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A survey of the scleractinian corals at Mermaid, Scott, and Seringapatam Reefs, Western Australia.

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Abstract – A diverse assemblage of scleractinian species was recorded during a rapid assessment of the shallow water coral taxa of Mermaid, Scott and Seringapatam Reefs. All taxa were predominately widespread Indo-Pacific species that present clear affinities with coral assemblages of Ashmore Reef and the Indonesian provinces to the north. A total of 269 scleractinian species from 57 genera in 14 families were recorded, comprised of 211 species at Mermaid Reef, 224 species at South Scott Reef, 201 species at North Scott, and 159 species at Seringapatam. The study yielded 22 new distribution records for Mermaid Reef, 18 new distribution records for Scott-Seringapatam, one new record for Western Australia (*Fungia moluccensis),* and one new record for the Rowley-Scott region *(Montipora digitata,* previously recorded from Ashmore Reef). Multivariate analyses indicated there were distinct communities within and among reefs associated with the reef front, lagoon, and intertidal reef flat habitats.

Keywords: Species richness, taxonomy, biogeography, disturbance.

INTRODUCTION

A considerable body of research has examined the ecology and distribution of the zooxanthellate scleractinia in coastal Western Australia. However, relatively few studies have investigated the coral biodiversity of the emergent shelf-edge atolls located in the oceanic region off the northwest continental mainland. Early taxonomic expeditions by the Western Australian Museum (WA Museum) documented the coral fauna of the Rowley Shoals, Scott Reef, and Seringapatam (Veron, 1986), and Ashmore Reef and Cartier Island (Veron, 1993; Veron and Marsh, 1988), while more recent taxonomic studies by Griffiths (1997) re-examined the corals of Ashmore Reef. Long-term monitoring of the region's coral resources by the Australian Institute of Marine Science (AIMS) including (Heyward *et al.*, 1995, 1997; Heyward *et al.*, 1999; Smith *et al.*, 2004) and several predominately taxonomic-based surveys by Done *et al.,* (1994) and Wolstenholme and Smith (unpublished data), has resulted in a relatively deep understanding of the region's coral fauna and the accumulation of a considerable taxonomic inventory for the region.

The Rowley Shoals, Scott Reef and Seringapatam Reefs are influenced by a common suite of environmental variables, including large tidal regimes, warm sea surface temperatures, exposed aspects, and clear oceanic water inputs. However, differing geomorphological and physical characteristics between and within the major reef systems have resulted in heterogeneous physical habitats across exposed reef fronts, protected lagoons, and intertidal reef flats. These reef systems have also been impacted by several major disturbance events: in 1998, sustained elevated sea surface temperatures resulted in mass bleaching (Heyward *et al.*, 1999; Smith *et al.*, in review), and in 2004, category five Cyclone Fay resulted in widespread destruction of coral communities (Gilmour and Smith, 2006).

This study presents a preliminary rapid assessment of scleractinian species richness and abundance at Mermaid Reef (Rowley Shoals), South Scott, North Scott, and Seringapatam Reefs. The primary aims of this survey were to assess regional coral biodiversity, provide a quantitative assessment of abundance, execute a repeatable search effort that may afford future comparison between further surveys, and examine the taxonomic and biogeographical relationships of the complex mosaic of coral communities that exist in the region.

METHODS

Surveys were conducted at a series of stations that were selected using satellite imagery and historical records to maximize habitat diversity and to

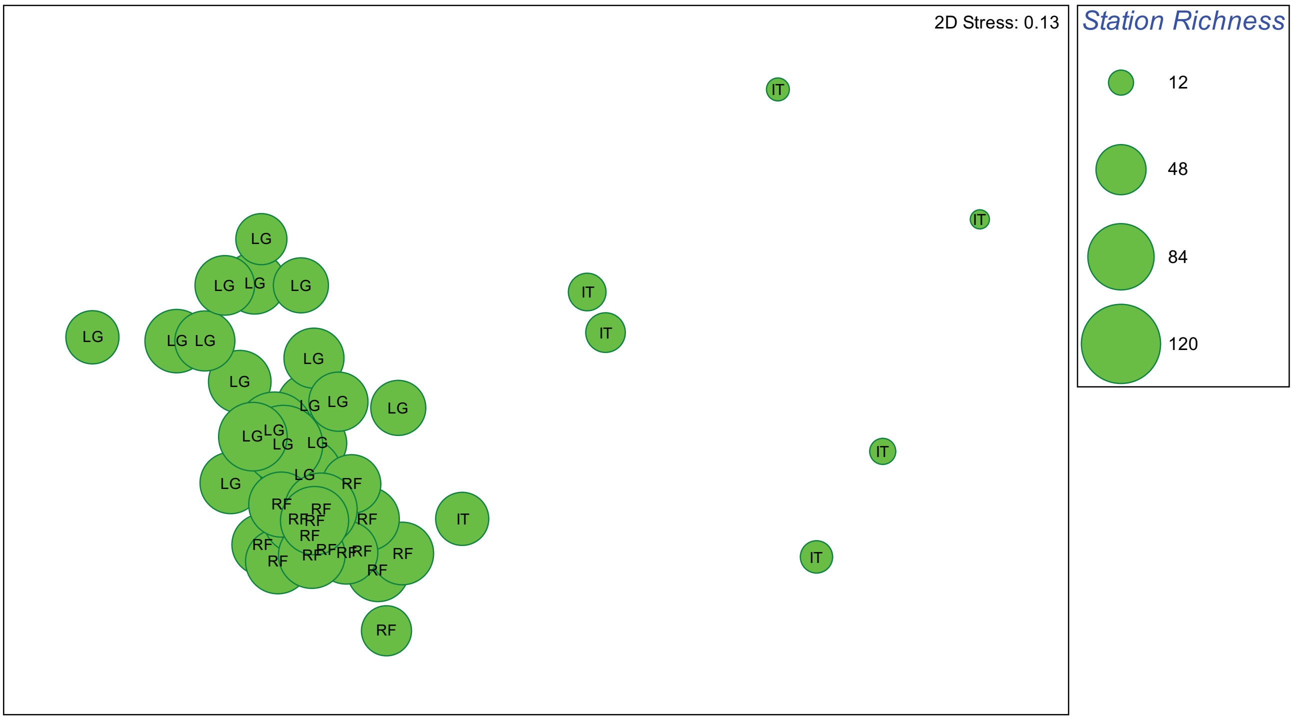

Figure 1 MDS ordination of 41 stations from Mermaid, South Scott, North Scott and Seringapatam, based on untransformed presence/absence and Bray-Curtis similarities. Station richness is superimposed over each station and the major habitat types are indicated: lagoon (LG), reef front (RF), intertidal reef flat (IT).

incorporate previous WA Museum and AIMS study sites. A total of 45 stations were surveyed by scuba, snorkelling and reef walking. A list of stations and habitat descriptions is presented in the Station and Transect Data section of this volume.

Surveys at each station were conducted along two 15 m x 1 m transects laid over the dominant habitat (typically parallel to the reef contour or reef crest) at approximately 5 m and 12 m depth, corrected to mean sea level. Transect depths were chosen to maximize species diversity and abundance by capturing the shallow reef slope between 3–6 m depth and the deeper reef slope at 10–14 m, as reported by Heyward for Scott Reef, (pers. comm.) and DeVantier *et al.*, in other locations (2006). Exceptions to the standard two transect method were stations 10, 13, 27, 40 (no transects were used, but surveyed for biodiversity), stations 29, 35, 42, 44 (one transect only used, plus 30 minutes additional search time), and stations 10, 13 (repeat survey at same location). Stations 10, 13, 27, 40 were excluded from all analyses due to non-standard search effort. Stations were scored against a series of habitat descriptors (refer Table 4), and a two-tiered survey approach was utilized at each station to assess biodiversity and abundance respectively.

Tier One: The presence of all species encountered along each transect was recorded during a visual survey. Additional search time to a maximum of 10 minutes per station was used to supplement sightings along the transects. Additional searches were conducted haphazardly, adjacent to, and between, transects. Opportunistic sightings, made outside the transect area or during additional search time, were recorded separately as extra sightings.

Station richness (defined as the total number of discrete species recorded at each station) was calculated by aggregating the number of species sighted along the transects, with those recorded during extra time or opportunistically off the transect.

Tier Two: Quantitative estimates of abundance at functional group levels were generated by video transect analysis, with estimates of percentage cover assigned to each group. Refer to, *The subtidal habitats of Mermaid Reef (Rowley Shoals), Scott and Seringapatam Reefs, Western Australia.* (this volume) for further discussion of these methods and analyses of these data.

Coral taxa on visual surveys were identified *in situ* to species level, or where identification could not be resolved, a voucher specimen was collected for further taxonomic analysis at WA Museum. Voucher specimens were bleached in calcium hypochlorite, then washed in seawater before being dried and packed for shipping.

Corals were identified using Veron (2000; 2002) and Veron and Stafford-Smith (2002), with the exception of the genus *Acropora* which follows

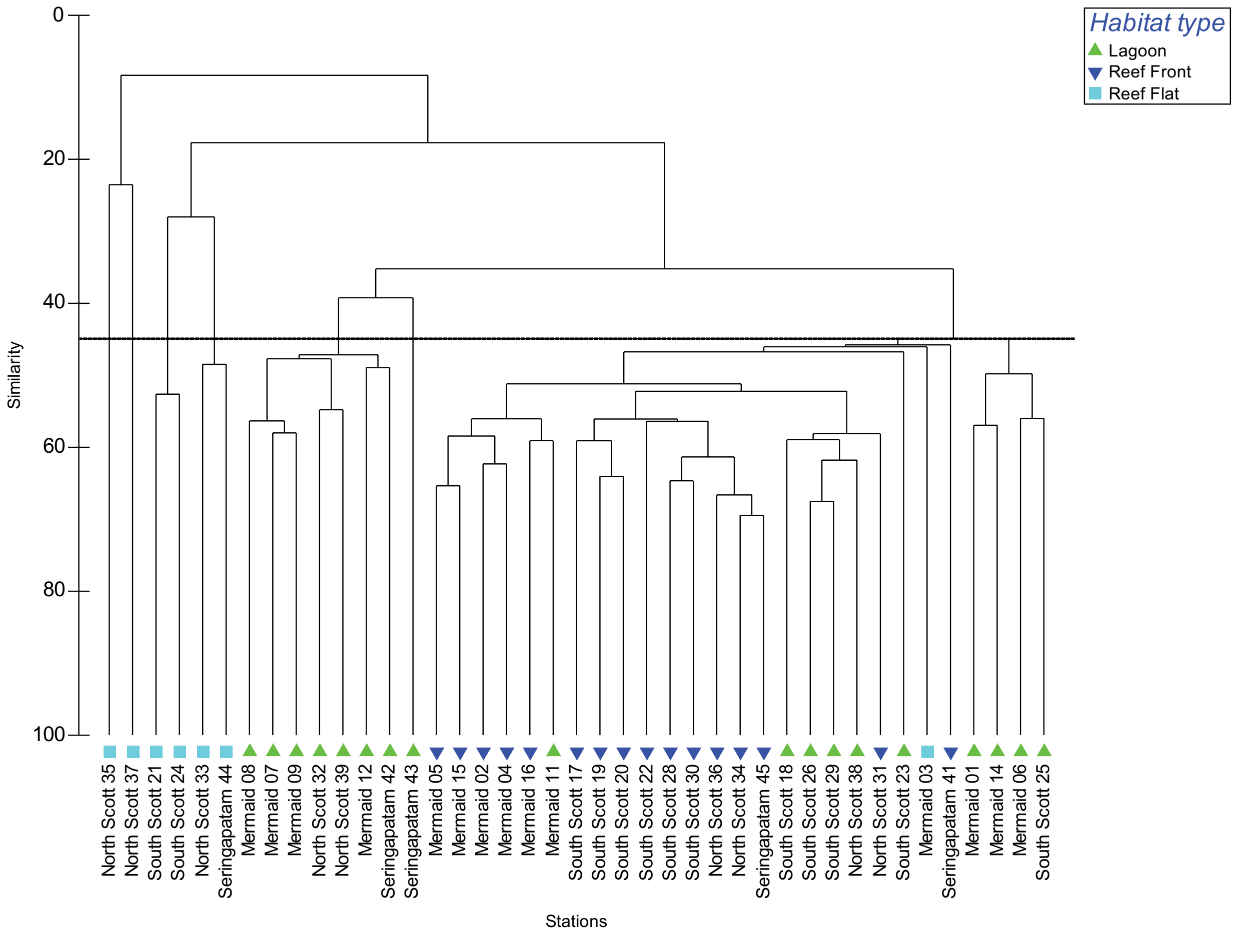

Figure 2 Dendrogram for hierarchical clustering of 41 stations at Mermaid, South Scott, North Scott and Seringapatam, using group-average linking of Bray-Curtis similarities, calculated on untransformed presence/absence data. A similarity level of 45% is indicated.

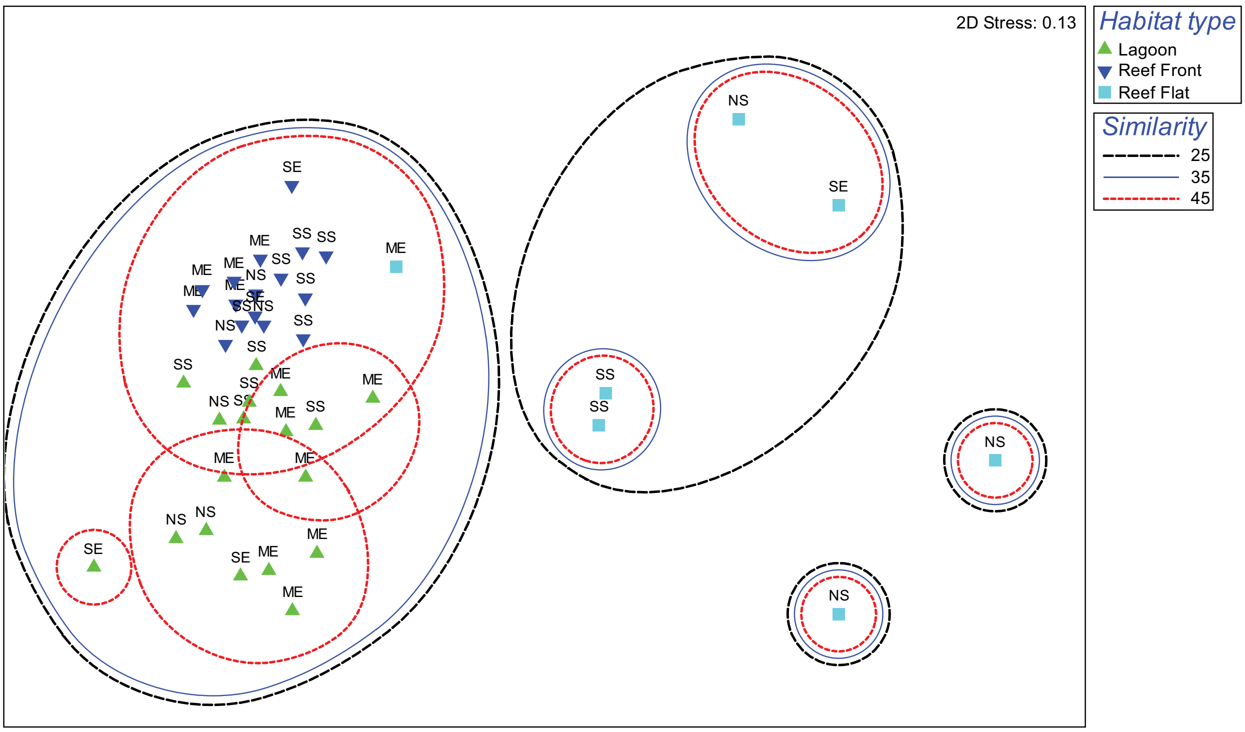

Figure 3 MDS ordination of 41 stations at Mermaid, South Scott, North Scott and Seringapatam, based on untransformed presence/absence data and Bray-Curtis similarities. Similarity contours from the cluster analysis at 25%, 35%, and 45% are indicated.

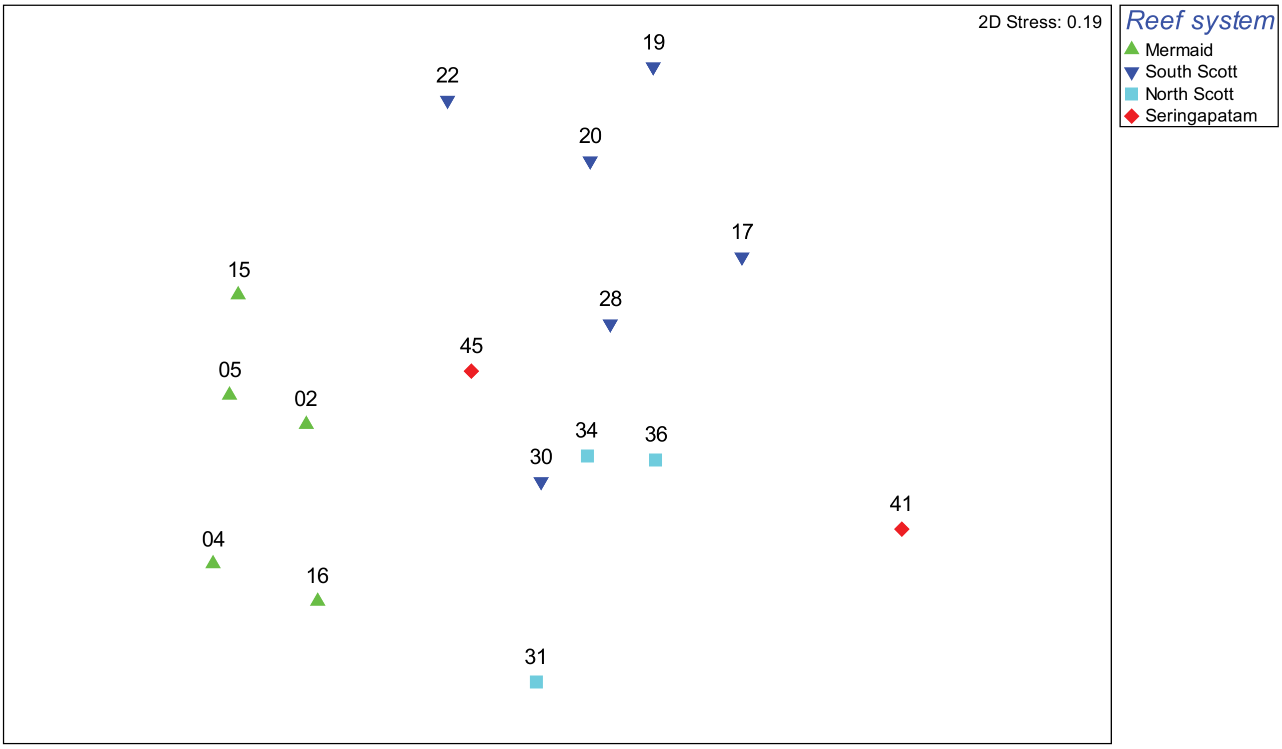

Figure 4 MDS ordination of 16 reef front stations at Mermaid, South Scott, North Scott and Seringapatam, based on untransformed presence/absence data and Bray-Curtis similarities.

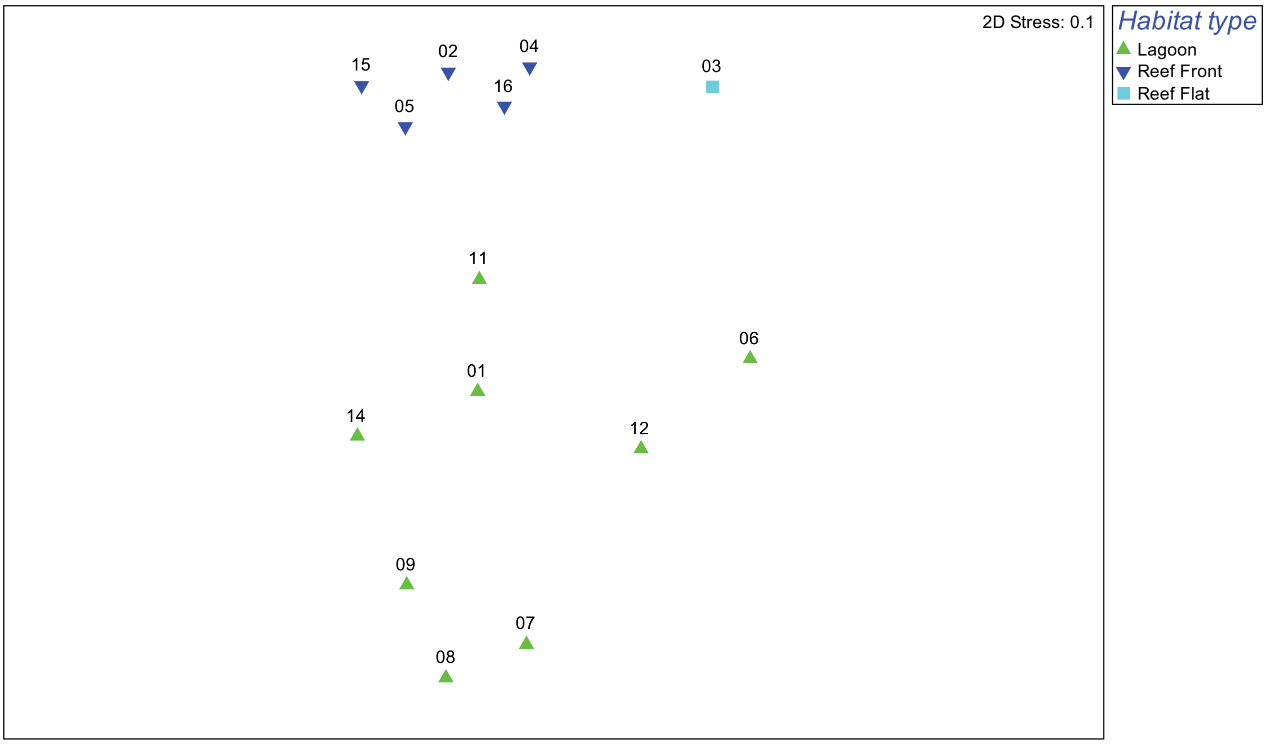

Figure 5 MDS ordination of 14 Mermaid stations, including reef front, lagoon, and intertidal reef flat habitats, based on untransformed presence/absence and Bray-Curtis similarities.

Left: Surveyed stations in Mermaid Reef lagoon displayed only minor cyclone damage; **Right:** The hard corals, *Seriatopora* (branching) and *Turbinaria* (encrusting) in the lagoon at Scott Reef. (Photos: Clay Bryce)

Wallace (1999) excluding *A. exquisita*, and the Fungiidae which follows Hoeksema (1989). Veron and Pichon (1975; 1980; 1982), Veron, Pichon and Wijsman-Best (1977), Veron and Wallace (1984) were also used to aid identification. The non-scleractinian species *Heliopora coerulea*, *Tubipora musica* and genus *Millepora* were also recorded during this survey.

Multivariate analyses of the two-way crossed survey design with replicates were performed using the software application PRIMER v6. A detailed discussion of these methods is provided in Clarke and Gorley (2006) and Clarke and Warwick (2001).

Deep and shallow transect data were aggregated in all analyses, as patterns of zonation with depth were relatively obscure within the higher-level patterns of habitat and reef system community similarity.

RESULTS

A total of 269 scleractinian species from 57 genera in 14 families were recorded during the present survey, comprised of 211 species at Mermaid, 224 species at South Scott, 201 species at North Scott, and 159 species at Seringapatam (Table 1).

The study yielded new distribution records for 22 species at Mermaid Reef and 18 species at Scott/Seringapatam. All new distribution records were small range extensions between individual reef systems in the Rowley-Scott complex, with the exception of *Fungia moluccensis*, a new record for Western Australia, and *Montipora digitata*, previously recorded from Ashmore Reef.

Station richness

Station richness recorded at all reef systems ranged from seven to 116 species per station (Table 1). Overall richness averaged 68 species per station, with mean values of 70 at Mermaid, 76 at South Scott, 60 at North Scott, and 55 at Seringapatam (Table 2). Intertidal stations were consistently depauperate (mean station richness = 23), while reef front and lagoon stations had relatively high station richness (mean richness = 77) (Figure 1). South Scott had four of the five highest station richness values recorded during the survey.

Nine of the 41 stations surveyed had high station richness (>80 species per site), 23 stations had medium station richness (>50 species), 6 stations had low richness (20–50 species), and three stations had very low richness (<20 species). Many of the species recorded were relatively rare, with 21 species recorded only once during the survey. A large proportion of species were uncommon, with 169 species recorded at less than 10 stations. 22 species were abundant and were recorded at more than 25 stations.

Left: Mermaid Reef. Branching *Acropora* and massive *Porites* corals; **Right:** Scott Reef. *Acropora* coral. (Photos: Clay Bryce)

Left: Mermaid Reef. *Fungia* mushroom corals surround the coral *Pectinia lactuca* (Pallas, 1766); **Right:** *Goniopora* sp., with tentacles extended, was common on all reefs. (Photos: Clay Bryce)

Community classification

Multivariate classification and non-metric multi-dimensional scaling (MDS) analyses showed strong clustering of stations based on similarities among and within reef systems and habitat types (Figure 2, 3).

Among reefs, strong clustering of stations occurred with habitat type. That is, habitat type was associated more strongly with community similarity than reef system location (Figure 3). Reef front stations were closely related between all reef systems, with Mermaid, South Scott, North Scott and Seringapatam reef front sites all strongly similar. Lagoon communities also clustered strongly, albeit it less than reef front stations, while intertidal reef flat stations clustered very weakly. Reef front and lagoon communities were more similar to each other than to intertidal communities.

Reef front stations at Mermaid were most closely related to reef front stations at North Scott. Reef front stations at South Scott were most closely related to reef stations at North Scott. Reef front stations at North Scott were intermediate between Mermaid and South Scott. Reef front stations at Seringapatam showed mixed affinities with Mermaid, South Scott, and North Scott.

Lagoon stations at Mermaid were most closely related to a mix of lagoon stations at South Scott, North Scott and Seringapatam. Some Mermaid lagoon stations tended towards reef front communities. Lagoon stations at South Scott presented mixed affinities with lagoon stations at Mermaid, and were closely related to all reef front stations. Lagoon stations at North Scott were most closely related to lagoon stations at Mermaid and South Scott. Lagoon stations at Seringapatam were closely related to lagoon stations at North Scott and Mermaid.

Intertidal reef flat communities were strongly dissimilar to both reef front and lagoon communities, with the exception of the Mermaid reef flat station, which was closely related to all reef front stations and South Scott in particular. Intertidal stations at South Scott, North Scott and Seringapatam were related only loosely.

Within each of the major habitat-associated communities, distinct reef system sub-communities were present. Each habitat community was typically comprised of several smaller clusters of stations belonging to each of the different reef systems. For example, within the major reef front

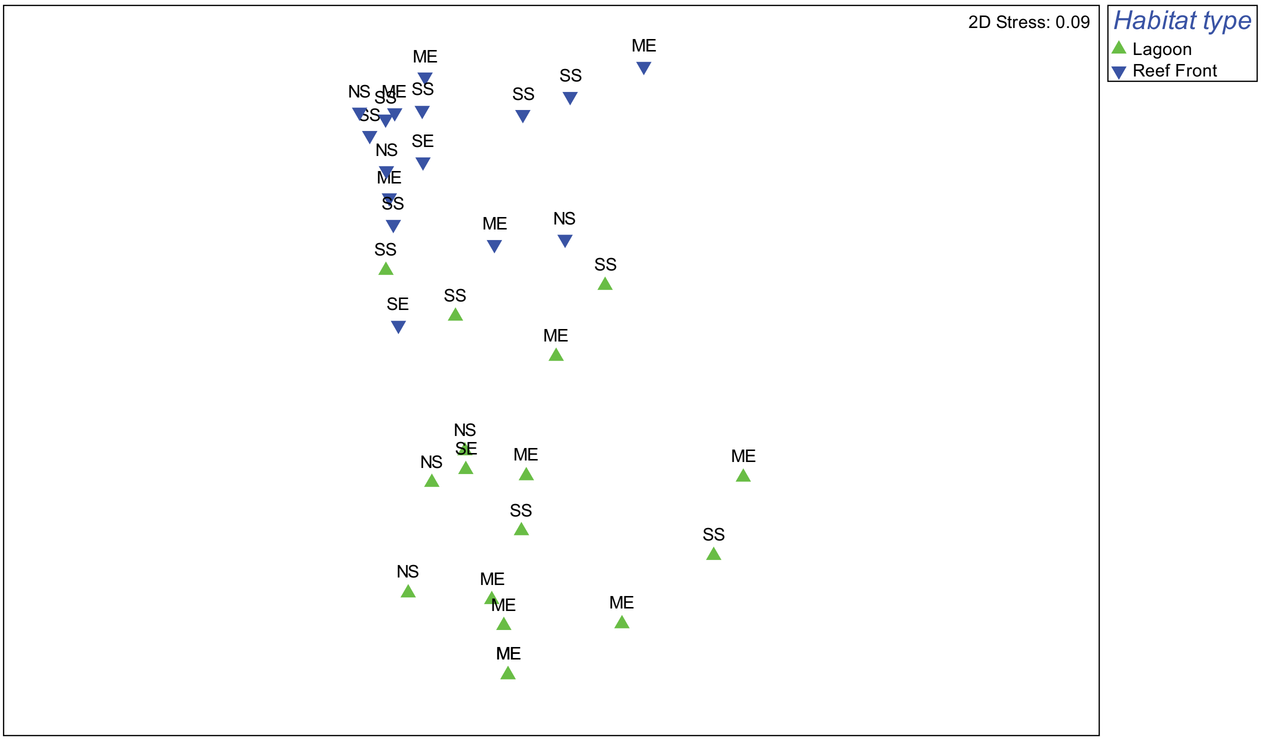

Figure 6 MDS ordination of 32 stations at Mermaid, South Scott, North Scott and Seringapatam, based on untransformed percent cover estimated from video transects, and Bray-Curtis similarities. Intertidal reef flat stations were not surveyed by video.

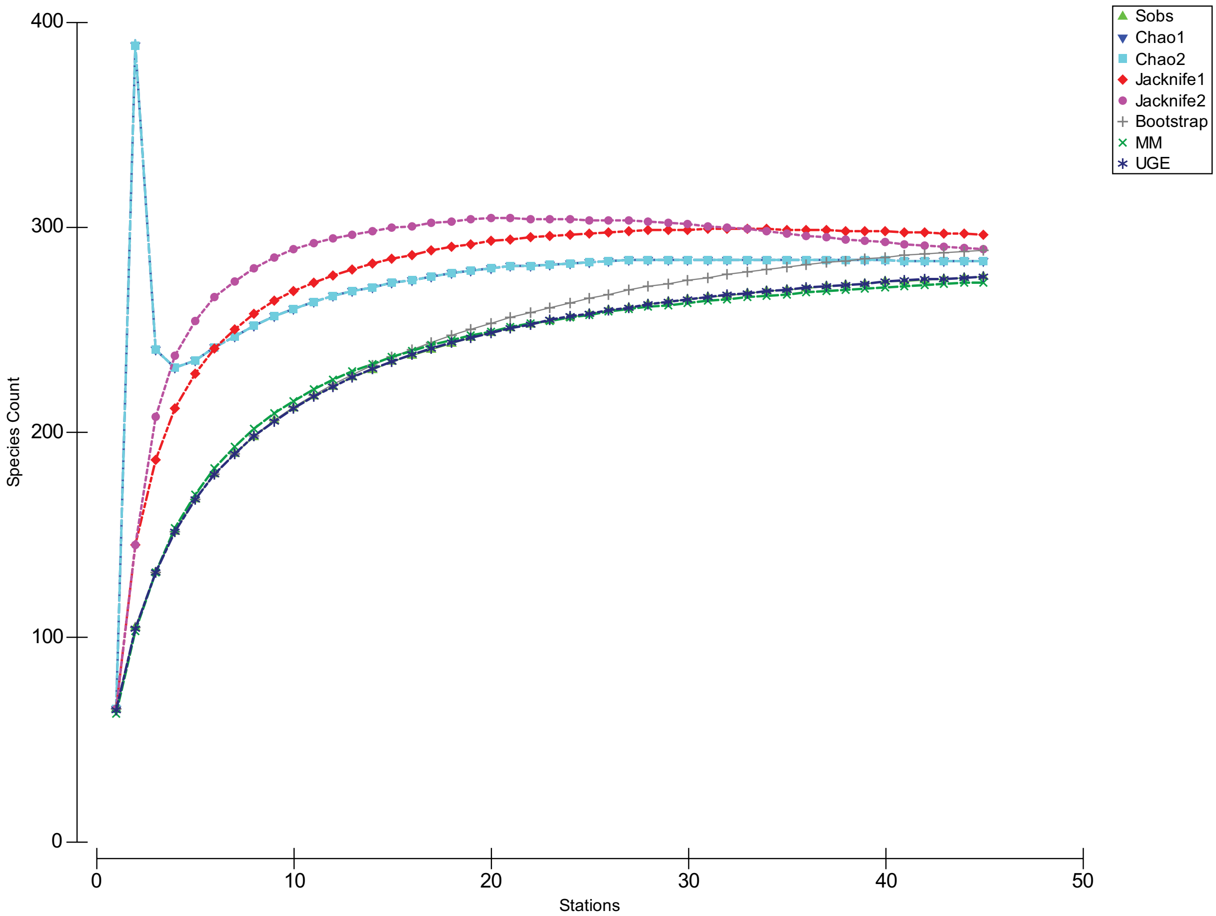

Figure 7 Combined species-area curve for all stations at Mermaid, South Scott, North Scott, and Seringapatam. Actual species counts are indicated (Sobs), as are projected values from Bootstrap, Jack-knife, Chao, and Michaelis-Menton models.

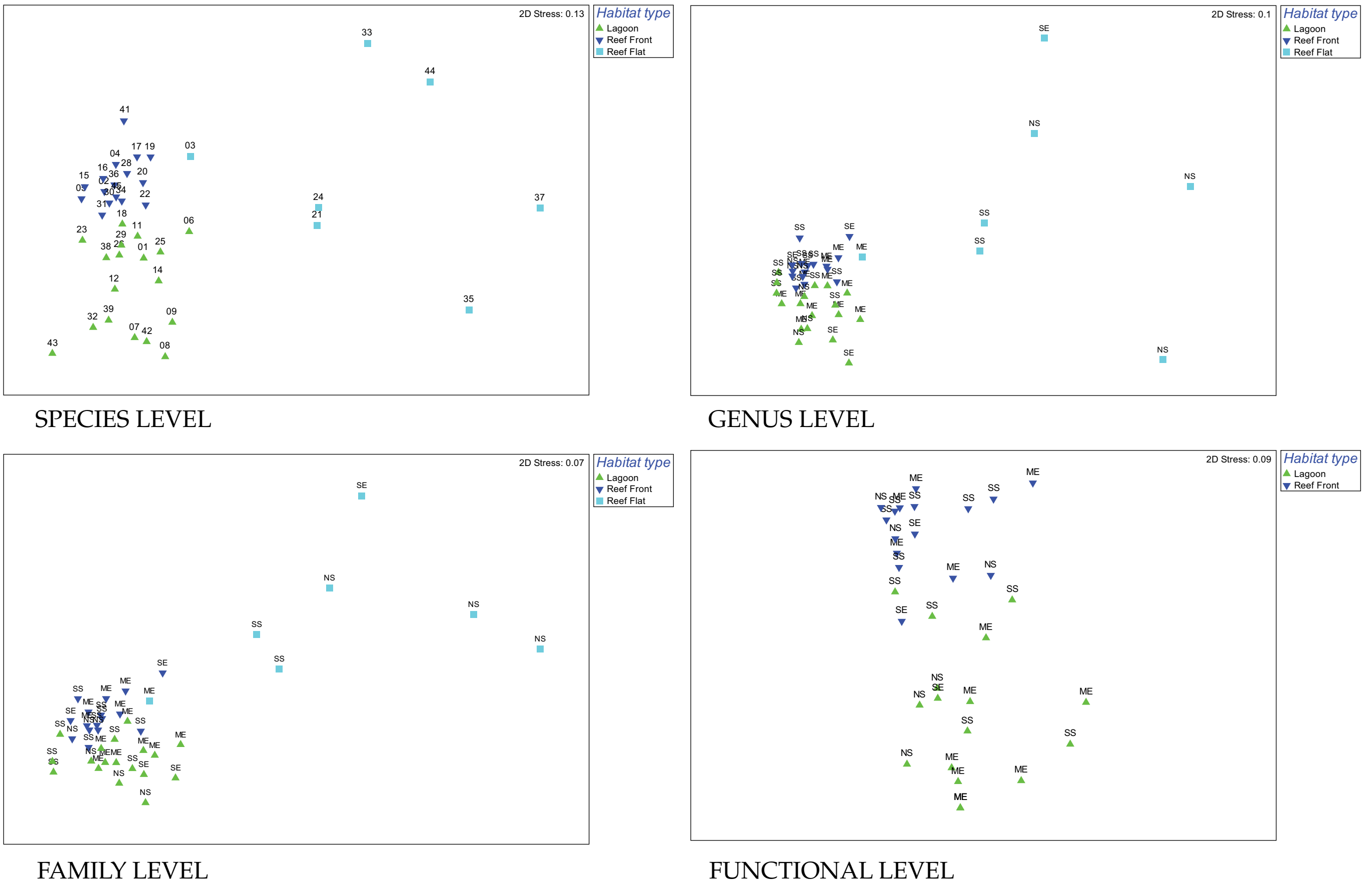

Figure 8 MDS ordinations of 41 stations at the species, genus, family, and functional group levels, based on untransformed presence/absence data and percent cover, with Bray-Curtis similarities. Intertidal reef flat stations were not surveyed by video and are therefore excluded from the functional group level MDS.

cluster, Mermaid communities were distinct from the South Scott and North Scott communities, which were in turn similar to each other, while Seringapatam showed mixed affinities with Mermaid, South Scott and North Scott (Figure 4). These patterns of intra-habitat reef system segregation were repeated in the lagoon-associated communities across the four major reef systems. Intertidal reef flat segregation relationships were unclear.

Patterns of similarity were also apparent within individual reef systems, with distinct habitat-associated communities occurring within each reef. Within the Mermaid reef system, lagoon sites were clearly distinct from reef sites (Figure 5). The intertidal station was also distinct from the reef front sites. These patterns of intra-reefal habitat segregation were repeated in lagoon- associated communities across the four major reef systems.

Pair-wise analysis of similarity tests for differences between all habitat types were statistically significant (p<1%), with R scores ranging from 0.716 to 0.935. Pair-wise tests for differences between all reef systems were also statistically significant (p<1%), with the exception of the North Scott-Seringapatam pair. R scores ranged from 0.344 to 0.657. Complete analysis of similarities (ANOSIM) test values are given in Table 3.

Benthic Cover

Analyses of video transect data also showed strong clustering of communities at the functional group level associated with the lagoon and reef front habitats (Figure 6). Within the lagoonal cluster, smaller sub-clusters were associated with the Mermaid and North Scott reef systems. Mermaid and North Scott were similar to each other, while South Scott and Seringapatam were loosely grouped, with no clear affinities to other reef systems. Within the reef front cluster, no clear patterns were associated with any single reef system. Rather, the four reef systems showed mixed affinities with each other while remaining distinct from the lagoon communities. Intertidal reef flat transects were not surveyed by video, therefore no analyses could be performed for this habitat.

Hard coral cover was highest at Mermaid (29%), followed by South Scott (21%), North Scott (17%), and Seringapatam (16%). Hard coral cover was highest in the reef front habitats (25%) followed by the lagoon habitats (22%).

Habitats

Habitat descriptor scores for each station are given in Table 4. The major species that typify the lagoon, reef front, and reef flat habitats are given in Table 5, as are the major species that discriminate between each habitat group. The major functional groups that typify the lagoon, reef front, and reef flat habitats are given in Table 6, as are the major functional groups that discriminate between each habitat group.

Lagoon stations were characterised by protected sandy floor or mixed reef and rubble habitats, interspersed with isolated outcrops and bommies, simple, regular structural features, low wave energy, low to medium water clarity, and flat or low slopes, to 10–20m deep. Key groups of taxa were the branching Acroporas, and massive non-Acroporas.

Reef front stations were characterised by exposed coral and coralline algae covered limestone platforms, complex, irregular structural features, medium to high wave energy, medium to high water clarity, and steep slopes to a terrace at 12–18m before an abrupt drop-off to very deep water. Key groups of taxa were the non-branching Acroporas and encrusting or massive non-Acroporas.

Intertidal reef flat stations were characterised by exposed combinations of reef crest zones, submerged elements of mixed reef, rubble, pavement and patch reefs, simple, regular structural features, medium to high wave energy, and extensive exposed reef flats at low tide. Key groups of taxa were the massive non-Acroporas, particularly *Porites* species.

Species-area curves

The cumulative species richness curve for the aggregated regional pool of the four major reef systems was close to reaching an asymptote, with few new discrete species encountered with additional station sampling in the region (Figure 7). However, examination of species-area curves for each separate reef system showed that individual

Above: An *Acropora* forest in the lagoon of Mermaid Reef. (Photo: Clay Bryce)

Above: The brooding coral, *Stylophora pistallata* Espar, 1797 (Photo: Clay Bryce)

reef species accumulations had not yet approached an asymptote, with new species continuing to be encountered with additional sampling. Estimates of the total number of species likely to be recorded in the Rowley-Scott region range from 273 to 296, based on a combination of Bootstrap, Jackknife, Chao, and Michaelis-Menton extrapolation models (Figure 7).

Aggregated taxonomic levels

MDS on aggregated taxonomic data at the levels of species, genus, family, and functional group showed similar community assemblages across multiple taxonomic levels, with the same overall patterns of community assemblages by site type and reef system (Figure 8). The species level data provide a detailed representation of community relatedness, with smaller sub-communities apparent at the species level, while genus and family level data display relatively similar, if less detailed, representations of relatedness. Functional group data provided a less clear picture of community relatedness.

Transect Ratio

The ratio of transect sightings to total sightings ranged very widely from 0% to 94%. Reef front and lagoon stations presented high ratios (79% and 74% respectively), while intertidal reef flat stations presented very low ratios (mean 32%), often with all records made off the transect (Table 2).

DISCUSSION

The total number of species recorded during this survey combined with historical survey records brings total species richness for the oceanic Rowley-Scott atolls to 291 species. Local biodiversity is therefore considerably less than the approximate 600 species found in the 'Coral Triangle' area of highest diversity centered around the Philippines, Indonesia, and Papua New Guinea (Donnelly *et*

Above: Corals from the family Acroporidae are dominant at Mermaid Reef. (Photo: Clay Bryce)

al., 2003; Erdmann and Pet-Soede, 2003; Green and Mous, 2004; Mous *et al*., 2005). Mermaid, Scott, and Seringapatam are therefore best described as a subset of Ashmore Reef (256 species), with neighbouring oceanic reef systems predominately sharing a complement of similar overlapping species.

South Scott had the highest mean station richness and included many of the highest station richness values recorded during the survey. South Scott also had the second highest percent cover of hard coral. Conservation values at South Scott, based on hard coral diversity and abundance, are therefore considerable. Seringapatam presented low levels of biodiversity, however this is most likely related to the very low levels of sampling employed (5 stations).

Aggregated distribution data for the northern reef group of Scott and Seringapatam, and southern Mermaid Reef support a net attenuation of species diversity across the latitudinal gradient from Indonesia towards Western Australia, consistent with the broad-scale latitudinal variability in scleractinian community assemblages documented by Veron (2000) and DeVantier *et al.,* (2006), and the larger global distribution themes presented by Mora and Robertson (2005). Cross-shelf gradients are strong in the northwest region, with the coral assemblages of the oceanic atolls being markedly different to those recorded from reefs in the inshore Kimberley region.

Multivariate analyses describe distinct communities associated with each of the reef front, lagoon, and reef flat habitats, as well as with the individual Mermaid, South Scott, North Scott, and Seringapatam reef systems. Communities were strongly dissimilar between habitats, and less distinct between reefs. Delineation of smaller community assemblages within the larger overall patterns of habitat and reef associated communities requires further analysis.

Coral communities in the region are clearly the product of response to a dynamic disturbance regime, that is compounded at varying spatial and temporal scales and intensities. Recent research in Western Australia suggests that disturbance regimes strongly influence site-scale species abundance and community assemblage structure, with severe disturbances resulting in the local reduction of coral abundance and shifts to alternate suites of coral assemblages (Smith *et al*., in press; Smith *et al*., in review; Smith *et al*., 2004).

The strong variability in scleractinian biodiversity recorded during this survey should be interpreted in the context of the complex suite of physical, biological, and anthropogenic forces that govern coral reef community structure. Isolation of the northwest oceanic atoll reefs, interdependencies with adjacent ecosystems, shelf-edge location and geomorphology, micro-habitat heterogeneity, larval transport and recruitment, gene flow, species interactions, and changing disturbance regimes,

Above: Scott Reef. Close up detail of the free living *Fungia* mushroom coral. (Photo: Clay Bryce)

are all likely to have shaped the faunal assemblages encountered in the region.

Thus, the nature of the strong association observed between habitat and community structure cannot be attributed to any single key driver. Rather, further investigation is required to determine the relative contributions of each of the above factors to the overall patterns of biodiversity and abundance recorded in the region. Recent studies by AIMS (Smith *et al*., 2004) suggest that recruitment and gene flow processes in the region may be largely driven at local, within-reef scales, rather than on a regional scale in which the atolls were suggested as stepping stones through a larger bio-geographic province. It is likely that other complex patterns of relatedness, biodiversity, and community structure will be revealed with further research.

The strong effect of search effort on species richness capture during a survey is well known (Clarke and Warwick, 2001) and search effort is therefore a critical variable between studies. Most previous studies have tended to utilize a haphazard timed swim over a non-defined area to capture coral species richness at a station. These techniques may represent unequal search effort, and interpretation of results between these studies may therefore be limited.

Analyses in the present survey also suggest that the efficacy of different search methods may be strongly affected by patterns of local-scale variability and microhabitat heterogeneity. Station richness during the survey was influenced strongly by the presence or absence of microhabitats within the sampled area, and the power associated with low transect replication was often insufficient to accurately capture community structure. Intertidal reef flat communities, which were typically characterised by low diversity and abundance, had very high proportions of species recorded off the transect. In contrast, the use of transects at reef front and lagoon stations, with a short period of additional search time, were relatively effective in capturing the major components of station biodiversity. These problems of scale and patchiness, and the adequacy of transect replication, are therefore critical to the successful design and development of future sampling regimes and monitoring programs. Further research is needed to determine appropriate sampling scales and levels of replication for the large and complex reef systems encountered in the northwest oceanic atolls. Future analysis of transect species-area curve data collected during this survey will be useful in this context.

Species-area curve analyses at the level of individual reef systems did not reach an accumulation asymptote, suggesting a restricted estimate of the within-reef species pools. This is supported by the large number of new distribution records for the Rowley Shoals and Scott Reef. On a larger scale, the combination of the Mermaid, South

Scott, North Scott, and Seringapatam richness data came close to reaching an asymptote, suggesting that total richness recorded during this survey may be close to total richness for the oceanic atolls. Further sampling, including examination of stations at Clerke and Imperieuse Reefs in the Rowley Shoals, would likely result in the upward revision of total biodiversity towards that predicted by the species-curve extrapolation models.

Non-metric MDS analyses on transect data aggregated to the higher taxonomic levels of genus and family presented strong similarities to that of data analysed at species level. Higher-level taxonomic analyses may therefore represent a useful tool to detect key patterns of change in local community assemblages (Olsgard *et al*., 1998; Somerfield and Clarke, 1995). The power of such analyses remains to be determined, and while video transect analysis at the functional group level showed mixed results, Edinger and Risk (2000) reported successful prediction of coral reef conservation values based on morphological rather than taxonomic classification.

Further examination of voucher specimens collected during this survey is required and may result in additional records for the region. Ongoing review of the historical survey data is also required, as the major taxonomic revisions associated with the release of Veron (2000; 2002) resulted in the re-classification of several species recorded during historical surveys. Finally, recent methods in molecular phylogenetics suggest that the conventional taxonomic relationships used in this study may also undergo considerable revision in the future (Fukami *et al*., 2004).

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Appendix

Table 1 Species recorded at Mermaid, South Scott, North Scott and Seringapatam Reefs, 2006. New records at Rowley Shoals are noted with [R]. New records at Scott Reef are noted with [S]. Species previously recorded in the region and not found during the present survey are noted with [P].

		Mermaid															
Species	**Authority**	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Acroporidae																	
Acropora abrolhosensis	Veron, 1985	1					1	1	1	1			1		1		
Acropora abrotanoides	(Lamarck, 1816)										1						
Acropora aculeus	(Dana, 1846)					1										1	
Acropora acuminata	(Verrill, 1864)																
Acropora anthocercis	(Brook, 1893)	1												1		1	
Acropora aspera	(Dana, 1846)														1		
Acropora austera	(Dana, 1846)													1			
Acropora carduus[R]	(Dana, 1846)	1						1	1	1					1		
Acropora caroliniana[S]	Nemenzo, 1976					1									1		
Acropora cerealis	(Dana, 1846)					1		1			1		1		1	1	
Acropora clathrata	(Brook, 1891)	1										1	1				
Acropora cytherea	(Dana, 1846)											1					
Acropora digitifera	(Dana, 1846)	1		1			1								1		
Acropora divaricata	(Dana, 1846)																
Acropora donei	Veron and Wallace, 1984													1			
Acropora echinata	(Dana, 1846)								1	1							
Acropora elseyi	(Brook, 1892)	1													1		
Acropora exquisita	Nemenzo, 1971	1						1	1				1				
Acropora florida	(Dana, 1846)	1					1	1	1	1		1	1		1		
Acropora gemmifera	(Brook, 1892)			1	1	1	1						1			1	
Acropora glauca	(Brook, 1893)										1						
Acropora grandis	(Brook, 1892)					1	1		1						1		
Acropora granulosa[R]	(Milne Edwards and Haime, 1860)		1			1								1			
Acropora horrida	(Dana, 1846)	1											1				
Acropora humilis	(Dana, 1846)	1	1	1		1	1	1		1	1	1	1		1	1	
Acropora hyacinthus	(Dana, 1846)	1		1		1	1				1		1	1	1	1	
Acropora indonesia	Wallace, 1997																
Acropora intermedia	(Brook, 1891)	1				1	1	1	1	1		1	1		1		
Acropora kimbeensis[P]	Wallace, 1999																
Acropora kirstyae[P]	Veron and Wallace, 1984																
Acropora latistella	(Brook, 1891)										1					1	
Acropora listeri	(Brook, 1893)			1	1						1						
Acropora loisetteae[R]	Wallace, 1994							1		1					1		
Acropora longicyathus	(Milne Edwards and Haime, 1860)	1															
Acropora loripes	(Brook, 1892)		1		1						1			1		1	1
Acropora lutkeni	Crossland, 1952										1						
Acropora microclados	(Ehrenberg, 1834)					1					1			1			1
Acropora microphthalma	(Verrill, 1859)	1					1	1	1	1		1			1		
Acropora millepora	(Ehrenberg, 1834)	1	1	1			1					1		1	1	1	
Acropora monticulosa	(Brueggemann, 1879)	1	1	1	1									1	1	1	1
Acropora muricata	(Linnaeus, 1758)	1	1					1		1		1			1		

South Scott														North Scott										Seringapatam				
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
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		Mermaid															
Species	**Authority**	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Acropora nana	(Studer, 1878)	1				1											
Acropora nasuta	(Dana, 1846)	1	1		1	1			1	1	1	1	1		1	1	1
Acropora paniculata	Verrill, 1902																
Acropora pichoni	Wallace, 1999																
Acropora polystoma	(Brook, 1891)		1		1	1					1					1	
Acropora pulchra	(Brook, 1891)							1	1	1					1		
Acropora robusta	(Dana, 1846)			1	1											1	1
Acropora samoensis	(Brook, 1892)	1									1				1		
Acropora secale	(Studer, 1878)																
Acropora selago	(Studer, 1878)				1	1											
Acropora spicifera	(Dana, 1846)	1	1	1	1	1	1				1	1	1			1	1
Acropora striata[P]	(Verrill, 1866)																
Acropora subglabra	(Brook, 1891)							1	1						1		
Acropora subulata	(Dana, 1846)																
Acropora tenuis	(Dana, 1846)	1	1		1	1	1	1		1	1	1	1		1	1	
Acropora valenciennesi	(Milne Edwards and Haime, 1860)																
Acropora valida	(Dana, 1846)	1		1		1								1	1		
Acropora vaughani	Wells, 1954														1		
Acropora yongei	Veron and Wallace, 1984														1		
Anacropora puertogalerae[P]	Nemenzo, 1964																
Astreopora cucullata[S]	Lamberts, 1980					1						1	1				
Astreopora expansa	Brueggemann, 1877				1	1								1		1	
Astreopora gracilis	Bernard, 1896																
Astreopora incrustans[R]	Bernard, 1896	1					1		1								
Astreopora listeri[S]	Bernard, 1896							1									
Astreopora myriophthalma	(Lamarck, 1816)	1					1	1	1	1			1		1	1	
Astreopora ocellata	Bernard, 1896																
Isopora brueggemanni	(Brook, 1891)	1			1	1	1	1	1	1		1	1		1	1	1
Isopora palifera	(Lamarck, 1816)			1	1	1					1	1			1	1	1
Montipora aequituberculata	Bernard, 1897							1			1				1		
Montipora angulata	(Lamarck, 1816)																
Montipora caliculata	(Dana, 1846)																
Montipora crassituberculata[R]	Bernard, 1897									1							
Montipora danae	(Milne Edwards and Haime, 1851)									1					1		
Montipora digitata[S]	(Dana, 1846)																
Montipora efflorescens	Bernard, 1897		1										1	1			
Montipora floweri	Wells, 1954												1				
Montipora foliosa	(Pallas, 1766)		1			1											
Montipora foveolata	(Dana, 1846)		1	1			1						1				
Montipora grisea	Bernard, 1897	1		1		1										1	1
Montipora hispida	(Dana, 1846)															1	
Montipora hoffmeisteri	Wells, 1954							1					1				
Montipora incrassata[R]	(Dana, 1846)			1	1		1						1			1	
Montipora informis	Bernard, 1897							1									
Montipora millepora[S]	Crossland, 1952	1															
Montipora mollis	Bernard, 1897								1	1							
Montipora monasteriata	(Forskal, 1775)	1	1		1								1				
Montipora nodosa	(Dana, 1846)												1				

South Scott														North Scott										Seringapatam				
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		Mermaid															
Species	**Authority**	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Montipora peltiformis[S]	Bernard, 1897															1	
Montipora spumosa[P]	(Lamarck, 1816)																
Montipora tuberculosa[R]	(Lamarck, 1816)	1	1	1	1					1			1			1	
Montipora turgescens	Bernard, 1897												1				
Montipora turtlensis[P]	Veron and Wallace, 1984																
Montipora undata	Bernard, 1897		1			1								1			
Montipora venosa[R]	(Ehrenberg, 1834)			1	1		1										
Montipora verrucosa	(Lamarck, 1816)																
Agariciidae																	
Coeloseris mayeri	Vaughan, 1918				1		1	1	1			1				1	1
Gardineroseris planulata	(Dana, 1846)		1		1	1					1						1
Leptoseris explanata	Yabe and Sugiyama, 1941																
Leptoseris foliosa	Dinesen, 1980																
Leptoseris hawaiiensis	Vaughan, 1907		1			1					1			1			
Leptoseris incrustans	(Quelch, 1886)		1			1					1			1		1	
Leptoseris mycetoseroides	Wells, 1954				1	1					1	1		1		1	1
Leptoseris papyracea	(Dana, 1846)																
Leptoseris scabra	Vaughan, 1907																
Leptoseris yabei	(Pillai and Scheer, 1976)																
Pachyseris rugosa	(Lamarck, 1801)		1			1					1		1			1	1
Pachyseris speciosa	(Dana, 1846)		1			1				1	1	1				1	
Pavona cactus	(Forskal, 1775)																
Pavona clavus[P]	(Dana, 1846)																
Pavona decussata	(Dana, 1846)	1						1	1	1					1		
Pavona duerdeni	Vaughan, 1907	1			1	1								1		1	1
Pavona explanulata	(Lamarck, 1816)		1			1		1		1	1	1		1		1	1
Pavona maldivensis	(Gardiner, 1905)				1	1								1		1	1
Pavona varians	Verrill, 1864	1	1	1	1	1	1	1	1	1	1	1			1	1	1
Pavona venosa	(Ehrenberg, 1834)												1				1
Astrocoeniidae																	
Stylocoeniella armata	(Ehrenberg, 1834)	1	1		1										1		
Stylocoeniella guentheri	Bassett-Smith, 1890					1		1					1				
Dendrophylliidae																	
Turbinaria frondens	(Dana, 1846)																
Turbinaria mesenterina[P]	(Lamarck, 1816)																
Turbinaria peltata[P]	(Esper, 1794)																
Turbinaria reniformis	Bernard, 1896																
Turbinaria stellulata	(Lamarck, 1816)							1		1	1	1	1				1
Euphyllidae																	
Euphyllia ancora	Veron and Pichon, 1980															1	
Euphyllia cristata[P]	Chevalier, 1971																
Euphyllia glabrescens	(Chamisso and Eysenhardt, 1821)																
Physogyra lichtensteini	(Milne Edwards and Haime,1851)	1	1			1		1		1	1	1	1		1	1	
Plerogyra sinuosa	(Dana, 1846)		1			1										1	
Faviidae																	
Caulastrea furcata	Dana, 1846																
Caulastrea tumida[P]	Matthai, 1928																
Cyphastrea agassizi[R]	(Vaughan, 1907)	1		1	1							1					

South Scott														North Scott										Seringapatam				
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
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Species	Authority	Mermaid 01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Cyphastrea chalcidicum	(Forskal, 1775)	1	1					1							1		
Cyphastrea microphthalma	(Lamarck, 1816)	1	1	1	1	1	1		1	1	1	1	1			1	1
Cyphastrea serailia	(Forskal, 1775)				1			1	1	1			1		1	1	
Diploastrea heliopora	(Lamarck, 1816)		1			1					1					1	1
Echinopora ashmorensis	Veron, 1990							1	1								
Echinopora gemmacea[P]	Lamarck, 1816																
Echinopora hirsutissima[P]	Milne Edwards and Haime, 1849																
Echinopora horrida	Dana, 1846					1						1		1	1	1	1
Echinopora lamellosa	(Esper, 1795)	1	1		1	1	1	1	1	1		1	1		1	1	1
Echinopora mammiformis	(Nemenzo, 1959)																
Favia danae	Verrill, 1872																
Favia favus	(Forskal, 1775)	1	1		1			1	1				1				
Favia helianthoides	Wells, 1954							1	1				1				
Favia laxa	(Klunzinger, 1879)																
Favia lizardensis	Veron and Pichon, 1977							1		1		1	1				
Favia matthaii	Vaughan, 1918		1	1	1	1	1				1	1	1		1		1
Favia maxima	Veron and Pichon, 1977							1							1	1	
Favia pallida	(Dana, 1846)	1	1	1	1	1	1	1				1	1		1	1	1
Favia rotumana	(Gardiner, 1899)							1	1	1							
Favia rotundata	(Veron and Pichon, 1977)																
Favia speciosa	Dana, 1846		1	1	1	1	1	1			1	1	1		1		
Favia stelligera	(Dana, 1846)		1	1	1	1	1				1	1	1		1	1	1
Favia truncatus[R]	Veron, 2000			1	1							1			1		
Favites abdita	(Ellis and Solander, 1786)	1	1	1	1	1				1	1		1		1		1
Favites chinensis	(Verrill, 1866)																
Favites complanata[R]	(Ehrenberg, 1834)			1		1	1	1	1	1		1	1		1		
Favites flexuosa	(Dana, 1846)																
Favites halicora	(Ehrenberg, 1834)					1	1	1		1							
Favites pentagona	(Esper, 1794)		1	1	1	1		1						1		1	1
Favites russelli	(Wells, 1954)	1			1	1		1			1	1		1	1	1	
Favites stylifera[R]	(Yabe and Sugiyama, 1937)	1	1														
Goniastrea aspera	Verrill, 1905			1	1					1	1						1
Goniastrea australensis[P]	(Milne Edwards and Haime, 1857)																
Goniastrea edwardsi	Chevalier, 1971	1	1	1	1	1	1					1	1			1	1
Goniastrea favulus	(Dana, 1846)																
Goniastrea palauensis	(Yabe and Sugiyama, 1936)																
Goniastrea pectinata	(Ehrenberg, 1834)	1	1	1	1	1	1	1			1	1	1			1	1
Goniastrea retiformis	(Lamarck, 1816)	1	1	1		1	1	1	1	1	1	1	1		1	1	1
Leptastrea aequalis	Veron, 2000																
Leptastrea inaequalis	Klunzinger, 1879						1										
Leptastrea pruinosa	Crossland, 1952			1	1			1		1		1	1			1	1
Leptastrea purpurea	(Dana, 1846)	1	1	1	1	1	1								1	1	
Leptastrea transversa	Klunzinger, 1879	1	1	1	1		1					1		1		1	
Leptoria phrygia	(Ellis and Solander, 1786)		1		1	1					1	1				1	1
Montastrea annuligera[S]	(Milne Edwards and Haime, 1849)				1					1		1					
Montastrea curta	(Dana, 1846)		1	1	1	1	1				1					1	1
Montastrea magnistellata	Chevalier, 1971	1					1	1	1	1		1	1	1	1	1	
Montastrea valenciennesi	(Milne Edwards and Haime, 1848)				1												

South Scott														North Scott										Seringapatam				
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		Mermaid															
Species	**Authority**	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Oulophyllia bennettae	(Veron and Pichon, 1977)							1					1				
Oulophyllia crispa	(Lamarck, 1816)							1	1	1	1		1				
Oulophyllia levis[P]	(Nemenzo, 1959)																
Platygyra daedalea	(Ellis and Solander, 1786)																
Platygyra lamellina	(Ehrenberg, 1834)																
Platygyra pini	Chevalier, 1975	1	1	1	1	1					1	1		1	1	1	1
Platygyra ryukyuensis	Yabe and Sugiyama, 1936		1	1	1			1					1				
Platygyra sinensis	(Milne Edwards and Haime, 1849)										1						
Platygyra verweyi	Wijsman-Best, 1976			1		1	1						1		1		1
Plesiastrea versipora	(Lamarck, 1816)						1										
Fungiidae																	
Ctenactis crassa	(Dana, 1846)	1					1								1		
Ctenactis echinata	(Pallas, 1766)	1					1		1	1		1	1				1
Cycloseris costulata	(Ortmann, 1889)									1							
Cycloseris vaughani	(Boschma, 1923)																
Cantharellus noumeae[P]	Hoeksema and Best, 1984																
Fungia concinnaR	Verrill, 1864	1	1				1	1		1		1					1
Fungia fungites	(Linnaeus, 1758)	1						1	1	1					1		1
Fungia granulosa	Klunzinger, 1879	1					1										
Fungia horrida	Dana, 1846	1					1	1	1	1		1	1		1		1
Fungia moluccensis[S]	Horst, 1919																
Fungia paumotensis	Stutchbury, 1833	1							1								
Fungia repanda[S]	Dana, 1846							1									
Fungia scutaria	Lamarck, 1801			1									1				1
Fungia scruposa[R]	Klunzinger, 1879							1									
Heliofungia actiniformis	(Quoy and Gaimard, 1833)																
Herpolitha limax	(Houttuyn, 1772)	1					1	1	1				1				
Lithophyllon mokai	Hoeksema, 1989																
Lithophyllon undulatum	Rehberg, 1892																
Podabacia crustacea	(Pallas, 1766)		1								1					1	
Polyphyllia talpina	(Lamarck, 1801)	1						1	1	1							
Sandalolitha robusta	Quelch, 1886						1						1			1	
Merulinidae																	
Hydnophora exesa	(Pallas, 1766)					1				1	1		1			1	
Hydnophora microconos[S]	(Lamarck, 1816)																
Hydnophora pilosa	Veron, 1985															1	
Hydnophora rigida	(Dana, 1846)	1					1					1					
Merulina ampliata	(Ellis and Solander, 1786)	1	1		1	1		1			1		1				
Merulina scabricula	Dana, 1846	1	1		1	1			1			1	1		1	1	1
Scapophyllia cylindrica	Milne Edwards and Haime, 1848				1		1	1			1		1				1
Mussidae																	
Acanthastrea brevis	Milne Edwards and Haime, 1849																
Acanthastrea echinata	(Dana, 1846)													1			
Australomussa rowleyensis	Veron, 1985															1	
Lobophyllia hataii	Yabe and Sugiyama, 1936							1			1					1	
Lobophyllia hemprichii	(Ehrenberg, 1834)	1	1		1	1	1	1		1	1	1	1		1	1	1
Symphyllia agaricia	Milne Edwards and Haime, 1849	1									1	1					
Symphyllia radians[R]	Milne Edwards and Haime, 1849										1		1				1

South Scott														North Scott										Seringapatam				
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Species	Authority	Mermaid															
Species	**Authority**	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Symphyllia recta	(Dana, 1846)			1													1
Symphyllia valenciennesii	Milne Edwards and Haime, 1849																
Oculinidae																	
Galaxea astreata	(Lamarck, 1816)	1	1	1	1		1	1		1		1					1
Galaxea fascicularis	(Linnaeus, 1767)	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1
Galaxea horrescens	(Dana, 1846)																
Galaxea longisepta	Fenner and Veron, 2000																
Pectiniidae																	
Echinophyllia aspera[R]	(Ellis and Solander, 1788)								1							1	
Echinophyllia echinata	(Saville-Kent, 1871)																
Echinophyllia echinoporoides[P]	Veron and Pichon, 1980																
Echinophyllia orpheensis	Veron and Pichon, 1980												1				
Mycedium elephantotus	(Pallas, 1766)							1									
Mycedium mancaoi	Nemenzo, 1979																
Mycedium robokaki	Moll and Best, 1984																
Oxypora glabra	Nemenzo, 1959							1									
Oxypora lacera	(Verrill, 1864)														1		1
Pectinia alcicornis	(Saville-Kent, 1871)	1						1	1	1		1	1	1	1		
Pectinia lactuca	(Pallas, 1766)		1									1		1		1	
Pectinia paeonia	(Dana, 1846)									1			1				
Pectinia teres	Nemenzo and Montecillo, 1981							1									
Pocilloporidae																	
Pocillopora damicornis	(Linnaeus, 1758)	1	1	1			1		1				1				
Pocillopora danae	Verrill, 1864																
Pocillopora eydouxi	Milne Edwards and Haime, 1860										1			1			
Pocillopora meandrina[R]	Dana, 1846		1	1	1											1	
Pocillopora verrucosa	(Ellis and Solander, 1786)	1	1	1	1	1					1	1				1	1
Pocillopora woodjonesi	Vaughan, 1918																
Seriatopora hystrix	Dana, 1846	1	1	1		1		1	1	1		1			1	1	1
Stylophora mordax[R]	(Dana, 1846)		1	1	1												
Stylophora pistillata	Esper, 1797	1	1	1	1	1			1	1		1	1	1	1	1	1
Poritidae																	
Alveopora allingi	Hoffmeister, 1925																
Alveopora catalaiP	Wells, 1968																
Alveopora fenestrata	(Lamarck, 1816)			1			1										
Alveopora spongiosa	Dana, 1846																
Alveopora tizardi[P]	Bassett-Smith, 1890																
Alveopora verrilliana[P]	Dana, 1872																
Goniopora burgosi[R]	Nemenzo, 1955	1	1		1	1		1	1			1					1
Goniopora columna[P]	Dana, 1846																
Goniopora djiboutiensis	Vaughan, 1907							1									
Goniopora lobata	Milne Edwards and Haime, 1860																
Goniopora minor	Crossland, 1952												1				
Goniopora palmensis[S]	Veron and Pichon, 1982	1															
Goniopora pendulus	Veron, 1985							1	1							1	
Goniopora stutchburyi[S]	Wells, 1955																
Goniopora tenuidens	(Quelch, 1886)						1	1									
Porites annae[S]	Crossland, 1952															1	1

South Scott														North Scott										Seringapatam				
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		Mermaid															
Species	**Authority**	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Porites cylindrica	Dana, 1846						1	1	1	1		1	1	1	1		1
Porites lichen	Dana, 1846																
Porites lobata	Dana, 1846	1			1				1			1	1		1		1
Porites lutea	Milne Edwards and Haime, 1851				1							1		1			
Porites monticulosa[R]	Dana, 1846		1		1	1								1	1	1	1
Porites murrayensis	Vaughan, 1918			1													
Porites nigrescens	Dana, 1846	1	1							1		1		1	1	1	
Porites rus	(Forskal, 1775)					1						1		1	1	1	1
Porites solida	(Forskal, 1775)		1														
Porites vaughani	Crossland, 1952		1		1	1					1	1		1		1	1
Siderastreidae																	
Coscinaraea columna[R]	(Dana, 1846)													1		1	1
Coscinaraea exesa[S]	(Dana, 1846)																
Coscinaraea wellsi	Veron and Pichon, 1980																
Psammocora contigua	(Esper, 1797)																
Psammocora digitata	Milne Edwards and Haime, 1851	1			1				1		1	1		1			1
Psammocora explanulata	Horst, 1922																
Psammocora haimeana	Milne Edwards and Haime, 1851		1		1	1					1						1
Psammocora nierstraszi	Horst, 1921																
Psammocora obtusangula	(Lamarck, 1816)																
Psammocora profundacella[R]	Gardiner, 1898	1	1	1	1	1				1	1	1			1	1	1
Psammocora superficialis	Gardiner, 1898										1						
Non-Scleractinian																	
Heliopora coerulea	(Pallas, 1766)			1			1				1						1
Tubipora musica	Linnaeus, 1758									1							
Millepora spp.	Linnaeus, 1758	1	1	1	1		1		1		1	1	1	1			1
Station Richness		**79**	**69**	**53**	**68**	**72**	**56**	**71**	**48**	**56**	**60**	**66**	**72**	**39**	**68**	**79**	**66**

South Scott														North Scott										Seringapatam				
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	1																											
1	1	1	1		1	1		1	1		1	1	1	1	1		1				1	1			1			1
74	**105**	**74**	**78**	**30**	**66**	**71**	**27**	**65**	**109**	**0**	**74**	**116**	**86**	**79**	**74**	**20**	**100**	**10**	**83**	**7**	**89**	**68**	**29**	**47**	**67**	**54**	**13**	**88**

Table 2 Station richness and transect ratios for 41 stations at Mermaid, South Scott, North Scott, and Seringapatam Reefs.

Station Richness	**Mermaid**	**South Scott**	**North Scott**	**Seringapatam**	**All Reefs**
Mean	69.500	76.462	60.000	54.600	67.805
Standard Error	2.633	7.611	12.407	12.663	4.059
Standard Deviation	9.851	27.443	37.222	28.316	25.993
Range	34	91	95	77	112
Minimum	52	27	6	13	6
Maximum	86	118	101	90	118
Count	**14**	**13**	**9**	**5**	**41**

Station Richness	**Reef Front**	**Lagoon**	**Reef Flat**	**All Habitats**
Mean	77.188	76.833	23.143	67.805
Standard Error	3.028	4.505	6.501	4.059
Standard Deviation	12.112	19.113	17.199	25.993
Range	53	66	51	112
Minimum	48	52	6	6
Maximum	101	118	57	118
Count	**16**	**18**	**7**	**41**

Transect Ratio	**Reef Front**	**Lagoon**	**Reef Flat**	**All Habitats**
Mean	78.799	74.354	32.333	67.001
Standard Error	3.384	3.706	3.480	4.656
Standard Deviation	12.200	11.119	8.524	24.638
Range	47.994	29.517	23.000	93.827
Minimum	45.833	57.692	21.000	0.000
Maximum	93.827	87.209	44.000	93.827
Count	**13**	**9**	**6**	**28**

Table 3 Analysis of similarities (ANOSIM), two-way crossed, on species presence/absence data.

Tests for differences between reef system groups
(across all Habitat type groups)
Global Test
Sample statistic (Global R): 0.483
Significance level of sample statistic: 0.1%
Number of permutations: 999 (Random sample from a large number)
Number of permuted statistics greater than or equal to Global R: 0

Pairwise Tests Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
Mermaid, South Scott	0.545	0.1	1783782	999	0
Mermaid, North Scott	0.495	0.1	36960	999	0
Mermaid, Seringapatam	0.657	0.3	945	945	3
South Scott, North Scott	0.344	0.7	47040	999	6
South Scott, Seringapatam	0.59	0.7	1764	999	6
North Scott, Seringapatam	0.181	15.8	400	400	63

Tests for differences between habitat type groups
(across all Reef system groups)
Global Test
Sample statistic (Global R): 0.739
Significance level of sample statistic: 0.1%
Number of permutations: 999 (Random sample from a large number)
Number of permuted statistics greater than or equal to Global R: 0

Pairwise Tests Groups	R Statistic	Significance Level %	Possible Permutations	Actual Permutations	Number >= Observed
Lagoon, Reef Front	0.716	0.1	17837820	999	0
Lagoon, Reef Flat	0.865	0.1	5670	999	0
Reef Front, Reef Flat	0.935	0.1	5040	999	0

Table 4 Habitat descriptor scores for 45 stations at Mermaid, South Scott, North Scott, and Seringapatam Reefs.

	Station Number																																												
Habitat Descriptor	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Reef Type: Reef Front		1		1	1										1	1	1		1	1		1						1		1	1			1		1					1				1
Reef Type: Lagoon								1						1				1								1						1													
Reef Type: Lagoon Bombie	1						1		1		1	1											1		1				1			1						1	1				1		
Reef Type: LagoonPlatform						1																				1			1													1			
Reef Type: Reef Flat			1																		1			1			1						1		1		1							1	
Reef Type: Tidal Channel										1			1																											1					
Aspect: Protected	1					1	1	1	1		1	1		1							1		1		1	1			1			1						1	1			1	1		
Aspect: Exposed		1	1	1	1					1			1		1	1	1	1	1	1		1		1			1	1		1	1		1	1	1	1	1			1	1			1	1
Wave Energy: Low	1					1	1	1			1			1				1			1		1		1	1						1						1				1	1		1
Wave Energy: Medium			1		1										1			1						1			1			1	1		1		1	1	1							1	1
Wave Energy: High		1		1						1			1		1	1	1		1	1		1		1				1												1	1				
Substrate: Sand	1					1	1	1	1		1			1				1			1		1	1	1	1	1					1		1	1			1	1			1			
Substrate: Mixed	1					1	1	1	1	1	1	1	1	1				1			1	1	1	1	1	1	1		1	1		1		1	1	1		1	1		1	1	1		
Substrate: Reef	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1		1	1	1	1	1	1		1	1	1
Substrate: Rubble	1			1		1	1	1			1	1		1	1								1		1				1	1	1	1			1	1		1	1		1	1	1		
Slope: Flat	1		1	1		1	1	1	1	1	1	1	1	1					1		1		1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
Slope: Sloped				1			1	1			1	1			1	1	1	1	1	1		1	1			1		1	1	1	1			1		1			1		1	1	1		
Slope: Wall		1		1	1																																								
Structure: Simple			1			1	1	1	1			1		1					1	1	1	1	1	1	1		1					1	1		1		1	1	1	1	1	1		1	
Structure: Medium	1										1																		1					1											
Structure: Complex		1		1	1					1	1		1		1	1	1	1								1		1		1	1					1							1		1
Surface: Regular	1		1			1	1	1	1					1					1	1	1	1	1	1	1		1		1			1	1	1	1		1	1	1		1			1	

Surface: Irregular		1		1	1					1	1	1	1	1	1	1	1	1					1			1		1		1	1			1		1				1		1	1		1
Features: Spur/Groove		1		1	1					1			1		1	1	1		1	1		1						1		1	1			1		1				1	1				1
Features: Outcrop/Bommies	1			1		1	1	1			1	1		1				1	1				1		1	1		1	1		1	1		1				1	1		1	1	1		
Features: Overhangs		1		1	1					1			1		1	1		1				1						1		1	1			1		1				1	1				1
Features: Reef Flat	1		1	1		1															1			1		1	1						1		1		1					1		1	
Water Clarity: Low								1			1	1		1											1							1						1	1				1		
Water Clarity: Medium	1							1	1			1							1				1		1			1	1					1	1	1				1	1	1			
Water Clarity: High	1	1		1	1	1	1			1			1		1	1	1	1		1		1				1		1	1	1	1			1	1	1						1			1
Coral Health: Low	1					1	1	1	1		1	1		1							1		1	1	1		1		1			1	1			1	1	1	1		1		1	1	
Coral Health: Medium	1					1	1		1		1	1		1					1	1		1						1	1	1	1	1	1	1	1	1					1		1		
Coral Health: High		1	1	1	1					1			1		1	1	1	1	1	1						1		1						1						1		1			1
Location: N									1																																				
Location: S				1				1						1			1								1	1	1						1								1				
Location: E	1				1										1								1														1		1						
Location: W						1	1									1		1	1	1	1			1																					
Location: NE		1	1							1	1		1																	1						1		1		1				1	1
Location: NW																						1																							
Location: SE																												1	1		1	1		1	1							1			
Location: SW																																													
Location: Central												1																															1		
Transects: 0 Transects										1			1														1													1					
Transects: 1 Transect only																													1						1							1		1	
Transects: 2 Transects	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1		1		1	1	1	1	1		1	1	1	1		1		1		1
Data reliablity: Good	1	1	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
Data reliability: Poor										1			1														1													1					

Table 5 Similarity Percentages of typifying and discriminating species (SIMPER).
Major species typifying and discriminating between lagoon, reef front, and reef flat habitats, listed in decreasing order. Two-way analysis examining habitat type groups (across all reef system groups).

Typifying: Group Lagoon					
Average similarity: 50.87					
	Av.Abund	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**
Galaxea fascicularis	1	1.4	5.69	2.75	2.75
Montastraea magnistellata	1	1.4	5.69	2.75	5.5
Goniastrea edwardsi	0.78	1.27	2.64	2.5	8
Acropora intermedia	0.89	1.25	2.41	2.46	10.46
Echinopora lamellosa	0.83	1.25	2.41	2.45	12.91
Acropora florida	0.83	1.15	1.79	2.26	15.17
Acropora brueggemanni	0.78	1.11	1.68	2.18	17.35
Acropora abrolhosensis	0.89	1.11	1.87	2.18	19.52
Lobophyllia hemprichii	0.89	1.08	1.91	2.12	21.64
Fungia horrida	0.72	1.07	1.53	2.1	23.75
Pavona varians	0.83	1.06	1.64	2.09	25.83
Astreopora myriophthalma	0.83	1.06	1.65	2.08	27.91
Acropora microphthalma	0.83	1.01	1.48	1.99	29.89
Acropora tenuis	0.67	0.99	1.58	1.94	31.83
Favites complanata	0.78	0.98	1.34	1.93	33.76
Pectinia alcicornis	0.83	0.98	1.42	1.92	35.68
Porites cylindrica	0.78	0.94	1.23	1.84	37.53
Acropora humilis	0.67	0.89	1.29	1.76	39.28
Acropora nasuta	0.78	0.83	1.2	1.63	40.91
Cyphastrea microphthalma	0.78	0.79	1.09	1.55	42.46
Seriatopora hystrix	0.72	0.78	1.1	1.53	43.99
Goniastrea pectinata	0.83	0.72	1.1	1.42	45.42
Millepora spp.	0.78	0.71	1.04	1.4	46.81
Stylophora pistillata	0.61	0.68	0.95	1.35	48.16
Favia pallida	0.67	0.67	0.97	1.31	49.47
Ctenactis echinata	0.67	0.66	0.87	1.3	50.77

Typifying: Group Reef Front

Average similarity: 58.51

	Av.Abund	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**
Acropora spicifera	1	1.33	12.08	2.27	2.27
Echinopora lamellosa	1	1.33	12.08	2.27	4.54
Favia stelligera	1	1.33	12.08	2.27	6.81
Galaxea fascicularis	1	1.33	12.08	2.27	9.08
Goniastrea pectinata	1	1.33	12.08	2.27	11.35
Pavona varians	1	1.33	12.08	2.27	13.62
Pocillopora verrucosa	1	1.33	12.08	2.27	15.89
Psammocora profundacella	0.94	1.28	4.77	2.18	18.07
Favia pallida	0.94	1.25	3.47	2.13	20.2
Favia matthaii	0.94	1.14	2.39	1.95	22.16
Favites abdita	0.94	1.14	2.39	1.95	24.11
Acropora palifera	0.94	1.13	2.4	1.93	26.05
Goniastrea edwardsi	0.94	1.13	2.4	1.93	27.98
Montastraea curta	0.94	1.09	2.11	1.86	29.84
Porites vaughani	0.88	1.04	1.73	1.78	31.62
Acropora humilis	0.88	0.98	1.72	1.68	33.3
Platygyra pini	0.81	0.97	1.57	1.66	34.96
Acropora nasuta	0.88	0.92	1.45	1.58	36.54
Lobophyllia hemprichii	0.81	0.87	1.34	1.49	38.02
Millepora spp.	0.75	0.87	1.34	1.48	39.5
Favites stylifera	0.75	0.84	1.34	1.44	40.95
Pocillopora damicornis	0.75	0.84	1.34	1.44	42.39
Acropora gemmifera	0.69	0.82	1.25	1.4	43.79
Acropora millepora	0.75	0.81	1.25	1.39	45.17
Leptoria phrygia	0.75	0.8	1.16	1.38	46.55
Stylophora pistillata	0.75	0.8	1.16	1.38	47.92
Galaxea astreata	0.81	0.77	1.16	1.31	49.24
Heliopora coerula	0.69	0.76	1.16	1.31	50.54

Typifying: Group Reef Flat
Average similarity: 27.74

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Acropora digitifera	1	7.34	2.16	26.45	26.45
Porites lutea	0.29	2.94	0.5	10.6	37.05
Cyphastrea chalcidicum	0.71	2.54	0.79	9.17	46.22
Porites lobata	0.43	1.85	0.5	6.67	52.89

Discriminating: Groups Lagoon & Reef Front
Average dissimilarity = 57.84

	Group Lagoon	Group Reef Front			
Species	**Av.Abund**	**Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**
Acropora abrolhosensis	0.89	0.06	0.58	2.46	1.01
Acropora florida	0.83	0.06	0.54	1.91	0.94
Porites vaughani	0.17	0.88	0.54	1.8	0.93
Pectinia alcicornis	0.83	0.13	0.53	1.8	0.92
Acropora microphthalma	0.83	0.19	0.5	1.58	0.86
Porites monticulosa	0.28	0.69	0.49	1.55	0.86
Gardineroseris planulata	0.06	0.69	0.49	1.54	0.85
Acropora carduus	0.72	0	0.48	1.54	0.83
Leptoria phrygia	0.33	0.75	0.48	1.46	0.83
Acropora intermedia	0.89	0.31	0.47	1.45	0.81
Acropora palifera	0.22	0.94	0.47	1.43	0.81
Favites pentagona	0.33	0.63	0.47	1.43	0.81
Montastraea curta	0.33	0.94	0.45	1.29	0.77
Leptoseris mycetoseroides	0.28	0.75	0.45	1.32	0.77
Montastraea magnistellata	1	0.38	0.44	1.26	0.76
Acropora loripes	0.11	0.63	0.44	1.28	0.76
Acropora subglabra	0.67	0	0.43	1.37	0.75
Montipora grisea	0.11	0.75	0.43	1.34	0.75
Pavona maldivensis	0.11	0.63	0.43	1.26	0.74
Pavona duerdeni	0.22	0.69	0.43	1.26	0.74

Pachyseris rugosa	0.44	0.5	0.42	1.24	0.73
Porites cylindrica	0.78	0.31	0.42	1.22	0.73
Echinopora horrida	0.44	0.38	0.41	1.25	0.71
Psammocora haimeana	0.17	0.38	0.41	1.19	0.71
Fungia horrida	0.61	0.06	0.41	1.22	0.7
Acropora muricata	0.61	0.13	0.41	1.25	0.7
Herpolitha limax	0.67	0	0.4	1.22	0.7
Astreopora myriophthalma	0.83	0.56	0.4	1.11	0.68
Favites complanata	0.78	0.44	0.4	1.11	0.68
Pavona explanulata	0.5	0.44	0.39	1.19	0.68
Acropora millepora	0.33	0.75	0.39	1.14	0.68
Ctenactis echinata	0.67	0.31	0.39	1.13	0.67
Merulina ampliata	0.67	0.44	0.38	1.08	0.65
Acropora monticulosa	0.11	0.56	0.38	1.08	0.65

Discriminating: Groups Lagoon & Intertidal Reef Flat
Average dissimilarity = 79.60

	Group Lagoon	Group Intertidal Reef Flat			
Species	**Av.Abund**	**Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**
Montastraea magnistellata	1	0	0.96	4.52	1.2
Lobophyllia hemprichii	0.89	0	0.88	2.76	1.11
Acropora abrolhosensis	0.89	0	0.88	2.88	1.1
Porites cylindrica	0.78	0.29	0.83	1.95	1.05
Acropora digitifera	0.22	1	0.83	1.93	1.04
Acropora microphthalma	0.83	0	0.81	2.15	1.02
Echinopora lamellosa	0.83	0	0.79	2.16	1
Sandalolitha robusta	0.67	0	0.79	1.73	0.99
Acropora carduus	0.72	0	0.78	1.74	0.98
Pectinia alcicornis	0.83	0	0.77	1.72	0.97
Acropora subglabra	0.67	0	0.77	1.73	0.97
Acropora intermedia	0.89	0.14	0.77	1.74	0.97
Millepora spp.	0.78	0.14	0.76	1.76	0.96

Discriminating: Groups Lagoon & Intertidal Reef Flat

Average dissimilarity = 79.60

	Group Lagoon	Group Intertidal Reef Flat			
Species	**Av.Abund**	**Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**
Merulina ampliata	0.67	0	0.73	1.56	0.92
Favia matthaii	0.67	0.14	0.73	1.58	0.92
Acropora nasuta	0.78	0	0.73	1.76	0.92
Galaxea fascicularis	1	0.14	0.73	1.47	0.91
Herpolitha limax	0.67	0	0.72	1.47	0.91
Acropora florida	0.83	0	0.72	1.55	0.9
Fungia concinna	0.67	0.14	0.68	1.37	0.86
Merulina scabricula	0.67	0	0.68	1.47	0.85
Goniastrea pectinata	0.83	0.29	0.68	1.28	0.85
Favites abdita	0.67	0.14	0.68	1.48	0.85
Lithophyllon undulatum	0.5	0	0.68	1.27	0.85
Fungia horrida	0.61	0	0.66	1.38	0.83
Acropora brueggemanni	0.78	0	0.65	1.47	0.82
Favia favus	0.61	0	0.65	1.25	0.81
Goniastrea aspera	0.11	0.71	0.64	1.36	0.8
Fungia fungites	0.61	0.14	0.63	1.29	0.8
Favia stelligera	0.61	0.14	0.62	1.4	0.78
Pachyseris speciosa	0.5	0	0.62	1.28	0.78

Discriminating: Groups Reef Front & Intertidal Reef Flat

Average dissimilarity = 77.02

	Group Reef Front	Group Intertidal Reef Flat			
Species	**Av.Abund**	**Av.Abund**	**Av.Diss**	**Diss/SD**	**Contrib%**
Echinopora lamellosa	1	0	0.97	5.81	1.25
Acropora palifera	0.94	0.14	0.85	2.22	1.11
Favites stylifera	0.75	0	0.85	2.22	1.11
Favia matthaii	0.94	0.14	0.85	2.21	1.1
Favites abdita	0.94	0.14	0.85	2.21	1.1

Acropora nasuta	0.88	0	0.83	2.18	1.08
Favia stelligera	1	0.14	0.82	1.97	1.07
Galaxea fascicularis	1	0.14	0.82	1.97	1.07
Pocillopora verrucosa	1	0.14	0.82	1.97	1.07
Galaxea astreata	0.81	0.14	0.81	1.95	1.05
Acropora millepora	0.75	0.14	0.8	1.95	1.03
Porites vaughani	0.88	0	0.79	1.94	1.03
Montipora grisea	0.75	0.14	0.78	1.76	1.01
Lobophyllia hemprichii	0.81	0	0.77	2.03	1
Montastraea curta	0.94	0.14	0.75	1.62	0.97
Acropora tenuis	0.75	0	0.73	1.83	0.95
Leptoseris mycetoseroides	0.75	0	0.72	1.59	0.94
Pavona varians	1	0.29	0.71	1.48	0.93
Millepora spp.	0.75	0.14	0.71	1.67	0.92
Turbinaria reniformis	0.56	0	0.71	1.54	0.92
Heliopora coerula	0.69	0.43	0.7	1.67	0.91
Acropora digitifera	0.25	1	0.7	1.46	0.91
Lithophyllon undulatum	0.56	0	0.7	1.53	0.9
Acropora cerealis	0.63	0	0.68	1.53	0.89
Leptoria phrygia	0.75	0	0.67	1.52	0.87
Goniastrea retiformis	0.94	0.29	0.65	1.26	0.84
Stylocoeniella armata	0.56	0	0.64	1.26	0.83
Pavona duerdeni	0.69	0	0.63	1.4	0.82
Goniastrea pectinata	1	0.29	0.62	1.18	0.81
Pocillopora eydouxi	0.56	0.14	0.62	1.18	0.81
Goniastrea aspera	0.19	0.71	0.62	1.25	0.8
Leptastrea transversa	0.75	0.29	0.62	1.3	0.8
Acropora specifera	1	0.29	0.62	1.18	0.8
Acropora gemmifera	0.69	0.14	0.6	1.31	0.78

Table 6 Similarity Percentages of functional groups (SIMPER).
Major functional groups typifying and discriminating between lagoon and reef front habitats, listed in decreasing order. Two-way analysis examining habitat type groups (across all reef system groups).

Typifying: Group Lagoon
Average similarity: 62.50

	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Rubble	0.43	32.78	2.13	52.46	52.46
Branching Acropora	0.12	11.42	1.53	18.28	70.73
Sand	0.11	8.12	1.59	12.99	83.73
Rock	0.2	7.47	0.66	11.95	95.68
Tabulate Acropora	0.02	1.04	0.79	1.67	97.34
Massive Non-Acropora	0.04	0.71	0.44	1.13	98.48
Soft Coral	0.01	0.34	0.29	0.55	99.03
Digitate Acropora	0.02	0.31	0.54	0.5	99.53
Macroalgae	0	0.12	0.4	0.2	99.73
Mushroom coral	0.01	0.09	0.29	0.14	99.86
Sub-massive Non-Acropora	0.01	0.05	0.45	0.08	99.95
Foliaceous Non-Acropora	0	0.02	0.22	0.03	99.97
Encrusting Non-Acropora	0	0.02	0.16	0.03	100

Typifying: Group Reef Front
Average similarity: 68.66

	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Rock	0.61	50.79	3.53	73.97	73.97
Encrusting Non-Acropora	0.1	6.63	1.35	9.65	83.62
Massive Non-Acropora	0.06	3.7	1.47	5.39	89.02
Digitate Acropora	0.03	1.63	1.74	2.37	91.39
Soft Coral	0.04	1.5	0.6	2.18	93.57
Sand	0.03	1.21	0.7	1.77	95.34
Tabulate Acropora	0.03	0.97	0.59	1.41	96.74
Rubble	0.07	0.96	0.35	1.39	98.13
Sub-massive Non-Acropora	0.02	0.91	1	1.32	99.45
Branching Acropora	0.01	0.13	0.45	0.2	99.65
Macroalgae	0.01	0.12	0.33	0.17	99.82
Foliaceous Non-Acropora	0.01	0.09	0.24	0.13	99.95
Sponge	0	0.03	0.25	0.05	100
Gorgonian Coral	0	0	0	0	100
Mushroom coral	0	0	0	0	100

Descriminating: Groups Lagoon & Reef Front
Average dissimilarity = 67.35

	Group Lagoon	Group Reef Front				
	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Rock	0.2	0.61	21.27	1.82	31.58	31.58
Rubble	0.43	0.07	17.93	1.84	26.62	58.2
Branching Acropora	0.12	0.01	6.3	1.18	9.36	67.56
Encrusting Non-Acropora	0	0.1	6.29	1.18	9.33	76.9
Sand	0.11	0.03	5.46	1.38	8.11	85
Massive Non-Acropora	0.04	0.06	2.51	1.48	3.72	88.73
Digitate Acropora	0.02	0.03	1.97	0.84	2.93	91.66
Soft Coral	0.01	0.04	1.76	0.74	2.61	94.26
Tabulate Acropora	0.02	0.03	1.48	0.69	2.19	96.46
Sub-massive Non-Acropora	0.01	0.02	0.93	1.31	1.38	97.84
Foliaceous Non-Acropora	0	0.01	0.54	0.71	0.8	98.63
Macroalgae	0	0.01	0.43	0.65	0.64	99.28
Mushroom coral	0.01	0	0.26	0.61	0.38	99.66
Sponge	0	0	0.15	0.74	0.22	99.88
Gorgonian Coral	0	0	0.08	0.19	0.12	100

Above: South Scott Reef lagoon, back slope. (Photo: Clay Bryce)

Above: *Odontodactylus scyllarus* (Linnaeus, 1758). The harlequin mantis shrimp. Photo: Glenn Moore)