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Identities of three taxa of the hippolytid shrimp genus *Heptacarpus* (Crustacea: Decapoda: Caridea), with description of a new species from East Asian waters

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Abstract

Taxonomy of the two previously described species of the hippolytid shrimp genus *Heptacarpus* Holmes, 1900, *H. camtschaticus* (Stimpson, 1860) and *H. geniculatus* (Stimpson, 1860), are reassessed. It has been found that *Eualus geniculata longirostris* Kobjakova, 1936, which has been regarded as a junior synonym of *Heptacarpus geniculatus*, is a valid taxon, herein reinstated as a full species. It has been found that two species were confounded in previous literature under the name *H. camtschaticus*, and one of them is described as new, *H. acuticarinatus* **n. sp.** Three species, *H. camtschaticus*, *H. geniculatus* and *H. longirostris*, are redescribed. These four species all belong to an informal species group characterized by the lack of pereopodal epipods. Differences in morphology and distributional pattern among the four species are discussed. A key in aid of the identification of the Asian species belonging to the species group is provided.

Key words: Crustacea, Decapoda, Caridea, Hippolytidae, *Heptacarpus*, taxonomic identity, new species, East Asia

Introduction

Stimpson (1860) described a number of new species of hippolytid shrimps from shallow waters in the Pacific Ocean, amongst them were two species currently referred to the genus *Heptacarpus* Holmes, 1900, i.e., *H. camtschaticus* and *H. geniculatus* (originally assigned to *Hippolyte*). These two species belong to a group of species characterized by the absence of epipods on pereopods (Rathbun, 1904; Hayashi, 1979; Butler, 1980;

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Wicksten, 1990). Although the type locality was not specifically indicated, the given name clearly indicates that the holotype of *Heptacarpus camtschaticus* was collected from the Kamtchatka Peninsula. This species has been recorded widely from the northern North Pacific, ranging from west coast of Canada to the southern part of Japanese mainland (Rathbun, 1904; Vinogradov, 1950; Hayashi & Miyake, 1968; Hayashi, 1979; Butler, 1980; Wicksten, 1990). *Heptacarpus geniculatus* was originally described from Hakodate, southern Hokkaido, Japan (Stimpson, 1860), and has been reported from East Asian waters, including Japan, Sakhalin, Peter the Great Bay, Korea and the Yellow Sea (Hayashi, 1979; Young & Kim, 2005). *Spirontocaris alcimede* De Man, 1906, described from the Seto Inland Sea, Japan, has been considered to be a junior synonym of *Heptacarpus geniculatus* (cf. Yokoya, 1930; Hayashi & Miyake, 1968; Hayashi, 1979). Kobjakova (1936) proposed a subspecific division of *H. geniculatus* (as *Eualus*), i.e., the nominotypical form and *Eualus geniculatus* var. *longirostris* Kobjakova, 1936. The latter subspecies was originally described from Peter the Great Bay, the continental side of the Sea of Japan (Kobjakova, 1936, 1937) and subsequently reported from localities in the Russian Far East, including southern Kurile Islands and Sakhalin (Vinogradov, 1950; Kobjakova, 1958, 1967). However, Hayashi (1979), who reviewed species of the genus *Heptacarpus* in Japanese waters, did not recognize the subspecific division of *H. geniculatus*, discussing that most of the differentiating characters cited by Kobjakova (1936, 1937) are considerably variable and do not provide diagnostic significance.

During a survey on the decapod crustacean fauna of northern Japan, many specimens of hippolytid shrimps were collected from shallow waters. Of particular interest were three species showing similarities to *Heptacarpus camtschaticus* or *H. geniculatus*. In the process of identifying the specimens from the existing literature (e.g., Hayashi, 1979; Butler, 1980; Wicksten, 1990), it was found that definite identification of them was difficult without reexamination of the type or authentic material used by previous authors. For example, it was necessary to reassess the status of *Eualus geniculata longirostris*, but it was difficult for the senior author to have access to material deposited in the Russian institutions. However, subsequent exchange of information led the authors to make a cooperative work attempting to fully clarify the taxonomic uncertainties regarding to these *Heptacarpus* species.

Although the types of *Heptacarpus camtschaticus* and *H. geniculatus* were presumably destroyed by the Chicago fire of 1871 (Evans, 1967), a good series of samples, including topotypic specimens, have been available to us. The second author tried to locate the material studied by Kobjakova (1936, 1937), but the type of *Eualus geniculata longirostris* was not found in the collection of the Zoological Institute, St. Petersburg (ZISP), in which the type should be deposited. Nevertheless, it was fortunate that some specimens identified with *Eualus geniculatus longirostris* by Z. I. Kobjakova herself has been available for examination. We have attempted to establish taxonomic identities of the three species in question based on material being available to us. During this study, we have found that there has been considerable confusion regarding the identities of *H. camtschaticus* and *H. geniculatus* in the previous literature. As a result, *Heptacarpus camtschaticus* and *H. geniculatus* are rediagnosed and *H. longirostris* is reinstated as a full species. It has been revealed that the previous records of *H. camtschaticus* from the Pacific coast of Japan (Balss, 1914; Parisi, 1914; Hayashi & Miyake, 1968; Hayashi, 1979), Korea (Cha *et al.*, 2001) and the Yellow Sea (Liu, 1963) were results of misidentifications. A new species, *H. acuticarinatus* **n. sp.**, is described for the taxon heretofore confounded with *H. camtschaticus*.

Material and methods

Species of *Heptacarpus* exhibit a certain degree of sexual dimorphism in various body structures (Hayashi, 1979; Hayashi & Chiba 1987; Komai, 1992). Therefore, the description is primarily based on females, and a brief description of males is separately presented for each species. Species comparison is made separately by sex if necessary.

Specimens used in this study are deposited in the Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University (HUMZ), Kitakyushu Museum of Natural History and Human History (KMNH; formerly housed in Zoological Laboratory, Faculty of Agriculture, Kyushu University [ZLKU]), Natural History Museum and Institute, Chiba (CBM), National Fisheries Research and Development Institute, Busan (NFRDI), National Museum of Natural History, Smithsonian Institution, Washington, D. C. (USNM), and Zoological Institute, St. Petersburg (ZISP). The postorbital carapace length (CL) is used as a standard measurement indicating the size of specimens. The total length (TL), measured from the level of the tip of the antennal scale to the tip of the telson, is also used as an indication of general body size. Counts of the meral spines on the third to fifth pereopods were taken primarily from the left side; when left appendage(s) is missing, the right pereopod(s) were used.

For comparison, the following material was examined.

Heptacarpus pandaloides (Stimpson, 1860). CBM-ZC 1693, 3 females (CL 4.8–11.1 mm), Nebama, Ohtsuchi Bay, Iwate Prefecture, 3–4 m, *Zostera* belt, sledge net, 26 May 1995, coll. T. Komai; CBM-ZC 8520, 1 female (CL 8.2 mm), 5 ovigerous females (CL 7.9–8.4 mm), 1 male (CL 6.1 mm), Kurahashi Island, Hiroshima Prefecture, Seto Inland Sea, ca. 5 m, 13 April 2005, commercial trawl, coll. Katsumi Hiramoto.

Heptacarpus stylus (Stimpson, 1864). USNM 27592, 17 females (CL 6.2–8.3 mm), Berkley Sound, British Columbia.

Taxonomy

Heptacarpus camtschaticus (Stimpson, 1860)

(Figs 1–4, 18, 19)

Hippolyte camtschatica Stimpson, 1860: 102 [type locality: not specifically indicated].
Spirontocaris camtschatica. – Rathbun, 1899: 556; 1904: 94, fig. 42.
Eualus camtshatica [sic]. – Brashnikov, 1907: 164, fig. 22a, b; Kobjakova, 1937: 117.
Eualus camtschatica. – Derjugin & Kobjakova, 1935: 142 (list); Kobjakova, 1936: 211, Makarov, 1941: 127; Kobjakova, 1958: 224.
Spirontocaris camtchatica [sic]. – Urita, 1942: 26.
Heptacarpus camtschaticus. – Holthuis, 1947: 12 (list); Squires & Figueira, 1974: 12; Butler, 1980: 217, unnumbered fig.; Haynes, 1981: 434, fig. 8 (first zoea); 1985: 277; Jensen, 1987: 399 (key); Williams *et al.*, 1989: 17 (list); Wicksten, 1990: 594 (key); Komai, 1994: 82; Chace, 1997: 44 (list); Ivanjushina, 1997: 197; Andrianov & Kussakin, 1998: 264 (list); Minemizu 2000: 92, unnumbered fig.
Heptacarpus camtschatica. – Vinogradov 1950: 210, pl. 16, fig. 67A, B.
Not *Spirontocaris camtschatica* [= *Heptacarpus acuticarinatus* **n. sp.**]. – Balss, 1914: 44; Parisi, 1919: 47; Yokoya 1933: 26.
Not *Heptacarpus camtschaticus* [= *Heptacarpus acuticarinatus* **n. sp.**]. – Liu, 1963: 237; Hayashi & Miyake, 1968: 134, fig. 6; Kikuchi & Miyake, 1978: 24 (list); Hayashi, 1979: 14 (?part); Kojima & Hanabuchi, 1981: 45 (list); Ohta, 1983: 230 (list); Hayashi, 1992: 180, figs 223a, 224a, 225a; Liu & Zhong, 1994: 559 (list); Cha *et al.*, 2001: 90–91.
Not *Heptacarpus camtschaticus* [= *Heptacarpus longirostris* (Kobjakova, 1936)]. – Igarashi, 1971: 2, pl. 2, fig. 4.

Type material. Presumably no longer extant (Evans, 1967).

Material examined. **Alaska**. USNM 13177, 1 female (cl 6.8 mm), Cape Lisburne, 9–12.6 m, coll. W. Dall; USNM 27693, 3 females (cl 6.5–7.3 mm), Belkofskyi Bay, 27–45 m, 1880, coll. W. Dall. **Aleutian Islands**. USNM 13191, 1 ovigerous female (cl 8.5 mm), off station reef, Iliuliuk Harbor, Unalaska, 5.4 m. **Kamchatka Peninsula**. USNM 13491, 3 males (cl 5.2–5.3 mm), 1 ovigerous female (cl 7.5 mm), 1 juvenile (cl 3.3 mm), Rakovaya Bay, Avacha Bay, coll. L. Stejneger; ZISP, 2 females (cl 6.6, 8.2 mm), "Alatyr", stn 429, western Kamchatka, 23 m, gravel, 22 August 1963, coll. A. Neyman. **Kurile Islands**. ZISP 2/33569, Matsuba Bay, Shikotan Island, 19.5–25 m, 18 September 1949, dredge No. 23, coll. E. F. Gurjanova, 1 male (cl 6.8 mm); ZISP no number, 1 female (cl 6.8 mm), off Veslo Peninsula, Kunashir Island, 7–8 m, sea grass

bed of *Zostera asiatica*, 6 August 1969, coll. Pushkin. **Sakhalin**. CBM-ZC 2412, 2 females (CL 7.0, 7.0 mm), Lebyazhiya Bay, 10 m, 31 July 1995, beam trawl, coll. M. Yabe. **Japan**. Hokkaido. CBM-ZC 92, 1 male (cl 4.6 mm), 3 females (cl 7.1–7.9 mm), off Usujiri, Minami Kayabe, 15–25 m, 11 June 1993, dredge, coll. F. Muto; CBM-ZC 270, 3 females (cl 6.0–7.1 mm), same locality, 15–30 m, 19 August 1993, dredge, coll. F. Muto; CBM-ZC 2433, 1 female (cl 7.1 mm), RV Tansei-maru, KT95-13 cruise, stn 2, Nemuro Bay, eastern Hokkaido, 43°29.8'N, 145°31.6'E, 23 m, sand bottom, 15 September 1995, beam trawl, coll. T. Komai; CBM-ZC 5495, 1 male (cl 4.0 mm), off Usujiri, 20–25 m, 8 October 1991, dredge, coll. T. Komai; CBM-ZC 8602, 1 male (cl 5.4 mm), 3 females (cl 6.2–6.5 mm), same locality, 4 July 1992, dredge, coll. T. Komai; CBM-ZC 8599, 13 males (cl 4.0–5.9 mm), 18 females (cl 5.4–8.1 mm), same locality, 13 November 1992, coll. T. Komai; HUMZ-C 1179, 1 female (cl 6.5 mm), off Irifune, Hakodate, Hakodate Bay, southern Hokkaido, depth unknown, 19 November 1990, small beam trawl, coll. T. Komai; HUMZ-C 2138, 1 female (cl 8.1 mm), off Usujiri, 20–30 m, 2 July 1991, dredge, coll. T. Komai; HUMZ-C 2158, 1 ovigerous female (cl 8.6 mm), same locality, 25 m, 23 April 1993, dredge, coll. F. Muto. **Prymorie**. ZISP, 1 female (cl 6.2 mm), Stark's Strait, Peter the Great Bay, 4 August 1979, sea grass meadow, coll. L. V. Mikulich. **Exact locality unknown**. ZISP 41392-1, Pacific Ocean, dredge 91-95, 1 female (cl 6.3 mm).

Description of females. Body (Fig. 1) moderately slender for genus; integument naked, glabrous, not particularly firm. Rostrum (Figs 1, 2A, B) straight, directed forward or slightly ventrad, styliform, slightly falling short of or reaching beyond distal margin of antennal scale, 1.03–1.43 length of carapace; dorsal margin armed with 5 or 6 teeth including 3–5 on rostrum proper and 1 or 2 on carapace, posteriormost tooth arising from 0.14–0.16 of carapace length, distal 0.28–0.59 of dorsal margin unarmed; ventral blade moderately deep, deepest at slightly proximal to midlength of rostrum; ventral margin with 4–7 (most frequently 5 or 6) teeth; teeth subequal or slightly unequal in size except for tiny distalmost tooth; lateral carina blunt. Carapace (Figs 1, 2A, B) with postorbital rostral ridge low, not extending to anterior 0.25 of carapace length; dorsal margin in lateral view straight; no postorbital tooth; antennal tooth moderately small; suborbital lobe (Fig 2C) conspicuous, rounded, constricted at base, reaching or slightly overreaching antennal tooth; pterygostomial angle unarmed or armed with tiny tooth.

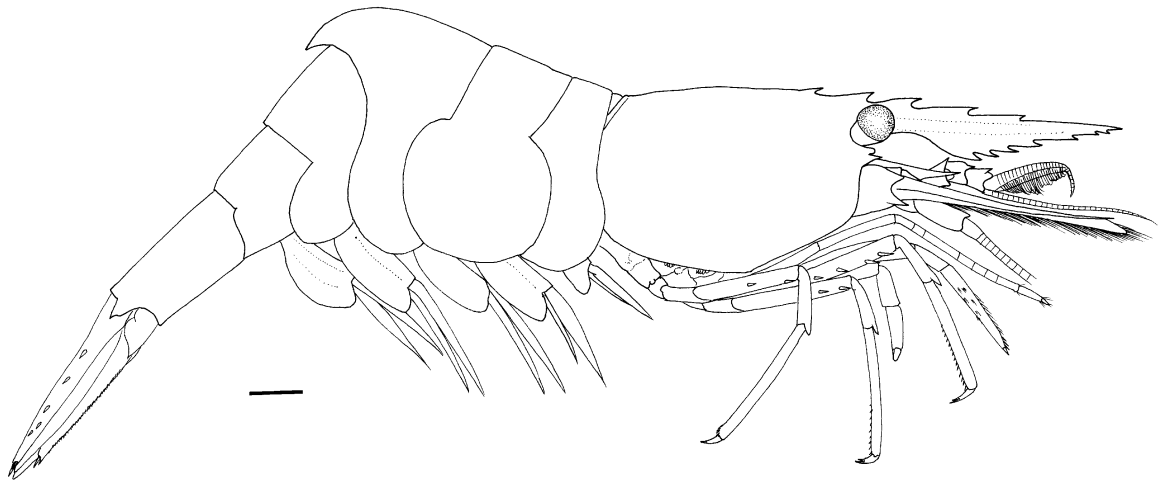

FIGURE 1. *Heptacarpus camtschaticus* (Stimpson, 1860). Female (cl 7.8 mm; CBM-ZC 8599), Usujiri, southern Hokkaido, habitus in lateral view.

Pleon (Fig. 1) dorsally rounded, weakly gibbous. Second somite with faint transverse groove on tergite. Dorsal surface of third tergite convex posteriorly, posterodorsal margin strongly produced and partially overhanging anterior part of fourth tergite. Pleura of anterior 4 somites broadly rounded, fifth pleuron with small posteroventral tooth; posterolateral margin of fifth pleuron slightly sinuous. Sixth somite 1.65–1.80 times

longer than fifth somite and 1.90–2.10 times longer than high, bearing small posteroventral tooth; posterolateral process terminating in acute tooth. Telson (Fig. 2D) about 1.20–1.30 length of sixth somite, 3.40–3.70 times longer than wide, lateral margins parallel in anterior 0.35, and then tapering posteriorly, armed with 3–6 (usually 4 or 5) dorsolateral spines on either side; posterior margin (Fig. 2E) with 1 tiny median tooth and 3 pairs of spines, mesial pair smaller than 2 lateral pairs, bearing marginal setules.

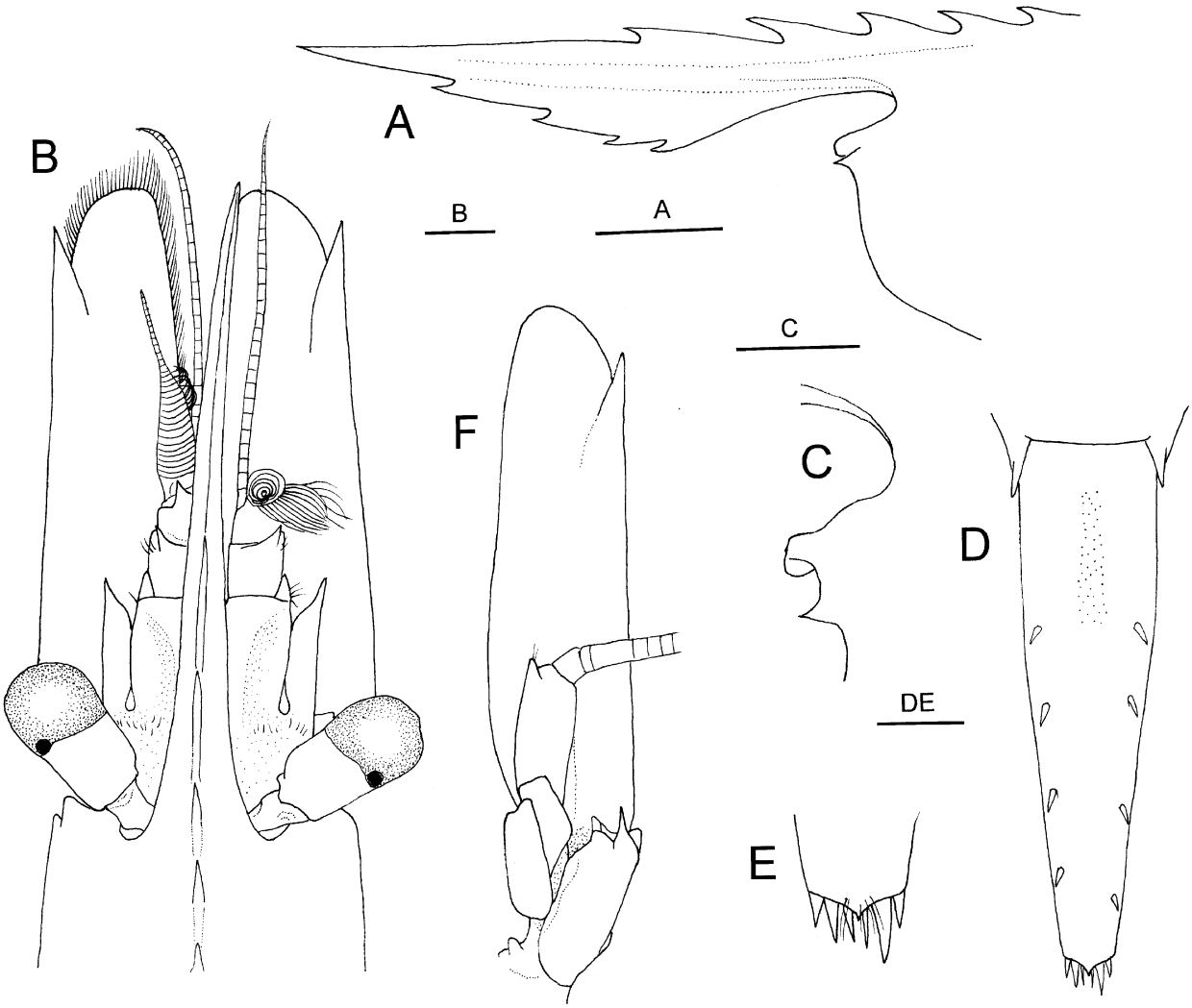

FIGURE 2. *Heptacarpus camtschaticus* (Stimpson, 1860). Female (cl 7.8 mm; CBM-ZC 8599), Usujiri, southern Hokkaido. A, rostrum and anterior part of carapace, lateral view; B, rostrum, anterior part of carapace and cephalic appendages, dorsal view; C, suborbital lobe and antennal tooth, lateral view; D, telson, dorsal view; E, posterior part of telson, dorsal view; F, left antennae, ventral view. Scale bars: 2 mm for A; 1 mm for B, C, D; 0.5 mm for E.

Eye-stalk (including cornea) (Fig. 2B) generally subpyriform; cornea slightly wider and subequal in length to remaining part of eye-stalk; ocellus distinct, showing as black spot; maximal diameter of cornea 0.15–0.17 of carapace length.

Antennular peduncle (Fig. 2B) slightly falling short of midlength of antennal scale. First segment distinctly longer than distal 2 segments combined, unarmed on dorsodistal margin; stylocerite overreaching distal margin of first segment, rather abruptly tapering to sharp point, mesial margin convex, closely in touch with first segment; second segment about 0.30 length of first segment, with large spine at dorsolateral distal angle; third segment short, with moderately large spine on dorsodistal margin. Lateral flagellum with thickened aesthetasc-bearing portion 0.35–0.37 of carapace length.

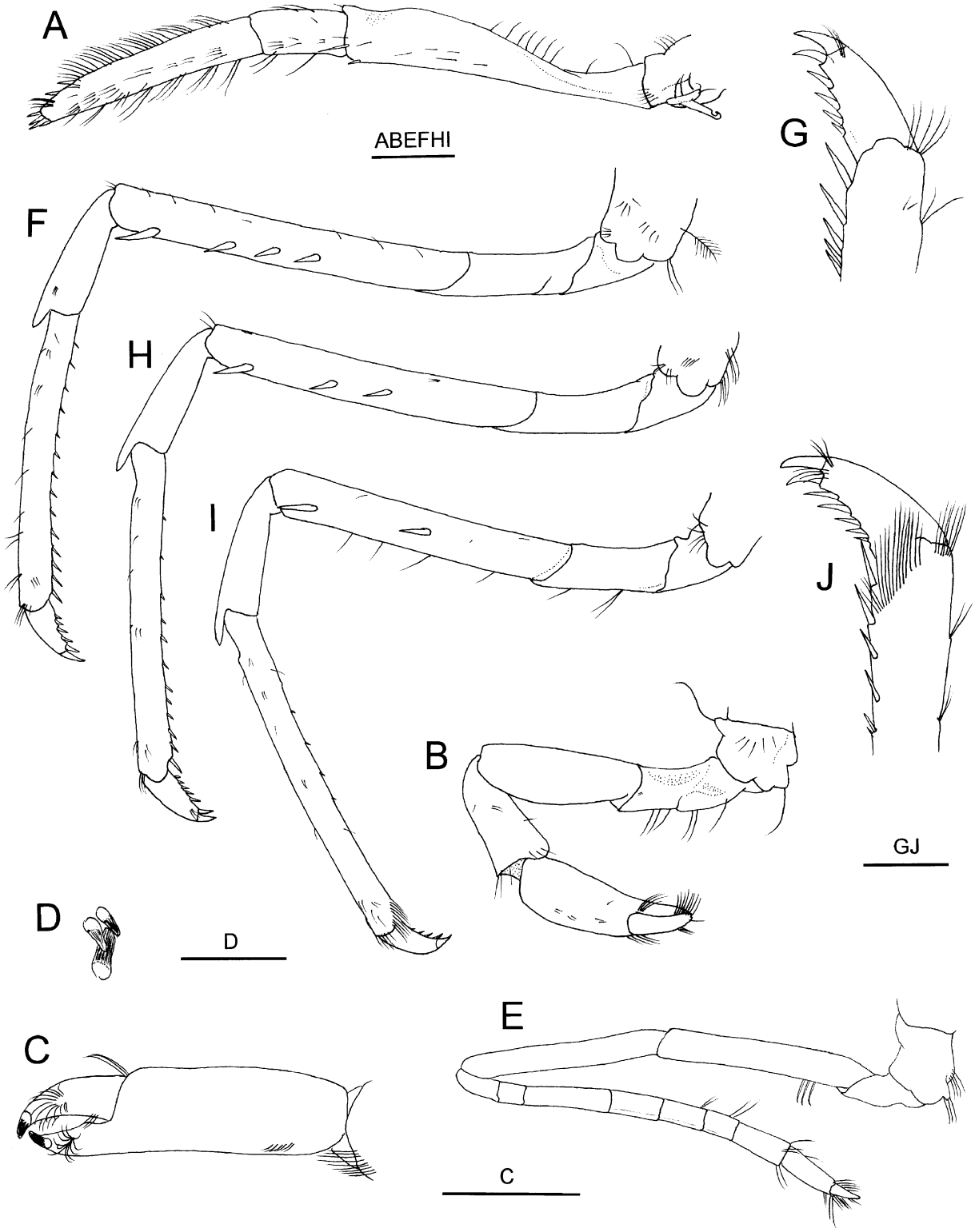

FIGURE 3. *Heptacarpus camtschaticus* (Stimpson, 1860). Female (cl 7.8 mm; CBM-ZC 8599), Usujiri, southern Hokkaido, left thoracic appendages. A, third maxilliped, lateral view; B, first pereopod, lateral view; C, chela of first pereopod, ventral (flexor) view; D, tips of dactylus and fixed finger of chela of first pereopod, apical view; E, second pereopod, lateral view; F, third pereopod, lateral view; G, dactylus and distal part of propodus of third pereopod, lateral view; H, fourth pereopod, lateral view; I, fifth pereopod, lateral view; J, dactylus and distal part of propodus of fifth pereopod, lateral view. Scale bars: 1 mm for A–C, E, F, H, I; 0.5 mm for D, G, J.

Antenna (Fig. 2B, F) with basicerite bearing moderately large ventrolateral distal tooth; carpocerite reaching 0.30 length of antennal scale or distal margin of second segment of antennular peduncle. Antennal scale 0.88–1.18 of carapace length and 3.40–4.00 times longer than wide; lateral margin nearly straight; distal lamella rounded, strongly produced, considerably exceeding beyond distolateral tooth.

Third maxilliped (Figs 1, 3A) moderately stout, reaching distal 0.30–0.40 of antennal scale; ultimate segment about 2.40 length of carpus (= penultimate segment), tapering distally, with several darkly pigmented corneous spines distally; antepenultimate segment subequal in length to distal 2 segments combined, with long, slender spine on distolateral margin, lateral surface rounded, with scattered tufts of short setae.

First pereopod (Fig. 3B) moderately stout, not reaching midlength of antennal scale; chela (Fig. 3C) 1.40–1.50 of carpal length; dactylus about half length of palm, terminating in 2 darkly pigmented, strong corneous ungues (Fig. 3D); fixed finger terminating in single corneous unguis (Fig. 3D); merus about 1.40 of carpal length, about 3.00 times longer than high; dorsolateral distal angle of ischium with tiny denticle. Second pereopods (Fig. 3E) equal, slightly falling short of distal margin of antennal scale; dactylus about 0.60 of palm length; carpus about 4.00 times longer than chela, divided in 7 unequal articles; ischium slightly longer than merus, with few spiniform setae subproximally on ventral margin. Third to fifth pereopods moderately long and slender, slightly decreasing in length posteriorly. Third pereopod (Fig. 3F) falling somewhat short of distal margin of antennal scale; dactylus (Fig. 3G) about 0.25 of propodal length, about 2.50 times longer than deep, terminating in acute, pigmented unguis, armed with 5 or 6 accessory spinules notably increasing in size distally and also pigmented; propodus with 2 rows of slender spinules on ventral margin (Fig. 3G); carpus 0.45–0.50 of propodal length; merus 7.50–8.50 times longer than high, armed with 3–5 spines decreasing in length proximally; ischium unarmed. Fourth pereopod (Fig. 3H) reaching distal 0.20–0.25 of antennal scale; merus with 2–5 (usually 3 or 4) spines on lateral surface ventrally. Fifth pereopod (Fig. 3I) reaching midlength of antennal scale; propodus with tufts of grooming setae distally (Fig. 3J); merus with 2–4 (usually 3) spines on lateral surface ventrally.

Gill formula as in Table 1. Only third maxilliped with strap-like epipod corresponding to setobranch on first pereopod; no epipods on pereopods, and thus no corresponding setobranchs on second pereopod and thereafter.

TABLE 1. Branchial formula of the four *Heptacarpus* species treated in this study.

Thoracic somites	1	2	3	4	5	6	7	8
Maxillipeds/pereopods	1	2	3	1	2	3	4	5
Pleurobranchs	-	-	-	1	1	1	1	1
Arthrobranchs	-	-	-	-	-	-	-	-
Podobranchs	-	1	-	-	-	-	-	-
Epipods	1	1	1	-	-	-	-	-
Exopods	1	1	-	-	-	-	-	-
Setobranchs	-	-	-	1	-	-	-	-

Pleopods typical of genus; ventrolateral lobe of protopods expanded in spawning molt; endopod of first pleopod subtriangular, without appendix interna. Uropod (Fig. 1) with both rami slightly overreaching posterior margin of telson.

Description of male. Body more slender than in females (Fig. 4A, C). Rostrum (Fig. 4B) 1.22–1.42 length of carapace, anterior 0.28–0.53 unarmed. Third pleonal tergite more strongly convex than in females (Fig. 4C). Corneal diameter about 0.20 of carapace length (Fig. 4A). Outer flagellum of antennule (Fig. 4A) larger than in females, thickened aesthetasc-bearing portion about half length of carapace. Antennal scale 0.98–1.21 times longer than carapace. Third to fifth pereopods less stout than in females. Meri of third to fifth

pereopods armed with 3 or 4 (rarely 5) spines, 3 or 4 (rarely 2) spines and 3 (rarely 2) spines, respectively. Endopod of first pleopod (Fig. 4D) elongate subtriangular, with conspicuous appendix interna at terminal position; distolateral lobule not differentiated; mesial margin with row of small spiniform setae, lateral margin with row of long plumose setae. Second pleopod with appendix masculina (Fig. 4E) slightly shorter than appendix interna, with numerous long setae on dorsal surface to tip.

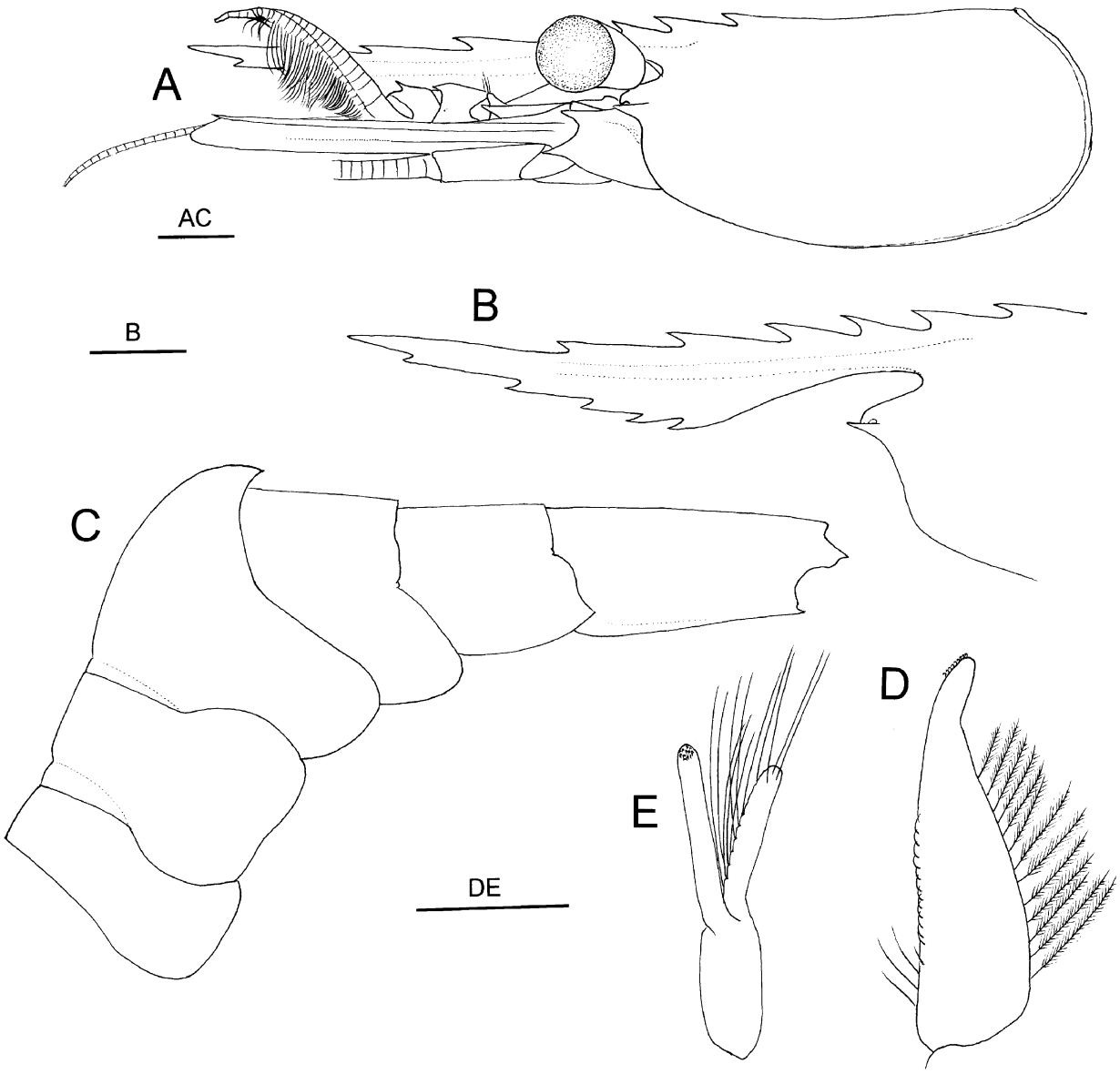

FIGURE 4. *Heptacarpus camtschaticus* (Stimpson, 1860). Male (cl 4.6 mm; CBM-ZC 8599), Usujiri, southern Hokkaido. A, carapace and cephalic appendages, lateral view; B, rostrum, lateral view; C, pleon, lateral view; D, endopod of left first pleopod, ventral view; E, appendices interna and masculina of left second pleopod, mesial view. Scale bars: 1 mm for A–C; 0.5 mm for D, E.

Coloration in life. Considerably variable from nearly colorless to brown, reddish brown or green.

Size. Females cl 5.3–8.9 mm, ovigerous females cl 7.5–8.9 mm; males cl 4.0–6.6 mm.

Variation. A total of 65 specimens, including 42 females, 22 males and one juvenile, were examined for assessing morphological variation in some characters possibly providing diagnostic significance.

The number of the rostral ventral teeth varies from three to seven (Fig. 18), but more than half of the specimens examined (31 of 54 specimens; 57.4 %) have five teeth. Thirteen specimens (24.0 %) have six teeth,

and eight (14.8 %) have four teeth. The possession of three or seven teeth appears unusual for the species, because there is only a single example for each case.

Frequency of the presence or absence of the pterygostomial tooth on the carapace varied with sexes (Table 2). Females are provided with the teeth on both sides in most specimens (84.6 %), and it is restricted to one side only in three specimens (7.7 %) or entirely absent in three specimens (7.7 %). On the other hand, only about one-fourth of males (27.3 %) have the teeth on both sides; five specimens (22.7 %) have the tooth on one side; and 11 specimens (50.0 %) entirely lack the tooth.

TABLE 2. Variation in the presence or absence of a pterygostomial tooth in *Heptacarpus camtschaticus* (Stimpson, 1860).

	Female	Male
Present on both sides	33 (84.6 %)	6 (27.3 %)
Present on one side	3 (7.7 %)	5 (22.7 %)
Absent on either side	3 (7.7 %)	11 (50.0 %)

The number of the meral spines on the third pereopod is variable from three to six (Fig. 19), but the majority of the specimens (88.0 %) have four or five spines. Six specimens (10 %) have six spines; only one specimen has six spines only on the left side, and thus this condition is rather unusual for this species.

Distribution. Widely distributed in the northern North Pacific Ocean: Peter the Great Bay, Sakhalin, Hokkaido, Kurile Islands, Kamtchatka Peninsula, Cape Lisburne in the Chukchi Sea, Bering Sea to Strait of Georgia; subtidal to 45 m.

Remarks. This study demonstrates that *Heptacarpus camtschaticus* is restricted to cold waters, although widely distributed in the northern North Pacific. The occurrence of the species in Honshu to Kyushu of Japan and Korea has not been confirmed. Specimens from the Pacific coast of Honshu, Japan, and Korea, which agree with the accounts of *Heptacarpus camtschaticus* by Hayashi & Miyake (1968) and Hayashi (1979, 1992) do represent a separate taxon, *H. acuticarinatus* **n. sp.** Therefore, previous records of *H. camtschaticus* from the Pacific coast of Honshu to Kyushu islands of Japan, Korea, and northern China (Balss, 1914; Parisi, 1919; Yokoya, 1933; Liu, 1963; Hayashi & Miyake, 1968; Kikuchi & Miyake, 1978; Hayashi, 1979, 1992; Cha *et al.*, 2001) are referred to the new species. Igarashi (1971) recorded *H. camtschaticus* from Usu Bay, Hokkaido. Although he did not properly describe morphological features of his specimen, the given photograph (Igarashi, 1971, pl. 2, fig. 4) clearly shows a short third maxilliped not reaching the midlength of the antennal scale and a somewhat geniculate pleon. These features clearly suggest that his specimen actually represent *H. longirostris*, instead of *H. camtschaticus* (see "Comparison").

***Heptacarpus acuticarinatus* n. sp.**
(Figs 5–9, 18, 19)

Spirontocaris camtchatica. – Balss, 1914: 44; Parisi, 1919: 47; Yokoya, 1933: 26. Not *Spirontocaris camtschatica* (Stimpson, 1860).

Heptacarpus camtschaticus. – Liu, 1963: 237; Hayashi & Miyake, 1968: 134, fig. 6; Kikuchi & Miyake, 1978: 24; Hayashi, 1979: 14; 1992: 180, figs 223a, 224a, 225a; Liu and Zhong, 1994: 559 (list); Cha *et al.* 2001: 90–91. Not *Heptacarpus camtschaticus* (Stimpson, 1860).

Type material. Holotype. CBM-ZC 8980, ovigerous female (cl 5.4 mm), Sagami Bay, 35°07.858'N, 139°33.698'E, 100–101 m, sand bottom, 22 January 2003, RV *Rinkai-maru*, dredge, coll. T. Komai.

Paratypes. **Japan**. CBM-ZC 3531, 1 female (cl 4.0 mm), off Kominato, Boso Peninsula, 100–150 m, 27

February 1997, gill net, coll. T. Komai; CBM-ZC 2695, 5 females (cl 2.6–3.9 mm), 1 ovigerous female (cl 5.4 mm), off Shionomisaki, Kii Peninsula, 80 m, 25 July 1991, dredge, coll. S. Nagai; HUMZ-C 1174, 1 male (cl 3.7 mm), Kashima-nada Sea off Ibaraki Prefecture, depth unknown, 25 September 1989, larva net accidentally on bottom, coll. D. Kitagawa; NSMT-Cr S 9, 1 ovigerous female (cl 4.9 mm), Sagami Bay, 35°07.90'N, 139°34.48'E, 94–95 m, sand bottom, 27 February 2002, RV *Rinkai-maru*, dredge, coll. T. Komai. **Korea**. NFRDI-Cr 20070417-1, 2 females (cl 5.5, 5.6 mm), 1 male (cl 5.2 mm), Hansan Island, 20–30 m, September 1998; NFRDI-Cr 20070417-2, 5 ovigerous females (cl 5.9–6.4 mm), same locality, 20 April 1999; NFRDI-Cr 20070417-3, 5 ovigerous females (cl 6.1–6.8 mm), same locality, 20 May 1999.

Other material. **Japan**. HUMZ-C 29, 2 females (cl 5.2, 5.7 mm), off Irifune, Hakodate, Hakodate Bay, southern Hokkaido, ca. 30 m, 9 November 1986, gill net, coll. T. Komai; HUMZ-C 1179, 1 female (cl 5.0 mm), similar locality, depth unknown, 19 November 1990, small beam trawl, coll. T. Komai.

Description of female. Body (Fig. 5) moderately robust for genus. Rostrum (Fig. 5, 6A, B) straight, directed forward, slightly falling short of or reaching distal margin of antennal scale, 1.22–1.53 length of carapace; dorsal margin armed with 5–7 teeth including 4–6 on rostrum proper and 1 or 2 on carapace, posteriormost tooth arising from 0.13–0.17 length of carapace, distal 0.16–0.30 of dorsal margin unarmed; ventral blade relatively deep, deepest at slightly proximal to midlength of rostrum; ventral margin with 5–8 teeth (teeth slightly unequal or subequal in size except for minute distalmost tooth); lateral carina sharply defined. Carapace (Fig. 5, 6A, B) with postorbital rostral ridge low, not extending to anterior 0.25 of carapace length; dorsal margin in lateral view nearly straight; suborbital lobe (Fig 6A) rounded, constricted at base, falling short of or reaching antennal tooth; pterygostomial angle always with small tooth.

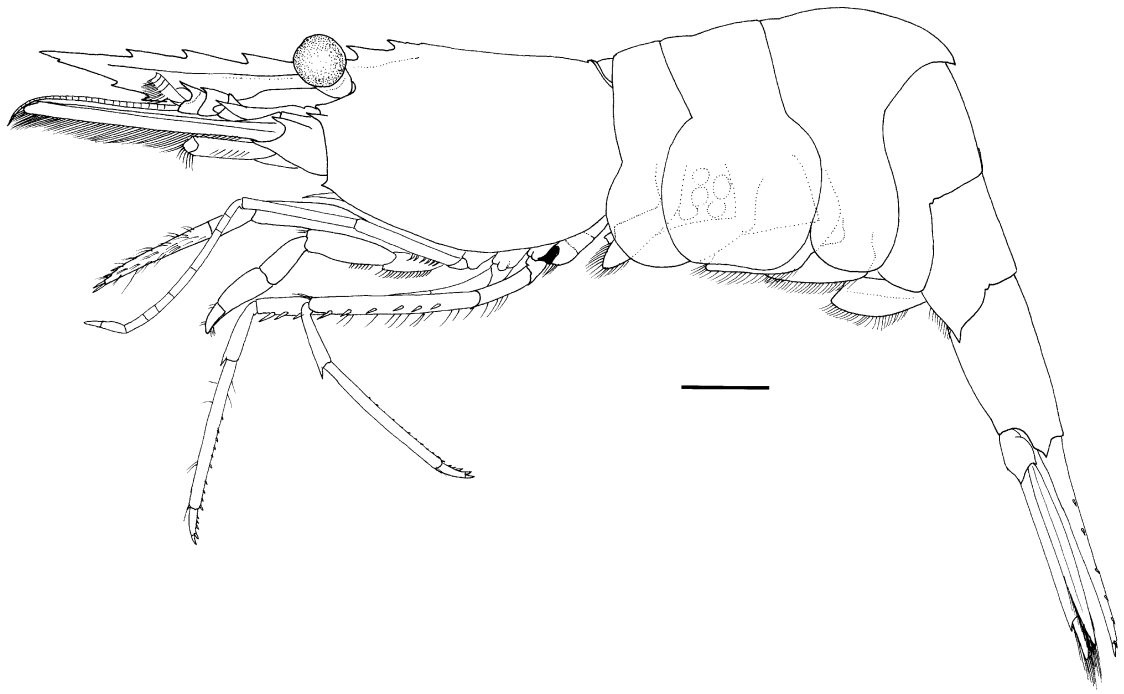

FIGURE 5. *Heptacarpus acuticarinatus* **n. sp.** Holotype, ovigerous female (cl 5.4 mm; CBM-ZC 8980), Sagami Bay, habitus in lateral view. Scale bar: 2 mm.

Pleon (Fig. 5) dorsally rounded, not gibbous. Second somite with faint transverse groove on tergite. Dorsal surface of third tergite evenly convex, posterodorsal margin somewhat produced. Pleura of anterior four somites broadly rounded; fifth pleuron with moderately large posteroventral tooth, posterolateral margin sinuous. Sixth somite 1.50–1.60 times longer than fifth and 1.90–2.00 times longer than high. Telson (Figs 5, 6C) 1.20–1.30 length of sixth somite, about 3.60 times longer than wide, armed with 5 or 6 dorsolateral spines on

either side; posterior margin terminating in acute tooth, with 3 pairs of unequal spines.

Eye-stalk (Fig. 6B) generally subpyriform; cornea slightly wider and longer than remaining part of eye-stalk; ocellus distinct, showing as black spot; maximal diameter of cornea 0.20–0.22 of carapace length.

Antennular peduncle (Fig. 6B) not reaching midlength of antennal scale. First segment unarmed on dorso-distal margin; stylocerite overreaching distal margin of first segment, acuminate, mesial margin convex or sinuous, closely in touch with first segment; second segment about 0.30 length of first segment, with small spine at dorsolateral distal angle; third segment short, with small spine on dorsodistal margin. Lateral flagellum with thickened aesthetasc-bearing portion 0.30–0.35 of carapace length.

Antenna (Fig. 6B, D) with basicerite bearing moderately large ventrolateral distal tooth; carpocerite reaching 0.30–0.35 length of antennal scale or distal margin of second segment of antennular peduncle. Antennal scale 1.02–1.09 length of carapace and 3.30–3.70 times longer than wide; lateral margin straight; distal lamella rounded, moderately produced, exceeding beyond distolateral tooth.

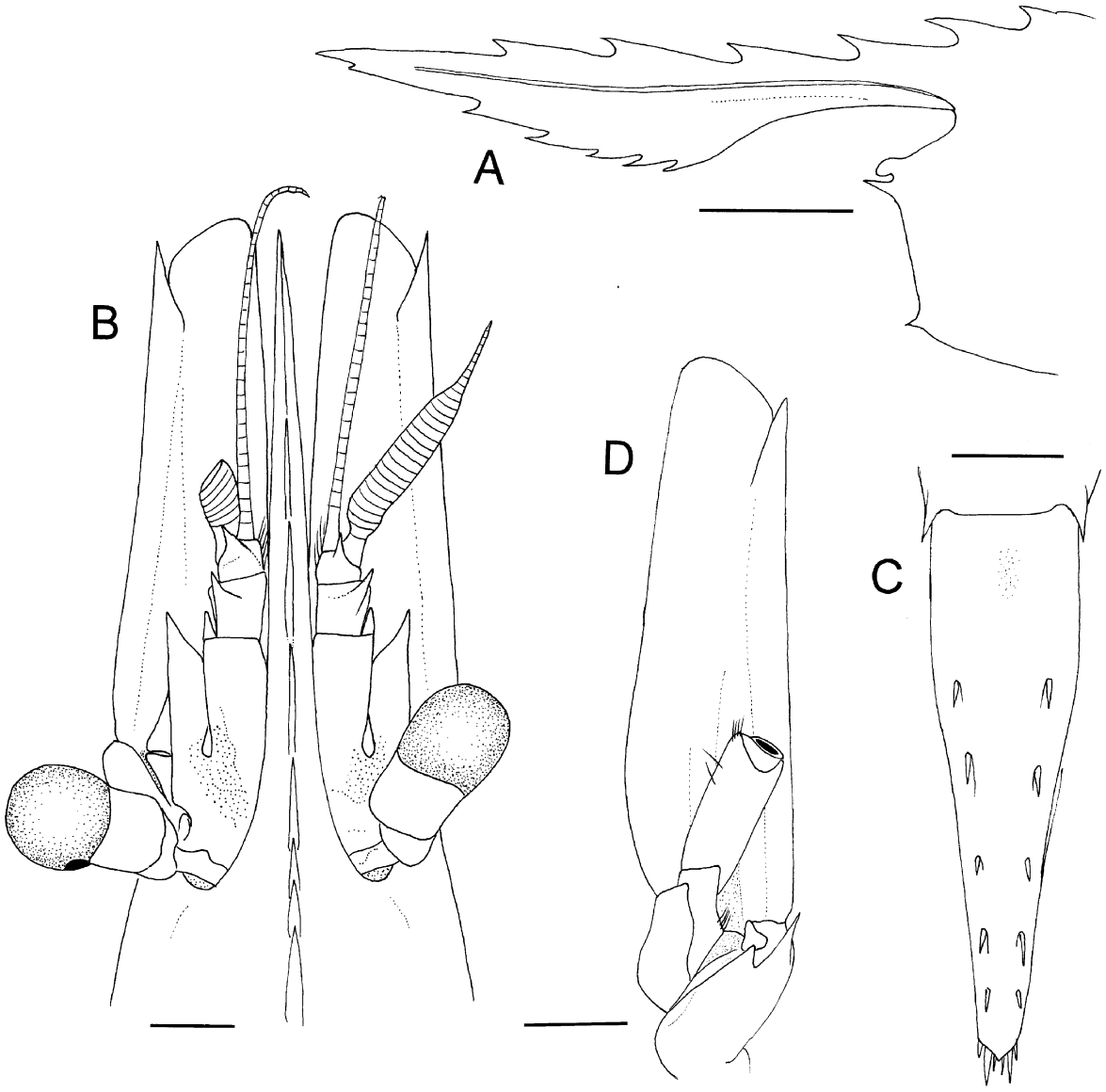

FIGURE 6. *Heptacarpus acuticarinatus* **n. sp.** Holotype, ovigerous female (cl 5.4 mm; CBM-ZC 8980), Sagami Bay. A, rostrum and anterior part of carapace, lateral view; B, rostrum, anterior part of carapace and cephalic appendages, dorsal view; C, telson, dorsal view; D, left antenna, ventral view. Scale bars: 2 mm for A; 1 mm for B–D.

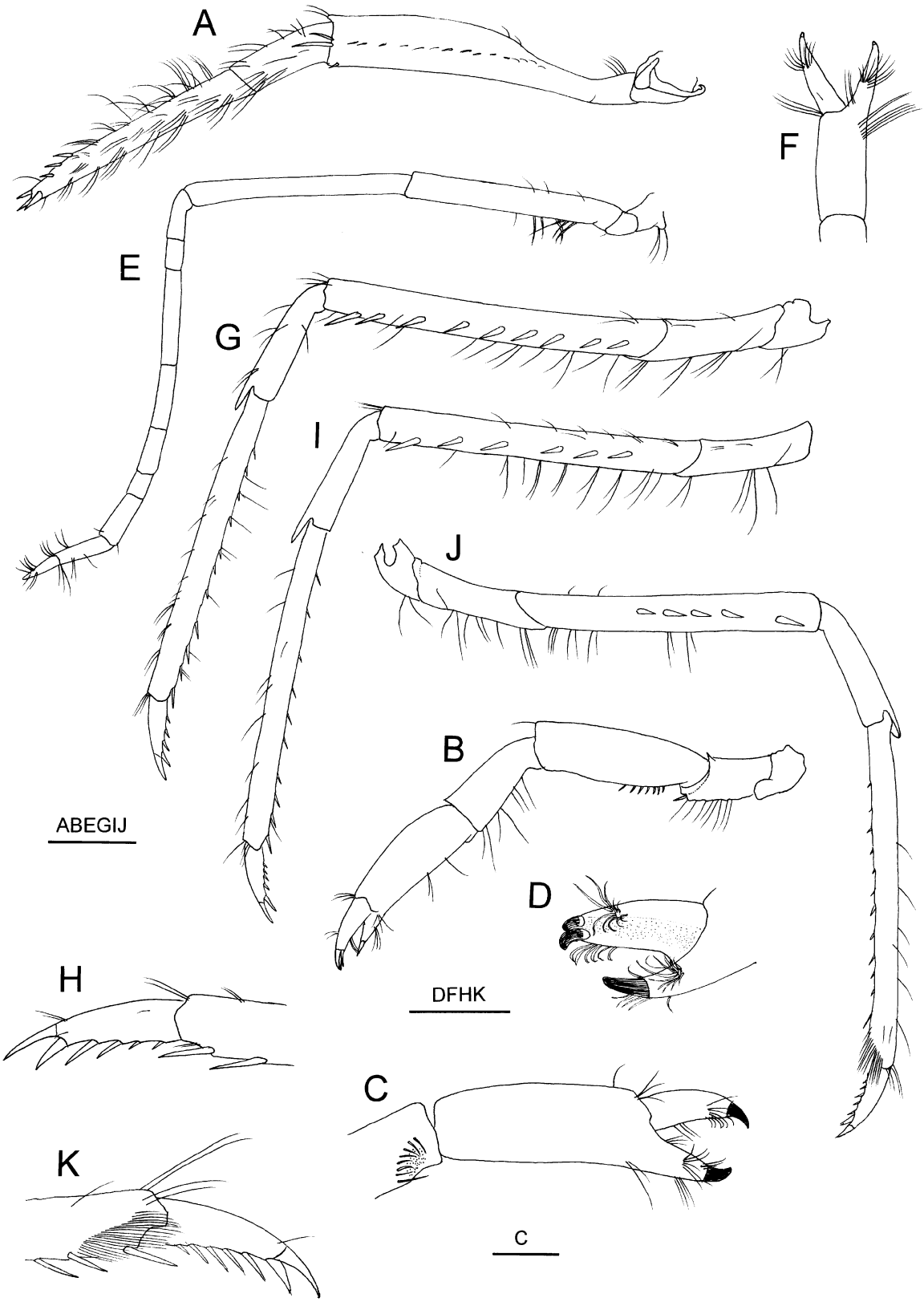

FIGURE 7. *Heptacarpus acuticarinatus* **n. sp.** Holotype, ovigerous female (cl 5.4 mm; CBM-ZC 8980), Sagami Bay. Left appendages (only fifth pereopod from right). A, third maxilliped, lateral view; B, first pereopod, lateral view; C, chela of first pereopod, dorsal (extensor) view; D, dactylus and fixed finger of first pereopod, oblique view; E, second pereopod, lateral view; F, chela of second pereopod; G, third pereopod, lateral view; H, dactylus and distal part of propodus of third pereopod, lateral view; I, fourth pereopod, lateral view; J, fifth pereopod, lateral view; K, dactylus and distal part of propodus of fifth pereopod, lateral view. Scale bars: 1 mm for A, B, E, G, I, J; 0.5 mm for C–F, H, K.

Third maxilliped (Figs 5, 7A) moderately stout, relatively long, reaching distal 0.15–0.30 of antennal scale; ultimate segment 2.20–2.40 length of carpus (= penultimate segment), tapering distally, with several darkly pigmented corneous spines distally.

First pereopod (Fig. 7B) moderately stout, reaching nearly to midlength of antennal scale; chela (Fig. 7C) about 1.85–2.00 of carpal length and 3.50–3.80 times longer than wide; dactylus 0.50–0.60 length of palm, terminating in 2 darkly pigmented, strong corneous ungues (Fig. 7D); fixed finger terminating 1 corneous unguis (Fig. 7D); merus about 1.70 of carpal length and about 3.20–3.40 times longer than high; dorsolateral distal angle of ischium with small denticle. Second pereopods (Fig. 7E) equal, slightly falling short of distal margin of antennal scale; dactylus 0.70–0.75 of palm length (Fig. 7F); carpus about 3.80 times longer than chela, divided in 7 unequal articles; ischium subequal in length to merus. Third to fifth pereopods relatively long, similar in structure. Third pereopod (Fig. 7G) reaching or slightly overreaching distal margin of antennal scale; dactylus (Fig. 7H) 0.25–0.30 of propodal length, 4.50–5.00 times longer than deep, terminating in long, acute, pigmented unguis, armed with 5 or 6 accessory spinules on flexor margin; propodus with 2 rows of slender spinules on flexor margin (Fig. 7H); carpus 0.40–0.45 of propodal length; merus 9.00–9.50 times longer than high, armed with 7–10 lateral spines; ischium unarmed. Fourth pereopod (Fig. 7I) reaching distal 0.70–0.80 of antennal scale; merus with 5–8 lateral spines. Fifth pereopod (Fig. 7J) reaching midlength of antennal scale; propodus with tufts of grooming setae distally (Fig. 7K); merus with 3–6 lateral spines.

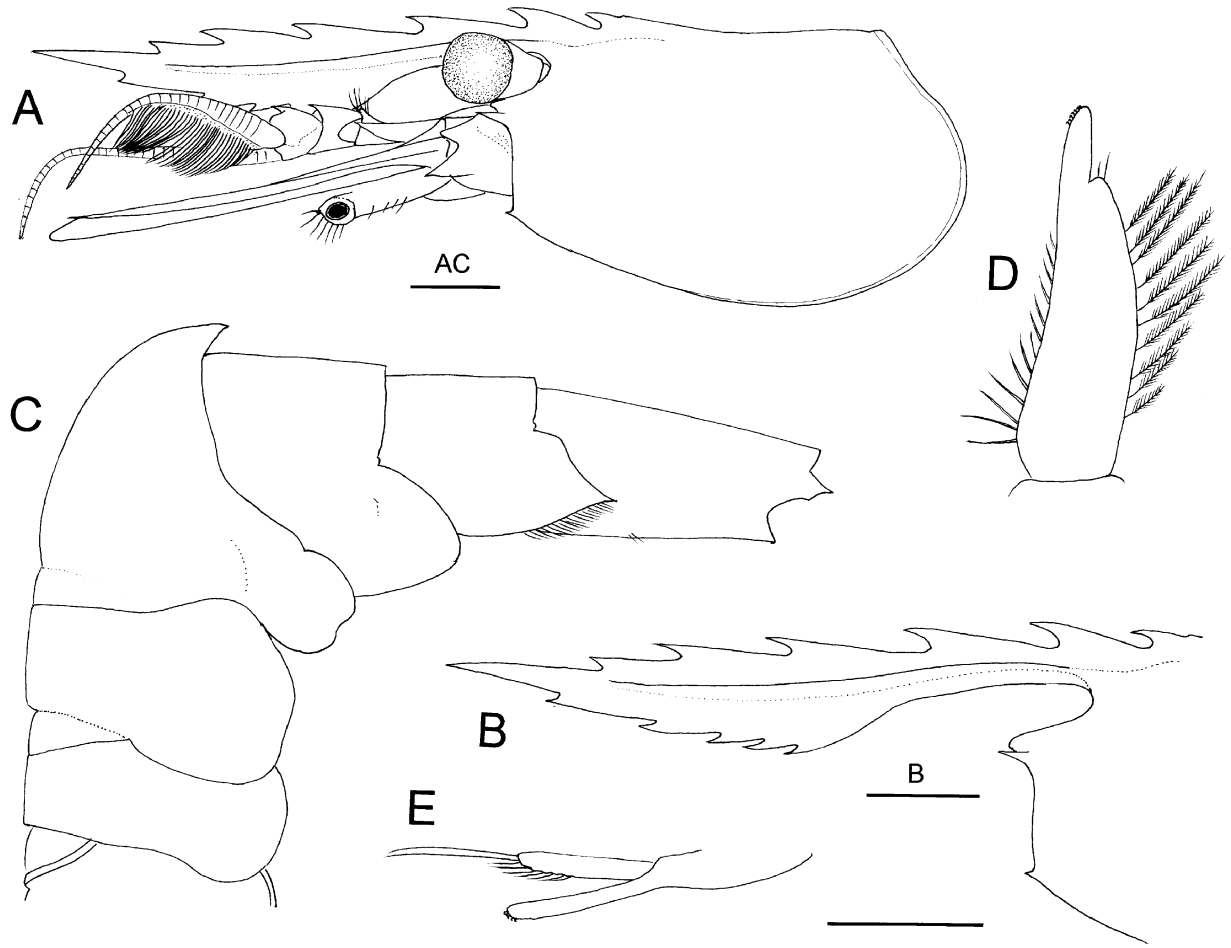

FIGURE 8. *Heptacarpus acuticarinatus* **n. sp.** Paratype, male (cl 3.7 mm; HUMZ-C 1174), Kashima-nada Sea, north-eastern Honshu. A, carapace and cephalic appendages, lateral view; B, rostrum, lateral view; C, pleon, lateral view; D, endopod of left first pleopod, ventral view; E, appendices interna and masculina of second pleopod, mesial view. Scale bars: 1 mm for A–C; 0.5 mm for D, E.

Gill formula as in Table 1. Only third maxilliped with strap-like epipod corresponding to setobranch on first pereopod.

Uropod (Fig. 5) with both rami reaching or slightly overreaching posterior margin of telson.

Description of males. Body slightly more slender than in females (Fig. 8A, C). Rostrum (Fig. 8A, B) 1.42–1.57 length of carapace, anterior 0.16–0.24 unarmed. Pleon (Fig. 8C) weakly geniculate; third pleonal tergite evenly convex in posterior part. Corneal diameter about 0.20–0.22 of carapace length (Fig. 8A). Outer flagellum of antennule larger than in females, thickened aesthetasc-bearing portion about 0.50 length of carapace (Fig. 8A). Antennal scale 1.14–1.25 times longer than carapace. Third to fifth pereopods similar to those of females. Endopod of first pleopod (Fig. 8D) elongate subtriangular, with conspicuous appendix interna at terminal position; distolateral lobule delineated; mesial margin with row of small spiniform setae, lateral margin with row of long plumose setae. Second pleopod with appendix masculina slightly shorter than appendix interna, with numerous setae increasing in length distally on dorsal surface to tip (Fig. 8E).

Size. Females cl 3.0–6.8 mm, ovigerous females cl 4.4–6.8 mm; males cl 5.2 mm.

Variation. A total of 25 specimens, including 23 females and two males, were examined for assessing morphological variation in some characters possibly providing diagnostic significance.

The number of the rostral ventral teeth varies from five to eight (Fig. 18).

In all the specimens examined, the carapace is provided with pterygostomial teeth on both sides.

The number of the meral spines on the third pereopod varies from seven to 10 (Fig. 19), but the majority of the examined specimens (23 of 25 specimens; 92 %) have seven to nine spines. Other two specimens (8.0 %) have ten meral spines.

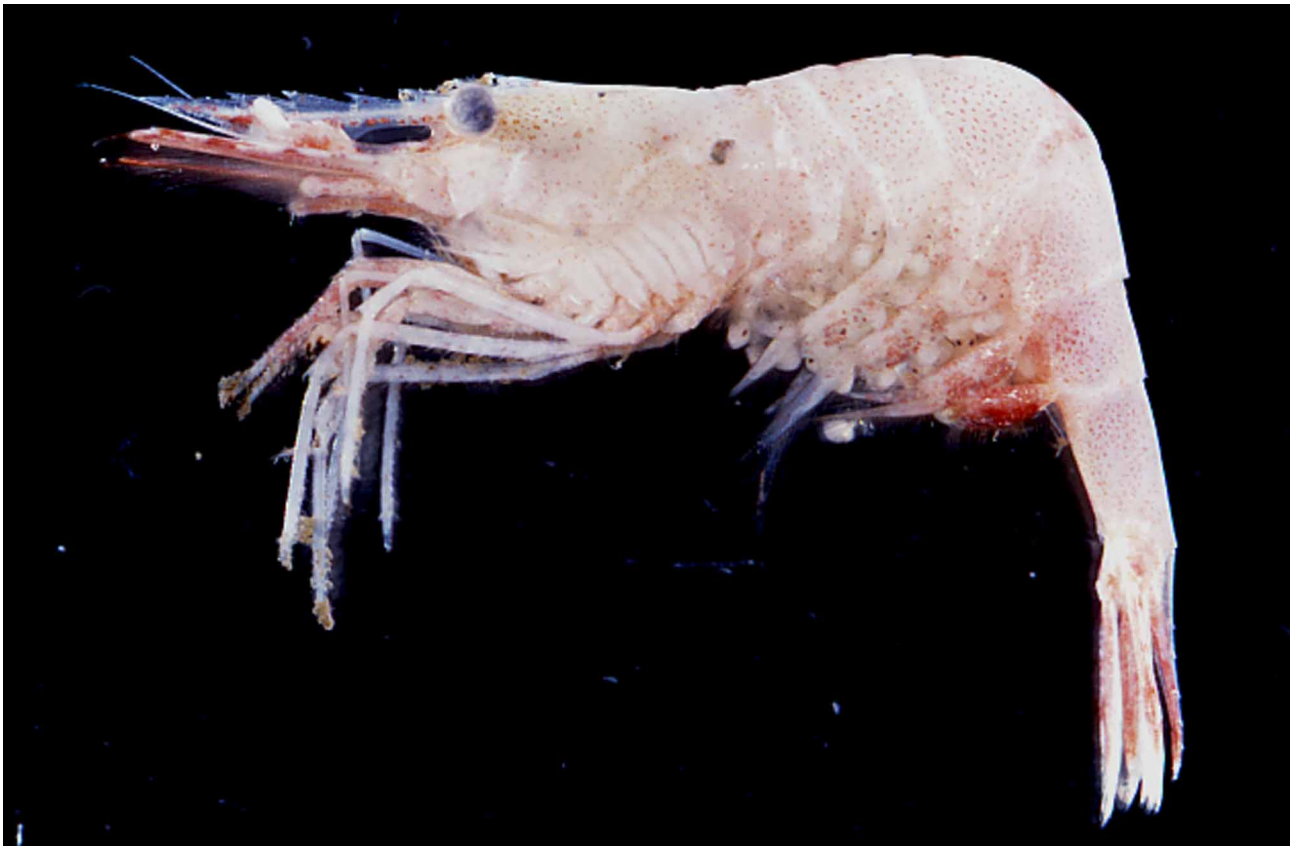

FIGURE 9. *Heptacarpus acuticarinatus* **n. sp.** Holotype, ovigerous female (cl 5.4 mm; CBM-ZC 8980), Sagami Bay, habitus in lateral view, showing coloration in life.

Coloration in life. Body and appendages generally pale pink; cornea gray (Fig. 9).

Distribution. Southern Hokkaido to Kyushu, Japan, Korea, and Yellow Sea, 30–150 m.

Remarks. The new species appears closest to *Heptacarpus camtschaticus*, with which it has been confounded, but is readily distinguished from the latter by a number of characters, including the sharp lateral carina of the rostrum and the relatively longer pereopods with more numerous meral spines (see "Comparison" for details). The present study strongly suggests that *H. camtschaticus* does not occur in the Pacific coast of Honshu to Kyushu, Japan. Thus, the records of *H. camtschaticus* by Balss (1914) and Parisi (1919) from Sagami Bay and Yokoya (1933) from Aichi Prefecture (all as *Spirontocaris*) are referred to *H. acuticarinatus* **n. sp.** There is little doubt that the specimen from Amakusa, Kyushu, cited as *H. camtschaticus* by Hayashi & Miyake (1968), Kikuchi & Miyake (1978), Hayashi (1979, 1992), is identical with the new species, because the morphological attributes described or shown in these references closely fit those of the new species. Similarly, the occurrence of *H. acuticarinatus* **n. sp.** instead of *H. camtschaticus* has been confirmed in Korean waters. Therefore, Korean records of *H. camtschaticus* by Cha *et al.* (2001) are also referred to the new species. Regarding the geographical range, the record of *H. camtschaticus* from northern China (Liu, 1963) is also most probably referred to the new species.

Etymology. The species name is a combination of the Latin *acutus* (= sharp) and *carinatus* (ridged), in reference to the characteristic sharp lateral carina of the rostrum.

Heptacarpus geniculatus (Stimpson, 1860)

(Figs 10–13, 18, 19)

Hippolyte geniculata Stimpson, 1860: 103 [type locality: Hakodate, Hokkaido]; Ortmann, 1890: 503 (in part), pl. 37, fig. 3; Doflein, 1902: 636 (in part).

Spirontocaris geniculata. – Rathbun, 1902: 45 (in part), fig. 19; Yokoya, 1930: 530; 1939: 270; Miyake, 1961: 8.

Spirontocaris alcimede De Man, 1906: 404 [type locality: Seto Inland Sea, Japan]; 1907: 416, pl. 32, figs 42–46; Yu, 1935: 43.

Heptacarpus geniculatus. – Holthuis, 1947: 12, 44; Liu, 1955: 38, pl. 14, figs 1, 2; Miyake *et al.*, 1962: 123; Sando, 1964: 32; Kubo, 1965: 615, fig. 975; Kikuchi, 1968: 180; Hayashi & Miyake, 1968: 132, fig. 5; Kurata, 1968: 137, fig. 1; Mukai, 1969: 2, fig. 4; Kim & Park, 1972: 200, pl. 3, fig. 3; Motoh, 1972: 40, fig. 3, pl. 8, figs 1, 2; Miyake, 1975: 102 (unnumbered fig.), 242; Hayashi, 1976: 16; Kikuchi & Miyake, 1978: 24; Hayashi, 1979: 21 (in part); Yamashita & Hayashi, 1980: 20, fig. 2f–j; Kojima & Hanabuchi, 1981: 45 (list); Miyake, 1982: 47; Takeda, 1982: 21, fig. 63; Hayashi, 1989: 3; Komai *et al.*, 1992: 193 (in part); Liu & Zhong, 1994: 559 (list); Hayashi, 1995: 311, fig. 21-252A, pl. 86, fig. 4; Chace, 1997: 44 (list); Komai, 1999: 59; Motoh & Toyota, 2005: 33, fig. 3-9; Yang & Kim, 2005: 12, fig. 1.

Heptacarpus geniculatus geniculatus. – Vinogradov, 1950: 211 (key).

Heptacarpus geniculata. – Kubo, 1960: 102, pl. 51, fig. 4.

? *Spirontocaris geniculata*. – Yokoya, 1933: 26; Nishimura, 1939: 26.

Not *Spirontocaris geniculata*. – Urita, 1942: 22. = *Heptacarpus camtschaticus* (Stimpson, 1860).

Not *Heptacarpus geniculatus* [= *Heptacarpus longirostris* (Kobjakova, 1936)]. – Igarashi, 1969: 7, pl. VIII, fig. 22, pl. XVI, fig. 49.

Not *Heptacarpus geniculatus* [= *Heptacarpus pandaloides* (Stimpson, 1860)]. – Miyake, 1982, pl. 16, fig. 3.

Type material. Presumably no longer extant (Evans, 1967).

Material examined. **Japan**. CBM-ZC 510, 10 females (cl 6.3–7.4 mm), 3 males (cl 4.9–6.2 mm), Miyajima, Hiroshima Prefecture, Seto Inland Sea, subtidal, 13 October 1997, coll. K. Yamashita; CBM-ZC 591, 1 female (cl 3.1 mm), Takeoka, Futtsu, Boso Peninsula, intertidal, 13 May 1994, coll. T. Sunobe; CBM-ZC 959, 2 females (cl 8.8, 9.9 mm), Kanbayashi Port, Miyako Bay, Iwate Prefecture, subtidal, trap, 12 August 1994, coll. T. Komai; CBM-ZC 1694, 1 ovigerous female (cl 9.4 mm), Nebama, Otsuchi Bay, Iwate Prefecture, 3–4 m, *Zostera* belt, small beam trawl, 26 May 1995, coll. T. Komai; CBM-ZC 8525, 2 ovigerous females (cl 8.3, 9.4 mm), Kurahashi Island, Hiroshima Prefecture, Seto Inland Sea, 5 m, commercial trawler, 13 April 2005, coll. K. Hiramoto; HUMZ-C 140, 1male (cl 5.5 mm), Kanbayashi Port, Miyako Bay, 2–3 m, 30 December 1982, trap, coll. T. Komai; HUMZ-C 159, same locality, 24 October 1987, trap, coll. T. Komai; KMNH (for-

merly ZLKU 4058), 17 ovigerous females (cl 8.3–9.1 mm), 5 females (cl 8.6–10.3 mm), 33 males (cl 4.8–6.1 mm), Tomioka Bay, Amakusa Islands, Kumamoto Prefecture, subtidal, *Zostera* belt, 22 and 23 December 1958, small Danish seine, coll. T. Kikuchi; KMNH (formerly ZLKU 9411), 4 females (cl 4.1–7.8 mm), Aomori Bay, Mutsu Bay, Aomori Prefecture, subtidal, 20 July 1959, small Danish seine, coll. H. Sando.

Description of female. Body (Fig. 10) slender for genus. Rostrum (Figs 10, 11A, B) straight, directed forward, generally styliform, slightly falling short of to slightly overreaching distal margin of antennal scale, 1.11–1.57 of carapace length; dorsal margin armed with 4–6 (most frequently 5) teeth including 2–4 (most frequently 3) on rostrum proper and 1 or 2 on carapace, posteriormost tooth arising from 0.14–0.17 length of carapace, distal 0.34–0.72 of dorsal margin unarmed; ventral blade relatively shallow, deepest at proximal to midlength; ventral margin with 6–9 (rarely 5) teeth; teeth subequal or slightly unequal except for smaller distalmost tooth; lateral carina blunt. Carapace (Figs 10, 11A, B) with postorbital rostral ridge low, not extending to anterior 0.25 of carapace length; dorsal margin in lateral view straight; suborbital lobe (Fig 11A) rounded, constricted at base, falling short of or reaching antennal tooth; pterygostomial angle unarmed or armed with tiny tooth.

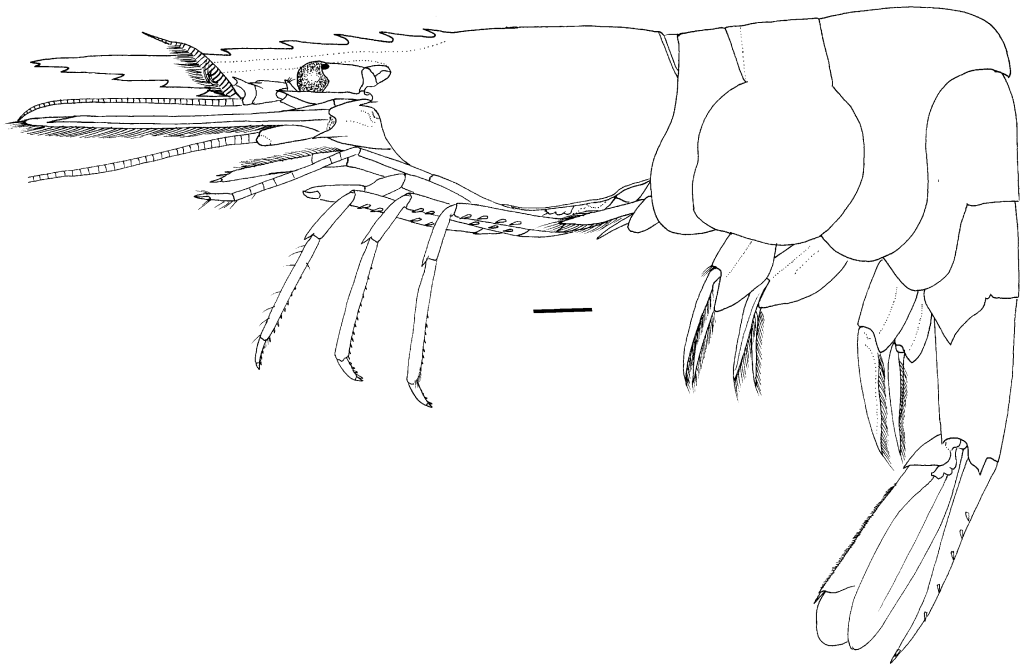

FIGURE 10. *Heptacarpus geniculatus* (Stimpson, 1860). Ovigerous female (cl 9.3 mm; ZLKU 4058), Tomioka Bay, Amakusa, Kyushu, habitus in lateral view. Scale bar: 2 mm.

Pleon (Figs 10, 13E) strongly gibbous. Second somite with faint transverse groove on tergite. Dorsal surface of third tergite strongly elevated in posterior part; posterodorsal margin of tergite weakly produced. Pleura of anterior four somites broadly rounded, fifth pleuron with moderately large posteroventral tooth; posterolateral margin of fifth pleuron slightly sinuous. Sixth somite 1.75–1.90 times longer than fifth and about 2.00 times longer than high. Telson (Fig. 11C) about 1.20–1.30 length of sixth somite, 3.40–3.70 times longer than wide, armed with 3–5 (most frequently 4) dorsolateral spines on either side; posterior margin with 1 sharp median tooth and 3 pairs of unequal spines.

Eye-stalk (Fig. 11B) generally subpyriform; cornea slightly wider and shorter than remaining part of eyestalk; ocellus distinct, showing as black spot; maximal diameter of cornea 0.15–0.18 of carapace length.

Antennular peduncle (Fig. 11B) falling short of midlength of antennal scale. First segment unarmed on dorsodistal margin; stylocerite overreaching distal margin of first segment, acuminate, mesial margin convex or sinuous, closely in touch with first segment; second segment about 0.30 length of first segment, with large spine at dorsolateral distal angle; third segment short, with moderately large spine on dorsodistal margin. Lateral flagellum with thickened aesthetasc-bearing portion 0.30–0.35 of carapace length.

Antenna (Fig. 11B, C) with basicerite bearing moderately large ventrolateral distal tooth; carpocerite reaching 0.30 length of antennal scale or distal margin of second segment of antennular peduncle. Antennal scale 0.96–1.29 of carapace length and 5.50–6.00 times longer than wide; lateral margin straight or slightly concave; distal lamella rounded, strongly produced, considerably exceeding beyond distolateral tooth.

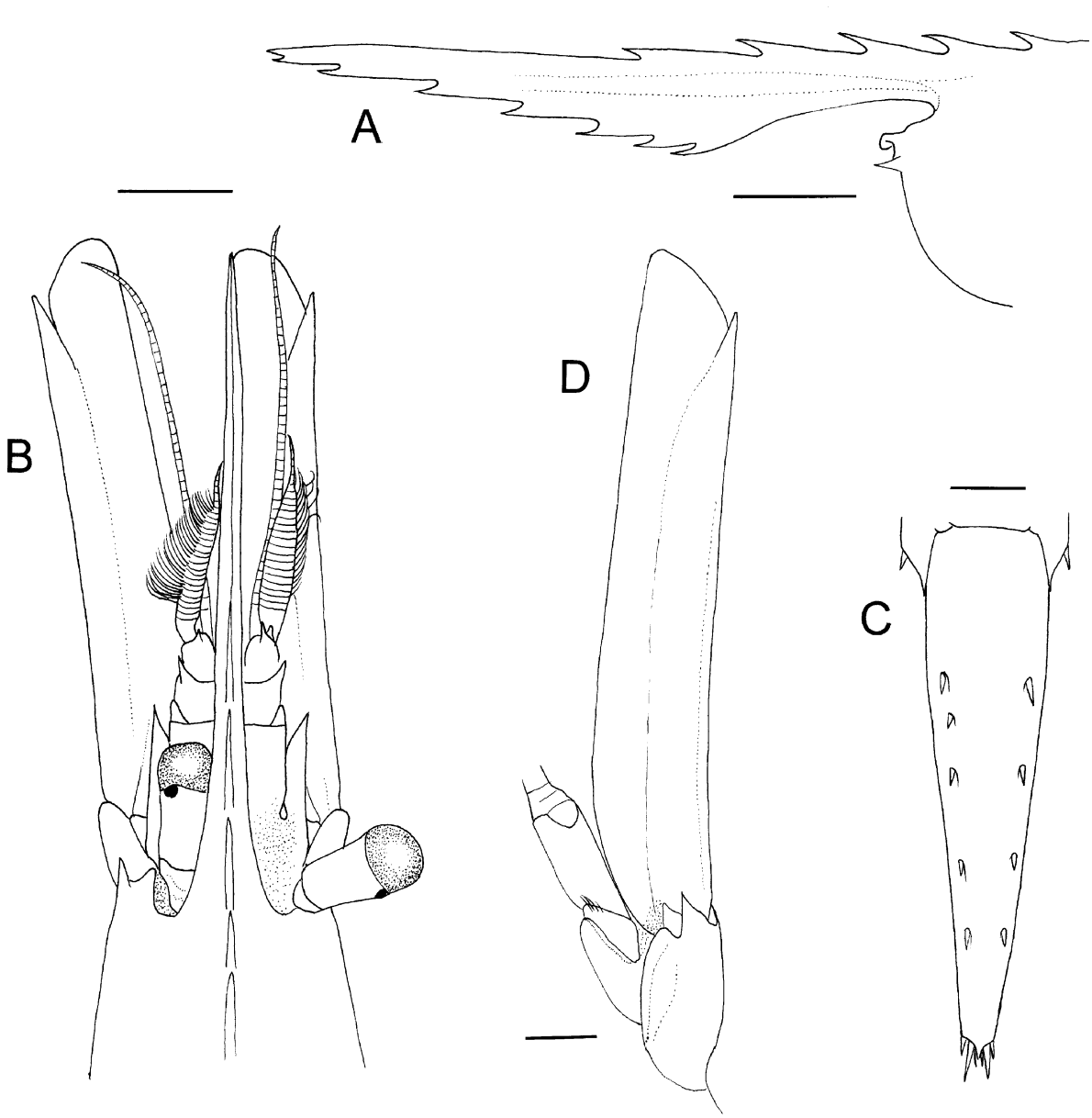

FIGURE 11. *Heptacarpus geniculatus* (Stimpson, 1860). Ovigerous female (cl 9.3 mm; ZLKU 4058), Tomioka Bay, Amakusa, Kyushu. A, rostrum and anterior part of carapace, lateral view; B, rostrum, anterior part of carapace and cephalic appendages, dorsal view (setae partially omitted); C, telson, dorsal view; D, left antennal scale, ventral view (setae omitted). Scales: 2 mm for A, B; 1 mm for C, D.

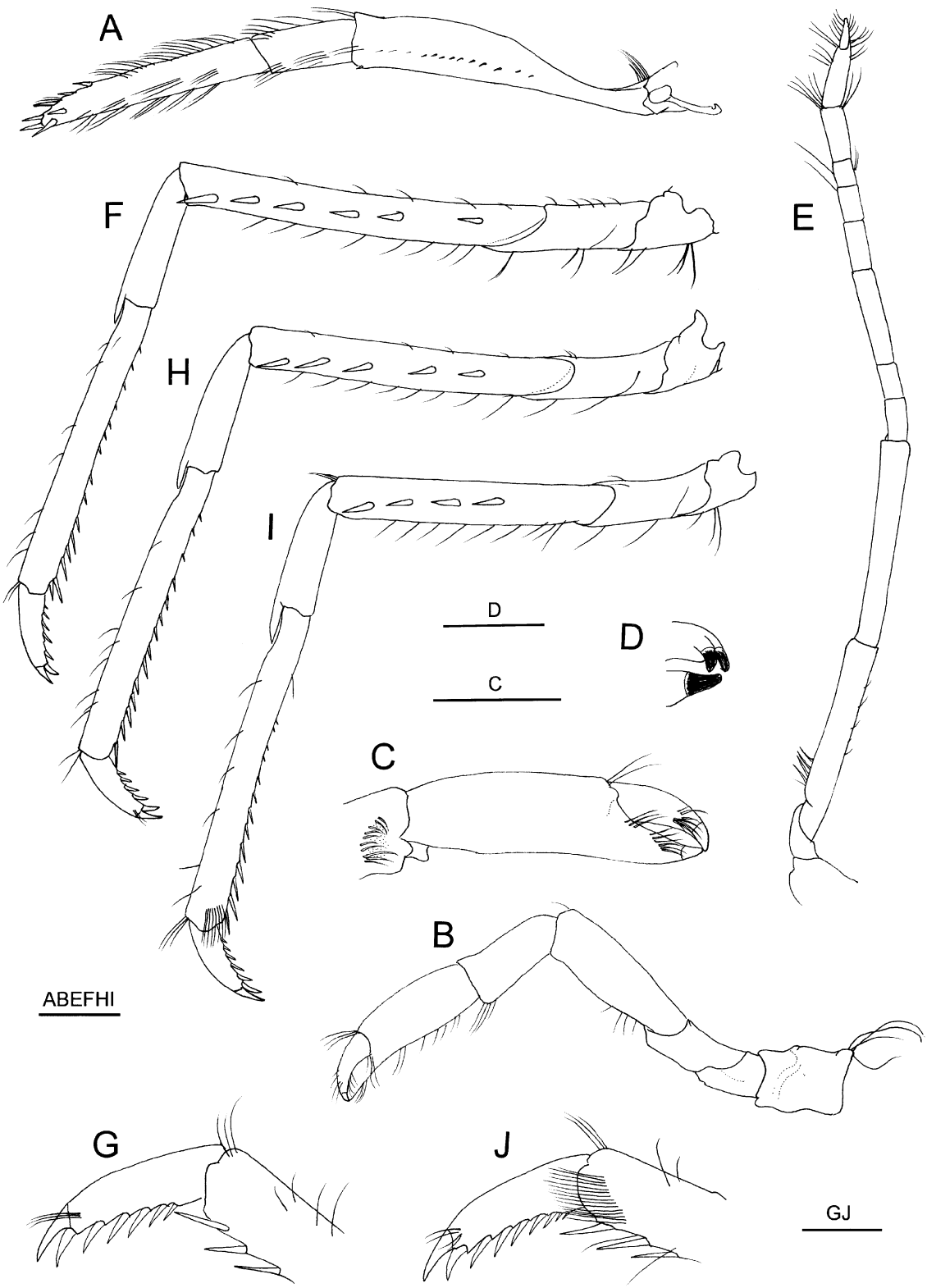

FIGURE 12. *Heptacarpus geniculatus* (Stimpson, 1860). Ovigerous female (cl 9.3 mm; ZLKU 4058), Tomioka Bay, Amakusa, Kyushu, left thoracic appendages. A, third maxilliped, lateral view; B, first pereopod, lateral view; C, chela of first pereopod, dorsal (extensor) view; D, tips of dactylus and fixed finger; E, second pereopod, lateral view; F, third pereopod, lateral view; G, dactylus and distal part of propodus of third pereopod, lateral view; H, fourth pereopod, lateral view; I, fifth pereopod, lateral view; J, dactylus and distal part of propodus of fifth pereopod, lateral view. Scales: 1 mm for A–C, E, F, H, I; 0.5 mm for D, G, J.

Third maxilliped (Figs 10, 12A) moderately stout, short, falling short of midlength of antennal scale; ultimate segment about 2.20 length of carpus (= penultimate segment), tapering distally, with several darkly pigmented corneous spines distally.

First pereopod (Fig. 12B) moderately stout, slightly overreaching base of antennal scale; chela (Fig. 12C) 1.50–1.70 of carpal length and 3.50–3.90 times longer than wide; dactylus about 0.60 length of palm, terminating in 2 darkly pigmented, strong corneous ungues (Fig. 12D); fixed finger terminating in single corneous unguis (Fig. 12D); carpus slightly widened distally; merus about 1.60 of carpal length, about 3.20 times longer than high; dorsolateral distal angle of ischium with minute denticle. Second pereopods (Fig. 12E) equal, reaching midlength of antennal scale; dactylus about 0.60 of palm length; carpus about 3.80 times longer than chela, divided in 7 unequal articles; ischium subequal in length to merus. Third to fifth pereopods relatively short, similar in structure. Third pereopod (Fig. 12F) overreaching midlength of antennal scale by length of dactylus; dactylus (Fig. 12G) 0.30–0.35 of propodal length, 3.50–3.80 times longer than deep, terminating in acute, pigmented unguis, armed with 5–6 accessory spinules on flexor margin; propodus with 2 rows of slender spinules on flexor margin; carpus 0.45–0.50 of propodal length; merus 8.50–9.50 times longer than high, armed with 6–8 spines ventrally; ischium unarmed. Fourth pereopod (Fig. 12H) not reaching midlength of antennal scale; merus with 4–7 lateral spines. Fifth pereopod (Fig. 12I) reaching 0.30 of antennal scale; propodus with tufts of grooming setae distally (Fig. 12J); merus with 3–5 lateral spines.

Gill formula as in Table 1. Only third maxilliped with strap-like epipod corresponding to setobranch on first pereopod.

Uropod (Fig. 10) with both rami slightly overreaching posterior margin of telson.

Description of male. Body more slender than in females (Fig. 13A, B). Rostrum (Fig. 13A) 1.32–1.55 length of carapace, anterior 0.39–0.71 unarmed. Third pleonal tergite very strongly convex in posterior part, sometimes markedly produced (Fig. 13B). Corneal diameter about 0.15–0.17 of carapace length (Fig. 13A). Outer flagellum of antennule larger than in females, thickened aesthetasc-bearing portion about 0.40 length of carapace (Fig. 13A). Antennal scale 1.16–1.26 times longer than carapace. Third to fifth pereopods less stout than in females, armature similar to that of females. Endopod of first pleopod (Fig. 13C) elongate subtriangular, with conspicuous appendix interna at terminal position; distolateral lobule not differentiated; mesial margin with row of small spiniform setae, lateral margin with row of long plumose setae. Second pleopod with appendix masculina distinctly longer than appendix interna, with numerous long setae on dorsal surface to tip (Fig. 13D).

Variation. A total of 79 specimens, including 43 females, 36 males, were examined for assessing morphological variation in some characters possibly providing diagnostic significance.

The number of ventral rostral teeth varies from five to ten (Fig. 18), but the many of the specimens examined have seven or eight teeth (47 of 69 specimens; 68.1 %). Ten and nine specimens (14.5 % and 13.0 %) have nine or six teeth respectively. Only two specimens and a single specimen have five or ten teeth respectively, and thus the conditions may be rather exceptional for *H. geniculatus*.

Frequency of the presence or absence of the pterygostomial tooth on the carapace is summarized in Table 3. Most of the females (35 of 42 specimens; 83.3 %) lack the pterygostomial tooth on either side, although seven specimens (16.7 %) have the tooth on both sides. There is no example that one side bears a tooth. On the other hand, the pterygostomial angle is exclusively unarmed on both sides in the male specimens.

TABLE 3. Variation in the presence or absence of a pterygostomial tooth in *Heptacarpus geniculatus* (Stimpson, 1860).

	Female	Male
Present on both sides	7 (16.7 %)	0 (0 %)
Present on one side	0 (0 %)	0 (0 %)
Absent on either side	35 (83.3 %)	36 (100 %)

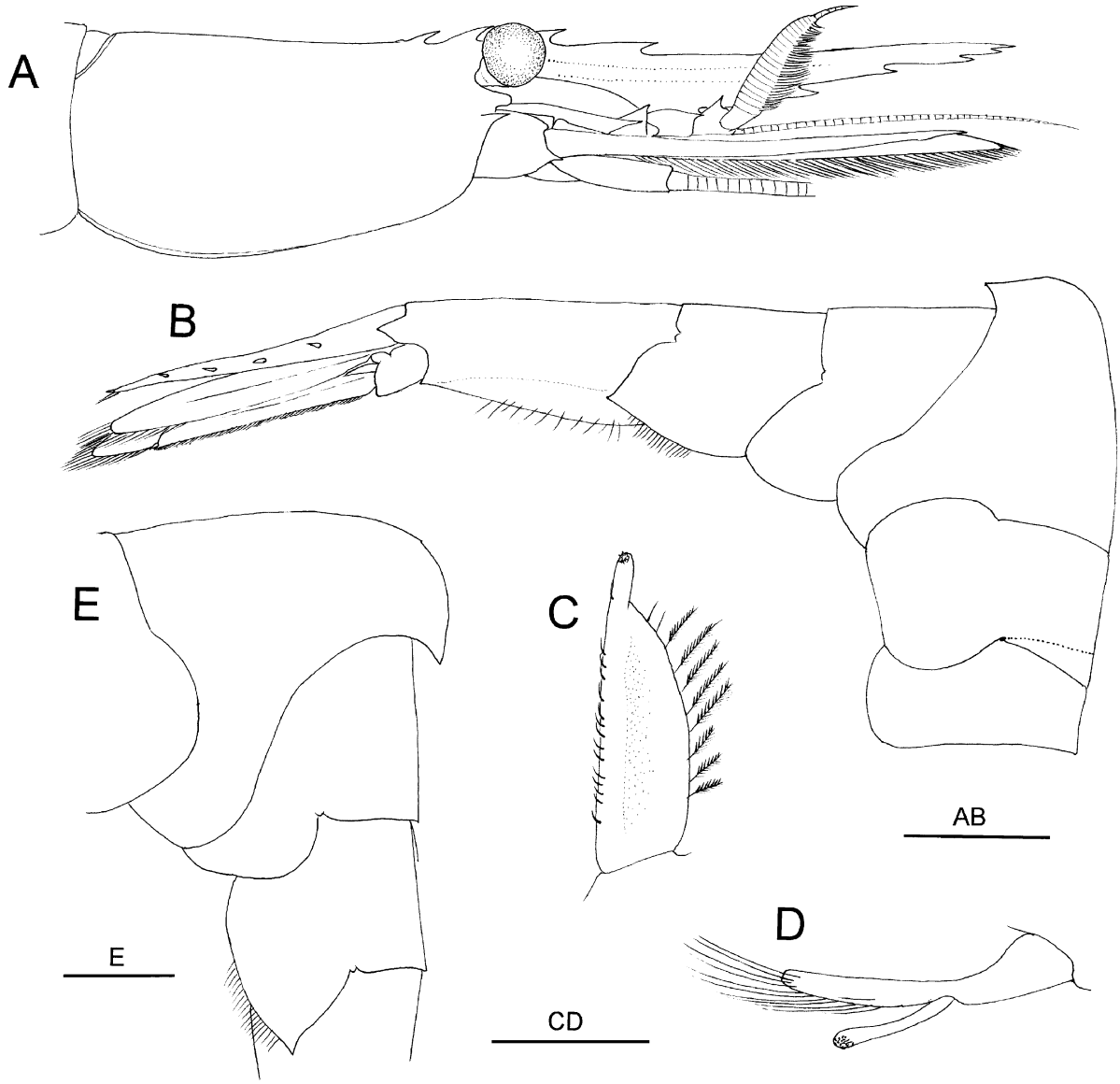

FIGURE 13. *Heptacarpus geniculatus* (Stimpson, 1860). A–D, male (cl 4.9 mm; CBM-ZC 510), Miyajima, Hiroshima Prefecture, Seto Inland Sea; E, female (cl mm; same lot). A, carapace and cephalic appendages, lateral view; B, pleon, telson and uropod, lateral view; C, endopod of left first pleopod, ventral view; D, appendices interna and masculina of left second pleopod, mesial view; E, third to fifth pleonal somites, lateral view. Scale bars: 2 mm for A, B, E; 0.5 mm for C, D.

The number of meral spines on the third pereopod varies from five to eight (Fig. 19), but the majority of the examined specimens (82.0 %) have six or seven spines. Nine specimens (11.5 %) have five meral spines, and five specimens (6.5 %) have eight spines.

Size. Females cl 3.3–9.9 mm, ovigerous females cl 7.5–9.4 mm; males cl 4.9–6.1 mm.

Coloration in life. Variable; body and appendages transparent, dark brown, reddish brown, or green. occasionally with white middorsal longitudinal stripe.

Distribution. Temperate waters in East Asia: southern Hokkaido to Kyushu, Japan, Korea, and northern China, intertidal to 4 m. Abundant in *Zostera* belts of inshore waters.

Remarks. The present study shows that *Heptacarpus geniculatus* is restricted to temperate parts in East Asia. Therefore, the records by Doflein (1902) and Rathbun (1902) are referable to *H. geniculatus* only at least in part, because their material contained specimens from Nemuro (Doflein, 1902) or from Muroran (as Mororan; Rathbun, 1902), the locations in Hokkaido where the occurrence of *H. geniculatus* has not been verified. Similarly, Nishimura's (1939) record of *Spirontocaris geniculata* can not be referred to the present species, as his specimens came from Nemuro and Muroran. It is impossible to specify what species was actually represented by these records, because no information on morphology was provided. From Nemuro and the adjacent area, the occurrence of *H. camtschaticus* and *H. longirostris* has been confirmed. Furthermore, the occurrence of *H. geniculatus* at sublittoral depths exceeding 100 m has not been confirmed. Therefore, the record by Yokoya (1933) from north of Oga Peninsula, Akita Prefecture, at a depth of 145 m is questionably included in the synonymy.

We concur with previous authors that *Spirontocaris alcimede* de Man, 1906 is a junior synonym of *Heptacarpus geniculatus*. *Eualus geniculata* var. *longirostris* Kobjakova, 1936, which was synonymized with *H. geniculatus* by Hayashi (1979), is resurrected as a full species (see "Remarks" of *H. longirostris*).

Heptacarpus longirostris (Kobjakova, 1936)

(Figs 14–19)

Hippolyte geniculata. —Doflein, 1902: 636 (? part).
Spirontocaris geniculata. —Rathbun, 1902: 45 (part); Urita, 1942: 22.
Eualus geniculata? —Derjugin & Kobjakova, 1935: 142 (list).
Eualus geniculata var. *longirostris* Kobjakova, 1936: 211, fig. 38 [type locality: Peter the Great Bay]; Chace, 1997: 43 (list).
Eualus geniculata longirostris.—Kobjakova, 1937: 121; 1958: 225 (in part).
Heptacarpus geniculatus longirostris. —Vinogradov, 1950: 210, pl. 16, fig. 68; Kobjakova, 1967: 235; Andrianov & Kussakin, 1998: 264 (list).
Spirontocaris geniculata longirostris. —Kobjakova, 1958: 225.
Heptacarpus geniculatus. —Igarashi, 1969: 7, pl. VIII, fig. 22, pl. XVI, fig. 49; Hayashi, 1979: 21 (in part).
Heptacarpus camtschaticus. —Igarashi, 1971: 2, pl. II, fig. 4. Not *Heptacarpus camtschaticus* (Stimpson, 1860).

Type material. Presumably no longer extant.

Material examined. **Kurile Islands**. ZISP 2/33569, 2 females (cl 8.0, 10.0 mm), Matsuba Bay, Shikotan Island, 19.5–25 m, 18 September 1949, dredge No. 23, coll. E. F. Gurjanova, identified with *Eualus geniculata longirostris* by Z. I. Kobjakova; ZISP 1/33568, interior part of Anama Bay, Shikotan Island, 3 August 1949, trawl, coll. E. F. Gurjanova, 1 female (cl 7.7 mm), identified with *Eualus geniculata longirostris* by Z. I. Kobjakova. **Japan**. Hokkaido. CBM-ZC 8659, 2 females (cl 6.2, 7.3 mm), Notoro Lake, Abashiri, Hokkaido, subtidal, *Zostera* belt, 13 May 2005, sledge, coll. S. Chiba; CBM-ZC 8600, 1 female (cl 6.6 mm), 1 ovigerous female (cl 6.4 mm), Usujiri, Minami-Kayabe, 20 m, 13 November 1992, dredge, coll. T. Komai; CBM-ZC 8601, 2 females (cl 7.8, 8.4 mm), 1 male (cl 4.6 mm), same locality, 20–25 m, 8 October 1991, dredge, coll. T. Komai; CBM-ZC 8660, 8 females (cl 5.0–7.3 mm), same locality, 30 September 2005, sledge, coll. S. Chiba; CBM-ZC 8661, 2 males (cl 3.7, 4.0 mm), 7 females (cl 8.2–6.2 mm), Futatsu-iwa, Abashiri, Hokkaido, subtidal, *Zostera* belt, 10 September 2005, coll. S. Chiba; CBM-ZC 8662, 2 ovigerous females (cl 6.1, 7.8 mm), 3 females (cl 5.7–6.5 mm), 2 males (cl 4.2, 4.4 mm), Notoro Lake, Hokkaido, 3–4 m, 23 October 1997, coll. S. Goshima; CBM-ZC 9044, 1 female (cl 6.6 mm), off Usujiri, Minami Kayabe, 15–25 m, 11 June 1993, dredge, coll. F. Muto. Exact locality unknown. ZISP 41392-2, Pacific Ocean, dredge 91-95, 1 female (cl 6.4 mm). **Prymorye**. ZISP, 2 females (cl 7.1, 7.5 mm), Stark's Strait, Peter the Great Bay, 4 August 1979.

Description of female. Body (Fig. 14) slender for genus. Rostrum (Figs 14, 15A, B) straight, directed forward, slightly falling short of to slightly overreaching distal margin of antennal scale, 1.03–1.32 length of car-

apace; dorsal margin armed with 4–6 (most frequently 5) teeth including 2–4 (most frequently 3) on rostrum proper and 1 or 2 on carapace, posteriormost tooth arising from 0.15–0.19 length of carapace, distal 0.50–0.70 of dorsal margin unarmed; ventral blade relatively shallow, deepest at proximal to midlength of rostrum; ventral margin with 4–6 (rarely 7 or 8) teeth (teeth unequal in size but not increasing in size posteriorly); lateral carina blunt. Carapace (Figs 14, 15A, B) with postorbital rostral ridge low, not extending to anterior 0.25 of carapace length; dorsal margin in lateral view slightly sinuous; suborbital lobe (Fig 15B) rounded, constricted at base, falling short of antennal tooth; pterygostomial angle frequently armed with tiny tooth.

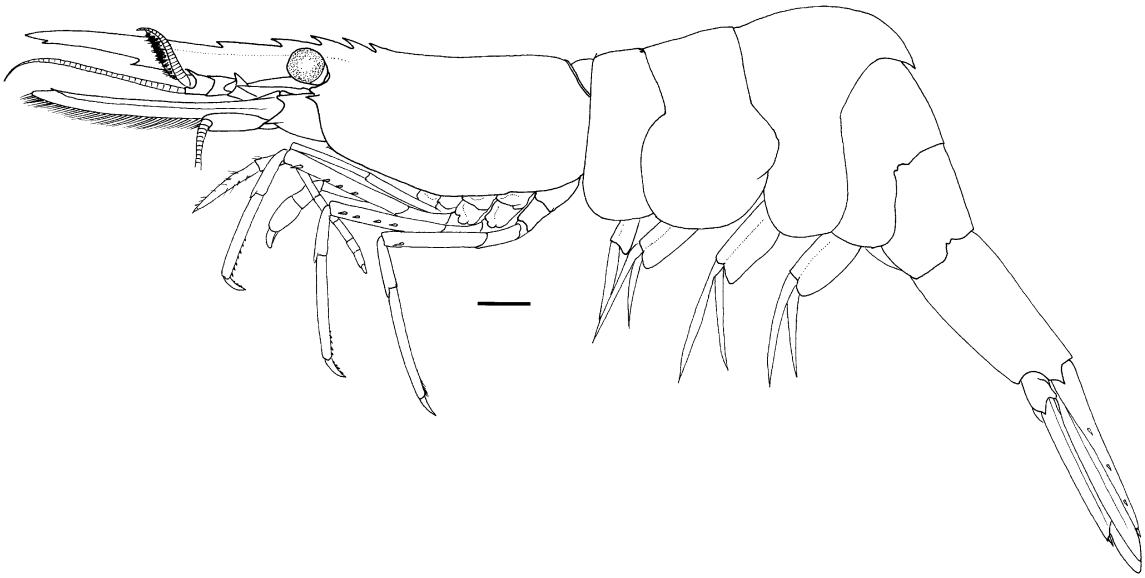

FIGURE 14. *Heptacarpus longirostris* (Kobjakova, 1936). Female (cl 8.4 mm; CBM-ZC 8601), Usujiri, southern Hokkaido, habitus in lateral view. Scale bar: 2 mm.

Pleon (Fig. 14) dorsally rounded, not markedly gibbous. Second somite with faint transverse groove on tergite. Dorsal surface of third tergite evenly convex, posterodorsal margin somewhat produced. Pleura of anterior 4 somites broadly rounded; fifth pleuron unarmed at posteroventral angle, posterolateral margin truncate. Sixth somite 1.75–1.90 times longer than fifth and 1.90–2.00 times longer than high. Telson (Fig. 15C) 1.15–1.30 length of sixth somite, about 4.40 times longer than wide, armed with 3 or 4 dorsolateral spines on either side; posterior margin bluntly triangular, with 3 pairs of unequal spines.

Eye-stalk (including cornea) (Fig. 15B) generally subpyriform; cornea slightly wider and shorter than remaining part of eye-stalk; ocellus distinct, showing as black spot; maximal diameter of cornea 0.15–0.17 of carapace length.

Antennular peduncle (Fig. 15B) falling short of midlength of antennal scale. First segment unarmed on dorsodistal margin; stylocerite reaching or slightly overreaching distal margin of first segment, acuminate, mesial margin convex or sinuous, closely in touch with first segment; second segment about 0.30 length of first segment, with small spine at dorsolateral distal angle; third segment short, with small spine on dorsodistal margin. Lateral flagellum with thickened aesthetasc-bearing portion 0.30–0.35 of carapace length.

Antenna (Fig. 15B, D) with basicerite bearing moderately large ventrolateral distal tooth; carpocerite reaching 0.25–0.30 length of antennal scale or distal margin of second segment of antennular peduncle. Antennal scale 0.89–1.11 length of carapace and 3.90–4.50 times longer than wide; lateral margin straight; distal lamella rounded, strongly produced, considerably exceeding beyond distolateral tooth.

Third maxilliped (Figs 14, 16A) moderately stout, short, not reaching midlength of antennal scale; ulti-

mate segment 1.90–2.00 length of carpus (= penultimate segment), tapering distally, with several darkly pigmented corneous spines distally.

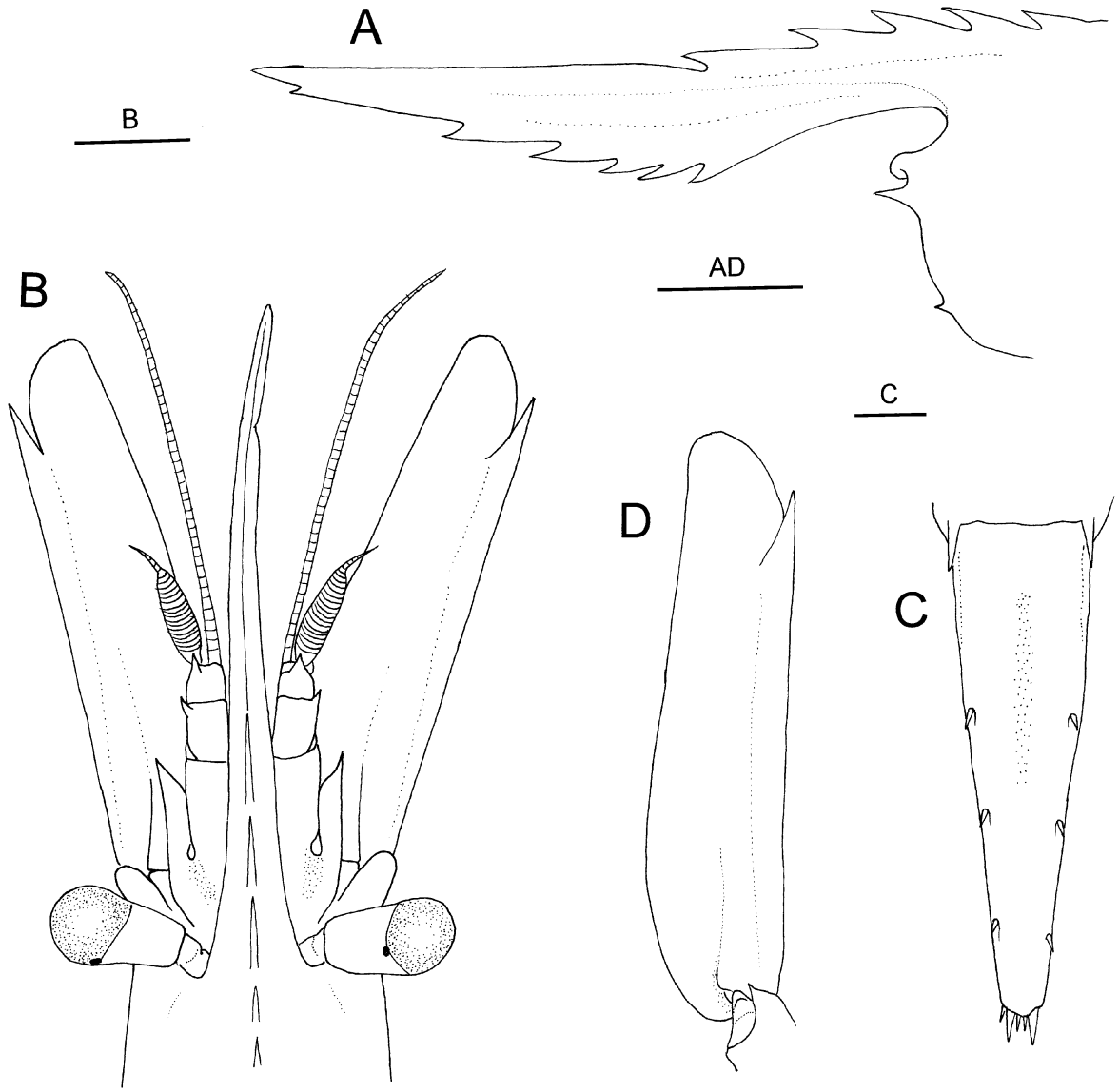

FIGURE 15. *Heptacarpus longirostris* (Kobjakova, 1936). Female (cl 8.4 mm; CBM-ZC 8601), Usujiri, southern Hokkaido. A, rostrum and anterior part of carapace, lateral view; B, rostrum, anterior part of carapace and cephalic appendages, dorsal view; C, telson, dorsal view; D, left antennal scale, ventral view. Scale bars: 2 mm for A, B, D; 1 mm for C.

First pereopod (Fig. 16B) moderately stout, overreaching base of antennal scale; chela (Fig. 16C) about 2.00 of carpal length and 3.00–3.50 times longer than wide; dactylus 0.45–0.50 length of palm, terminating in 3 darkly pigmented, strong corneous ungues (Fig. 16D); fixed finger terminating also in three corneous ungues (Fig. 16D); merus 1.60–1.70 of carpal length, about 3.40 times longer than high; dorsolateral distal angle of ischium with minute denticle. Second pereopods (Fig. 16E) equal, reaching midlength of antennal scale; dactylus about 0.60 of palm length; carpus about 4.30 times longer than chela, divided in 7 unequal articles; ischium subequal in length to merus. Third to fifth pereopods relatively short, similar in structure. Third pereopod (Fig. 16F) overreaching midlength of antennal scale by length of dactylus; dactylus (Fig. 16G) 0.28–0.35 of propodal length, 2.80–3.00 times longer than deep, terminating in acute, pigmented unguis, armed with 4–6 accessory spinules on flexor margin, of them distal 1 or 2 weakly hooked; propodus with 2

rows of slender spinules on flexor margin (Fig. 16G); carpus 0.45–0.55 of propodal length; merus 8.10–9.50 times longer than high, armed with 3–5 (rarely 2) lateral spines; ischium unarmed. Fourth pereopod (Fig. 16H) not reaching midlength of antennal scale; merus with 3 or 4 lateral spines. Fifth pereopod (Fig. 16I) reaching proximal 0.30 of antennal scale; propodus with tufts of grooming setae distally; merus with 3 or 4 (rarely 2) lateral spines.

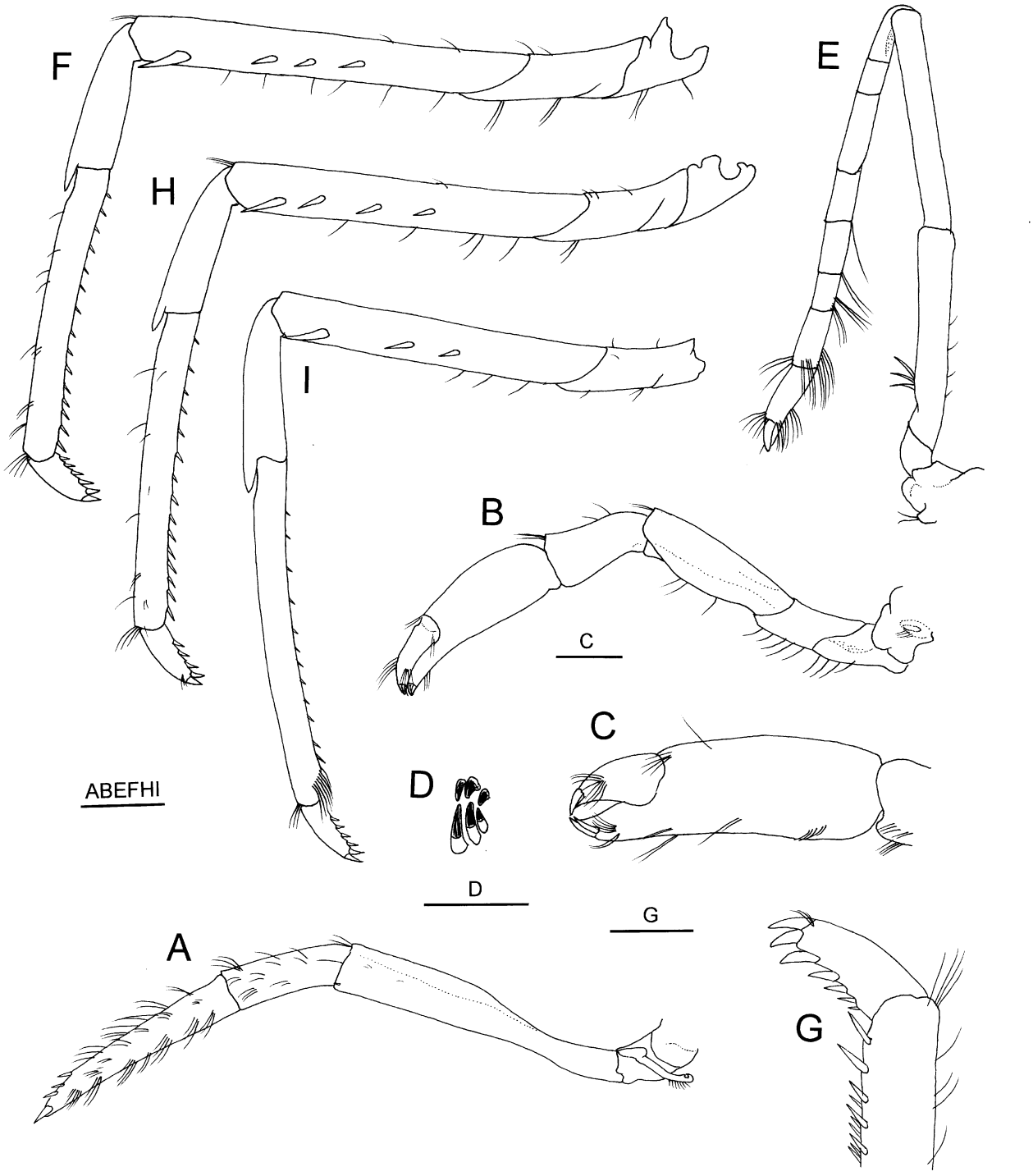

FIGURE 16. *Heptacarpus longirostris* (Kobjakova, 1936). Female (cl 8.4 mm; CBM-ZC 8601), Usujiri, southern Hokkaido, left appendages. A, third maxilliped, lateral view; B, first pereopod, lateral view; C, chela of first pereopod, dorsal (extensor) view; D, tips of dactylus and fixed finger; E, second pereopod, lateral view; F, third pereopod, lateral view; G, dactylus and distal part of propodus of third pereopod, lateral view; H, fourth pereopod, lateral view; I, fifth pereopod, lateral view. Scale bars: 1 mm for A, B, E, F, H, I; 0.5 mm for C, D, G.

Gill formula as in Table 1. Only third maxilliped with strap-like epipod corresponding to setobranch on first pereopod.

Uropod (Fig. 14) with both rami slightly overreaching posterior margin of telson.**Description of male**. Body slightly more slender than in females (Fig. 17A, C). Rostrum (Fig. 17B) 1.29–1.43 length of carapace, anterior 0.58–0.66 unarmed. Pleon (Fig. 17C) weakly geniculate; third pleonal tergite weakly convex in posterior part. Corneal diameter about 0.15–0.17 of carapace length (Fig. 17A). Outer flagellum of antennule larger than in females, thickened aesthetasc-bearing portion about 0.40–0.45 length of carapace (Fig. 17A). Antennal scale 0.97–1.11 times longer than carapace. Third to fifth pereopods less stout than in females, armament similar to that of females. Endopod of first pleopod (Fig. 17D) elongate subtriangular, with conspicuous appendix interna at terminal position; distolateral lobule not differentiated; mesial margin with row of small spiniform setae, lateral margin with row of long plumose setae. Second pleopod (Fig. 17E) with appendix masculina slightly shorter than appendix interna, with numerous long setae on dorsal surface to tip.

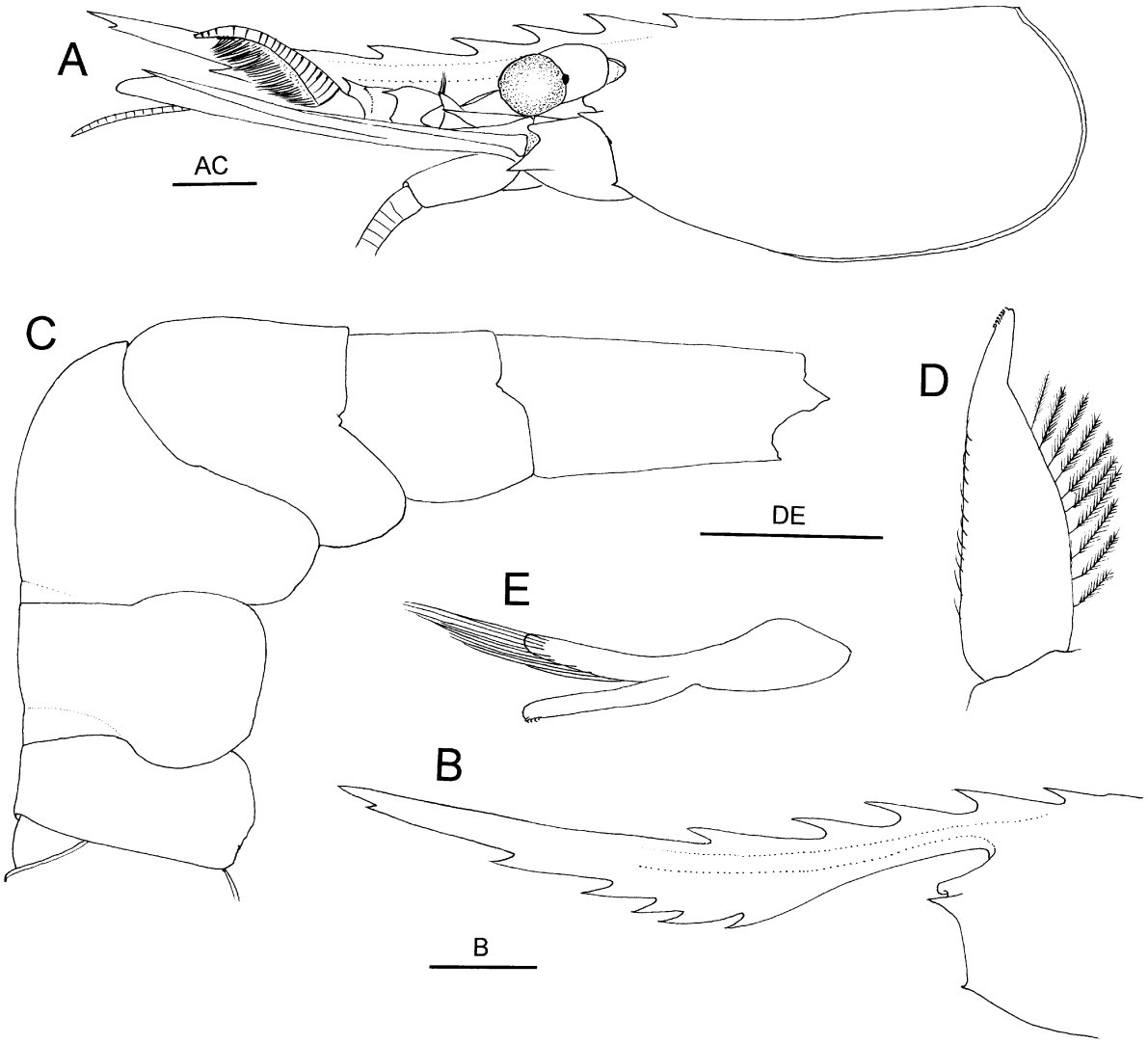

FIGURE 17. *Heptacarpus longirostris* (Kobjakova, 1936). Male (cl 4.0 mm; CBM-ZC 8661), Abashiri, Hokkaido, Okhotsk Sea. A, carapace and cephalic appendages, lateral view; B, rostrum, lateral view; C, pleon, lateral view; D, endopod of left first pleopod, ventral view; E, appendices interna and masculina of second pleopod, mesial view. Scale bars: 1 mm for A–C; 0.5 mm for D, E.

Variation. A total of 32 specimens, including 27 females and five males, were examined for assessing morphological variation in some characters possibly providing diagnostic significance.

The possession of five or six rostral ventral teeth appears usual for *H. longirostris* (26 of 30 specimens examined; 86.7 %), although the number of the teeth varies from four to eight (Fig. 18). Only two specimens have four teeth; the possession of seven or eight teeth is found respectively in a single specimen.

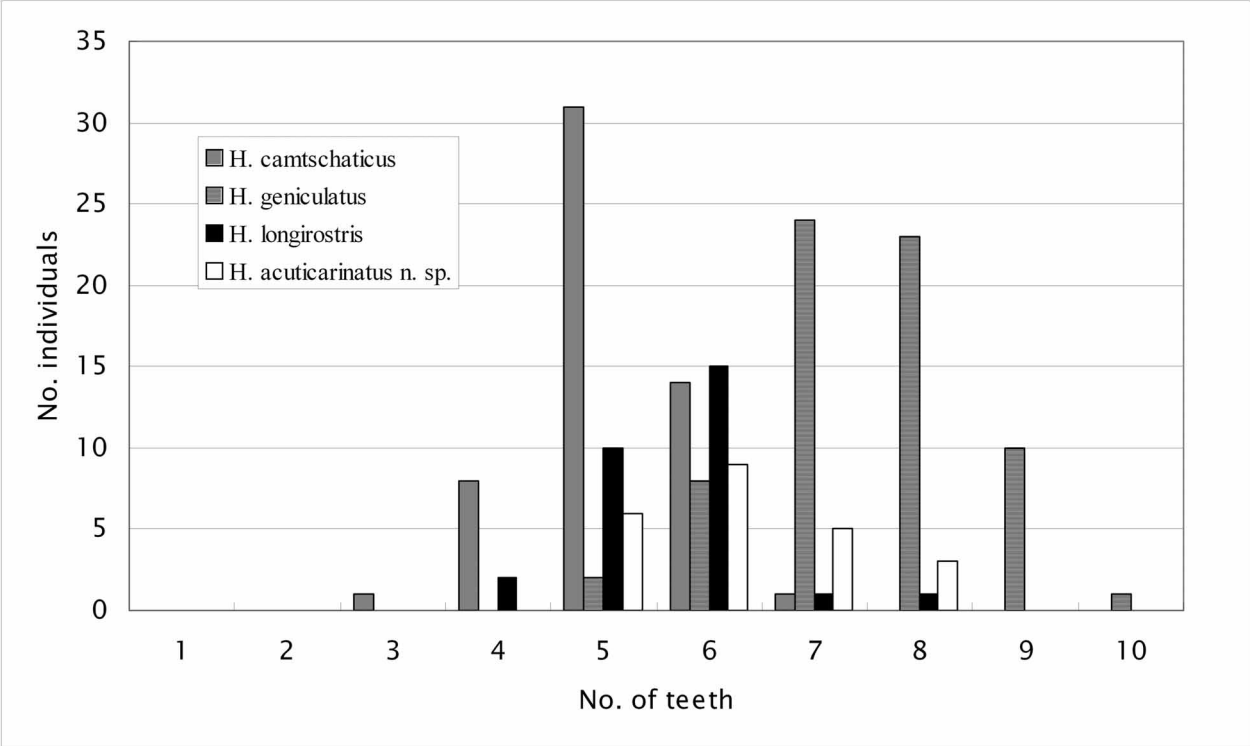

FIGURE 18. Variation in the number of rostral ventral teeth of four *Heptacarpus* species.

Frequency of the presence or absence of the pterygostomial tooth on the carapace is summarized in Table 4. Most of the females (22 of 27 specimens; 81.5 %) have the pterygostomial teeth on both sides, although only one specimen entirely lacks the tooth; four specimens (14.8 %) have the tooth on one side. All five male specimens have the pterygostomial teeth on both sides.

TABLE 4. Variation in the presence or absence of a pterygostomial tooth in *Heptacarpus longirostris* (Kobjakova, 1936).

	Female	Male
Present on both sides	22 (81.5 %)	5 (100 %)
Present on one side	4 (14.8 %	0 (0 %)
Absent on either side	1 (3.7 %)	0 (0%)

The number of the meral spines on the third pereopod varies from two to five (Fig. 19), but the majority of the examined specimens (30 of 33 specimens; 90.9 %) have three or four spines. One specimen (11.5 %) has two meral spines, and other two specimens (6.1 %) have five spines.

Size. Females cl 5.4–8.2 mm, ovigerous females cl 6.1–7.8 mm; males cl 3.7–4.6 mm.

Coloration in life. Not recorded.

Distribution. Peter the Great Bay, southern Kurile Islands and Hokkaido, Japan, subtidal to 25 m. Abundant in *Zostera* belts of inshore waters.

Remarks. Kobjakova (1936) described a new taxon *Eualus geniculata* var. *longirostris* from Peter the Great Bay. This taxon is deemed as a subspecies according to the ICZN Code (ICZN, 1999). Later Kobjakova

(1937) discussed more in detail the distinctions between the nominotypical and her new subspecies. The differentiating characters are: (1) rostrum long, reaching beyond scaphocerite, and about 1.5 times as long as carapace; (2) unarmed part of dorsal margin of rostrum large; (3) scaphocerite not longer than carapace; (4) pterygostomial tooth usually present and (5) lamellar part of scaphocerite exceeding distolateral tooth. Based on specimens from various localities in Japan, Hayashi (1979) critically examined these characters cited by Kobjakova (1936, 1937). He found that all but the third character are considerably variable, and thus came to a conclusion that Kobjakova's taxon was a junior synonym of *H. geniculatus*.

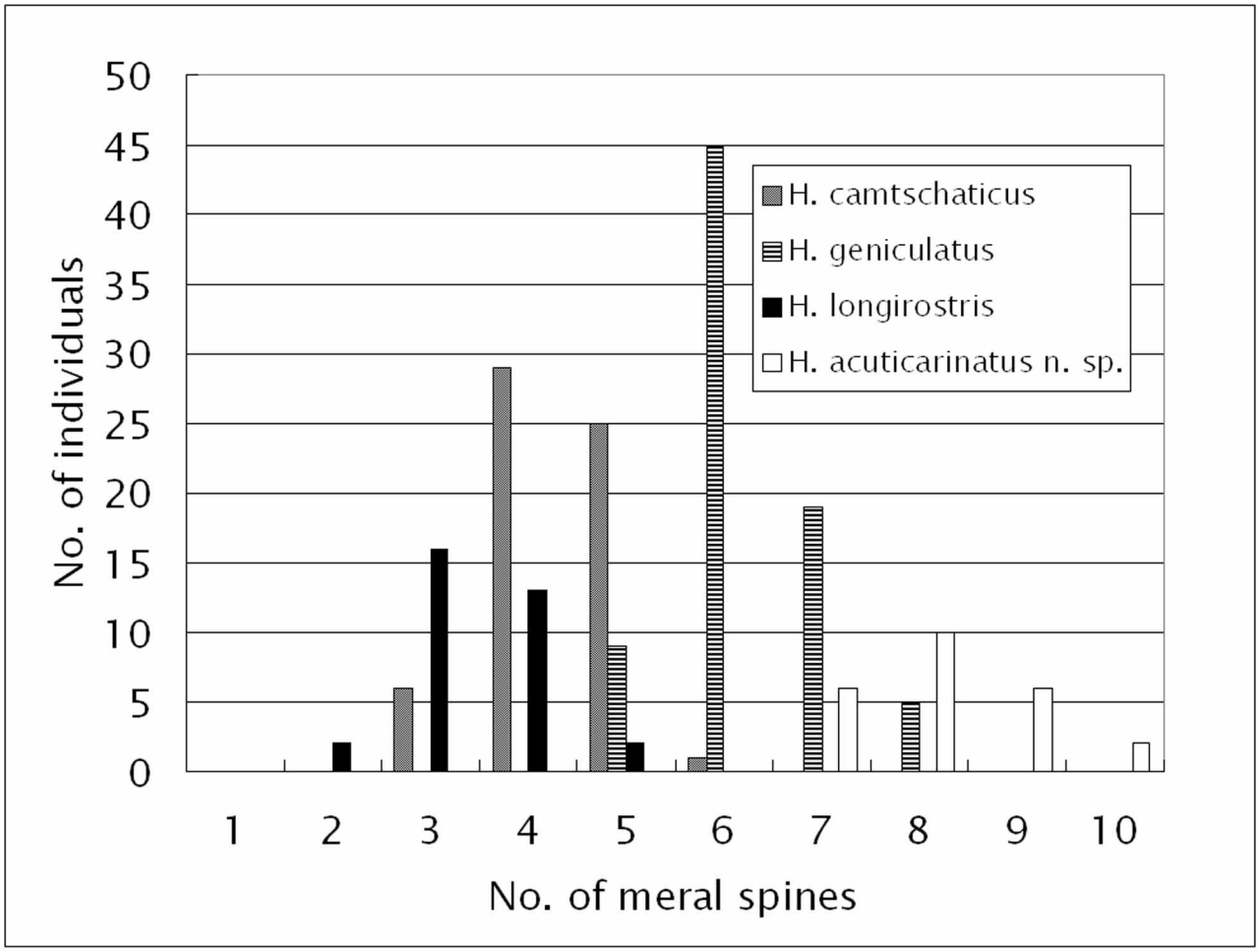

FIGURE 19. Variation in the number of meral spines on the third pereopod of four *Heptacarpus* species.

However, we noticed the existence of a distinct species resembling *Heptacarpus geniculatus* and *H. camtschaticus* in our material, and then considered a possibility that Kobjakova's taxon might correspond to the unidentified species under question. The unidentified species is characterized by the rounded fifth pleonal pleuron, the third maxilliped not reaching the midlength of the antennal scale, the possession of three ungues on each dactylus and fixed finger of the first pereopod (see "Comparison"). As noted above, in spite of the effort by the second author, the type material of *Eualus geniculata longirostris* was not located in the collection of the ZISP, in which it should be deposited. Nevertheless, fortunately, specimens identified with *E. geniculata longirostris* by Z. I. Kobjakova herself and those from the Peter the Great Bay, the type locality of the taxon, have been available for study (see "Material examined"). Reexamination of the material identified by Dr. Kobjakova has disclosed that two species, including *H. camtschaticus*, are confounded, but the second species corresponds to the unidentified species in question. Comparison with the accounts given by Kobjakova (1936, 1937) suggested that her new taxon does not correspond to *H. camtschaticus* in the usual presence of a pterygostomial tooth on the carapace in females and the greater unarmed part of the dorsal margin of the

rostrum. We propose to reinstate Kobjakova's taxon as a full species of *Heptacarpus*, because it is easily separable by morphological characters and distributional patterns from the other known species in the genus (see "Comparison"). It is likely that the type material used by Kobjakova (1936) might be actually a mixture of the two species, *H. longirostris* and *H. camtschaticus*, but we feel hesitation to designate a neotype for Kobjakova's taxon, because a more through search would be desirable in order to confirm if the type material was really lost.

Igarashi (1969) reported *Heptacarpus geniculatus* from off Mashike, Oshoro Bay, and off Shimamaki, Hokkaido. The given photograph (Igarashi, 1969, pl. 8, fig. 22) clearly shows that the pleon is not strongly geniculate, whereas it is strongly geniculate and gibbous at the third somite in *H. geniculatus*. Therefore, his record is at least partially referred to *H. longirostris*. As mentioned before, a specimen referred to *H. camtschaticus* by Igarashi (1971) actually represents *H. longirostris*.

Comparison

The four species treated in this study are morphologically similar for one another. All species are characterized by the presence of a strap-like epipod only on the third maxilliped; no epipods are present on any pereopods; the rostrum is subequal to or longer than the carapace; the fourth pleonal pleuron is rounded; the antennal scale exceeds 3.00 times longer than wide; and the third maxilliped does not reach the distal margin of the antennal scale. These characters are considered to be apomorphic in the genus (Bauer, 1984). Morphological differences among the four species, which are summarized in Table 5, are discussed below.

Rostral length. In general, the proportional length of the rostrum greatly overlaps for each other among the four species. Nevertheless, when males are compared, the rostrum is shorter in *H. longirostris* than in other three species (0.97–1.13 as long as the carapace versus 1.24–1.57).

Armature on dorsal margin of rostrum. In all of the four species, the distal part of the dorsal margin of the rostrum is unarmed, and the extension of the unarmed part is different among the species. The unarmed part is distinctly shorter in *H. acuticarinatus* **n. sp.** than in the other three species.

Ventral teeth of rostrum. Although the number of the rostral ventral teeth overlap among the four species, it is helpful in distinguishing between *H. camtschaticus* and *H. geniculatus* (normally four to six in the former versus normally six to nine in the latter) (Fig. 18).

Rostral lateral carinae. *Heptacarpus acuticarinatus* **n. sp.** is characterized by a sharply delineated rostral lateral carina (Figs 6A, 8A), which is blunt and rather obsolescent in the other three species (Figs 2B, 4B for *H. camtschaticus*; Figs 11B, 13A for *H. geniculatus*; and Figs 15B, 17B for *H. longirostris*).

Armature of pterygostomial angle of carapace. The presence or absence of a pterygostomial tooth is variable in *H. camtschaticus*, *H. geniculatus*, and *H. longirostris*, but the pattern of variation is different among the three species. In *H. camtschaticus*, this character varies with sex (Table 2). Most of the females (92.3 %) have the pterygostomial tooth at least on one side, while nearly half of males (47.6 %) entirely lack the tooth. In *H. geniculatus*, most of the females (83.3%) do not have pterygostomial teeth on both sides, and the males exclusively lack the tooth (Table 3). In *H. longirostris*, this character appears less variable than in *H. camtschaticus* and *H. geniculatus* (Table 4); majority of the specimens examined have pterygostomial teeth on both sides in both sexes. In *H. acuticarinatus* **n. sp.**, a pterygostomial tooth is always present on either side.

Similar sexual discrepancies in the development of the pterygostomial tooth have been reported in *Heptacarpus jordani* (Rathbun, 1902) (Hayashi & Chiba, 1987) and *H. sitchensis* (Brandt, 1851) (Stamatiou & Jensen, 2004). Previous keys (e.g., Butler, 1980; Jensen, 1987; Wicksten, 1990) routinely use the presence or absence of a pterygostomial tooth as a character for differentiating species, which could result in specimens being misidentified. Nevertheless, this character is still useful in the recognition of species in the genus, although it should be used with caution.

TABLE 5. Summary of major morphological differences among four species of *Heptacarpus*.

Characters	*H. camtschaticus*	*H. acuticarinatus* n. sp.	*H. geniculatus*	*H. longirostris*
RL/CL Female	1.09–1.37	1.22–1.53	1.11–1.57	1.03–1.39
Male	1.24–1.42	1.42–1.57	1.33–1.57	0.97–1.13
Unarmed part of dorsal margin of rostrum	0.28–0.57	0.16–0.28	0.40–0.72	0.40–0.74
Ventral margin of rostrum	usually with 3–6 teeth	with 5–8 teeth	usually with 6–9 teeth	with 4–7 teeth
Rostral lateral carina	blunt	sharp	blunt	blunt
Pterygostomial tooth	variable	always present	variable	usually present
Third pleonal tergite	convex posteriorly, making pleon weakly gibbous	slightly convex	strongly elevated posteriorly, making pleon notably gibbous	evenly convex, making pleon weakly gibbous
Fifth pleonal pleuron	with posteroventral tooth	with posteroventral tooth	with posteroventral tooth	unarmed
Antennal scale length/ width	3.40–4.00	3.30–3.70	5.50–6.00	3.90–4.50
Length of third maxilliped	reaching distal 0.30–0.40 of antennal scale	reaching distal 0.15–0.30 of antennal scale	not reaching midlength of antennal scale	not reaching midlength of antennal scale
Number of ungues of first pereopod (dactylus+fixed finger)	2+1	2+1	2+1	3+3
Extension of third pereopod (by tip of propodus)	reaching distal 0.20–0.30 of antennal scale	nearly reaching distal margin of antennal scale	falling short of midlength of antennal scale	falling short of midlength of antennal scale
Meral spines on third pereopod	usually 3–5	7–10	5–8	2–4

Structure of pleon. In *Heptacarpus geniculatus*, the third pleonal tergite is strongly elevated in the posterior part, making the pleon strongly gibbous (Figs 10, 13B, E). It is convex posteriorly in *H. camtschaticus* (Figs 1, 4C) and evenly convex in *H. longirostris* (Figs 14, 17C), whereas in *H. acuticarinatus* **n. sp.** the tergite is only slightly convex (Figs 5, 8C). In *H. camtschaticus* and *H. longirostris*, the pleon appears weakly gibbous.

Armature of fifth pleonal pleuron. *Heptacarpus longirostris* is distinctive in lacking a posteroventral tooth on the fifth pleonal pleuron (Figs 14, 17C). In *H. camtschaticus*, *H. geniculatus* and *H. acuticarinatus* **n. sp.**, as well as the other congeneric species, the fifth pleonal pleuron is normally armed with a sharp posteroventral tooth (Figs 1, 4C for *H. camtschaticus*; Figs 5, 8C for *H. acuticarinatus* **n. sp.**; and Figs 10, 13B, E for *H. geniculatus*).

Shape of antennal scale. *Heptacarpus geniculatus* is characteristic in having a very narrow antennal scale (5.50–6.00 times longer than wide; Fig. 11D). In the other three species, the antennal scale is less elongate than in *H. geniculatus*, viz., 3.30–3.70 times longer than wide in *H. acuticarinatus* n. sp. (Fig. 6D), 3.40–4.00 in *H. camtschaticus* (Fig. 2F), and 3.90–4.50 in *H. longirostris* (Fig. 15D). This character may be still useful in discriminating between *H. acuticarinatus* n. sp. and *H. longirostris*.

Length of third maxilliped. In *H. geniculatus* and *H. longirostris*, the third maxilliped does not reach the midlength of the antennal scale (Figs 10, 14), whereas it distinctly overreaches that point in *H. camtschaticus*

and *H. acuticarinatus* **n. sp.** (Figs 1, 5). Furthermore, the appendage is more elongate in the new species than in *H. camtschaticus*, reaching to the distal 0.10–0.30 in the former and to the distal 0.30–0.40 in the latter.

Length of pereopods. The pereopods are moderately long for the genus in *H. acuticarinatus* **n. sp.** (Fig. 5) and are short in *H. geniculatus* and *H. longirostris* (Figs 10, 14). The pereopods of *Heptacarpus camtschaticus* are intermediate between the new species and the latter two species with regard to the length (Fig. 1). For example, the third pereopod reaches nearly to the distal margin of the antennal scale in *H. acuticarinatus* **n. sp.**, while it reaches slightly beyond the midlength of the antennal scale by the tip of the propodus in *H. geniculatus* and *H. longirostris*. In *H. camtschaticus*, the appendage reaches the distal 0.20–0.30 of the antennal scale by the tip of the dactylus.

Ungues of chela of first pereopod. *Heptacarpus longirostris* appears unique in having three ungues on each dactylus and fixed finger of the first pereopod (Fig. 16D). In the other three species, the dactylus and fixed finger are provided with two and one ungues, respectively (Fig. 3D for *H. camtschaticus*; Fig. 7D for *H. acuticarinatus* **n. sp.**; and Fig. 12D for *H. geniculatus*).

Number of meral spines of third pereopod. The number of meral spines on the third pereopod is different among the four species (Fig. 19). The spines are fewest in *H. longirostris* (two to four) and *H. camtschaticus* (normally three to five), and most numerous in *H. acuticarinatus* **n. sp.** (seven to ten), placing *H. geniculatus* at an intermediate position (five to eight).

Coloration in life. The general body color is considerably variable in *H. camtschaticus* and *H. geniculatus* from transparent to dark or reddish brown or green, occasionally with a white middorsal longitudinal stripes. In *H. acuticarinatus* **n. sp.**, the body is entirely light pink without particular markings. No record on the color is available for *H. longirostris*.

Geographical distribution. The geographical distribution is also different among the four species. *Heptacarpus camtschaticus* is most widely and northerly distributed among the four. The range includes Peter the Great Bay on the continental coast of the Sea of Japan, Hokkaido, Sakhalin, Kurile Islands, Kamtchatka Peninsula, Cape Lisburne in the Chukchi Sea, and Bering Sea to Strait of Georgia. It is remarkable that the occurrence of this species has not been confirmed on the coasts of Honshu to Kyushu, Japan, and Korea. The other three species appear restricted to East Asian waters. *Heptacarpus geniculatus* and *H. acuticarinatus* **n. sp.** occurs in Japan ranging from the southern Hokkaido to Kyushu, Korea and the Yellow Sea. *Heptacarpus longirostris* is limited to a rather narrow area, including waters around Hokkaido and Peter the Great Bay.

Bathymetric range. *Heptacarpus camtschaticus*, *H. geniculatus*, and *H. longirostris* inhabit shallow water, and particularly the latter two species prefer grass belts at intertidal to 5 m depths. On the other hand, *H. acuticarinatus* **n. sp.** is found in greater depths (20–150 m), and does not occur inshore water on grass belts.

Other than the four species treated in this paper, the following nine congeneric species are referred to the species group characterized by the absence of pereopodal epipods (Rathbun, 1904; Hayashi, 1979; Butler, 1980; Wicksten, 1990): *H. brachydactylus* (Rathbun, 1902), *H. decorus* (Rathbun, 1902), *H. franciscanus* (Schmitt, 1921), *H. kincaidi* (Rathbun, 1902), *H. maxillipes* (Rathbun, 1902), *H. pandaloides* (Stimpson, 1860), *H. stylus* (Stimpson, 1864), *H. tenuissimus* Holmes, 1900, and *H. tridens* (Rathbun, 1902). Among them, *H. franciscanus*, *H. pandaloides* and *H. stylus* are similar to *H. geniculatus* in general morphology. Particularly, the short third maxilliped, which does not reach the midlength of the antennal scale, is the common character among them (Schmitt, 1921; personal observation). Nevertheless, *H. geniculatus* is distinguished from the other three species in the third pleonal tergite with a strongly elevated posterior part. In the latter three species, the third pleonal tergite is only slightly convex (*H. pandaloides* and *H. stylus*) or weakly convex posteriorly (*H. franciscanus*) (Schmitt, 1921). The fewer meral spines on the third pereopod further distinguishes *H. stylus* from *H. geniculatus* (three to five versus usually six to eight). *Heptacarpus pandaloides* is distinctive in the strongly elongate body form and the possession of numerous rostral ventral teeth (nine to 13 versus usually less than nine in the other species), and the even shorter pereopods. For example, the third pere-

opod does not reach the midlength of the antennal scale in *H. pandaloides*, rather than overreaching it in *H. geniculatus*.

A key in the aid of identification of Asian species of *Heptacarpus* referred to the group characterized by the lack of pereopodal epipods is presented below.

Key to Asian species of *Heptacarpus* characterized by the lack of pereopodal epipods

1. Fifth pleonal pleuron unarmed.....*H. longirostris* (Kobjakova, 1936)
–. Fifth pleonal pleuron with sharp posteroventral tooth..... 2
2. Third maxilliped overreaching midlength of antennal scale 3
–. Third maxilliped falling short of midlength of antennal scale..... 5
3. Third maxilliped overreaching distal margin of antennal scale.....*H. maxillipes* (Rathbun, 1902)
–. Third maxilliped falling short of distal margin of antennal scale..... 4
4. Rostral lateral carina sharp; merus of third pereopods with 7–10 lateral spines ..... *H. acuticarinatus* **n. sp.**
–. Rostral lateral carina blunt; merus of third pereopod with 3–5 lateral spines .... *H. camtschaticus* (Stimpson, 1860)
5. Rostrum with 6–9 ventral teeth; tergite of third pleonal somite strongly elevated in posterior part, making pleon noticeably gibbous; third pereopod overreaching midlength of antennal scale..... ..... *H. geniculatus* (Stimpson, 1860)
–. Rostrum with 9–13 ventral teeth; tergite of third pleonal somite only slightly convex; third pereopod not reaching midlength of antennal scale ..... *H. pandaloides* (Stimpson, 1860)

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