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A new species of the genus *Hippolyte* (Decapoda: Caridea: Hippolytidae) from Singapore

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Abstract. A new hippolytid shrimp species of the genus *Hippolyte* Leach, 1814, *H. singaporensis* n. sp., is described and illustrated based on dozens of specimens collected from sublittoral zones of Singapore. Morphologically, the new species is closely related to the Indo-Pacific species of the genus *Hippolyte*, but differs from them by the structure of the rostrum, the exopod of the third maxilliped, the dactylus of the last three pereiopods, and the position of the hepatic spine.

Key words. *Hippolyte singaporensis* n. sp., *Hippolyte*, Hippolytidae, Singapore

INTRODUCTION

The hippolytid genus *Hippolyte* Leach, 1814 at present contains 31 named species (De Grave & Fransen, 2011) and a number of unnamed species (d'Udekem d'Acoz, 1996, 2007), and is considered a taxonomically very difficult genus due to its considerable variation in morphology and imperfect literature (d'Udekem d'Acoz, 1996). The Indo-West Pacific region contains about one third of the known species in the genus *Hippolyte*. However, a couple of unnamed species in d'Udekem d'Acoz (1996) indicates the systematics of the Indo-West Pacific species of the genus *Hippolyte* is grossly imperfect. During a study on hippolytid shrimps from the collections of the National University of Singapore (NUS), dozens of *Hippolyte* specimens, collected from Singapore waters, were under question. These specimens were initially labeled as *Hippolyte ventricosa* H. Milne Edwards, 1837. However, their rostrum, carapace, mandible and dactylus of last three pereiopods are entirely different from that of *H. ventricosa*, as well as *H. australiensis* (Stimpson, 1860) (d'Udekem d'Acoz, 1999, 2001) and *Hippolyte ngi* Gan & Li, 2017 (Gan & Li, 2017). Detailed examination and comparison with known species of *Hippolyte* indicates that they belong to a new species. The species is herein described and illustrated, and its systematic position is discussed.

MATERIAL & METHODS

The specimens were collected from Singapore's waters between 1957 and 1967 by tow net, and stored in UNS. The specimens were preserved in 75% ethanol. Dissection and illustrations were made using a stereomicroscope (Nikon SMZ 1500, Japan). Length ratios were calculated according to the method proposed by d'Udekem d'Acoz (1996). The following abbreviations are used: CL = carapace length, the length from the posterior orbital margin to the posterior margin of carapace; Coll. = collector.

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TAXONOMY

Family Hippolytidae Bate, 1888

Genus *Hippolyte* Leach, 1814

Hippolyte singaporensis spec. nov.
(Figs. 1–4)

Material examined. Holotype: 1 ovigerous female, 0.9 mm CL, ZRC1979.4.28.132, Singapore, Coll. R. u. G., 28 March 1967. Paratypes: 2 ovigerous females, 0.8–1.0 mm CL, 2 female, 0.7–0.9 mm CL, ZRC1979.4.28.133–136, Singapore, Coll. R. u. G., 28 March 1967; 1 ovigerous female, 1.1 mm CL, ZRC1979.4.28.129, Changi, Singapore, Coll. Lim Bee Cheng, 27 March 1967; 3 ovigerous females, 0.7–0.9 mm CL, 1 female, 0.7 mm CL, 1 male, 0.6 mm CL, ZRC1979.4.28.122–126, Changi, Singapore, Coll. D. S. Johnson, 26 August 1957; 2 males, 0.6–0.7 mm CL, ZRC1979.4.28.137–138, Singapore, Coll. Lim Bee Cheng, 18 May 1967; 15 ovigerous females, 0.7–1.0 mm CL, 7 females, 0.6–0.8 mm CL, 5 males, 0.5–0.7 mm CL, ZRC1979.4.28.189–215, Tg. Teritip, Singapore, Coll. Lim Bee Cheng, 29 March 1967; 8 ovigerous females, 0.7–1.0 mm CL, 14 females, 0.6–0.9 mm CL, 4 males, 0.5–0.7 mm CL, ZRC1979.4.28.80–105, Singapore, Coll. Lim Bee Cheng, 28 April 1967.

Description. Very small-sized shrimp (0.5–1.1 mm CL in present material) with normal body form (Fig. 1A). Ratio lateral length/height of carapace 1.2–1.6. Rostrum (Figs. 1B,

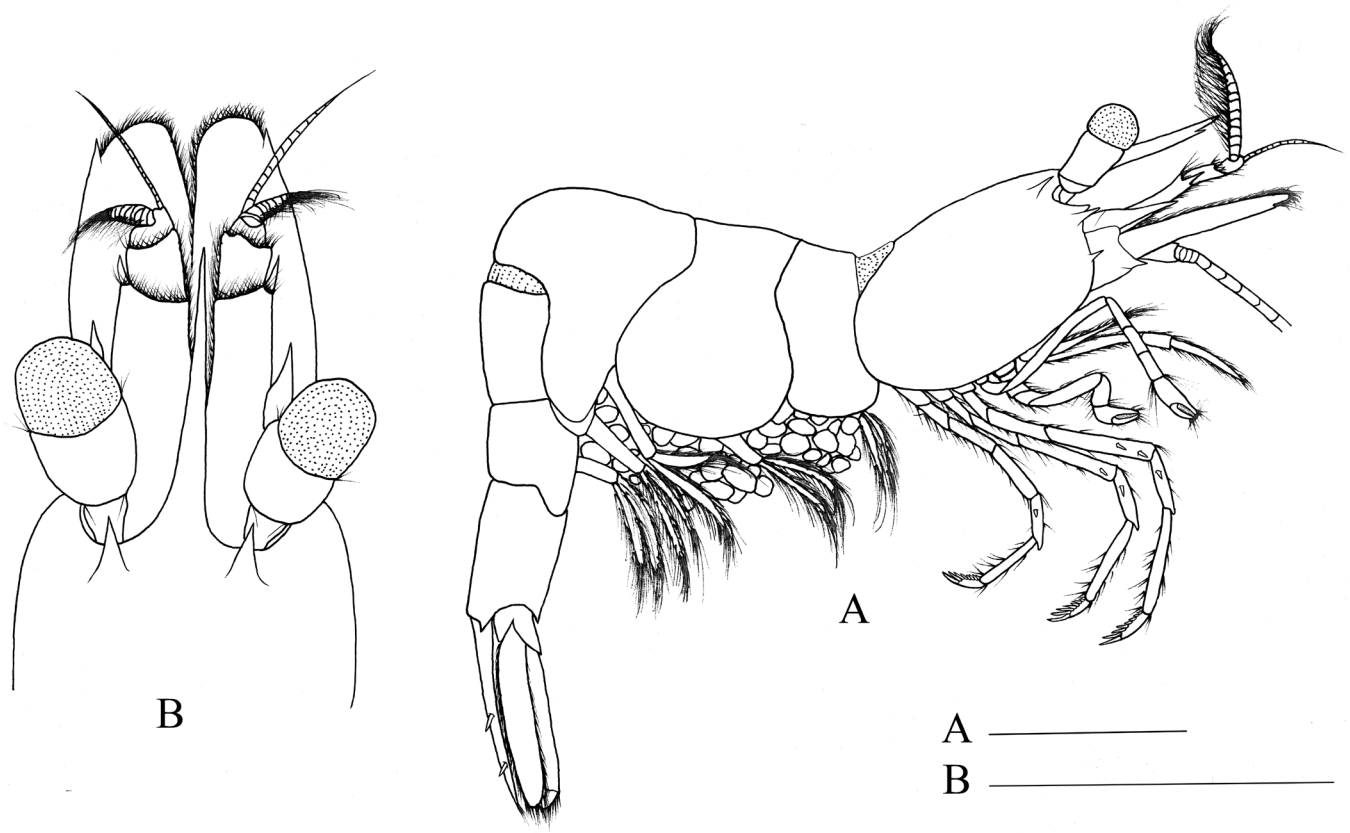

Fig. 1. *Hippolyte singaporensis* spec. nov. Ovigerous female holotype, ZRC1979.4.28.132, lateral view. Scales: 1 mm.

2A) slender, 7.3–7.6 times as long as high, straight, slightly shorter or longer than carapace length, distinctly falling short of antennular peduncle apex. Rostrum without lateral carina, without dorsal tooth, with only one ventral tooth in distal position. Carapace smooth and glabrous, with robust supraorbital spine, antennal spine and hepatic spine (Figs. 1A, 2A). Base of supraorbital spine posterior to posterior orbital margin. Tip of antennal spine slightly overreaching inferior orbital angle. Base of hepatic spine nearly situating at anterior edge of carapace. Inferior orbital angle strongly produced; pterygostomian region rounded, not produced (Figs. 1A, 2A).

Abdominal segments smooth (Fig. 1A). Third abdominal segment geniculately curved. Ratio dorsal length/height of the sixth abdominal segment 1.5–1.7. Telson (Fig. 2B) distinctly longer than sixth abdominal segment; posterior margin rounded, armed with eight strong spines, outer spines smallest, medial two longest, without intermediate spinules. Dorsal surface armed with two pairs of spines situated on distal 0.2 and 0.4 telson length.

Eye (Figs. 1A, 1B) well developed; unpigmented part of eyestalk slightly longer than broad; cornea semispherical, reaching stylocerite apex when extended forward; cornea shorter than unpigmented part of eyestalk.

Antennular peduncle (Figs. 1B, 2C) reaching proximal 0.8–0.9 length of scaphocerite. First segment of antennular peduncle with only one distolateral tooth, distinctly longer than second and third segments combined; inner ventral tooth on middle-length of first segment (excluding distolateral tooth); stylocerite reaching 0.6 (distolateral tooth included), or 0.7 (distolateral tooth excluded) of first segment. Second segment of antennular peduncle 1.5 times as long as broad in dorsal view, approximately 1.2 times as long as third segment in dorsal view. Outer antennular flagellum shorter and thicker than inner. Scaphocerite (Fig. 2D) 2.6–2.8 times as long as wide; distolateral spine of scaphocerite terminating well short of distal margin of blade; distolateral spine and blade separated by notch.

Mouthparts typical for genus. Mandible (Fig. 3A) without palp, incisor process with three acute teeth, molar process without teeth. Maxillula (Fig. 3B) with simple curved palp, upper lacinia broad, distal margin armed with 13–15 spines and two plumose setae. Maxilla (Fig. 3C) with simple palp; lateral border of scaphognathite slightly convex; inner lacinia bilobed, distal margin furnished with row of spines; proximal endite well developed, with simple setae on distal margin. Epipod of first maxilliped (Fig. 3D) with outer margin continuous; palp slender, outer margin with long simple setae; exopod with well-developed flagellum, bearing long simple setae at apex; caridean lobe feebly developed; basal endite broad, mesial margin incised, outer margin setose. Second maxilliped (Fig. 3E) with epipod deeply bilobed; exopod well-developed, with long simple apical setae; endopod normal, dactylar segment short but broad, terminal margin furnished with spinous setae; propodal segment with anteromedial margin slightly produced, outer margin bearing simple setae; carpus smaller than merus; ischium and basis fused, outer margin furnished with long plumose setae. Third

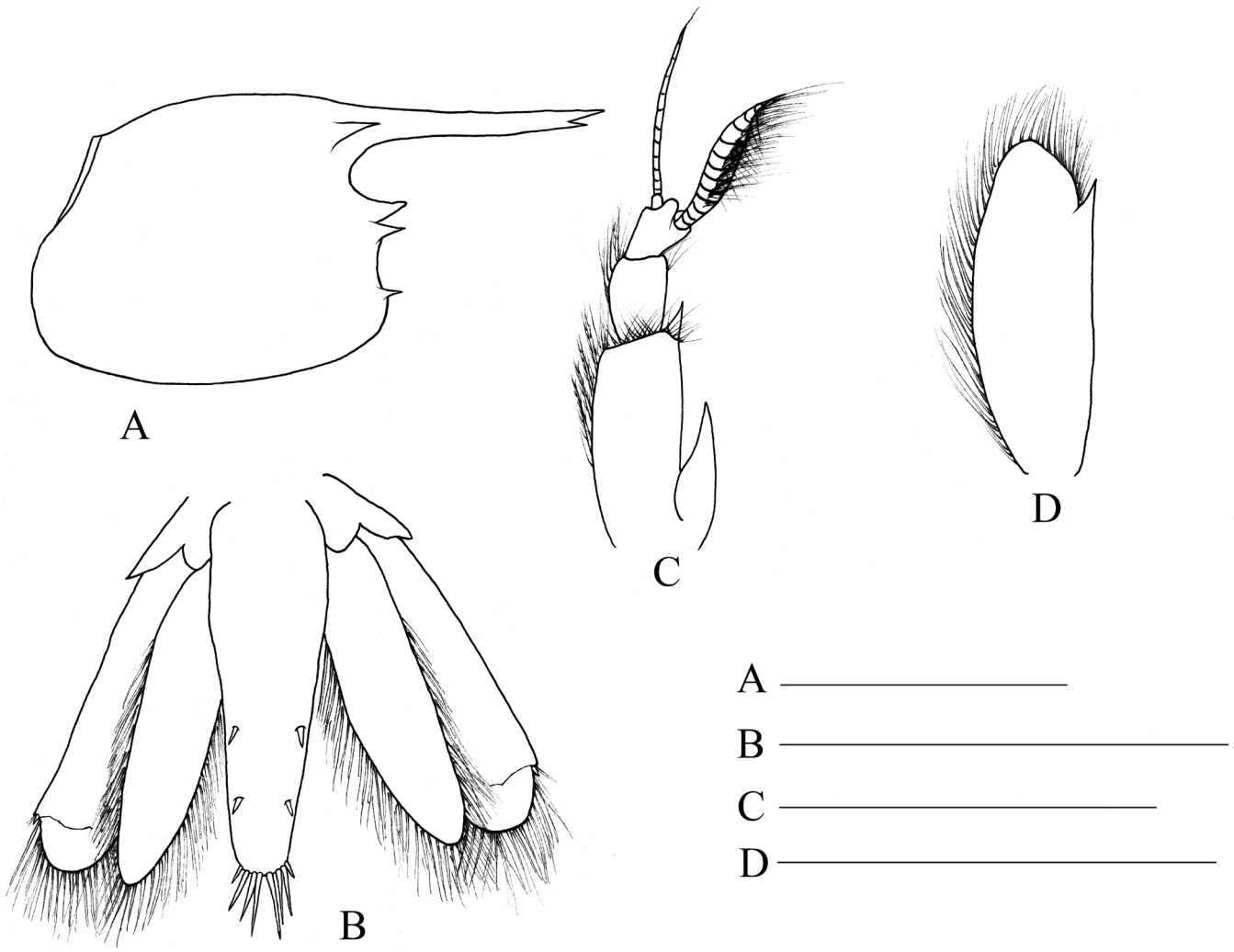

Fig. 2. *Hippolyte singaporensis* spec. nov. Ovigerous female holotype, ZRC1979.4.28.132. A, carapace and rostrum, lateral; B, telson and uropods, dorsal; C, right antennula, dorsal; D, right scaphocerite, dorsal. Scales: 1 mm.

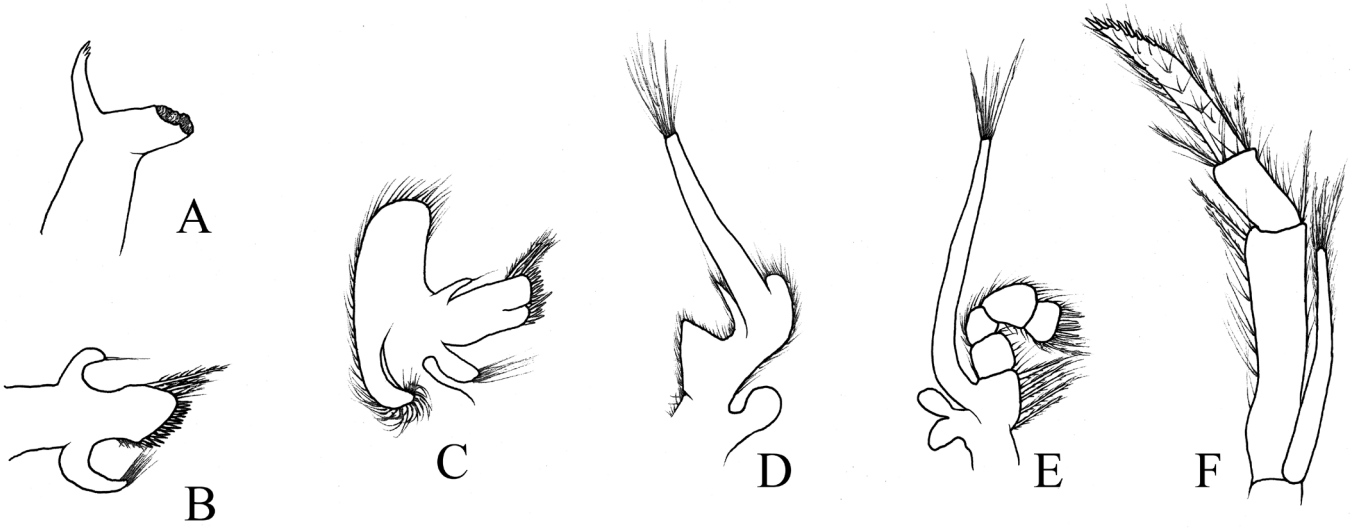

Fig. 3. *Hippolyte singaporensis* spec. nov. Ovigerous female holotype, ZRC1979.4.28.132. A, left mandible; B, left maxillula; C, left maxilla; D, right first maxilliped; E, right second maxilliped; F, left third maxilliped. Scale: 1 mm.

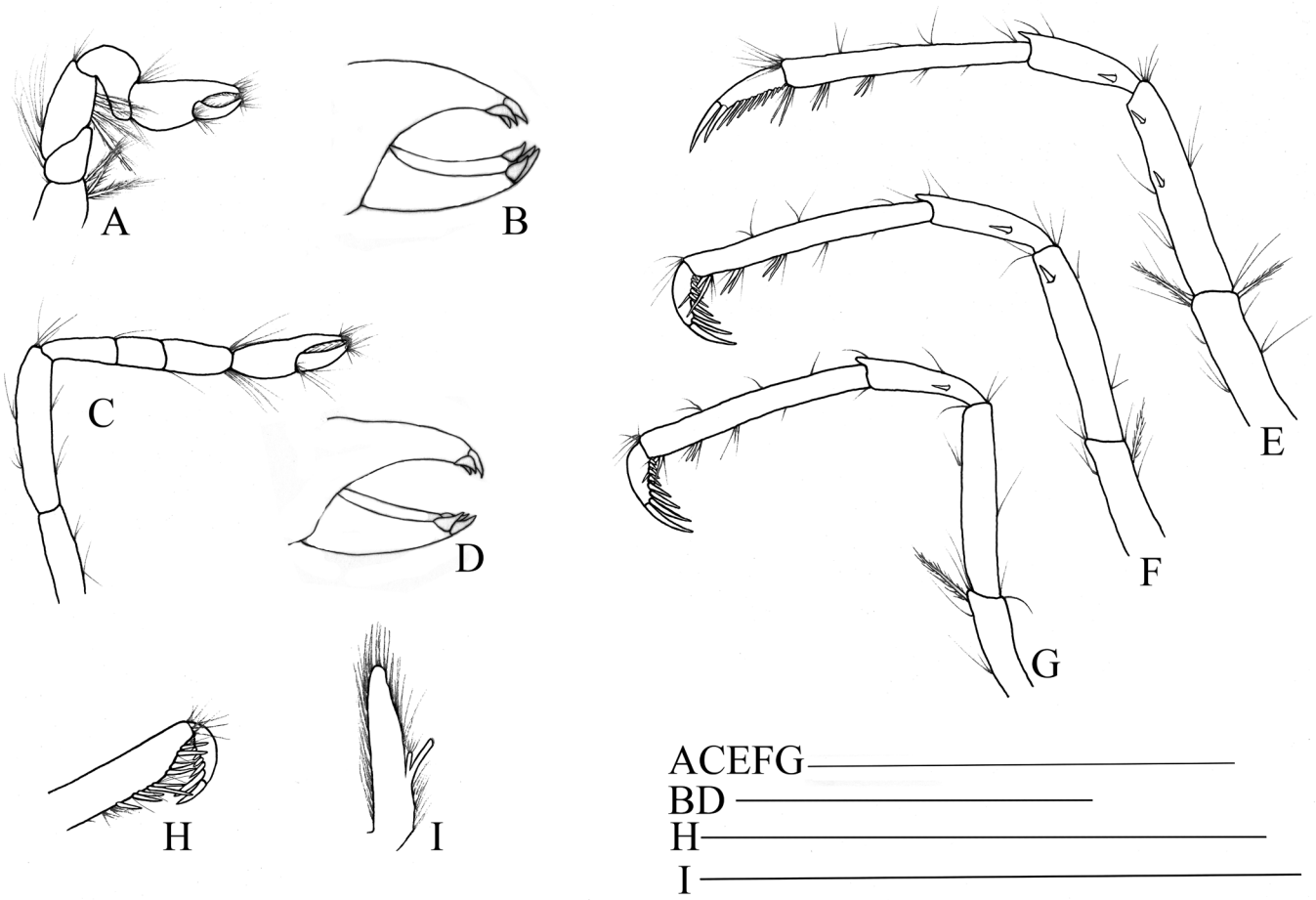

Fig. 4. *Hippolyte singaporensis* spec. nov. Ovigerous female holotype, ZRC1979.4.28.132 (AE). Male paratype, ZRC1979.4.28.133 (F, G). A, right first pereiopod, lateral; B, tip of the right first pereiopod, mesial (setae not shown); C, right second pereiopod, lateral; D, tip of the right second pereiopod, mesial (setae not shown); E, left third pereiopod, lateral; F, left fourth pereiopod, lateral; G, left fifth pereiopod, lateral; H, propodus and dactylus of left third pereiopod, lateral; I, endopod of right second pleopod, lateral. Scales: A, C, E–I, 1 mm; B, D, 5 mm.

maxilliped (Fig. 3F) reaching about 0.5–0.6 of scaphocerite when extended forward; ultimate segment (excluding apical spine) 1.9–2.0 times as long as penultimate segment, distal 0.4 of ultimate segment with eight to nine strong spines; antepenultimate segment slightly shorter than ultimate segment and penultimate segment combined; exopod long, nearly reaching distal margin of antepenultimate segment.

First pereiopod (Fig. 4A) moderately robust, slightly overreaching basicerite when extended forward. Basis and merus furnished with few long plumose setae. Cutting edges of fingers of chela not denticulate, but with tiny setula and long simple apical setae; tip of fixed finger with three tiny spines; tip of dactylus with four tiny spines (Fig. 4B).

Second pereiopod (Fig. 4C) not reaching distolateral spine of scaphocerite when extended forward. Carpus with three subsegments, first segment longest, about 1.4–1.5 times as long as second segment, third segment slightly shorter than or subequal to first segment; first segment 2.7 times as long as wide; second segment 1.6 times as long as wide; third segment 2.1 times as long as wide. Cutting edges of fingers of chela not denticulate, tip of fixed finger and dactylus armed with three tiny spines (Fig. 4D).

Third to fifth pereiopods long and robust. Third pereiopod (Fig. 4E) reaching beyond terminal blade of scaphocerite by dactylus when extended forward. Dactylus of third pereiopod with 8–11 spines; all spines in ventral or apical position (none in dorsal or subdorsal position); two large apical spines, ultimate one strongest and longest. Propodus 7.8 times as long as wide, armed with five to seven pairs of spines on ventral margin, the spines considerably increasing in size from proximal to distal pair. Carpus 3.5 times as long as wide, armed with one proximal lateral spine. Merus of third pereiopod 5.5 times as long as wide, armed with two lateral spines. Ratio length of third pereiopod dactylus with longest apical spine/length of propodus 0.5; ratio length of third pereiopod dactylus with longest apical spine/length of carpus 1.1; ratio length of dactylus without spines/breadth of dactylus without spines 3.3; ratio length of dactylus with longest spines/breadth of dactylus without spines 5.7; ratio length of longest spine of dactylus/breadth of dactylus without spines 2.7. Fourth and fifth pereiopods (Fig. 4F, G) similar in shape to third pereiopod, but slightly decreasing in size. Merus of fourth pereiopod armed with one lateral spine; merus of fifth pereiopod without lateral spine.

Sexual dimorphism. Propodus and dactylus of third pereiopod of male specimens forming a prehensile apparatus (Fig. 4H). Appendix masculina with six apical setae, about half length of appendix interna (Fig. 4I).

Colouration. Unknown.

Habitat. All specimens were collected at low tide level. The holotype was captured among seagrass bed (*Enhalus acoroides* [Linnaeus f.] Royle, 1839); paratypes ZRC1979.4.28.189–215 were captured among gulfweed (*Sargassum* sp.); paratypes ZRC1979.4.28.137–138 were captured among *Padina* sp.

Etymology. The new species is named after its type locality, Singapore.

Distribution. Currently only known from the type locality, Singapore.

DISCUSSION

The new species has the features of first article of antennular peduncle with one distolateral tooth and fifth pleonite without dorsolateral tooth; and these characteristics distinguish the new species from all of the Atlantic and Mediterranean species of genus *Hippolyte*. Meanwhile, these characteristics indicates *H. singaporensis*, new species, is closely related to the Indo-Pacific '*Hippolyte ventricosa*' species complex proposed by d'Udekem d'Acoz (1996) which includes *H. acuta* (Stimpson, 1860), *H. australiensis*, *H. ventricosa*, *Hippolyte* sp. A of Australia, *Hippolyte* sp. B of Hawaii, *Hippolyte* sp. C of the Malay Archipelago, and *Hippolyte* sp. D of Madagascar (d'Udekem d'Acoz, 1996). Recently, Gan & Li (2017) described a new *Hippolyte* species from South China Sea and Singapore, i.e. *H. ngi*, which belongs to '*Hippolyte ventricosa*' species complex as well.

Within this species complex, *H. singaporensis*, new species, appears to be morphologically closest to *H. australiensis*. They both have an unarmed dorsal margin of the rostrum and the mandibular incisor process with only three teeth. However, the present new species is obviously different from *H. australiensis* by the following aspects: Firstly, in *H. australiensis*, the rostrum overreaches the antennular peduncle nearly by distal half-length and has a sharp longitudinal dorsolateral carinae, while the rostrum of *H. singaporensis*, new species, does not reach the end of antennular peduncle and has no longitudinal dorsolateral carina. Secondly, the dactylus of the last three pereiopods of *H. australiensis* have four terminal teeth, those of *H. singaporensis*, new species, have only two terminal teeth. Thirdly, in *H. australiensis*, the exopod of the third maxilliped only reaches half of antepenultimate segment, while that of *H. singaporensis*, new species, nearly reaches the terminal end of antepenultimate segment. Finally, the third pereiopod of *H. australiensis* does not reach the scaphocerite apex, but, it overreaches the terminal blade of the scaphocerite by dactylus.

Hippolyte sp. A of Australia (d'Udekem d'Acoz, 1996), initially recorded as *H. australiensis* (Hale, 1927, 1928), is poorly known. It is speculated that the differences between *Hippolyte* sp. A and *H. singaporensis*, new species, are also in rostrum, dactylus of the last three pereiopods, and the exopod of third maxilliped.

H. singaporensis, new species, differs from *H. acuta*, *H. ngi*, and *H. ventricosa* by the short and unarmed dorsal margin of rostrum, mandibular incisor process with three teeth, the position of the hepatic spine, as well as the long exopod of the third maxilliped.

H. singaporensis, new species, differs from *Hippolyte* sp. B of Hawaii (d'Udekem d'Acoz, 1996; Hayashi, 1981), *Hippolyte* sp. C of Malay Archipelago (d'Udekem d'Acoz, 1996; Holthuis, 1947), and *Hippolyte* sp. D of Madagascar (d'Udekem d'Acoz, 1996; Ledoyer, 1970) by the dactylus of the last three pereiopods without subdorsal spine, by its short and unarmed dorsal margin of the rostrum, mandibular incisor process with only three teeth, and the position of the hepatic spine.

In the Indo-Pacific region, *H. bifidirostris* (Miers, 1876), *H. caradina* Holthuis, 1947, *H. edmondsoni* Hayashi, 1981, *H. jarvinensis* Hayashi, 1981, and *H. multicolorata* Yaldwyn, 1971 also have the feature of first article of the antennular peduncle with one distolateral tooth, similar to *H. singaporensis*, new species. However, the rostrum of *H. bifidirostris* and *H. multicolorata* is very long and strongly dentate with a bifid or trifid rostral apex (Richardson & Yaldwyn, 1958), entirely different from that of *H. singaporensis*, new species. *H. caradina* has the rostrum not exceeding the distal margin of the antennular peduncle (Ledoyer, 1984), as well as *H. edmondsoni* and *H. jarvinensis* (Hayashi, 1981), but they all have the rostrum armed or unarmed both in dorsal and ventral margin. The carapace of *H. caradina* and *H. edmondsoni* has postrostral teeth, which are absent in *H. singaporensis*, new species. The exopod of the third maxilliped of *H. jarvinensis* only reaches half of the antepenultimate segment length, while it nearly reaches the distal margin in *singaporensis*, new species; the dactylus of the last three pereiopods of *H. jarvinensis* has two short terminal spines (the distal spine longer but thinner than the penultimate spine), while there are two long terminal spines in *H. singaporensis*, new species (the distal spine longer and stouter than the penultimate spine).

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