

ASSOCIATES OF SINGAPORE GORGONIANS: CRUSTACEA, MOLLUSCA, ECHINODERMATA AND CHORDATA

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ABSTRACT

Gorgonian associates from the phyla Crustacea, Mollusca, Echinodermata and Chordata are reported for the first time from Singapore. Associations range from opportunistic detrital feeding off the host branches, to living and possibly breeding within the host, to predation on host tissue. Four crab and two shrimp species are reported from the Crustacea; a species of bivalve and at least three ovulid gastropods from the Mollusca; five species of ophiuroids from the Echinodermata and a single species of goby from the Chordata. At least 14 species of gorgonians from Singapore were found to host animal associates.

INTRODUCTION

Gorgonian corals are relatively common and abundant on Singapore reefs, with at least 20 species recognised (Goh & Chou, in press). When suitable currents and substrata are present, they dominate the fauna on the lower reef slope and bottom (Goh, 1991). They thus represent a significant and important component of reef biota in Singapore (Goh & Chou, this volume). Colonies of these invertebrates orient themselves to face the current as they grow, maximising water flow through the fan as well as providing stability against toppling (Wainright & Dillon, 1969).

Animals that are able to attach themselves to the branches of gorgonians, where they are above the relatively still waters of the boundary layer, achieve two advantages over species that are strictly benthic: access to a larger amount of particulate food material and improved gaseous exchange. Paradoxically, the epizoic habit may also provide a refuge from predation (Patton, 1972). Besides the fact that most gorgonian associates are inconspicuous while on the branches of their host, the work of Randall (1967) has established that in the Caribbean, fishes generally do not feed on gorgonian tissue, leading to decreased chance encounters between gorgonian associates and predator fish species. Bakus (1981) showed that many gorgonian species contain extractable substances toxic to fish. Living on the branches of gorgonians, rather than being a liability in terms of predation, becomes non-threatening or even advantageous to the animal associates.

The term 'gorgonian associate' used here refers generally to any animal that can be found on or in a gorgonian. It includes both obligate and facultative relationships, and ranges from animals found on the host for short-term activity like feeding, to the more intimate associations like commensalism, mutualism or parasitism. The only previous study of gorgonian associates on Singapore reefs was an unpublished work by Goh (1991) that listed animal associates belonging to eight phyla. However, many of the specimens listed in that report were not identified beyond broad taxonomic categories. The present study reports on new material from the phyla Crustacea, Mollusca, Echinodermata and Chordata.

MATERIALS AND METHODS

All specimens were hand-collected at various reef sites south of Singapore. To prevent loss of specimens during collection, the entire gorgonian colony was placed in a plastic bag before cutting it at the base and securing the open end of the bag. Associates like the ophiuroids, which cling tenaciously to the branches were relaxed using menthol crystals before separation from the host and then preserved.

The shrimps, *Hamodactylus boschmai* and *H. noumeae* are at present in the collection of Dr A.J. Bruce at the Northern Territory Museum of Arts and Sciences in Darwin. The other associates are in the personal collection of the first author and will eventually be lodged in the Zoological Reference Collection, National University of Singapore.

RESULTS AND DISCUSSION

The gorgonian associates from the Crustacea, Mollusca, Echinodermata and Chordata (Table 1) range in relationship to their hosts from opportunistic feeding on detrital matter trapped by host branches, to living and apparently breeding within the host to predation on host tissue.

Table 1. Reef animals associated with gorgonians in Singapore.

ASSOCIATE	HOST(S)
Phylum CRUSTACEA	
<i>Polyonyx telestophilus</i>	<i>Solenocaulon</i> spp. A, B
<i>Porcellana latifrons</i>	<i>Solenocaulon</i> sp. A
<i>Petrolisthes</i> sp.	<i>Solenocaulon</i> sp. A
<i>Hyastenus</i> sp.	<i>S. mollis</i> , ? <i>Acabaria</i> sp. A
<i>Hamodactylus boschmai</i> Holthius	<i>C. pectinata</i> , <i>Echinogorgia</i> sp.
<i>H. noumeae</i> Bruce	unidentified gorgonian
Phylum MOLLUSCA	
<i>Pteria</i> sp.	<i>S. mollis</i> , <i>S. suberosa</i> , <i>Verucella</i> sp. B, Plexaurid genus A
<i>Phenacovolva</i> sp.	<i>Verucella</i> sp. B, <i>Echinogorgia</i> sp. C
<i>P. birostris</i> Linne, 1767	<i>Echinogorgia</i> sp.
<i>P. longirostrata</i> (Sowerby, 1828)	? <i>Acabaria</i> sp. A
Other ovulids	<i>S. suberosa</i> , ? <i>Melithaea</i> sp., Plexaurid genus A
Phylum ECHINODERMATA	
<i>Ophiothela danae</i>	<i>Solenocaulon</i> sp. B, <i>S. suberosa</i> , other unidentified gorgonians
<i>O. hadra</i>	<i>Astrogorgia</i> sp., unidentified gorgonian
<i>O. venusta</i>	<i>Solenocaulon</i> sp. B
<i>Ophiopsammium semperi</i>	<i>Solenocaulon</i> sp. B
<i>Ophiothrix miles</i> (juvenile)	unidentified gorgonian
Phylum CHORDATA	
<i>Bryaninops ampulus</i>	<i>Junceella</i> sp. A

The hollow axis of the gorgonians *Solenocaulon* spp. A and B provide shelter for the crabs *Polyonyx telestophilus*, *Porcellana latifrons* and *Petrolisthes* sp. These crabs belong to the family Porcellanidae, and where they occur, are found in groups of at least two crabs (one male and one female) in each colony. The crabs follow the colouration of their host and have not been observed to leave the hollow axis. Within a particular gorgonian colony, only one species of crab is usually found.

Hyastenus sp. has only been observed at night, apparently feeding on particulate matter trapped from the current by the gorgonian branches. The relationship appears to be facultative and distant. The two species

from which it has been collected, *S. mollis* and ?*Acabaria* sp. A both have a network of reticulate branches which act effectively as a sieve for water-borne particulates. The meshwork of branches also facilitates climbing for the crab. These factors may account for the choice of these species by the crab to forage for food.

The two shrimp species of the genus *Hamodactylus* have stripes that enable them to blend in with their hosts. These shrimps are probably particulate feeders taking advantage of the debris trapped on the branches of their gorgonian host. The cryptic colouration camouflages the shrimp and acts as a safeguard against predation. Bruce (1970) described the two species, which were both found on the gorgonian *Mopsella ellisi* Hickson. *Hamodactylus boschmai* was recorded at Djeddan, Aru Islands in 1899 and at Ternate, Indonesia in 1930, while *H. noumeae* was collected from the Red Sea in 1970.

The winged oyster, *Pteria* sp. normally attaches itself by means of strong byssus at branch intersections on the host gorgonian. It is a filter feeder, taking advantage of the high flushing rate that exists through the branches of its host. It appears to be an opportunistic associate, with no host specificity, being found on at least four different species of gorgonians in Singapore. This bivalve can grow to about 5cm in length on the branches of gorgonians.

All the gastropod associates found here belong to the family Ovulidae, known to feed on coral and gorgonian tissue (Wagner & Abbott, 1978). While their effect on the gorgonians in Singapore is not known, Gerhart (1990) reported minimal direct feeding effects by *Cyphoma gibbosum* on *Plexaura homomalla* in Curacao but found a secondary deleterious effect of fouling by epibionts that resulted from the grazing of the gastropod. The ovulid *Ovula ovum* has been found to transform a toxic terpenoid product of the soft coral *Sarcophyton* into a significantly less toxic compound (Coll et al., 1983). The question that now arises is how these gastropods cope with the toxins from the gorgonians. Vrolijk & Targett (1992) found enzymes that detoxified the allelochemicals from their gorgonian prey in *Cyphoma gibbosum*. It is not known whether similar biotransformation enzymes exist in the Ovulidae of Singapore, and could make an interesting follow-up study.

At least five ophiuroid species are associated with gorgonians in Singapore. Many ophiuroids are known to have an epizoic juvenile stage (Clark, 1976), but only one (*O. miles*) of the five found here was a juvenile. The other four were adults that appear to live on the gorgonians throughout their life cycle. In the laboratory, the ophiuroids do not move from their perches on the gorgonian and keep the oral disc above the surface of the gorgonian. They have also been observed to sweep their arms in the water when presented with food. Infestation of gorgonians by ophiuroids can be quite severe, with hundreds of individuals on a single host colony, but laboratory observations suggest that the host is not harmed.

The goby *Bryaninops ampulus* was found on the sea whip *Junceella* sp. A. This species has been reported to be associated with gorgonian sea whips from Madagascar and the Seychelles to the Hawaiian Islands (Randall et al., 1990). The presence of this goby in Singapore puts it almost right in the middle of this range.

The presence of representatives from four major animal phyla associated with gorgonians in Singapore emphasizes the importance of these coelenterates to the ecology of coral reef communities in Singapore. The gorgonians and their associates represent a significant portion of this community and should be considered in ecological and resource management decisions concerning the reefs of Singapore.

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