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Long-term coral community monitoring in the Montebello/Barrow Islands marine protected areas: site descriptions and summary analysis of baseline data collected in December 2006

Marine Science Program Data Report

MSPDR9 June 2011

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Marine Science Program, Science Division




Department of Environment and Conservation
Our environment, our future

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Cover photographs: (small images, L to R) Energy industry infrastructure; faviid coral *Lobophyllia* sp.; *Acanthaster planci* crown-of-thorns starfish; black-spot tusk fish *Choerodon schoenlenii*; and (large image) baler shell *Melo amphora*. (All images courtesy Marine Science Program, DEC.)

SUMMARY

In December 2006, 26 long-term monitoring sites were established in the Montebello/Barrow Islands marine protected areas (MBIMPAs), which comprises the Montebello Island Marine Park, Barrow Island Marine Park and the Barrow Island Marine Management Area. At each site, the cover of benthic communities (including hard corals, soft corals, macroalgae and sponges), relative abundances of targeted finfish and corallivorous invertebrates were measured/surveyed (Bancroft 2009). The sites were established to monitor future changes in coral reef community condition that occurs naturally and by anthropogenic causes. The initial data report (Bancroft 2009) records the metadata and the archive records of the data and provides directions to future researchers and managers as to the storage locations of data, video and images. This data report provides site descriptions, a summary of baseline data and provides recommendations to improve the network of monitoring sites.

The key findings of the baseline data are:

- An extensive area of coral communities extends for approximately 100 km along the eastern margin of the MBIMPAs;
- The long-term monitoring sites dominated by *Porites* colonies along the eastern margin of the inter-island shelf, Lowendal Shelf and the Barrow Shoals shelf, seem to support a high abundance and high diversity of finfish relative to the other long-term monitoring sites;
- The percent cover of live hard corals suggests a negative relationship with relative exposure to long-period ground swell and cyclonic waves. The greater the relative level of exposure, the less live hard coral cover present;
- The observed abundance of *Drupella* spp. is not causing significant mortality to the coral communities of the MBIMPAs; and
- The observed abundance of *Acanthaster planci* is not causing significant mortality to the coral reef communities of the MBIMPAs.

The following recommendations to management have been formulated:

Recommendation 1. Detailed mapping of coral reefs along the eastern margin of the MBIMPAs should be undertaken to fully document this system.

Recommendation 2. Establish long-term benthic monitoring sites in coral reef communities on the western margin of the Barrow Shoals shelf and Barrow Island.

Recommendation 3. If suitable locations can be located, at least two more poritid bommie sites (P-sites) should be established within sanctuary zones as reference sites.

Recommendation 4. Develop a long-term finfish monitoring program which provides comparable data across different habitat types and management zones.

Recommendation 5. Undertake Acanthaster planci *density surveys when establishing long-term coral community monitoring sites (Recommendation 2).*

Recommendation 6. Undertake a baseline survey for long-term Drupella *spp. density monitoring in coral reef communities throughout the MBIMPAs.*

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1 INTRODUCTION

The Montebello/Barrow Islands marine protected areas (MBIMPAs), incorporating the Montebello Islands Marine Park, Barrow Island Marine Park and the Barrow Island Marine Management Area (Figure 1), are located off the Pilbara coast in north-west Western Australia. The MBIMPAs is approximately 1,600 km north of Perth, approximately 110 km west of Dampier and 80 km north of Onslow and covers an area of approximately 2,100 km^2 (Department of Environment and Conservation 2007). The Montebello Islands is a complex archipelago of 265 low-lying islands and islets, composed of limestone and sandstone. The coastlines of the islands are generally convoluted and the islands are dominated by lagoons, channels, intertidal embayments, barrier and fringing reefs, and undercut shoreline reef platforms. Some of the islands are capped with vegetated sand dunes, however most are bare rock. The Lowendal Islands consist of more than 40 limestone islands and islets, which are mainly bare but several are covered with dunes of white sand. Barrow Island complex includes Barrow Island, the largest island in the MBIMPAs, and nine other smaller islands (Osborne et al. 2000).

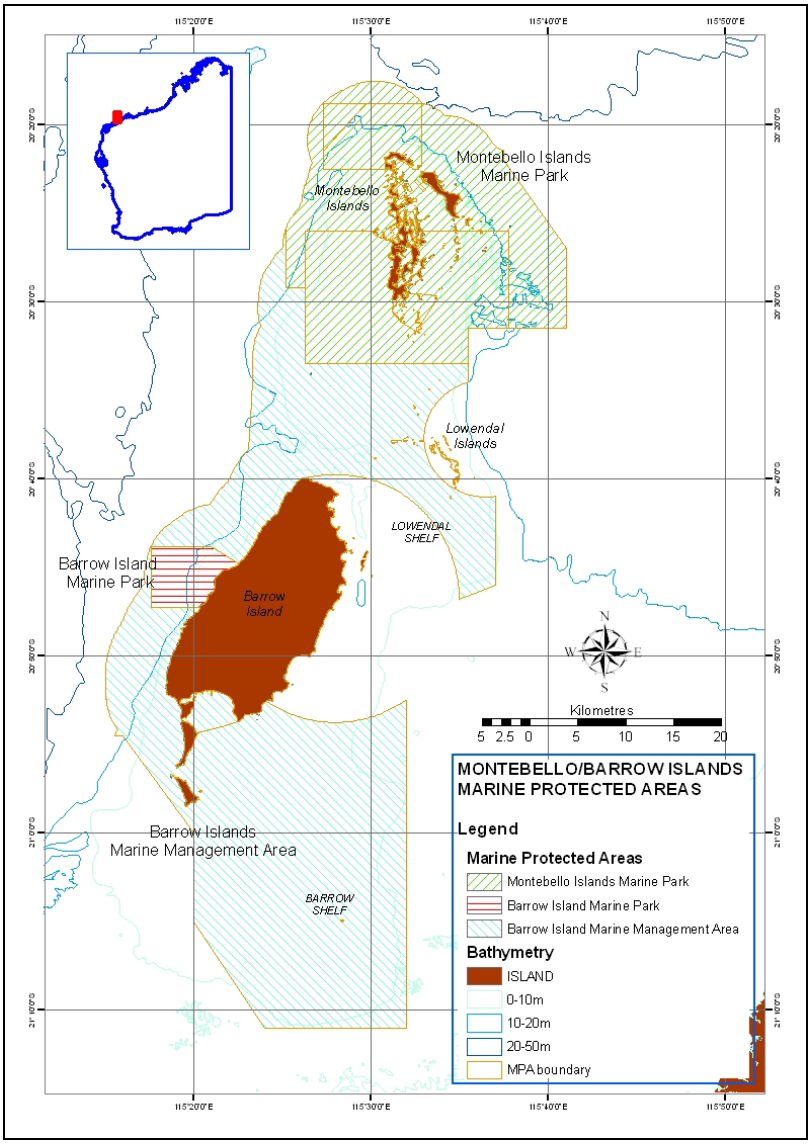

Figure 1. Study area: The Montebello/Barrow Islands marine protected areas.

The marine flora and fauna of the MBIMPAs are predominantly tropical. Recent oceanographic modelling undertaken by the CSIRO (Condie et al. 2006; Condie et al. 2005) suggests the MBIMPAs may have biological connectivity to tropical coral reefs on the mainland to the east and to the south. The MBIMPAs may be a source of larval recruitment for coral reefs further south, such as the Pilbara inshore islands, Muiron Islands and Ningaloo reef (Bancroft & Long 2008), and transported by the polar flowing, relatively low salinity and warmer waters of the Leeuwin Current. Macroalgae dominated limestone reef and subtidal reef/sand are the dominant benthic habitats, however, coral reef, mangrove and sand are also major habitat types at the MBIMPA (Department of Environment and Conservation 2007).

The MBIMPAs were gazetted in 2005 and are vested in the Marine Parks and Reserves Authority (MPRA). The WA Department of Environment and Conservation (DEC), in collaboration with the Department of Fisheries (DoF), is responsible for the progressive implementation of the MBIMPAs' management plan (Department of Environment and Conservation 2007) on behalf of the MPRA.

The DEC's Marine Science Program, in collaboration with DEC's Pilbara Region, is establishing a comprehensive long-term monitoring program in the MBIMPAs (Bancroft 2009). Monitoring programs are a requirement stated in all WA marine protected area management plans and will, ultimately, provide long-term time-series data on the condition of, and pressure(s) on, the ecological values/assets of the MPAs and the effectiveness of management actions to ameliorate these pressures. Key Performance Indicators, such as coral reef communities, have been identified (Department of Environment and Conservation 2007) and are regarded as the highest monitoring priority.

Significant oil and gas production facilities have operated for more than two decades within and immediately outside the boundaries of the MBIMPAs (Department of Environment and Conservation 2007). Currently, there is a major gas development proposal for Barrow Island which involves a gas condensate plant, power generation plant, desalination plant, >4 km loading jetty and associated infrastructure and a 18-20 month dredging program (Chevron Australia Pty Ltd 2005a; 2005b; 2005c). The companies involved have undertaken significant research and compliance monitoring programs over this period and have extensive time-series data of great scientific value (Chevron Australia Pty Ltd 2005d; 2005e; Cohen 2002; Nielsen 2001; Ryan 2006). These data will be used, with appropriate permission, to complement data gathered in DEC marine monitoring programs.

A scoping field trip was undertaken in August 2006 by the Marine Science Program to identify possible monitoring sites for key benthic communities, particularly coral reef communities at the MBIMPAs (Bancroft et al. 2006). In December 2006, a survey was undertaken to implement the first phase of a multi-year program to establish a comprehensive suite of long-term monitoring sites in the MBIMPAs and to focus on establishing sites within representative coral reef communities on the northern and eastern coral reefs. Future surveys will complete the spatial coverage of the coral reef component of the monitoring program (on the south, south-west and western reefs) and also establish monitoring sites for other key performance indicators of management (for example, macroalgae and seagrass communities, mangroves, water quality, turtles, and dugong).

The initial data report (Bancroft 2009) records the metadata and the archive records of the data and provides directions to future researchers and managers to the storage locations of data, video and images. This report provides the context, objectives and methods of the survey; site descriptions; summary analysis of baseline data collected in December 2006; and where applicable, implications to management.

2 OBJECTIVES

The primary objectives of the December 2006 survey were to:

(i) select representative sites in coral reef communities on the northern and eastern sectors of the MPAs for future long-term monitoring of benthos;
(ii) select impact monitoring sites in areas of existing/future human activity;
(iii) establish a baseline of benthic habitat information for future comparisons at these reference and impact sites;

(iv) assist in the selection of future finfish monitoring sites by determining the relative abundance of selected finfish groups/species; and
(v) determine the relative abundance of two common coral predators, the crown-of-thorns starfish (*Acanthaster planci*) and the corallivorous gastropods, *Drupella cornus* and *D. rugosa*, and their impact on coral communities.

Secondary objectives were to:
(i) determine the nature and extent of coral reef communities on the seaward reef slopes of the barrier/fringing reefs of the Montebello Islands Marine Park;
(ii) collect further marine habitat ground-truth data; and
(iii) (iii)obtain still and video footage of benthic communities at representative sites to assist with future education, awareness, and marine science communication programs.

3 MATERIAL AND METHODS

The field and analytical methods used for the benthic component of this survey (that is, the primary objective) are largely standard monitoring protocols developed by the Australian Institute of Marine Science (AIMS) for tropical coastal ecosystems (Page et al. 2001). The methods used to estimate the relative abundance and distribution of finfish and coral predators were modified methods to provide preliminary semi-quantitative data to assist the design of future quantitative monitoring programs that will be established for these fauna in the future (Armstrong 2007; Halford & Thompson 1996). Benthos, finfish and coral predator data were collected in December 2006 (Bancroft 2009).

3.1 Long-term monitoring sites

Areas of coral community large enough to accommodate the establishment of long-term monitoring sites were typically determined through identification from aerial photography coupled with *in situ* verification either by visual observation or drop-down videography. Several monitoring sites were established nearby to existing and proposed industry monitoring sites (Cohen 2002; Nielsen 2001) for future comparisons.

To assist in describing the results and discussion points, the study area was divided into seven sectors based on exposure to long-period swells, cyclonic waves and gross geomorphic features as described below in Section 4.1. To test the suitability of this construct, the composition of the benthic assemblages were analysed using a Principal Components Analysis (PCS) routine in PRIMER 5.2 statistical package (Clarke & Gorley 2006).

3.2 Benthos

Permanent monitoring sites were established with the objective of developing a better understanding of the affect of natural and human influences on the coral reef communities of the MPAs. Although most sites were established to assess the nature, extent and causes of natural variability within these reef communities, several sites were located in areas where future human impact is likely to occur and or/complement existing industry monitoring sites.

Coral reef habitats were initially identified using a combination of existing broad-scale benthic habitat maps, high resolution (1:20000) ortho-aerial photography and existing ground-truth data. In areas of unknown benthic habitat, further ground-truth data were collected using drop-down video cameras and in situ observations via a bathyscope.

Within these coral reef habitats, sites were located randomly within two types of representative sub-tidal (depth range between 1-9 m below chart datum) coral reef habitat:
1) 'typical' coral reef habitat (C-sites): significant live coral cover (>20% live hard coral cover) and large enough to accommodate the 'transect' methods; and
2) *Porites* 'bommie' habitat (P-sites): large (>5 m diameter), distinctly separate (up to 200 m apart) living *Porites* 'bommies' randomly selected at each site.

Both types of sites were located, where possible, in areas not directly exposed to long-period swell and cyclonic waves to minimise the possibility of mechanical damage to the habitat from these natural events (that is, to distinguish anthropogenic effects from natural effects, unfortunately this was not always possible). At individual sites, care was taken to ensure transects were laid at consistent depths to avoid any possible zonation effects (that is, in flat areas and not across the gradient of reef slopes). To facilitate diver access, sites were selected in areas where tidal currents during spring tides were less than approximately 0.5 m s^{-1} and where water depths were less than 10 m.

At C-sites, depending on the size and shape of the habitat to be surveyed, three replicate 50 m fibreglass tape transects were positioned either in parallel, approximately 20 m apart (using a diver wrist compass to avoid crossover), or in series approximately 10 m apart. At each of seven P-sites, transects were positioned north-south from the most northern point and east-west from the most eastern point across the upper surface of three individual *Porites* 'bommies'. The latitude and longitude (Datum GDA94) was recorded at each end of C-site transects and at the intersection of the two transects on each *Porites* 'bommie' at the P-sites (Garmin GPSMap models 76 and 76CSx to resolution of 0.0001 of a degree).

Video data of the benthos was collected according to the standard operational procedure developed by AIMS (Page *et al.* 2001). A brief summary is outlined below. At each C-site, a diver using a high definition digital video camera and a clapperboard, recorded site details, including date, location and transect number.

At both C-sites and P-sites, the diver then proceeded slowly along a transect with the camera held about 50 cm above the benthos and to the right of the transect line ensuring that the tape was inside the field of view. A 360° panoramic view of the surrounding benthos was recorded at the beginning and end of each transect. At each P-site site, this differed slightly, as the diver recorded a panorama by swimming around the 'bommie' recording its morphology. Each transect took about six minutes to complete.

The AIMS Video Transect Analysis System (AVTAS) method was used to analyse the video record of each transect (Page et al. 2001) and is described briefly below. At the C-sites, the video records are sampled by identifying the benthos occurring at 200 fixed points along each 50 m transect (that is, 40 frames with 5 random points each). A range of 70 to 210 data points, with an average of 120, were sampled on P-site transects (average length of all transects was 11.8 m). The data were saved to a Microsoft Access© database.

For each transect, the percentage cover for the following benthic groups was recorded: total live hard coral; Acroporidae; Pocilloporidae; Faviidae; Poritidae; Fungiidae; 'other' live hard coral; bleached hard coral; recently dead hard coral; live soft coral; macroalgae; rubble/turf algae; rubble/coralline algae; reef/turf algae; reef/coralline algae; sponge; living unidentified; sand; and indeterminate.

3.3 Finfish

To assess the suitability of coral sites for future long-term monitoring of 'finfish' abundance, a number of selected fisher-targetted finfish groups and iconic species were counted by visual census at 'coral' monitoring sites. The methodology used was a variation of belt-transect fish census methods used in coral reef systems (Ayling & Ayling 1987; Halford & Thompson 1996; International Risk Consultants 2007; Nielsen 2001) and is briefly described. At each C-site, the numbers of selected fisher-targetted finfish groups and iconic species were counted (up to 100 then >100) and recorded by a diver within three, 50 m by 5 m belt transects. At P-sites the same count was made within the area bounded by a distance of 2.5 m from the base and outside edge of three individual *Porites* 'bommies'. Finfish assessments were made before benthic community transects were laid to avoid unnecessary disturbance to the fish communities.

The abundance of the major finfish species targeted by recreational fishers, such as lutjanids (snappers); lethrinids (emperors); serranids (particularly coral trouts of the *Plectropomus* genus); small cods (mostly *Epinephelus* and *Cephalopholis* spp.); and tusk fish (*Choerodon* spp.), and large iconic species of interest to the marine nature-based tourism industry including *Epinephelus tukula* (potato

cod); *Cheilinus undulatus* (maori wrasse); carangids (trevally); scombrids (mackerel); and sharks, were recorded.

3.4 Coral predators

The abundance of two common coral predators, *Acanthaster planci* (crown-of-thorns sea star) and the corallivorous gastropods, *Drupella cornus* and *D. rugosa*, were recorded on the finfish transects described above. The total number and the maximum diameter of each *A. planci*, was recorded at all sites. *Drupella* spp. often occurs in large aggregations of up to tens to hundreds of individuals and a significant proportion of the aggregations are cryptic. To obtain a relative estimate of the population at each site, the number and relative size of non-cryptic aggregations, rather than individuals, were recorded. Aggregation size was categorised as small (1-4 individuals), medium (5-10), and large (>10). Observations of the presence or absence of the corallivorous sea stars, *Culcita* spp., were also recorded.

4 RESULTS AND DISCUSSION

This section presents the results of each component of the survey and brief discussions on the spatial patterns of the data.

4.1 Establishment of long-term monitoring sites

In December 2006, 26 long-term benthic community monitoring sites were established in the MBIMPAs (Figure 2). To assist in describing the results and discussion points, the study area has been divided into seven sectors categorised by exposure to long-period swells, cyclonic waves and gross geomorphic features (Figure 2), as described below in Table 1.

The sites were located in the Western Montebello Islands (WMI), Eastern Montebello Islands (EMI), Central Montebello Islands (CMI), Eastern Lowendal Shelf (ELS) and the Eastern Barrow Shoals shelf (EBSS) sectors. During this survey, no sites were established on the western margin of the Barrow shoals shelf (WBSS) and Western Barrow Island (WBI) sectors due to time and logistical constraints. Current understanding of the distribution of coral reef communities in the MBIMPAs (Department of Conservation and Land Management 2004) suggests that sites could be established in Flacourt Bay within the Barrow Island Marine Park and south-western Barrow Island. It is unknown if coral reef communities occur on the WBSS sector.

Table 1. Environmental and geomorphic characteristics of the sectors of the MBIMPAs study area.

MBIMPA sector	Exposure to long-period swell	Exposure to cyclonic waves	Other physical and geomorphic features	Number of C-sites and P- sites
EMI - East Montebello Islands	Moderate-Low	High	Slightly depth graded limestone reef platform, NE aspect.	4 C-sites
WMI - West Montebello Islands	High	High-Moderate	Barrier reef system, seaward facing fore reef slope (W).	3 C-sites
CMI - Central Montebello Islands	No	Low	Sheltered, inter-island channels, tidal current dominated.	4 C-sites
ELS - East Lowendal Shelf	No	Moderate	Eastern reef slope off the Lowendal Shelf, exposed to easterly winds.	3 C-sites 5 P-sites
WBI - West Barrow Island	Low	Moderate-Low	Steep island shelf area, seaward facing fore reef slope.	No sites established
EBSS - East Barrow Shoals Shelf	No	Moderate-Low	Eastern reef slope off the Barrow Shoals Shelf, exposed to easterly winds.	C-sites 2 P-sites
WBSS - West Barrow Shoals Shelf	Low	Moderate-Low	Western part of Barrow Shoals Shelf, shallow shelf includes Bandicoot Bay and environs, sheltered from long-period swells and cyclonic waves.	No sites established

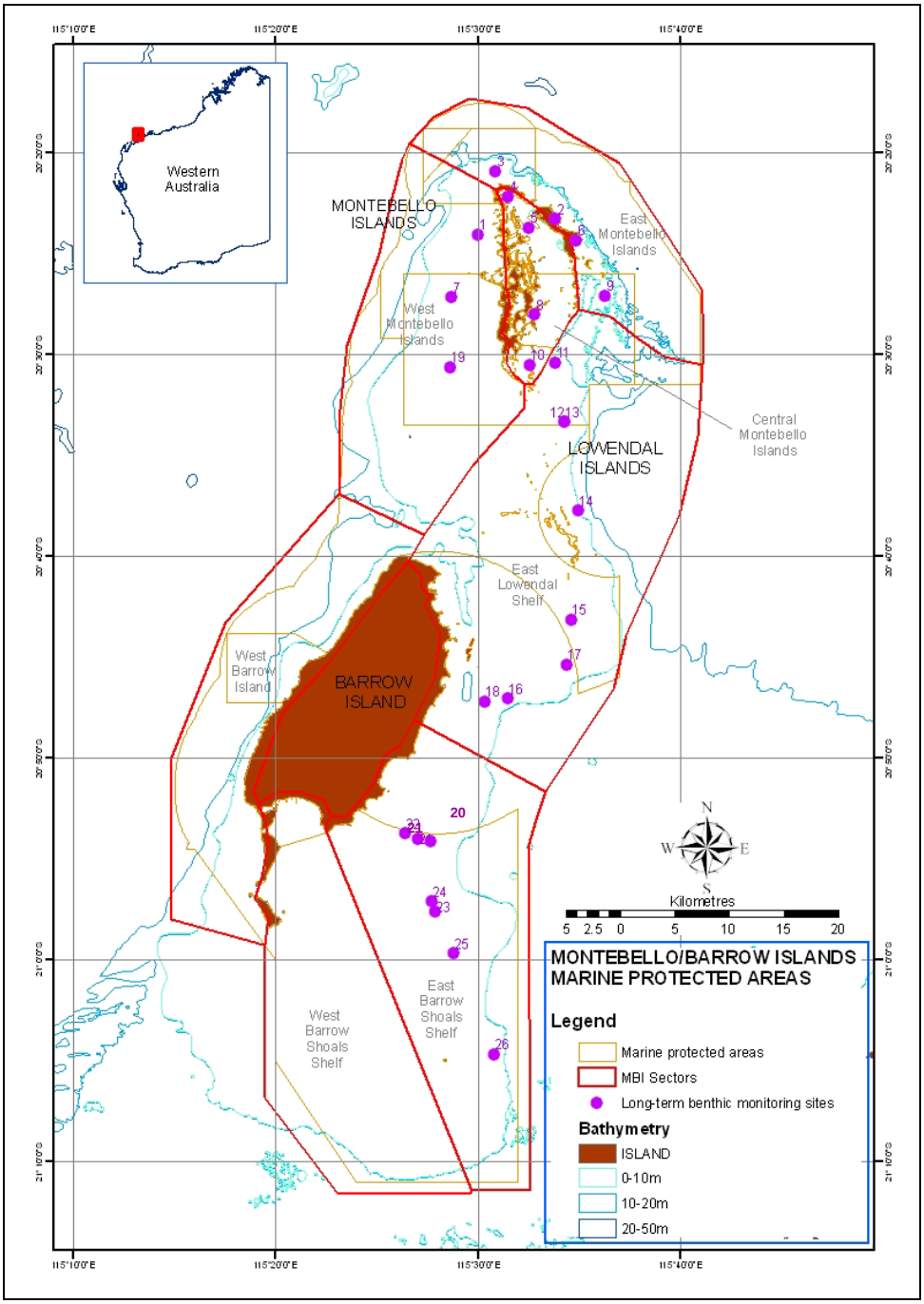

Figure 2. Twenty-six long-term coral community monitoring sites established in five sectors of the MBIMPAs in December 2006.

Nineteen of the transect sites (C-sites) and seven *Porites* bommie sites (P-sites) were established and have been individually described in Appendix 1. Three C-sites were established in the WBI sector, four C-sites in the EMI, five C-sites in the CMI, three C-sites and five P-sites in the ELS, and five C-sites and two P-sites in EBSS sector. No long-term monitoring sites were established in WBI and WBSS sectors. The GPS coordinates of the start and finish of each C-site transect and the centre of each P-site bommie recorded in the field were downloaded directly to computer and are presented in Appendix 2 and Appendix 3, respectively. Sites varied in depth (0.5-7.2 m below chart datum) and in mean live coral cover (2.3-62.6%). C-sites 6, 18, 19 and 22 have depths of <1 m below LAT and consequently may not be suitable as long-term monitoring sites.

Percent cover and abundance values referred to in the following text are presented in the site report cards which provide brief site descriptions, site images, summary statistics of benthic cover, relative finfish and shark abundance estimates and *Drupella* spp. and *Acanthaster planci* numbers (Appendix 4).

4.2 Benthic cover

The benthic community data were used to assess the suitability of the sectors as described above in Section 4.1. The mean densities of the various benthic categories (Appendix 5) recorded at each site within each sector were subjected to Principal Components Analysis (PCA) and coded for each sector (Figure 3). The PCA indicates that the sites within groups are variable, however sites in sectors ELS, EBSS and CMI, formed relatively discrete groupings. In general terms, ELS sites have high Poritidae cover compared with CMI sites, which generally have low coral cover (see Appendix 6 Figure 1).

Most EBSS sites have grouped together which seem to reflect a low to medium cover of mixed coral classes, the exceptions being sites 21 and 22 which possibly reflect a high rubble/turf algae percentage. ELS site 18 and WMI site 19 are outliers as they have high acroporid cover (Appendix 6 Figure 2). The remaining two WMI sites (sites 1 and 7) group with the EMI sector sites, possibly reflecting the low live hard coral cover or the relatively high rubble/turf algae cover recorded at these sites. The implication highlighted by the PCA plot (Figure 3), is that EMI and WMI sectors are similar in benthic composition.

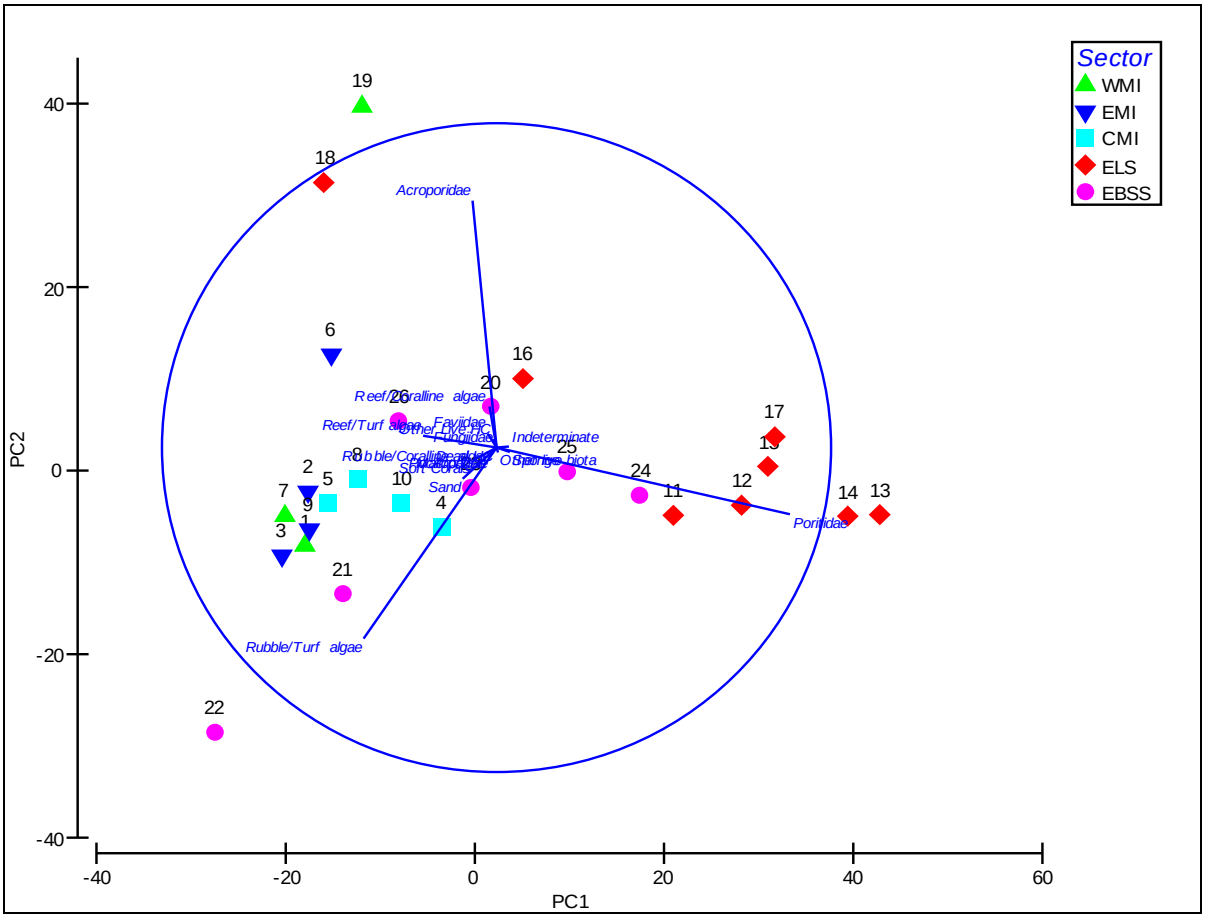

Figure 3. Principal Components Analysis plot using the benthic community abundance data, indicating the suitability of the assigned sectors.

Overall, these sectors based on relative exposure to long-period swell, cyclonic waves and gross geomorphological features, seem to be a suitable construct to discern the various broadscale coral reef communities found in the MBIMPAs.

4.2.1 Live hard corals

Live hard corals were present at all sites (Appendix 6 Figure 1). Mean percent cover of live hard coral at C-sites ranged from 2.3% at site 7 to 58% at site 26, and at P-sites from 36.8% at site 25 to 62.6% at site 13. P-sites 14, 15 and 17, recorded 59.8%, 55.5% and 60% respectively. The high coral cover at P-sites may be a reflection of the method used where discrete *Porites* colonies were selected. Consequently, high poritid coral cover was expected. All the P-sites are located in ELS and EBSS sectors.

Overall, ELS had the highest live coral cover with all sites having between 40% and 60% mean live coral cover at C-site 18 and P-site 17, respectively. All sites in this sector have high mean *Porites* sp. cover of 19.8-57.1%, with the exception of C-site 18 which was dominated by branching and plate acroporids (39.7%). C-sites 2, 7, 9 and 22 have <10% live coral cover.

Acroporids were present at all sites with the exception of P-site 24. C-sites 18 and 19 had the highest mean live cover of acroporid corals with 39.7% and 40.7%, respectively (Appendix 6 Figure 2). Both sites have relatively low exposure to long-period swell and cyclonic waves.

C-sites 1 and 3 had the highest mean live pocilloporid coral cover having 4.7% and 6.5%, respectively (Appendix 6 Figure 3).

Relative to the other sites, site 26 had a high mean faviid coral cover, 38.2% (Appendix 6 Figure 4) and other live corals, 16.8% (Appendix 6 Figure 5).

As expected, poritids were most abundant at P-sites (19.8%-57.1%), however, a high poritid percent cover of 42.2% was recorded at C-site 12 (Appendix 6 Figure 6), which may be attributed to this site being located within the same reef patch as P-site 13.

Fungiid corals were recorded in low mean percent cover (0.2-0.5%) only at C-sites 4, 19, 20, 21 and 22 (Appendix 6 Figure 7). As the latter three sites are all located in close proximity to each other within Dugong Reef, in effect, fungiids were only found at two locations (Dugong Reef and Bunsen Channel).

The spatial pattern of coral reef diversity and abundance, illustrated in Appendix 6 Figure 1, indicates that the sites located in ELS and EBSS have high live hard coral cover, suggesting that the eastern margin of the MBIMPAs (~100 km long) may be a regionally important network of tropical coral reef communities and a possible source of coral recruitment to the Pilbara mainland reef systems (Bancroft & Long 2008; Bancroft et al. 2007).

The benthic community data collected suggest that spatial distributions of live hard corals over the MBIMPAs are quite distinct and the communities in each sector can be described in the following terms:

- WMI, low coral cover and low diversity with coralline algae and turf algae on rubble;
- EMI, low coral cover and low diversity, supporting relatively high soft coral and reef/turf algae assemblages;
- CMI, moderate coral cover and moderate diversity, associated with rubble/turf algae ;
- ELS, high coral cover and low diversity, dominated by poritid coral communities; and
- EBSS, moderate coral cover and relatively high diversity (C-sites 21 & 22 being the exception with high rubble/turf algae cover).

Other patterns to note are:

(a) Site 19 in the WMI sector, had a relatively high live hard coral percent cover, unlike the rest of the sites located along the west coast where low coral cover was observed; and

(b) The percent cover of live hard corals seems to have a negative relationship with the relative exposure to long-period ground swell and cyclonic waves - greater the relative level of exposure, the less live hard coral cover present.

4.2.2 Live soft coral

With the exception of sites 1 and 4, soft corals were present at all sites within the Montebello Islands archipelago system: WMI, EMI and CMI sectors (Appendix 6 Figure 8). Outside of the Montebello Islands sectors, soft corals were only present at five of the remaining 14 sites, sites 11, 12, 16, 20 and 24. Overall, the mean percent cover of live soft coral ranged from 0.2% to 11.8% at sites 20 and 10, respectively.

The spatial distribution patterns of live soft coral suggest that the Montebello Islands archipelago system provides more suitable environmental conditions for supporting soft corals, relative to the EBSS and ELS sectors.

4.2.3 Algae

Algae, in the form of macroalgae (large fleshy algae), reef/turf algae (turf <100 mm covering a reef substratum), reef/coralline algae (encrusting coralline red algae on reef substratum), rubble/turf algae (algae <100 mm in height typically covering coral rubble) and rubble/coralline algae (encrusting coralline red algae on coral rubble) were recorded at all sites (Appendix 6 Figure 9).

Sites 1 and 3 recorded the highest mean macroalgae cover with 5.7% and 3.7% respectively. Turf algae on reef (reef/turf algae) was the most commonly present algae with a range of mean cover of 26.7% at site 14 to 66.5% at site 23. Reef/coralline algae (coralline algae on reef) mean cover at site 19 was 11.3% and mean rubble/turf algae (turf algae on coral rubble) cover of 54% was recorded at site 22.

There were no obvious spatial patterns for the distribution of algae.

4.2.4 Sponges

Sponge cover was low and patchy, being present at 15 of the 26 sites with percent cover ranging from <1% to 8.2% at sites 5 and 14, respectively (Appendix 6 Figure 10). Sponges were recorded at all sites in the ELS sector.

There were no obvious spatial patterns for the distribution of sponges.

4.3 Finfish distributions

Counts of selected fish groups were undertaken to provide relative diversity and abundance of finfish and sharks to assist in the future selection of finfish monitoring sites in the MBIMPAs, in view of the suitability of these sites for long-term finfish monitoring.

In general terms, the highest relative diversity and abundances of the selected finfish and sharks were recorded at all seven P-sites (Appendix 6 Figure 11). High mean abundances of lutjanids were recorded at P-sites 16 and 25 with 71.7 and 101 individuals, respectively. Relatively small numbers of serranids were recorded at all P-sites with 15, 16, and 24 having the mean abundances greater than five individuals. No *E. tukula* or *C. undulatus* and low abundances of lethrinids, carangids and scombrids were recorded at P-sites. One shark was recorded at each of P-sites 14, 15 and 17 with two recorded at P-site 25.

The data suggests that the P-sites established among the network of coral communities dominated by *Porites* colonies along the eastern margin of the inter-island shelf, Lowendal Shelf and the Barrow Shoals shelf support a diverse and abundant coral reef finfish population and that all P-sites would be suitable as finfish monitoring sites.

C-sites 7, 10, 12, 20, 21 and 23 had comparable diversity with a minimum of five fish groups present (Appendix 6 Figure 12), however, the relative abundances were much lower than the P-sites. These C-sites were relatively rugose, and had more structure than the remaining C-sites suggesting that sites with more rugosity provide more suitable habitat for finfish. A total of ten or less finfish from any group were recorded at C-sites 1, 2, 3, 6, 8, 9, 18, 19 and 22.

No *C. undulatus* were recorded at any C-sites and only one *E. tukula* was recorded at C-site 7 on the west side of the Montebello Islands. Low abundances of scombrids and carangids were recorded at one and two C-sites, respectively. Low numbers of serranids were recorded at 11 C-sites with C-sites 12 and 23 having the highest mean abundances of 2.67 and 2.33 respectively. Sharks were only recorded at C-sites on the eastern margin of the MBIMPAs at sites 2, 10, 12, 22, and 26.

The data suggests that C-sites 1, 2, 3, 6, 8, 9, 19 and 22 may not suitable as finfish monitoring sites as diversity and abundance were relatively low.

4.4 Corallivores

4.4.1 Drupella spp. distributions

In December 2006 at the MBIMPAs, the overall numbers of *Drupella* spp. observed were low, relative to those recently observed in the Great Barrier Reef Marine Park (Sweatman et al. 2005), and in Ningaloo Marine Park and the Muiron Islands Marine Management Area (Armstrong 2005a; 2005b; 2006b; 2007). Both *D. cornus* and *D. rugosa* were present in MBIMPAs. *Drupella* spp. were recorded at 19 sites, the exception were sites 9, 11, 14, 15, 16, 20 and 24 (Appendix 6 Figure 13). The highest numbers of *Drupella* spp. were observed at C-sites 23 and 26.

Overall, the sites with mixed coral assemblages (C-sites) had the highest numbers of *Drupella* spp. in contrast to the poritid dominant coral bommie sites (P-sites). Subsequently, low numbers of *Drupella* spp. were observed in the ELI sector. This is consistent with *Drupella* spp. prey preference to acroporid corals, which were found at most C-sites (Ayling & Ayling 1987; Forde 1994; Fujioka 1984; Oxley 1988; Page 1987; Sutton 1996).

The observed abundance of *Drupella* spp. are not causing significant mortality to the coral communities of the MBIMPAs, however, a long-term *Drupella* spp. monitoring program should be established incorporating sites in coral reef areas of WBI and WBSS sectors.

4.4.2 Acanthaster planci distributions

In December 2006 at the MBIMPAs, *A. planci* were observed in low abundances comparable to those recorded in the Great Barrier Reef Marine Park (Sweatman et al. 2005) and in the Dampier Archipelago (Johnson & Stoddart 1988). *A. planci* were recorded at nine sites: C-sites 9, 11, 12, 18, 20, 23 and 24; and P-sites 13 and 14 (Appendix 6 Figure 14). The highest relative abundance of individuals was observed at C-site 11 with a total of four *A. planci* recorded on the three replicate transects, collectively. Overall, the data indicates that the distribution of *A. planci* is mainly on the eastern margin of the inter-island shelf and the Barrow Shoals with a latitudinal spread from Karangi Island in the EMI sector to Batman Reef in the EBSS sector.

Diameters of the observed *A. planci* ranged between 25 cm and 47 cm (Figure 4) and 15 of the total 17 were >30 cm, suggesting that the majority of the population observed were mature adults, approximately three to four years old (CRC Reef Research Centre 2003). The remaining two individuals were ≤30 cm sub-adult sea stars, approximately two years old (CRC Reef Research Centre 2003).

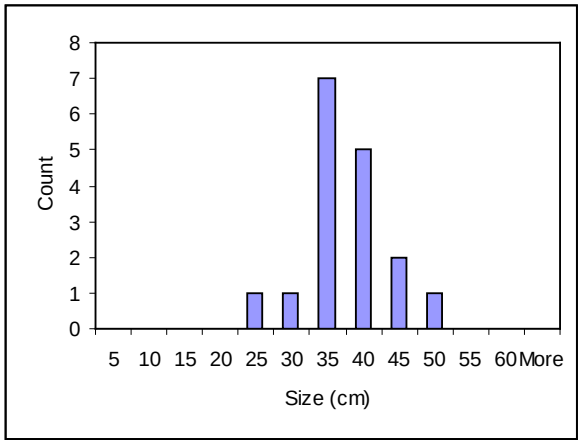

Figure 4. Histogram of diameters of *A. planci* observed at long-term monitoring sites (n=17).

The observed abundance of *Acanthaster planci* are not causing significant mortality to the coral reef communities of the MBIMPAs but surveys should be undertaken in coral reef areas of WBI and WBSS sectors where long-term monitoring sites are yet to be established.

5 IMPLICATIONS TO MANAGEMENT

5.1 Long-term coral community monitoring sites

As a result of this survey, DEC has a better understanding of the distribution patterns of coral reef communities in the Montebello Islands and the eastern margin of the inter-island shelf, Lowendal Shelf and the Barrow Shoals shelf. However, little is known of the marine ecological communities of the western margin of the Barrow Shoals shelf and Barrow Island (WBI and WBSS sectors). This area was not visited during this survey and subsequently, no long-term coral community monitoring sites were established.

Recommendation 1. Detailed mapping of coral reefs along the eastern margin of the MBIMPAs should be undertaken to fully document this system.

Recommendation 2. Establish long-term benthic monitoring sites in coral reef communities on the western margin of the Barrow Shoals shelf and Barrow Island.

Of the seven P-sites established, only site 13 was located within a sanctuary zone. More P-sites should be established within sanctuary zones to provide comparable reference sites for those that have no zoning protection from adverse impacts from human activities.

Recommendation 3. If suitable locations can be located, at least two more poritid bommie sites (P-sites) should be established within sanctuary zones as reference sites.

5.2 Finfish

The visual census of selected functional finfish groups was undertaken to provide relative abundance of finfish at the coral monitoring sites to allow an assessment of the use of these sites as future long-term finfish monitoring sites. This census highlighted that the highest relative diversity and abundance of finfish were recorded at P-sites relative to C-sites, suggesting that the network of *Porites* sp. bommies in the ELI, EBSS sectors are important finfish habitat and supports significant finfish populations. With the exception of P-site 13, all these sites are outside of sanctuary zones and are located either in general purpose zones or designated port areas. Consequently, these sites are vulnerable to recreational fishing and other anthropogenic pressures. Further P-sites need to be established inside sanctuary zones as reference sites to those that are not afforded any protection from adverse impacts from human activities, as recommended above (Recommendation 2).

The visual census data suggests that most long-term benthic monitoring sites established during the December survey are suitable as long-term finfish monitoring sites, except for C-sites 1, 2, 3, 6, 8, 9 18, 19 and 22 as their relative finfish abundance was <10 individuals. All P-sites would be suitable but a comparable finfish census method designed to allow for different habitat structure would need to be used.

Recommendation 4. Develop a long-term finfish monitoring program which provides comparable data across different habitat types and management zones.

5.3 *Acanthaster planci*

The current relative abundances of *A. planci* observed do not represent a threat to the coral reef communities of the MBIMPAs, however surveys should be undertaken in coral reef areas on the western margin of Barrow Island and the Barrow Shoals shelf where long-term monitoring sites are yet to be established.

Recommendation 5. Undertake Acanthaster planci density surveys when establishing long-term coral community monitoring sites (Recommendation 2).

5.4 *Drupella*

The observed abundances of *Drupella* spp. are relatively low and do not represent a threat to the coral communities of the MBIMPAs, however, the establishment of quantitative baseline data for long-term monitoring similar to the Ningaloo Marine Park *Drupella* Long-term Monitoring Program (Armstrong 2006a; 2006b; 2007), is recommended.

Recommendation 6. Undertake a baseline survey for long-term Drupella spp. density monitoring in coral reef communities throughout the MBIMPAs.

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8 APPENDICES

Appendix 1. General description of each long-term coral community monitoring site established in the Montebello/Barrow Islands marine protected areas in 2006

SITE NO	TYPE	LOCALITY	DEPTH BELOW CHART DATUM	RELATIVE LEVEL OF EXPOSURE	DESCRIPTION
1	C-site	West of Bluebell Island	1.6	High exposure to long-period swell Moderate exposure to cyclonic swell	Back-reef site; >10% tabulate and corymbose acroporids; rubble/turf algae and reef/turf algae; limestone substrate; sand patches present, particularly on the northern edge of the coral habitat; very shallow; highly exposed to long period swell and moderately exposed to cyclonic swells; NE current (<1 m.s^{-1}) was present; low visibility ~5m.
2	C-site	Pitt Pt, Trimouille Island	3.5	Low-moderate exposure to long-period swell High exposure to cyclonic swell	Reef in an area fringing and protected by a rocky point to the north; sparse hard coral cover ~10% cover; includes tabular acroporid, corymbose pocilloporid and massive poritid hard corals; ~15% cover of soft corals mainly *Sinularia* spp.; sandy substrate ~30%; relatively shallow; unlikely to be exposed to long period swell and moderately exposed to cyclonic swells; no current was present during site survey; low visibility ~5m.
3	C-site	North West Island	1.5	Low-moderate exposure to long-period swell High exposure to cyclonic swell	An area of low coral cover on the relatively "sheltered" southern edge of a reef; low hard coral cover <20%; main hard coral species were acroporid and poritid; benthos was dominated by turf algae covered reef pavement; very shallow; moderately exposed to long period swell and highly exposed to cyclonic swells; a moderate E current (~1 m.s^{-1}) was present; turbid; low visibility <5m.
4	C-site	Sack Bay, North West Island	2.8	No exposure to long-period swell No exposure to cyclonic swell	A narrow (10-20 m) strip of coral habitat on the edge of a deep hole in intertidal reef area; <20% hard coral cover; an arborescent non-acroporid, likely poritid, was the dominant hard coral; relatively shallow; very sheltered area; slight E current was experienced; very low visibility <3m.
5	C-site	North Bunsen Channel	3.3	No exposure to long-period swell No exposure to cyclonic swell	A narrow band of reef (<20m) fringing a deep channel; low hard coral cover <20%; main hard corals were massive poritids, with corymbose acroporids and other corymbose/encrusting corals; relatively sheltered; very sheltered within island group; a strong N current (~2 m.s^{-1}) was experienced; low visibility ~5m.
6	C-site	Benedicline Bay, Trimouille Island	0.8	Low-moderate exposure to long-period swell High exposure to cyclonic swell	Shallow back reef area close to the shoreline; ~20% live hard coral cover; most dominant hard corals being tabulate acroporids; some encrusting/sub-massive poritids, faviids and montiporids algal turf covered reef pavement with sand patches to the west; very shallow, possibly intertidal; low exposure to long period swell and highly exposed to cyclonic swells; a slight W current (~1 m.s^{-1}), was experienced; low visibility ~5m.
7	C-site	Southern end of West Reef	3.4	High exposure to long-period swell Moderate exposure to cyclonic swell	A narrow patchy band (5-15 m) of live hard coral fringing a major reef opening and deep (>5 m) channel; ~10% live coral cover with the major hard corals being massive *Platygyra* spp., and branching acroporids; ~10% soft corals mainly *Sinularia* spp. and *Sarcophyton* spp.; substrate mainly turf algae covered reef pavement with patches of rubble and sand; relatively shallow; site was exposed to the open ocean to south and to the east; high exposure to long period swell and moderately exposed to cyclonic swells ; a moderate W current (~1 m.s^{-1}) was experienced; low visibility ~5m; relative high finfish diversity and abundance.
8	C-site	Stephenson Channel, Hermite Island	3.0	No exposure to long-period swell No exposure to cyclonic swell	A narrow (10-15 m) strip of fringing coral reef next to a deep channel; ~30% live hard coral cover; dominant coral was an arborescent acroporid; other hard corals included massive poritids and foliose montiporids and echinoporids; algal turf covered the reef pavement; very sheltered site; relatively shallow; strong currents (>2-3 m.s^{-1}) may be experienced; slight inflowing current (~1 m.s^{-1}) was experienced; good visibility <10m.
9	C-site	Shoals south of Karangi Island	2.8	Low-medium exposure to long-period swell High exposure to cyclonic swell	Scattered corals within inter-island shallows; <20% live coral cover; major hard corals being massive poritids, encrusting montiporids and tabulate acroporids, ~10% *Sarcophyton* spp. soft corals present; turf algae covered reef pavement was the dominant substrate; relatively shallow; no exposure to long-period swell and moderate exposure to cyclonic swells; a slight W current (<1 m.s^{-1}) was experienced; low visibility ~5m.
10	C-site	Ah Chong Channel	4.6	No exposure to long-period swell No exposure to cyclonic swell	Scattered coral patch along a deep channel between the island and shallow shelf area; live coral hard cover ~30%; major hard corals being massives such as *Porites*, *Platygyra* and *Goniastrea*, and encrusting *Turbinaria*; relatively deep site; sheltered from long-period and cyclonic swells; a moderate W current (~1 m.s^{-1}) was experienced in the channel; good visibility >10 m; relative high finfish diversity and abundance.

SITE NO	TYPE	LOCALITY	DEPTH BELOW CHART DATUM	RELATIVE LEVEL OF EXPOSURE	DESCRIPTION
11	C-site	West of Ah Chong Island	7.1	No exposure to long-period swell Moderate exposure to cyclonic swell	A substantial area of coral reef off the inter-island shelf; 40% live hard coral cover; major hard corals were massive and arborescent poritids, and encrusting *Favites* spp. and *Galaxea* spp.; relatively deep site; sheltered from long-period swells and moderately exposed to cyclonic swells; slight N current (~1 $m.s^{-1}$) was experienced; good visibility >10m.
12	C-site	Shelf slope east of Black Rock	7.0	No exposure to long-period swell Moderate exposure to cyclonic swell	A substantial area of coral reef east of the Montebello/Lowendal inter-island shelf; high live hard coral cover ~50%; major hard corals were massive poritids, and arborescent and tabulate acroporids; other benthos included *Sarcophyton* spp. soft coral; turf algae covered reef pavement; relatively deep site; sheltered from long-period swells and moderately exposed to cyclonic swells; slight N current (~1 $m.s^{-1}$) was experienced; low visibility ~5m.
13	P-site	Shelf slope east of Black Rock	5.9	No exposure to long-period swell Moderate exposure to cyclonic swell	This site was placed in the general area of the previous site; a substantial area of coral reef east off the Montebello/Lowendal inter-island shelf; three clusters of massive poritid bommies; high live coral cover of ~50%; other benthos included arborescent and tabular acroporids, sponges and hydroids; turf algae covered reef pavement; relatively deep site; sheltered from long-period swells and moderately exposed to cyclonic swells; slight N current (~1 $m.s^{-1}$) was experienced; low visibility ~5m
14	P-site	Shelf slope NE of Bridled Is	6.1	No exposure to long-period swell Moderate exposure to cyclonic swell	A substantial area of poritid bommies east off the Montebello/Lowendal inter-island shelf; three individual poritid bommies; high live coral cover ~60%; other hard corals present included arborescent and tabulate acroporids; other benthos included sponges; turf algae covered reef pavement; relatively deep site; sheltered from long-period swells and moderately exposed to cyclonic swells; a slight N current (~1 $m.s^{-1}$) was experienced; low visibility ~5m; relative high finfish diversity and abundance.
15	P-site	Shelf slope S of Varanus Is	5.9	No exposure to long-period swell Moderate exposure to cyclonic swell	A substantial area of poritid bommies off the Montebello/Lowendal inter-island shelf; three individual poritid bommies; high live coral cover ~50%; other hard corals present included arborescent and tabulate acroporids; other benthos included sponges; turf algae covered reef pavement; relatively deep site; sheltered from long-period swells and moderately exposed to cyclonic swells; a slight N current (~1 $m.s^{-1}$) was experienced; low visibility ~5m; high finfish diversity and abundance.
16	P-site	South Lowendal Shelf	4.2	No exposure to long-period swell Moderate-low exposure to cyclonic swell	A substantial area of poritid bommies off the Lowendal shelf; three individual bommies; high live coral cover <50%; other hard corals include arborescent and tabulate acroporids and encrusting montiporids; other benthos included Gorgonians and hydroids; turf algae covered reef pavement; relatively deep site; sheltered from long-period swells and moderate-low exposure to cyclonic swells; a slight E current (~1 $m.s^{-1}$) was experienced; relatively good visibility ~10m; high finfish diversity and abundance.
17	P-site	SE Lowendal Shelf	6.5	No exposure to long-period swell Moderate-low exposure to cyclonic swell	Three isolated poritid bommies located in a bommie field east off the Lowendal shelf; live hard coral cover was >50%; other hard corals present include tabulate and branching acroporids and foliose *Turbinaria* spp.; turf algae covered reef pavement; relatively deep site; sheltered from long-period swells and moderate-low exposure to cyclonic swells; slight E current (~1 $m.s^{-1}$) was experienced; low visibility ~5m; relative high finfish diversity and abundance.
18	C-site	Southern Lowendal Shelf	0.5	No exposure to long-period swell Moderate-low exposure to cyclonic swell	Vast area of coral reef habit on the southern end of the Lowendal Shelf; deeper water is ~150m south of site; mainly comprising arborescent acroporid; tabulate and corymbose acroporid forms are present; ~70% live hard coral cover; turf algae on reef pavement; some coral rubble areas; some coral bleaching was observed; very shallow site; could be intertidal; relatively deep site; sheltered from long-period swells and moderate-low exposure to cyclonic swells; slight W current was experienced; relatively good visibility ~10m.
19	C-site	Inside Wonnich Reef	0.6	Moderate exposure to long-period swell Moderate-low exposure to cyclonic swell	Substantial back reef area dominated by tabular acroporids, approximately 95% cover of coral (dead and live); evidence that the top surface of the plate coral has been exposed to air probably at spring low tide; top surface has substantial amounts of algal turf covered dead coral; live hard coral cover was ~50%; other hard coral includes corymbose acroporids; coralline and turf algae covered dead coral and reef pavement; very shallow site; could be intertidal; moderately exposed to long-period swells and moderate-low exposure to cyclonic swells; no current was present; relatively good visibility >10m.

SITE NO	TYPE	LOCALITY	DEPTH BELOW CHART DATUM	RELATIVE LEVEL OF EXPOSURE	DESCRIPTION
20	C-site	East Dugong Reef	3.7	No exposure to long-period swell Moderate-low exposure to cyclonic swell	A substantial area of coral reef fringing the Dugong shoals; high live hard coral cover of ~60%; high diversity of corals present, including massive poritids and faviids, foliose echinoporids and montiporids, corymbose pocilloporids and acroporids, and encrusting forms of poritids and echinoporids; relatively shallow site; sheltered from long-period swells and moderate-low exposure to cyclonic swells; slight N current was experienced; relatively good visibility >10m.
21	C-site	Central Dugong Reef	1.4	No exposure to long-period swell Moderate-low exposure to cyclonic swell	A scattered coral reef area with significant rubble zone; located on the northern edge of central Dugong shoals; this area suffered a significant natural death event in the early 1990s; ~20% live hard coral cover; dominated by small massive and sub-massive poritids and faviids; turf algae covered reef pavement and rubble was the dominant substrate type; relatively shallow site; sheltered from long-period swells and moderate-low exposure to cyclonic swells; slight E current was experienced; low visibility ~5m.
22	C-site	West Dugong Reef	0.4	No exposure to long-period swell Moderate-low exposure to cyclonic swell	A scattered coral reef area with significant areas of turf covered coral rubble zones; live coral hard cover was ~10%; small massive poritids and faviids e.g. *Favia*, *Favites* and *Goniopora*; turf algae covered reef pavement and rubble was the dominant substrate type; very shallow site; may be intertidal; sheltered from long-period swells and moderate-low exposure to cyclonic swells; moderate E current (~2 $m.s^{-1}$) was experienced; low visibility ~5m.
23	C-site	South Batman Reef	2.2	No exposure to long-period swell Moderate-low exposure to cyclonic swell	A scatter patch of coral reef comprising mainly turf algae covered rubble and reef pavement; live hard coral cover was ~30%; mainly massive and sub-massive poritids; other hard corals were encrusting montiporids and branching poritids and acroporids; sheltered from long-period swells and moderate-low exposure to cyclonic swells; moderate E current (~2 $m.s^{-1}$) was experienced; low visibility ~5m; relatively high finfish diversity and abundance.
24	P-site	North Batman Reef	2.5	No exposure to long-period swell Moderate-low exposure to cyclonic swell	Three discrete poritid bommies in an area of bommies; sand on reef pavement in between the bommies; ~50% live hard coral cover; some small faviids scattered throughout; turf algae and rubble areas present; relatively shallow site; sheltered from long-period swells and moderate-low exposure to cyclonic swells; moderate E current (~2 $m.s^{-1}$) was experienced; low visibility ~5m; relative high finfish diversity and abundance.
25	P-site	Northern Barrow Island Shoals	1.5	No exposure to long-period swell Moderate-low exposure to cyclonic swell	Three discrete poritid bommies selected in an area of bommies; sand, macroalgae and rubble in between bommies; ~40% live hard coral cover; mixture of other hard corals such as *Montipora* and *Platygyra*; shallow site; sheltered from long-period swells and low exposure to cyclonic swells; a moderate N current was experienced; moderate-low visibility relative high finfish diversity and abundance.
26	C-site	Central East Barrow Island Shoals	2.7	No exposure to long-period swell Moderate-low exposure to cyclonic swell	A substantial area of hard coral just off the Barrow Shelf; ~60% live coral cover; dominated by a foliose echinoporid; other hard corals include small massive *Goniastrea* spp. and branching *Porites* spp. and macroalgae (*Sargassum* spp., *Turbinaria* spp.); some sand patches and rubble zones; relatively shallow site; sheltered from long-period swells and moderate-low exposure to cyclonic swells; moderate E current was experienced; relatively low visibility >5m.

Appendix 2. Actual GPS coordinates (decimal degrees, datum WGS84) of the start and finish of each of the three transects surveyed at 19 C-sites established in the Montebello/Barrow Islands marine protected areas in 2006

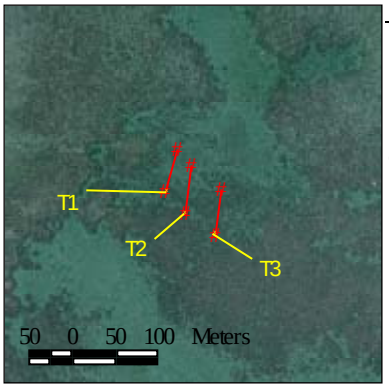
		Transect Start		*Transect Finish*	
C-SITE	TRANSECT	LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
1	T1	-20.40074	115.50008	-20.40030	115.50020
	T2	-20.40097	115.50029	-20.40047	115.50036
	T3	-20.40119	115.50062	-20.40071	115.50068
2	T1	-20.38753	115.56417	-20.38783	115.56455
	T2	-20.38746	115.56445	-20.38775	115.56482
	T3	-20.38756	115.56483	-20.38774	115.56530
3	T1	-20.34829	115.51375	-20.34830	115.51419
	T2	-20.34820	115.51454	-20.34826	115.51504
	T3	-20.34828	115.51513	-20.34842	115.51558
4	T1	-20.36857	115.52574	-20.36898	115.52552
	T2	-20.36895	115.52545	-20.36934	115.52551
	T3	-20.36962	115.52526	-20.36997	115.52547
5	T1	-20.39450	115.54197	-20.39487	115.54223
	T2	-20.39496	115.54231	-20.39527	115.54264
	T3	-20.39532	115.54258	-20.39567	115.54288
6	T1	-20.40527	115.58188	-20.40507	115.58146
	T2	-20.40562	115.58174	-20.40538	115.58132
	T3	-20.40566	115.58121	-20.40592	115.58159
7	T1	-20.45272	115.47837	-20.45294	115.47801
	T2	-20.45254	115.47898	-20.45263	115.47854
	T3	-20.45212	115.47971	-20.45230	115.47931
8	T1	-20.46594	115.54676	-20.46634	115.54697
	T2	-20.46636	115.54700	-20.46678	115.54710
	T3	-20.46707	115.54725	-20.46752	115.54723
9	T1	-20.45131	115.60510	-20.45085	115.60513
	T2	-20.45146	115.60556	-20.45099	115.60562
	T3	-20.45108	115.60600	-20.45150	115.60594
10	T1	-20.50853	115.54332	-20.50891	115.54308
	T2	-20.50814	115.54358	-20.50849	115.54347
	T3	-20.50780	115.54412	-20.50804	115.54386
11	T1	-20.50663	115.56473	-20.50620	115.56479
	T2	-20.50644	115.56454	-20.50606	115.56456
	T3	-20.50627	115.56437	-20.50584	115.56437
12	T1	-20.55498	115.57309	-20.55512	115.57270
	T2	-20.55512	115.57240	-20.55524	115.57201
	T3	-20.55527	115.57198	-20.55538	115.57152
18	T1	-20.78606	115.50667	-20.78653	115.50666
	T2	-20.78611	115.50639	-20.78653	115.50639
	T3	-20.78618	115.50609	-20.78663	115.50611
19	T1	-20.50972	115.47731	-20.51017	115.47735
	T2	-20.50970	115.47759	-20.51016	115.47760
	T3	-20.50972	115.47782	-20.51015	115.47788
20	T1	-20.90191	115.46174	-20.90191	115.46220
	T2	-20.90225	115.46178	-20.90228	115.46225
	T3	-20.90262	115.46172	-20.90265	115.46219
21	T1	-20.89988	115.45084	-20.89979	115.45127
	T2	-20.90009	115.45097	-20.90007	115.45144
	T3	-20.90030	115.45108	-20.90026	115.45154
22	T1	-20.89502	115.44035	-20.89507	115.43988
	T2	-20.89540	115.44046	-20.89549	115.44001
	T3	-20.89570	115.44062	-20.89580	115.44017
23	T1	-20.95983	115.46517	-20.95980	115.46569
	T2	-20.96021	115.46515	-20.96017	115.46567
	T3	-20.96057	115.46518	-20.96057	115.46567
26	T1	-21.07781	115.51321	-21.07740	115.51316
	T2	-21.07778	115.51346	-21.07734	115.51350
	T3	-21.07781	115.51379	-21.07738	115.51387

Appendix 3 . GPS coordinates (decimal degrees, datum WGS84) of the centre of each of the three bommies surveyed at seven P-sites established in the Montebello/Barrow Islands marine protected areas in 2006

		Centre of bommie	
P-SITE	LOCATION	LATITUDE	LONGITUDE
13	B1	-20.55596	115.57250
	B2	-20.55539	115.57160
	B3	-20.55530	115.57190
14	B1	-20.62902	115.58313
	B2	-20.62845	115.58339
	B3	-20.62850	115.58259
15	B1	-20.71888	115.57636
	B2	-20.71887	115.57748
	B3	-20.71936	115.57805
16	B1	-20.78461	115.52475
	B2	-20.78435	115.52507
	B3	-20.78386	115.52550
17	B1	-20.75566	115.57447
	B2	-20.75621	115.57412
	B3	-20.75583	115.57347
24	B1	-20.95105	115.46285
	B2	-20.95157	115.46258
	B3	-20.95197	115.46247
25	B1	-20.99494	115.47984
	B2	-20.99451	115.48091
	B3	-20.99388	115.48074

Appendix 4. Site report cards presenting brief site descriptions, site images, summary statistics of benthic cover, and relative abundances of finfish and shark, *Drupella* spp. and *Acanthaster planci*

Site 1

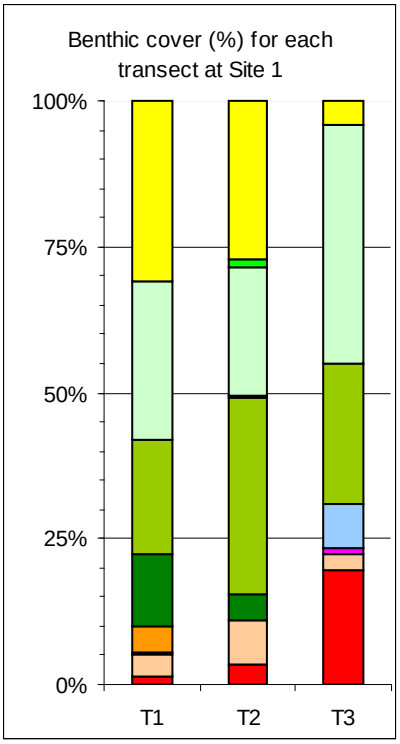


Site Code	**MBI/COR-001**
Locality	West of Bluebell Island
Tenure	Montebello Islands Marine Park, Montebellos General Use Zone
Position	20.40067°S latitude; 115.50033°E longitude
Description	C-site; back reef area east of the western barrier reef; transects laid close to parallel on a bearing of 10°; approximately 2 ha coral patch with patches of sand and reef/turf algae; depth 1.6 m below chart datum.

Images of site

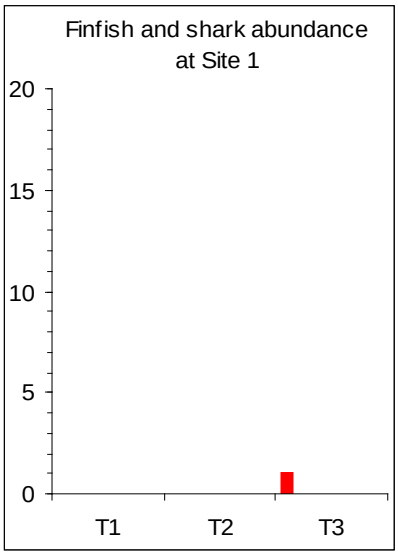
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	1.5	3.5	19.5	8.2	5.70
Pocilloporidae	3.5	7.5	3.0	4.7	1.42
Faviidae	0.5	0	1.0	0.5	0.29
Poritidae	4.5	0	0	1.5	1.50
Fungiidae	0	0	0	0	0
Other live hard coral	0	0	7.5	2.5	2.50
Total live hard coral	**10.0**	**11.0**	**31.0**	**17.3**	**6.84**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	12.5	4.5	0	5.7	3.66
Rubble/turf algae	19.5	33.5	24.0	25.7	4.13
Rubble/coralline algae	0	0.5	0	0.2	0.17
Reef/turf algae	27.0	22.0	41.0	30.0	5.69
Reef/coralline algae	0	1.5	0	0.5	0.50
Sponge	0	0	0	0	0
Other live biota	0	0	0	0	0
Sand	31.0	27.0	4.0	20.7	8.41
Indeterminate	0	0	0	0	0



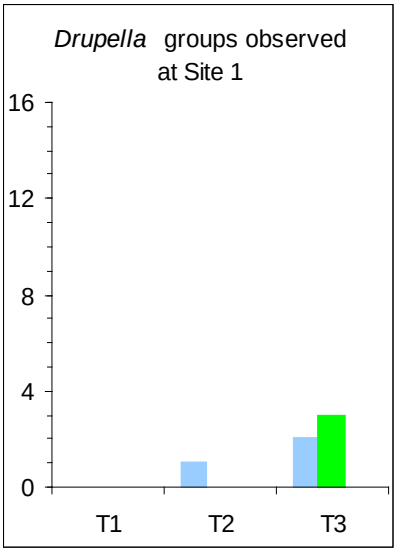
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	0	0	1
Emperor	0	0	0
Coral trout	0	0	0
Small cod	0	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	0	0	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



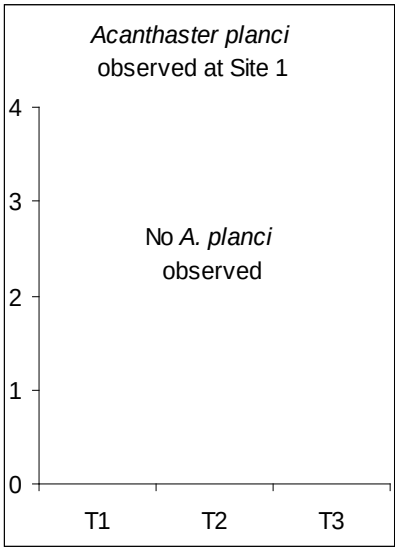
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	1	2	**3**
5-10	0	0	3	**3**
>10	0	0	0	**0**

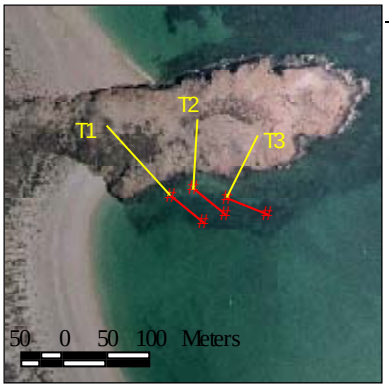


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

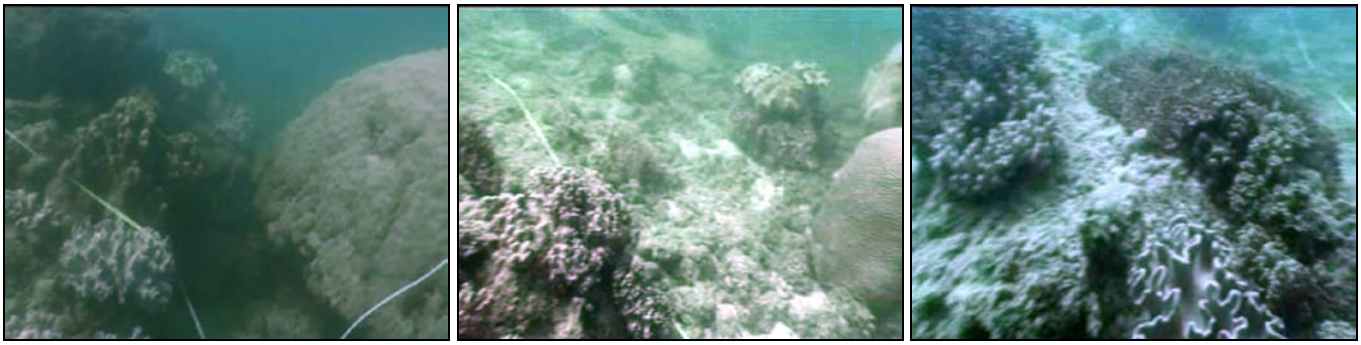


Site 2



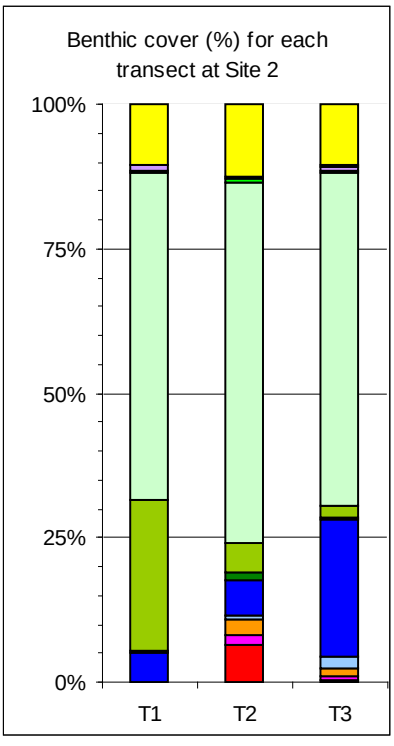
Site Code	**MBI/COR-002**
Locality	Pitt Point, Trimouille Island
Tenure	Montebello Islands Marine Park, Montebellos General Use Zone
Position	20.38766°S latitude; 115.56458°E longitude
Description	C-site; narrow strip of coral reef fringing Pitt Point; scattered soft corals throughout; transects laid close to parallel but staggered; T1 and T2 laid on a bearing of 135° and T3 on 125°; depth 3.5 m below chart datum.

Images of site



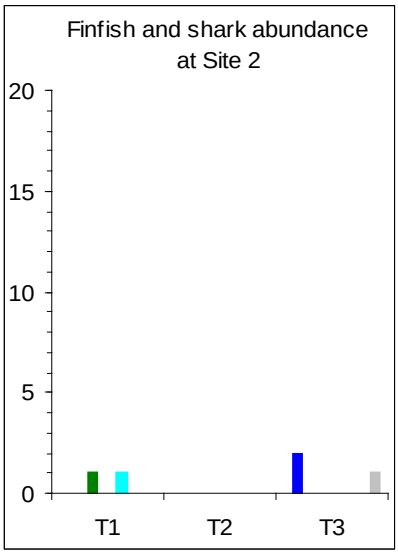
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	0	6.5	0.5	2.3	2.09
Pocilloporidae	0	0	0	0	0
Faviidae	0	1.5	0.5	0.7	0.44
Poritidae	0	3.0	1.5	1.5	0.87
Fungiidae	0	0	0	0	0
Other live hard coral	0	0.5	2.0	0.8	0.60
Total live hard coral	**0**	**11.5**	**4.5**	**5.33**	**3.35**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	5.0	6.0	23.5	11.5	6.01
Macroalgae	0.5	1.5	0.5	0.8	0.33
Rubble/turf algae	26.0	5.0	2.0	11.0	7.55
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	56.5	62.5	57.5	58.8	1.86
Reef/coralline algae	0.5	0.5	0.5	0.5	0
Sponge	1.0	0	0.5	0.5	0.29
Other live biota	0	0.5	0.5	0.3	0.17
Sand	10.5	12.5	10.5	11.2	0.67
Indeterminate	0	0	0	0	0



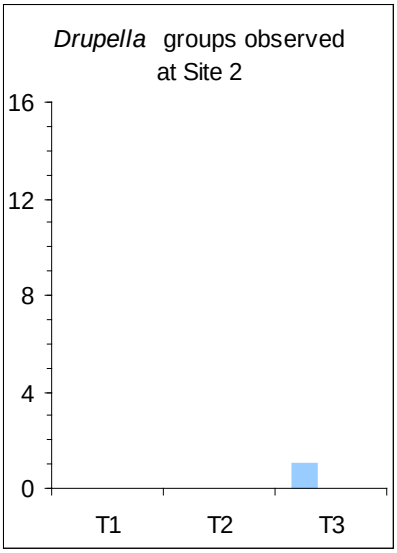
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	0	0	0
Emperor	0	0	2
Coral trout	0	0	0
Small cod	1	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	1	0	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	1



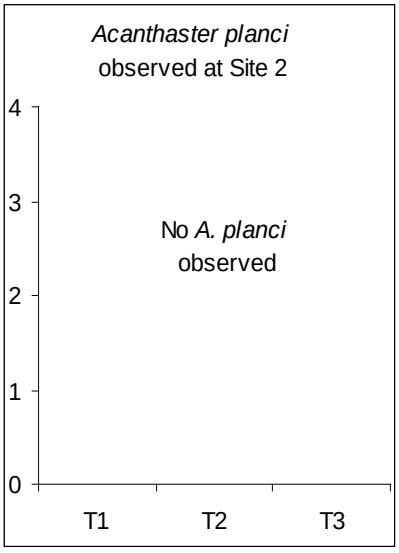
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	0	1	**1**
5-10	0	0	0	**0**
>10	0	0	0	**0**

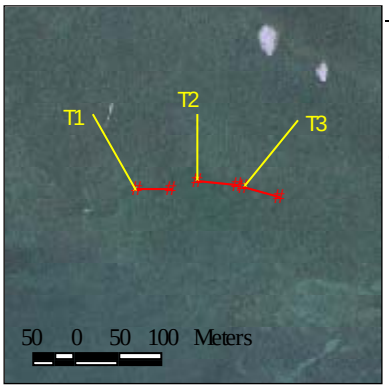


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

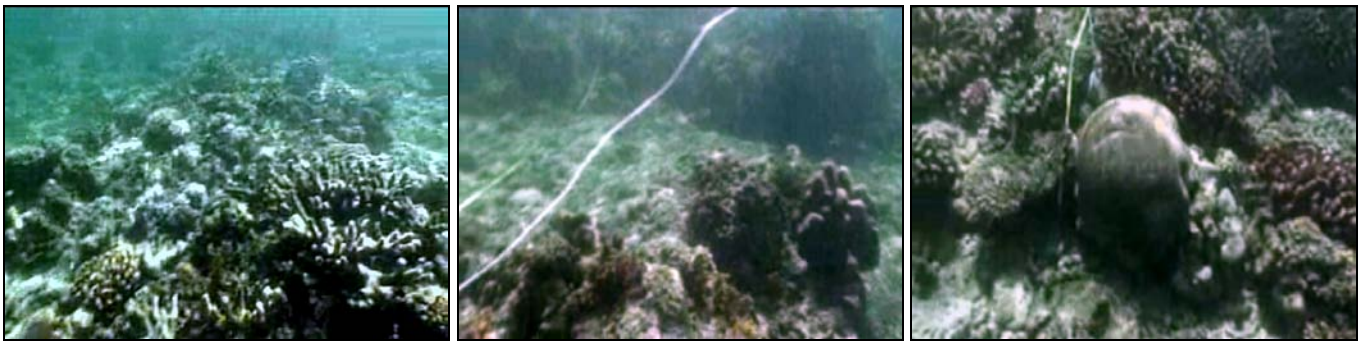


Site 3



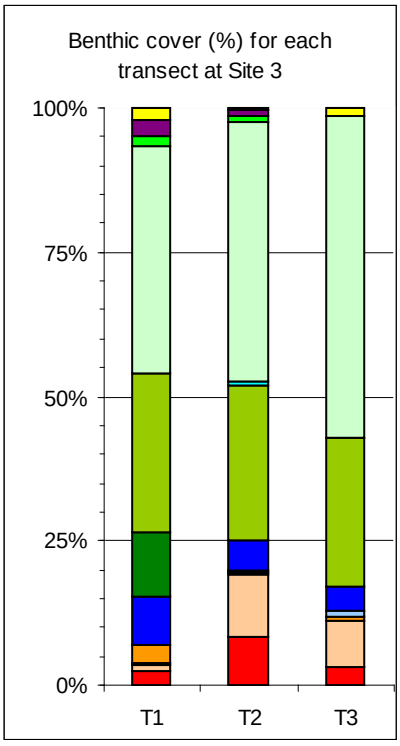
Site Code	**MBI/COR-003**
Locality	North West Island
Tenure	Montebello Islands Marine Park, Northern Montebellos Sanctuary Zone
Position	20.3482°S latitude; 115.51480°E longitude
Description	C-site; sparse patches of hard corals with scattered soft corals; approximately 1.5 km north of North West Island; transects laid in series at 90°; depth 1.5 m below chart datum.

Images of site



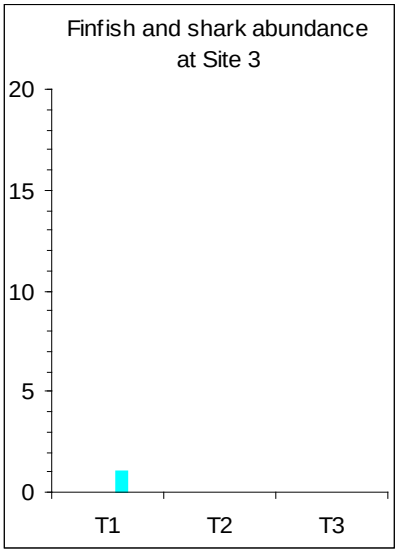
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	2.5	8.5	3.0	4.7	1.92
Pocilloporidae	1.0	10.5	8.0	6.5	2.84
Faviidae	0.5	0.5	0.0	0.3	0.17
Poritidae	3.0	0.0	1.0	1.3	0.88
Fungiidae	0.0	0.0	0.0	0.0	0.00
Other live hard coral	0.0	0.5	1.0	0.5	0.29
Total live hard coral	**7.0**	**20.0**	**13.0**	**13.3**	**3.76**
Bleach hard coral	0.0	0.0	0.0	0.0	0.00
Dead hard coral	0.0	0.0	0.0	0.0	0.00
Soft corals	8.5	5.0	4.0	5.8	1.36
Macroalgae	11.0	0.0	0.0	3.7	3.67
Rubble/turf algae	27.5	27.0	26.0	26.8	0.44
Rubble/coralline algae	0.0	0.5	0.0	0.2	0.17
Reef/turf algae	39.5	45.0	55.5	46.7	4.69
Reef/coralline algae	1.5	1.0	0.0	0.8	0.44
Sponge	0.0	0.0	0.0	0.0	0.00
Other live biota	3.0	1.0	0.0	1.3	0.88
Sand	2.0	0.5	1.5	1.3	0.44
Indeterminate	0.0	0.0	0.0	0.0	0.00



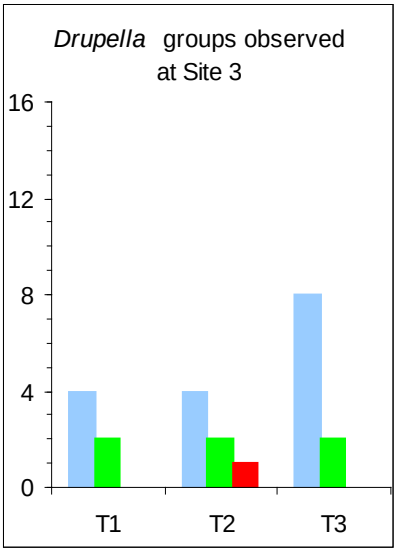
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	0	0	0
Emperor	0	0	0
Coral trout	0	0	0
Small cod	0	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	1	0	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



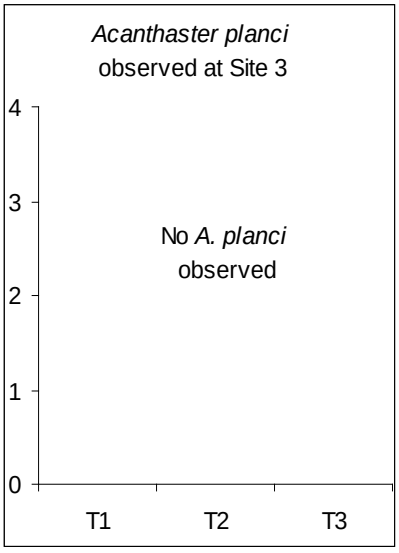
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	4	4	8	**16**
5-10	2	2	2	**6**
>10	0	1	0	**1**

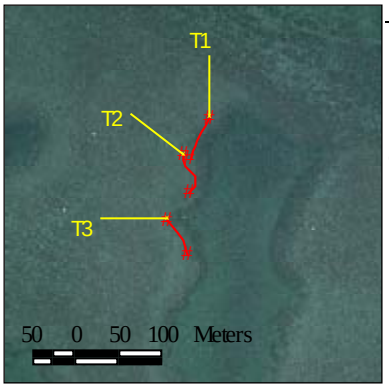


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

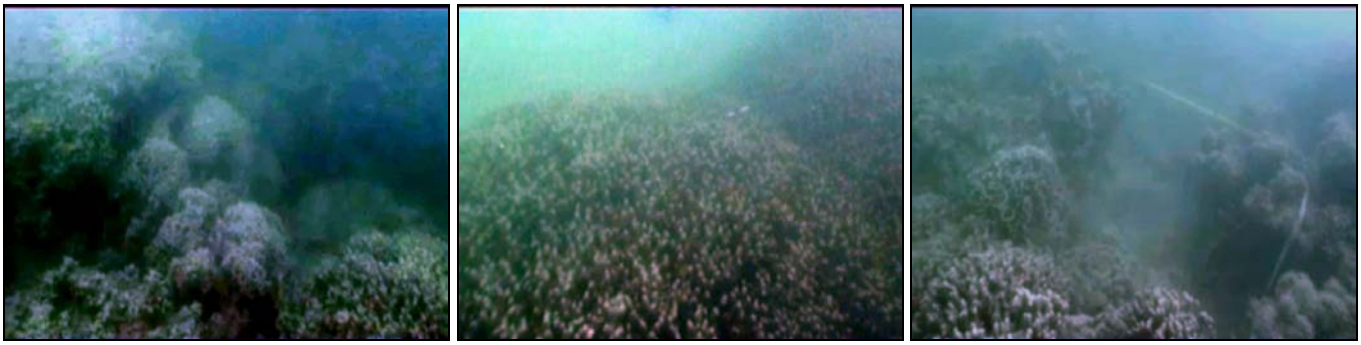


Site 4



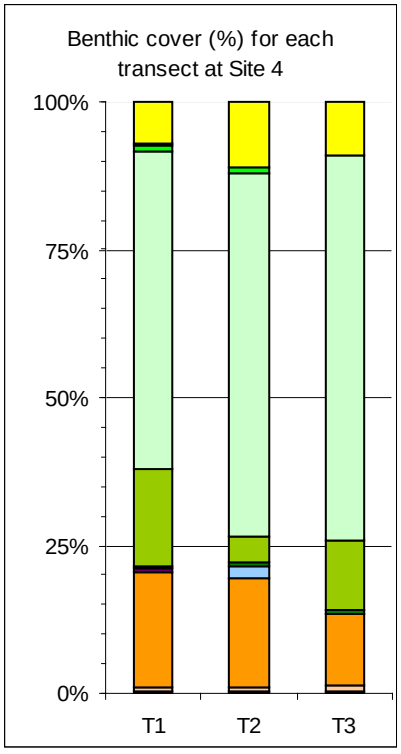
Site Code	**MBI/COR-004**
Locality	Sack Bay, North West Is
Tenure	Montebello Islands Marine Park, Montebellos General Use Zone, between Special Purpose (Aquaculture) Zones
Position	20.36917°S latitude; 115.52550°E longitude
Description	C-site; laid in series running along a narrow and shallow coral reef fringing an edge of a deeper hole in a mainly intertidal reef flat; the transects followed a constant depth contour; depth 2.8 m below chart datum.

Images of site



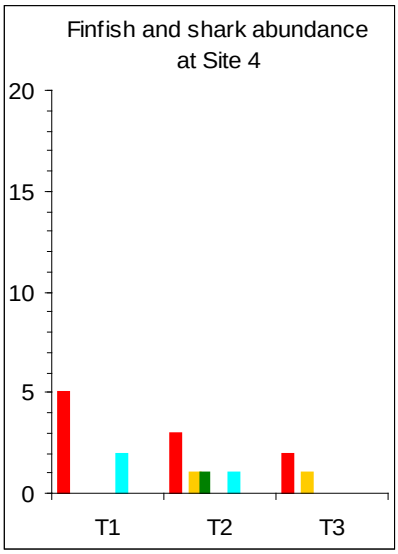
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	0.5	0.5	0.5	0.5	0.00
Pocilloporidae	0.5	0.5	1.0	0.7	0.17
Faviidae	0.0	0.0	0.0	0.0	0.00
Poritidae	19.5	18.5	12.0	16.7	2.35
Fungiidae	0.5	0.0	0.0	0.2	0.17
Other live hard coral	0.5	2.0	0.0	0.8	0.60
Total live hard coral	**21.5**	**21.5**	**13.5**	**18.8**	**2.67**
Bleach hard coral	0.0	0.0	0.0	0.0	0.00
Dead hard coral	0.0	0.0	0.0	0.0	0.00
Soft corals	0.0	0.0	0.0	0.0	0.00
Macroalgae	0.0	0.5	0.5	0.3	0.17
Rubble/turf algae	16.5	4.5	12.0	11.0	3.50
Rubble/coralline algae	0.0	0.0	0.0	0.0	0.00
Reef/turf algae	53.5	61.5	65.0	60.0	3.40
Reef/coralline algae	1.0	1.0	0.0	0.7	0.33
Sponge	0.5	0.0	0.0	0.2	0.17
Other live biota	0.0	0.0	0.0	0.0	0.00
Sand	7.0	11.0	9.0	9.0	1.15
Indeterminate					



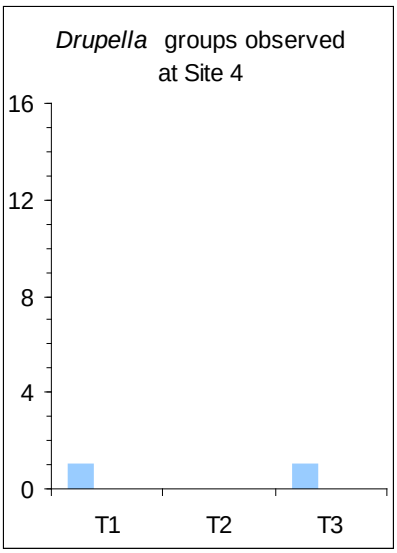
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	5	3	2
Emperor	0	0	0
Coral trout	0	1	1
Small cod	0	1	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	2	1	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



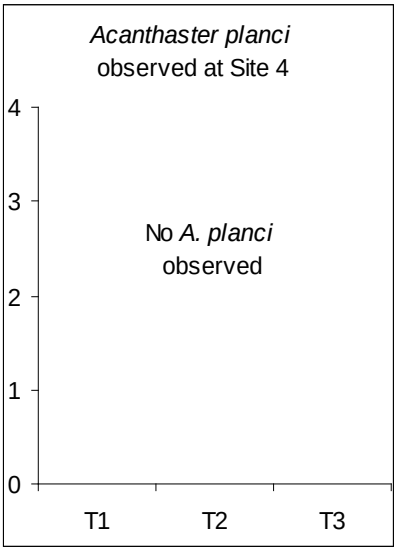
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	1	0	1	**2**
5-10	0	0	0	**0**
>10	0	0	0	**0**

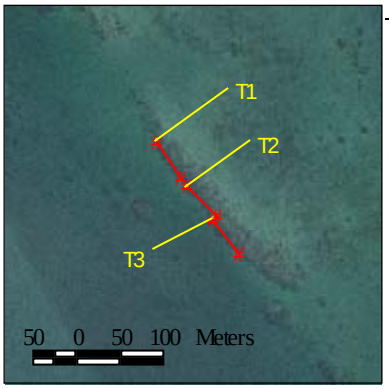


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

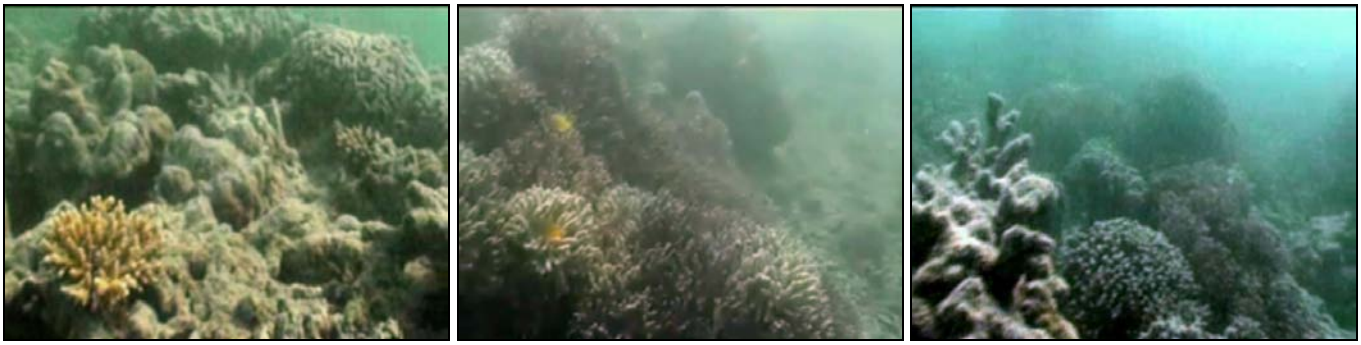


Site 5



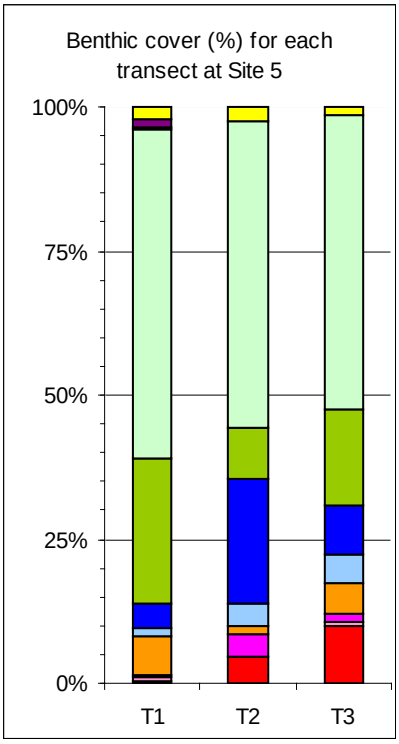
Site Code	**MBI/COR-005**
Locality	North Bunsen Channel
Tenure	Montebello Islands Marine Park, Montebellos General Use Zone, just a couple of metres outside the Northern Montebellos Sanctuary Zone
Position	20.39511°S latitude; 115.54249°E longitude
Description	C-site; narrow band of reef fringing a channel inside shallow reef platform; transects laid following contour and edge of drop-off; depth 3.3 m below chart datum.

Images of site



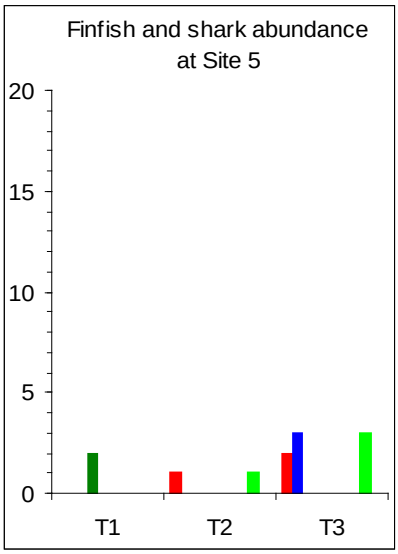
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	0.5	4.5	10.0	5.0	2.75
Pocilloporidae	0.5	0.0	0.5	0.3	0.17
Faviidae	0.5	4.0	1.5	2.0	1.04
Poritidae	6.5	1.5	5.5	4.5	1.53
Fungiidae	0.0	0.0	0.0	0.0	0.00
Other live hard coral	1.5	4.0	5.0	3.5	1.04
Total live hard coral	**9.5**	**14.0**	**22.5**	**15.3**	**3.81**
Bleach hard coral	0.0	0.0	0.0	0.0	0.00
Dead hard coral	0.0	0.0	0.0	0.0	0.00
Soft corals	4.5	21.5	8.5	11.5	5.13
Macroalgae	0.0	0.0	0.0	0.0	0.00
Rubble/turf algae	25.0	9.0	16.5	16.8	4.62
Rubble/coralline algae	0.0	0.0	0.0	0.0	0.00
Reef/turf algae	57.0	53.0	51.0	53.7	1.76
Reef/coralline algae	0.5	0.0	0.0	0.2	0.17
Sponge	0.0	0.0	0.0	0.0	0.00
Other live biota	1.5	0.0	0.0	0.5	0.50
Sand	2.0	2.5	1.5	2.0	0.29
Indeterminate	0.0	0.0	0.0	0.0	0.00



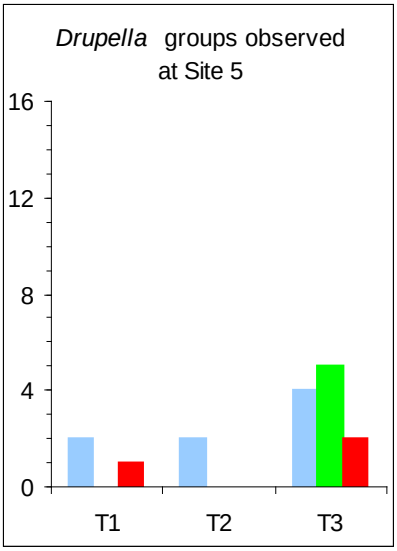
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	0	1	2
Emperor	0	0	3
Coral trout	0	0	0
Small cod	2	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	0	0	0
Trevally	0	0	0
Mackerel	0	1	3
Shark	0	0	0



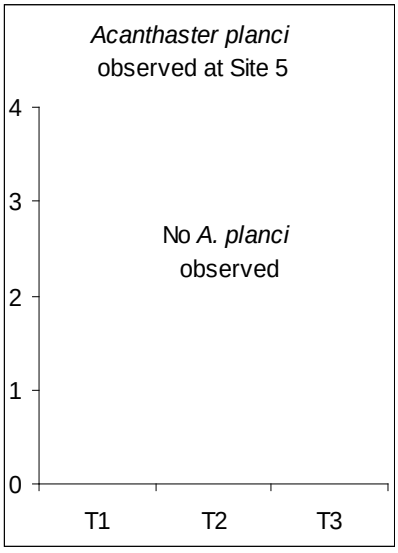
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	2	2	4	**8**
5-10	0	0	5	**5**
>10	1	0	2	**3**

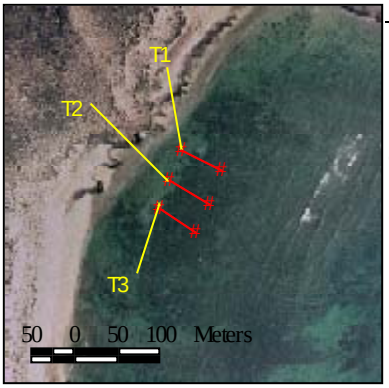


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

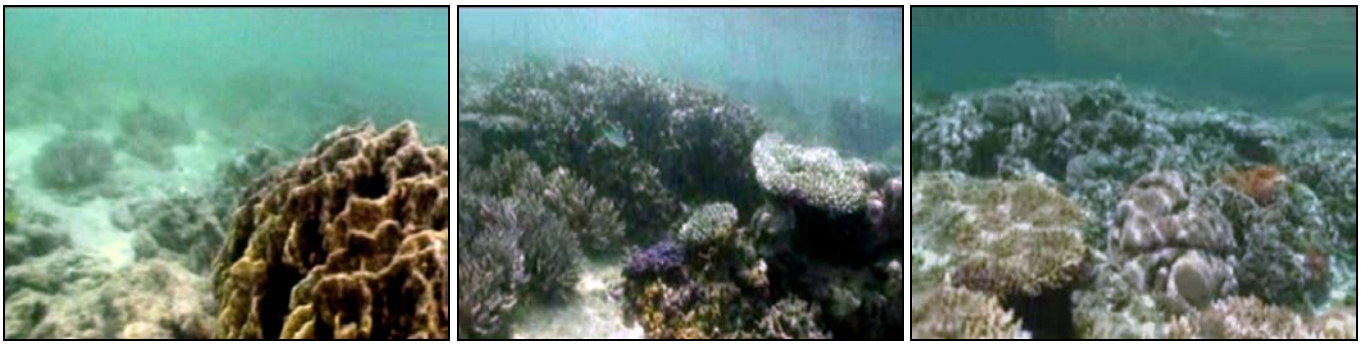


Site 6



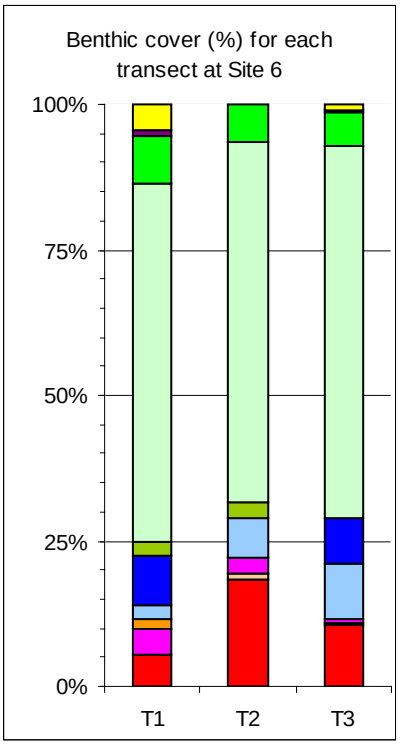
Site Number	**MBI/COR-006**
Location	Benedicline Bay, Trimouille Island
Tenure	Montebello Islands Marine Park, Montebellos General Use Zone
Lat/Longs	20.40551°S latitude; 115.58152°E longitude
Description	C-site; shallow fringing reef; maybe intertidal; transects laid in parallel at approx 90° to coast on a bearing of 125°; depth 0.8 m. below chart datum.

Images of site



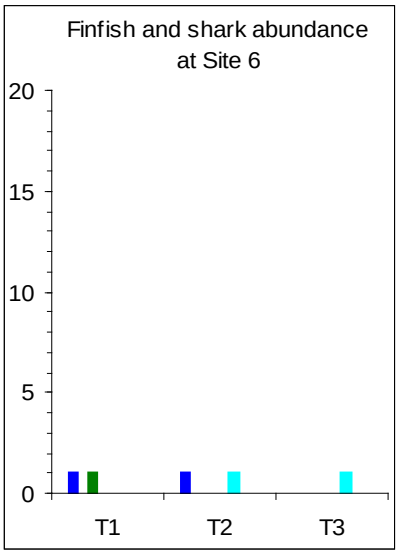
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	5.5	18.5	10.5	11.5	3.79
Pocilloporidae	0.0	1.0	0.5	0.5	0.29
Faviidae	4.5	2.5	0.5	2.5	1.15
Poritidae	1.5	0.0	0.0	0.5	0.50
Fungiidae	0.0	0.0	0.0	0.0	0.00
Other live hard coral	2.5	7.0	9.5	6.3	2.05
Total live hard coral	**14.0**	**29.0**	**21.0**	**21.3**	**4.33**
Bleach hard coral	0.0	0.0	0.0	0.0	0.00
Dead hard coral	0.0	0.0	0.0	0.0	0.00
Soft corals	8.5	0.0	8.0	5.5	2.75
Macroalgae	0.0	0.0	0.0	0.0	0.00
Rubble/turf algae	2.5	2.5	0.0	1.7	0.83
Rubble/coralline algae	0.0	0.0	0.0	0.0	0.00
Reef/turf algae	61.5	62.0	64.0	62.5	0.76
Reef/coralline algae	8.0	6.5	5.5	6.7	0.73
Sponge	0.0	0.0	0.0	0.0	0.00
Other live biota	1.0	0.0	0.5	0.5	0.29
Sand	4.5	0.0	1.0	1.8	1.36
Indeterminate	0.0	0.0	0.0	0.0	0.00



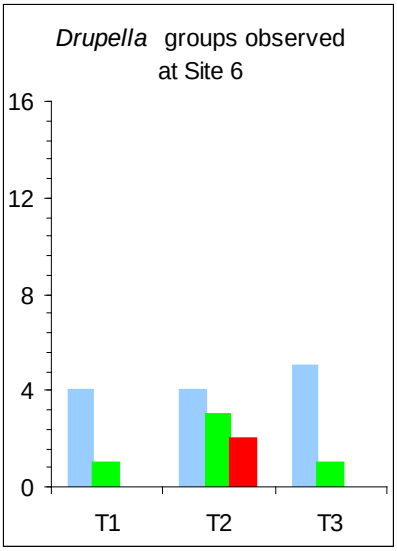
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	0	0	0
Emperor	1	1	0
Coral trout	0	0	0
Small cod	1	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	0	1	1
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



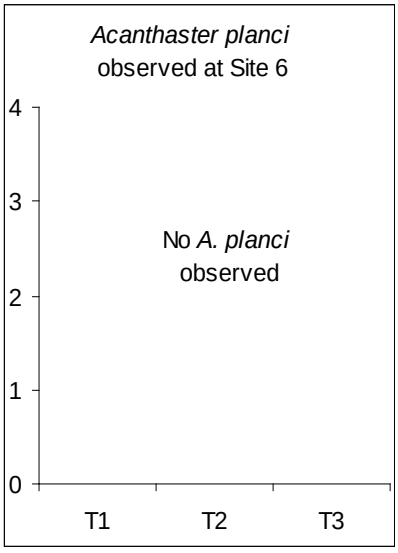
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	4	4	5	**13**
5-10	1	3	1	**5**
>10	0	2	0	**2**

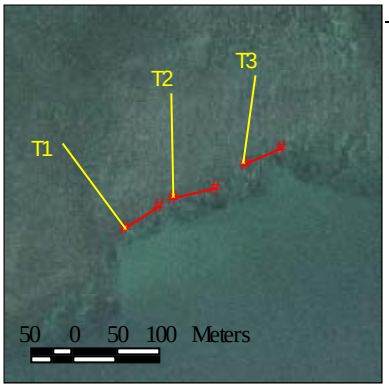


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**



Site 7

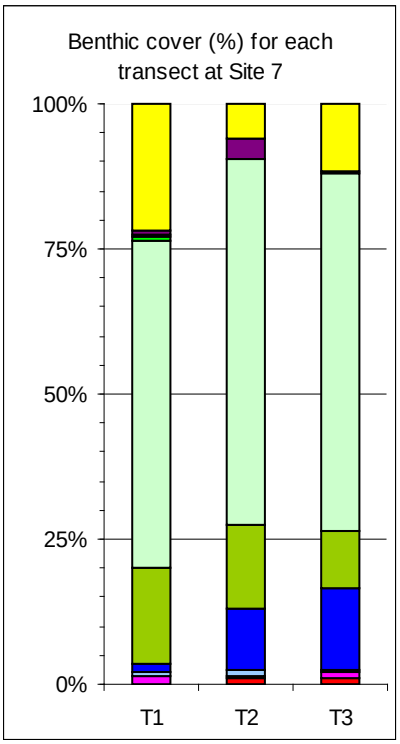


Site Code	**MBI/COR-007**
Locality	Southern end of West Reef
Tenure	Montebello Islands Marine Park, Montebellos General Use Zone
Position	20.45257°S latitude; 115.47876°E longitude
Description	C-site; transects laid in series on an approximate bearing of 60°; along a narrow strip of coral reef comprised of mainly soft corals; open water to the south; depth 3.4 m below chart datum.

Images of site

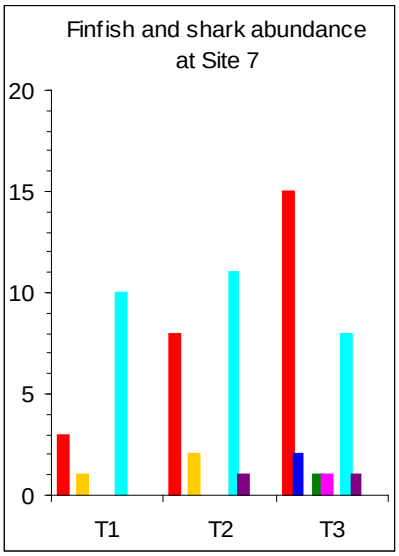
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	0.0	1.0	1.0	0.7	0.33
Pocilloporidae	0.0	0.0	0.0	0.0	0.00
Faviidae	1.5	0.5	1.0	1.0	0.29
Poritidae	0.0	0.0	0.5	0.2	0.17
Fungiidae	0.0	0.0	0.0	0.0	0.00
Other live hard coral	0.5	1.0	0.0	0.5	0.29
Total live hard coral	**2.0**	**2.5**	**2.5**	**2.3**	**0.17**
Bleach hard coral	0.0	0.0	0.0	0.0	0.00
Dead hard coral	0.0	0.0	0.0	0.0	0.00
Soft corals	1.5	10.5	14.0	8.7	3.72
Macroalgae	0.0	0.0	0.0	0.0	0.00
Rubble/turf algae	16.5	14.5	10.0	13.7	1.92
Rubble/coralline algae	0.0	0.0	0.0	0.0	0.00
Reef/turf algae	56.5	63.0	61.5	60.3	1.96
Reef/coralline algae	0.5	0.0	0.0	0.2	0.17
Sponge	0.5	0.0	0.0	0.2	0.17
Other live biota	0.5	3.5	0.5	1.5	1.00
Sand	22.0	6.0	11.5	13.2	4.69
Indeterminate	0.0	0.0	0.0	0.0	0.00



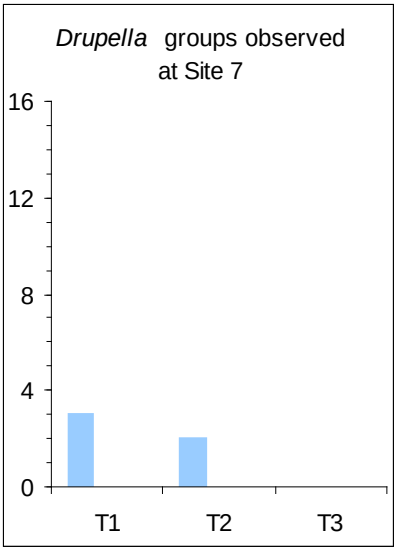
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	3	8	15
Emperor	0	0	2
Coral trout	1	2	0
Small cod	0	0	1
Potato cod	0	0	1
Maori wrasse	0	0	0
Tusk fish	10	11	8
Trevally	0	1	1
Mackerel	0	0	0
Shark	0	0	0



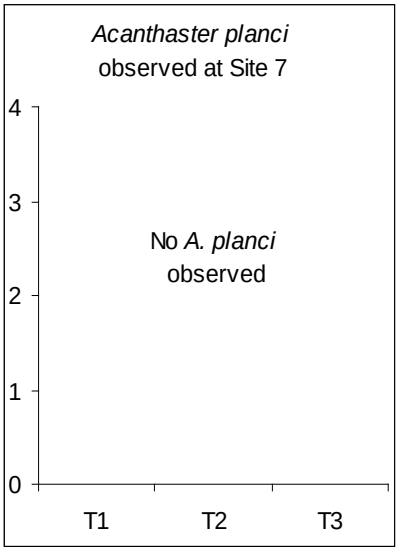
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	3	2	0	**5**
5-10	0	0	0	**0**
>10	0	0	0	**0**

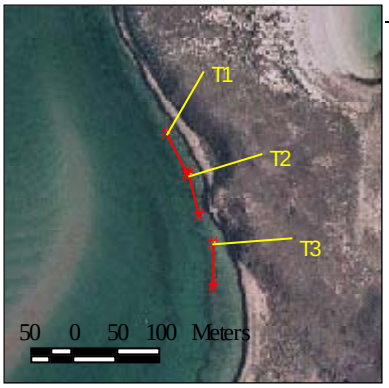


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

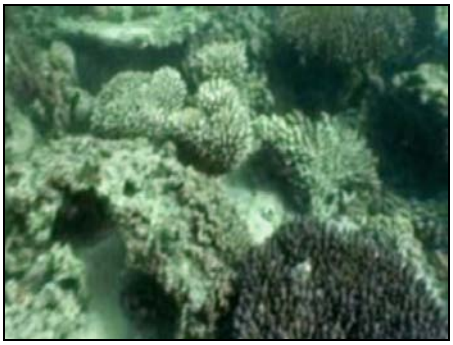
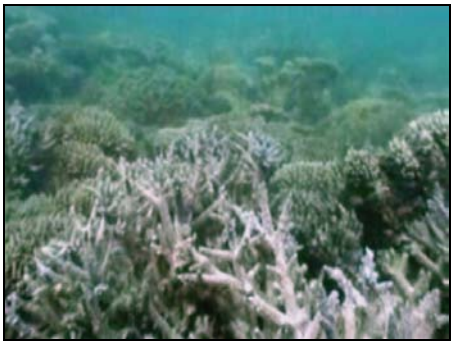


Site 8



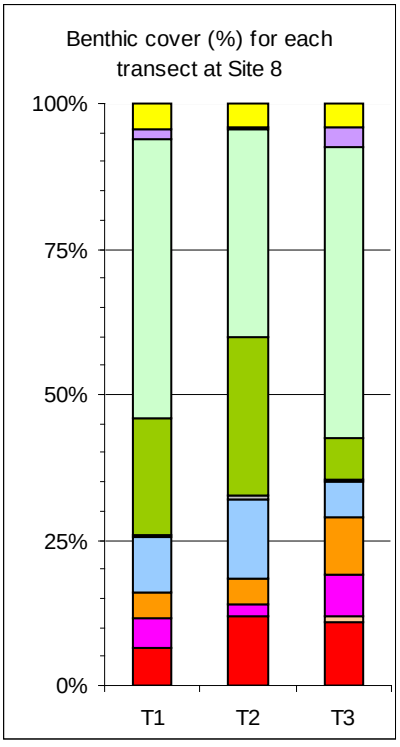
Site Code	**MBI/COR-008**
Locality	Stephenson Channel, Hermite Island
Tenure	Montebello Islands Marine Park, Stephenson Channel Recreation Zone
Position	20.46659°S latitude; 115.54704°E longitude
Description	C-site; transects run in series along a narrow strip of coral fringing the land dropping off into a deep tidal channel; depth 3.0 m below chart datum.

Images of site

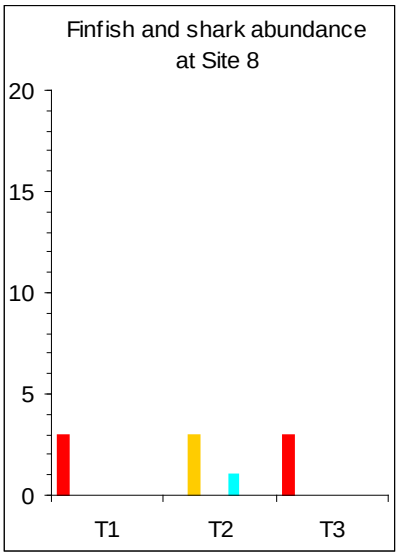
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	6.5	12.0	11.0	9.8	1.69
Pocilloporidae	0	0	1.0	0.3	0.33
Faviidae	5.0	2.0	7.0	4.7	1.45
Poritidae	4.5	4.5	10	6.3	1.83
Fungiidae	0	0	0	0	0
Other live hard coral	9.5	13.5	6.0	9.7	2.17
Total live hard coral	**25.5**	**32.0**	**35.0**	**30.8**	**2.80**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0.5	0	0.2	0.17
Soft corals	0.5	0	0.5	0.3	0.17
Macroalgae	0	0	0	0	0
Rubble/turf algae	20	27.5	7.0	18.2	5.99
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	48.0	35.5	50	44.5	4.54
Reef/coralline algae	0	0	0	0	0
Sponge	1.5	0.5	3.5	1.8	0.88
Other live biota	0	0	0	0	0
Sand	4.5	4.0	4.0	4.2	0.17
Indeterminate	0	0	0	0	0



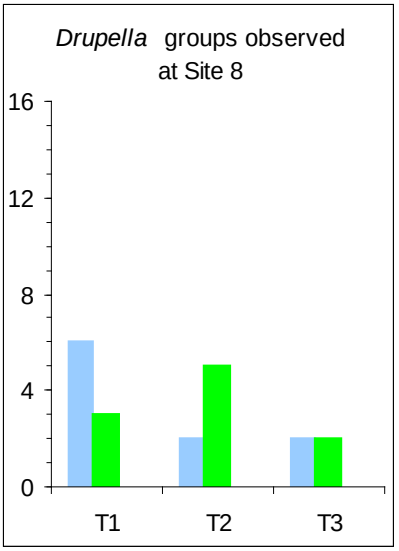
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	3	0	3
Emperor	0	0	0
Coral trout	0	3	0
Small cod	0	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	0	1	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



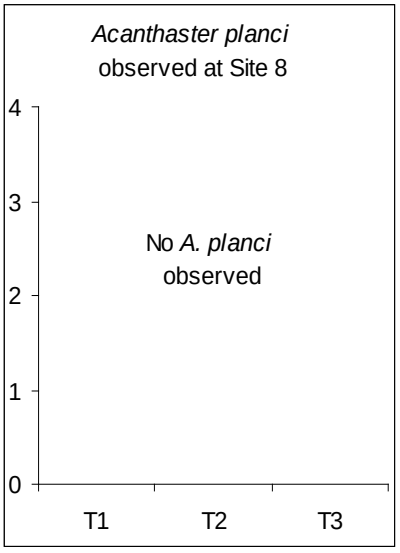
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	6	2	2	**10**
5-10	3	5	2	**10**
>10	0	0	0	**0**

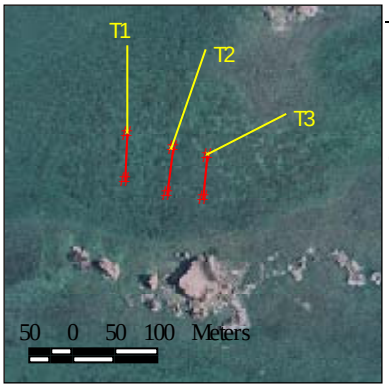


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**



Site 9

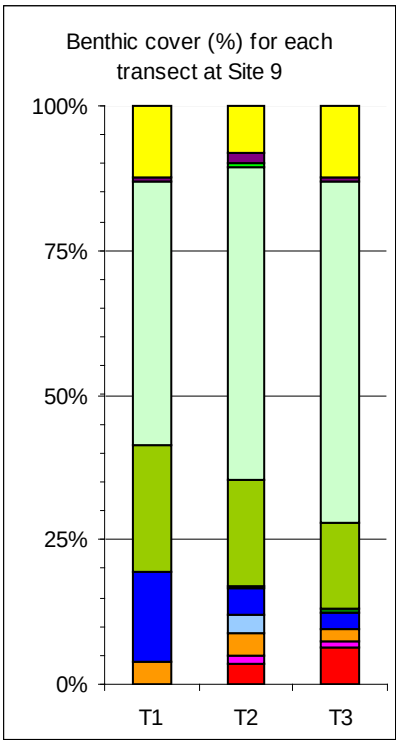


Site Code	**MBI/COR-009**
Locality	Shoals south of Karangi Is
Tenure	Montebello Islands Marine Park, Southern Montebellos Sanctuary Zone
Position	20.45122°S latitude; 115.60559°E longitude
Description	C-site; transects laid in parallel on a bearing of 180°; substantial patch of coral reef; depth 2.8 m below chart datum.

Images of site

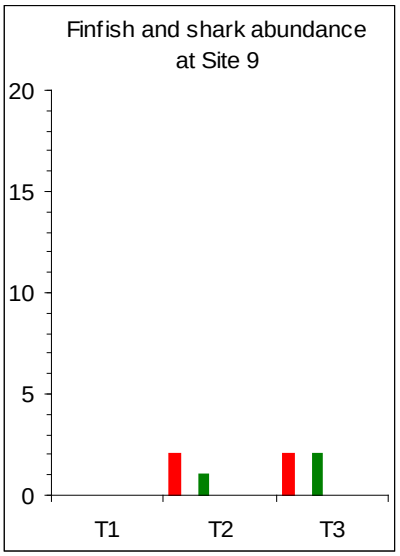
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	0	3.5	6.5	3.3	1.88
Pocilloporidae	0	0	0	0	0
Faviidae	0	1.5	1.0	0.8	0.44
Poritidae	4.0	4.0	2.0	3.3	0.67
Fungiidae	0	0	0	0	0
Other live hard coral	0	3.0	0	1.0	1.00
Total live hard coral	**4.0**	**12.0**	**9.5**	**8.5**	**2.36**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	15.5	4.5	3.0	7.7	3.94
Macroalgae	0	0.5	0.5	0.3	0.17
Rubble/turf algae	22.0	18.5	15.0	18.5	2.02
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	45.5	54.0	59.0	52.8	3.94
Reef/coralline algae	0	0.5	0	0.2	0.17
Sponge	0	0	0	0	0
Other live biota	0.5	2.0	0.5	1.0	0.50
Sand	12.5	8.0	12.5	11.0	1.50
Indeterminate	0	0	0	0	0



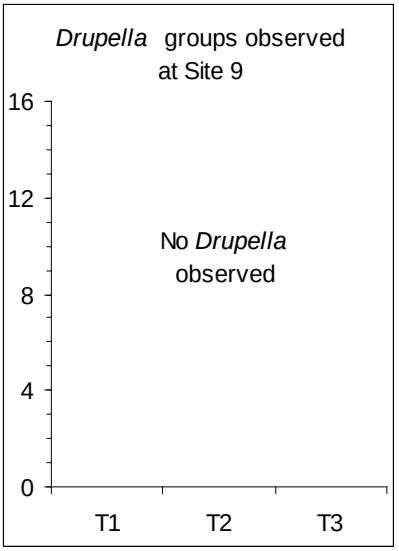
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	0	2	2
Emperor	0	0	0
Coral trout	0	0	0
Small cod	0	1	2
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	0	0	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



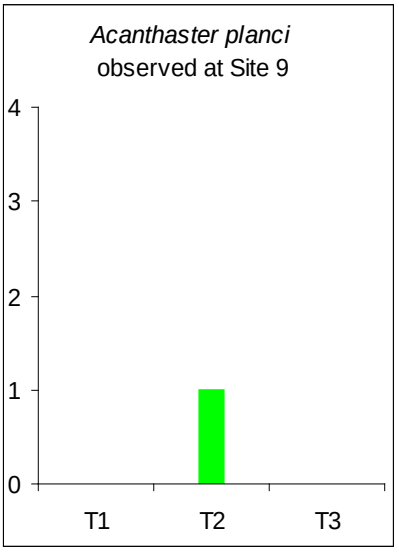
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	0	0	**0**
5-10	0	0	0	**0**
>10	0	0	0	**0**

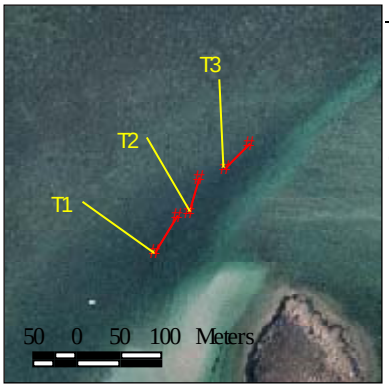


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	1	0	**1**
> 30 cm	0	0	0	**0**

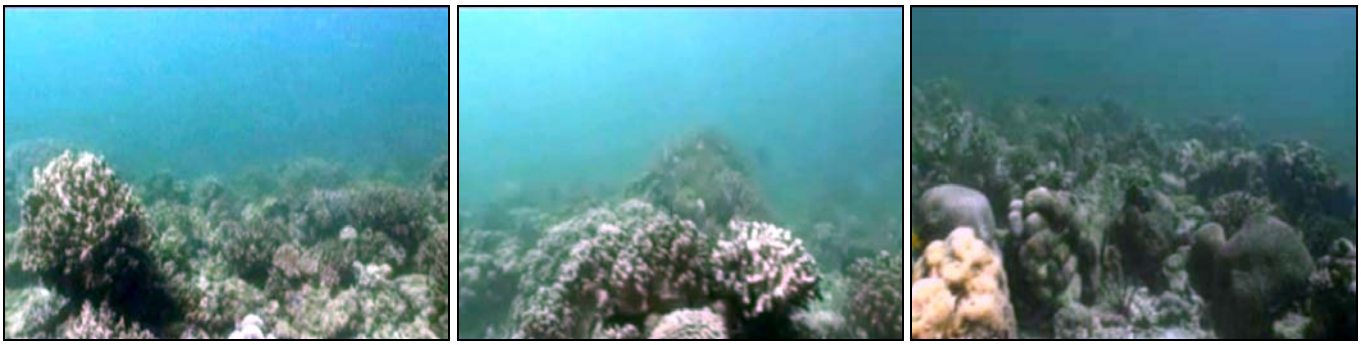


Site 10



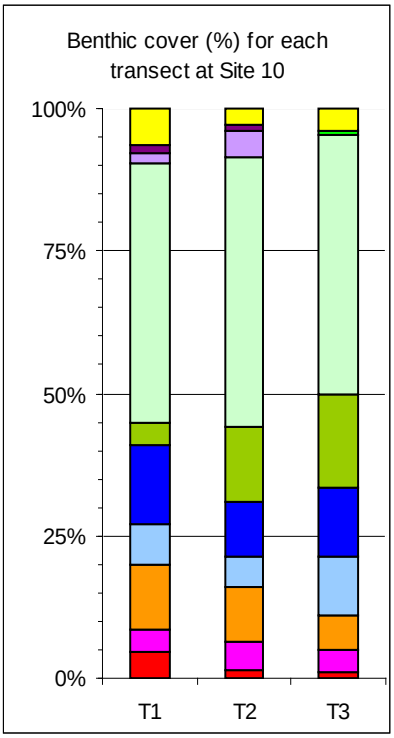
Site Code	**MBI/COR-010**
Locality	Ah Chong Channel
Tenure	Montebello Islands Marine Park, Southern Montebellos Recreation Zone
Position	20.50830°S latitude; 115.54352°E longitude
Description	C-site; transects laid in series along the edge of a channel at an approximate bearing of 45°; depth 4.7 m below chart datum.

Images of site



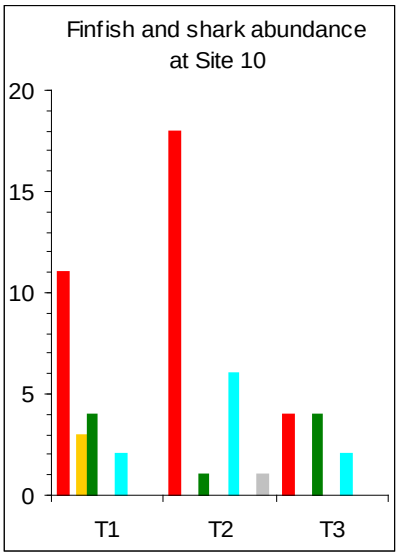
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	4.5	1.5	1.0	2.3	1.09
Pocilloporidae	0	0	0	0	0
Faviidae	4.0	5.0	4.0	4.3	0.33
Poritidae	11.5	9.5	6.0	9.0	1.61
Fungiidae	0	0	0	0	0
Other live hard coral	7.0	5.5	10.5	7.7	1.48
Total live hard coral	**27.0**	**21.5**	**21.5**	**23.3**	**1.83**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	14.0	9.5	12.0	11.8	1.30
Macroalgae	0	0	0	0	0
Rubble/turf algae	4.0	13.0	16.5	11.2	3.72
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	45.5	47.5	45.5	46.2	0.67
Reef/coralline algae	0	0	0.5	0.2	0.17
Sponge	1.5	4.5	0	2.0	1.32
Other live biota	1.5	1.0	0	0.8	0.44
Sand	6.5	3.0	4.0	4.5	1.04
Indeterminate	0	0	0	0	0



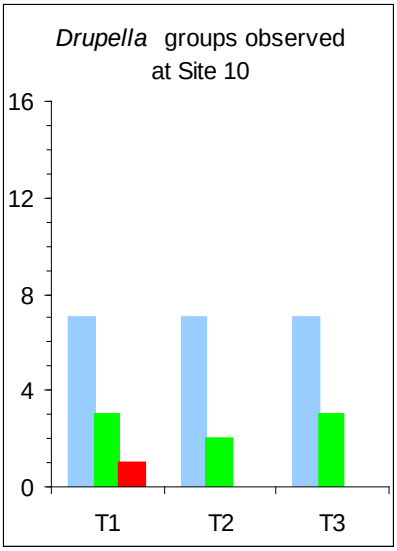
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	11	18	4
Emperor	0	0	0
Coral trout	3	0	0
Small cod	4	1	4
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	2	6	2
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	1	0



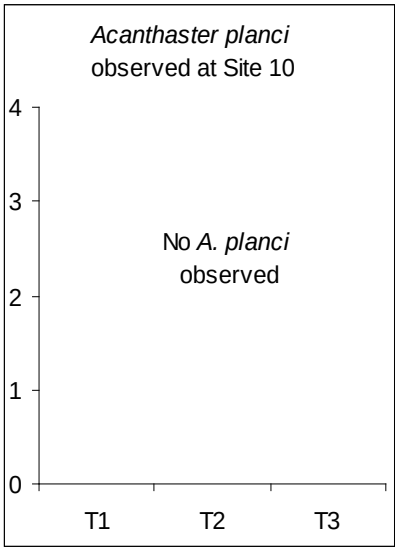
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	7	7	7	**21**
5-10	3	2	3	**8**
>10	1	0	0	**1**

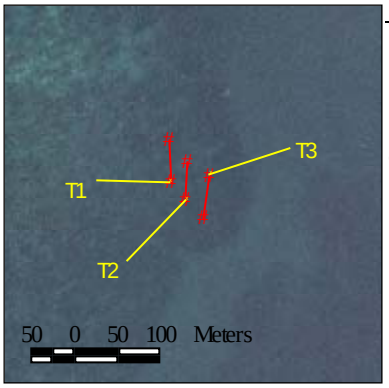


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

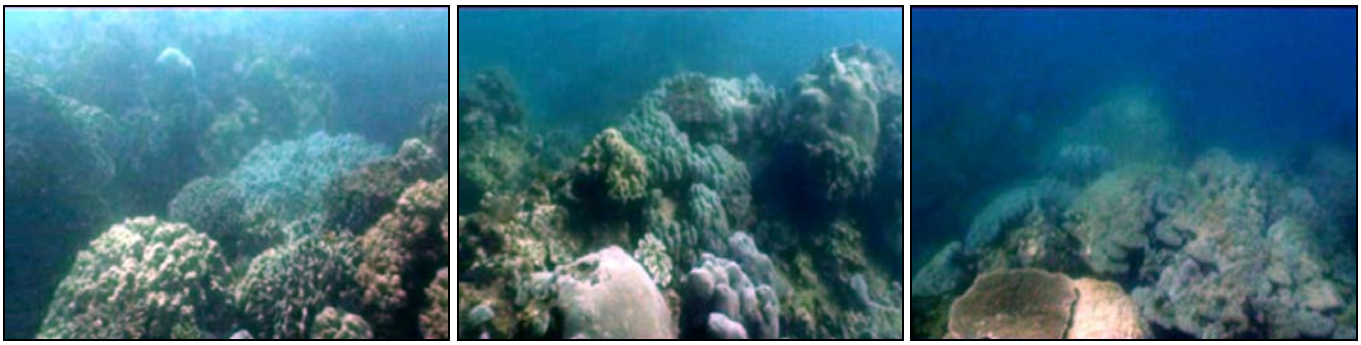


Site 11



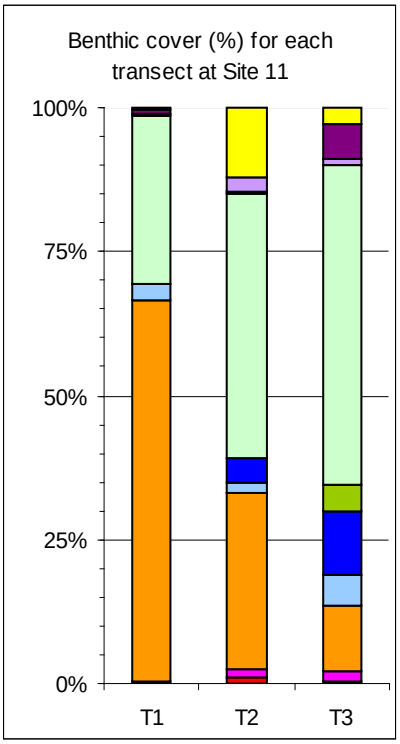
Site Code	**MBI/COR-011**
Locality	East of Ah Chong Island
Tenure	Montebello Islands Marine Park, Southern Montebellos Sanctuary Zone
Position	20.50624°S latitude; 115.56454°E longitude
Description	C-site; approximately 2 km east of Ah Chong Is; transect laid roughly in parallel at a bearing of 180°; an area with many large *Porites* bommies and high coral cover; depth 7.1 m below chart datum.

Images of site



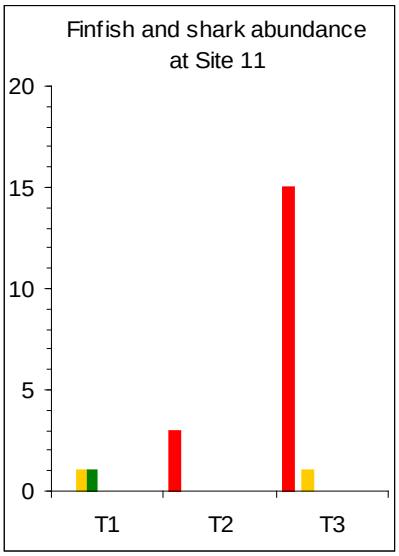
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	0.5	1.0	0	0.5	0.29
Pocilloporidae	0	0	0.5	0.2	0.17
Faviidae	0	1.5	1.5	1.0	0.50
Poritidae	66.0	30.5	11.5	36.0	15.97
Fungiidae	0	0	0	0	0
Other live hard coral	3.0	2.0	5.5	3.5	1.04
Total live hard coral	**69.5**	**35.0**	**19.0**	**41.2**	**14.90**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	4.0	11.0	5.0	3.21
Macroalgae	0	0	0	0	00
Rubble/turf algae	0	0	4.5	1.5	1.50
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	29.0	46.0	55.5	43.5	7.75
Reef/coralline algae	0.5	0.5	0	0.3	0.17
Sponge	0	2.5	1.0	1.2	0.73
Other live biota	0.5	0	6.0	2.2	1.92
Sand	0	12.0	3.0	5.0	3.61
Indeterminate	0.5	0	0	0.2	0.17



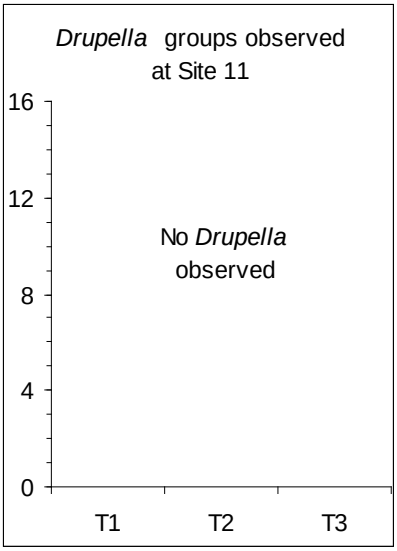
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	0	3	15
Emperor	0	0	0
Coral trout	1	0	1
Small cod	1	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	0	0	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



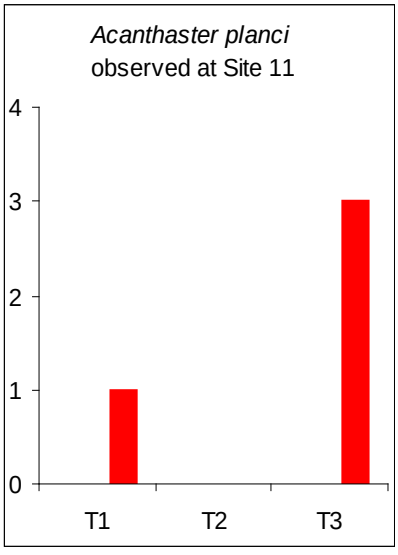
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	0	0	**0**
5-10	0	0	0	**0**
>10	0	0	0	**0**

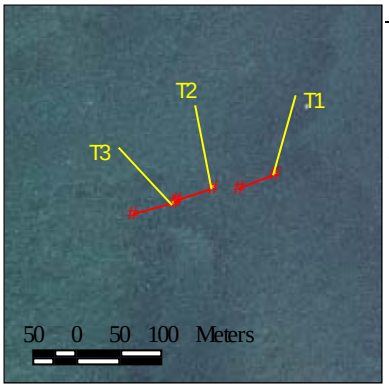


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	1	0	3	**4**

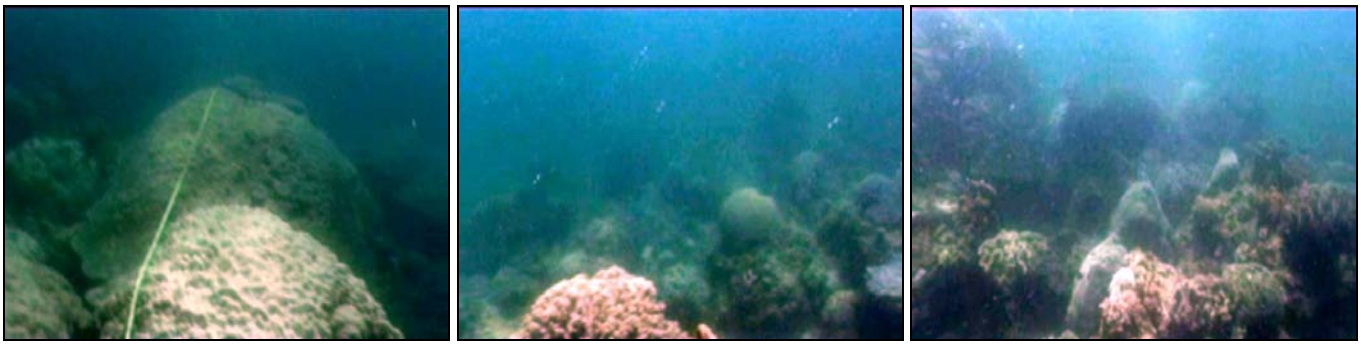


Site 12



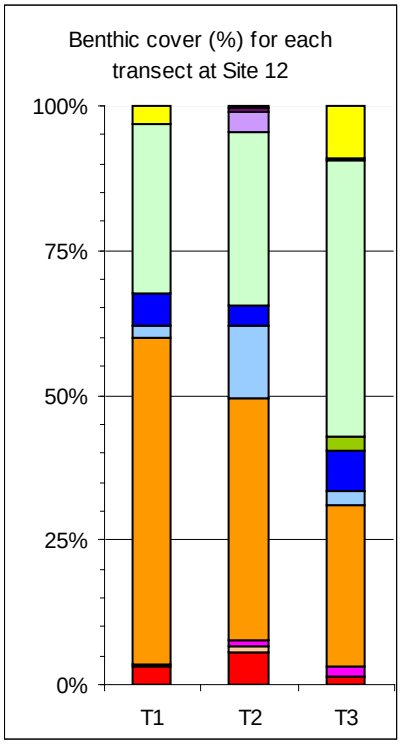
Site Code	**MBI/COR-012**
Locality	Shelf slope 2 km east of Black Rock
Tenure	Montebello Islands Marine Park, Southern Montebellos Sanctuary Zone
Position	20.55521°S latitude; 115.57220°E longitude
Description	C-site; transects laid in series on a bearing of 250°; an area of scattered *Porites* bommies and high coral cover; approximately 350 m north of boundary with Barrow Island Marine Protected Area; depth 7.0 m below chart datum.

Images of site



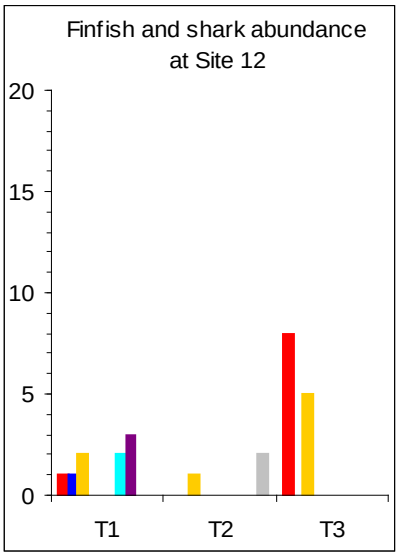
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	3.0	5.5	1.5	3.3	1.17
Pocilloporidae	0	1.0	0	0.3	0.33
Faviidae	0.5	1.0	1.5	1.0	0.29
Poritidae	56.5	42.0	28.0	42.2	8.23
Fungiidae	0	0	0	0	0
Other live hard coral	2.0	12.5	2.5	5.7	3.42
Total live hard coral	**62.0**	**62.0**	**33.5**	**52.5**	**9.50**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	5.5	3.5	7.0	5.3	1.01
Macroalgae	0	0	0	0	0
Rubble/turf algae	0	0	2.5	0.8	0.83
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	29.5	30	47.5	35.7	5.92
Reef/coralline algae	0	0	0	0	0
Sponge	0	3.5	0	1.2	1.17
Other live biota	0	0.5	0.5	0.3	0.17
Sand	3.0	0.5	9.0	4.2	2.52
Indeterminate	0	0	0	0	0



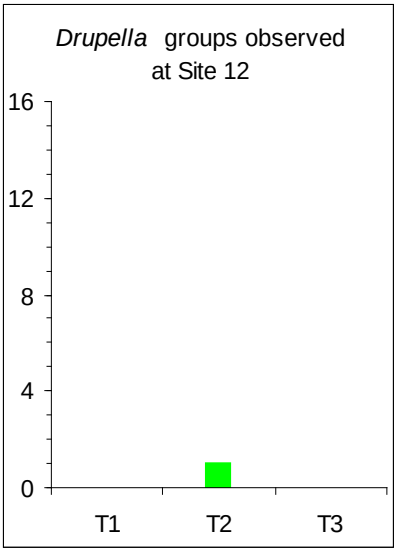
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	1	0	8
Emperor	1	0	0
Coral trout	2	1	5
Small cod	0	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	2	0	0
Trevally	3	0	0
Mackerel	0	0	0
Shark	0	2	0



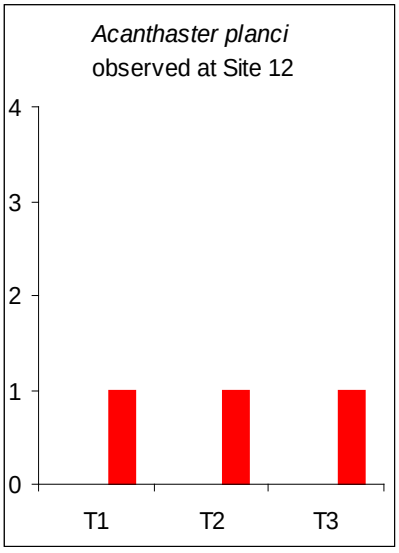
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	0	0	**0**
5-10	0	1	0	**1**
>10	0	0	0	**0**

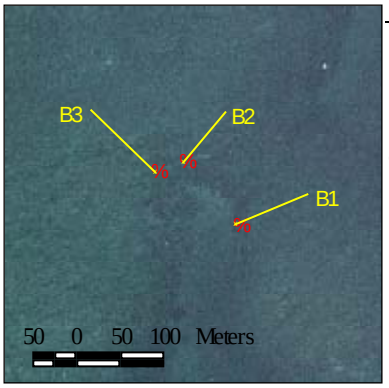


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	1	1	1	**3**

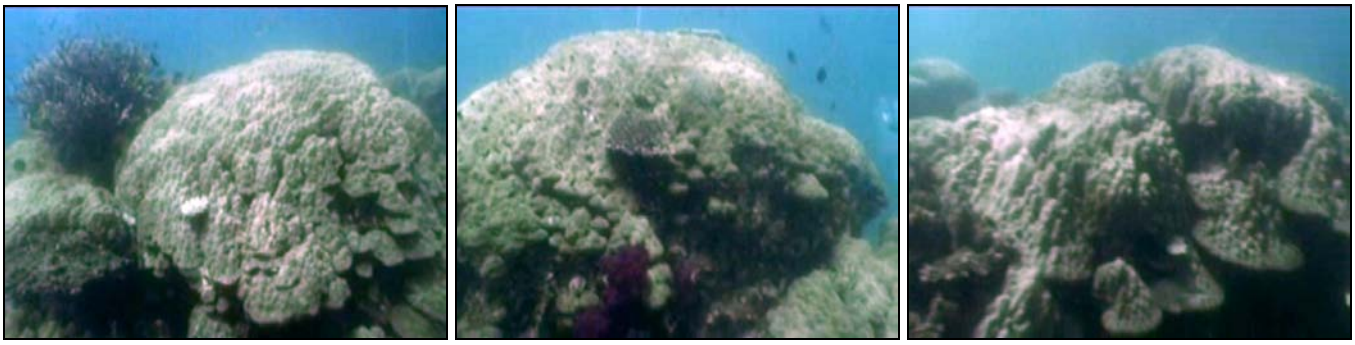


Site 13



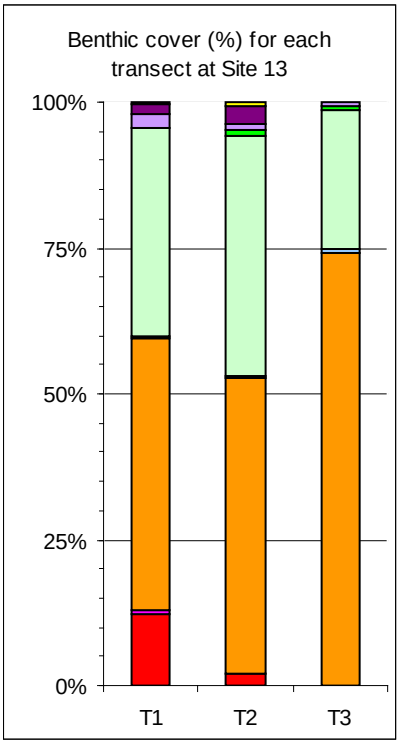
Site Code	**MBI/COR-013**
Locality	Shelf slope 2 km east of Black Rock
Tenure	Montebello Islands Marine Park, Southern Montebellos Sanctuary Zone
Position	20.55560°S latitude; 115.57201°E longitude
Description	P-site; an area of scattered *Porites* bommies and high cover of coral reef community between; approximately 300 m north of boundary with Barrow Island Marine Protected Area; close to Site 12; depth 5.9 m below chart datum.

Images of site



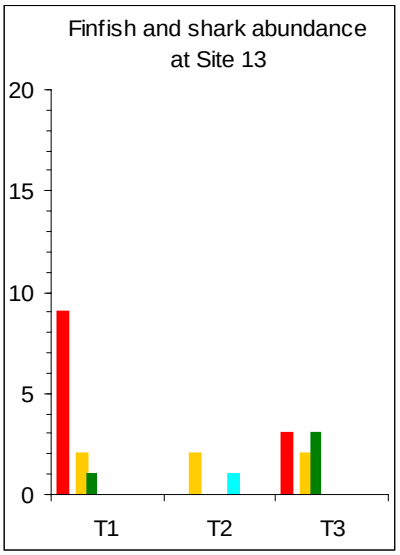
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	12.4	2.1	0	4.8	3.82
Pocilloporidae	0	0	0	0	0
Faviidae	0.5	0	0	0.2	0.16
Poritidae	46.7	50.5	74.0	57.1	8.54
Fungiidae	0	0	0	0	0
Other live hard coral	0.5	0.5	0.7	0.6	06
Total live hard coral	**60.0**	**53.2**	**74.7**	**62.6**	**6.34**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	0	0	0	0	0
Rubble/turf algae	0	0	0	0	0
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	35.7	41.1	24.0	33.6	5.04
Reef/coralline algae	0	1.1	0.7	0.6	0.31
Sponge	2.4	1.1	0.7	1.4	0.52
Other live biota	1.4	3.2	0	1.5	0.91
Sand	0	0.5	0	0.2	0.18
Indeterminate	0.5	0	0	0.2	0.16



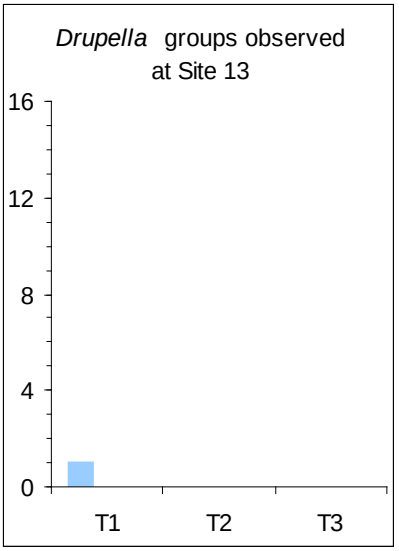
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	9	0	3
Emperor	0	0	0
Coral trout	2	2	2
Small cod	1	0	3
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	0	1	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



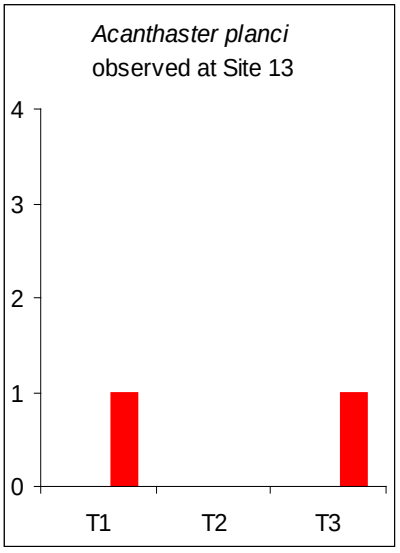
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	1	0	0	**1**
5-10	0	0	0	**0**
>10	0	0	0	**0**

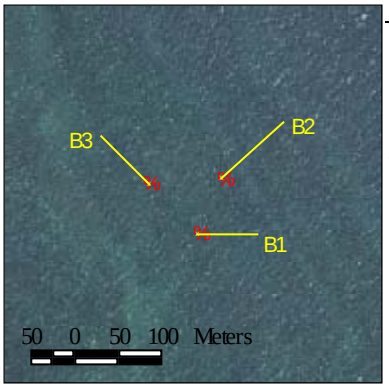


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	1	0	1	**2**



Site 14

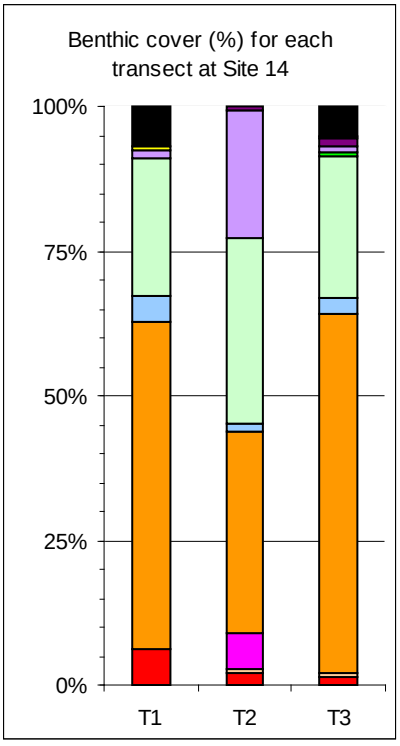


Site Code	**MBI/COR-014**
Locality	Shelf slope 2 km N of Bridled Island
Tenure	Port of Varanus Island
Position	20.62865°S latitude; 115.58306°E longitude
Description	P-site; an area of scattered medium and large sized *Porites* bommies; depth 6.1 below chart datum.

Images of site

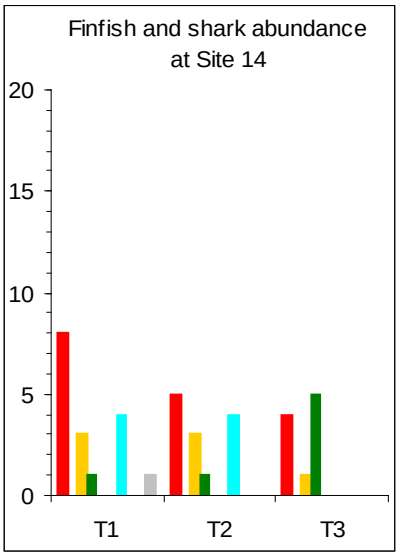
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	6.4	2.1	1.5	3.3	1.53
Pocilloporidae	0	0.5	0.5	0.3	0.17
Faviidae	0	6.3	0	2.1	2.11
Poritidae	56.4	34.7	62.0	51.0	8.31
Fungiidae	0	0	0	0	0
Other live hard coral	4.5	1.6	3.0	3.0	0.86
Total live hard coral	**67.3**	**45.3**	**67.0**	**59.8**	**7.29**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	0	0	0	0	0
Rubble/turf algae	0	0	0	0	0
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	23.6	32.1	24.5	26.7	2.69
Reef/coralline algae	0	0	0.5	0.2	0.17
Sponge	1.4	22.1	1.0	8.2	6.98
Other live biota	0	0.5	1.5	0.7	0.44
Sand	0.9	0	0.5	0.5	0.26
Indeterminate	6.8	0	5.0	3.9	2.04



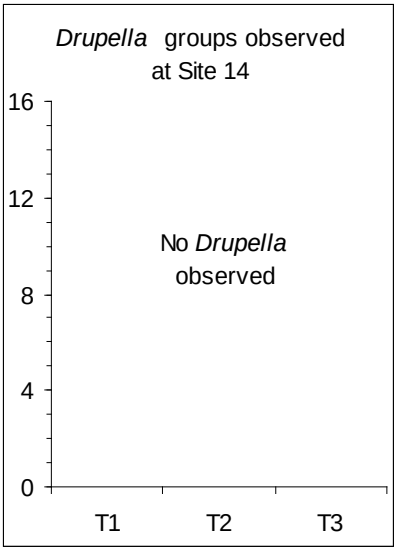
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	8	5	4
Emperor	0	0	0
Coral trout	3	3	1
Small cod	1	1	5
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	4	4	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	1	0	0



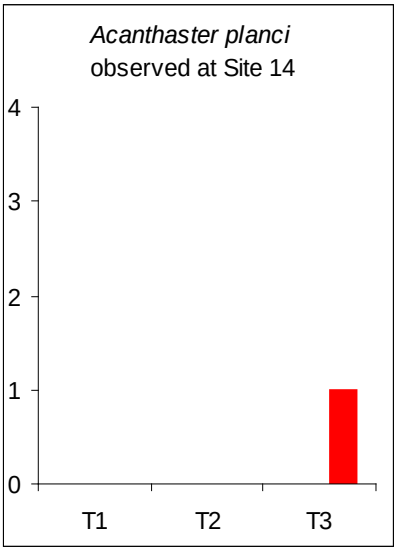
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	0	0	**0**
5-10	0	0	0	**0**
>10	0	0	0	**0**

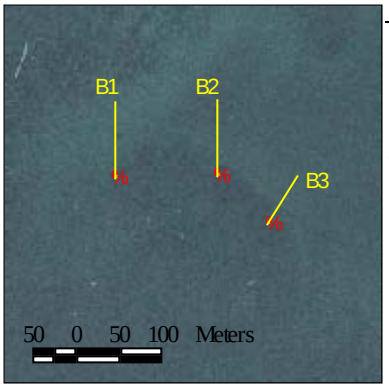


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	1	**1**

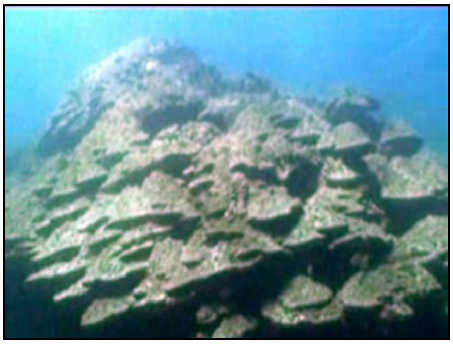
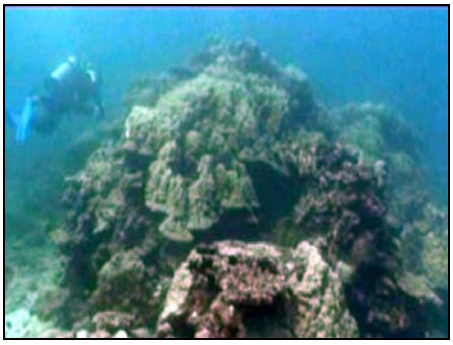


Site 15



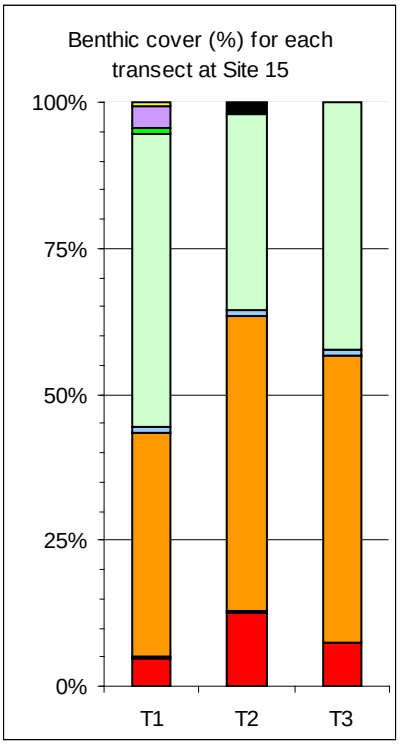
Site Code	**MBI/COR-015**
Locality	Shelf slope 7 km S of Varanus Island
Tenure	Barrow Island Marine Management Area
Position	20.71895°S latitude; 115.57733°E longitude
Description	P-site; an area of scattered medium and large sized *Porites* bommies; depth 5.9 m below chart datum.

Images of site

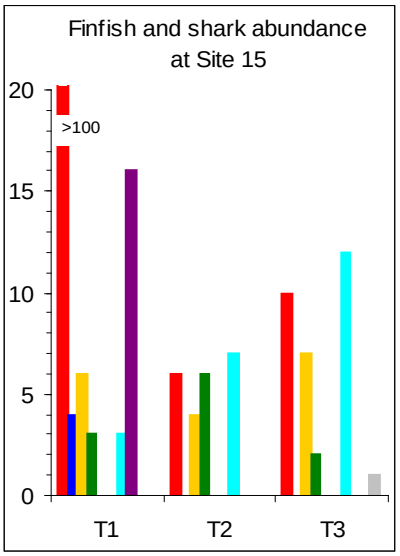

Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	4.9	12.5	7.6	8.3	2.23
Pocilloporidae	0	0	0	0	0
Faviidae	0.3	0.5	0	0.3	0.14
Poritidae	38.4	50.5	49.0	46.0	3.82
Fungiidae	0	0	0	0	0
Other live hard coral	0.8	1.0	1.0	0.9	0.06
Total live hard coral	**44.3**	**64.5**	**57.6**	**55.5**	**5.92**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	0	0	0	0	0
Rubble/turf algae	0	0	0	0	0
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	50.3	33.5	42.4	42.1	4.84
Reef/coralline algae	1.1	0	0	0.4	0.36
Sponge	3.8	0	0	1.3	1.26
Other live biota	0	0	0	0	0
Sand	0.5	0	0	0.2	0.18
Indeterminate	0	2.0	0	0.7	0.67



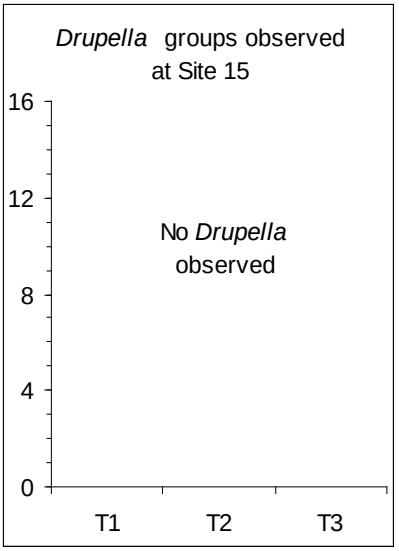
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	101	6	10
Emperor	4	0	0
Coral trout	6	4	7
Small cod	3	6	2
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	3	7	12
Trevally	16	0	0
Mackerel	0	0	0
Shark	0	0	1



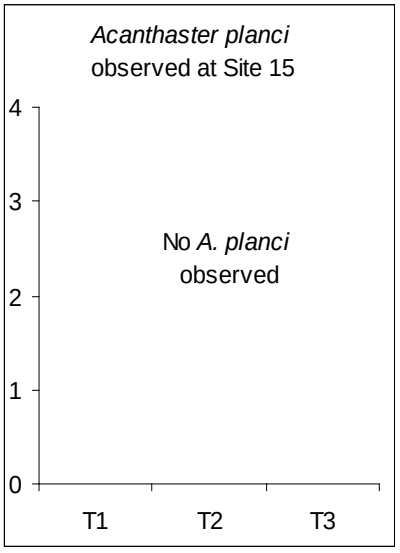
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	0	0	**0**
5-10	0	0	0	**0**
>10	0	0	0	**0**

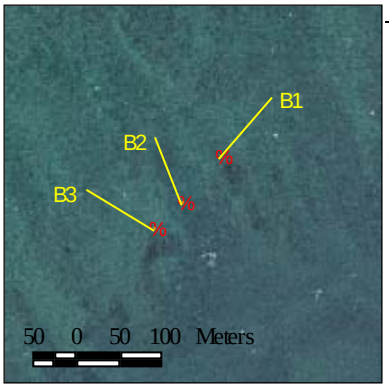


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

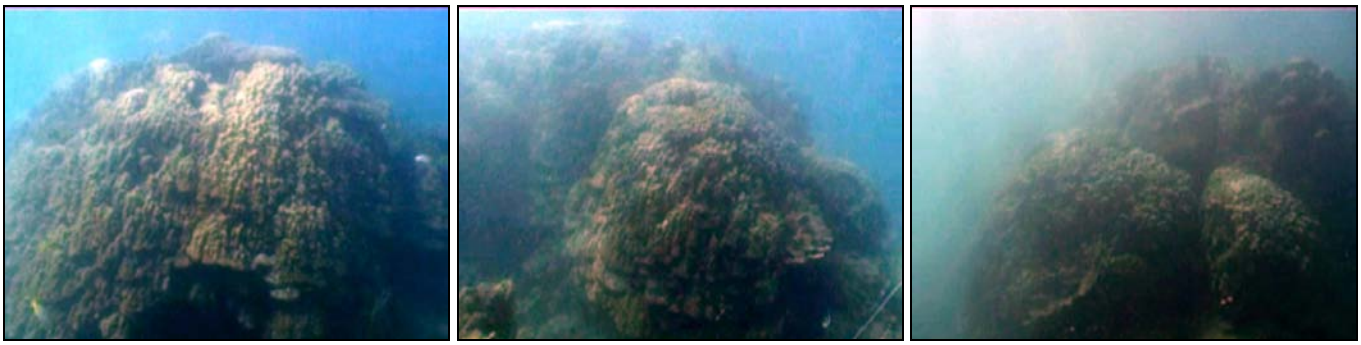


Site 16



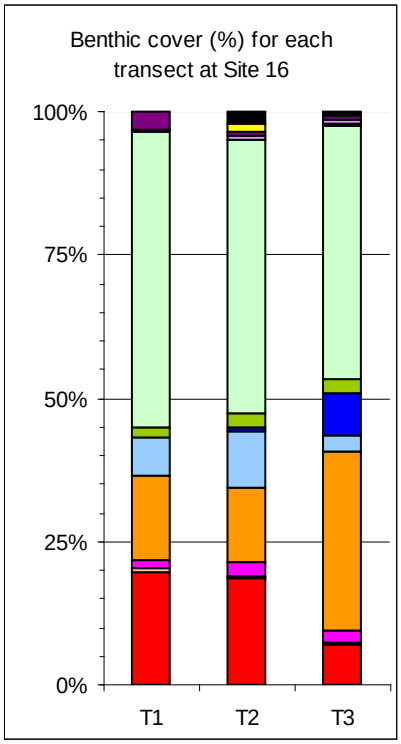
Site Code	**MBI/COR-016**
Locality	South Lowendal Shelf
Tenure	Barrow Island Port Area
Position	20.78418°S latitude; 115.52524°E longitude
Description	P-site; close to the southern end of the Lowendal Shelf; approximately 7 km E of Barrow Island, in an area of scattered *Porites* bommies; depth 4.2 m below chart datum.

Images of site



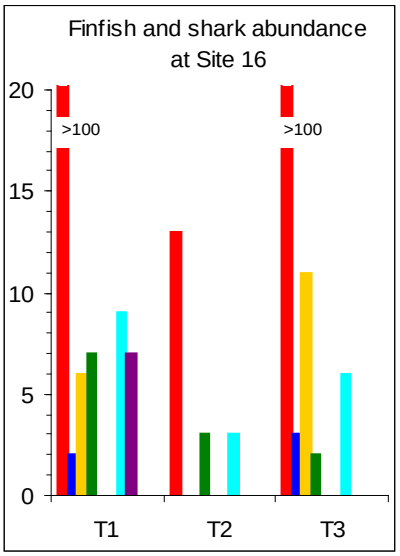
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	19.7	18.6	7.0	15.1	4.06
Pocilloporidae	0.7	0.5	0.3	0.5	0.12
Faviidae	1.3	2.3	2.3	2.0	0.31
Poritidae	15.0	13.2	31.3	19.8	5.74
Fungiidae	0	0	0	0	0
Other live hard coral	6.3	9.5	2.8	6.2	1.96
Total live hard coral	**43.0**	**44.1**	**43.5**	**43.5**	**0.32**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0.3	0.9	7.5	2.9	2.30
Macroalgae	0	0	0	0	0
Rubble/turf algae	1.7	2.3	2.3	2.1	0.20
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	51.7	47.7	44.3	47.9	2.14
Reef/coralline algae	0.3	0	0.5	0.3	0.15
Sponge	0	0.9	0.8	0.6	0.28
Other live biota	3.0	0.5	0.5	1.3	0.84
Sand	0	1.4	0	0.5	0.45
Indeterminate	0	2.3	0.8	1.0	0.67



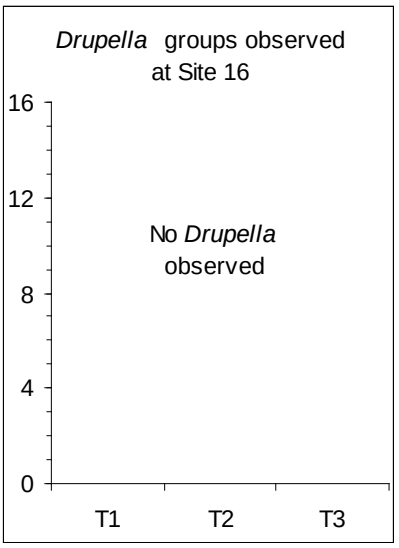
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	101	13	101
Emperor	2	0	3
Coral trout	6	0	11
Small cod	7	3	2
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	9	3	6
Trevally	7	0	0
Mackerel	0	0	0
Shark	0	0	0



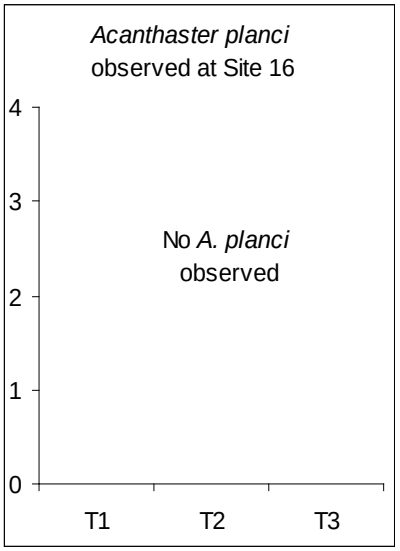
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	0	0	**0**
5-10	0	0	0	**0**
>10	0	0	0	**0**

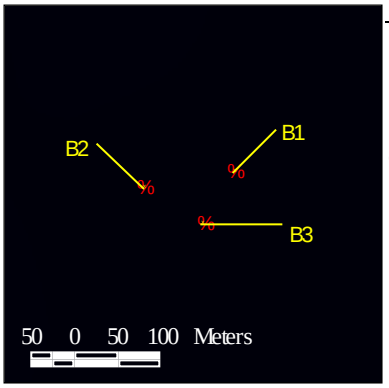


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**



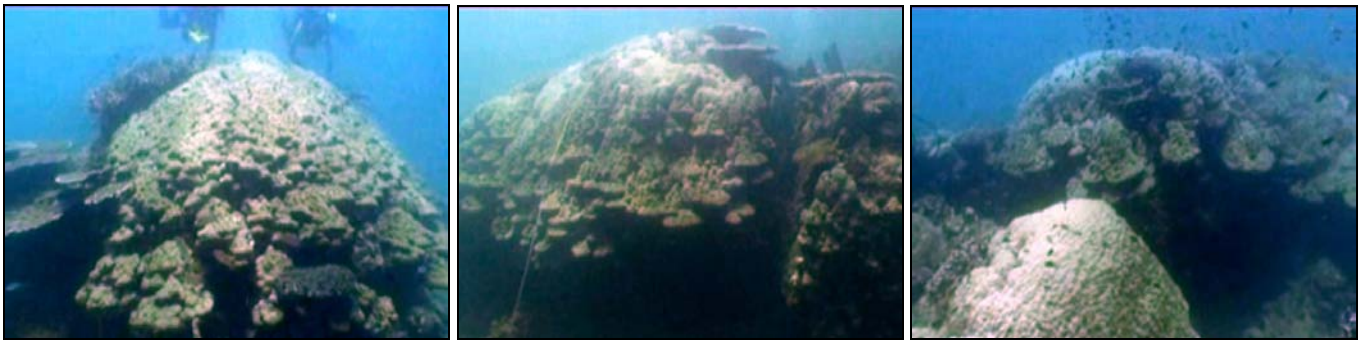
Site 17



(No image available)

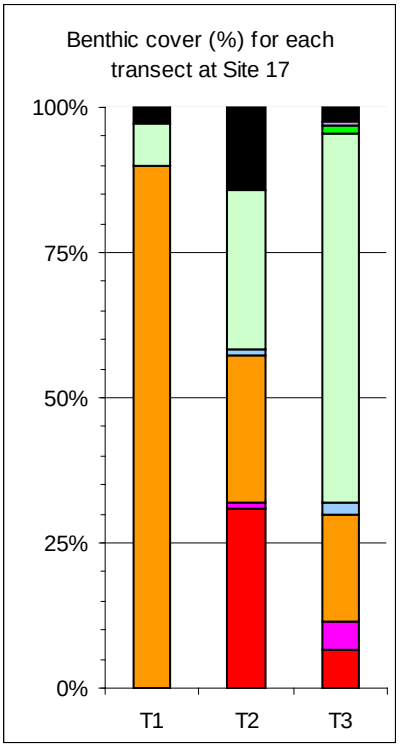
Site Code	**MBI/COR-017**
Locality	SE Lowendal Shelf
Tenure	Barrow Island Port Area
Position	20.75590°S latitude; 115.57408°E longitude
Description	P-site; 9 km E of Double Island; sites are located in an area of scattered *Porites* bommies of all sizes; along the shelf edge; depth 6.5 m below chart datum.

Images of site



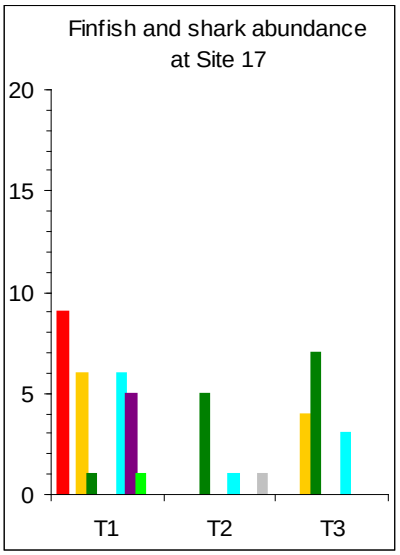
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	0.0	30.9	6.6	12.5	9.40
Pocilloporidae	0.0	0.0	0.0	0.0	0.00
Faviidae	0.0	0.9	4.7	1.9	1.45
Poritidae	90.0	25.5	18.7	44.7	22.73
Fungiidae	0.0	0.0	0.0	0.0	0.00
Other live hard coral	0.0	0.9	1.8	0.9	0.53
Total live hard coral	**90.0**	**58.2**	**31.8**	**60.0**	**16.81**
Bleach hard coral	0.0	0.0	0.0	0.0	0.00
Dead hard coral	0.0	0.0	0.0	0.0	0.00
Soft corals	0.0	0.0	0.0	0.0	0.00
Macroalgae	0.0	0.0	0.0	0.0	0.00
Rubble/turf algae	0.0	0.0	0.0	0.0	0.00
Rubble/coralline algae	0.0	0.0	0.0	0.0	0.00
Reef/turf algae	7.3	27.7	63.7	32.9	16.47
Reef/coralline algae	0.0	0.0	1.3	0.4	0.44
Sponge	0.0	0.0	0.8	0.3	0.26
Other live biota	0.0	0.0	0.0	0.0	0.00
Sand	0.0	0.0	0.0	0.0	0.00
Indeterminate	2.7	14.1	2.4	6.4	3.86



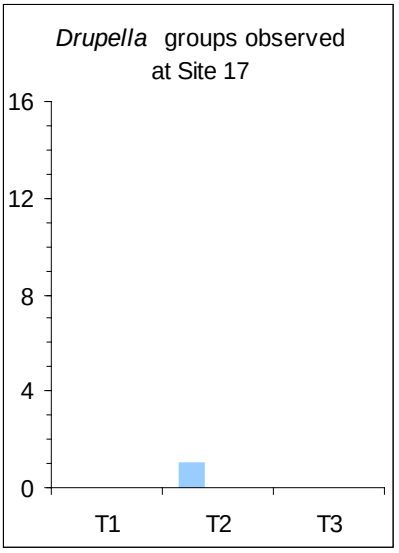
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	9	0	0
Emperor	0	0	0
Coral trout	6	0	4
Small cod	1	5	7
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	6	1	3
Trevally	5	0	0
Mackerel	1	0	0
Shark	0	1	0



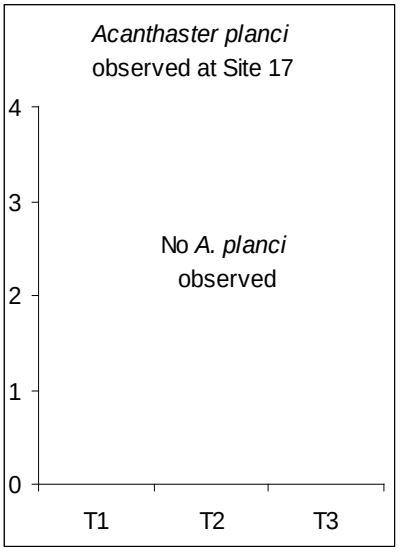
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	1	0	**1**
5-10	0	0	0	**0**
>10	0	0	0	**0**

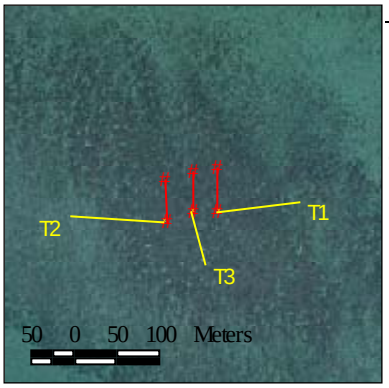


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

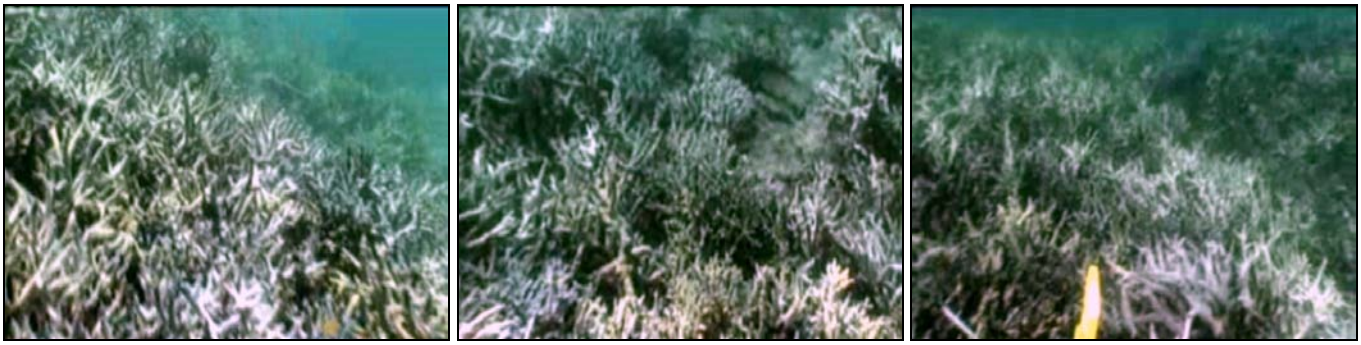


Site 18



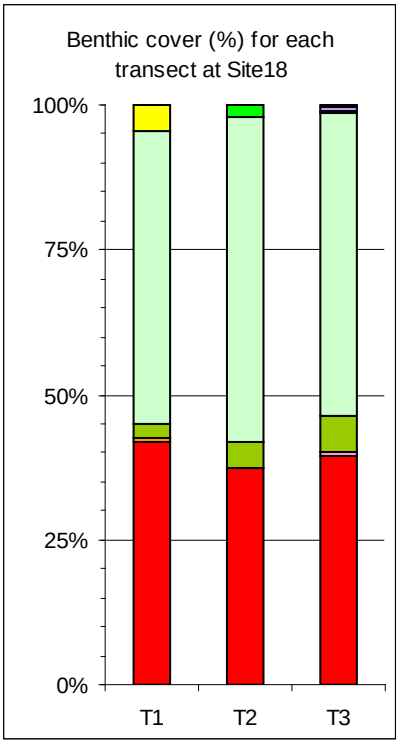
Site Code	**MBI/COR-018**
Locality	Southern Lowendal Shelf
Tenure	Barrow Island Port Area
Position	20.78631°S latitude; 115.50638°E longitude
Description	C-site; transects were laid in parallel at a bearing of 0°; a substantial area (~0.5 km^2) of mainly arborescent *Acropora* corals; at the southern tip of the Lowendal Shelf; depth 0.5 m below chart datum.

Images of site



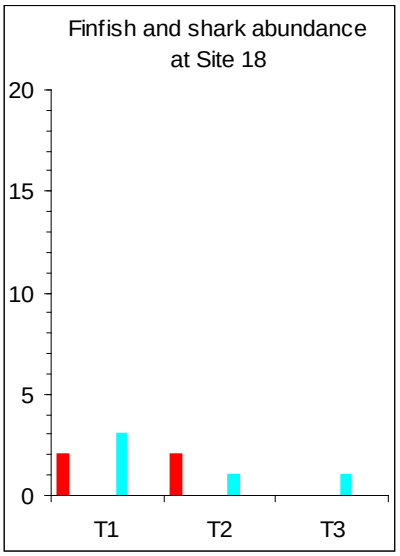
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	42.0	37.5	39.5	39.7	1.30
Pocilloporidae	0	0	0.5	0.2	0.17
Faviidae	0	0	0	0	0
Poritidae	0	0	0	0	0
Fungiidae	0	0	0	0	0
Other live hard coral	0.5	0	0	0.2	0.17
Total live hard coral	**42.5**	**37.5**	**40**	**40**	**1.44**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	0	0	0	0	0
Rubble/turf algae	2.5	4.5	6.5	4.5	1.15
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	50.5	56.0	52.0	52.8	1.64
Reef/coralline algae	0	2.0	0.5	0.8	0.60
Sponge	0	0	0.5	0.2	0.17
Other live biota	0	0	0	0	0
Sand	4.5	0	0.5	1.7	1.42
Indeterminate	0	0	0	0	0



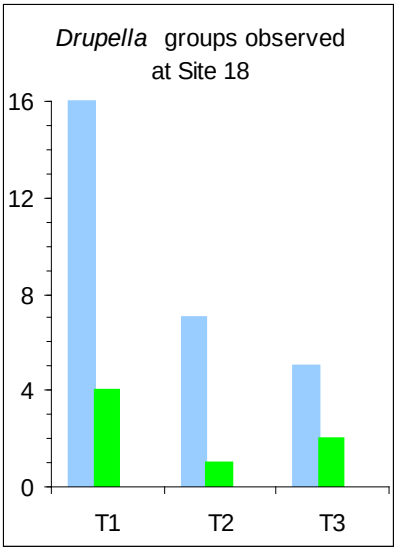
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	2	2	0
Emperor	0	0	0
Coral trout	0	0	0
Small cod	0	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	3	1	1
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



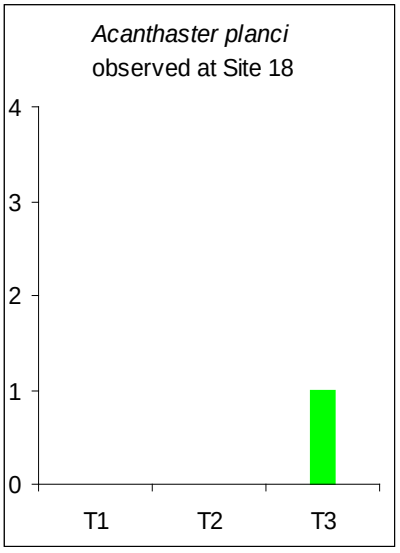
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	16	7	5	**28**
5-10	4	1	2	**7**
>10	0	0	0	**0**

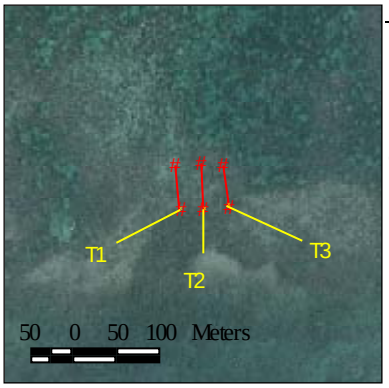


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	1	**1**
> 30 cm	0	0	0	**0**



Site 19

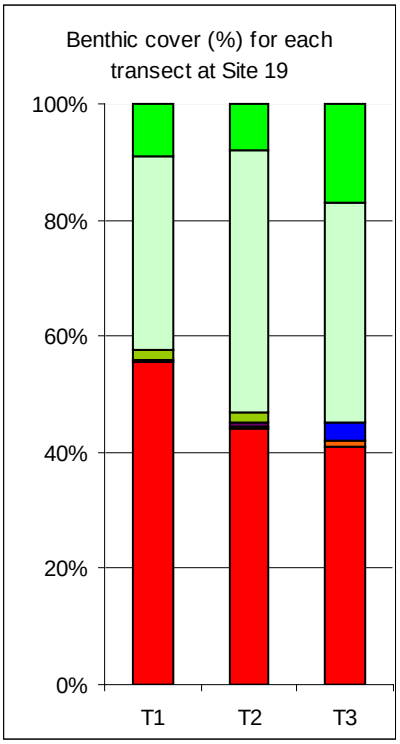


Site Code	**MBI/COR-019**
Locality	Inside Wonnich Reef
Tenure	Montebello Islands Marine Park, Southern Montebellos Sanctuary Zone
Position	20.50991°S latitude; 115.47759°E longitude
Description	C-site; transects were laid in parallel at a bearing of 0°; a substantial area (~1.5 km^2) of plate *Acropora* corals; appears to be a typical back reef assemblage; approximately 2.5 km east of Wonnich Reef; depth 0.6 m below chart datum.

Images of site

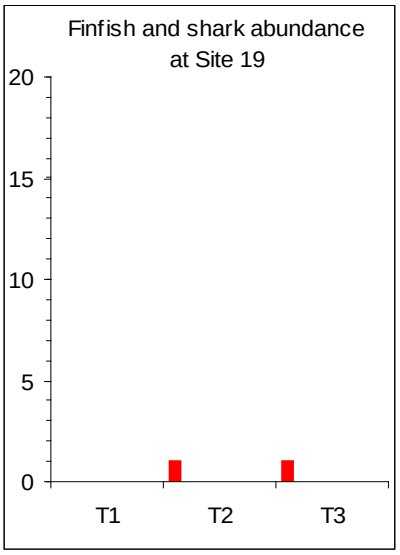
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	55.5	44.0	41.0	46.8	4.42
Pocilloporidae	0	0.5	0	0.2	0.17
Faviidae	0	0	0	0	0
Poritidae	0	0	1.0	0.3	0.33
Fungiidae	0.5	0.5	0	0.3	0.17
Other live hard coral	0	0	0	0	0
Total live hard coral	**56.0**	**45.0**	**42.0**	**47.7**	**4.26**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	3.0	1.0	1.00
Macroalgae	0	0	0	0	0
Rubble/turf algae	1.5	2.0	0	1.2	0.60
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	33.5	45.0	38.0	38.8	3.35
Reef/coralline algae	9.0	8.0	17.0	11.3	2.85
Sponge	0	0	0	0	0
Other live biota	0	0	0	0	0
Sand	0	0	0	0	0
Indeterminate	0	0	0	0	0



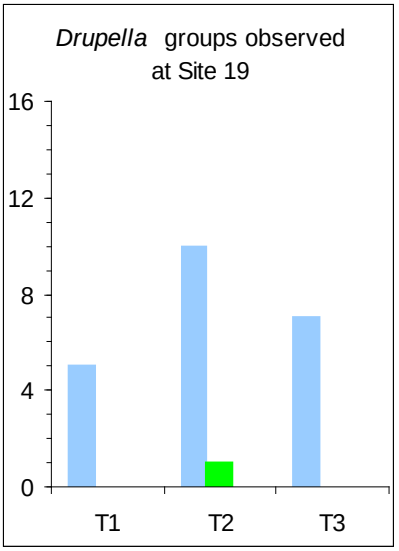
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	0	1	1
Emperor	0	0	0
Coral trout	0	0	0
Small cod	0	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	0	0	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



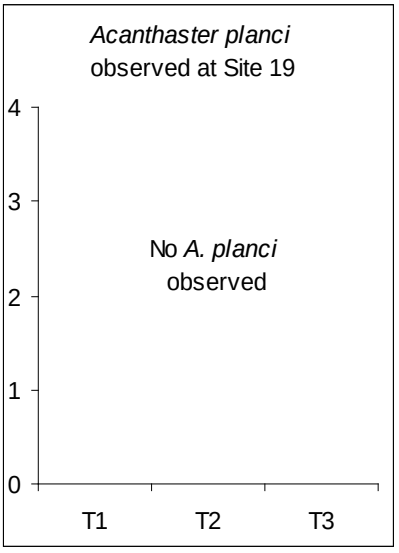
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	5	10	7	**22**
5-10	0	1	0	**1**
>10	0	0	0	**0**

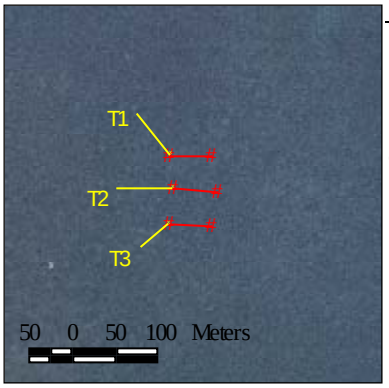


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

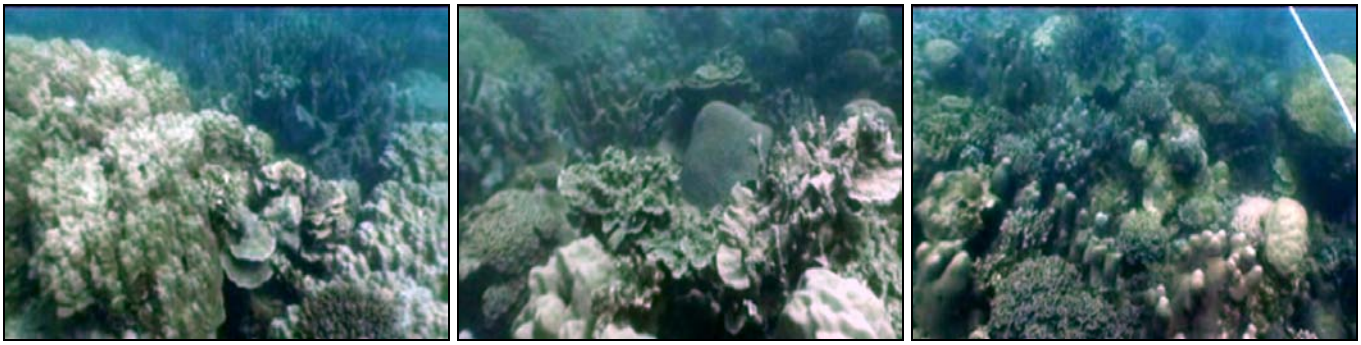


Site 20



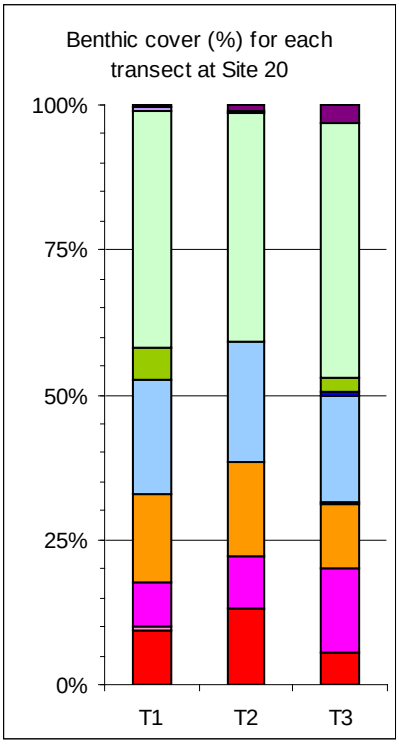
Site Code	**MBI/COR-020**
Locality	East Dugong Reef
Tenure	Barrow Island Marine Management Area
Position	20.90227°S latitude; 115.46203°E longitude
Description	C-site; transects were laid in parallel at a bearing of 90°; a substantial area (~2.0 km^2) of highly diverse and abundant coral reef; at the northern end of the shoals; approximately 1.5 km south of boundary of the Barrow Island Port Area; depth 3.7 m below chart datum.

Images of site



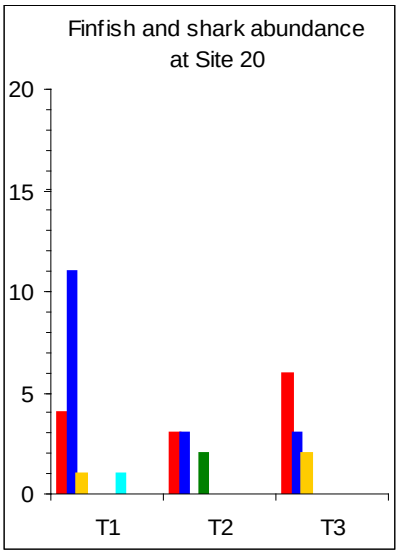
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	9.5	13.0	5.5	9.3	2.17
Pocilloporidae	0.5	0	0	0.2	0.17
Faviidae	7.5	9.0	14.5	10.3	2.13
Poritidae	15.5	16.5	11.0	14.3	1.69
Fungiidae	0	0	0.5	0.2	0.17
Other live hard coral	19.5	20.5	18.5	19.5	0.58
Total live hard coral	**52.5**	**59.0**	**50**	**53.8**	**2.68**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0.5	0.2	0.17
Macroalgae	0	0	0	0	0
Rubble/turf algae	5.5	0	2.5	2.7	1.59
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	41.0	39.5	44.0	41.5	1.32
Reef/coralline algae	0	0.5	0	0.2	0.17
Sponge	0.5	0	0	0.2	0.17
Other live biota	0.5	1.0	3.0	1.5	0.76
Sand	0	0	0	0	0
Indeterminate	0	0	0	0	0



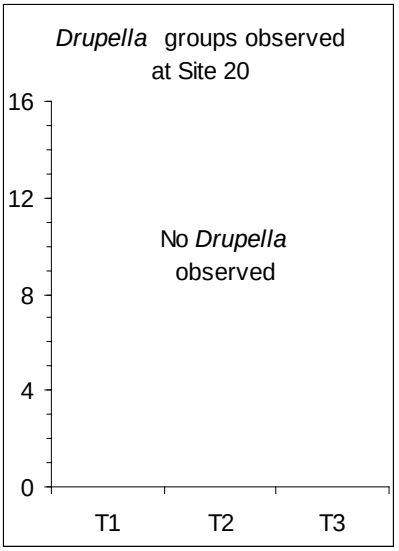
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	4	3	6
Emperor	11	3	3
Coral trout	1	0	2
Small cod	0	2	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	1	0	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



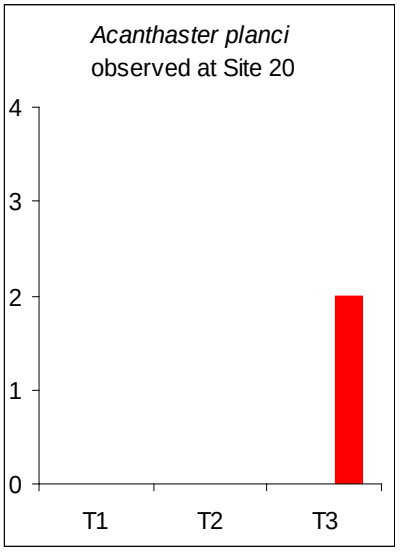
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	0	0	**0**
5-10	0	0	0	**0**
>10	0	0	0	**0**

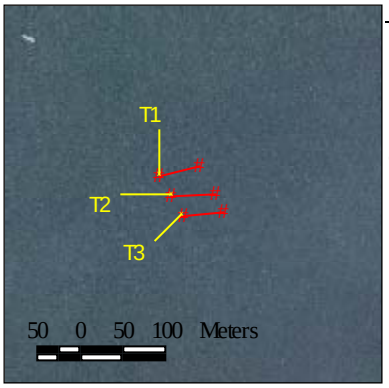


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	2	**2**

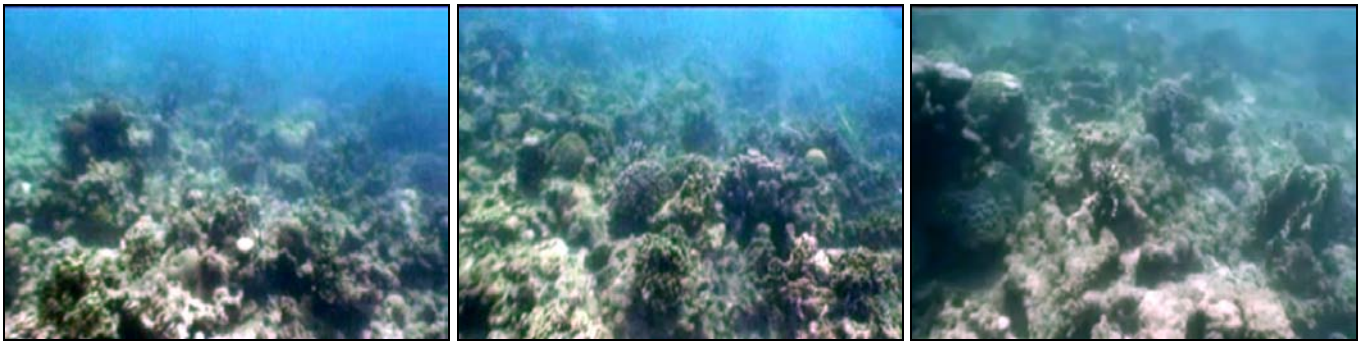


Site 21



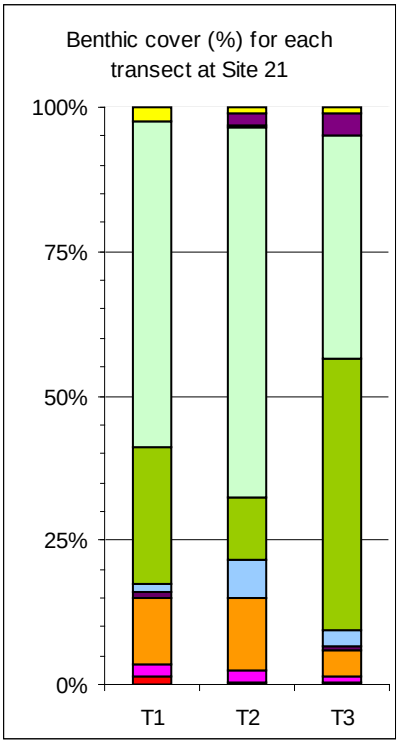
Site Code	**MBI/COR-021**
Location	Central Dugong Reef
Tenure	Barrow Island Marine Management Area
Lat/Longs	20.90007°S latitude; 115.45120°E longitude
Description	C-site; transects were laid in parallel at a bearing of 90°; approx 2 ha of coral reef with moderate coral cover and rubble zones; at the northern end of the shoals; approximately 1 km south of boundary of Barrow Island Port Area; depth 1.4 m below chart datum.

Images of site



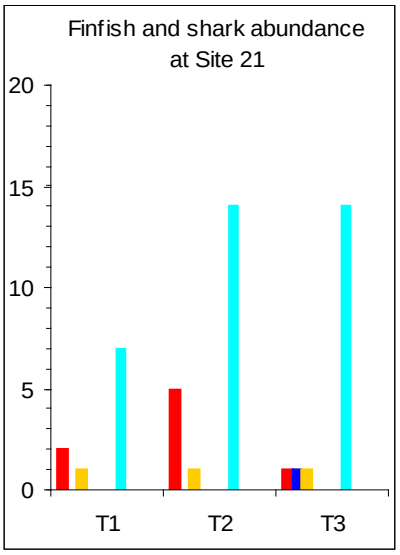
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	1.5	0.5	0.5	0.8	0.33
Pocilloporidae	0	0	0	0	0
Faviidae	2.0	2.0	1.0	1.7	0.33
Poritidae	11.5	12.5	4.5	9.5	2.52
Fungiidae	1.0	0	0.5	0.5	0.29
Other live hard coral	1.5	6.5	3.0	3.7	1.48
Total live hard coral	**17.5**	**21.5**	**9.5**	**16.2**	**3.53**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	0	0	0	0	0
Rubble/turf algae	23.5	11.0	47.0	27.2	10.55
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	56.5	64.0	38.5	53.0	7.57
Reef/coralline algae	0	0	0	0	00
Sponge	0	0.5	0	0.2	0.17
Other live biota	0	2.0	4.0	2.0	1.15
Sand	2.5	1.0	1.0	1.5	0.50
Indeterminate	0	0	0	0	0



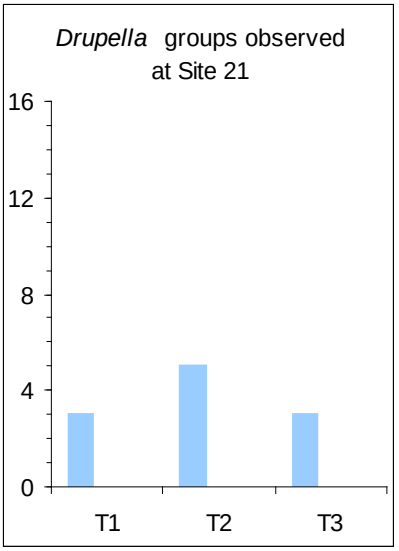
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	2	5	1
Emperor	0	0	1
Coral trout	1	1	1
Small cod	0	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	7	14	14
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



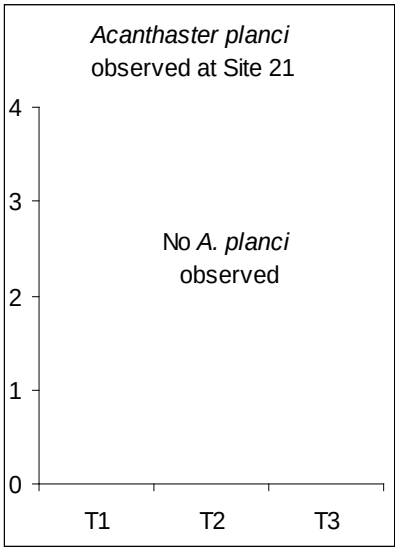
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	3	5	3	**11**
5-10	0	0	0	**0**
>10	0	0	0	**0**

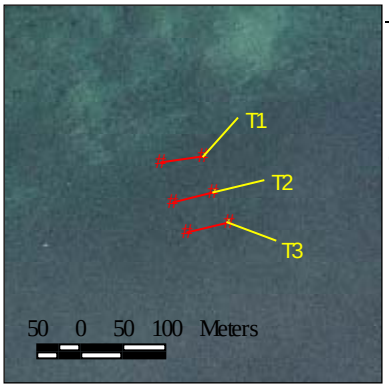


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**



Site 22

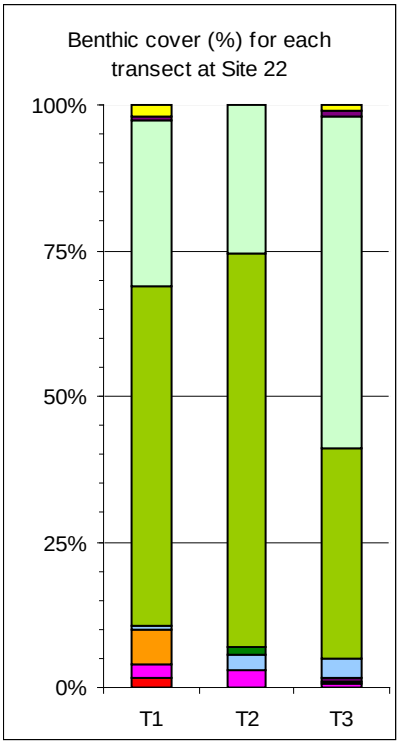


Site Code	**MBI/COR-022**
Locality	West Dugong Reef
Tenure	Barrow Island Marine Management Area
Position	20.89544°S latitude; 115.44023°E longitude
Description	C-site; transects were laid in parallel at a bearing of 260°; a substantial area (> 2 km^2) of dead coral and coral rubble; at the northern end of the shoals; approximately 0.5 km south of boundary of Barrow Island Port Area; depth 0.4 m below chart datum.

Images of site

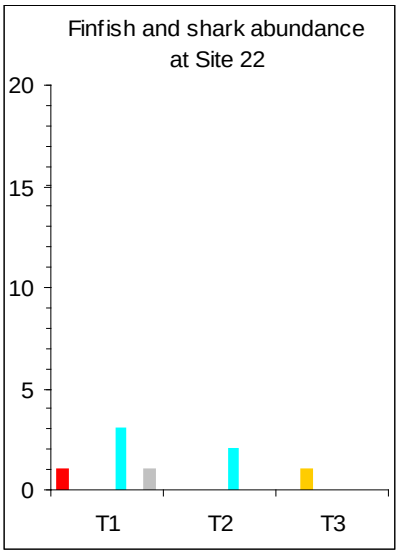
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	1.5	0	0	0.5	0.50
Pocilloporidae	0	0	0	0	0
Faviidae	2.5	3.0	0.5	2.0	0.76
Poritidae	6.0	0	0.5	2.2	1.92
Fungiidae	0	0	0.5	0.2	0.17
Other live hard coral	0.5	2.5	3.5	2.2	0.88
Total live hard coral	**10.5**	**5.5**	**5.0**	**7.0**	**1.76**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	0	1.5	0	0.5	0.50
Rubble/turf algae	58.5	67.5	36.0	54.0	9.37
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	28.5	25.5	57.0	37.0	104
Reef/coralline algae	0	0	0	0	0
Sponge	0	0	0	0	0
Other live biota	0.5	0	1.0	0.5	0.29
Sand	2.0	0	1.0	1.0	0.58
Indeterminate	0	0	0	0	0



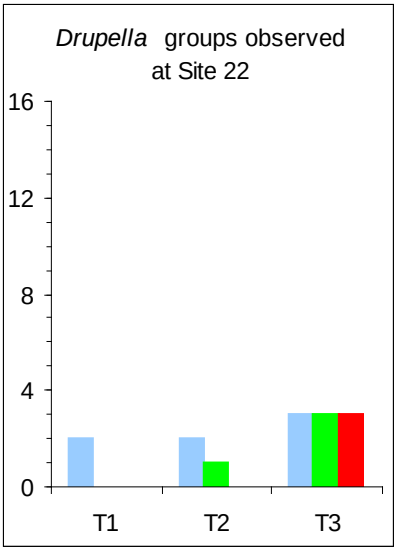
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	1	0	0
Emperor	0	0	0
Coral trout	0	0	1
Small cod	0	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	3	2	0
Trevally	0	0	0
Mackerel	0	0	0
Shark	1	0	0



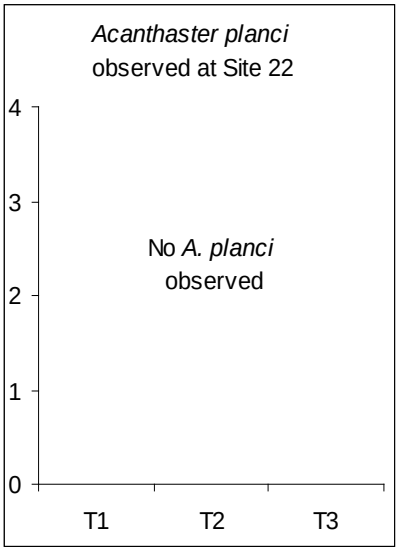
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	2	2	3	**7**
5-10	0	1	3	**4**
>10	0	0	3	**3**

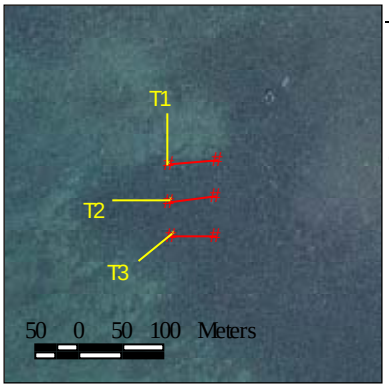


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**



Site 23

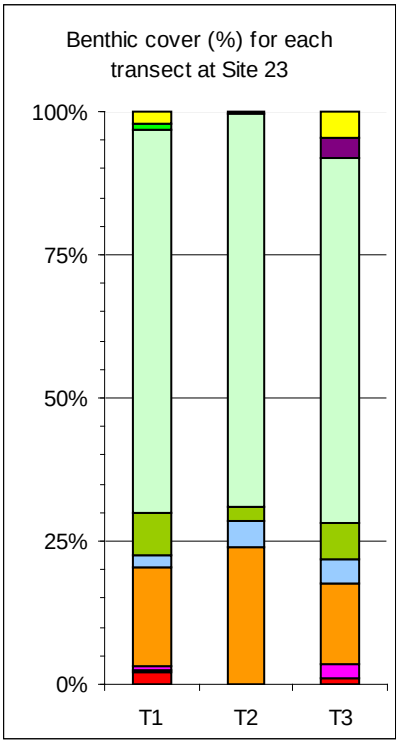


Site Code	**MBI/COR-023**
Locality	South Batman Reef
Tenure	Barrow Island Marine Management Area
Position	20.96019°S latitude; 115.46542°E longitude
Description	C-site; transects were laid in parallel at a bearing of 90°; a patch of coral and coral rubble and small bommies (< 2m diameter); positioned at the south-west edge of the shoals; depth 2.2 m below chart datum.

Images of site

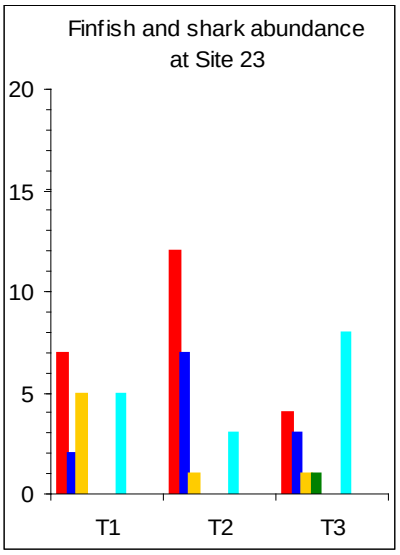
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	2.0	0	1.0	1.0	0.58
Pocilloporidae	0.5	0	0	0.2	0.17
Faviidae	0.5	0	2.5	1.0	0.76
Poritidae	17.5	24.0	14.0	18.5	2.93
Fungiidae	0	0	0	0	0
Other live hard coral	2.0	4.5	4.5	3.7	0.83
Total live hard coral	**22.5**	**28.5**	**22.0**	**24.3**	**2.09**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	0	0	0	0	0
Rubble/turf algae	7.5	2.5	6.0	5.3	1.48
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	67.0	68.5	64.0	66.5	1.32
Reef/coralline algae	1.0	0	0	0.3	0.33
Sponge	0	0	0	0	0
Other live biota	0	0	3.5	1.2	1.17
Sand	2.0	0.5	4.5	2.3	1.17
Indeterminate	0	0	0	0	0



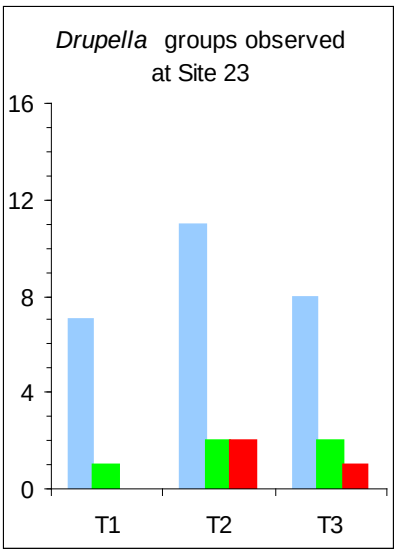
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	7	12	4
Emperor	2	7	3
Coral trout	5	1	1
Small cod	0	0	1
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	5	3	8
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	0



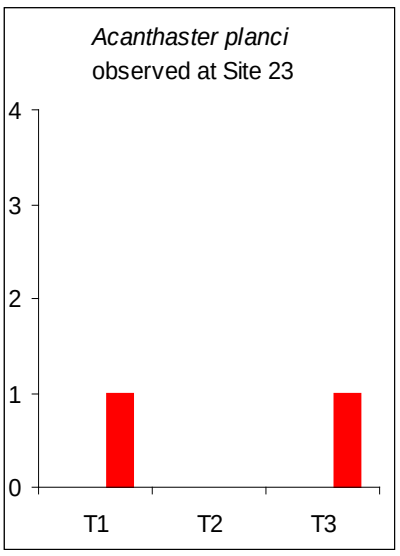
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	7	11	8	**26**
5-10	1	2	2	**5**
>10	0	2	1	**3**

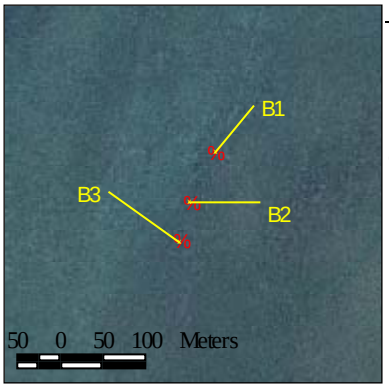


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	1	0	1	**2**



Site 24

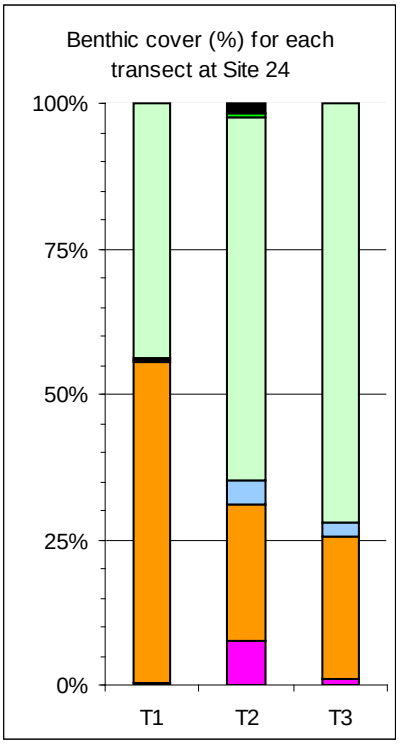


Site Code	**MBI/COR-024**
Locality	North Batman Reef
Tenure	Barrow Island Marine Management Area
Position	20.95149°S latitude; 115.46262°E longitude
Description	P-site; an area with scattered small (< 2 m diameter) *Porites* bommies, macroalgae and some corals between; located on the north-western edge of the shoals; depth 2.5 m below chart datum.

Images of site

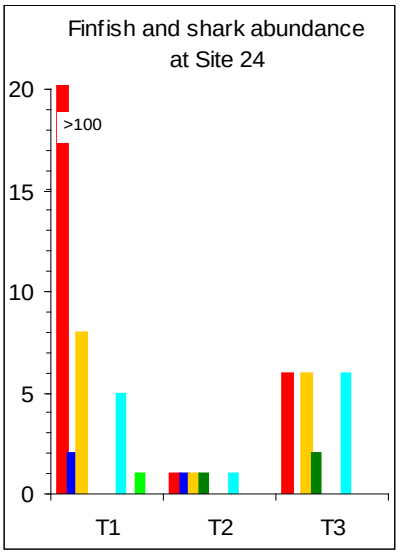
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	0	0	0	0	0
Pocilloporidae	0	0	0	0	0
Faviidae	0.5	7.6	1.1	3.1	2.30
Poritidae	55.0	23.5	24.4	34.3	10.34
Fungiidae	0	0	0	0	0
Other live hard coral	0.5	4.1	2.2	2.3	1.06
Total live hard coral	**55.9**	**35.3**	**27.8**	**39.7**	**8.41**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0.5	0	0	0.2	0.15
Macroalgae	0	0	0	0	0
Rubble/turf algae	0	0	0	0	0
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	43.6	62.4	72.2	59.4	8.38
Reef/coralline algae	0	0.6	0	0.2	0.20
Sponge	0	0	0	0	0
Other live biota	0	0	0	0	0
Sand	0	0	0	0	0
Indeterminate	0	1.8	0	0.6	0.59



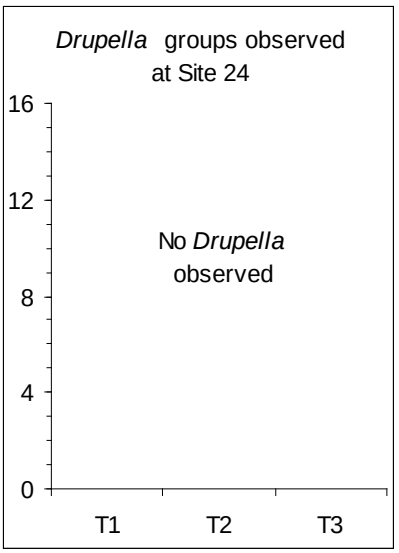
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	22	1	6
Emperor	2	1	0
Coral trout	8	1	6
Small cod	0	1	2
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	5	1	6
Trevally	0	0	0
Mackerel	1	0	0
Shark	0	0	0



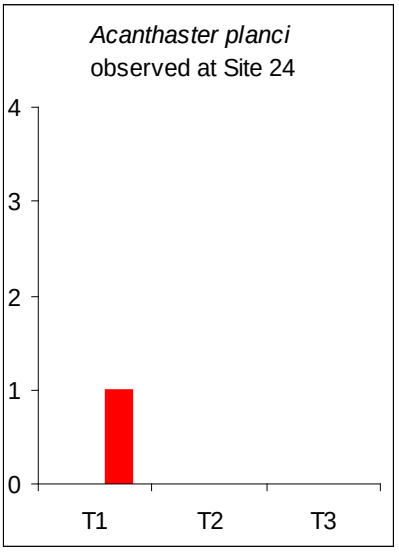
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	0	0	**0**
5-10	0	0	0	**0**
>10	0	0	0	**0**

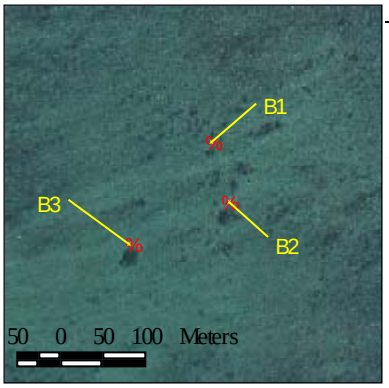


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	1	0	0	**1**



Site 25

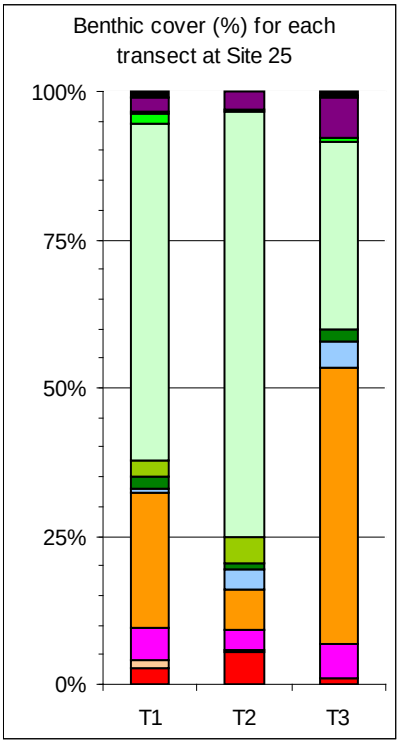


Site Code	**MBI/COR-025**
Locality	North Barrow Shoals
Tenure	Barrow Island Marine Management Area
Position	20.99447°S latitude; 115.48062°E longitude
Description	P-site; sites located in area of sparsely scattered small (< 2 m diameter) *Porites* bommies with mainly sand between; depth 1.5 m below chart datum

Images of site

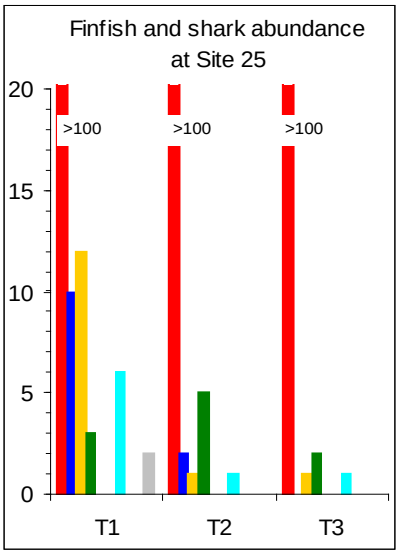
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	2.6	5.5	1.1	3.1	1.29
Pocilloporidae	1.4	0.3	0	0.6	0.43
Faviidae	5.4	3.2	5.6	4.7	0.76
Poritidae	22.9	7.1	46.7	25.5	11.50
Fungiidae	0	0	0	0	0
Other live hard coral	0.9	3.2	4.4	2.8	1.05
Total live hard coral	**33.1**	**19.4**	**57.8**	**36.8**	**11.24**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	2.0	1.0	2.2	1.7	0.39
Rubble/turf algae	2.6	4.5	0	2.4	1.31
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	56.9	71.6	31.7	53.4	11.66
Reef/coralline algae	1.7	0.3	0.6	0.9	0.43
Sponge	0.3	0	0	0.1	0.10
Other live biota	2.6	3.2	6.7	4.2	1.27
Sand	0	0	0.6	0.2	0.19
Indeterminate	0.9	0	0.6	0.5	0.25



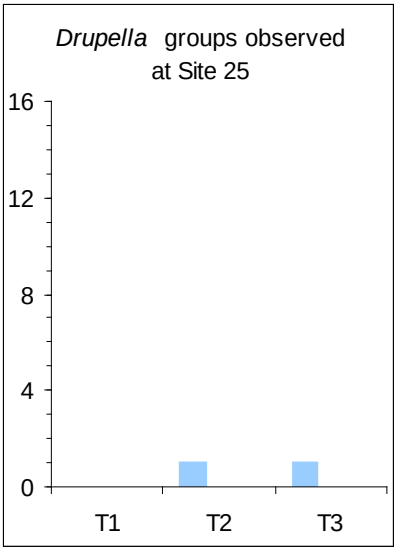
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	101	101	101
Emperor	10	2	0
Coral trout	12	1	1
Small cod	3	5	2
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	6	1	1
Trevally	0	0	0
Mackerel	0	0	0
Shark	2	0	0



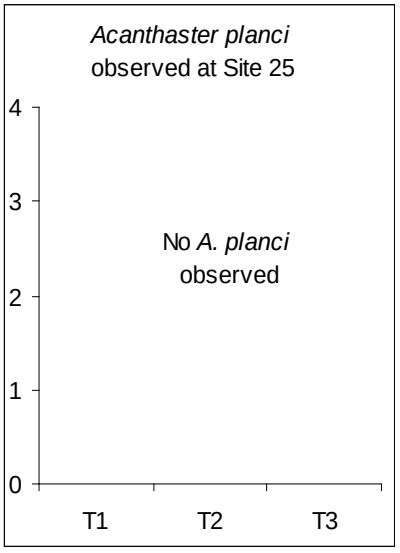
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	0	1	1	**2**
5-10	0	0	0	**0**
>10	0	0	0	**0**

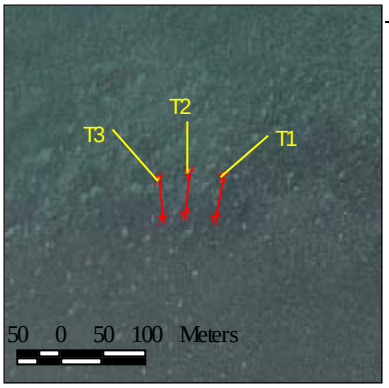


Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

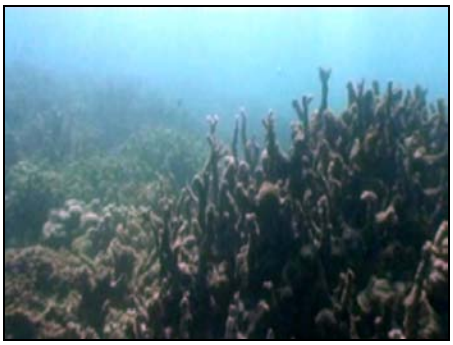


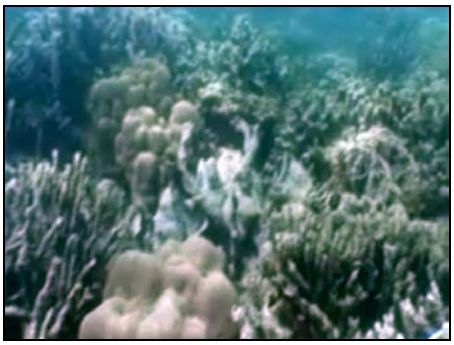
Site 26



Site Code	**MBI/COR-026**
Locality	Central East Barrow Shoals
Tenure	Barrow Island Marine Management Area
Position	21.07757°S latitude; 115.51348°E longitude
Description	C-site; transects were laid parallel on a bearing of 180°; a substantial area (~2 km^2) of coral reef; depth 2.7 m below chart datum.

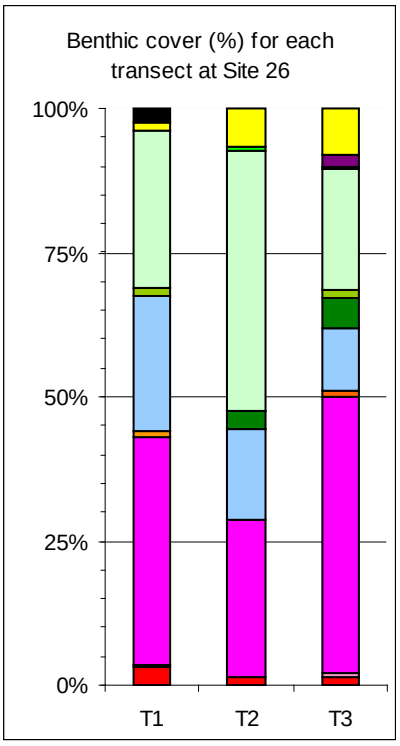
Images of site





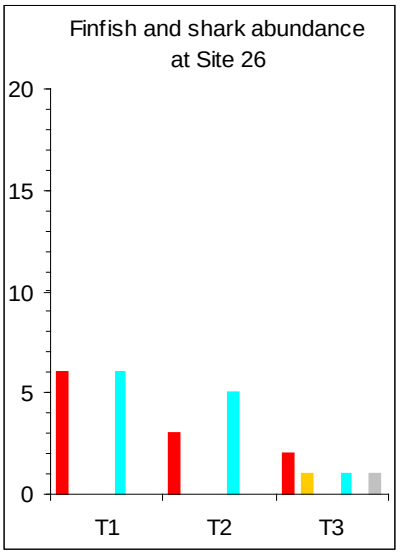
Benthic community

BENTHOS	T1	T2	T3	$\bar{X}$	se
Acroporidae	3.0	1.5	1.5	2.0	0.50
Pocilloporidae	0.5	0	0.5	0.3	0.17
Faviidae	39.5	27.0	48.0	38.2	6.10
Poritidae	1.0	0	1.0	0.7	0.33
Fungiidae	0	0	0	0	0
Other live hard coral	23.5	16.0	11.0	16.8	3.63
Total live hard coral	**67.5**	**44.5**	**62.0**	**58.0**	**6.93**
Bleach hard coral	0	0	0	0	0
Dead hard coral	0	0	0	0	0
Soft corals	0	0	0	0	0
Macroalgae	0	3.0	5.0	2.7	1.45
Rubble/turf algae	1.5	0	1.5	1.0	0.50
Rubble/coralline algae	0	0	0	0	0
Reef/turf algae	27.0	45.0	21.0	31.0	7.21
Reef/coralline algae	0	1.0	0.5	0.5	0.29
Sponge	0	0	0	0	0
Other live biota	0	0	2.0	0.7	0.67
Sand	1.5	6.5	8.0	5.3	1.96
Indeterminate	2.5	0	0	0.8	0.83



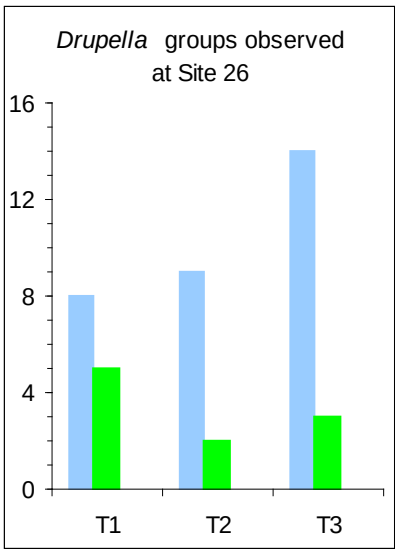
Finfish and sharks

FINFISH AND SHARKS	T1	T2	T3
Snapper	6	3	2
Emperor	0	0	0
Coral trout	0	0	1
Small cod	0	0	0
Potato cod	0	0	0
Maori wrasse	0	0	0
Tusk fish	6	5	1
Trevally	0	0	0
Mackerel	0	0	0
Shark	0	0	1



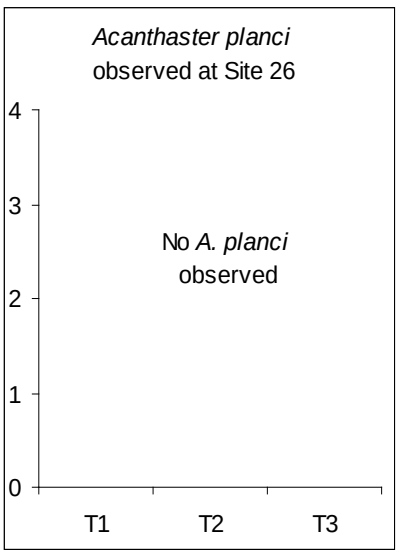
Drupella

DRUPELLA GROUP	T1	T2	T3	TOTAL
1-4	8	9	14	**31**
5-10	5	2	3	**10**
>10	0	0	0	**0**



Acanthaster planci

DIAMETER	T1	T2	T3	TOTAL
< 20 cm	0	0	0	**0**
20-30 cm	0	0	0	**0**
> 30 cm	0	0	0	**0**

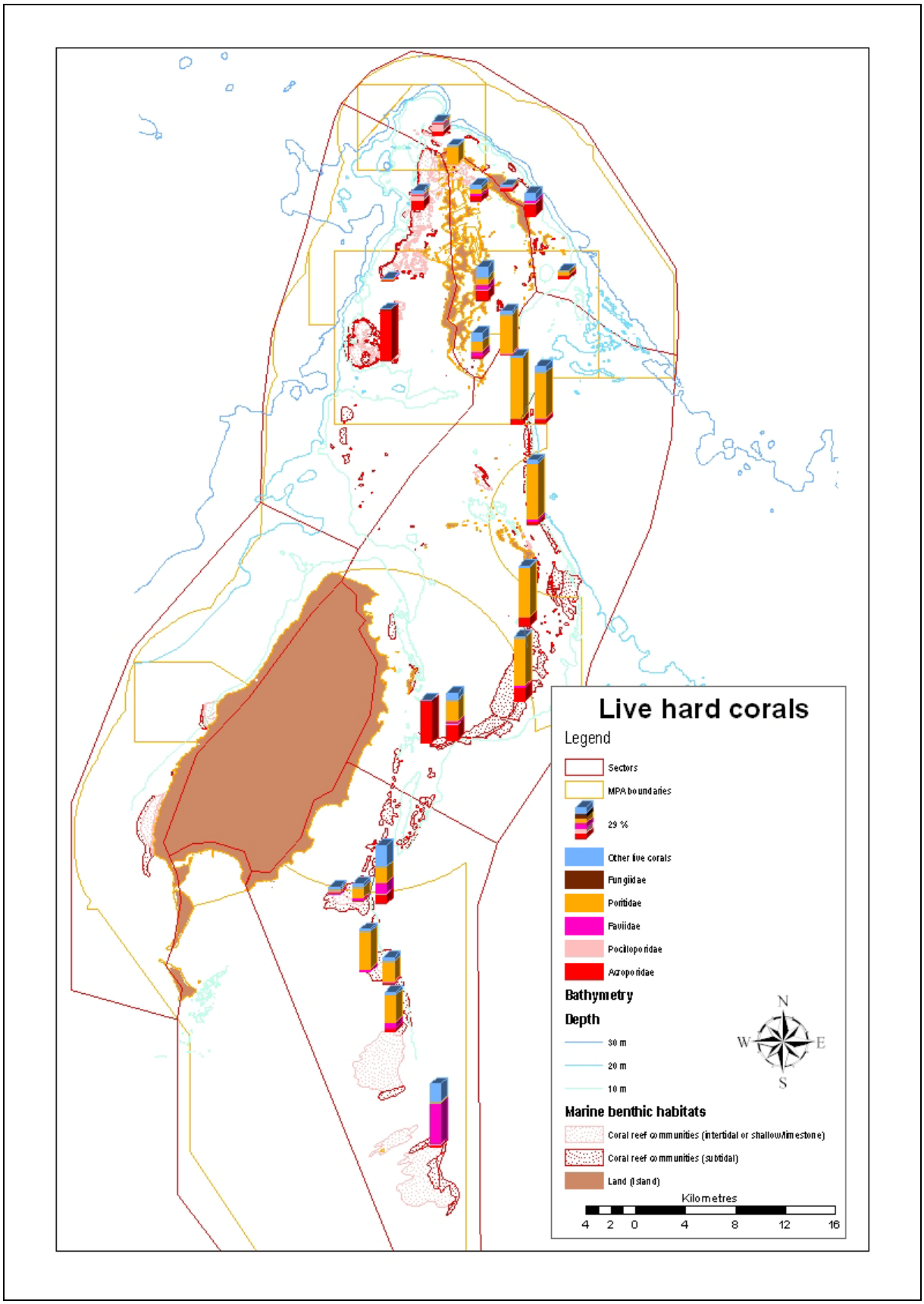


Appendix 5. Complete list of benthic categories identified in video transects from the Montebello/Barrow Islands marine protected areas in 2006

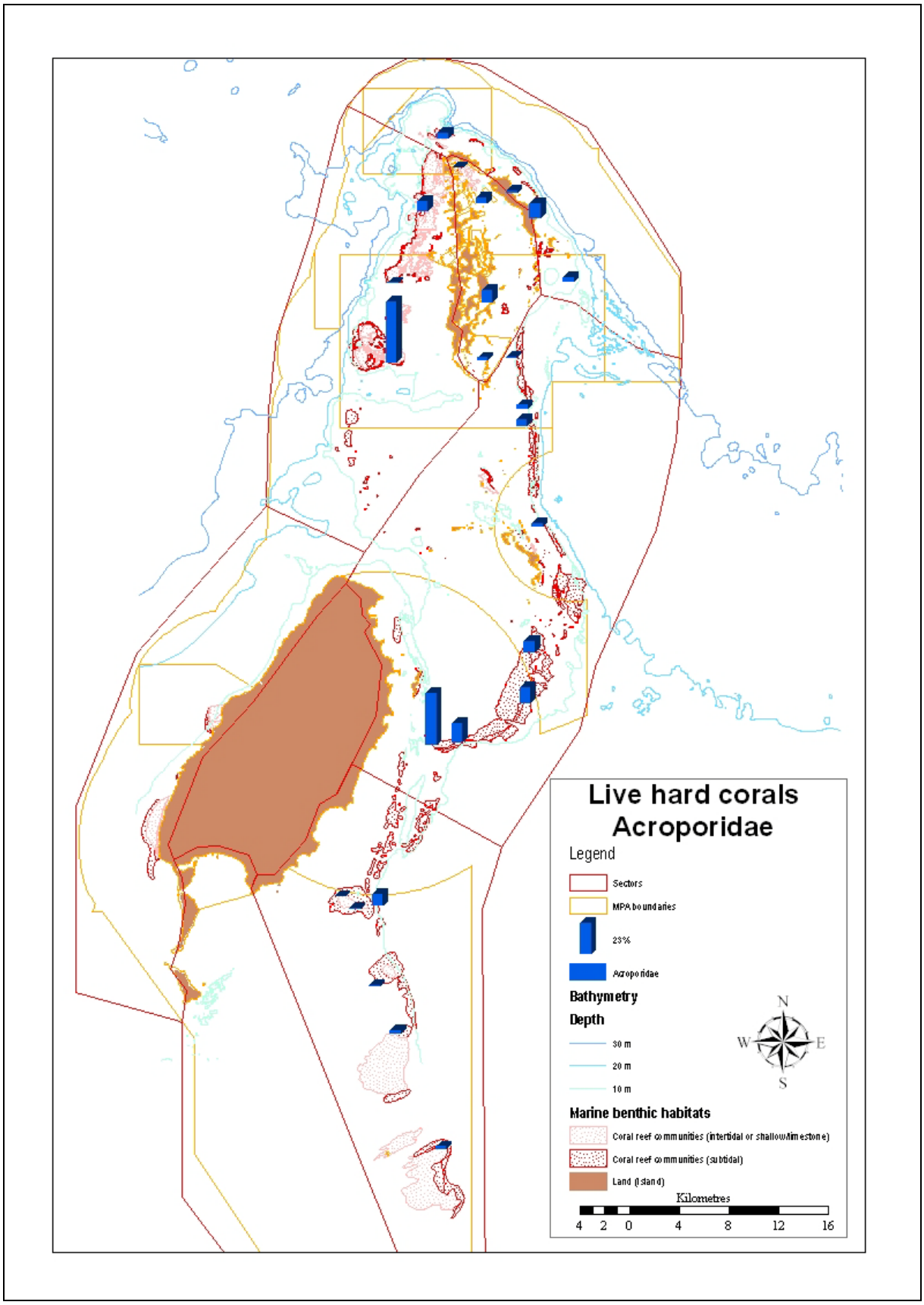
BENTHIC CATEGORY	DETAILED DESCRIPTION	BENTHIC CLASSIFICATION
Branching *Acropora*	*Acropora* spp.	Acroporidae
Corymbose *Acropora*	*Acropora* spp.	Acroporidae
Digitate *Acropora*	*Acropora* spp.	Acroporidae
Submassive *Acropora*	*Acropora* spp.	Acroporidae
Tabulate *Acropora*	*Acropora hyacinthus*	Acroporidae
Tabulate *Acropora*	*Acropora* spp.	Acroporidae
Encrusting non-*Acropora*	*Montipora* spp.	Acroporidae
Foliose non-*Acropora*	*Montipora* spp.	Acroporidae
Massive non-*Acropora*	*Montipora* spp.	Acroporidae
Submassive non-*Acropora*	*Montipora* spp.	Acroporidae
Branching non-*Acropora*	*Seriatopora hystrix*	Acroporidae
Branching non-*Acropora*	*Echinopora* spp.	Faviidae
Foliose non-*Acropora*	*Echinopora* spp.	Faviidae
Submassive non-*Acropora*	*Echinopora* spp.	Faviidae
Massive non-*Acropora*	*Favia* spp.	Faviidae
Encrusting non-*Acropora*	*Favid* spp.	Faviidae
Encrusting non-*Acropora*	*Favites* spp.	Faviidae
Massive non-*Acropora*	*Goniastrea* spp.	Faviidae
Massive non-*Acropora*	*Leptoria phrygia*	Faviidae
Encrusting non-*Acropora*	*Platygyra* spp.	Faviidae
Massive non-*Acropora*	*Platygyra* spp.	Faviidae
Mushroom coral	Family Fungiidae	Fungiidae
Mushroom coral	*Fungia* spp.	Fungiidae
Massive non-*Acropora*	*Alveopora* spp.	Other hard corals
Branching non-*Acropora*	Non-*Acropora* coral	Other hard corals
Encrusting non-*Acropora*	Non-*Acropora* coral	Other hard corals
Foliose non-*Acropora*	Non-*Acropora* coral	Other hard corals
Submassive non-*Acropora*	Non-*Acropora* coral	Other hard corals
Encrusting non-*Acropora*	*Galaxea fascicularis*	Other hard corals
Encrusting non-*Acropora*	*Echinophyllia* spp. (and *Oxypora*)	Other hard coral
Branching non-*Acropora*	*Hydnophora rigida*	Other hard corals
Encrusting non-*Acropora*	*Hydnophora pilosa*	Other hard corals
Submassive non-*Acropora*	*Hydnophora* spp.	Other hard corals
Massive non-*Acropora*	*Lobophyllia* spp.	Other hard corals
Encrusting non-*Acropora*	*Merulina ampliata*	Other hard corals
Foliose non-*Acropora*	*Merulina ampliata*	Other hard corals
Foliose non-*Acropora*	*Merulina scabricula*	Other hard corals
Submassive non-*Acropora*	*Merulina ampliata*	Other hard corals
Foliose non-*Acropora*	*Oxypora* spp.	Other hard corals
Foliose non-*Acropora*	*Pachyseris speciosa*	Other hard corals
Foliose non-*Acropora*	*Pavona decussata*	Other hard corals
Massive non-*Acropora*	*Pavona* spp.	Other hard corals
Submassive non-*Acropora*	*Pavona maldivensis*	Other hard corals
Encrusting non-*Acropora*	*Pectinia lactuca*	Other hard corals
Foliose non-*Acropora*	*Pectinia paeonia*	Other hard corals
Foliose non-*Acropora*	*Pectinia lactuca*	Other hard corals
Massive non-*Acropora*	*Physogyra lichtensteini*	Other hard corals
Massive non-*Acropora*	*Symphyllia* spp.	Other hard corals
Submassive non-*Acropora*	*Tubastraea micranthra*	Other hard corals
Encrusting non-*Acropora*	*Turbinaria* spp.	Other hard corals
Encrusting non-*Acropora*	*Turbinaria stellulata*	Other hard corals
Foliose non-*Acropora*	*Turbinaria* spp.	Other hard corals
Foliose non-*Acropora*	*Turbinaria mesenterina*	Other hard corals
Foliose non-*Acropora*	*Turbinaria peltata*	Other hard corals
Submassive non-*Acropora*	*Pocillopora verrucosa/meandrina*	Pocilloporidae
Submassive non-*Acropora*	*Pocillopora damicornis*	Pocilloporidae
Submassive non-*Acropora*	*Pocillopora eydouxi/woodjonesi*	Pocilloporidae
Submassive non-*Acropora*	*Stylophora pistillata*	Pocilloporidae
Massive non-*Acropora*	*Goniopora* spp. / *Alveopora* spp.	Poritidae
Branching non-*Acropora*	*Porites* spp.	Poritidae
Encrusting non-*Acropora*	*Porites* spp.	Poritidae

BENTHIC CATEGORY	DETAILED DESCRIPTION	BENTHIC CLASSIFICATION
Massive non-*Acropora*	*Porites* spp.	Poritidae
Submassive non-*Acropora*	*Porites* spp.	Poritidae
Dead coral (recent)	Dead standing coral (white)	Bleached hard coral
Millepora	*Millepora* spp,	Other live biota
Other organisms	Ascidian	Other live biota
Other organisms	Can't tell	Other live biota
Other organisms	Hydroid	Other live biota
Other organisms	*Diadema* spp.	Other live biota
Other organisms	Holothurian	Other live biota
Other organisms	*Tridacna* spp.	Other live biota
Other organisms	Crinoid	Other live biota
Other organisms	Starfish (not *A. planci*)	Other live biota
Other organisms	*Tridacna maxima*	Other live biota
Other organisms	Other organisms	Other live biota
Other organisms	*Acanthaster planci*	Other live biota
Zoanthid	Zoanthid	Other live biota
Soft coral	Family Alcyoniidae	Soft coral
Arborescent Soft Coral	Gorgonia	Soft coral
Massive Soft Coral	*Heliopora coerulea*	Soft coral
Soft coral	Family Nephtheidae	Soft coral
Massive Soft Coral	*Pachyclavularia* spp.	Soft coral
Capitate Soft Coral	*Sarcophyton* spp.	Soft coral
Arb & Enc Soft Coral	*Sinularia* spp.	Soft coral
Sponge Branching	Sponge spp.	Sponge
Sponge Encrusting	Sponge spp.	Sponge
Sponge Foliaceous	Sponge spp.	Sponge
Sponge Massive	Sponge spp.	Sponge
Macroalgae	*Turbinaria ornata*	Macroalgae
Macroalgae	*Padina australis*	Macroalgae
Macroalgae	Macro Algal spp.	Macroalgae
Macroalgae	*Caulerpa cupressoides*	Macroalgae
Macroalgae	*Sargassum* spp.	Macroalgae
Macroalgae	*Lobophora* spp.	Macroalgae
Coralline algae	Coralline algae	Coralline algae
Turf algae	Filamentous algae	Turf algae
Sand	Sand	Sand
Unknown	Water	Indeterminate
Unknown	Fibreglass Tape	Indeterminate

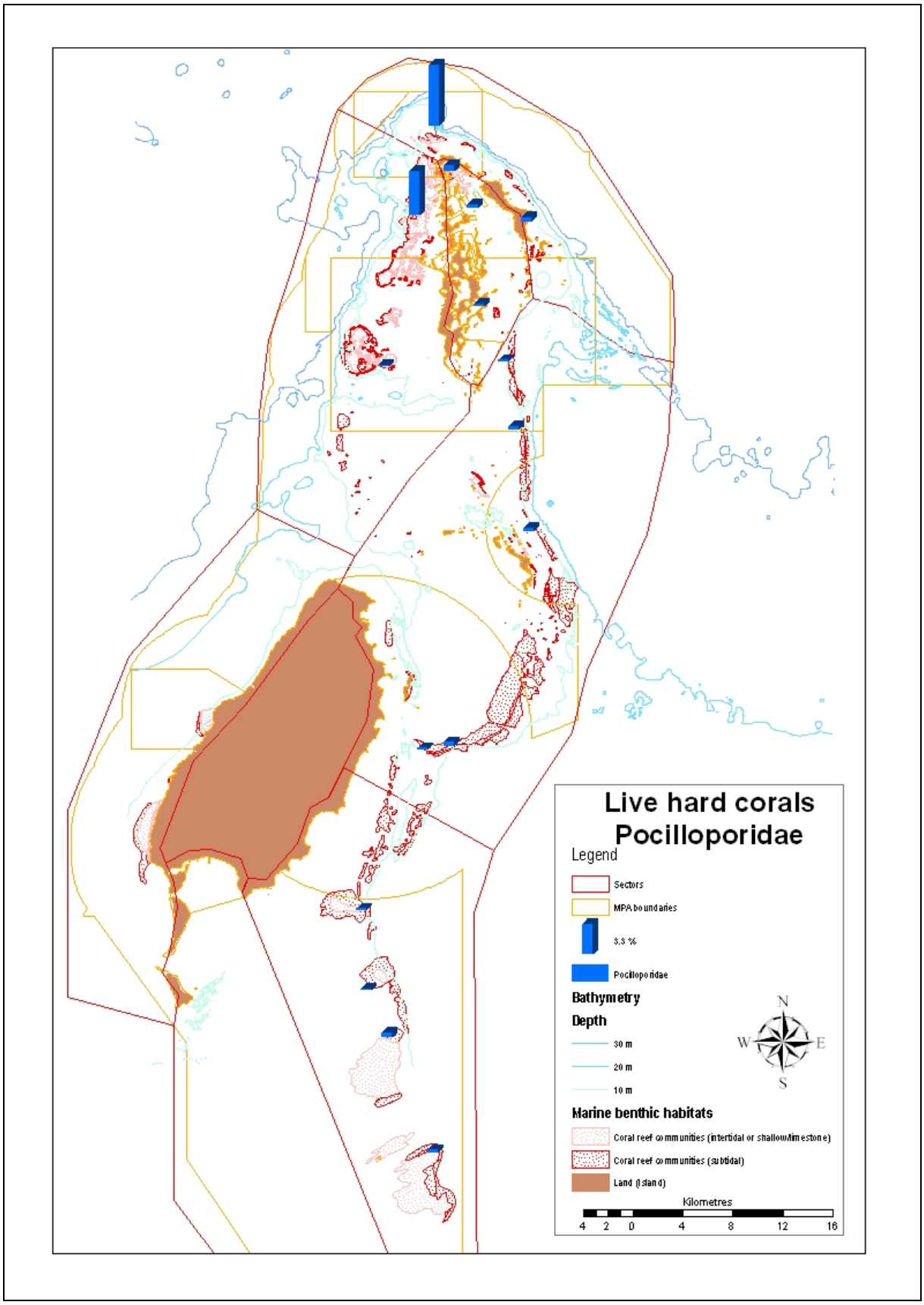
Appendix 6. Spatial distributions of surveyed biota



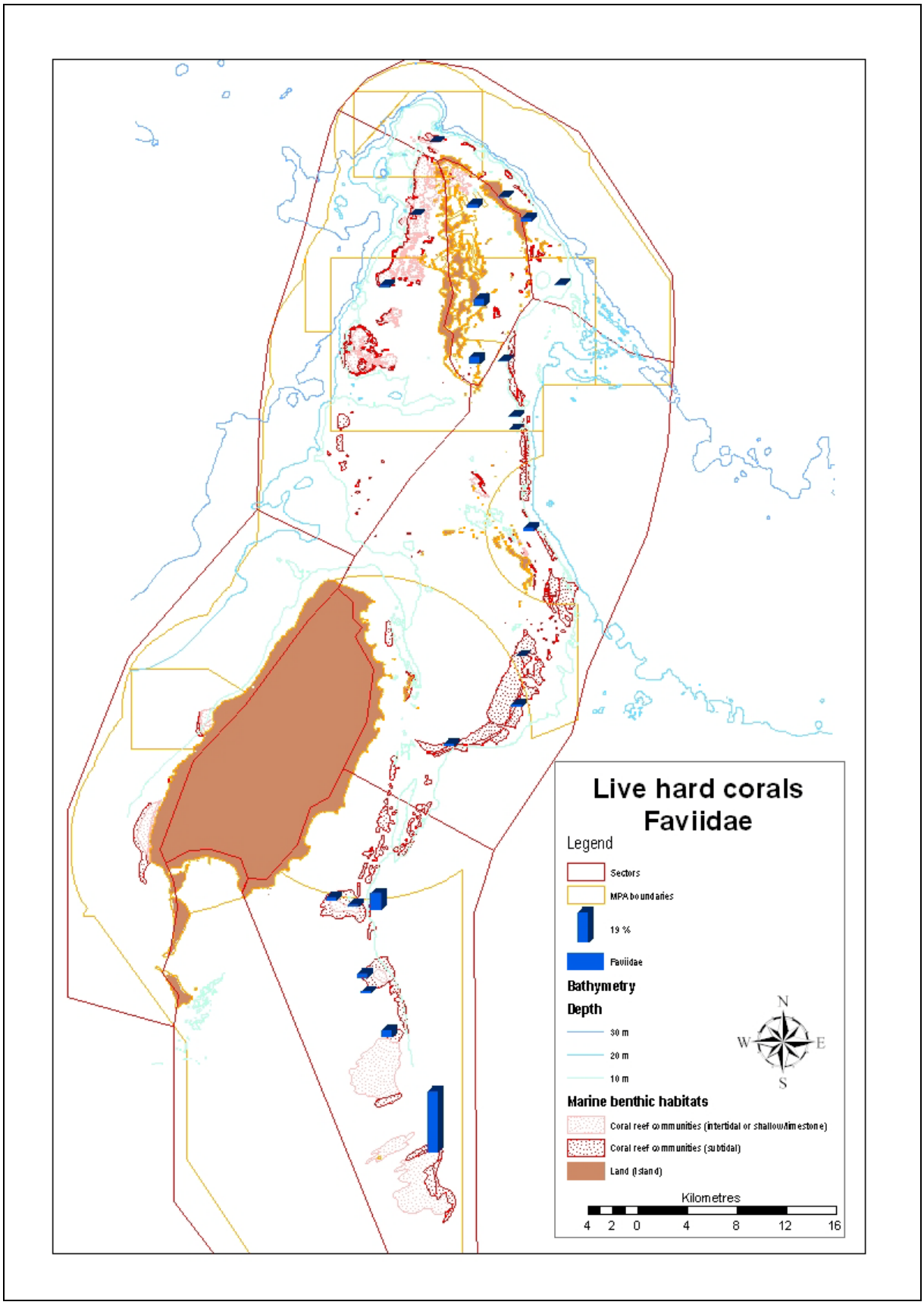
Appendix 6 Figure 1 . Mean percent cover of live hard coral categories at long-term coral community monitoring sites.



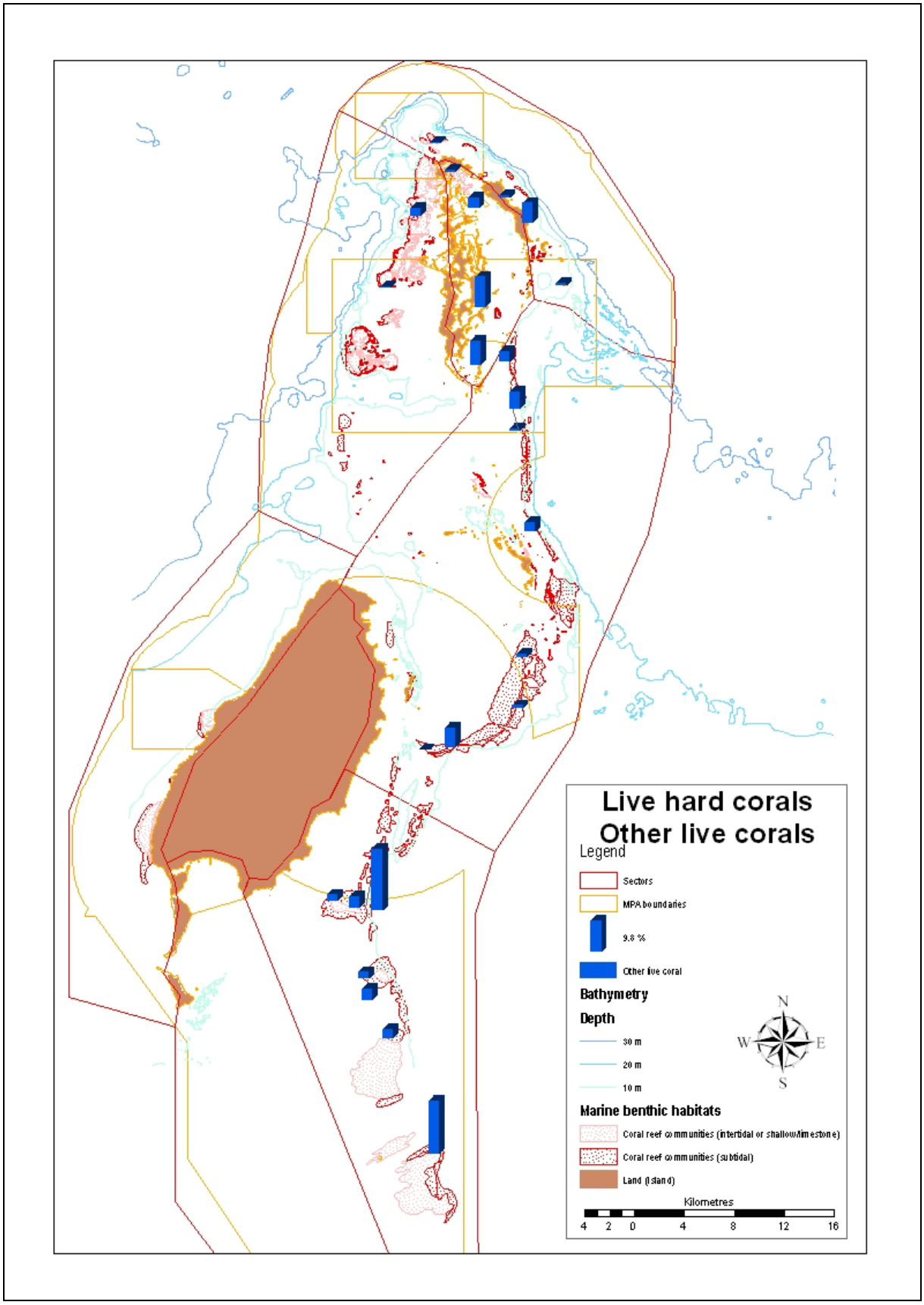
Appendix 6 Figure 2. Mean percent cover of live Acroporidae corals.



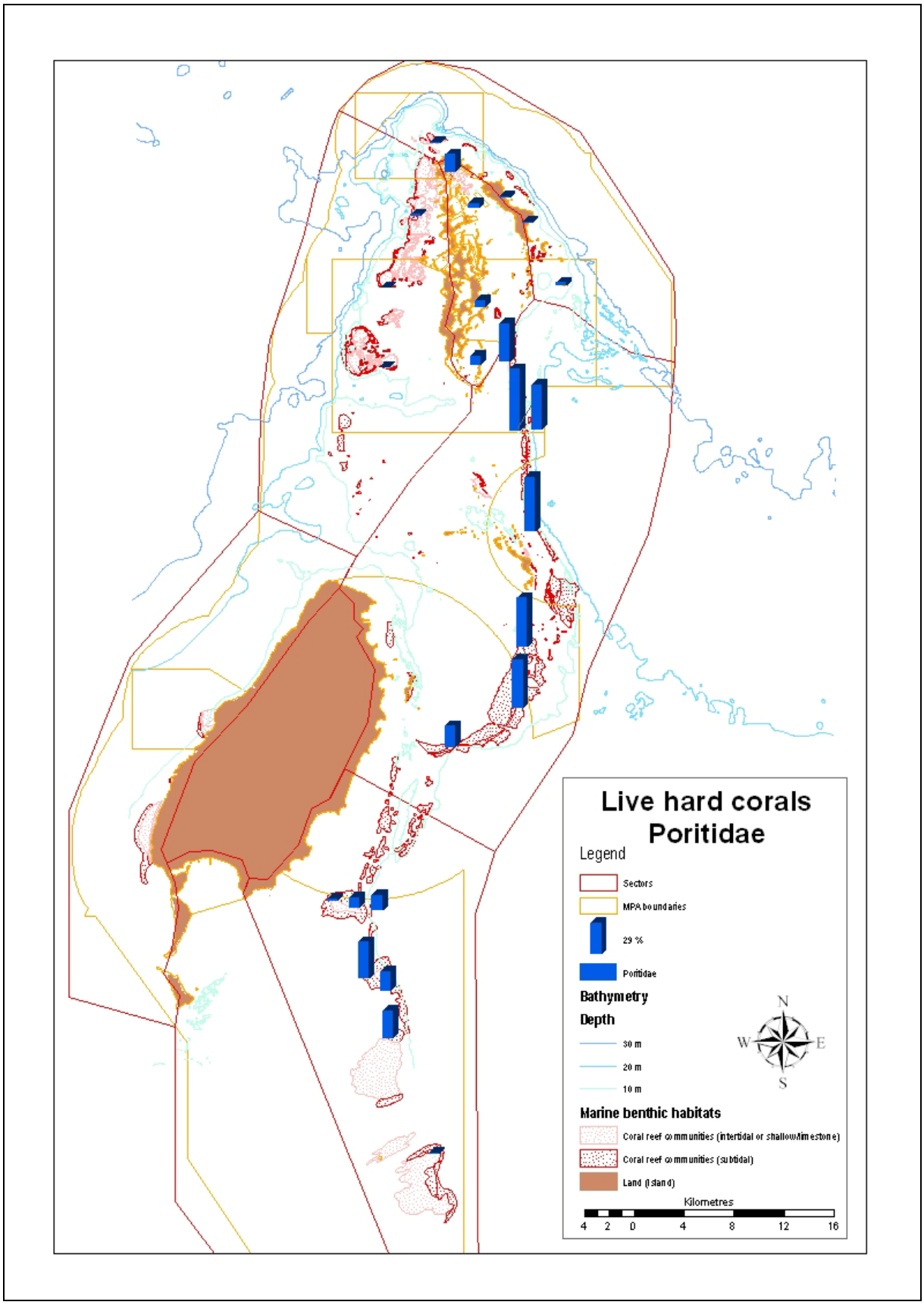
Appendix 6 Figure 3. Mean percent cover of live Pocilloporidae corals.



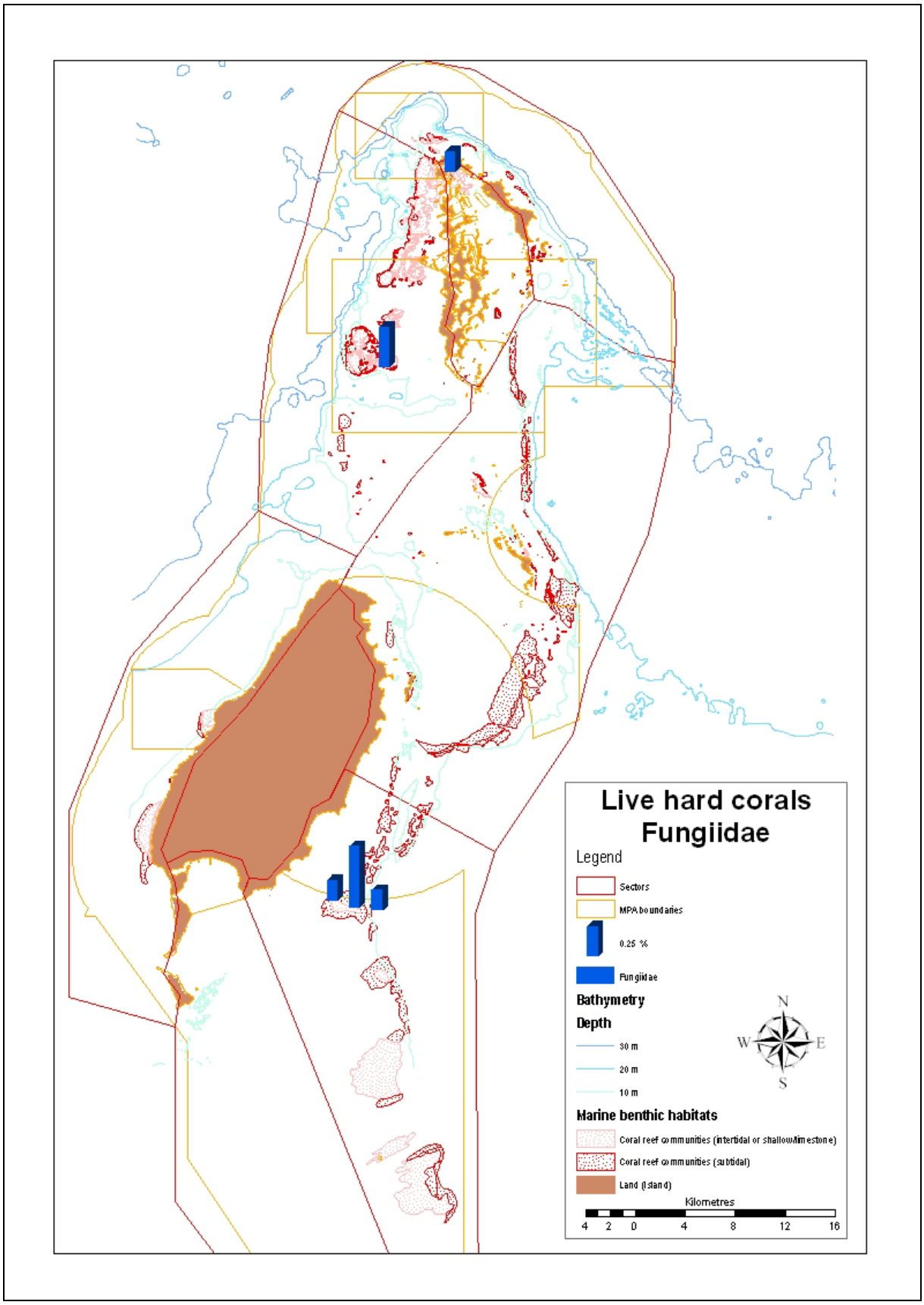
Appendix 6 Figure 4. Mean percent cover of live Faviidae corals.



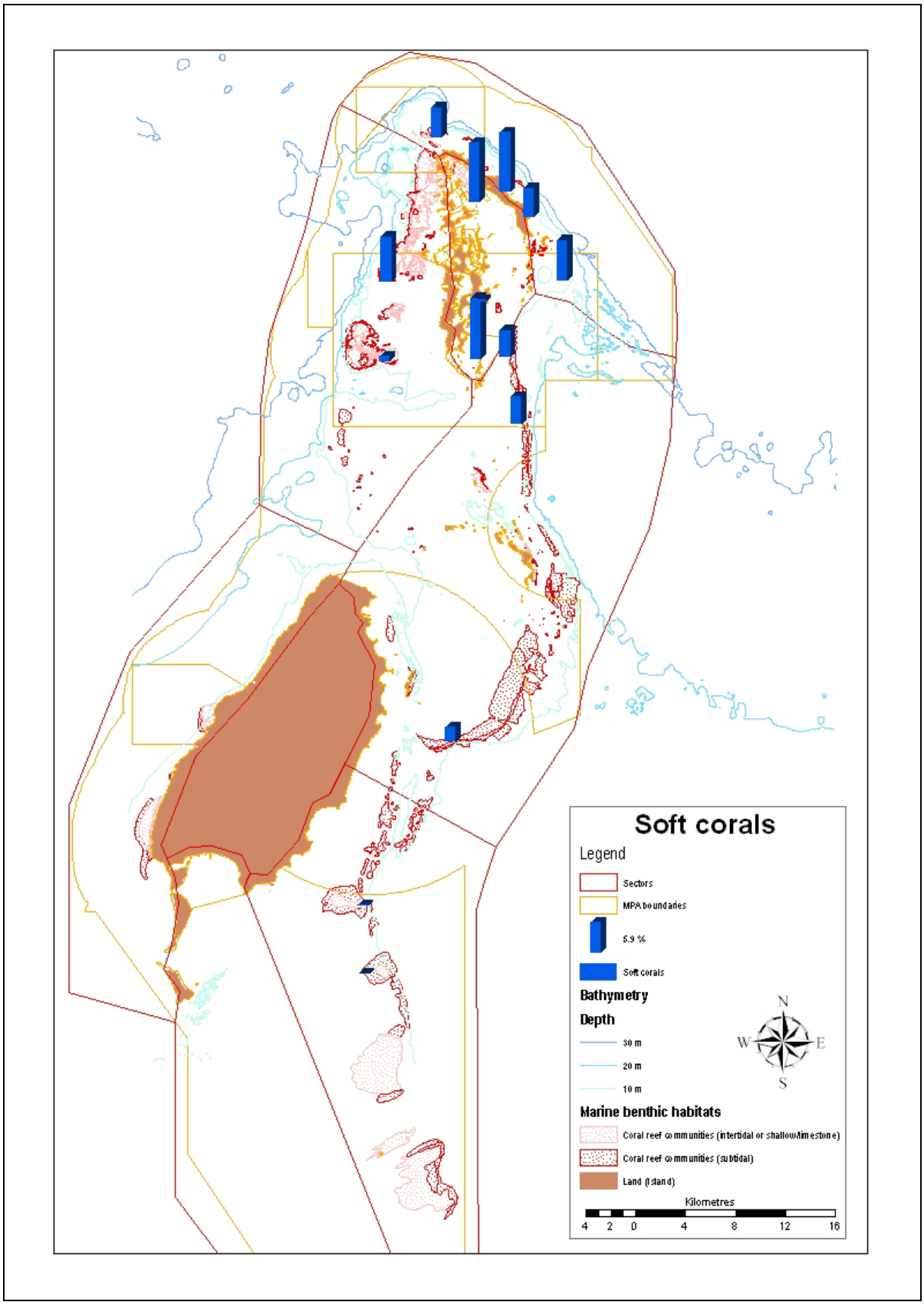
Appendix 6 Figure 5. Mean percent cover of other live hard corals.



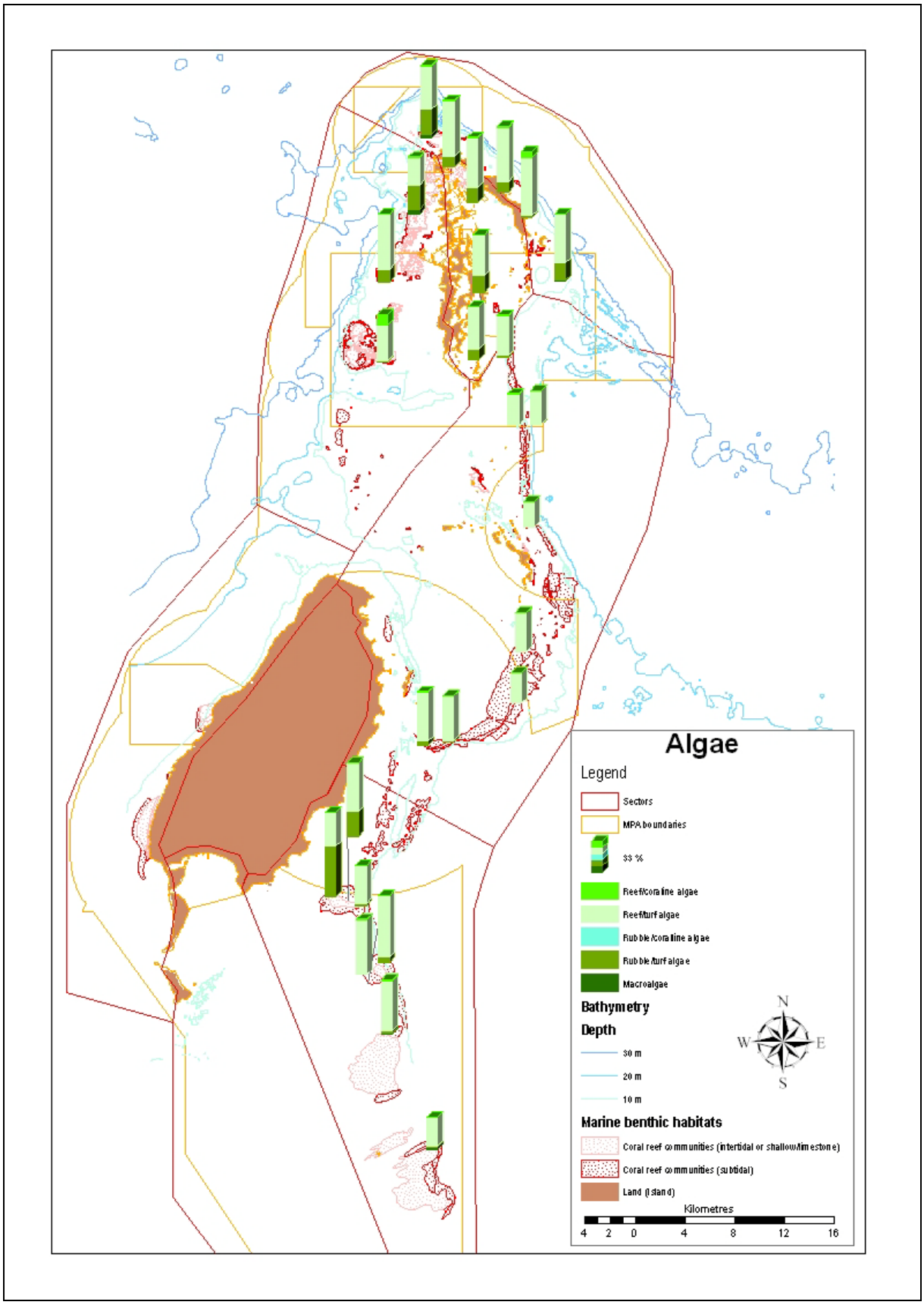
Appendix 6 Figure 6. Mean percent cover of live Poritidae corals.



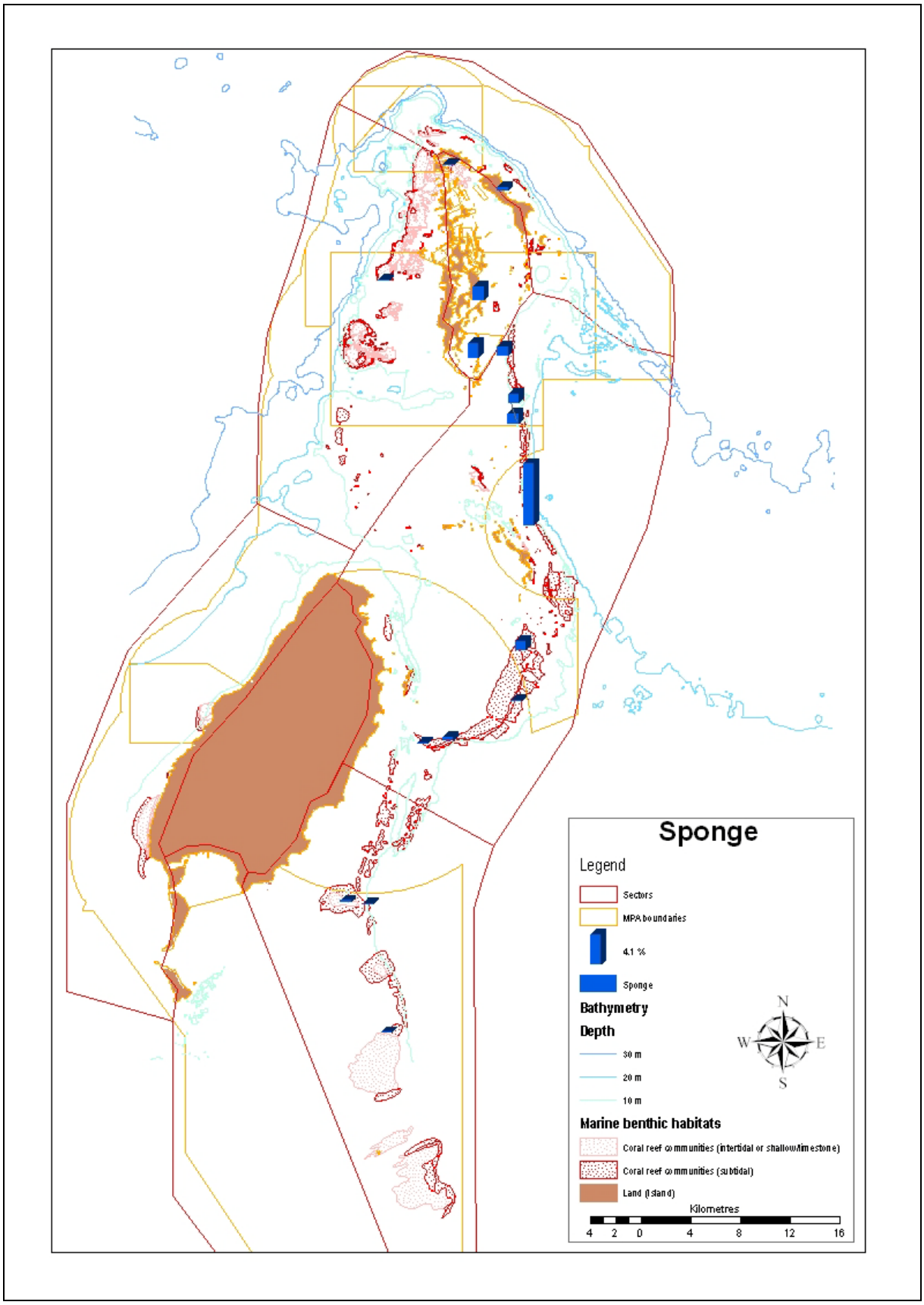
Appendix 6 Figure 7. Mean percent cover of live Fungiidae corals.



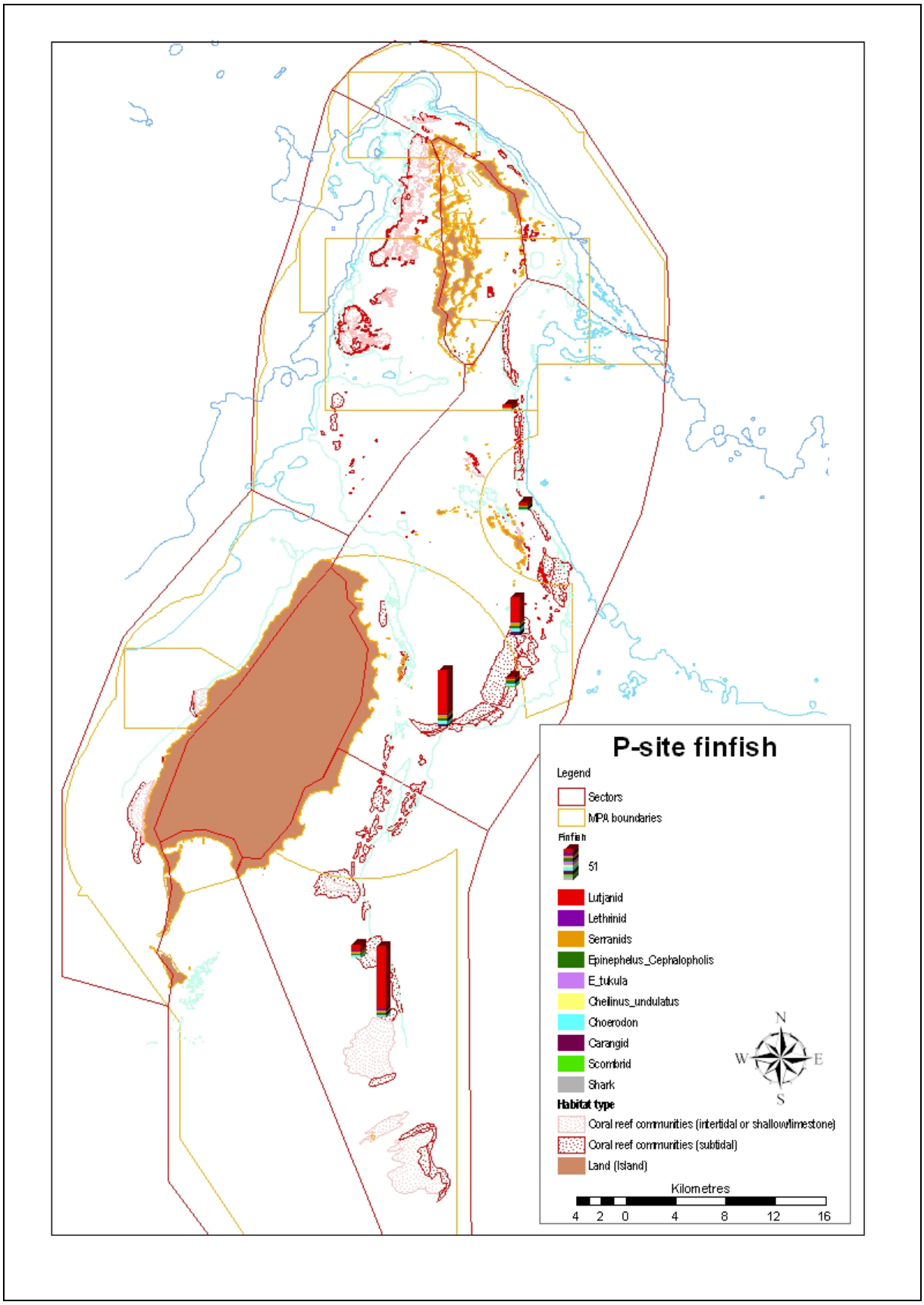
Appendix 6 Figure 8. Mean percent cover of live soft coral cover.



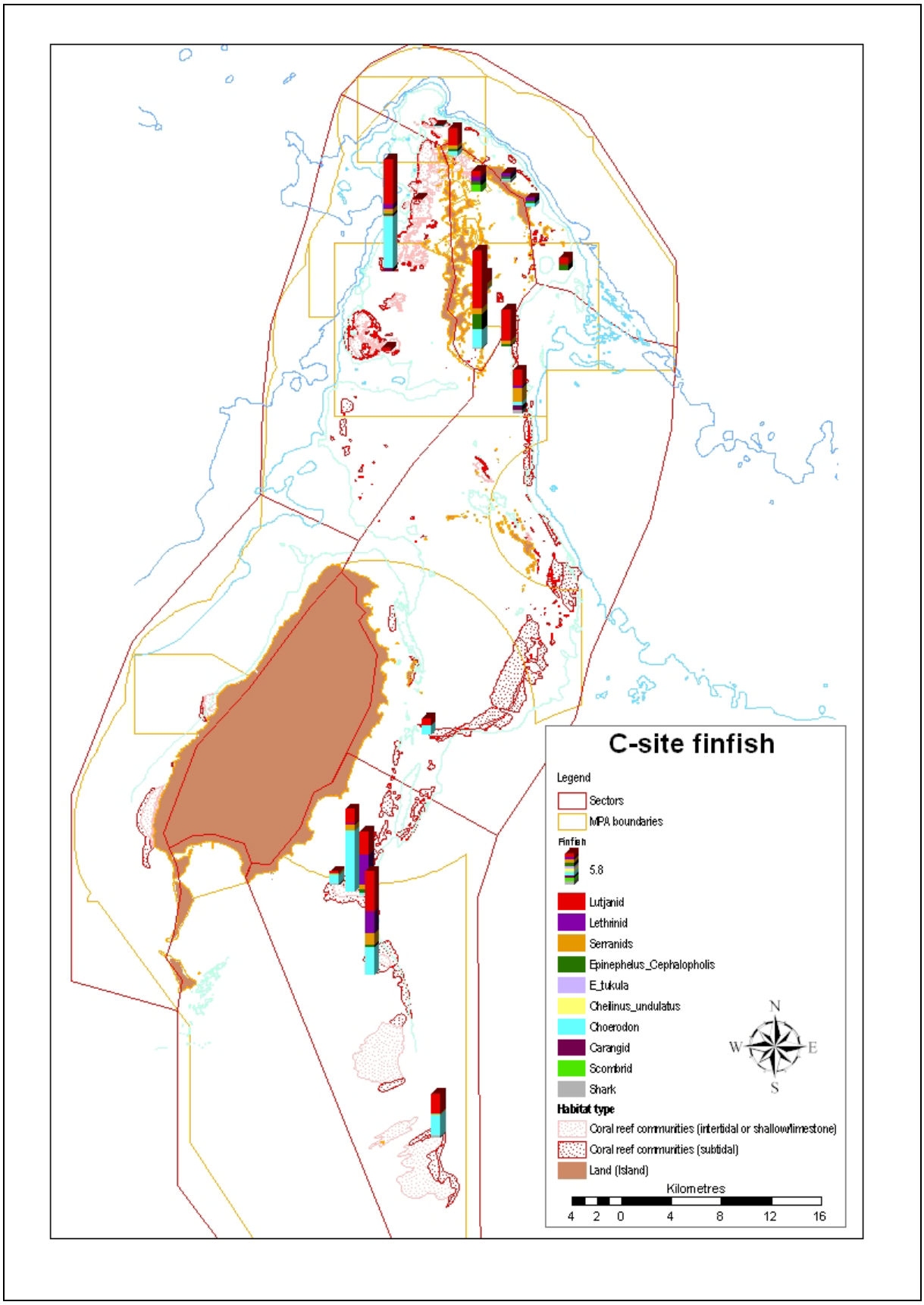
Appendix 6 Figure 9. Mean percent cover of algae.



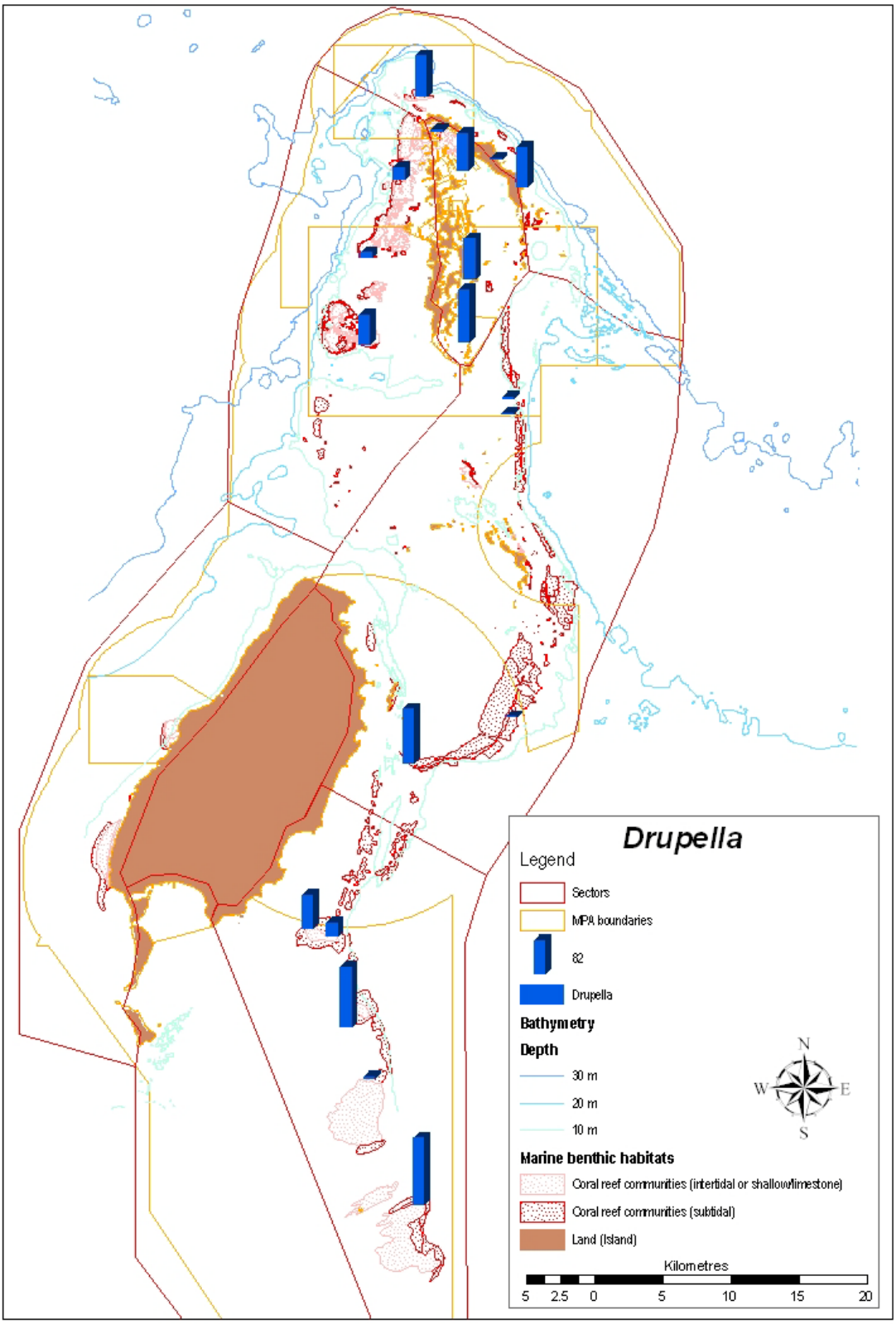
Appendix 6 Figure 10. Mean percent cover of sponges.



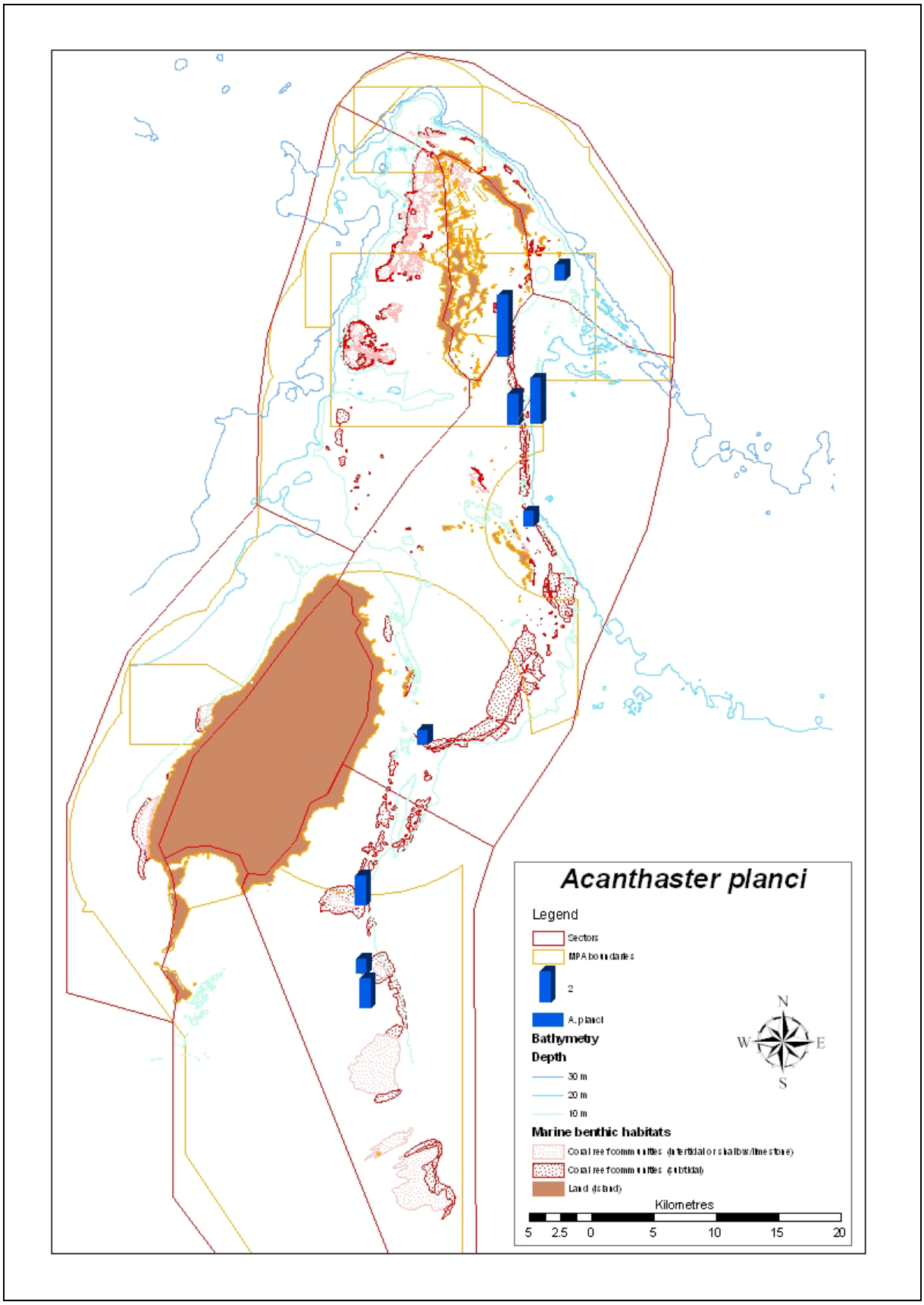
Appendix 6 Figure 11. Relative abundance of finfish surveyed at P-sites



Appendix 6 Figure 12. Relative mean abundance of finfish surveyed at C-sites



Appendix 6 Figure 13. Relative abundance of *Drupella*.



Appendix 6 Figure 14. Relative abundance of *Acanthaster planci*.

List of Marine Science Program reports

Data Report Series

MSPDR 1. Preliminary assessment of coral communities at selected sites in the proposed Dampier Archipelago Marine Park. Armstrong SJ (2008).

MSPDR 2. Anoxic impacts at Bill's Bay, Ningaloo Marine Park associated with the 2008 coral spawning event. Armstrong SJ, Syme R (2009).

MSPDR 3. Mapping the coral reef communities of the Shark Bay marine protected areas: Data collected during the February 2008 field survey. Bancroft KP (2009).

MSPDR 4. Establishing long-term coral community monitoring sites in the Montebello/Barrow Islands marine protected areas: data collected in December 2006. Bancroft KP (2009).

MSPDR 5. Ningaloo Marine Park *Drupella* long-term monitoring program: Data collected during the 2008 survey. SJ Armstrong (2009).

MSPDR 6. Assessing the effectiveness of sanctuary zones in the proposed Dampier Archipelago Marine Park: Data collected during the 2007 survey. SJ Armstrong (2009).

MSPDR 7. Comparative marine biodiversity of the Rowley Shoals 2007: Benthic assemblages data report. Long SC, Holmes TH (2009).

MSPDR 8. Summary of marine research and monitoring applicable to the management of Jurien Bay Marine Park: 2000 to June 2008. Bancroft KP (2009).

Other Marine Science Program Reports

MSP 2006/01 Long-term monitoring program in the Montebello/Barrow Islands marine protected areas. Scoping field trip: 8-11 August 2006. Field Program Report. Bancroft KP, Simpson CJ, Long S (2006).

MSP 2006/02 Establishment of additional long-term monitoring sites for *Drupella cornus* populations in the southern section of the Ningaloo Marine Park and the Muiron and Sunday Islands Marine Management Areas. Field Program Report. Armstrong SJ (2006).

MSP 2006/03 Long-term monitoring program in the Montebello/Barrow Islands marine protected areas. Scoping field trip: 8-11 August 2006. Data Report. Bancroft KP (2006).

MSP 2006/04 Disturbance and recovery of coral communities in Bill's Bay, Ningaloo Marine Park: 2006 survey. Field Program Report. Long S (2006).

MSP 2006/05 Establishing baseline benthic community monitoring sites in the Montebello/Barrow Islands marine protected areas: 7-22 December 2006. Field Program Report. Bancroft KP, Armstrong SJ (2006).

MSP 2007/01 Bibliography of marine scientific research relevant to the Rowley Shoals Marine Park and the Mermaid Reef Marine National Nature Reserve. Data Report. Edwards A, Bancroft KP (2007).

MSP 2007/02 Current and proposed marine research projects relevant to the Rowley Shoals Marine Park and the Mermaid Reef Marine National Nature Reserve. Data Report. Edwards A, Bancroft KP (2007).

MSP 2007/03 Ningaloo Marine Park *Drupella* Long-term Monitoring Program: Results of the 2006 survey. Technical Report. Armstrong SJ (2007).

MSP 2007/04 Summary of the winter coral bleaching event at Ningaloo Marine Park, July 2006. Data Report. Armstrong S, Webster F, Kendrick A, Mau R, Onton K (2007).

MSP 2007/05 Disturbance and recovery of coral communities in Bill's Bay, Ningaloo Marine Park: Field survey 16-23 October 2006. Technical and Data Report. Long S (2007).

MSP 2007/06 Bibliography of marine scientific research relevant to Perth's metropolitan marine protected areas and adjacent waters. Data Report. Lierich D, Bancroft KP (2007).

MSP 2007/07 Current and proposed marine research projects relevant to Perth's metropolitan marine protected areas and adjacent waters. Data Report. Lierich D, Bancroft KP (2007).

MSP2007/08 Disturbance history of coral communities in Bill's Bay, Ningaloo Marine Park, 1975-2007. Data Report. van Schoubroeck P, Long S (2007).

MSP 2008/01 Comparative marine biodiversity survey of the Rowley Shoals 1-17 December 2007. Metadata Report. Long S, Armstrong SJ, Fabricius K, Field I, Cook K, Colquhoun J, Huisman J (2008).


MARINE PARKS