Ectocommensals of the stichopodid sea cucumbers *Thelenota anax* and *Stichopus vastus* on the northern Great Barrier Reef

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Abstract

Sea cucumbers can act as hosts for a wide range of commensal organisms, both externally (ectocommensals) and internally (endocommensals), but this role might vary among localities. We recorded ectocommensals on the body wall of *Thelenota anax* and *Stichopus vastus* at several coral reef sites around Lizard Island in the northern Great Barrier Reef. Few ectocommensals were found on either species, at any of the sites. Scaleworms were the most common epibiont on the sea cucumbers. Although studies at other sites have reported diverse and abundant commensal organisms on holothuroids, our study shows that the role of sea cucumbers as hosts might be minor at other localities. Further research across multiple localities is needed to better understand the ecological role of sea cucumbers in reef ecosystems.

Introduction

Offering protection, a potential source of food and displacement, sea cucumbers are a popular host choice for various commensal organisms (Lyskin and Britaev 2005; Purcell and Eriksson 2015; Caulier et al. 2012). Holothuroids host commensal organisms both externally and internally. Ectocommensal organisms of holothuroids are those living on the outer body wall of sea cucumbers, and include synaptid holothuroids, crabs, shrimps, ophiuroids, gastropods (mostly parasitic) and scaleworms (Polynoidae) (Eeckhaut et al 2004; Purcell and Eriksson 2015). Using the host animal as a vehicle, this diverse range of taxa can travel from one reef structure to another (Eeckhaut 2003). This can potentially aid the dispersal of ectocommensal animals and further enhance reef biodiversity.

At some localities, the number of ectocommensal animals on host sea cucumbers can be amazingly high (Purcell and Eriksson 2015). In other locations, the numbers of these "piggybacking" animals can be lower and quite variable (Lyskin and Britaev 2005). Sometimes, just one or two commensal organisms are found on the host holothuroid (Mercier and Hamel 2005).

As part of an ecological study of *Thelenota anax* and *Stichopus vastus*, we examined and recorded the incidence of ectocommensal animals on more than 60 hosts collected at several sites around Lizard Island on the northern Great Barrier Reef, Australia. This study provides the first focused examination of symbionts of these two holothuroids, and a further evaluation of the ecological role of holothuroids as hosts.

Methods

All fieldwork was undertaken at Lizard Island between 09:00 and 17:00 for 10 days in February 2019. Due to logistics and time constraints, no night-time observations were undertaken. The average seawater temperature was 29°C.

We collected *Thelenota anax* and *Stichopus vastus* from a range of depths (2–18 m) at five sites: Mermaid Cove, Palfrey Lagoon, Trawler Beach, Lagoon Bommie and Coconut Beach (Table 1). Body lengths of the host sea cucumbers were measured *in situ* with a ruler before placing them into labelled plastic bags. They were then taken to the surface, where they were allowed to drain off out of water for five minutes (following Skewes et al. 2004) and then weighed to the nearest 10 g using a digital hanging scale. During the draining period, sea cucumbers were checked for external commensal organisms, which were enumerated and recorded in major taxonomic groups. In total, 33 *Stichopus vastus* were examined and 30 *Thelenota anax* were examined.

Results and discussion

Body lengths of *Thelenota anax* ranged from 37 cm to 83 cm, and weights ranged from 2.0 kg to 7.2 kg. Body lengths of *Stichopus vastus* ranged from 29 cm to 48 cm, and weights ranged from 1.5 kg to 3.8 kg.

A small number of epibionts were found on *T. anax*, with an average of 1.3 commensal organisms per sea cucumber. The highest number was at Palfrey Lagoon, which was the shallowest site (Table 1). Scaleworms (Fig. 1) were the most prevalent commensal organism on *T. anax*, with an average of 1.1 per host across the three sites.

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Table 1. Average number of epibionts per host (*Thelenota anax* and *Stichopus vastus*) at five sites at Lizard Island, northern Great Barrier Reef, Australia.

Site	Species	Hosts (n)	Ophiuroids	Scaleworms	Gastropods
Coconut Beach	*T. anax*	11	0	0.2	0
Trawler Beach	*S. vastus*	11	0	0.2	0.1
Mermaid Cove	*T. anax*	7	0	1.7	0
Lagoon Bommie	*S. vastus*	11	0	0	0
Palfrey Lagoon	*T. anax*	12	0.2	1.5	0.3
Palfrey Lagoon	*S. vastus*	11	0	0.2	0.1

Figure 1. Scaleworms (Polychaeta: Polynoidae) on the dorsal (left) and ventral (right) body wall of *Thelenota anax* at Lizard Island, Australia. (Images: L: Alison Hammond; and R: Steven Purcell)

The overall number of epibionts on *S. vastus* was particularly low, especially in comparison with other holothuroid species in other locations. Purcell and Eriksson (2015) recorded 27 ± 40 commensals per *Stichopus herrmanni* host at one site in New Caledonia, the majority of which were ophiuroids. Only two epibiont animals, four scaleworms and two parasitic gastropods, were found in association with *S. vastus* in our study. None of the eleven *S. vastus* examined from the Lagoon Bommie site carried any visible symbiotic organisms.

Despite there being a multitude of ophiuroids on the surrounding sand at the Coconut Beach site, none of the *T. anax* that we surveyed at that location carried any brittle stars. The ectocommensal scaleworm found on *T. anax* and *S. vastus* is likely *Gastrolepidia clavigera* (Fig. 1),which is known to live on the surface of large holothuroids, including *T. anax* (Britayev and Zamishliak 1996; Martin and Britayev 1998). The average number of scaleworms on *T. anax* (1.5) is comparable with other studies, which have reported around 1.0 to 3.0 *G. clavigera* per host sea cucumber (Gibbs 1969; Britayev and Zamishliak 1996).

This study shows that ectocommensal animals can occur in low frequencies on sea cucumbers in some locations, such as Lizard Island, and that the number and diversity of epibionts are likely to vary spatially. The density of epibionts, however, does not appear to be simply due to location. A lower frequency of ectocommensals was observed for *S. vastus*. At one site in Palfrey Lagoon, where we found both species, *T. anax* was also inspected for epibionts at that site and at the same time as *S. vastus*. Our findings of low incidence of epibionts on *T. anax* and *S. vastus* call for further studies on the geographic and interspecific variation in the frequency of commensal organisms of holothuroids. Such studies will give further clarity to our understanding of their role in supporting biodiversity in marine ecosystems.

Acknowledgements

This research was funded through a grant by the Marine Ecology Research Centre of Southern Cross University. We thank the staff of the Lizard Island Research Station.

References

Britayev T.A. and Zamishliak E.A. 1996 Association of the commensal scaleworm *Gastrolepidia clavigera* (Polychaeta: Polynoidae) with holothurians near the coast of South Vietnam. Ophelia 45:175–190.

Caulier G., Parmentier E., Lepoint G., Van Nedervelde F. and Eeckhaut I. 2012. Characterization of the population of the Arlequin crab, *Lissocarcinus orbicularis* Dana, 1852, an obligate symbiont of holothuroids, in Toliara Bay (Madagascar). Zoosymposia 7:177–183.

Eeckhaut I. 2003. Symbiosis. p. 31–34. In: Craig S.F., Thoney D.A. and Schlager N. (eds). Grzimeck's Animal Life Encyclopedia, Vol. 2: Protostomes. Farmington Hills, USA: Gale Group.

Eeckhaut I., Parmentier E., Becker P., Gomez Da Silva S. and Jangoux M. 2004. Parasites and biotic disease in field and cultivated sea cucumbers. p. 311–326. In: Advances in Sea Cucumber Aquaculture and Management. Lovatelli A., Conand C., Purcell S., Uthicke S., Hamel J-F. and Mercier A. (eds). FAO Technical Paper No. 463. Rome: Food and Agriculture Organization of the United Nations.

Gibbs P. 1969. Aspects of polychaete ecology with particular reference to commensalism. Philosophical Transactions of the Royal Society B: Biological Sciences 255:443–458.

Lyskin S.A. and Britaev T.A. 2005. Symbionts of holothurians from South Vietnam: Intra- and interspecific interactions. Doklady Biological Sciences 401:116–119.

Martin D. and Britayev T.A. 1998. Symbiotic polychaetes: Review of known species. p. 217–340. In: Ansell A., Barnes M. and Gibson R. (eds). Oceanography and Marine Biology: An Annual Review 36. London: CRC Press. 468 p.

Mercier A. and Hamel J.-F. 2005. Note on the association between *Plakobranchus ocellatus* (Mollusca: Gastropoda: Opisthobranchia) and *Holothuria atra* (Echinodermata: Holothuroidea). Cahiers de Biologie Marine 46:399–402.

Purcell S.W. and Eriksson H. 2015. Echinoderms piggybacking on sea cucumbers: Benign effects on sediment turnover and movement of hosts. Marine Biology Research 11:666–670.

Skewes T., Smith L., Dennis D., Rawlinson N., Donovan A. and Ellis N. 2004. Conversion ratios for commercial beche-de-mer species in Torres Strait. Australian Fisheries Management Authority, Torres Strait Research Program, Canberra.