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A New Species of *Psammogammarus* (Amphipoda: Melitidae) from Kuchinoerabu Island, Japan, with a Note on its Feeding Habits

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A new melitoid Amphipoda, *Psammogammarus mawatarii*, is described from Kuchinoerabu Island, Kagoshima Prefecture, Japan. This is the first record of the genus from Asia. The new species is morphologically similar to *P. garthi*, but differs from the latter in the following features: 1) lateral cephalic lobe of head not strongly produced; 2) head lacking antennal sinus; and 3) posteroventral corner of epimeral plate 3 rounded. Morphology of maxillae 1 and 2, and mandible, and gut contents (harpacticoid Copepoda) of *P. mawatarii* indicate that the feeding type of the species seems to be, at least facultatively, carnivorous.

Key words: *Psammogammarus*, Melitidae, Amphipoda, new species, feeding, Japan, taxonomy

INTRODUCTION

The amphipod genus *Psammogammarus* S. Karaman, 1955 has been recorded from littoral marine interstitial or anchialine waters of the Mediterranean Sea, California, the West Indies, the Red Sea, the Canary Islands, and the Cape Verde Islands, and is currently composed of 12 species (G. Karaman, 1984; Stock and Sanchez, 1987; Vonk and Stock, 1987; Vonk, 1990; Jaume and Garcia, 1992; Stock and Vonk, 1992; Ortiz et al., 1993; Van Der Ham and Vonk, 2003; Sawicki et al., 2005).

The feeding habits of amphipods have been investigated in several species (e.g. Watling, 1993; Yu et al., 2003; Platvoet et al., 2006; Mayer et al., 2008). To date, seven feeding categories have been recognized in Amphipoda based on feeding methods (Enequist, 1949; Biernbaum, 1979): suspension-feeders, surface detritivores, buried detritivores, scavengers, carnivores, commensals, and grazers on living food. However, neither feeding habit nor functional morphology for feeding has been described for *Psammogammarus* species.

During a field survey of littoral marine invertebrates in a tide pool at Kuchinoerabu Island, Kagoshima Prefecture, Japan in 2009, one of the authors (HY) collected specimens of an undescribed species of *Psammogammarus*. In this paper, the feeding habits and functional morphology of mouthparts of *Psammogammarus* for feeding are briefly discussed.

MATERIAL AND METHODS

Amphipods were collected from accumulated sands on the bottom of a tide pool at Kuchinoerabu Island, Kagoshima Prefecture, Japan (Figs. 1, 2). Sand grains were washed out by seawater, and

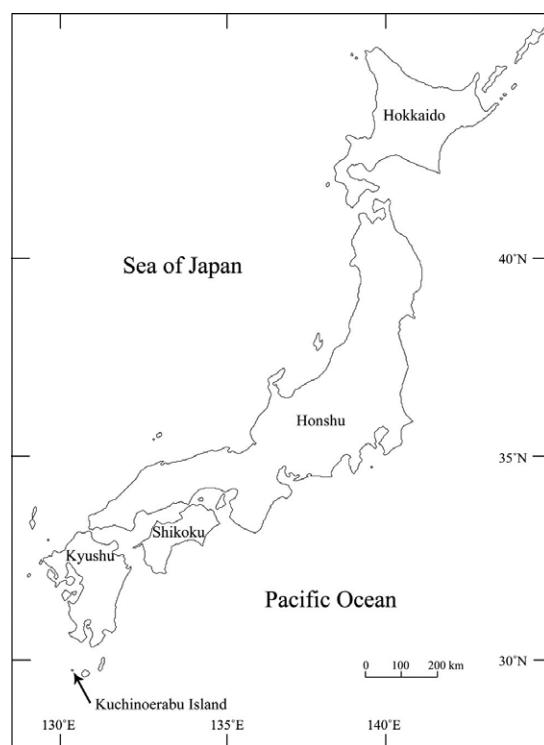


Fig. 1. Map showing the collecting site of *Psammogammarus mawatarii* sp. nov. Arrowhead indicates Kuchinoerabu Island in Japan.

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Fig. 2. Photograph of the type locality (tide pool of Kuchinoerabu Island) of *Psammogammarus mawatarii* sp. nov.

amphipods were collected from supernatant sea water using a plankton net (mesh size 43 μm). They were fixed in 99% ethanol and examined in 99% ethanol with glycerin. All appendages were embedded in gum-chloral medium and mounted on glass slides

under a stereomicroscope (Olympus SZX7). Specimens were examined using a light microscope (Olympus BH2), and were illustrated with the aid of a camera lucida. Some specimens were dehydrated through a graded ethanol series, dried using hexamethyldisilazane (HMDS) (Nation, 1983), sputter-coated with gold, and observed with a scanning electron microscope (JSM-6510LV). The body length from the tip of the rostrum to the base of the telson was measured to the nearest 0.1 mm.

The type series is deposited in the National Museum of Nature and Science, Tokyo (NSMT).

The gut parts of some of the amphipods were carefully removed and immersed in gum-chloral medium on glass slides. Gut contents were examined under a light microscope.

Terminology follows Bradbury and Williams (1999).

SYSTEMATICS

Genus *Psammogammarus* S. Karaman, 1955
(Japanese name: Sukima yokoebi zoku, new)

Psammogammarus mawatarii sp. nov.
(Japanese name: Mawatari sukima yokoebi, new)
(Figs. 3–11)

Diagnosis

Lateral cephalic lobe of head not strongly produced; antennal sinus absent. Posteroventral corner of epimeral plate 3 rounded. Incisor of right mandible 4-dentate. Palmar margin of gnathopod 1 transverse. Gnathopod 2 sexually dimorphic; palmar corner of male gnathopod 2 with 2 robust setae. Uropod 1 with robust setae on basofacial part of

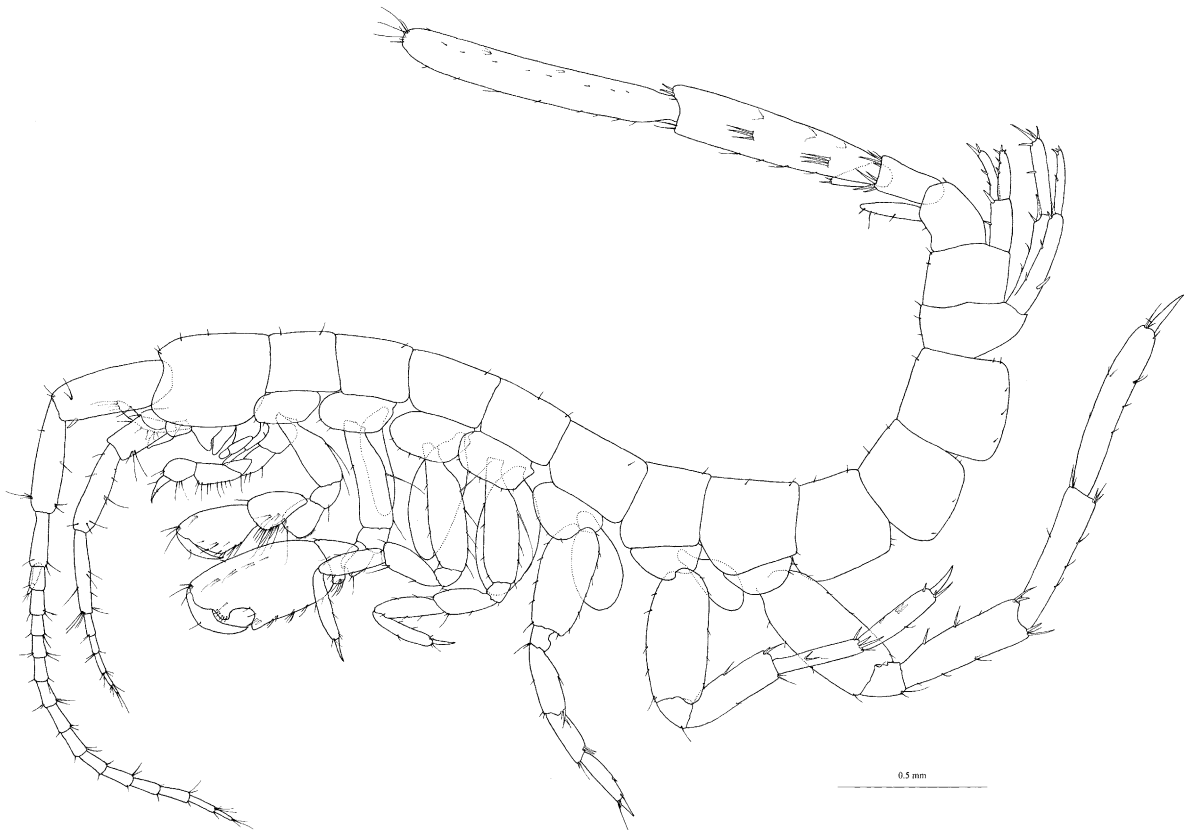


Fig. 3. *Psammogammarus mawatarii* sp. nov., holotype, male (3.5 mm), NSMT-Cr 20988, Kuchinoerabu Island, Kagoshima Prefecture. Habitus, lateral view.

peduncle; rami of uropods 1 and 2 with marginal setae. Inner ramus of uropod 3 shorter than quarter length of outer ramus. Telson without inner marginal setae; apical seta on each lobe slender and very short.

Material examined

Holotype: NSMT-Cr 20988, a mature male (3.5 mm)

from sands of tide pool in Honmura (30°27'41"N, 130°11'52"E), Kuchinoerabu Island, Kagoshima Prefecture, Japan, collected by Hiroshi Yamasaki on 25 May 2009. Paratypes: NSMT-Cr 20989, a mature male (3.3 mm); NSMT-Cr 20990, a mature female (3.7 mm); NSMT-Cr 20991, an ovigerous female (3.2 mm). Data same as for the holotype.

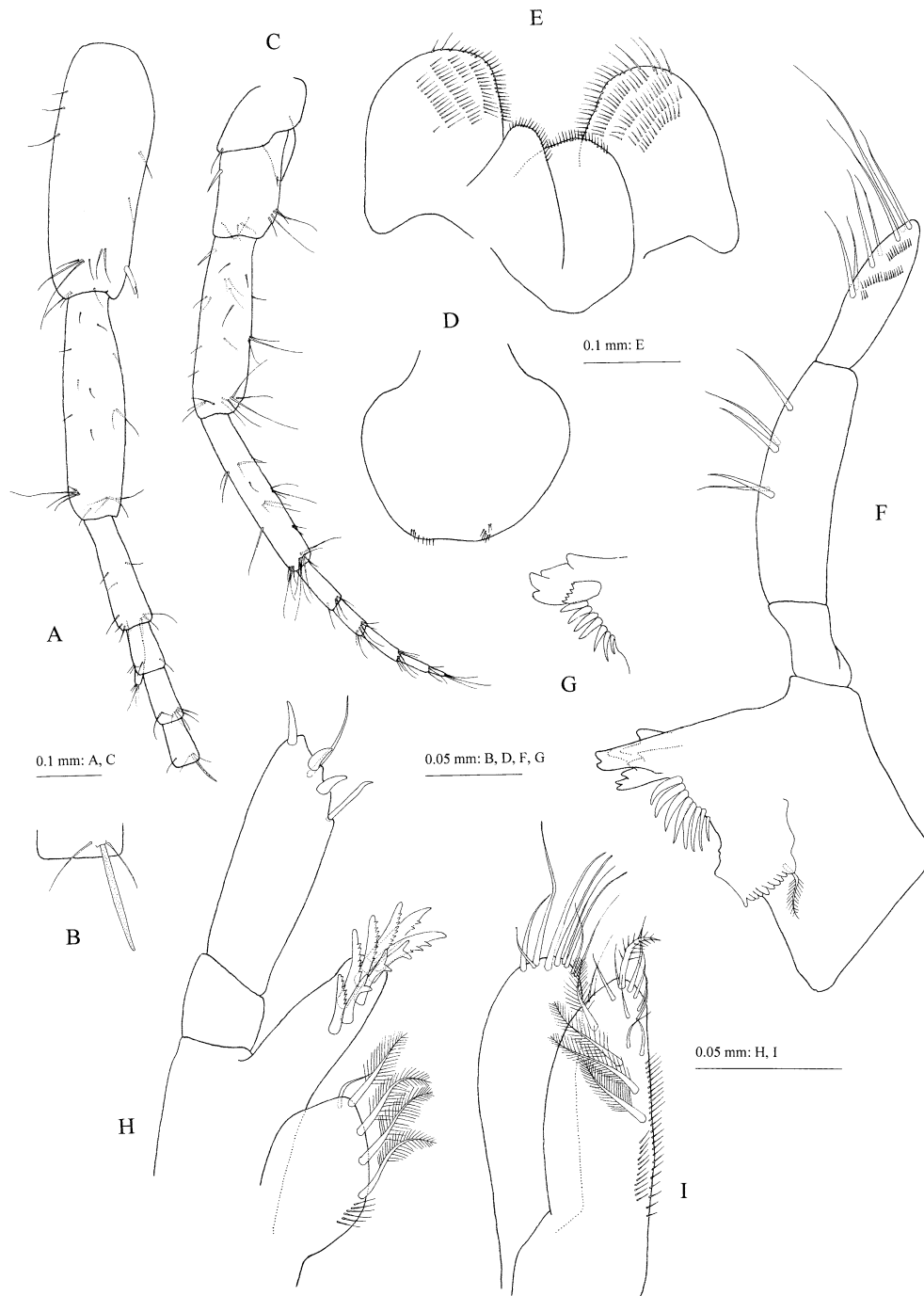


Fig. 4. *Psammogammarus mawatarii* sp. nov., holotype, male (3.5 mm), NSMT-Cr 20988, Kuchinoerabu Island, Kagoshima Prefecture. (A) peduncular articles 1–3, primary flagellar articles 1–3, and accessory flagellum of antenna 1, medial view; (B) aesthetasc and associated setae on primary flagellum of antenna 1, medial view; (C) antenna 2, medial view; (D) upper lip, anterior view; (E) lower lip, ventral view; (F) left mandible, lateral view; (G) incisor, lacinia mobilis, and accessory setal row of right mandible, medial view; (H) maxilla 1, dorsal view; (I) maxilla 2, dorsal view.

Material for SEM observation

One partly damaged male (length unknown). Data same as for the holotype.

Description of male (holotype, NSMT-Cr 20988)

Head (Fig. 3) with short rostrum; lateral cephalic lobe rounded, not strongly produced, unnotched; antennal sinus absent; eyes absent; dorsal surface with fine setae. Dorsal surfaces of pereonites, pleonites, and urosomites with fine

setae. Posterior margin of epimeral plate 1 with 2 setae, posteroventral corner rounded, ventral margin bare (Fig. 7I); posterior margin of plate 2 with 2 setae, posteroventral corner rounded, ventral margin with 2 setae (Fig. 7J); posterior margin of plate 3 with 2 setae, posteroventral corner rounded, ventral margin with 3 setae (Fig. 7K).

Antenna 1 (Fig. 4A) 0.62 times as long as body length, posterodistal corner of peduncular article 1 with robust seta, peduncular articles 1 to 3 in length ratio of 1.0:0.9:0.5;

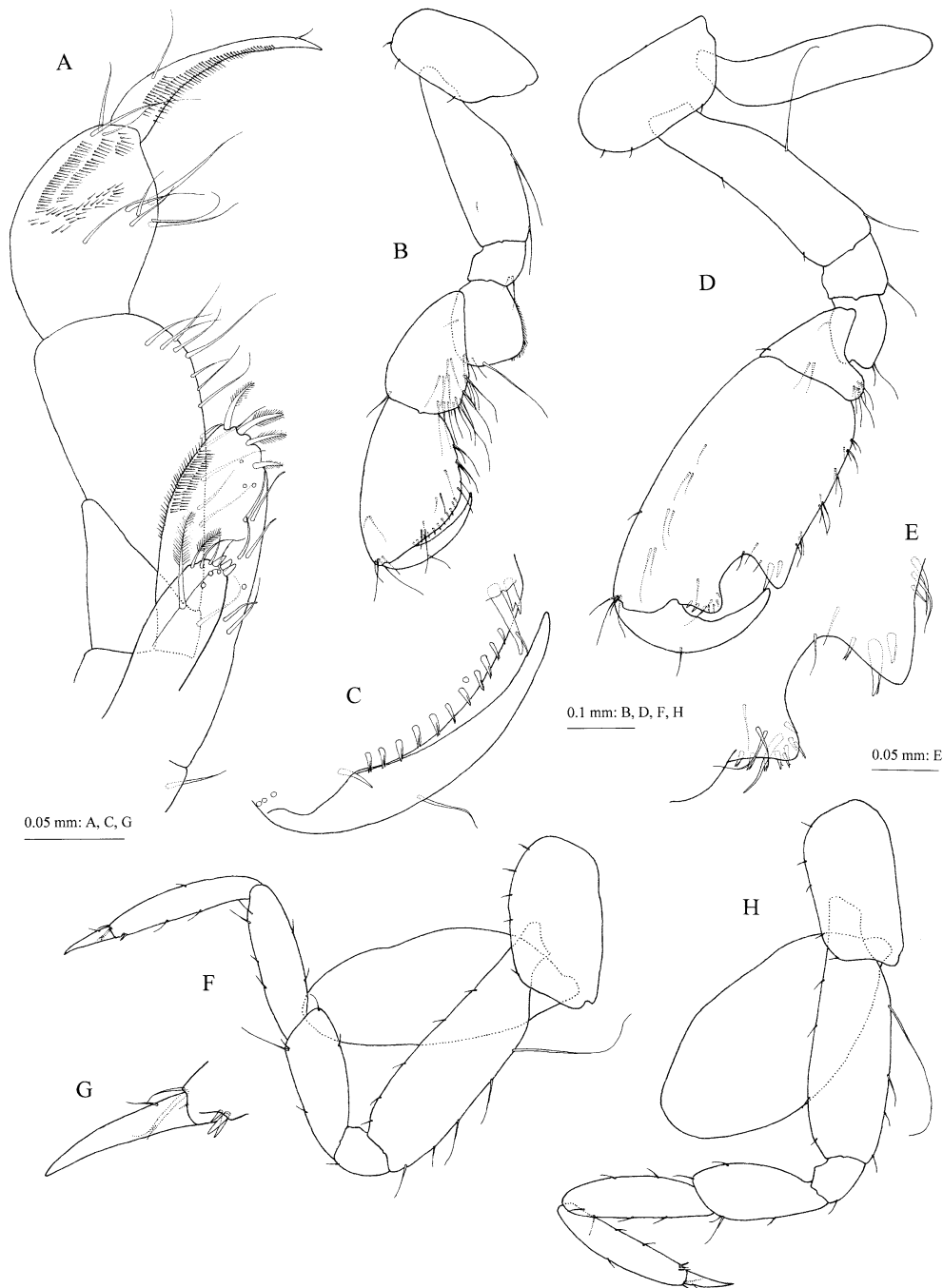


Fig. 5. *Psammogammarus mawatarii* sp. nov., holotype, male (3.5 mm), NSMT-Cr 20988, Kuchinoerabu Island, Kagoshima Prefecture. (A) maxilliped, dorsal view, some setae omitted; (B) gnathopod 1, lateral view; (C) palmar margin and article 7 of gnathopod 1, medial view, some setae omitted; (D) gnathopod 2, lateral view; (E) palmar margin of gnathopod 2, lateral view; (F) pereopod 3, lateral view; (G) article 7 of pereopod 3, lateral view; (H) pereopod 4, lateral view.

accessory flagellum slightly longer than primary flagellum article 1, 2-articulate; primary flagellum 14-articulate, each article with 1 aesthetasc (Fig. 4B). Antenna 2 (Fig. 4C) 0.49 times as long as antenna 1; flagellum 0.51 times as long as peduncular articles 4 and 5 combined, consisting of 5 articles, calceoli absent.

Upper lip (= labrum) (Fig. 4D) with nearly straight distal margin, bearing fine setae. Mandibles (Fig. 4F, G) with left and right incisors 5- and 4-dentate, respectively; left lacinia mobilis 5-dentate, right lacinia not bifid, bearing 6 fine teeth; molar process present, non-triturative, with plumose seta;

accessory setal rows of left and right mandibles with 8 and 7 blade-like setae, respectively; palp 3-articulate, palp article 1 bare, article 2 with 5 setae, article 3 with 4 D- and 3 E-setae and minute setae on its medial margin, articles 1 to 3 in length ratio of 1.0:2.9:2.0. Lower lip (= labium) (Fig. 4E) with broad outer lobes, mandibular process of outer lobe rounded apically; inner lobes distinct. Maxilla 1 (Fig. 4H) with inner and outer plates and palp; medial margin of inner plate with 4 plumose and 1 simple setae; outer plate sub-rectangular with 9 serrate teeth apically; palp 2-articulate, much longer than outer plate, article 1 lacking marginal

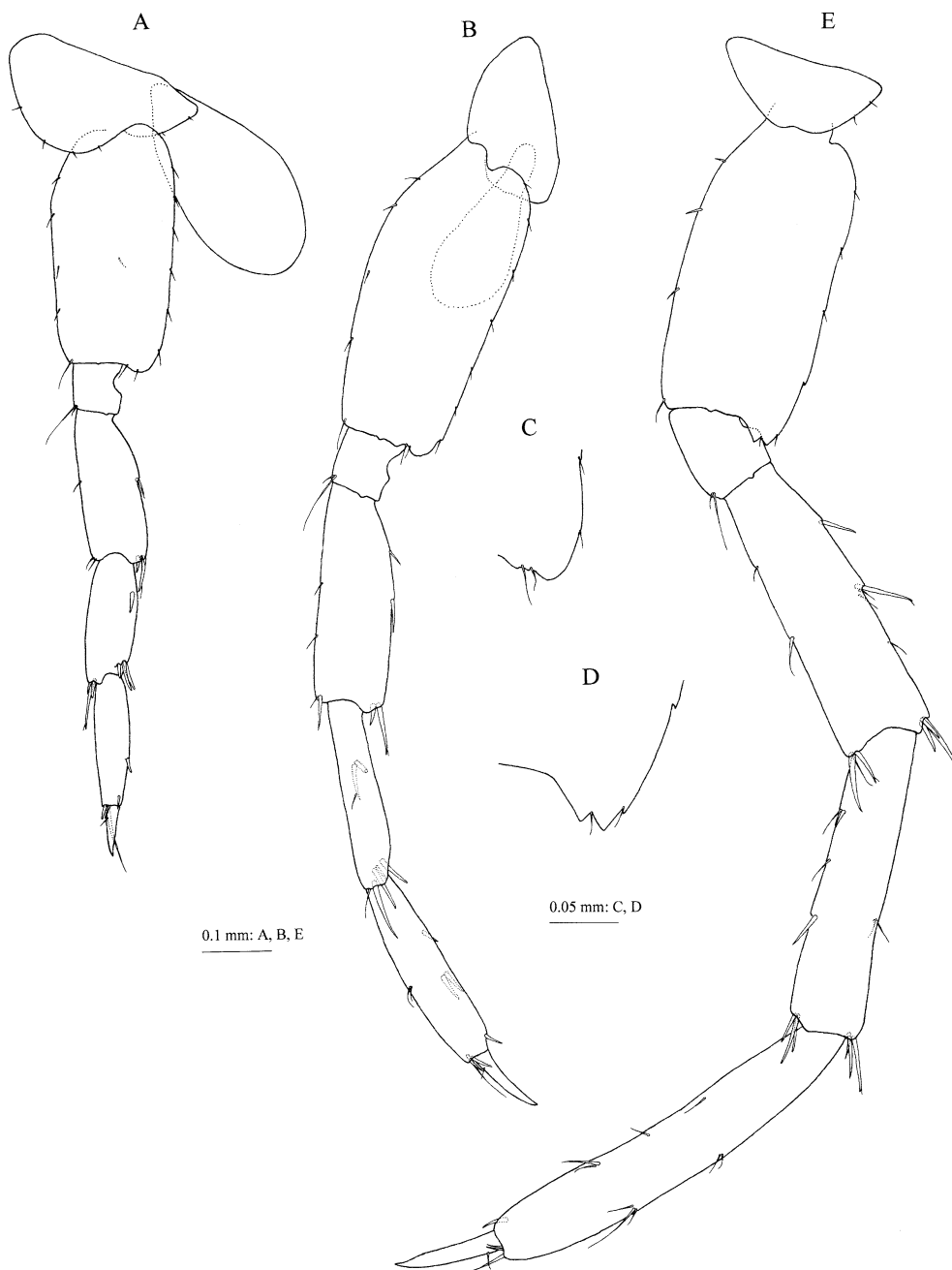


Fig. 6. *Psammogammarus mawatarii* sp. nov., holotype, male (3.5 mm), NSMT-Cr 20988, Kuchinoerabu Island, Kagoshima Prefecture. (A), pereopod 5, lateral view; (B), pereopod 6, lateral view; (C) and (D) posterodistal lobes of articles 2 of pereopods 6 and 7, respectively, lateral views; (E) pereopod 7, lateral view.

setae, article 2 with 3 robust and 2 slender setae on its apical margin. Maxilla 2 (Fig. 4I) with oblique inner row of 4 plumose setae on inner plate; outer plate slightly longer than inner plate. Maxilliped (Fig. 5A) with inner and outer plates and palp; inner plate with 3 robust setae apically; outer plate with 4 apical plumose setae; palp 4-articulate, article 1 with

mediodistal seta, inner margins of articles 2 and 3 with setae, article 4 curved, with 2 setae on its outer margin.

Gnathopod 1 (= pereopod 1) (Fig. 5B, C) with shallow coxa (= article 1), width 1.9 times as long as length, bearing seta on its anterodistal corner and 2 setae on ventral margin; posterior margin and inner surface of article 2 with 2 and

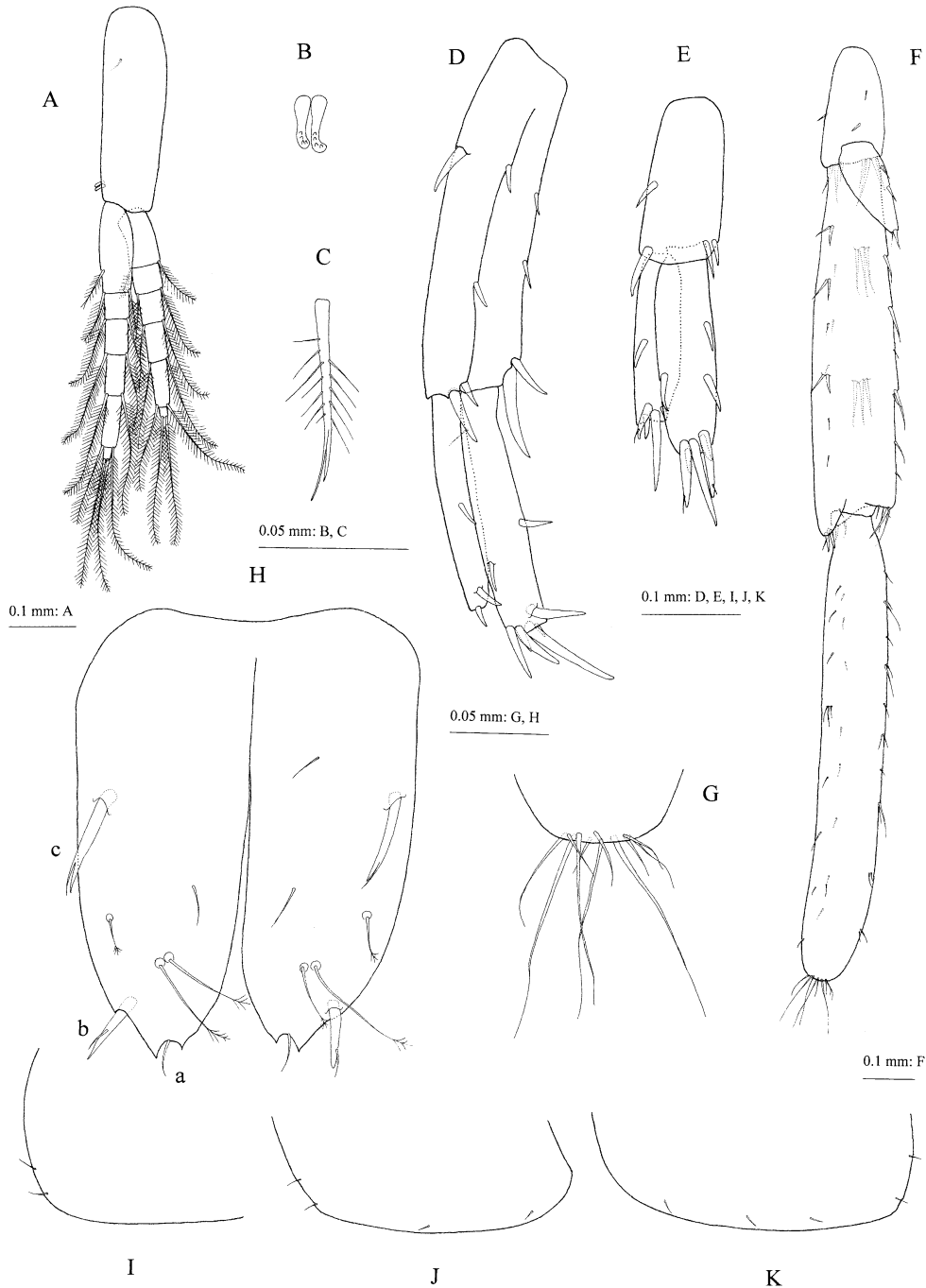


Fig. 7. *Psammogammarus mawatarii* sp. nov., holotype, male (3.5 mm), NSMT-Cr 20988, Kuchinoerabu Island, Kagoshima Prefecture. (A) pleopod 2, anterior view; (B) retinacula on peduncle of pleopod 2, medial view; (C) bifid plumose seta (clothes-pin seta) on inner basal margin of inner ramus of pleopod 2, anterior view; (D–F) left uropods 1–3, respectively, dorsolateral view in uropod 1 and dorsal views in uropods 2 and 3; (G) distal part of terminal article of outer ramus of uropod 3, dorsal view; (H) telson, dorsal view (a, apical seta; b, subapical seta on outer lateral margin; c, lateral seta); (I) right epimeral plate 1, lateral view; (J) right epimeral plate 2, lateral view; (K) left epimeral plate 3, lateral view.

1 setae, respectively; posterodistal corner of article 3 with 2 setae; anterodistal corner of article 5 with seta; article 6 1.4 times as long as article 5, palmar margin oblique, weakly convex, with 11 robust setae, palmar corner with 1 simple and 1 bifid robust setae (Fig. 5C); article 7 as long as palmar margin, posterior margin smooth (Fig. 5C). Gnathopod 2 (= pereopod 2) (Fig. 5D, E) with shallow coxa, width 2.1 times as long as length, bearing seta on its anterodistal corner and

2 setae on ventral margin; anterior and posterior margins of article 2 each with 2 setae; posterodistal corner of article 3 with seta; article 6 length 3.4 times as long as article 5, palmar corner of article 6 produced bearing 2 robust setae, palmar margin humped (Fig. 5E); article 7 curved, distal end not exceeding palmar corner, posterior margin smooth. Pereopod 3 (Fig. 5F, G) with shallow coxa, width 1.9 times as long as length, bearing 5 setae on its ventral margin;

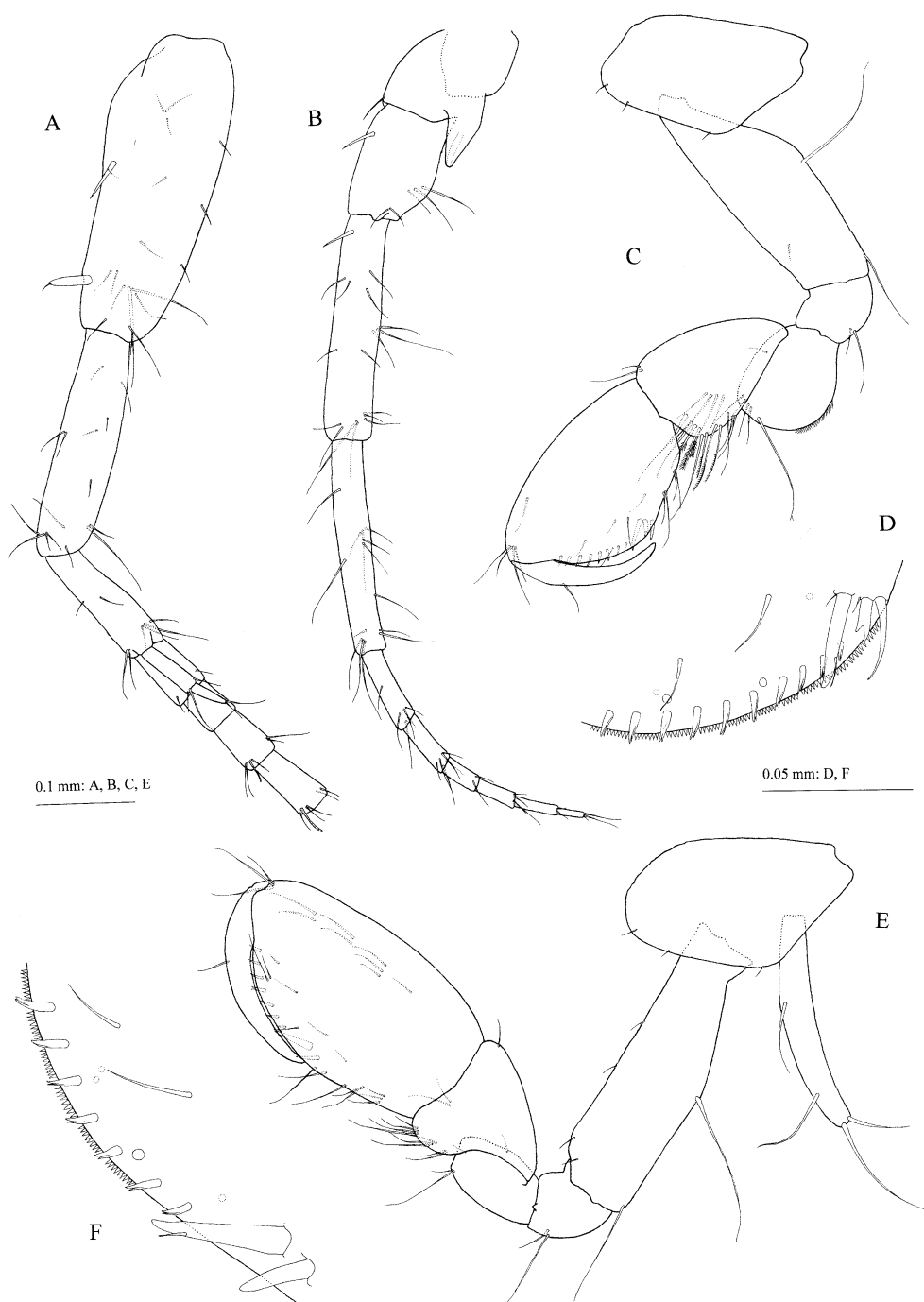


Fig. 8. *Psammogammarus mawatarii* sp. nov., paratype, female (3.2 mm), NSMT-Cr 20990, Kuchinoerabu Island, Kagoshima Prefecture. (A) peduncular articles 1–3, primary flagellar articles 1–4, and accessory flagellum of antenna 1, medial view; (B) antenna 2, medial view; (C) gnathopod 1, lateral view; (D) palmar margin of gnathopod 1, medial view, some setae omitted; (E) gnathopod 2, lateral view; (F) palmar margin of gnathopod 2, medial view, some setae omitted.

anterior and posterior margins of article 2 each with 5 setae; article 7 0.3 times as long as article 6, with seta on antero-proximal margin (Fig. 5G). Pereopod 4 (Fig. 5H) with shallow coxa, width 1.9 times as long as length, bearing seta on its anterodistal corner and 4 setae on ventral margin; anterior and posterior margins of article 2 each with 4 setae; article 4 broader than that of pereopod 3; article 7 0.3 times as long as article 6, with seta on antero-proximal margin. Pereopod 5 (Fig. 6A) with weakly bilobed coxa bearing 4 and 2 setae on its anterior and posterior lobes, respectively; anterior and posterior margins of article 2 with 4 and 6 setae, respectively, anterodistal corner with seta, posterodistal lobe developed, bearing 2 setae; article 7 0.4 times as long as article 6, with seta on posteroproximal margin. Pereopod 6 (Fig. 6B, C) with weakly bilobed coxa; anterior and posterior margins of article 2 with 4 and 7 setae, respectively, anterodistal corner with seta, posterodistal lobe developed bearing 2 setae (Fig. 6C); article 7 0.4 times as long as article 6, with seta on posteroproximal margin. Pereopod 7 (Fig. 6D, E) with concave ventral margin of coxa bearing 2 setae; anterior and posterior margins of article 2 each with 3 setae, anterodistal corner with seta, posterodistal lobe developed bearing 2 setae (Fig. 6D); article 7 0.3 times as long as article 6, with seta on posteroproximal margin.

Coxal gills on gnathopod 2 and pereopods 3–6, sternal gill absent.

Pleopods 1–3 (Fig. 7A–C) each with paired retinacula (Fig. 7B) on inner distal margin of peduncle, and bifid plu-

mose seta (clothes-pin seta) on inner basal margin of inner ramus (Fig. 7C); inner rami of pleopods 1–3 consisting of 7, 6, and 5 articles, respectively; outer rami of pleopods 1–3 consisting of 6, 6, and 5 articles, respectively.

Uropod 1 (Fig. 7D) with robust seta on basofacial part of peduncle; inner ramus 0.7 times as long as peduncle, inner and outer margins each with robust seta, ventral margin with slender seta; outer ramus 0.9 times as long as inner, its outer margin with robust seta. Uropod 2 (Fig. 7E) with inner and outer rami; inner ramus 1.3 times as long as peduncle, its inner and outer margins with 2 and 1 setae, respectively; outer ramus 0.8 times as long as inner ramus, its outer margin with robust seta. Uropod 3 (Fig. 7F, G) with peduncle 0.14 times as long as outer ramus, with 3 setae; inner ramus 0.12 times as long as outer ramus, with 2 robust setae on inner margin, and 1 robust and 1 slender apical setae; outer ramus 2-articulate, proximal article with simple, slender setae, terminal article 1.3 times as long as proximal article, with slender setae apically.

Telson (Fig. 7H) 1.3 times as long as wide, cleft for 90% of length, apical seta (seta a) short, 0.09 times as long as telson, subapical seta on outer lateral margin (seta b) robust and 0.17 times as long as telson, lateral seta (seta c) robust and quarter length of telson.

Description of female (paratypes, NSMT-Cr 20990 and NSMT-Cr 20991 for eggs)

Antenna 1 (Fig. 8A) 0.4 times as long as body length,

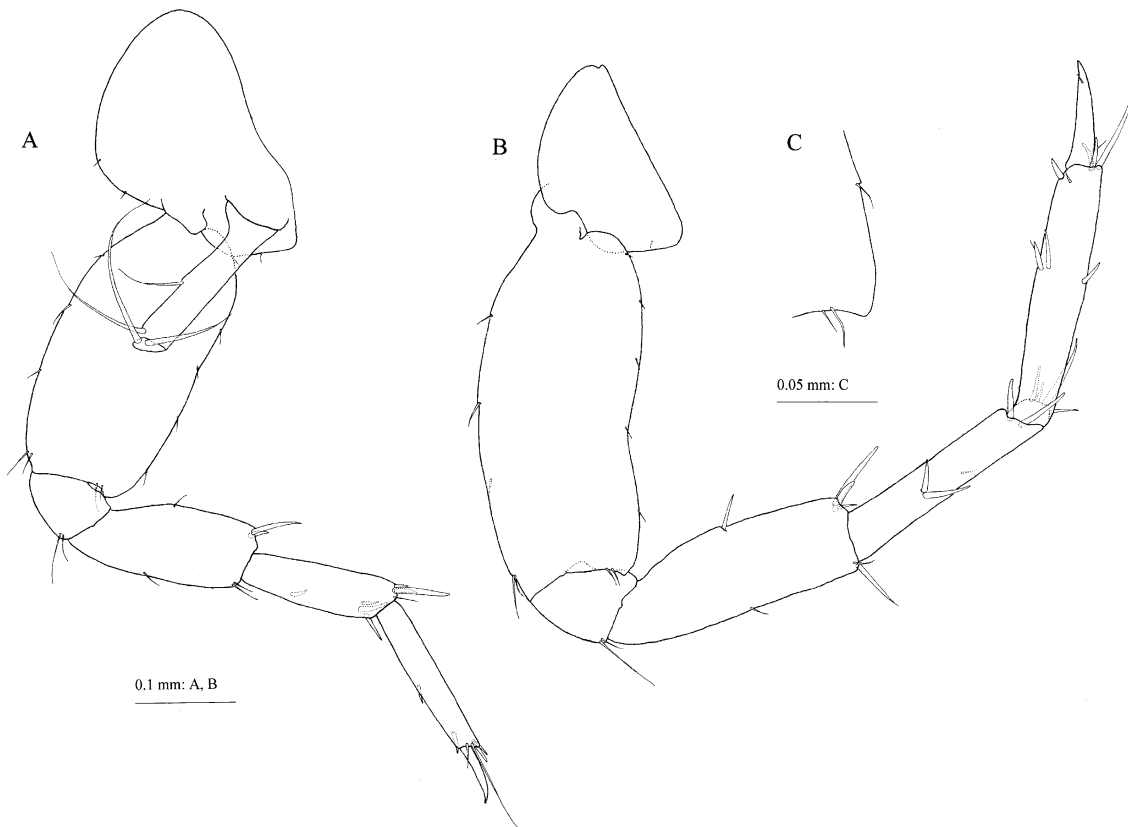


Fig. 9. *Psammogammarus mawatarii* sp. nov., paratype, female (3.2 mm), NSMT-Cr 20990, Kuchinoerabu Island, Kagoshima Prefecture. (A) pereopod 5, medial view; (B) pereopod 6, lateral view; (C) posterodistal lobe of article 2 of pereopod 6, lateral view.

peduncular articles 1 to 3 in length ratio of 1.0:0.8:0.5; accessory flagellum longer than primary flagellum article 1; primary flagellum 12-articulate. Antenna 2 (Fig. 8B) 0.7 times as long as antenna 1; flagellum 0.7 times as long as peduncular articles 4 and 5 combined, consisting of 6 articles.

Gnathopod 1 (Fig. 8C, D) with shallow coxa, width 1.6 times as long as length; anterodistal corner of article 5 with 2 setae; article 6 subchelate, length 1.7 times as long as article 5, palmar margin with 10 robust setae, palmar corner with 1 simple and 1 bifid robust seta, and slender seta (Fig. 8D). Gnathopod 2 (Fig. 8E, F) with shallow coxa, width 1.7 times as long as length; anterior and posterior margins of article 2 with 2 and 1 setae, respectively, anterodistal and posterodistal corners with 2 and 1 setae, respectively; posterodistal corner of article 3 with 2 setae; article 6 subchelate, length 2.0 times as long as article 5, palmar margin oblique bearing 7 robust setae, palmar corner bearing 2 robust setae (Fig. 8F). Anterior and posterior margins of article 2 of pereopod 5 (Fig. 9A) with 3 and 4 setae, respectively, anterodistal and posterodistal corners each with 2 setae; article 7 0.37 times as long as article 6. Anterior and posterior margins of article 2 of pereopod 6 (Fig. 9B, C) with 3 and 5 setae, respectively, anterodistal and posterodistal corners each with 2 setae; article 7 0.4 times as long as article 6. Anterior and posterior margins of article 2 of pereopod 7 (Fig. 10A, B) with 2 and 4 setae, respectively, anterodistal and posterodistal corners with 2 and 1 setae, respectively;

article 7 0.4 times as long as article 6.

Brood plates (= oostegites) narrow and shorter than article 2 of pereopods, with a few marginal setae, on gnathopod 2 and pereopods 3–5 (Figs. 8E, 9A). Eggs oval, longest and shortest diameters 0.59 and 0.31 mm, respectively.

Uropod 1 (Fig. 10C) with 2 robust setae on basofacial part of peduncle. Uropod 3 (Fig. 10D, E) with peduncle 0.18 times as long as outer ramus, with 2 robust setae; inner ramus 0.2 times as long as outer ramus, with 2 robust setae on medial margin, and 2 robust apical setae; proximal article of outer ramus with both robust setae and simple, slender setae, terminal article of outer ramus 1.3 times as long as proximal article.

SEM observation of male specimen

Scanning electron photomicrographs of selected parts are shown in Fig. 11. The article 4 of gnathopod 1 bears trifurcate setae on the posterodistal part (Fig. 11B). Detailed morphology of these setae was difficult to see under the light microscope, and could be observed with scanning electron microscope only. Robust setae on the palmar margins of gnathopods 1 and 2 incompletely divide dichotomously and weakly crumpled (Fig. 11C, D). Dorsal margins of urosomites 1–3 bear pair of minute setae (Fig. 11E).

Variation

Individuals of the type series are generally similar in

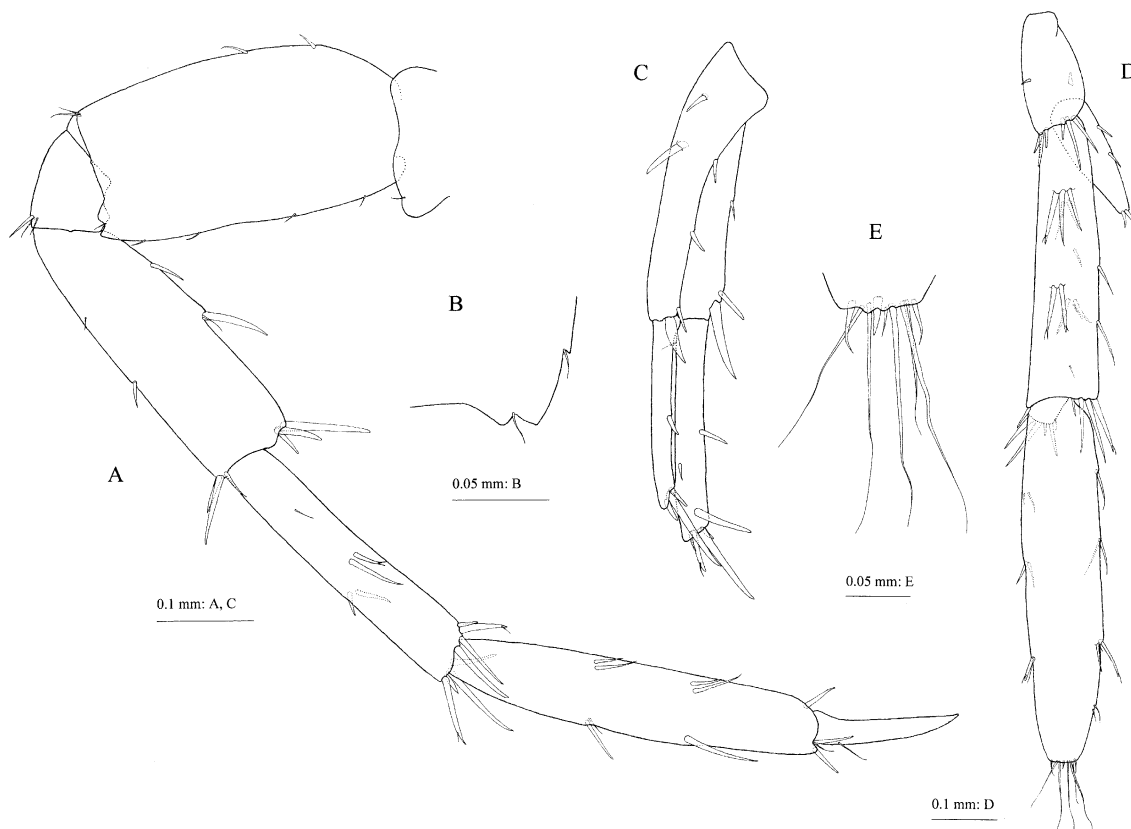


Fig. 10. *Psammogammarus mawatarii* sp. nov., paratype, female (3.2 mm), NSMT-Cr 20990, Kuchinoerabu Island, Kagoshima Prefecture. (A) pereopod 7, lateral view; (B) posterodistal lobe of article 2 of pereopod 7, lateral view; (C) left uropod 1, dorsolateral view; (D) right uropod 3, ventral view; (E) distal part of terminal article of outer ramus of uropod 3, ventral view.

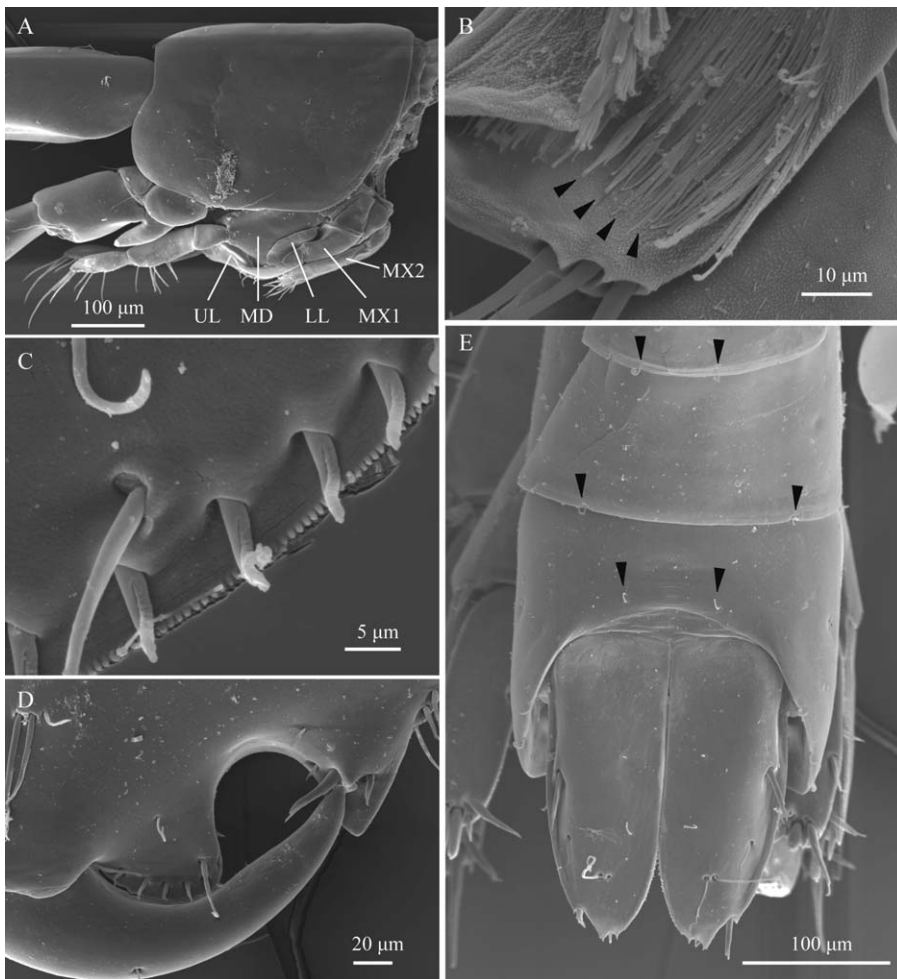


Fig. 11. Scanning electron photomicrographs of *Psammogammarus mawatarii* sp. nov., male. (A) head, lateral view (UL, upper lip; MD, mandible; LL, lower lip; MX1, maxilla 1; MX2, maxilla 2); (B) posterodistal part of article 4 of gnathopod 1, medial view, arrowheads indicate trifurcate setae; (C) palmar margin of gnathopod 1, medial view; (D) palmar margin and article 7 of gnathopod 2, medial view; (E) urosomites 1–3 and telson, dorsal view, arrowheads indicate setae on dorsal margins of urosomites 1–3.

morphology. However, the following features are slightly variable: 1) oblique inner row on inner plate of maxilla 2 always with four plumose setae except in one female (paratype, NSMT-Cr 20990), in which it is three plumose setae; 2) accessory setal rows of left and right mandibles with seven to eight and six to seven blade-like setae, respectively; 3) uropod 1 with always two robust setae on basofacial aspect of peduncle except in holotype, where it is one robust seta.

Etymology

The species is named in honour of Dr. Shunsuke F. Mawatari who has contributed greatly to the taxonomy of the Japanese invertebrates.

Distribution

The new species is known only from the type locality. This is the first record of the genus from Asia, although two species of the related genus, *Flagitopisa* G. Karaman, 1984, are distributed in freshwater of The Philippines (Sawicki et al., 2005).

Remarks

The present new species is assigned to *Psammogammarus* in having the following features: 1) lateral cephalic lobe without incision; 2) article 3 of mandibular palp shorter than article 2; 3) anterodistal corner of coxa of gnathopod 1 not produced; 4) article 2 of pereopod 7 not broad; and 5) telson with lateral robust setae (G. Karaman, 1984; Jaime and Garcia, 1992). Distinguishing features among species of *Psammogammarus* are summarized in the Table 1. *Psammogammarus mawatarii* sp. nov. is the most similar to *P. garthi* J. L. Barnard, 1952 from the coast of Lower California in sharing the following features: 1) incisor of right mandible four-dentate; 2) palmar margin of gnathopod 1 transverse and not expanded; 3) sexual dimorphism in gnathopod 2 present; 4) palmar corner of male gnathopod 2 with two robust setae; 5) uropod 1 with robust setae on basofacial aspect of peduncle; 6) rami of uropods 1 and 2 bearing marginal setae; 7) inner ramus of uropod 3 shorter than one-quarter length of its outer ramus; 8) telson lacking inner lateral setae; and 9) apical seta of telson slender and very short. However, the former is distinguished from the latter in the following respects (features of *P. garthi* in parentheses): 1) lateral cephalic lobe of head not produced (versus strongly produced); 2) head lacking antennal sinus (vs. with very shallow antennal sinus); 3) posteroventral corner of epimeral plate 3 rounded (vs. strongly pointed).

DISCUSSION

We found hard parts of mouthparts and legs of harpacticoid Copepoda in the midgut of the holotype of *P. mawatarii* (Fig. 12). In general, carnivorous amphipods have mandibles with stout incisors and lacinia mobilis, the cutting edges of which are broadened to sharp; molars of mandibles are reduced and non-tritulative; and, maxillae 1 and 2 with setae reduced in number and size (Coleman, 1989; Mayer et al., 2008). These features might be useful to predation of animal tissues. *Psammogammarus mawatarii* sp. nov. shares features found in a carnivorous type: the incisors and lacinia mobilis of the mandibles are stout and its cutting edges are sharp; the molars are non-tritulative; setae on the maxillae 1 and 2 are reduced, the inner plate of maxilla 1 bears one simple and four plumose setae on its medial margin, the inner plate of the maxilla 2 bears an oblique inner row of three or four plumose setae. Judging from the morphology of its mouthparts and gut contents, *P. mawatarii* seems to be

Table 1. A comparison among *Psammogammarus* species.

	<i>P. mawatarii</i> sp. nov.	<i>P. bluefieldensis</i> Ortiz, Lalana and Beltran, 1993	<i>P. burri</i> Jaume and Garcia, 1992	<i>P. caecus</i> S. Karaman, 1955	<i>P. caesicolus</i> Stock, 1980	<i>P. garthi</i> J. L. Barnard, 1952	<i>P. gracilis</i> (Ruffo and Schiecke, 1975)
Right mandible, incisor	with 4 dentes	with 5 (?) dentes	with 4 dentes	with 5 dentes	with 5 dentes	with 4 (?) dentes	with 5 dentes
Gnathopod 1, palmar margin	transverse	expanded	transverse	transverse	transverse	transverse	transverse
Gnathopod 2, sexual dimorphism in propodus	present	?	absent	present	present	present	present
Gnathopod 2 in male, number of robust setae on palmar corner	2	?	2	2	4	2	1
Pereopods 5–7, dactyli	normal	normal	normal	normal	normal	normal	normal
Epimeral plate 3, posteroventral corner	rounded	pointed	quadrate	pointed	quadrate	pointed	rounded
Uropod 1, basofacial robust setae	present	absent	present	present	present	present	absent
Uropods 1 and 2, marginal setae of rami	present	absent	absent in uropod 1, present in 2	present	present	present	absent
Uropod 3, inner ramus	12–20% of outer ramus	21% of outer ramus	13% of outer ramus	25% of outer ramus	40% of outer ramus	10.6–20% of outer ramus	9.5% of outer ramus
Telson, inner lateral setae	absent	absent	absent	absent	absent	absent	absent
Telson, apical seta	slender; 9% of telson	slender; 19% of telson	slender; 8% of telson	slender; 8% of telson	slender; 9% of telson	slender; 7% of telson	robust; 41% of telson
References	Present study	Ortiz, Lalana and Beltran (1993)	Jaume and Garcia (1992)	S. Karaman (1955), Ruffo and Schiecke (1975)	Stock (1980)	J. L. Barnard (1952)	Ruffo and Schiecke (1975)

	<i>P. initialis</i> Stock and Sanchez, 1987	<i>P. longidactylus</i> Vonk and Stock, 1987	<i>P. longiramus</i> (Stock and Nijssen, 1965)	<i>P. scopulorum</i> Stock, 1983	<i>P. spinosus</i> Stock and Vonk, 1992	<i>P. stocki</i> Vonk, 1990
Right mandible, incisor	with 5 dentes	with 6 dentes	with 5 dentes	with 4 dentes	with 5 dentes	?
Gnathopod 1, palmar margin	transverse	transverse	transverse	transverse	transverse	transverse
Gnathopod 2, sexual dimorphism in propodus	present	absent	?	?	present	present
Gnathopod 2 in male, number of robust setae on palmar corner	2	2	?	?	2	2
Pereopods 5–7, dactyli	normal	elongate	normal	normal	normal	normal
Epimeral plate 3, posteroventral corner	pointed	pointed	pointed	pointed	weakly pointed	rounded
Uropod 1, basofacial robust setae	present	present	present	present	present	absent
Uropods 1 and 2, marginal setae of rami	present	present	present	present	present	absent
Uropod 3, inner ramus	45% of outer ramus	76% of outer ramus	73% of outer ramus	50% of outer ramus	17% of outer ramus	9% of outer ramus
Telson, inner lateral setae	present	absent	present	absent	absent	absent
Telson, apical seta	robust; 17% of telson	robust; 11% of telson	robust; 13% of telson	slender; 15% of telson	slender; 67% of telson	absent
References	Stock and Sanchez (1987)	Vonk and Stock (1987)	Stock and Nijssen (1965)	Stock (1983)	Stock and Vonk (1992)	Vonk (1990)

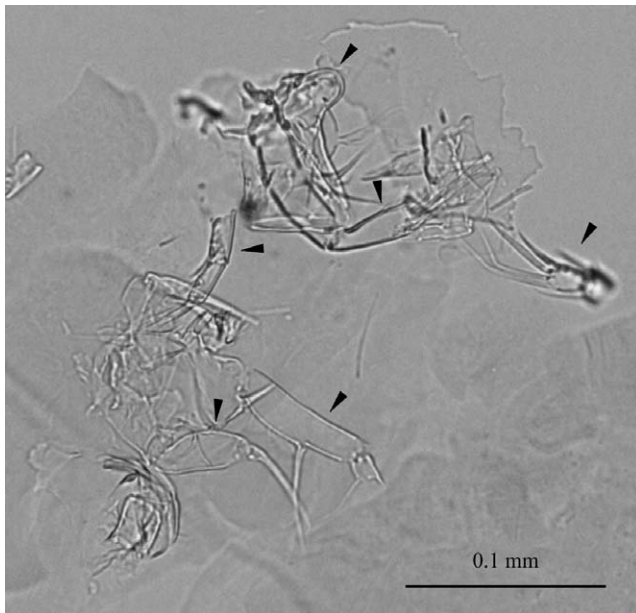


Fig. 12. Optical photomicrograph of gut contents of *Psammogammarus mawatarii* sp. nov. Arrowheads indicate hard parts of harpacticoid Copepoda.

assigned to a carnivorous type of amphipods. Meanwhile, we recognized the occurrence of tanaid crustaceans (families Leptochelidae and Tanaidae) in the same locality, but did not find its remnants in amphipod gut. Platvoet et al. (2006) mentioned that feeding types can only be applied in combination with a thorough knowledge of the feeding habits of the organisms involved, because feeding types may be seasonally changeable, or due to their developmental state or food supply. Further study of feeding behavior will be needed to ensure the above speculation regarding the feeding type of *P. mawatarii*. Although feeding behaviors of other species of *Psammogammarus* are little known, some species, *P. burri*, *P. longiramus*, *P. initialis*, and *P. longidactylus* have many long plumose setae on inner plates of the maxillae 1 and 2 besides stout incisors and lacinia mobilis of the mandibles and its cutting edges are sharp, suggesting that, in addition to a carnivorous type, other modes of feeding are possible for these species. Long plumose setae on the maxillae 1 and 2 seem to be used for filtering suspended particles or surface detritus. They may not be specialized carnivores, but rather unspecialized generalist feeders.

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