

A New Species of the Sand-burrowing Dogielinotidae, *Haustorioides furotai*, from Tokyo Bay, Japan (Crustacea: Amphipoda)

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(Received 11 February 2020; Accepted 10 December 2020)

<http://zoobank.org/7B7942B9-1754-4D12-BD2E-4D962AEED65C>

A new species of the sand-burrowing dogielinotid amphipod genus *Haustorioides* Oldevig, 1958, *Haustorioides furotai* Ogawa, sp. nov., is described from Banzu tidal flat, east coast of Tokyo Bay, Japan. The new species is mainly characterized by a slender and triangular outer plate of the maxilliped, poorly setose antennae and pereopods, straightly acute posterodistal corner of epimeral plates 2 and 3, and an uncleft and ridged telson. Analyses of the mitochondrial cytochrome *c* oxidase subunit I sequences verified that *H. furotai* belongs to the monophyletic clade consisting of the other *Haustorioides* species. Additionally, *Eohaustorioides* Bousfield and Tzvetkova, 1982, and *Parhaustorioides* Ren, 2006 are synonymized with *Haustorioides* based on morphological analysis. An identification key to the species of the genus *Haustorioides* is also provided.

Key Words: new synonym, Japan, COI.

Introduction

The dogielinotid genus *Haustorioides* Oldevig, 1958 is known as sand-burrowing amphipods inhabiting shallow waters in the northwest Pacific and represented by the following eight species in this genus: *H. gurjanovae* Bousfield, 1982, *H. indivisus* Jo, 1988, *H. japonicus* Kamihira, 1977, *H. koreanus* Jo, 1988, *H. latipalpus* Jo, 1988, *H. munsterhjelmii* Oldevig, 1958, *H. magnus* Bousfield, 1982, and *H. nesogenes* Jo, 1988 (Kamihira 1999).

Bousfield and Tzvetkova (1982) split *H. japonicus* off from *Haustorioides* and established the new genus *Eohaustorioides* Bousfield and Tzvetkova, 1982 for the species as monotypy. *Eohaustorioides* was distinguished from *Haustorioides* by following 5 characters: 1) proboscoid epistoma, 2) carpus of pereopod 5 subtriangular, 3) dactylus of pereopod 6–7 long and wide, 4) straight-toothed epimeral plates 1–3, and 5) uncleft telson.

However, Jo (1988) reported that proboscoid epistoma is absent in a topotype specimen of *H. japonicus*. He also found that three Korean species *H. indivisus*, *H. latipalpus* and *H. nesogenes* displayed intermediate characters of the two genera *Haustorioides* and *Eohaustorioides* (e.g., straight-toothed epimeral plates 2–3; variously cleft and completely fused telson), and have concluded that the genus *Eohaustorioides* was invalid. Later, Kamihira (1999) confirmed Jo's suggestion by phenetic analysis of 11 species of Dogielinotidae.

Barnard and Karaman (1991) treated *Eohaustorioides* as a

valid taxon and did not consider Jo (1988)'s report in their study. Recent studies (Serejo 2004; Ren 2006; Wongkamhaeng et al. 2018) referred to Barnard and Karaman (1991) without consideration of Jo's argument.

In addition, Ren (2006) established the genus *Parhaustorioides* Ren, 2006 for *P. littoralis* Ren, 2006 as monotypy. According to the study, the genus *Parhaustorioides* was distinguished from *Haustorioides* by the following 3 characters: 1) each merus of pereopod 3 and 4 without sharp anterodistal lobes, 2) posterodistal corner of epimeral plate 3 without large tooth, and 3) telson uncleft.

Therefore, two species of sand-burrowing dogielinotids were known from Japan. *H. japonicus* was described from western Hokkaido (Kamihira 1977), and thereafter reported along the coast of the Japan Sea southwest to Shimane Prefecture, and also along the coasts of the Pacific Ocean south to Tokyo Bay, Aomori and Miyagi prefectures (Kamihira 1992). On the other hand, *H. munsterhjelmii* was reported from eastern Hokkaido (Kamihira 1992). Recently, Takada et al. (2018) recognized five genetic clades among the populations of *H. japonicus* along the Japanese coast of Japan Sea, East China Sea and the northwestern Pacific, and Sakuma et al. (2019) reported an additional population from Miyagi Prefecture. However, the taxonomic status of those clades still remains undetermined.

During surveys of intertidal amphipod fauna around Tokyo Bay from 2010, a number of specimens belonging to *Haustorioides* were collected from Banzu tidal flat, Chiba Prefecture. Careful morphological observations and genetic analyses revealed that they composed a single species, which

is distinguished from *H. japonicus*. Therefore, we herein describe them as a new species.

Materials and Methods

Field sampling and morphological observation. All specimens were collected from Banzu tidal flat, located at a mouth of Obitsu River, Chiba Prefecture, Japan (Fig. 1). Amphipods were taken together with the sandy mud substrate of the tidal flat surface by a shovel at low tide in the intertidal zone or were caught by a trawl net (net length: 10,000 mm, mesh size: 1 mm, width of mouth flame: 500 mm, height of mouth flame: 250 mm, with front chain, products by RIGO Co., Ltd.) in high tide in the subtidal zone. Samples were sieved through a 1 mm mesh and sorted in the field, then fixed and preserved in 70% ethanol. In some cases, whole bodies of individuals were preserved in 6 M TNES (Tris HCl, EDTA, NaCl, SDS) urea buffer (hereafter “urea buffer”) which contains a high concentration of urea and allows cell lysis and DNA preservation at ambient temperature. Specimens used for morphological observations were transferred to pure glycerin, parts were dissected, mounted on slides, and illustrated using a drawing tube attached to a stereomicroscope (Leica MZ8) and a biological microscope (Olympus BX50). Body length (BL) was measured along the dorsal side of the body from the apex of the rostrum to the distal tip of the telson. Two different size groups in adult were recognized, small (less than 4 mm BL) individuals occurred from spring to fall are designated “summer population”, and large (over 5 mm BL) individuals that occurred from summer to next spring are designated “winter population” for convenience. The holotype is selected from the winter population, and paratypes from both

winter and summer populations. After examination, the dissected parts were mounted on slides with gum-chloral medium. Specimens examined in this study are deposited in the National Museum of Nature and Science, Tsukuba (NSMT) and Natural History Museum and Institute, Chiba (CBM).

Laboratory procedures and data processing for genetic analyses. Total genomic DNA was extracted from each ethanol or urea-buffer-preserved specimen by using the Qiagen DNeasy Blood & Tissue kit (QIAGEN), following the manufacturer’s instructions. DNA was extracted using the whole body of 12 specimens chosen from the summer population. Additionally, eight specimens (paratypes: NSMT-Cr 28359–28362, CBM-ZC 16177–16180) of the winter population were extracted using internal tissues for DNA analysis with the remaining exoskeleton utilized for morphological observation. Partial sequences of the mitochondrial cytochrome *c* oxidase subunit I (COI) gene were amplified using the pairs of primers Crust-COIF and Perac-COIR (Teske et al. 2007), or LCO1490 and HCO2198 (Folmer et al. 1994). Premix Taq (Takara Bio) or KOD -plus- (TOYOBO) were used in polymerase chain reaction (PCR). PCRs were performed following the manufacturer’s instruction, with different annealing temperature (40 and 50°C) and number of reaction cycles (35 and 25) for Premix Taq and KOD -plus-. For more detailed procedures, see Takada et al. (2018). All PCR products were subsequently sequenced in both directions by a commercial sequencing facility (FASMAC).

The forward and reverse sequences were assembled using Mesquite v3.01 (Maddison and Maddison 2011) and visually inspected. We also used COI sequences of the four congeners (*H. japonicus*, *H. koreanus*, *H. munsterhjelmii*, and *H. indivisus*), as well as *Exhyalella natalensis* Stebbing, 1917, another species in the family Dogielinotidae, and two species in the family Talitridae [*Platorchestia platensis* (Krøyer, 1845) and *Trinorchestia longiramus* Jo, 1988] as outgroup taxa. The sequences were aligned with the multiple sequence alignment program MAFFT v7.294 (Katoh and Standley 2013) and manually trimmed in MEGAX (Kumar et al. 2018). All sequences used in this study were deposited in GenBank (for accession numbers, see Table 1).

Phylogenetic analyses. Phylogenetic relationships between and within the species were inferred by Maximum-likelihood (ML) and Neighbor-joining (NJ) trees. We used RAxML v7.2.8 (Stamatakis 2006) for the ML analysis of COI sequences. The GTRCAT model, an approximation of General Time Reversible model of nucleotide substitution under the Gamma model of rate heterogeneity (GTR+Γ: Yang 1994) was used with 1000 rapid bootstrap iterations. For the NJ-tree, the best-fit nucleotide substitution model (TN93+Γ: Tamura and Nei 1993) was determined with MEGA prior to the analysis and used as a distance method. MEGAX was used for NJ analysis with 1000 bootstrap replicates.

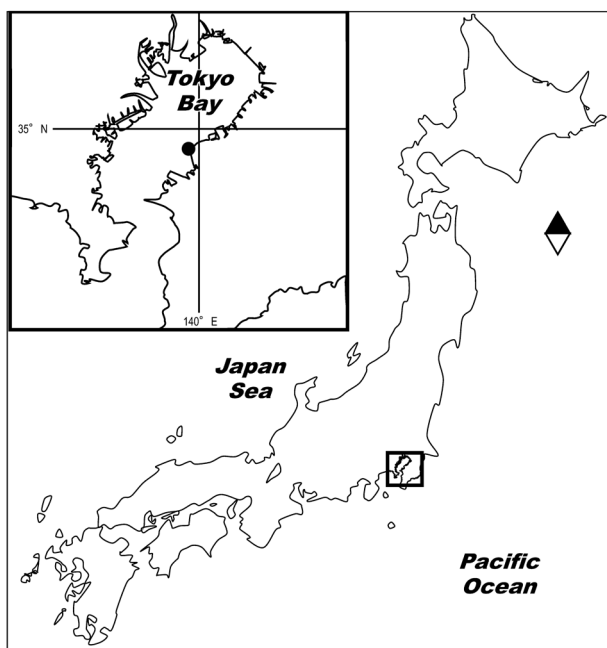


Fig. 1. Map showing a collecting site, Banzu tidal flat, Kisarazu City, Chiba Prefecture, Japan (filled circle).

Table 1. Specimens and INSDC accession numbers for their COI sequences examined in this study.

Taxon	Locality	Voucher	Accession no.
Dogielinotidae			
<i>Haustorioides furotai</i>	Chiba, Japan	NSMT-Cr 28359 (paratype)	Hfu 190101001 (LC595617)
<i>Haustorioides furotai</i>	Chiba, Japan	NSMT-Cr 28360 (paratype)	Hfu 190101002 (LC595618)
<i>Haustorioides furotai</i>	Chiba, Japan	CBM-ZC 16177 (paratype)	Hfu 190101003 (LC595619)
<i>Haustorioides furotai</i>	Chiba, Japan	CBM-ZC 16178 (paratype)	Hfu 190101004 (LC595620)
<i>Haustorioides furotai</i>	Chiba, Japan	NSMT-Cr 28361 (paratype)	Hfu 190101005 (LC595621)
<i>Haustorioides furotai</i>	Chiba, Japan	NSMT-Cr 28362 (paratype)	Hfu 190101006 (LC595622)
<i>Haustorioides furotai</i>	Chiba, Japan	CBM-ZC 16179 (paratype)	Hfu 190101007 (LC595623)
<i>Haustorioides furotai</i>	Chiba, Japan	CBM-ZC 16180 (paratype)	Hfu 190101008 (LC595624)
<i>Haustorioides indivisus</i>	South Korea		JX502953
<i>Haustorioides japonicus</i>	Yamaguchi, Japan		LC224260
<i>Haustorioides japonicus</i>	Saga, Japan		LC224278
<i>Haustorioides koreanus</i>	Korea	MABIK CR00246522	MN840593
<i>Haustorioides munsterhjelmii</i>	Hokkaido, Japan		LC224279
<i>Exhyalella natalensis</i>			AF520436
Talitridae			
<i>Platorchestia platensis</i>	Canada	BIOU 09BBCRU-0025	HQ946116
<i>Trinorchestia longiramus</i>			MH542431

Taxonomy

Genus *Haustorioides* Oldevig, 1958

[Japanese name: Naminori-sokoebi-zoku]

Haustorioides Oldevig, 1958: 343; Barnard 1967: 287; Bousfield and Tzvetkova 1982: 87; Jo 1988: 26–27; Barnard and Karaman 1991: 278; Ren 2006: 447.

Eohaustorioides Bousfield and Tzvetkova, 1982: 92 (type species: *Haustorioides japonicus* Kamihira, 1977, fixed by original designation). syn. nov.

Parhaustorioides Ren, 2006: 449–450, 557 (type species: *P. littoralis* Ren, 2006, fixed by original designation). syn. nov.

Type species. *Haustorioides munsterhjelmii* Oldevig, 1958, fixed by original designation.

Included species. *Haustorioides gurjanovae*; *H. indivisus*; *H. japonicus*; *H. koreanus*; *H. latipalpus*; *H. littoralis* comb. nov.; *H. magnus*; and *H. nesogenes*.

Amended diagnosis. Body smooth. Rostrum distinct. Eyes medium, ovoid or subtriangular. Lateral cephalic lobe subtriangular, lower antennal sinus heavily slanted. Antenna 1 subequal or shorter than antenna 2, without accessory flagellum, peduncles of both antennae shorter than flagellums. Labrum not proboscoid. Mandible: lacking palp, molar strongly triturate, incisor well toothed, lacinia mobilis 4–5 toothed. Labium with small inner lobes. Inner lobe of maxilla 1 short, bearing 2–3 apical plumose setae, outer lobe with long pectinate spines, palp minute, 1-articulated. Palp of maxilliped elongated, 4-articulated, multisetose; outer lobe not elongated.

Coxal plates 1–4 moderately large, deep, without distal process on posterior margins. Coxal plate 1 not reduced, with oblique angle anteroventrally. Gnathopod 2 sexually dimorphic, male gnathopod 2 subchelate, larger than gna-

thopod 1; female gnathopods 1 and 2 similar, each propodus subtriangular. Pereopods 3–4: each merus and carpus with long setae on posterior margins, each merus with anterodistal lobe; coxal plate 4 excavate posteriorly. Pereopod 5: basis expanded, merus and carpus expanded and with long seta on posterior margin, propodus linear. Pereopod 6: basis and merus expanded, posterior margin of merus with long setae, carpus and propodus linear, anterior margin of dactylus with some setae. Pereopod 7: basis expanded, merus, carpus and propodus linear, anterior margin of dactylus with setae. Coxal gills subrectangular or subtriangular. Oostegites on gnathopod 2 and pereopod 5 subtriangular, oostegites on pereopods 3–4 subrectangular.

Epimeral plates 1–2 each posterodistal corner with or without tooth. Epimeral plate 3 posterodistal corner with small or large tooth. Pleopods very powerful, peduncles short, with some retinacula on medial margins, rami with numerous plumose setae. Urosomites free, urosomite 1 dorsally overhanging 2 and 3. Uropods 1 and 2: biramous, each peduncle with seta on outer margin and without spines on dorsal margin; rami unarmed. Uropod 3 lacking rami. Telson cleft medially or uncleft.

Remarks. Jo (1988) concluded that the genus *Eohaustorioides* was invalid, but some recent studies (e.g., Barnard and Karaman 1991) without consideration of Jo's argument, probably because Jo's paper is not well-known and those recent studies missed his work. In addition, the ML and NJ trees of COI gene strongly suggest that *Eohaustorioides* is nested within *Haustorioides*. Therefore, we highlight Jo (1988)'s work again and treat *Eohaustorioides* as an invalid genus.

Additionally, Ren (2006) described the genus *Parhaustorioides* and suggested that 3 morphological characters were able to distinguish the genus from *Haustorioides*. However, those characters are also recognized in other *Haustorioides* species: 1) *H. nesogenes* with distinct broad lobe on each merus of pereopod 3 and 4 anterodistally, and *H. indivisus*,

H. japonicus, and *H. latipalpus* with small acute lobes on each merus of pereopod 3 and 4 anterodistally; 2) *H. indivisus*, *H. latipalpus*, and *H. nesogenes* with small tooth on postero-distal corner of epimeral plate 3; and 3) *H. indivisus* and *H. japonicus* with uncleft telson. As morphological differences between the two genera are unclear, we consider that *Par-haustorioides* is a synonym of *Haustorioides*.

***Haustorioides furotai* Ogawa, sp. nov.**

[New Japanese name: Usuge-naminori-sokoebi]
(Figs 2–8)

Material examined. Holotype: NSMT-Cr 28350, male (7.2 mm), Banzu tidal flat, Kisarazu City, Chiba Prefecture, 35°25'11"N, 139°52'36"E–35°24'46"N, 139°53'47"E, intertidal, 17 February 2018, coll. H. Ogawa. Paratypes: NSMT-Cr 28351, ovigerous female (7.2 mm), same data as holotype. NSMT-Cr 28352, immature female (9.3 mm), same data as holotype. NSMT-Cr 28355, male (8.0 mm), NSMT-Cr 28353, male (4.0 mm), NSMT-Cr 28354, ovigerous female (4.0 mm), and NSMT-Cr 28356, female (6.1 mm), Banzu tidal flat, 35°25'00"N, 139°51'00"E–35°24'59"N, 139°51'59"E, upper subtidal, 17 August 2010, coll. T. Furota, R. Suzuki, and H. Ogawa. NSMT-Cr 28357, ovigerous female (2.8 mm), Banzu tidal flat, 900 m offshore from the mouth of Obitsu River, 35°24'11"N, 139°53'00"E–35°24'59"N, 139°53'18"E, intertidal, 25 June 2010, coll. H. Ogawa. NSMT-Cr 28358, male (2.8 mm), Banzu tidal flat, 24 June 2010, coll. M. Taru. NSMT-Cr 28359, female (7.8 mm), NSMT-Cr 28360, female (7.5 mm), CBM-ZC 16177, female (8.5 mm), CBM-ZC 16178, female (8.2 mm), NSMT-Cr 28361, male (5.5 mm), NSMT-Cr 28362, male (6.8 mm), CBM-ZC 16179, male (5.1 mm), and CBM-ZC 16180, male (6.3 mm), Banzu tidal flat, 35°25'11"N, 139°52'36"E–35°24'46"N, 139°53'47"E, 9 March 2019, coll. H. Ogawa.

Diagnosis. Flagellums of antennae 1–2 with marginal setae on each article, 0–2 long (crossing, or reaching distal margin of next article) setae ventrodistally, and medium length (not reaching distal margin of next article) setae dorsodistally and ventrodistally. Labrum not proboscoid, without mid-medial seta, distally subtruncated. Outer plate of maxilliped acute angled. Coxal plates 1–4, each anterior margin with 0–5 setae. Anterodistal lobes of each merus pereopods 3 and 4 overlapped to each carpus. Dactyli of all pereopods claw-shaped (in pereopods 3 and 4, anterior margin curved, posterior margin straight; in pereopods 5–7, anterior margin straight, posterior margin curved) poorly setose; each dactylus of pereopods 5–7 about 0.6 times of each propodus in lengths. Pleopods with 4–7 retinacula. Epimeral plate 1 with a small tooth, epimeral plates 2 and 3 with straight tooth. Telson uncleft with a ridge reaching distal margin.

Description of male (based on holotype, NSMT-Cr 28350). Body smooth (Fig. 2). Rostrum distinct, medium. Eyes medium size, irregular ovoid. Lateral cephalic lobe slightly rounded triangular.

Antenna 1 (Fig. 3A): slightly shorter than antenna 2, fla-

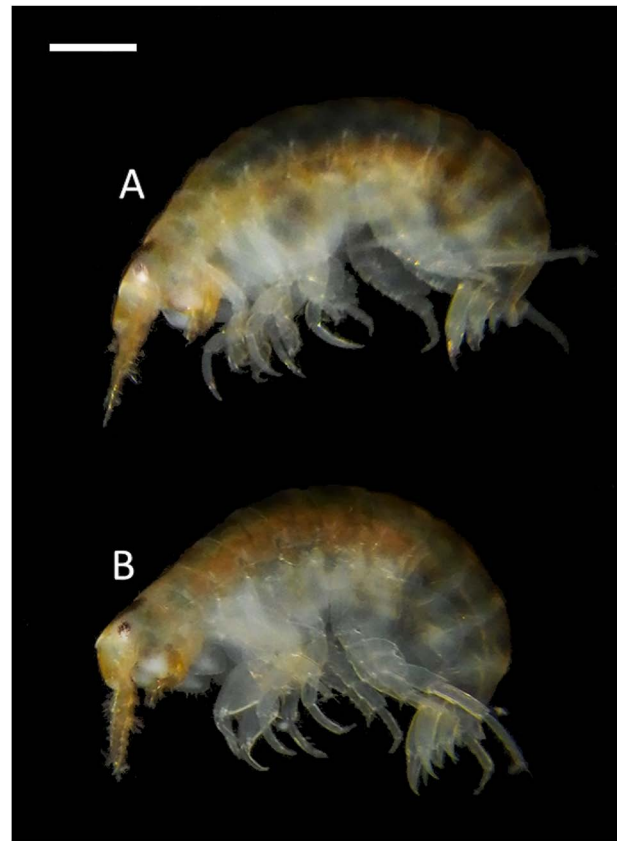


Fig. 2. *Haustorioides furotai* Ogawa, sp. nov., photographs of live animals. A, Paratype female (NSMT-Cr 28351), 7.2 mm; B, holotype, male (NSMT-Cr 28350), 7.2 mm. Scale bar: 1 mm.

gellum 7-articulated, each article with marginal setae (<10) include 0–2 long (crossing distal margin of next article) setae ventrodistally. 1 or 2 aesthetascs on ventrodistal margin of each article except first and last one. Antenna 2 (Fig. 3B): flagellum 9-articulated; each article with marginal setae (<20), include 0–2 long (crossing distal margin of next article) setae ventrodistally, except dorsolateral side.

Labrum (Fig. 3C): usual structure, not proboscoid, without mid-medial seta, distally subtruncated. Mandible (Fig. 3G, H): ventral side of molar with long plumose seta, right lacinia mobilis with slender teeth, left lacinia mobilis with robust teeth, each lacinia mobilis followed by 3 or more plumose blades. Maxilla 1 (Fig. 3E): palp minute, inner lobe short, with 2 apical plumose setae. Maxilla 2 (Fig. 3F) and labium (Fig. 3D) usual structure.

Maxilliped (Fig. 3I): inner lobe distally truncated, with 3 distal robust setae, not extending beyond apex of outer lobe; outer lobe subtriangular, reaching to top of lateral margin of palp article 1, palp as generic character.

Coxal plates 1–4 deep, with 3–5 marginal setae anteriorly.

Gnathopod 1 (Fig. 4A): subchelate, basis with a seta on posterodistal corner; propodus with a hump and bifid spines on posterior corner of palm; palm with microscopic scale-like structures (Fig. 4B).

Gnathopod 2 (Fig. 4C): subchelate; basis with 2 long setae on posterior margin; carpus with 3 small setae on anterodistal corner; propodus 2.5 times as long as carpus, slightly

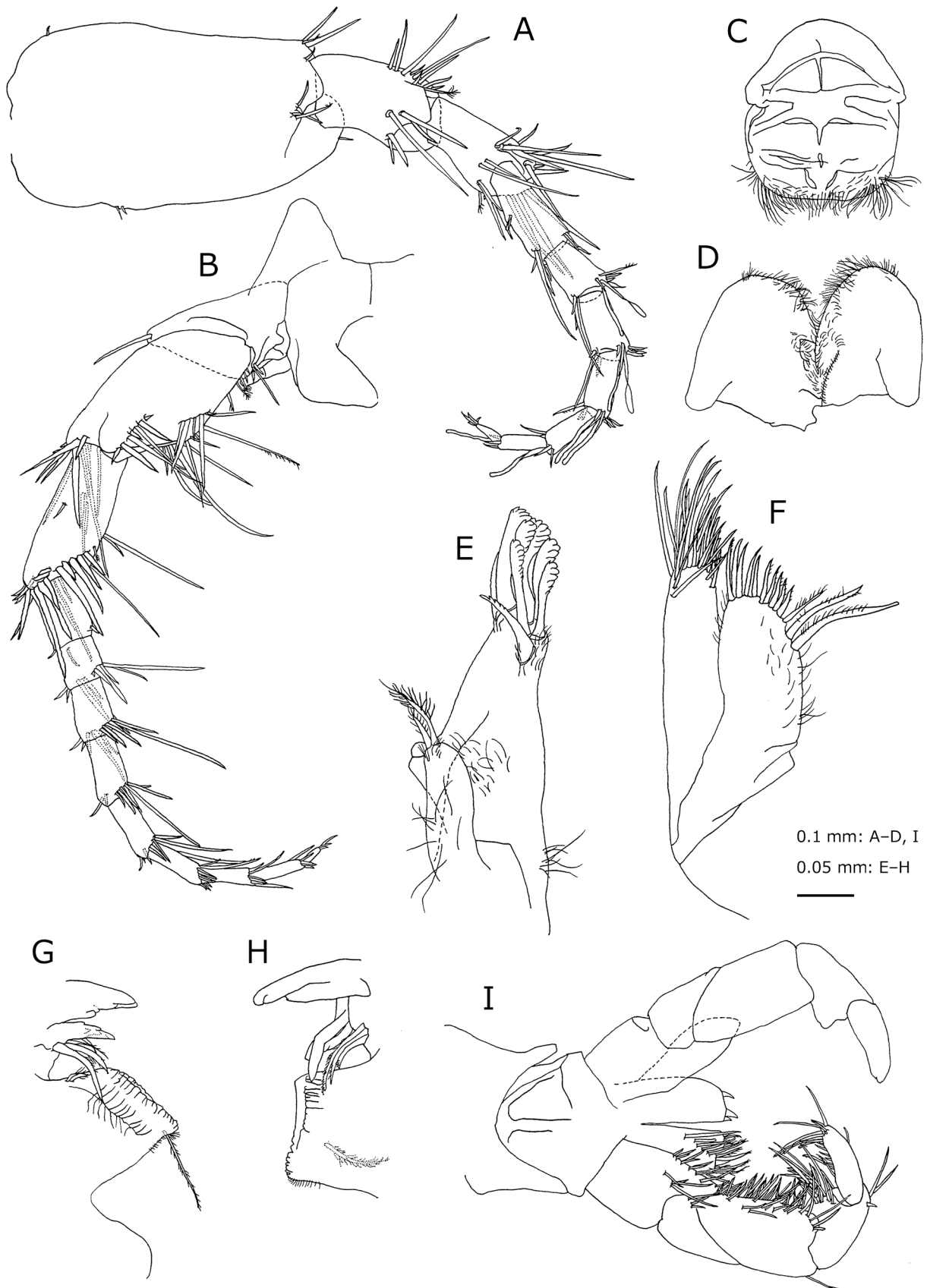


Fig. 3. *Haustorioides furotai* Ogawa, sp. nov., holotype, male (NSMT-Cr 28350), 7.2 mm. A, Left antenna 1; B, left antenna 2; C, labrum; D, labium; E, left maxilla 1; F, left maxilla 2; G, right mandible; H, left mandible; I, maxilliped.

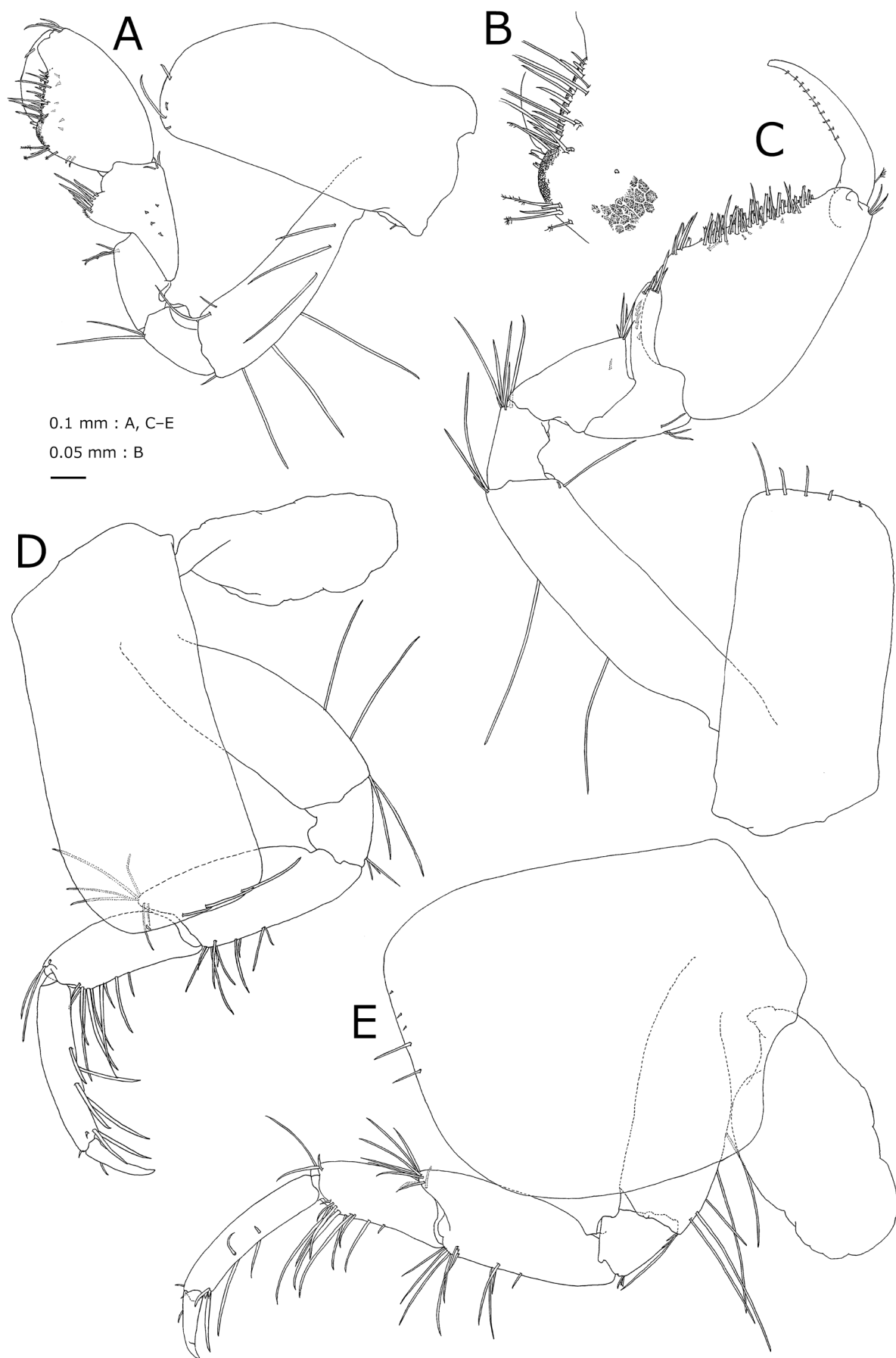


Fig. 4. *Haustorioides furotai* Ogawa, sp. nov., holotype, male (NSMT-Cr 28350), 7.2 mm A, Left gnathopod 1; B, palm of left gnathopod 1; C, left gnathopod 2; D, left pereopod 3; E, left pereopod 4.



Fig. 5. *Haustorioides furotai* Ogawa, sp. nov., holotype, male (NSMT-Cr 28350), 7.2 mm. A, Left pereopod 5; B, left pereopod 6; C, left pereopod 7.

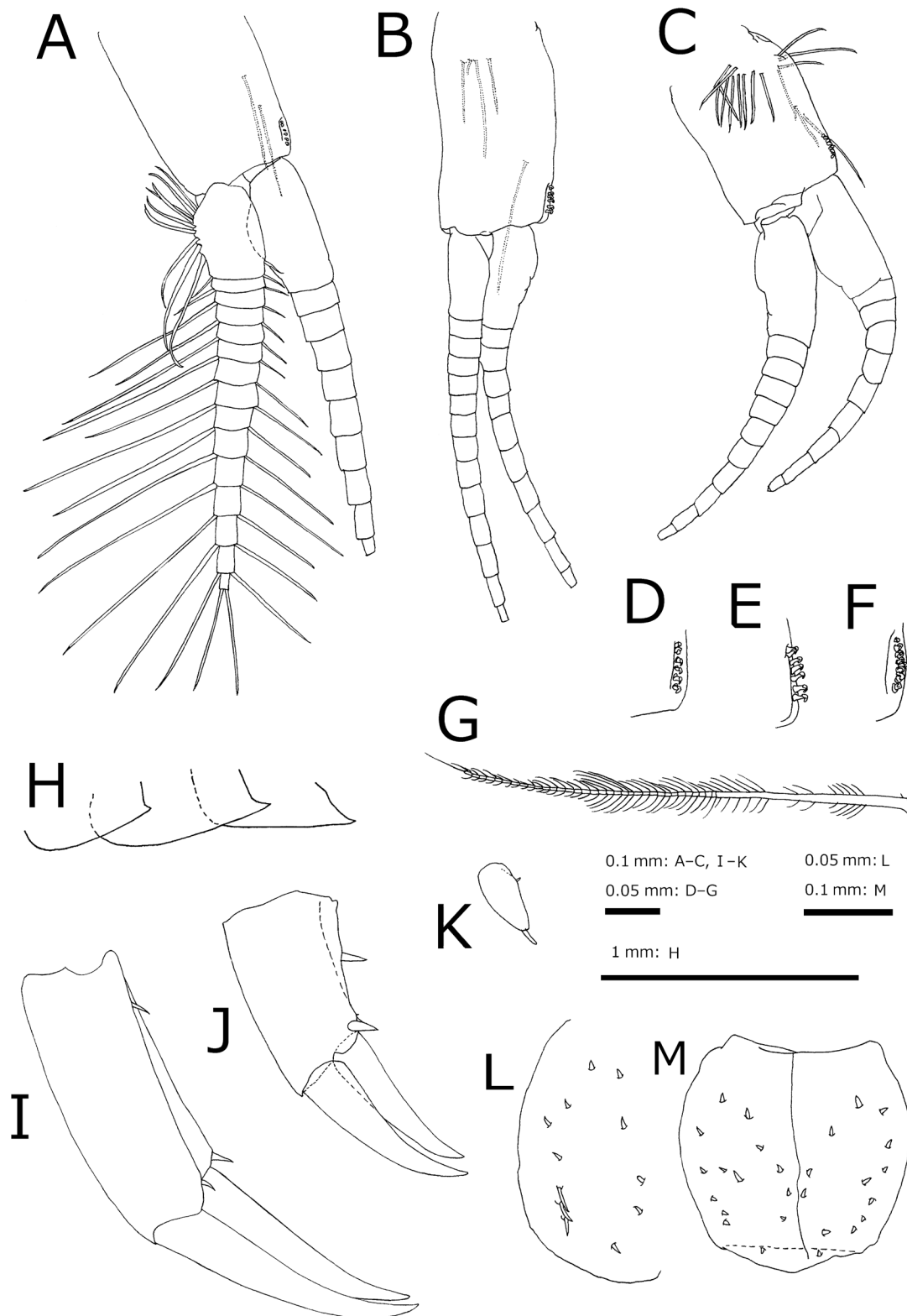


Fig. 6. *Haustorioides furotai* Ogawa, sp. nov., holotype, male (NSMT-Cr 28350; A–L), 7.2 mm, and paratype, female (NSMT-Cr 28351; M), 9.0 mm. A, Left pleopod 1, branch of plumose setae of outer ramus and plumose setae of inner ramus omitted; B, left pleopod 2, plumose setae of both rami omitted; C, left pleopod 3, plumose setae of both rami omitted; D, retinacula of pleopod 1; E, retinacula of pleopod 2; F, retinacula of pleopod 3; G, plumose setae of pleopod ramus; H, epimeral plates 1–3; I, left uropod 1; J, left uropod 2; K, left uropod 3; L, left lobe of telson; M, telson.

inflated anteriorly, palm longer than 1.5 times of posterior margin.

Pereopods 3–4: each merus with sharp anterodistal lobe

and overlapped to carpus; each merus and carpus with some setae on posterior margin; each dactylus without setae on posterior margin.

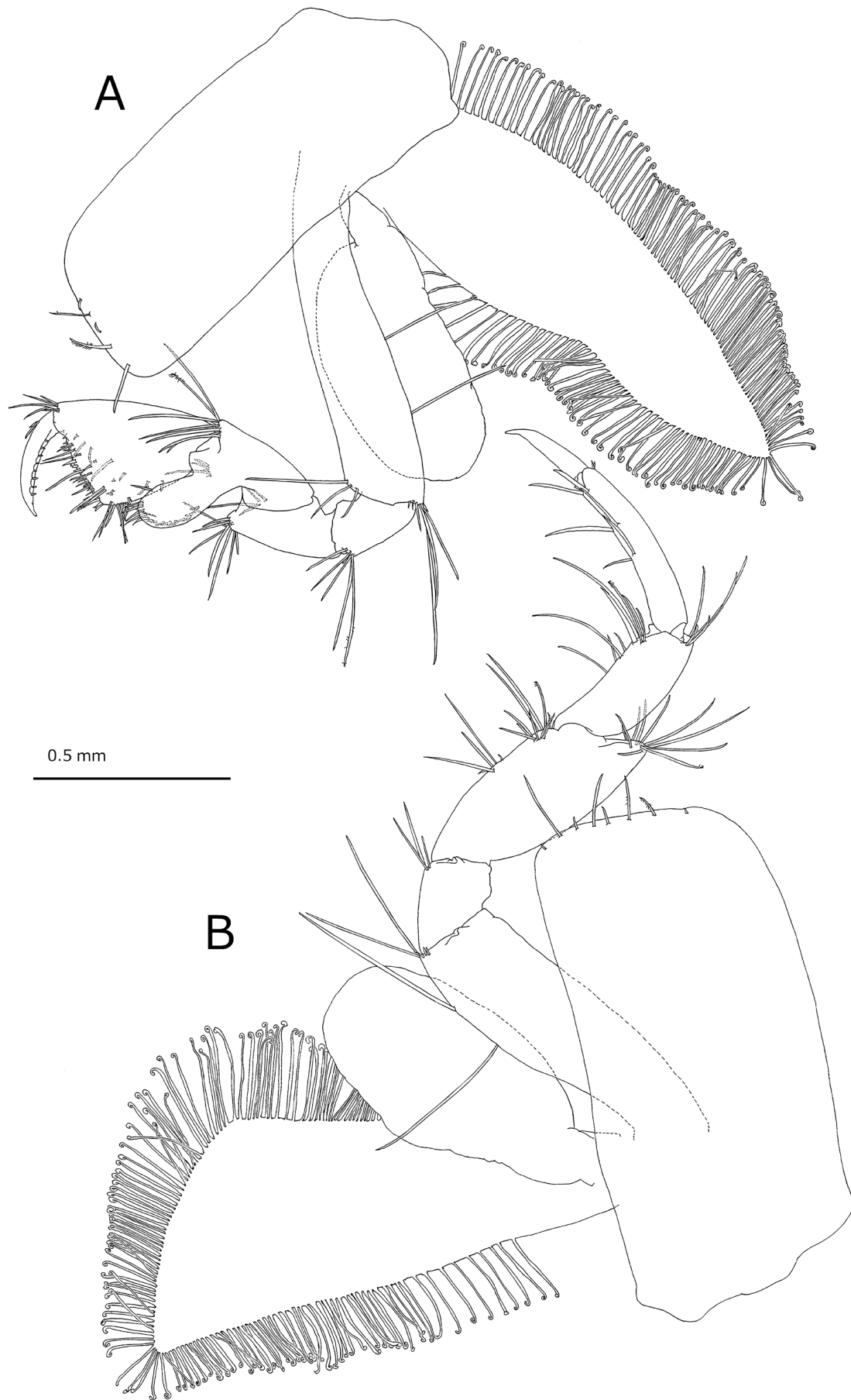


Fig. 7. *Haustorioides furotai* Ogawa, sp. nov., paratype, female (NSMT-Cr 28351), 9.0 mm. A, Left gnathopod 2; B, left pereopod 3.

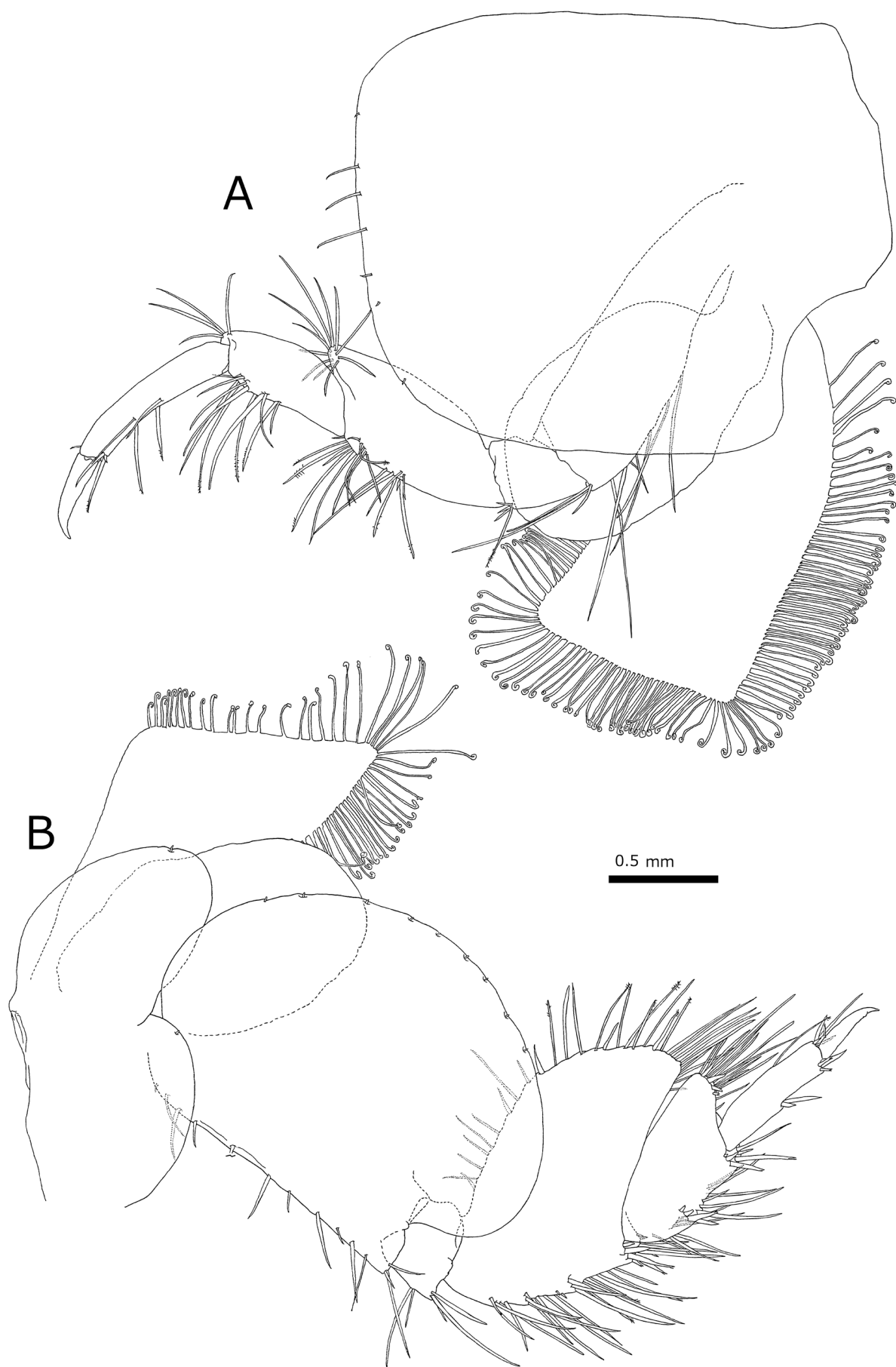


Fig. 8. *Haustorioides furotai* Ogawa, sp. nov., paratype, female (NSMT-Cr 28351), 9.0 mm. A, Left pereopod 4; B, left pereopod 5.

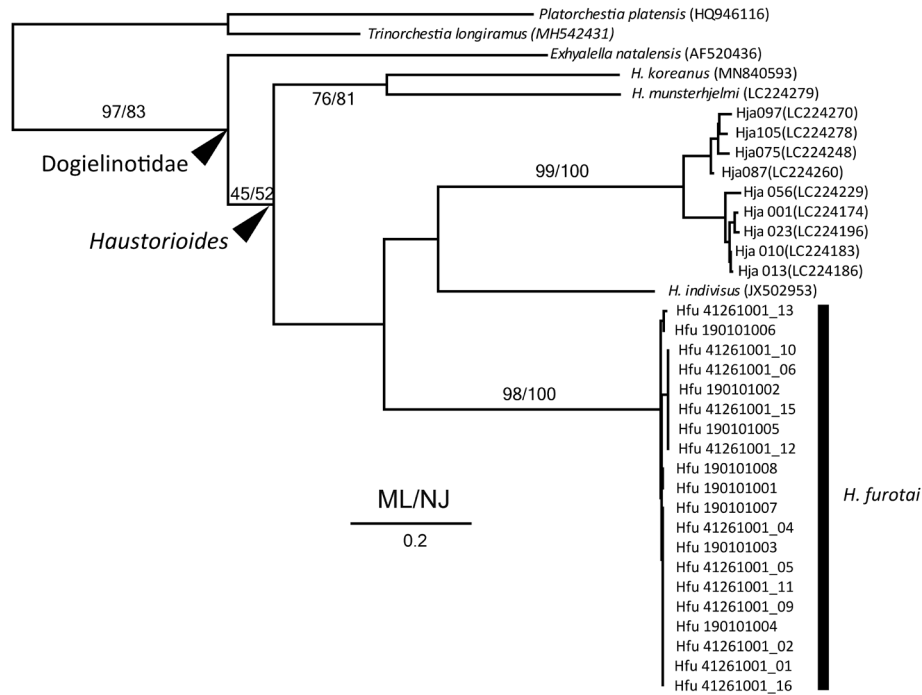


Fig. 9. Best-scoring maximum likelihood tree of mitochondrial COI haplotypes from *Haustorioides furotai* and other species. Numerals near nodes indicate bootstrap support values based on ML/NJ analyses.

Pereopod 3 (Fig. 4D): basis with 2 distal setae on posterior margin and 1 bundle of setae on posterodistal corner; ischium with 1 bundle of setae on posterodistal corner; carpus with 2 long setae on apex of anterior lobe; propodus with 2 bundles of setae on posterior margin and 1 bundle of setae on posterodistal corner.

Pereopod 4 (Fig. 4E): basis with 5 long setae on posterior margin and 1 bundle of setae on posterodistal corner; ischium with 1 bundle of short setae on posterodistal corner; carpus with 2 long setae on anterodistal lobe; anterior and posterior margins of propodus with setae.

Pereopods 5–7: each basis expanded posteriorly and lobed ventrally, short setae on anterior margins, and with tiny setae on posterior margins.

Pereopod 5 (Fig. 5A): ischium with 1 long distal seta on anterodistal corner; merus wider than long, expanded posterodistally and hanging carpus, with bundles of setae on posterior margin, with long distal setae and 5 spinous setae on posterior margin; carpus subrectangular, with bundles of setae on anterior margin, with bundle of setae containing 1 plumose seta on posterodistal corner; propodus with spinous setae on anterodistal corner, with 1 tiny and above 2 long spinous seta posterior margin; dactylus with 2 tiny setae on anterior margin.

Pereopod 6 (Fig. 5B): basis with 2 setae on anterior margin; merus with 3 bundles of setae on anterior margin, posterior margin with long setae and spinous setae, posterodistal lobe elongated; carpus with spinous setae on anterodistal corner, and with 1 long seta on posterodistal corner; dactylus with 1 long and 3 short setae.

Pereopod 7 (Fig. 5C): basis with 2 apical setae on anterodistal corner; ischium with 3 apical setae on anterodistal

corner; merus with 1 bundle of setae on anterior and posterior margins; carpus with 1 bundle of setae on anterior margin, with 1 bundle of setae on posterodistal corner; propodus with 2 bundles of setae on anterior and posterior margins, with bundles of setae including plumose and simple setae; dactylus with plumose and distal setae on anterior margin.

Epimeral plates 1–3 (Fig. 6H): each posterodistal corner toothed; epimeral plate 1 with a small tooth; epimeral plates 2 and 3 with straight teeth, elongated posteriorly; tooth on epimeral plate 2 subequal epimeral plate 3.

Pleopods 1–3 (Figs. 6A–C): each peduncle with facial fine setae and 6–7 retinacula; inner ramus 10–11 articulated; outer ramus 11–15 articulated (Figs. 6D–F).

Uropods 1–2: each ramus without setae. Uropod 1 (Fig. 6I) peduncle with 2 apical spinous setae. Uropod 2 (Fig. 6J) peduncle with 1 apical spinous seta. Uropod 3 (Fig. 6K): lacking rami, peduncle with 1 apical spinous seta and 3 tiny setae on dorsal margin.

Telson (Figs. 6L, M) fused, ridge reaching distal tip, with small facial setae.

Description of female (based on paratype, NSMT-Cr 28351). Similar to male except for the following characters (Figs 7, 8).

A hump on palm of gnathopod 1 weaker than that of male (Fig. 7A). Gnathopod 2 (Fig. 7B) carpus with 1 bundle of long setae on anterodistal corner, propodus almost same length to carpus, propodus palm slightly shorter than posterior margin.

Morphological variations. The new species exhibits morphological variations in the number of flagella of both antennae 1 (5 to 8-articulated) and 2 (6 to 9-articulated) and

Table 2. Mean distance between species based on uncorrected *p*-distance (lower) and the best-fit substitution model (TN93+G).

	<i>H. furotai</i>	<i>H. japonicus</i>	<i>H. indivisus</i>	<i>H. munsterhjelmii</i>	<i>H. koreanus</i>
<i>H. furotai</i>	—	0.302	0.281	0.331	0.344
<i>H. japonicus</i>	0.193	—	0.279	0.305	0.315
<i>H. indivisus</i>	0.184	0.183	—	0.286	0.202
<i>H. munsterhjelmii</i>	0.204	0.194	0.186	—	0.176
<i>H. koreanus</i>	0.209	0.198	0.325	0.263	—

each pleopod (with 4 to 8 retinacula).

Coloration in life. Body whitish. Head deep brown posterodorsally. Eyes white with dark red spots. Both antennae pale yellowish-orange from article 2 of peduncle forward flagellum, and dorsodistal corner of peduncle article 1. Maxilliped yellowish-orange. Each pereosome and pleosome with wide brown band anteriorly.

DNA analyses. In the ML and NJ trees, all selected specimens of *H. furotai* are included in a monophyletic lineage (Fig. 9). Uncorrected *p*-distances between *H. furotai* and congeners (Table 2) are greater than the proposed threshold for amphipod species (3.5–4.4%: Rock et al. 2007; Witt et al. 2008; Hou et al. 2009; Tomikawa et al. 2018).

Distribution and habitat. Known only from the type locality inhabiting sandy mud bottom of intertidal to upper subtidal zones.

Etymology. The specific name is dedicated to Professor Toshio Furota, the first author's supervisor at Toho University, and in honor of his substantial contributions to conservation ecology of tidal flats in Tokyo Bay.

The Japanese name of “usage” refer to the species with poorly setose antennal flagellums and pereopodal dactyli in contrast to the majority of their congeners.

Remarks. The new species *H. furotai* can be distinguished from *H. gurjanovae*, *H. magnus*, and *H. munsterhjelmii* by the following characters: posterodistal tooth of epimeral plate 3 is elongate straightly (vs. curved posterodorsally); peduncles of uropods 1 and 2, each outer margin with less than 5 setae on outer margin (vs. with more than 5 setae) and telson uncleft (vs. cleft to medium).

Haustorioides furotai also can be distinguished from *H. koreanus*, *H. latipalpus* and *H. nesogenes* by the following characters: merus of pereopod 6, posterior margin with less than 20 setae (vs. with more than 20 setae); ventral margin of epimeral plates 2 without setae (vs. armed numerous setae); telson uncleft (vs. cleft to medium or with small notch).

Haustorioides furotai is similar to *H. indivisus* and *H. littoralis* in lacking a curved tooth on epimeral plates 2 and 3, each peduncle of uropod 1 and 2 with less than 5 spinous setae and uncleft telson; however, *H. furotai* differs from *H. indivisus* in labrum subtruncated distally (vs. distal margin emarginated), inner plate of maxilliped acute angled (vs. moderate broad and obtuse angled) and apex of reaching inner margin of palp article 1 (vs. outer margin of article of outer plate), and from *H. littoralis* in outer plate of maxilliped reaching (vs. far shorter) to top of outer margin of palp article 1 and each epimeral plate 2 and 3 with straight tooth posterodistally (vs. without elongated tooth).

Haustorioides furotai also shows similarities to *H. japonicus* in having straight teeth on posterodistal corner of epimeral plates 2 and 3 and uncleft telson, however differs in the labrum subtruncated distally (vs. distal margin slightly emarginated), triangular and slender outer plate of maxilliped (vs. moderate broad and rounded distally), posterior margin of pereopod 3 with no more than 10 (vs. more than 20) long setae, dactylus on pereopod 5–7 crow-shaped (vs. knife-shaped).

Key to species of *Haustorioides*

1. Telson wider than long, distally truncated, cleft to medium (about 1/4 of length) 2
- Telson cleft and longer than wide, or uncleft, slightly rounded or slightly acute distally 4
2. Peduncle of uropod 1 armed with 14–15 long setae on lateral margin *H. magnus*
- Peduncle of uropod 1 armed with less than 12 long setae on lateral margin 3
3. Dactylus of pereopod 5 claw-shaped, merus of pereopod 6 with posterodistal lobe and overlapping to carpus, carpus of pereopod 6 about 2 times longer than the wide. *H. koreanus*
- Dactylus of pereopod 5 knife-shaped, merus of pereopods 6 without posterodistal lobe, length in carpus of pereopod 6 subequal to the wide. *H. munsterhjelmii*
4. Telson cleft to medium 5
- Telson with small notch or uncleft 6
5. Peduncle of uropod 1 armed with 5–7 long setae on lateral margin; epimeral plate 2 with small tooth on posterodistal corner, on epimeral plate 3 strongly concaved dorsally; telson cleft to the middle (about 1/3), subequal length to width *H. gurjanovae*
- Peduncle of uropod 1 with only 1 seta on distrolateral corner, without medium marginal setae; posterodistal corners on epimeral plates 2 and 3 with medium teeth; telson longer than wide, cleft to the middle (about 1/4). *H. latipalpus*
6. Posterodistal corners of epimeral plates 2 and 3 with sharp teeth, elongated straightly *H. japonicus*
- Posterodistal corners of epimeral plates 2 and 3 with small teeth. 7
7. Palp of maxilla 1 with 1 apical seta; telson longer than wide, subtruncated distally, very shallowly cleft; basis of male gnathopod 1 with 6 long setae on posterior margin. *H. nesogenes*
- Palp of maxilla 1 without setae; telson uncleft, distal tip

- acute or slightly rounded; basis of male gnathopod 1 with 3 long setae on posterior margin 8
8. Inner lobe of maxilliped not reaching beyond the lateral margin of 1st article of palp; each merus of pereopod 3–4 without posterodorsal lobe; dactylus of pereopod 7 with >10 setae and about 0.7 times as long as propodus; telson wider than long *H. littoralis*
- Inner lobe of maxilliped reaching beyond the lateral margin of 1st article of palp; each merus of pereopod 3–4 with posterodorsal lobe; dactylus of pereopod 7 with <8 setae and about 0.5 times as long as propodus; telson is longer than wide or length and width subequal 9
9. Distal margin of labrum distinctly emarginated; outer lobe of maxilliped right-angled on distromedial corner; basis of male gnathopod 1 with 3 small setae anterodistally, 6 long setae posteriorly; coxal plate of pereopod 3 with 6 long marginal setae anteriorly *H. indivisus*
- Labrum subtruncated distally, not emarginated; outer lobe of maxilliped acute-angled on distromedial corner; basis of male gnathopod 1 with 2 small setae anterodistally, 3 long setae posteriorly; coxal plate of pereopod 3 with 3 long marginal setae anteriorly.
..... *H. furotai* sp. nov.

Acknowledgements

This work would not have been possible without the support of the National Museum of Nature and Science, Tokyo. The authors especially indebted to Dr. Hiroshi Morino for tolerant and kind instructions on the whole of the study and Dr. Hironori Komatsu who allowed to use facilities of Tsukuba Research Department. We express our sincere thanks to Dr. Masafumi Kodama (Assistant Professor in the Faculty of Fisheries, Kagoshima University) and Dr. Tomoyuki Komai (Natural History Museum and Institute, Chiba) for their critical advice and provide literature. Comments given by Dr. Ko Tomikawa (Hiroshima University) has been a great help in this study. We are indebted to Dr. Hiroyuki Ariyama (Osaka Museum of Natural History), Dr. Dmitry A. Sidorov (Institute of Biology and Soil Science) and Takayuki Suenaga (Alumnus of Tohoku University) for collecting literature. We are also particularly grateful to Risa Ishida (Staff of Japan Sea National Fisheries Research Institute), who made enormous contribution to molecular analysis. We especially appreciate the feedback offered by Zachary B. Hancock (Texas A&M University). We would like to thanks to Naoya Jibiki, Ryu Oowada, Rintaro Suzuki (Alumni of Toho University) and Masanori Taru (Tokyo Bay Ecosystem Research Center, Toho University) for helping the collections.

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