DISTRIBUTION AND ABUNDANCE OF BATH SPONGES IN TORRES STRAIT

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CRC TORRES STRAIT

CONTENTS

page

INTRODUCTION

The global market for bath sponges for domestic and industrial use is approximately $40 million per year. Commercial bath sponges are mostly sourced from wild populations located in the Caribbean, Bahamas and Florida, however, many of these sponge populations have been overharvested or decimated by disease (Vacelet et al. 1994, Pronzato 1999). Consequently, current bath sponge production cannot satisfy market demand, and thus alternative supply methods need to be established. One method that may supply sufficient and sustainable quantities of bath sponges is aquaculture. Studies have shown that farmed sponges can grow quickly with high survival (Verdenal and Vacelet 1990, Duckworth and Battershill 2003). Sponge aquaculture may also be a suitable industry for coastal Indigenous communities because sponges are generally inexpensive and easy to culture and process, and once processed involve minimal storage and transport costs. The first step is to identify a suitable bath sponge species.

Commercial bath sponges are species from the order Dictyoceratida (keratose sponges) that have a high quality spongin skeleton. Currently, all commercial bath sponges are from the Dictyoceratida family Spongiidae. In addition to spongin quality, bath sponge size and shape can greatly affect its market value. Ideally, a commercial species should be of sufficient size and shape to produce spherical “bath sponges” at least “fist-sized” following processing. Lastly, a bath sponge species should be locally abundant so as to supply sufficient material for farming experiments and possible future commercial culture.

After initial community consultation, including through the CRC Torres Strait office on Thursday Island, interest in farming bath sponges in Torres Strait was expressed by local communities in two eastern locations, Darnley Island and Yorke Islands, and two western locations, Badu Island group and Thursday Island group (Figure 1). The survey was done using the AIMS RV Cape Ferguson, with fishery permits to collect sponges obtained from the Australian Fisheries Management Authority (reference no: F2003/1882) and Queensland Department of Primary Industries (permit number: 01NOCA2371).

METHODS

To thoroughly survey the waters around Darnley, Yorke, Badu and Thursday Islands, each location was divided into several sites: 6 sites at Darnley; 5 sites at Yorke; and 7 sites each at Badu and Thursday (Figure 2). At each location, we surveyed sites close to the main

community and on neighbouring islands. The position of each site was selected using both nautical charts and local knowledge, and was generally on the lee-wind side of the island or reef. All sites were at least 2 km apart and were situated on various hard-bottom habitats including coral reef slope, coral rubble, sediment covered rock, reef flats and seaweed gardens (Figure 3). Surveying different habitats and from several islands gave a greater understanding of bath sponge distribution and abundance in each location and throughout Torres Strait.

Two dive teams situated about 200 m apart were used at each site, with each team doing two 50 x 2 m strip transects. The two transects followed a constant depth profile or compass bearing and were separated by at least 30 m so that each transect was statistically independent. All transects were done between 5-15 m depth. During each transect, one diver would lay out a rope that was weighted at one end (Figure 4a), which the second diver would follow recording every Dictyoceratid sponge found within 2m of one side of the rope. Once a transect was completed, a plastic bottle tied to the end of the 50 m long rope was purged with air sending it to the surface for retrieval (Figure 4b). This allowed the transect lines to be reused for subsequent surveys. For Dictyoceratid sponges that we could not positively identify underwater, a small tissue sample was collected and preserved in alcohol for later taxonomic analysis. At each location, we also collected a small tissue sample from several representative sponges of every Dictyoceratid species to confirm our field identification. To aid identification, underwater photos were taken of representative sponges of known and "new" species. To investigate size, each surveyed sponge was placed into one of three size categories: small, <10 cm in longest dimension; medium, 10-20 cm; and large, >20 cm. After the second transect each dive team did a general survey of the area to find any Dictyoceratid species that were not recorded during the two transects.

To examine spongin quality of Torres Strait species and thus help determine their suitability as a commercial bath sponge, tissue samples were collected and processed. Processing involved stomping on the sponge to first kill it and then leaving it in sea water for 2-10 days until its mesohyl (living tissue) had disintegrated and fallen off leaving behind a clean spongin skeleton. Processing in this study did not involve any later stages, such as bleaching skeletons with potassium permanganate and sulphuric acid, which were not possible on board the RV Cape Ferguson.

In addition to recording sponge number and size, for each transect we also noted general habitat features such as the dominant organisms (e.g. hard coral, sponges), depth, and substrate type and slope. Substrate type examined the presence of solid rock, rubble and sand, with each categorised as follows: 0 = 0-1%, 1 = 2-25%, 2 = 26-50%, 3 = 51-75%, and 4 = 76-

100% cover. Rock slope was categorised into three classes: 1 = 1-30º, 2 = 31-60º, and 3 = 61-90º. Ambient water temperature and salinity, the latter measured using a refractometer, were also recorded at each survey site. These additional factors may help assess the optimal farming requirements.

This study ran from 15th to 25th July, 2004, with 25 sites and 10,000 m^2 of Torres Strait seabed quantitatively surveyed for Dictyoceratid or bath sponges. The timeline is shown in table 1.

RESULTS AND DISCUSSION

Habitat characteristics and physical factors

The composition of the substrate recorded during the surveys is shown in Figure 5. The occurrence of solid substrate, either bedrock or consolidated carbonate reef, varied slightly among the four locations (Kruskal-Wallis One-Way ANOVA: $H_{df(3)}$=7.78, P=0.051), being more common at Darnley and Yorke than at the two western locations. The percentage of rubble differed significantly among the four locations (Kruskal-Wallis One-Way ANOVA: $H_{df(3)}$=13.6, P=0.004), being greatest at Badu and Thursday. The occurrence of sand did not vary significantly between locations (Kruskal-Wallis One-Way ANOVA: $H_{df(3)}$=6.89, P=0.076). Substrate slope for most surveys was between 1-30º and did not differ significantly between locations (Kruskal-Wallis One-Way ANOVA: $H_{df(3)}$=3.48, P=0.322). Survey depth was also similar between locations (One-Way ANOVA: $F_{df(3,21)}$=1.91, P=0.16), averaging 8.6 m.

At all four locations, hard coral was a dominant organism at most survey sites. Other conspicuous organisms were also recorded, however, whose distribution varied noticeably between the 4 locations. In addition to hard corals, soft corals were also commonly found at Darnley, sponges (non-Dictyoceratid species) at Yorke, seaweeds at Badu, and both sponges and seaweeds at Thursday.

Ambient water temperature and salinity was relatively constant throughout Torres Strait in July 2004 being 24-26ºC and 36‰, respectively.

Abundance and distribution

In total, we recorded 1552 Dictyoceratid sponges representing 25 species (Table 2). Because of the expense and difficulty of sponge taxonomy, many of the species could only be identified to the genus level. Therefore, for many of the *Dysidea* and *Ircinia* species we have

classified them to their distinguishing characteristic such as colour. Figures 6 to 10 show an underwater photo of the common Dictyoceratid species in Torres Strait. For each location, no species were found in the general survey (post-transect) that were not recorded in the strip transects. This result indicates that the strip transect method used in this study is a good method of surveying Dictyoceratid sponges in Torres Strait.

Dictyoceratid distribution and abundance varied greatly among the four locations. *Dysidea* and *Ircinia* species were most commonly found in and around Badu and Thursday Islands (Table 2). In contrast, *Carteriospongia flabellifera*, *Coscinoderma* sp. and *Phyllospongia* species were most abundant in Eastern Torres Strait (Table 2). Dictyoceratida richness was highest at Thursday and lowest for Yorke with 13 and 4 species, respectively. Eleven Dictyoceratida species were recorded at both Darnley and Badu. No single species was found in all four locations. Localised distribution is typical for many Australian sponge species, where a particular species is common in one area but rare or absent at adjacent locations (Hooper et al. 1999).

The abundance of many species also varied within a location. At the Yorke Islands, for example, *Coscinoderma* sp. was very common on the fringing reefs at Kodall and Massig Islands with an average of 15 sponges per 100 m^2, but uncommon at neighbouring Aukane Is with a density of approximately 1 per 100 m^2. There were no obvious differences in habitat characteristics such as substrate type or depth between the survey sites that could explain the variation in abundance. Similarly, in the Thursday Island group *Dysidea* sp. pink was relatively common around Wednesday Island, averaging 5 sponges per 100 m^2, but was absent or rare at the other survey sites a few kilometres away. Similar to variation between locations, patchy distribution within a location is also common trait for many sponge species and it may reflect poor larval distribution, microhabitat requirements or result from localised events such as disease and storms.

Sponge size and shape

The percentage of small, medium and large sponges of the most abundant Dictyoceratid sponges is shown in Figure 11. We consider that only common species, those with >25 individuals recorded in total, would provide sufficient material for the farming trials. In the Torres Strait survey, 10 Dictyoceratids fit this category. Some species such as *Ircinia* sp. light grey and *Dysidea* sp. pink and white are predominantly small, with most or all individuals less than 10 cm in size. In contrast, most individuals of *D. herbacea*, *Ircinia* sp. dark grey, *Coscinoderma* sp. and *P. papyracea* recorded in the Torres Strait survey were

larger than 10 cm in length. However, both *D. herbacea* and *P. papyracea* are thin sponges, generally less than 1 cm in width (Figures 6 and 10). Because most commercial bath sponges are generally spherical in shape and sold about "fist-size" or greater, *D. herbacea* and *P. papyracea* are probably unsuitable as a commercial product. In contrast, *Coscinoderma* sp. and *Ircinia* sp. dark grey have a large, massive morphology (Figures 7 and 8). For example, we recorded many individuals of *Coscinoderma* sp. that were over 20 x 10 x 10 cm in size.

Spongin quality

Spongin quality will be discussed for *Coscinoderma* sp. and *Ircinia* sp. dark grey only, because these two species were the only Dictyoceratids in Torres Strait that were abundant and had good shape and size, qualities important for bath sponge culture. *Ircinia* sp. dark grey did not retain its shape once processed, with its fibres having a "matted-hair" appearance and eventually falling apart (Figure 12). This supports other studies that have discovered that *Ircinia* species generally fall apart once processed. Therefore, *Ircinia* sp. dark grey has no commercial value as a bath sponge. In contrast, processed *Coscinoderma* sp. retained their shape well (Figure 12), with fibres compressible and having a good "spongy" feel. We have found that this is typical for *Coscinoderma* species, with conspecifics in the Northern Territory and Great Barrier Reef also having good quality spongin fibres. *Coscinoderma* sp. was the only species recorded from Torres Strait that is included in the Dictyoceratida family Spongiidae.

COMMUNITY CONSULTATION AND PARTICIPATION

Prior to the survey, consultation occurred with key leaders and members of the Torres Strait community, to determine which communities were interested in the project. This built on significant consultation over the previous two years, which had raised awareness about the project and the potential opportunity of sponge aquaculture. The CRC TS liaison person Mr Toshi Nakata, and TSRA task associate for this project Ms Robin Maxwell, were instrumental in contacting relevant communities and explaining the details of the proposed project. This process resulted in advice that four communities voiced strong interest in and support for the project: Darnley, Yorke, Badu and Thursday/Horn Islands. This was the basis on which these areas were selected for the survey.

Immediately prior to and during the survey trip, specific and detailed presentations about the project and the survey design were given at the TSRA (open presentation including ICC and AFMA, and individual meetings), Kawalagal Aboriginal Corporation on Horn Island (Isaac Savage), Yorke Island (Don Mosby), and Darnley Island (Walter Lui). The team did not go ashore at Badu Island for consultation purposes during the survey, out of respect for the families of three community members lost at sea the previous week. However, phone contact with Mr Manuel Namoa confirmed that the community council at Badu supported the project and wished us to proceed with the survey in the waters around Badu Island.

A Torres Strait Islander and marine biologist, Mr Stanley Lui, participated in the work of the survey. To ensure Mr Lui's role in the scientific team was as complete as possible, the project funded the cost of upgrading his diving and associated qualifications to the standard required at AIMS. The project looks forward to Mr Lui's ongoing role in the project, in his new capacity as Indigenous Aquaculture Liaison Officer (DPI).

On conclusion of the survey, a detailed presentation of the survey's preliminary findings was given at TSRA, with an open invitation to staff at ICC, AFMA, and QBFP (DPI). This was well attended, with a high level of interest apparent. Additionally, radio and local news interviews were given, and a subsequent national press release was prepared jointly by TSRA, AIMS and the TS CRC.

As the survey results indicated the largest population of suitable sponges adjacent to Masig Island, this was selected as the most ideal location for phase two of the project. Discussions with the chairman and council of Masig Island, including a half day meeting in Cairns, confirmed this selection. AIMS and the Masig Island Community Council have decided to conduct phase two of the project together as collaborators, with community participation in the work of the project, and are currently negotiating a Memorandum of Understanding which will detail the roles, responsibilities and expectations of each party in this relationship.

The results of this survey will be extended to representatives of the other three areas involved in the survey, by provision of this written report, and if appropriate, a face to face meeting.

SUMMARY

During a Torres Strait bath sponge study that quantitatively surveyed 10,000 m^2 of hard-bottom substrate in and around Darnley, Yorke, Badu and Thursday Islands, we recorded 1552 sponges representing 25 species. Distribution and abundance patterns were often specific to a particular location or even survey site. The best commercial bath sponge candidate was *Coscinoderma* sp., which has good quality spongin, grows to a large size and is locally abundant around the Yorke Islands. The community of Yorke (Masig) Island supports the project. A collaborative partnership between AIMS and the Masig Island Community Council will conduct future experiments to examine the potential of commercially farming *Coscinoderma* sp.

ACKNOWLDGEMENTS

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Vacelet J, Gaino E, Gallissian MF, Vacelet E. 1994. Bacterial attack of spongin skeleton during the 1986-1990 Mediterranean sponge disease. In: van Soest RWM, van Kempen TMG, Braekman JC (eds.) Sponges in Time and Space. Balkema, Rotterdam, pp 355-362.

Table 1. Summary of the timeline for the Torres Strait Dictyoceratid survey in July, 2004.

14 July. Scientists flew to Yorke Island to met RV Cape Ferguson

15 July. Yorke Is, practised survey method. Steamed to Darnley Is.

16 July. Darnley Is, surveyed site 1 and 2.

17 July. Darnley Is, surveyed site 3, 4 and 5.

18 July. Darnley Is, surveyed site 6. Transit to Yorke Is, surveyed site 1.

19 July. Yorke Is, surveyed site 2, 3, 4 and 5.

20 July. Transit to Badu.

21 July. Badu Is, surveyed site 1 and 2.

22 July. Badu Is, surveyed site 3 and 4.

23 July. Badu Is, surveyed site 5, 6 and 7

24 July. Thursday Is, surveyed site 1, 2 and 3

25 July. Thursday Is, surveyed site 4 and 5.

26 July. Thursday Is, surveyed site 6 and 7

27 July. Post-survey meeting with Torres Strait Regional Authority and Australian Fisheries Management Authority.

28 July. Scientists depart.

Table 2 List of the Dictyoceratid families and species identified from Torres Strait. Also shown for each species are the numbers of sponges found per location and total number recorded. Because of the difficulty of separating the three *Hyrtios* species in situ, the combined number is given instead.

Family	Species	Darnley	Yorke	Badu	Thursday	Total
Dysideidae	*Dysidea* cf *frondosa*			3		3
Dysideidae	*Dysidea herbacea*		8	26	5	39
Dysideidae	*Dysidea* sp., blue				1	1
Dysideidae	*Dysidea* sp., grey				8	8
Dysideidae	*Dysidea* sp., pink	2			39	41
Dysideidae	*Dysidea* sp., purple			2		2
Dysideidae	*Dysidea* sp., white			15	24	39
Irciniidae	*Ircinia ramosa*	1	1		11	13
Irciniidae	*Ircinia* sp., blue				1	1
Irciniidae	*Ircinia* sp., brown			2		2
Irciniidae	*Ircinia* sp., cream	1				1
Irciniidae	*Ircinia* sp., dark grey			20	21	41
Irciniidae	*Ircinia* sp., grey with turrets			1		1
Irciniidae	*Ircinia* sp., light grey	13		3	14	30
Spongiidae	*Coscinoderma* sp.	6	186			192
Thorectidae	*Carteriospongia flabellifera*	219			6	225
Thorectidae	*Collospongia auris*	8				8
Thorectidae	*Dactylospongia* sp.			1		1
Thorectidae	*Hyrtios* species	54	54	228	469	805
Thorectidae	*Hyrtios erecta*					
Thorectidae	*Hyrtios granulosa*					
Thorectidae	*Hyrtios reticulata*					
Thorectidae	*Phyllospongia lamellosa*	55		3		58
Thorectidae	*Phyllospongia papyracea*	27			6	33
Thorectidae	*Semitaspongia* sp.				1	1
Thorectidae	*Strepsichordaia* n. sp.	7				7

Figure 1. Map of Torres Strait showing the four survey locations: Darnley, Yorke, Badu and Thursday Islands.

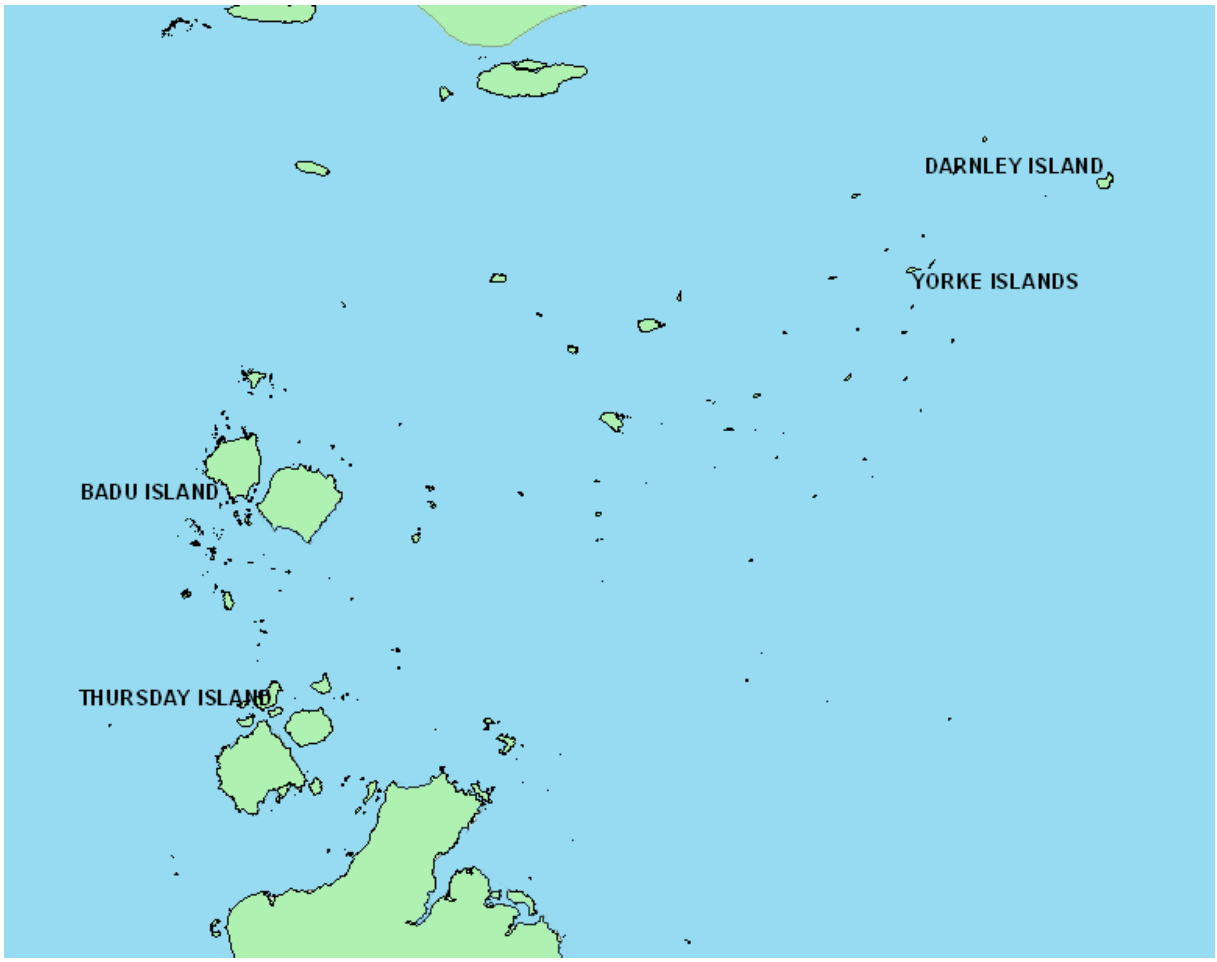
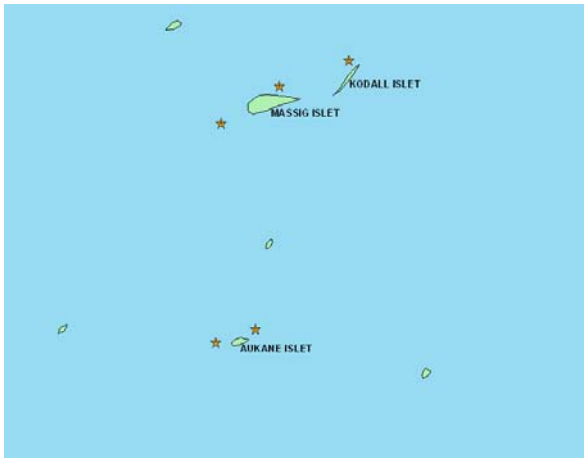


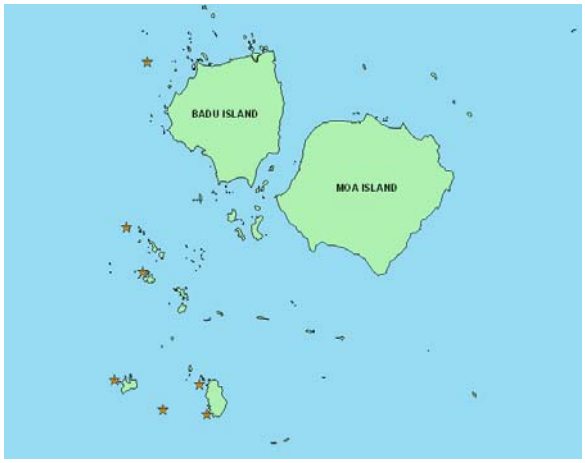
Figure 2. Map of each location showing the survey sites (stars).

Darnley location

Yorke location



Badu location



Thursday location

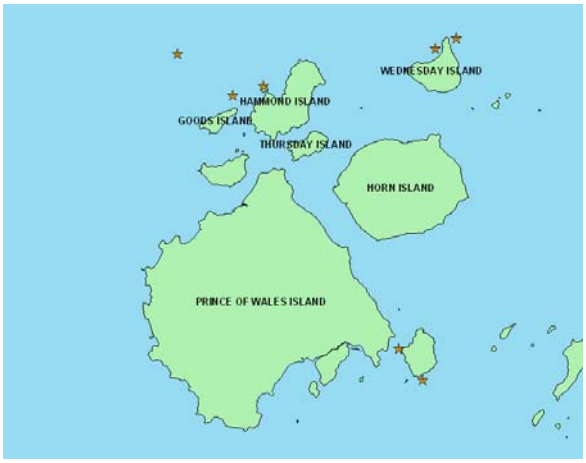


Figure 3. Underwater photos showing some of the habitats surveyed for Dictyoceratid sponges.

Coral reef slope

Rubble

Reef flat

Seaweed garden

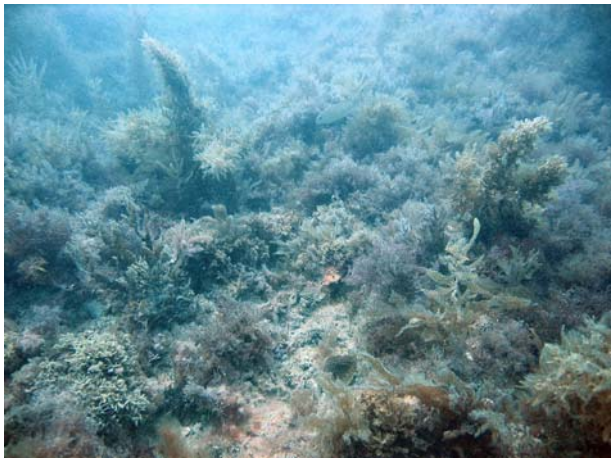
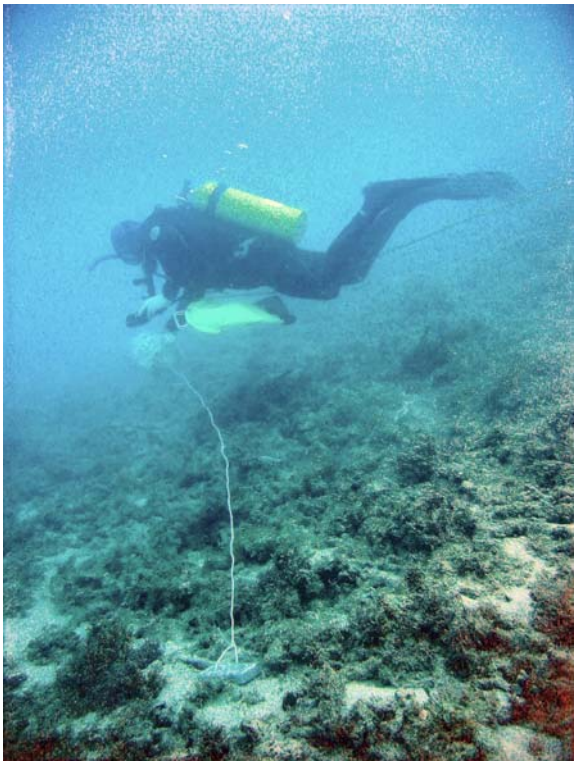


Figure 4. Underwater photos of the strip transect, showing (a) the rope being laid out from the weighted-end and (b) the plastic bottle filled with air and ready for release to the surface.

(a)



(b)

Figure 5. The mean occurrence of rock, rubble and sand at each location surveyed in Torres Strait. The y-axis shows the percentage group: 0 = 0-1%, 1 = 2-25%, 2 = 26-50%, 3 = 51-75%, and 4 = 76-100% cover. Error bars show variation between survey sites.

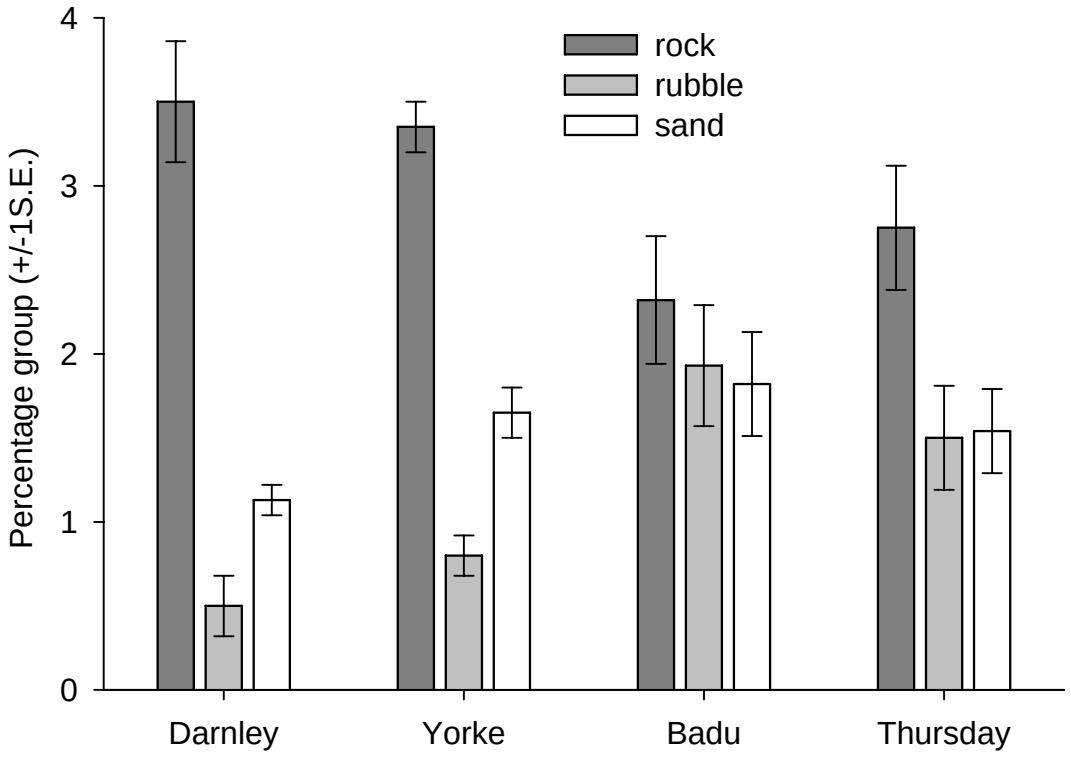


Figure 6. Underwater photos of the main *Dysidea* species found in Torres Strait.

Dysidea herbacea

Dysidea sp., pink

Dysidea sp., white

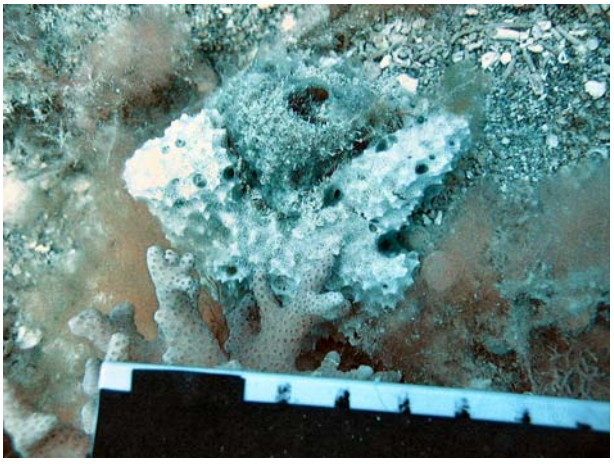


Figure 7. Underwater photos of the main *Ircinia* species found in Torres Strait.

Ircinia ramosa

Ircinia sp., dark grey

Ircinia sp., light grey

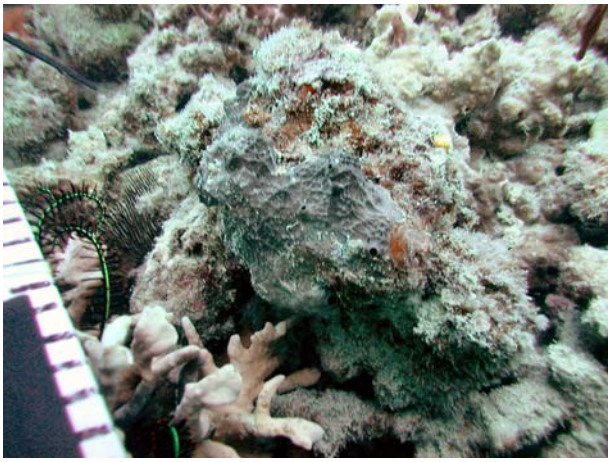
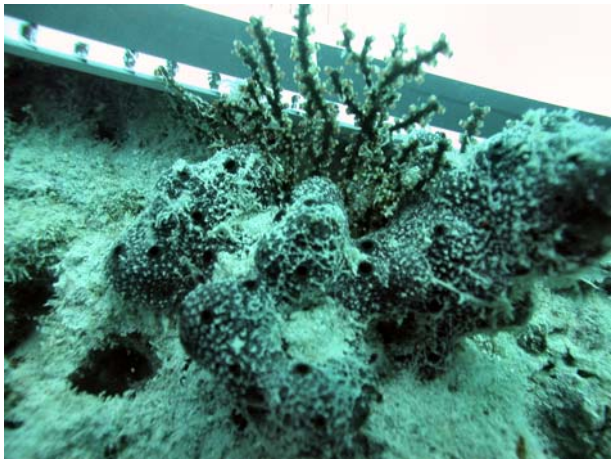


Figure 8. Underwater photos of the *Coscinoderma* sp. found in Torres Strait.

Figure 9. Underwater photos of three *Hyrtios* species found in Torres Strait.

Hyrtios erecta



Hyrtios granulosa

Hyrtios reticulata

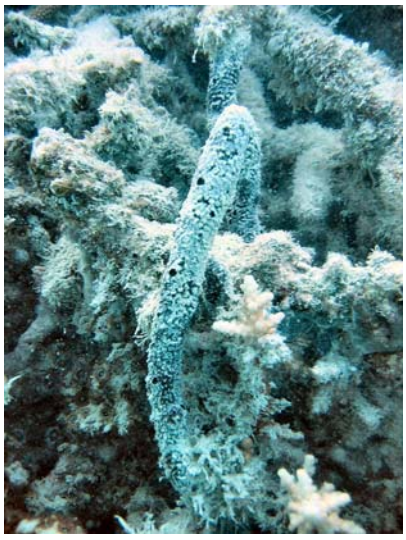
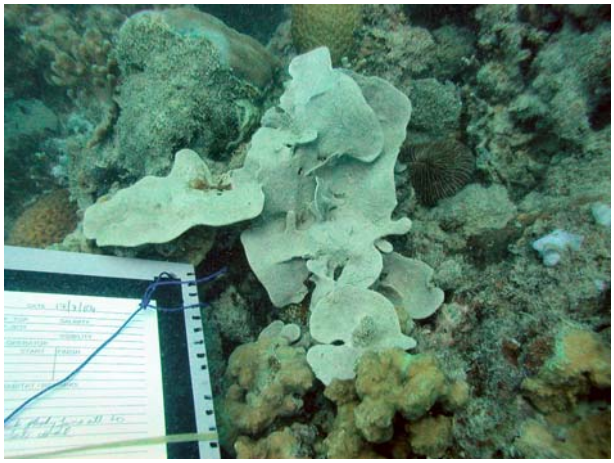


Figure 10. Underwater photos of common Dictyoceratida species found in Torres Strait.

Carteriospongia flabellifera



Phyllospongia lamellosa

Phyllospongia papyracea

Figure 11. Percentage of small (<10 cm), medium (10-20 cm) and large (>20 cm) sponges of the most abundant Dictyoceratida sponges in Torres Strait.

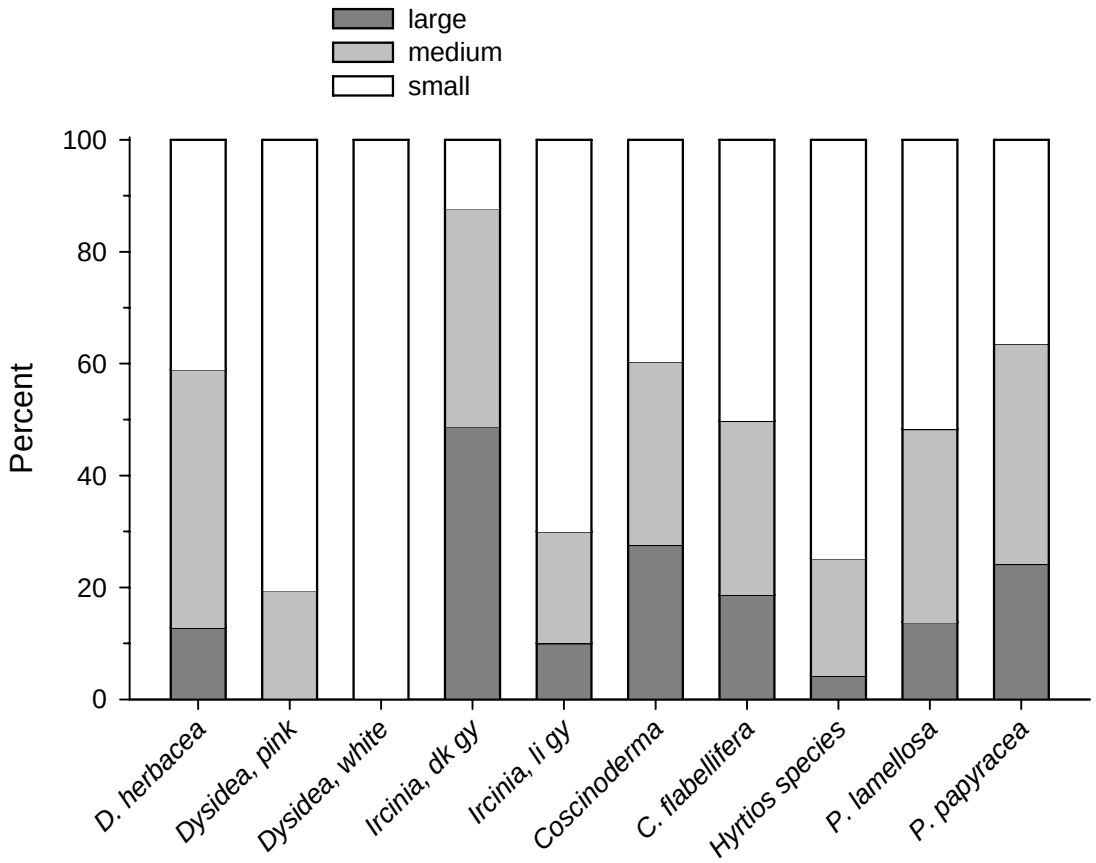


Figure 12. Photographs of processed sponges of *Coscinoderma* sp. and *Ircinia* sp. dark grey.

Coscinoderma sp.

Ircinia sp. dark grey