Phuket mar. biol. Cent. Res. Bull. **82:** 1-8 (2025)

NEW RECORD OF *Hemiaegina minuta* MAYER, 1890 (AMPHIPODA, SENTICAUDATA, CAPRELLIDAE) FROM SULTAN ISKANDAR MARINE PARK, MALAYSIA

Jacqueline Lim Hui-Chern[1] and Azman Abdul Rahim[2]*

[1]Dwi Emas International School, 40000 Shah Alam, Selangor, Malaysia
[2]Department of Earth Sciences and Environment,
Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia
*Corresponding author: *abarahim@ukm.edu.my*

ABSTRACT: The Sultan Iskandar Marine Park (SIMP) in Malaysia is home to a diverse range of marine species, yet many remain underexplored. A new locality in the waters of Peninsular Malaysia is reported for one species of caprellid amphipod from the genus *Hemiaegina.* The present study provides a detailed description of *Hemiaegina minuta* Mayer, 1890 (Amphipoda, Senticaudata, Caprellidae) based on newly collected specimens from Pulau Besar, Sultan Iskandar Marine Park, Malaysia. The specimens of *H. minuta* examined in this study exhibited several distinctive characteristics, namely: 1) the outline of its pereonites which appeared hexagonal in shape when viewed dorsally; 2) body smooth dorsally and ventrally with a pair of projections/spines between gnathopod 2; 3) peduncular article 3 of antenna 1 very short; 4) gnathopod 1 with a round or blunt proximal projection covered in setules; 5) gnathopod 2 with elongated basis, large propodus with a small proximal tooth/grasping spine with unique U-shaped notch; 6) palm of pereopod 7 with proximal knobs, each provided with a spine followed by a short row of serriform teeth; and 7) abdomen with a pair of biarticulate appendages. The biogeography and habitat preference of *H. minuta* are also discussed. This record increases the number of caprellid amphipods from the Malaysian coast to 15 species. This new record emphasizes the importance of continued biodiversity assessments in the region, providing essential data for marine conservation efforts.

Key words: Amphipoda, Caprellidae, Malaysia, new record, *Hemiaegina minuta* Mayer, 1890

INTRODUCTION

Since 2010, numerous new species have been discovered in the Sultan Iskandar Marine Park (SIMP) as a result of ongoing faunal surveys conducted in shallow coral reef habitats (Lim *et al.* 2010; Azman and Melvin 2011; Lim *et al.* 2012; Chew *et al.* 2014; Chew et al. 2016; Lim *et al.* 2019; and Feirulsha and Rahim 2020). This continuous effort is part of the project entitled 'The marine biodiversity of Sultan Iskandar Marine Park', which aims to provide a comprehensive inventory and assessment of the marine biodiversity in the region.

The genus *Hemiaegina* has been recorded in a range of tropical and temperate marine habitats across the Indo-Pacific and North Atlantic regions. Currently the genus *Hemiaegina* is monotypic (*H. minuta* Mayer 1890) recorded from the South-western coast of Xiamen (off Amoy). Although, *H. costai* Quitete, 1972 (from the coast of Brazil) and *H. quadripunctata* Sundara Raj, 1927 (from Gulf of Manaar) were originally described as new spe cies, both were later placed as junior synonyms of *H. minuta* (Serejo 1997). Nevertheless, *H. minuta* has been documented from at least 20 different localities (McCain and Steinberg 1970; Quitete 1972; Guerra-García 2003a; Guerra-García 2003b; Diaz *et al.* 2005; Krapp-Schickel and Guerra-García 2005; Shin *et al.* 2021). The present study focuses on the discovery of the caprellid species *H. minuta* Mayer 1890, with the objective of providing new records found in SIMP waters and detailed taxonomic descriptions of both male and female specimens.

This paper increases the number of caprellid species from Malaysian waters (Lim *et al.* 2012; Lim *et al.* 2019; Azman *et al.* 2022) from 14 to 15. The generic diagnosis for the genus *Hemiaegina* is revised here based on descriptions of the present study and improvements derived from Mayer (1890), Sundara Raj (1927), McCain (1968), Arimoto (1976), Takeuchi (1993) and Serejo (1997).

MATERIAL AND METHODS

The materials described herein were obtained from a single locality, Pulau Besar, SIMP (Fig. 1). The specimens were collected at various depths around the shallow reef through SCUBA diving. The epifaunal organisms were transferred to a tray containing formalin for washing. Caprellids were hand-picked from the formalin-washed samples for identification and preserved in 4% formalin in seawater. Dissected mouthparts and appendages were stored on temporary slides mounted on glycerol. The familial classification of this study follows that of Takeuchi (1993). All materials are deposited at the Universiti Kebangsaan Malaysia Muzium Zoologi (UKMMZ), Malaysia.

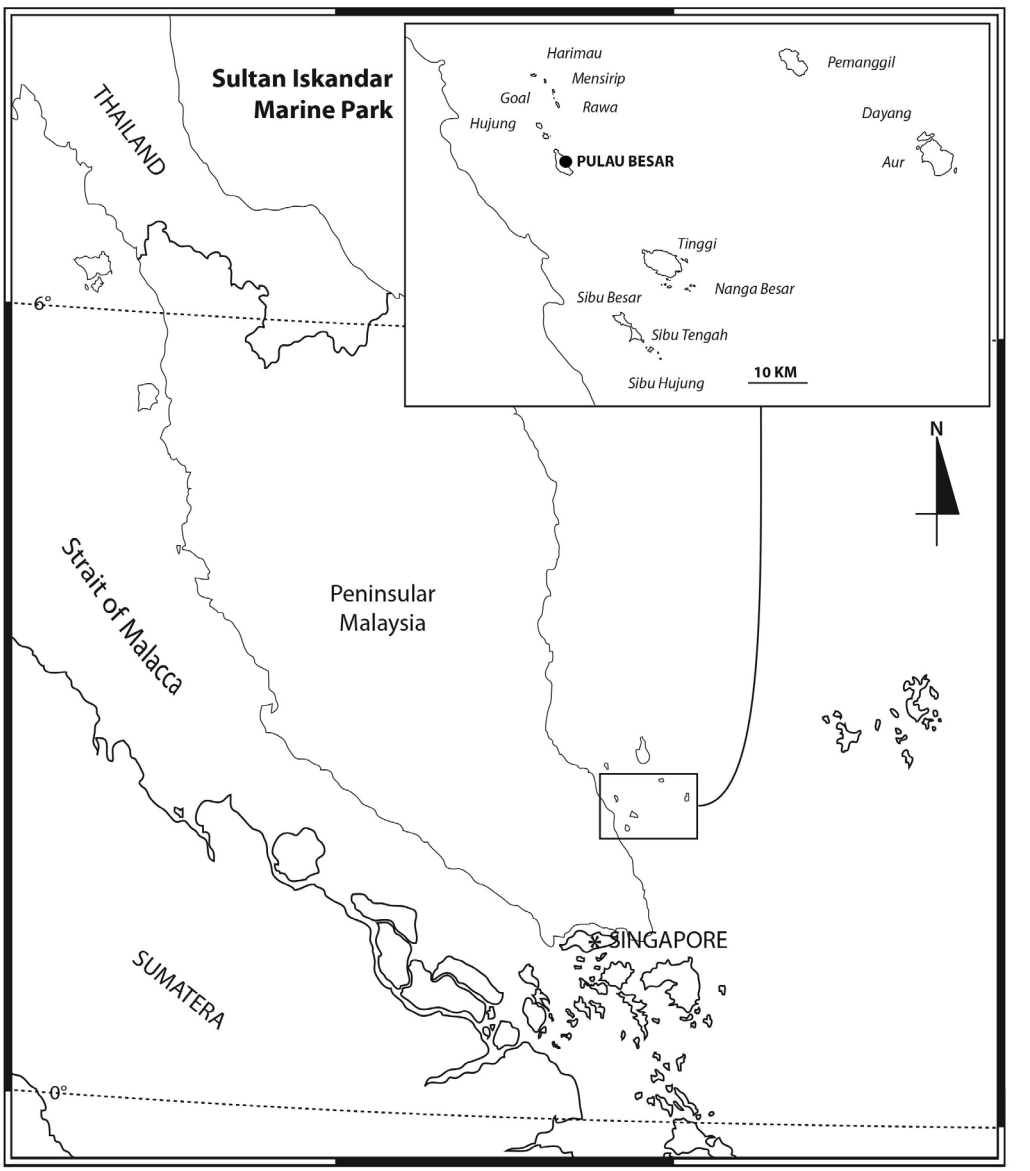

Figure 1. Pulau Besar of Sultan Iskandar Marine Park (SIMP), Malaysia.

SYSTEMATICS

Order Amphipoda Latreille, 1816
Suborder Corophiidea Leach, 1814
Family Caprellidae Leach, 1814

Diagnosis. Head and pereonite 1 completely fused. Antenna 1 well developed; flagellum with more than 2 articles. Antenna 2 well developed, swimming setae absent, flagellum with 2 articles. Mandible without palp, molar present. Maxilliped well developed; inner plate (basal endite) smaller than outer plate (ischial endite); outer plate (ischial endite) well developed; palp article 3 without distal projection; palp article 4 well developed. Pereonite 4 clavate appendage absent. Pereonites 6 and 7 not fused (separated). Gills present on pereonites 3 and 4. Pereopods 3 and 4 vestigial, with 1 article. Pereopods 5 - 7 well developed, with 6 articles; propodus well developed. Abdomen with a pair of biarticulate appendages.

Type species. *Hemiaegina minuta* Mayer, 1890

Remarks. This genus is monotypic and was originally described by Mayer in 1890 based on *Hemiaegina minuta* Mayer, 1890 that was first reported off Amoy, China (Mayer, 1890). Subsequently, Sundara Raj (1927) reported the discovery of *H. quadripunctata* Sundara attached to vegetation on the piers of Pamban Bridge (collected during low tide) off Krusadai Island located in the Gulf of Mannar, India while Quitete (1972) described *H. costai* from the coasts of Brazil. However, recent taxonomic studies have proposed that these two species of *Hemiaegina* are junior synonyms of *Hemiaegina minuta* Mayer, 1890 (see McCain and Steinberg 1970, Arimoto 1976, Takeuchi 1993, and Serejo 1997).

Hemiaegina minuta Mayer, 1890
(Fig. 2)

Hemiaegina minuta Mayer, 1890: 40, pl.1: figs. 25–27, pl. 3: figs. 32–35, pl. 5: figs. 52–53,pl. 6: figs. 13, 33–34, pl. 7: fig. 4; McCain 1968: 61 – 64, figs. 29–30; Utinomi 1969: 297 – 299, fig. 2; Arimoto 1970: 15; McCain and Steinberg 1970: 51; Gosner 1971: 508-510; Laubitz 1972: 59–60, fig. 15; Griffiths 1973: 303; Griffiths 1974: 332; Griffiths 1975: 175; Arimoto 1976: 58–60, 62, figs. 26–28; Arimoto and Kikuchi 1977: 95–96, fig. 41; Gable and Lazo-Wasem 1987: 637; Müller 1990: 836; Aoki and Asakura 1995: 192; Takeuchi 1995: 196–197, fig. 21; Serejo 1997: 630–632, fig. 1; Ortiz *et al.* 2002: fig. 32; Guerra-García 2003b:105–106, fig. 10; Guerra-García 2003c: 6–7, fig. 3; Guerra-García 2004: 39–40, fig. 32; Foster *et al*. 2004: 163,165, fig. 3; Díaz *et al*. 2005: 5,6,18, fig.9; Krapp-Schickel and Guerra-García 2005: 50,51, fig. 3; Shin et al. 2021: 249–254, figs. 1–3. *Hemiaegina quadripunctata* Sundara Raj, 1927: 126–127, pl. 18. *Hemiaegina* costai Quitete, 1972: 165–168, pls. 1–2.

Material examined. Male, 3.92 mm, UKMMZ-1457, coral reef, Teluk Rapang, Pulau Besar, SIMP, Johor, 02°26.994'N, 103°59.210'E, SCUBA diving, 23 March 2010, 10.05 am, depth 11.0 m, coll. Azman, B.A.R., Gan, S.Y., Khoo, M.L., Lim, J.H.C., and Shamsul, B.

Other material examined. 1 female, UKMMZ-1458 (Fig. 1-2); 13 males, 3 females, UKMMZ-1459; 13 males, 3 females, UKMMZ-1460; 13 males, 2 females, UKMMZ-1461; same station data.

Description. Male. Body length, 3.92 mm. UKMMZ-1457. Body dorsally smooth.

Head, 0.2 mm, and pereonite 1, 0.49 mm; head and pereonite 1 fused, suture absent; eye distinctive. Pereonite 2, 0.68 mm, longest, mid-ventrally with one small projection between gnathopods 2. Pereonite 3, 0.63 mm. Pereonite 4, 0.54 mm. Pereonite 5, subequal with pereonite 4, 0.53 mm. Pereonite 6, 0.59. Pereonite 7, 0.26 mm.

Antenna 1, 0.63 x body length; peduncular article 2 longest, 2.72 x article 1; article 3, 0.17 x article 2; flagellum with 10 articles, proximal article composed of 3/2 articles.

Antenna 2, 0.44 x the length of antenna 1, 0.28 x body length; peduncular article 2, 1.3 x article 1, article 3, 2.75 x article 2, article 4 longest, 1.12 x article 3, with several long setae near margin; flagellum with 2 articles; proximal article 1.92 x distal article.

Mouthparts are typical of *H. minuta*. (see McCain 1968; Zeina and Abou Zaid 2013)

Pereon. Gnathopod 1 basis longest, subequal with merus and carpus combined; merus posterodistal corner pronounced, with 1 long and several shorter setae; carpus subequal in length with merus, expanded

distally; propodus 0.85 x basis, longer than wide (2.17 x width) with 2 rows of submarginal setae, palm begins 1/5 along posterior margin, proximal projection round and blunt, provided with 1 seta medially and very fine submarginal setules, palm with several long and short setae; dactylus slightly curved distally.

Gnathopod 2 begins 1/2 along anterior margin of pereonite 2; basis 1.56 x the length of pereonite 2, scarcely setose, 4.57 x the length of gnathopod 1 basis, 2.1 x longer than ischium, merus and carpus combined; merus subovate, scarcely setose; carpus subtriangular; propodus subovate, length 2.25 x width, longer than basis (1.1 x basis), palm proximal projection with one stout tooth (grasping spine), mid-palmar projection acute with several setae followed by a U-shaped liked excavation/ notch and a well-developed distal shelf provided with 2 projections, distal shelf with several marginal setae; dactylus falcate, with several fine setae on inner margin. Gill 3 length 3.56 x width, 0.9 x pereonite 3, elongated and oval.

Pereopod 3 minute, 0.12 x gill 3 length, 0.11 x the length of pereonite 3, 1-articulate with 2 distal setae. Gill 4 length 3.65 x width, 1.09 x longer than gill 3, longer than pereonite 4 (1.14 x longer), elongated and oval. Pereopod 4 minute, subequal in length with pereopod 3, 0.11 x gill 4, 0.13 x the length of pereonite 4, 1-articulate with 2 distal setae. Pereopods 5-7 well developed. Pereopod 5 basis longest; ischium, merus and carpus scarcely setose; propodus subequal with merus, proximal projection with a pair of grasping spines, palm with several robust and slender setae; dactylus falcate. Pereopod 6 similar with pereopod 5, basis subequal in length with pereonite 6; carpus with one small distal projection, propodus subequal with merus, proximal projection with a pair of grasping spines; dactylus falcate, inner margin smooth with several fine setae. Pereopod 7 more robust than pereopods 5 and 6, basis longest, 2.27 x pereonite 7; merus scarcely setose; carpus 0.71 x merus, subcylindrical, with one distal projection; propodus subequal with merus, palm with 6 proximal knobs, each provided with a spine, mid-palmar margin with a short row of closely placed serriformed teeth, distally with several setae; dactylus falcate, inner margin with a short row of serrations after the mid-section, corresponding to the row of serriformed teeth on palm.

Penis situated medially.

Abdomen with a pair of biarticulate appendages, dorsal lobe bilobed with a pair of plumose setae.

Female. Body length, 3.41 mm. UKMMZ-1458. Body dorsally smooth. Head length 0.2 mm and pereonite 1, 0.43 mm; head and pereonite 1 fused, suture absent; eye distinctive. Pereonite 2 longest, 0.63 mm. Pereonite 3 and 4 segmentation unclear, 0.9 mm. Pereonite 5, 0.47 mm. Pereonite 6, 0.52 mm. Pereonite 7, 0.27 mm. Antenna 1, 0.64 x body length; peduncular article 2 longest, 2.4 x article 1; article 3 short, 0.17x article 2; flagellum length 1.58 x peduncle, with 11 articles, proximal article composed of 2 articles. Antenna 2, 0.41 x antenna 1; peduncular article 1 and 2 subequal; article 3, 2.78 x article 2, scarcely setose; article 4, 1.24 x article 3 with several long and short setae; flagellum length 0.21 x peduncle, with 2 articles; proximal article 2.1 x distal article.

Pereon. Gnathopod 1 basis longest, slightly longer than ischium, merus and carpus combined (0.92 x shorter); merus posterodistal corner pronounced provided with 1 long and 3 short setae; carpus subequal in length with merus, slightly expanded distally; propodus 0.82 x basis, longer than wide (2 x width) with 2 rows of submarginal setae, palm begins 1/4 along posterior margin, proximal projection round and blunt, provided with 1 seta and very fine submarginal setules, palm with several long and short setae; dactylus slightly curved distally. Gnathopod 2 begins 1/2 along anterior margin of pereonite 2; basis 1.43 x the length of pereonite 2, longer than ischium, merus and carpus combined (1.91 x longer); merus subovate, scarcely setose; carpus subtriangular; propodus subovate, length 2.43 x width, subequal in length with basis, palm proximal projection small, provided with 1 stout tooth (grasping spine), mid-palmar projection acute with 1 distal seta followed by V-shaped sinus and a large triangular projection provided with 1 seta, distal end of palm with several setae; dactylus falcate, fitting on palm. Gill 3 length 0.54 x pereonites 3 and 4 combined, oval, length 4.45 x width. Pereopod 3 minute, 0.12 x gill 3 length, 0.07 x the length of pereonites 3 and 4 combined, 1-articulate with 2 distal setae. Oostegite 3 length 1.21 x width, setose along entire margin. Gill 4 length 0.60 x the length of pereonites 3 and 4 combined, oval, length 5.4 x width, 1.1 x longer than gill 3. Pereopod 4 minute, subequal in length with pereopod 3, 0.11 x gill 4, 1-articulate with 2 setae. Oostegite 4 length 1.11 x width, scarcely setose. Pereopods 5-7 well

developed, becoming more robust progressively. Pereopod 5 basis longest, 1.04 x pereonite 5; merus and carpus scarcely setose; propodus with a pair of proximal grasping spines; dactylus falcate. Pereopod 6 basis longest, subequal in length with pereonite 6; merus expanded distally; carpus with 1 small distal projection; propodus subequal in length with merus, proximal projection with a pair of grasping spines; dactylus falcate. Pereopod 7 basis longest, 1.78 x pereonite 7; carpus with 1 distal projection; propodus slightly shorter than basis, palm with 6 proximal knobs, each provided with a spine, followed by a short row of closely placed serriform teeth on mid-palmar margin, distally with several setae; dactylus falcate, inner margin with a short row of serrations after the mid-section, corresponding to the row of serriform teeth on palm.

Abdomen with a pair of biarticulate appendages.

Remarks. Specimens of *H. minuta* examined in this study exhibit very distinctive characteristics. The outline of the pereonites appears hexagonal in shape when viewed dorsally. The body is smooth dorsally but ventrally features one pair of projections/ spines between the gnathopods 2; peduncular article 3 of antenna 1 very short; gnathopod 1 with a round or blunt proximal projection covered in setules; gnathopod 2 with an elongated basis, large propodus with a small proximal tooth/grasping spine and very unique U-shaped notch followed by a well-developed distal shelf; gills oblong-shaped; palms of pereopods 5 and 6 have a normal structure; palm of pereopod 7 with proximal knobs, each provided with a spine followed by a short row of serriform teeth and inner margin of dactylus with a short row of serrations; abdomen with a pair of biarticulate appendages.

Local Distribution. Pulau Nanga Besar, Pulau Besar.

General Distribution. Type locality: Off Amoy, China, 15–46 m deep (Mayer 1890; McCain 1968). Other records: off Bermuda; Virginia; Cape Hatteras, North Carolina; Elliot Key, Florida; Loggerhead Key, Tortugas; 29°44'N 88°23.5'W, Florida; Port Aransas, Texas; St. John, Virgin Islands, West coast of United States; False Bay, South Africa; Oahu, Hawaii; Bora Bora; Sunohama and Tateyama, Japan; 1°42.5'S 130°47.5'E; Fremantle, Australia; Krusadai Island, India; South Arabian coast (McCain and Steinberg 1970); Pernambuco, Alagos, Bahia and Rio de Janeiro, Brazil (Quitete 1972); Papua New Guinea (Guerra-García 2003a); Mauritius (Guerra-García 2003b); Venezuela (Diaz *et al.* 2005); Indonesia (Krapp-Schickel and Guerra-García 2005); Queensland, Australia (Guerra-García 2006), Korea (Shin *et al*. 2021)

DISCUSSION

Hemiaegina minuta Mayer, 1890 was first reported off Amoy, China (Mayer, 1890) and is currently regarded as a cosmopolitan species having been observed in both tropical and temperate marine environments across of the world's oceans (Müller 1990; McCain 1968). Müller (1990) additionally indicated that *H. minuta* preferred more exposed reef locations. This species can be found in a wide variety of habitat types such as; 1) algae (*Dictyota simplex, Sargassum* sp., *Halimeda* sp., *Gracilaria* sp., *Galaxaura* sp., *Amansia glomerata* (Agardh), *Turbinaria ornata* (Turner) J. Agardh) recorded from Colombia, Queensland, north-western Australia, Papua New Guinea, Mauritius, Indonesia and central Japan (Takeuchi and Hirano 1995; Guerra-García 2003b; 2003c; 2004; 2006; Krapp-Schickel and Guerra-García 2005; Guerra-García *et al.* 2006), 2) seagrass (*Thalassia testudinium, Posidonia* sp., *Halophila* sp.) recorded from Queensland, north-western Australia, and India (Stoner and Lewis 1985; Guerra-García 2004; Guerra-García et al. 2009), 3) bivalves such as the turkey wing ark clam (*Arca zebra*) in Venezuela (Díaz *et al*. 2005), 4) tunicates, 5) sponges, 6) coral rubble encrusted with algal turf, and 7) under small boulders (Guerra-García 2004; 2006). They have also been collected in plankton tows (McCain 1968). A recent study by Guerra-García and Tierno de Figueroa (2009) on the dietary habits of caprellids indicated that *H. minuta* are detritivores with 86 % of their digestive contents represented by detritus.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the staff of the Sultan Iskandar Marine Park, and Department of Fisheries (Malaysia) for their invaluable assistance during fieldwork and travel. We would also like to express our gratitude to Ms Gan Sim Yee, Dr. Khoo Mei Ling and Mr. Shamsul Bahar for their enthusiasm

and assistance during the fieldwork. We also thank Dr.Chalermrat Sangmanee and Dr. Charatsee Aungtonya of the Phuket Marine Biological Center and three anonymous reviewers for their meticulous and constructive feedback on an earlier version of the manuscript.

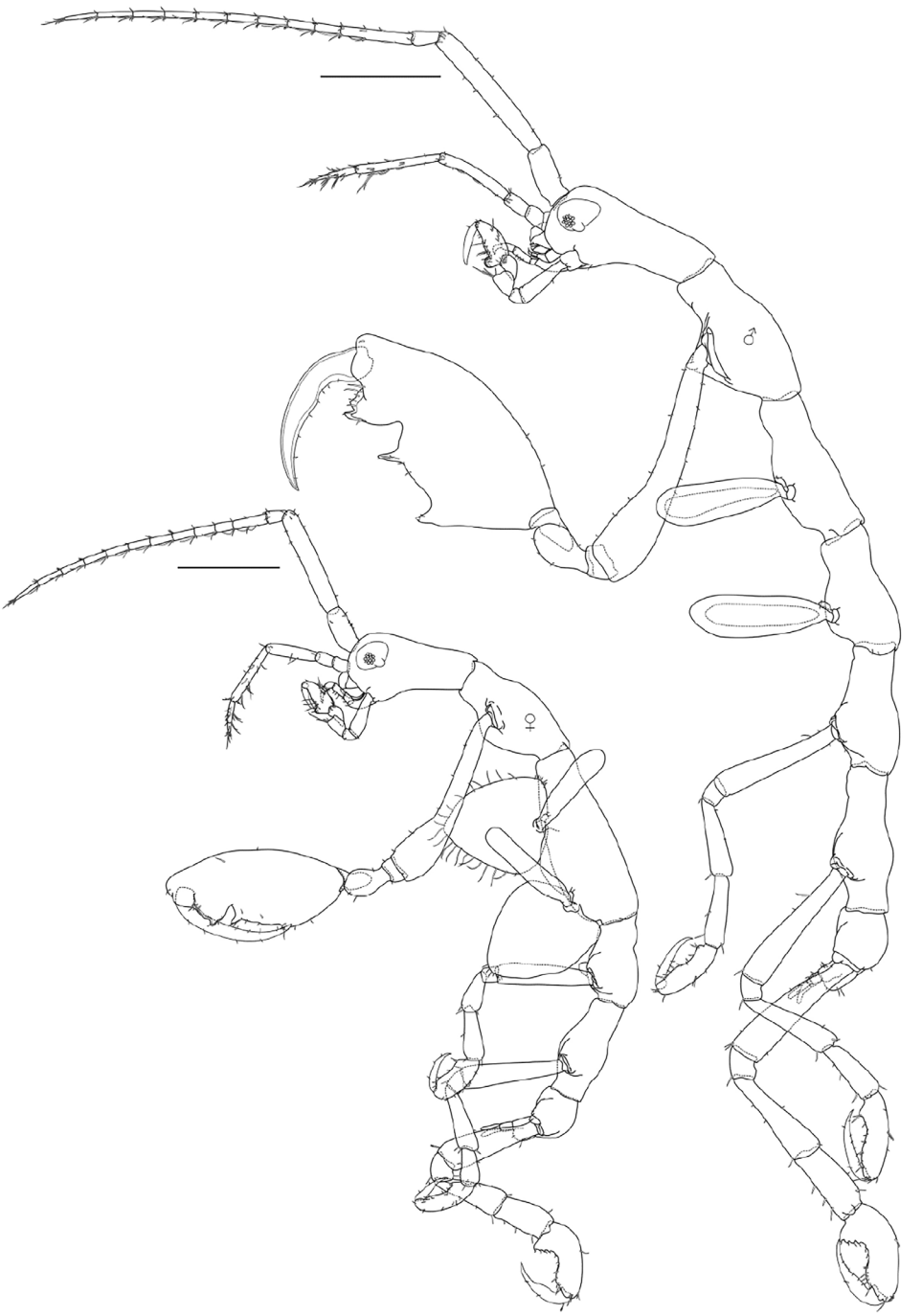

Figure 2. *Hemiaegina minuta*, male, 3.92 mm, UKMMZ-1457. Female, 3.41 mm, UKMMZ-1458, Teluk Rapang, Pulau Besar, SIMP. Scales for whole body represent 0.5 mm.

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