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Studies on hippolytid shrimps from Japan - VII. The genus *Heptacarpus* HOLMES*

By

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HOLTHUIS (1947) has listed 26 species of the genus *Heptacarpus* in his excellent monograph on the family Hippolytidae. Of these *H. propugnatrix* (DE MAN) was shown to be a junior synonym of *H. pandaloides* (MIYAKE and HAYASHI, 1968a). *Nauticaris futilirostris* BATE and *Hippolyte amabilis* LENZ, which had been treated by HOLTHUIS (1947) under species incertae, proved to be the valid species and belong to the present genus (MIYAKE and HAYASHI, 1968b and HOLTHUIS 1969), though the latter is identical with *H. tenuissimus* HOLMES. KOBJAKOVA (1936) established a new subspecies under the name *Eualus geniculatus longirostris* from Gulf of Peter the Great, but it seems to be identical with the typical species.

Among considerable numbers of specimens collected from Japan and its adjacent waters, all the Japanese species, except for *H. jordani* (RATHBUN) and *H. minutus* (YOKOYA) have been found. Of these exception Dr. F. A. CHACE, JR. has kindly examined the holotype of *H. jordani* and provided details of this species and the Sôyô Maru specimen referred by YOKOYA (1933) to *Spirontocaris minuta* could fortunately be reexamined. This specimen has a small exopod on the third maxilliped and thus it is impossible to refer his specimen to the genus *Heptacarpus*. It is very obscure whether the species, *Spirontocaris minuta*, is actually valid or not. It, however, may be better not to disregard the species as yet, as it was originally well described (YOKOYA, 1930).

A new species, *H. commensalis* sp. nov., is also found to be associated with some coelenterates in both Amakusa Islands, Kyushu and southern parts of Kii Peninsula. This is related to *H. futilirostris* and *H. rectirostris* but much smaller than those species and shows some definite morphological differences. It is probably only one symbiont of this genus with other invertebrates. Mature specimens do not present any morphological dimorphism, except for size differences.

Most specimens are preserved at the Zoological Laboratory, Kyushu University (ZLKU), but partly at Shimonoseki University of Fisheries (SUF), Tokyo University of Fisheries (TUF), at the National Science Museum, Tokyo (NSMT) and in the United States National Museum (USNM). The initials given in parentheses after the name of the institutions are used in the material source of this paper to indicate these institutions.

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Genus *Heptacarpus* HOLMES, 1900

Heptacarpus HOLMES, 1900, p. 195.
Heptacarpus HOLTHUIS, 1947, pp. 12 (list), 43.
Heptacarpus HOLTHUIS, 1955, p. 102.
Heptacarpus HEMMING, 1958, p. 156.
Heptacarpus HAYASHI and MIYAKE, 1968, p. 131.

Definition Rostrum long, slender with upper and lower teeth. Supraorbital spine absent, antennal spine present, pterygostomial spine present or absent. Abdomen smooth, pleura of first three somites rounded, fourth pointed or rounded, fifth usually pointed. Telson with 3—7 pairs of dorsal spines. Carpus of second pereiopod with seven joints. Merus of last three pereiopods with a row of several outer spines. Mandible consisting of an incisor process and two-jointed palp. Pleurobranchs on all pereiopods, podobranch on second maxilliped only, exopods on first two maxillipeds, epipods variable, at least, on first two maxillipeds.

Type species *Hippolyte palpator* OWEN

Remarks All the species have been reported from the northern Pacific only. The descriptions emphasized the differences of carapacial and rostral shape and armature, characters that are important but liable to vary with growth and sex. Species should be distinguished by more stable characters and the best of these is thought to be the epipods on the thoracic appendages. The known species may be grouped in the following table according to the number of epipods (Table 1).

Table 1. *Heptacarpus* species arranged by number of thoracic epipods

Epipods on at least	Asian species	American species
1st and 2nd maxillipeds	—	*H. tenuissimus*
1st three maxillipeds	*H. camtschaticus* *H. geniculatus* *H. pandaloides*	*H, brachydactylus, H. camtschaticus,* *H. decorus, H. franciscanus,* *H. kincaidi, H. maxillipes, H. stylus,* *H. tridens*
All maxillipeds and 1st pereiopods	—	*H. moseri, H. sitchensis*
Maxillipeds and 1st two pereiopods	*H. flexus*	*H. paludicola, H. pictus*
Maxillipeds and 1st three pereiopods	*H. commensalis* *H. futilirostris* *H. grebnitzkii* *H. jordani, H. minutus,* *H. rectirostris*	*H. brevirostris, H. carinatus* *H. palpator, H. stimpsoni* *H. taylori*

Heptacarpus species are more numerous in the American side than in the Asian side of the north Pacific Ocean and only ten species have found on the Asian side but nearly double the number of species from the American side, including one amphi-Pacific species. The American species were described and distinguished by RATHBUN (1902b) and SCHMITT (1921), while the Asian species leave not to be completely revised, though VINOGRADOV (1950) has partly reviewed these species. The Asian species may be distinguished by the following key.

Key to the Asian species of the genus *Heptacarpus*

1. Third maxilliped with an epipod 2
1. An epipod on at least first two pereiopods 4
2. Third abdominal somite strongly geniculate. Pterygostomial spine usually absent ..... *H. geniculatus* (STIMPSON)
2. All abdominal somites not geniculate 3
3. Rostrum reaching just to tip of antennal scale, 4—7 teeth along upper margin and 4—6 teeth on lower margin. Pterygostomial spine present ..... *H. camtschaticus* (STIMPSON)
3. Rostrum extending beyond tip of antennal scale, 7—10 teeth on posterior two-thirds of upper margin, and 9—13 teeth on lower margin. Pterygostomial spine usually absent ..... *H. pandaloides* (STIMPSON)
4. First two pereiopods with epipods. Abdomen strongly geniculate. Pterygostomial spine present. First segment of antennular peduncle without marginal spine ..... *H. flexus* (RATHBUN)
4. First three pereiopods with epipods 5
5. Merus of first pereiopod with a subterminal spine 6
5. Merus of first pair of pereiopods unarmed 7
6. Pleura of fourth abdominal somite rounded. First segment of antennular peduncle usually with two spines. Rostrum long, reaching beyond tip of antennal scale, with 6—9 teeth on posterior half of upper margin and 2 or 3 teeth on middle part of lower margin ..... *H. grebnitzkii* (RATHBUN)
6. Pleura of fourth and fifth abdominal somites pointed posteriorly. First segment of antennular peduncle with a single marginal spine. Rostrum rather short, reaching just to end of antennular peduncle with 5—6 teeth along upper margin and 3—4 teeth on lower margin near apex ..... *H. rectirostris* (STIMPSON)
7. First segment of antennular peduncle with 4 or 5 marginal spines. Rostrum extending barely to tip of antennular peduncle, with 8 teeth along upper margin and one tooth on lower margin near apex ..... *H. jordani* (RATHBUN)
7. First segment of antennular peduncle with a single marginal spine 8
8. Pleuron of fourth abdominal somite rounded. Rostrum reaching beyond tip of antennal scale, with 7 teeth along upper and lower margins ... *H. minutus* (YOKOYA)
8. Pleura of fourth and fifth abdominal somites pointed posteriorly, at least, in females. Rostrum not reaching tip of antennal scale 9
9. Body large. Rostrum shorter than carapace. Mature males larger than females with elongated third maxilliped and strengthened first pereiopod. Free living, usually from coastal weed belts ..... *H. futilirostris* (BATE)
9. Body small. Rostrum as long as or longer than carapace. Mature males smaller than females and having normal appendages ..... *H. commensalis* sp. nov.

Heptacarpus camtschaticus (STIMPSON)

Restricted synonymy
Hippolyte camtschatica STIMPSON, 1860, p. 102 (33).
Eualus camtschatica KOBJAKOVA, 1936, p. 211.
Eualus camtschatica KOBJAKOVA, 1937, p. 17
Heptacarpus camtschatica VINOGRADOV, 1950, p. 210, pl. 16 fig. 67.
Eualus camtschatica KOBJAKOVA, 1958, p. 224.
Heptacarpus camtschaticus HAYASHI and MIYAKE, 1968, p. 134, fig. 6 (synonymy).
Heptacarpus camtschaticus KIKUCHI and MIYAKE, 1978, p. 24 (list).

Material examined Sea of Japan, off Fujitsuka, Niigata Prefecture, depth 120 m, June 26, 1957, Japan Sea Regional Fisheries Research Laboratory - 1 ♂, 1 ♀ (ZLKU No. 1294); off Tsuiyama, Hyogo Prefecture, depth 75-76 m, April 28, 1976, Y. HAMANAKA leg. - 1 ovig. ♀ (SUF).

Beppu Bay, Ooita Prefecture, December 1, 1967, Nansei Regional Fisheries Research Laboratory - 1 sp. (SUF).

Yellow Sea, 35°00.0'N, 121°15.0'E, depth 35 m, November 28, 1964, time 03:38, H. YAMASHITA leg. -2 ovig. ♀♀ (ZLKU).

Size The ovigerous females vary from 4.5—6.5 mm in carapace length and 5.1—8.0 mm in rostrum length. The largest male is 4.0 mm in carapace length and 5.6 mm in rostrum length. The type is 25.1 mm in length (STIMPSON, 1860).

Distribution Kamchatka (STIMPSON, 1860); from Arctic Alaska southward to Kamchatka and Aleutian Islands and eastward to Port Etches, depth 3—60 fms (RATHBUN, 1902b); Okhotsk Sea, Terpeniya Bay, depth 15—43 m (BRASHNIKOV, 1907), depth 7—36 m (KOBJAKOVA, 1937); Shikotan I., Kurile Islands, depth 5—40 m (KOBJAKOVA, 1958); continental side of Sea of Japan (DERJUGIN and KOBJAKOVA, 1935), depth 7—75 m (KOBJAKOVA, 1937); Sea of Japan, depth 75—120 m (present publication); Sagami Bay (PARISI, 1919), depth 20—180 m (BALSS, 1914); Aichi Pref., depth 18—23 m (YOKOYA, 1933); Amakusa Islands (HAYASHI and MIYAKE, 1968; KIKUCHI and MIYAKE, 1978); Beppu Bay (present publication); Yellow Sea, depth 35 m (present publication).

Heptacarpus commensalis sp. nov.

(Figs. 1 and 2 *a-n*)

Heptacarpus futilirostris HAYASHI and MIYAKE, 1968, p. 139 (part).

Material examined Wakayama Prefecture, Sabiura, Kushimoto, *Acropora* sp., November 29, 1971, H. MISAKI leg. - 1 ovig. ♀ (paratype, SUF); Kuishi, Kushimoto, depth 15 m, July, 1972, I. MIYAWAKI, M. IRIE and S. NAKAMURA leg. - 1 ovig. ♀ (paratype, SUF); Engetsujima, Shirahama, tide pool, August 6, 1967, *Dendronephthya* sp., Y. MIYA leg. - 1 sp. (ZLKU); just north of Seto Marine Biological Station, Shirahama, *Acropora* sp., July 8, 1977, W. K. PATTON leg. - 1 ovig. ♀ (holotype, NSMT), 1 ♂, 3 spp. (paratypes, NSMT).

Kumamoto Prefecture, off Tororo, Amakusa Islands, dredge, data uncertain, T. KIKUCHI leg. - 1 ♂, 3 ovig. ♀♀ (paratypes, ZLKU No. 8401).

Description Small shrimps about 15 mm body length in ovigerous females and 10 mm in males. Rostrum straight, as long as or slightly longer than carapace, with 5—6 teeth on

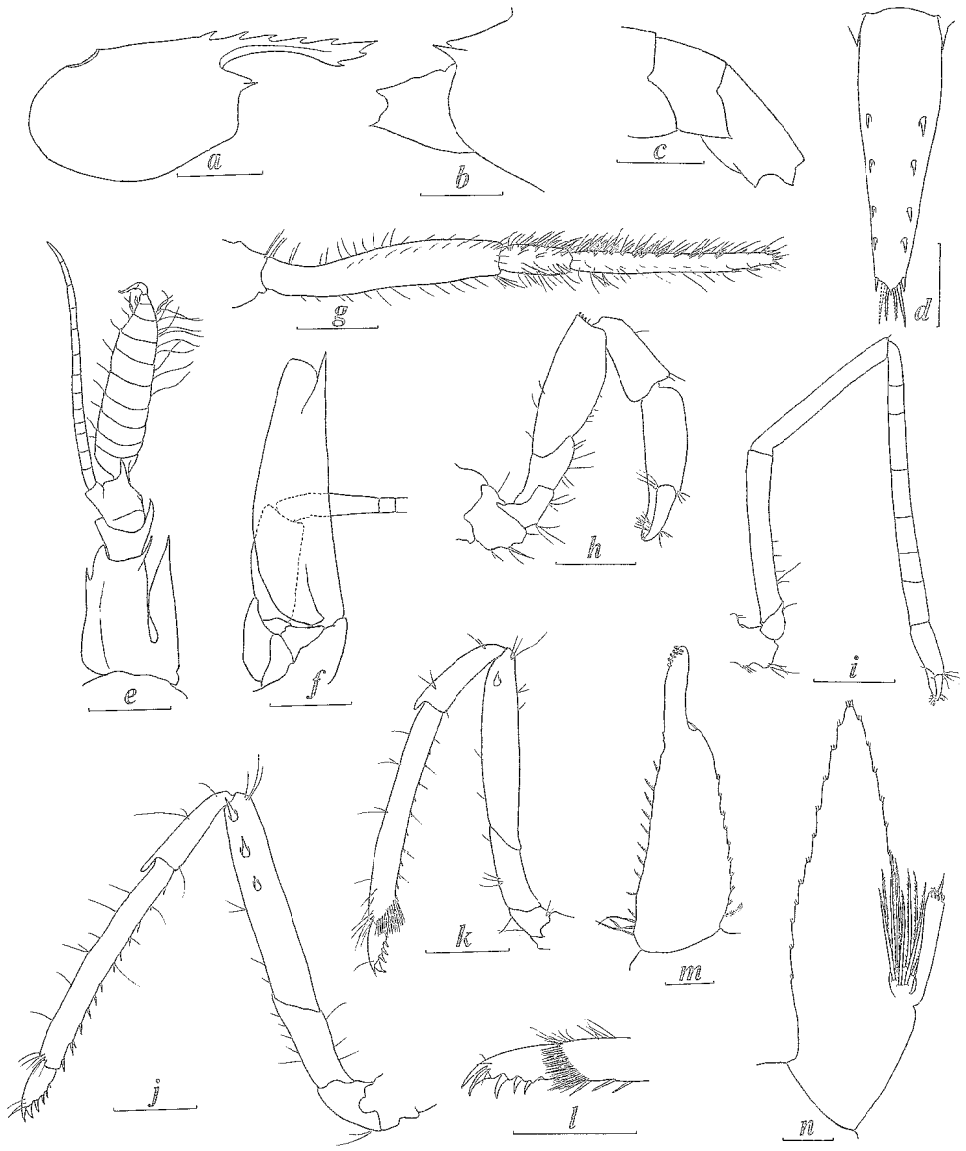

Fig. 2. *Heptacarpus commensalis* sp. nov., paratypes, *a*, *c-n*, male from Kushimoto, *b*, male from Amakusa Island ; *a*, carapace, *b*, anterior part of carapace and basicerite of antennal peduncle, *c*, fourth to sixth abdominal somites, *d*, telson, *e*, antennular peduncle, *f*, antennal peduncle, *g*, third maxilliped, *h*, first pereiopod, *i*, second pereiopod, *j*, third pereiopod, *k*, fifth pereiopod, *l*, dactylus of fifth pereiopod, *m*, endopod of first pleopod, *n*, endopod of second pleopod. Scales for *a*, *c* represent 1.0 mm, those for *b-l* represent 0.5 mm and those for *m*, *n* represent 0.1 mm.

upper margin, of which the posterior two teeth are present on carapace and two teeth on lower margin near apex. Carapace smooth, with well-developed antennal and pterygostomial spines in females but with a well-developed antennal spine only and pterygostomial angle unarmed in males.

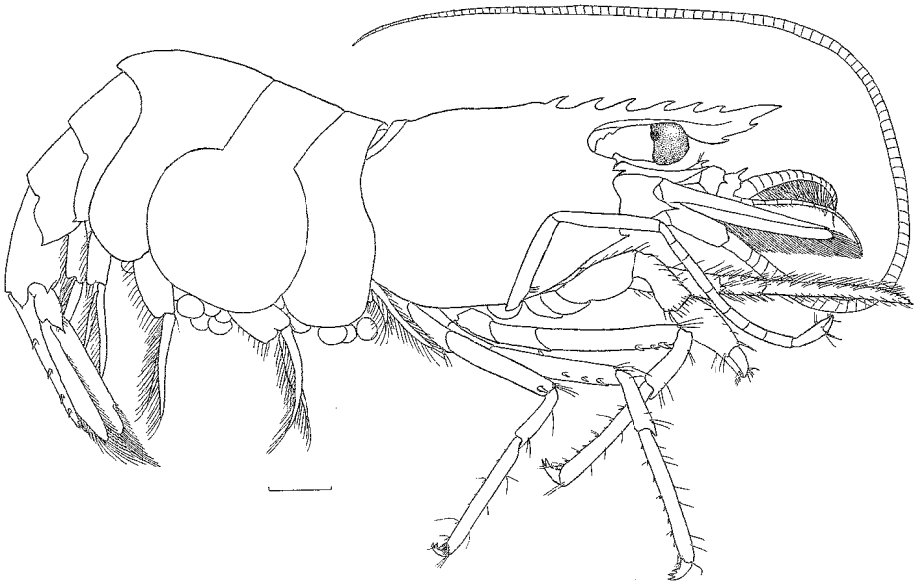

Fig. 1. *Heptacarpus commensalis* sp. nov., holotype, ovigerous female from Shirahama. Scale represent 1.0 mm.

Abdomen smooth, third somite not strongly geniculate. Pleura of fourth and fifth somites ending in a sharp tooth in both sexes, but in males the tooth on fourth somite sometimes indistinct. Telson 1.2—1.3 times as long as sixth somite with 4 pairs of dorsal spines ; posterior margin pointed at middle, armed with 3 pairs of spines.

Eye comparatively large, with distinct ocellus. Antennular peduncle reaching nearly to rostral apex, each segment with a small marginal spine. Stylocerite reaching distal margin of first segment. Antennal scale broad, exceeding beyond rostrum by distal half. Outer terminal spine exceeding lamellar part. Third maxilliped reaching beyond antennal scale by distal half of ultimate segment. First pereiopod robust, reaching end of antennal scale, merus without subterminal spine. Second pereiopod slender, exceeding antennal scale by chela and distal half of carpus, which is subdivided into 7 joints. Third pereiopod exceeding antennal scale by dactylus and half of propodus. Dactylus short with 6 teeth on posterior margin, propodus slender, about 4 times as long as dactylus, with 11 teeth on posterior margin. Merus with 3 or 4 teeth on outer surface. Epipods on third maxilliped

Table 2. Characters separating *H. commensalis* sp. nov. from *H. futilirostris* (BATE) and *H. rectirostris* (STIMPSON)

Species / Characters	*H. futilirostris*	*H. rectirostris*	*H. commensalis* sp. nov.
Size	males much larger than females	females larger than males	females larger than males
Carapace length (mm) ovig. ♀ largest ♂	 4.7—8.8 10.0	 6.7—8.2 4.0	 2.6—3.3 1.9
Rostrum	shorter than carapace	as long as or slightly longer than carapace	as long as or slightly longer than carapace
Rostral teeth	5—7/2	5—7/3—4	5—6/2
Pterygostomial angle	strongly spiniform in both sexes	spiniform in females, rectangular but not spiniform in males	spiniform in females rounded in males
Pleural spine on 4th abdominal somite	distinct in both sexes	distinct in both sexes	distinct in females indistinct in males
Stylocerite	usually reaching distal margin of second antennular segment	reaching distal margin of first antennular segment	reaching distal margin of first antennular segment
3rd maxilliped	normal in females, elongated in mature males	normal even in mature males	normal even in mature males
1st pereiopod	normal in females, strengthened in mature males	normal in females, elongated in mature males	normal even in mature males
Meral spine on 1st pereiopod	absent	present	absent
Meral spines on 3rd leg	2-5, mostly 2-3	4-6	2-4, mostly 3-4
Meral spines on 5th leg	1	3-5	1
Appendix masculina	as long as appendix interna, with many plumose setae near apex	much shorter than appendix interna, with many plumose setae	much shorter than appendix interna, with many plumose setae
Habitat	littoral weed belts in southern Japan	littoral weed belts of Japanese waters, but abundant in northern Japan	associated with coelenterates from two localities, strongly influenced by warm Kuroshio Current and its branch

and first three pereiopods. Following two pereiopods resemble third one in shape. Fourth pereiopod exceeding antennal scale by dactylus and half propodus. Fifth pereiopod just reaching to end of antennal scale. Dactylus and propodus of these two pereiopods slightly shorter than those of third pereiopod but with similar armature, but with a tuft of hairs on outer distal end of fifth propodus. Merus of fourth pereiopod with 2 or 3 spines on outer surface near distal articulation, that of fifth pereiopod with a single subterminal spine.

Endopod of first pleopod with some retinaculae near apex and with about 10 short plumose setae on inner margin. Endopod of second male pleopod as long as exopod, appendix masculina very short, with about 10 setae on top. Appendix interna long with some retinacula near apex. Uropod longer than telson, outer margin of exopod straight, ending in a small spine flanked by a slender one. Eggs few and small, measuring 0.3 × 0.5 mm in diameter.

Remarks The species is very closely related to *H. futilirostris* (BATE) and *H. rectirostris* (STIMPSON) and has previously been referred to the former species (HAYASHI and MIYAKE, 1968). The distinctions between *H. futilirostris* and *H. rectirostris* were already shown by MIYAKE and HAYASHI (1968b), but male specimens of *H. rectirostris* were not known. Including male characters of that species, details of which will be described later, the distinctive features between these species are summarized in the Table 2.

Biology Some specimens examined were actually observed in association with coelenterates, such as the madreporarian *Acropora* sp. and the octocorallian *Dendronephthya* sp. Other specimens also were thought to have been associated with some invertebrates, because they were found in the bottom of the plastic tank, which had been for the transportation of many organisms freshly collected in Kushimoto and in the dredge samples in Amakusa Islands.

Size The ovigerous females are about 13—15 mm in body length, 2.6—3.3 mm in carapace length. The largest male is 10 mm in body length and 1.9 mm in carapace length.

Distribution Kushimoto and Shirahama, Wakayama Pref., depth 15 m, associated with *Acropora* spp. and *Dendronephthya* sp. (present publication); Amakusa Islands, Kumamoto Pref., depth 20 m (HAYASHI and MIYAKE, 1968 ; present publication).

Heptacarpus flexus (RATHBUN)

(Fig. 3)

Spirontocaris flexa RATHBUN, 1902a, p. 896.
Spirontocaris flexa RATHBUN, 1904, p. 78, fig. 32.
? *Eualus flexa* BRASHNIKOV, 1907, p. 167.
Spirontocaris flexa SCHMITT, 1921, p. 58, fig. 36.
Eualus flexa DERJUGIN and KOBJAKOVA, 1935, p. 142.
Eualus flexa KOBJAKOVA, 1936, p. 211, fig. 32.
Eualus flexa KOBJAKOVA, 1937, p. 118.

Spirontocaris flexa NISHIMURA, 1939, p. 383, fig.
not *Spirontocaris* sp. (cf. *flexa*) URITA, 1942, p. 22.
Heptacarpus flexus HOLTHUIS, 1947, p. 12.
Hepiacarpus flexa VINOGRADOV, 1950, p. 210, pl. 16 fig. 69.
Eualus flexa KOBJAKOVA, 1958, p. 225.

Material examined Shumshu Island, Kurile Islands, August 21, 1936 - 1♂, 1♀ (TUF).

Description Rostrum very slender, nearly horizontal, upper margin with 4 or 5 teeth, of which the posterior one or two lie on carapace, lower margin with 7 teeth, of which the foremost one is near apex. Carapace carinate on its anterior third, antennal and pterygostomial spines well developed.

Abdomen strongly geniculate and bent at a right angle at third somite. Pleura of first four abdominal somites rounded, that of fifth somite pointed posteriorly. Telson a little longer than sixth somite, with 6 dorsal spines on left and 4 on right side, posterior margin broken in both specimens examined.

Eye cylindrical with a distinct ocellus. Antennular peduncle reaching middle of rostrum, stylocerite reaching to or slightly beyond end of basal segment, which bears no marginal spine, second and third segments subequal in length, each with a small marginal spine. Antennal scale reaching tip of rostrum, about 5 times as long as broad, outer spine falling short of obliquely truncated lamella. Basicerite with two processes, upper bluntly and lower sharply pointed, carpocerite reaching end of second segment of antennular peduncle.

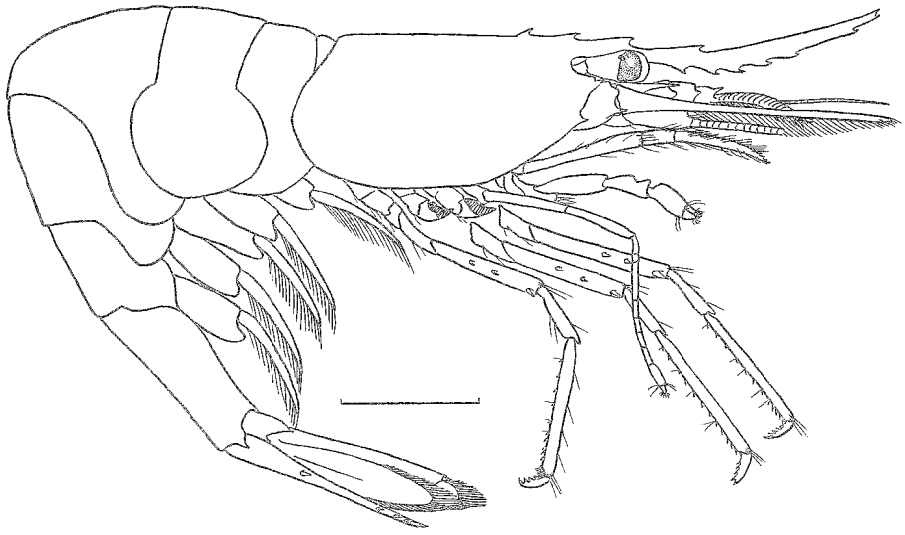

Fig. 3. *Heptacarpus flexus* (RATHBUN), female from Shumshu Island. Scale represents 5.0 mm.

Third maxilliped reaching middle of antennal scale, with an epipid. First two pereiopods with an epipod also. First pereiopod reaching end of antennular peduncle. Second pereiopod exceeding third maxilliped by length of chela. Merus of last three pereiopods with a row of three spines on outer surface.

Endopod of first pleopod in male modified to appendix interna with small retinacula. Appendix masculina as long as appendix interna and with many simple setae terminally. Endopod of uropod as long as telson and shorter than exopod, protopod with two spines, one on outer distal end and the other on base of endopod.

Male much more slender than female. In male thickened part of outer antennular flagellum longer than in female, extending nearly to end of antennal scale, while in female it reaches to distal third of antennal scale only.

Size The female examined is 8.4 mm in carapace length and 11 mm in rostrum length, the male is 5.5 mm in carapace length and 7.5 mm in rostrum length. The type is 54 mm in length, 8.5 mm in carapace length and 11.5 mm in rostrum length (RATHBUN, 1902b).

Distribution Alaska, depth 21 fms (RATHBUN, 1902a) ; from Bering Sea to Drekes Bay, California, depth 10-93 fms (RATHBUN, 1902a and 1904 : SCHMITT, 1921) ; Kamchatka (BRASHNIKOV, 1907) ; Okhotsk Sea (BRASHNIKOV, 1907), depth 27—50 m (KOBJAKOVA, 1936) ; Kurile Islands, Shumshu I. (NISHIMURA, 1939 ; present publication) ; Shikotan I. and Itrup I., depth 4—250 m (KOBJAKOVA, 1958) ; Sea of Japan (BRASHNIKOV, 1907 ; DERJUGIN and KOBJAKOVA, 1935).

Heptacarpus futilirostris (BATE)

(Fig. 4 *a—c*)

Restricted synonymy

Nauticaris futilirostris BATE, 1888, p. 606, pl. 109, fig. 1.
Heptacarpus futilirostris MIYAKE and HAYASHI, 1968b, p. 437, figs. 3, 4, 6 and 7 e, f (synonymy).
Heptacarpus futilirostris HAYASHI and MIYAKE, 1968, p. 139, fig. 9 (part).
Heptacarpus futilirostris KURATA, 1968a, p. 253, figs. 1-27.
Heptacarpus futilirostris HAYASHI, 1976, p. 16 (list).
Heptacarpus futilirostris KIKUCHI and MIYAKE, 1978, p. 24 (list).

Material examined Sabiura, Kushimoto, Wakayama Prefecture, January 2, 1972, H. MISAKI leg. - 1 ♂, 1 ovig. ♀ (SUF).

Many specimens deposited at ZLKU and reported by MIYAKE and HAYASHI (1968b) have also been reexamined.

Biology The species is very common in shallow waters of southern Japan (HAYASHI and MIYAKE, 1968) and the larvae are well described by KURATA (1968a).

Size The ovigerous females vary from 4.7—8.8 mm in carapace length and 2.4-6.1 mm in rostrum length. The males are larger than the females, the largest male being 9.8 mm in carapace length and 6.0 mm in rostrum length.

Distribution Sado I., Niigata Pref. (HAYASHI, 1976); Kanagawa Pref., Arasaki, Aburatsubo (MIYAKE and HAYASHI, 1968b ; KURATA, 1968a); Kii Peninsula (KEMP, 1916 ; UTINOMI, 1956 ; MIYAKE and HAYASHI, 1968b ; present publication) ; Akashi Strait, depth 50 fms (BATE, 1888) ; Inland Sea of Japan (DE MAN, 1906 and 1907 ; YASUDA, 1956) ; off Kochi Pref. (MIYAKE and HAYASHI, 1968b) ; Fukuoka Pref., Munakata-oshima I., Off Tsuyazaki, Mitoma, Shingu (MIYAKE and HAYASHI, 1968b); Sea of Ariake (MIYAKE, 1961b) ; Amakusa Is. (MIYAKE, 1961a ; MIYAKE and HAYASHI, 1968b ; KIKUCHI and MIYAKE, 1978); Kagoshima Pref., Kagoshima Bay (URITA, 1921), Hanasezaki (MIYAKE and HAYASHI, 1968b), Yakushima I. (MIYAKE and HAYASHI, 1968b) ; N. China (URITA, 1926 ; YU, 1935 ; LIU, 1955).

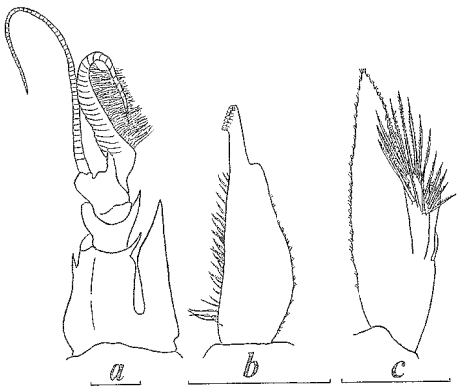

Fig. 4. *Heptacarpus futilirostris* (BATE), male from Kushimoto; *a*, antennular peduncle, *b*, endopod of first pleopod, *c*, endopod of second pleopod. Scales represent 1.0 mm.

Heptacarpus geniculatus (STIMPSON)

Restricted synonymy

Hippolyte geniculatus STIMPSON, 1860, p. 103 (34).
Eualus geniculata ? DERJUGIN and KOBJAKOVA, 1935, p. 142 (list).
Eualus geniculata var. *longirostris* KOBJAKOVA, 1936, p. 211, fig. 38.
Eualus geniculata longirostris KOBJAKOVA, 1937, p. 121.
Heptacarpus geniculatus longirostris VINOGRADOV, 1950, p. 210, pl. 16. fig. 68.
Heptacarpus geniculata geniculata VINOGRADOV, 1950, p. 211.
Spirontocaris geniculata longirostris KOBJAKOVA, 1958, p. 225.
Heptacarpus geniculata longirostris KOBJAKOVA, 1967, p. 235.
Heptacarpus geniculatus HAYASHI and MIYAKE, 1968, p. 132, fig. 5 (synonymy).
Heptacarpus geniculatus KURATA, 1968b, p. 137, fig. 1.
Heptacarpus geniculatus MUKAI, 1969, p. 2, fig. 4.
Heptacarpus geniculatus HAYASHI, 1976, p. 16 (list).
Heptacarpus geniculatus KIKUCHI and MIYAKE, 1978, p. 24 (list).

Material examined Aomori Bay, *Zostera* belt, small beam trawl, July 20, 1959, H. SANDO leg. - 4 spp. (ZLKU No. 9411), July 21, 1959, H. SANDO leg. -2 spp. (ZLKU No. 9432), July 27, 1959, H. SANDO leg. - 4 spp. (ZLKU No. 9536), August 4, 1959, H. SANDO leg. -2 spp. (ZLKU No. 9705), August 5, 1959, H. SANDO leg. - 1 sp. (ZLKU No. 10136), August 15, 1967, H. SANDO leg. - 2 ♂♂, 7 ♀♀ (ZLKU No. 10227).

Tsushima Island, Izuhara, among plankton sample from surface, July 25, 1968, night, H. MINEI, Y. NAKASONE and M. TAKEDA leg. - 1 ♀ (ZLKU No. 15647).

Fukuoka Prefecture, off Tsuyazaki, *Zostera* belt, bottom sandy mud, depth 5 m, February 28, 1957, Y. DOTSU leg. - 1 ovig. ♀ (ZLKU No. 1086), *Zostera* and *Sargassum* belts, small beam trawl, May 23, 1967, S. MATSUURA leg. - 1 ♀ , 1 juv. (ZLKU No. 9414), April 25, 1967, night, T. FUJINO leg. - 1 ♀ (ZLKU No. 9109), among floating weed, January 1, 1959, collector uncertain - 2 juv. (ZLKU No. 6975) ; Munakata-oshima Island, depth 10 m, February 14, 1959, MOTOMATSU leg. - 1 ovig. ♀ (ZLKU No. 2138).

South of Hirado Island, Nagasaki Pref., larva net, May 16, 1953, T. SENTA leg. - 1 juv. (ZLKU No. 306).

Other specimens deposited at ZLKU and collected from Amakusa Islands have also been reexamined (HAYASHI and MIYAKE, 1968).

Remarks KOBJAKOVA (1936 and 1937) described a new subspecies under the name *Eualus geniculata longirostris* from the Gulf of Peter the Great. He included this subspecies in the genus *Eualus,* for earlier Russian authors did not separate *Heptacarpus* from *Eualus.* According to KOBJAKOVA (1937) the new subspecies is characterized by the following five features ; 1) rostrum long, reaching beyond scaphocerite, and about 1.5 times as long as carapace, 2) unarmed part of upper margin of rostrum large, 3) scaphocerite not longer than carapace, 4) pterygostomial spine usually present and 5) lamellar part of scaphocerite exceeding outer spine.

After the examination of great number of specimens from Japanese waters, these features, except for the third, are considerably variable. KOBJAKOVA mentioned the rostrum as long, being about 1.5 times as long as carapace, but his figure (KOBJAKOVA, 1936, pl. 4 fig. 38) shows the rostrum being about 1.3 times as long as the carapace. The rostrum of the present material is 1.3 times as long as the carapace in the ovigerous females and more than 1.4 times in the males and reaches just to or slightly beyond the apex of the rostrum in both sexes. The unarmed part of the upper margin of the rostrum is also highly variably, with at least the distal half, occasionally distal three-fourths, being smooth. The presence of the pterygostomial spine has already been mentioned by YOKOYA (1930) based upon the specimens from the Miyagi Prefecture, though he used the term "branchiostegal spine." Indeed the present collection contains some specimens from Aomori Bay (5 specimens) and off Tsuyazaki, Fukuoka Prefecture (2 specimens) which bear a small spine on one or both sides of the pterygostomial angle. The specimens with the pterygostomial spine seem to be rather more common in northern Japan than in southern Japan as in *Heptacarpus pandaloides* (STIMPSON). The lamellar part of the scale also falls far short of the outer spine in the present materials. With regard to these four characters the two subspecies can not be clearly separated.

The antennal scale is constantly longer than the carapace in the Japanese specimens examined. This character is thought to be the most useful in separating the subspecies. Nevertheless VINOGRADOV (1950) did not use the comparative length of the antennal scale in his descriptive key of these subspecies. Therefore there is some doubt, not only about the length of the antennal scale in the original description of the subspecies *longirostris* but also of the validity of the subspecies itself.

Biology The species is very abundant in the littoral weed belts, such as *Zostera* and *Sargassum*, and its seasonal change of the population was clearly demonstrated by KIKUCHI (1962) in the *Zostera* belt of the Amakusa Islands and by MUKAI (1969) in the *Sargassum* belt of the Inland Sea of Japan. The larval development is well discussed by KURATA (1968b).

Size The ovigerous females vary from 7.1—9.7 mm in carapace length and 9.5—13.0 mm in rostrum length. The males are much shorter and more slender than the females,

measuring 5.4-6.1 mm in carapace length and 7.6—9.0 mm in rostrum length.

Distribution Sakhalin, depth 2—5 fms (URITA, 1942) ; Shikotan I., Kurile Islands, depth 1—23 m (KOBJAKOVA, 1958) ; Hokkaido, Nemuro (DOFLEIN, 1902 ; NISHIMURA, 1939), Muroran (RATHBUN, 1902), Hakodate, depth 2 fms (STIMPSON, 1860) ; continental side of Sea of Japan (DERJUGIN and KOBJAKOVA, 1935), depth 5—9 m (KOBJAKOVA, 1936 and 1937 ; VINOGRADOV, 1950; KOBJAKOVA, 1967); Mutsu Bay, depth 7.5—10 m (YOKOYA, 1939), Aomori Bay (SANDO, 1964; present publication); N. of Oga, depth 145 m (YOKOYA, 1933); Sado I., Niigata Pref. (HAYASHI, 1976); Onagawa Bay, depth 5—19 fms (YOKOYA, 1930); Tokyo Bay (ORTMANN, 1890); Inland Sea of Japan (DE MAN, 1906 and 1907 ; MUKAI, 1969) ; Tsushima Island (present publication) ; Fukuoka Pref., Tsuyazaki, depth 5—10 m (MIYAKE *et al*, 1962 ; present publication), Munakata-oshima I., depth 10 m (present publication) ; Amakusa I. (MIYAKE, 1961a ; KIKUCHI, 1969 ; HAYASHI and MIYAKE, 1968 ; KIKUCHI and MIYAKE, 1978) ; Hirado I. (present publication) ; N. China (YU, 1935 ; LIU, 1955).

Heptacarpus grebnitzkii (RATHBUN)

(Fig. 5)

Spirontocaris grebnitzkii RATHBUN, 1902b, p. 44, fig. 18.
Spirontocaris grebnitskii KEMP, 1914, p. 123 (list).
Eualus grebnitzkii DERJUGIN and KOBJAKOVA, 1935, p. 142 (list).
Eualus grebnitzkii KOBJAKOVA, 1936, p. 211, fig. 39.
Eualus grebnitzkii KOBJAKOVA, 1937, p. 121.
Spirontocaris grebnitzkii URITA, 1942, p. 23.
Heptacarpus grebnitzkii HOLTHUIS, 1947, p. 12 (list).
Heptacarpus grebnitzkii VINOGRADOV, 1950, p. 210, pl. 16 fig. 60.
Eualus grebnitzkii KOBJAKOVA, 1958, p. 224.
Heptacarpus grebnitzkii KOBJAKOVA, 1967, p. 235.

Material examined Notsuke Bay, Hokkaido, August 14, 1953, collector uncertain - 2 ♀♀ (TUF), September 18—25 1953, I. KUBO leg. —12 ♀♀ (TUF), June 29, 1936, collector uncertain —3 ovig. ♀♀, 6 ♀♀ (TUF).

Aomori Bay, Tsuchiya, *Sargassum* belt, summer 1959, H. SANDO leg. —1 juv. (USNM), 6 juv. (ZLKU No. 9099) ; Asamushi, *Zostera* belt, August 15, 1967, small beam trawl, H. SANDO leg. -1 ♀ (ZLKU No. 10799).

Description Rostrum long, straight, with 6—9 close set teeth on upper margin, two of which are situated on carapace, the anterior tooth remote from rostral apex, lower margin with two or three teeth, the posterior of which is just anterior to the distal tooth of the upper margin. A strong antennal and small pterygostomial spine present.

Abdomen smooth, not strongly geniculate at third abdominal somite. Pleura of first four somites rounded, that of fifth pointed. Telson 1.5 times as long as sixth somite, with 4 pairs of dorsal spines, posterior margin pointed at middle with 3 pairs of spines.

Eye very small, with a distinct ocellus. Antennular peduncle reaching middle of antennal scale, basal segment with 1—3, usually 2, small dorsal spines on distal margin, stylocerite reaching middle of second segment of antennular peduncle. Third segment as long as second, both with a single marginal spine. Thickened part of outer flagellum

reaching nearly to outer spine of antennal scale. Antennal scale falling short of rostral apex, 2.3 times as long as broad. Basicerite with 2 processes, upper bluntly and lower sharply pointed, carpocerite reaching end of antennular peduncle.

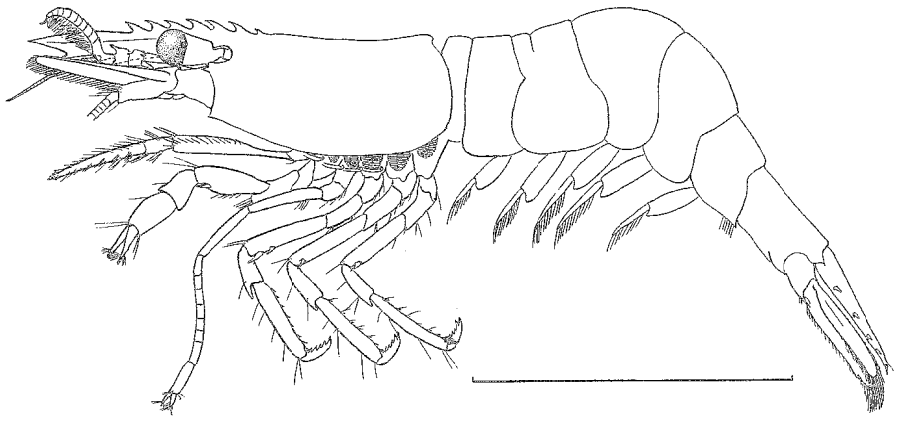

Fig. 5. *Heptacarpus grebnitzkii* (RATHBUN), female from Aomori Bay. Scale represents 5.0 mm.

Third maxilliped exceeding antennal scale by distal third or fourth of ultimate segment, with epipod. First pereiopod stout, merus with a prominent subterminal spine inserted near distal margin. Second pereiopod exceeding antennal scale by chela, which is as long as distal three joints of carpus. Merus of third pereiopod with a row of 2 or 3, usually 2, spines on outer surface, that of fourth pereiopod with 1 or 2 similar spines, that of fifth pereiopod with a single subterminal spine. Propodus of last three pereiopods about 2.5 times as long as dactylus, with 5—7 spines on posterior margin.

Endopod of uropod as long as exopod, both longer than telson, protopod with 2 spines, one on outer distal end, the other on base of endopod, outer margin of exopod straight, ending in 2 spines. Eggs numerous and small, measuring 0.45—0.5 × 0.6—0.7 mm in diameter.

Biology The species is found in littoral weed belts, such as *Cystophyllum, Zostera, Phyllospadix* and *Sargassum* (KOBJAKOVA, 1936 and 1937). In Aomori Bay, juvenile specimens are abundant in summer in *Zostera* belts.

Size The specimens examined are all females ; the ovigerous females vary from 8.0—8.6 mm in carapace length and 8.5—9.5 mm in rostrum length. The female type (USNM, 26159) has a postorbital carapace length of 9.2 mm (personal communication from Dr. F. A. CHACE, JR.). The male is 49.0 mm in total length, 8.7 mm in carapace length and 10.3 mm in rostrum length (URITA, 1942).

Distribution Sakhalin, low water mark (URITA, 1942; KOBJAKOVA, 1958); Shikotan I.,

Kurile Is., depth 8 m (KOBJAKOVA, 1958); Muroran (RATHBUN, 1902a), Notsuke Bay (present publication); Aomori Bay (present publication); Sea of Japan (DERJUGIN and KOBJAKOVA, 1935), depth 0.2—2.6 m (KOBJAKOVA, 1936, 1937 and 1967).

Heptacarpus jordani (RATHBUN)

Spirontocaris jordani RATHBUN, 1902a, p. 44, fig. 17.
Spirontocaris jordani BALSS, 1914, p. 44.
Spirontocaris jordani KEMP, 1914, p. 123 (list).
Heptacarpus jordani HOLTHUIS, 1947, p. 12 (list).

Remarks The species is very rare and could not be examined during the present study. Dr. F. A. CHACE, JR. kindly examined the type specimen (USNM, 26158), 8.0 mm in carapace length and provided the following information. "The merus of the first pereiopod is unarmed. The merus of the third pereiopod bears a row of three spines near the flexor margin of the distal third or fourth of the segment. The merus of the fourth pereiopod has a single subdistal spine. Both fifth pereiopods missing. The first antennular segment on the right side is armed with four dorsal spines on the distal margin, the one on the left side with five spines. The second segment has one very large lateral spine. The third segment bears one submedian dorsal spine."

Size The female type is 46.5 mm in length, 8.0 mm in carapace length and 5.0 mm in rostrum length (RATHBUN, 1902a; CHACE, personal communication).

Distribution Hakodate (RATHBUN, 1902a), Sagami Bay, depth 150 m (BALSS, 1914).

Heptacarpus minutus (YOKOYA)

Spirontocaris minuta YOKOYA, 1930, p. 53, fig. 2.
not *Spirontocaris minuta* YOKOYA, 1933, p. 28, fig. 11.
Spirontocaris minuta YOKOYA, 1939, p. 271.
Heptacarpus minutus HOLTHUIS, 1947, p. 12 (list).
Heptacarpus minutus HOLTHUIS, 1955, fig. 70a on p. 102.

Remarks Many specimens of *Heptacarpus* obtained from Aomori Bay, a part of the Mutsu Bay, which is the type locality of *Spirontocaris minuta* YOKOYA (1930), have been examined, but no specimen referrable to that species could be found. The Sôyô Maru specimen from the Sea of Japan identified by YOKOYA (1933) with *S. minuta* bears a small exopod on the third maxilliped. Moreover it bears an epipod on the first two pereiopods only, rather than on the first three pereiopods as in the original description of *S. minuta*. Therefore the specimen is not identical with that species but with *Eualus townsendi* (RATHBUN). It is very obscure whether the species, *S. minuta*, is actually valid or not. It, however, may be better not to disregard the species as yet, as it was originally well described.

Heptacarpus pandaloides (STIMPSON)

Restricted synonymy
Hippolyte pandaloides STIMPSON, 1860, p. 103 (34).
Heptacarpus pandaloides MIYAKE and HAYASHI, 1968a, p. 374, fig. 1 (synonymy).
Heptacarpus pandaloides HAYASHI and MIYAKE, 1968, p. 136, fig. 7.
Heptacarpus pandaloides KIKUCHI, 1968, p. 180.
Heptacarpus pandaloides HAYASHI, 1976, p. 16 (list).
Heptacarpus pandaloides KIKUCHI and MIYAKE, 1978, p. 24 (list).

Material examined Notsuke Bay, Hokkaido, depth 5 m, October 1, 1936—1♀ (ZLKU No. 2424).
Many other specimens deposited at ZLKU and reported by MIYAKE and HAYASHI (1968a) have also been reexamined.

Biology The species is most abundant in the *Zostera* belt in northern Japan (KURATA, 1963; SANDO, 1964) and less common in southern Japan (MIYAKE and HAYASHI, 1968a). The life history of the species has been well discussed by KURATA (1963) based upon the material from the Ishinomaki Bay, Miyagi Prefecture. Seasonal changes seem to show the same pattern as in *H. geniculatus*.

Size The ovigerous females vary from 9.5—11.0 mm in carapace length and 14.0—16.1 mm in rostrum length. The males are 5.1—6.0 mm in carapace length and 8.4—10.0 mm in rostrum length.

Distribution Hokkaido, Hakodate (DOFLEIN, 1902), depth 2 fms (STIMPSON, 1860), Notsuke Bay, depth 5 m (present publication); Mutsu Bay, depth 5—17 fms (YOKOYA, 1930), Aomori Bay (SANDO, 1964; MIYAKE and HAYASHI, 1968a); off Toyama Pref. (MIYAKE *et al*, 1962); off Niigata Pref. (MIYAKE *et al*, 1962; HAYASHI, 1976); Miyagi Pref., Onagawa Bay, depth 7.8—18 m (YOKOYA, 1939); Ishinomaki Bay (KURATA, 1963); Kanagawa Pref., Yokohama (DOFLEIN, 1902; PARISI, 1919); Misaki (BALSS, 1914; KEMP, 1914); Enoshima (PARISI, 1919); Inland Sea of Japan, depth 6 fms (DE MAN, 1906 and 1907; YASUDA, 1956); Fukuoka Pref., Tsuyazaki (MIYAKE *et al*, 1962; MIYAKE and HAYASHI, 1968a; HAYASHI and MIYAKE, 1968); Amakusa Is. (MIYAKE, 1961b; HAYASHI and MIYAKE, 1968; KIKUCHI, 1968, KIKUCHI and MIYAKE, 1978); N. China (YU, 1935; LIU, 1955); Karachi, India (KEMP, 1914).

Heptacarpus rectirostris (STIMPSON)

(Fig. 6 *a*—*g*)

Restricted synonymy
Hippolyte rectirostris STIMPSON, 1860, p. 102.
not *Eualus rectrostris* ? DERJUGIN and KOBJAKOVA, 1935, p. 142.
not *Eualus rectirostris* KOBJAKOVA, 1936, p. 211, fig. 37 (= ? *Hippolyte gracilirostris* STIMPSON).
not *Eualus rectirostris* KOBJAKOVA, 1937, p. 122 (= ? *Hippolyte gracilirostris* STIMPSON).

not *Heptacarpus rectirostris* VINOGRADOV, 1950, p. 209, pl. 16 fig. 71.
Heptacarpus rectirostris MIYAKE and HAYASHI, 1968b, p. 434, figs. 1, 2 and 7, a-d (synonymy).
Heptacarpus rectirostris HAYASHI and MIYAKE, 1968, p. 138, fig. 8.
Heptacarpus rectirostris HAYASHI, 1976, p. 17 (list).
Heptacarpus rectirostris KIKUCHI and MIYAKE, 1978, p. 24 (list).

Meterial examined Asamushi, Aomori Bay, Aomori Prefecture, other data uncertain - 11♂♂, 3 ovig. ♀♀ (SUF).

Many other specimens deposited at ZLKU and reported by MIYAKE and HAYASHI (1968b) have also been reexamined.

Remarks The males of this species have not been previously described. There are a number of males in the present material, which reveal some interesting features, in comparison with those of the related species, *H. futilirostris* and *H. commensalis* sp. nov.

Males are smaller than females and show considerable morphological differences from females. In males the rostrum is slightly longer than the carapace though with the same number of rostral teeth as in females. The pterygostomial angle is not spiniform in males. The first male pereiopod is strongly elongated, exceeding the rostral apex by the entire chela, which is as long as the carpus and merus combined. The immovable finger is provided with long setae along the base of the cutting edge and the merus is armed with a distinct subterminal spine. The third maxilliped is never elongated or strengthened even in mature males. The meral spines of the posterior three pereiopods are similar to those in females and the dactylus of these pereiopods is more slender.

The endopod of the male first pleopod tapers in distal third, with some retinacula near the apex. The endopod of the male second pleopod is provided with a long slender appendix interna and very short appendix masculina. The comparison between *H. futilirostris*, *H, commensalis* and *H. rectirostris* is shown in the account for the new species.

A single small specimen collected from the Gulf of Peter the Great was referred by KOBJAKOVA (1936 and 1937) to *Eualus rectirostris* which species is now included in the genus *Heptacarpus*. Russian authors did not accept the latter genus at that time. Although KOBJAKOVA described the specimen in detail and figured well, it belongs not to *Heptacarpus* but to *Eualus* s.s. VINOGRADOV (1950) also reported the species under the name *Heptacarpus rectrostris*, but did not enlarge the knowledge of the species. Judging from KOBJAKOVA's description and figure, it is probably a male of *Eualus gracilirostris* (STIMPSON).

Biology The species is very common in weed belts in northern Japan (SANDO, 1964). The larvae are being described by YAMASHITA and HAYASHI (in press).

Size The ovigerous females vary from 6.7—8.2 mm in carapace length and 4.5—5.2 mm in rostrum length. The largest male is 4.0 mm in carapace length and 4.2 mm in rostrum length.

Distribution Hokkaido, Hakodate, deep water (STIMPSON, 1860; DOFLEIN, 1902; RATHBUN, 1902a); Mutsu Bay, depth 5—6 fms (YOKOYA, 1930); Aomori (BALSS, 1914; SANDO, 1964; MIYAKE and HAYASHI, 1968b: present publication); Iwate Pref., Miyako Bay, depth 9 m (MIYAKE and HAYASHI, 1968b); Yamada Bay, depth 14 m (MIYAKE and HAYASHI, 1968b);

Miyagi Pref., Onagawa Bay, depth 8—12 m (YOKOYA, 1939) ; Inland Sea of Japan (DE MAN, 1907; MIYAKE and HAYASHI, 1968b); Matsushima Bay (MIYAKE and HAYASHI, 1968 b); Sagami Bay ? (BALSS, 1914); Buzen Sea (MIYAKE and HAYASHI, 1968b); off Oita (MIYAKE and HAYASHI, 1968b); Fukuoka Pref., off Tsuyazaki (MIYAKE and HAYASHI, 1968b); Nagasaki ? (BALSS, 1914) ; Amakusa Is. (MIYAKE and HAYASHI, 1968b ; KIKUCHI and MIYAKE, 1978); Korea ? (RATHBUN, 1902a).

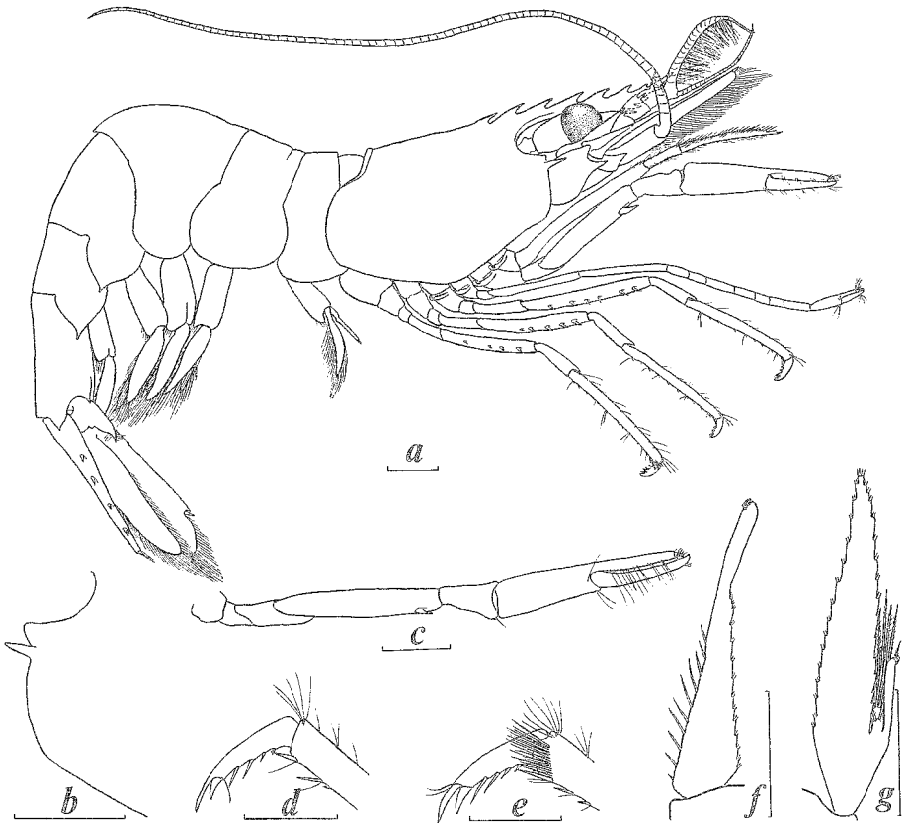

Fig. 6. *Heptacarpus rectirostris* (STIMPSON), males from Aomori Bay ; *a*, animal in lateral view, *b*, anterior part of carapace, *c*, first pereiopod, *d*, dactylus of third pereiopod, *e*, dactylus of fifth pereiopod, *f*, endopod of first pleopod, *g*, endopod of second pleopod. Scales for *a-c* represent 1.0 mm and those for *d-g* represent 0.5 mm.

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invaluable advice and encouragement in the course of this study. Thanks are also due to Dr. F. A. CHACE, JR. of the United States National Museum for examination of the types of *Heptacarpus jordani* (RATHBUN) and *H. grebnitzkii* (RATHBUN), and to Dr. A. J. BRUCE of Heron Island Research Station for his critical reading the manuscript. I am much indebted to any peaple, who collected and donated many interesting specimens, upon which this paper is largely depend.

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