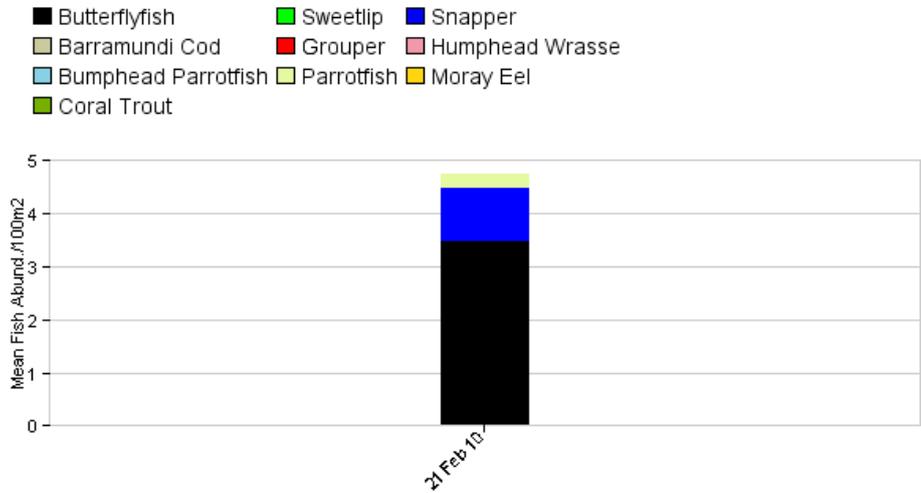


Figure 13b: Mean abundance of fish at Agincourt Reef: Phil's Reef: shallow: Site 1: Back reef slope

**Hayman Island Reef, Blue Pearl Bay, site 1**

The coral cover at Blue Pearl Bay has fluctuated above and below 60% mark in the last 9 years of data (Figure 14a). Surveyors reported considerable damage from recent Cyclone Ului which could account for a decrease in hard coral cover and increased amounts of rubble in 2010. A high level of siltation and some recently killed corals were recorded and were most likely the result of the cyclone. The impact report shows high levels of other damage for 2010 (Figure 14b).

Blue Pearl Bay of Hayman Island is a shallow fringing reef with many fire corals and leathery soft corals among massive *Porites* sp. colonies. The surveyors remarked on the abundance of snapper and fusiliers which were very tame and inquisitive. It is possible that the fish associated the surveyors with the possibility of obtaining food. Cyclone Ului damage was more evident in Blue Pearl Bay than other sites in the Airlie Beach region.

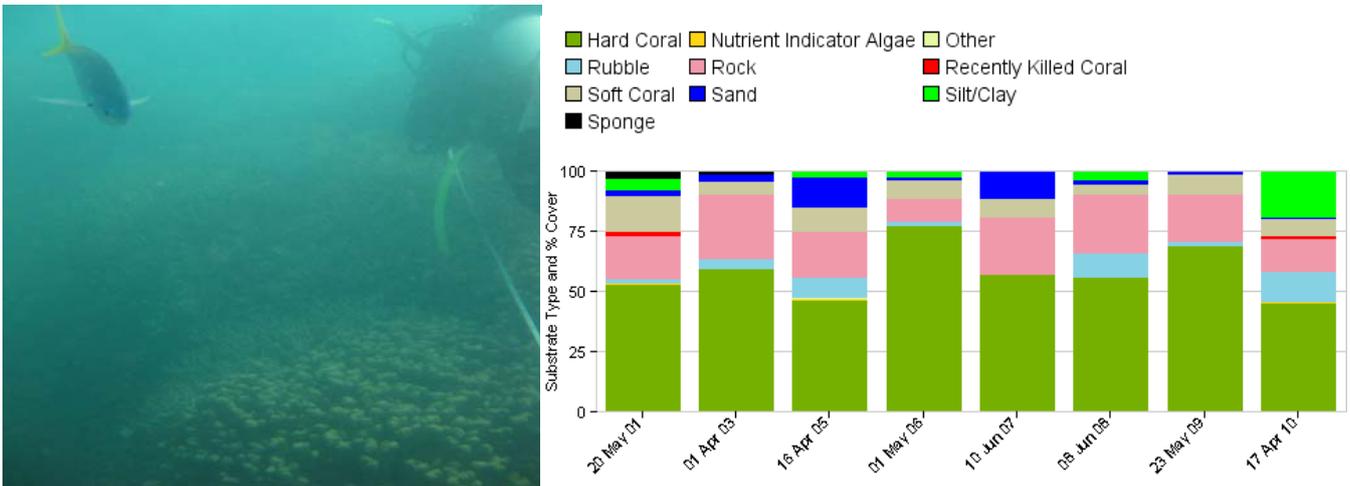


Figure 14a: Substrate type and percent cover at Hayman Island Reefs: Blue Pearl Bay: shallow: Site 1: Fringing reef leeward

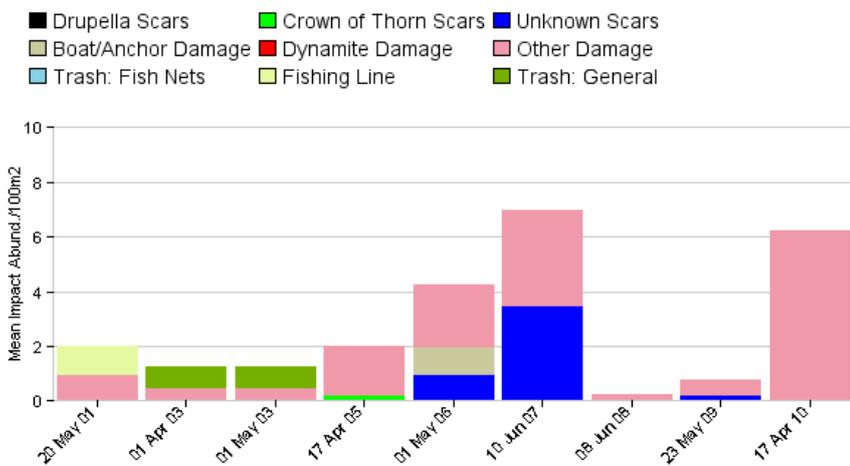


Figure 14b: Mean abundance of impacts at Hayman Island Reefs: Blue Pearl Bay: shallow: Site 1: Fringing reef leeward

### Hayman Island Reef, Blue Pearl Bay, site 3

The coral cover at Blue Pearl Bay site 3 has fluctuated since 2003 (Figure 15a). Surveyors reported damage from Cyclone Ului which could explain a decrease in hard coral cover and increased amounts of rubble and silt for 2010. A high level of other damage could also be attributed to the aftermath of Ului (Figure 15b).

Site 3 of Blue Pearl Bay is on the South side of the small shipping channel and appeared to be more sheltered from recent Cyclone Ului as less damage was observed. Shallow rocky reef substrate of this site gives way to deeper trenches and pinnacles as you move south along the transect.

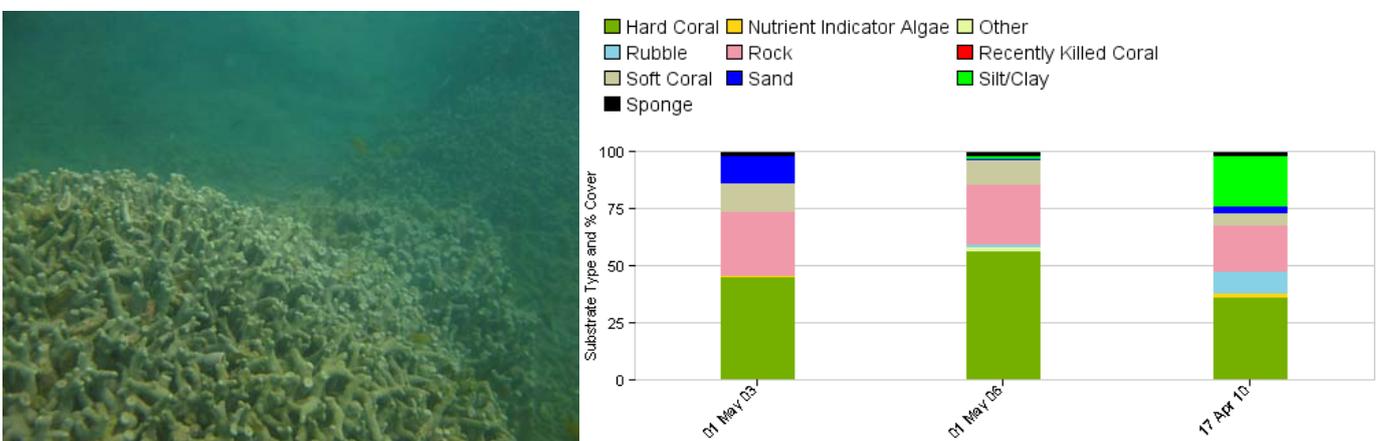


Figure 15a: Substrate type and percent cover at Hayman Island Reefs: Blue Pearl Bay: shallow: Site 3: Fringing reef leeward

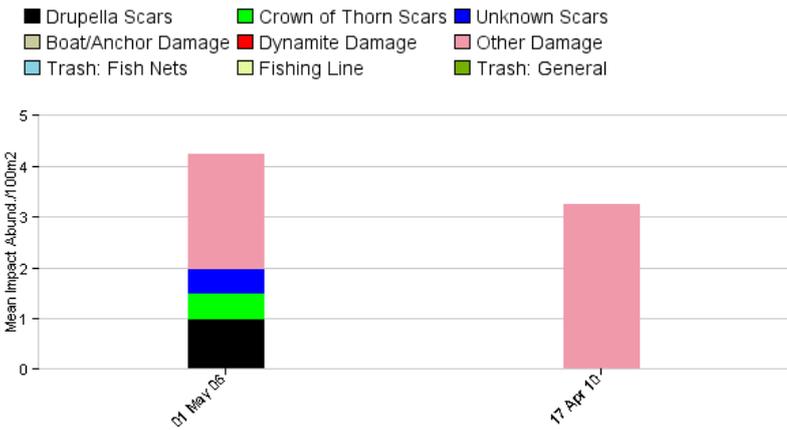


Figure 15b: Mean abundance of impacts at Hayman Island Reefs: Blue Pearl Bay: shallow: Site 3: Fringing reef leeward

### Hardy Reef, site 1

Hard coral cover at Hardy Reef site 1 has fluctuated above and below 40% throughout our eight year study (Figure 16a). The data collected in 2010 shows hard coral has increased steadily since 2008. An increase in recently killed coral could be attributed to weather damage from the recent Cyclone Ului. Hard corals are predominately branching and rock surfaces are mainly covered in turf algae. Other coral damage has increased from previous years' data (Figure 16b).

Hardy Reef site 1 is a reef wall with a number of overhangs interspersed with shallower slopes. Staghorn *Acropora* sp. species dominate the site, while giant clams (a couple almost 1m long) were the most abundant invertebrate. Large fish species, including sweetlips and groupers, were abundant. The only obvious evidence of Cyclone Ului was a large *Turbinaria* sp. coral colony overturned.

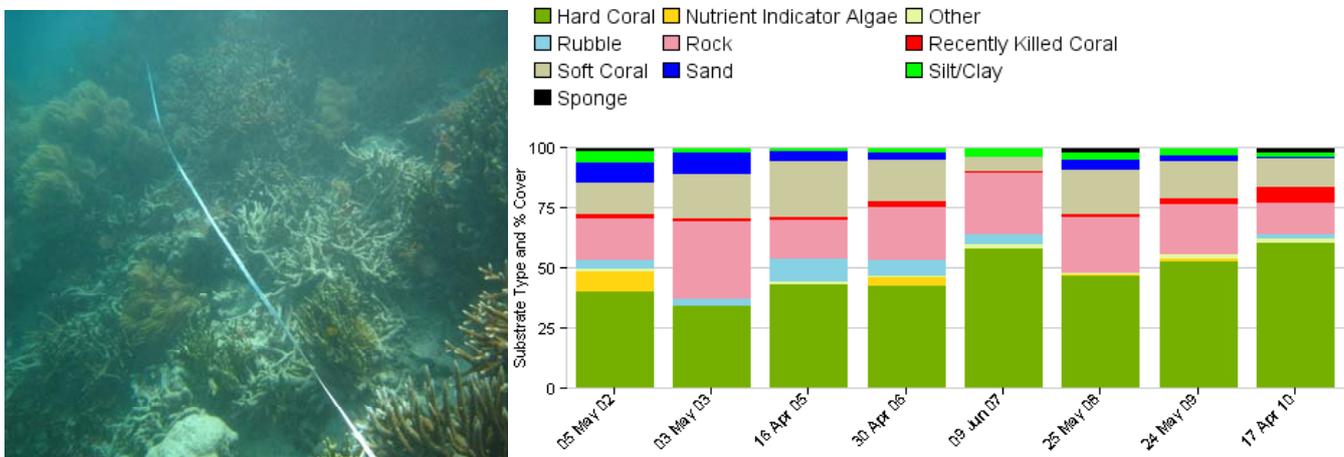


Figure 16a: Substrate type and percent cover at Hardy Reef: Hardy Reef: shallow: Site 1: Back reef wall

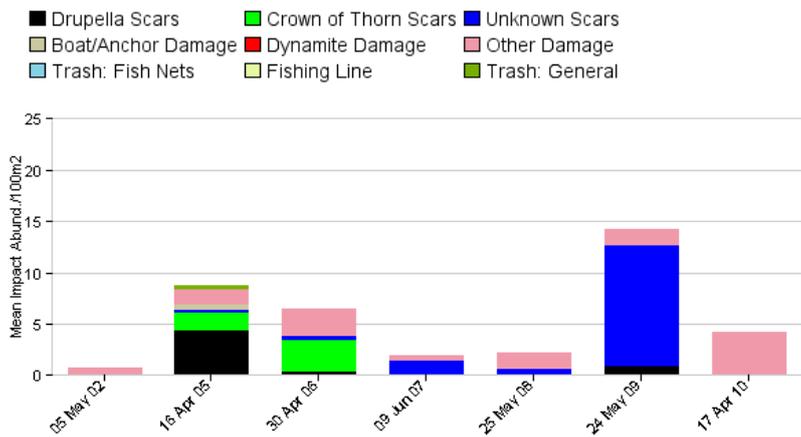


Figure 16b: Mean abundance of impacts at Hardy Reef: Hardy Reef: shallow: Site 1: Back reef wall

### Knuckle Reef, site 2 (North Bommie)

Hard coral cover has fluctuated above (2009) and below (2010) our initial recording of 25% for Knuckle Reef site 2 (Figure 17). Soft coral cover was mostly leathery with some colonies showing signs of bleaching. The site was described by coral reef surveyors as being patchy in its coral cover with many small, young colonies seen. Rock substrate accounted for the highest percent cover in 2006 and 2010, the majority of which was covered in turf algae. The increased amount of recently killed coral in 2010 may be attributed to the recent damage of Cyclone Ului.

Knuckle Reef's "North Bommie" lies just north of the pontoon and is large enough to lay two 100 metre tapes around it. Many colorful soft corals and sponges cover the slope of the bommie. Surveyors reported schooling bannerfish and sweetlips on the back side of North Bommie.

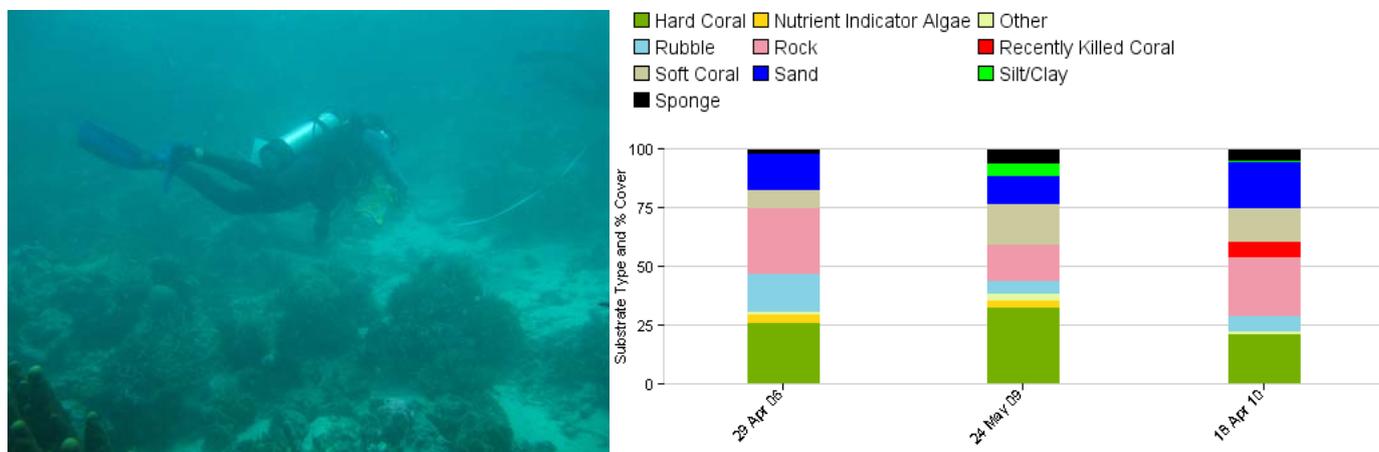


Figure 17: Substrate type and percent cover at Knuckle Reef: Knuckle Reef: shallow: Site 2: Back reef slope

### Low Isles Reef, site 1

Hard coral cover continues to fluctuate over our 8 year study of Low Isles site 1 (Figure 18a) and was dominated by massive forms. Soft coral is the most abundant substrate type which has been largely stable around 70% for the last four surveys. The soft coral remains predominantly soft coral leathery although there has been a decrease in amount from 2009 to 2010 (Figure 18b). A decrease in giant clam abundance and an absence of *Drupella* sp. snails occurred since the previous year's surveys. A substantial increase in other coral damage could be attributed to Cyclone Olga which combined with the king tides occurring end of January 2010 causing damage to shallow reefs (Figure 18c).

This site is a popular relaxing destination for the inhabitants of Port Douglas and the reefs are often visited by snorkelers. The reef around the island is shallow and fringing, largely dominated by leathery soft corals.

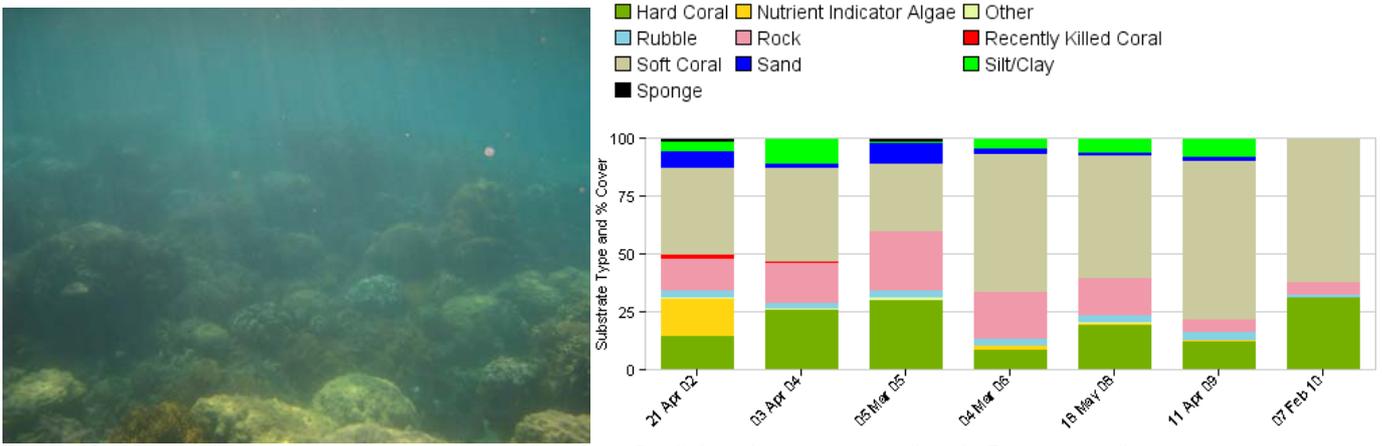


Figure 18a: Substrate type and percent cover at Low Isles Reef: Low Isles: shallow: Site 1: Fringing reef leeward

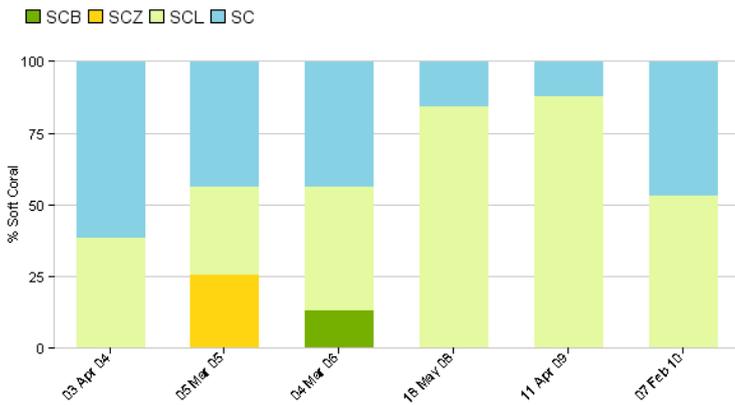


Figure 18b: Soft coral type and percent cover at Low Isles Reef: Low Isles: shallow: Site 1: Fringing reef leeward

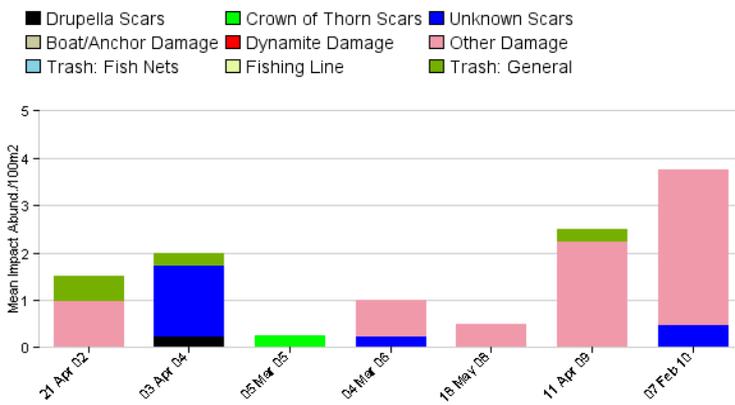


Figure 18c: Mean abundance of impacts at Low Isles Reef: Low Isles: shallow: Site 1: Fringing reef leeward

## Low Isles Reef, site 2

Hard coral cover fluctuated between 15% and 45% from 2004 to 2010 at this site (Figure 19a). Soft coral cover and silt/clay have both decreased in 2010's data resulting in a higher level of bare rock substrate. Low levels of silt and sand could also be the result of recent storm activity which may have moved sand/silt substrate uncovering bare rock. Low Isles site 2 experienced the same increase in other coral damage as seen at site 1 in 2010 further suggesting large scale weather damage (Figure 19b).

This site is a gentle slope from the coral reef flat fringing Woody Island. A substantial number of hard coral colonies were found overturned and bleached showing clear impact of Cyclone Olga.

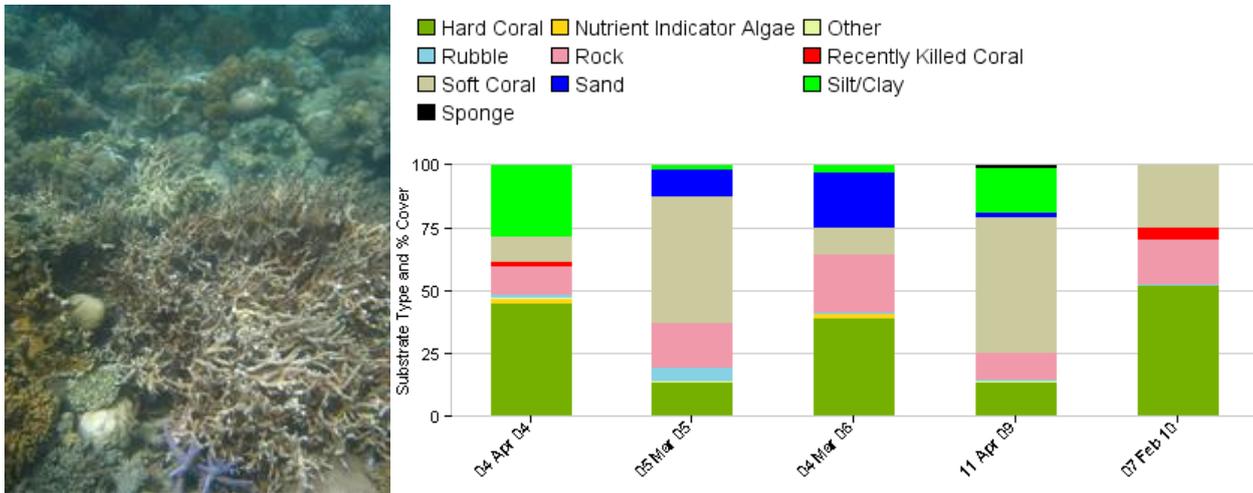


Figure 19a: Substrate type and percent cover at Low Isles Reef: Low Isles: shallow: Site 2: Fringing reef leeward

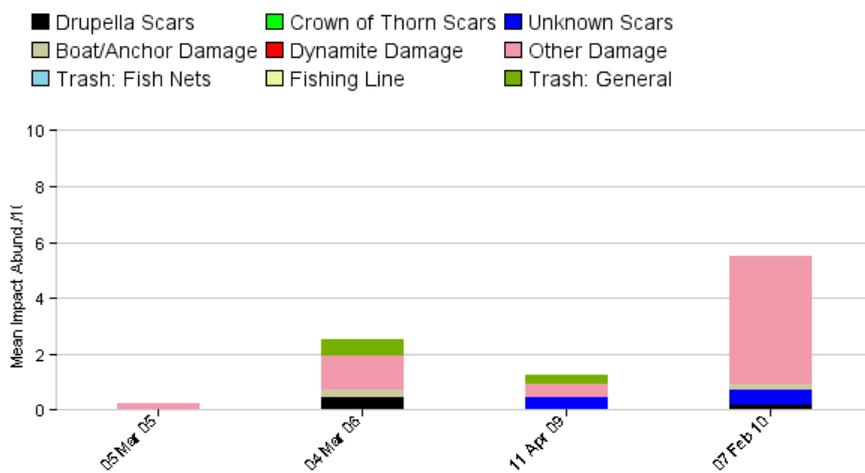


Figure 19b: Mean abundance of impacts at Low Isles Reef: Low Isles: shallow: Site 2: Fringing reef leeward

### Moore Reef, Reef Magic Pontoon, site 1, shallow

Hard coral cover has fluctuated around 40 % since the beginning of our site study in 2005, but 2010 shows a 10% increase (Figure 20). Site 1 is dominated by branching *Acropora formosa* hard corals. Rock substrate showed even levels of bare, covered in turf algae, and covered in coralline algae. The 2010 surveyors recorded one *Trochus* sp. snail and one COTS, a decrease from last year's numbers. The presence of COTS two years in a row at this site is an interesting finding which should be closely monitored. A decrease in unknown scars from 2009 to 2010 could be attributed to fewer COTS.

This site was described by surveyors as a shallow field of corals, mainly *Acropora formosa*, overgrowing the old pontoon mooring chain. The start of the transect is marked by a large *Porites* sp. bommie that rises to the surface.

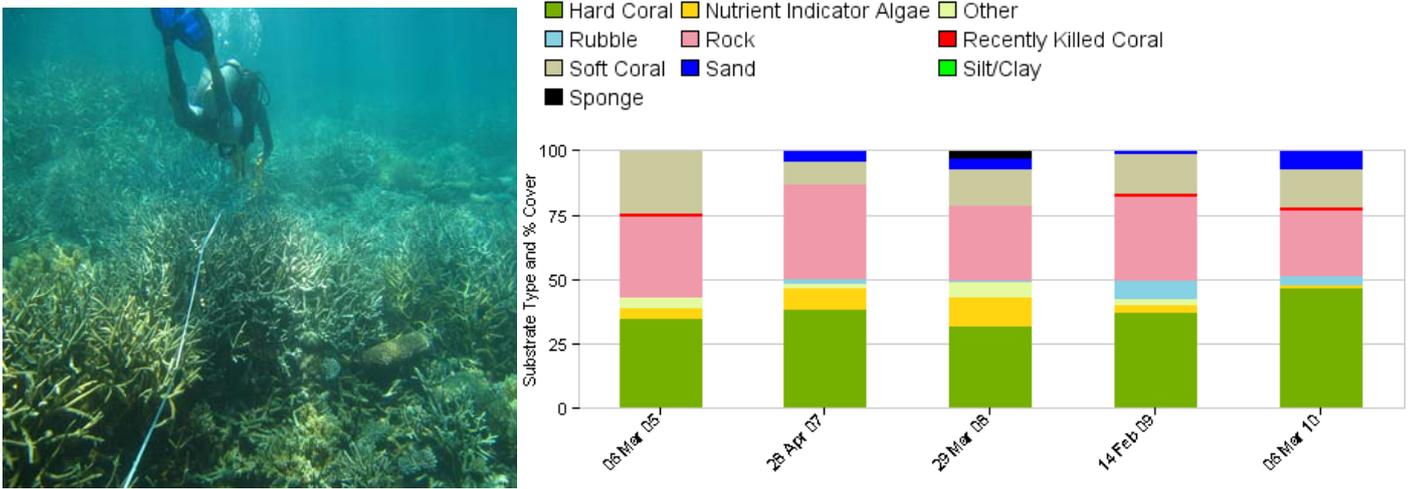


Figure 20: Substrate type and percent cover at Moore Reef: Moore Reef: shallow: Site 1: Back reef slope

### Opal Reef, Bashful Bommie, site 1, shallow

The hard coral cover has fluctuated throughout the long scale study of this site, but seems to be largely stable at 30% if viewing data since 2007 (Figure 21a). Hard corals were predominantly massive and soft corals were predominantly leathery. Greater than 90% of all rock surfaces recorded were covered in turf algae which is consistent with all other years data (Figure 21b). The 2010 invertebrate report showed an increase in giant clam numbers as well as a lobster, a rare occurrence and the first recorded for this site.

This site consists of patches of reef with massive *Porites* sp. bommies scattered across a sandy slope. A large moray eel was spotted by one surveyor as it swam from its hiding place along the transect.

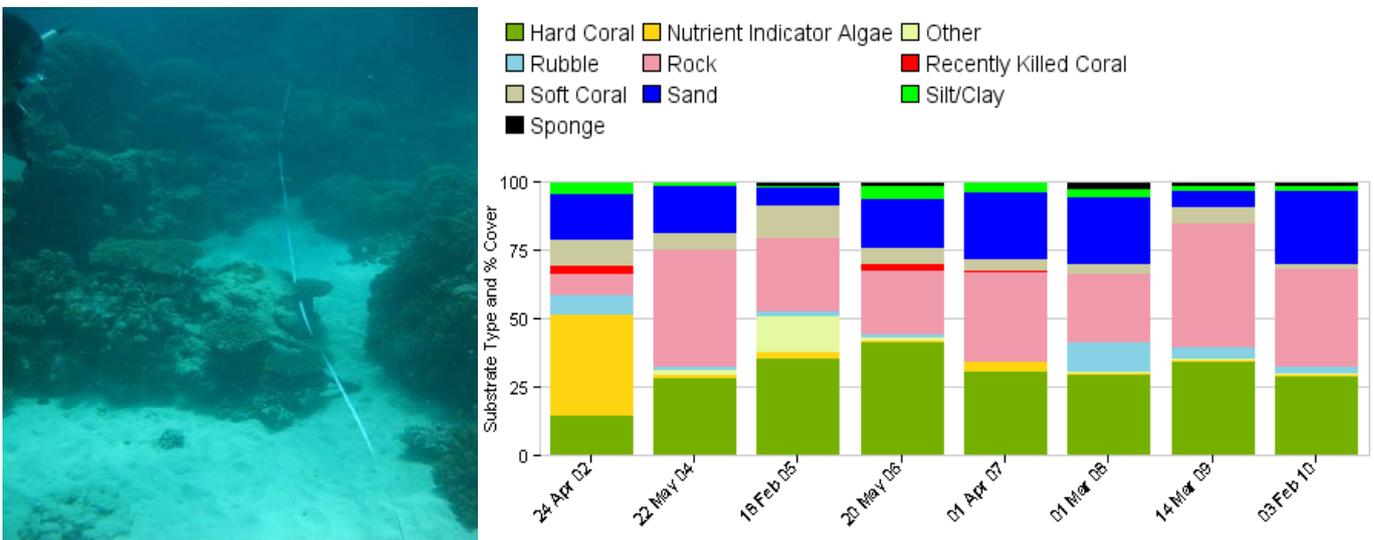


Figure 21a: Substrate type and percent cover at Opal Reef: Bashful Bommie: shallow: Site 1: Back reef slope

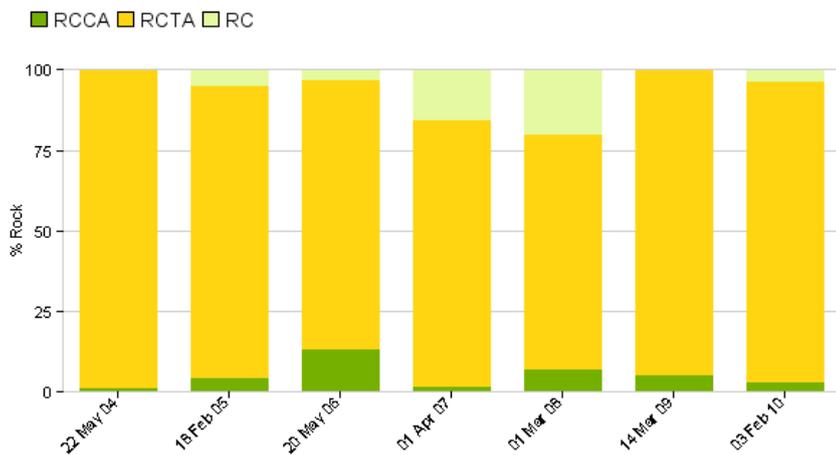


Figure 21b: Rock category type and percent cover at Opal Reef: Bashful Bommie: shallow: Site 1: Back reef slope

### Opal Reef, Bashful Bommie, site 1, medium

Hard coral cover has fluctuated since our first survey in 2003, but the last two years of data at this site are quite similar with hard coral at 45% cover (Figure 22a). The site is largely dominated by massive corals and soft coral cover shows an even amount of soft coral and soft coral leathery. *Drupella* sp. snail sightings have decreased from the last three years findings and sea cucumbers have been recorded at this site each year since 2005 (Figure 22b). Decreases in other coral damage and bleaching were recorded from 2009 to 2010.

“Bashful bommie” rises from 16m to near surface and is covered in hard and soft corals; its towering structure creates a small wall habitat for gorgonians and sea whips. In the shallows, hundreds of silverside baitfish were being hunted by mackerel.

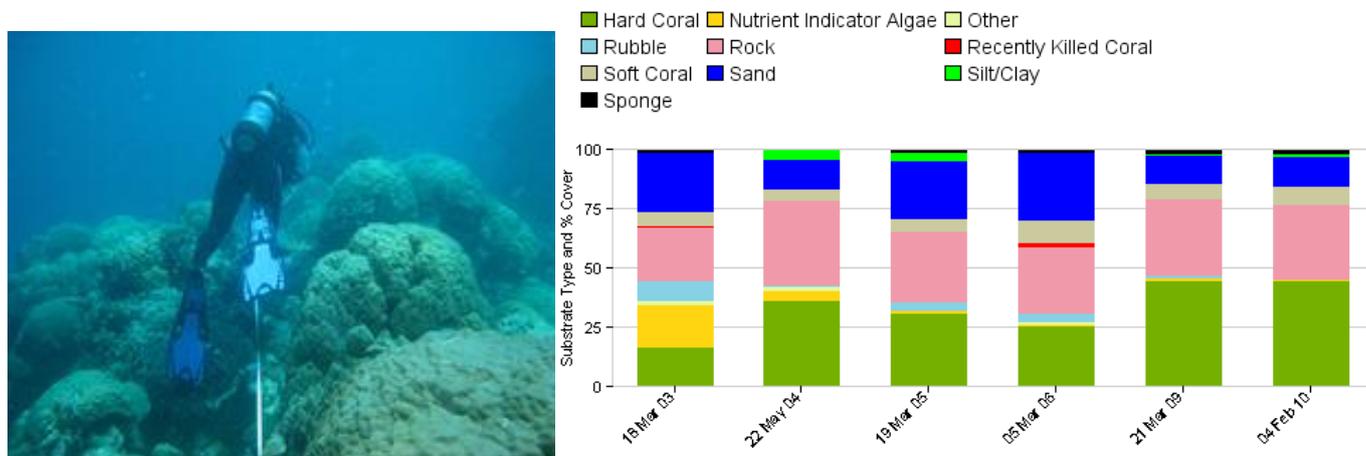


Figure 22a: Substrate type and percent cover at Opal Reef: Bashful Bommie: medium: Site 1: Back reef slope

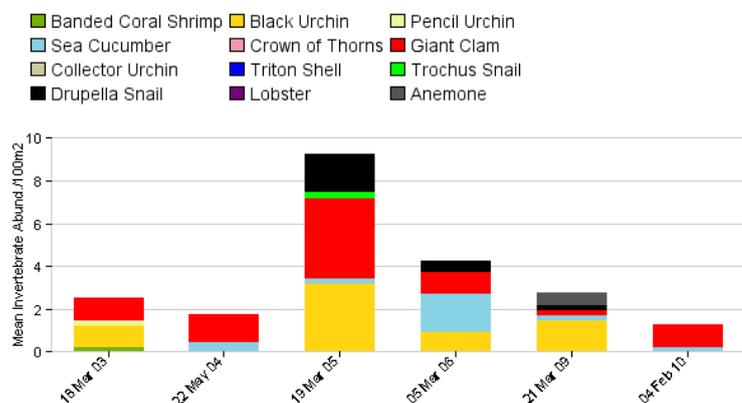


Figure 22b: Mean abundance of invertebrates at Opal Reef: Bashful Bommie: medium: Site 1: Back reef slope

## Opal Reef, The Wedge

Although coral cover has fluctuated between 20% and 40% throughout our study of "The Wedge," the last three years of data have shown a steady increase towards 50% hard coral cover (Figure 23a). All five hard coral lifeforms were represented with the majority being branching. Black spine urchins were absent and an increase in giant clams was recorded in 2010. Several smaller giant clams and a few greater than 50cm in size were recorded (Figure 23b). Fish data included a dozen red snapper schooling under a floating mass of *Sargassum* sp. seaweed, a juvenile humphead wrasse (off transect), and 4 coral trout between 30 and 50cm (Figure 23c).

A shallow reef slope with fingers and gullies jutting from the reef flat, slight current through and around "The Wedge" may explain why surveyors described this site as having abundant fish life.

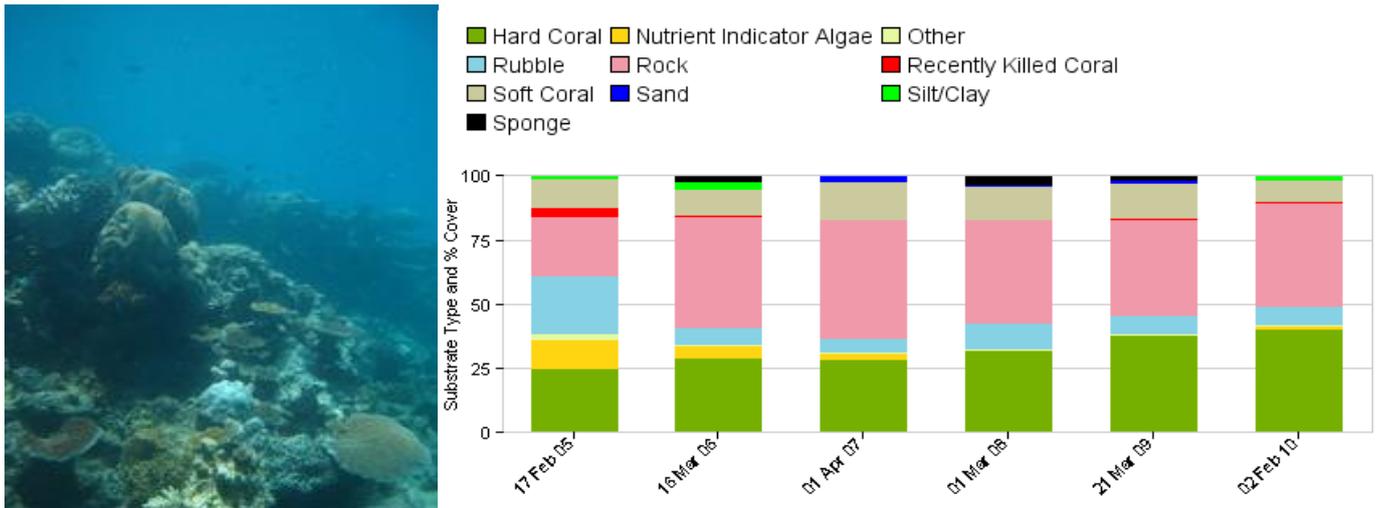


Figure 23a: Substrate type and percent cover at Opal Reef: The Wedge: shallow: Site 1: Back reef slope

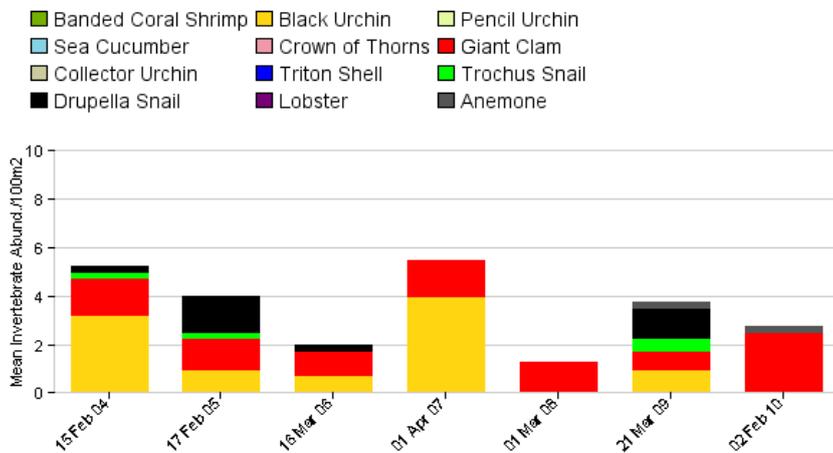


Figure 23b: Mean abundance of impacts at Opal Reef: The Wedge: shallow: Site 1: Back reef slope

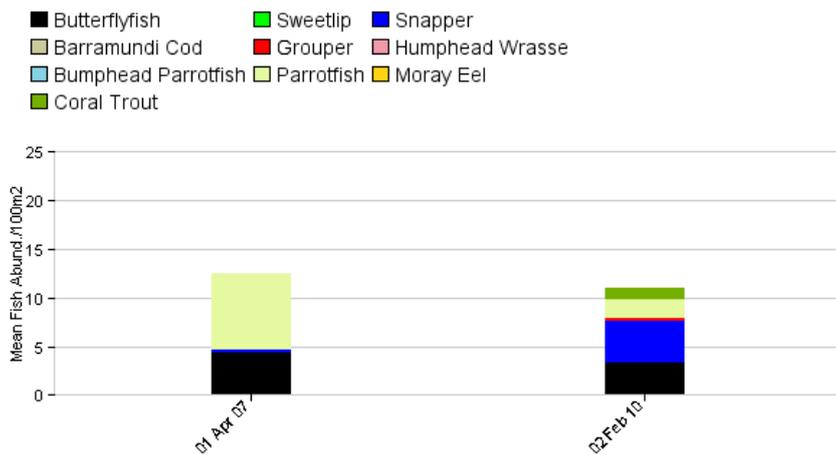


Figure 23c: Mean abundance of fish at Opal Reef: The Wedge: shallow: Site 1: Back reef slope

### Opal Reef, Two Tone

Hard coral has fluctuated 10% above and below a central 30% cover at Two Tone since 2003 (Figure 24a). Massive coral lifeforms were most common in 2010 and surveyors recorded a decrease in siltation from the previous year's survey. Turf algae cover most rock substrate and leathery soft corals were more abundant than non-leathery type. Invertebrates present in 2010 consisted of giant clams, sea cucumbers, *Drupella* sp. and *Trochus* sp. snails. Impacts are consistent with 2009's data showing some other damage and unknown scarring. Fish sighted in 2010 includes a mix of butterflyfish and parrotfish with one 30-40cm grouper (Figure 24b).

Two Tone consists of a shallow reef flat sloping to a sandy bottom, surveyors described this site as a shallow coral garden with blue and gold fusiliers schooling in the shallows. Exceptional visibility only added to the beauty of this site.

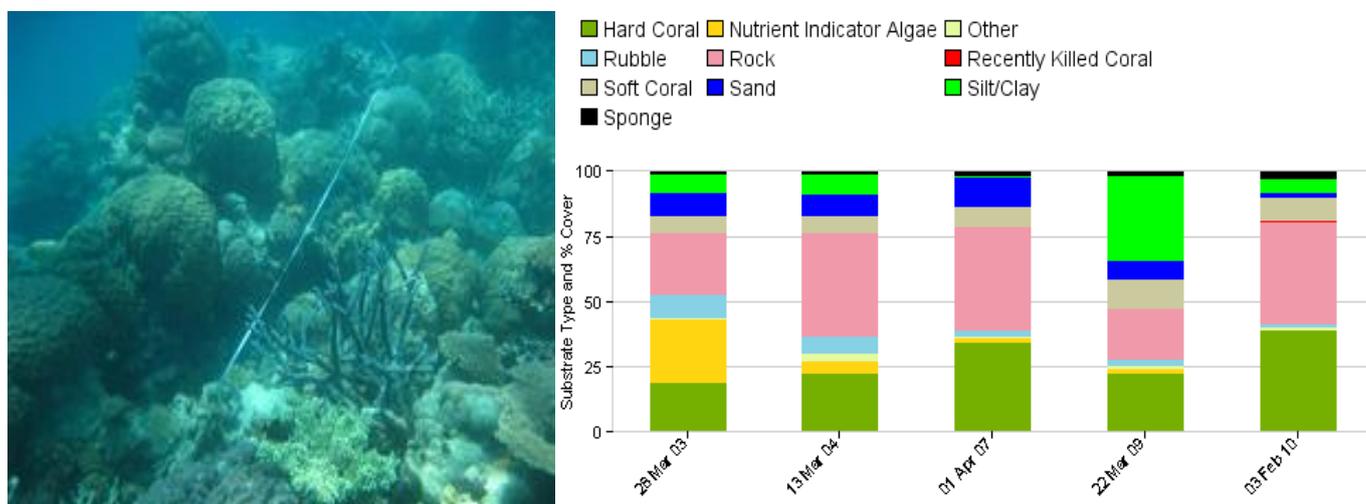


Figure 24a: Substrate type and percent cover at Opal Reef: Two Tone: shallow: Site 1: Reef flat

- Butterflyfish      ■ Sweetlip      ■ Snapper
- Barramundi Cod      ■ Grouper      ■ Humphead Wrasse
- Bumphead Parrotfish      ■ Parrotfish      ■ Moray Eel
- Coral Trout

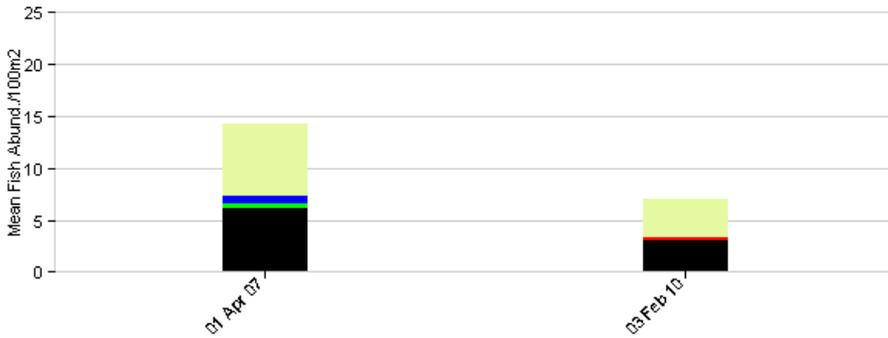


Figure 24b: Mean abundance of fish at Opal Reef: Two Tone: shallow: Site 1: Reef flat

### Saxon Reef, site 1

Coral cover has fluctuated by 10% above and below 25% during our 5 year study of Saxon Reef, site 1 (Figure 25a). Similar levels of hard coral cover and rock were detected in 2010 as 2009 with lower levels of nutrient indicator algae. Surveyors recorded an even number of branching and massive coral growth forms this year whereas the site had been dominated by branching corals in the past. The prevalence of *Drupella* sp. snails continues in 2010 although in lower numbers than previous years (Figure 25b). Low levels of other coral damage, unknown scars, coral bleaching and one piece of fishing line were recorded this year.

Site 1 at Saxon reef is a 5-7 metre shallow coral garden with some patches of rubble. Divers commented on beautiful *Porites* sp. colonies and colourful soft corals and sponges and a green sea turtle near the end of the survey.

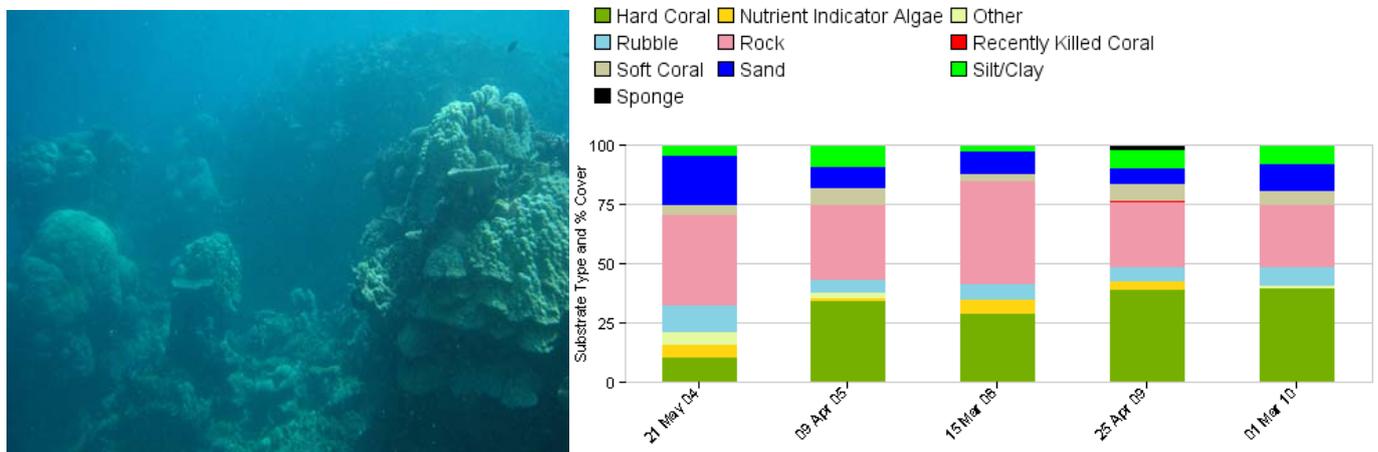


Figure 25a: Substrate type and percent cover at Saxon Reef: Saxon Reef: shallow: Site 1: Back reef slope

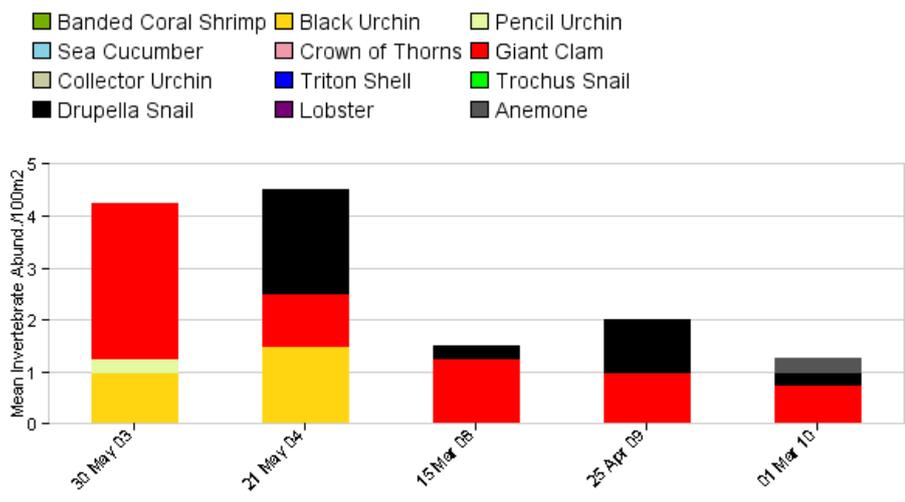


Figure 25b: Mean abundance of invertebrates at Saxon Reef: Saxon Reef: shallow: Site 1: Back reef slope

### Wheeler Reef, The Mooring, site 1

Hard coral has 10% fluctuations above and below 70% cover throughout our 5 year study of Wheeler Reef, The Mooring, site 1 (Figure 26a). Similar levels of rock and sand were found as previous years with a slight increase in amounts of nutrient indicator algae and recently killed coral. Hard corals have been largely branching at this site with several expansive fields of *Acropora* sp. throughout the transect. The fish report showed high numbers of butterflyfish with some parrotfish and a lone coral trout and humphead wrasse (Figure 26b).

Wheeler Reef's public mooring site is a favourite among surveyors because of its exceptionally high hard coral cover and abundant fish life. The transect follows the back reef slope across fields of branching coral colonies and winds around larger bommies and sandy patches.

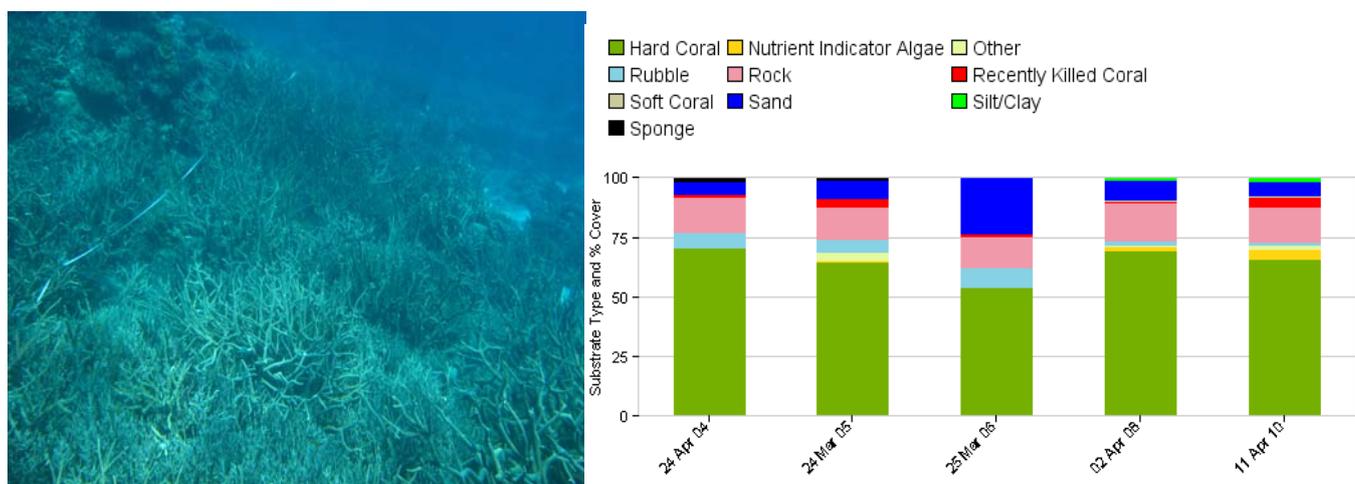


Figure 26a: Substrate type and percent cover at Wheeler Reef: The Mooring; medium: Site 1: Back reef slope

- Butterflyfish      ■ Sweetlip      ■ Snapper
- Barramundi Cod      ■ Grouper      ■ Humphead Wrasse
- Bumphead Parrotfish      ■ Parrotfish      ■ Moray Eel
- Coral Trout

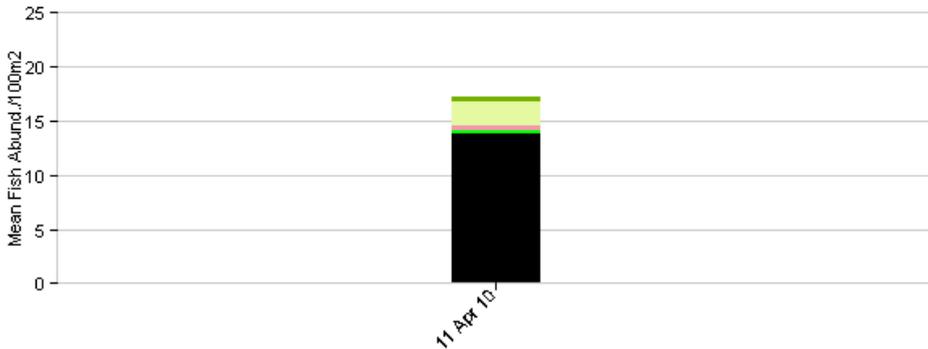


Figure 26b: Mean fish abundance at Wheeler Reef: The Mooring: medium: Site 1: Back reef slope

## E. Dive sites where coral cover remained largely stable

### Hardy Reef, site 3

Hard coral cover for Hardy Reef site 3 has remained largely stable since our first survey in 2009 (Figure 27a). Damage from Cyclone Ului could account for increased amounts of recently killed coral and silt loading (Figure 27b). Hard coral structure is mainly branching and soft corals mostly non-leathery. Surveyors recorded an increased number of giant clams in 2010 and in both years anemones were also present (Figure 27c).

Site 3 starts as a steep wall, followed by shallower slope habitats covered with branching *Acropora* sp. The second half of the transect appeared to have a more diverse community of corals as well as more fish species, though mostly damselfish and fusiliers.

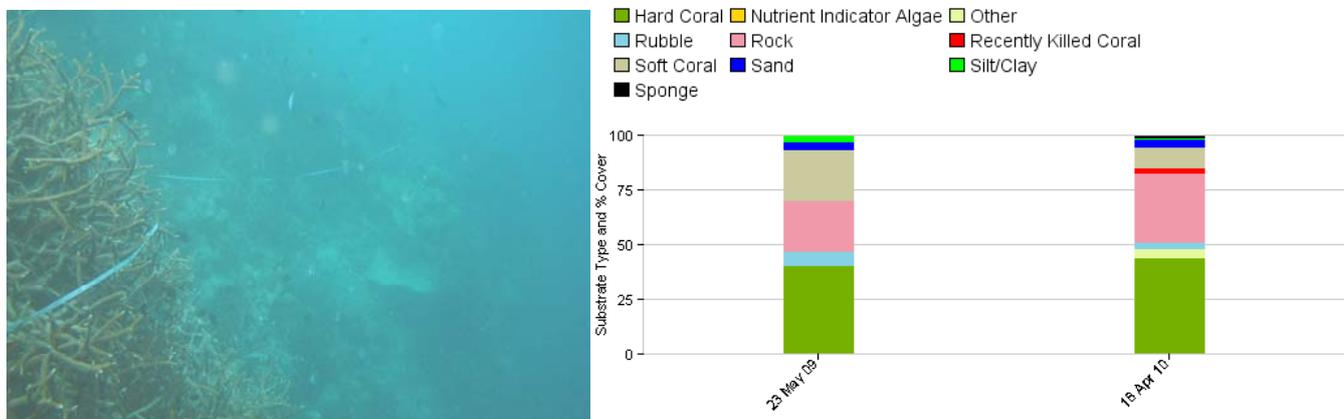


Figure 27a: Substrate type and percent cover at Hardy Reef: Hardy Reef: shallow: Site 3: Back reef wall

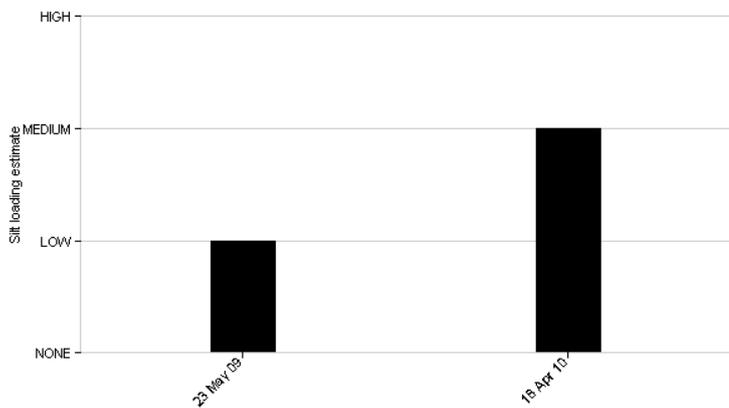


Figure 27b: Silt loading at Hardy Reef: Hardy Reef: shallow: Site 3: Back reef wall

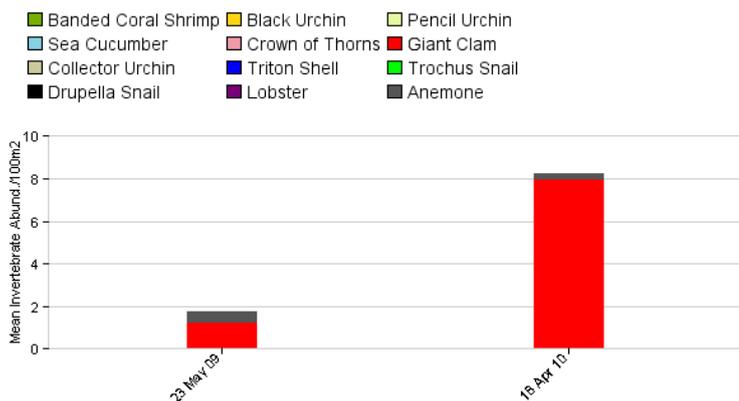


Figure 27c: Mean abundance of invertebrates at Hardy Reef: Hardy Reef: shallow: Site 3: Back reef wall

### Hastings Reef, North Hastings A, site 1

Hard coral cover increased 10% in 2010, but remains overall largely stable (Figure 28a). The diversity of coral lifeforms was high showing a similar trend to 2009 (Figure 28b). Half of all rocky substrates recorded were bare and half covered with turf algae. One *Drupella* sp. snail and one giant clam in 2010 showed fewer invertebrates recorded than previous years. Low levels of bleaching and damage were the only impacts reported which are consistent with our 2009 data. The absence of black urchins which were present in the last 4 years of data is noteworthy.

A shallow maze of coral bommies along a sandy slope comprises site 1 at North Hastings reef. Many reef fish were observed congregating around tall reef escarpments. Surveyors observed large titan triggerfish near end of transect 4.

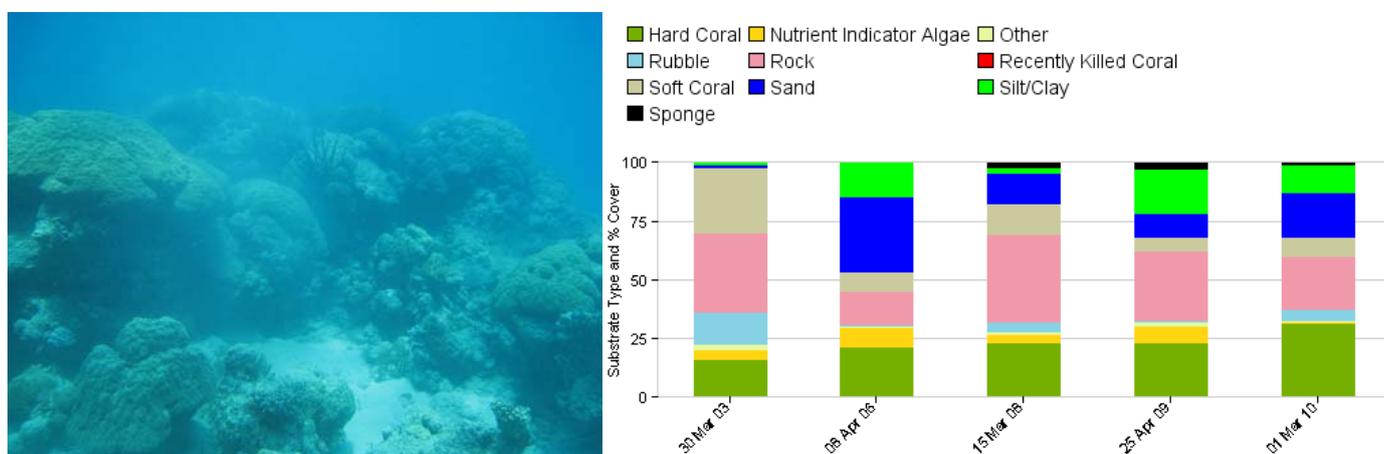


Figure 28a: Substrate type and percent cover at Hastings Reef: North Hastings A: shallow: Site 1: Back reef wall

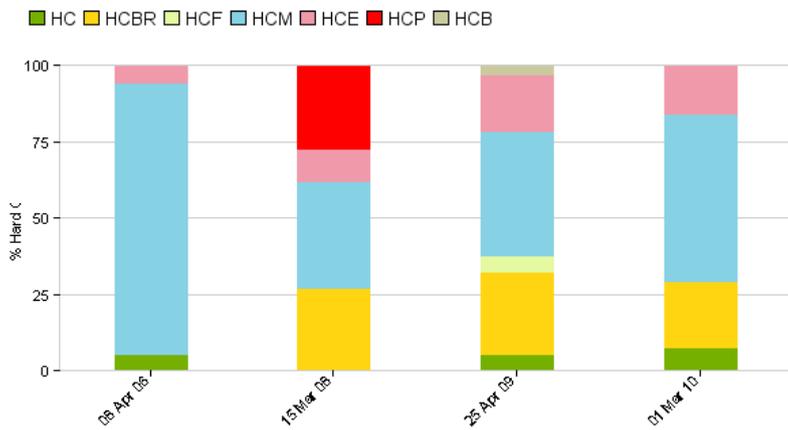


Figure 28b: Hard coral lifeform and percent cover at Hastings Reef: North Hastings A: shallow: Site 1: Back reef wall

### Knuckle Reef, site 1

The trend of largely stable hard coral cover at Knuckle Reef site 1 continues into 2010 with exactly 50% hard coral cover (Figure 29a). Hard corals are predominantly branching and soft corals mostly leathery. Giant clam numbers increased in 2010 after a steady decline from the last 3 years data (Figure 29b). Increased amounts of other damage were most likely caused by recent Cyclone Ului (Figure 29c).

Site 1 at Knuckle Reef follows the reef slope south towards the "Twin Sisters" bommies. Surveyors observed several anemones and giant clams were abundant. Many large branching coral colonies cover the sandy bottom of the reef slope.

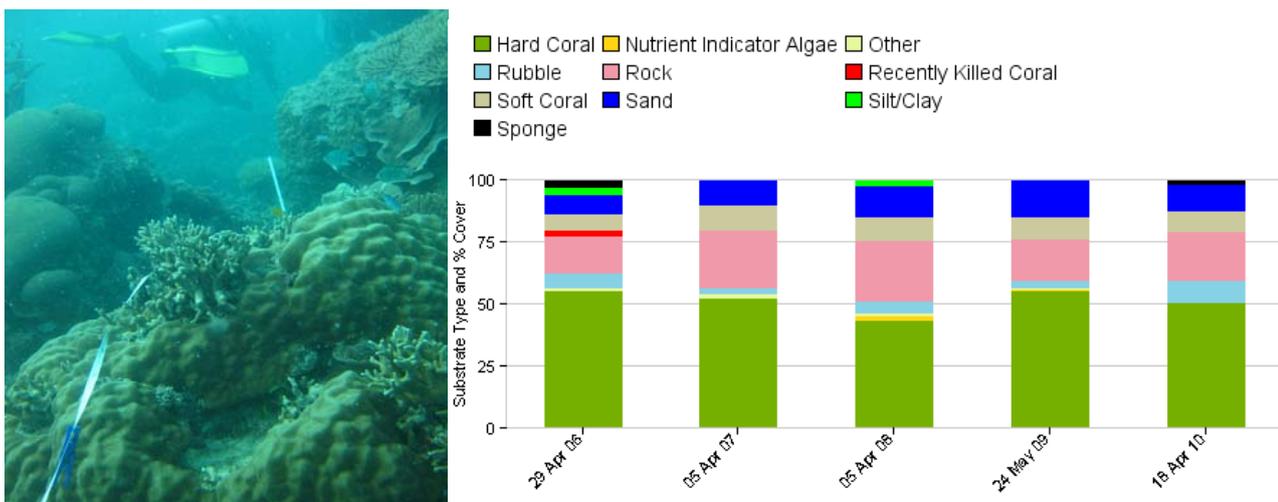


Figure 29a: Substrate type and percent cover at Knuckle Reef: Knuckle Reef: shallow: Site 1: Back reef slope

NOTE: Individual clam size distributions may not be recorded.

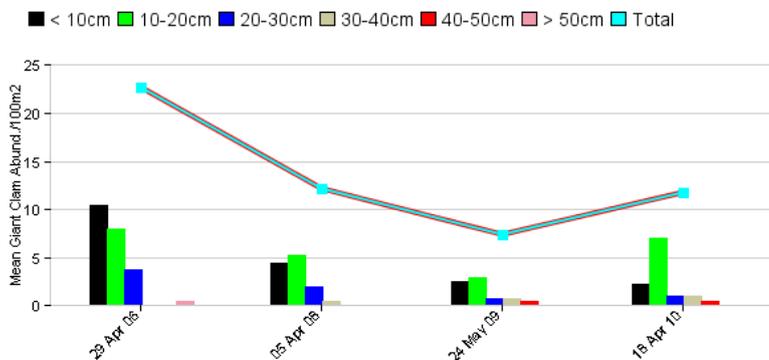


Figure 29b: Mean abundance of giant clam size classes at Knuckle Reef: Knuckle Reef: shallow: Site 1: Back reef slope

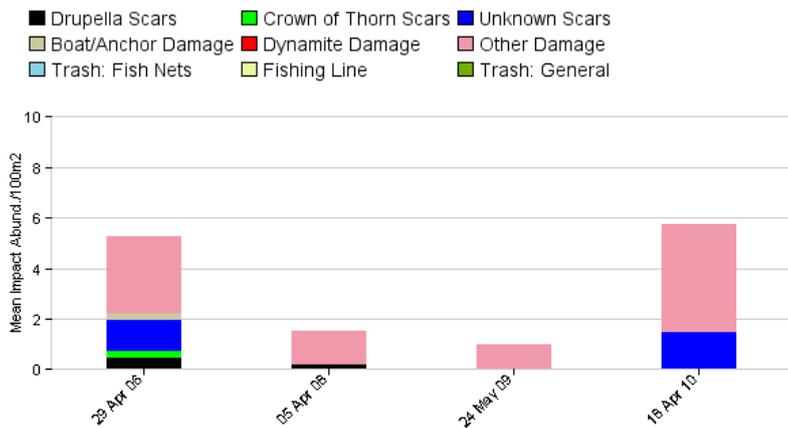


Figure 29c: Mean abundance of impacts at Knuckle Reef: Knuckle Reef: shallow: Site 1: Back reef slope

### Opal Reef, Bashful Bommie, site 2, shallow

Hard coral cover has increased 15% in 2010 and remains largely stable (Figure 30). The increased amount of recently killed coral could be due to weather damage from recent cyclone Olga. The site remains largely dominated by massive hard corals and soft coral are mainly leathery. The 2010 invertebrate report shows increased numbers of giant clams and sightings of *Drupella* sp. snails. Other coral damage has increased by one incidence per 100m<sup>2</sup> from previous year's data and coral bleaching percent cover is less than one.

Surveyors were greeted by "Funchie" the local Maori wrasse upon entry. Site 2 follows a channel east of "Bashful Bommie" further towards the reef flat.

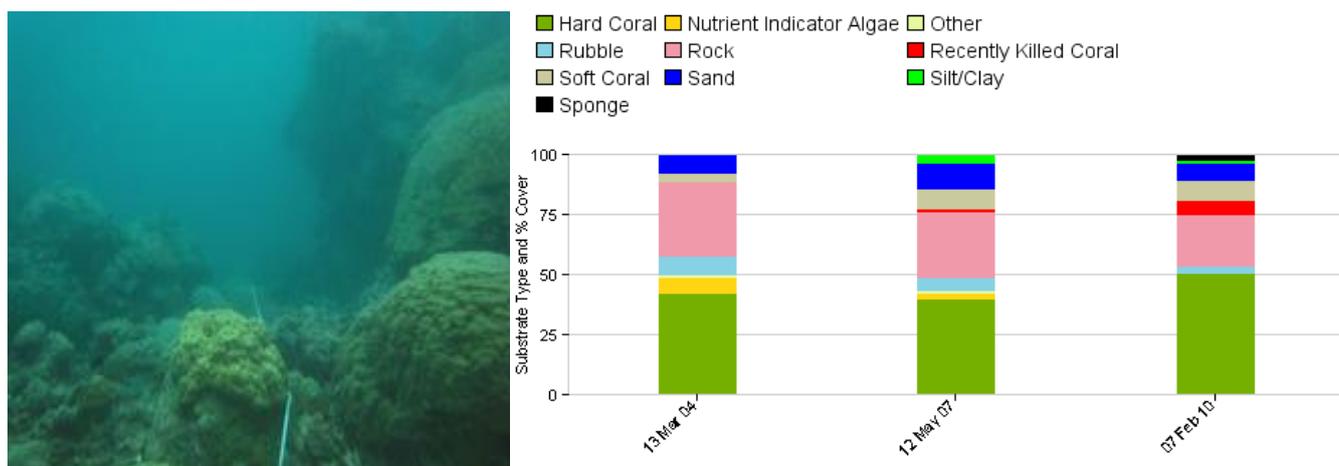


Figure 30: Substrate type and percent cover at Opal Reef: Bashful Bommie: shallow: Site 2: Back reef slope

### Opal Reef, SNO (South North Opal), site 1

Our second survey at SNO shows nearly identical amounts of hard coral cover (Figure 31a). This site is dominated by massive hard corals and turf algae cover most rock substrate. *Drupella* sp. snails sighted in 2009 were not present in this year's survey and other coral damage and bleaching have slightly increased from the previous year. Our fish report shows mainly parrotfish and butterflyfish with some snapper and one coral trout was sighted in 2010 (Figure 31b).

SNO or the Southern end of North Opal consists of a reef flat sloping to a small wall with gullies and pinnacles providing good fish habitat. RCA's medium depth transect at SNO lies along the steep slope of the reef which drops off quickly to 20 metres. Volunteers observed abundant coral and fish life including a few coral trout and various pelagic species.

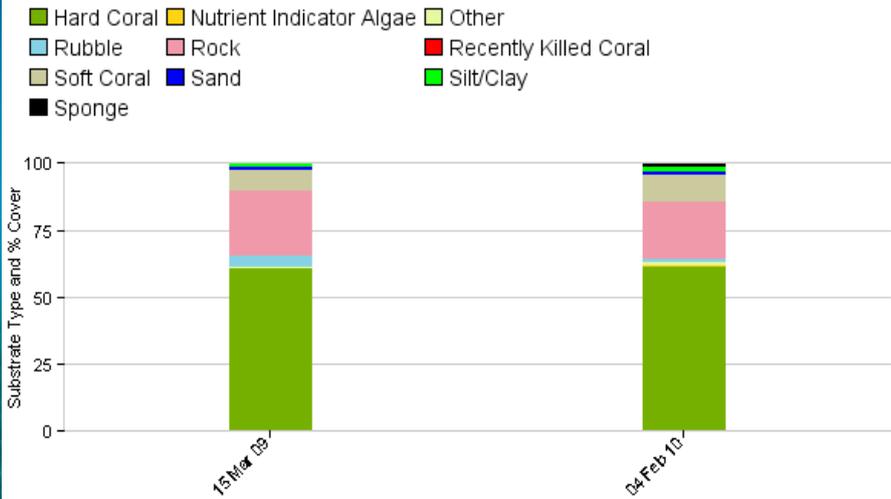


Figure 31a: Substrate type and percent cover at Opal Reef: SNO (South North Opal): medium: Site 1: Back reef crest

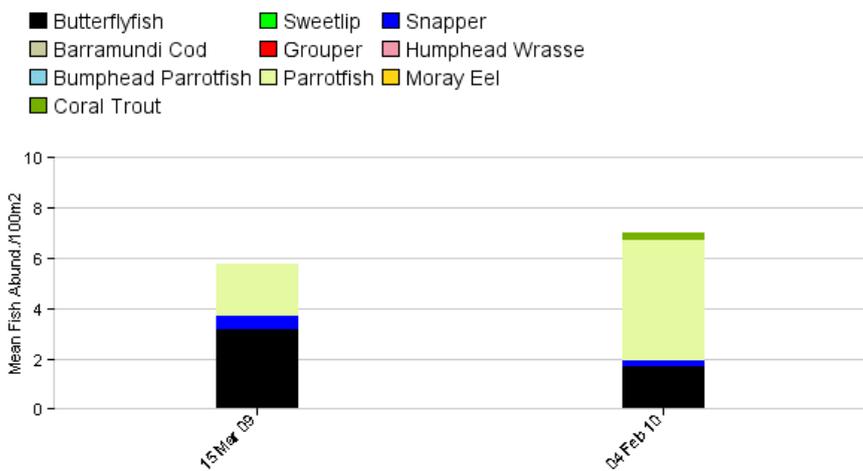


Figure 31b: Mean abundance of fish at Opal Reef: SNO (South North Opal): medium: Site 1: Back reef crest

## F. New sites

Overall, 6 new research sites were surveyed, including 1 new dive site, for which no previous data existed. These sites were mostly surveyed when the operator could not go to the previously surveyed reefs for weather and safety reasons or when a new transect was added to a previously surveyed site. It is likely that the new reefs surveyed will be also used in the future when the conditions do not allow access to the intended dive site.

Table 4: New research sites added 2010.

Reef name	Dive site name	Site	Coral cover	Site description by surveyors
Low Isles	Low Isles	2 (reef flat)	10 %	Shallow reef flat dominated by leathery soft corals. High density of rock covered in turf algae and patches of hard coral colonies.
Moore Reef	Reef Magic Pontoon	3 (back reef wall)	45%	Named "Pressure Point," a dramatic back wall incised by deep gullies. High coral cover, both hard and soft, with some rock and marginal NIA. A grey whaler shark was spotted near the end of the transect.
Moore Reef	Sunlover Pontoon	1 (back reef slope)	23 %	Located right alongside Sunlover's pontoon, the majority of this site was rock covered in turf algae. Patches of sand encompass hard and soft coral colonies with a low level of bleaching.
Moore Reef	Sunlover Pontoon	2 (back reef slope)	20 %	This new medium depth transect is stretched between the two walls that make up Sunlover's dive area. Consists of bommies of hard coral along a sandy bottom with some soft coral and a high density of rock substrate.
Opal	South-North Opal (SNO)	1 (reef flat)	43 %	High density of hard corals and rock substrate with some sand, rubble and leathery soft corals scattered throughout. Surveyors recorded some bleaching and coral disease as well as drupella snails and scars.
Opal	Split Bommie	1 (back reef slope)	33 %	A new medium depth transect was added to this site in 2010. At 7 metres depth the habitat on split bommie is steep and wall-like, mainly hard coral and rock, with some soft corals, sponges, and gorgonians

