DENT ISLAND GOLF COURSE ACCESS JETTY: BIOLOGICAL SURVEY OF A PROPOSED NEW LOCATION

Draft Report Prepared for Hamilton Island

By Sea Research: A.M and A.L. Ayling

6th March 2007

1. Introduction

The Dent Island passenger access jetty and barge landing for the Dent Island Golf Course development was initially proposed to be on the north-east face of the island immediately south of Titan Island (Figure 1). For aesthetic reasons Hamilton Island are proposing to separate the passenger access ferry landing from the barge landing and site the passenger landing immediately to the north of Cowry Island.

In January 2007 Sea Research carried out a biological survey of the area of the Dent Island fringing reef likely to be impacted by the installation of the access jetty. This document reports on the findings of that survey and compares the fringing reef in the jetty area with two control sites and with the previously proposed jetty site.

2. Methods

2.1. Design

The biological survey was based on groups of four 20 metre line intersect transects set up in three depth strata down the fringing reef. These depth strata or habitats were:

- Group 1 on the reef crest at the transition between the reef flat and the reef slope.
- Group 2 on the shallow slope in 3-5 m depth.
- Group 3 on the deep slope in 8-10 m depth.

The reef flat had very low coral cover with moderate cover of algae and seagrasses (Ayling and Ayling 2001b). Management agencies were not concerned with temporary loss of these ephemeral groups and the survey did not target this habitat.

These three habitat groups of four transects comprised a site. One site was surveyed at the end of the previously proposed jetty position (jetty 1 location) and similar sites were surveyed 60 m to the north and south. Another site was surveyed at the end of the new Cowry Island proposed jetty position (jetty 2 location), also with similar sites to the north and south (Table 1).

Two similar control locations were set up, both with two adjacent sites of three groups of four 20 m permanent transects, for a total of 48 transects. Control 1 was about 400 m south of the

old jetty location, between Cowry and Titan Island, and Control 2 was about 600 m to the south of the jetty 2 location, to the south of Cowry Island (Figure 1).

GPS positions were taken for each survey site.

Table 1. Design of the Jetty Survey.

Habitat: Site:	Crest	Shallow slope	Deep slope
Jetty 1 centre site	4 transects	4 transects	4 transects
Jetty 1 north site	4 transects	4 transects	4 transects
Jetty 1 south site	4 transects	4 transects	4 transects
Jetty 2 centre site	4 transects	4 transects	4 transects
Jetty 2 north site	4 transects	4 transects	4 transects
Jetty 2 south site	4 transects	4 transects	4 transects
Control 1 north site	4 transects	4 transects	4 transects
Control 1 south site	4 transects	4 transects	4 transects
Control 2 north site	4 transects	4 transects	4 transects
Control 2 south site	4 transects	4 transects	4 transects

All these transects were surveyed during January 2007.

2.2. Survey Methods.

Coral cover was surveyed along permanently marked 20 m long intersect line transects at the two control locations and at the jetty 1 location. Similar 20 m transects were surveyed at the proposed new jetty 2 location. Previous trials have shown that there is no advantage in extending these transects longer than 20 m (Mapstone et al. 1992), and all programs we have been involved with have used 20 m transects (Ayling and Ayling 1991b, 1995, 1998a, 2001a; Ayling et al. 1998, GHD Hay Point 2006). These transects were positioned haphazardly, running as straight as possible and approximately parallel to the reef edge. The permanent transects were marked using one metre lengths of 12 mm reinforcing rod driven into the reef substratum at 5 m intervals along the transect line. Our experience has shown that this method does not damage the reef community and provides reliable marks that can be relocated over a period of at least five years (Ayling and Ayling 1998b).

The following organisms or groups of organisms were surveyed along the line intersect transects: all hard corals down to species level where possible but to structural groupings where reliable field identification was not possible eg. *Porites* spp. massive; total cover of fire corals (*Millepora* spp.); all soft corals to generic level where possible; total sponges; total area of substratum covered by turfing algae; total area covered by *Sargassum* and other macroalgae. The intersect lengths in cm of all the above organisms with the transect line were recorded for conversion to percentage cover measurements. Our experience has shown that

line intersect transects are more accurate than video transects on fringing reefs where macroalgae are present (Ayling and Ayling 1998a). Comparative studies using both methods along the same transects have shown that line intersect transects, as carried out by Sea Research, are equally as accurate as video transects in non-algal benthic communities, and more accurate than video where macroalgae are present (Ayling and Ayling 1998a).

When conditions allowed digital photographs were taken to provide a visual record of the benthos at each site.

To get a wider sample of the benthic community and to record damage to hard corals, counts were made of all damaged hard coral and soft coral colonies within one metre each side of each 20 m transect. Colonies were scored in a number of categories: partially bleached; bleached; diseased and/or partially dead; damaged by sediment deposition; physically damaged. This technique was used successfully as part of the recent Hay Point dredge monitoring program (GHD Hay Point Monitoring 2006).

2.3. Analysis

The survey was set up to allow patterns to be detected using analysis of variance (anova) techniques. Abundance patterns among the three sites at each location were tested using a two factor analysis of variance (Table 2), while differences between the four locations were analysed using a three factor anova (Table 3).

Table 2. Benthic Cover Patterns Analysis of Variance Design Testing Jetty 2 Site Against Adjacent North and South Sites

Source of variation	degrees of freedom	Fixed/Random	Denominator
Site	2	F	error (transects)
Habitat	2	F	error (transects)
Site x Habitat	4		error (transects)
error (transects)	27	R	

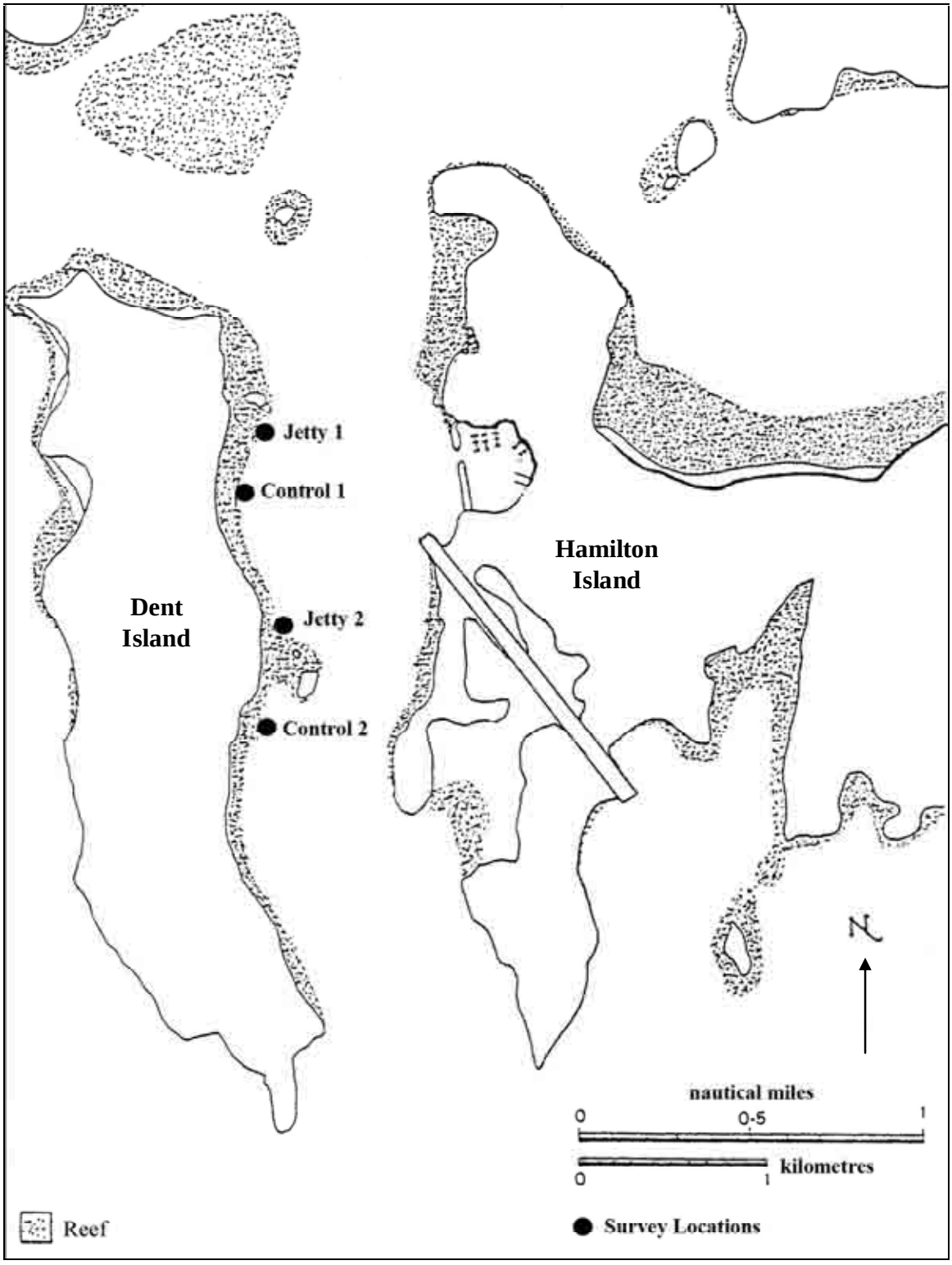
Table 3. Benthic Cover Patterns Analysis of Variance Design Testing Jetty Locations and Controls

Source of variation	degrees of freedom	Fixed/Random	Denominator
Location	3	F	error (transects)
Site (Location)	4	F	error (transects)
Habitat	2	F	error (transects)

Location x Habitat	6		error (transects)
Location x Site (L)	8		error (transects)
error (transects)	72	R	

Figure 1. Map of the Dent/Hamilton Area Showing Survey Locations.

Two adjacent sites were surveyed at each control location and three at each jetty location, with three depth strata or habitats in each site and four 20 m long line intersect transects surveyed in each habitat.



3. Results

3.1. Jetty 1 Location Description

On the reef crest at the old jetty 1 location on Dent Island immediately south of Titan Island (Figure 1) there was a relatively low cover of *Sargassum* and other macroalgae such as *Turbinaria* and a high cover of hard corals. Poritids were the most abundant hard coral group, primarily *Porites* finger colonies, and accounted for over third of hard coral cover. Acroporid corals also accounted for about a third of hard coral cover, with *Acropora* staghorn especially common. Soft corals were relatively common with almost 10% cover of mainly encrusting *Briarium* species (Figure 2-10, appendix 1). Fire coral colonies *Millepora* spp. were relatively common on the reef crest of the jetty 1 location (Figure 14).

On the shallow reef slope in 3-5 m depth algae were rare and hard corals were very abundant with a mean of about 56% cover. Poritids were again the most abundant coral group, accounting for almost 35% of hard corals, with finger *Porites* making up the bulk of this family in this habitat. Staghorn *Acropora* colonies were also common on the shallow slope, covering over 14% of the substratum. Agariciids were moderately common, especially large colonies of *Pavona cactus*, as were pectiniids and faviids. Soft corals were not as common as on the reef crest, covering only 8% of the substratum with both encrusting growth forms and *Sinularia* and *Sarcophyton* species present on the shallow reef slope habitat (Figure 2-10, appendix 1).

Algae were not recorded in the transects on the deeper slope habitat in 8-10 m depth but hard corals were similar in abundance to the shallow reef slope with a mean of 50% cover. Acroporid corals, including *Acropora* staghorn and explanate *Montipora*, were the most abundant hard coral group, accounting for almost 30% of hard corals, but pectiniids and agariciids were also common especially the species *Mycedium elephantotus, Echinophyllia* spp., *Pachyseris speciosa* and *Pavona cactus*. Poritids covered over 6% of the substratum, and were represented mainly by large colonies of *Goniopora* spp (Figure 2-10, appendix 1). Soft corals were not common on the deeper slope but sponges and black coral trees were more abundant than in the shallower habitats (Figure 15).

3.2. Jetty 2 Location Description

The new jetty 2 location, immediately north of Cowry Island, had a similar algal cover on the reef crest as the jetty 1 location, with almost 13% cover. Hard coral cover was relatively low in this location, at a mean of about 22% cover, with acroporids accounting for about 50% of corals. Poritids were also common, especially *Goniopora* spp. colonies. Soft corals were moderately common with 8% cover of mainly *Sinularia* and *Sarcophyton* species (Figure 2-10, appendix 1).

On the shallow reef slope in 3-5 m depth algae were uncommon and hard corals more common with a mean of 48% cover. Poritids were the most abundant coral group, accounting for over one third of hard corals, with large *Goniopora* colonies making up 85% of this group. Acroporids were also common on the shallow slope, covering 16% of the substratum,

with a range of faviids making up 4% cover. *Sinularia* and *Sarcophyton* soft coral species were similar in abundance to the reef crest habitat (Figure 2-10, appendix 1).

Turf algae and macroalgae were present on the deeper slope habitat in 8-10 m depth at the jetty 2 location but only covered 2% of the substratum. Hard corals were common, covering over 44% of the substratum. A range of hard coral groups were present, with *Acropora* spp., *Montipora* spp., *Goniopora* spp., agariciid, pectiniid and faviid corals covering between 4% and 7% of the substratum. Soft corals were not common on the deeper slope and sponges and black coral trees were less abundant than in the jetty 1 location (Figure 2-10, appendix 1).

3.3. Control 1 Location Description

Algal cover on the Control 1 crest was similar to that at the jetty 2 location but hard corals were more abundant with a mean cover of 35%. Staghorn and clumping *Acropora* corals were dominant here, accounting for 36% of hard corals but poritids were also abundant (34% of hard corals), especially finger growth form *Porites*. Fire corals were moderately common and soft corals were similar in abundance to the shallow jetty 2 habitats (Figure 2-10, appendix 1).

Algae were uncommon on the shallow slope habitat in the control 1 location with a mean cover of about 0.4% including both turfing and macroalgae. Hard corals were more abundant here than in the jetty locations with almost 70% cover. Coral composition was different at the two sites surveyed in this location, with large *Goiniopora* colonies making up over 70% of hard corals at one site and staghorn acroporids dominant at the other (22% of corals) along with some *Goniopora* (20% of corals). Pectiniids and faviids were also common here, with occasional large colonies of the faviid *Caulastrea furcata* being recorded. Soft corals and fire corals were less abundant than on the reef crest (Figure 2-10, appendix 1).

Algae were not recorded on the deeper reef slope where corals covered a mean of 50% of the substratum. Coral composition was again different between sites in this habitat, with *Goniopora* dominant at one site, with agariciids and pectiniids also common, and pectiniids dominant at the other where acroporids, agariciids and faviids were also common. As in the jetty locations soft corals were less abundant on the deeper slope than in the shallow habitats (Figure 2-10, appendix 1).

3.4. Control 2 Location Description

The reef crest at the second control location had a higher cover of algae, especially *Sargassum* and *Turbinaria* macroalgae, than the crests at the other three locations but had similar moderate hard coral cover to the jetty 2 location crest. Explanate *Montipora* corals (acroporids) were dominant at one site and *Galaxea* corals at the other. Soft corals were present at about half the abundance as at the other two locations and fire corals were not recorded in the survey transects (Figure 2-10, appendix 1).

On the shallow reef slope of the control 2 location coral cover was nominally higher than on control 1 and about 80% higher than in the jetty 2 location. The coral community was dominated by large massive colonies of *Galaxea* that made up 60% of hard coral cover. This

species was uncommon at the other two locations. However, acroporids, agariciids and pectiniids were also common as they were in the other locations. Poritids were uncommon in the second control location as were soft corals and fire corals (Figure 2-10, appendix 1).

Large colonies of *Galaxea* coral also dominated the deeper reef slope habitat at control 2 location, accounting for over 50% of hard corals. Agariciids and pectiniids were also common, as they were on the deeper slope in the other two locations. Algae, soft corals and fire corals were uncommon on the control 2 deep reef slope (Figure 2-10, appendix 1).

3.5. Patterns in Benthic Abundance

There were significant differences in abundance of all the major benthic groups amongst the jetty and control locations with the exception of faviid hard corals (Table 4, 5, Figure 2-10). The cover of total hard corals and pectiniid corals was lower in the jetty 2 location than in the other three locations. There was a significantly higher cover of algae and *Galaxea* corals in the Control 2 location compared with the other three locations. The cover of agariciids and acroporids was significantly higher in the jetty 1 location than in the controls or jetty 2. Soft corals were significantly lower in percentage cover at the control locations compared with the two jetty locations. The cover of poritids was highest in the first control location. In general the cover of all groups was lower in the jetty 2 location than in the other three locations (Table 5).

There were also significant differences in benthic abundance for all but one major benthic group between the three habitats over all locations (Table 5, 8, Figure 2-10). As would be expected the cover of algae was significantly higher on the crest than in either slope habitat. On the other hand the cover of total hard coral, poritids and *Galaxea* was lower in the crest habitat than in the slope habitats. The cover of acroporids and soft corals was significantly lower on the deep slope than in the two shallow habitats, while the cover of pectiniids and agariciids was higher on the deep slope than in the shallow habitats.

These habitat patterns were not consistent for all locations in some of the benthic groups giving a significant location x habitat interaction (Table 4, Figure 2-10).

Table 4. Anova Results for Comparison of Jetty Locations and Controls.

NS = not significant; * = 0.05>p>0.01; ** = 0.01>p>0.001; *** = p<0.001

Benthic group	Location	Site(L)	Habitat	L x H	S x H(L)
Total algae	***	NS	***	***	NS
Total hard corals	***	***	***	***	*
Acroporidae	***	***	**	NS	NS
Poritidae	***	***	***	**	*
Agariciidae	*	**	***	NS	NS
Pectiniidae	*	**	***	NS	NS
Faviidae	NS	**	NS	NS	NS
Galaxea	***	***	***	***	NS
Total soft coral	***	**	***	NS	NS

Table 7. Comparison of Benthic Cover Amongst the Survey Locations.

Benthic Group	Jetty 1	Jetty 2	Control 1	Control 2
Total algae	moderate	moderate	moderate	**high**
Total hard corals	**very high**	high	**very high**	**very high**
Acroporidae	**moderate/high**	moderate	moderate	low
Poritidae	moderate	moderate	**high**	low
Agariciidae	**high**	low	low	moderate
Pectiniidae	**moderate**	low	**moderate**	**moderate**
Faviidae	low	low	low	low
Galaxea	low	low	low	**high**
Total soft coral	**moderate**	**moderate**	low	low

Table 8. Comparison of Benthic Cover Amongst the Survey Habitats.

Benthic Group	Crest	Shallow slope	Deep slope
Total algae	**high**	low	low
Total hard corals	high	**very high**	**very high**
Acroporidae	**moderate**	**moderate**	low
Poritidae	moderate	**high**	moderate
Agariciidae	low	low	**moderate**
Pectiniidae	low	moderate	**high**
Faviidae	low	low	low
Galaxea	low	**high**	**high**
Total soft coral	**moderate**	**moderate**	low

3.6. Benthic Patterns Within the Jetty 2 Location.

At the jetty 2 location groups of transects were surveyed on the proposed jetty position and separate groups of transects were surveyed 60 m each side of the jetty position. The results of comparison tests between these three sites at the proposed new jetty location showed that there were significant site differences within the jetty location for many of the common benthic groups (Table 9).

Algal cover was higher in the central jetty site than to the north or the south. As would be expected total hard coral showed the opposite pattern with higher coral cover to the north and south of the jetty site, as did the dominant coral family poritids. Acroporids and soft corals were more abundant in the south site than in the jetty or north sites (Table 9, Figures 11-13).

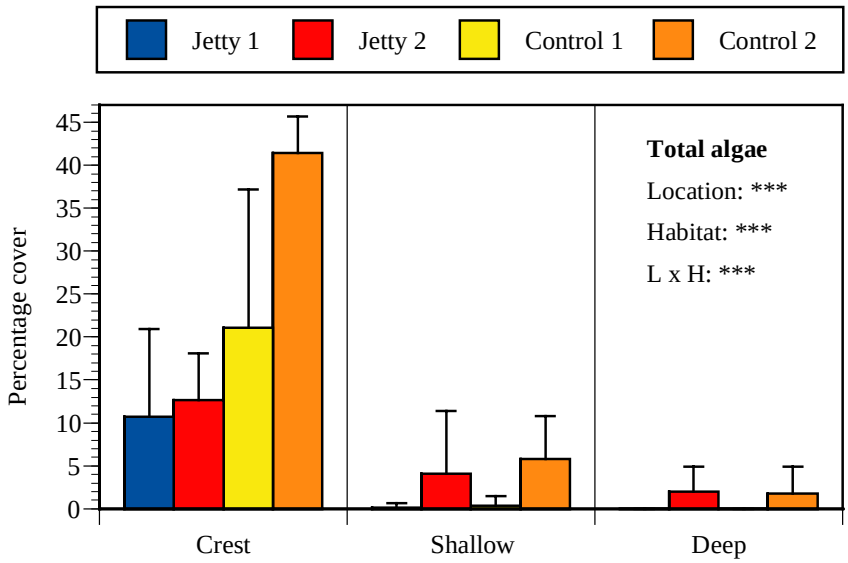
Table 9. Anova Results for Comparison of the Three Jetty 2 Sites.

NS = not significant; * = 0.05>p>0.01; ** = 0.01>p>0.001; *** = p<0.001

Benthic group	Site	Habitat	S x H
Total algae	***	***	**
Total hard corals	***	***	*
Acroporidae	**	NS	NS
Poritidae	**	**	*
Agariciidae	NS	**	NS
Pectiniidae	NS	*	NS
Faviidae	NS	**	NS
Galaxea	NS	*	NS
Total soft coral	*	*	NS

Figure 2. Distribution of All Algae in the Jetty and Control Survey Locations.

Graphs show grand means in each habitat for each location from two sites of four 20 m line intersect transects. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

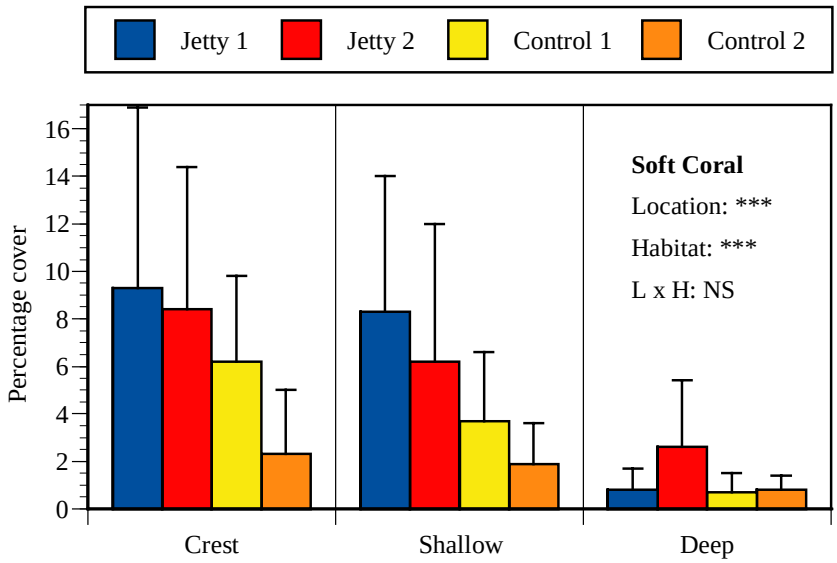


Left: Dense stand of macroalgae (*Sargassum* spp.) and *Turbinaria ornata* (centre right) on the control 1 location reef crest, along with *Montipora* coral colony (centre).

Right:Macroalgae (*Sargassum* spp.) was not common on the jetty 1 and 2 locations reef crest. Hard coral colonies *Porites cylindrica* (centre and top), *Goniopora* and *Acropora* sp. were abundant instead.

Figure 3. Distribution of All Soft Corals in the Jetty and Control Survey Locations.

Graphs show grand means in each habitat for each location from two sites of four 20 m line intersect transects. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

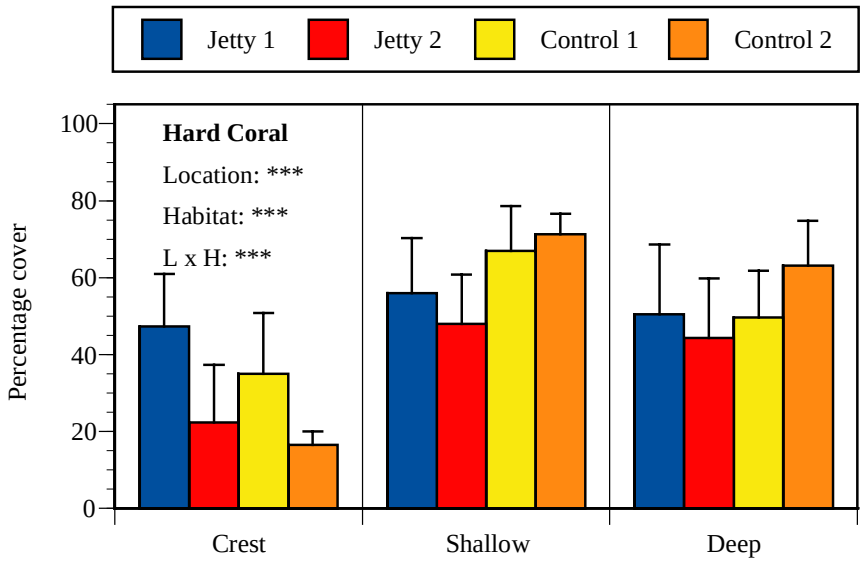


Left: A clump of *Sarcophyton* soft corals on the shallow reef slope at the jetty 2 location, along with a clump of nephthyiid soft corals (back top) and staghorn *Acropora* (left top).

Right: Large spreading colony of the pinkish encrusting soft coral *Briarium* sp. on the reef crest at the jetty 1 location. This species covered 16% of the substratum on the reef crest in the central jetty 1 location.

Figure 4. Distribution of All Hard Corals in the Jetty and Control Survey Locations.

Graphs show grand means in each habitat for each location from two sites of four 20 m line intersect transects. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

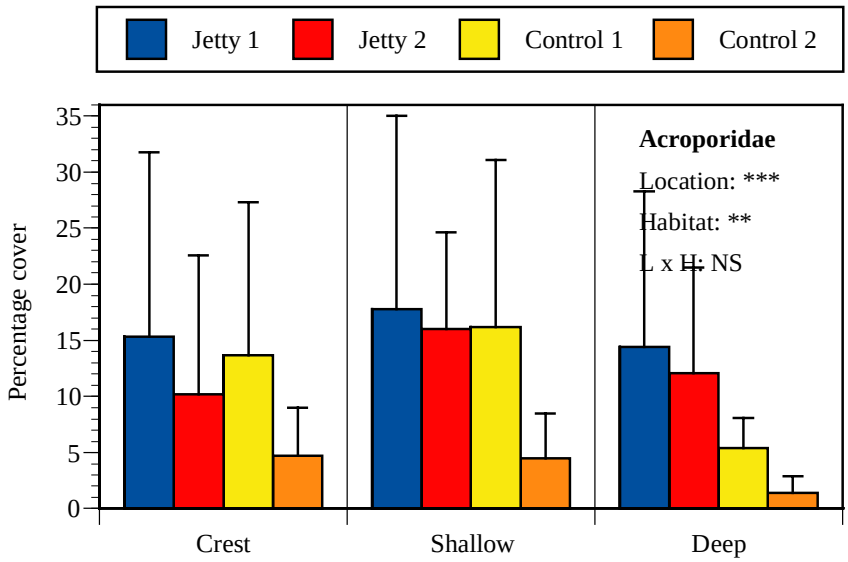


Left:A variety of hard corals on the jetty 2 location slope, with a *Turbinaria* whorl (centre bottom), *Podabacia crustacea* sheet (left), *Lobophora* (top right) and *Pachyseris speciosa* (centre).

Right: Hard coral colonies on the jetty 2 slope, including *Heliofungia actiniformis* (left), *Lobophyllia hemprichii* (top centre) and *Acropora* staghorn and bottlebrush colonies (right).

Figure 5. Distribution of Acroporid Corals in the Jetty and Control Survey Locations.

Graphs show grand means in each habitat for each location from two sites of four 20 m line intersect transects. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

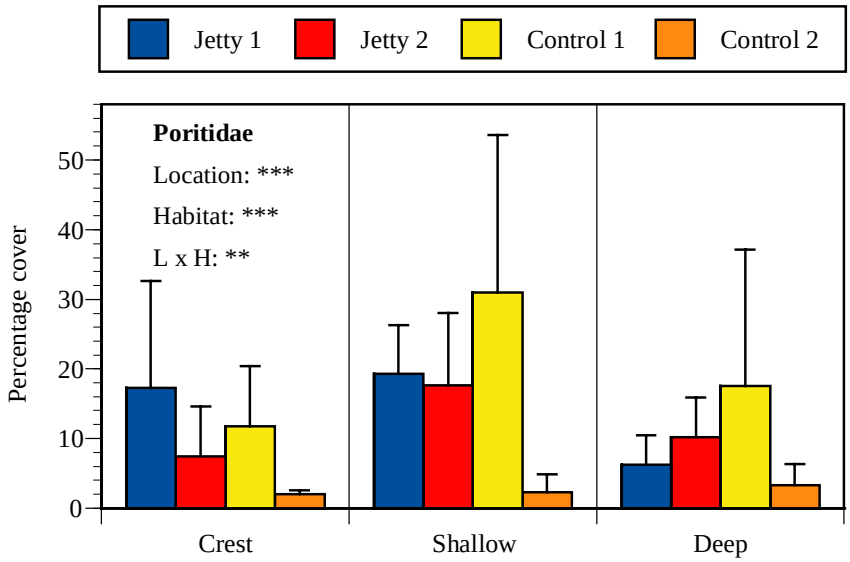


Left: Dense stand of the staghorn coral *Acropora formosa* on the shallow reef slope at the jetty 2 location.

Right: Explanate *Montipora* colonies (family Acroporidae) were moderately common on the deep slope at the jetty 1and 2 locations.

Figure 6. Distribution of Poritid Corals in the Jetty and Control Survey Locations.

Graphs show grand means in each habitat for each location from two sites of four 20 m line intersect transects. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

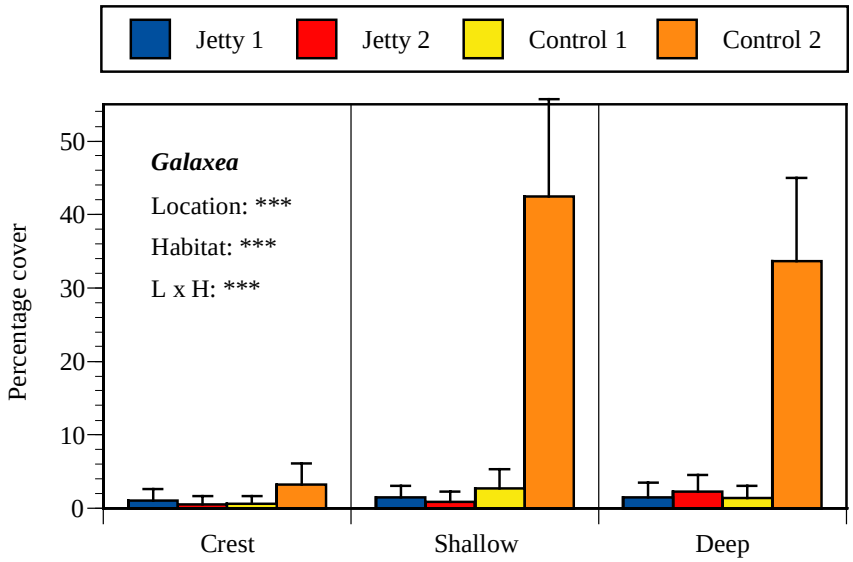


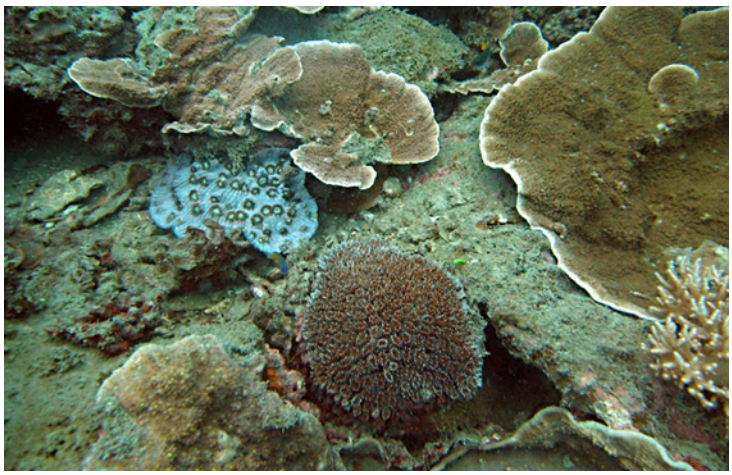
Left: Colonies of the poritid *Goniopora* sp. were the most abundant corals on the jetty 2 location shallow slope.

Right: A colony of massive *Porites* sp. on the shallow slope of the control 1 location, along with finger *Porites* (background) and a faviid colony (right).

Figure 7. Distribution of *Galaxea* Corals in the Jetty and Control Survey Locations.

Graphs show grand means in each habitat for each location from two sites of four 20 m line intersect transects. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.



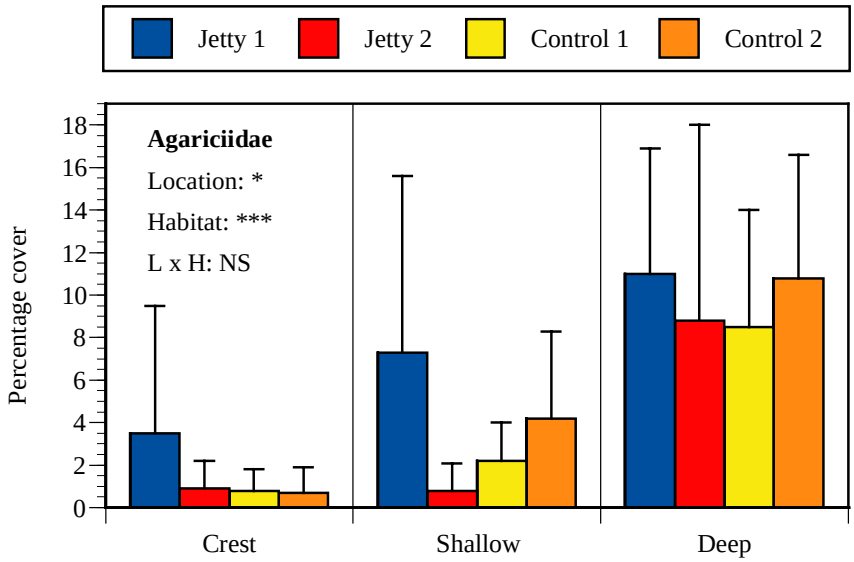


Left: At all except the Control 2 location small colonies of *Galaxea* (centre bottom) covered less than 5% of the substratum.

Right: Massive growth form colony of *Galaxea* on the shallow reef slope at the control 2 location where this group of hard corals made up over 50% of hard corals.

Figure 8. Distribution of Agariciid Corals in the Jetty and Control Survey Locations.

Graphs show grand means in each habitat for each location from two sites of four 20 m line intersect transects. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

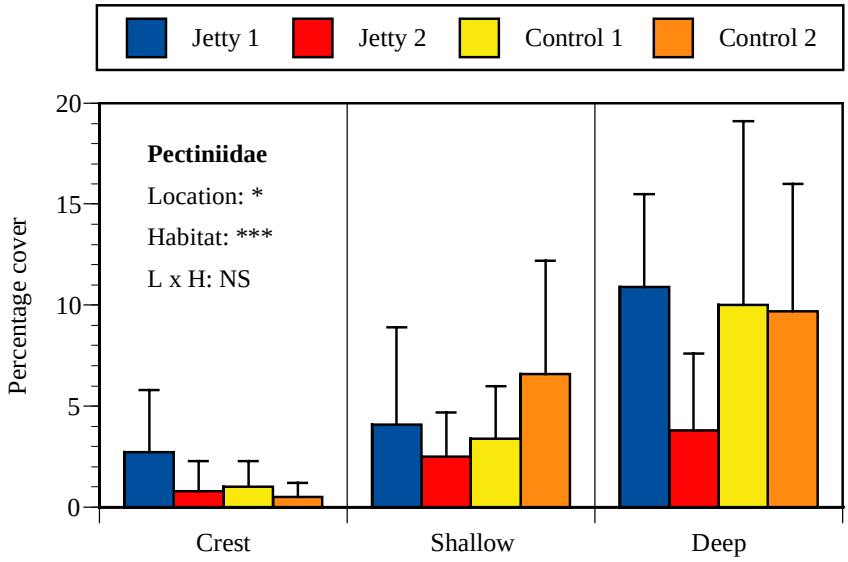


Left: A large explanate colony of the agariciid *Pachyseris speciosa* on the deep reef slope of the jetty 2 location.

Right: The agariciid coral *Pavona cactus* formed large colonies on the deep slope in the jetty 2 location.

Figure 9. Distribution of Pectiniid Corals in the Jetty and Control Survey Locations.

Graphs show grand means in each habitat for each location from two sites of four 20 m line intersect transects. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

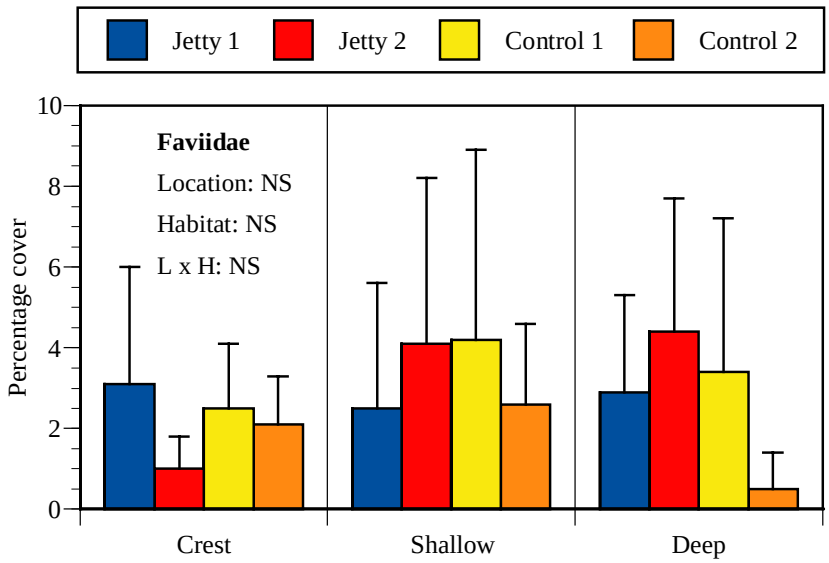


Left: Large explanate colonies of the pectiniid corals *Echinophyllia* spp. were common on the deep reef slopes of all except the jetty 2 location.

Right:The pectiniid coral *Mycedium elephantotus* was also common on the deep slope of all except jetty 2 location.

Figure 10. Distribution of Faviid Corals in the Jetty and Control Survey Locations.

Graphs show grand means in each habitat for each location from two sites of four 20 m line intersect transects. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.



Left: A variety of faviid corals were present on the reef slope at the jetty 2 location, including the species *Oulophyllia crispa*.

Right:The faviid coral *Echinopora lamellosa* was found on the reef slope of all locations.

Figure 11. Major Benthic Group Patterns in the Jetty 2 Survey Sites (A).

Graphs show means from four 20 m line intersect transects in each habitat from the Jetty 2 site and adjacent sites to the North and South. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

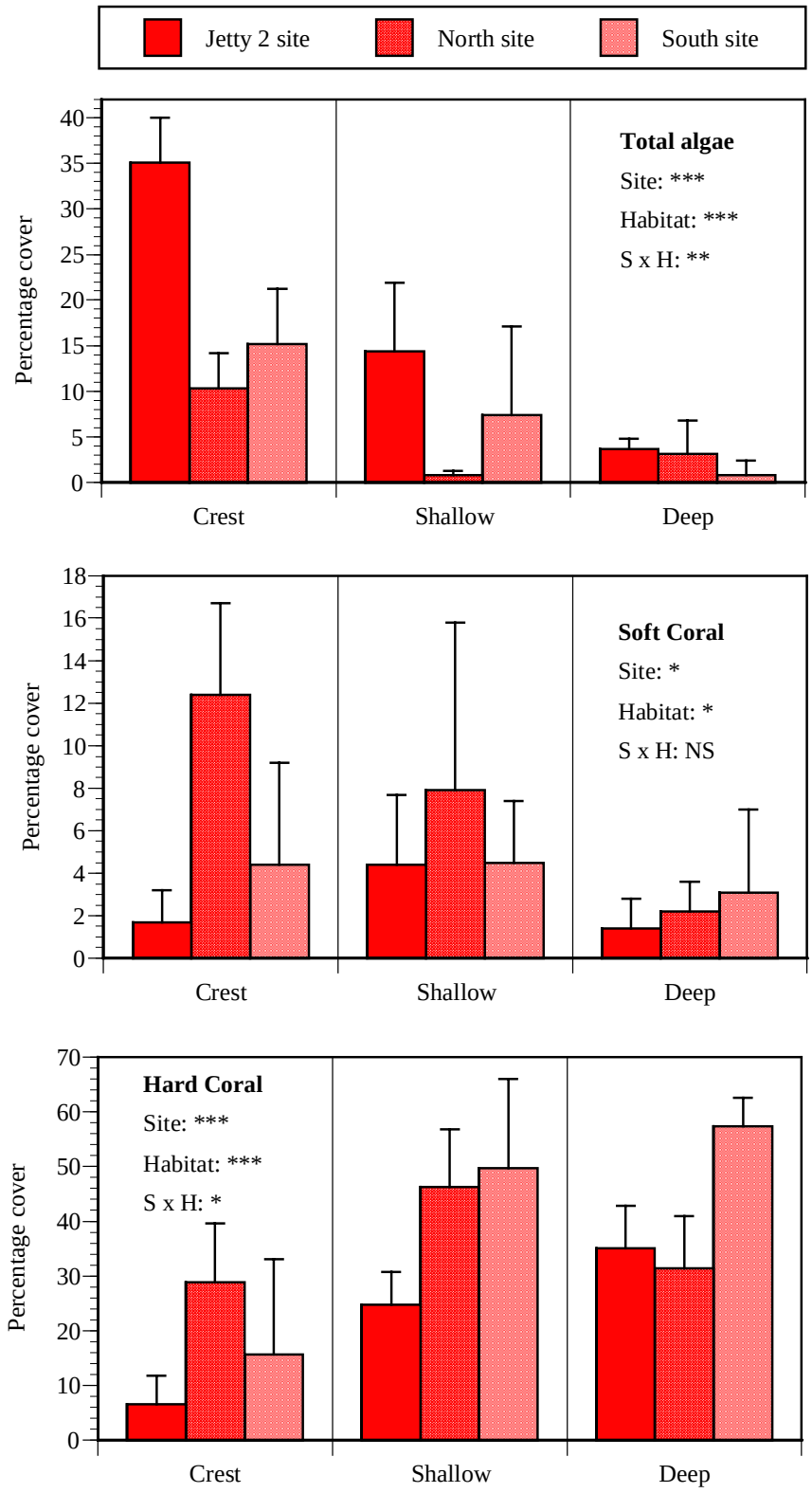


Figure 12. Major Benthic Group Patterns in the Jetty 2 Survey Sites (B).

Graphs show means from four 20 m line intersect transects in each habitat from the Jetty 2 site and adjacent sites to the North and South. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

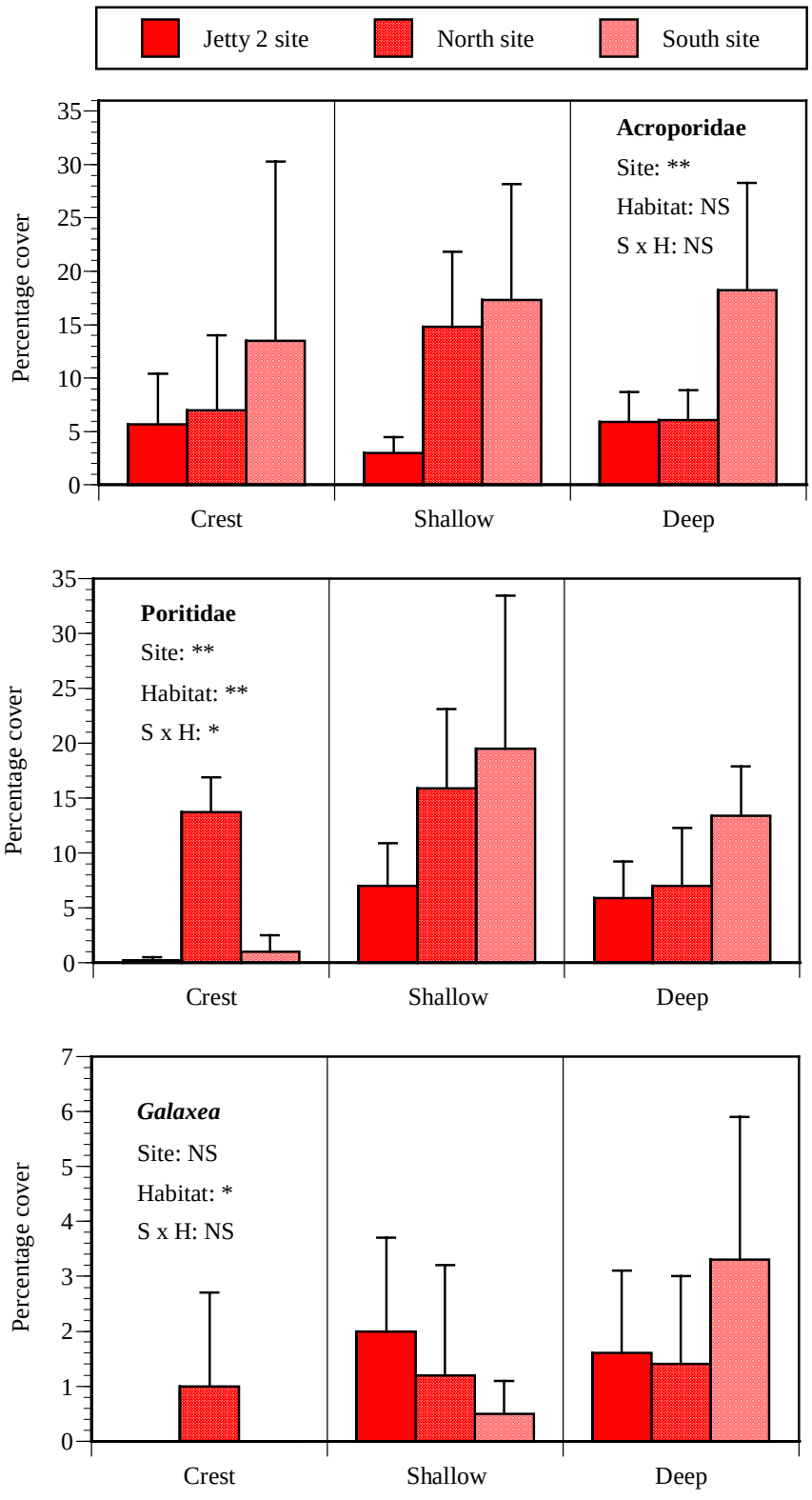


Figure 13. Major Benthic Group Patterns in the Jetty 2 Survey Sites (C).

Graphs show means from four 20 m line intersect transects in each habitat from the Jetty 2 site and adjacent sites to the North and South. Error bars are standard deviations. The significance of location and habitat differences and the location x habitat interactions are shown on each graph.

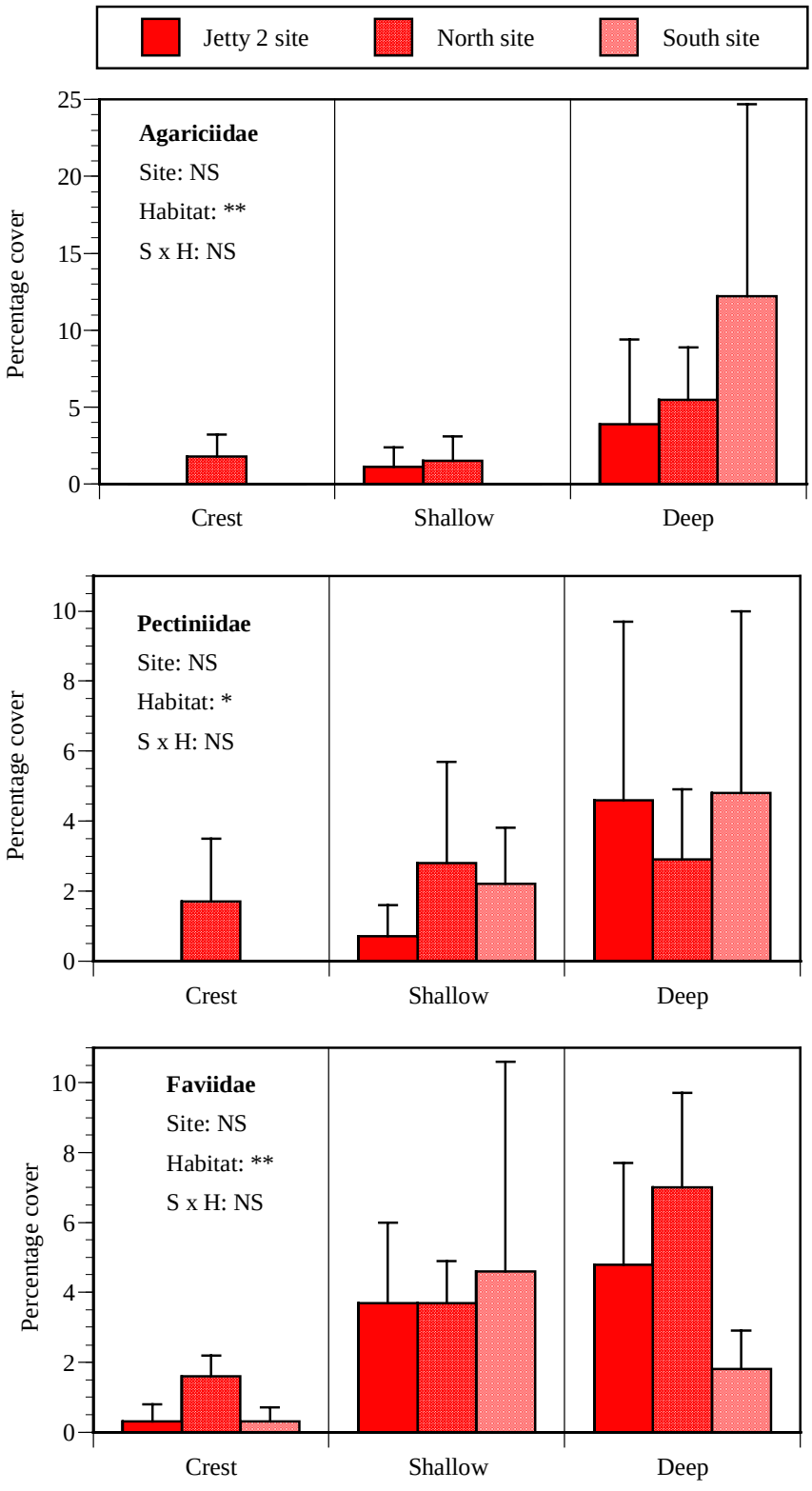


Figure 14. Branching *Millepora* Fire Coral Colonies Covered Over 8% of the Jetty 1 Reef Crest But Were Uncommon in the Jetty 2 Location.

Figure 15. Several Species of Black Coral *Antipathes* sp. were Found on the Reef Slope Below About 10m Depth.

3.7. Damaged and Diseased Corals

Hard corals are subject to a number of different diseases that can cause partial mortality of affected colonies. During this survey of fringing reefs in the Dent Jetty locations and controls a mean of between 0.5 and 1.0 colony per 40 sq m transect exhibited partial mortality that appeared to be a result of disease (Table 10). The majority of diseased corals were *Acropora* species with coral eroding disease (Figure 16) but there were also a few *Galaxea* and *Goniopora* colonies with disease as well as a selection of other damaged species (Figure 17).

Fringing reefs in this area are subject to strong tidal currents that naturally resuspend fine sediment and deposit it on the surface of the coral colonies. This sediment can accumulate in depressions on the colony surface during bad conditions and cause patches of mortality. A mean of 0.1-1.7 colonies per 40 sq m had suffered recent patches of mortality due to sediment smothering (Table 10). Explanate growth form colonies of *Pachyseris speciosa* and *Merulina ampliata* were the species most commonly affected by sediment smothering (Figure 18, 19) but all other corals with the exception of *Acropora* species also had some sediment damaged colonies. Sediment smothering was much more frequent in the two control locations than in the proposed jetty locations (Table 10) possibly because both jetty locations were subject to stronger currents than the controls.

A few coral colonies showed some physical damage, usually breakage of some fingers on *Porites* finger colonies, or had small patches of partially bleached tissue (Table 10).

Table 10. Summary of Coral Damage and Disease for the Jetty Survey Locations.

Damage category	Jetty 1		Jetty 2		Control 1		Control 2	
	mean	sd	mean	sd	mean	sd	mean	sd
Diseased corals	0.5	0.9	0.7	1.1	1.0	1.3	0.6	0.8
Sediment damage	0.1	0.3	0.2	0.5	1.7	1.6	1.5	1.4
Broken corals	0.1	0.4	0.1	0.2	0.1	0.3	0.0	0.0
Partially bleached	0.1	0.2	0.1	0.3	0.1	0.2	0.0	0.0

Figure 16. *Acropora* Corymbose Plate Colony with Disease Induced Mortality.

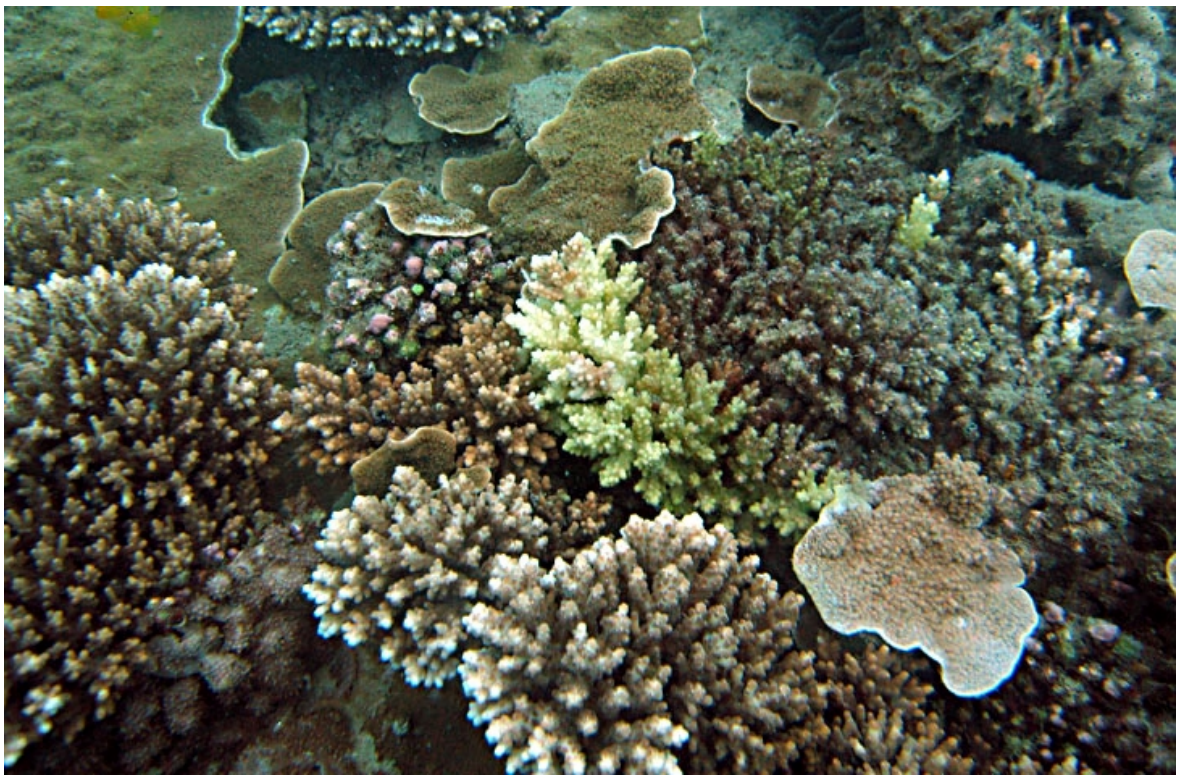


Figure 17. Diseased *Leptoseris* Colony Showing a Grey Patch of Fungal Disease.

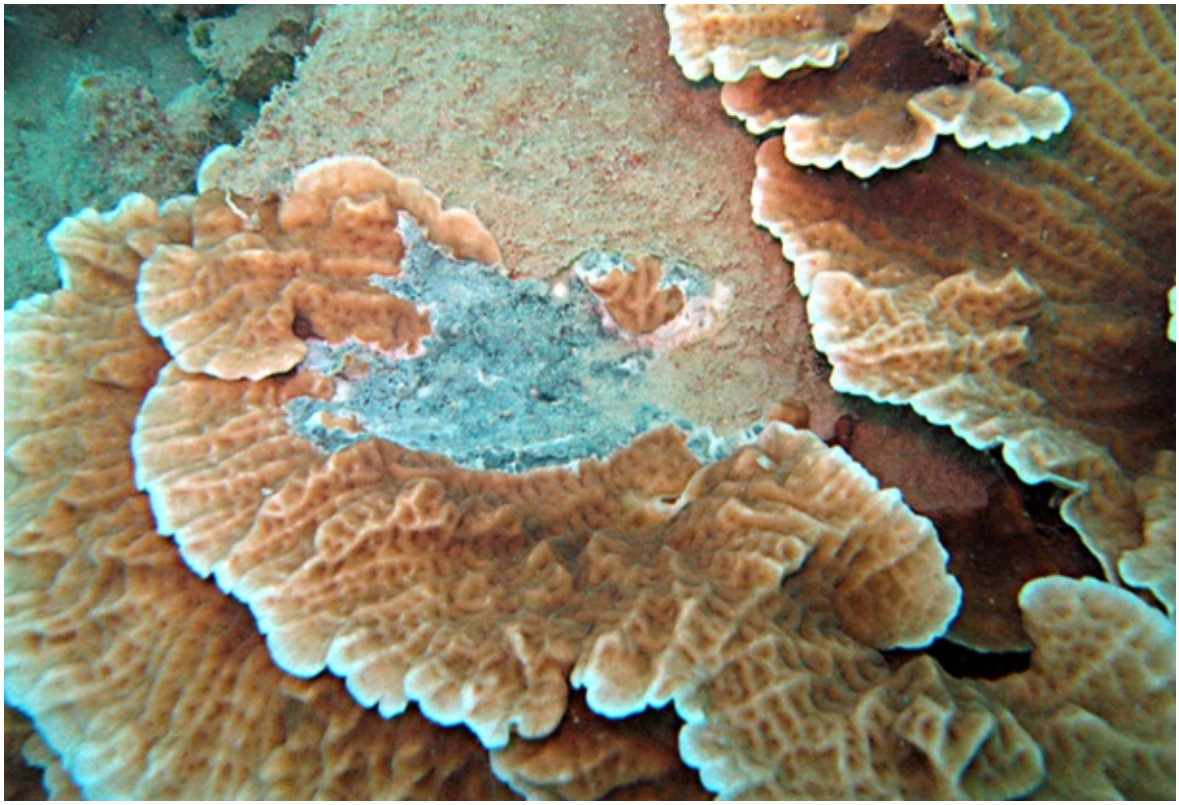
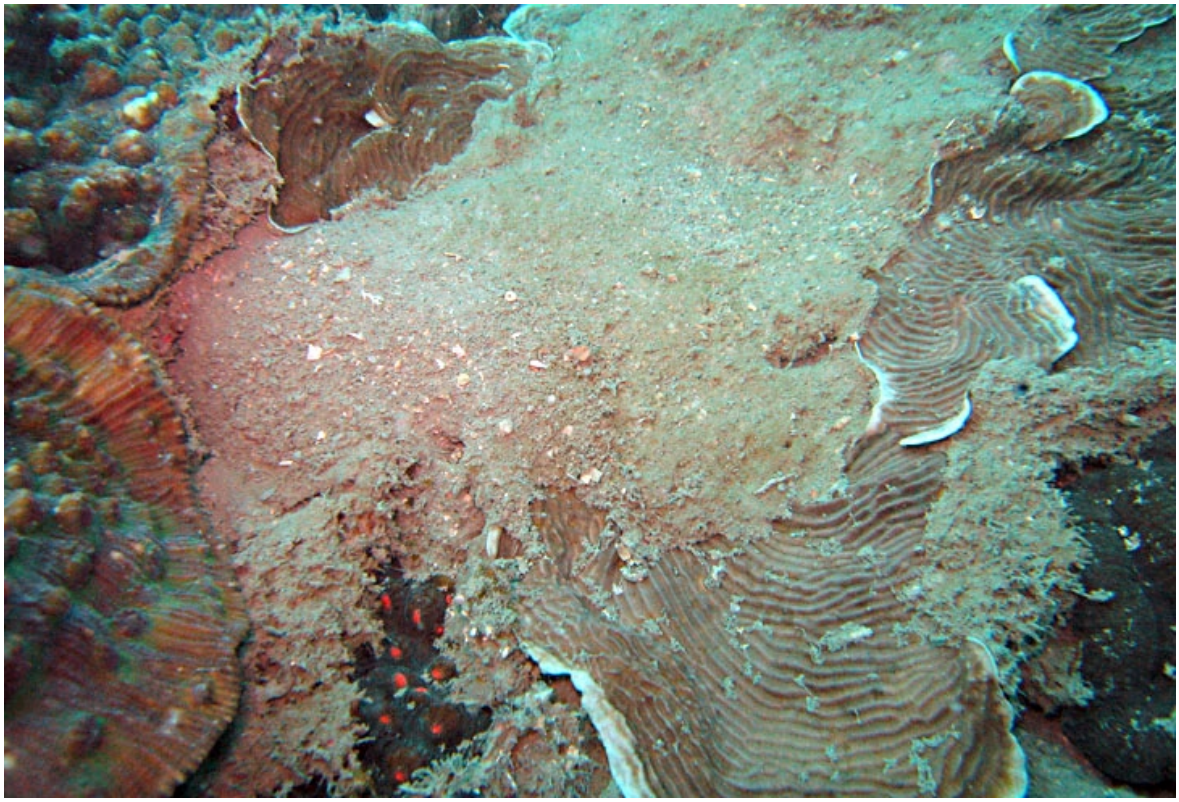


Figure 18. Sediment Smothering on an Explanate *Merulina ampliata* Colony

Figure 19. Sediment Smothering on an Explanate *Pachyseris* Colony at Control 1.



4. Discussion

The fringing reefs on the east side of Dent Island generally support a rich community of hard corals despite the damage inflicted by the 1998 and 2002 bleaching events. The combined percentage cover of hard corals ranged from almost 30% on the reef crest to 55% on the shallow slope and 50% on the deep slope. Overall coral cover during the latest survey was still similar to that recorded during the first major survey in this area in 1990 (Ayling and Ayling 1991a).

Like most other fringing reefs there were many large coral colonies on the fringing reefs in this area. *Goniopora* colonies of between 5 and 20 m across were common, along with *Acropora* staghorn, *Porites* finger, *Pachyseris speciosa*, *Leptoseris yabei*, *Echinophyllia*, *Pavona cactus*, *Caulastrea furcata* and *Merulina ampliata* colonies from 2 to 5 m across.

Reef communities at the proposed new passenger landing location (jetty 2) were similar to those on other parts of the Dent east coast although overall coral cover, as well as the cover of most other benthic groups, was significantly lower here than in the other three survey locations. There were no unique features of the fringing reef in the jetty 2 location compared with other reefs we have surveyed in the area.

The density of diseased corals in the survey locations was very similar to that recorded recently on Hay Point fringing reefs in the Mackay area (GHD Hay Point reports 2006), where the normal density of diseased corals was between 0.6 and 1.3 per 40 sq m. The density of sediment smothered coral colonies was markedly lower at the jetty locations than in the two controls probably because the jetty locations are subjected to stronger tidal currents than the controls.

The strong north flowing currents at the jetty 2 location during falling tides will ensure that any sediment that may be generated during the landing construction process is carried quickly away from the reef.

5. References

Ayling A.M. and Ayling A.L. 1991a. Proposed environmental monitoring program - Hamilton Island northern harbour and Dent Island harbour. Unpublished report to the Great Barrier Reef Marine Park Authority. 10 pp.

Ayling A.M. and Ayling A.L. 1991b. The effect of sediment run-off on the coral populations of the fringing reefs at Cape Tribulation. Great Barrier Reef Marine Park Authority Research Publication No. 26. Townsville, Queensland, Australia.

Ayling A.M. and Ayling A.L. 1995. A preliminary survey of benthic communities on fringing reefs in the middle Cairns Section. Unpublished report submitted to the Great Barrier Reef Marine Park Authority.

Ayling A.M. and Ayling A.L. 1998a. Magnetic Quays monitoring program benthic transects: a resurvey and methods comparison. Unpublished report to the Great Barrier Reef Marine Park Authority. 18 pp.

Ayling A.M. and Ayling A.L. 1998b. Medium-term changes in coral populations of fringing reefs at Cape Tribulation. Unpublished report to the Great Barrier Reef Marine Park Authority. 48 pp.

Ayling A.M. and Ayling A.L. 2001a. Long Term Monitoring Program for Marine benthos in the vicinity of Keswick Island Development (Whitsunday Island group): Baseline Survey. Unpublished report to the Great Barrier Reef Marine Park Authority. 18 pp.

Ayling A.M. and Ayling A.L. 2001b. A Biological Survey of marine habitats in the vicinity of the proposed resort and golf course on Dent Island with comments on the likely impacts of the resort on these habitats. Unpublished report to Hamilton Island Enterprises. 28 pp.

Ayling A.M., Ayling A.L. and Berkelmans R. 1998. Shoalwater Bay fringing reef resource assessment. Great Barrier Reef Marine Park Authority Research Publication No. 54. Townsville, Queensland, Australia.

GHD 2006. Report for Port of Hay Point Capital Dredging Environmental Monitoring Program. Various reports. Ports Corporation of Queensland, Brisbane, Australia.

Mapstone B.D., Choat J.H., Cumming R.L. and Oxley W.G. 1989. The fringing reefs of Magnetic Island: benthic biota and sedimentation - a baseline survey. Unpublished report to the Great Barrier Reef Marine Park Authority. 88 pages.

Appendix 1. Summary of Cover for the Major Benthic Groups in the Three Habitats at Each Location.

Table 11. Composition of the Benthic Communities in the Jetty Locations.

Figures show means from groups of four 20 m line intersect transects at each location, along with the standard deviation (sd) in italics.

Location	Jetty 1 central	Jetty 1 north	Jetty 1 south	Jetty 2 central	Jetty 2 north	Jetty 2 south
Benthic Group:	mean (sd)	mean (sd)	mean (sd)	mean (sd)	mean (sd)	mean (sd)
REEF CREST						
Total algae	8.8 *9.9*	8.1 *6.2*	13.3 *13.7*	35.1 *4.9*	10.3 *3.9*	15.2 6.0
Sponges	-	0.1 *0.3*	-	0.1 *0.2*	2.4 *2.0*	0.3 *0.2*
Millepora	8.2 *2.8*	5.6 *5.2*	2.8 *4.1*	-	1.6 *3.3*	-
Total Hard Coral	41.8 *12.2*	54.8 *4.2*	39.8 *16.4*	6.5 *5.3*	28.9 *10.7*	15.7 *17.3*
Pocilloporidae	-	0.3 *0.3*	-	-	0.2 *0.3*	-
Acroporidae	4.5 *3.9*	29.5 *9.9*	1.1 *0.7*	5.7 *4.7*	7.0 *7.0*	13.5 *16.8*
Acropora	3.8 4.5	28.8 *9.7*	0.9 *0.6*	5.6 *4.4*	6.8 *6.9*	12.6 *15.1*
Montipora	0.7 *1.1*	0.8 *0.6*	0.2 *0.2*	0.2 *0.3*	0.2 *0.3*	0.7 *1.3*
Poritidae	26.2 *14.3*	10.5 *7.1*	24.2 *19.4*	0.2 *0.3*	13.7 *3.2*	1.0 *1.5*
Agariciidae	1.5 *2.2*	-	6.9 *7.3*	-	1.8 *1.4*	-
Pectiniidae	1.1 *2.1*	4.7 *3.2*	0.8 *1.6*	-	1.7 *1.8*	-
Faviidae	2.9 *1.3*	4.6 *3.2*	1.7 *1.9*	0.3 *0.5*	1.6 *0.6*	0.3 *0.4*
Galaxea	1.4 *0.8*	0.5 *0.4*	1.5 *2.2*	-	1.0 *1.7*	-
Total Soft Coral	19.8 *11.9*	5.1 *3.6*	13.6 *8.6*	1.7 *1.5*	12.4 *4.3*	4.4 *4.8*
SHALLOW SLOPE						
Total algae	-	0.1 *0.1*	0.4 *0.8*	14.4 *7.5*	0.8 *0.5*	7.4 *9.7*
Sponges	1.4 *1.2*	0.6 *0.5*	0.2 *0.3*	0.5 *0.7*	1.6 *1.2*	0.3 *0.6*
Millepora	1.3 *1.6*	1.4 *1.9*	1.9 *2.2*	1.14 *2.0*	2.3 *4.2*	0.3 *0.6*
Total Hard Coral	57.4 *4.1*	68.6 *5.1*	43.2 *4.5*	24.8 *5.9*	46.3 *10.5*	49.7 16.3
Pocilloporidae	0.1 *0.2*	0.3 *0.7*	0.4 *0.7*	-	0.7 *0.6*	-
Acroporidae	11.1 *6.6*	33.5 *5.8*	2.1 *1.3*	3.0 *1.5*	14.8 *7.0*	17.3 *10.9*

Location	Pipeline north	Pipeline south	Control 1 north	Control 1 south	Control 2 north	Control 2 south
	mean (sd)	mean (sd)	mean (sd)	mean (sd)	mean (sd)	mean (sd)
Acropora	9.6 *7.3*	32.1 *7.0*	2.1 *1.3*	1.5 *2.1*	11.1 *7.6*	13.5 *10.5*
Montipora	1.5 *1.3*	1.4 *1.9*	-	0.9 *0.9*	2.1 *1.8*	3.8 *1.2*
Poritidae	25.5 *5.6*	17.4 *6.3*	21.1 *8.0*	7.0 *3.9*	15.9 *7.2*	19.5 *13.9*
Agariciidae	5.0 *7.6*	1.2 *1.7*	13.3 *7.8*	1.1 *1.3*	1.5 *1.6*	-
Pectiniidae	4.9 *4.2*	7.4 *4.9*	0.9 *0.7*	0.7 *0.9*	2.8 *2.9*	2.2 *1.6*
Faviidae	3.6 *1.1*	2.9 *4.5*	2.1 *1.6*	3.7 *2.3*	3.7 *1.2*	4.6 *6.0*
Galaxea	1.5 *1.4*	2.1 *1.6*	0.9 *1.3*	2.0 *1.7*	1.2 *2.0*	0.5 *0.6*
Total Soft Coral	8.6 *4.6*	5.0 *2.2*	11.6 *6.4*	4.4 *3.3*	7.9 *7.9*	4.5 *2.9*
DEEP SLOPE						
Total algae	-	-	-	3.7 *1.1*	3.1 *3.7*	0.8 *1.6*
Sponges	3.2 *2.3*	1.7 *2.0*	1.8 *0.6*	1.8 *1.3*	1.4 *1.4*	0.5 *0.3*
Millepora	-	-	0.3 *0.7*	-	0.1 *0.2*	-
Total Hard Coral	58.8 *3.2*	62.1 *14.3*	38.8 *14.9*	35.0 7.8	31.4 *9.5*	57.3 *5.3*
Pocilloporidae	-	-	0.6 *0.9*	0.1 *0.3*	0.2 *0.5*	-
Acroporidae	8.3 *1.5*	23.4 *15.1*	5.5 *3.2*	5.9 *2.8*	6.1 *2.8*	18.2 *10.1*
Acropora	2.1 *2.5*	18.9 *15.1*	3.6 *2.5*	2.0 *2.3*	1.6 *0.7*	11.5 *8.3*
Montipora	5.9 *3.1*	4.4 *2.8*	1.8 *1.7*	3.7 *2.1*	3.3 *1.9*	6.6 *3.7*
Poritidae	4.2 *4.1*	5.6 *2.7*	6.9 *6.0*	5.9 *3.3*	7.0 *5.3*	13.4 *4.5*
Agariciidae	23.7 *8.0*	10.0 *4.8*	12.1 *7.4*	3.9 *5.5*	5.5 *3.4*	12.2 *12.5*
Pectiniidae	16.3 *5.5*	13.1 *2.6*	8.6 *5.5*	4.6 *5.1*	2.9 *2.0*	4.8 *5.2*
Faviidae	3.2 *1.6*	3.8 *3.4*	2.0 *0.4*	4.8 *2.9*	7.0 *2.7*	1.8 *1.1*
Galaxea	-	2.5 *2.5*	0.4 *0.5*	1.6 *1.5*	1.4 1.6	3.3 *2.6*
Total Soft Coral	0.7 *0.5*	0.3 *0.4*	1.3 *1.0*	1.4 *1.4*	2.2 *1.4*	3.1 *3.9*

Table 12. Composition of the Benthic Communities in the Control Locations.

Figures show means from groups of four 20 m line intersect transects at each site, along with the standard deviation (sd) in italics.

Location	Control 1 north	Control 1 south	Control 2 north	Control 2 south
Benthic Group:	mean (sd)	mean (sd)	mean (sd)	mean (sd)
REEF CREST				
Total algae	23.6 *16.4*	18.6 *17.8*	41.6 *3.0*	41.2 5.9
Sponges	0.2 *0.2*	0.3 *0.3*	0.1 *0.1*	-
Millepora	4.8 *6.6*	2.0 *1.8*	-	-
Total Hard Coral	29.9 *15.6*	40.2 *16.4*	16.4 *2.5*	16.7 *4.8*
Pocilloporidae	-	0.3 *0.6*	-	-
Acroporidae	6.4 *6.1*	21.1 *15.9*	1.4 *0.3*	8.0 *3.8*
Acropora	6.0 *5.9*	19.0 *15.3*	0.9 *0.2*	3.1 *2.4*
Montipora	0.4 *0.4*	2.1 *1.4*	0.5 *0.4*	5.0 *1.9*
Poritidae	15.4 *10.4*	8.3 *5.5*	2.2 *0.6*	1.7 *0.5*
Agariciidae	0.1 *0.2*	1.4 *1.1*	0.5 *0.6*	0.9 *1.8*
Pectiniidae	0.5 *1.0*	1.5 *1.6*	0.7 *0.8*	0.2 *0.5*
Faviidae	2.4 *2.4*	2.7 *0.8*	2.5 *1.7*	1.7 *0.3*
Galaxea	1.2 *1.4*	-	5.3 *1.7*	1.0 *2.1*
Total Soft Coral	4.8 *3.8*	7.7 *3.2*	3.6 *3.5*	1.0 *0.4*
SHALLOW SLOPE				
Total algae	-	0.8 *1.5*	7.9 *5.8*	3.8 *3.8*
Sponges	0.4 *0.5*	2.1 *1.5*	0.8 *0.8*	0.9 *0.7*
Millepora	0.6 *0.6*	-	-	-
Total Hard Coral	69.5 *6.9*	64.5 *15.8*	71.4 *5.2*	71.3 6.2
Pocilloporidae	0.4 *0.9*	0.6 *0.7*	-	0.2 *0.3*
Acroporidae	9.1 *8.6*	23.3 *17.6*	4.1 *4.6*	5.0 *4.0*
Acropora	8.8 *8.0*	20.2 *18.9*	1.2 *1.0*	4.1 *4.3*
Montipora	0.2 *0.4*	3.1 *4.0*	2.9 *3.6*	0.9 *1.8*

Location	Control 1 north	Control 1 south	Control 2 north	Control 2 south
	mean (sd)	mean (sd)	mean (sd)	mean (sd)
Poritidae	49.4 *16.3*	12.7 *5.8*	1.9 *2.5*	2.8 *3.1*
Agariciidae	1.4 *2.1*	2.9 *1.3*	2.7 *2.8*	5.6 *5.1*
Pectiniidae	1.7 *1.6*	5.1 *2.1*	3.8 *3.8*	9.3 *6.3*
Faviidae	0.8 *1.2*	7.7 *4.3*	1.2 *1.3*	4.0 *1.4*
Galaxea	1.0 *1.6*	4.4 *2.5*	51.9 *5.8*	33.0 *11.7*
Total Soft Coral	3.7 *1.7*	3.8 *4.1*	1.2 *0.9*	2.6 *2.2*
DEEP SLOPE				
Total algae	-	-	3.5 *3.7*	-
Sponges	1.1 *1.4*	3.6 *1.8*	1.4 *1.3*	2.4 *1.0*
Millepora	-	-	-	-
Total Hard Coral	56.8 *13.0*	42.6 5.9	63.5 *8.6*	62.7 *15.4*
Pocilloporidae	0.1 *0.2*	-	-	-
Acroporidae	4.3 *1.8*	6.5 *3.3*	2.4 *1.5*	0.4 *0.5*
Acropora	0.6 *0.5*	3.2 *3.8*	0.7 *1.1*	0.2 *0.5*
Montipora	3.7 *1.9*	3.3 *2.3*	1.7 *1.8*	0.2 *0.3*
Poritidae	29.9 *21.7*	5.3 *3.2*	3.4 *2.6*	3.3 *3.8*
Agariciidae	11.7 *5.7*	5.3 *3.1*	10.3 *3.3*	11.4 *8.2*
Pectiniidae	5.8 *1.2*	14.3 *12.0*	6.9 *2.1*	12.5 *8.2*
Faviidae	1.5 *1.6*	5.2 *4.8*	0.3 *0.6*	0.8 *1.1*
Galaxea	2.0 *2.3*	0.8 *0.6*	36.6 11.3	30.6 *12.2*
Total Soft Coral	0.3 *0.4*	1.1 *1.0*	0.8 *0.8*	0.7 *0.6*