Note on the pea crab *Holotheres semperi* (Bürger, 1895) parasitising the sea cucumber *Holothuria scabra* in Rempang, Indonesia

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Abstract

The present study documents the extension of the distribution range of the pea crab *Holotheres semperi*, which was recently found associated with the sea cucumber *Holothuria scabra* off the island of Rempang in the Riau Islands of Indonesia. The pea crabs were found in the right respiratory tree of the host, mainly as heterosexual pairs. The presence of *H. semperi* elicited detrimental effects on the development of the host's gonads, and can thus be considered parasitic. Aspects of its biology are discussed.

Introduction

Pea crabs (family Pinnotheridae) are decapod crustaceans that are often associated with holothuroid echinoderms or sea cucumbers, with a number of genera found only in these hosts (Schmitt et al. 1973; Jangoux 1987; Ng and Manning 2003; Ng 2018). They were historically grouped in *Pinnotheres* but are currently placed in *Holotheres*, a genus in which all members live in sea cucumbers (Ng and Manning 2003). Some species were described as colonising the respiratory tree exclusively (Hamel et al. 1999), while others to occur throughout the gut and cloaca of the host (Schmitt et al. 1973; Jangoux 1987). Pea crabs associated with holothuroids have been classified as commensal, inquilistic, parasitic or undetermined symbionts (Jones and Mahadevan 1965; Vanden Spiegel and Jangoux 1989; VandenSpiegel et al. 1992; Hamel et al. 1999). Several authors mentioned that the crabs did not feed on host tissues, nor cause detrimental effects, except to slightly wound the wall of the respiratory tree or the cloaca, forming a membranaceous cyst (Tao 1930; Jones and Mahadevan 1965; Jangoux 1987; VandenSpiegel et al. 1992). Hamel et al. (1999), however, indicated that *Holotheres halingi* in Solomon Islands induced atrophy of the right respiratory tree in its host *Holothuria scabra*. A number of other pea crabs have been previously found in *Holothuria scabra*. One, *Buegeres deccanensis*, was observed in the respiratory tree of sea cucumbers collected in Indian coastal waters (Chopra 1931; Jones and Mahadevan 1965).

Study of parasites of *Holothuria scabra* in Rempang Island, Indonesia

Between September and December 2015, specimens of the sea cucumber *Holothuria scabra* were collected at 1–3 m depth around the village of Tanjung Kertang on Pulau Rempang in the Riau Islands of Indonesia (0.934925N and 104.08063E). Upon dissection, a number of pea crabs were found. The precise location of the pea crabs in the respiratory tree was described, their sex was determined, and any visually noticeable side effects on the host (on the respiratory tree itself and other organs, including the gonads) were recorded. Voucher specimens were deposited in the Zoological Reference Collection of the Lee Kong Chian Natural History Museum at the National University of Singapore (catalogue number ZRC 2017.0823).

The crab was identified as *Holotheres semperi* (Bürger, 1895) on the basis of its carapace, third maxilliped, male pleonal and gonopod structures, as discussed in Ng and Manning (2003) (Fig. 1). Although this species has been described as a parasite of *H. scabra* around Singapore by Lanchester (1900) and Chuang (1961), the biology of this species is not well known, and its ecology and biology remain virtually unstudied. The present work extends its distribution range by 50 km to the south.

Holotheres semperi have always been found in the right respiratory tree of *H. scabra*, as described in Lanchester (1900) and Chuang (1961), have always

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been found to be firmly attached to the inner body wall. The infestation frequency was ~86.2% of all sea cucumbers examined (n = 29), including 13 males and 12 female hosts (4 sea cucumbers were found without crab). Occurrences of the pea crabs in the different hosts included single individuals (n = 3), pairs (n = 21) and one trio.

Holotheres semperi is light brown or beige when alive. The carapace width is 750 ± 45 μm in males and 1,100 ± 85 μm in females (Fig. 1). The single individuals found were all males, the pairs were composed of one individual of each sex, and one trio was composed of a male, a female, and one small juvenile (435 μm). In pairs, individuals were positioned side by side, touching each other; the male was always deeper inside the respiratory tree than the female. Both were attached firmly to the inner surface of the respiratory tree with elastic threads. In the case of the trio, the smaller individual was the one closest to the cloaca.

The proximity of both sexes may facilitate fertilisation during the reproductive season. Moreover, the fact that the female is closer to the cloacal opening likely favours the release of larvae outside the host, as previously suggested for *H. halingi* (cf. Hamel et al. 1999). The pelagic first zoeae of *H. halingi* were observed during exhalation of a host sea cucumber *H. scabra* (expulsion of seawater through the anus) (Hamel et al. 1999). When a third pea crab was found in the same host, but was not attached to the inner wall of the respiratory tree, suggests that it was an established pair that was visited by another pea crab, presumably an immature individual seeking a new host. As colonisation of the host is believed to primarily occur at the final larval stage (Hamel et al. 1999), it is possible that the third individual metamorphosed in an area where the number of infected sea cucumbers was already very high and there were few or no 'uncolonised' hosts available.

The respiratory tree of *H. scabra* individuals hosting *H. semperi* showed signs of atrophy and thickening of its general structure, similar to what was seen with *H. scabra* infested by *H. halingi* in Solomon Islands (Hamel et al. 1999). When compared with other individuals of *H. scabra* collected during the same period, in which normally developed gonads were found (n = 4 individuals), the sea cucumbers infected by pea crabs always possessed small degenerated gonads or no gonads at all, suggesting that the association is a parasitic one. This, to our knowledge, represents the first documentation of a major detrimental effect associated with the presence of a pea crab in a sea cucumber host. Because pea crabs are commonly found deep inside sea cucumbers, and thus are difficult to detect and monitor, our understanding of their behaviour and social interactions remains fragmentary. The present observations are significant as the pea crabs can affect how well and how fast cultured sea cucumbers grow, and whether they can be used as broodstock, especially if the degree of parasitism is high.

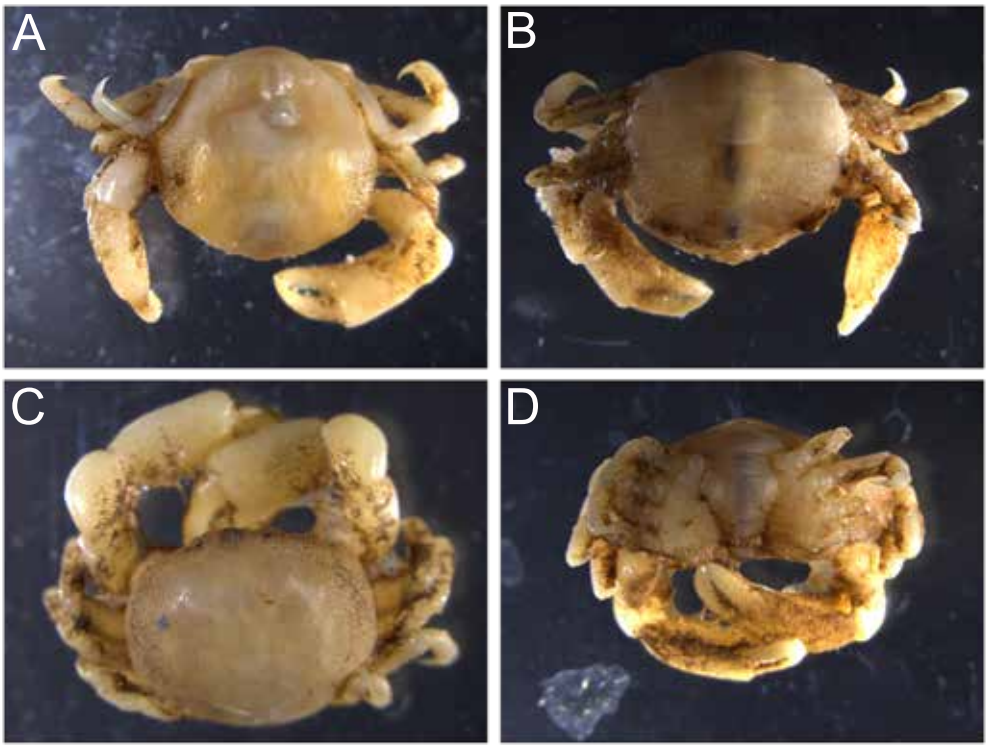

Figure 1. *Holotheres semperi*. (A) Dorsal view and (B) ventral view of female (~980 μm carapace width). (C) Dorsal view and (D) ventral view of male (~750 μm carapace width).

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