Space partitioning by symbiotic shrimp species cohabitating in the mushroom coral *Heliofungia actiniformis* at Semporna, eastern Sabah

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Fig. 1 A coral of *Heliofungia actiniformis* at Bumbun I., eastern Sabah, hosting shrimps: **a** *Ancylomenes venustus*, **b** *Thor amboinensis* and **c** *Cuapetes tenuipes*. Scale bars: 1 cm

Many pontonine shrimps are known as symbionts of anthozoans, such as scleractinian corals and sea anemones (Fransen 1989). So far, six shrimp species have been recorded from the solitary, free-living mushroom coral *Heliofungia actiniformis* (Quoy and Gaimard 1833), a coral resembling a sea anemone with long tentacles (De Grave 1998).

During the Semporna Marine Ecological Expedition (SMEE2010), eastern Sabah (Malaysia), six shrimp species were observed in association with *H. actiniformis*, including five Pontoninae: *Ancylomenes sarasvati* (Okuno, 2002), *A. venustus* (Bruce, 1990), *Cuapetes kororensis* (Bruce, 1969), *C. tenuipes* (Borradaile, 1898), *Hamopontonia corallicola* (Bruce, 1970), and the hippolytid *Thor amboinensis* (De Man, 1888). This is a first host record for *A. sarasvati*. *Periclimenes watamuae* (Bruce, 1976), recorded by De Grave (1998), was not found in the present survey.

One coral was inhabited by *A. sarasvati* individuals on and between its tentacles and a pair of *C. kororensis* deep in between the tentacles. Another coral was occupied by three shrimp species, i.e., individuals of *A. venustus* on and between the tentacles (Fig. 1a), several *T. amboinensis* roaming on an adjacent piece of rock, the sandy substrate, and the polyp (Fig. 1b), and a *C. tenuipes* underneath the coral (Fig. 1c). Another *H. actiniformis* host was observed with a *C. tenuipes* in between the tentacles and one more host with a *C. tenuipes* underneath a small rock in close proximity.

This is the first record of three shrimp species in simultaneous symbiosis with a single mushroom coral host. In previous studies, individuals of just two species were found on a single individual of *H. actiniformis* (De Grave 1998). Large sea anemones have also been reported with three symbiotic shrimp species, including *T. amboinensis* (Guo et al. 1996). By occupying different parts of the host or by showing dissimilar behaviour (hiding or moving), multiple shrimp species can co-occur on the same host coral, especially if it offers sufficient hiding places.

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Reef sites

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