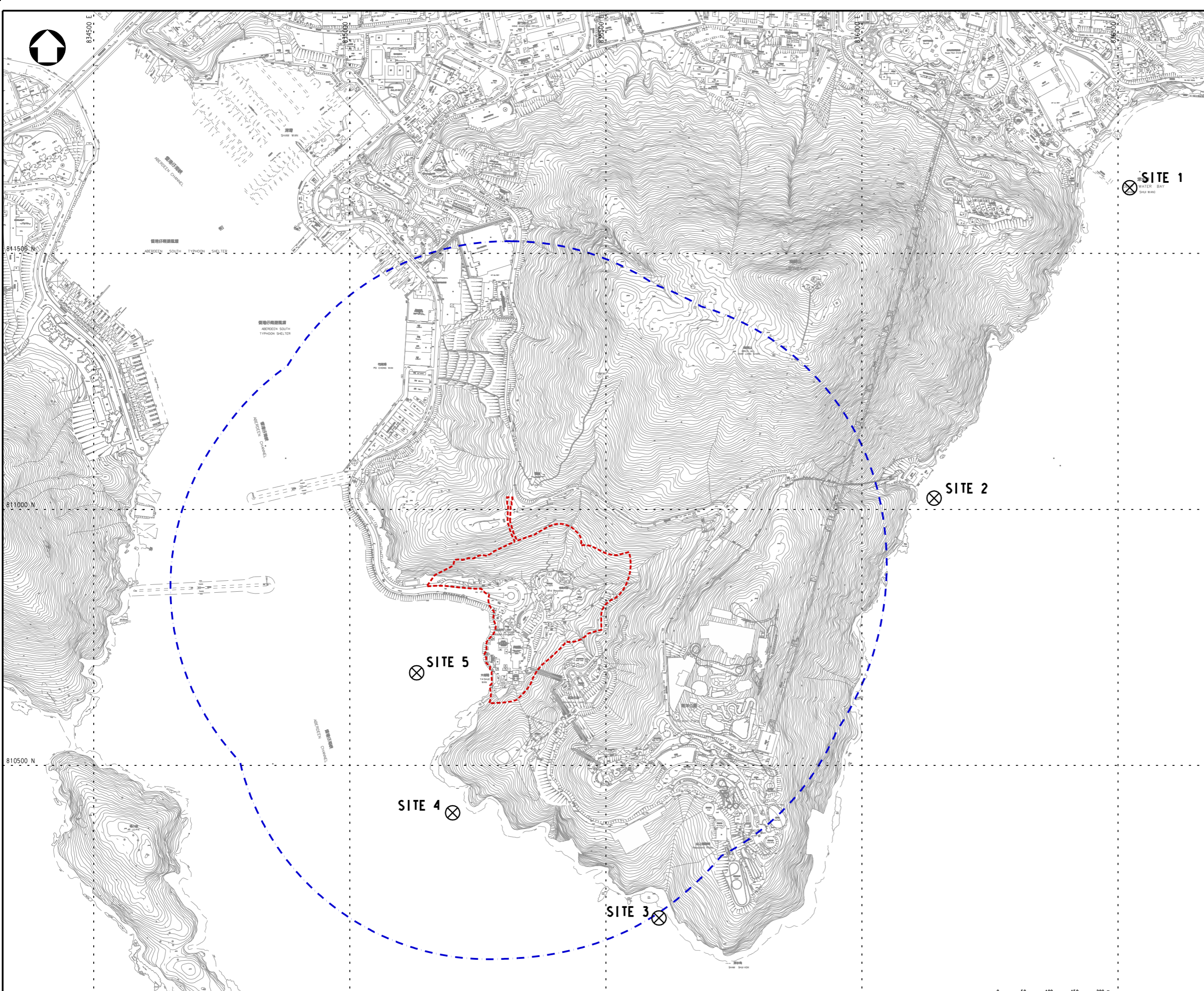


**Appendix 10.4 Information extracted from Coral Monitoring Surveys for  
Ocean Park Corporation Master Redevelopment Project**

- Location of Coral Impact Monitoring Station
- Initial Coral Survey (2007)
- Report for Coral Monitoring Survey in July 2012 (Post-construction Monitoring Survey)





Notes

- Key to symbols
- - - 500m ASSESSMENT AREA
  - - - PROJECT BOUNDARY
  - ⊗ CORAL IMPACT MONITORING STATION

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P3	MAR 14	MING	GENERAL REVISION	RH	AFK
P2	NOV 13	MING	GENERAL REVISION	RH	AFK
P1	OCT 13	MING	FIRST ISSUE	RH	AFK



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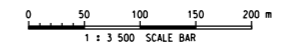
Project

**TAI SHUE WAN DEVELOPMENT  
AT OCEAN PARK**

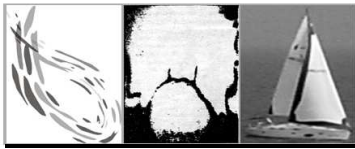
Title

**LOCATIONS OF CORAL IMPACT  
MONITORING STATION**

Designed	ANNA	Eng check	FW
Drawn	MING	Coordination	FW
Dwg check	GC	Approved	AFK
Scale at A1	1:3500	Status	PRE
Drawing Number	APPENDIX 10.4	Rev	P3







Ocean Park Corporation Master Development Project  
Contract No. C105  
Site Formation, Funicular Tunnel and Miscellaneous Works

**miniprojects co. Ltd.**

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**Ocean Park Corporation Master Redevelopment Project**  
**Contract No. C105**  
**Site Formation, Funicular Tunnel and Miscellaneous Works**

**Report for**  
**Initial Coral Survey and Coral Tagging Exercise**

**27 April 2007**

**Prepared by:**  
**miniprojects co. Ltd.**  
**Lam Laboratories Limited**

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## 1 INTRODUCTION

### 1.1 Project Background

- 1.1.1 Ocean Park planned to upgrade and expand the existing area to meet the anticipated visitor demands and to position Ocean Park as a premium tourist attraction and a regional leader in the themed recreational and educational park experience.
- 1.1.2 Lam Laboratories Limited (LAM) has been appointed to formulate a Coral Survey Team to conduct the Marine Ecology Survey for Ocean Park Corporation Master Redevelopment Project Contract No. C105 – Site Formation, Funicular Tunnel and Miscellaneous Works.
- 1.1.3 miniprojects Company Limited (miniprojects co. Ltd.) have been commissioned by LAM to undertake coral surveys and tagged coral monitoring at five monitoring sites around the construction site and one control site for captioned project. This report presents the results of the initial coral surveys conducted in April 2007.
- 1.1.4 Monitoring surveys of the coral community for the marine ecological EM&A were required in accordance with the EM&A manual. Monitoring requirement for initial coral survey and coral tagging exercise are presented in Appendix I.
- 1.1.5 This report presents the findings of,
- Initial coral survey at six sites (five monitoring and one control)
  - Tagging of hard coral colonies at the six sites for monitoring during the construction works
- 1.1.6 As background to this initial survey, a brief review of previous subtidal survey findings has been included and is presented in Section 2 of this report. The report then goes on to describe the survey methodology (Section 3) and results (Section 4) for both the initial survey and tagged coral study at the six sites.

## 2 PREVIOUS SURVEY FINDINGS

### 2.1 Repositioning and Long Term Operation Plan of Ocean Park – Environmental Impact Assessment Study – Maunsell Consultant Asia Ltd.

2.1.1 The only available previous information on coral community around the construction area is from the dive survey conducted in 2005 for the EIA Ocean Park development.

2.1.2 The five survey sites in the 2005 report correspond to Sites 1 to 5 of the present survey. Data were collected using the semi-quantitative Rapid Ecological Assessment (REA) method that provided general information on the biological and ecological attributes of the study areas. The existing data are summarized in Table 2.1.

**Table 2.1 Summary of Site Description for the 5 Coral Survey Sites in 2005 Survey.**

		Site 1	Site 2	Site 3	Site 4	Site 5
Shallow	<b>Substrate Type</b>	Large boulder	Continuous pavement	Continuous pavement	Continuous pavement	Artificial Seawall
	<b>Hard Coral Cover (%)</b>	10	5	5	1	1
	<b>Soft Coral Cover (%)</b>	0	0	1	1	0
Middle	<b>Substrate Type</b>	Small blocks & sand	Sand	Large boulder & small block	Continuous pavement	Large boulder
	<b>Hard Coral Cover (%)</b>	5	1	1	1	0
	<b>Soft Coral Cover (%)</b>	0	0	5	3	0
Deep	<b>Substrate Type</b>	Sand	Sand	Sand & large boulder	Large boulder	Sand
	<b>Hard Coral Cover (%)</b>	0	0	0	1	0
	<b>Soft Coral Cover (%)</b>	0	0	3	3	1
<b>Number of Hard Coral Species</b>		16	13	8	7	1
<b>Number of Soft Coral Taxa</b>		0	0	9	7	1

2.1.3 In the 2005 survey, the shallow zone at Sites 1 and 2 had the highest total species (including hard and soft coral and other benthic organisms) recorded, 17 and 18, respectively. The lowest total species was recorded from the deep zone of Site 2 with only one taxon observed. The highest diversity was recorded from the shallow zone of Sites 1 and 2. Furthermore, Site 5 had a low diversity and species richness from all zones, i.e., shallow, middle and deep. The highest hard coral cover was recorded at Site 1 and was estimated at 10% in the shallow zone. Soft coral cover was highest for the middle zone at Site 3 and was estimated at 5%.



### **3 METHODOLOGY**

#### **3.1 Initial Coral Survey**

- 3.1.1 Initial coral survey was conducted at the five monitoring sites (Sites 1, 2, 3, 4 and 5) and one control site (Control Site C) from 5<sup>th</sup> to 12<sup>th</sup> April 2007.
- 3.1.2 The purpose of initial coral survey is to verify the status of coral community in the 6 sites in terms of species composition, abundance, cover and healthiness before the commencement of the construction. Baseline data collected in this survey serve as reference materials for post-construction survey to evaluate the possible impact of the construction on the marine environment. Quantitative data on substrate characteristics and coral community status were collected using random transect (line and belt) method.
- 3.1.3 At each site, 3 x 30 m transects were laid randomly and parallel to the coastline at the depth between 3 and 9 m where corals are commonly located. Locations of the starting and ending points of each transect were recorded by GPS (GPSmap 60CS, Garmin).
- 3.1.4 General physical parameters were recorded for each survey site, including substrate characteristics, visibility, weather, tidal conditions and water current. Common benthic flora and fauna were also described.
- 3.1.5 Quantitative data on the substrate type were examined along the transect lines. The substrate and sessile organisms were classified into 12 categories; type of substrate was recorded at 0.5 m intervals on each transect. Percentage cover of each category was computed for each survey site. The 12 substrate types are listed as below,
- Bare rock
  - Sand and shell debris
  - Silt
  - Sponge
  - Macroalgae
  - Encrusting algae
  - Coralline algae
  - Bryozoan
  - Barnacles
  - Hard coral
  - Soft coral
  - Sea anemone
- 3.1.6 Quantitative data on coral community were inspected by belt transect method. A belt transect of 2 m wide, i.e. 1 m on either side of the transect line, was surveyed for any coral colony exist within the swath. Each coral colony was identified to species level, the colony size, the percentage area of sedimentation on colony surface, the percentage area of bleaching and recent mortality were recorded. Photographs were taken for representative colonies.

3.1.7 Abundance (number of colonies), number of species (S), and Shannon-Weiner diversity ( $H'$ ) (Shannon and Weaver 1963) were computed for each survey site. Multivariate analyses were performed to determine spatial variations in the substrate composition (relative % of 12 substrate types from 6 sites,  $n = 3$  transects for each site). All multivariate analyses were based on Bray-Curtis dissimilarity matrices calculated from non-transformed data. To visualize multivariate patterns, non-metric multi-dimensional scaling (nMDS) ordination was performed using PRIMER 6 (Clarke and Gorley 2006). Analysis of Similarity (ANOSIM) was used to test the significance of the spatial patterns shown in the nMDS ordination. Similarity percentage (SIMPER) procedure in PRIMER was used to identify the substrate types or coral species, which contributed to the observed patterns.

### **3.2 Coral Tagging Exercise**

3.2.1 At each site, at least 10 hard coral colonies were identified to species level (if possible) and tagged for impact monitoring during the construction works. Corals were tagged giving priority to the largest, undamaged colonies since damage to these colonies would be more evident compared to smaller colonies or corals with existing damage. Corals were also selected for tagging based on the most suitable coral species and growth forms. As far as possible, tagging of hard coral species with tall polyps were avoided due to their higher tolerance of sedimentation.

3.2.2 The selected colonies were tagged using two-level marking,

- A numbered stone, painted in bright yellow, was placed next to each tagged colony,
- A numbered plastic tag was nailed into an adjacent piece of hard substrate.

3.2.3 For each tagged coral, specific detailed information was collected including species identification, size, growth form, depth and general condition for immediate surroundings. The health status of each tagged coral colony was carefully recorded, including information on existing surface area with partial mortality and bleached area. Sediment cover was recorded including percentage cover, texture and approximate thickness of sediment on the colony. Any contiguous patches of sediment cover  $>10\%$  should be counted. The condition of each tagged coral colony was recorded by taking a photograph from an angle and distance that best represents the entire colony.



## 4 RESULTS

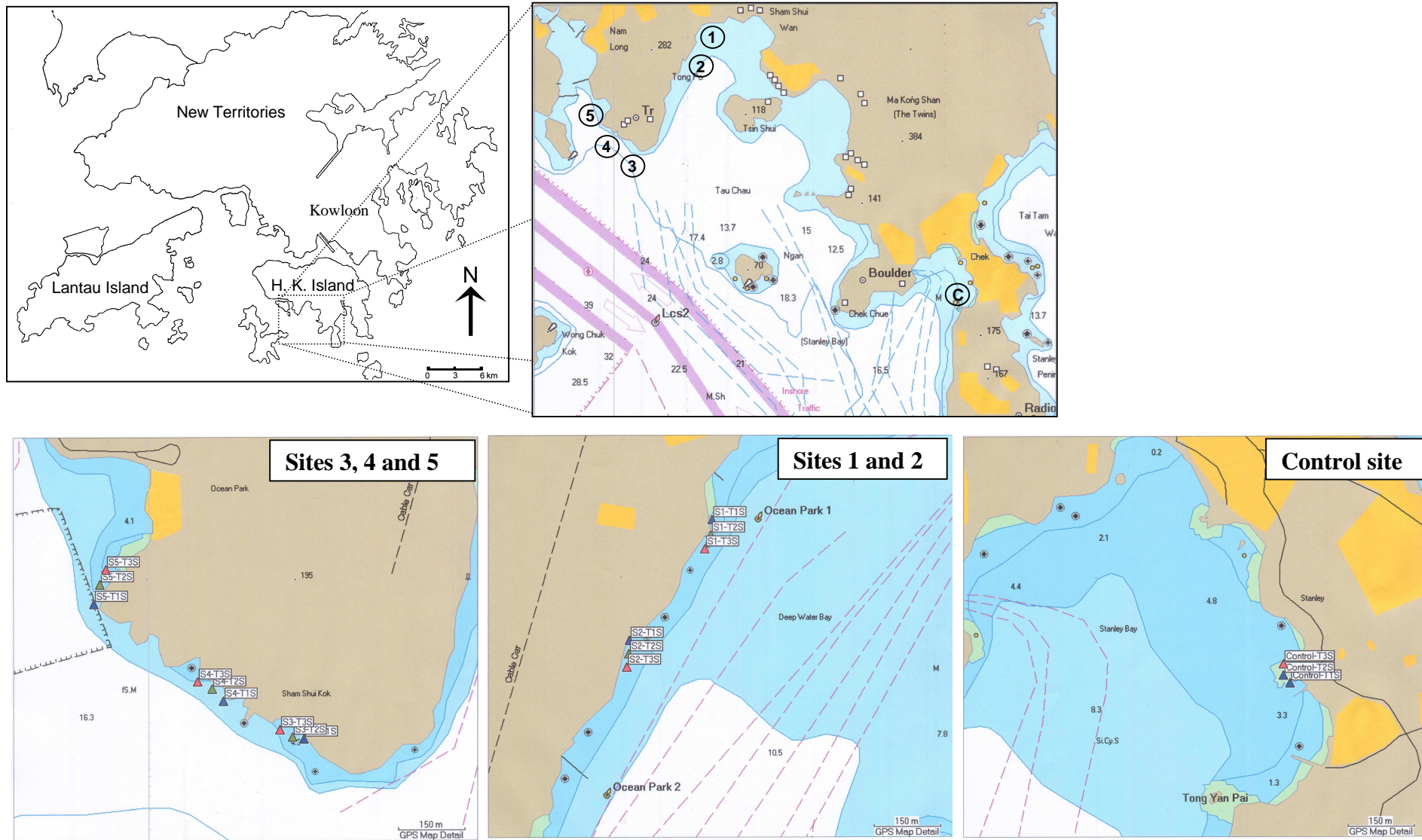
### 4.1 Initial Coral Survey

- 4.1.1 Geographic location of each transect in each survey site was recorded by GPS (Table 4.1) and illustrated in Fig. 4.1. Physical parameters at each site, including depth of transects, level of sedimentation on rock surface, visibility, tidal condition and water current are recorded and summarized in Table 4.1.
- 4.1.2 Percentage cover of the 12 substrate types was computed and illustrated in Figs. 4.2a-c. Summary of physical environment and coral cover was shown in Table 4.2.
- 4.1.3 Recorded of individual coral colonies, area of sediment, bleaching and mortality for each transect of the 6 survey sites are presented in Appendix II. Summary of coral community for each site is shown in Table 4.2, and record of hard coral species is listed in Table 4.3.
- 4.1.4 Among the 5 monitoring sites, the subtidal environment showed different level of variation in physical and biological characteristics. Sites 1 and 2, located at east coast of Nam Long Shan, are relatively sheltered, with gentler slope and mainly covered with boulders and rubbles. Higher abundance of hard corals was observed and colonies mainly reside on the boulder surfaces. Sites 3 and 4 at the south coast are more exposed to wave action and tidal current from the East Lamma Channel. The substrate profile is steeper and composed mainly of bedrock. Lower abundance of corals was found, encrusted on the bedrock surface. Site 5 was a sheltered bay at the west coast, but the site is affected by relatively potent tidal current. Hard corals were scarcely observed on boulder surfaces. The Control Site C was situated in St. Stephen's Beach where is a sheltered bay covered mainly by boulders, sand, high abundance and diversity of hard corals.
- 4.1.5 The substrate compositions at Site 1, Site 2 and Control Site C were clearly separated from the other sites in nMDS ordinations, in which the groups with shorter distance are more similar (Fig. 4.3). These site differences were confirmed by ANOSIM ( $R = 0.885$ ,  $p < 0.001$ ), which revealed significant site differences in substrate compositions. Samples from Control Site C were significantly separated from samples collected at Sites 1 and 2, which were similar to each other (Fig. 4.3). SIMPER showed that higher average dissimilarity (ADS) was found between Control Site C and Sites 3 (78.2 %), 4 (69.1 %) and 5 (75.7 %) than between Control Site C and Sites 1 (47.6 %) and 2 (46.3 %). Control Site C was characterized by higher percentage covers of coral (mean of 3 transects, 23.3 % vs. 2.2 – 12.8 % at other sites), barnacles (31.3 %) and coralline algae (13.9 %) (Fig. 4.2c). Sites 1 and 2 exhibited higher percentage cover of macroalgae (27.3 and 25.0 %, respectively; Fig. 4.2a), whilst Sites 3 and 4 were dominated by encrusting algae (56.1 and 39.43 %, respectively; Fig. 4.2b), and the substrates of Site 5 was mostly covered by silt layer (43.9 %) (Fig. 4.2c).

**Table 4.1 Coral Survey Sites and Conditions.**

Site	Transact Replicate	GPS Coordinates	Depth (m)	Sedimentation on Rocks Surface (mm)	Visibility (m)	Weather	Tide	Current (knot)
1	T1	Start	N 22°14'34.2" E 114°10'43.1"	3.6-4.8	0-1	1-1.5	calm, cloudy	ebb
		End	N 22°14'33.3" E 114°10'43.0"					
	T2	Start	N 22°14'33.1" E 114°10'43.0"	3.6-3.9	0-1			
		End	N 22°14'32.3" E 114°10'42.6"					
	T3	Start	N 22°14'32.1" E 114°10'42.5"	3.3-4.5	0-1			
		End	N 22°14'31.4" E 114°10'41.8"					
2	T1	Start	N 22°14'25.5" E 114°10'36.6"	3.6-3.9	0-1			
		End	N 22°14'24.6" E 114°10'36.6"					
	T2	Start	N 22°14'24.5" E 114°10'36.5"	4.2-4.5	0-2			
		End	N 22°14'23.7" E 114°10'36.4"					
	T3	Start	N 22°14'23.6" E 114°10'36.4"	3.6-3.9	0-1			
		End	N 22°14'22.8" E 114°10'35.9"					
3	T1	Start	N 22°13'49.5" E 114°10'14.1"	5.5-6.7	0-2			
		End	N 22°13'49.9" E 114°10'13.2"					
	T2	Start	N 22°13'49.7" E 114°10'13.2"	5.5-7.6	0-2			
		End	N 22°13'50.3" E 114°10'12.4"					
	T3	Start	N 22°13'50.2" E 114°10'12.2"	5.5-6.7	0-2			
		End	N 22°13'50.7" E 114°10'11.4"					
4	T1	Start	N 22°13'52.3" E 114°10'07.7"	8.2-9.4	1-4			
		End	N 22°13'53.0" E 114°10'06.9"					
	T2	Start	N 22°13'53.2" E 114°10'06.8"	5.8-9.1	0-4			
		End	N 22°13'53.6" E 114°10'05.9"					
	T3	Start	N 22°13'53.7" E 114°10'05.7"	5.8-7.3	0-2			
		End	N 22°13'54.1" E 114°10'04.8"					
5	T1	Start	N 22°13'59.3" E 114°09'57.5"	5.2-6.1	2-5			
		End	N 22°14'00.3" E 114°09'57.6"					
	T2	Start	N 22°14'00.7" E 114°09'58.0"	6.4-6.7	2-5			
		End	N 22°14'01.3" E 114°09'58.7"					
	T3	Start	N 22°14'01.8" E 114°09'58.5"	6.1-7.0	2-5			
		End	N 22°13'50.7" E 114°09'58.4"					
C	T1	Start	N 22°12'48.6" E 114°12'50.6"	2.7-4.5	0-1			
		End	N 22°12'49.5" E 114°12'50.4"					
	T2	Start	N 22°12'49.2" E 114°12'50.1"	2.4-3.6	0-1			
		End	N 22°12'50.1" E 114°12'49.8"					
	T3	Start	N 22°12'50.1" E 114°12'50.1"	4.8-5.5	0-1			
		End	N 22°12'50.7" E 114°12'50.7"					





**Fig. 4.1 Map Showing the Positions of the Transects (Only Starting Points are Shown) at the 6 Survey Sites.**

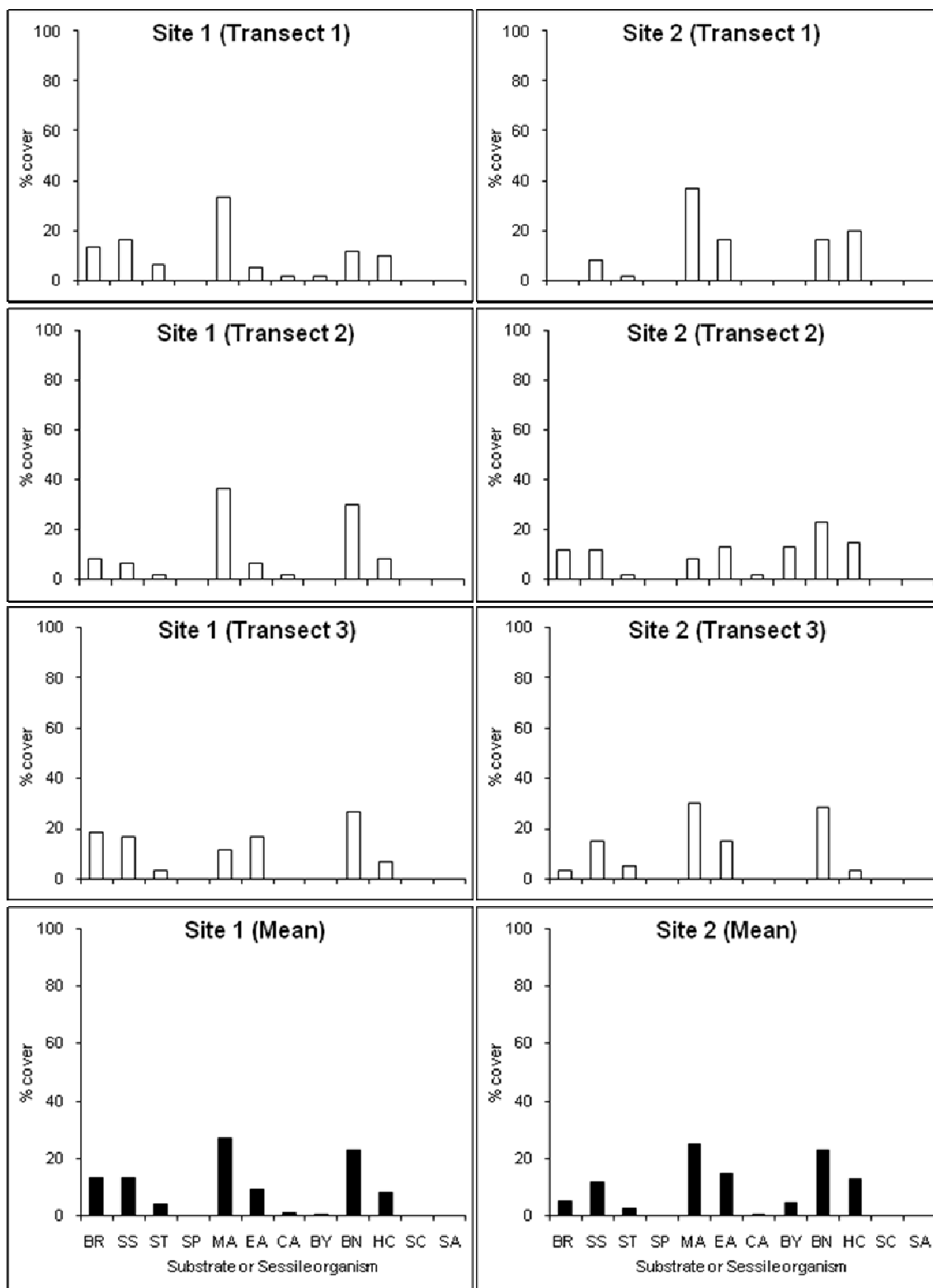
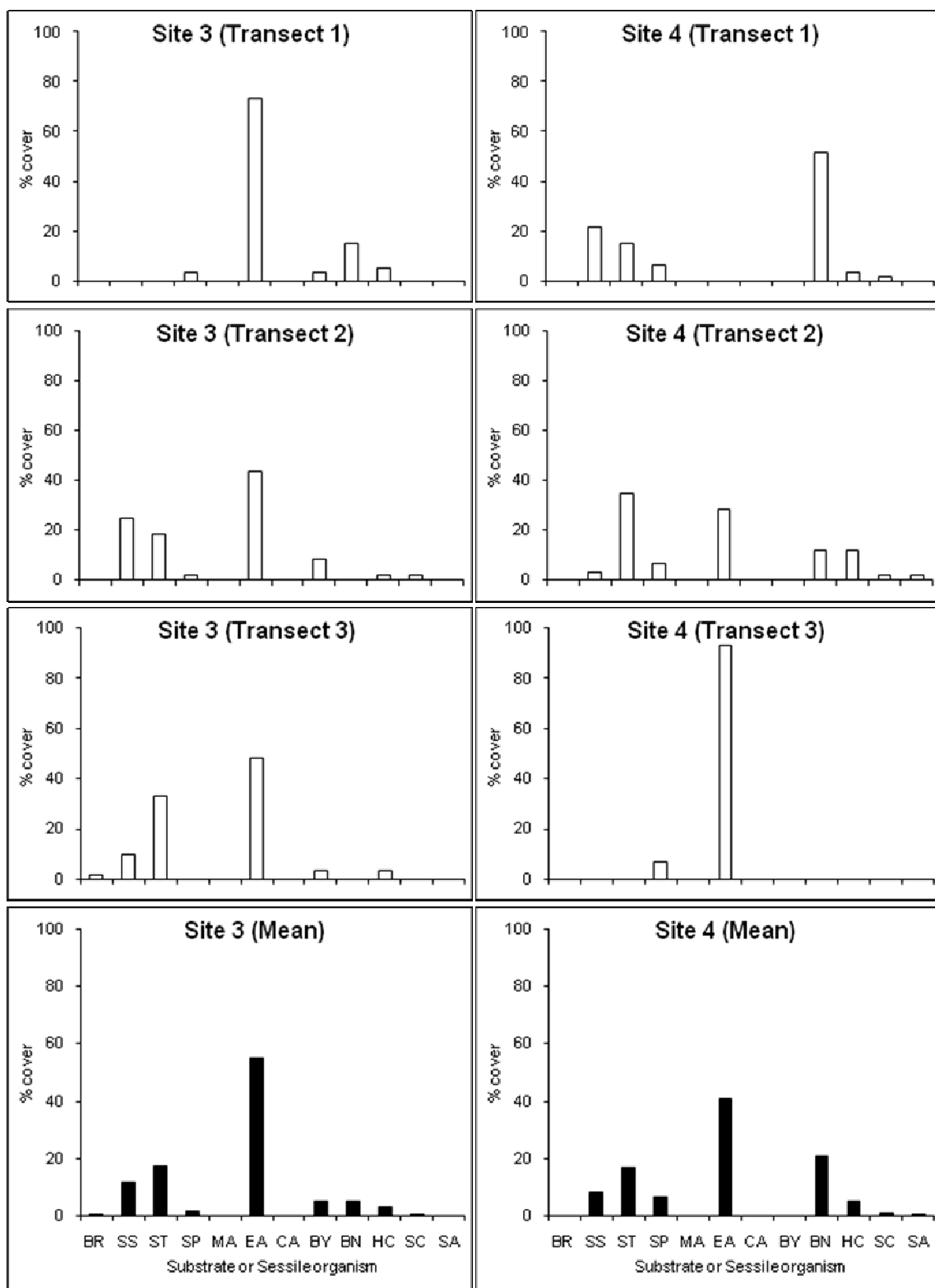
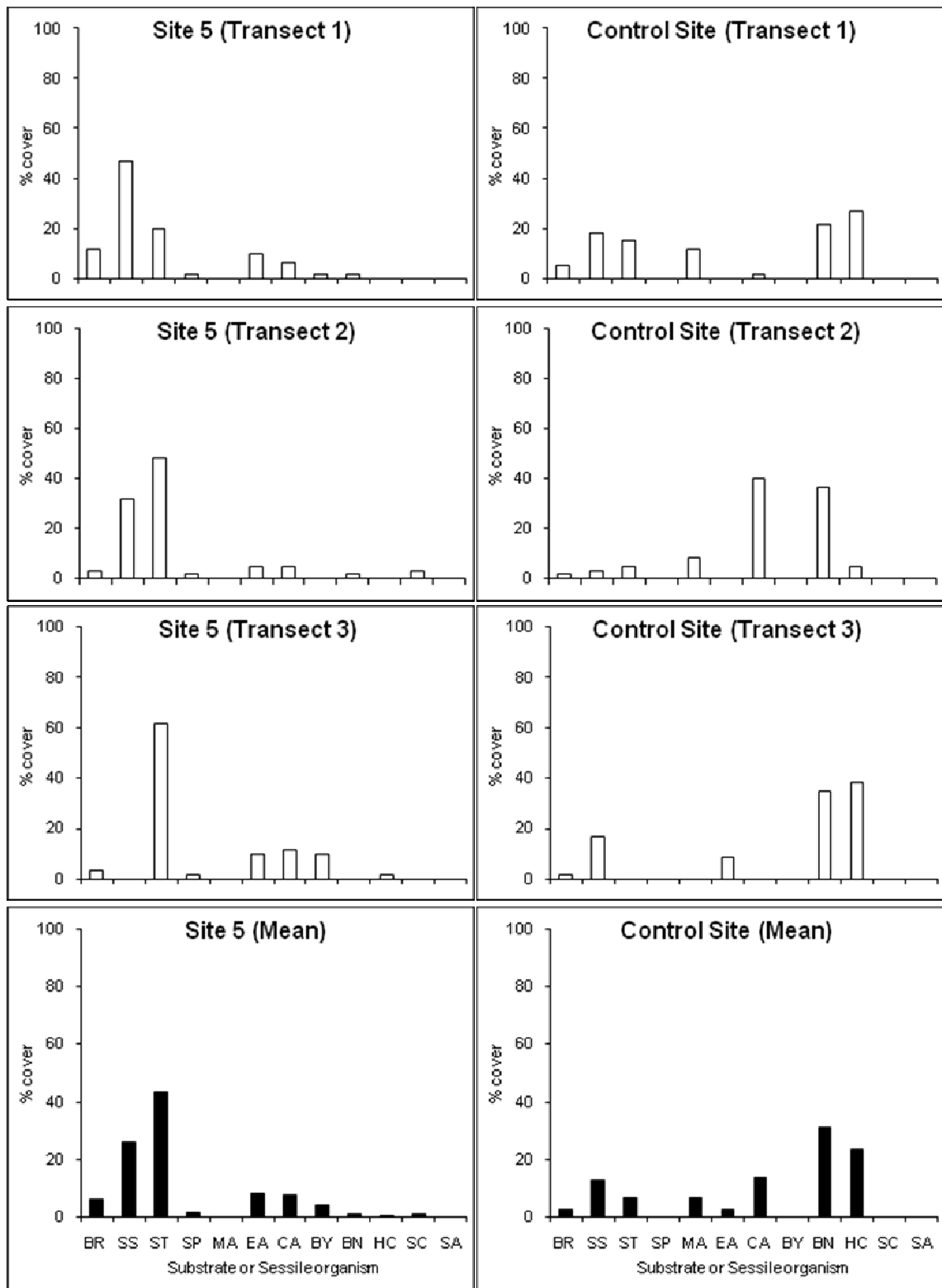


Fig. 4.2a Percentage Cover for Substrate or Sessile Organism Recorded in Each of the Three Transects and Mean for Sites 1 and 2 in April 2007 . BR, bare rock; SS, sand and shell debris; ST, silt; SP, sponge; MA, macroalgae; EA, encrusting algae; CA, coralline algae; BY, bryozoan; BN, barnacle; HC, hard coral; SC, soft coral; SA, sea anemone.

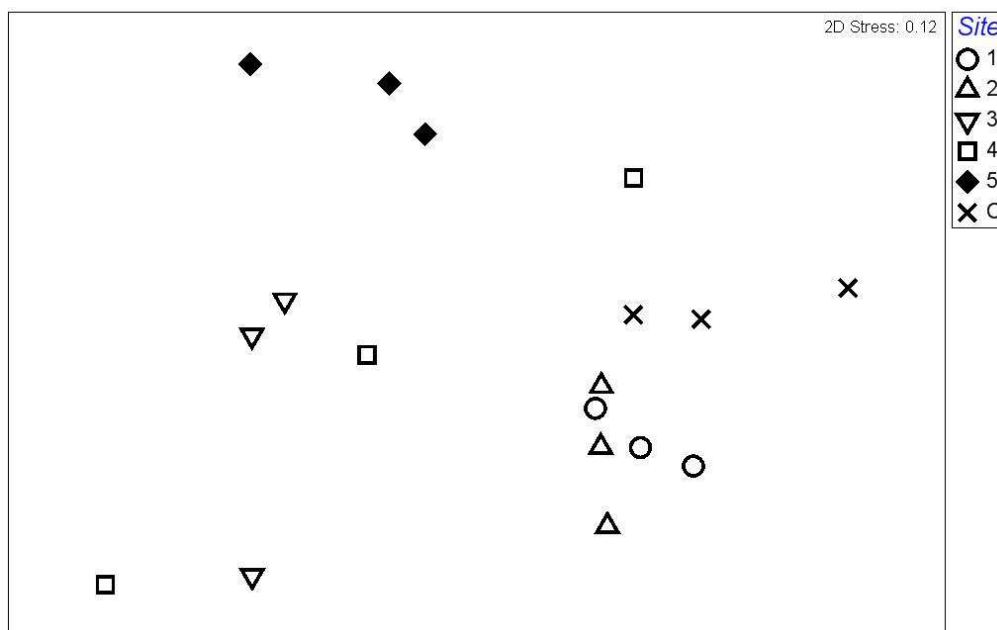




**Fig. 4.2b Percentage Cover for Substrate or Sessile Organism Recorded in Each of the Three Transects and Mean for Sites 3 and 4 in April 2007 . BR, bare rock; SS, sand and shell debris; ST, silt; SP, sponge; MA, macroalgae; EA, encrusting algae; CA, coralline algae; BY, bryozoan; BN, barnacle; HC, hard coral; SC, soft coral; SA, sea anemone.**



**Fig. 4.2c Percentage Cover for Substrate or Sessile Organism Recorded in Each of the Three Transects and Mean for Site 5 and Control Site C in April 2007 . BR, barerock; SS, sand and shell debris; ST, silt; SP, sponge; MA, macroalgae; EA, encrusting algae; CA, coralline algae; BY, bryozoan; BN, barnacle; HC, hard coral; SC, soft coral; SA, sea anemone.**



**Fig. 4.3 nMDS Ordinations of Substrate Compositions at the 6 Survey Sites Based on Non-transformed Bray Curtis Similarity Matrix.**

**Table 4.2 Summary of Survey Site Habitat and Coral Community**

		Site 1	Site 2	Site 3	Site 4	Site 5	Control Site C
Substrate Type		Boulder & sand	Boulder & sand	Bedrock & boulder	Bedrock & sand	Bedrock & boulder	Boulder & sand
Line Transect	Hard Coral - Mean % Cover	8.3	12.8	3.3	5.0	0.6	23.3
	Soft Coral - Mean % Cover (%)	0	0	0.6	1.1	1.1	0
	Hard Coral - Total Number of Colony	61	79	45	65	9	137
Bell Transect	Hard Coral - Total Area (cm <sup>2</sup> )	18,420	23,220	13,880	10,300	1,330	51,080
	Hard Coral - Colony Size Range (cm <sup>2</sup> )	30-2,300	40-1,450	20-1,600	10-600	90-220	40-3,000
	Hard Coral - Number of Species	12	15	14	7	4 + 3*	19 + 1*
	Shannon Diversity Index (H <sup>2</sup> )	1.00	1.11	1.07	0.78	0.48	1.23
	Hard Coral - Mean % Area sediment	0.98	1.86	1.22	1.30	2.66	0.98
	Hard Coral - Mean % Area Bleaching	0	0.09	0	0	0	0
	Hard Coral - Mean % Area Mortality	0.13	0.14	0.29	0.08	0.33	0.77
	Soft Coral - Total Number of Colony	0	0	10	27	15	0
	Soft Coral - Number of Species	0	0	3	3	2	0

\* off transect record

**Table 4.3 List of Hard and Soft Coral Species Recorded in the 6 Survey Sites.**

<b>Hard Coral</b>	<b>Site 1</b>	<b>Site 2</b>	<b>Site 3</b>	<b>Site 4</b>	<b>Site 5</b>	<b>Control Site C</b>
<b>Siderastreidae</b>						
<i>Psammocora profundacella</i>				✓		✓
<i>Psammocora superficialis</i>	✓	✓	✓	✓	✓*	✓
<b>Acroporidae</b>						
<i>Montipora cf. turgescens</i>			✓	✓	✓	
<i>Montipora peltiformis.</i>		✓	✓			✓
<b>Agariciidae</b>						
<i>Pavona decussata.</i>	✓	✓	✓			✓
<b>Faviidae</b>						
<i>Favia fava</i>						✓
<i>Favia lizardensis</i>	✓					
<i>Favia rotumana</i>	✓	✓				✓
<i>Favia speciosa</i>		✓	✓	✓		✓
<i>Favites abdita</i>	✓	✓	✓			✓
<i>Favites pentagona</i>	✓	✓				✓
<i>Platygyra acuta</i>	✓	✓	✓			✓
<i>Platygyra carnosus</i>	✓	✓	✓			✓
<i>Montastrea magnistellata</i>				✓		
<i>Plesiastrea versipora</i>	✓	✓	✓		✓*	✓
<i>Cyphastrea serailia.</i>	✓	✓	✓		✓	✓
<i>Goniastrea aspera.</i>		✓	✓			✓
<i>Goniastrea favulus</i>						✓*
<i>Leptastrea pruinosa</i>	✓	✓			✓	✓
<b>Poritidae</b>						
<i>Goniopora stutchburyi</i>			✓	✓	✓	✓
<i>Porites sp.</i>	✓	✓	✓	✓	✓*	✓
<b>Merulinidae</b>						
<i>Hydnophora exessa</i>		✓				✓
<b>Dendronphylliidae</b>						
<i>Turbinaria peltata</i>			✓			✓
<b>Total Number of Hard Coral Species</b>	<b>12</b>	<b>15</b>	<b>14</b>	<b>7</b>	<b>4 + 3*</b>	<b>19 + 1*</b>
<b>Soft Coral</b>						
<b>Alcyoniidae</b>						
<i>Lobophytum depressum.</i>					✓	
<b>Nephtheidae</b>						
<i>Dendronephthya sp.</i>			✓	✓		
<b>Plexauridae</b>						
<i>Euplexaura sp.</i>			✓	✓	✓	
<i>Echinomuricea sp.</i>			✓	✓		
<b>Total Number of Soft Coral Species</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>0</b>

\* off transect record

### Site 1

4.1.6 In Site 1, the sea bottom run from onshore to offshore in a gentle slope. The bedrock is replaced by boulders and sand at depth of around 3 m. The rock surface was mainly covered by seasonal macroalgae (27.2%), barnacle (22.8%) or bare rock (13.3%) (Fig. 4.2a). Hard coral cover (8.3%) was the second highest among the 5 monitoring sites (Table 4.2). Colonies were mainly observed at 3 to 6 m. From the bell transects, a total of 61 hard coral colonies from 12 species and 4 families was recorded (Tables 4.2 and 4.3). Shannon diversity index ( $H'$ ) was 1.00. The common species include the brain coral *Platygyra carnosus* and *Favites abdita*, both belong to family Faviidae and are common species in shallow waters of Hong Kong. Health status of the colonies was generally normal; low level of sedimentation (0.98), bleaching (0%) and mortality (0.13%) was recorded.

### Site 2

4.1.7 The substratum character of Site 2 is similar to Site 1; sea bottom are mainly composed of boulders and sand, the rock surface was mainly covered by seasonal macroalgae (25%), barnacle (22.8%) and encrusting algae (15%) (Fig. 4.2a). Hard coral cover (12.8%) was the highest among the 5 monitoring sites (Table 4.2) and corals mainly inhabit the depth from 3 to 6 m. Bell transect data recorded a total of 79 hard coral colonies from 15 species from 5 families (Tables 4.2 and 4.3). Common species include *Favites pentagona* and *Platygyra carnosus*. Shannon diversity index ( $H'$ ) was higher than the other 4 monitoring sites (1.11). Heath of the existing coral was generally good, sedimentation (1.86%) and mortality (0.14%) was low. Bleaching (0.09%) was observed on few *Porites sp.* colonies but the portion is minor.

### Site 3

4.1.8 Site 3 is a more exposed shore, the bottom is mainly covered with bedrock that extends down to about 6 m before replaced by boulders, sand and silt. The bedrock and boulder surface was mainly inhabited with encrusting algae (55%) (Fig. 4.2b). Macroalgae was not recorded due to the unfavourable exposed environment. Hard coral cover (3.3%) was lower than Site 1 and 2 (Table 4.2) and were mainly found at 4 to 9 m. A total of 50 hard coral colonies was recorded in the bell transect which was composed of 14 species from 5 families (Tables 4.2 and 4.3). Different from Site 1 and 2, the common hard coral species include *Goniopora stutchburyi* and *Montipora cf. turgescens*. The former is the common species usually found in deeper community, while *Montipora cf. turgescens* is an uncommon species that is associated with deeper and wavy habitat (Chan et al. 2005). Shannon diversity index ( $H'$ ) was relatively high in context (1.07). Sedimentation (1.22%) and mortality (0.29%) was low, and no bleaching was observed on the standing hard corals. Three species of soft coral were also recorded at the deeper portion of transect 2 and 3 (Table 4.3; Appendix II), no apparent mortality was evidenced in these colonies.



#### Site 4

- 4.1.9 Site 4 shares some substratum properties with Site 3 that bedrock runs down in steep profile to about 6 to 9 m and connect to boulder or sand substrate. Due to the non-uniform topography, the 3 transects varied in depth and hence their associated flora and fauna. Transect 1 was located at greater depth where is mainly bedrock and sand, the rock surface was mainly covered by barnacle (51.7%) but no algae (Fig. 4.2b). Transect 2 transitioned from deeper to shallower water and transect 3 was mainly boulder at shallower water where encrusting algae (93.3%) is the major covering organism on the rock surface. Hard coral cover (5.0%) was similar to Site 3 (Table 4.2). The species composition and distribution, however, was highly biased. A total of 67 hard coral colonies was recorded on the bell transects, which was composed of only 7 species from 3 families (Tables 4.2 and 4.3). Moreover, over 80% (55 out of 67 colonies) of the record was occupied by a single species *Goniopora stutchburyi* at the deeper portion of the transects. The Shannon diversity index ( $H'$ ) was highly reduced (0.78) due to the bias in hard coral composition. Health condition was generally good, little sedimentation (1.30%), no bleaching and low mortality (0.08%) was observed. Soft corals were also recorded at deeper region and species composition was similar to Site 3 (Table 4.3; Appendix II).

#### Site 5

- 4.1.10 Site 5 is relatively limited in hard substratum, boulders and rubbles extend to about 4 to 5 m and become scattered on sand (26.1%) or silt (43.3%). Rock surface was either bare (6.1%) or covered with encrusting algae (8.3%), coralline algae (7.8%) (Fig. 4.2c). Hard coral cover (0.6%) was the lowest of all survey sites. Only 9 hard coral colonies from 4 species and 3 families were found on the bell transects (Tables 4.2 and 4.3). Three more species were observed away from the transects, the colonies were scattered. The record was dominated by *Goniopora stutchburyi* (7 of 9 colonies). The Shannon diversity index ( $H'$ ) was low (0.48). Sedimentation (2.66%) was higher than the other sites but still in low level. Little mortality (0.33%) and no bleaching were observed in the standing colonies. Two taxa of soft coral was found in the deeper region, both taxa are common record in local waters and no mortality was observed in the community (Table 4.3; Appendix II).

#### Control Site C

- 4.1.11 The Control Site C at St. Stephen's Beach is, similar to Site 1 and 2, a sheltered bay covered mainly by boulders and sand. The hard substratum was mainly inhabited by barnacle (31.1%), hard coral (23.3%) and coralline algae (13.9%) (Fig. 4.2c). Site 5 had higher values than the 5 monitoring sites in terms of hard coral cover (23.3%), number of colonies on bell transect (137), number of species (19) and Shannon diversity index (1.23) (Table 4.2). Common species included *Favia rotamana*, *Favites pentagona*, *Plesiastrea versipora* and *Favia specios* (Table 4.3; Appendix II). Level of sedimentation was low (0.98%) (Table 4.2). Higher mean mortality (0.77%) was recorded due to contribution from a 50%-mortality colony (*Favites pentagona*) in transect 3 (Appendix II).

The mortality was caused by abrasion like physical damage and no sign of infection or sickness was witnessed. All other colonies were normal in their health condition, and hence the site is suitable as a control site for monitoring survey.

- 4.1.12 Photographs of benthic organisms found at the Survey Sites are shown in Appendix III.

## **4.2 Coral Tagging Exercise**

- 4.2.1 The code, species name, area, sedimentation level, and percentage of bleaching and mortality of the tagged coral colonies at each site were summarized in Tables 4.4a-f. Photographs of the colonies were shown in Appendices IVa-f. The survey team had tried to take photographs of the corals from an angle and distance that best represented the colonies but difficulties sometimes occurred as a result of low water visibility during the surveys.
- 4.2.2 Tagging of hard coral species with tall polyps had been avoided. Few colonies of *Goniopora stutchburyi* had been, however, tagged in Sites 4 and 5 as the number of coral colonies that could be tagged were limited.
- 4.2.3 In general, the healthy status of the tagged coral colonies was normal, with low levels of sedimentation, bleaching and mortality.

**Table 4.4a Code, Species Name, Percentage of Sedimentation, Bleaching and Mortality of the Tagged Coral Colonies at Site 1.**

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (%, mm)	Bleaching (%)	Mortality (%)
A01	<i>Platygyra carnosus</i>	1000	0, 0	0	0
A02	<i>Platygyra carnosus</i>	2000	0, 0	0	0
A03	<i>Favites pentagona</i>	200	0, 0	0	0
A04	<i>Leptastrea pruinosa</i>	400	5, 1	0	0
A05	<i>Platygyra carnosus</i>	1200	0, 0	0	5
A06	<i>Platygyra carnosus</i>	1600	0, 0	0	0
A07	<i>Favia rotumana</i>	800	5,1	0	0
A08	<i>Platygyra carnosus</i>	1000	0, 0	0	0
A09	<i>Platygyra carnosus</i>	350	0, 0	0	0
A10	<i>Platygyra carnosus</i>	700	0, 0	0	0

**Table 4.4b Code, Species Name, Percentage of Sedimentation, Bleaching and Mortality of the Tagged Coral Colonies at Site 2.**

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (%, mm)	Bleaching (%)	Mortality (%)
B01	<i>Platygyra carnosus</i>	450	0, 0	0	0
B02	<i>Plesiastrea versipora</i>	300	0, 0	0	0
B03	<i>Psammocora superficialis</i>	1000	5, 1	0	0
B04	<i>Favia speciosa</i>	300	4, 1	0	0
B05	<i>Plesiastrea versipora</i>	900	3, 1	0	0
B06	<i>Platygyra carnosus</i>	600	0, 0	0	0
B07	<i>Cyphastrea serailia</i>	700	0, 0	0	0
B08	<i>Plesiastrea versipora</i>	1200	0, 0	0	0
B09	<i>Favites pentagona</i>	600	0, 0	0	0
B10	<i>Favites pentagona</i>	400	0, 0	0	0

**Table 4.4c Code, Species Name, Percentage of Sedimentation, Bleaching and Mortality of the Tagged Coral Colonies at Site 3.**

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (%, mm)	Bleaching (%)	Mortality (%)
C01	<i>Platygyra acuta</i>	2000	0, 0	0	0
C02	<i>Platygyra carnosus</i>	1000	0, 0	0	0
C03	<i>Porites</i> sp.	400	5, 1	0	1
C04	<i>Cyphastrea serailia</i>	600	4, 1	0	0
C05	<i>Pavona decussata</i>	600	0, 0	0	0
C06	<i>Pavona decussata</i>	1200	0, 0	0	0
C07	<i>Montipora</i> cf. <i>turgescens</i>	200	2, 1	0	0
C08	<i>Favia favius</i>	600	4, 1	0	4
C09	<i>Favites pentagona</i>	150	1, 1	0	0
C10	<i>Montipora peltiformis</i>	300	0, 0	0	0

**Table 4.4d Code, Species Name, Percentage of Sedimentation, Bleaching and Mortality of the Tagged Coral Colonies at Site 4.**

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (%, mm)	Bleaching (%)	Mortality (%)
E01	<i>Goniopora stutchburyi</i>	300	0, 0	0	0
E02	<i>Goniopora stutchburyi</i>	200	0, 0	0	0
E03	<i>Goniopora stutchburyi</i>	150	0, 0	0	0
E04	<i>Porites</i> sp.	400	5, 1	0	0
E05	<i>Goniopora stutchburyi</i>	300	0, 0	0	0
E06	<i>Goniopora stutchburyi</i>	450	0, 0	0	0
E07	<i>Favia speciosa</i>	600	10, 1	0	0
E08	<i>Porites</i> sp.	150	2, 1	0	4
E09	<i>Porites</i> sp.	200	8, 1	0	4
E10	<i>Porites</i> sp.	500	0, 0	3	0

**Table 4.4e Code, Species Name, Percentage of Sedimentation, Bleaching and Mortality of the Tagged Coral Colonies at Site 5.**

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (%, mm)	Bleaching (%)	Mortality (%)
D01	<i>Psammocora</i> sp.	600	10, 1	0	0
D02	<i>Montipora</i> cf. <i>turgescens</i>	100	6, 1	0	0
D03	<i>Goniopora stutchburyi</i>	400	0, 0	0	0
D04	<i>Leptastrea pruinosa</i>	500	4, 1	0	0
D05	<i>Porites</i> sp.	400	5, 1	1	4
D06	<i>Plesiastrea versipora</i>	1000	0, 0	0	5
D07	<i>Leptastrea pruinosa</i>	800	0, 0	0	0
D08	<i>Plesiastrea versipora</i>	100	0, 0	0	0
D09	<i>Cyphastrea</i> sp.	150	5, 1	0	0
D10	<i>Montipora</i> cf. <i>turgescens</i>	200	0, 0	0	0

**Table 4.4f Code, Species Name, Percentage of Sedimentation, Bleaching and Mortality of the Tagged Coral Colonies at Control Site C.**

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (%, mm)	Bleaching (%)	Mortality (%)
F01	<i>Favia speciosa</i>	900	0, 0	0	0
F02	<i>Favites pentagona</i>	1000	4, 1	0	0
F03	<i>Favites pentagona</i>	800	0, 0	0	0
F04	<i>Porites</i> sp.	800	5, 1	4	4
F05	<i>Cyphastrea serailia</i>	800	4, 1	0	1
F06	<i>Psammocora</i> sp.	1800	0, 0	0	0
F07	<i>Plesiastrea versipora</i>	3000	0, 0	0	0
F08a	<i>Favia speciosa</i>	150	0, 0	0	0
F08b	<i>Goniastrea favulus</i>	300	0, 0	0	0
F09	<i>Favites pentagona</i>	1800	10, 1	0	0
F10	<i>Platygyra carnosus</i>	2800	0, 0	0	0



## 5 SUMMARY AND CONCLUSION

### 5.1 Summary – Coral Community

- 5.1.1 The present survey recorded 23 hard coral species from the 5 monitoring and 1 control sites (Tables 4.2 and 4.3). Number of species at each site ranged from 7 to 20. Hard coral cover ranged from 0.6% to 23.3%. A total of 402 hard coral colonies was observed on the bell transects, ranged from 9 to 137 for the 6 sites. Sizes of coral colonies ranged from 10 to 3,000 cm<sup>2</sup>. Diversity index (H') ranged from 0.48 to 1.23. Mean sediment cover on corals (range 0.98 to 2.66%), mean bleaching area (range 0 to 0.09%) and mean mortality area (range 0.08 to 0.77) were low for all the six sites.
- 5.1.2 On site bases, Site 1, Site 2 and Control Site C had higher coral abundance and diversity, species composition was typical for southern shallow waters of Hong Kong. Similar communities had been reported at other locations such as Lamma Island and Stanley (MEMCL 2000; Hyder 2002). For Site 3, Site 4 and Site 5, corals were mainly located at greater depth, cover and abundance were lower and were composed of deeper water species.
- 5.1.3 In Hong Kong context, however, the values of coral cover, species composition and diversity were not high for all the 6 sites. Territory-wide information on local coral communities has been obtained in different surveys (OCL 2003, AFCD 2006), well developed coral communities were mainly located at Northeastern waters such as Hoi Ha Wan, Tung Ping Chau. Some of the representative sites are shown in Table 5.1, coral cover and number of coral species were much higher.

**Table 5.1 Summary of the Coral Cover and Diversity of the 6 Survey Sites and Representative Communities in Hong Kong.**

Site	% Coral Cover	Species Diversity (no. of species)	Shannon Diversity Index
Tung Ping Chau	69 <sup>1</sup>	47 <sup>2</sup>	2.24 <sup>2</sup>
Hoi Ha Wan	70 <sup>1</sup>	38 <sup>2</sup>	1.60 <sup>2</sup>
Bluff Island	63 <sup>1</sup>	43 <sup>2</sup>	2.06 <sup>2</sup>
Chek Chau	62 <sup>1</sup>	45 <sup>2</sup>	1.41 <sup>2</sup>
Long Ke Wan	59 <sup>1</sup>	44 <sup>2</sup>	1.84 <sup>2</sup>
Present Survey			
Site 1	8.3	12	1.00
Site 2	12.8	13	1.11
Site 3	3.3	13	1.07
Site 4	5.0	6	0.78
Site 5	0.6	3	0.48
Control Site C	23.3	18	1.23

<sup>1</sup> Data from Reef Check 2006 (AFCD 2006)

<sup>2</sup> OCL 2003

- 5.1.4 In overall, although abundance and richness was not high, the communities in all sites were generally in good conditions with low level of sedimentation,

bleaching and mortality. Monitoring of the communities during the course of construction is necessary in order to avoid adverse impact to the standing corals.

## 6 REFERENCES

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## **APPENDICES**

## **Appendix I Monitoring Requirements**

- 1.1 The construction phase coral monitoring programme should comprise an Initial Survey with coral tagging exercise, Impact Monitoring Surveys and a Post-Construction Monitoring Survey.
- 1.2 Coral monitoring work should be conducted by a qualified marine biologist with specialist knowledge of corals and sound experience at identifying corals in the field. To ensure consistency, it is recommended that the same coral specialist should be used on each dive survey. The coral specialist should be approved by AFCD prior to the commencement of the monitoring programme.

### Initial Survey / Coral Tagging Exercise

- 1.3 A initial survey and coral tagging exercise at all 5 coral impact sites and one control site should be conducted preferably no more than one month before commencement of construction works. Tagging of a minimum of 10 hard coral colonies at each coral monitoring site is considered appropriate. Corals should be tagged giving priority to the largest, undamaged colonies since damage to these colonies would be more evident compared to smaller colonies or corals with existing damage. Corals should also be selected for tagging based on the most suitable coral species and growth forms. As far as possible, tagging of hard coral species with tall polyps should be avoided due to their higher tolerance of sedimentation.
- 1.4 Coral colonies should be tagged using small brightly coloured (e.g. orange or green) stones marked with labeled tags. For each tagged coral, specific detailed information should be collected including location, size, depth and general condition of their immediate surroundings. Tagged coral colonies should also be identified to species level.
- 1.5 The health status of each tagged coral colony should be carefully recorded, including information on existing surface area with partial mortality and bleached area. For each tagged hard coral colony, sediment cover should be recorded including percentage cover, colouration, texture and approximate thickness of sediment on the colony itself and on adjacent hard substrate. Any contiguous patches of sediment cover >10% should be counted. The condition of each tagged coral colony should also be recorded by taking a photograph from an angle and distance that best represents entire colony. The information of selected corals collected during the Baseline Survey should be submitted to AFCD for approval.



**Appendix II List of Hard and Soft Coral Colonies, Percentage Sedimentation, Bleaching and Mortality in Bell Transect Survey.**

<b>Site 1</b>															
	<b>Transect 1</b>					<b>Transect 2</b>					<b>Transect 3</b>				
	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>
1	<i>Leptastrea pruinosa</i>	200	0	5	0	<i>Favites abdita</i>	30	0	4	0	<i>Favites pentagona</i>	120	0	0	0
2	<i>Favites pentagona</i>	280	0	1	0	<i>Favites abdita</i>	110	0	2	0	<i>Favia rotumana</i>	100	0	0	0
3	<i>Pavona decussata</i>	260	0	0	0	<i>Platygyra carnosus</i>	140	0	3	0	<i>Favia rotumana</i>	130	0	0	0
4	<i>Pavona decussata</i>	90	0	0	0	<i>Favia rotumana</i>	160	0	10	0	<i>Favia rotumana</i>	140	0	1	0
5	<i>Favites pentagona</i>	110	0	1	0	<i>Favites abdita</i>	220	0	4	0	<i>Platygyra acuta</i>	220	0	0	0
6	<i>Platygyra carnosus</i>	40	0	0	0	<i>Favites abdita</i>	250	0	0	0	<i>Favites abdita</i>	290	0	3	0
7	<i>Favites abdita</i>	100	0	3	0	<i>Platygyra carnosus</i>	130	0	4	0	<i>Platygyra carnosus</i>	150	0	1	0
8	<i>Platygyra carnosus</i>	1300	0	0	0	<i>Platygyra acuta</i>	130	0	8	0	<i>Platygyra carnosus</i>	280	0	0	0
9	<i>Favites pentagona</i>	530	0	1	0	<i>Favites pentagona</i>	200	0	4	0	<i>Platygyra carnosus</i>	150	0	0	0
10	<i>Favites pentagona</i>	500	0	0	0	<i>Plesiastrea versipora</i>	400	0	1	0	<i>Favites abdita</i>	130	0	3	0
11	<i>Favia rotumana</i>	280	0	3	0	<i>Favites abdita</i>	480	3	5	0	<i>Favites abdita</i>	180	0	5	0
12	<i>Platygyra acuta</i>	470	0	2	0	<i>Favites abdita</i>	100	0	1	0	<i>Platygyra acuta</i>	200	0	4	0
13	<i>Favites abdita</i>	330	0	2	0	<i>Favites abdita</i>	130	0	0	0	<i>Favia lizardensis</i>	200	5	5	0
14	<i>Platygyra acuta</i>	490	0	0	0	<i>Favia rotumana</i>	100	0	2	0	<i>Favia rotumana</i>	220	0	3	0
15	<i>Platygyra acuta</i>	250	0	0	0	<i>Platygyra carnosus</i>	160	0	1	0	<i>Favia rotumana</i>	180	0	2	0
16	<i>Favites pentagona</i>	260	0	0	0	<i>Cyphastrea serailia</i>	170	0	0	0	<i>Platygyra carnosus</i>	120	0	1	0
17	<i>Favites abdita</i>	330	0	0	0										
18	<i>Platygyra acuta</i>	230	0	1	0										
19	<i>Platygyra carnosus</i>	2300	0	0	0										
20	<i>Favites pentagona</i>	360	0	2	0										
21	<i>Plesiastrea versipora</i>	390	0	2	0										
22	<i>Psammocora superficialis</i>	400	0	3	0										
23	<i>Psammocora superficialis</i>	130	0	1	0										

<b>Site 1 (con't)</b>															
	<b>Transect 1</b>					<b>Transect 2</b>					<b>Transect 3</b>				
	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>
24	<i>Porites sp.</i>	180	0	0	0										
25	<i>Psammocora superficialis</i>	190	0	0	0										
26	<i>Porites sp.</i>	220	0	0	0										
27	<i>Platygyra carmosus</i>	1800	0	1	0										
28	<i>Psammocora superficialis</i>	350	0	2	0										
29	<i>Porites sp.</i>	330	0	0	0										

Site 2															
	Transect 1					Transect 2					Transect 3				
	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)
1	<i>Cyphastrea serailia</i>	130	0	0	0	<i>Porites sp.</i>	250	0	4	3	<i>Montipora peltiformis</i>	200	0	0	0
2	<i>Cyphastrea serailia</i>	220	0	0	0	<i>Platygyra carnosus</i>	320	0	0	0	<i>Platygyra carnosus</i>	290	0	0	0
3	<i>Cyphastrea serailia</i>	250	0	0	0	<i>Platygyra acuta</i>	100	0	0	0	<i>Platygyra carnosus</i>	160	0	0	0
4	<i>Platygyra acuta</i>	280	0	1	0	<i>Montipora peltiformis</i>	320	0	0	0	<i>Montipora peltiformis</i>	210	0	0	0
5	<i>Platygyra carnosus</i>	140	0	0	0	<i>Plesiastrea versipora</i>	120	0	2	0	<i>Favites abdita</i>	240	0	1	0
6	<i>Cyphastrea serailia</i>	40	0	0	0	<i>Goniastrea aspera</i>	80	0	0	0					
7	<i>Cyphastrea serailia</i>	850	0	4	0	<i>Plesiastrea versipora</i>	300	0	0	0					
8	<i>Favites abdita</i>	200	0	1	0	<i>Favia rotumana</i>	150	0	2	0					
9	<i>Platygyra carnosus</i>	230	0	0	0	<i>Favites pentagona</i>	400	0	0	0					
10	<i>Favites pentagona</i>	190	0	1	0	<i>Leptastrea pruinosa</i>	350	0	0	0					
11	<i>Platygyra acuta</i>	250	0	1	0	<i>Plesiastrea versipora</i>	550	2	2	0					
12	<i>Favites pentagona</i>	180	0	0	0	<i>Pavona decussata</i>	250	0	3	0					
13	<i>Favites pentagona</i>	300	0	2	0	<i>Plesiastrea versipora</i>	1450	0	3	0					
14	<i>Cyphastrea serailia</i>	130	0	0	0	<i>Favites pentagona</i>	320	0	0	0					
15	<i>Cyphastrea serailia</i>	100	0	0	0	<i>Platygyra carnosus</i>	200	0	2	0					
16	<i>Porites sp.</i>	340	0	3	2	<i>Favites pentagona</i>	150	0	0	0					
17	<i>Favites abdita</i>	230	0	3	0	<i>Favites pentagona</i>	780	0	2	0					
18	<i>Favites abdita</i>	200	0	0	0	<i>Hydnophora exesa</i>	500	0	0	0					
19	<i>Platygyra carnosus</i>	1050	0	2	0										
20	<i>Favites abdita</i>	100	0	1	0										
21	<i>Leptastrea pruinosa</i>	240	0	2	0										
23	<i>Favites pentagona</i>	130	0	1	0										
24	<i>Favites pentagona</i>	150	0	1	0										
25	<i>Platygyra acuta</i>	380	0	2	0										
26	<i>Favites pentagona</i>	120	0	0	0										

Site 2 (con't)															
	Transect 1					Transect 2					Transect 3				
	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)
27	<i>Psammocora superficialis</i>	1100	2	8	0										
28	<i>Platygyra carnosus</i>	600	0	3	0										
29	<i>Favites pentagona</i>	400	0	2	0										
30	<i>Favites pentagona</i>	200	0	0	0										
31	<i>Favites pentagona</i>	100	0	0	0										
32	<i>Favites pentagona</i>	150	0	0	0										
33	<i>Favia rotumana</i>	210	0	2	0										
34	<i>Platygyra carnosus</i>	350	0	0	0										
35	<i>Platygyra carnosus</i>	330	1	2	0										
36	<i>Favites pentagona</i>	220	0	0	0										
37	<i>Plesiastrea versipora</i>	310	0	3	0										
38	<i>Favites pentagona</i>	230	0	1	0										
39	<i>Psammocora superficialis</i>	200	0	10	0										
40	<i>Montipora peltiformis</i>	100	0	0	0										
41	<i>Montipora peltiformis</i>	60	0	0	0										
42	<i>Montipora peltiformis</i>	80	0	0	0										
43	<i>Montipora peltiformis</i>	60	0	1	0										
44	<i>Favites pentagona</i>	300	0	0	0										
45	<i>Favites abdita</i>	120	0	1	0										
46	<i>Favites pentagona</i>	550	0	3	0										
47	<i>Favites pentagona</i>	150	0	0	0										
48	<i>Platygyra acuta</i>	280	0	3	0										
49	<i>Favia speciosa</i>	230	0	2	0										
50	<i>Plesiastrea versipora</i>	900	0	2	0										
51	<i>Platygyra carnosus</i>	250	0	2	0										

<b>Site 2 (con't)</b>															
	<b>Transect 1</b>					<b>Transect 2</b>					<b>Transect 3</b>				
	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>
52	<i>Favia rotumana</i>	200	0	1	0										
53	<i>Favia rotumana</i>	220	1	3	0										
54	<i>Favites pentagona</i>	450	0	0	0										
55	<i>Porites sp.</i>	350	0	3	2										

Site 3															
	Transect 1					Transect 2					Transect 3				
	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)
1	<i>Porites sp.</i>	130	3	0	0	<i>Montipora peltiformis</i>	40	0	0	0	<i>Platygyra carnosus</i>	650	0	2	0
2	<i>Montipora cf. turgescens</i>	70	0	0	0	<i>Montipora cf. turgescens</i>	260	0	1	0	<i>Goniopora stutchburyi</i>	210	0	4	0
3	<i>Goniopora stutchburyi</i>	210	0	0	0	<i>Montipora cf. turgescens</i>	250	0	0	0	<i>Plesiastrea versipora</i>	80	0	2	0
4	<i>Goniopora stutchburyi</i>	180	0	0	0	<i>Montipora cf. turgescens</i>	100	0	0	0	<i>Psammocora superficialis</i>	920	0	5	0
5	<i>Goniopora stutchburyi</i>	60	0	0	0	<i>Goniopora stutchburyi</i>	160	0	0	0	<i>Goniastrea aspera</i>	410	0	3	0
6	<i>Montipora cf. turgescens</i>	100	0	0	0	<i>Goniopora stutchburyi</i>	80	0	0	0	<i>Plesiastrea versipora</i>	500	0	1	0
7	<i>Montipora cf. turgescens</i>	310	0	3	0	<i>Goniopora stutchburyi</i>	30	0	0	0	<i>Goniopora stutchburyi</i>	180	0	2	0
8	<i>Montipora cf. turgescens</i>	180	0	3	0	<i>Porites sp.</i>	30	0	0	0	<i>Goniopora stutchburyi</i>	200	0	0	0
9	<i>Montipora cf. turgescens</i>	20	0	0	0	<i>Favia speciosa</i>	300	0	0	0	<i>Goniopora stutchburyi</i>	210	0	1	0
10	<i>Porites sp.</i>	150	0	1	0	<i>Porites sp.</i>	280	6	0	0	<i>Goniopora stutchburyi</i>	150	0	3	0
11	<i>Porites sp.</i>	110	0	0	0	<i>Favites abdita</i>	270	0	0	0	<i>Goniopora stutchburyi</i>	300	0	2	0
12	<i>Montipora cf. turgescens</i>	100	0	0	0	<i>Porites sp.</i>	180	0	2	0	<i>Goniopora stutchburyi</i>	120	0	0	0
13	<i>Montipora cf. turgescens</i>	70	0	0	0	<i>Pavona decussata</i>	780	0	0	0	<i>Turbinaria peltata</i>	270	0	0	0
14	<i>Porites sp.</i>	100	0	0	0						<i>Psammocora superficialis</i>	330	0	2	0
15	<i>Montipora peltiformis</i>	320	6	1	0						<i>Goniopora stutchburyi</i>	220	0	3	0
16	<i>Goniopora stutchburyi</i>	90	0	0	0										
17	<i>Cyphastrea serailia</i>	410	0	2	0										
18	<i>Porites sp.</i>	300	0	0	0										
19	<i>Goniopora stutchburyi</i>	280	0	3	0										
20	<i>Goniopora stutchburyi</i>	180	0	1	0										
21	<i>Platygyra acuta</i>	430	0	0	0										
22	<i>Platygyra acuta</i>	1600	0	0	0										
23	<i>Platygyra carnosus</i>	970	0	1	0										

<b>Site 3 (con't)</b>															
	<b>Transect 1</b>					<b>Transect 2</b>					<b>Transect 3</b>				
	<b>Soft Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Soft Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Soft Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>
1						<i>Euplexaura sp.</i>	NA	0	NA	NA	<i>Euplexaura sp.</i>	NA	0	NA	NA
2						<i>Dendronephthya sp.</i>	NA	0	NA	NA	<i>Euplexaura sp.</i>	NA	0	NA	NA
3						<i>Echinomuricea sp.</i>	NA	0	NA	NA	<i>Euplexaura sp.</i>	NA	0	NA	NA
4						<i>Euplexaura sp.</i>	NA	0	NA	NA					
5						<i>Echinomuricea sp.</i>	NA	0	NA	NA					
6						<i>Echinomuricea sp.</i>	NA	0	NA	NA					

Site 4															
	Transect 1					Transect 2					Transect 3				
	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)
1	<i>Goniopora stutchburyi</i>	10	0	0	0	<i>Goniopora stutchburyi</i>	450	0	1	0	<i>Goniopora stutchburyi</i>	300	0	0	0
2	<i>Goniopora stutchburyi</i>	100	0	1	0	<i>Goniopora stutchburyi</i>	430	0	3	0	<i>Goniopora stutchburyi</i>	170	0	4	0
3	<i>Psammocora profundacella</i>	150	0	1	0	<i>Goniopora stutchburyi</i>	180	0	2	0	<i>Montipora cf. turgescens</i>	150	0	3	0
4	<i>Psammocora profundacella</i>	130	0	0	0	<i>Goniopora stutchburyi</i>	220	0	1	0					
5	<i>Goniopora stutchburyi</i>	70	0	0	0	<i>Goniopora stutchburyi</i>	250	0	2	0					
6	<i>Goniopora stutchburyi</i>	50	0	0	0	<i>Goniopora stutchburyi</i>	70	0	0	0					
7	<i>Goniopora stutchburyi</i>	70	0	0	0	<i>Goniopora stutchburyi</i>	250	0	0	0					
8	<i>Goniopora stutchburyi</i>	120	0	0	0	<i>Goniopora stutchburyi</i>	90	0	0	0					
9	<i>Goniopora stutchburyi</i>	100	0	0	0	<i>Goniopora stutchburyi</i>	40	0	0	0					
10	<i>Goniopora stutchburyi</i>	60	0	0	0	<i>Goniopora stutchburyi</i>	30	0	0	0					
11	<i>Goniopora stutchburyi</i>	130	0	0	0	<i>Goniopora stutchburyi</i>	120	0	0	0					
12	<i>Goniopora stutchburyi</i>	100	0	1	0	<i>Goniopora stutchburyi</i>	80	0	0	0					
13	<i>Goniopora stutchburyi</i>	70	0	0	0	<i>Goniopora stutchburyi</i>	110	0	0	0					
14	<i>Goniopora stutchburyi</i>	200	0	0	0	<i>Goniopora stutchburyi</i>	60	0	0	0					
15	<i>Goniopora stutchburyi</i>	60	0	1	0	<i>Goniopora stutchburyi</i>	110	0	0	0					
16	<i>Goniopora stutchburyi</i>	180	0	0	0	<i>Goniopora stutchburyi</i>	100	1	0	0					
17						<i>Goniopora stutchburyi</i>	70	0	0	0					
18						<i>Goniopora stutchburyi</i>	30	0	0	0					
19						<i>Goniopora stutchburyi</i>	120	0	0	0					
20						<i>Goniopora stutchburyi</i>	70	0	0	0					
21						<i>Goniopora stutchburyi</i>	110	0	0	0					
22						<i>Goniopora stutchburyi</i>	60	0	0	0					
23						<i>Goniopora stutchburyi</i>	130	0	1	0					
24						<i>Goniopora stutchburyi</i>	60	0	0	0					



<b>Site 4 (con't)</b>															
	<b>Transect 1</b>					<b>Transect 2</b>					<b>Transect 3</b>				
	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Hard Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>
25						<i>Goniopora stutchburyi</i>	40	0	0	0					
26						<i>Goniopora stutchburyi</i>	40	0	0	0					
27						<i>Goniopora stutchburyi</i>	120	0	0	0					
28						<i>Goniopora stutchburyi</i>	100	0	0	0					
29						<i>Goniopora stutchburyi</i>	80	0	0	0					
30						<i>Goniopora stutchburyi</i>	300	0	0	0					
31						<i>Goniopora stutchburyi</i>	400	0	0	0					
32						<i>Goniopora stutchburyi</i>	450	0	1	0					
33						<i>Goniopora stutchburyi</i>	200	0	0	0					
34						<i>Goniopora stutchburyi</i>	120	0	0	0					
35						<i>Goniopora stutchburyi</i>	230	0	0	0					
36						<i>Goniopora stutchburyi</i>	180	0	0	0					
37						<i>Goniopora stutchburyi</i>	240	0	0	0					
38						<i>Goniopora stutchburyi</i>	350	0	1	0					
39						<i>Goniopora stutchburyi</i>	270	0	0	0					
40						<i>Porites sp.</i>	50	0	0	0					
41						<i>Psammocora superficialis</i>	330	0	2	0					
42						<i>Porites sp.</i>	320	0	2	0					
43						<i>Porites sp.</i>	160	2	3	0					
44						<i>Porites sp.</i>	90	5	0	0					
45						<i>Montastrea magnistellata</i>	200	0	2	0					
46						<i>Favia speciosa</i>	600	0	10	0					
	<b>Soft Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Soft Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Soft Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>
1	<i>Euplexaura sp.</i>	NA	0			<i>Echinomuricea sp.</i>	NA	0							
2	<i>Echinomuricea sp.</i>	NA	0			<i>Euplexaura sp.</i>	NA	0							

<b>Site 4 (con't)</b>															
	<b>Transect 1</b>					<b>Transect 2</b>					<b>Transect 3</b>				
	<b>Soft Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Soft Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>	<b>Soft Coral</b>	<b>Area (cm<sup>2</sup>)</b>	<b>Mortality (%)</b>	<b>Sediment (%)</b>	<b>Bleaching (%)</b>
3	<i>Euplexaura sp.</i>	NA	0			<i>Echinomuricea sp.</i>	NA	0							
4	<i>Euplexaura sp.</i>	NA	0			<i>Dendronephthya sp.</i>	NA	0							
5	<i>Echinomuricea sp.</i>	NA	0			<i>Echinomuricea sp.</i>	NA	0							
6	<i>Echinomuricea sp.</i>	NA	0			<i>Echinomuricea sp.</i>	NA	0							
7	<i>Echinomuricea sp.</i>	NA	0			<i>Echinomuricea sp.</i>	NA	0							
8	<i>Echinomuricea sp.</i>	NA	0			<i>Echinomuricea sp.</i>	NA	0							
9	<i>Euplexaura sp.</i>	NA	0			<i>Euplexaura sp.</i>	NA	0							
10	<i>Euplexaura sp.</i>	NA	0			<i>Echinomuricea sp.</i>	NA	0							
11	<i>Euplexaura sp.</i>	NA	0			<i>Echinomuricea sp.</i>	NA	0							
12	<i>Echinomuricea sp.</i>	NA	0			<i>Euplexaura sp.</i>	NA	0							
13						<i>Echinomuricea sp.</i>	NA	0							
14						<i>Echinomuricea sp.</i>	NA	0							

Site 5															
	Transect 1					Transect 2					Transect 3				
	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)
1	<i>Cyphastrea serailia</i>	90	0	1	0	<i>Goniopora stutchburyi</i>	110	0	5	0	<i>Goniopora stutchburyi</i>	170	0	3	0
2	<i>Leptastrea pruinosa</i>	220	2	2	0						<i>Goniopora stutchburyi</i>	120	0	2	0
3											<i>Goniopora stutchburyi</i>	210	0	4	0
4											<i>Goniopora stutchburyi</i>	180	0	3	0
5											<i>Goniopora stutchburyi</i>	130	0	1	0
6											<i>Montipora cf. turgescens</i>	100	0	2	0
	Soft Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Soft Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Soft Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)
1						<i>Lobophytum depressum</i>	NA	0			<i>Euplexaura sp.</i>	NA	0		
2						<i>Lobophytum depressum</i>	NA	0			<i>Euplexaura sp.</i>	NA	0		
3						<i>Lobophytum depressum</i>	NA	0			<i>Euplexaura sp.</i>	NA	0		
4						<i>Lobophytum depressum</i>	NA	0							
5						<i>Lobophytum depressum</i>	NA	0							
6						<i>Lobophytum depressum</i>	NA	0							
7						<i>Lobophytum depressum</i>	NA	0							
8						<i>Lobophytum depressum</i>	NA	0							
9						<i>Lobophytum depressum</i>	NA	0							
10						<i>Lobophytum depressum</i>	NA	0							
11						<i>Lobophytum depressum</i>	NA	0							
12						<i>Lobophytum depressum</i>	NA	0							

Control Site C															
	Transect 1					Transect 2					Transect 3				
	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)
1	<i>Favia rotumana</i>	150	0	0	0	<i>Favia rotumana</i>	190	0	0	0	<i>Favia rotumana</i>	450	0	2	0
2	<i>Favia rotumana</i>	240	0	1	0	<i>Platygyra acuta</i>	120	0	1	0	<i>Favia rotumana</i>	280	0	0	0
3	<i>Platygyra acuta</i>	180	0	0	0	<i>Platygyra acuta</i>	90	0	0	0	<i>Favia speciosa</i>	280	0	1	0
4	<i>Platygyra carnosus</i>	240	0	0	0	<i>Favia rotumana</i>	210	0	0	0	<i>Favites pentagona</i>	90	0	0	0
5	<i>Platygyra carnosus</i>	400	0	0	0	<i>Favia rotumana</i>	360	0	0	0	<i>Favites pentagona</i>	670	0	0	0
6	<i>Cyphastrea serailia</i>	200	0	0	0	<i>Favites pentagona</i>	420	0	0	0	<i>Cyphastrea serailia</i>	190	0	0	0
7	<i>Favia rotumana</i>	210	0	0	0	<i>Favia rotumana</i>	380	0	0	0	<i>Porites sp.</i>	450	0	4	0
8	<i>Favia rotumana</i>	320	0	0	0	<i>Favia rotumana</i>	80	0	0	0	<i>Favia rotumana</i>	190	0	0	0
9	<i>Goniastrea aspera</i>	400	0	2	0	<i>Favites abdita</i>	400	5	1	0	<i>Favia rotumana</i>	210	0	0	0
10	<i>Favia rotumana</i>	200	0	0	0	<i>Favia rotumana</i>	280	0	0	0	<i>Favia rotumana</i>	40	0	0	0
11	<i>Favia rotumana</i>	500	0	0	0	<i>Favia rotumana</i>	280	3	0	0	<i>Favia rotumana</i>	200	7	3	0
12	<i>Favia rotumana</i>	300	0	0	0	<i>Favia rotumana</i>	350	0	0	0	<i>Goniastrea aspera</i>	500	0	4	0
13	<i>Porites sp.</i>	300	3	5	0	<i>Favites abdita</i>	240	2	0	0	<i>Pavona decussata</i>	130	0	0	0
14	<i>Platygyra carnosus</i>	560	0	1	0	<i>Leptastrea pruinosa</i>	330	0	0	0	<i>Pavona decussata</i>	50	0	0	0
15	<i>Favia rotumana</i>	250	0	0	0	<i>Favia rotumana</i>	400	0	0	0	<i>Favites pentagona</i>	1400	0	3	0
16	<i>Favites pentagona</i>	380	0	0	0	<i>Favia rotumana</i>	200	0	0	0	<i>Favites pentagona</i>	250	0	2	0
17	<i>Favites pentagona</i>	280	0	0	0	<i>Platygyra acuta</i>	120	0	0	0	<i>Psammocora superficialis</i>	800	0	5	0
18	<i>Favia rotumana</i>	190	0	0	0	<i>Favites pentagona</i>	130	0	0	0	<i>Plesiastrea versipora</i>	60	0	3	0
19	<i>Favia rotumana</i>	350	0	0	0	<i>Favites abdita</i>	140	2	0	0	<i>Favia speciosa</i>	60	0	2	0
20	<i>Favia rotumana</i>	300	0	0	0	<i>Favia rotumana</i>	200	0	0	0	<i>Favia speciosa</i>	240	0	2	0
21	<i>Favia rotumana</i>	280	5	0	0	<i>Porites sp.</i>	420	0	3	0	<i>Porites sp.</i>	190	0	4	0
23	<i>Favites abdita</i>	200	0	3	0	<i>Favia rotumana</i>	330	0	0	0	<i>Favia rotumana</i>	290	0	3	0
24	<i>Favites abdita</i>	260	0	0	0	<i>Cyphastrea serailia</i>	290	0	3	0	<i>Favia rotumana</i>	350	0	2	0
25	<i>Cyphastrea serailia</i>	260	3	0	0	<i>Platygyra carnosus</i>	120	0	0	0	<i>Favites pentagona</i>	60	0	2	0
26	<i>Favia speciosa</i>	430	0	1	0	<i>Favia rotumana</i>	500	0	0	0	<i>Favia rotumana</i>	120	0	0	0

Control Site C (con't)															
	Transect 1					Transect 2					Transect 3				
	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)
27	<i>Plesiastrea versipora</i>	220	0	0	0	<i>Favia rotumana</i>	100	0	0	0	<i>Goniopora stutchburyi</i>	220	0	0	0
28	<i>Goniastrea aspera</i>	190	0	0	0	<i>Porites sp.</i>	130	0	0	0	<i>Favia speciosa</i>	370	0	0	0
29	<i>Turbinaria peltata</i>	90	0	0	0	<i>Porites sp.</i>	350	0	0	0	<i>Montipora peltiformis</i>	280	0	1	0
30	<i>Goniastrea aspera</i>	120	0	0	0	<i>Favia rotumana</i>	60	0	0	0	<i>Plesiastrea versipora</i>	500	0	3	0
31	<i>Goniastrea aspera</i>	750	0	0	0	<i>Favia rotumana</i>	90	0	0	0	<i>Goniopora stutchburyi</i>	450	0	5	0
32	<i>Favites pentagona</i>	700	0	0	0						<i>Favia speciosa</i>	490	0	2	0
33	<i>Favia rotumana</i>	320	0	0	0						<i>Plesiastrea versipora</i>	280	0	1	0
34	<i>Favites pentagona</i>	650	0	1	0						<i>Plesiastrea versipora</i>	50	0	1	0
35	<i>Porites sp.</i>	400	0	1	0						<i>Plesiastrea versipora</i>	300	0	1	0
36	<i>Porites sp.</i>	200	0	1	0						<i>Hydnophora exesa</i>	210	0	0	0
37	<i>Favia speciosa</i>	500	0	0	0						<i>Favia speciosa</i>	350	0	2	0
38	<i>Psammocora profundacella</i>	200	0	0	0						<i>Plesiastrea versipora</i>	1500	0	2	0
39	<i>Platygyra acuta</i>	390	0	0	0						<i>Favia speciosa</i>	220	0	1	0
40											<i>Porites sp.</i>	500	6	2	0
41											<i>Plesiastrea versipora</i>	140	0	0	0
42											<i>Goniopora stutchburyi</i>	480	0	3	0
43											<i>Plesiastrea versipora</i>	500	0	0	0
44											<i>Psammocora superficialis</i>	130	0	0	0
45											<i>Plesiastrea versipora</i>	60	0	0	0
46											<i>Plesiastrea versipora</i>	3000	0	0	0
47											<i>Plesiastrea versipora</i>	200	0	0	0
48											<i>Plesiastrea versipora</i>	580	0	0	0
49											<i>Favia speciosa</i>	170	0	0	0
50											<i>Cyphastrea serailia</i>	160	0	0	0
51											<i>Goniopora stutchburyi</i>	180	0	0	0

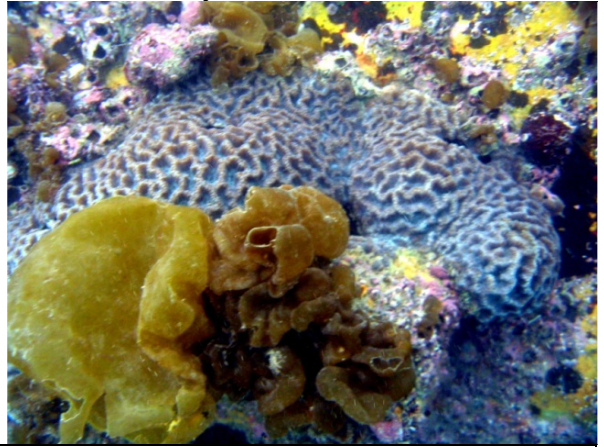
Control Site C (con't)															
	Transect 1					Transect 2					Transect 3				
	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)	Hard Coral	Area (cm <sup>2</sup> )	Mortality (%)	Sediment (%)	Bleaching (%)
52											<i>Psammocora superficialis</i>	500	0	2	0
53											<i>Psammocora superficialis</i>	500	8	2	0
54											<i>Plesiastrea versipora</i>	2200	0	1	0
55											<i>Favia speciosa</i>	220	0	2	0
56											<i>Psammocora superficialis</i>	850	6	1	0
57											<i>Favia rotumana</i>	250	0	2	0
58											<i>Favia rotumana</i>	250	8	1	0
59											<i>Favia fавus</i>	350	0	1	0
60											<i>Psammocora profundacella</i>	250	6	1	0
61											<i>Montipora peltiformis</i>	200	0	3	0
62											<i>Psammocora superficialis</i>	300	0	3	0
63											<i>Cyphastrea serailia</i>	320	0	1	0
64											<i>Favia speciosa</i>	250	0	1	0
65											<i>Psammocora superficialis</i>	580	4	1	0
											<i>Platygyra carnosus</i>	2600	0	0	0
											<i>Platygyra carnosus</i>	1400	0	1	0



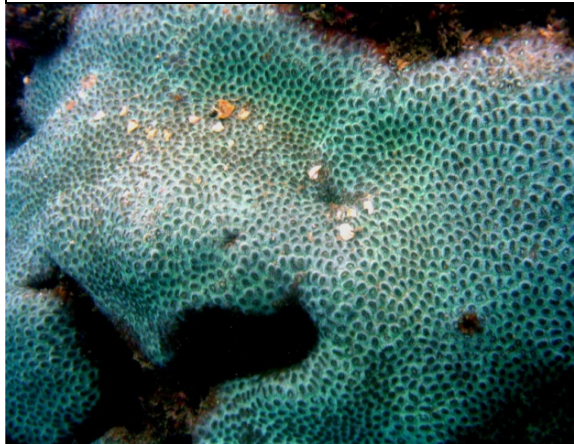
**Appendix III Photographs of benthic organisms at the survey sites.**



Site 1 – Sea urchin *Anthocidaris crassispina*



Site 1 – Macroalgae *Colpomenia sinuosa* (front)  
Hard coral *Platygyra carnosus* (back)



Site 1 – Hard coral *Plesiastrea versipora*



Site 1 – Hard coral *Favites abdita*



Site 1 – Hard coral *Pavona decussata*



Site 2 – Sea cucumber *Colochirus quadrangularis*



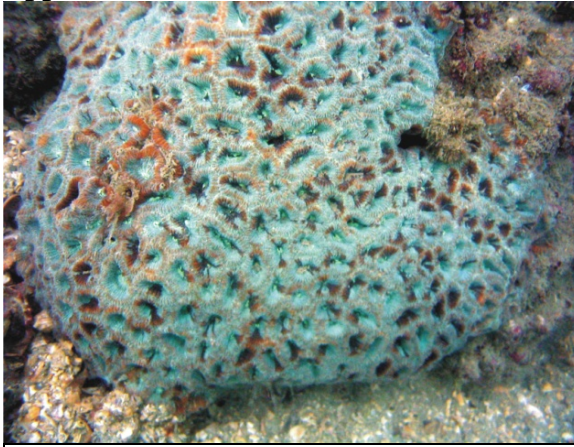
Site 2 – Hard coral *Favites pentagona*



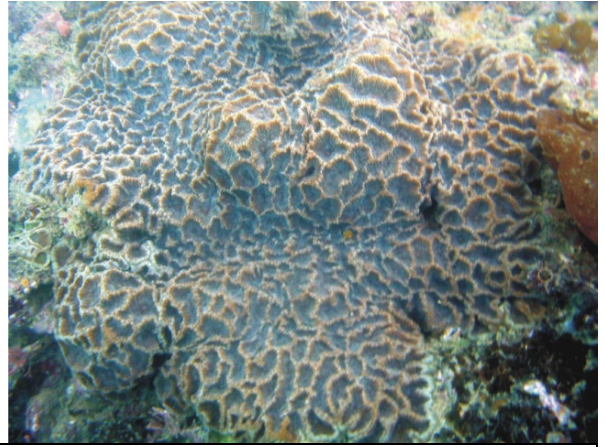
Site 2 – Hard coral *Cyphastrea serailia*



Appendix III continued.....



Site 2 – Hard coral *Favia speciosa*



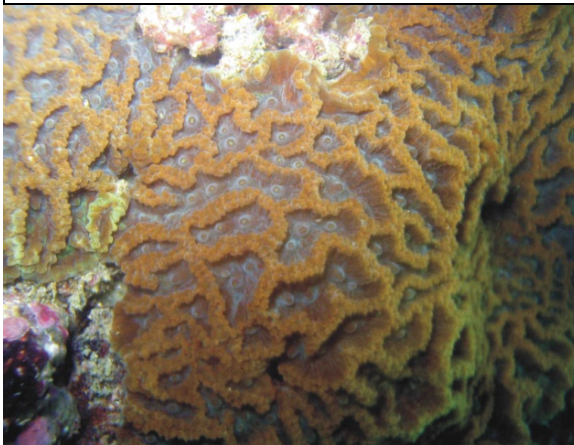
Site 2 – Hard coral *Platygyra acuta*



Site 3 – Cowrie *Cypraea* sp.



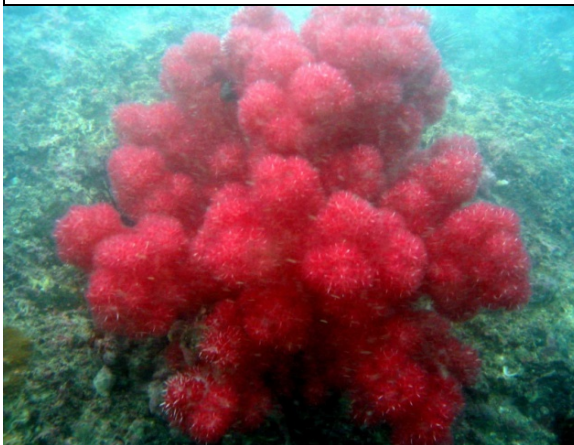
Site 3 – Hard coral *Montipora peltiformis*



Site 3 – Hard coral *Platygyra carnosus*



Site 3 – Hard coral *Turbinaria peltata*



Site 3 – Soft coral *Dendronephthya* sp.



Site 3 – Sea whip *Euplexaura* sp.



Appendix III continued.....



Site 4 – Fanworm belongs to the family Sabellidae



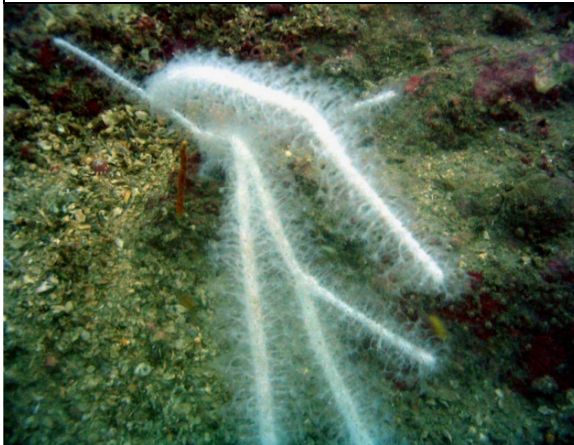
Site 4 – Hard coral *Montastrea magnistellata*



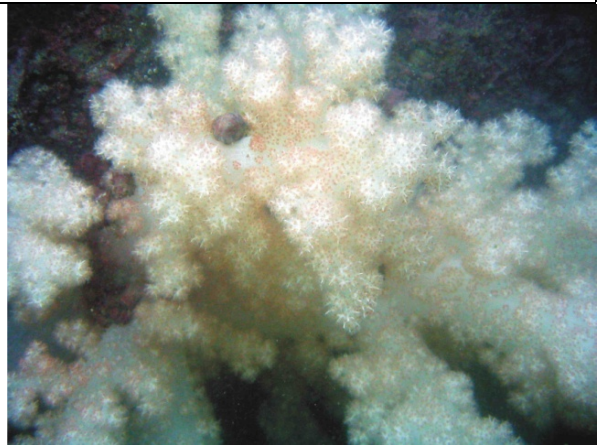
Site 4 – Hard coral *Psammocora profundacella*



Site 4 – Hard coral *Montipora cf. turgescens*



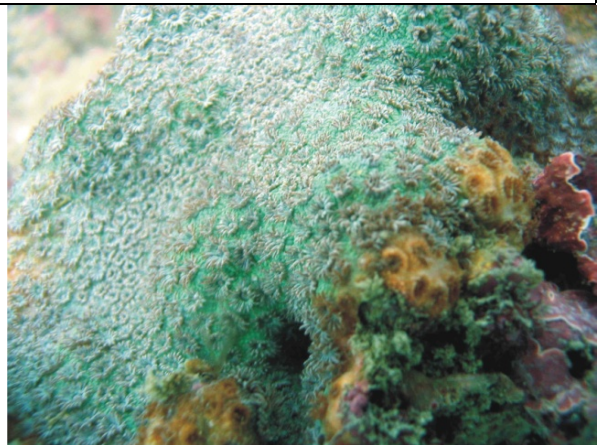
Site 4 – Sea whip *Echinomuricea* sp.



Site 4 – Soft coral *Dendronephthya* sp.



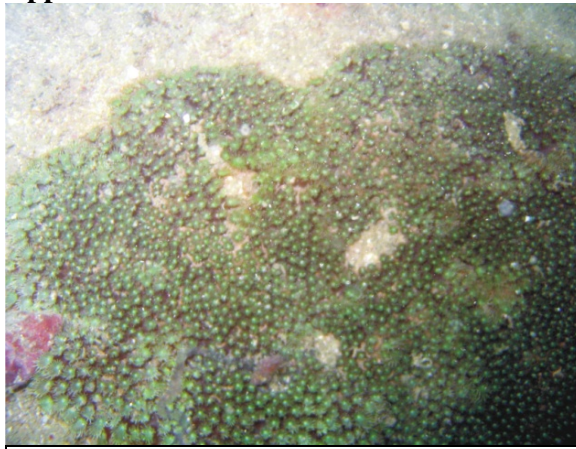
Site 5 – Sea urchin *Salmacis sphaeroides*



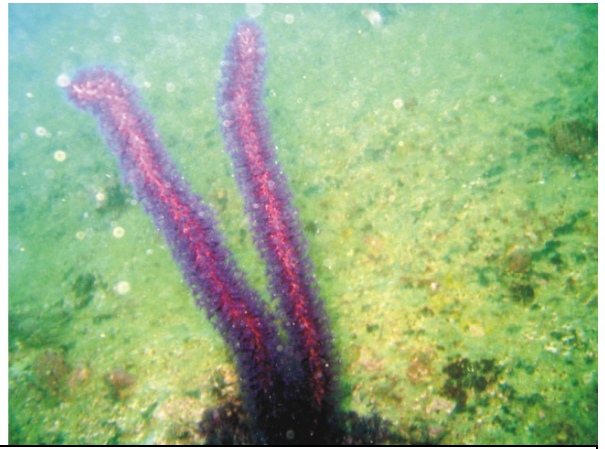
Site 5 – Hard coral *Cyphastrea serailia*



Appendix III continued.....



Site 5 – Hard coral *Goniopora stutchburyi*



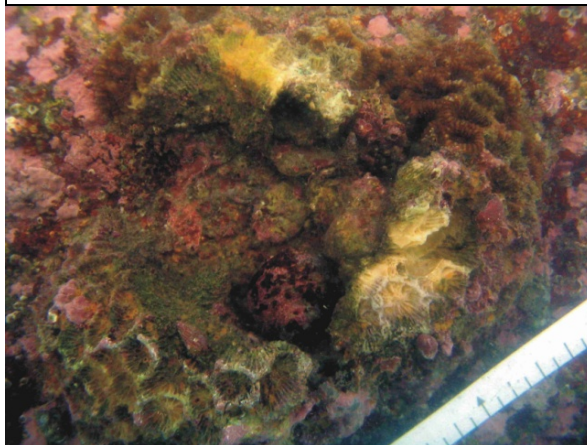
Site 5 – Sea whip *Euplexaura sp.*



Site 5 – Soft coral *Lobophytum depressum*



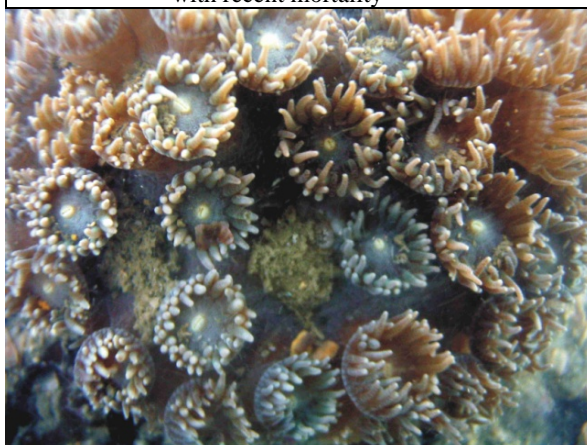
Control Site – Hard coral *Favia rotumana*



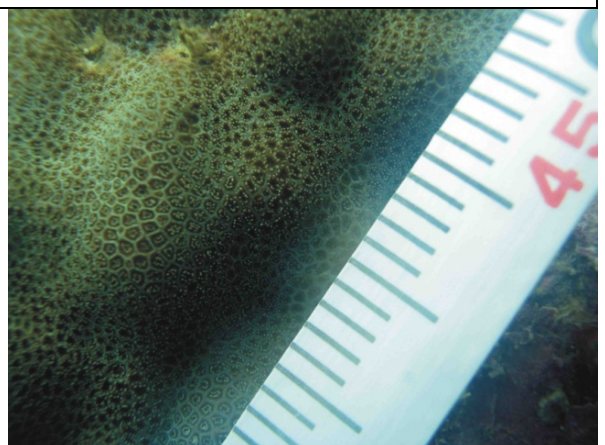
Control Site – Hard coral *Favites pentagona*  
with recent mortality



Control Site – Hard coral *Hydnophora exesa*



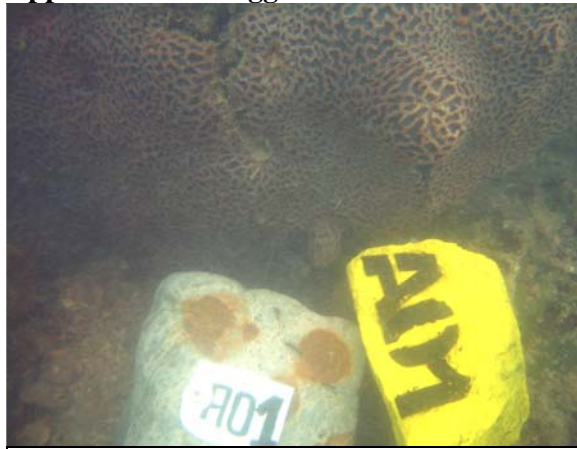
Control Site – Hard coral *Turbinaria peltata*



Control Site – Hard coral *Porites sp.*



Appendix IVa Tagged coral colonies at Site 1.



A01



*Platygyra carnosus*



A02



*Platygyra carnosus*



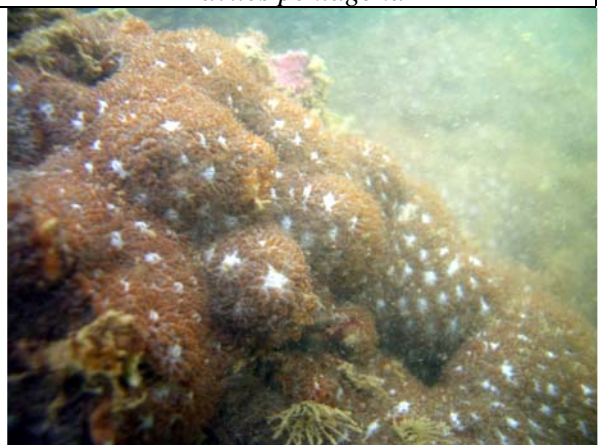
A03



*Favites pentagona*



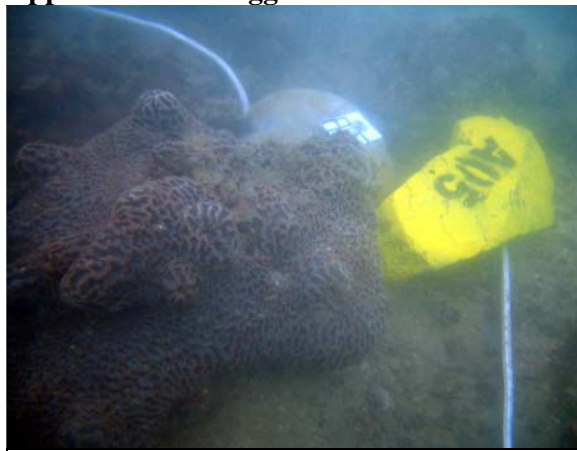
A04



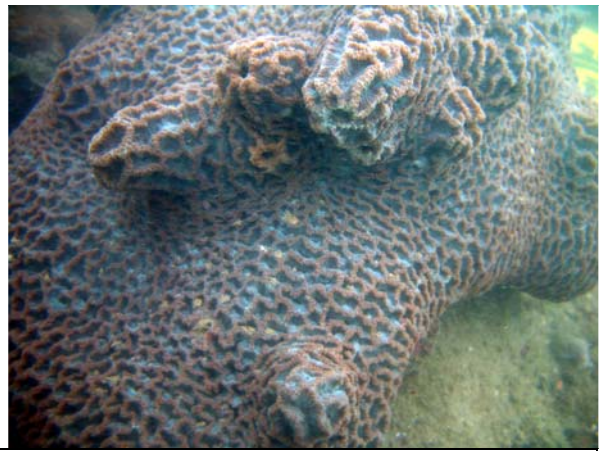
*Leptastrea pruinosa*



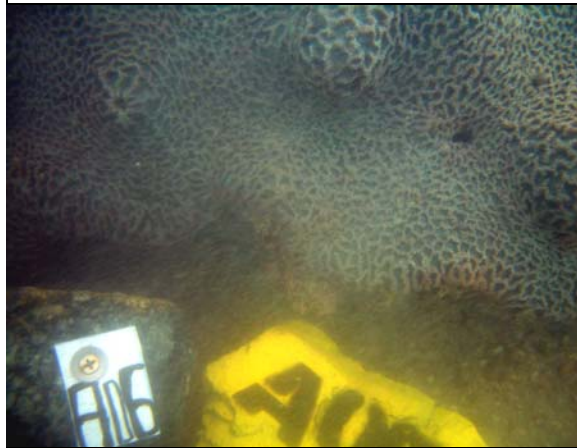
Appendix IVa Tagged coral colonies at Site 1.....continued.



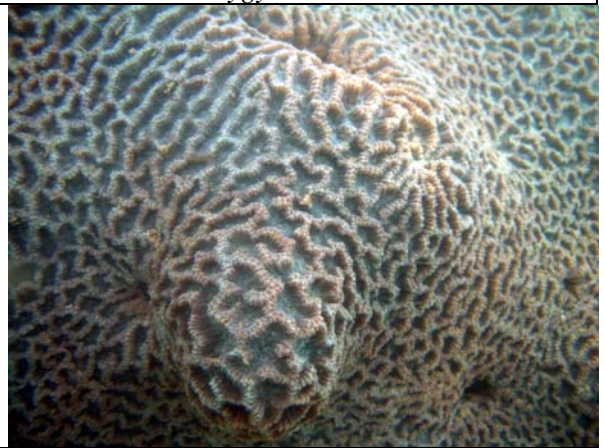
A05



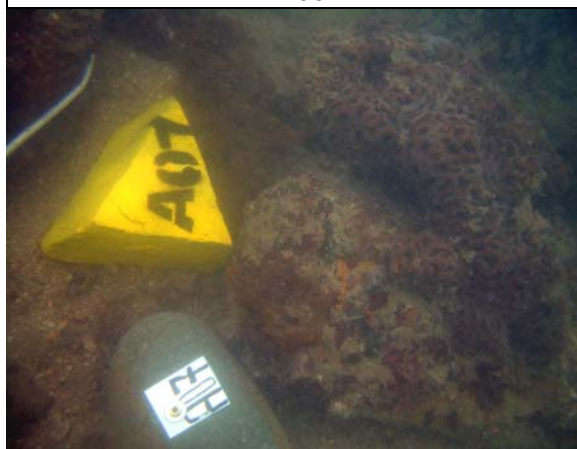
*Platygyra carnosus*



A06



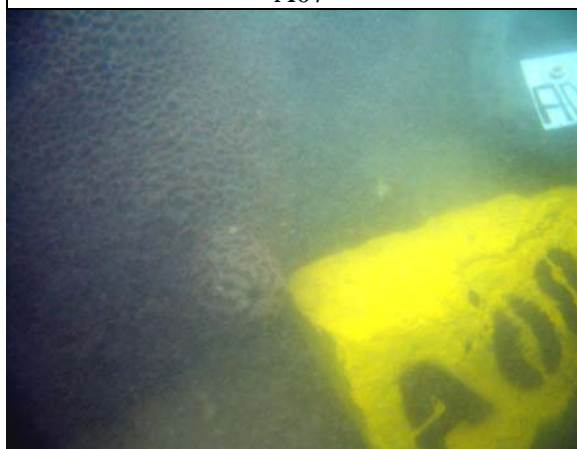
*Platygyra carnosus*



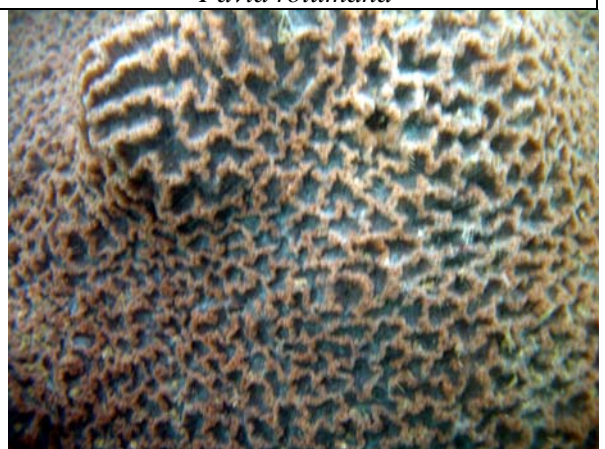
A07



*Favia rotumana*



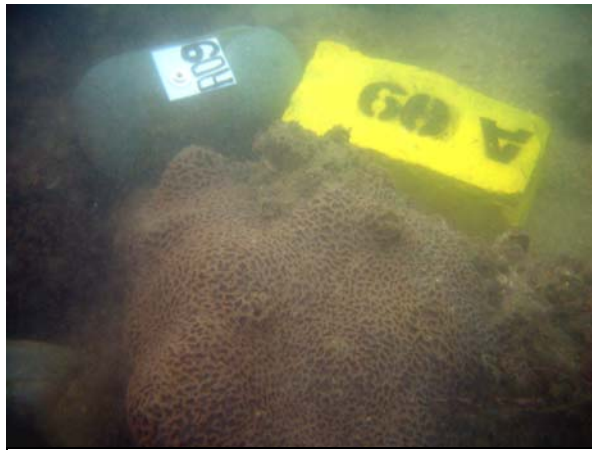
A08



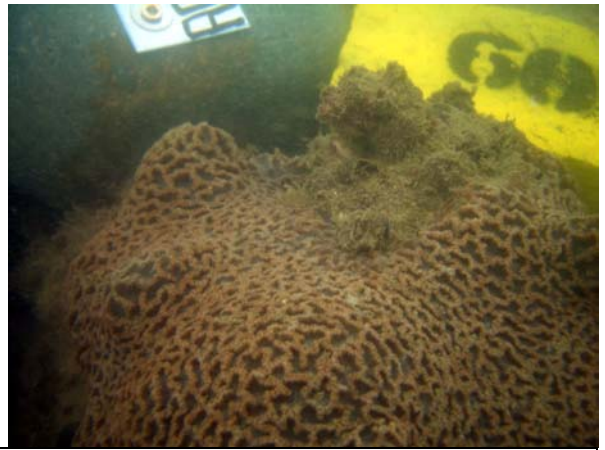
*Platygyra carnosus*



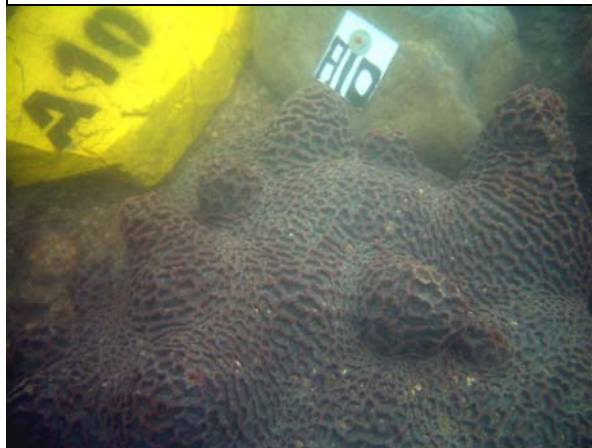
Appendix IVa Tagged coral colonies at Site 1.....continued.



A09



*Platygyra carnosus*



A10



*Platygyra carnosus*



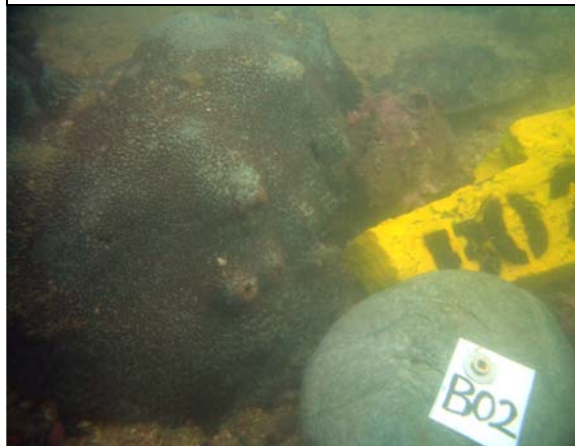
Appendix IVb Tagged coral colonies at Site 2.



B01



*Platygyra carnosus*



B02



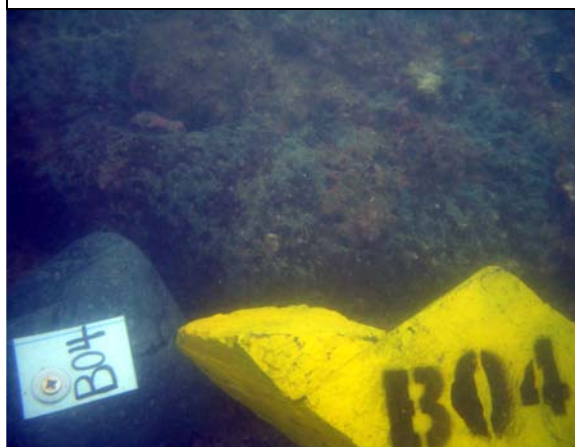
*Plesiastrea versipora*



B03



*Psammocora superficialis*



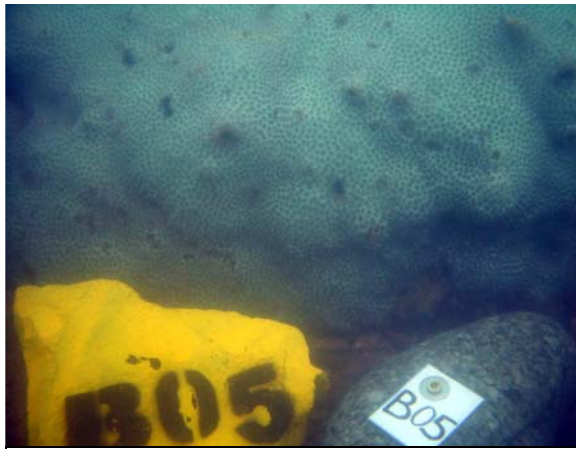
B04



*Favia speciosa*



Appendix IVb Tagged coral colonies at Site 2.....continued.



B05



*Plesiastrea versipora*



B06



*Platygyra carnosus*



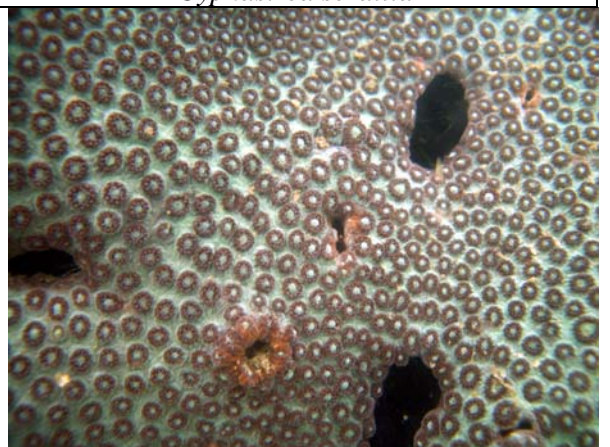
B07



*Cyphastrea serailia*



B08



*Plesiastrea versipora*



Appendix IVb Tagged coral colonies at Site 2.....continued.



B09



*Favites pentagona*



B10



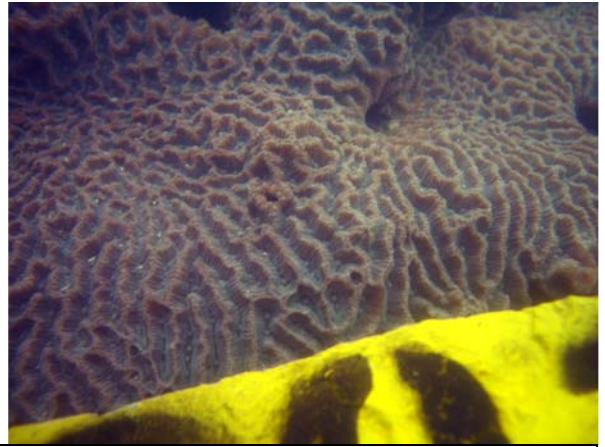
*Favites pentagona*



Appendix IVc Tagged Coral Colonies at Site 3.



C01



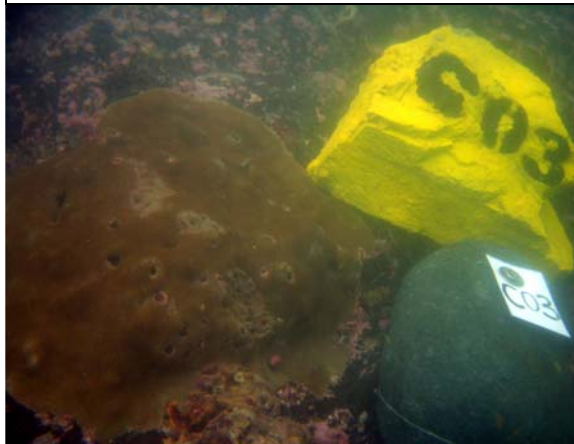
*Platygyra acuta*



C02



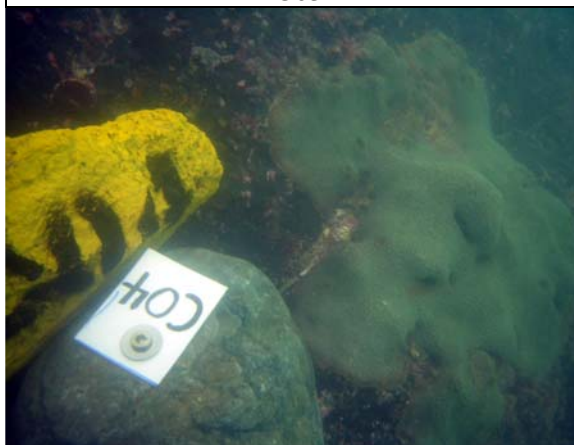
*Platygyra carnosus*



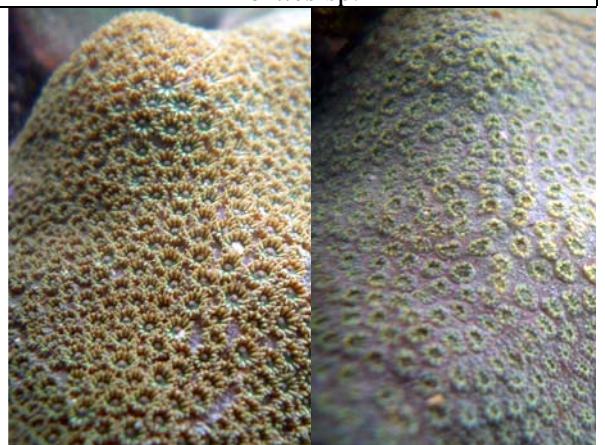
C03



*Porites* sp.



C04



*Cyphastrea serailia*



Appendix IVc Tagged Coral Colonies at Site 3.....continued.



C05



*Pavona decussata*



C06



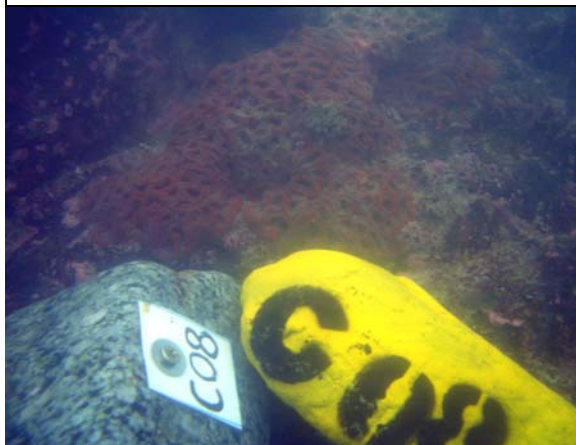
*Pavona decussata*



C07



*Montipora cf. turgescens*



C08



*Favia favaus*



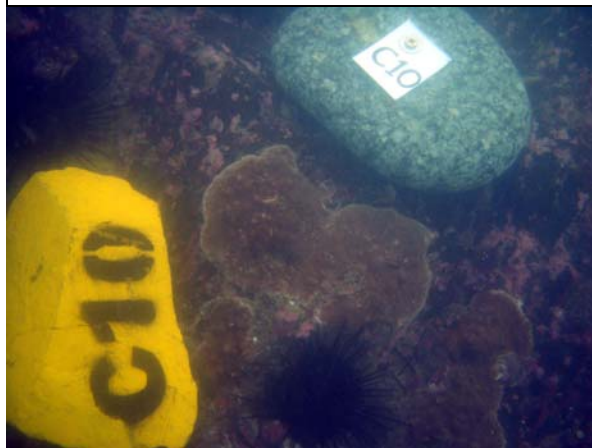
Appendix IVc Tagged Coral Colonies at Site 3.....continued.



C09



*Favites pentagona*



C10



*Montipora peltiformis*



Appendix IVd Tagged Coral Colonies at Site 4.



E01



*Goniopora stutchburyi*



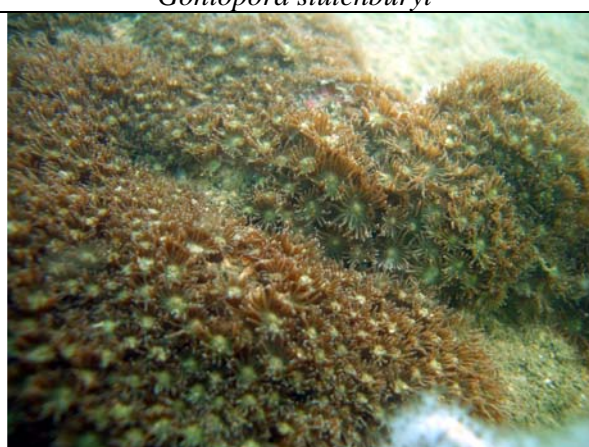
E02



*Goniopora stutchburyi*



E03



*Goniopora stutchburyi*



E04



*Porites* sp.



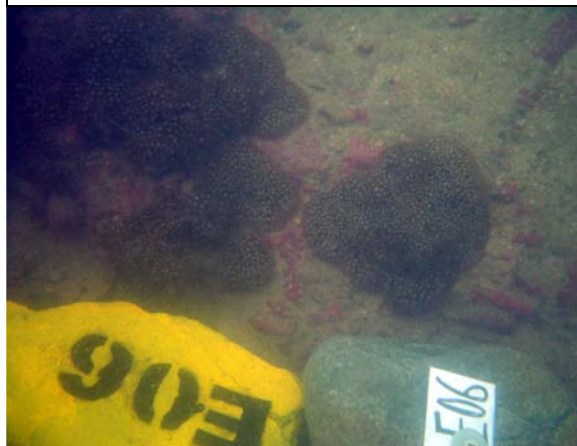
Appendix IVd Tagged Coral Colonies at Site 4.....continued.



E05



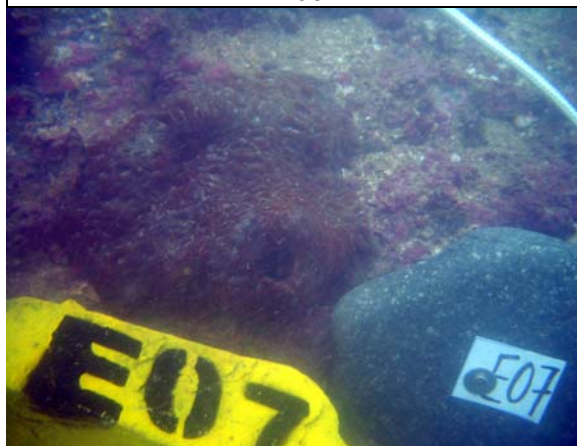
*Goniopora stutchburyi*



E06



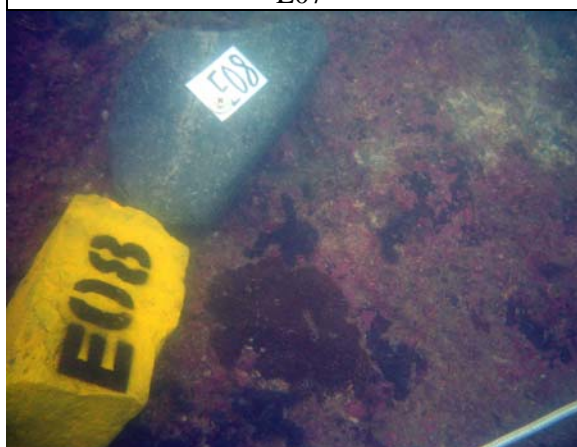
*Goniopora stutchburyi*



E07



*Favia speciosa*



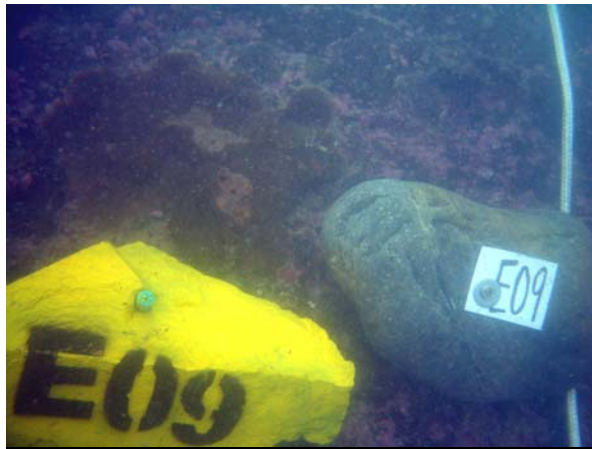
E08



*Porites* sp.



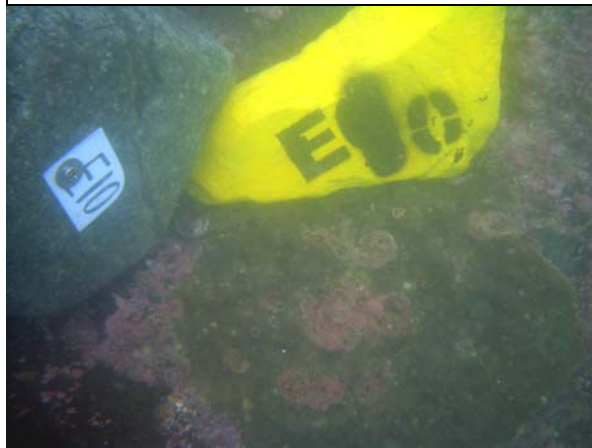
Appendix IVd Tagged Coral Colonies at Site 4.....continued.



E09



*Porites* sp.



E10



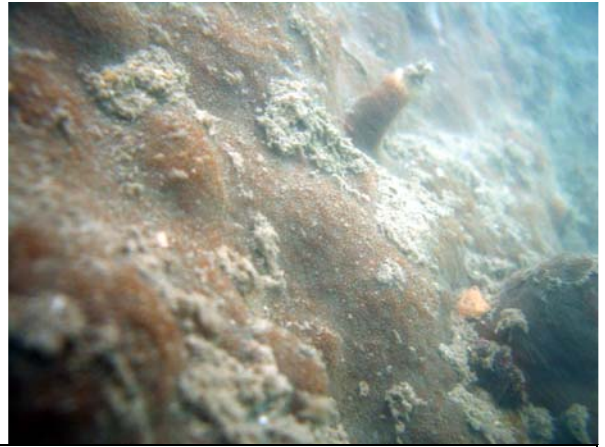
*Porites* sp.



Appendix IVe Tagged Coral Colonies at Site 5.



D01



*Psammocora* sp.



D02



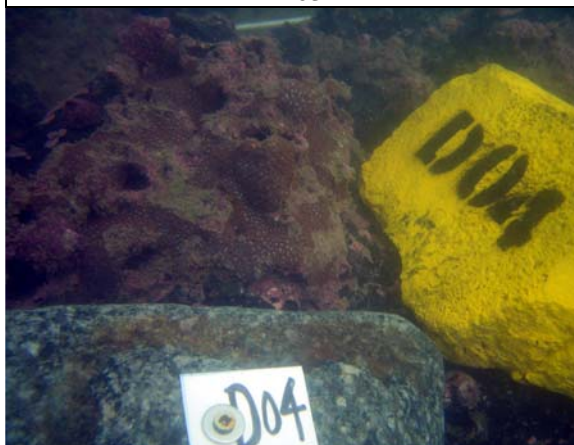
*Montipora* cf. *turgescens*



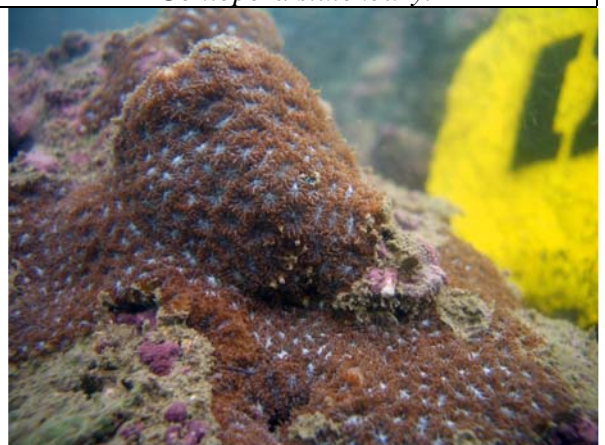
D03



*Goniopora* *stutchburyi*



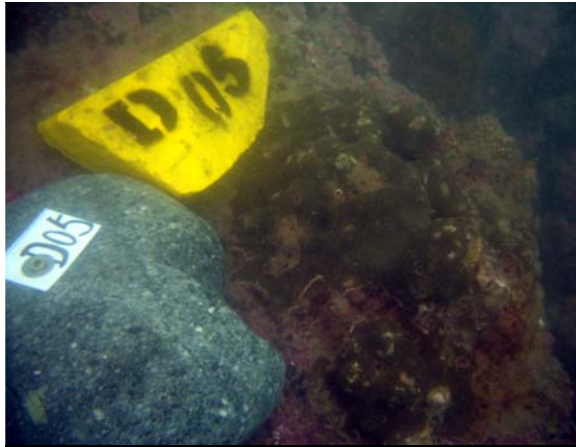
D04



*Leptastrea* *pruinosa*



Appendix IVe Tagged Coral Colonies at Site 5.....continued.



D05



*Porites* sp.



D06



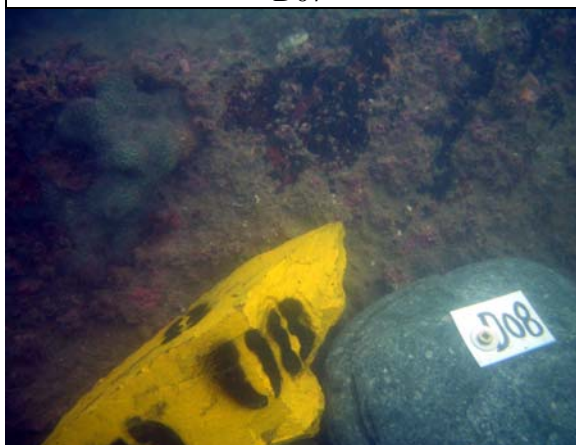
*Plesiastrea versipora*



D07



*Leptastrea pruinosa*



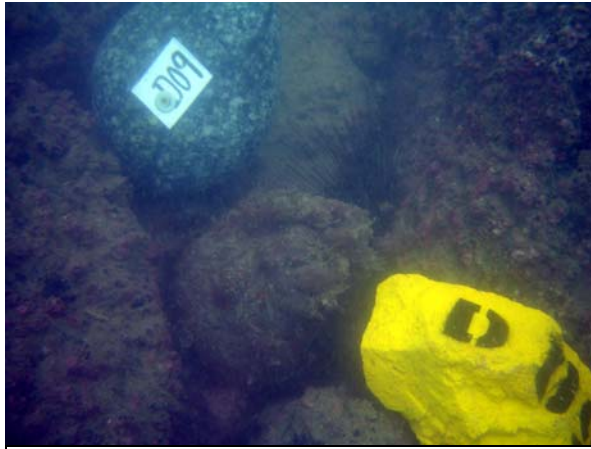
D08



*Plesiastrea versipora*



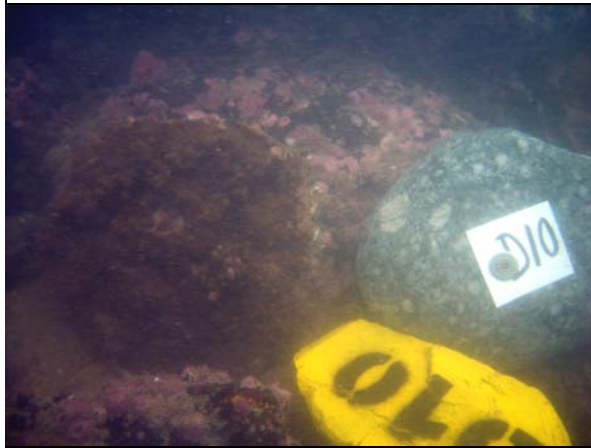
Appendix IVe Tagged Coral Colonies at Site 5.....continued.



D09



*Cyphastrea* sp.



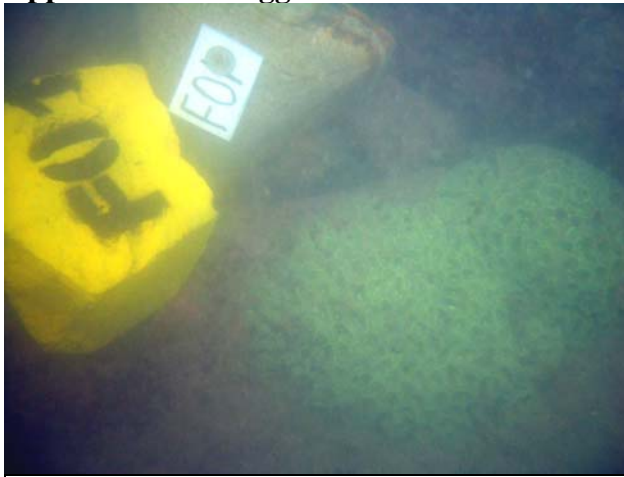
D10



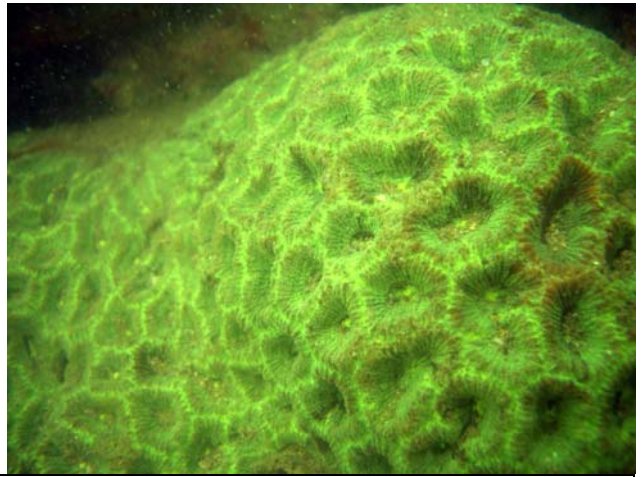
*Montipora* cf. *turgescens*



Appendix IVf Tagged coral colonies at Control Site.



F01



*Favites speciosa*



F02



*Favites pentagona*



F03



*Favites pentagona*



F04



*Porites* sp.



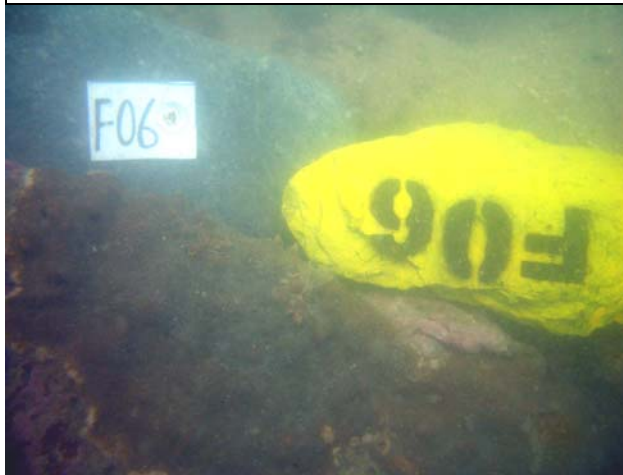
Appendix IVf Tagged coral colonies at Control Site.....continued.



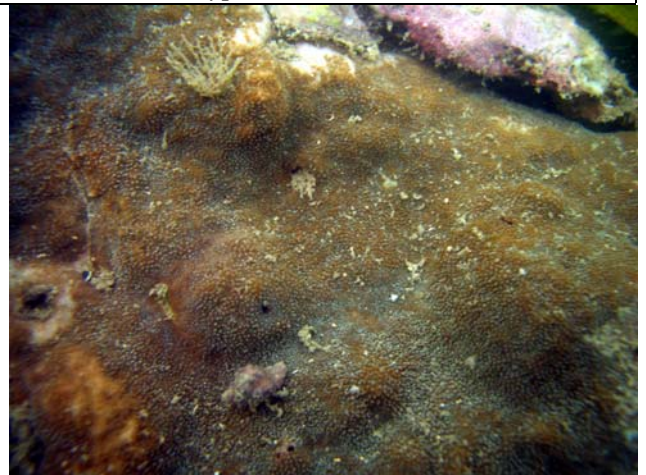
F05



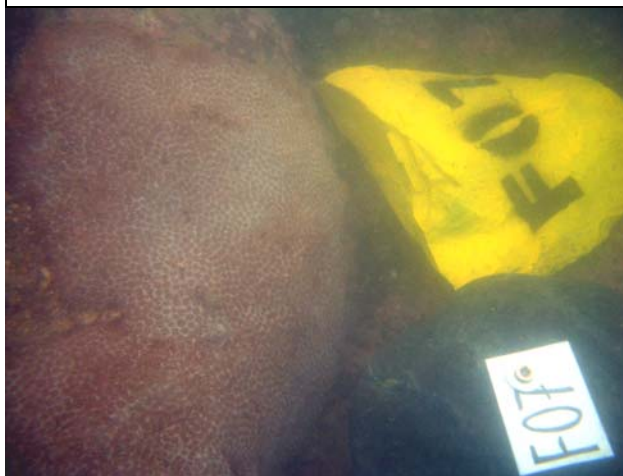
*Cyphastrea serailia*



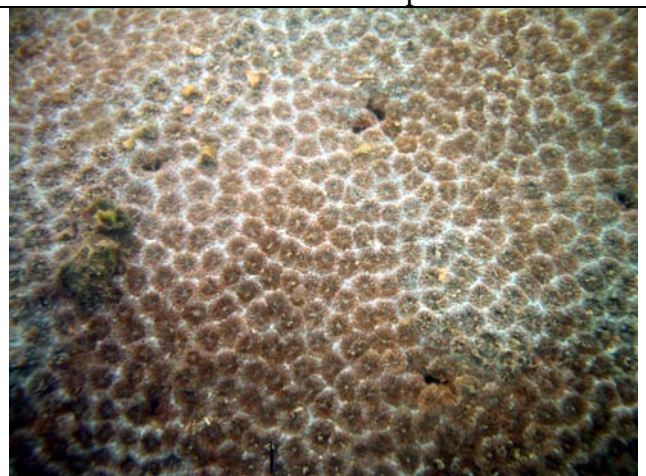
F06



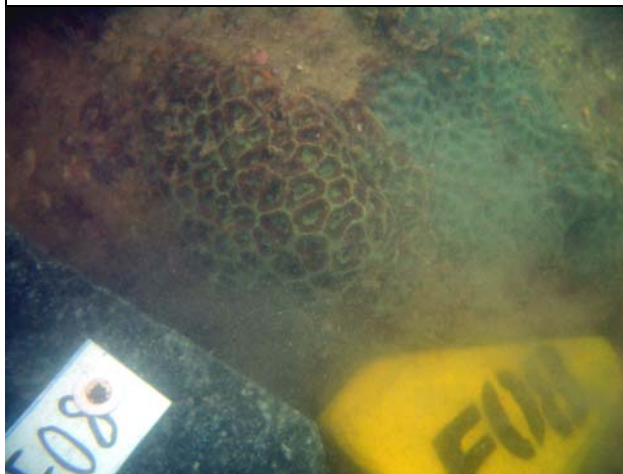
*Psammocora* sp.



F07



*Plesiastrea versipora*



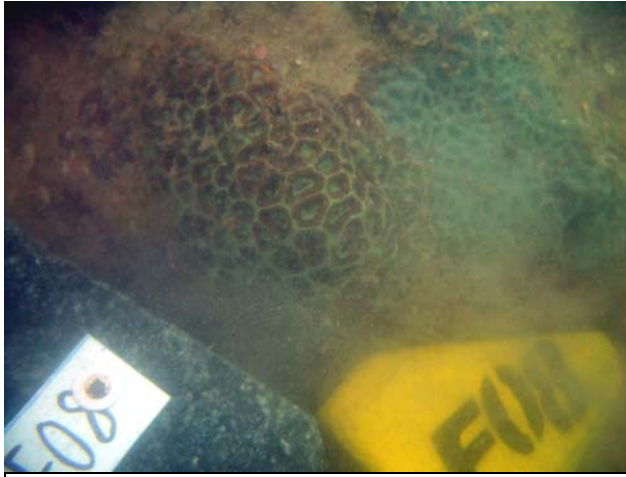
F08a



*Favites speciosa* (left side)



Appendix IVf Tagged coral colonies at Control Site.....continued.



F08b



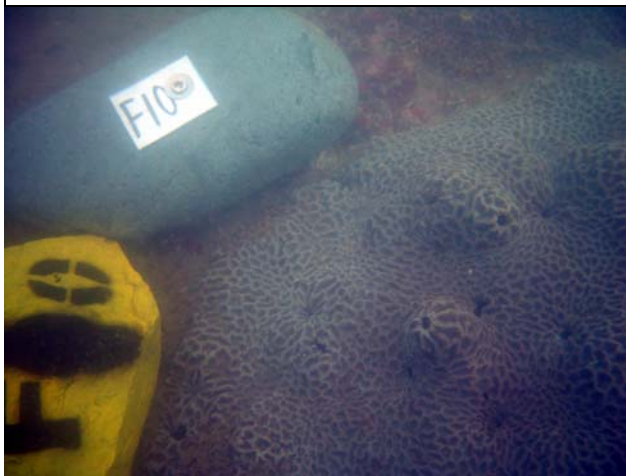
*Goniastrea favulus* (right side)



F09



*Favites pentagona*



F10



*Platygyra carnosus*

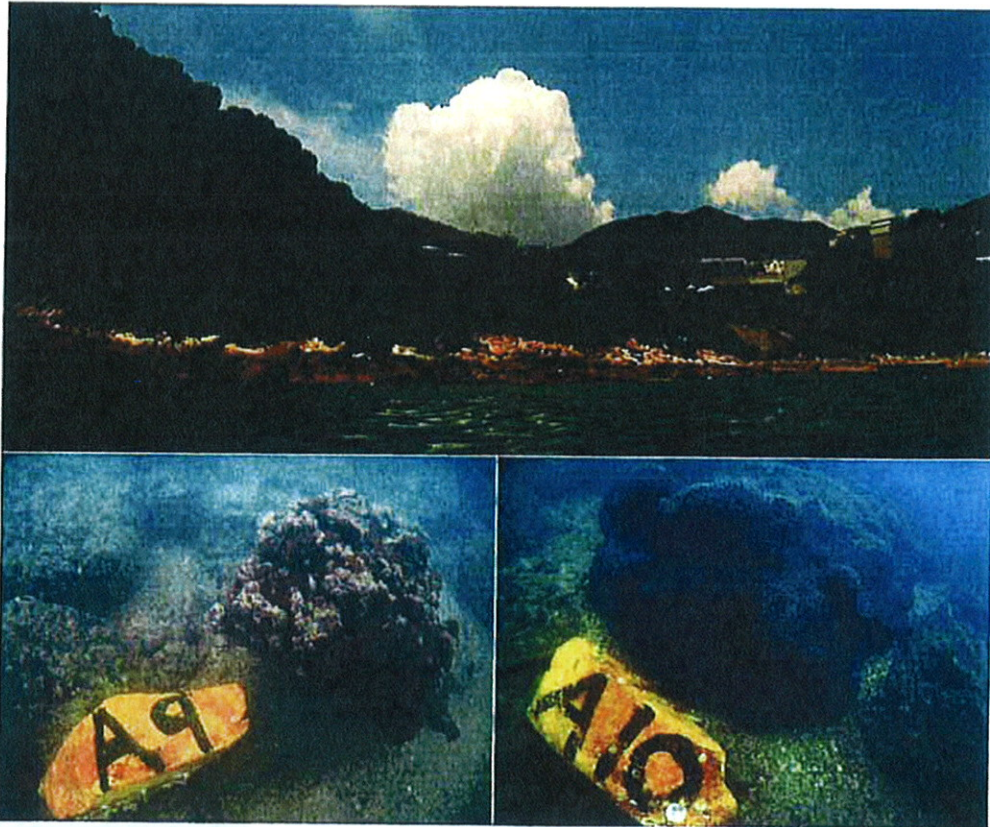




Lam Environmental Services Limited

Ocean Park Corporation Master  
Redevelopment Project  
Contract No. CS-03  
Thrill Mountain and Polar Adventure

**Ocean Park Corporation Master Redevelopment Project**  
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**Thrill Mountain and Polar Adventure**



**Report for**  
**Coral Monitoring Survey**

**July 2012**



**miniprojects co. Ltd.**



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## 1 INTRODUCTION

### 1.1 Project Background

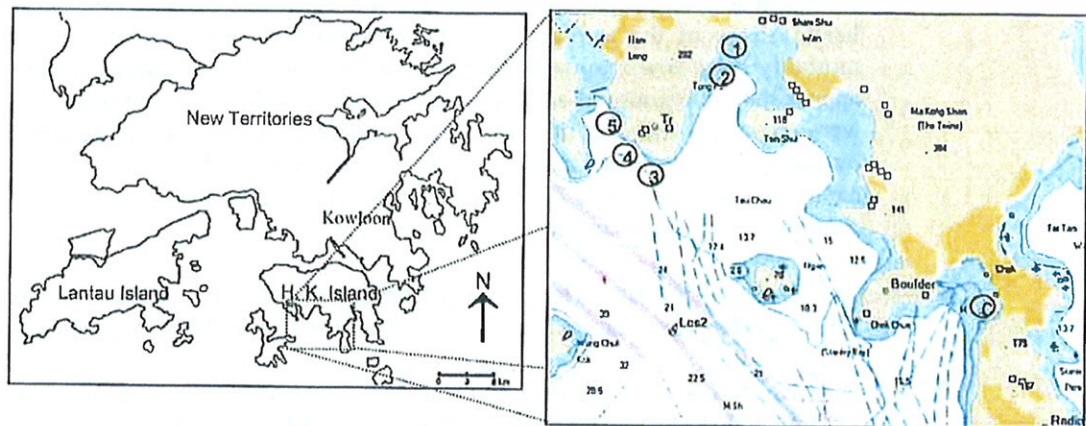
- 1.1.1 Ocean Park planned to upgrade and expand the existing area to meet the anticipated visitor demands and to position Ocean Park as a premium tourist attraction and a regional leader in the themed recreational and educational park experience.
- 1.1.2 Lam Environmental Services Limited (LAM) has been appointed to formulate a Coral Survey Team to conduct the Marine Ecology Survey for Ocean Park Corporation Master Redevelopment Project Contract No. C105 – Site Formation, Funicular Tunnel and Miscellaneous Works and Contract No. CS-03 – Thrill Mountain and Polar Adventure.
- 1.1.3 miniprojects Company Limited (miniprojects co. Ltd.) has been commissioned by LAM to undertake Coral Monitoring Survey on the tagged hard coral colonies at five Monitoring Sites around the Construction Site and one Control Site for captioned project.
- 1.1.4 In the impact monitoring surveys conducted on 16 August 2009, six out of the 60 tagged coral colonies were found to detach completely from their substrate and 46 tagging stones or marks were loss or worn out in all five Monitoring Sites and one Control Site. Such physical damage on the coral colonies and tags was believed to be caused by several strong tropical cyclones attacked Hong Kong prior to the August 2009 surveys.
- 1.1.5 miniprojects co. Ltd. has been commissioned by LAM to undertake the Coral Re-tagging Exercise and Baseline Data Re-collection on the re-tagged hard coral colonies in November 2009 at all five Monitoring Sites around the Construction Site and one Control Site and subsequent quarterly monitoring surveys since November 2009 for captioned project.
- 1.1.6 This report presents the results of the 10<sup>th</sup> Coral Monitoring Survey after Coral Re-tagging Exercise in November 2009 and was a post-construction coral monitoring survey conducted on 15 July 2012 after the completion of construction.

## 2 METHODOLOGY

### 2.1 Monitoring Surveys – Locations

- 2.1.1 Five locations close to the potential impact areas were identified and designated as Impact Monitoring Sites (Sites 1 to 5; Fig. 2.1). In order to identify background environmental perturbations that are not associated with the construction, St. Stephen Beach, which is away from the impact areas, was designated as the Control Site (Control Site C; Fig. 2.1). Locations (GPS coordinates) of the five Impact Monitoring Sites and one Control Site C are summarized in Table 3.1.

Fig. 2.1 Map Showing the Locations of the Five Impact Monitoring Sites (1 to 5) and One Control Site (C).



### 2.2 Monitoring Requirements

- 2.2.1 The construction phase coral monitoring programme comprises an Initial Survey, Coral Tagging Exercise and Impact Monitoring Surveys. Initial Survey and Coral Tagging Exercise were completed on 07-12 April 2007.
- 2.2.2 Impact monitoring aims to determine whether impacts are occurring on tagged corals during the period of construction works commenced in June 2007. A particular focus of the Impact Monitoring is the effects of sedimentation, bleaching and mortality on corals.
- 2.2.3 As required in the EM&A manual, coral monitoring at Site 5 and Control Site C should be conducted twice a month at first 3 months of the construction (i.e. June, July and August 2007). The monitoring frequency would be changed to monthly for month 4 to month 6 (i.e. September, October and November 2007) if no adverse effects were recorded (Table 2.1). After that, the monitoring will be changed to quarterly from month 7 (i.e. December 2007) until the end of construction works.





- 2.2.4 Monitoring Survey for Sites 1 to 4 should be conducted monthly during the first 2 months (i.e. June and July 2007) of the construction works. If there is no exceedance recorded (Table 2.1), the monitoring frequency would be adjusted to quarterly from month 3 (i.e. August 2007) till the end of the construction period.
- 2.2.5 Several tropical cyclones, attacked Hong Kong between May and August 2009, led to serious physical damage on tagged and un-tagged coral colonies and the loss of the tagging stones and marks in all five Monitoring Sites and one Control Site. Coral re-tagging exercise and baseline data re-collection were undertaken in November 2009 (month 30) at all five Monitoring Sites around the Construction Site and one Control Site. The results will be as reference and reviewed during further Coral Monitoring surveys.
- 2.2.6 At each of the Impact Monitoring and Control Sites, 10 hard coral colonies were re-tagged for continuous monitoring over the course of construction phase. The health status of the re-tagged corals including area of bleaching and partial mortality, and level of sedimentation as percentage of sediment cover and approximate thickness of sediment on the colony and on adjacent hard substrate were recorded. The condition of each re-tagged coral colony was also recorded by taking photographs that best represents the entire colony. General physical parameters were recorded for each survey site, including visibility, weather, tidal conditions and water current.
- 2.2.7 The results of the Coral Re-tagging Exercise and Baseline Data Re-collection will be as reference and reviewed with further the Coral Monitoring Surveys.
- 2.2.8 This report presented the results of the 10<sup>th</sup> Coral Monitoring Survey in month 62 (July 2012) after Coral Re-tagging Exercise and Baseline Data Re-collection, required at Sites 1 to 5 and Control Site C. The schedule was summarized as follow,

**Table 2.1 Schedule of Coral Monitoring**

	Coral Monitoring Survey Date
	15 July 2012
Site 1	✓
Site 2	✓
Site 3	✓
Site 4	✓
Site 5	✓
Control Site C	✓



## 2.3 Compliance / Event Action Plan

2.3.1 Coral monitoring results were evaluated against Action and Limit Levels. Evaluation were based on recorded changes in,

- Percentage of partial mortality
- Percentage of sediment cover
- Percentage of bleaching

2.3.2 Action and Limit Levels are defined in Table 2.1

2.3.3 If the defined Action Level or Limit Levels for coral monitoring were exceeded, the stepwise procedures should be implemented in accordance to the EM&A manual to reverse the unfavourable impact on the coral communities.

**Table 2.3 Action and Limit Level for Coral Monitoring**

Parameter	Action Level Definition	Limit Level Definition
Sedimentation	If during Impact Monitoring a 15% increase in the percentage of sediment cover on hard corals occurs at more than 20% of the tagged coral at any one Impact Monitoring Site that is not recorded at the Control Site, then the Action Level is exceeded.	If during the Impact Monitoring a 25% increase in the percentage of sediment cover occurs at more than 20% of the tagged coral at any one Impact Monitoring Site that is not recorded at the Control Site, then the Limit Level is exceeded.
Bleaching	If during Impact Monitoring a 15% increase in the percentage of bleaching (bleached white) on hard corals occurs at more than 20% of the tagged coral at any one Impact Monitoring Site that is not recorded at the Control Site, then the Action Level is exceeded.	If during the Impact Monitoring a 25% increase in the percentage of bleaching (bleached white) occurs at more than 20% of the tagged coral at any one Impact Monitoring Site that is not recorded at the Control Site, then the Limit Level is exceeded.
Mortality	If during Impact Monitoring a 15% increase in the percentage of partial mortality on hard corals occurs at more than 20% of the tagged coral at any one Impact Monitoring Site that is not recorded at the Control Site, then the Action Level is exceeded.	If during the Impact Monitoring a 25% increase in the percentage of partial mortality occurs at more than 20% of the tagged coral at any one Impact Monitoring Site that is not recorded at the Control Site, then the Limit Level is exceeded.





### 3 RESULTS

#### 3.1 Sites 1 to 5 and Control Site C – Coral Monitoring Survey Date: 15 July 2012

3.1.1 Coral monitoring survey at Sites 1 to 5 and Control Site C were conducted on 15 July 2012. The physical conditions of each site are summarized in Table 3.1.

**Table 3.1 Sites 1 to 5 and Control Site C – Physical Conditions.**

Site	Site 1	Site 2	Site 3	Site 4	Site 5	Control Site C
GPS Coordinates	N 22°14'34.1" E 114°10'43.6"	N 22°14'25.39" E 114°10'37.2"	N 22°13'49.3" E 114°10'14.2"	N 22°13'53.3" E 114°10'07.3"	N 22°14'01.9" E 114°09'59.3"	N 22°12'48.3" E 114°12'51.2"
Date	15 July 2012					
Sedimentation on Rock surfaces (mm)	1-2	1-2	1-2	1-2	1-2	1-2
Visibility (m)	0.5 - 1					
Weather	South-east wind; sun patches					
Tide	Neap tide; ebb tide during survey					
Current (Knot)	0.5-1.0	0.5-1.0	0.5-1.0	0.5-1.0	0.5-1.0	0.5-1.0

3.1.2 Percentages of sedimentation, bleaching and mortality of each re-tagged colony were presented in Tables 3.2 and 3.3. Photographs of each re-tagged coral in Sites 1 to 5 and Control Site C were illustrated in Appendices Ia to If, respectively.

#### Site 1

3.1.3 When compared with baseline data collected in November 2009, increased sedimentation was recorded on two colonies (A4 and A9R), by 2 to 6%. No bleaching was recorded. All tagged corals were in good condition with low percentages of sedimentation (1 – 10%) and no bleaching (0%). Small percentage of partial mortality (2 - 5%) in three colonies A2, A7 and A10R, recorded in the baseline surveys, remained unchanged (Table 3.2). (Table 3.2).

#### Site 2

3.1.4 When compared with the baseline data in November 2009, sedimentation increased in four colonies (B2, B3, B4 and B9) by 1 to 5%. All tagged corals were in good condition, no bleaching was recorded. Partial mortality found in four colonies (B3, B4, B5 and B9) in baseline survey remained unchanged (Table 3.2).



### Site 3

- 3.1.5 When compared with baseline data in November 2009, sedimentation increased in five colonies (C1, C2, C5, C6 and C8) by 2 to 4%. All tagged corals were in good condition, no bleaching was recorded. Partial mortality found in four colonies (C1, C2, C3, and C5) in baseline survey remained unchanged (Table 3.2).

### Site 4

- 3.1.6 When compared with baseline data in November 2009, sedimentation increased in four colonies (E2, E3, E5 and E7) by 1 to 5%. All tagged corals were in good condition, no bleaching was recorded. Partial mortality found in five colonies (E3, E5, E6, E8 and E10) in baseline survey remained unchanged (Table 3.2).

### Site 5

- 3.1.7 When compared with baseline data in November 2009, sedimentation increased in four colonies (D5, D7, D8 and D9) by 1 to 5%. All tagged corals were in good condition, no bleaching was recorded. Partial mortality found in five colonies (D1, D6, D7, D9 and D10) in baseline survey remained unchanged (Table 3.2).

### Control Site C

- 3.1.8 When compared with baseline data in November 2009, four colonies (F3, F4, F5 and F9) showed increase in sedimentation by 3 to 10 %. All tagged corals were in good condition, no bleaching was recorded. Partial mortality found in 3 colonies (F2, F3 and F6) in baseline survey remained unchanged (Table 3.2).





Table 3.2 Sites 1 to 5 and Control Site C – Percentage and thickness of Sedimentation, Bleaching and Mortality of the Re-tagged Coral Colonies in Coral Re-tagging Exercise and Baseline Data Collection (November 2009) and the Present Monitoring Survey (July 2012). “▲” and “▼” indicate increased and decreased in percentage, respectively, when compared with the coral re-tagging exercise and baseline data collected in November 2009.

Site 1

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (% mm)			Bleaching (%)			Mortality (%)				
			21 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	21 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	21 Nov 09 (baseline)	Nov 2011	Feb 2012
A1	<i>Platygyra carnosus</i>	1200	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0
A2	<i>Favites abdita</i>	400	5.1	2.1▼	3.1▼	5.1	0	0	0	2	2	2	2
A3	<i>Plesiastrea versipora</i>	600	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0
A4	<i>Lepastrea purpurea</i>	6200	0.0	5.1▲	4.1▲	6.1▲	0	0	0	0	0	0	0
A5	<i>Platygyra carnosus</i>	3200	1.1	0.0▼	0.0▼	1.1	0	0	0	0	0	0	0
A6	<i>Platygyra carnosus</i>	2600	2.1	0.0	0.0	0.0	0	0	0	0	0	0	0
A7	<i>Favia speciosa</i>	500	2.1	0.0▼	2.1	2.1	0	0	0	5	5	5	5
A8	<i>Platygyra carnosus</i>	1500	2.1	0.0▼	2.1	2.1	0	0	0	0	0	0	0
*A9R	<i>Lepastrea purpurea</i>	1500	4.1	8.0	8.0	10.0▲	-	0	0	-	0	0	0
*A10R	<i>Platygyra carnosus</i>	2250	0.0	5.0	5.0	5.0	-	0	0	-	2	2	2

\*Notes: A9R and A10R are re-tagged coral colonies as A9 and A10 were damaged by anchoring or typhoon events, and not suitable for monitoring purpose.

Site 2

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (% mm)			Bleaching (%)			Mortality (%)				
			29 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	29 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	29 Nov 09 (baseline)	Nov 2011	Feb 2012
B1	<i>Platygyra carnosus</i>	1300	2.1	0.0▼	0.0▼	2.0	0	0	0	0	0	0	0
B2	<i>Plesiastrea versipora</i>	650	4.1	0.0▼	0.0▼	5.0▲	0	0	0	0	0	0	0
B3	<i>Psammocora superficialis</i>	4400	5.1	5.1	5.1	10.1▲	0	0	0	3	3	3	3
B4	<i>Favia speciosa</i>	800	0.0	0.0	0.0	5.1▲	0	0	0	2	2	2	2
B5	<i>Plesiastrea versipora</i>	1000	2.1	2.1	2.1	2.1	0	0	0	2	2	2	2
B6	<i>Platygyra carnosus</i>	1500	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0
B7	<i>Hydophora exesa</i>	1600	1.1	0.0▼	0.0▼	1.1	0	0	0	0	0	0	0
B8	<i>Plesiastrea versipora</i>	1300	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0
B9	<i>Favia speciosa</i>	450	1.1	1.1	1.1	5.1▲	0	0	0	2	2	2	2
B10	<i>Psammocora superficialis</i>	400	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0





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Site 3

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (% mm)			Bleaching (%)			Mortality (%)				
			28 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	28 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	28 Nov 09 (baseline)	Nov 2011	Feb 2012
C1	<i>Porites sp</i>	100	2,1	5,1▲	2,1	5,1▲	0	0	0	3	3	3	3
C2	<i>Porites sp</i>	210	3,1	3,1	3,1	5,1▲	0	0	0	5	5	5	5
C3	<i>Goniopora stutchburyi</i>	410	5,1	0,0▼	0,0▼	5,1	0	0	0	7	7	7	7
C4	<i>Pavona decussata</i>	240	4,1	2,1▼	2,1▼	4,1	0	0	0	0	0	0	0
C5	<i>Pavona decussata</i>	210	3,1	0,0▼	0,0▼	5,1▲	0	0	0	1	1	1	1
C6	<i>Pavona decussata</i>	200	3,1	0,0▼	0,0▼	5,1▲	0	0	0	0	0	0	0
C7	<i>Montipora cf. turgescens</i>	960	3,1	3,1	3,1	3,1	0	0	0	0	0	0	0
C8	<i>Goniopora stutchburyi</i>	140	1,1	1,1	1,1	5,1▲	0	0	0	0	0	0	0
C9	<i>Porites sp</i>	300	3,1	3,1	3,1	3,1	0	0	0	0	0	0	0
C10	<i>Cyphastrea serailia</i>	600	4,1	2,1▼	4,1	4,1	0	0	0	0	0	0	0

Site 4

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (% mm)			Bleaching (%)			Mortality (%)				
			28 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	28 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	28 Nov 09 (baseline)	Nov 2011	Feb 2012
E1	<i>Goniopora stutchburyi</i>	290	5,1	0,0▼	5,1	5,1	0	0	0	0	0	0	0
E2	<i>Coccoloba sp.</i>	620	0,0	0,0	0,0	5,1▲	0	0	0	0	0	0	0
E3	<i>Goniopora stutchburyi</i>	300	4,1	0,0▼	4,1	5,1▲	0	0	0	3	3	3	3
E4	<i>Goniopora stutchburyi</i>	130	3,1	0,0▼	0,0▼	3,1	0	0	0	0	0	0	0
E5	<i>Goniopora stutchburyi</i>	460	6,1	3,1▼	3,1▼	10,1▲	0	0	0	4	4	4	4
E6	<i>Goniopora stutchburyi</i>	380	10,1	5,1▼	5,1▼	10,1	0	0	0	8	8	8	8
E7	<i>Goniopora stutchburyi</i>	120	3,1	0,0▼	3,1	5,1▲	0	0	0	0	0	0	0
E8	<i>Goniopora stutchburyi</i>	230	4,1	4,1	4,1	4,1	0	0	0	2	2	2	2
E9	<i>Goniopora stutchburyi</i>	170	3,1	3,1	3,1	3,1	0	0	0	0	0	0	0
E10	<i>Goniopora stutchburyi</i>	540	7,1	5,1▼	5,1▼	7,1	0	0	0	3	3	3	3



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Site 5

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (%/mm)			Bleaching (%)			Mortality (%)				
			29 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	29 Nov 09 (baseline)	Nov 2011	Feb 2011	July 2012	29 Nov 09 (baseline)	Nov 2011	Feb 2011
D1	<i>Psammocora</i> sp.	800	6,1	0,0▼	5,1▼	6,1	0	0	0	3	3	3	3
D2	<i>Montipora peltiformis</i>	600	4,1	1,1▼	4,1	5,1	0	0	0	0	0	0	0
D3	<i>Goniopora stuechburyi</i>	450	2,1	0,0▼	2,1	2,2	0	0	0	0	0	0	0
D4	<i>Cyphastrea serailia</i>	100	3,1	3,1	3,1	3,1	0	0	0	0	0	0	0
D5	<i>Montipora cf. turgescens</i>	320	4,1	4,1	4,1	5,1▲	0	0	0	0	0	0	0
D6	<i>Montipora peltiformis</i>	480	10,1	5,1▼	5,1▼	10,1	0	0	0	20	20	20	20
D7	<i>Montipora peltiformis</i>	500	8,1	8,1	8,1	10,1▲	0	0	0	2	2	2	2
D8	<i>Montipora peltiformis</i>	410	6,1	6,1	6,1	10,1▲	0	0	0	0	0	0	0
D9	<i>Montipora peltiformis</i>	200	5,1	5,1	5,1	10,1▲	0	0	0	5	5	5	5
D10	<i>Goniopora stuechburyi</i>	510	7,1	5,1▼	5,1▼	7,1	0	0	0	5	5	5	5

Control Site C

Code	Coral Species	Area (cm <sup>2</sup> )	Sedimentation (%/mm)			Bleaching (%)			Mortality (%)				
			21 Nov 09 (baseline)	Nov 2011	Feb 2012	July 2012	21 Nov 09 (baseline)	Nov 2011	Feb 2011	July 2012	21 Nov 09 (baseline)	Nov 2011	Feb 2011
F1	<i>Goniastrea aspera</i>	450	2,1	0,0▼	0,0▼	2,1	0	0	0	0	0	0	0
F2	<i>Favites pentagona</i>	2100	2,1	2,1	2,1	2,1	0	0	0	2	2	2	2
F3	<i>Favites pentagona</i>	1000	0,0	0,0	0,0	5,1▲	0	0	0	5	5	5	5
F4	<i>Porites</i> sp	1300	2,1	2,1	2,1	5,1▲	0	0	0	0	0	0	0
F5	<i>Cyphastrea seraili</i>	2100	0,0	10,1▲	0,0	10,1▲	0	0	0	0	0	0	0
F6	<i>Porites</i> sp	2100	5,1	5,1	5,1	5,1	0	0	0	2	2	2	2
F7	<i>Plesiasireia versipora</i>	3000	2,1	2,1	2,1	2,1	0	0	0	0	0	0	0
F8	<i>Favites pentagona</i>	680	0,0	0,0	0,0	0,0	0	0	0	0	0	0	0
F9	<i>Favites pentagona</i>	2600	0,0	4,1▲	4,1▲	5,1▲	0	0	0	0	0	0	0
F10	<i>Favia rotundana</i>	600	0,0	0,0	0,0	0,0	0	0	0	0	0	0	0





## 4 SUMMARY AND CONCLUSION

### 4.1 Summary

4.1.1 In the post-construction monitoring surveys conducted on 15 July 2012, from all the 5 Monitoring Sites 1 to 5, the change in level of sedimentation on the tagged colonies was small ( $\leq 10\%$ ) when using the baseline data in November 2009 and previous survey in February 2012 as reference. The level of sedimentation in all sites was low and within the range of that in the Control Site C (0 to 10%). This small difference in sedimentation was likely a natural fluctuation as a result of stream runoffs during the wet season, and also daily tidal current and wave exposure, etc. No increase in level of bleaching or partial mortality suggested the all tagged corals were in good condition and healthy.

4.1.2 The data from this monitoring survey showed no significant enhancement in sedimentation, bleaching or mortality in all the 5 Monitoring Sites 1 to 5 and the Control Site C. Hence, no adverse impact by the construction activity on the coral community was observed.

### 4.2 Compliance / Event Action Plan

4.2.1 The monitoring results were evaluated against the Action and Limit Levels as defined in the EM&A manual and summarized in Table 4.1.

4.2.2 Overall, the healthy status of the tagged coral colonies was normal, with low levels of sedimentation. Neither action/limit level of sedimentation, bleaching or mortality was exceeded in the monitoring survey conducted in February 2012.

**Table 4.1 Evaluation of Monitoring Results against Action and Limit Level for Coral Monitoring Survey.** Note Definition of Action/Limit levels are listed in Table 2.1. "No" indicates NO exceedance.

Site	Exceedance		Sedimentation		Bleaching		Mortality	
	Action Level	Limit Level	Action Level	Limit Level	Action Level	Limit Level	Action Level	Limit Level
Site 1	No	No	No	No	No	No	No	No
Site 2	No	No	No	No	No	No	No	No
Site 3	No	No	No	No	No	No	No	No
Site 4	No	No	No	No	No	No	No	No
Site 5	No	No	No	No	No	No	No	No
Control Site C	No	No	No	No	No	No	No	No





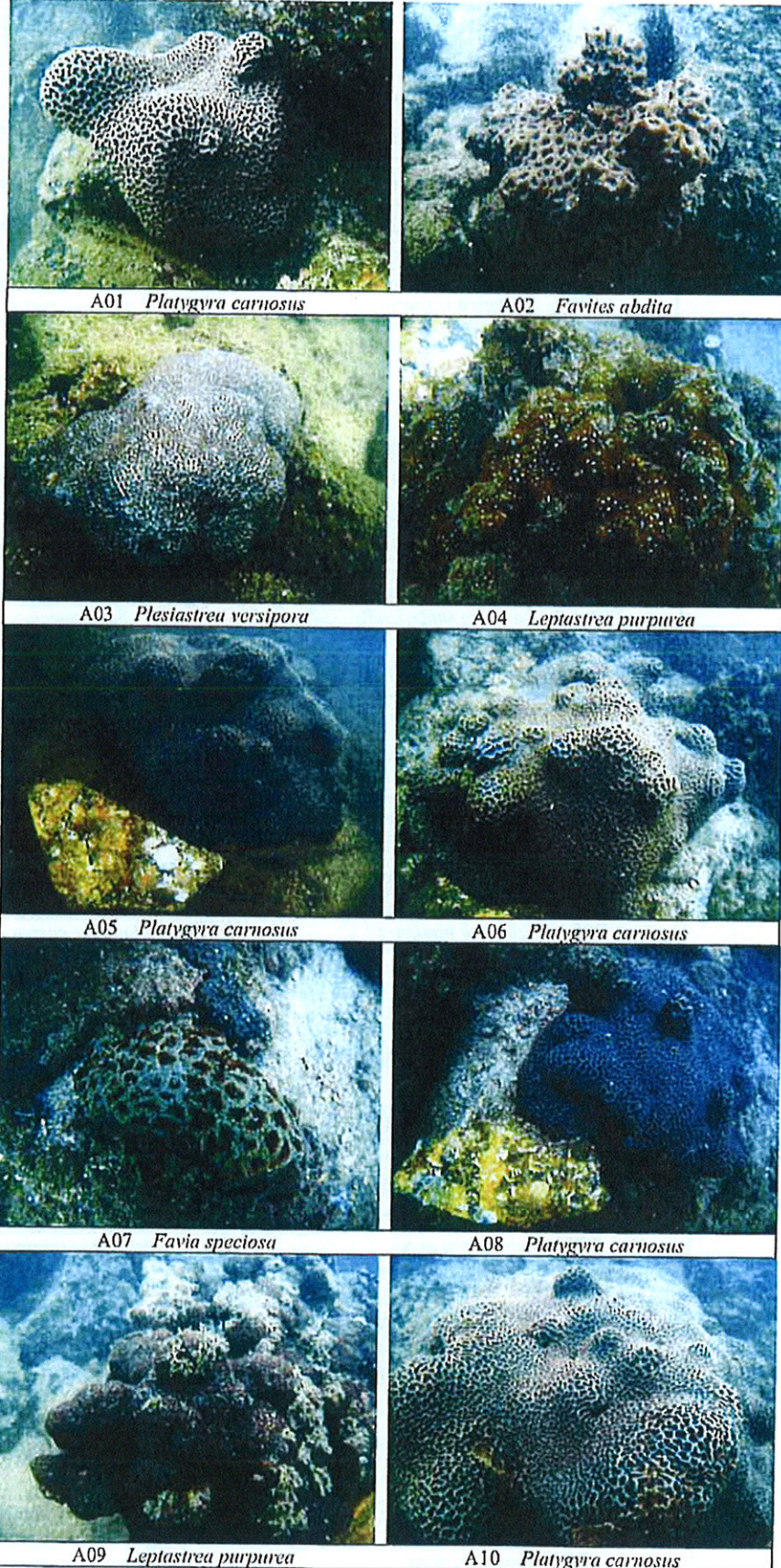
**Lam Environmental Services Limited**

Ocean Park Corporation Master  
Redevelopment Project  
Contract No. CS-03  
Thrill Mountain and Polar Adventure

## **APPENDIX I**

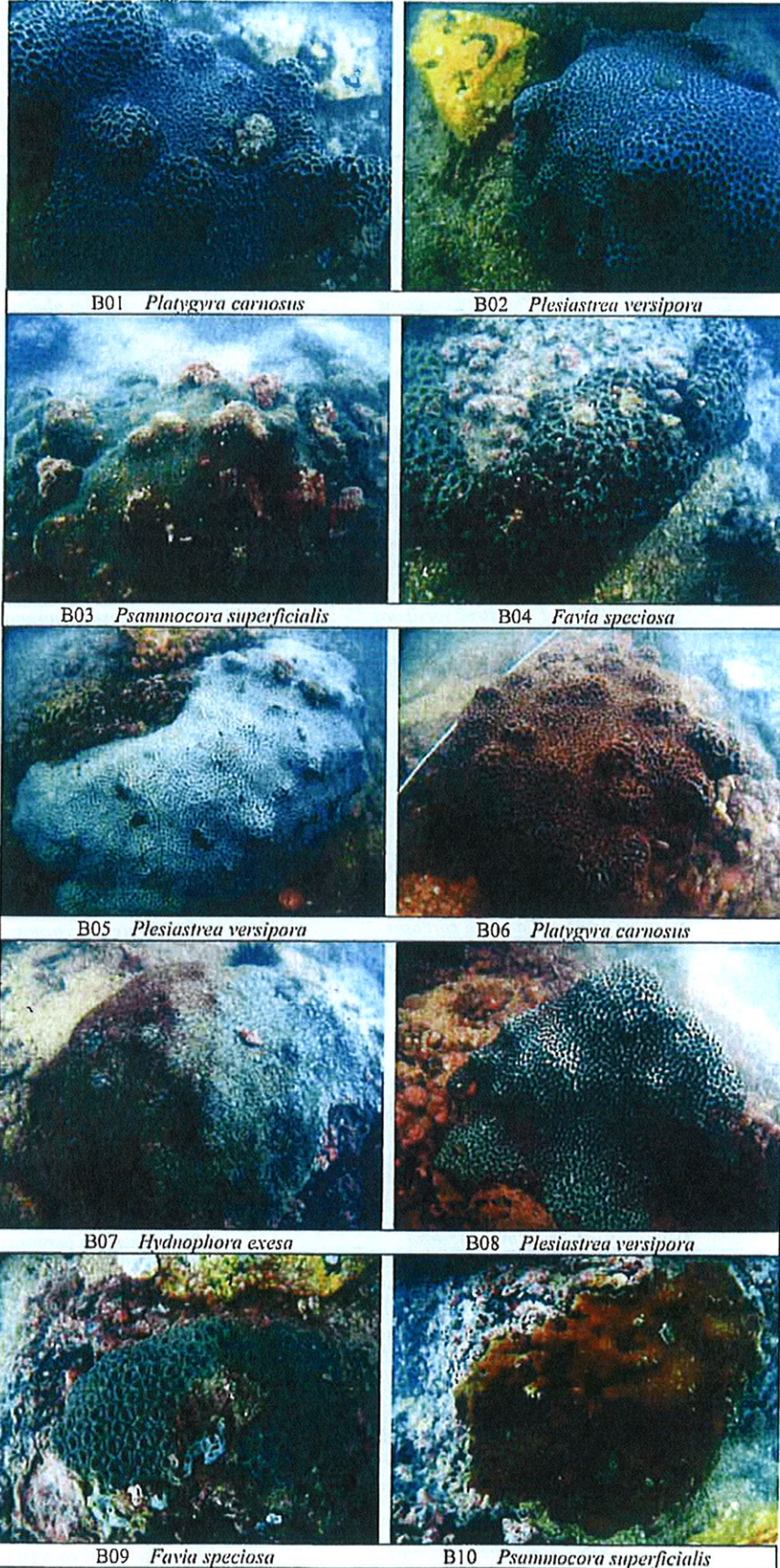
### **Photographs of the Tagged Corals at Sites 1 to 5 and Control Site C**

Appendix Ia Tagged Coral Colonies at Site 1.



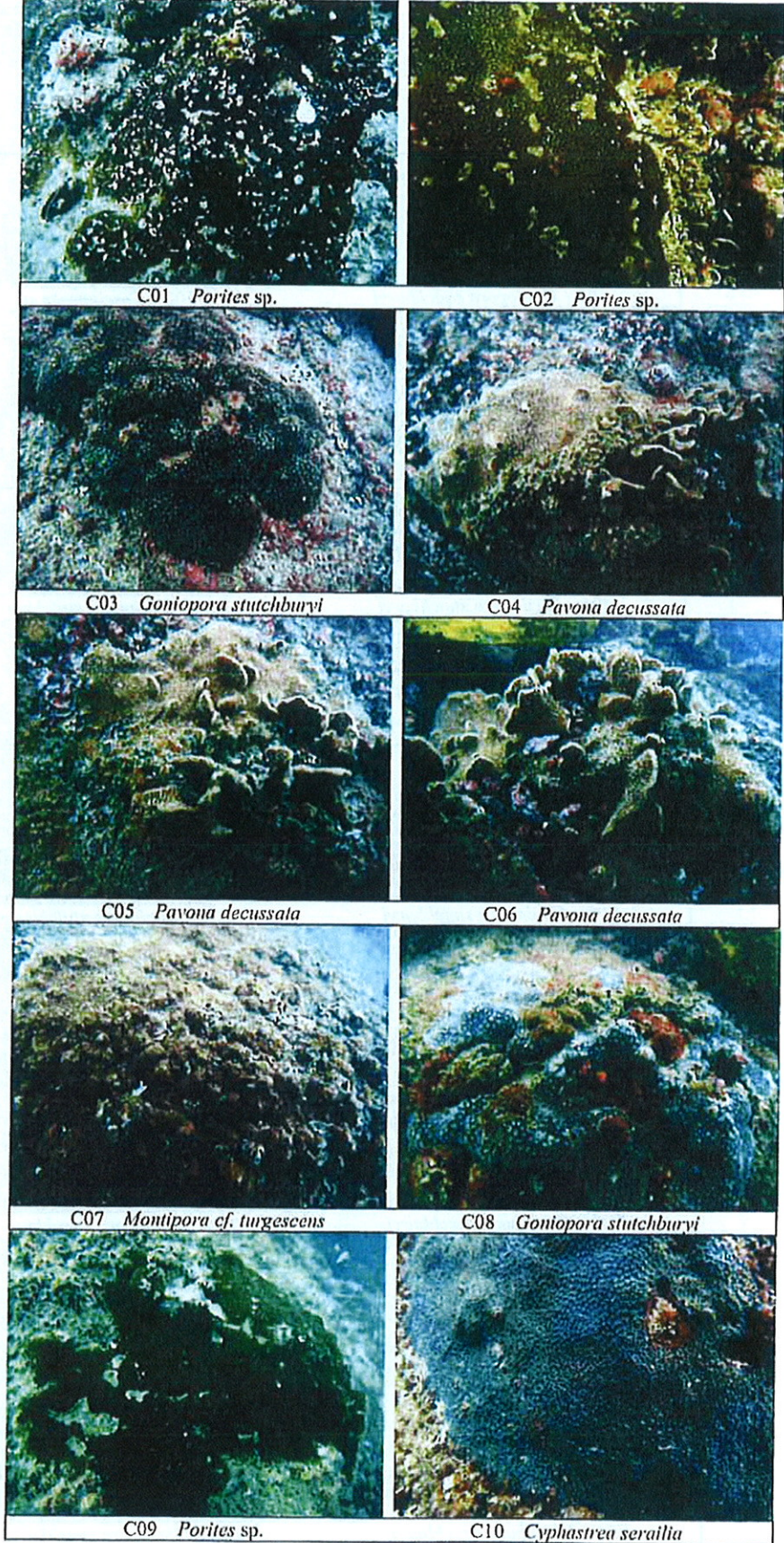


Appendix Ib Tagged Coral Colonies at Site 2.



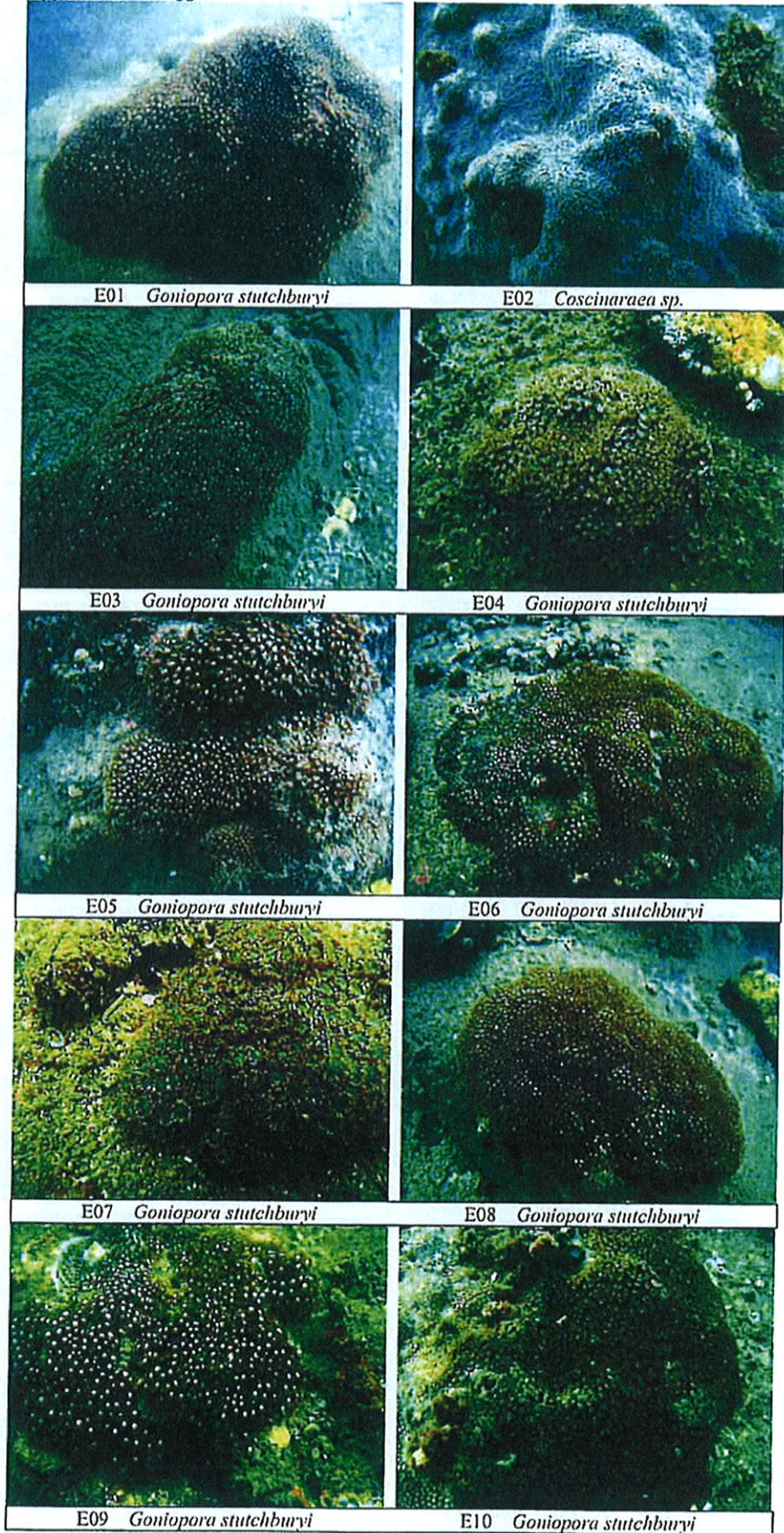


Appendix Ic Tagged Coral Colonies at Site 3.



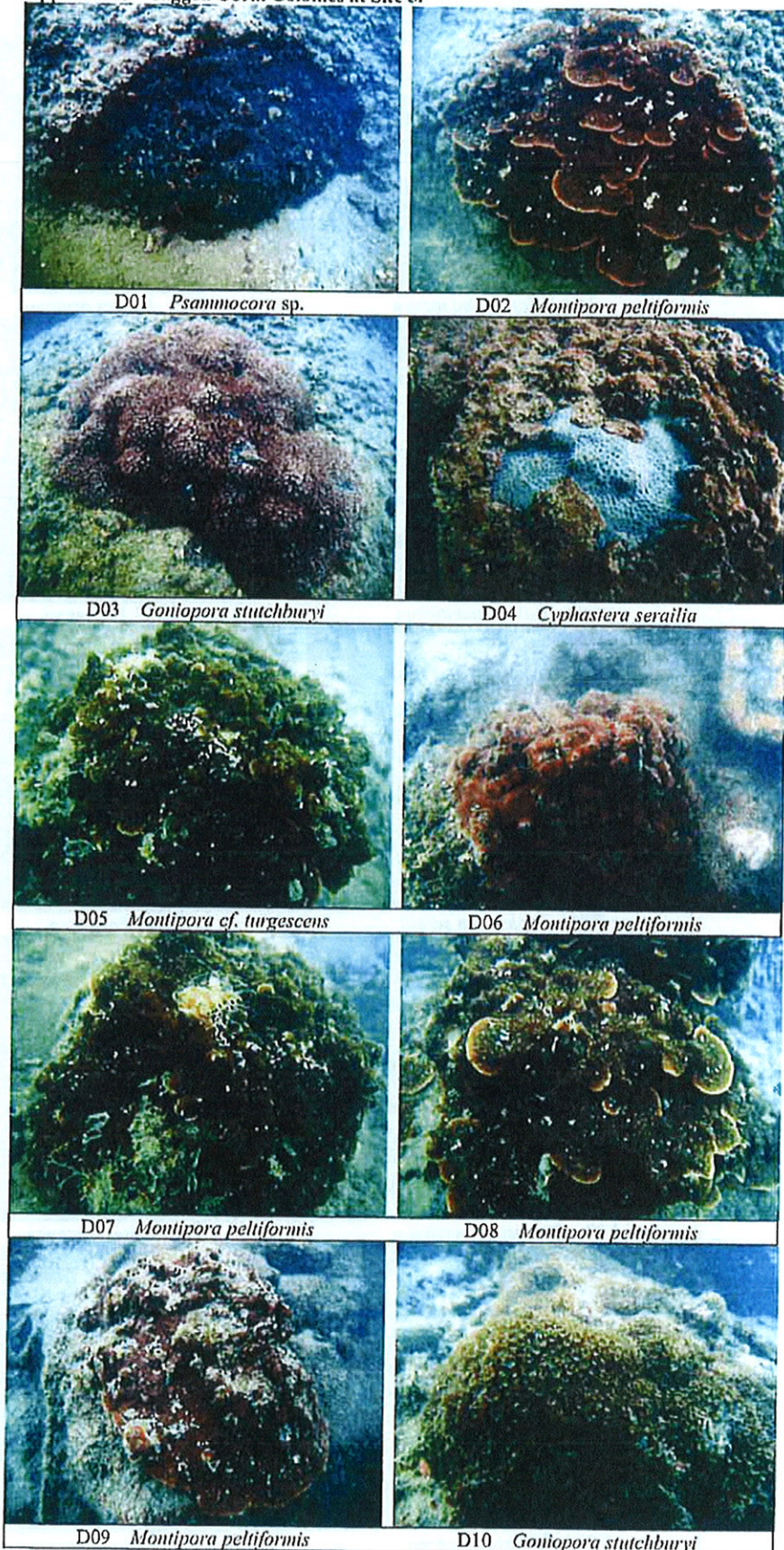


Appendix Id Tagged Coral Colonies at Site 4.





Appendix 1e Tagged Coral Colonies at Site 5.





Appendix If Tagged Coral Colonies at Control Site C.

