

Subtidal Habitats of Mermaid Reef (Rowley Shoals), Scott and Seringapatam Reefs, Western Australia.

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Abstract – The sub-tidal habitats at Mermaid (Rowley Shoals), Scott and Seringapatam Reefs were recorded on video during a survey in 2006 and analysed for percentage cover. Recording was undertaken along 25 m transects at two water depths (5 m and 12 m relative to mean sea level). The purpose of the video recording was to provide a permanent record of each station while the video transect analysis provided a quantitative description of the benthic habitat to complement semi-quantitative specimen collections.

The general benthic cover on the outer reef at Mermaid Reef was at least 60% sand, rubble or rock (abiotic) while the lagoon sites varied greatly between 23–97% abiotic cover. The outer reef stations had a higher proportion of encrusting coral while the lagoon stations were more heavily dominated by tabulate and branching corals. The coral morphologies found on the outer reef areas are characteristic of high energy environments, i.e. outer reefs were characterised by the presence of more robust species attached to or encrusting coral rock. The near vertical aspect of the outer reef precluded the deposition of coral sand, which was a major feature of the lagoonal areas. Much of the lagoonal habitat surveyed was associated with bommies, in particular, the slopes and top surfaces.

Unlike the outer reef areas of Mermaid Reef, South Scott Reef had a more gradual slope rather than vertical walls. This slope was often heavily dissected with gutters indicating the high energy nature of the surrounding environment. As a result, the benthic cover at the outer reef stations was at least 40% abiotic. Like the outer reef stations at Mermaid Reef those at South Scott Reef had a higher proportion of encrusting coral. However, the significant abundance of soft corals, tabulate and digitate corals were in stark contrast. The lagoon stations were more heavily dominated by abiotic cover, in particular, rubble and rock.

All stations at North Scott Reef were dominated by the abiotic categories sand, rubble and rock ranging from 65–95% cover. The hard corals were dominated by massive and encrusting corals as well as branching corals.

Only two offshore reef stations and one lagoon station were surveyed at Seringapatam Reef, thus, it is difficult to generalise about the habitats of this

reef or differences between outer and lagoonal reef habitats. Habitat cover varied from 100% abiotic at a shallow outer reef transect to 60% abiotic and 40% biotic at a deep outer reef transect, with the biotic component comprising soft coral and seven hard coral categories.

AIM

The purpose of the video recording was to provide a permanent record of each station while the video transect analysis provided a quantitative description of the benthic habitat to complement semi-quantitative specimen collections.

METHODS

Video recording was undertaken at two depths (approximately 5 m and 12 m relative to mean sea level) at each of 32 of a total of 45 surveyed stations in triplicate (three replicate transects) parallel to each other and one metre apart. Recordings were acquired by movement of a Digital Video camera in a housing along 25 m transects according to the protocol developed by the Australian Institute of Marine Science (Carelton and Done 1995). At each depth a transect was marked by laying a 25 m measuring tape along the substrate of relatively uniform depth. A SCUBA diver maintained a constant speed of 0.2 m/sec. and the video was kept 0.5 m above the surface of the benthic habitat. This captured a band width of approximately 0.6 m resulting in an area of 15 m² per transect and 45 m² for the three transects.

Video recordings of the 32 stations were captured electronically, saved to file and then stored on compact disc. The SKM Video Transect Analysis

System then retrieved the electronically recorded transect for analysis. The program randomly selects 150 frames for analysis from approximately 3,125 recorded along the 25 m transect. Each selected frame was allocated with one randomly placed spot on the monitor by the program. The substrate type beneath the respective spot was assigned one of the following 15 benthic descriptors (refer to Figure 1):

- three abiotic categories (sand, rubble and rock);
- one macroalgae category;
- one sponge category;
- one gorgonian category;
- one soft coral category comprised of neptheids and alcyoniids; and
- eight hard coral categories (branching, digitate, tabulate, encrusting, foliose, sub-massive, massive and mushroom corals).

Since the purpose of the transect analysis was to provide a general description of the benthic habitat, the benthos was identified to functional group level rather than genus or species. Once a benthic descriptor was assigned and the respective frame completed, the program advanced the recording to the next randomly selected frame and this process was repeated until the designated number of frames were completed. Upon completion, the

program computed tallied counts and percentage cover (Osborne and Oxley 1997). The results of the triplicate transects were averaged to increase the area covered rather than for statistical purposes. The data for each station was exported into an Excel spreadsheet for graphical presentation.

The mean values for each habitat at each depth per station were used to create a Bray-Curtis dissimilarity correlation matrix. Analysis by Non-metric Multidimensional Scaling (MDS) was then undertaken using the dissimilarity matrix to produce a plot. The purpose of the analysis was to provide a comparison of the stations and depths to complement the semi-quantitative specimen collections.

RESULTS

The general description of the physical characteristics of the seabed at each station for the four reefs is presented in Table 1 through Table 4.

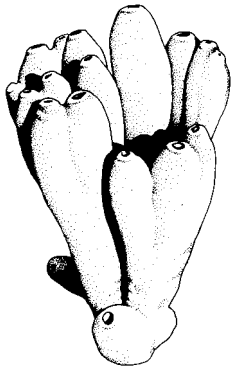
The mean percentage cover by benthic habitat at each station transect is presented graphically for each of the four reefs in Figure 2 through Figure 15. The data is presented as percentage cover by the 15 benthic categories as well as by a reduced category data set, which amalgamates the abiotic, soft coral and hard coral categories resulting in a set of 5 categories.



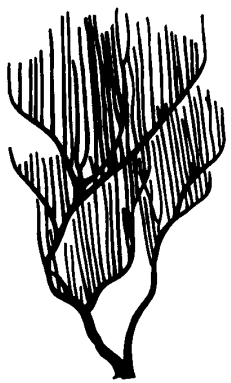
Above: East Hook, South Scott Reef. The edge of a small mobile sand cay. (Photo: Clay Bryce)



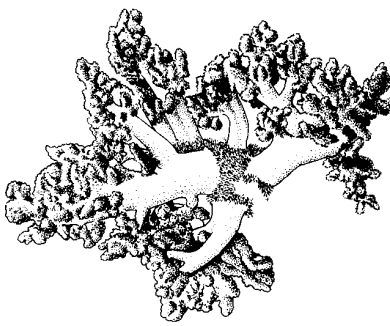
Macroalgae



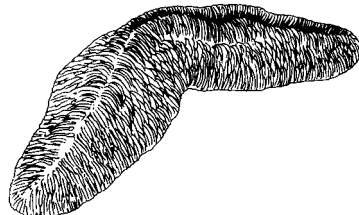
Sponge



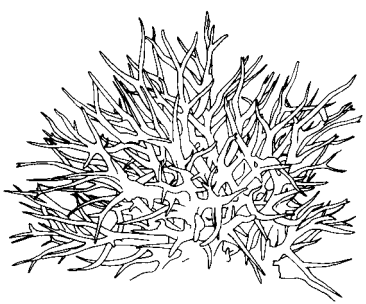
Gorgonian



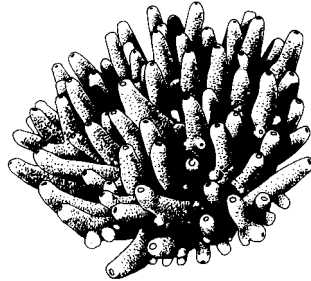
Soft coral



Mushroom coral



Branching coral



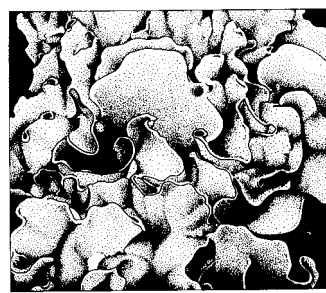
Digitate coral



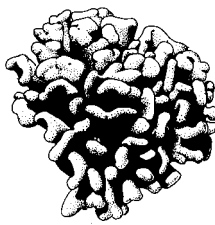
Tabulate coral



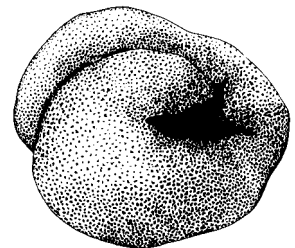
Encrusting coral



Foliose coral



Sub-massive coral



Massive coral

Figure 1 Benthic life-form categories

MERMAID REEF

The general description of the physical characteristics of the seabed at each station for Mermaid Reef is presented in Table 1. The mean percentage cover at each station transect is presented graphically by the 15 benthic categories in Figure 2. The data is also presented as percentage cover by a reduced category data set, which amalgamates the abiotic, soft coral and hard coral categories resulting in a set of 5 categories in Figure 3.

Analysis of the data indicates that the outer reef and lagoon transects were distinctly different, particularly the shallow transects in 5 m of water (see Figure 4 and Figure 5).

The benthic cover at the outer reef stations was at least 60% abiotic, with the exception of station 2, while the lagoon sites varied greatly between 23–97% abiotic cover (Figure 3). The outer reef stations had a higher proportion of encrusting coral while the lagoon stations were more heavily dominated by tabulate and branching corals (Figure 2).

The coral morphologies found on the outer reef areas were characteristic of high energy environments, i.e. outer reefs were characterised by the presence of more robust species attached to or encrusting coral rock. The near vertical aspect of the outer reef precluded the deposition of coral sand, which was a major feature of the lagoonal areas.

Much of the lagoonal habitat surveyed was associated with bommies, in particular, the slopes and top surfaces. The lagoonal areas were far more protected from wave action were dominated by the more fragile species were deposition areas for coral rubble and sand. The benthic cover differed greatly between the deep (12 m) and shallow (5 m) transects. Much of this variation was associated with the position of the transect on the bommie. The flat seabed around the base of the bommies supported a greater cover of branching coral, whereas the slopes were more sparsely covered by live coral. The tops of bommies were relatively similar in coral cover.

Table 1 Transect topography at Mermaid Reef

Station	Habitat	Depth (m)	Description
1	Lagoon	5	Bommie slope with coral rubble.
		12	Relatively flat seabed of fine coral sand and rubble.
2	Outer reef	5	Reef wall dissected with gutters.
		12	Reef wall dissected with gutters.
4	Outer reef	5	Shallow reef wall from 3m dropping onto coral rubble at 7m.
		12	Reef wall dissected by large gutters with a coral rubble floor.
5	Outer reef	5	Near vertical wall.
		12	Near vertical wall.
7	Lagoon	5	Bommie slope with coral rubble.
		12	Relatively flat seabed of fine coral sand and rubble.
8	Lagoon	5	Bommie slope with coral rubble.
		12	Relatively flat seabed of fine coral sand and rubble.
9	Lagoon	5	Slope with coral rubble.
		12	Relatively flat seabed of fine coral sand and rubble.
11	Lagoon	5	Base of coral bommie.
		12	Coral sand with low relief bommies.
12	Lagoon	5	Top of bommie with undulating surface.
		12	Coral sand with many small bommies.
14	Lagoon	5	Base of coral bommie.
		12	Relatively flat seabed of fine coral sand and rubble.
15	Outer reef	5	Crest of steep drop-off.
		12	Near vertical wall.
16	Outer reef	5	Heavily dissected reef edge.
		12	Gradually sloping seabed with deeply cut gutters.

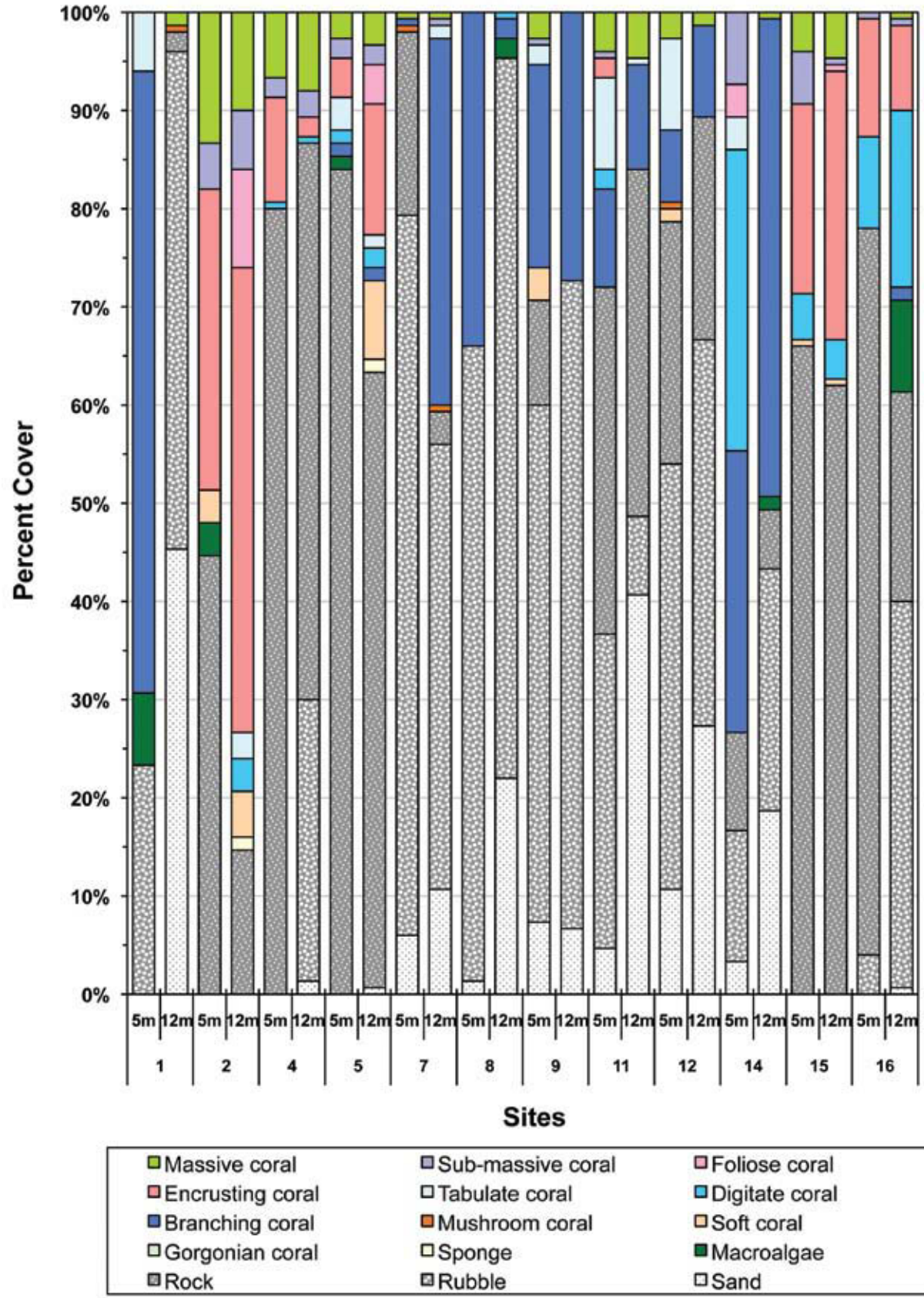


Figure 2 Mermaid Reef habitat cover

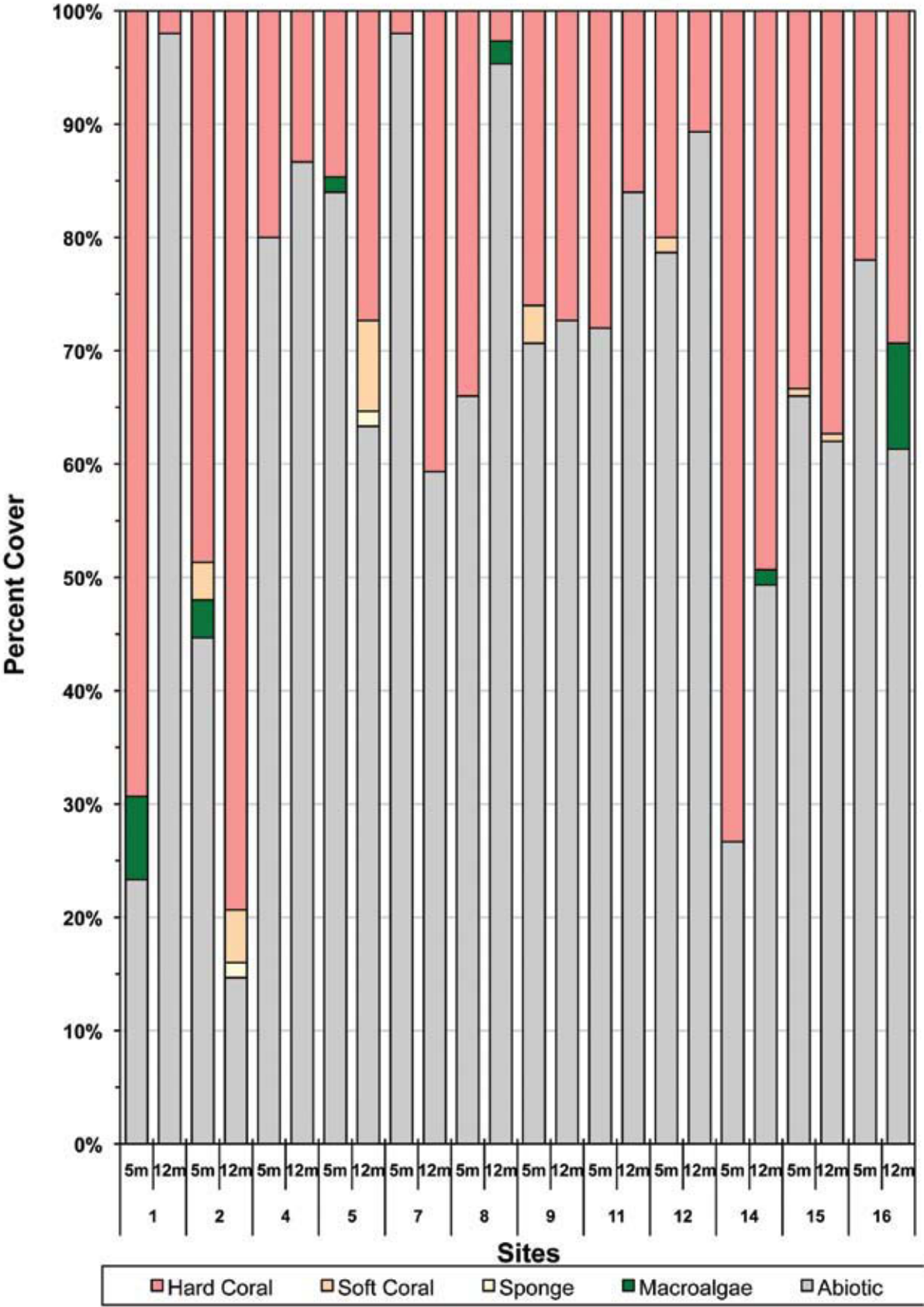


Figure 3 Mermaid Reef grouped habitat cover

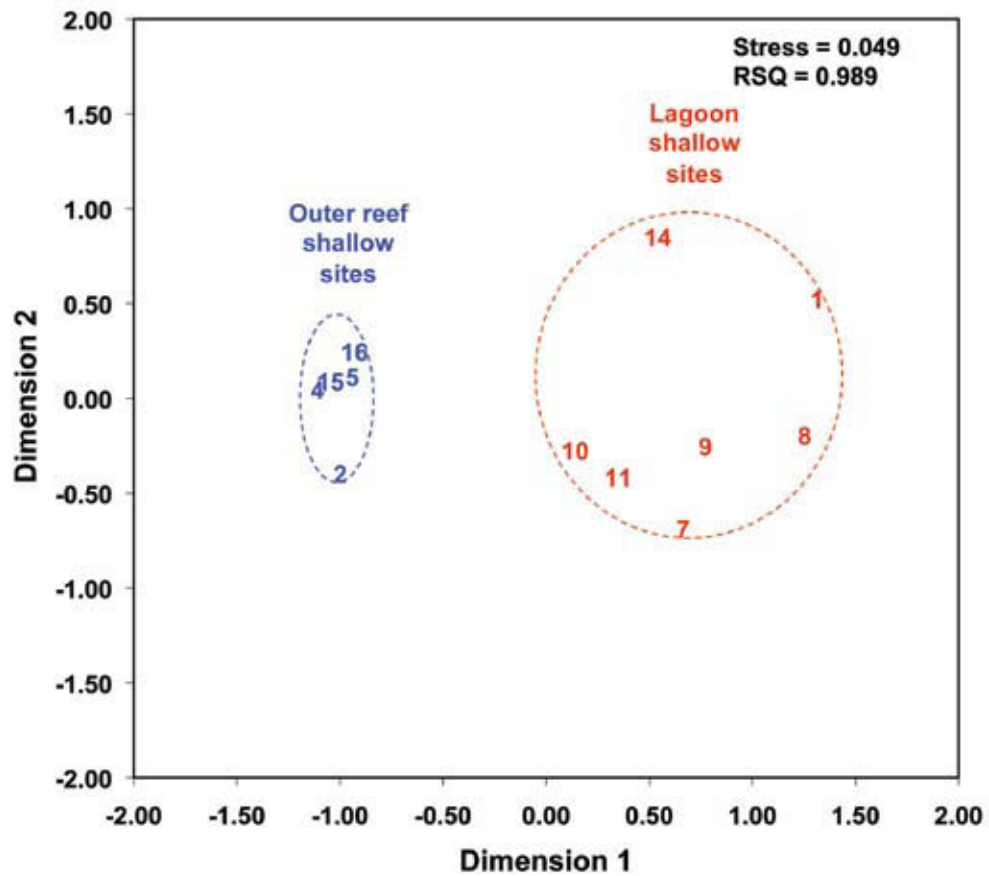


Figure 4 MDS Plot of Mermaid Reef shallow transects

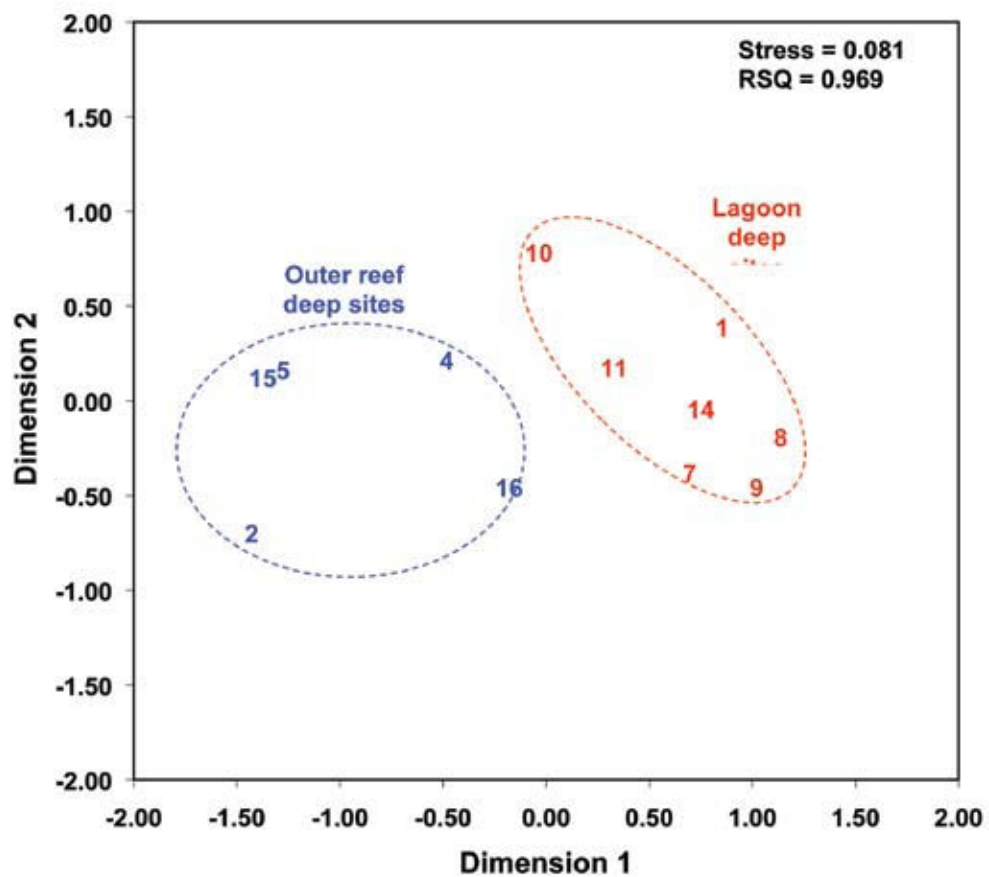


Figure 5 MDS Plot of Mermaid Reef deep transects



Above: Station 3, Mermaid Reef. Outer reef platform. (Photo: Clay Bryce)



Above: Station 24, South Scott Reef intertidal station. (Photo: John Huisman)

SOUTH SCOTT REEF

The general description of the physical characteristics of the seabed at each station for South Scott Reef is presented in Table 2. The mean percentage cover by benthic habitat at each station transect is presented graphically by the 15 benthic categories in Figure 6. The data is also presented as percentage cover by a reduced category data set, which amalgamates the abiotic, soft coral and hard coral categories resulting in a set of 5 categories in Figure 7.

Analysis of the data indicates that the outer reef and lagoon transects were different but less so than was observed at Mermaid Reef (see Figure 8 and Figure 9).

Unlike the outer reef areas of Mermaid Reef, South Scott Reef had a more gradual slope rather than vertical walls. This slope was often heavily dissected with gutters indicating the high energy nature of the surrounding environment. As a result, the benthic cover at the outer reef stations was at least 40% abiotic (Figure 7). Like the outer reef stations at Mermaid Reef those at South Scott Reef had a higher proportion of encrusting coral. However, the significant abundance of soft corals, tabulate and digitate corals were in stark contrast.



Above: Coral regrowth at South Scott Reef. (Photo: Clay Bryce)

The lagoon stations were more heavily dominated by abiotic cover (Figure 7) and, in particular, rubble and rock (Figure 6). Only the deep transect at station 29 had coral cover similar to that of the outer reef stations.

Table 2 Transect topography at South Scott Reef

Station	Habitat	Depth (m)	Description
17	Outer reef	5	Gradual sloping seabed.
		12	Gradual slope towards a steep drop-off.
18	Outer reef	5	Gradual sloping seabed.
		12	Broken reef with high and low relief lumps on sand patches
19	Outer reef	5	Gradual slope dissected by gutters.
		12	Gradual sloping seabed.
20	Outer reef	5	Gradual slope dissected by gutters.
		12	Gradual sloping seabed.
22	Outer reef	5	Gradual slope dissected by gutters.
		12	Gradual sloping seabed.
23	Lagoon	5	Top of bommie with a very uneven surface.
		12	Base of bommie with coral rubble.
25	Lagoon	5	Top of bommie with a very uneven surface.
		12	Relatively flat seabed of fine coral sand and rubble.
26	Lagoon	5	Bommie slope with coral rubble.
		12	Base of coral bommie.
28	Outer reef	5	Heavily dissected reef.
		12	Heavily dissected reef.
29	Lagoon	12	Top of bommie with fine coral sand and rubble.
30	Outer reef	5	Heavily dissected reef with very steep gutter sides.
		12	Heavily dissected reef with very steep gutter sides.

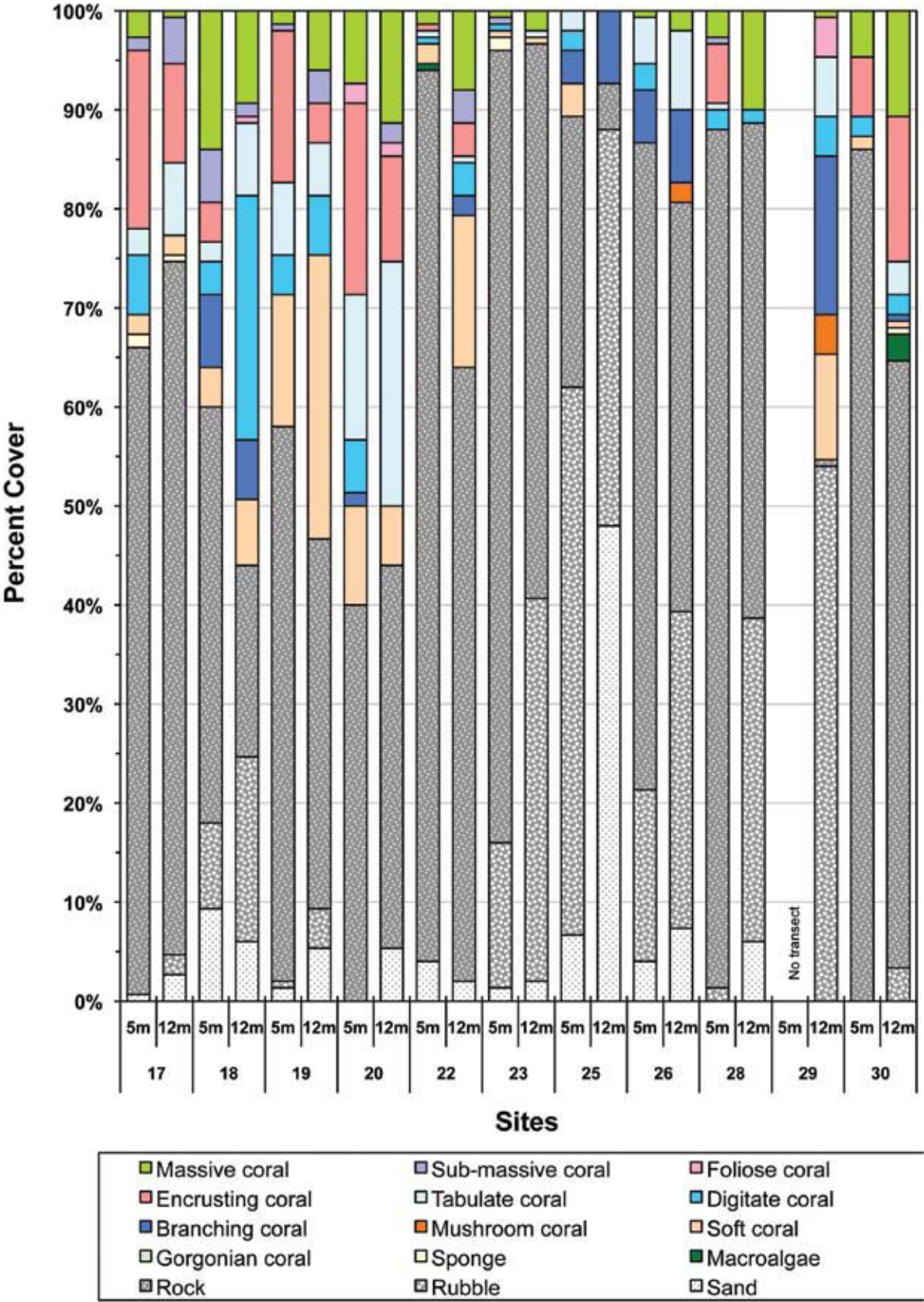


Figure 6 South Scott Reef habitat cover

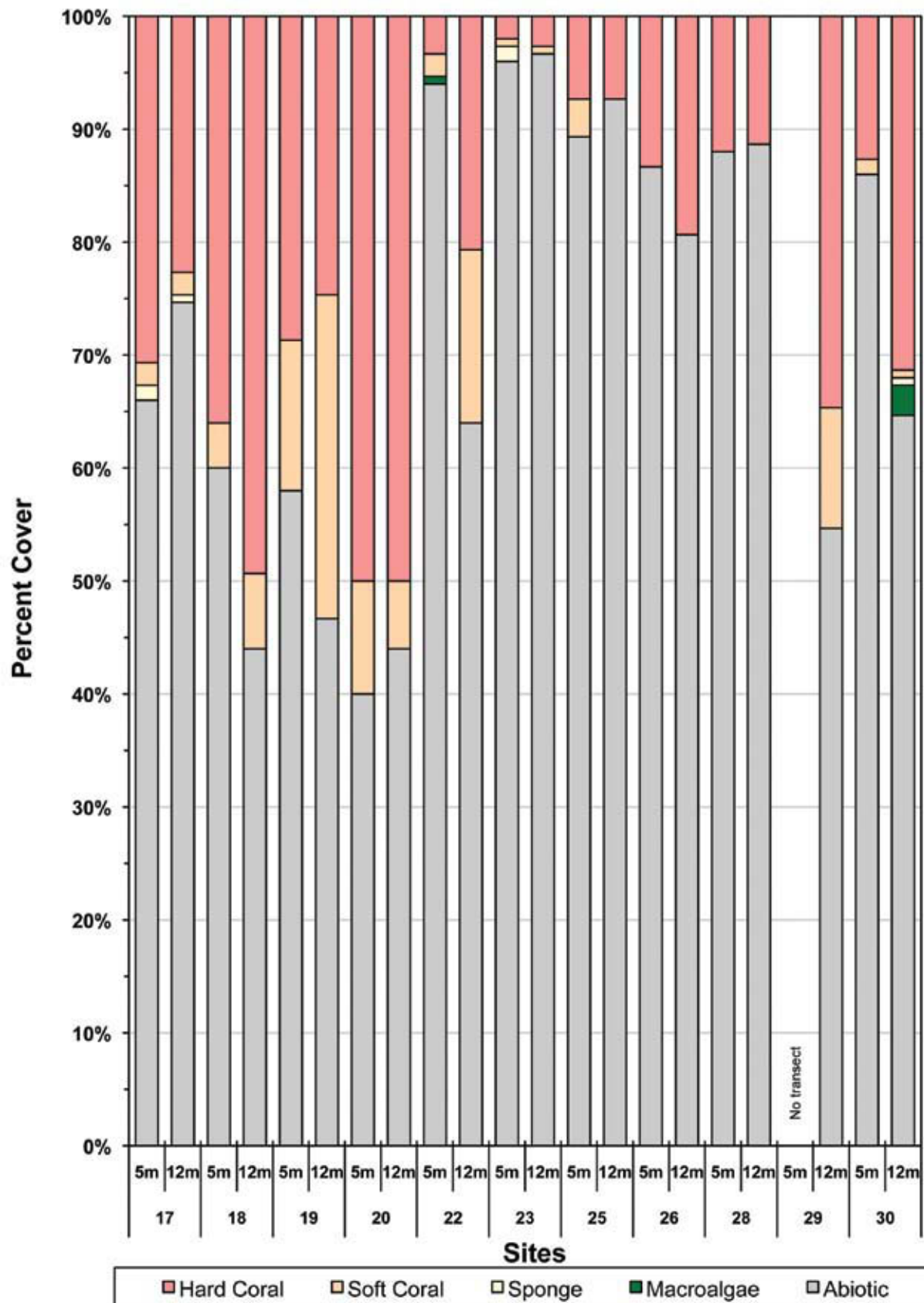


Figure 7 South Scott Reef grouped habitat cover

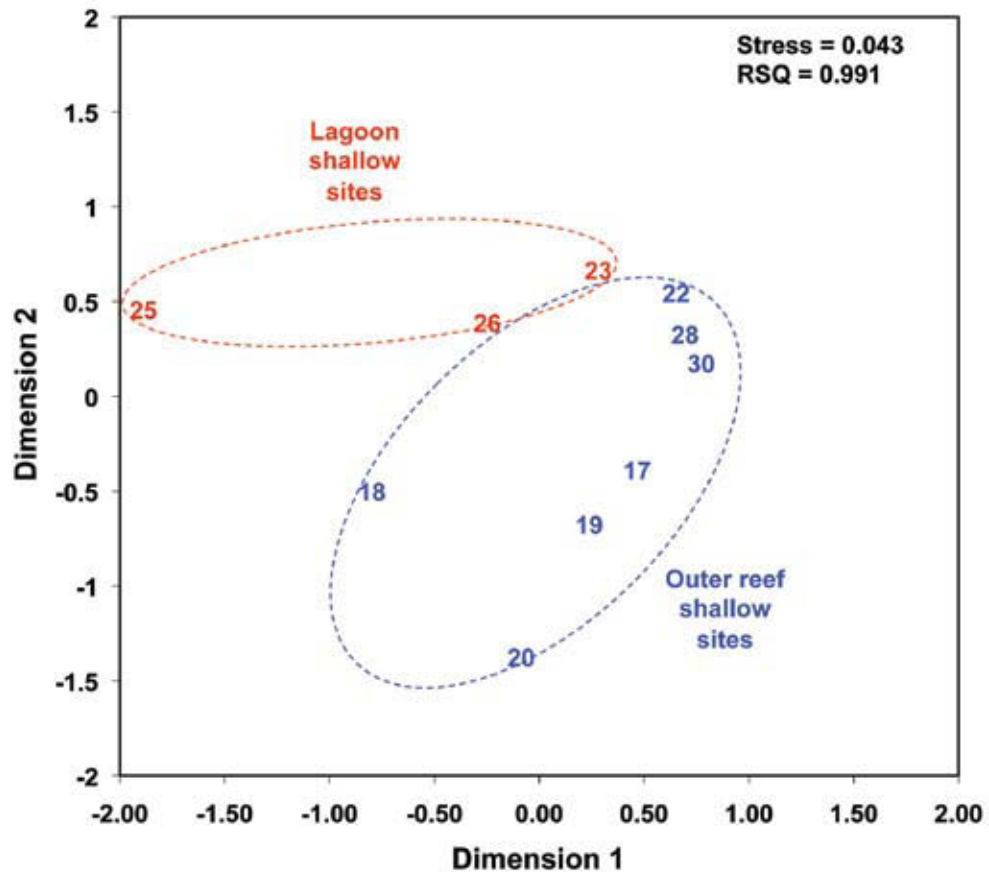


Figure 8 MDS Plot of South Scott Reef shallow transects

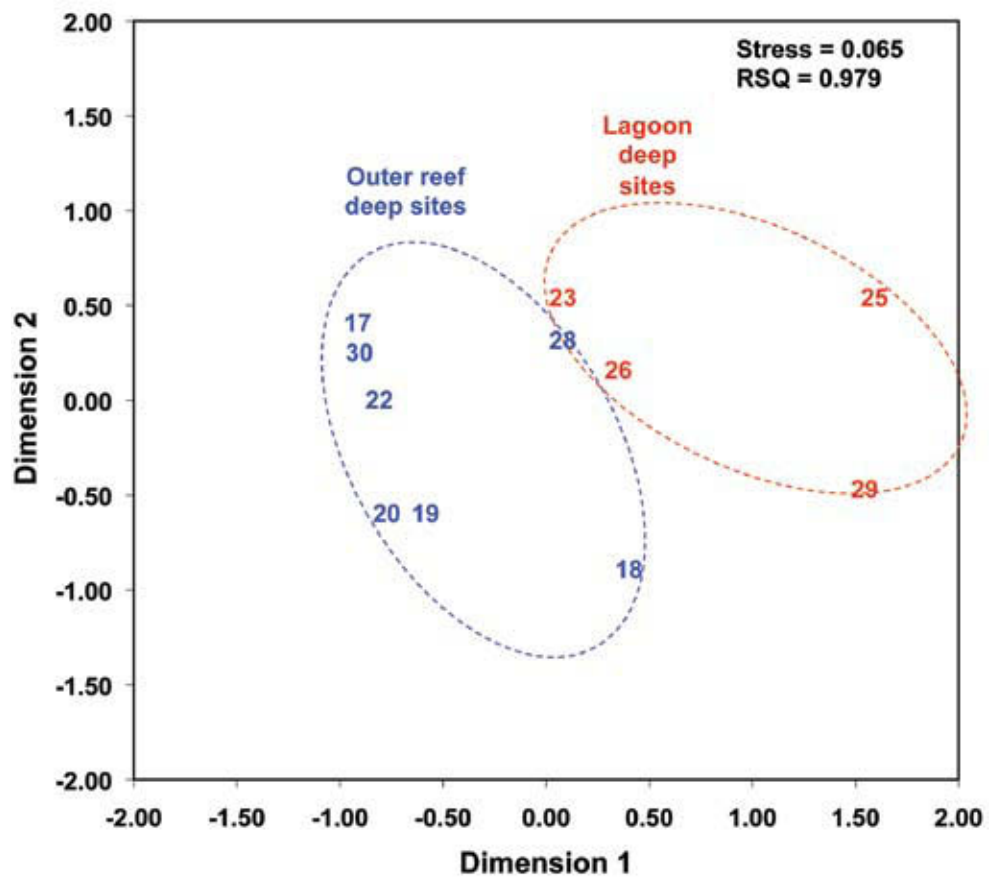


Figure 9 MDS Plot of South Scott Reef deep transects



Above: Station 44, Mermaid Reef. Shallow drainage channels dissect the reef platform. (Photo: Clay Bryce)

NORTH SCOTT REEF

The general description of the physical characteristics of the seabed at each station for North Scott is presented in Table 3. The mean percentage cover by benthic habitat at each station transect is presented graphically by the 15 benthic categories graphically in Figure 10. The data is also presented as percentage cover by a reduced category data set, which amalgamates the abiotic, soft coral and hard coral categories resulting in a set of 5 categories in Figure 11.

Analysis of the data indicates that the outer reef and lagoon transects were distinctly different at both shallow and deep transects (see Figure 12 and Figure 13).

All stations at North Scott Reef were dominated by the abiotic categories sand, rubble and rock ranging from 65–95% cover (Figure 10). The hard corals were dominated by massive and encrusting corals as well as branching corals. Gorgonians were found at the shallow lagoon station 38 and were not recorded on any other transect in the four reefs surveyed.

Table 3 Transect topography at North Scott Reef

Station	Habitat	Depth (m)	Description
31	Outer reef	5	Heavily dissected reef with near vertical walls and rubble bases.
		12	Heavily dissected reef with near vertical walls and rubble bases.
32	Lagoon	5	Bommie top with coral rubble.
		12	Sandy seabed with coral bommies and rocky outcrops.
34	Outer reef	5	Heavily dissected reef with deep gutters and sandy patches.
		12	Heavily dissected reef with deep gutters and patches of rubble.
36	Outer reef	5	Heavily dissected reef with undulating ridges and gutters.
		12	Heavily dissected reef with deep gutters and flattened ridges.
38	Lagoon	5	Slope of small bommie.
		12	Small lumps surrounded by coral sand and rubble.
39	Lagoon	5	Bommie slope with coral rubble.
		12	Coral sand and rubble with several small rocky outcrops.

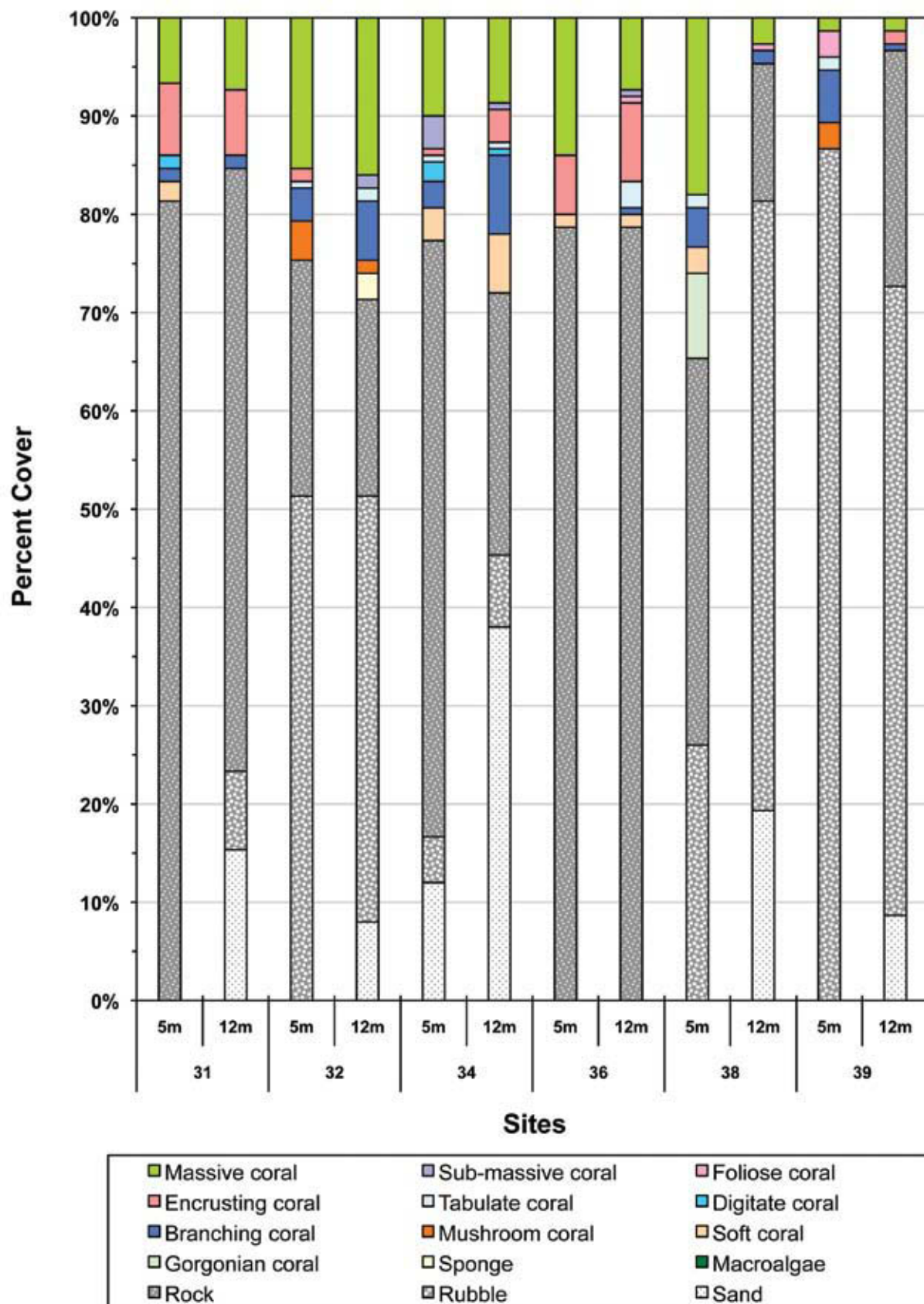


Figure 10 North Scott Reef habitat cover

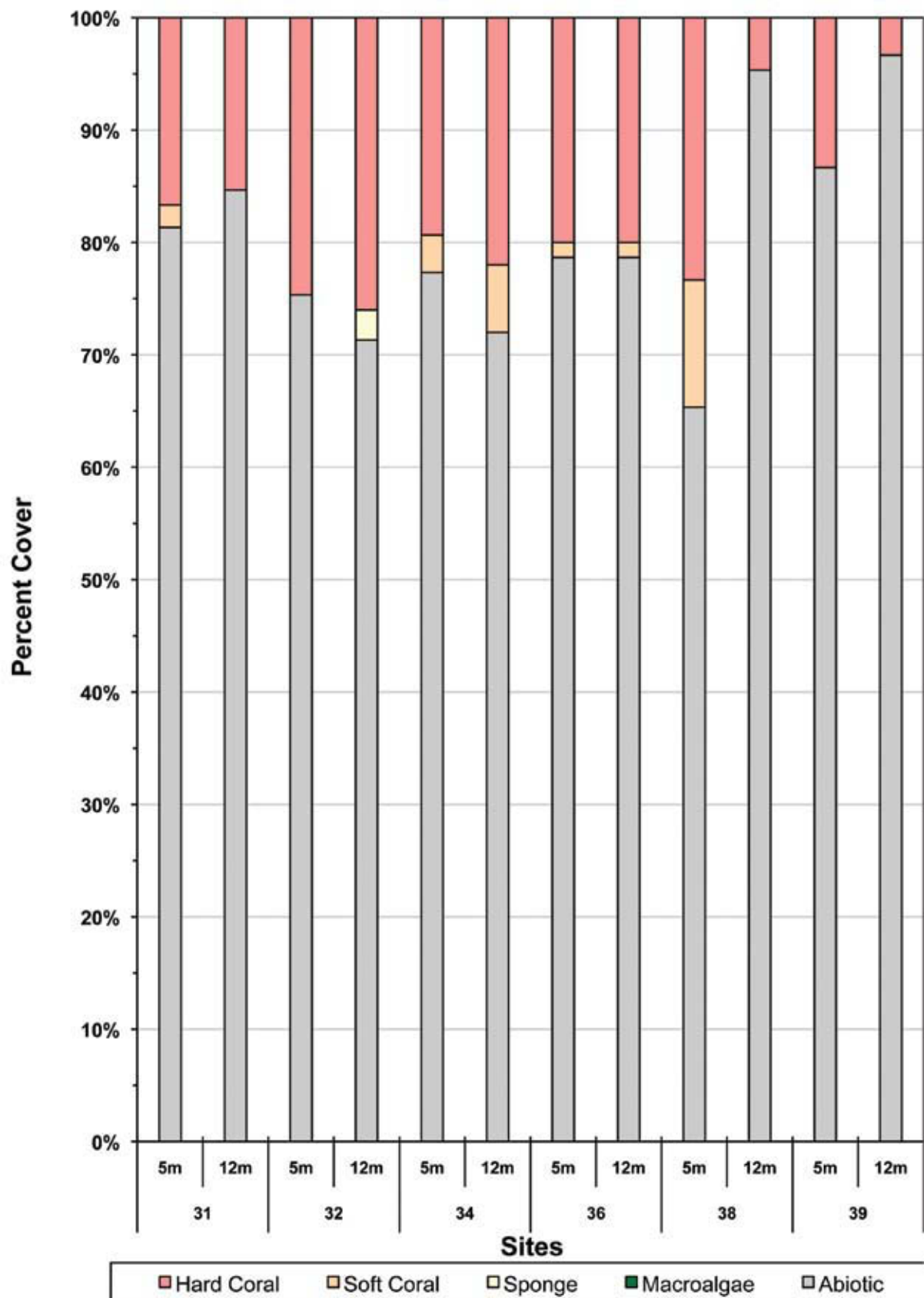


Figure 11 North Scott Reef grouped habitat cover

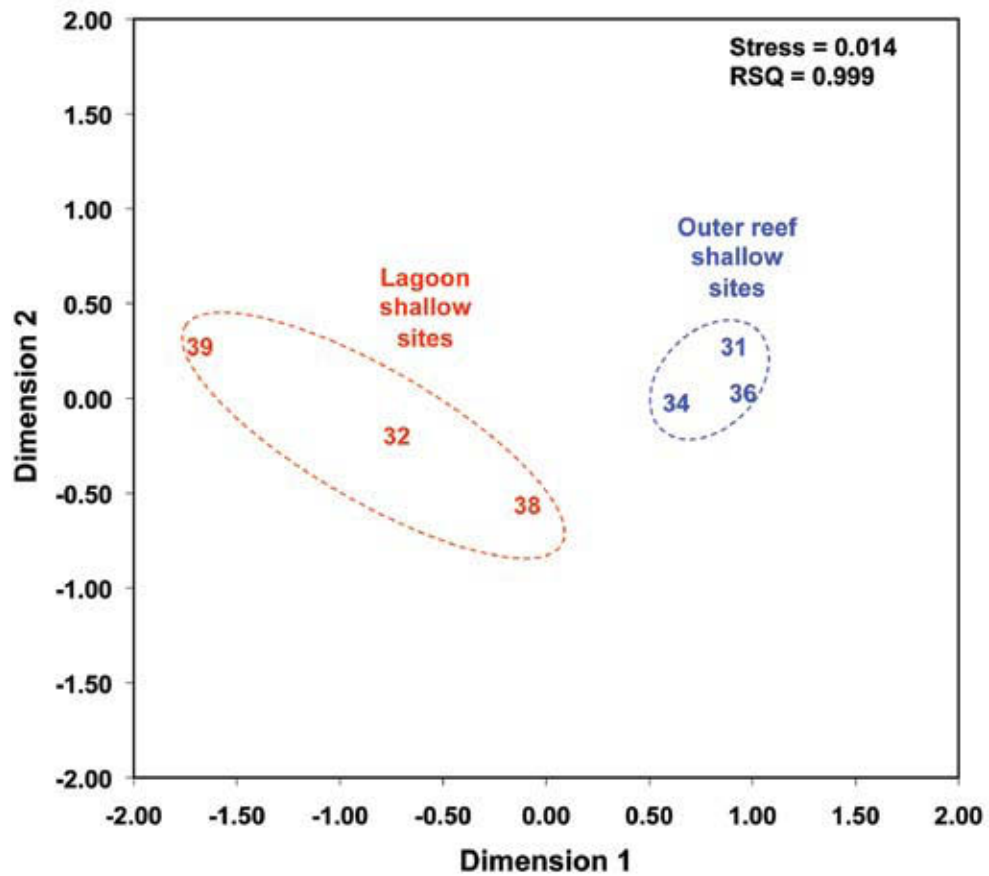


Figure 12 MDS Plot of North Scott Reef shallow transects

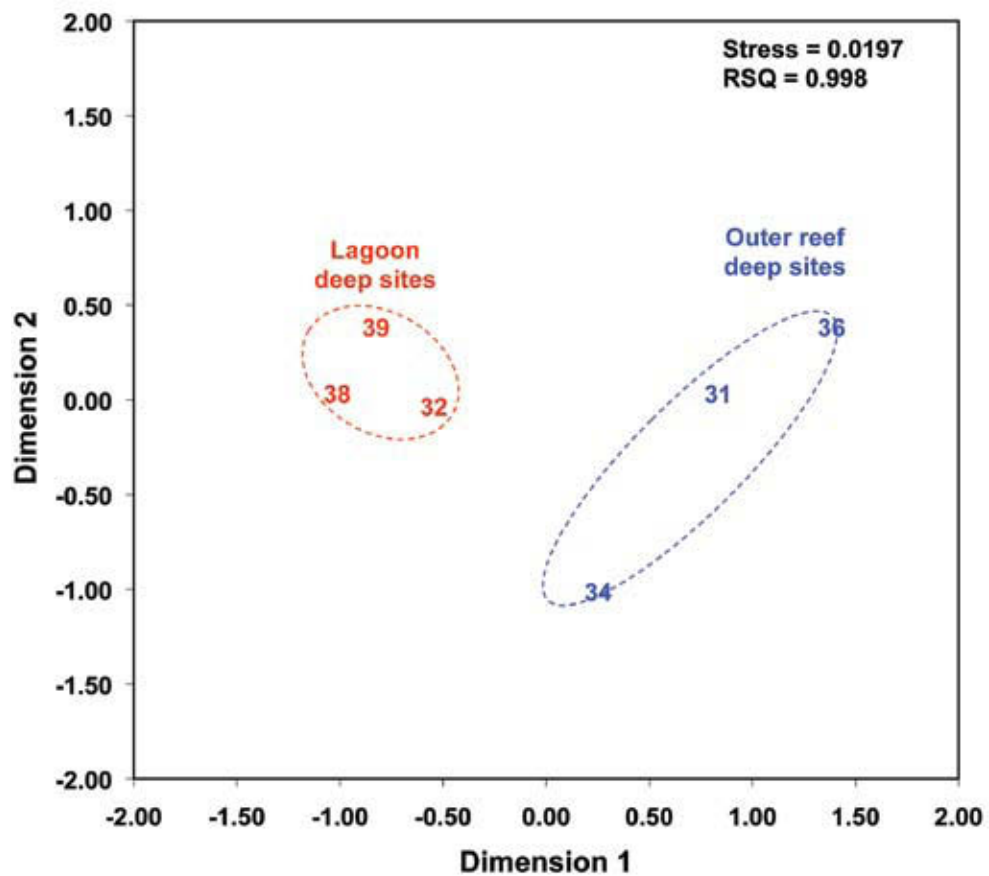


Figure 13 MDS Plot of North Scott Reef deep transects



Above: Station 24, South Scott Reef. *Thalassia* seagrass. (Photo: Clay Bryce)



Above: Mermaid Reef exposed by the tide. (Photo: John Huisman)



Above: Station 37, North Scott Reef. Well tumbled coral-boulders at the outer edge of the reef platform. (Photo: Clay Bryce)

SERINGAPATAM REEF

The general description of the physical characteristics of the seabed at each station for Seringapatam is presented in Table 4. The mean percentage cover by benthic habitat at each station transect is presented graphically by the 15 benthic categories in Figure 14. The data is also presented as percentage cover by a reduced category data set, which amalgamates the abiotic, soft coral and hard coral categories resulting in a set of 5 categories in Figure 15.

Analysis of the data indicates that the outer reef and lagoon shallow transects were distinctly different; however, the variability of the deeper offshore reef transects encompasses the deep lagoon transect (see Figure 16 and Figure 17).

Only two offshore reef and one lagoon stations were surveyed at Seringapatam, thus, it is difficult to generalise about the habitats of this reef or differences between outer and lagoonal reef habitats. Habitat cover varied from 100% abiotic at the shallow outer reef transect at station 41 to 60% abiotic and 40% biotic at the deep outer reef transect at station 45, which comprised soft coral and seven hard coral categories.

REFERENCES

- Carellon, J.H. and Done, T.J. (1995). Quantitative video sampling of coral reef benthos: large scale application. *Coral Reefs* 14:35–46.
- Osborne, K. and Oxley, W.G. (1997). Sampling benthic communities using video transects. In English, S., Wilkinson, C. and Baker, V. (eds), *Survey manual for tropical marine resources*. The Australian Institute of Marine Sciences, Townsville, Queensland.

Table 4 Transect topography at Seringapatam Reef

Station	Habitat	Depth (m)	Description
41	Outer reef	5	Heavily dissected reef.
		12	Rocky patches surrounded by coral rubble.
43	Lagoon	5	Top of bommie with rocky lumps.
		12	Uneven seabed with several rocky lumps.
45	Outer reef	5	Heavily dissected reef with deep gutters.
		12	Heavily dissected reef with large isolated blocks and deep gutters.

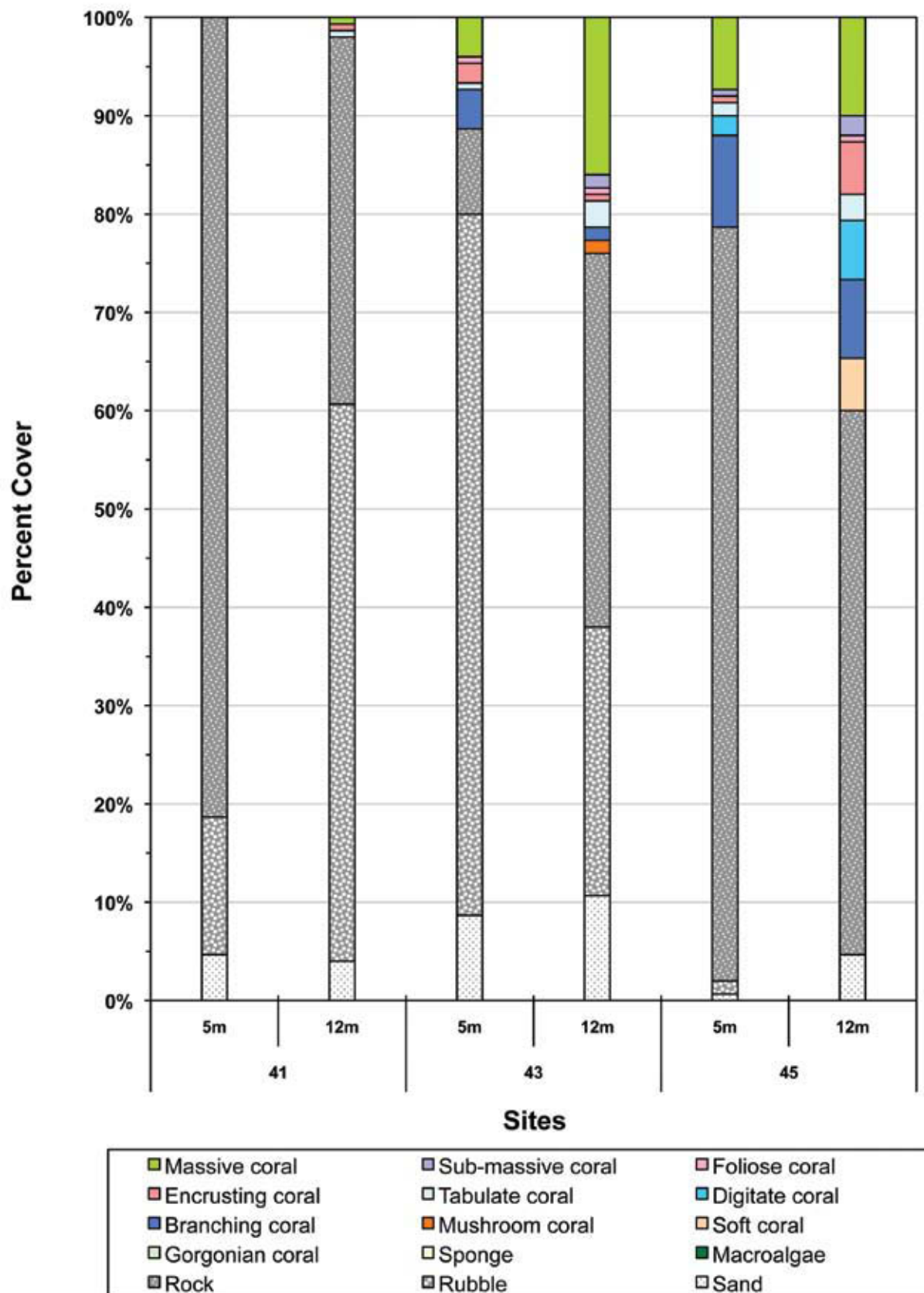


Figure 14 Seringapatam Reef habitat cover

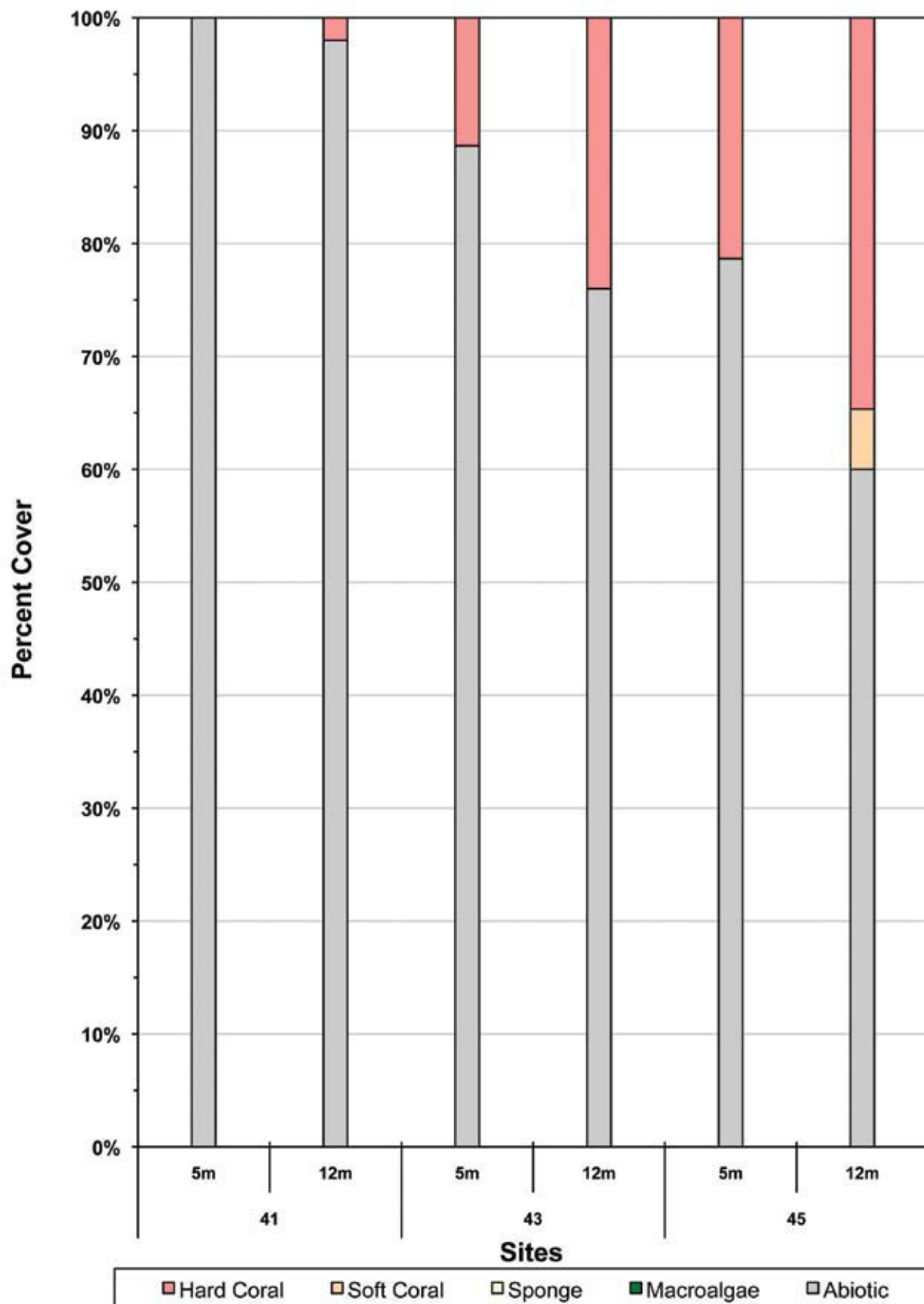


Figure 15 Seringapatam Reef Grouped habitat cover

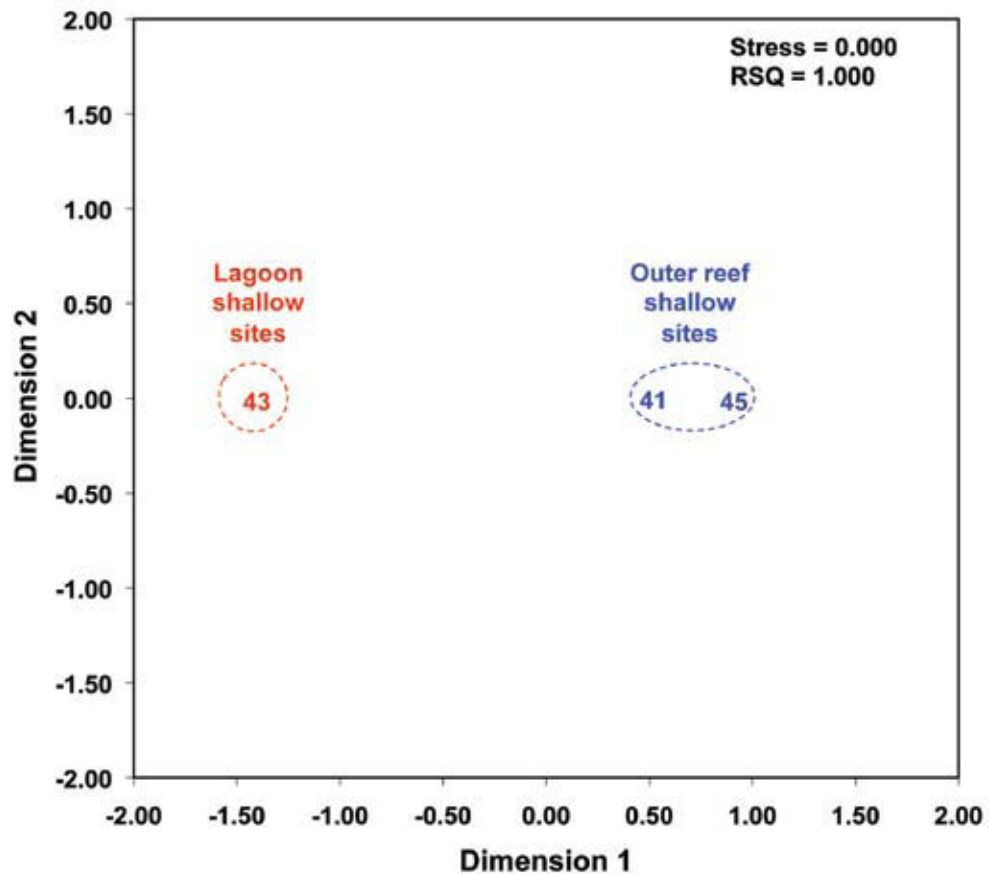


Figure 16 MDS Plot of Seringapatam Reef shallow transects

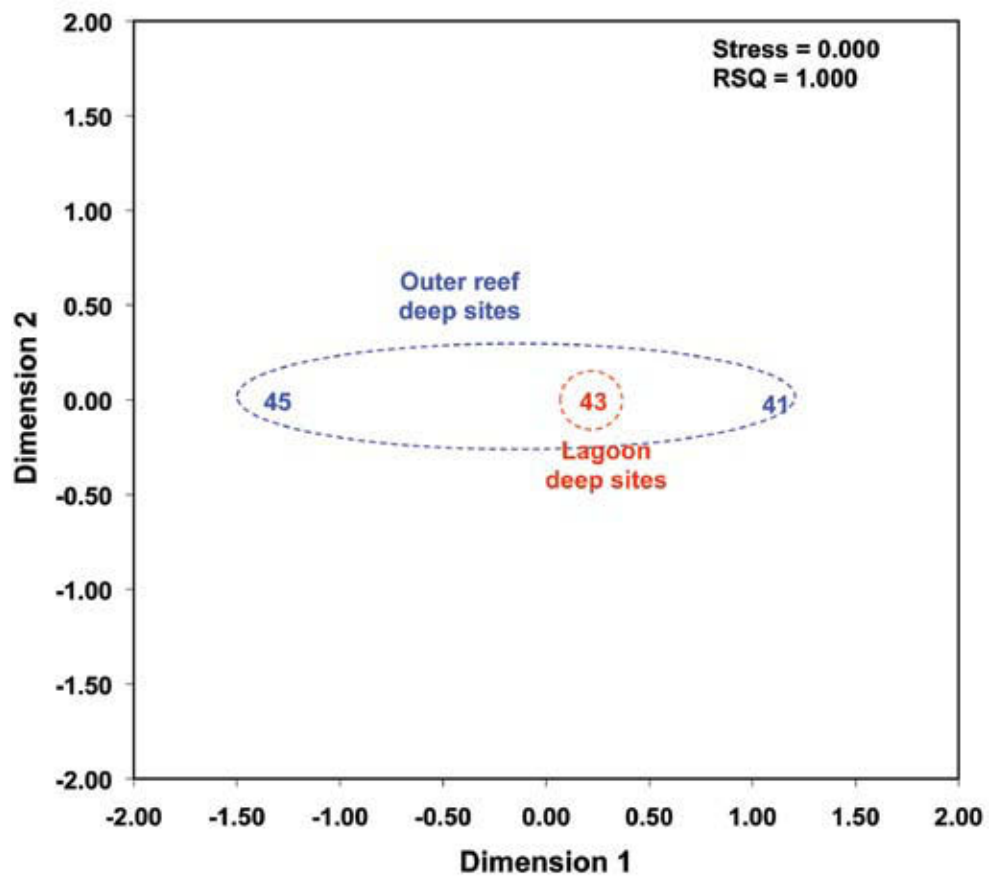


Figure 17 MDS Plot of Seringapatam Reef deep transects