

A new hemiarthrine bopyrid, *Quadripediphyrxus mayuzumii* gen. et sp. nov. (Isopoda: Epicaridea: Bopyridae), infesting the abdomen of *Synalpheus streptodactylus* Coutière, 1905 (Decapoda: Caridea: Alpheidae)

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Abstract.— A hemiarthrine bopyrid, *Quadripediphyrxus mayuzumii* gen. et sp. nov. (Isopoda: Epicaridea: Bopyridae), is described based on a pair of specimens infesting the ventral surface of the abdomen of a snapping shrimp, *Synalpheus streptodactylus* Coutière, 1905 (Decapoda: Caridea: Alpheidae). The shrimp was collected from ornamental coral rock of an unidentified species of Poritidae (Cnidaria: Anthozoa) from Ehime Prefecture, Japan. The female of the new genus is similar to those in the genera *Hemiphyrxus* Bruce, 1978, *Eriphrixus* Markham, 1990, and *Micropodiphyrxus* Boyko, 2012, in having seven and four pereopods on the concave and convex sides of the body, respectively. However, female of the new genus can be distinguished from those in the other genera by the presence of a tiny triangular pleotelson bearing uropods. This finding represents the 12th species of hemiarthrine bopyrids found infesting the abdomen of caridean shrimps recorded from Japan.

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Key words: *Alpheidae*, *Bopyridae*, *Hemiarthrinae*, *shrimp parasite*

■ Introduction

The subfamily Hemiarthrinae Markham, 1972 contains modified bopyrid isopods that mostly occur on the ventral or dorsal surfaces of the abdomens of marine caridean shrimps (Markham, 1972). Sixty species in 28 genera have been recorded worldwide (Boyko *et al.*, 2008 onwards), with 11 described and four unidentified species known from Japan, attached to the abdomens of caridean shrimps belonging to five families (Alpheidae, Hippolytidae, Palaemonidae, Pandalidae, and Rhynchocinetidae) (Saito, 2015). A specimen of snapping shrimp, *Synalpheus streptodactylus* Coutière, 1905 (Decapoda: Caridea), was collected by an amateur aquarist, bearing one female hemiar-

thrine bopyrid accompanied by one dwarf male on the ventral pleon of the shrimp and brought to the present author. Detailed examination has shown that this hemiarthrine represent an undescribed genus and species in the subfamily and they are described herein. This finding represents the 12th species of bopyrids attached to abdomens of caridean shrimps from Japan.

The bopyrid specimens and their host shrimp were fixed in 10% formalin in sea water and preserved in 70% ethanol. Size measurements included total body length of bopyrids (TL), measured from the tip of the head to the posterior end of the final pleomere along the dorsal mid-line, and postorbital carapace length of host shrimp (CL), measured from the posterior margin of the orbit to the midpoint of the pos-

terodorsal margin of the carapace. Other measurements and terminology follow Markham (1985) for the bopyrids and Hayashi (2007) for the host shrimp. Morphological characters of the bopyrids and the host shrimp were observed under a binocular dissecting microscope (Olympus X-II). Measurements and drawings were made with the aid of a compound microscope (Olympus BHB-Tr) equipped with a drawing tube. The type materials of the new bopyrid, along with the host shrimp, are deposited in the Seto Marine Biological Laboratory, Kyoto University (SMBL).

■ Taxonomic Account

Family Bopyridae Rafinesque, 1815
 Subfamily Hemiarthrinae Markham, 1972
 Genus *Quadripediphryxus* gen. nov.
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Diagnosis

Female: body markedly asymmetrical, brood pouch expanded on convex side; pereomeres 1 to 3 fused to head; pereomeres 4–7 distinct on dorsal surface and marginally on concave side. Seven and four pereopods present on concave and convex sides of pereon, respectively; pereopod 3 on convex side complete and far out on edge of brood pouch. Four distinct pleomeres and tiny triangular pleotelson present; four pairs of uniramous lateral plates, four pairs of biramous pleopods and uropods present. Male: body symmetrical, elliptical in general outline; head distinct from pereomere 1; all seven pereomeres distinctly demarcated dorsally; pleon completely fused; pleopods and uropods absent.

Type Species

Quadripediphryxus mayuzumii sp. nov., by original designation.

Etymology

The generic name is a combination of the Greek *quadri-* and *pedi-* meaning “four” and “leg”, respectively, in reference to the number of pereopods on the convex side of the female’s body, which is added to the generic stem *-phryxus*.

Remarks

The numbers of pereopods (seven and four) on the concave and convex sides of the body in the female of the new genus support a close relationship with the genera *Hemiphryxus* Bruce, 1978, *Eriphrixus* Markham, 1990, and *Micropodiphryxus* Boyko, 2012, each of which is known only from its type species; *Hemiphryxus malindiae* (Bruce, 1974) from *Coralliocaris superba* (Dana, 1852) (Palaemonidae), *Eriphrixus obesus* Markham, 1990 from *Periclimenes vaubani* Bruce, 1990 (Palaemonidae), and *Micropodiphryxus richardsonae* (Chopra, 1930) from *Philocheras lowisi* (Kemp, 1916) (Crangonidae) (Chopra, 1930; Bruce, 1974, 1978; Markham, 1990; Boyko, 2012). These characters are not found in any other genera of Hemiarthrinae (Miura, 2014; An *et al.*, 2015; Saito, 2015). However, the female of the new genus can be readily distinguished from those of the above-mentioned genera by the presence of a tiny triangular pleotelson (*vs.* bifid in *Micropodiphryxus*, a globose knob in *Eriphrixus*, and absent in *Hemiphryxus*) and uropods (*vs.* absent in those genera). Furthermore, the female of the new genus can be separated from those of *Hemiphryxus* and *Micropodiphryxus* by the number of distinct pereomeres (4 in the new genus *vs.* 7 in those genera) and structure of the lateral plates (uniramous in the new genus *vs.* biramous in *Micropodiphryxus* and absent in *Hemiphryxus*).

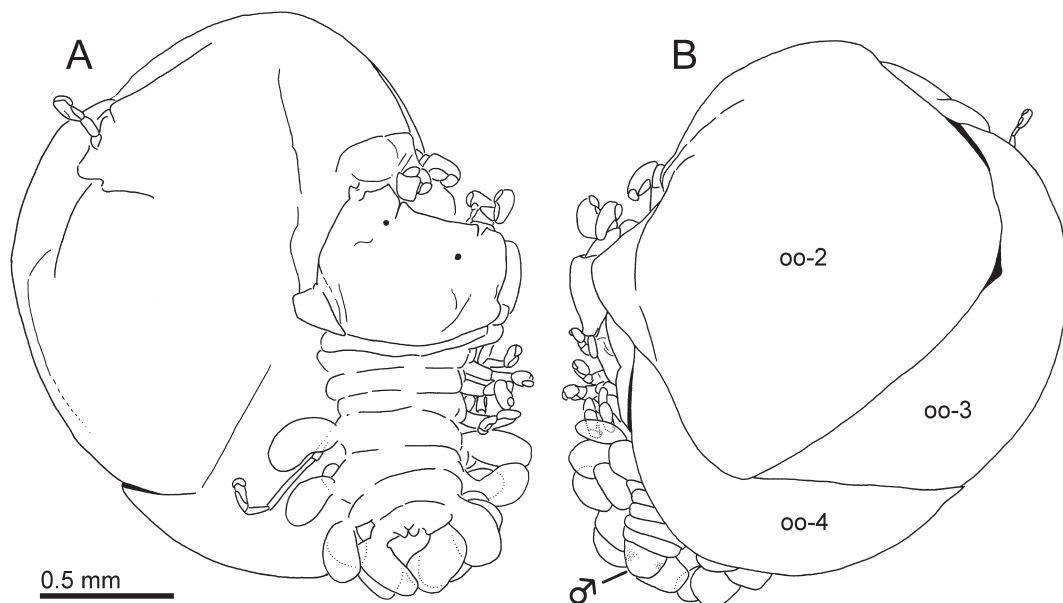


Fig. 1. *Quadripediphyxus mayuzumii* gen. et sp. nov., holotype, female (TL 1.25 mm), SMBL-V0579, removed from ventral surface of abdomen of snapping shrimp, *Synalpheus streptodactylus* Coutière, 1905 (CL 2.56 mm). A, dorsal view; B, ventral view. Abbreviations: oo-2–4, oostegites 2–4.

***Quadripediphyxus mayuzumii* sp. nov.**

(Figs. 1–3, 4B)

[New Japanese name: Tsunoteppo-harayadori]

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Material examined

Holotype: ovigerous female (TL 1.25 mm). SMBL-V0579, removed from ventral surface of the abdomen of a snapping shrimp, *Synalpheus streptodactylus* Coutière, 1905 (CL 2.56 mm), sex unknown, removed from ornamental coral rock of an unidentified species of Poritidae, Ehime Prefecture, Shikoku, Japan, 19 September 2016, coll. Takeshi Mayuzumi. Paratype: male (TL 0.50 mm), SMBL-V0580, removed from the pleon of the holotype female.

Description of holotype female

Body (Fig. 1) ovate in general outline, greatly expanded on convex (left) side; body axis distortion approximately 10°; maximal body

width about 0.9 times as long as length along major axis of body including brood pouch.

Head (Fig. 1A) approximately 40% of total length, frontal margin nearly straight with pair of deep clefts. Small, round eyes (Fig. 1A) present.

Antennule (Fig. 2A) of 3 articles, article 3 with terminal setae.

Antenna (Fig. 2B) of 4 articles, articles 2 and 3 with marginal and distal setae, article 4 with terminal setae.

Right and left maxillipeds (Fig. 2C, D) symmetrical, semi-ovoidal, nearly straight medially, roundly angled anteriorly, without palp, bearing short spur; anterior article approximately 3 times as long as posterior article.

Barbula (Fig. 2E) with pair of short stout lateral projections.

Pereon (Fig. 1A): pereomeres 1 to 3 fused to head; pereomeres 4–7 distinct on dorsal surface and concave (right) side. Pereomere 2 with large dorsolateral bosses on convex side. Inflated closed brood pouch (Fig. 1B) broadly

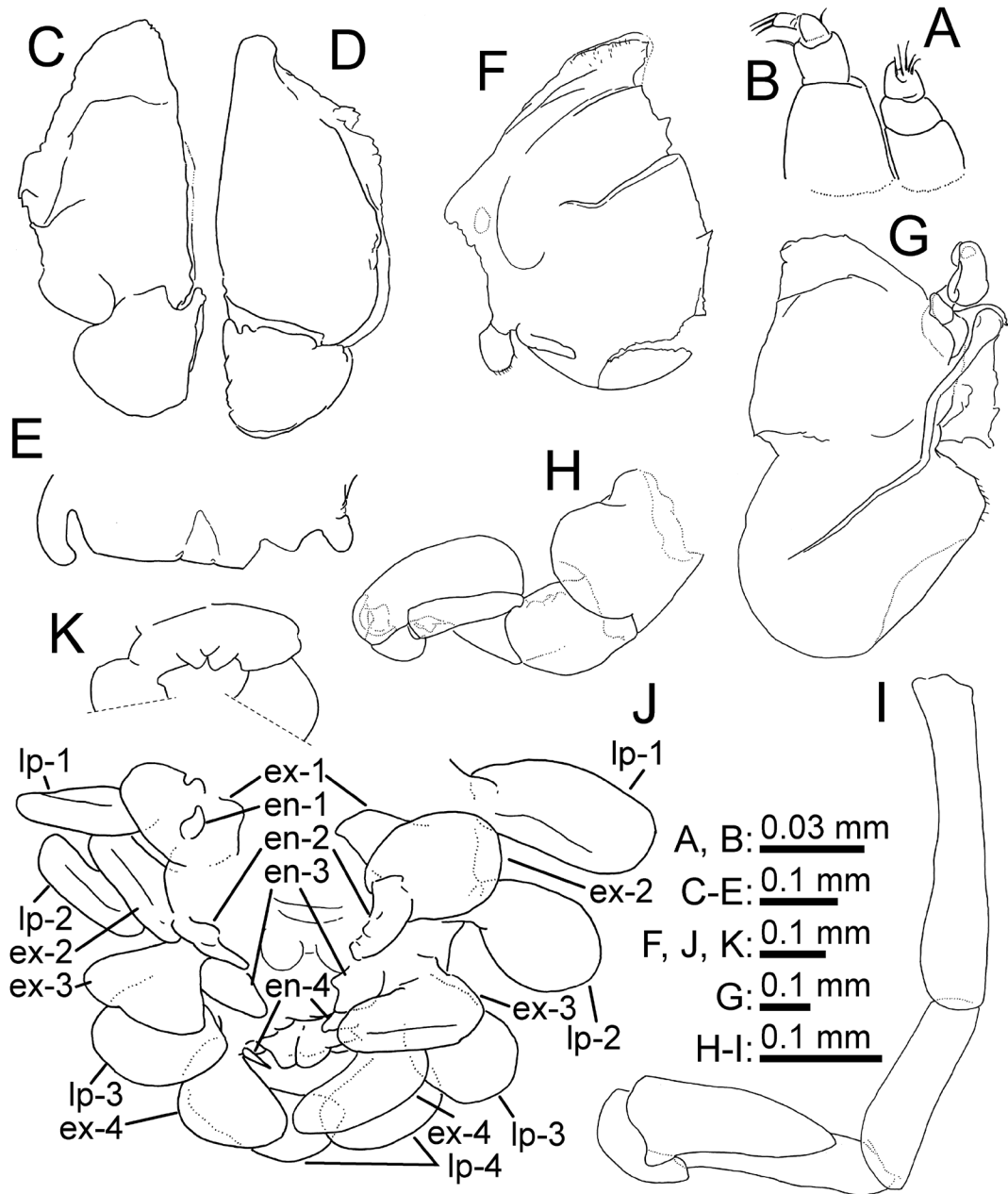


Fig. 2. *Quadripediphyxus mayuzumii* gen. et sp. nov., holotype, female (TL 1.25 mm), SMBL-V0579. A, right antennule, ventral view; B, right antenna, ventral view; C, right maxilliped, ventral view; D, left maxilliped, ventral view; E, barbula, dorsal view; F, right oostegite 1, ventral view; G, left oostegite 1, ventral view; H, right pereopod 1, medial view; I, left last pereopod, lateral view; J, pleon, ventral view; K, terminal pleomere with pleotelson and uropods, dorsal view. Abbreviations: en 1–4, pleopodal endopods 1–4; ex 1–4, pleopodal exopods 1–4; lp 1–4, lateral plates 1–4.

expanded laterally and anteriorly, formed by fusion of convex oostegites 2–4 medially.

Oostegite 1 of concave side (Fig. 2F) oval,

two-segmented, produced into small posterior-lateral lobe; that of convex side (Fig. 2G) bilobed. Oostegites 2–5 of concave side all sepa-

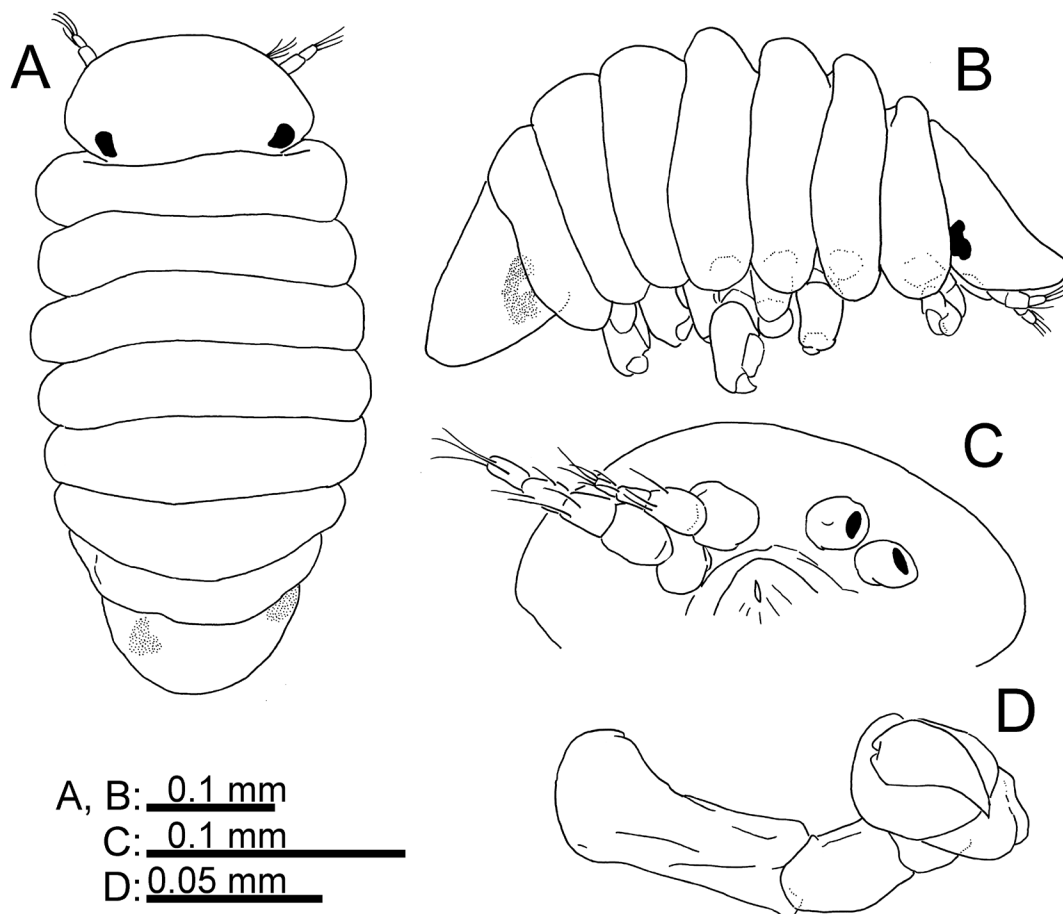


Fig. 3. *Quadripediphyxus mayuzumii* gen. et sp. nov., paratype, male (TL 0.50 mm), SMBL-V0580. A, dorsal view; B, right lateral view; C, head, ventral view; D, right pereopod 1, lateral view.

rated.

Seven and four pereopods on concave and convex sides of body, respectively (Fig. 1A); on both sides, first two pairs of pereopods slightly more robust, adjacent to head: both pairs with all articles distinct: basis rectangular, ischium trapezoidal and shorter than basis, merus triangular and shorter than ischium, carpus triangular, propodus ovate, dactylus stout (Fig. 2H). On convex side, pereopod 3 narrower, widely separated by expanded part of pereomere; last pereopod, apparently arises from seventh pereomere (as such would pereopod 7), markedly elongated (Figs. 1A, 2I). Pereopods 3–7 of concave side tightly clumped, subequal

in size to each one (Fig. 1A).

Pleon (Figs. 1A, B; 2J, K): four dorsally distinct pleomeres; pleomere 2 with pair of ventral tubercles; terminal pleomere with tiny triangular tubercle (pleotelson?).

Four pairs of uniramous oval lamellar lateral plates with short peduncles and four pairs of biramous pleopods present (Fig. 2J). Pleopodal exopods lobe-shaped semi-equal in size and shape to lateral plates, pleopodal endopods rudimentary (Fig. 2J). Pair of dorsally positioned extensions of terminal pleomere (uropods?) present (Fig. 2K).

Table 1. List of hemiarthrine bopyrids that occur on the abdomens of shrimp in the genus of *Synalpheus*.

Hemiarthrine Bopyrid	Host	Locality	Literature
<i>Azygopleon schmitti</i> (Pearse, 1932)	<i>Synalpheus brooksi</i> Coutière, 1909; <i>S. hemphilli</i> Coutière, 1909; <i>S. longicarpus</i> (Herrick, 1891); <i>S. mcclendoni</i> Coutière, 1910; <i>S. pectiniger</i> Coutière, 1907	North Carolina, Florida; Belize; Bahama Is.; Hispaniola; Jamaica; Bonaire; Curaçao	Pearse (1950); Markham (1985)
<i>Eophrixus brevicauda</i> (Chopra, 1923)	<i>Synalpheus hastilicrassus</i> Coutière, 1905; <i>S. tumidomanus</i> (Paul'son, 1875)	Andaman Is.; Hong Kong	Chopra (1923); Markham (1992)
<i>Eophrixus laevimanus</i> Caroli, 1930	<i>Synalpheus gambarelloides</i> (Nardo, 1847)	Gulf of Naples	Caroli (1930)
<i>Eophrixus subcaudalis</i> (Hay, 1917)	<i>Synalpheus brooksi</i> Coutière, 1909; <i>S. goodei</i> Coutière, 1909; <i>S. hemphilli</i> Coutière, 1909; <i>S. longicarpus</i> (Herrick, 1891); <i>S. mcclendoni</i> Coutière, 1910; <i>S. pandionis</i> Coutière, 1909; <i>S. pectiniger</i> Coutière, 1907	North Carolina, Florida; Yukatan, Belize; Hispaniola; Curaçao	Hay (1917); Markham (1985)
<i>Epiphrixus adriaticus</i> Nierstrasz & Brender à Brandis, 1932	<i>Synalpheus gambarelloides</i> (Nardo, 1847)	Adriatic Sea	Nierstrasz & Brender à Brandis (1932)
<i>Hemiarthrus synalpheii</i> (Pearse, 1950)	<i>Synalpheus fritzmulleri</i> Coutière, 1909; <i>S. hemphilli</i> Coutière, 1909; <i>S. longicarpus</i> (Herrick, 1891)	North Carolina, Florida; Haiti	Pearse (1950); Markham (1985)
<i>Hypohyperphrixus latilamellaris</i> Nierstrasz & Brender à Brandis, 1932	<i>Synalpheus trianguiculatus</i> (Paul'son, 1875)	Red Sea	Nierstrasz & Brender à Brandis (1932)
<i>Quadripediphryxus mayuzumii</i> gen. et sp. nov.	<i>Synalpheus streptodactylus</i> Coutière, 1905	Japan	Present study

Description of paratype male

Body (Fig. 3A, B) small, approximately 0.4 times as long as female, elliptical in general outline; body width half as wide as whole body, maximal width at pereomere 4.

Head (Fig. 3A, C) distinct from pereomere 1, semicircular, expanded laterally, 1.5 times as long as pereomere 1. Large, kidney-shaped eyes (Fig. 3A) present.

Antennule (Fig. 3C) of 4 articles; articles 2 to 4 each with tuft of long setae marginally and distally.

Antenna (Fig. 3C) of 5 articles, approximately 1.4 times as long as antennule.

Pereon (Fig. 3A) lacking ventral tubercles; lateral margins curved; pereomere 7 and pleon

distinct.

Pereopods (Fig. 3D) all of similar size and structure; all articles distinct.

Pleon (Fig. 3A) completely fused, semi-ovoidal, representing approximately 20% long of whole body length; posterior margin rounded, smooth, without anal tube. Pleopods and uropods absent.

Ecological note

The host shrimp, *Synalpheus streptodactylus*, is known from South Africa and the Red Sea to Hawaiian waters (Hayashi, 1996). It is common in infralittoral bottom on the Pacific coast of central Japan (Nomura, 1996). Ecologically, this shrimp has been reported from cracks or

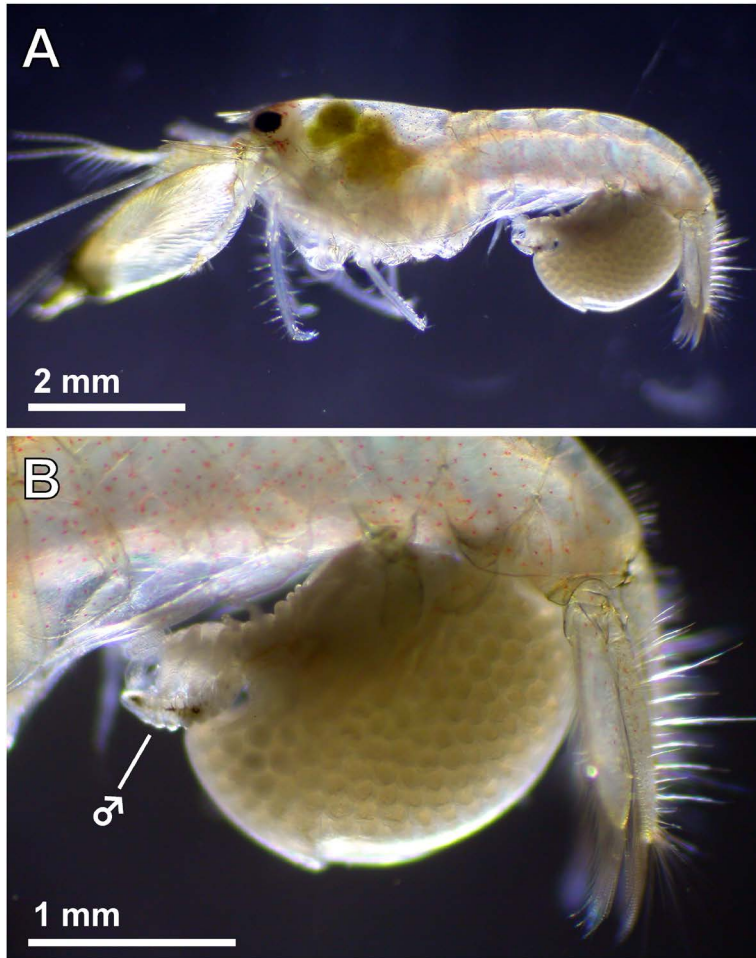


Fig. 4. A, *Synalpheus streptodactylus* Coutière, 1905 (CL 2.56 mm) extracted from ornamental coral rock of unidentified species of Poritidae from Ehime Prefecture, Japan, host of *Quadripediphryx mayuzumii* gen. et sp. nov.; B, region of attachment, new bopyrid attached by pereopods 1 and 2 to posterior ventral margin of pleonite 3 of shrimp, and hooked by at least pereopods 6 and 7 of concave side to lateral margin of pereopod 3.

gaps in rubble substrates and/or associated with sponges and bryozoan colonies (Hayashi, 1996; Nomura, 1996). Previously, seven species in five genera of hemiarthrine bopyrids were described from abdomens of *Synalpheus* shrimp species (Table 1). This is the first record of bopyrid infestation on *Synalpheus streptodactylus*.

When the female of the new species is attached on the ventral surface of the shrimp abdomen (Fig. 4A), the dorsal body surface is oriented to the posterior margin on the host's

pleopod 3 and appeared to be attached by pereopods 1 and 2 to the posterior ventral margin of pleonite 3 of the host shrimp, and with at least pereopods 6 and 7 of the concave side hooked to the lateral margin of the left pleopod 3 of the host (Fig. 4B). The male was attached to the ventral side of the female bopyrid's pleon.

Etymology

The specific name is the Latin genitive *mayuzumii* selected to honour the collector of the

type-material, Mr. Takeshi Mayuzumi, an amateur aquarist.

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