

First Record of the Sponge-Dwelling Palaemonid Shrimp, *Thaumastocaris streptopus* (Crustacea: Decapoda: Palaemonidae) from Korea

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ABSTRACT

The sponge-dwelling shrimp *Thaumastocaris streptopus* is widely distributed across tropical and subtropical waters of the Indo-West Pacific. During a 2023 faunal survey in Jeju Island, Korea, 2 pairs of *T. streptopus* were collected from the spongocoels of the tubular sponge *Callyspongia confoederata* at Munseom and Seopseom Islets, marking the first record of the species in Korean waters and extending its known range to the temperate Northwest Pacific. The Korean specimens coincide with the original description in key morphological features, such as the shape and armament of the rostrum, a single well-developed antennal tooth on the carapace, biunguiculate dactyli of the ambulatory pereiopods, as well as subsegmented merus and carpus of the first pereiopods. An illustrated description of the specimen and *in situ* photographs are provided herein to aid future recognition.

Keywords: Jeju Island, symbiotic, *Thaumastocaris*, taxonomy, Korean fauna

INTRODUCTION

The monospecific genus *Thaumastocaris* Kemp, 1922, comprises only the sponge-dwelling shrimp *Thaumastocaris streptopus* Kemp, 1922, originally described from a single male specimen collected in Noumea, New Caledonia, its type locality (Kemp, 1922). Since its original description, the species has been recorded as widely distributed from tropical to subtropical latitudes across the Indo-West Pacific (IWP) region (Fig. 1A). And *T. streptopus* is primarily known for its close association with various tubular sponges (Bruce, 1991; Limviriyaikul et al., 2020; Poupin et al., 2022).

In the Korean fauna, seven palaemonid shrimps have been recorded as sponge-dwellers: *Anchistoides compressus* Paulson, 1875; *Hamodactylus boschmai* Holthuis, 1952; *Mesopontonia verrucimanus* Bruce, 1996; *Onycocaris callyspongiae* Fujino and Miyake, 1969; *Periclimenaeus alius* Park and De Grave, 2021; *P. djiboutensis* Bruce, 1970; and *P. gorgonidarum* (Balss, 1913) (see Kim and Kim, 1985; Koo and Kim, 2003; Park et al., 2019, 2020a, 2020b, 2021; Park and De Grave, 2021). During a faunal survey around Jeju Island in 2023, four specimens of *T. streptopus* were collected by

SCUBA diving at Munseom and Seopseom Islets (Fig. 1B, C). The shrimps were found with the tubular sponge, *Callyspongia confoederata* (Ridley, 1884), inhabiting its spongocoels at Munseom Islet (Fig. 5A). This finding represents the first record of the species in the Korean fauna, expanding its known geographic range to the temperate waters of the Northwest Pacific (Fig. 1A). Additionally, the species now becomes the eighth sponge-associated palaemonid shrimp recorded from Korea.

In the present study, the Korean specimens are compared with those from Taiwan, Palau, Malaysia, and the Philippines, as well as previous records from the IWP, to highlight regional variations. An illustrated description to the sponge-associated shrimps of Korea is provided to aid future recognition. Specimens are deposited in the National Marine Biodiversity Institute of Korea (MABIK), Seocheon and the Marine Decapod Resources Depository of Korea (MDEK) at the Jeonbuk National University (JBNU), Jeonju. All specimens were measured for postorbital carapace length (pocl), defined as the distance from the postorbital margin to the posterior dorsal margin of the carapace.

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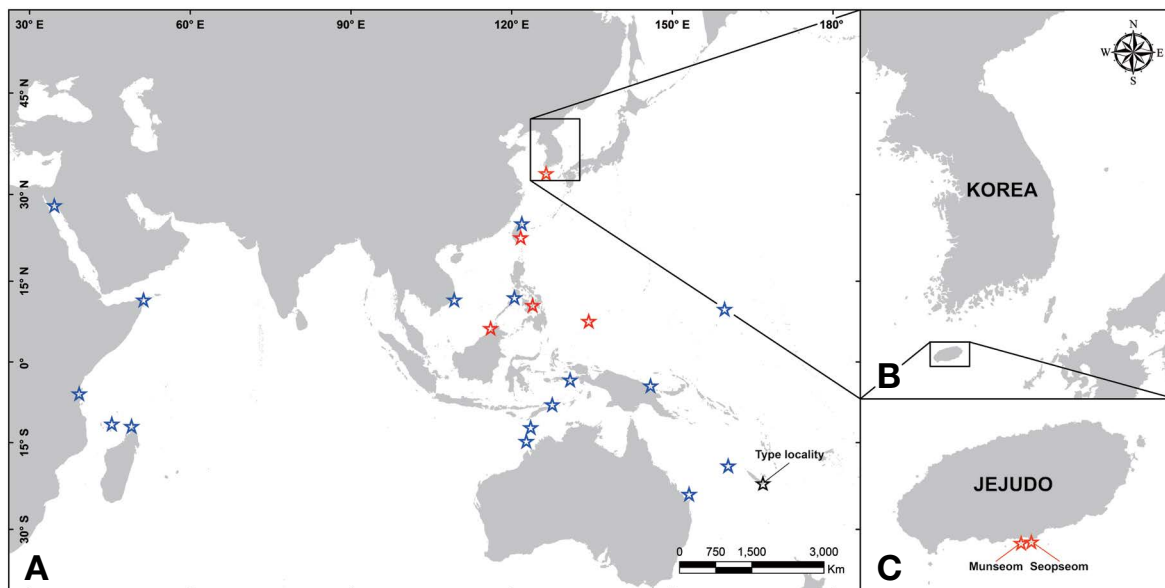


Fig. 1. Map of Indo West Pacific Ocean. A, Geographic distribution of *Thaumastocaris streptopus* Kemp, 1922; B, Map of Korea and adjacent seas; C, Collection localities of Jeju Island, Korea. Black-bordered star: type locality, Noumea, New Caledonia; Blue-bordered stars: previous records; Red-bordered stars: present records from Korea, Taiwan, the Philippines, Malaysia, and Palau.

SYSTEMATIC ACCOUNTS

Order Decapoda Latreille, 1802

Family Palaemonidae Rafinesque, 1815

¹*Genus *Thaumastocaris* Kemp, 1922

²**Thaumastocaris streptopus* Kemp, 1922 (Figs. 2–5)

Thaumastocaris streptopus Kemp, 1922: 244, figs. 78–80 (type locality: Noumea, New Caledonia); Holthuis, 1952: 111, figs. 46, 47; 1955: 59, fig. 32c; Bruce, 1974: 484; 1978a: 255; 1978b: 120; 1979: 227, fig. 3C, D; 1980: 13, fig. 5D–J; 1981: 23; 1984: 212; 1991: 258, fig. 21; 1996: 250, fig. 21; 2006: 33; 2007: 124; Bruce and Svoboda, 1983: 25, fig. 9; Müller, 1993: 137; Chace and Bruce, 1993: 131; De Grave, 2000: 143, fig. 7; Li, 2000: 286, fig. 380; Li and Bruce, 2006: 727; Marin and Savinkin, 2007: 193, fig. 92B; De Grave and Franssen, 2011: 372; Li et al., 2012: 25, fig. 16; Limviriyakul et al., 2020: 3, fig. 5r; Poupin et al., 2022: 142, fig. 6C.

Material examined. Korea: 1 ♀ (ovigerous, pochl 7.3 mm), Jeju Island, Seopseom Islet, 23 Nov 2023, leg. Park CY & Yun SY (MABIK CR00258290) (fcn JH1541); 1 ♀ (pocl 5.0 mm), same data (JBNU_JH1542) (fcn JH1542); 1 ♀ (ovigerous, pochl 8.2 mm), Jeju Island, Munseom Islet, depth 15 m, 22 Nov 2023, leg. Park CY (JBNU_JH1539) (fcn JH1539); 1 ♂ (pocl 6.0 mm), same data, leg. Park CY (JBNU_JH1540).

(fcn JH1540).

Comparative material of *Thaumastocaris streptopus*. Philippines: 1 ♀ (pocl 7.4 mm), Nogas Island (10°24'48.24"N, 121°55'27.23"E), depth 27 m, 25 Mar 2014, leg. Park JH (JBNU_PI119) (fcn PI119); 1 ♂ (pocl 6.8 mm), Bohol (10°0'10.79"N, 123°54'56.05"E), depth 24 m, 13 Feb 2019, leg. Park JH (JBNU_PB38) (fcn PB38); 1 ♂ (pocl 4.5 mm), same data (JBNU_PB39) (fcn PB39); 1 ♀ (pocl 5.2 mm), same data (JBNU_PB40) (fcn PB40); 1 ♂ (pocl 4.8 mm), same data (JBNU_PB41) (fcn PB41). Taiwan: 1 ♀ (ovigerous, pochl 5.2 mm), Green Island (22°38'36.02"N, 121°28'56.14"E), 21 May 2016, leg. Park JH (JBNU_TW62) (fcn TW62; GenBank accession No. MK602867). Malaysia: 1 ♀ (ovigerous, pochl 4.8 mm), Kota Kinabalu, Saba, Sapi Island (6°0'32.64"N, 116°0'34.07"E), depth 15 m, 2 Nov 2017, leg. Park JH (JBNU_MK1) (fcn MK1); 1 ♂ (pocl 4.3 mm), same data (JBNU_MK2) (fcn MK2); 1 ♂ (pocl 7.1 mm), same data, 3 Nov 2017, leg. Park JH (JBNU_MK33) (fcn MK33); 1 ♀ (pocl 6.0 mm), Kota Kinabalu, Saba, Gaya Island (6°1'36.16"N, 116°3'13.99"E), depth 15 m, 4 Nov 2017, leg. Park JH (JBNU_MK85) (fcn MK85). Palau: 1 ♀ (pocl 3.7 mm), SNU_ND station 1 (7°19'30.54"N, 134°26'3.64"E), depth 25 m, 20 Sep 2019, leg. Park JH (JBNU_PAL3) (fcn PAL3); 1 ♂ (pocl 5.2 mm), SNU_DD station 4 (7°16'49.77"N, 134°31'37.49"E), depth 46 m, 22 Sep 2019, leg. Park JH (JBNU_PAL62) (fcn PAL62); 1 ♂ (pocl 3.5 mm), SNU_ND station 3, same data, 23 Sep 2019, leg. Park JH (JBNU_PAL113) (fcn PAL113).

Korean name: ¹*해면살이새우속 (신칭), ²*해면살이새우 (신칭)

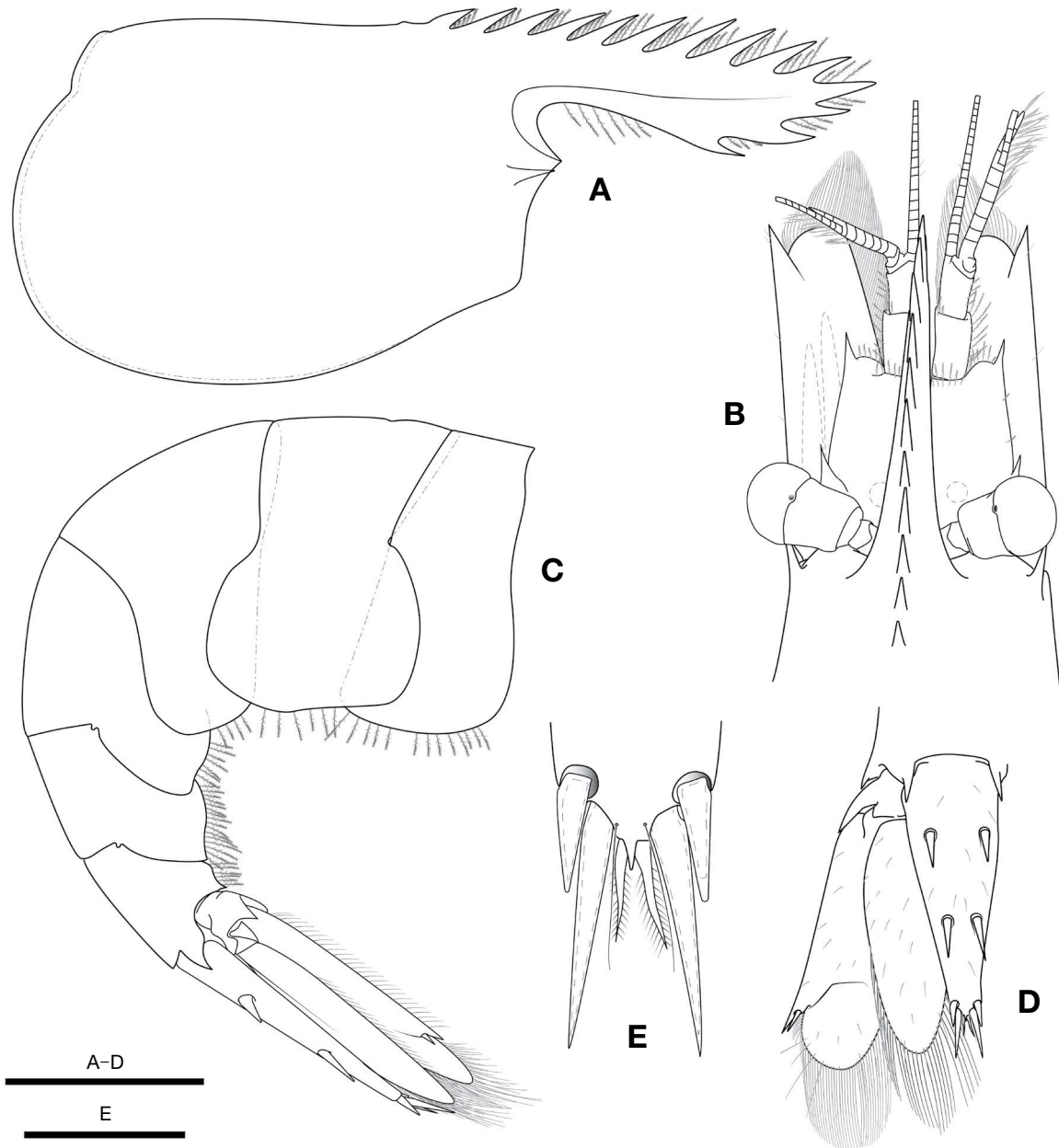


Fig. 2. *Thaumastocaris streptopus* Kemp, 1922 from Jeju Island, Korea, male, pocl 6.0 mm, JBNU_JH1540. A, Carapace, lateral; B, Anterior carapace and appendages, dorsal; C, Abdomen, lateral; D, Sixth pleonal segment, telson, and left uropod, dorsal; E, Posterior margin of telson, dorsal. Scale bars: A-D=3.0 mm, E=0.5 mm.

Description of Korean male specimen (JBNU_JH1540).

Body medium-sized, subcylindrical form. Carapace smooth (Fig. 2A). Rostrum straight, about 0.7 of pocl, slightly exceeding distal margin of scaphocerite; dorsal margin with ten subequal teeth, first situated above level of 0.75 of pocl; ventral margin deep at medial part, with 3 teeth. Inferior orbital angle feebly produced medially. Antennal tooth well-developed, situated closely below inferior orbital angle. Anterolateral

angle of carapace blunt, not produced. Supraorbital and hepatic tooth absent.

Abdominal pleura of first to fourth somite rounded (Fig. 2C). Fifth abdominal somite short, about 0.65 of dorsal length of third somite; posteroventral angle pointed. Sixth abdominal somite short, as long as dorsal length of fourth somite; posterolateral margin with well-developed tooth on each side, posteroventral angles sharply pointed.

Telson (Fig. 2D) about 1.9 times length of sixth abdominal somite, about 2.7 times proximal width, tapering distally; 2 pairs of large dorsal spiniform setae at 0.3 and 0.6 of telson length. Posterior margin with median tooth and 3 pairs of spiniform setae (Fig. 2E); lateral pair short, distinctly stouter and slightly longer than submedian pair; intermediate pair well-developed, about 2 times length of lateral pair; submedian pair long, slender, setulose distally.

Eye (Fig. 2B) with hemispherical cornea, with distinct nebenaugae, obliquely set on eyestalk; eyestalk swollen proximally.

Antennule (Fig. 2B) with peduncle reaching 0.9 of scaphocerite; proximal segment with distinct sharp distolateral tooth, anterior margin feebly produced medially; medioventral tooth distinct at about middle of length of proximal segment, with plumose setae on dorsoproximal and dorsodistal surface; stylocerite distally acute, about half length of proximal segment. Intermediate and distal segment short, together equal to about 0.6 of proximal segment length. Upper flagellum biramous, with 6 segments fused; short free ramus with 4 segments; fused part and short ramus with 15–16 groups of aesthetascs, longer free ramus filiform. Lower flagellum slender, filiform.

Antenna (Fig. 2B) with basicerite distodorsally rounded, ventrodistal margin with small tooth. Ischiocerite and mero-cerite unarmed. Carpocerite reaching to about middle of scaphocerite length. Scaphocerite about 2.8 times as long as broad; lateral border almost straight, ending in strong distolateral tooth; anterior margin of lamella rounded, distolateral tooth large, overreaching lamella.

Mouthparts not dissected. Third maxilliped (Fig. 3A) with coxa, with rounded lateral lobe, with arthrobranch. Basis fused with ischiomerus; ischio-basal suture demarcated. Compound antepenultimate segment about 5 times as long as wide basally, with long simple and serrulate setae medially. Penultimate segment about 0.8 times length of antepenultimate segment, with long serrulate setae medially. Ultimate segment 0.5 times length of penultimate segment, with rows of serrulate and simple setae medially. Exopod reaching to about 0.8 of ischiomerus, with plumose setae distally.

First pereopod (Fig. 3B) long, slender, overreaching distal end of scaphocerite by half of carpus. Coxa with small medial setose process. Basis and ischium with simple setae medially. Merus about 0.8 times as long as carpus, subdivided into 3 divisions. Carpus about 3.3 times chela length, subdivided into 5 divisions. Carpo-propodal brush well-developed medially. Chela with subcylindrical palm, about 4.5 times as long as width. Fingers about 0.4 of palm length, with several groups of terminal setae; cutting edges with lamella laterally over entire length; tips hooked.

Second pereopods robust, dissimilar in shape, unequal in size. Major second pereopod reaching distal end of anten-

nule peduncle by entire length of chela. Coxa and basis normal. Ischium short, about 0.4 of merus length, with minute and subacute tubercles along ventral margin. Merus about 3.1 times maximal width, about 1.8 times carpus length, with minute and subacute tubercles along ventral margin. Carpus short, tapering proximally, about 1.1 times maximal width, about 0.2 of chela length, with minute tubercles along entire margin, with irregular strong tubercles on dorsodistal margin. Chela (Fig. 3C) about 2.0 times pochl, about 1.3 times length of second minor chela, with minutely tuberculate along entire margin; palm subcylindrical, about 2.1 times dactylus length, about 3.5 times maximal width. Fixed finger distally curved, with pointed strong tip; cutting edge entire distally, with deep fossa centrally, with small blunt tooth proximally. Dactylus distally curved, with pointed strong tip; cutting edge entire centrally, with large triangular tooth centrally.

Minor second pereopod reaching distal end of carpocerite by entire length of carpus. Coxa and basis normal. Ischium short, about 0.3 of merus length, with minute and subacute tubercles along ventral margin. Merus about 2.6 times maximal width, about 1.6 times carpus length, with minute and subacute tubercles along ventral margin. Carpus short, tapering proximally, about 1.2 times maximal width, about 0.2 of chela length, with minute tubercles along entire margin, with irregular strong tubercles on dorsodistal margin. Chela (Fig. 3D) about 1.5 times pochl, with minutely tuberculate along entire margin; palm subcylindrical, about 1.7 times dactylus length, about 3.2 times maximal width. Fixed finger distally curved, with pointed strong tip; cutting edge with very thin lamella laterally up to 0.6 of length from distal end; with deep fossa and blunt teeth proximally. Dactylus distally curved, with pointed strong tip; cutting edge with very thin lamella laterally up to 0.6 of length from distal end; with large triangular tooth and blunt tooth proximally.

Ambulatory pereopods (Fig. 4) subequal in shape, third pereopod slightly longer than fourth and fifth. Third pereopod (Fig. 4A) with coxa, basis, and ischium normal, unarmed. Merus about 1.9 times carpus length, unarmed. Carpus about 0.5 of propodus length, unarmed. Propodus about 11 times proximal width, about 9 times dactylus length, with 8 spiniform setae on ventral margin, with a pair of stout spiniform setae on distoventral flexor margin (Fig. 4B). Dactylus about 2 times proximal width, biunguiculate, dorsal unguis slender than ventral one, flexor margin entire (Fig. 4B).

Fourth pereopod (Fig. 4C) with coxa, basis, and ischium normal, unarmed. Merus about 2.1 times carpus length, unarmed. Carpus about 0.5 of propodus length, unarmed. Propodus about 6.6 times dactylus length, with 8 spiniform setae on ventral margin, with a pair of stout spiniform setae on distoventral flexor margin (Fig. 4D). Dactylus about 2 times proximal width, biunguiculate, dorsal unguis slender than

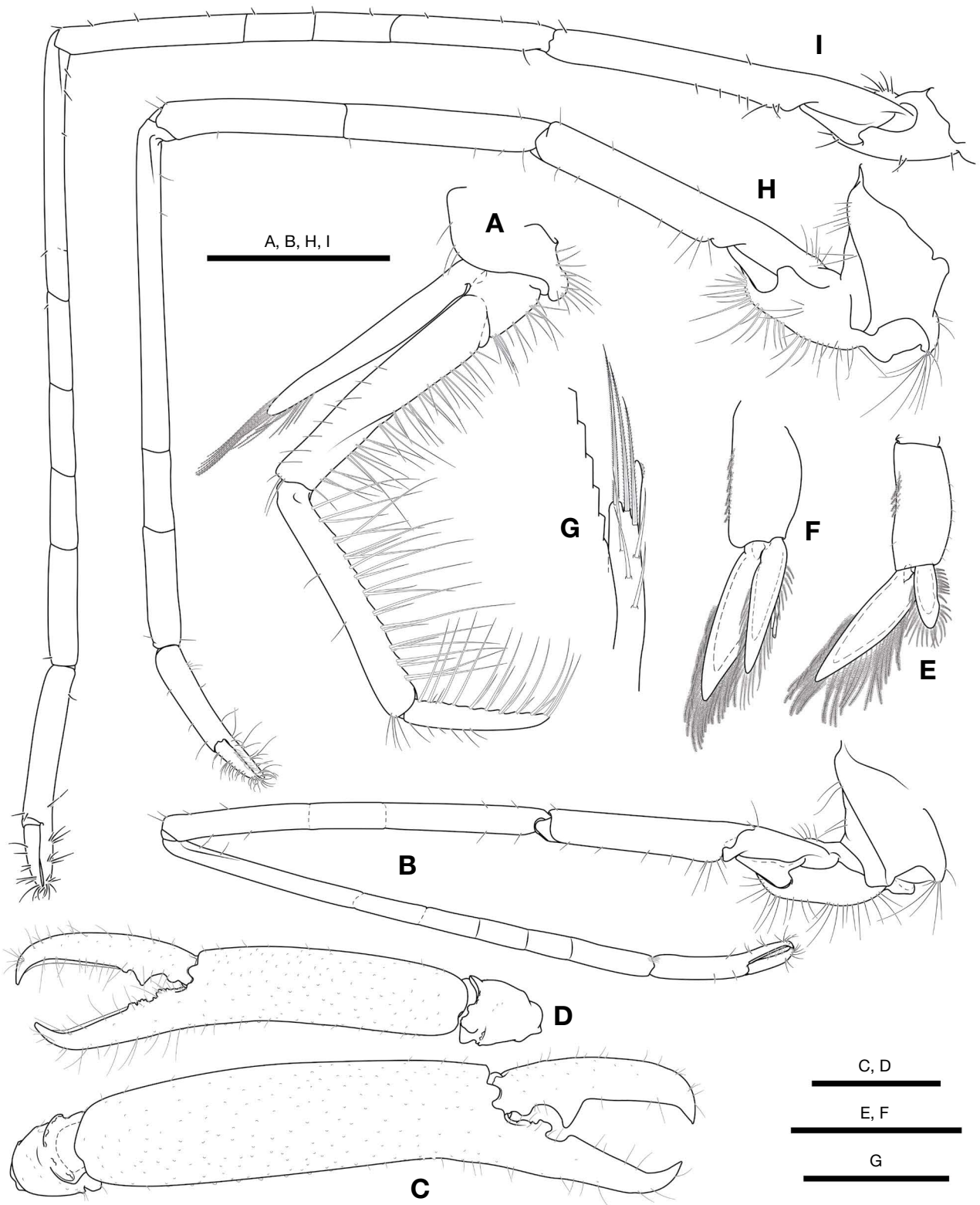


Fig. 3. *Thaumastocaris streptopus* Kemp, 1922, (A-G) male, pocl 6.0 mm, JBNU_JH1540, (H) ovigerous female, pocl 7.3 mm, MABIK CR00258290, (I) female, pocl 7.4 mm, JBNU_PI119. A, Third maxilliped; B, First pereopod; C, Major second pereopod, dactylus to carpus; D, Minor second pereopod, dactylus to carpus; E, First pleopod; F, Second pleopod; G, Appendices interna and masculine; H, First pereopod; I, Same. Scale bars: A, B, H, I=1.5 mm, C-F=3.0 mm, G=0.5 mm.

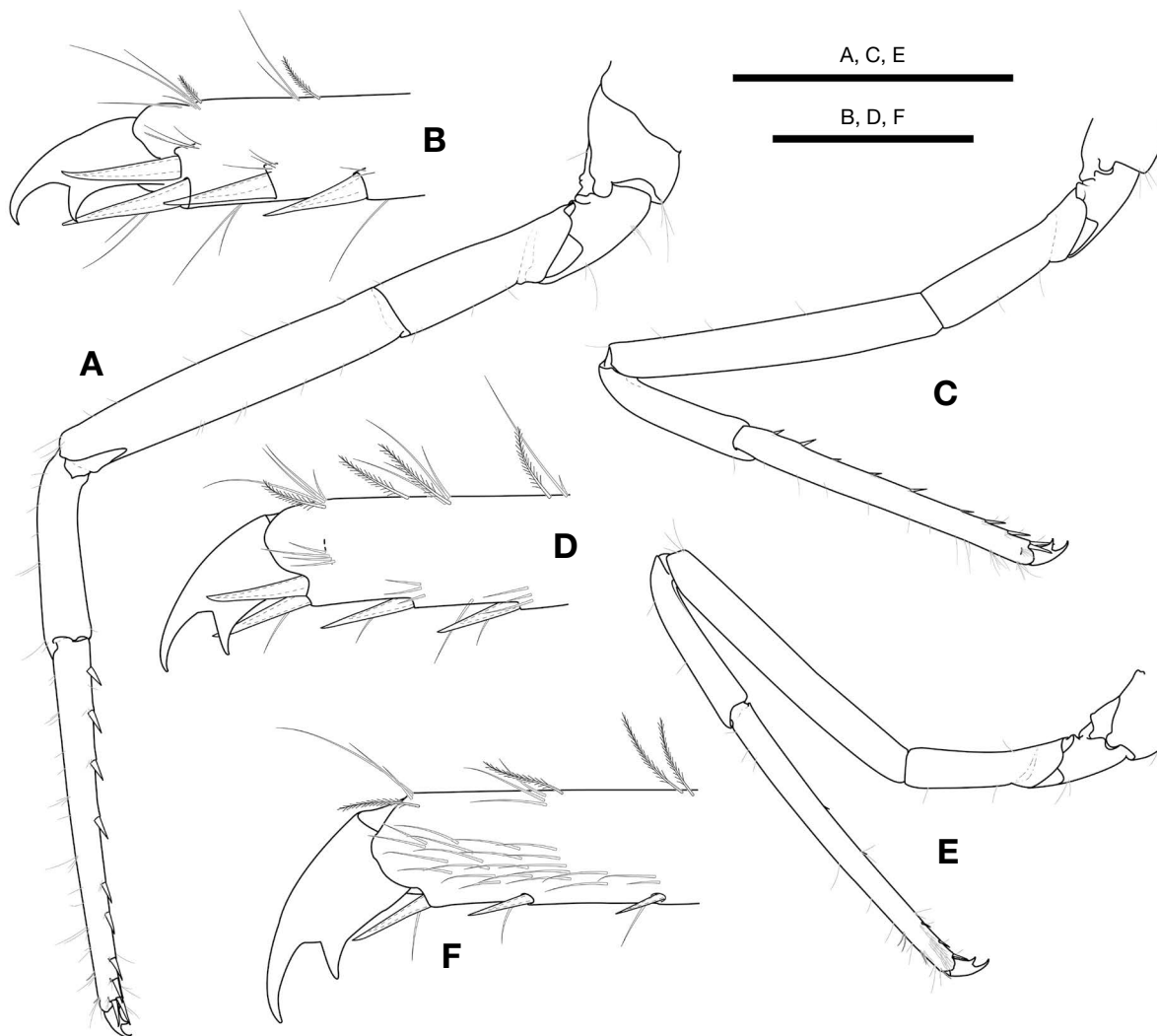


Fig. 4. *Thaumastocaris streptopus* Kemp, 1922 from Jeju Island, Korea, male, pocl 6.0 mm, JBNU_JH1540. A, Third pereopod, lateral; B, Same, dactylus and distal propodus, ventromesial; C, Fourth pereopod; D, Same, dactylus and distal propodus, ventromesial; E, Fifth pereopod, lateral; F, Same, dactylus and distal propodus, ventromesial. Scale bars: A, C, E=3.0 mm, B, D, F=0.5 mm.

ventral one, flexor margin entire (Fig. 4D).

Fifth pereopod (Fig. 4E) with coxa, basis, and ischium normal, unarmed. Merus about 1.6 times carpus length, unarmed. Carpus about 0.5 of propodus length, unarmed. Propodus about 6.8 times dactylus length, with 4 spiniform setae on ventral margin, with single spiniform setae on distoventral flexor margin, with row of serrulate cleaning setae in distolateral margin (Fig. 4F). Dactylus about 2.5 times proximal width, biunguiculate, dorsal unguis larger than ventral one, flexor margin entire (Fig. 4F).

First pleopod of male (Fig. 3E) with basipodite as long as endopod exopod, about 2.2 times longer than wide, medially with plumose setae. Endopod about 3.3 times longer than maximal wide, tapering distally, with plumose setae, without

appendix interna. Exopod about 3.7 times longer than maximal width, with plumose setae.

Second pleopod of male (Fig. 3F) with basipodite as long as endopod, about 2.0 times longer than wide, medially with plumose setae. Endopod about 4.8 times longer than maximal wide, tapering distally, with plumose setae. Exopod about 4.2 times longer than maximal wide, with plumose setae. Appendix masculine (Fig. 3G) slightly shorter than appendix interna, 4 serrulate setae medially, 3 long serrulate setae distally.

Uropod (Fig. 2C, D) extending well beyond tip of telson. Protopodite unarmed laterally. Exopod slightly longer than endopod, with lateral border almost straight, terminating in spiniform seta; distolateral tooth well-developed.

Color in life. Body and appendages semitransparent, with

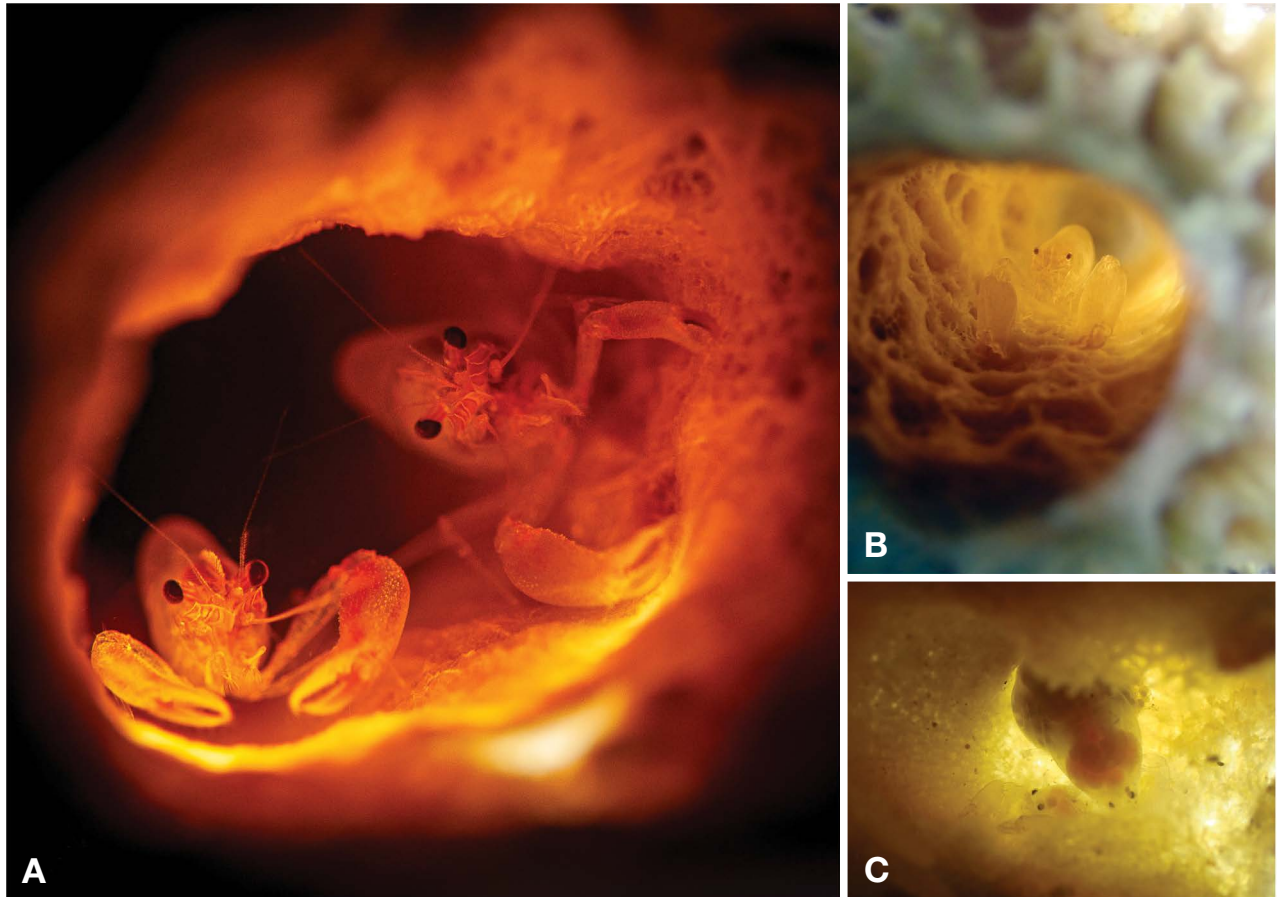


Fig. 5. Sponge-dwelling palaemonid shrimps from Jeju Island, Korea. A, A pair of *Thaumastocaris streptopus* Kemp, 1922, (JBNU_JH1539, 1540, pocl 8.2 mm and 6.0 mm) in the spongocoel of *Callyspongia confoederata* (Ridley, 1884); B, Female of *Periclimenaeus gorgonidarum* (JBNU_JH131, pocl 3.5 mm) in the spongocoel of *C. confoederata*; C, A pair of *Onycoecaris callyspongiae* inside a channel of the sponge wall of *C. confoederata*. Photograph by CY Park (A) and JH Park (B, C).

sparse yellow and red chromatophores faintly developed along the body. Distinct red stripes are developed vertically across the eyestalks (Fig. 5A).

Geographical distribution. *Thaumastocaris streptopus* is widely distributed in tropical to temperate waters of the Indo-Pacific Ocean (Fig. 1), including the Red Sea (Jordan: Aqaba), the western Indian Ocean (East Africa: Zanzibar, Kenya, Somalia, Madagascar, Comoros, and Mayotte), the eastern Indian Ocean (Western Australia: Cartier and Hibernia Reefs, Churchill Reefs), and the Pacific Ocean (Eastern Australia: Heron Island, Wistari Reef, New Caledonia, Papua New Guinea, Eniwetok Atoll, Palau, Indonesia, Malaysia, Vietnam, Philippines, Taiwan, and Korea) (Kemp, 1922; Holthuis, 1952; Johnson, 1962; Bruce, 1974, 1978a, 1978b, 1979, 1980, 1981, 1984, 1991, 1996, 2007; Bruce and Svoboda, 1983; Chace and Bruce, 1993; De Grave, 2000; Li and Bruce, 2006; Marin and Savinkin, 2007; Li et al., 2012; Limviriyakul et al., 2020; Poupin et al., 2022; present study).

DISCUSSION

The Korean specimens of *Thaumastocaris streptopus* show overall agreement with the original description (Kemp, 1922) in key morphological features. These include the shape and armament of the rostrum, the carapace with only a well-developed antennal tooth, the short sixth abdominal somite with a well-developed posterolateral tooth, two pairs of large dorsal spiniform setae on the telson, the obscurely articulated merus and carpus of the first pereiopods, and the biunguiculate dactyli of the ambulatory pereiopods. However, a few minor differences and notable variations were observed (Fig. 3B, H): (1) The carpus of the first pereiopod in the Korean specimens is subdivided into 3–6 segments (vs. 6 subsegments in the original description) and (2) The merus of the first pereiopod in the Korean specimens is subdivided into 2–3 segments (vs. 2 segments in the original description).

Most of the specimens examined herein for comparative

purposes correspond closely to the Korean specimens, with the exception of a female specimen from the Philippines (pocl 7.4 mm; JBNU_PII19) (Fig. 3I). This specimen exhibits 11 teeth on the dorsal margin of the rostrum (vs. 10 dorsal rostral teeth in the Korean material), 5 subsegments in the carpus of the first pereopods (vs. 3–6 subsegments in the Korean material), and 4 subsegments in the merus of the first pereopods (vs. 2–3 subsegments in the Korean material). Such differences in the various number of subsegments in the carpus of the first pereopods have previously been reported across the IWP region (Holthuis, 1952; Bruce, 1996; De Grave, 2000).

All Korean specimens were collected from the spongocoels of the tubular sponge, *Callyspongia confoederata* (Ridley, 1884), at depths below 20 m (Fig. 5A). In Korea, two other shrimp species, *Periclimenaeus gorgonidarum* (Balss, 1913) and *Onycocaris callyspongiae* Fujino and Miyake, 1969, have been reported from the same sponge species (Park et al., 2019). *Periclimenaeus gorgonidarum* inhabits the spongocoels of the host sponge (Fig. 5B), whereas *O. callyspongiae* inhabits inside a channel of the sponge wall (Fig. 5C), showing ecological differentiation. However, two spongocoel-dwelling shrimp, *T. streptopus* and *P. gorgonidarum*, were each found exclusively in different individuals of the same sponge species, *C. confoederata*, suggesting that habitat competition may occur between these two species.

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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