

## Patterns of abundance and size of Dictyoceratid sponges among neighbouring islands in central Torres Strait, Australia

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**Abstract.** Distribution and size frequency patterns of sessile organisms such as sponges may vary among and within neighbouring reefs. In the present study, we examined small-scale variation of dictyoceratid sponges (class Demospongiae), commonly found on coral reefs, by surveying six neighbouring islands in central Torres Strait. Each island had four study sites, at least 1 km apart, with each site consisting of three shallow (4 to 6 m) and three deep (10 to 15 m) 20 m<sup>2</sup> transects. For each transect, we recorded the number of each species and measured the size of the more common dictyoceratid sponges. Seven species of dictyoceratid were recorded in central Torres Strait, with only three species, *Coscinoderma* sp., *Dysidea herbacea* and *Hyrtilis erecta*, common to all six islands. Abundance patterns generally varied greatly among islands or sites within islands, perhaps resulting from a combination of physical, biological and stochastic factors. More dictyoceratids were found in deeper water; however, abundance across depth for some species varied among islands or sites. Size-frequency distribution patterns also varied greatly among islands and dictyoceratid species, indicating that factors that may promote growth for one species may not necessarily promote growth for a related species. This study shows that patterns of abundance and size of dictyoceratids can vary greatly over small spatial scales, and that patterns are species-specific.

**Additional keywords:** depth, spatial variation.

### Introduction

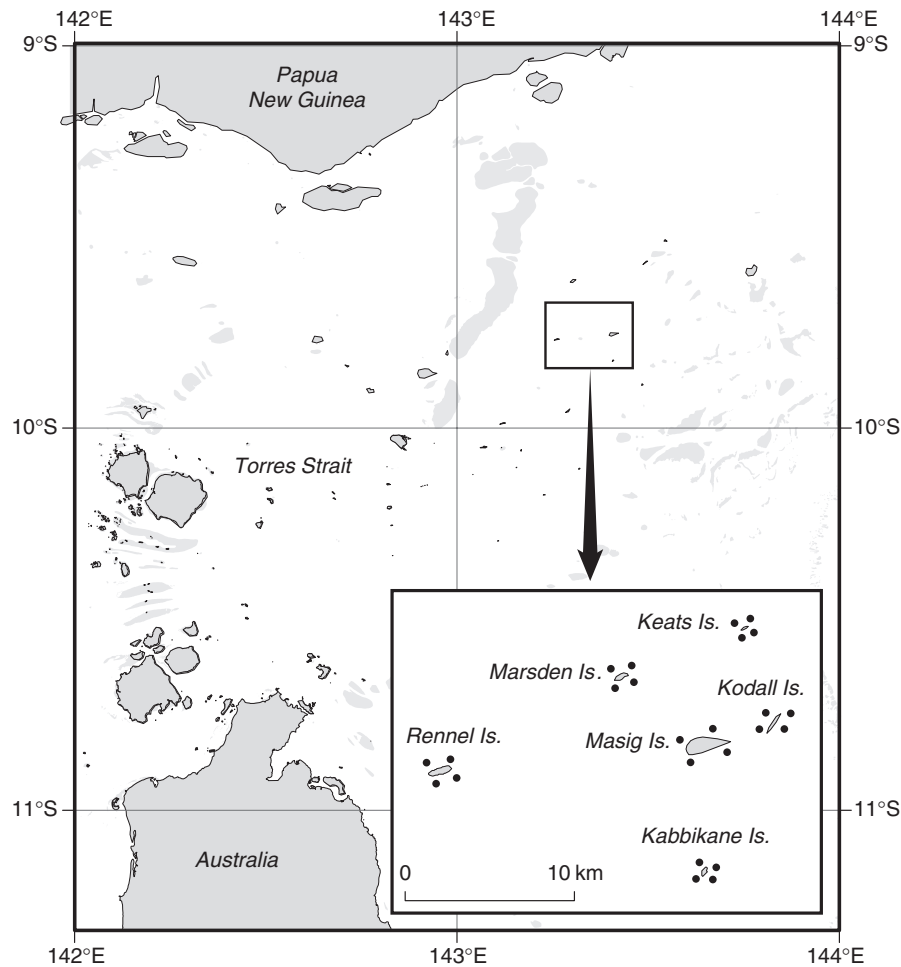
Benthic communities can show great variation in diversity and composition within and between neighbouring reefs (Burns 1985; Wilkinson and Cheshire 1989; Harriott *et al.* 1994; Hooper and Kennedy 2002). Heterogeneity over small spatial scales (<10 km) results from the interaction of physical, biological and stochastic factors influencing the distribution and abundance of individual species (Wilkinson and Cheshire 1989; Zea 2001). Sponges are an important component in many benthic communities and can dominate the benthos in some regions in terms of biomass and diversity (Schmahl 1990; Wilkinson and Cheshire 1990). Being efficient filter feeders of small particulate matter, sponges also represent an important energy coupling between the benthic and pelagic communities (Reiswig 1971; Pile *et al.* 1996; Duckworth *et al.* 2006).

The abundance and distribution patterns of sponges can be influenced by water flow and depth (Wilkinson and Evans 1989; Roberts and Davis 1996), larval dispersal and recruitment patterns (Maldonado and Young 1996), predation (Dunlap and Pawlik 1996), light intensity (Wilkinson and Trott 1985) and substrate and habitat type (Reiswig 1973; Adjeroud 1997). Environmental and biological factors can also generate randomness in sponge distribution (Zea 2001). The influence or impact of each factor varies among sponge species, often restricting species to a specific area or depth (Wilkinson and Evans 1989)

and exacerbating heterogeneity in community structure between and within reefs or islands.

Structuring factors that promote patchy distributions may also influence size-frequency patterns of sponges over short spatial scales. Light intensity, for example, affects the size of phototrophic sponges – species that obtain nutrients from photosynthetic symbionts – so that sponge size varies with depth (Wilkinson and Evans 1989). The effect of a physical or biological factor on size frequency patterns is often complex (Turon *et al.* 1998; Bell *et al.* 2002) and may have a positive or negative impact depending on its level of intensity. For example, sponge growth rates will generally increase as water flow increases because of the greater availability of suspended food (Wilkinson and Vacelet 1979; Duckworth and Battershill 2003); however, high water flow can also damage sponges, remove tissue, and decrease their size (Trautman *et al.* 2000).

Dictyoceratid sponges (Class Demospongiae: Order Dictyoceratida), characterised by anastomosing spongin fibres and lacking a mineral skeleton, are a common component of the coral reef fauna, often outnumbering other sponge groups (Wilkinson and Cheshire 1989). For example, on central Torres Strait reefs, dictyoceratids represent ~40% of total sponge diversity and >50% of sponge biomass (authors' unpubl. data). A recent survey of dictyoceratid sponges across Torres Strait recorded 23 heterotrophic and phototrophic species, which were found in a



**Fig. 1.** Map of Torres Strait showing the location of the six neighbouring islands in central Torres Strait surveyed for dictyoceratid sponges. Also shown are the approximate positions of the study sites (•) around each island.

range of coral reef zones and depths (Duckworth *et al.* 2005). Examining trawled fauna, Hooper *et al.* (1999) identified 46 sponge species from Torres Strait, of which 33% were endemic to the region. Two expeditions in the late 19th Century also surveyed for sponges in Torres Strait, but species identification from both expeditions is unreliable (Hooper *et al.* 1999). The aims of the present study were to quantify patterns of abundance and size of the more common dictyoceratids among neighbouring islands in central Torres Strait, and thus to examine variation across small spatial scales. The present study also investigated the importance of depth in structuring sponge distributions.

## Materials and methods

### Study area and sampling strategy

Central Torres Strait is situated between Papua New Guinea and northern Queensland, Australia, and is bordered by the Warrior Reefs to the west and volcanic islands and the edge of the continental shelf to the east (Fig. 1). Islands in central Torres Strait

are sand cays enclosed by a fringing coral reef, and are generally low-lying (<10 m in height) and small in size (<5 km<sup>2</sup>). South-easterly trade winds are common from April to December, while monsoonal weather patterns with more northerly winds dominate in summer. Surveys for Dictyoceratid sponges were conducted around six neighbouring islands in central Torres Strait: Kabbikane, Keats, Kodall, Marsden, Masig and Rennel (Fig. 1). Most islands were <10 km apart, with distances ranging from 3 to 17 km. The reef flat extends 50 to 200 m from each island, greatest on the southern and eastern sides. The reef slope generally starts at a depth of 6 m (mean low water) and stops at 15 m, descending at an angle ranging from 20 to 60°. Maximum depth between neighbouring islands is ~30 m, with the substrate consisting of muddy sand (Harris 1988). However, between Kodall and Masig, broken reef connects the two islands.

Four sites were surveyed at each island, with sites at least 1 km apart (Fig. 1). At each site, dictyoceratids were surveyed at both shallow (4 to 6 m) and deep (10 to 15 m) depths, with the former generally on the reef flat. Three 20 × 1-m transects were examined at each depth, with transects separated by at least 20 m

to retain independence. For each transect, divers recorded identifications or sampled every dictyoceratid sponge found within 1 m of one side of the transect line. Surveys were conducted in December 2004 and September and December 2005, with sites randomly chosen among the six islands to reduce any possible temporal variation in sponge patterns.

#### Size-frequency distributions

To examine size-frequency distribution patterns for each species, the greatest dimension of every dictyoceratid was measured by a ruler attached to the dive slate, and recorded. Specimens were grouped into five size classes: <5 cm, 5–10 cm, 10–20 cm, 20–50 cm and >50 cm. Preliminary analysis found that these size classes of unequal ranges best cover the size of dictyoceratids in Torres Strait, allowing quick recording of data, necessary owing to the high number of surveyed sponges and limited dive time.

#### Environmental factors

For each transect we also recorded reef slope and the percentage of consolidated rock and rubble. These environmental variables were previously found to influence dictyoceratid distribution in Torres Strait (Duckworth *et al.* 2005).

#### Data analysis

General Linear Model ANOVA (GLM ANOVA) was used to examine differences in sponge abundance among islands, sites (nested) and depths for all dictyoceratid sponges and for species with  $\geq 20$  recorded individuals, thus establishing the influence of scale on spatial patterns. The abundance of uncommon species (<20 individuals) would be zero at too many sites and islands for ANOVA to be appropriate. Abundance data were  $\log(x + 1)$  transformed to meet the requirements of ANOVA. For all ANOVA (and MANOVA) tests, 'Island' was considered a random factor and 'Depth' was a fixed factor. A partially hierarchical model was therefore employed, analysed using Number Crunching Statistical Systems version 2004 (Number Crunching Statistical Systems: Kaysville, Utah, USA).

Agglomerative hierarchical cluster analysis using the group average clustering (unweighted pair group) algorithm was undertaken on abundance data to examine (dis)similarity among Island  $\times$  Depth combinations. This determined which combinations surveyed among the neighbouring islands have a similar composition of dictyoceratid sponges. Abundance data were  $\log(x + 1)$  transformed to reduce the importance of dominant species (van Tongeren 1987).

For species that were present at all six islands, size frequency distributions were analysed using chi-square contingency tests to examine size variation among islands. For each examined species, sites and depths were pooled to islands to increase numbers for statistical analysis.

A MANOVA was conducted to examine the influence of island (all transects from each site pooled), depth and their interaction on the three environmental factors (slope, %rock and %rubble), thus examining small-scale variation. Both %rock and %rubble were arcsine transformed (Zar 1999). Within-cell correlation analyses detected no multicollinearity problems for any variable ( $r^2 < 0.99$ ) while Bartlett-Box homogeneity tests determined that the covariance matrices are equal ( $P > 0.05$ ). Wilks'

**Table 1.** Summary of ANOVAs examining differences of the measured environmental factors among islands (sites pooled) and depths  
*F*-ratios shown. % rock and rubble were arcsine transformed

Source	DF	% Rock	% Rubble	Reef slope
Island	5	1.66	2.05	1.46
Depth	1	7.98*	0.81	96.38***
Island $\times$ Depth	5	1.64	1.52	1.32
Residual	36			

\* $P < 0.05$ ; \*\*\* $P < 0.001$ .

$\lambda$  was used to compute *F*-ratios and data were then analysed further by ANOVA.

## Results

#### Environmental variables

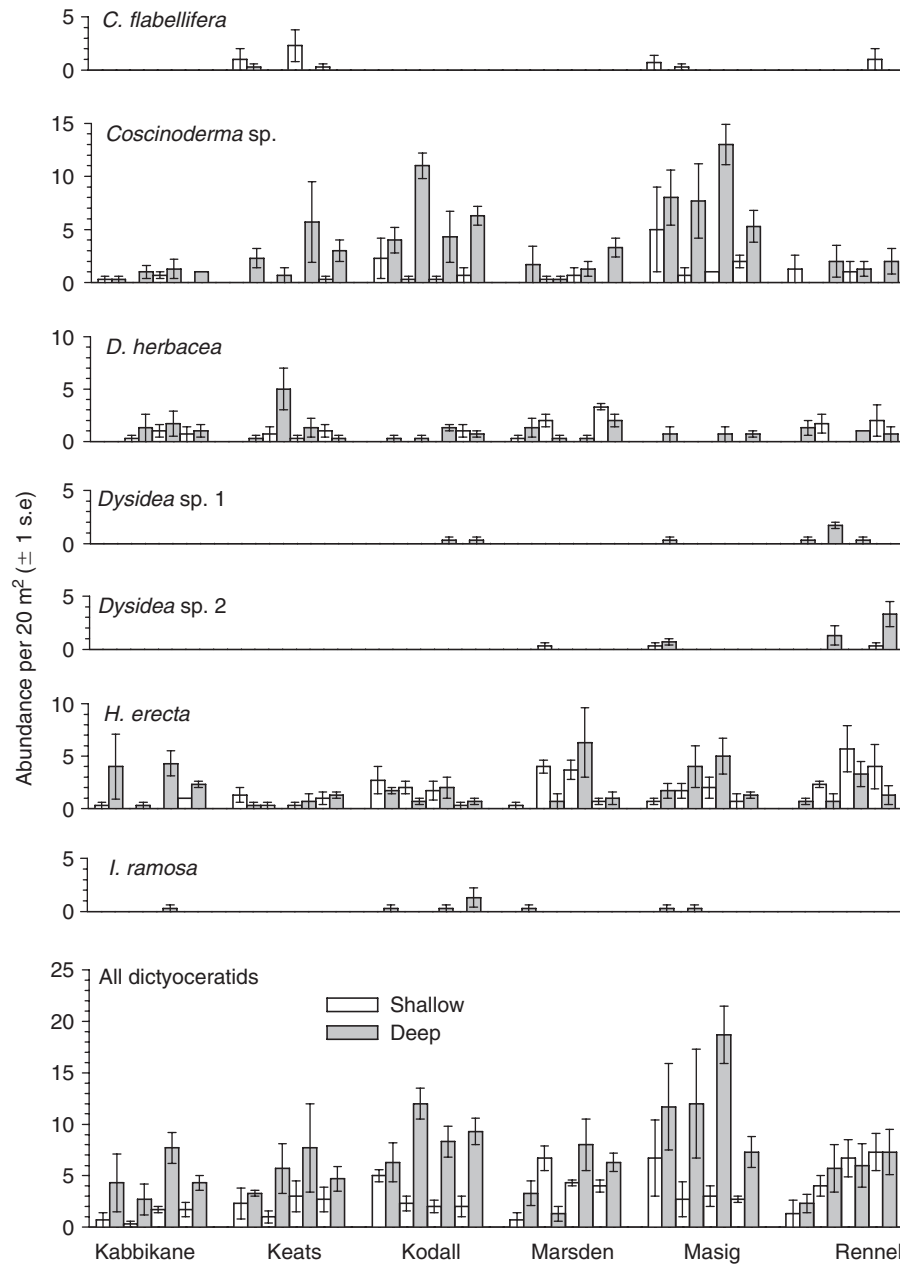
A MANOVA of the three environmental factors found a significant effect of depth (Wilks'  $\lambda$ ,  $F_{3,3} = 27.62$ ;  $P = 0.011$ ), and no significant effect for either Island (Wilks'  $\lambda$ ,  $F_{15,94} = 1.43$ ;  $P = 0.147$ ) or the Island  $\times$  Depth interaction (Wilks'  $\lambda$ ,  $F_{15,94} = 1.11$ ;  $P = 0.361$ ). Of the ANOVAs examining the three environmental variables, the Depth treatment was significant only for %rock and reef slope (Table 1). On average, rock substrate averaged 78% (s.e. = 3) and 64% (s.e. = 3) at shallow and deep transects respectively. Reef slope was, on average,  $6^\circ$  (s.e. =  $1^\circ$ ) in the shallows and  $40^\circ$  (s.e. =  $3^\circ$ ) in the deep. The % of rubble substrate averaged 14% (s.e. = 11) overall. In addition to rock and rubble, the substrate consisted of loose sediment such as sand. These results indicate that the measured environmental variables are similar among the six neighbouring islands.

#### Dictyoceratid species

In total, 723 dictyoceratid sponges were found on reef surrounding the six islands, representing 7 species: *Carteriospongia flabellifera*, *Coscinoderma* sp., *Dysidea herbacea*, *Dysidea* sp. 1, *Dysidea* sp. 2, *Hyrtios erecta* and *Ircinia ramosa*. Only three species, *Coscinoderma* sp., *D. herbacea* and *H. erecta*, were common to all islands (Fig. 2). Because of low abundances, the four other dictyoceratids species were not statistically analysed. Species richness varied among islands, with four species recorded from Kabbikane and all seven species found at Masig. Species richness also varied between depths, with an average of four species in the shallows and five species at deeper depths. A taxonomic study of scientifically new dictyoceratid species recorded from Torres Strait will follow shortly.

#### Dictyoceratid abundance

For *Coscinoderma* sp., analysis determined that abundance varied significantly among islands (Table 2), being up to five times more abundant around Kodall and Masig than the other neighbouring islands (Fig. 2). Abundance of *Coscinoderma* sp. also varied significantly between depth strata (Table 2), with more individuals found on deeper reef (Fig. 2). For example, mean *Coscinoderma* sp. density (per 20 m<sup>2</sup>) at shallow and deep depths



**Fig. 2.** Mean abundance of each dictyoceratid species among sites, islands and depths. There are four sites at each island, with each shallow-deep pairing (white and grey bars) representing one site. The mean abundance of all dictyoceratids is also shown. The y-axis is the same scale for each graph.

was 0.9 and 6.4 at Kodall and 2.2 and 8.5 at Masig respectively. In total, 312 *Coscinoderma* sp. were recorded in this survey.

Analysis also showed that *D. herbacea* had a significant Site(Island) × Depth interaction (Table 2), indicating that its abundance at depth varied among sites. At Rennel, for example, *D. herbacea* was only found on deeper reef at Site 1, while at Site 2 it was only recorded in the shallows (Fig. 2). Overall, 111 *D. herbacea* were recorded. Both *Dysidea* sp. 1 and 2 are uncommon in central Torres Strait with only 10 and 19 individuals recorded, respectively.

For *H. erecta*, statistical analysis showed a significant Island × Depth interaction (Table 2), indicating that its abundance between depth strata varies among islands. For example, mean density (per 20 m<sup>2</sup>) of *H. erecta* at shallow and deep depths was 0.3 and 2.8 at Kabbikane but 3.0 and 1.5 at Rennel, respectively (Fig. 2). Abundance of *H. erecta* could also vary greatly among sites around an island (Table 2). For example, among the four sites at Marsden, mean density ranged from 0.2 to 5 sponges per 20 m<sup>2</sup>. In total, 243 *H. erecta* were recorded in the present study.

**Table 2. Summary of ANOVAs examining differences in abundance of all dictyoceratids and common species among islands, sites (nested) and depths**  
F-ratios shown. All abundance data were  $\log(x + 1)$  transformed

Source	DF	All dictyoceratids	<i>Coscinoderma</i> sp.	<i>D. herbacea</i>	<i>H. erecta</i>
Island	5	2.75	19.32***	1.25	0.84
Site(Island)	18	2.60**	0.81	2.41	4.30***
Depth	1	14.53*	19.92**	4.86	0.24
Island $\times$ Depth	5	2.54	2.74	0.56	3.79*
Site(Island) $\times$ Depth	18	1.45	1.44	1.94*	1.31
Residual	96				

\* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ .

Both *C. flabellifera* and *I. ramosa* are uncommon sponges in central Torres Strait (Fig. 2), with 18 and 10 individuals recorded from 144 transects respectively. The abundance of *C. flabellifera* varied among the six islands, being found at Keats, Masig and Rennel only (Fig. 2). Similarly, *I. ramosa* was recorded from only some islands (Fig. 2).

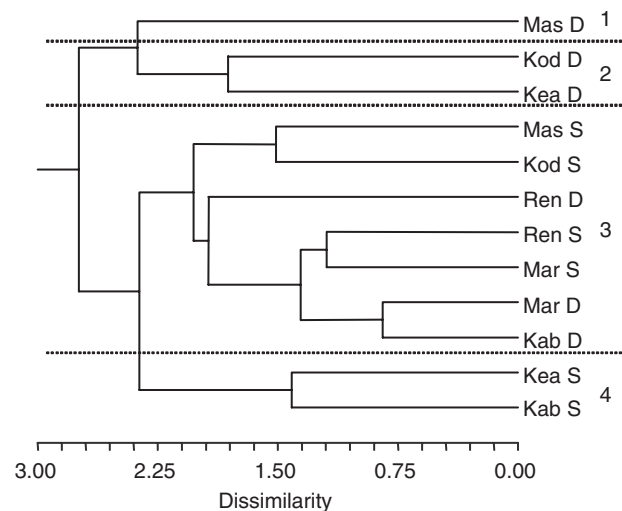
Statistical analysis on the abundance of all dictyoceratids determined that each of the six islands had a similar overall density (Table 2) of 5.0 sponges per 20 m<sup>2</sup>. However, abundance varied significantly among sites within an island (Table 2), indicating variation at smaller spatial scales (Fig. 2). Among the four sites at Rennel, for example, mean density of dictyoceratids ranged from 1.8 to 7.3 sponges per 20 m<sup>2</sup>. In contrast, at Marsden, density among sites ranged from 2.0 to 6.2 sponges per 20 m<sup>2</sup>. Dictyoceratid abundance also varied greatly between depth strata (Table 2; Fig. 2), being more common in deep water (mean = 6.9 sponges per 20 m<sup>2</sup>) than in the shallows (3.1 sponges per 20 m<sup>2</sup>).

#### Clustering analysis

Hierarchical cluster analysis displayed a cophenetic correlation of 0.72 and  $\delta$  (0.5, 1.0) values of  $< 0.2$ , indicating that the dendrogram has a high 'goodness-of-fit' to the sponge distribution data. The twelve Island  $\times$  Depth combinations were grouped into four clusters (Fig. 3). Deep reef at Masig (Cluster 1) had the highest abundance of dictyoceratids (12.4 sponges per 20 m<sup>2</sup>), generally two or three times the number found in the other Island  $\times$  Depth combinations. In particular, *Coscinoderma* sp. and *H. erecta* were common on deep reef at Masig, with mean abundances of 8.5 and 3.0 individuals per 20 m<sup>2</sup> respectively. In comparison, deep reef at Keats and Kodall (Cluster 2) had relatively high numbers of *Coscinoderma* sp. (4.7 sponges per 20 m<sup>2</sup>) but low numbers of *H. erecta* (0.9 sponges per 20 m<sup>2</sup>). Island  $\times$  Depth combinations in Cluster 3 generally had moderate numbers of *Coscinoderma* sp. (1.1 sponges per 20 m<sup>2</sup>) and *D. herbacea* (0.8 sponges per 20 m<sup>2</sup>), and relatively high numbers of *H. erecta* (2.0 sponges per 20 m<sup>2</sup>). Cluster 3 included both shallow and deep reefs. Shallow reefs at Kabbikane and Keats (Cluster 4) had the overall lowest abundances of dictyoceratids (1.7 sponges per 20 m<sup>2</sup>), generally two to four times less than other Island  $\times$  Depth combinations.

#### Size-frequency

Size-frequency distributions (Fig. 4) were only statistically analysed for dictyoceratid species that were found at all six



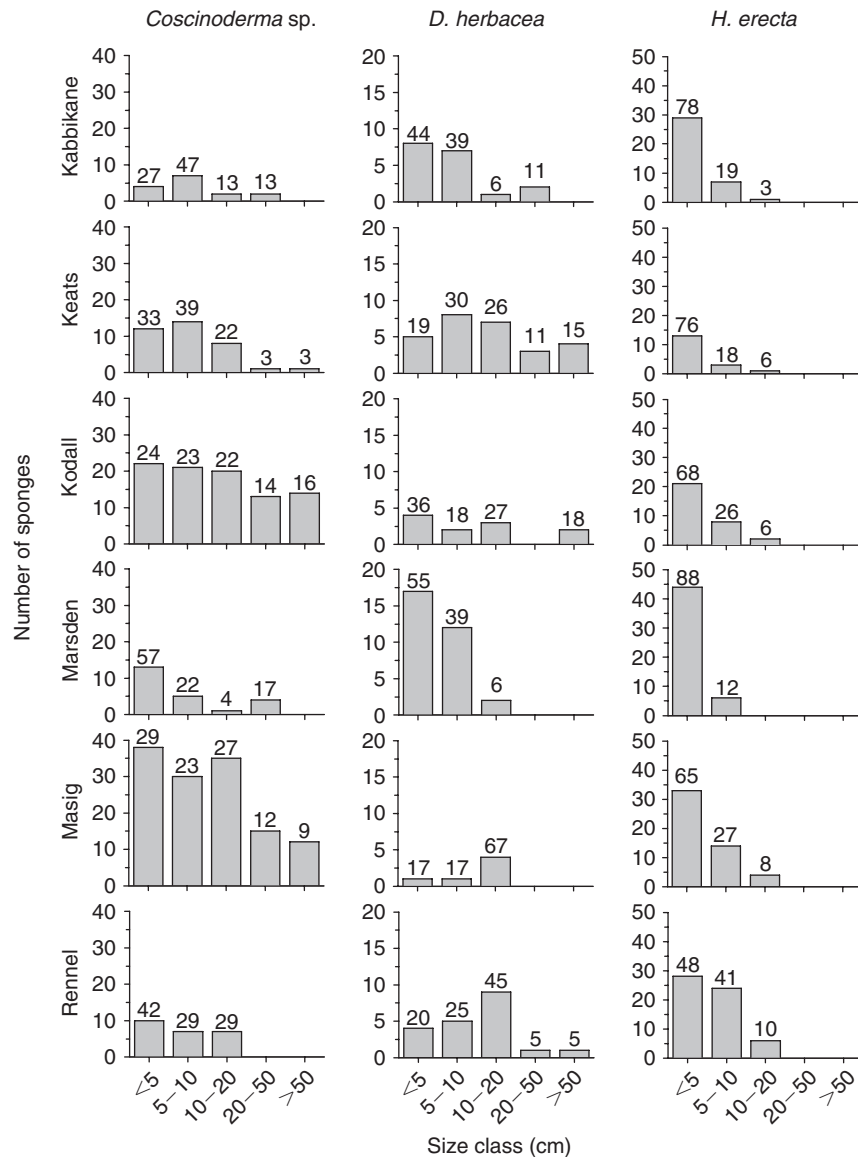
**Fig. 3.** Dendrogram showing dissimilarity among the twelve Island  $\times$  Depth treatments: Kab, Kabbikane; Kea, Keats; Kod, Kodall; Mar, Marsden; Mas, Masig; Ren, Rennel; S, shallow; D, deep. Four clusters were found.

islands. Chi-square contingency tests determined that size frequency distribution varied among islands for *Coscinoderma* sp. ( $\chi^2_{20} = 37.0$ ;  $P = 0.012$ ), *D. herbacea* ( $\chi^2_{20} = 40.3$ ;  $P = 0.005$ ) and *H. erecta* ( $\chi^2_{10} = 23.4$ ;  $P = 0.009$ ). For *Coscinoderma* sp. and *D. herbacea* only, sponges  $< 5$  cm could be considered juveniles.

For *Coscinoderma* sp., most sponges at Kabbikane and Keats and all sponges at Rennel were less than 20 cm in size (Fig. 4). In contrast, the *Coscinoderma* sp. populations at Kodall and Masig contained relatively high numbers of sponges  $> 20$  cm in size. Both Kodall and Masig also had several large ( $> 50$  cm) sponges. The juvenile proportion ( $< 5$  cm) of the *Coscinoderma* sp. population at each island ranged from 24 to 57%, highest overall at Marsden (Fig. 4).

Similar to *Coscinoderma* sp., the juvenile proportion of *D. herbacea* varied greatly among islands, being highest overall at Marsden (Fig. 4). Marsden and Masig were also populated by *D. herbacea* less than 20 cm in size. In contrast, Keats and Kodall had a relatively high proportion of large ( $> 50$  cm) sponges.

For *H. erecta*, all recorded individuals were less than 20 cm in size (Fig. 4). At Marsden, all *H. erecta* were relatively small



**Fig. 4.** Size frequency distributions for *Coscinoderma* sp., *D. herbacea* and *H. erecta* for each of the six islands. The y-axis varies for each species. The numbers in each graph represent the % of each size class for each island.

(<10 cm), with most sponges less than 5 cm in size (Fig. 4). In contrast, at Rennel, over half of the recorded sponges were larger than 5 cm.

## Discussion

The abundance and distribution of dictyoceratids varied greatly among and within islands in central Torres Strait. For some dictyoceratids, such as *Coscinoderma* sp., abundance varied significantly among the six neighbouring islands. For other species, such as *Dysidea herbacea* and *Hyrtios erecta*, abundance varied greatly among sites around a particular island and thus highlighted small-scale spatial heterogeneity ( $\geq 1$  km). Variation in sponge abundance and diversity over small spatial scales is

typical throughout Torres Strait (Duckworth *et al.* 2005), similar to many sponge communities (Wilkinson and Cheshire 1989; Roberts and Davis 1996; Hooper and Kennedy 2002). The variation in abundance of a dictyoceratid species among islands or sites around islands could result from biological and physical factors such as localised disturbance events, differences in food availability and patterns of water transport affecting larval dispersal.

Dictyoceratid sponges typically produce well-developed larvae with poor swimming abilities that settle within a few hours or days (Bergquist and Sinclair 1968; Maldonado and Young 1996). In central Torres Strait, eddies may form around islands (Wolanski *et al.* 1984), which could potentially trap larvae and promote high settlement and abundance of dictyoceratids at a

site. However, currents between islands in central Torres Strait can exceed  $50 \text{ cm s}^{-1}$  (Wolanski and Ruddick 1981), which suggests that dictyoceratid larvae could be quickly transported among neighbouring islands. The fact that four of the seven dictyoceratid species were not recorded from some of the surveyed islands indicates that water transport and larval dispersal only partially explain differences in abundance patterns of sponges in central Torres Strait.

Water turbulence and UV radiation can also influence sponge distributions, restricting some species to less-turbulent areas where physical damage is less or to areas where radiation levels are low (Reiswig 1973; Jokiel 1980; Wilkinson and Trott 1985; Wilkinson and Evans 1989; Bell and Barnes 2003). Over variable depth, this generally results in highest sponge abundance and species richness in deeper water where levels of water turbulence and radiation are lower (Wilkinson and Evans 1989; Diaz *et al.* 1990; Schmahl 1990; Roberts and Davis 1996). Dictyoceratid abundance in central Torres Strait showed a similar pattern, with more sponges and species found on deep reef (10 to 15 m). However, abundances of dictyoceratids such as *H. erecta* over depth varied among islands or sites within an island, possibly reflecting differences in water turbulence or storm events among islands and sites. High water turbulence generated from storms can fragment sponges with branching morphologies, increasing local abundances (Wulff 1991). This may help explain the high abundances of the branching dictyoceratid *H. erecta* at some sites.

The distribution of phototrophic sponges, species that derive most of their nutrition from photosynthetic symbionts, is also greatly influenced by water clarity (Wilkinson and Trott 1985). Two phototrophic sponges, *C. flabellifera* and *D. herbacea*, were found in the present study, with the latter recorded at relatively high but patchy abundance among sites and islands. Because water clarity can vary greatly over small spatial scales in Torres Strait (A. Duckworth, unpublished data), it is likely to have contributed towards the patchy distribution of *D. herbacea*.

Four of the seven dictyoceratid species recorded from central Torres Strait, *Carteriospongia flabellifera*, *Dysidea* sp. 1 and 2, and *Ircinia ramosa*, were found at low abundances. For each species, less than 20 individuals were recorded from 2880 m<sup>2</sup> of surveyed reef. In contrast, both *Coscinoderma* sp. and *H. erecta* were found at every surveyed site and often at relatively high abundances. In total, *Coscinoderma* sp. and *H. erecta* constituted over 75% of the dictyoceratid sponges recorded from central Torres Strait reefs. Dominance of one or two sponge species in a location appears typical for Torres Strait (Duckworth *et al.* 2005) and may result from high recruitment success, species longevity and favourable environmental conditions. A similar pattern of species dominance has been found in other sponge communities (Wilkinson 1988; Monteiro and Muricy 2004).

The dominance of *Coscinoderma* sp. and *H. erecta* in central Torres Strait influenced the structure of the dictyoceratid community among islands and depths. Cluster analysis showed that over half of the Island  $\times$  Depth combinations (Cluster 3) had a similar dictyoceratid community. This cluster included five of the six surveyed islands and both shallow and deep reef. However, the other three clusters were specific to a particular depth, highlighting again the effect that depth can have on abundance patterns of sponges. Both reef slope and the percentage of rock

substrate varied between depth strata, which along with other factors mentioned above may have contributed to differences in community structure. The present study therefore suggests that physical, biological and chance factors influence the distribution patterns and structure the dictyoceratid communities in central Torres Strait, with no one factor clearly dominating.

In Indonesia, human settlement can have an adverse effect on local sponge communities (de Voogd *et al.* 2006). In contrast, sponge abundance was highest on deep reef around Masig, which is the only island in the present study that is inhabited. On shallower reef at Masig, sponge abundance was similar to that found at neighbouring uninhabited islands. In addition, dictyoceratid diversity in Torres Strait is highest around Thursday Island and neighbouring reefs (Duckworth *et al.* 2005), which is the most populated region in Torres Strait. These findings suggest that human settlement in Torres Strait is not having an adverse effect on either dictyoceratid abundance or diversity. No evidence of predation from spongivores such as turtles was observed for any dictyoceratid species, even though turtles are common in central Torres Strait (A. Duckworth, pers. obs.). Thus, any reduction in spongivore abundance through human predation is unlikely to have affected dictyoceratid patterns among islands.

Along with abundance, size-frequency patterns of dictyoceratids varied greatly among islands in central Torres Strait. Others studies have found that size-frequency patterns of some sponges also vary over space (Wilkinson and Evans 1989; Turon *et al.* 1998; Trautman *et al.* 2000; Bell *et al.* 2002). Possible reasons include patchy recruitment, differences in food abundance among islands that cause uneven growth rates, and size-selective mortality resulting from environmental disturbances such as water turbulence (Reiswig 1973; Turon *et al.* 1998; Trautman *et al.* 2000).

In the present study, size-frequency patterns among islands also varied among dictyoceratid species, particularly for the large size classes. Generally, the largest individuals were found at Kodall and Masig for *Coscinoderma* sp., Keats and Kodall for *D. herbacea* and Rennel for *H. erecta*. Such interspecific variation suggests that environmental or biological factors that promote growth and large size of one species may not have a similar effect on a related species. In contrast, patterns of the smallest-sized sponges of each species were similar, with the highest percentage of small *Coscinoderma* sp., *D. herbacea* and *H. erecta* individuals found at Marsden. High frequency of small dictyoceratids on Marsden may have resulted from a recent recruitment pulse of dictyoceratids or, possibly, local waters are comparatively nutrient poor, leading to reduced growth rates and final size.

For dictyoceratids in central Torres Strait, size-frequency patterns may correlate with distribution patterns. For example, *Coscinoderma* sp. was most abundant and reached largest size at Masig and Kodall, while it was uncommon and generally small in size at Kabbikane and Rennel. High abundance and great size of *Coscinoderma* sp. at Kodall and Masig may result from stable conditions around these islands, which promote long periods of high survival and growth. However, for *D. herbacea* and *H. erecta*, there was no clear correlation between size frequency and distribution pattern. These differences further highlight the great variation in patterns of abundance and size that can exist among closely related sponge species over small spatial scales.

This variation among and within neighbouring reefs is structured and influenced by a variety of factors, but it appears that no one factor dominates. It is also likely that the interaction of environmental and biological factors uniquely affects each dictyoceratid species, leading to species-specific patterns of distribution and size frequency.

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