STATUS OF REEFS AROUND MAGNETIC ISLAND: 2003 - 2007

REEF CHECK AUSTRALIA

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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 future effects of silt loading on the Middle Reef area.

Magnetic Island is a large continental island situated in Cleveland Bay 7km north of Townsville, Queensland (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 from mainland Australia.

2. METHODS

2.1 Survey Sites

A total of seven sites have been surveyed around Magnetic Island by Reef Check volunteers: Middle Reef, Picnic Bay Detached Reef, Nelly Bay, Geoffrey Bay, Alma Bay and Florence Bay. Picnic Bay Jetty was also visited by the volunteer team during December 2005. Volunteers visited Radical Bay during 2006, however insufficient coral was found to conduct a 100 m long survey.

All sites were surveyed at low tide depths between 2 metres (m) and 6 metres and so correspond to "shallow" sites in the Reef Check international protocol.

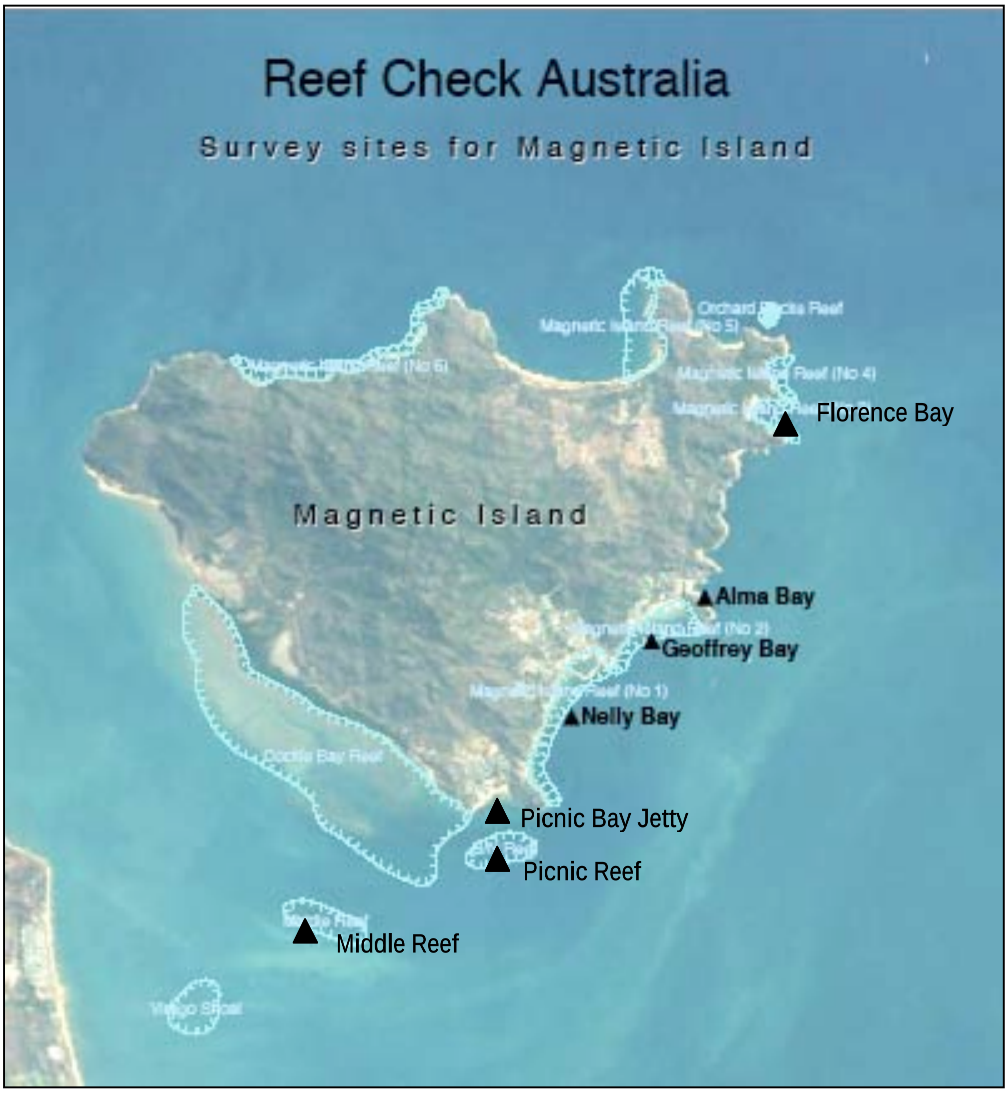

Figure 2.1 Survey sites around Magnetic Island.

Table 2.1 Specifications of survey sites.

Site Name	MP Zone	Year	GPS Coordinates	Transects Surveyed	Depth at Low Tide	Time of Year Surveyed
Middle Reef Flat	Yellow	2006	19° 11.759' S; 146° 48.999' E 19° 11.784' S; 146° 48.581' E	2	2 metres	February
Middle Reef Slope	Yellow	2007	19° 11.900' S; 146° 48.910' E 19° 11.789' S; 146° 48.789' E 19° 11.785' S; 146° 48.581' E	3	3m	September
		2006	19° 11.900' S; 146° 48.913' E	1	2m	February
		2005	19° 11.759' S; 146° 48.999' E 19° 11.784' S; 146° 48.581' E 19° 11.900' S; 146° 48.913' E	3	2m	September
Picnic Bay Detached Reef	Yellow	2007	19° 11.320' S; 146° 49.954' E	1	3m	March
		2006	19° 11.320' S; 146° 49.954' E 19° 11.326' S; 146° 49.981' E 19° 11.318' S; 146° 50.101' E	3	2m	February & October
		2005	19° 11.320' S; 146° 49.954' E 19° 11.326' S; 146° 49.981' E 19° 11.318' S; 146° 50.101' E	3	3m	October
Picnic Bay Jetty	Yellow	2005	19° 10.896' S; 146° 50.336' E	1*	3m	December
Nelly Bay	Blue	2007	19° 10' S; 146° 50' E	1	5m	March
		2005	19° 10' S; 146° 50' E 19° 10' S; 146° 50' E	2	5m	March
		2003	19° 10' S; 146° 50' E 19° 10' S; 146° 50' E	2	5m	April & June
Geoffrey Bay	Blue	2007	19° 09' S; 146° 50' E	2	3.5m	March
		2005	19° 09.160' S; 146° 51.380' E 19° 09.160' S; 146° 51.380' E 19° 09.160' S; 146° 51.380' E	3	5m	February & March
		2003	19° 10' S; 146° 50' E	1	3.5m	May
Alma Bay	Blue	2005	19° 08.535' S; 146° 52.080' E	2	5m	February & March
Florence Bay North	Green	2006	19° 07.313' S; 146° 52.850' E	1	4m	October
Florence Bay South	Green	2007	19° 07.427' S; 146° 52.710' E	1	3m	July
		2006	19° 07.487' S; 146° 52.697' E	1	4m	October

* 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, and the overall effects of poor water quality. In addition, coral damage, coral disease, coral bleaching (from global climate change), and predation from crown-of-thorns starfish and *Drupella* snails are considered. The Reef Check method differs from those used by the Australian Institute of Marine Science (AIMS) by its focus on basic human impacts rather than on fine-scale differences in community assemblages.

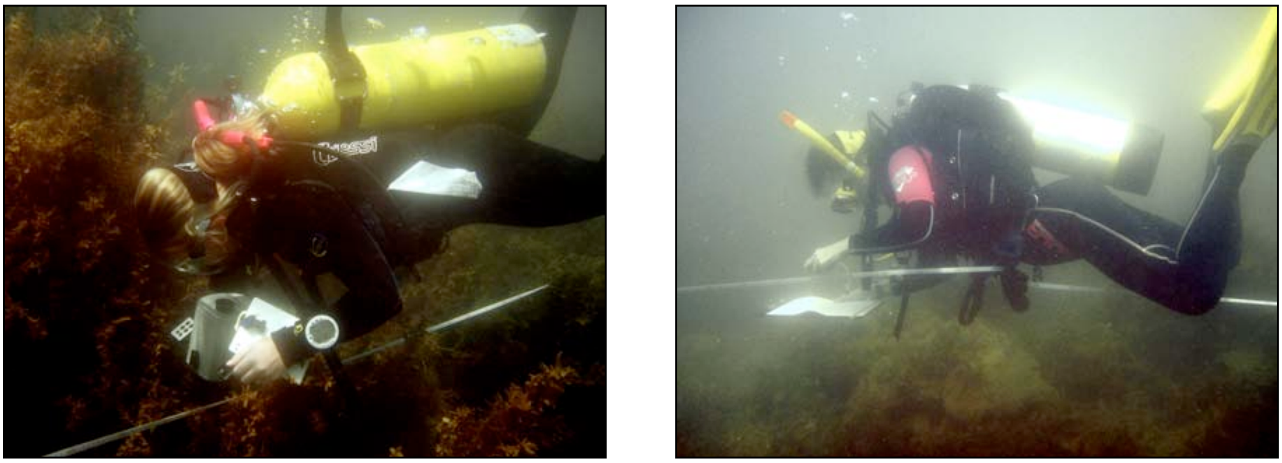

Plate 2.1 Video survey at Picnic Bay Detached Reef in 2006 with macroalgae in high abundance.

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 (not covered with algae)
ROCK	RCTA: Rock covered with Turf Algae RCCA: Rock covered with Coralline Algae RC: Rock (bare, not covered with algae)
SPONGES	SPE: Encrusting sponges SP: All other sponges
MA	Macroalgae: includes *Turbinaria* sp., *Sargassum* sp., and *Padina* sp. Where macro algae is present, observers tally its incidence along the point intercept transect as well as recording the benthic/substrate category below. The result is a % cover of macro algae that is *in addition* to a substrate % cover.
NIA	Nutrient Indicator Algae: includes algae that may proliferate in high nutrient conditions
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 bare rock it was decided to also record an observed silt loading for the site. None = no silt, Low = some silt in some RCTA but not all and not a thick layer, Medium = All RCTA with a thin silt later or some RCTA with a thick silt layer, High = All RCTA surfaces thick with silt.
SD	Sand
RB	Rubble: rock pieces between 0.5 and 15cm in diameter.
OT	Other: includes ascidians, hydroids, *Halimeda* sp. algae and other organisms 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 and 2007 (winter surveys), Middle Reef slope and flat in 2006 (summer survey). The dominant substrate categories of the reef slope found in 2005, 2006 and 2007 were hard coral (HC) and rock (RC). The percent cover of hard coral observed was similar between the three survey periods at 44.2% in 2005; 45.6% in 2006 and 46.3% in 2007. The observed percent cover of soft coral on the reef slope was 9.2% in 2005; 1.3% in 2006 and 5.9% in 2007. Coral bleaching was observed in both hard and soft corals during February 2006 and 2007. 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.

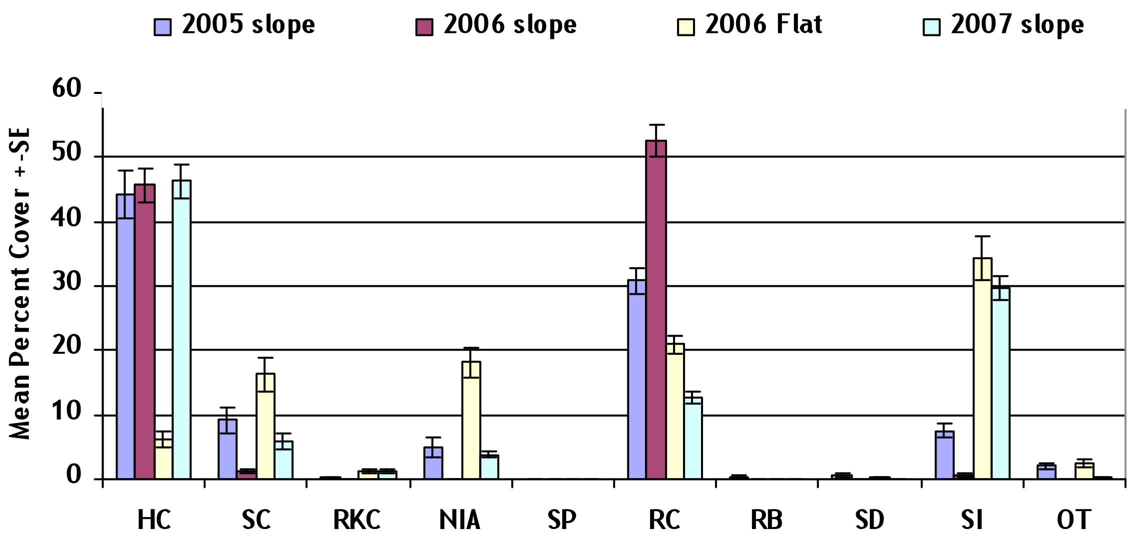

Figure 3.1 Mean Percent Cover of Substrate for Middle Reef Slope 2005 (2m depth) compared to Middle Reef Slope 2006 (2m depth), Middle Reef Flat 2006 (2m depth) and Middle Reef Slope 2007 (3m depth).

Hard coral consisted mainly of foliose and branching forms (Figure 3.2 and Plate 3.1).

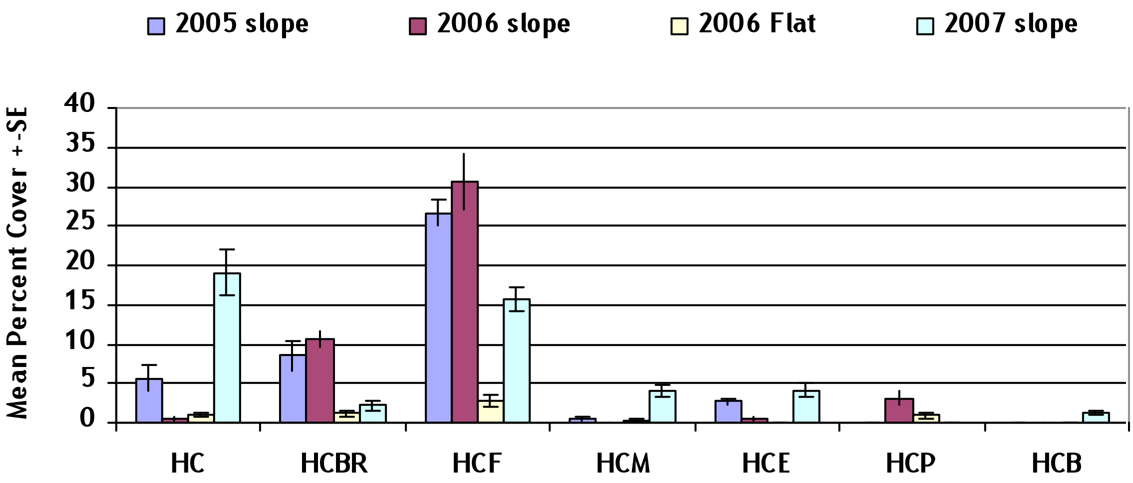

Figure 3.2 Mean Percent Cover of Hard Corals for Middle Reef Slope 2005 (2m depth) compared to Middle Reef Slope 2006 (2m depth) and Middle Reef Slope 2007 (3m depth).

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

The rock category includes turf algae (RC TA) which was heavily laden with silt (Plate 3.2, 3.3 and 3.4). Therefore, silt and turf algae figures are 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 (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. Silt loads were high. The change in the RC (rock) category is likely due to observer effects with "rock with turf algae" being recorded when the turf algae was actually laden with silt. Observers also record the horizontal visibility as ~ 2 m on all surveys and a silt loading of high at all times.

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).

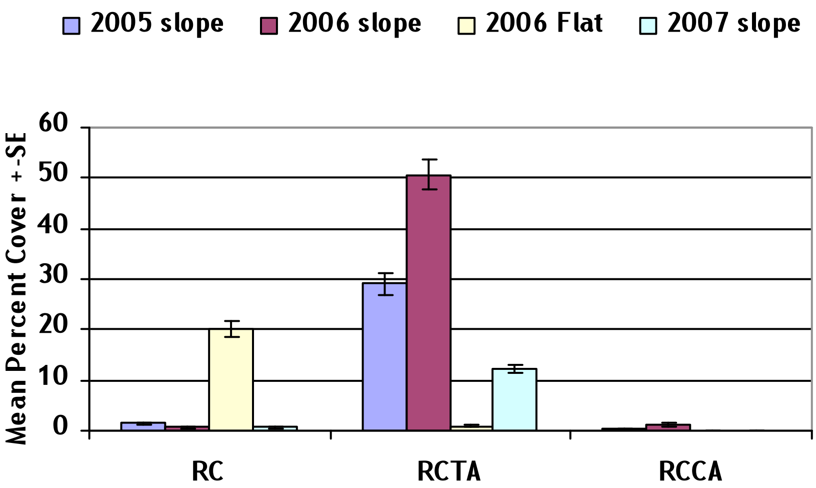

Figure 3.3 Mean Percent Cover of Rock, Turf Algae and Coralline Algae for Middle Reef Slope 2005 (2m depth) compared to Slope 2006 (2m depth), Flat 2006 (2m depth) and Slope 2007 (3m depth).

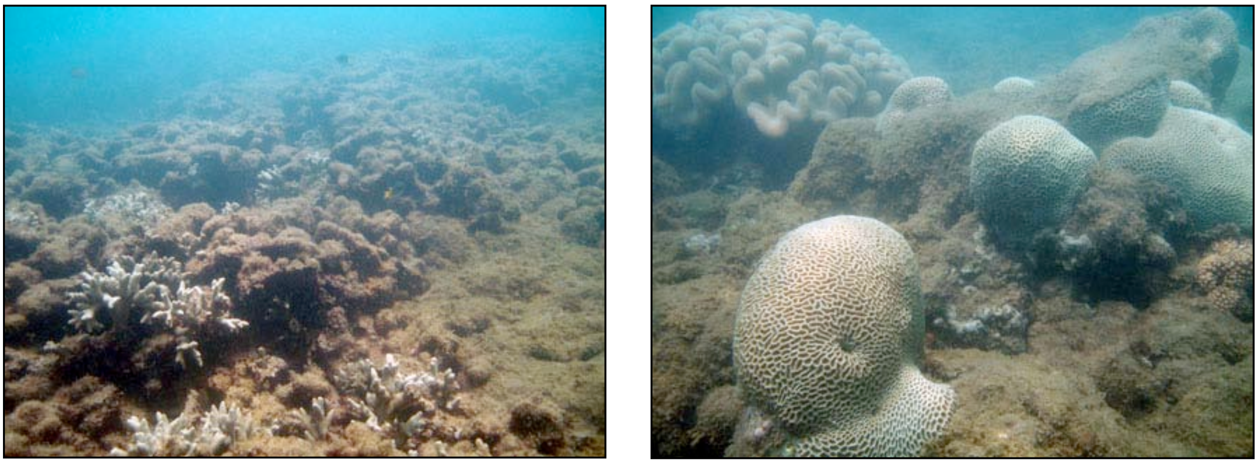

Plate 3.2 Turf algae at the reef flat of Middle Reef during 2006.

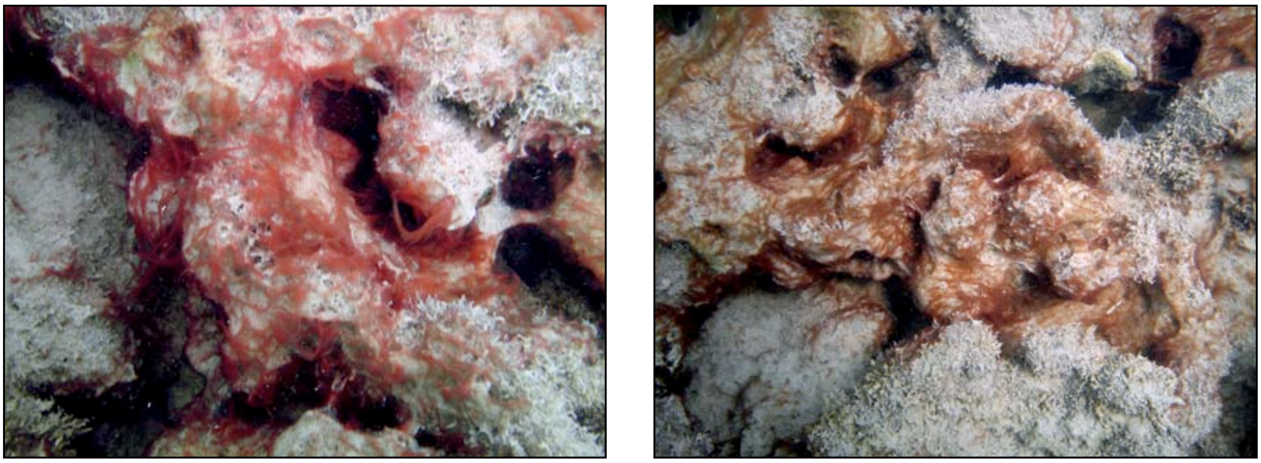

Plate 3.3 Turf algae, silt and nutrient indicator algae at the reef slope of Middle Reef during 2006.

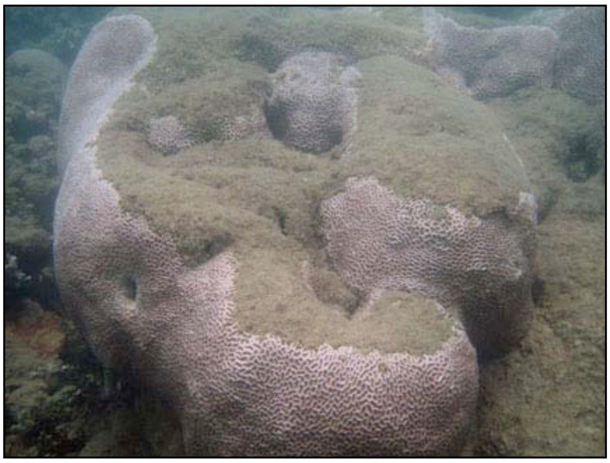

Plate 3.4 Partially dead coral colonies covered with silt-laden turf algae in 2006 (left) and small recruits of Montipora *sp. observed growing on the silty turf algae in 2005 (right).*

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) and 3.8% on the reef slope in 2007. No NIA were 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 (MA) 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 *Turbinaria* sp. in 2005, and *Padina* sp. and *Sargassum* sp. in 2006 (see Plate 3.7).

Plate 3.7 Dominant macroalgae Padina *sp. (right) found during 2006 and* Turbinaria *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	2007 Reef Slope
Long-spined sea urchin	0	0	5.5	5.5
Giant clam	0.33	0	0.5	0
Collector urchin	2	0	0	0
Drupella snail	0.33	6	5	0.5
Drupella scars	2.67	1	0.5	0
COTS scars	2.33	0	0	0
Trochus	0	0	0	0.25

Low levels of hard coral bleaching were observed both in the winter and summer surveys at <1% of hard coral (Plates 3.7 and 3.8). Soft coral bleaching was also observed during the Summer 2006 survey. 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 during the summer months.


Plate 3.7 Possible bleached hard coral and scarring observed at Middle Reef.

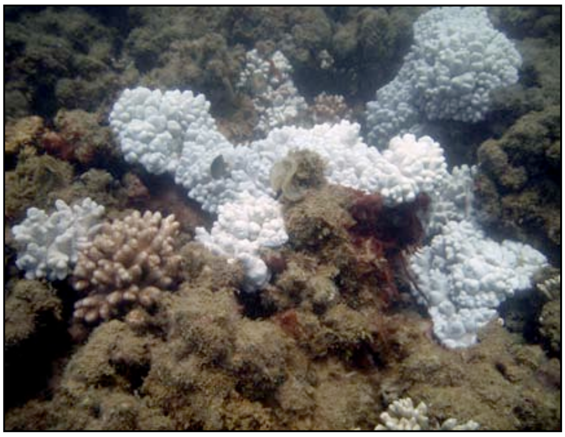


Plate 3.8 Bleached soft coral at Middle Reef 2006.

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.

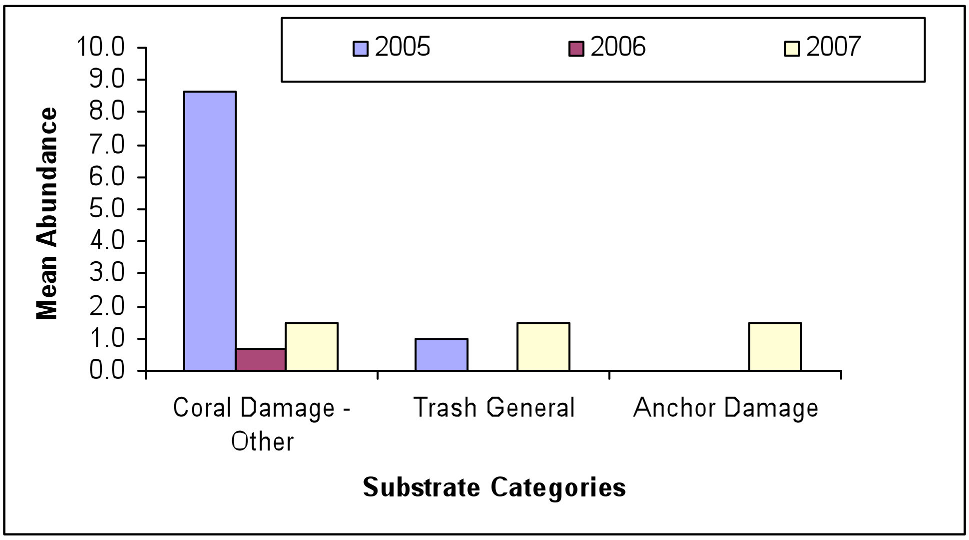

Figure 3.4 Mean Abundance of Damage Impacts for Middle Reef Slope (2m depth) 2005 compared to Slope (2m depth) 2006, Flat (2m depth) 2006 and Slope 2007 (3m depth).

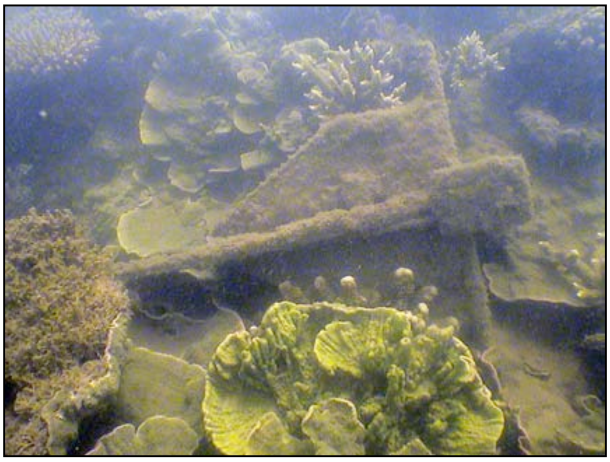

Plate 3.9 Anchor damage found at Middle Reef in 2005 (right) and 2006 (left).

3.2 PICNIC BAY REEF

3.2.1 Substrate Survey

Figure 3.2 compares the reef slope in summer from 2005 to 2007, and also in 2006 winter. The dominant substrate categories in summer were hard coral, rock, rubble and sand and in winter were hard coral and rock. Hard coral cover increased from 2005 to 2006 and reduced slightly in 2007. Conversely the percentage cover of rock decreased in the winter of 2007 from approximately 33.1% in 2006 to 22.7%. These findings differ from the results of ground truthing surveys for the Coastal Resources of Magnetic Island (CRMI) report of 1989 when the dominant substrates recorded were soft sands and mud.

Silt was not a dominant substrate in winter, 2005, at 7.9%. Sand, dominant in summer 2005 with a cover of approximately 27.5% decreased to approximately 0.4% in winter of 2007. This may represent discrepancy between observers recording the silty bottom as sand as well as differences in transect placement (Figure 3.10).

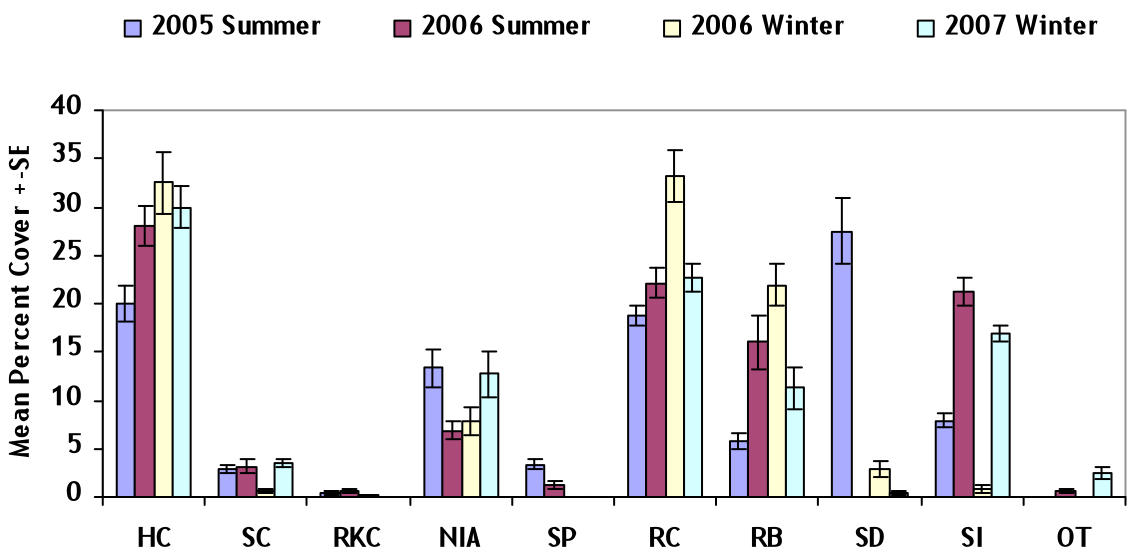

Figure 3.5 Mean Percent Cover of substrate for Picnic Bay, detached reef winter 2005 (3m depth) compared to Picnic Bay detached reef summer and winter 2006 (2m depth) and Picnic Bay Detached Reef winter 2007 (3m depth).

The percentage cover of soft coral remained similar in summer 2005 and winter 2007 with 2.9% and 3.5% respectively. Colonial Zoanthids were recorded at this site in summer, but not in winter or at Middle Reef in winter and summer (Plate 3.10).

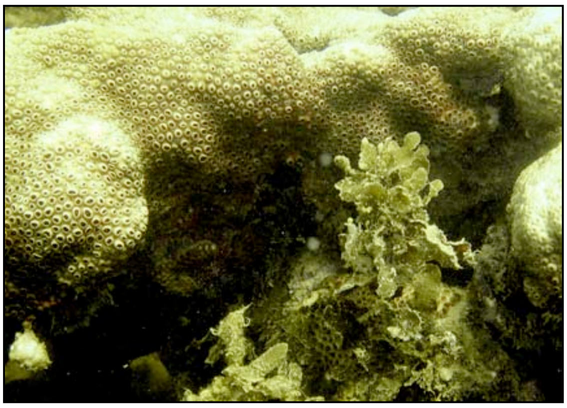

Plate 3.10 Colonial zoanthids at Picnic Bay Detached Reef in summer 2006.

Nutrient indicator algae did not increase or decrease significantly for the period 2005 to 2007, staying below 14% on each survey. 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 macroalgae had the highest mean percentage cover at 30% (plate 3.11).

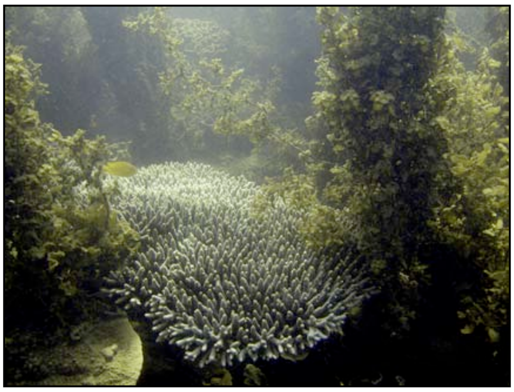

Plate 3.11 Macroalgae, Padina *sp., laden with silt (top right)* Turbinaria *sp., and* Sargassum *sp. in summer.*

There was a very small percentage of bare rock in summer 2005, 0.2% which increased to 14.6% in winter 2006 and reduced to no occurrences in winter 2007. Observed percent cover of coralline and turf algae were similar in the winter and summer (Figure 3.7 and Plate 3.12).

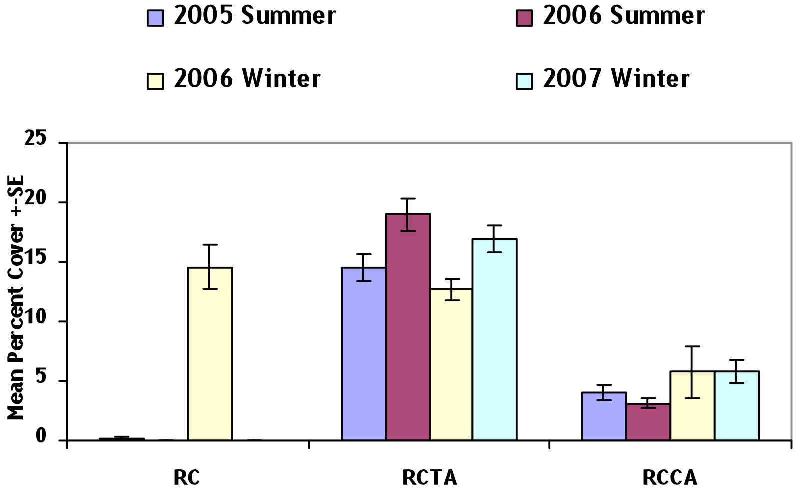

Figure 3.7 Mean Percent Cover of Rock, Turf Algae and Coralline Algae for Picnic Bay detached Reef 2005 (3m depth) compared to Picnic Bay detached reef 2006 (2m depth) and Picnic Bay detached reef 2007 (2m depth).


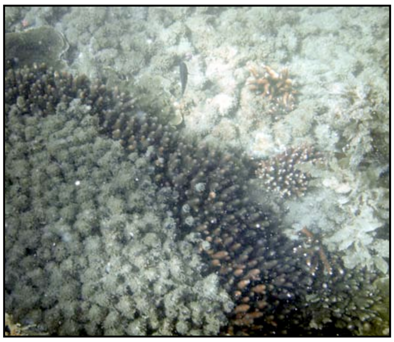

Plate 3.12 Turf algae on hard coral and laden with silt (right).

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 summer 2005 to 5.7% in winter 2006. This corresponds with an increase in sea surface temperatures from approximately 27ºC to 31ºC (Bassim et al, 2002). 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 (SD) 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 (SP) covered 5.0% of the substrate with equal proportions of encrusting and normal species.

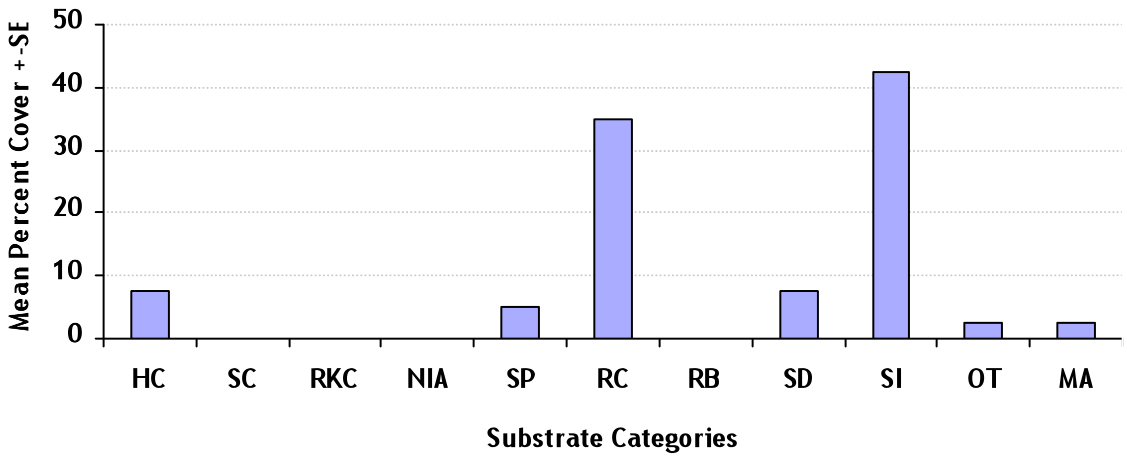

Figure 3.8 Percent Cover of Substrate for Picnic Bay Jetty 2005 (3m depth).

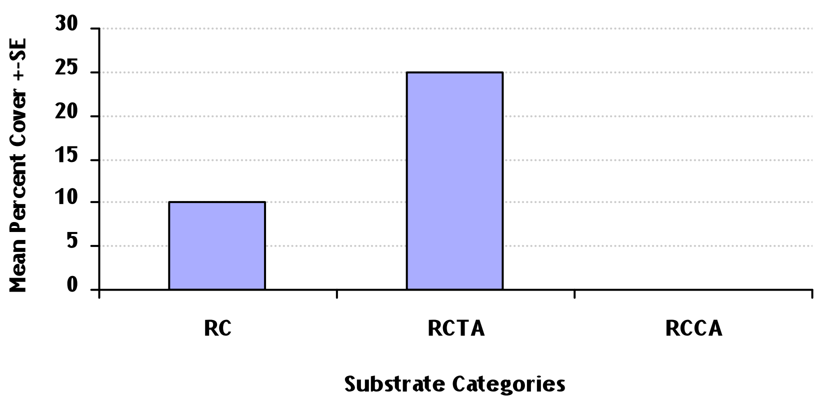

Figure 3.9 Mean percentage cover of Rock sub-categories at Picnic Bay Jetty 2005 (3m depth).

3.3.2 Invertebrates and Impacts

A small abundance of invertebrates were found at this site, two giant clams and one *Stichopus variegatus* (spotted dick). There was no scars form *Drupella* snails, crown-of-thorns starfish (*Acanthaster planci*) 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 aluminium cans.

3.4 ALMA BAY

3.4.1 Substrate Survey

For Alma Bay, the dominant substrate categories in 2005 were hard coral and rock at 34.7% and 29.1% respectively. Sand and silt were also prevailing in 2005 with similar percentage cover of 11.3% for sand and 10.6% for silt (Figure 3.10). Macroalgae were observed to be present at Alma to a high extent (Plate 3.14).

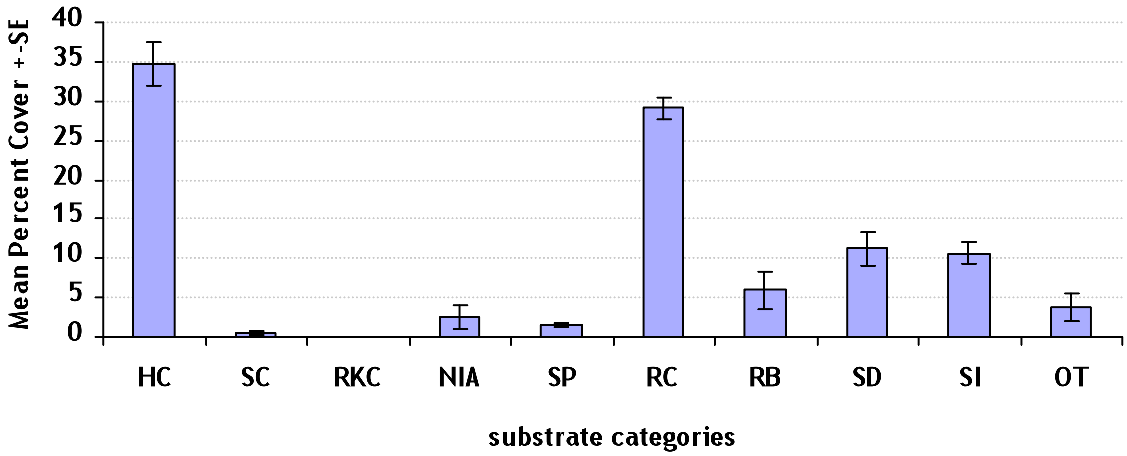

Figure 3.10 Mean Percent Cover of Substrate for Alma Bay 2005 (5m depth).

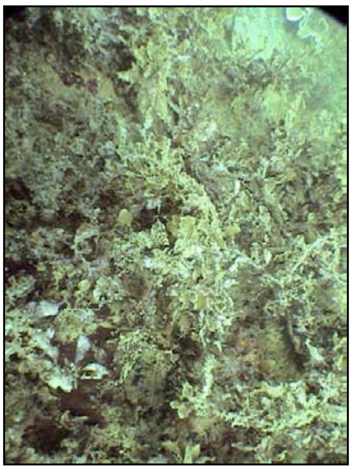

Plate 3.14 Sargassum *sp. macroalgae at Alma Bay 2005 at a depth of 5m.*

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).

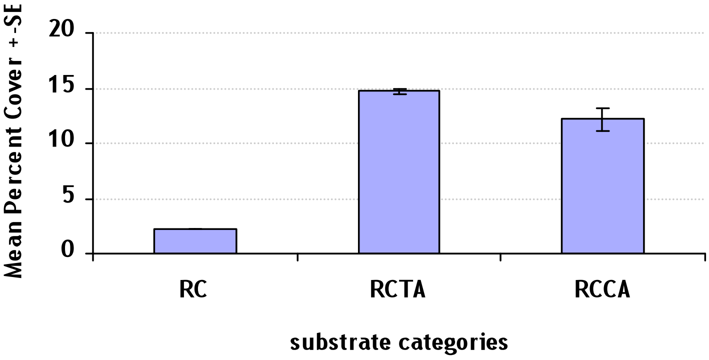

Figure 3.11 Mean percent cover of rock, coralline algae and turf algae for Alma Bay in 2005 (5m depth).

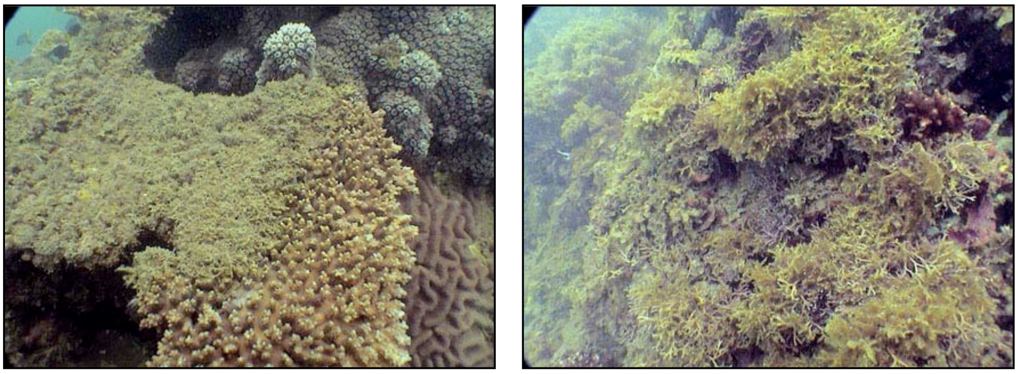

Plate 3.15 Turf overgrowing hard coral (left) and coralline algae (right).

3.4.2 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).

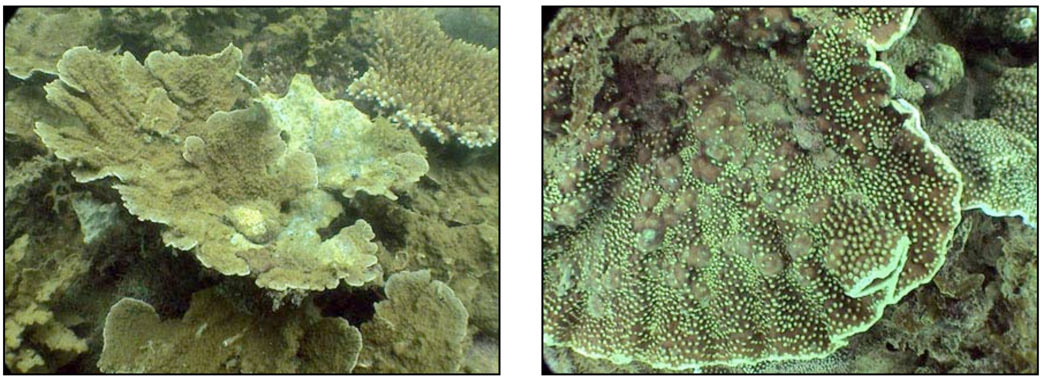

Plate 3.16 The coral-eating snail, Drupella, *on foliose hard coral.*

Disease was found to be present in 2005. Mean observed physical damage, including damage by boats and anchors was 2.25 incidences per $100m^2$.

3.5 NELLY BAY

3.5.1 Substrate Survey

The dominant substrates in 2003 were hard coral, nutrient indicator algae and sand. Hard coral remained dominate through 2007 and increased to 74.4% from 45.9% in 2003. Rock abundance decreased slightly from 9.4% in 2003 to 5.6% in 2007. Nutrient Indicator algae decreased to 14% in 2003 from 8.1% in 2007. Likewise sand decreased to 0.6% from 14.4% 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. Observed silt levels increased slightly from 3.4% in 2003 to 5.6% in 2007 (Figure 3.12).

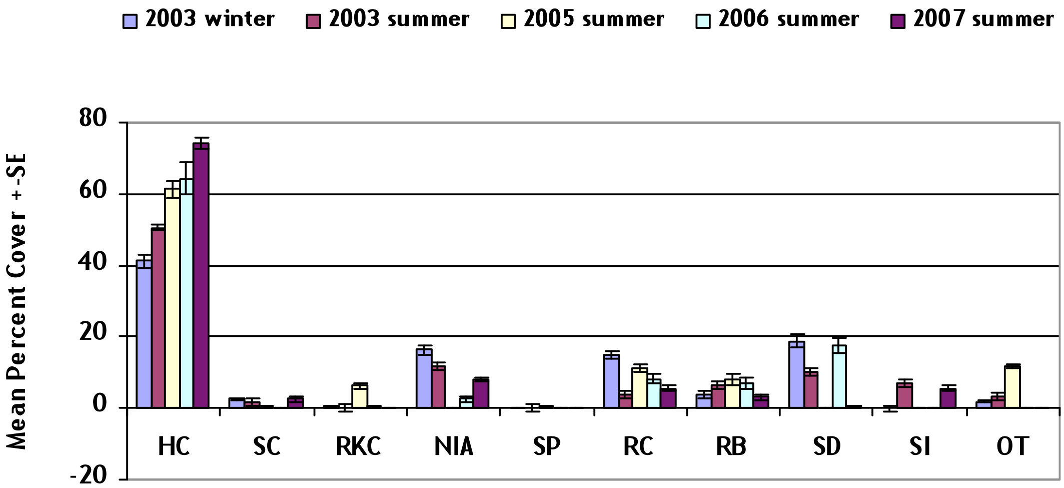

Figure 3.12 Mean percent Cover of Substrate for Nelly Bay 2003 (5m depth) compared to Nelly Bay 2005 (5m depth) compared to Nelly Bay 2006 and 2007 (5m depth).

Recently killed coral was highest 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 coralline 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).

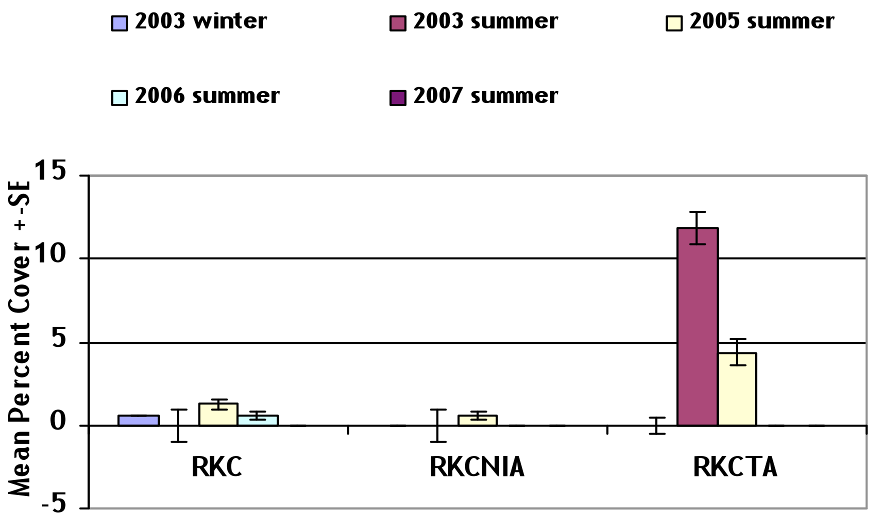

Figure 3.13 Mean percent cover of recently killed coral that was bare (RKC), covered in nutrient indicator algae (RKCNIA) and covered in turf algae (RKCTA) for Nelly Bay in 2003 (5m depth) 2005 (5m depth), 2006 (5m depth) and 2007 (5m depth).

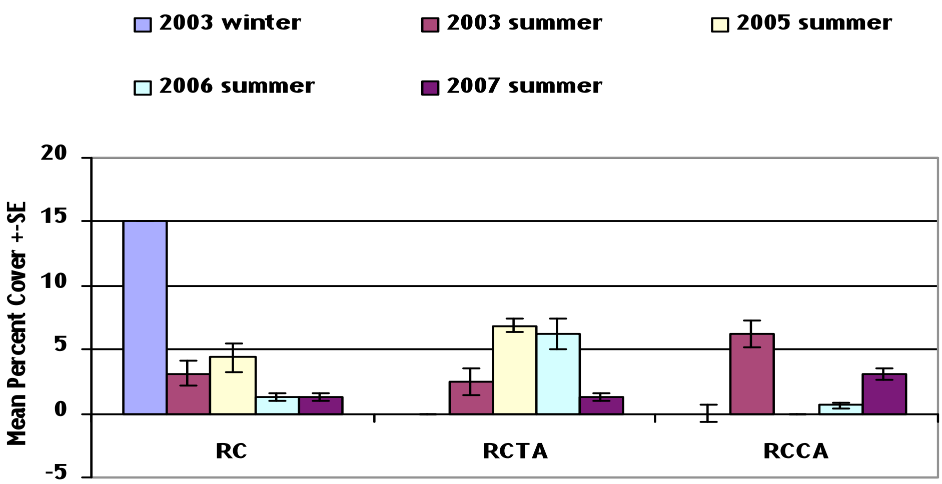

Figure 3.14 Mean percent cover of rock (RC), turf algae (RCTA) and coralline algae (RCCA) for Nelly Bay in 2003 (5m depth), 2005 (5m depth), 2006 (5m depth) and 2007 (5m depth).

3.5.2 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 100m² 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

3.6 GEOFFREY BAY

3.6.1 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 2007 with percentage covers of 7.5%, 6.8% and 11.9% respectively. Hard coral and rock were dominant in 2007 with mean percentage covers of 45% and 18.7% respectively (Figure 3.15).

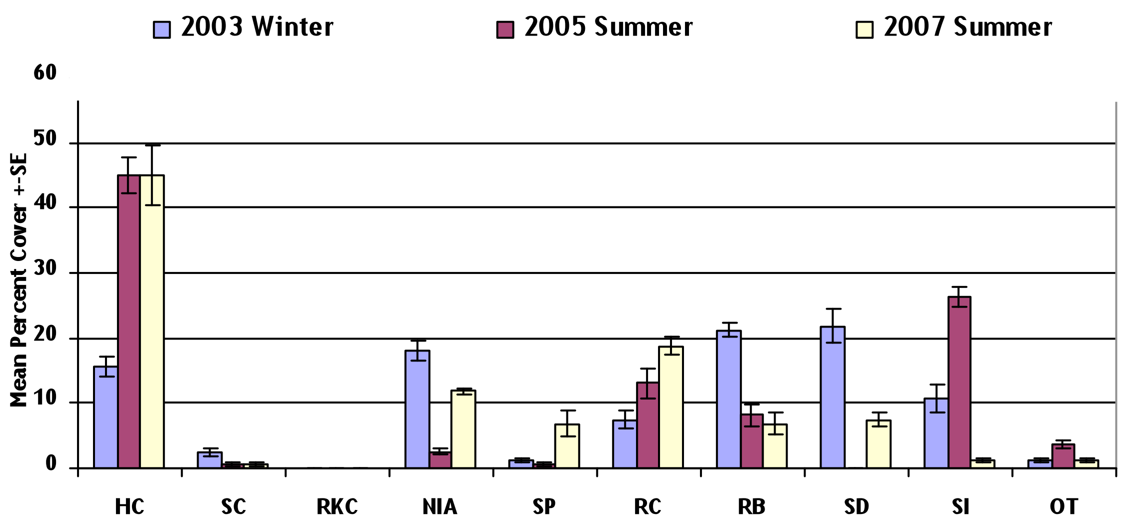

Figure 3.15 Mean Percent Cover of Substrate for Geoffrey Bay 2003 (3.5m depth) compared to Geoffrey Bay 2005 (5m depth) and Geoffrey Bay 2007 (5m depth).

Rock substrate increased from 7.5% in 2003 to 18.8% in 2007. Rubble was reduced from 21.3% to 6.9% in the same time period. Rubble may be cemented together by coralline algae (RCCA) however this might also be an observer effect in defining lose rubble with that which has started to consolidate with encrusting organisms, the effect of different transect placement between the initial survey and subsequent ones or an increase in hard coral covering the rubble bottom. All Reef Check sites are now mapped to guide volunteers to the same start point, it is possible the original transect was done in a slightly different place. Continued surveys will help to determine if there is a trend for increasing coral cover. The percentage of rock covered in coralline algae was 21.3% in winter of 2003 and 5.6% in summer 2007.

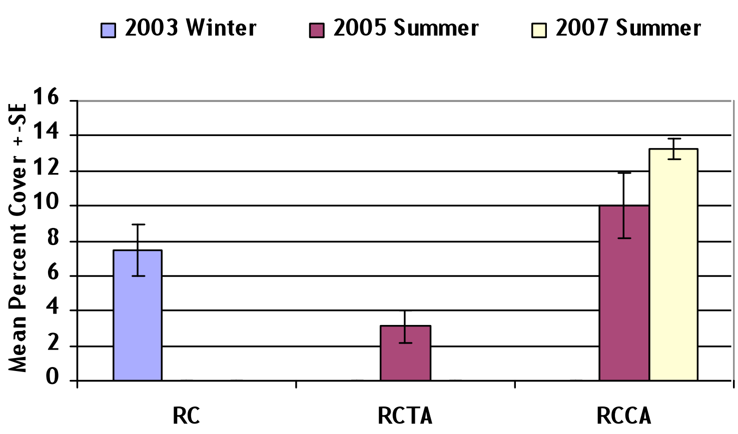

Figure 3.16 Mean percent cover of rock, turf algae and coralline algae for Geoffrey Bay in 2003 (3.5m depth), 2005 (5m depth) and 2007 (5m depth).

Macroalgae was also observed at this site (Plate 3.17).

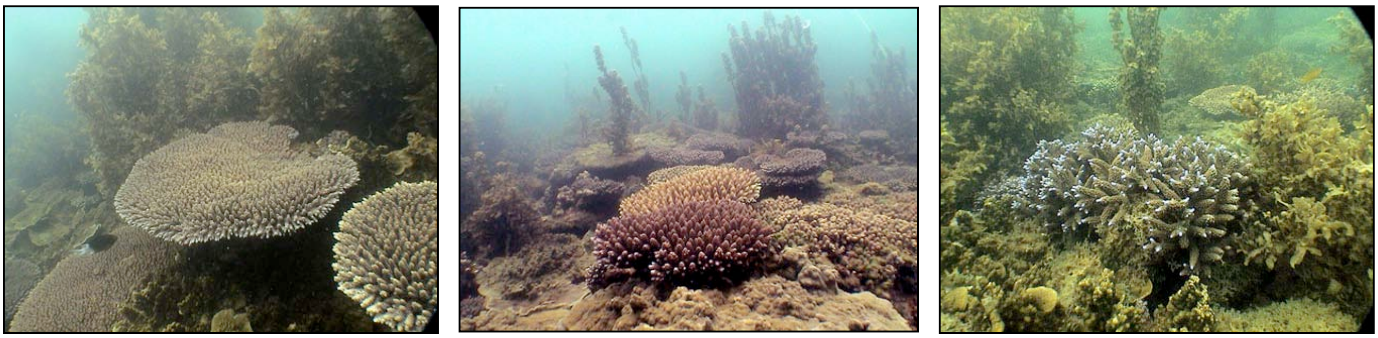

Plate 3.17 Macroalgae, Turbinaria *sp. and* Sargassum *sp., with plate and branching hard corals.*

3.6.2 Invertebrates and Impacts

Again, with the exception of *Drupella*, only one species of invertebrate (lobster) was found at this site from either 2003 to 2007. Table 3.4 compares the results of scarring, *Drupell*a abundance, bleaching and trash at Geoffrey Bay from 2003 to 2007. A small section of coral was observed to be damaged (Plate 3.18).

Table 3.4 Mean numbers of invertebrates found in a 100m^2 area during the 2005, 2006 and 2007 surveys.

	2003	2005	2007
Lobster	0	0	0.5
Drupella	0	1.167	2
Drupella scars	0	0.417	0.5
% of coral population bleached	0	0.25	1%
Other scars	0	0.083	2
General trash	0	0.083	0.5

Plate 3.18 Coral damage at Geoffrey Bay in 2005. Broken pieces coral possibly caused by diver damage. Turf algae is present at the bottom of the photograph.

3.7 NORTH AND SOUTH FLORENCE BAY

3.7.1 Substrate

Figure 3.17 shows the percentage cover of Reef Check categories in 2006 and 2007 at North and South Florence Bay. The most dominant substrates are hard coral and rock. Hard coral covered 38.1% of the substrate in 2007 and 45% in 2006 in North Florence Bay. The difference may indicate differences in transect placement or a slight decrease. Subsequent surveys will enable us to determine which is the case. The hard coral substrate covered 29.4% in South Florence Bay in 2006. Nutrient Indicator Algae abundances increased slightly from 0% in 2006 to 13.7% in North Florence Bay with 0.6% detected in 2006 in South Florence Bay. Rock decreased from 2006 to 2007 in South Florence Bay from 39.4% to 16.2%. Rock abundances were 28.1% at South Florence Bay with Rubble at 27.5%.

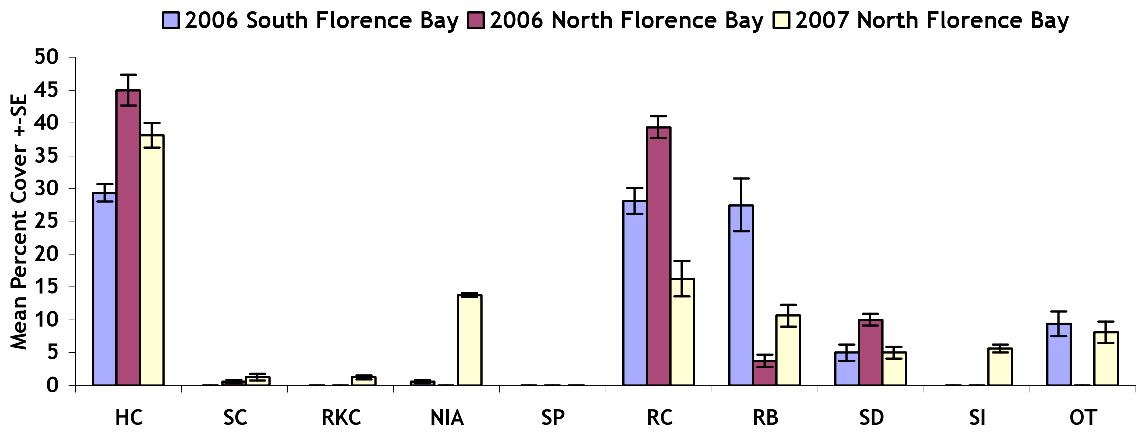

Figure 3.17 Percent *Cover of Substrate North and South Florence Bay, 2006 (4m depth) and 2007 (3m depth).*

Plate 3.19 Branching hard coral at Florence Bay South, 2007.

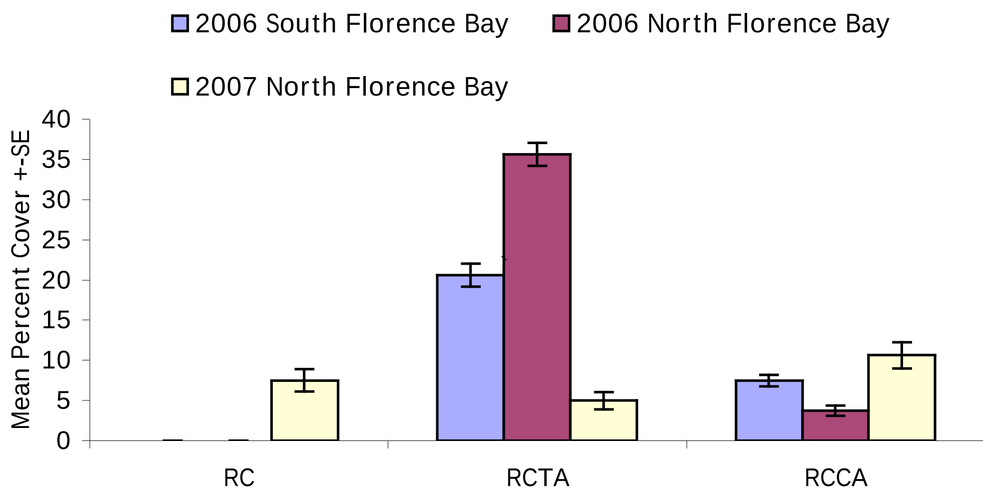

Figure 3.18 Mean percentage cover of rock sub-categories at North and South Florence Bay, 2006 (4m depth) and 2007 (3m depth).

Figure 3.18 shows the percentage cover of rock sub-categories at North and South Florence Bay in 2006 and 2007. Lower amounts of rock covered with turf algae was observed at the North Florence Bay site during 2007.



Plate 3.20 Nutrient indicator algae, rubble and silt cover at South Florence Bay, 2007.

3.7.2 Invertebrates and Impacts

A small abundance of *Drupella* invertebrates were found at this site in 2006. There was no scars form *Drupella* snails, crown-of-thorns starfish (*Acanthaster planci*) or physical damage relating to human activities. There were small occurrences of fish nets and general trash in the area.

The major impact that this survey recorded was the occurrence of bleaching to individual coral colonies and coral populations (Table 3.5).

Table 3.5 Mean numbers of invertebrates and impacts found in Florence Bay South 2006.

	2006
Drupella	6
% of coral colony bleached	7
% of coral population bleached	10
Trash: fish nets	3
Trash: general	1

4. DISCUSSION

This report provides baseline and initial monitoring 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 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 both Picnic Bay and Nelly Bay with a recorded hard coral abundance of 75%. These results correspond with a 40% cover recorded by the AIMS Longterm Monitoring Program surveys of the Middle Reef slope during 2005.

Reef Check recommend that observed differences of 5% be discounted as real change and differences of up to 10% be interpreted with care. We understand that our volunteer observations for hard coral are the most precise out of all Reef Check categories. 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 from 45.9% in 2003 to 74.3% in 2007 as well Geoffrey Bay with an increase from 15.6% in 2003 to 45% in 2007. Again some of the differences may be attributed to the transect being laid in a slightly different location, however it appears clear that hard coral has increased at these sites. Hard coral abundances at North Florence Bay were 45% in 2006 and data from South Florence Bay suggests that hard coral has increased slightly from 29.4% to 38.1% the following year. Nutrient Indicator Algae (NIA) increased slightly from 0.6% in 2006 to 13.7% in 2007 at South Florence Bay.

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 & 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. However the differences might also be an observer effect in defining lose rubble with that which has started to consolidate with encrusting organisms, the effect of different transect placement between the initial survey and subsequent ones or an increase in hard coral covering the rubble bottom. All Reef Check sites are now mapped to guide volunteers to the same start point, it is possible the original transect was done in a slightly different place. Continued surveys will help to determine if there is a trend for increasing coral cover.

One of the most visible consequences of anthropogenic impacts on coastal coral reefs is sediment pollution. Sediment on coral reefs near urban centres 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 reefs. 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 the future it might be useful to look for coral recruits to determine settlement levels. While this might not be a sensible addition to a volunteer observer program, Reef Check video surveys may be analysed by scientists in the future should this type of information be required. 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. However silt traps involve a significant amount of resources in setting up, collecting and analysing the traps.

The Reef Check methods are unfortunately not able to precisely provide levels of silt because there is a high amount of observer error when recording silt, sand and rock with turf algae. This has become particularly apparent when comparing Reef Check data for sites around Magnetic Island, a high silt environment, from 2003 onwards. From 2007 onwards, to improve interpretation of Reef Check results, observers were asked to record silt-loading as: None = no silt, Low = some silt in some RCTA but not all and not a thick layer, Medium = All RCTA with a thin silt later or some RCTA with a thick silt layer, High = All RCTA surfaces thick with silt. Where the % cover of silt appears to change, we recommend looking at the silt loading and visibility of the site to determine if there might be a difference in the silt levels, or whether the change was likely due to observer variability in recording silt and RCTA.

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 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, 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 & 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 (SST) 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^{o}C to 31^{o}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 impacts may be related to the high numbers of recreational fishers that frequent the coral reef areas of Magnetic Island. It might be worthwhile to provide 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. This included 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, or coral diversity into the future. The continuation of the Reef Check monitoring program on Magnetic Island reefs will provide a way for the local community to keep watch on the health of this area, as well as report to the 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 establish 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.

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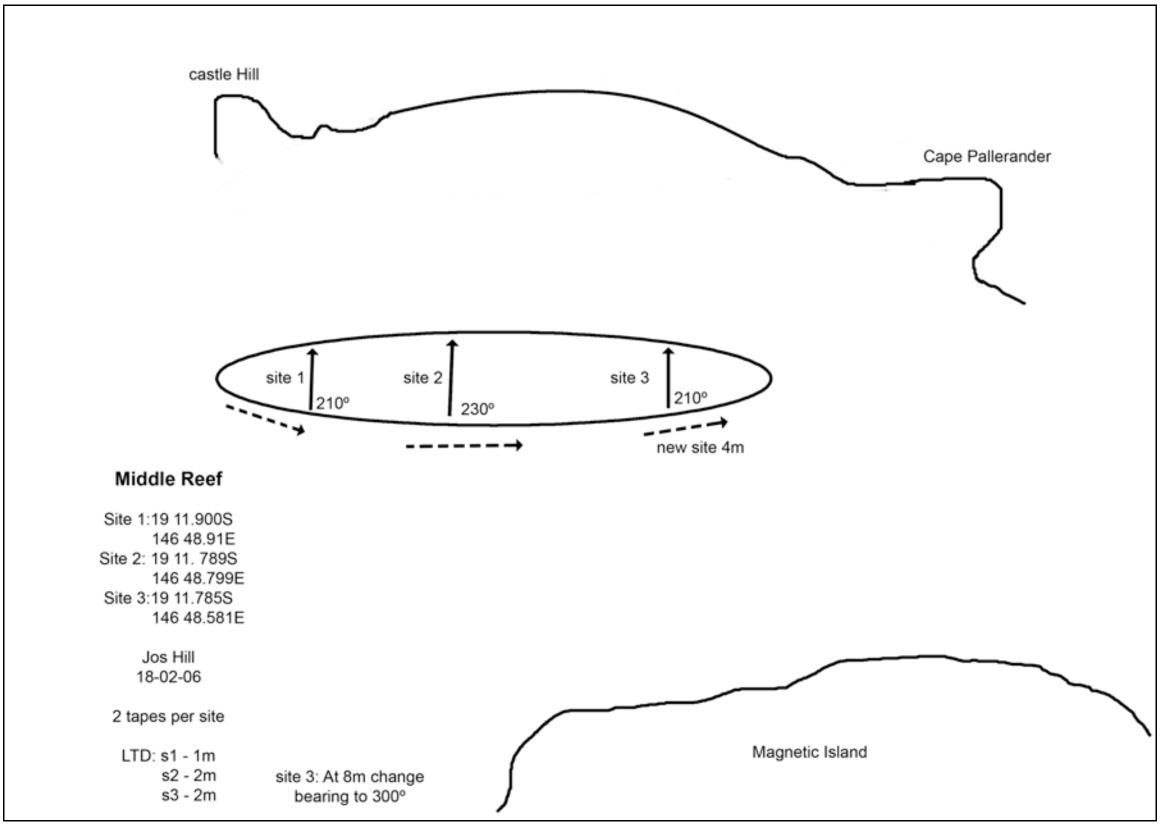
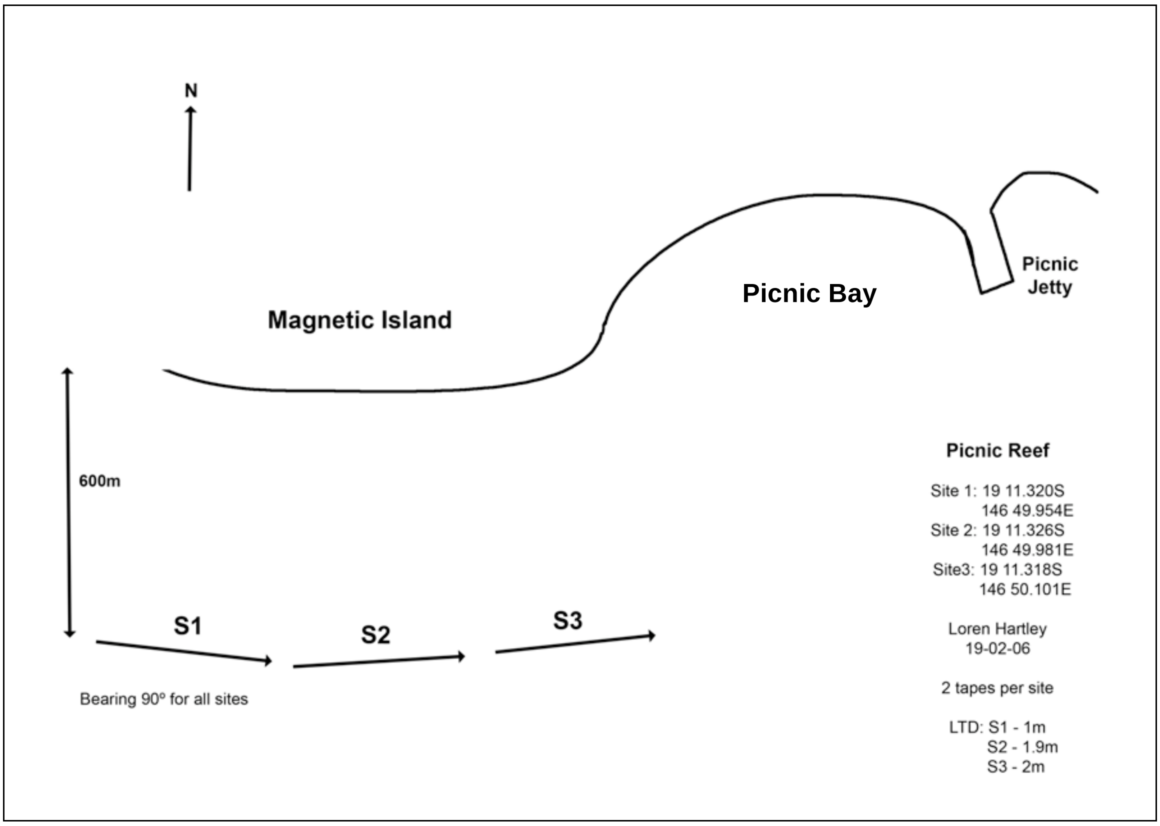
APPENDIX 1

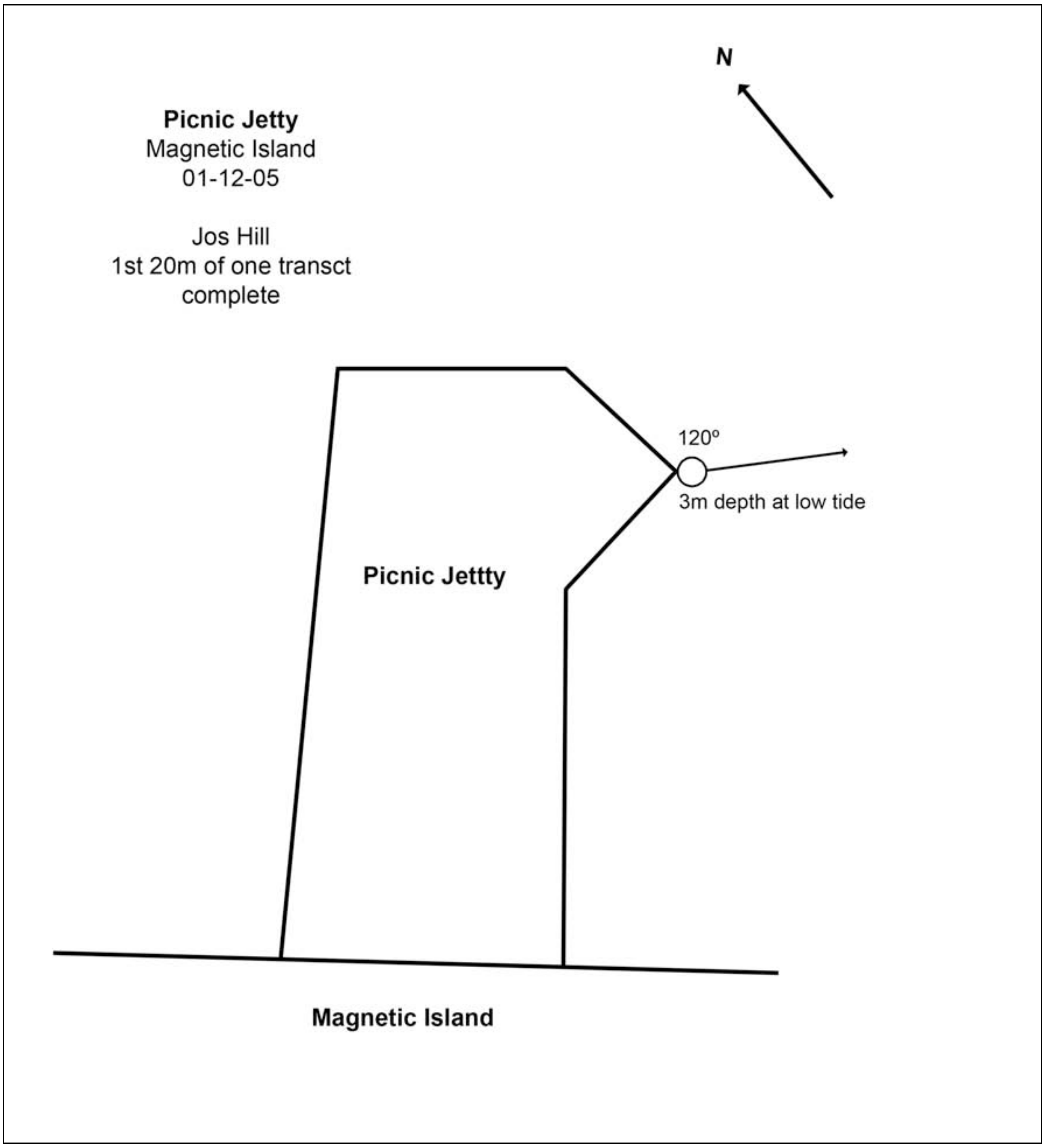
Maps illustrating the locations of transects at each survey site around Magnetic Island.



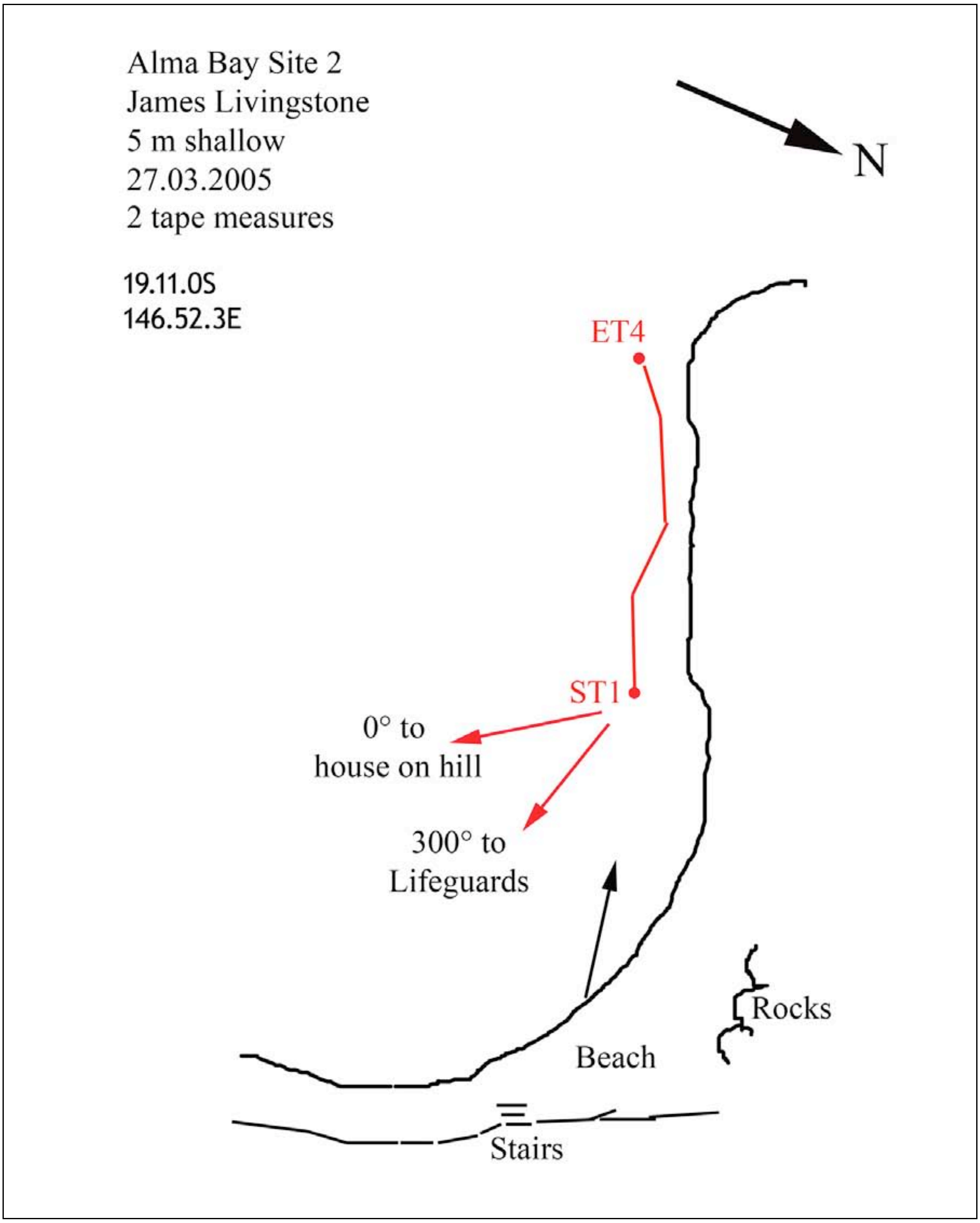
Map 1: Middle Reef



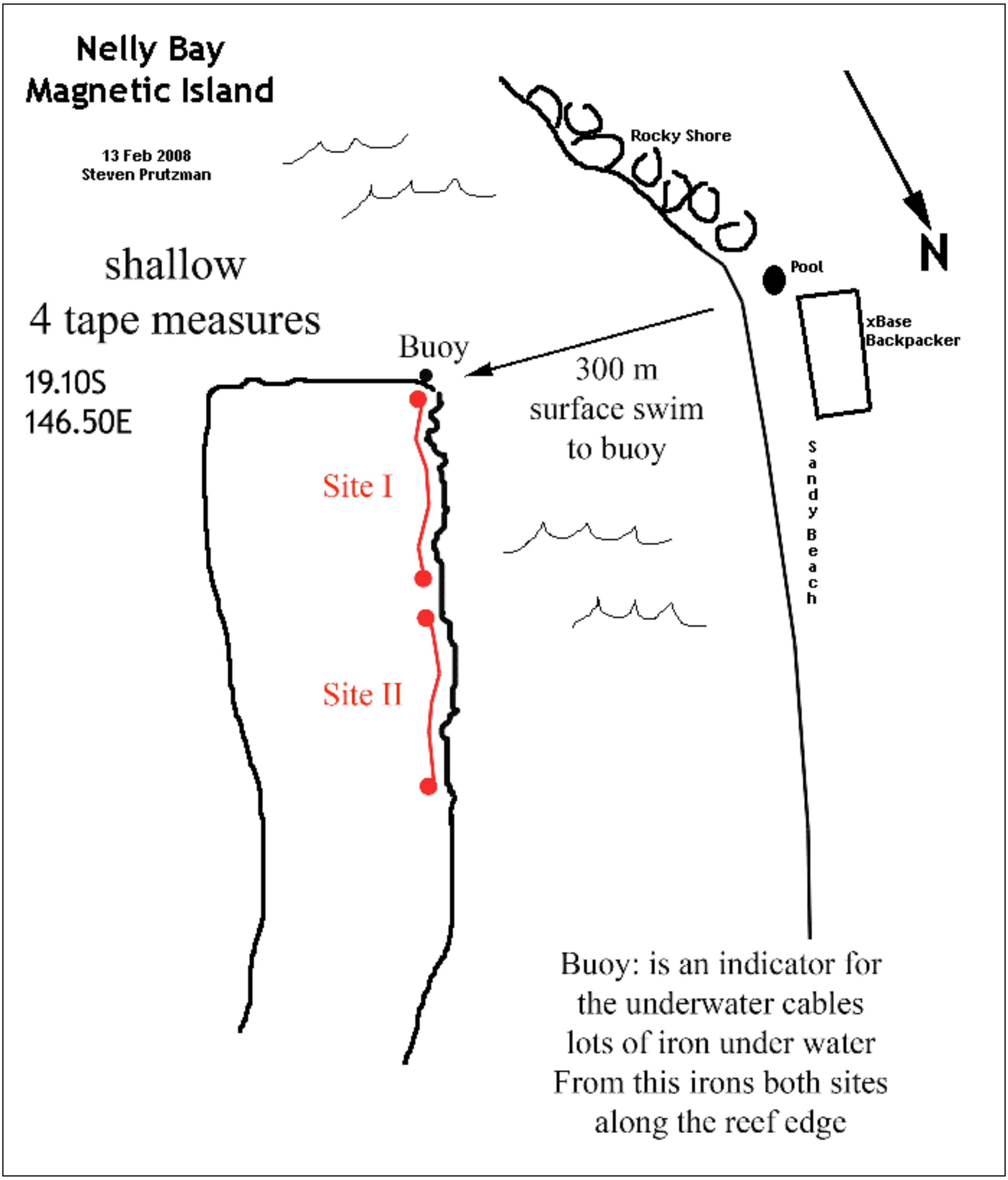
Map 2: Picnic Bay Reef



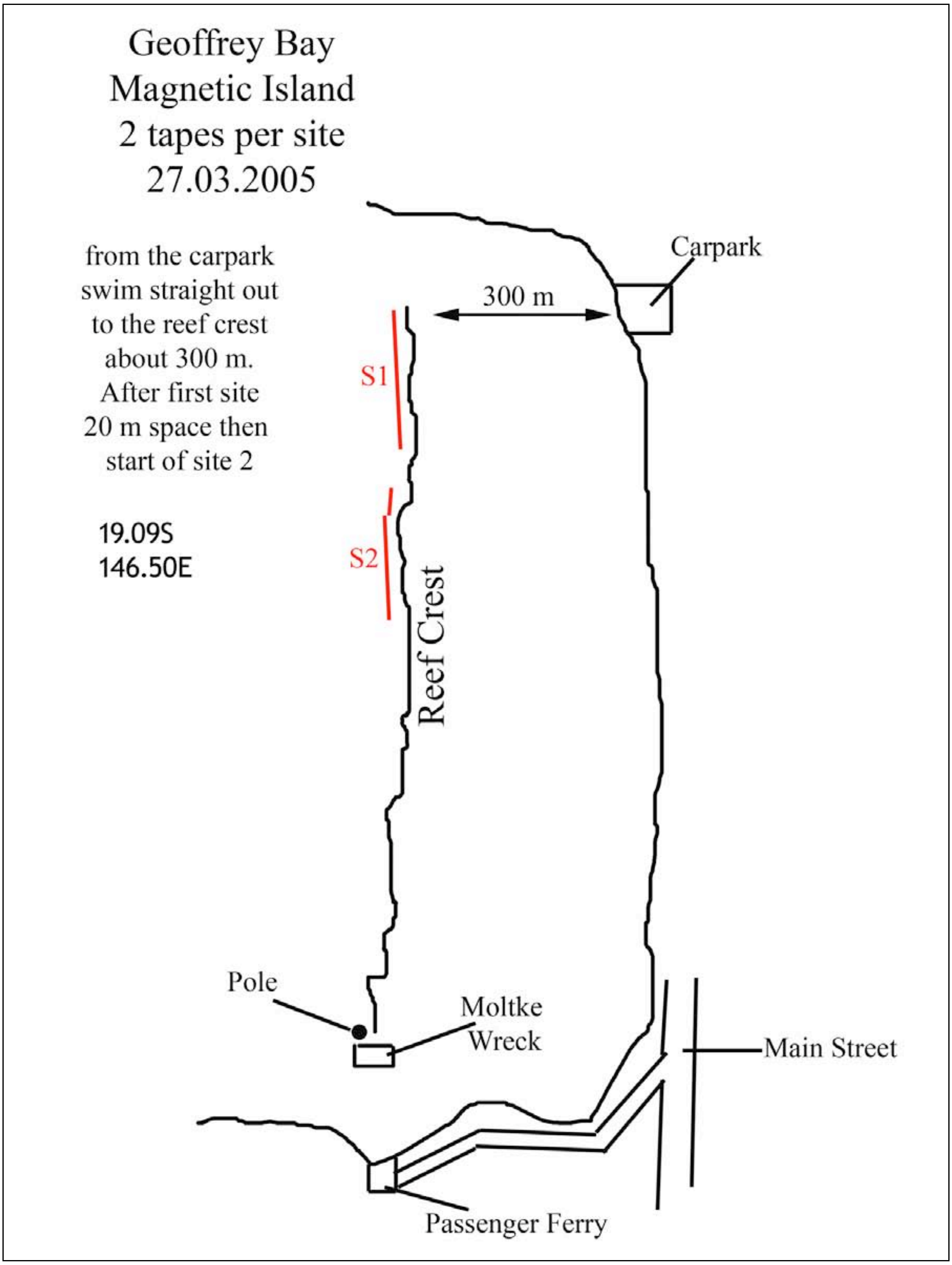
Map 3: Picnic Bay Jetty



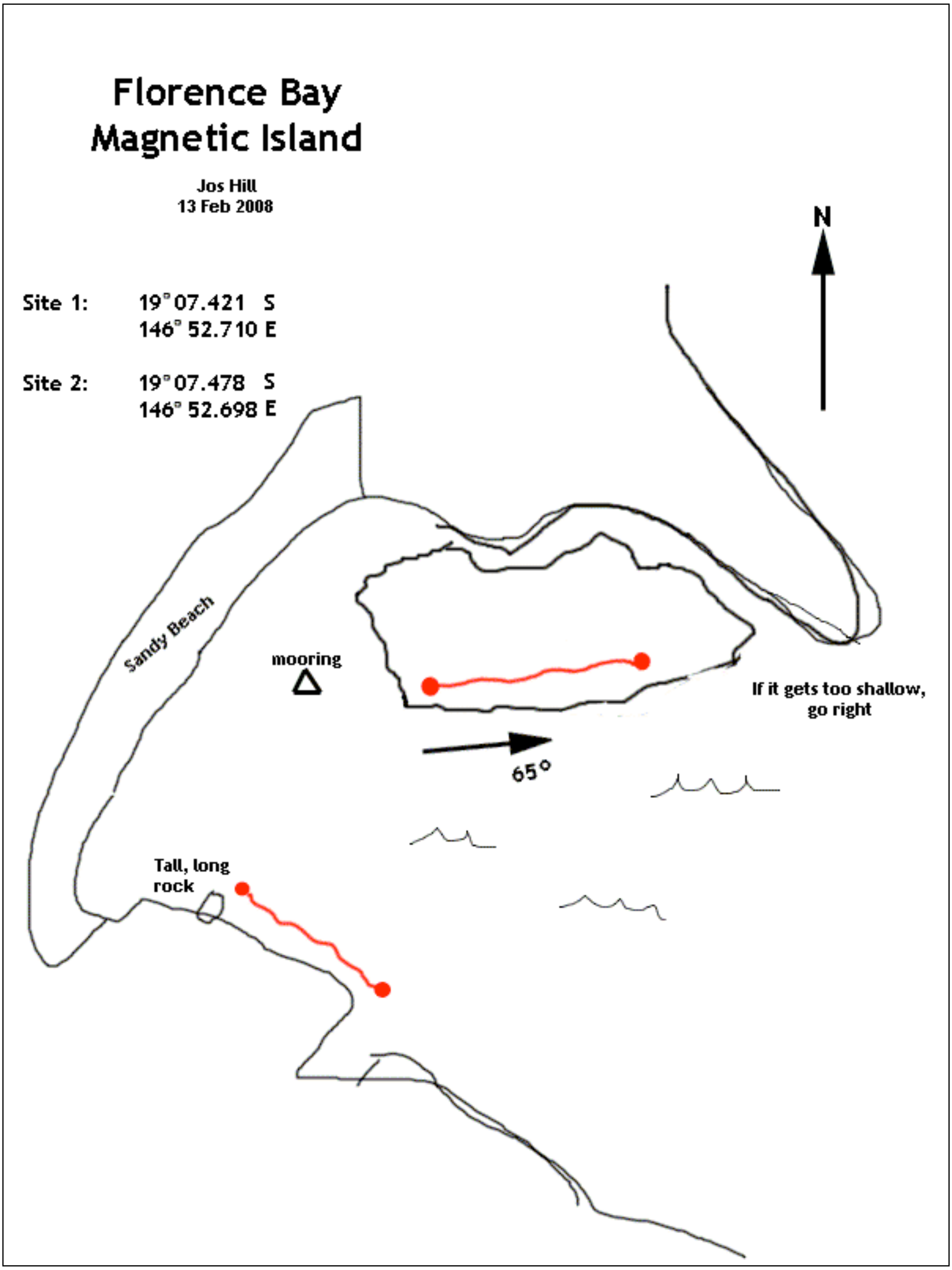
Map 4: Alma Bay



Map 5: Nelly Bay



Map 6: Geoffrey Bay



Map 7: Florence 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.