STATUS OF REEFS AROUND MAGNETIC ISLAND: 2003 - 2006

REEF CHECK AUSTRALIA

Zoë Andrews

Loren Hartley

Jos Hill

April 2006

1 INTRODUCTION

The purpose of this project was to engage Townsville community members in monitoring the health of Magnetic Island's fringing coral reefs. A pipeline has recently been built between Magnetic Island and Rose Bay. This project was developed out of local interest in the effects of silt loading in the Middle Reef area in the future.

Magnetic Island

Magnetic Island is a large continental island situated in Cleveland Bay 7km north of Townsville (Figure 2.1) and is surrounded by fringing reefs. Due to its close proximity to the mainland and the topography of Cleveland Bay the fringing reefs of Magnetic Island are exposed to sedimentation. The surrounding waters and submerged lands around the island are contained within the Great Barrier Reef World Heritage Area (GBRWHA).

Figure 1.1: Magnetic Island

2. METHODS

2.1 Survey Sites

A total of 2 coral reef sites were surveyed in September 2005 and February 2006 as a part of this project: Middle Reef and Picnic Reef. Picnic Bay jetty was also visited by the volunteer team during December 2005. In addition to these sites, local Reef Check volunteers have been monitoring an additional 3 fringing reef sites since 2003 at Nelly Bay and Geoffrey Bay, and at Alma Bay since 2004 (figure 2.2).

All sites were surveys at low tide depths between 2 and 6m and so correspond to shallow sites in the Reef Check protocol.

Figure 2.1 *Survey sites around Magnetic Island*

Table 2.1 *Specifications of survey sites*

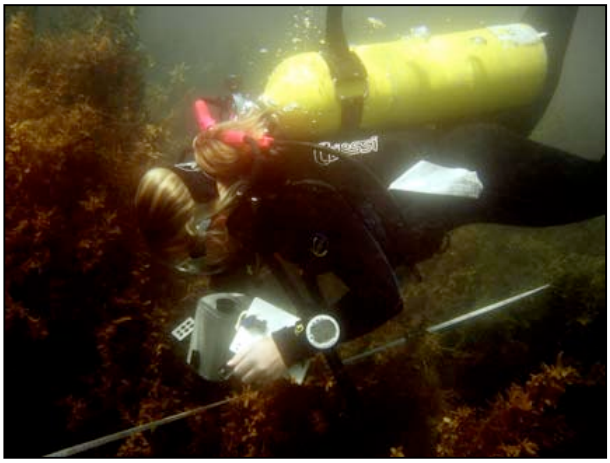
SITE	MP ZONE	YEAR	GPS	NUMBER OF TRANSECTS	DEPTH AT LOW TIDE	TIME OF YEAR SURVEYED
Middle Reef Flat	Yellow	2006	19 11.759S; 146 48.999E 19 11.784S; 146 48.581E	2	2m	February
Middle Reef Slope	Yellow	2006	19 11.900S;146 48.913E	1	2m	February
		2005	19 11.759S; 146 48.999E 19 11.784S; 146 48.581E 19 11.900S; 146 48.913E	3	2m	September
Picnic Bay – detached reef	Yellow	2006	19 11.320S; 146 49.954E 19 11.326S; 146 49.981E 19 11.318S;146 50.101E	3	2m	February
		2005	19 11.320S; 146 49.954E 19 11.326S; 146 49.981E 19 11.318S;146 50.101E	3	3m	September
Picnic Bay Jetty	Yellow	2005	Unknown	*	3m	December
Nelly Bay	Blue	2005	19.10 S 146.50 E	2	5m	March
		2003	19.10 S 146.50 E	2	5m	April and June
Geoffrey Bay	Blue	2005	19° 09.160 146° 51.380	3	5m	February and March
		2003	19.10 S 146.50 E	1	3.5m	May
Alma Bay	Blue	2005	19° 08.535 146° 52.080	2	5m	February and March

* Due to resource limitations only 1 x 20m transect was completed.

2.2 Methods

Reef Check is a volunteer program, which engages community members who are recreational divers in monitoring the health of their local coral reefs. The Reef Check protocol has been designed to detect human as well as natural impacts. These impacts include siltation from nearby development, dredging and mining, effects of poor water quality, trash, coral damage, coral disease, coral bleaching (from global climate change), and predation from crown-of-thorns starfish and *Drupella* snails. This method differs from those used by the Australian Institute of Marine

Science by its focus on basic human impacts rather than on fine-scale differences in community assemblages.



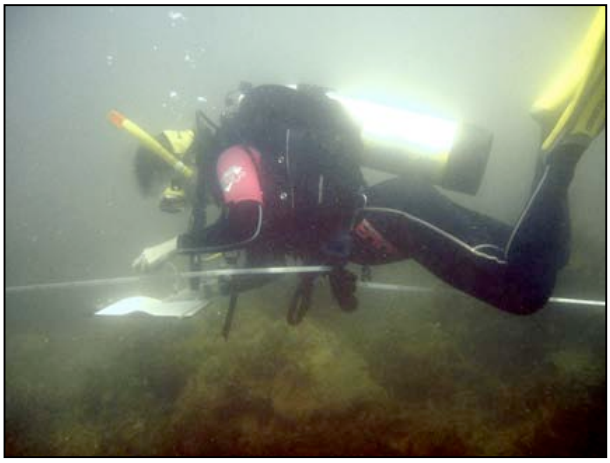


Plate 2.1 *Video survey at Picnic Bay – Detached reef in 2006 with macroalgae in high abundance.*

Table 2.2 *Coral and Substrate Growth Form Codes*

HARD CORALS **Growth Forms**	**HCBR**: Branching Hard Coral **HCF**: Foliose Hard Coral **HCM**: Massive Hard Coral **HCE:** Encrusting Hard Coral **HCP:** Plate Hard Coral **HC:** gathers other growth forms (digitate, columnar, etc.) **HCB**: Bleached Hard Coral
SOFT CORALS	**SCL:** Leathery Soft Coral **SCZ:** Zoanthids **SC:** Other Soft Coral (tree or flower shaped) **SCB:** Bleached Soft Coral
RECENTLY KILLED CORAL	**RKCTA**: Recently killed coral covered with Turf Algae **RKCNIA:** Recently Killed Coral covered with Nutrient Indicator Algae **RKC:** Recently killed coral (non covered with algae)
ROCK	**RCTA:** Rock covered with Turf Algae **RCCA:** Rock covered with Coralline Algae **RC:** Rock (non covered with algae)
SPONGES	**SPE:** Encrusting sponge **SP:** All other sponges
NIA	**Nutrient indicator algae: includes algae that may proliferate in high nutrient conditions.**
MA	**Includes *Turbinaria* sp., *Sargassum* sp., and *Padina* sp. The substrate below the MA is recorded but the presence of MA is also noted.**
SI	**Silt: where the layer is > 1mm thick. Normally RCTA that is laden with silt would be recorded as silt. However, due to the high levels of silt-laden RCTA in addition to silt on back rock it was decided to record the RCTA and put a note where this was laden with silt.**
SD	**Sand**
RB	**Rubble (pieces between 0.5-15cm diameter)**
OT	**Other includes ascidians, hydroids, *Halimeda* sp. algae and other orga and substrates not included in the other categories.**

For detailed information on Reef Check Australia's methods see the attached document "How Does Reef Check Check our Reefs"

3 RESULTS

3.1 MIDDLE REEF

3.1.1 Substrate Survey

Figure 3.1 compares the percent mean cover of each substrate category for Middle Reef slope in 2005 (winter survey) and Middle Reef slope and flat in 2006 (summer survey). The dominant substrate categories of the reef slope found in 2005 and 2006 were hard coral and rock. The percent cover of hard coral observed was similar between the 2 survey periods at 44.2% in 2005 and 45.6% in 2006. The observed percent cover of soft coral on the reef slope was 9.1% in 2005 and 1.3% in 2006. Coral bleaching was observed in both hard and soft corals during February 2006. Please refer to the section on impacts for more details.

The reef flat was found to have a lower cover of hard coral (6.3%) and higher soft coral cover (16.3%) than the reef slope.

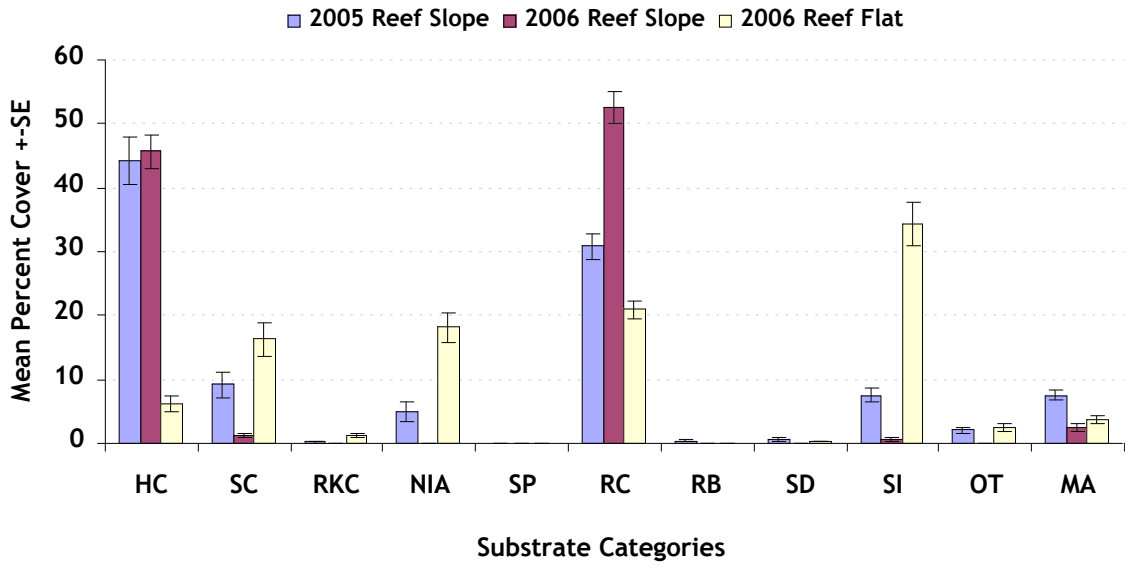


Figure 3.1 *Mean Percent Cover of Substrate for Middle Reef Slope 2005 (2m depth) compared to Middle Reef Slope 2006 (2m depth) and Middle Reef Flat 2006 (2m depth).*

Hard coral consisted of foliose and branching forms with some massive corals present (Figure 3.2 and Plate 3.1).

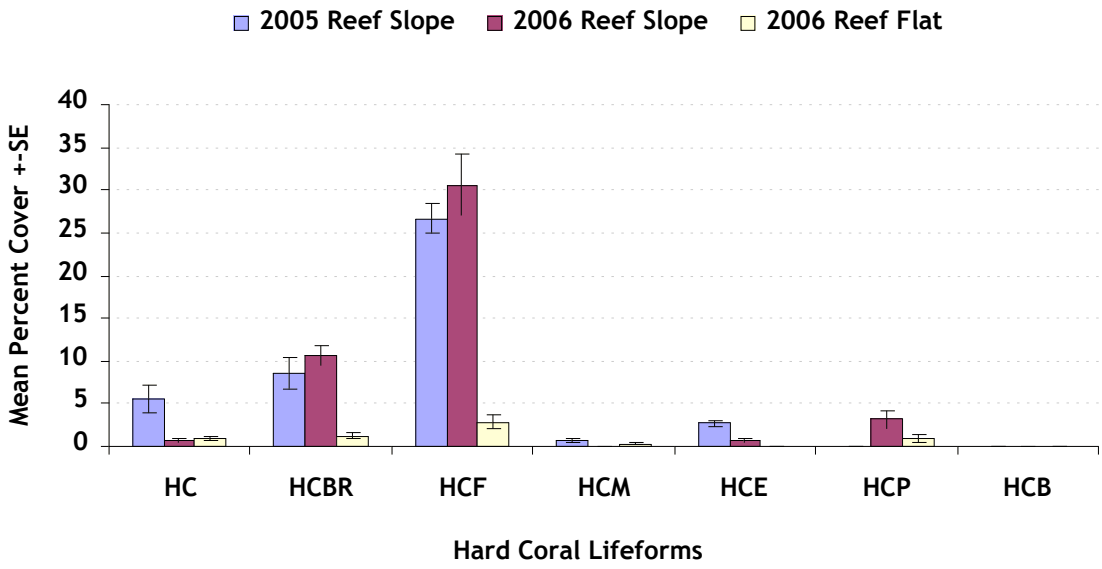


Figure 3.2 *Mean Percent Cover of Hard Coral Lifeforms for Middle Reef Slope 2005 (2m depth) compared to Middle Reef Slope 2006 (2m depth) and Middle Reef Flat 2006 (2m depth).*

Plate 3.1 *Hard coral foliose and hard coral branching (Acropora sp.) at Middle Reef.*

The rock category includes turf algae which was heavily laden with silt (Plate 3.2, 3.3 and 3.4). We recommend viewing the silt and turf algae figures together for this site. The percent cover of rock on the reef slope was 52.5% in 2006 compared to 30.8% in 2005 with 94.8% and 96.4% of this rock was covered in turf algae in 2006 and 2005 consecutively (see Figure 3.3). However, a higher percent cover of silt was recorded in 2005 and this corresponds with the lower observed cover of turf algae.

On the reef flat in 2006 rock cover was 20.9%, of which 95.7% of this was covered in turf algae that was heavily laden with silt. In addition, a 34.3% cover of silt was recorded on the reef flat on top of bare rock and dead coral (figure 3.1).

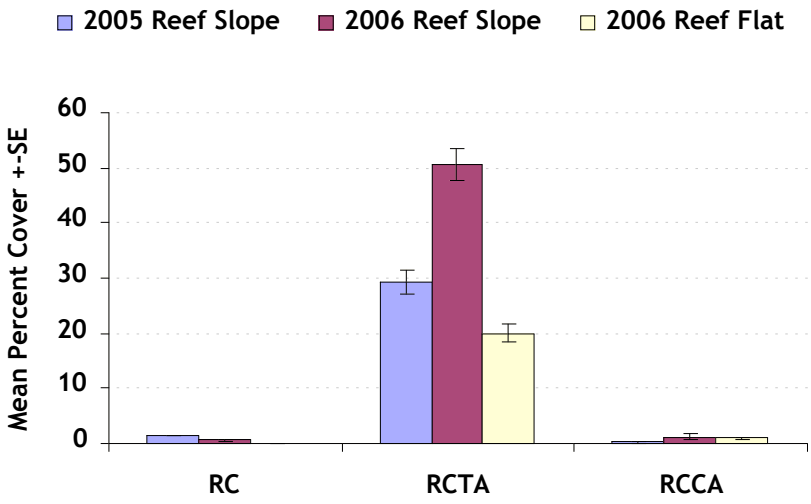


Figure 3.3 *Mean Percent Cover of Rock, Coralline Algae and Turf Algae for Middle Reef Slope 2005 (2m depth) compared to Middle Reef Slope 2006 (2m depth) and Middle Reef Flat 2006 (2m depth).*

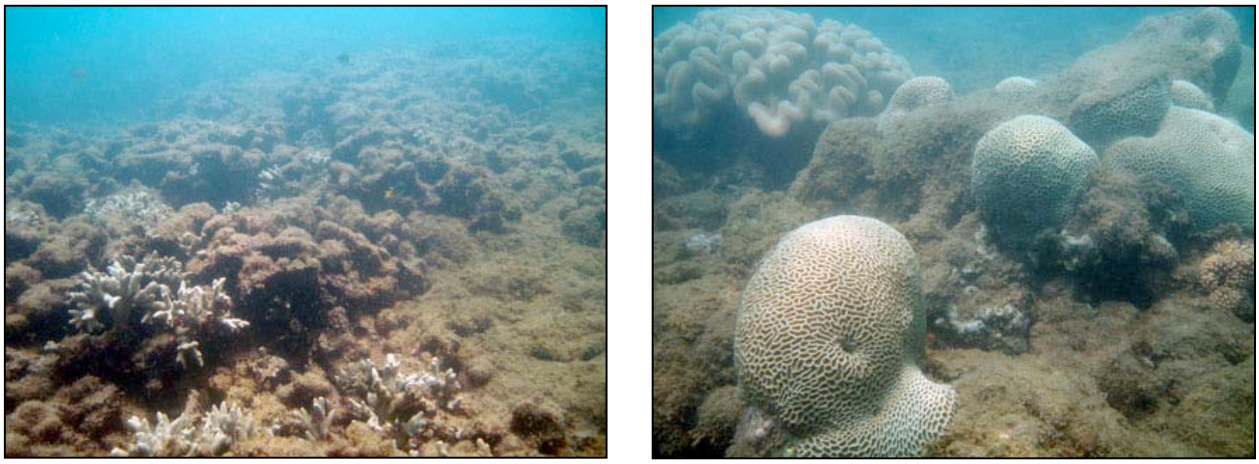


Plate 3.2 *Turf algae at the Reef flat of Middle Reef during 2006.*

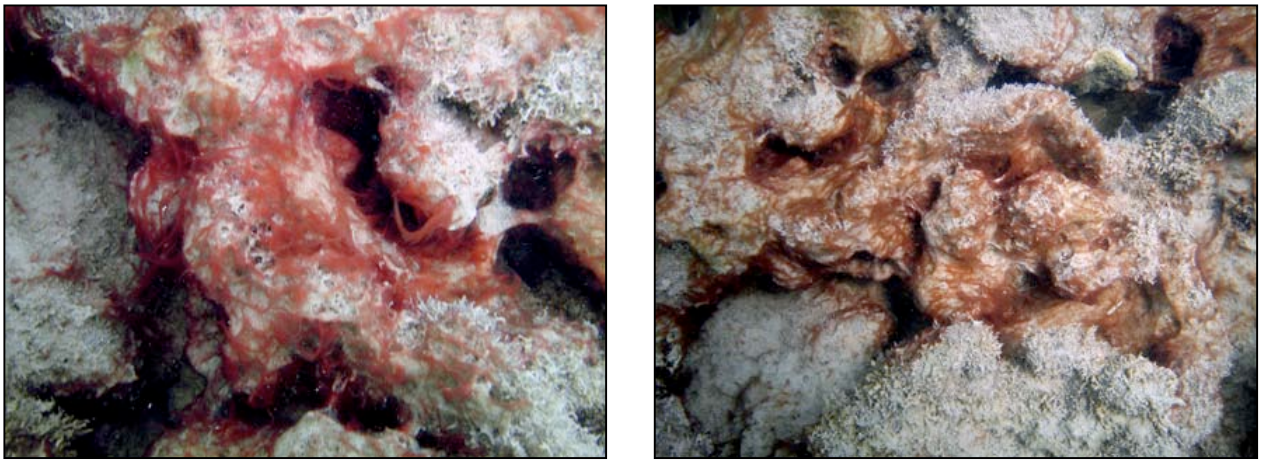


Plate 3.3 *Turf algae, silt and nutrient indicator algae at the reef slope of Middle Reef during 2006*

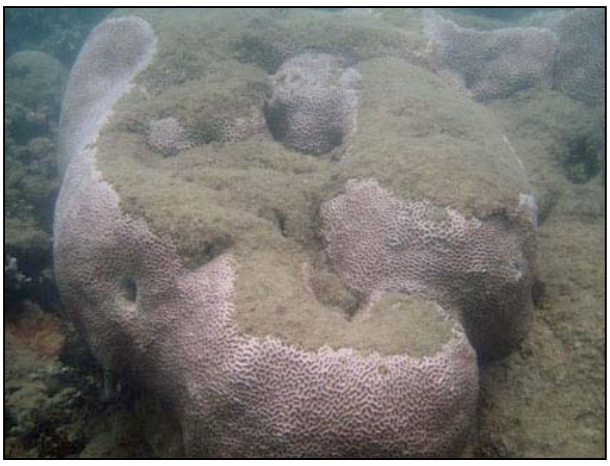


Plate 3.4 *Partially dead coral colonies covered with silt-laden turf algae in 2006 (left) and small recruits of Montipora sp. observed growing on the silty turf algae in 2005 (right).*

The highest cover of nutrient indicator algae (NIA) was found on the reef flat, 18.1% in 2006 compared to 5% on the reef slope in 2005 (see Plate 3.4). No NIA was found directly on the transect at the reef slope in 2006, however it was observed to be present at the site (see Plate 3.3, 3.5 and 3.6).

Plate 3.5 *Dominant nutrient indicator algae found on the reef flat during the 2006 survey of Middle Reef.*

Plate 3.6 *Dominant nutrient indicator algae found on the reef slope during the 2006 survey of Middle Reef.*

Observed percent cover of macroalgae on the reef slope decreased from 7.5% in September 2005 to 2.5% in February 2006. In comparison the reef flat was found to have 3.8% macroalgae cover. The dominant macroalgae were *Turbanaria* sp. in 2005, and *Padina* sp. and *Sargussum* sp. in 2006 (see Plate 3.7).

Plate 3.7 *Dominant macroalgae Padina* sp. *(right) found during 2006 and Turbanaria* sp. *(left) found during 2005.*

3.1.2 Invertebrate and Impact Survey

Table 3.1 shows the mean abundance of invertebrates found in a 100m^2 area during the 2005 and 2006 surveys. Low abundances of invertebrates were observed at all sites with *Diadema* urchins only observed on the reef flat. Higher numbers of the coral-eating *Drupella* snail was observed on the reef flat and slope in the summer survey than the winter survey although a higher incidence of *Drupella* predation scars were observed during the winter survey suggesting more snails may have been present than observed. However more scars were observed in the 2005 survey (Plate 3.7).

Table 3.1 *Mean numbers of invertebrates found in a 100m^2 area during the 2005 and 2006 surveys.*

	2005 REEF SLOPE	2006 REEF SLOPE	2006 REEF FLAT
Long-spined sea urchin	0	0	5.5
Giant clam	0.33	0	0.5
Collector urchin	2	0	0
Drupella snail	0.33	6	5
Drupella scars	2.67	1	0.5
COTS scars	2.33	0	0

Similar levels of hard coral bleaching were observed both in the winter and summer surveys (Plate 3.7 and 3.8) with 2.3% of hard corals bleached on the reef flat and 1% on the reef slope. Bleaching is a stress response of hard corals and can occur from low tides or high silt levels as well as from high sea surface temperatures, which is now a common occurrence on coral reefs around the world during the summer months, which is attributed to increased emissions of fossil fuels.

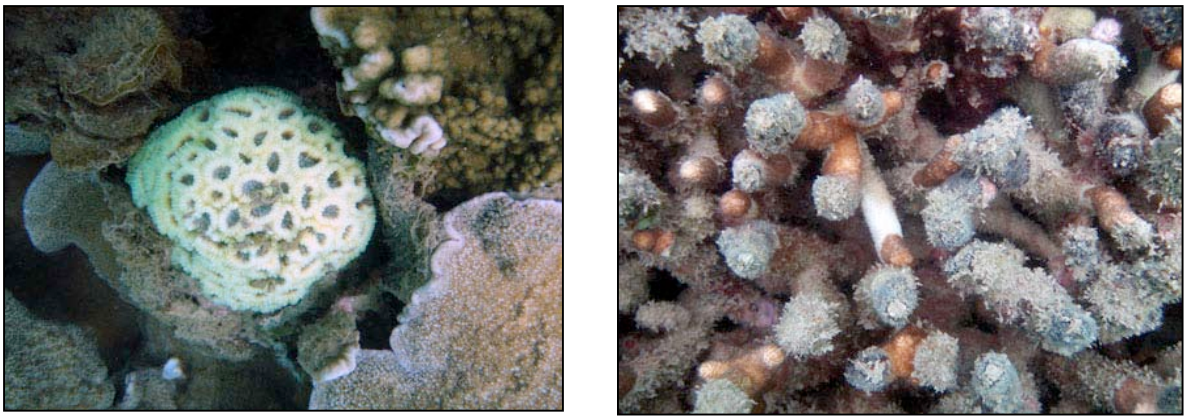


Plate 3.7 *Bleaching of hard coral and scarring observed at Middle Reef*

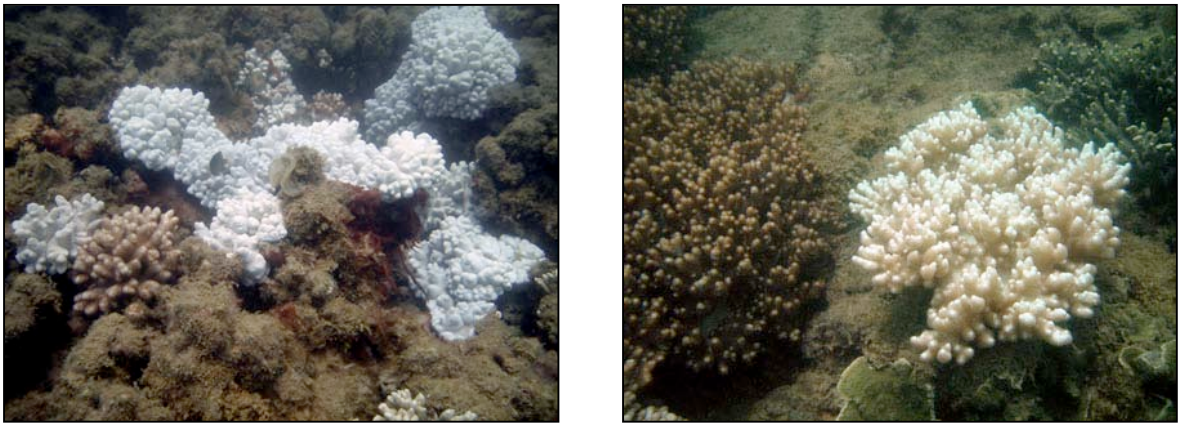


Plate 3.8 *Bleached soft coral at Middle Reef 2006*

A small amount of coral damage was observed some of which was attributed to anchor damage (figure 3.4 and plate 3.9). Some trash was also observed in 2005.

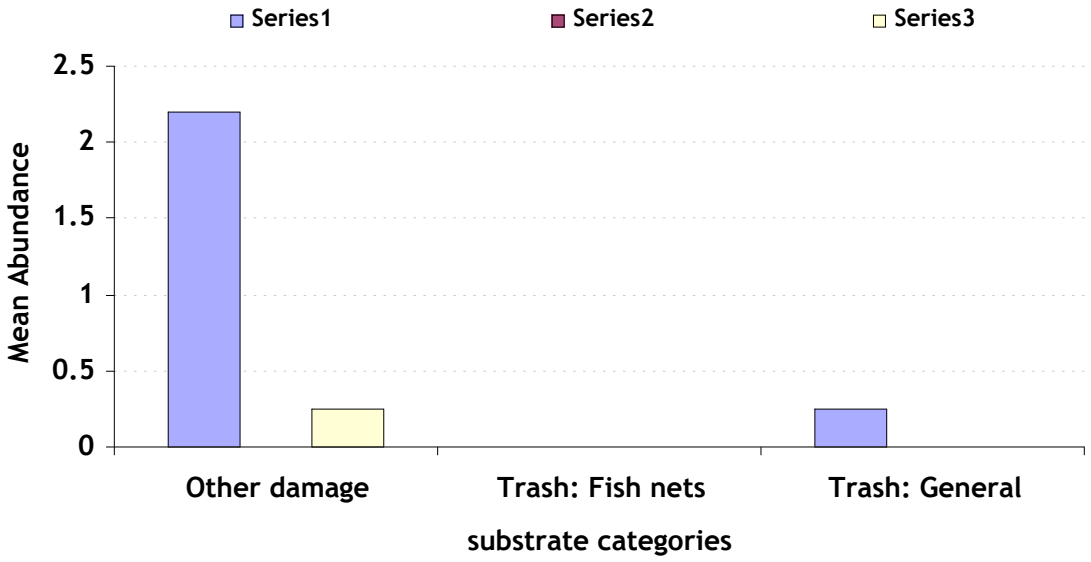


Figure 3.4 *Mean Abundance of Damage Impacts for Middle Reef Slope (2m depth) 2005 compared to Middle Reef Slope (2m depth) 2006 and Middle Reef Flat (2m depth) 2006.*

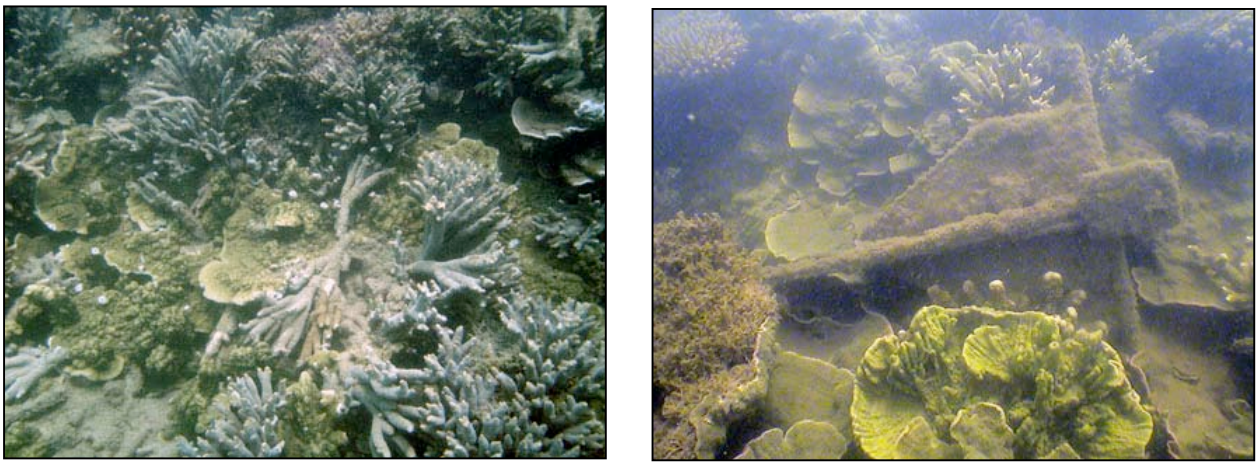


Plate 3.9 *Anchor damage found at Middle Reef in 2005 (right) and 2006 (left).*

3.2 PICNIC BAY REEF

3.2.1 Substrate Survey

Figure 3.2 compares the reef slope in October 2005, winter, to the reef slope in February 2006, summer. The dominant substrate categories in winter were hard coral, rock and sand and in summer were hard coral, rock and silt. Hard coral cover observed was higher at 20% in winter than 28.1% observed in the summer. Conversely the percentage cover of rock was higher in the summer at 18.8% than 22.1% in winter. These finding differ from the results of ground truthing surveys for the Coastal Resources of Magnetic Island report of 1989 when the dominant substrates recorded were soft sands and mud.

Silt was not a dominant substrate in winter at 7.9%; however observed amounts increased to 21.3% in summer. Sand, dominant in winter with a cover of 27.5% decreased to 0% in summer. This may represent discrepancy between observers recording the silty bottom as sand (figure 3.10).

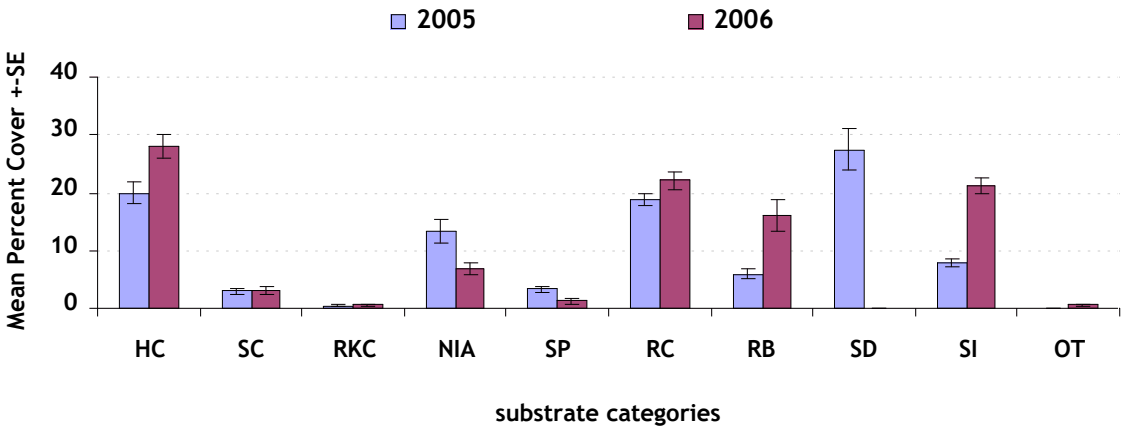


Figure 3.5 *Mean Percent Cover of Substrate for Picnic Bay, detached reef winter 2005 (3m depth) compared to Picnic Bay detached reef summer 2006 (2m depth).*

The percentage cover of soft coral remained similar in winter and summer with 2.9% and 3.1% respectively. Colonial zooanthids were recorded at this site in summer, but not in winter or at Middle reef in winter and summer (plate 3.10).

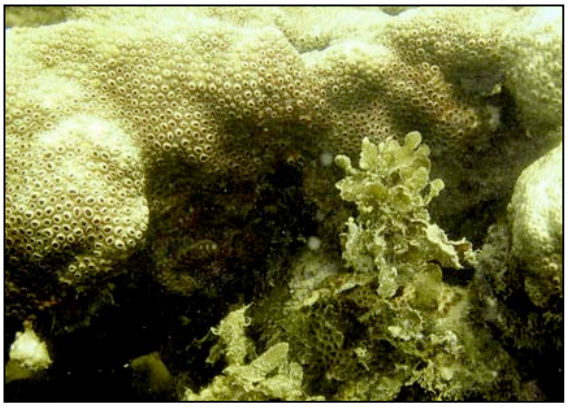


Plate 3.10 *Colonial zoonathids at Picnic Bay Detached Reef in Summer 2006*

Nutrient indicator algae decreased from 13.3% in winter to 6.9% in summer. Macroalgae, which tends to increase during summer months, was dominant on the reef in both winter and summer. Like Middle Reef, the dominant macroalgae were observed to be *Sargassum* sp. and *Turbinaria* sp. There was no quantitative data for winter however in summer macro-algae had the highest mean percentage cover at 30% (plate 3.11).

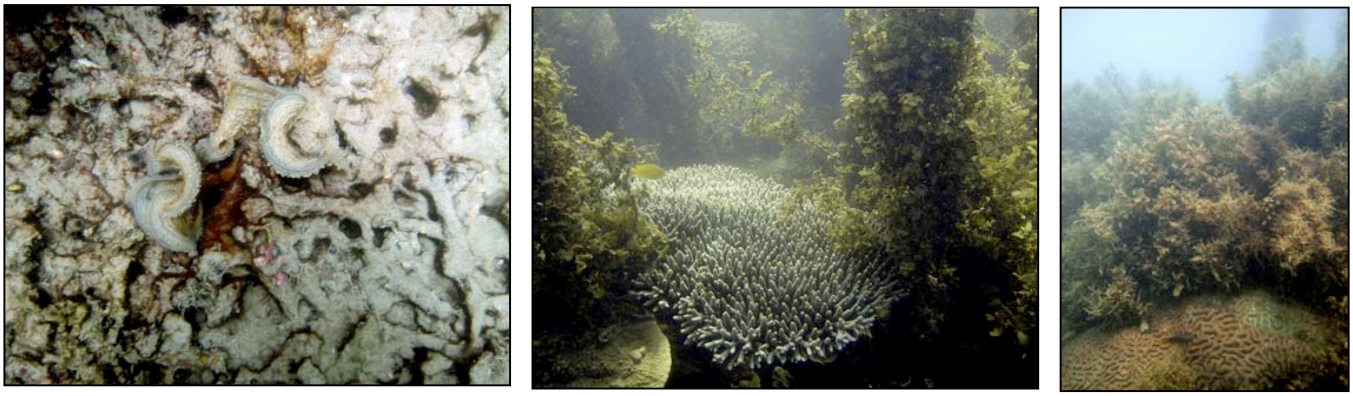


Plate 3.11 *Macroalgae, Padina sp, laden with silt (top right) Turbinaira sp., and Sargassum sp. in summer.*

Figure 3.5 shows an overall decrease in the percentage of sponge. Figure 3.6 compares encrusting sponge with other forms of sponge. Observed levels of sponges are similar between encrusting and other forms in both winter and summer.

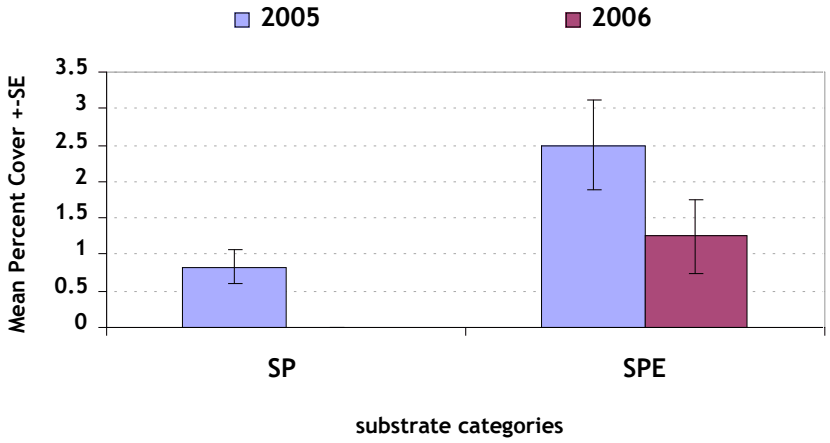


Figure 3.6 *Mean percentage cover of Sponge and Encrusting Sponge for Picnic Bay detached Reef 2005 (3m depth) and 2006 (2m depth).*

There was a very small percentage of bare rock in winter, 0.02%, and no bare rock in summer. Observed percent cover of coralline and turf algae were similar in the winter and summer (figure 3.7 and plate 3.12).

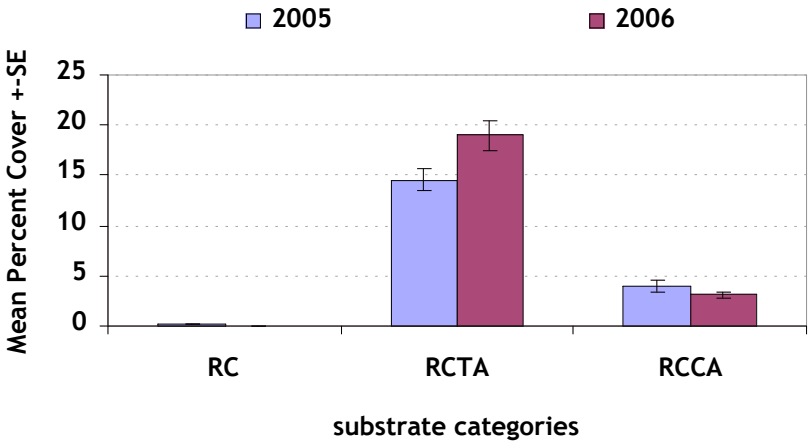


Figure 3.7 *Mean Percent Cover of Rock, Coralline Algae and Turf Algae for Picnic Bay detached reef 2005 (3m depth) compared to Picnic Bay detached reef 2006(2m depth).*

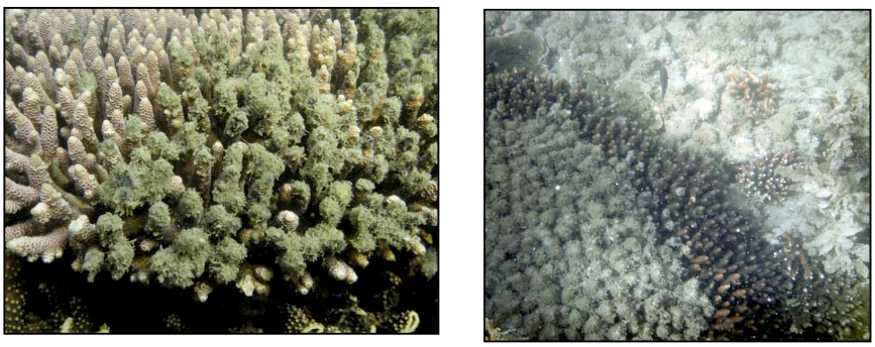


Plate 3.12 *Turf algae on hard coral and laden with silt (right).*

3.2.2 Invertebrate and Impacts survey

Table 3.2 *Mean numbers of invertebrates found in a 100m^2 area during the 2005 and 2006 surveys.*

	2005	2006
Long-spined sea urchin	5.083	1.75
Giant clam	0	0.25
Drupella snail	1.583	2
Drupella scars	0.333	0.417
COTS scars	0	0.167
Other scars	1.917	0.25
Boat damage	0.333	0.617
Other damage	3	0.167
General and fishing related trash	0	0.25
% of coral population bleached	1.167	5.677

The incidence of coral bleaching increased from 0.8% in winter to 5.7% in summer. This corresponds with an increase in sea surface temperatures from approximately 27ºC to 31ºC (Australian Government Bureau of Metreology). Only hard coral was bleached (plate 3.13).

Plate 3.11 *Only Porites sp. massive colonies were bleached at Picnic Bay Reef.*

3.3 PICNIC BAY (AT THE JETTY)

3.3.1 Substrate

Figure 3.8 shows the percentage cover of Reef Check categories in December of 2005 at Picnic Bay Jetty. The most dominant substrate is silt covering 42.5% of the substrate. Rock was also dominant with a percentage cover of 35%. 71.4% of rock surface was covered in turf algae and there was an absence of coralline algae (figure 3.9). Hard coral and sand were equal in percentage cover at 7.5%. Hard coral were encrusting and massive species. Macroalgae was present at this site and covered 2.5% of the substrate. Sponge covered 5% of the substrate with equal proportions of encrusting and normal species.

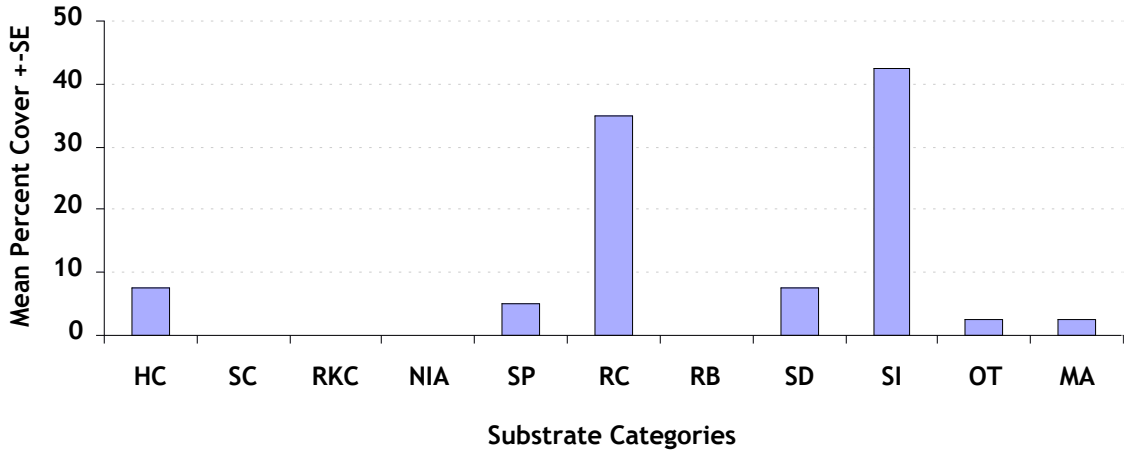


Figure 3.8 *Percent Cover of Substrate for Picnic Bay Jetty 2005 (3m depth).*

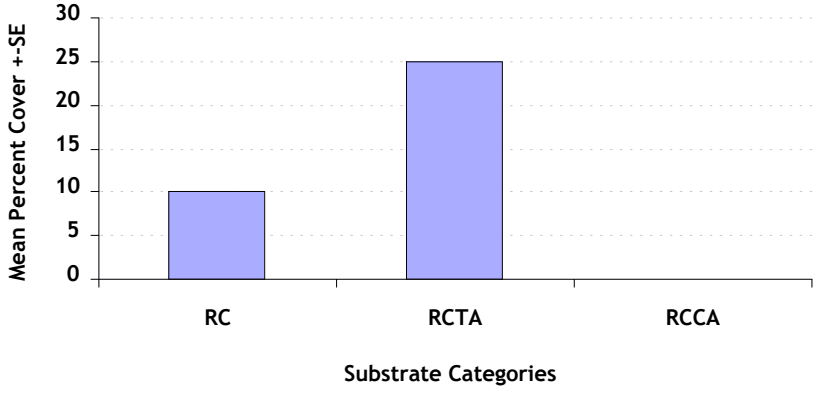


Figure 3.9 *Mean percentage cover of Rock sub-categories at Picnic Bay Jetty 2005 (3m depth).*

3.3.2 Invertebrates and Impacts

A small abundance of invertebrates were found at this site, 2 giant clams and 1 *Stichopus variegatus* (Spotted dick). There was no scars form *Drupella*, Crown-of-thorns starfish or physical damage relating to human activities. There was no bleaching or disease recorded.

The major impact that this survey recorded was a large quantity of trash around the jetty, a total of 23 pieces ranging from fishing line to beer cans.

3.4 ALMA BAY

3.4.1 Substrate Survey

The dominant substrate categories in 2005 were hard coral and rock at 34.7% and 29.1% respectively. Sand and silt were also dominant in 2005 with similar percentage cover of 11.3% for sand and 10.6% for silt (figure 3.10). Macroalgae was observed to be present at Alma to a high extent (plate 3.14).

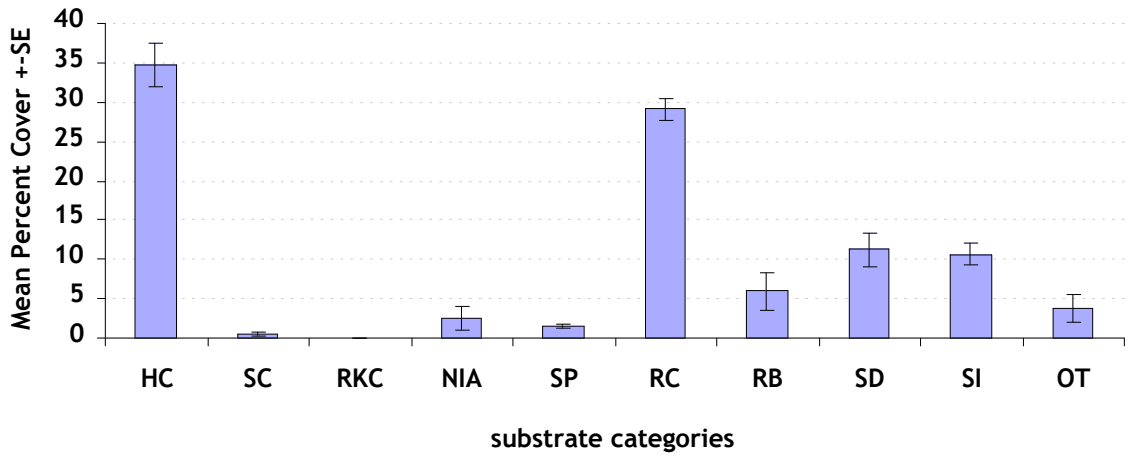


Figure 3.10 *Mean Percent Cover of Substrate for Alma Bay 2005 (5m depth).*

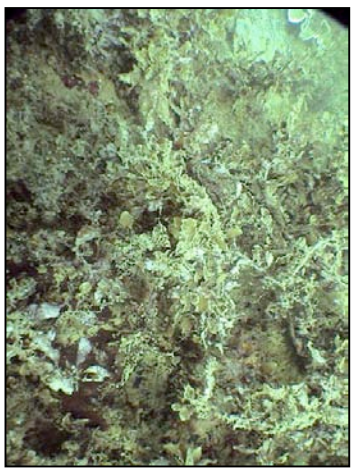


Plate 3.14 *Sargassum species, macroalgae at Alma Bay 2005 at a depth of 5m*

There was a small percentage of bare rock, 2.2%. The mean percent cover of coralline algae and turf algae was 12.2% and 14.7% respectively (figure 3.11 and plate 3.15).

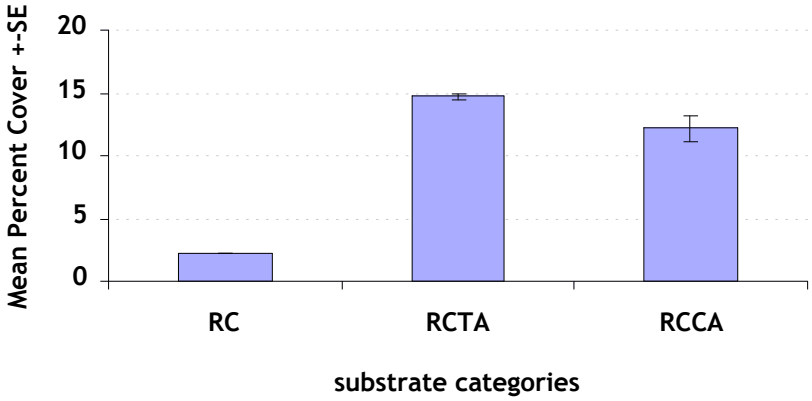


Figure 3.11 *Mean percent cover of rock, coralline algae and turf algae for Alma Bay in 2005 (5m depth).*

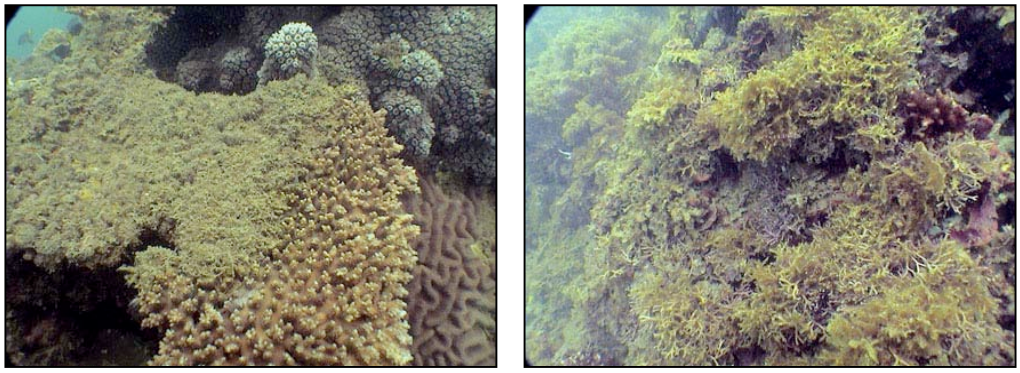


Plate 3.15 *Turf overgrowing hard coral (left and coralline algae (right).*

3.3.2 Invertebrates and Impacts

Only a low abundance of the Reef Check indicator species of invertebrates was recorded. A mean abundance of one Trochus was found per 100m^2. There was a mean of 1.5 *Drupella* per 100m^2. This correlates with the extent of scarring on coral caused by these coral-eating snails with an average of 0.25 scars (plate 3.16).

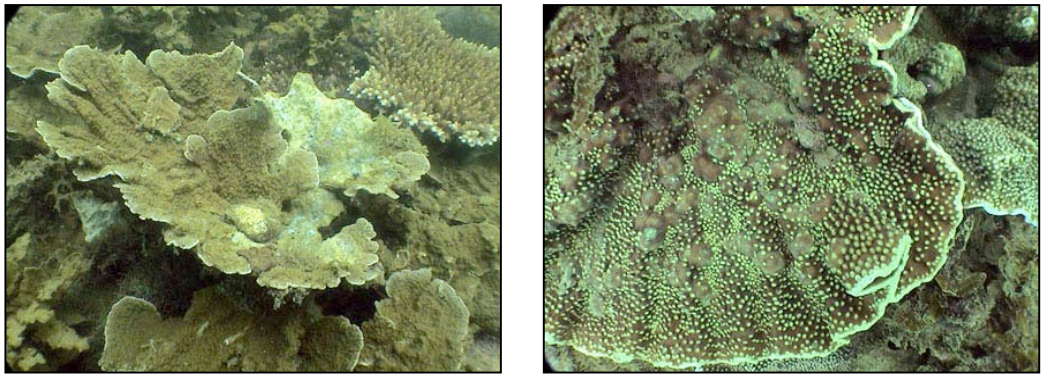


Plate 3.16 *The coral eating snail Drupella on folise hard coral.*

The degree of bleaching also increased from 2004 to 2005 and disease was found to be present in 2005. Mean observed physical damage, including damage by boats and anchors was 2.25 incidences per 100^2m.

3.4 NELLY BAY

3.4.1 Substrate

The dominant substrates in 2003 were hard coral, nutrient indicator algae and sand. Hard coral remained dominate in 2005 and increased to 56.9% from 38.4% in 2003. Rock was also dominant in 2005 at 13.1%, an increase from 9.4% in 2003. Nutrient Indicator algae decreased to 3.1% in 2005 from 19.1% in 2003. Likewise sand decreased to 0.6% from 26.3% in 2003. A high percentage cover, 13.4% of other species, which are not Reef Check indicators, was recorded in 2005. This cover could be made up of other types of algae, e.g. *Halimeda*, or invertebrates. There was a decrease of soft coral of from 1.3% in 2003 to 0.3 in 2005. Sponge remained unchanged at 0.6% cover. Silt was an absent from silt in 2003 and 2005 (figure 3.12).

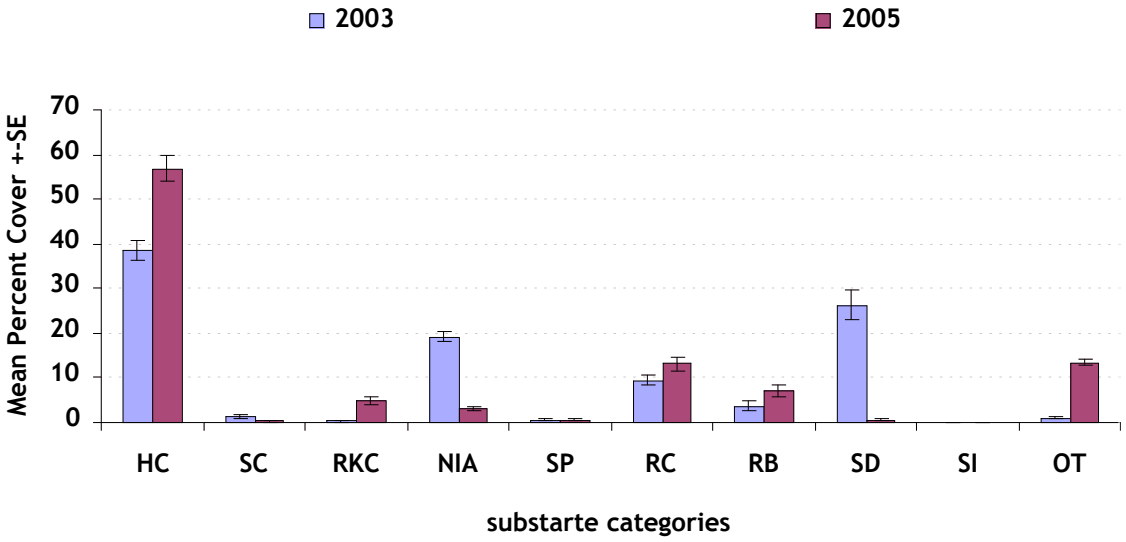


Figure 3.12 *Mean percent Cover of Substrate for Nelly Bay 2003 (5m depth) compared to Nelly Bay 2005 (5m depth).*

Recently killed coral was higher in 2005. In 2003 all recently killed coral was bare whereas in 2005 73.3% was covered in turf algae. The remaining surface of recently killed coral had an equal percentage of bare and covered in corralling algae (figure 3.13). Results for rock were similar in that in 2003 all rock was bare whereas in 2005 71.4% was covered in turf algae. Only 2.4% of the rock in 2005 was covered with coralline algae (figure 3.14).

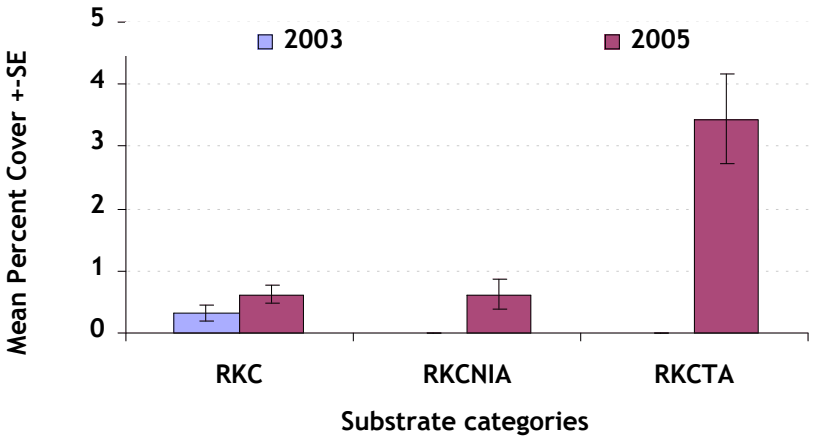


Figure 3.13 *Mean percent cover of recently killed coral that was bare, covered in nutrient indicator algae and covered in turf algae for Nelly Bay in 2003 (5m depth) and 2005 (5m depth).*

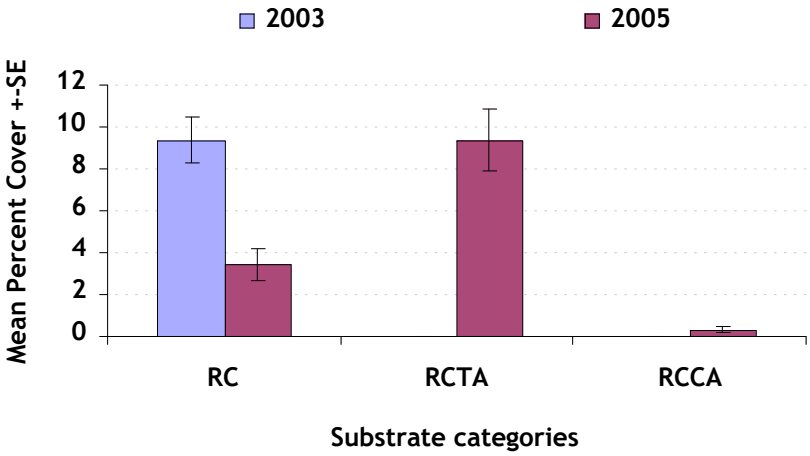


Figure 3.14 *Mean percent cover of rock, coralline algae and turf algae for Nelly Bay in 2003 (5m depth) and 2005 (5m depth).*

3.4.2 Invertebrates and Impacts

Table 3.3 compares the results from the invertebrate and impacts surveys in 2003 and 2005. With the exception of *Drupella,* none of the species of Reef Check indicator invertebrates were found at this site in either 2003 or 2005. Additionally no trash was found.

Table 3.3 *Mean numbers of invertebrates found in a 100m^{2}area during the 2003 and 2005 surveys.*

.

	2003	2005
Drupella	0	3
Drupella Scars	0	2
% of coral population bleached	0.27	0.25
Other scars	0	1.627
Other damage	0.625	2.5

3.5 GEOFFREY BAY

3.5.1 Substrate

Sand, rubble and nutrient indicator algae were the dominant substrates in 2003 at Geoffrey Bay with mean percentage covers of 21.9%, 21.3% and 18.1% respectively. These substrates decreased in 2005 to 1.6%, 7.2% and 3.1%. Hard coral, rock and silt were dominant in 2005 with mean percentage covers of 28.1%, 43.8% and 9.4% respectively (figure 3.15).

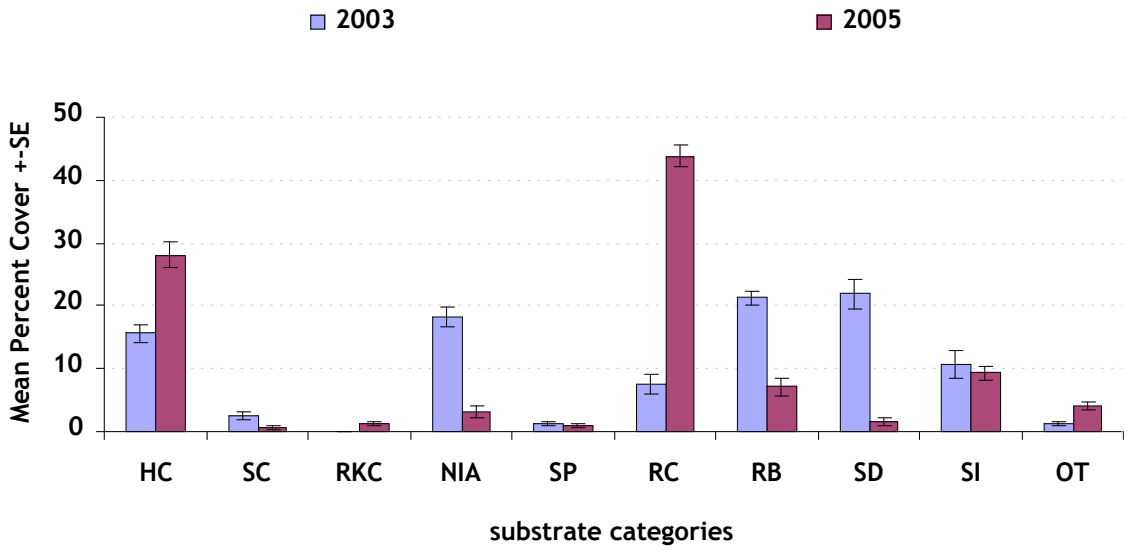


Figure 3.15 *Mean Percent Cover of Substrate for Geoffrey Bay 2003 (3.5m depth) compared to Geoffrey Bay 2005 (5m depth).*

Rock increased from 7.5% in 2003 as loose rubble had been cemented together by coralline algae. The percentage of rock covered in coralline algae was 70.8% and turf algae was 27.3%. The rest was bare rock. In 2003 all rock was bare (figure 3.16).

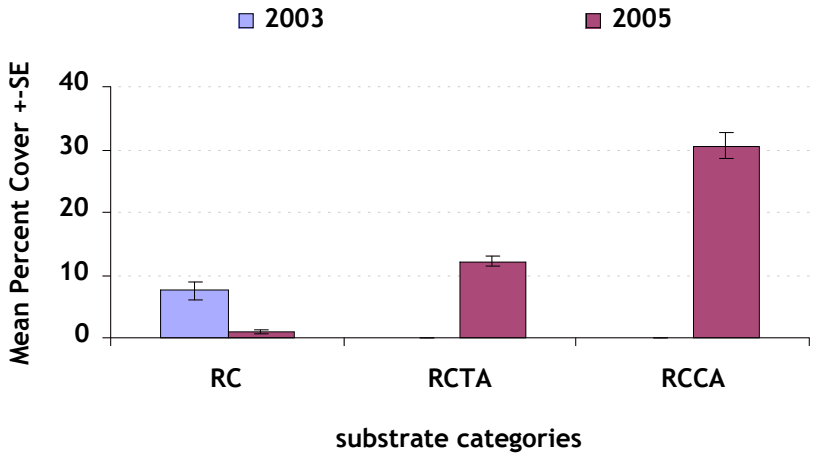


Figure 3.16 *Mean percent cover of rock, coralline algae and turf algae for Geoffrey Bay in 2003 (3.5m depth) and 2005 (5m depth).*

Macrolagae was also observed at this site (plate 3.17).

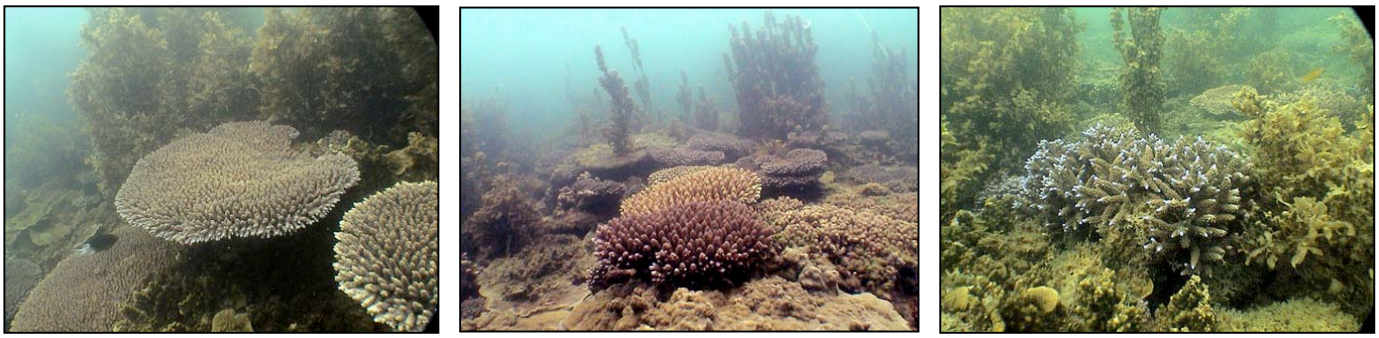


Plate 3.17 *Macroalgae, Turbinaria sp. and Sargassum sp., and plate and branching hard coral.*

3.5.2 Invertebrates and Impacts

Again, with the exception of *Drupella* no Reef Check Australia species were found at this site in either 2003 or 2005. Table 3.4 compares the results of scarring, *Drupell*a abundance, bleaching and trash at Geoffrey Bay in 2003 and 2005. A small section of coral was observed to be damaged (see plate 3.18).

Table 3.4 *Mean numbers of invertebrates found in a 100m^2 area during the 2005 and 2006 surveys.*

	2003	2005
Drupella	0	1.167
Drupella Scars	0	0.417
% of coral population bleached	0	0.25
Other scars	0	0.083
General trash	0	0.083

***Plate 3.18**. Coral damage at Geoffrey Bay 2005: Broken pieces coral possible caused by diver damage. Turf algae at bottom of plate.*

4. DISCUSSION

This report provides the base-line data for the establishment of a long-term monitoring program for the coral reef communities of Magnetic Island. The main objective of this project was to engage Townsville community members in providing a quantitative description of the coral communities, in terms of substrate cover, invertebrates and impacts. These long-term monitoring surveys will help us to understand the natural variability and long-term trends in the coral reefs and provide managers and community stakeholders with an early warning of any threats to ecosystem health (e.g. large scale disturbances and/or human activities).

Hard coral cover was found to be a dominant substrate at all sites except Picnic Bay Jetty were cover was low (7.5%) and a silty bottom dominated. Hard coral cover was highest at Middle Reef Slope, 44.2% in 2005 and a similar 45.6% in 2006. These results correspond with a 40% cover recorded by the AIMS LTMP surveys of the Middle Reef slope during 2005.

At Picnic Bay, observed hard coral cover increased by 8.1% between the winter and summer surveys. Because of the small time-period between surveys much of this increase is probably due to slight differences in where the transects were laid between each survey period. Reef Check recommend that observed differences of 5% be discounted as real change and differences of up to 10% be interpreted with care. Maps of each survey site showing the location of the transects are drawn to repeat monitoring, however the data collected would be more precise if permanent transects were used.

Observed mean percent cover of hard coral increased at Nelly Bay by 18.5% between 2003-5 and at Geoffrey Bay by 12.1%. Again some of the differences may be attributed to the transect being laid in a slightly different place, however it is clear that hard coral has increased at these sites.

Rock cover was also found to be a dominant substrate at all the sites surveyed. All rock was predominantly covered in turf algae with the exception of Geoffrey Bay where the rock was covered in coralline algae. Coralline algae are important as they can facilitate coral settlement and therefore promote coral recruitment (Belliveau and Paul, 2002). It is apparent that coralline algae has cemented together much of the rubble that was observed in 2003. When rubble is consolidated together it becomes a more stable platform for coral recruits than loose rubble.

One of the most visible consequences of anthropogenic impacts on coastal coral reefs is sediment pollution. Sediment on coral reefs near urban centers and ports can often be attributed to coastal development, dredging, beach replenishment and mining (Richmond, 1993). High silt levels were observed at all sites except Nelly Bay where coral cover dominated. Silt however was present in

this bay in-between coral reef. At Picnic Reef and Geoffrey Bay silt levels increased from each survey period. Furthermore, all turf algae at Middle Reef and Picnic Bay in 2006 was laden with silt. Silt, as a result of sedimentation, can reduce hard coral cover by smothering the coral and by inhibiting the settlement of coralline algae and future coral recruits. Juvenile survival and growth rates also tend to be lower in areas that receive high sediment loads (Maragos, 1993; Richmond, 1993). Likewise when turf algae holds silt it also inhibits the settlement of coral recruits. In future surveys it will be useful to look for coral recruits to determine settlement levels. Studies have also shown that suspended sediments decrease the quality and quantity of incident light levels, resulting in a decline in the photosynthetic productivity of zooxanthellae (Dallmeyer *et al.,* 1982). Because of the dependency of coral on zooxanthellae, such a decrease in algal productivity causes a requisite drop in the nutrition, growth, reproduction and depth distribution of corals (Richmond, 1993). Recent development and channel dredging over the past few decades at Magnetic Island and Townsville Port may account for the high silt levels observed. If permanent transects can be put in place for this program to continue long-term, silt traps could also be deployed to measure the sediment loads reaching the survey sites.

Macroalgae was observed throughout the survey sites. Cover was highest at Picnic Bay with the dominant macroalgae being *Sargassum* sp. and *Turbinaria* sp. In Nelly Bay, Geoffrey Bay and Picnic Bay, Nutrient Indicator Algae (NIA) decreased to a low cover from each survey period. Low cover was also observed at Middle Reef slope and Alma Bay. Macroalgae was highest on the Middle Reef flat at 18.1%. As these algae levels can be expected to change with the seasons (we expect higher levels in the summer), long-term monitoring can provide us with a better understanding of how algae levels change with seasons and over time. Macroalgae can also be an indicator of nutrient enrichment associated with sewage pollution (Hodgson, 1999). If NIA and macroalgae were to increase then they could have a detrimental effect as they can out-compete corals for space and thus inhibit the recruitment of future coral larvae, further endangering the ability of coral to survive (Lapointe *et al*., 1997; Belliveau and Paul, 2002). The entrapment of sediment by macroalgae or NIA can also inhibit coral recruitment.

All sites surveyed were observed to have a very low cover of recently killed coral, most of which was attributed to low predation levels by *Drupella* snails. Throughout all survey sites invertebrates were observed in very low abundances. The majority of invertebrates were the long-spined sea urchin (*Diadema*) and the coral eating *Drupella* snail found at Middle Reef and Picnic Bay. *Drupella* was also observed at Alma Bay and during the 2005 surveys at Nelly Bay and Geoffrey Bay. No *Drupella* was observed at Picnic Bay Jetty but coral cover was extremely low here. The highest abundance of *Drupella* were found at Middle Reef during the summer and winter surveys. Levels of predation were low at all sites. However, when high levels are observed they can cause extensive loss of coral tissue and colony mortality have been recorded (Turner 1994).

Bleaching was observed to be low at all sites except Picnic Bay Jetty where no bleaching was observed. Bleaching is a stress response of hard corals and can occur from low tides or high silt levels, as well as from high sea surface temperatures which is now a common occurrence on coral reefs around the world during the summer months which is attributed to increased use of fossil fuels. Bleaching of hard coral was highest at Picnic Bay increasing from 0.8% in the winter to 5.7% in the summer. The incidence of bleaching corresponded with an increase in SST from approximately 27°C to 31°C (Australia Government Bureau of Metrology). Interestingly only the *Porites* sp. (massive) were affected by partial bleaching. This is concerning as massive *Porites* colonies may be hundreds of years old and are therefore ecologically important species in building the reef. The observed bleaching regime indicates that the other coral species (dominated by *Acropora*, *Montipora* and *Turbinaria* sp.) were more resistant to heat stress than the *Porites*.

A small amount of coral damage was observed at Picnic bay, Nelly Bay and Middle Reef. The damage at Middle Reef was mainly attributed to anchor damage. Such damage impacts may be related to the high numbers of recreational fishers that frequent the coral reef areas of Magnetic Island. It might be worthwhile providing public information on the coral reef sites around Magnetic Island and advice on minimising damage to coral through responsible use of anchors.

A major impact observed at Picnic Bay Jetty was the large quantities of trash recorded at the site. On Sunday 5th March 2006 ("Clean Up Australia Day"). Reef Check Australia collaborated with Adrenalin Dive, Sunferries and the North Queensland Underwater Explorers Club (NQUEC) on an official Project AWARE Reef clean up at Picnic Bay Jetty. More than 40 Reef Check and NQUEC volunteer divers worked to remove harmful marine debris, including fishing tackle, nets and plastic bottles, from the underwater reef areas around Picnic Bay Jetty (see Appendix 2 for more details).

5. CONCLUSIONS

The hard coral populations around Magnetic Island are spectacular and much appears very healthy. However, there are high silt loads in the area, which may affect the health of corals in the future. The continuation of the Reef Check community monitoring program on Magnetic Island reefs will provide a way for the local community to keep an eye on the health of this area and report to local and regional management and the general public. We recommend that permanent transects be put in place to increase the precision of surveys as well as establishing sediment traps to determine sediment loads from nearby anthropogenic activities. Incidence of anchor damage represents another potential threat to coral populations. The provision of public information on the coral reef

sites around Magnetic Island and advice on minimising damage to coral through responsible use of anchors may provide an avenue to reduce this type of damage.

REFERENCES

Bell,R.A. and Kettle,B.T. 1989. The Coastal Resources of Magnetic Island. DRAFT.

Belliveau, S.A. and Paul V.J. 2002. Effects of herbivory and nutrients on the early colonization of crustose coralline algae and fleshy algae. Marine Ecology Progress Series. **232**: 105-114.

Dallmeyer, D.G., Porter, J.W. and Smith, G. J. 1982. Effects of particulate peat on the behaviour and physiology of the Jamaican reef-building coral *Montastrea annularis*. *Maine Biology*. **68**:229-233. DDNREC (Delaware Department of Natural Resources and Environmental Control).

Hodgson, G. 1999. A global assessment of human effects on coral reefs. *Marine Pollution Bulletin*. **38**(5): 345-55.

Lapointe, B.E., Littler, M.M. and Littler, D.S. 1997. Macroalgal overgrowth of fringing coral reefs at Discovery Bay, Jamaica: bottom up versus top down control. *Proceedings of the 8th International Coral Reef Symposium* **1**: 927-932.

Maragos, J. 1993. Impact of coastal construction on coral reefs in the U.S.- affiliated Pacific islands. *Coastal Management*. **21**: 235-269.

Richmond, R.H. 1993. Coral reefs: present problems and future concerns resulting from anthropogenic disturbance. *American Zoology*. **33**: 524-536.

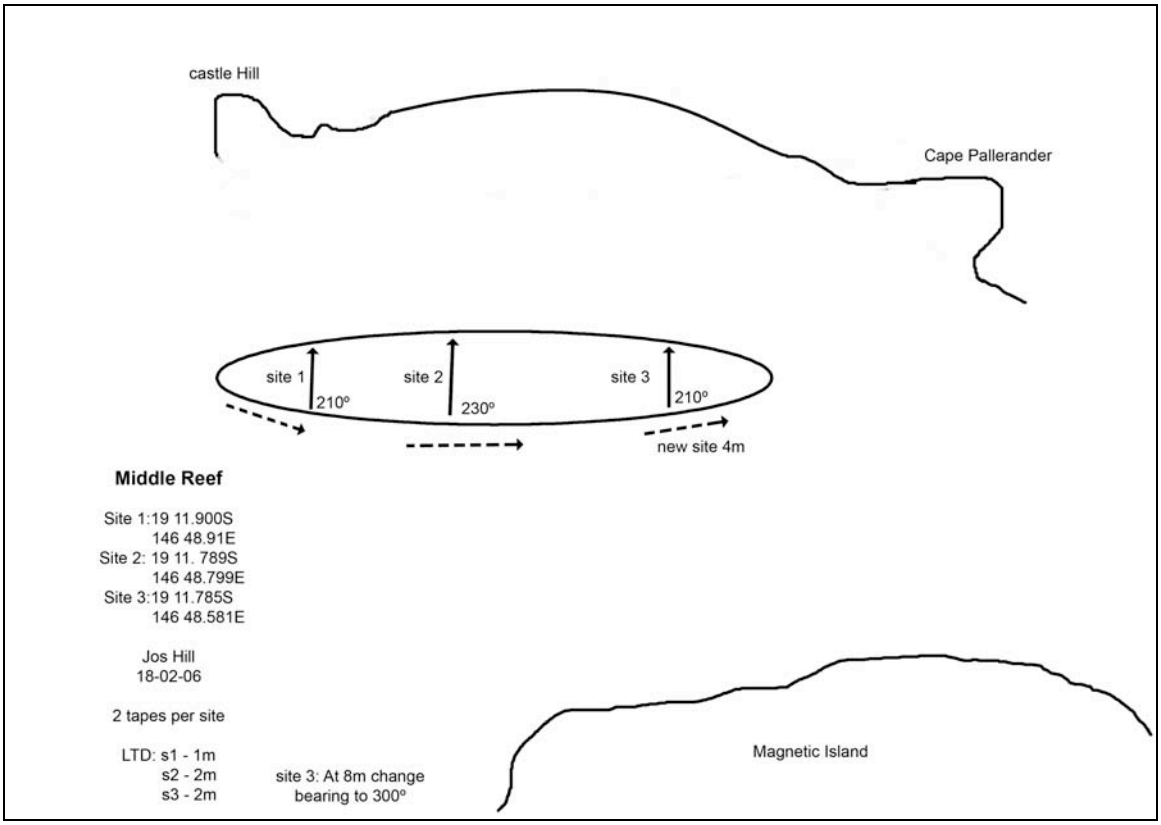
Sweatman, H., Burgess, S., Cheal, A., Coleman, G., Delean. S., Emslie, M., McDonald, A., Miller, I., Osborne, K. and Thompson, A. 2005. Long-term Monitoring of the Great Barrier Reef. Australian Institute of Marine Science (AIMS). Status report 7.

Turner, S.J. 1994. The biology and population outbreaks of the corallivorous gastropod *Drupella* on Indo-Pacific reefs. *Oceanography and Marine Biology Annual Review*. **32**: 461–530.

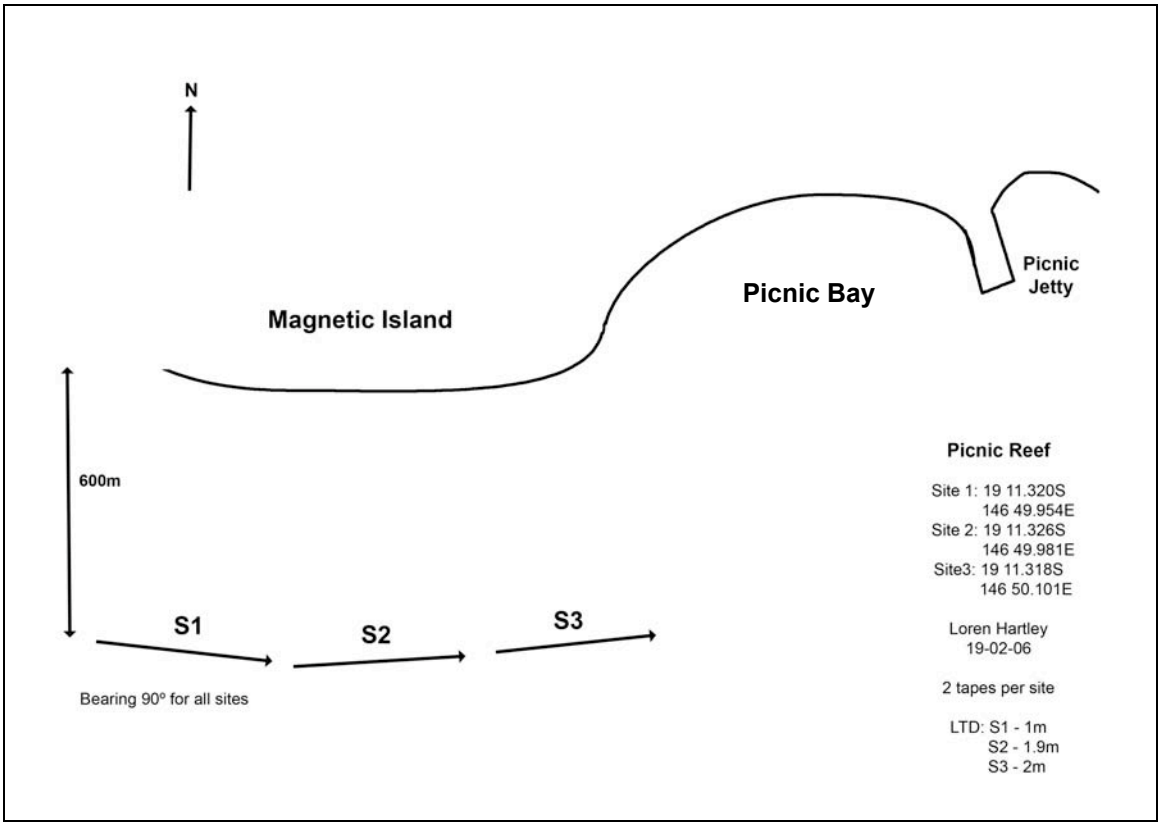
www.bom.gov.au Australian Government Bureau of Meteorlogy.

APPENDIX 1

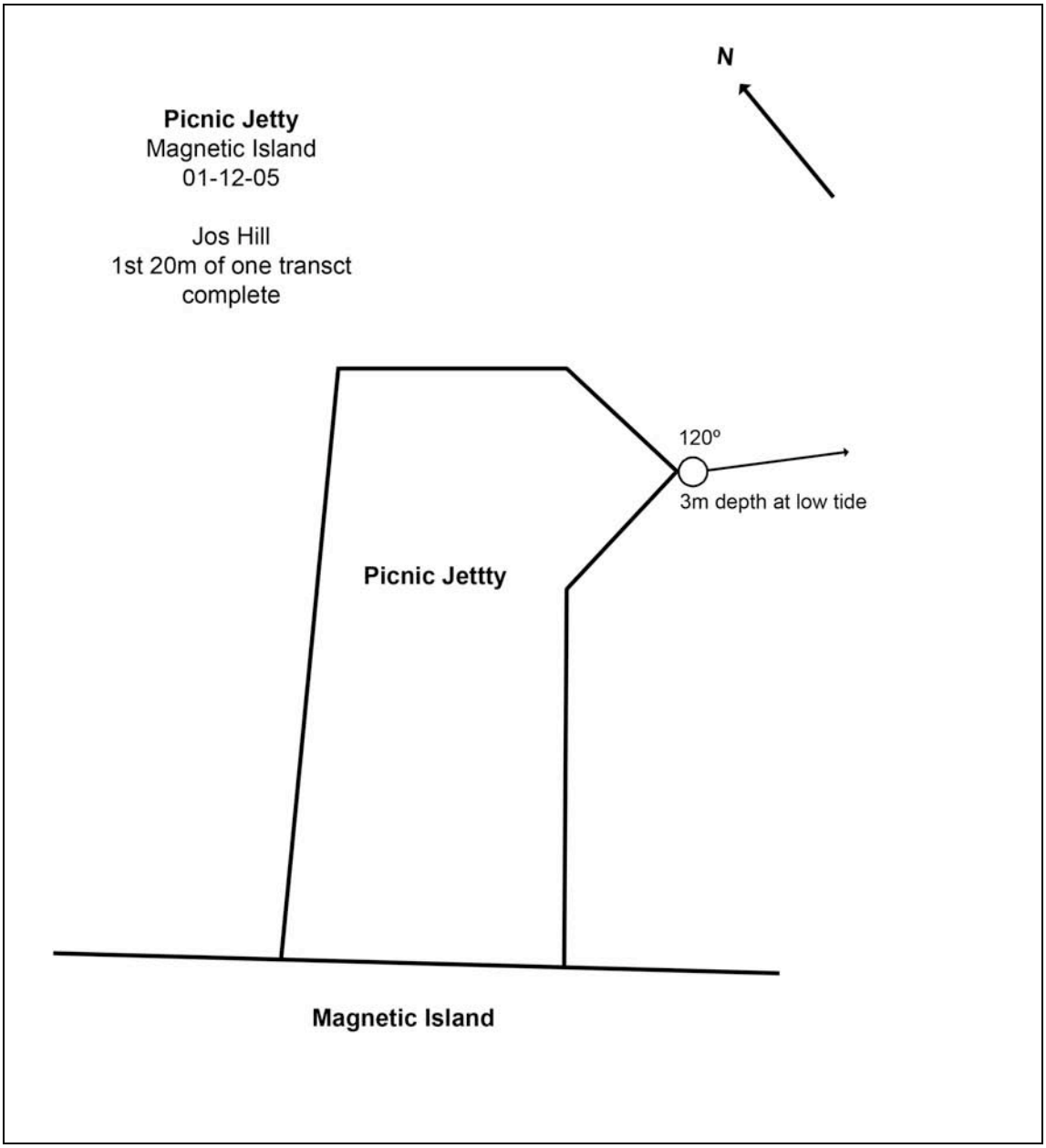
Maps illustrating the location of the transects at each survey site around Magnetic Island



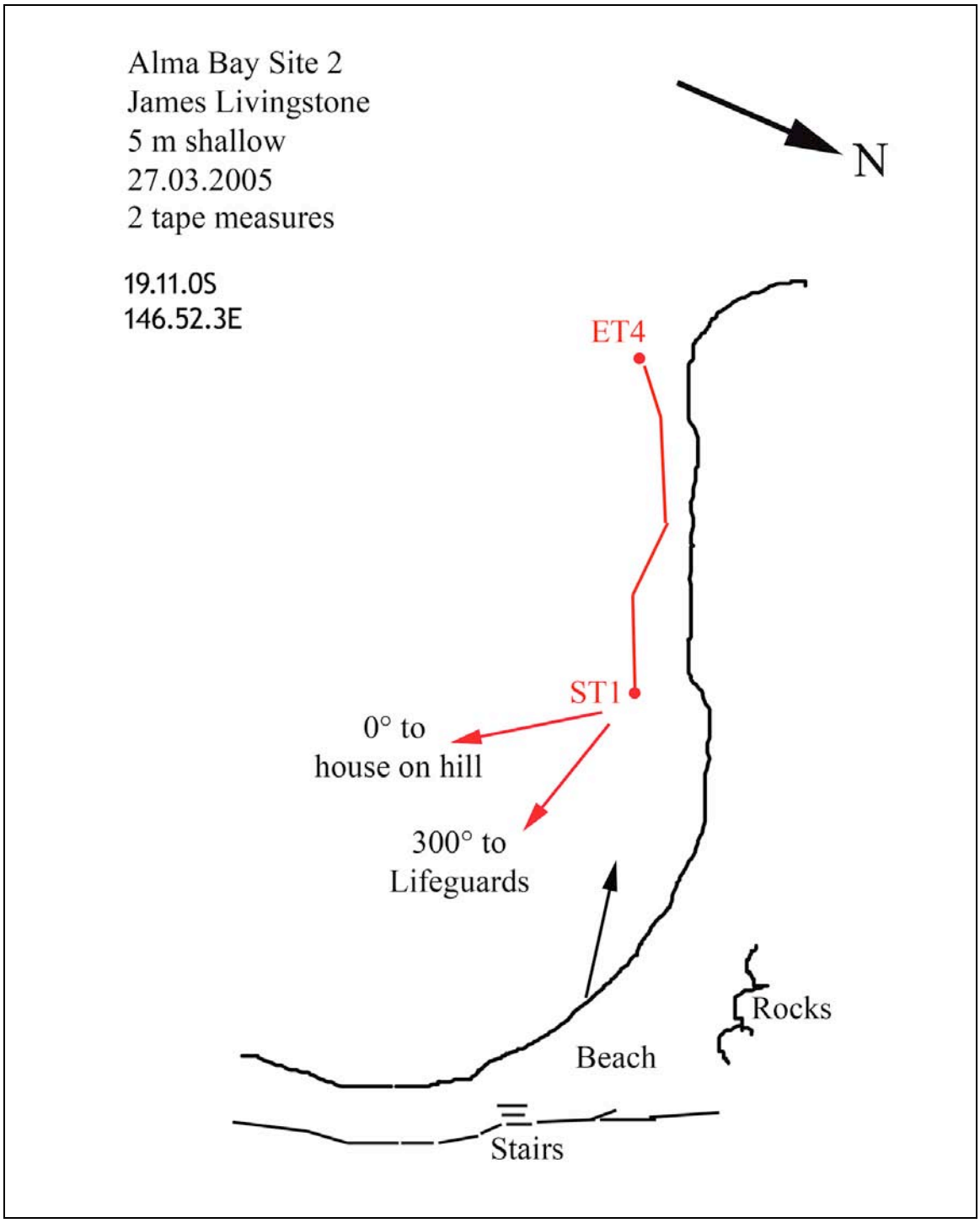
***Map 1**: Middle Reef*



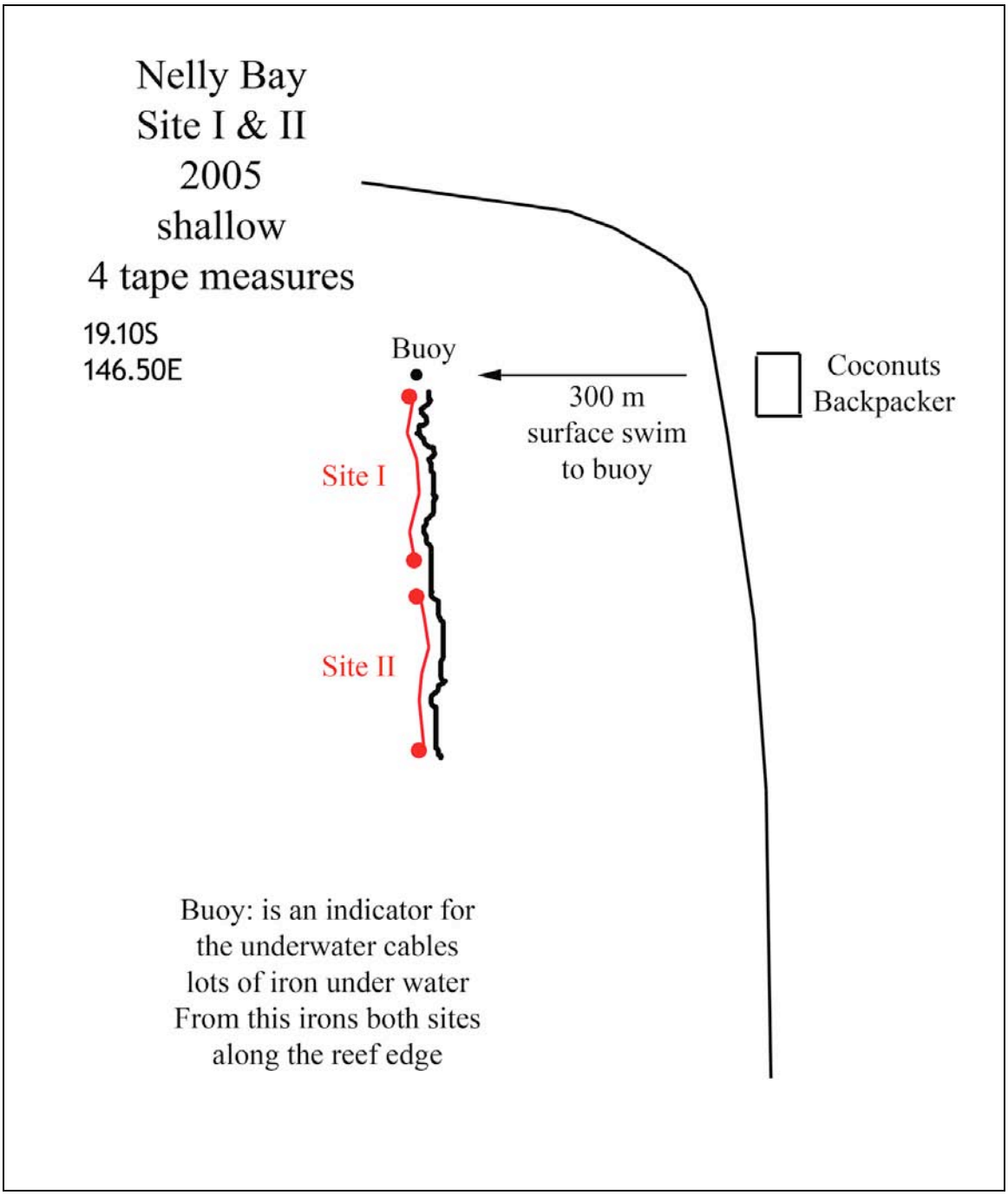
Map 2: *Picnic Bay Reef*



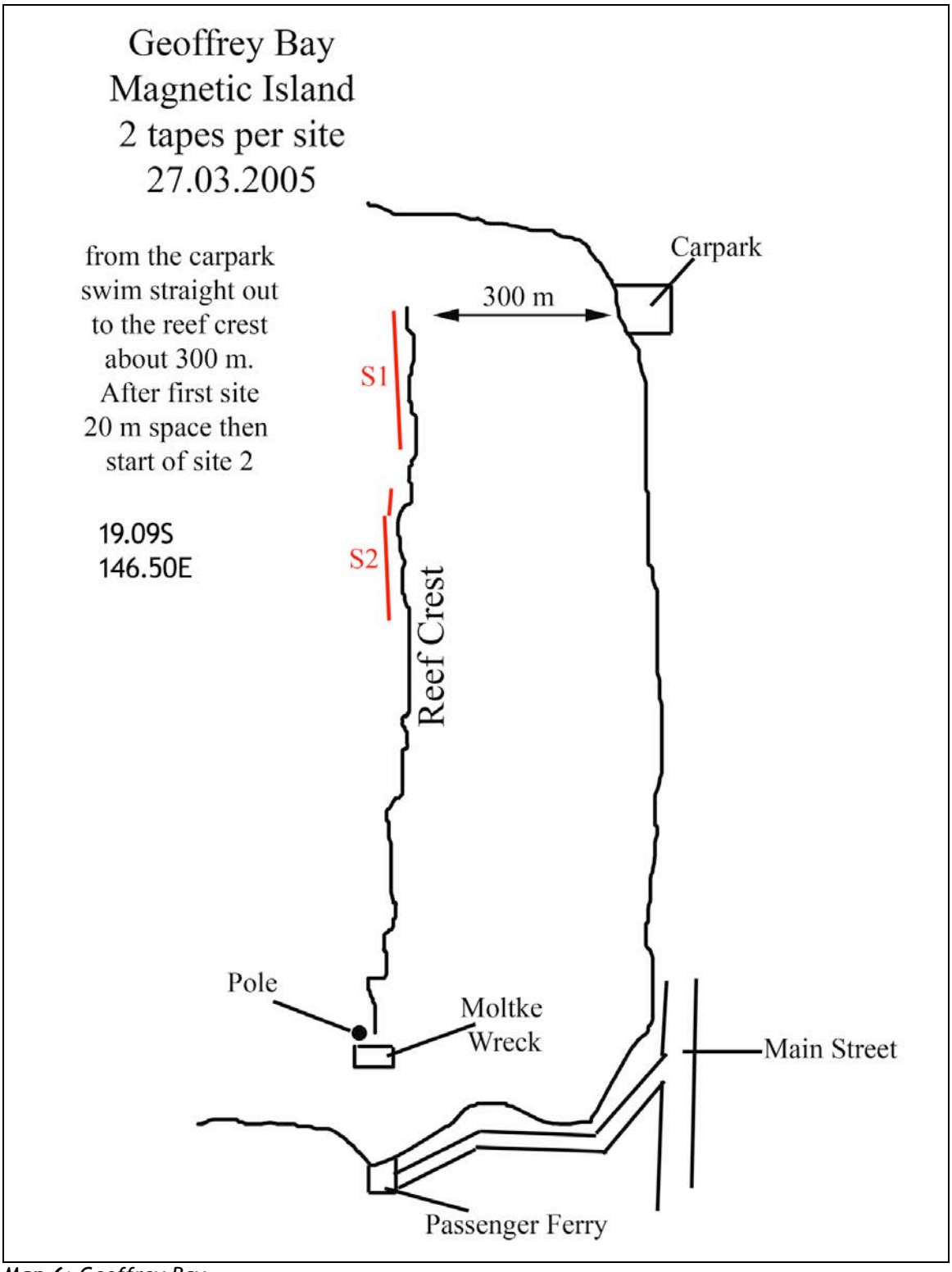
Map 3: *Picnic Bay Jetty*



Map 3: *Alma Bay*



***Map 5**: Nelly Bay*



***Map 6**: Geoffrey Bay*

APPENDIX 2

Reef Relief: Community Volunteers Resuscitate Maggie.

CLEAN UP AUSTRALIA DAY ~ Sunday 5th March 2006

Community Partnership: Reef Check Australia, Adrenalin Dive, Sunferries and the North Queensland Underwater Explorers Club (NQUEC) are pleased to announce that as part of their commitment to Clean Up Australia Day they joined forces on an official Project AWARE reef cleanup at Picnic Bay on Magnetic island. More than 40 Reef Check and NQUEC volunteer divers worked in 'buddy' pairs to remove harmful marine debris from the underwater reef areas around Picnic Bay jetty.

Community Initiative: The cleanup was prompted by the findings of a recent inshore monitoring program survey conducted by Reef Check and funded by Townsville City Council's Creek to Coral initiative. The survey team found hazardous debris including fishing tackle, nets and plastic bottles at the Picnic Bay site. Wearing full wetsuits and thick gloves for protection the clean up volunteers removed car tyres, bottles, fishing tackle and even a discarded outboard motor from around the coral encrusted jetty pylons and reef outcrops. On a positive note despite the debris the divers reported good fish and coral life across the Bay and a reduction in the overall amount of rubbish collected compared to previous years.

The **"Don't Let Rubbish Become Part of the Scenery"** message is sinking in.

"Community participation is the key to promoting a sense of stewardship and a duty of care for the marine environment." Australia's Ocean Policy

Community action: Reef Check is the United Nations' global community coral reef monitoring program. Our mission is to monitor the health of the world's reefs, educate the public about coral ecosystems and empower local communities to conserve them. In Australia Reef Check is the ONLY community based organisation that actively trains local people to participate in monitoring the health of the GBR.