HOKKAIDO UNIVERSITY

Title	Taxonomic Studies of the Family Pleustidae (Crustacea, Amphipoda, Gammaridea) from Coastal Waters of Northern Japan. : I. The Genus Parapleustes (With 32 Text-figures and 1 Table)
Author(s)	ISHIMARU, Shin-ichi
Citation	北海道大學理學部紀要, 23(4), 403-453
Issue Date	1984-06
Doc URL	https://hdl.handle.net/2115/27684
Type	departmental bulletin paper
File Information	23(4)_P403-453.pdf

Hokkaido University Collection of Scholarly and Academic Papers : HUSCAP

Taxonomic Studies of the Family Pleustidae (Crustacea, Amphipoda, Gammaridea) from Coastal Waters of Northern Japan. I. The Genus *Parapleustes*

By

Shin-ichi Ishimaru

Zoological Institute, Hokkaido University

(*With 32 Text-figures and 1 Table*)

Introduction

The marine gammaridean fauna of Japan has been gradually clarified by effort of various authors. Among them, important contributions may be the comprehensive taxonomic work around the Seto Inland Sea by Nagata (1965a-c, 1966), and the recent vigorous survey around western Kyushu made by Hirayama (1983). However, most of taxonomic works so far made on the marine gammarideans of Japan, have been performed along its southern coasts affected by the warm Kuroshio Current. Therefore, our knowledge on the gammaridean fauna of northern Japanese coasts which are affected by the cold Oyashio Current is yet very much restricted at present, and is based only on fragmentary records of several taxonomists.

In recent years the author has surveyed shallow water gammarideans around northern Japan, mainly Hokkaido, and obtained a number of species of various groups. The present series of papers deals with the family Pleustidae, which is mainly distributed in the cold water regions of both the Hemispheres. Although four species of this family have been recorded from the southern Japanese coasts along the Kuroshio Current (Nagata, 1960, 1964, 1965b; Irie and Nagata, 1962), any species has not yet been recorded from northern Japan. As the first issue of this taxonomic work, the present paper deals with the descriptions of six species of the genus *Parapleustes*, together with brief notes on their distribution and ecology. Among them three are new to science and the other three are all new to Japan. Two hitherto described species are subjected to some changes of taxonomic status. Further, a tentative grouping of the species within the genus is made based on the external morphological characters.

Methods

Animals were fixed in 5 percent neutralized formalin solution diluted with

Jour. Fac. Sci. Hokkaido Univ. Ser. VI, Zool. 23(4), 1984.

seawater and were sorted after a few days to a few months fixation. The sorted animals were washed with freshwater and thereafter preserved in 70 percent ethanol until dissected. Smaller specimens were immersed in a drop of neat glycerine on a hollow slide glass, and dissected using a pair of fine needles under a dissecting microscope. Dissected appendages were mounted with gum-chloral medium on a slide glass, and the remaining carcass was mounted with glycerine on a hollow slide glass. Larger specimens were dissected in a petri dish filled with 70 percent ethanol, using pincers and a blunt needle. Released thin parts such as mouth appendages and telson were mounted by the same way as smaller specimens. The other thick appendages such as pereopods and the remainder of the body were bottled in glass tubes with cotton piths, and immersed in 70 percent ethanol. At the examination, such thick parts were transferred to a slide glass with a drop of glycerine and set with a cover slip. Figures were drawn under a light microscope, a phase-contrast microscope or a dissecting microscope with the aid of a camera lucida.

Remarks on the descriptions

1. Material

The material used in the present study was collected at eight localities of northern Japan given in Fig. 1.

The type series are deposited in the Zoological Museum, Faculty of Science, Hokkaido University.

2. Presentation of specific data

Description of each species is based on one and only specimen, for which an adult specimen was chosen as possible. If adult specimens were not available, a juvenile specimen of not so small size was chosen. If the described specimen was partly destroyed or a marked variation was observed among other specimens, some additional specimens were chosen to supplement the description of the first specimen. For new species, an adult male specimen was designated as a holotype wherever possible, and other additional specimens were listed under the heading "Paratypes." If the paratype specimens include females with oostegites, one of them was designated as an allotype. An adult female specimen was selected as a holotype, only when there is no specimen unquestionably determined as male.

3. Measurements

Measurements were made on various body parts whose values or ratios are given in descriptions. Only body length is given by actual value in tenths of millimeters. Length of other characters was expressed in percent ratio to the length of another character. Some measured parts are explained below (Fig. 2).

Body length (BL) of animals was computed from the apex of the rostrum along the dorsal margin to the posterior limit of pleonite 3, with the aid of a

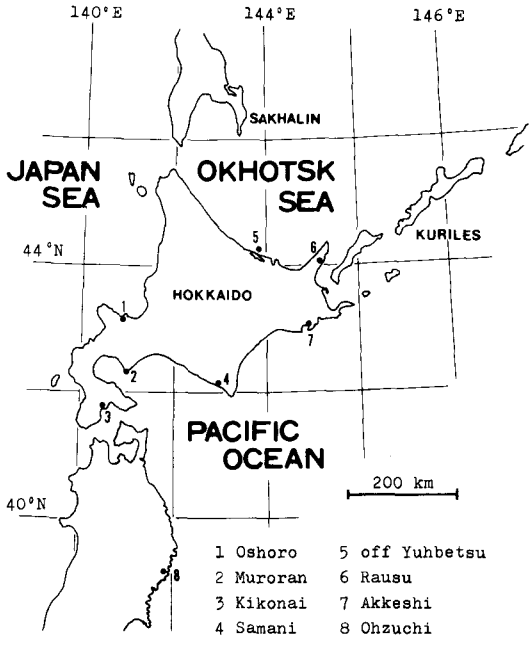

Fig. 1. Map showing the provenance of materials.

camera lucida, without stretching the pleon even if it was strongly bent beneath the pereon. *Head length* (HL) was measured from the apex of the rostrum to the anterior limit of pereonite 1. *Length of the distal process of the article 4 of pereopods* was measured from the proximal limit of the article 5 to the apex of the process, and expressed in the relative length to the length of the article 5. *Length of uropodal ramus* (UR) was represented in two ways; in relative length to the length of the peduncle of uropod 3, and to the widest width of telson.

4. *Abbreviations*

The following abbreviations are consistently used throughout the present and coming papers:

♂: an adult male with a pair of distinct penial papillae
♂?: a presumable male whose penial papillae are indistinct (see below)
♀: a female specimen with rudimentary oostegites
ov♀: a female specimen with full-grown oostegites
juv: a juvenile specimen; the remainder of the above four categories
SI: Shin-ichi Ishimaru, the author

Further, the following abbreviations are used in the legends of figures. so, setae (or spines) omitted; ds, dorsal view; vr, ventral view; ant, anterior view; post, posterior view; inn, inner view; out, outer view; R, right appendage (or

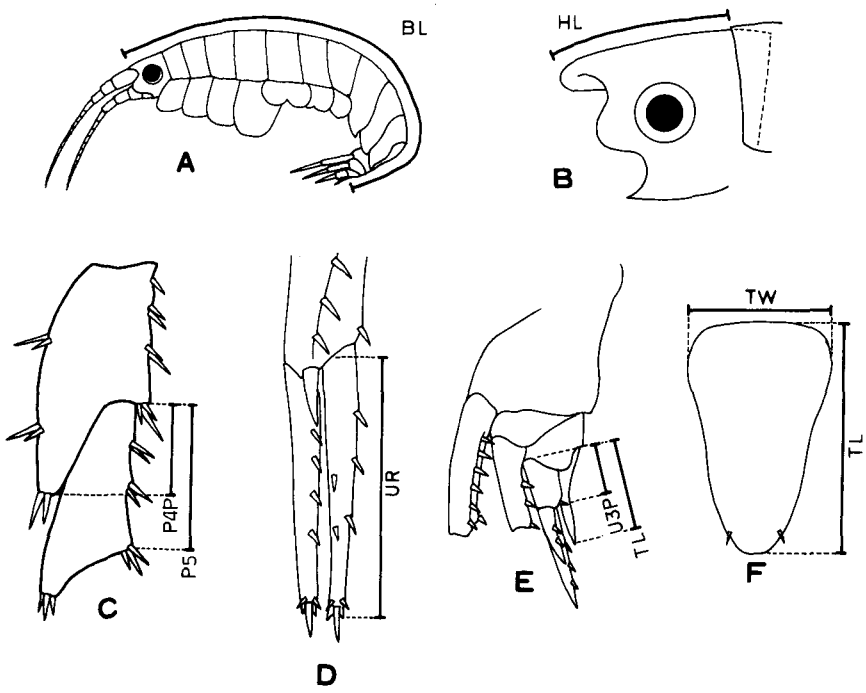

Fig. 2. Parts of body measured. A, body length (BL); B, head length (HL); C, length of the distal process of the 4th articles of pereopods (P4P) and length of 5th articles (P5); D, length of uropodal ramus (UR); E, telsonic length (TL) and length of the peduncle of uropod 3 (U3P); F, telsonic width (TW).

part); L, left appendage (or part).

As many species of the family show little sexual dimorphism, it is often difficult in some species to distinguish adult male specimens from juveniles, if the male has indistinct penial papillae. Intraspecifically variable but species-specific size of maturity is one of the factors which make difficult to determine whether the observed specimen without oostegites is a mature male or a sexually undifferentiated juvenile. If an unquestionable male is hitherto undescribed and any specimen with distinct penial papillae is not available in the present study and, further, the mature size of female is unknown, a specimen without oostegites, which is sufficiently larger than the minimum size of female, is designated as "♂?". Thus it is yet probable that such "tentatively designated males" are truely mere immature specimens.

Description

Genus ***Parapleustes*** Buchholz, 1874

Parapleustes Buchholz, 1874, p. 337; J.L. Barnard, 1969b, p. 425; Gurjanova, 1972, p. 131; Lincoln, 1979, p. 428.
Incisocalliope J.L. Barnard, 1959, p. 22.

Before describing each species, several characters which are common to the six species described herein are mentioned below. These characters are not repeated in the description of each species.

Labrum subcircular, asymmetrically incised. *Mandible* Body of mandible subquadrate; molar vestigial, conical, very weakly chitinized and smooth, with distal half pubescent. Palp 3-articulate; article 3 falcate, with outer face highly bristly. *Labium* typical to the family, without inner lobe; margin between both outer lobes horizontal. *Maxilla 1* Outer plate apically armed with a ventral and a dorsal row, each consisting of 4 and 5 pectinate spines. Palp biarticulate, extending beyond outer plate. *Maxilliped* Inner plate adz-shaped. Outer plate furnished with a setal row along inner margin. Palp 4-articulate, ornamented with many setae along inner margin; article 3 not distally produced; article 4 falcate; dorsal face of articles 3-4 highly bristly. *Gnathopods 1-2* Article 3 with a triangular distal lobe. Article 7 falcate, with a row of small hairs along inner margin. *Pleopods 1-3* Both rami equal in shape. *Pleopod 3* Peduncle with one or a few spines on posterior face near coupling spines. *Uropod 1* the longest. Peduncle bearing a large stout spine at distal end of outer ridge. Both rami armed with two apical protrusions; a spine of medium length inset between both protrusions. *Uropod 2* Peduncle armed with a spine distally on inner ridge. *Uropod 3* Peduncle armed with a spine distally on outer ridge. Both rami blunt at apex.

Parapleustes behningi (Gurjanova, 1938) **n. comb.**

(Figs. 3-9)

Neopleustes behningi Gurjanova, 1938, p. 315, fig. 30.
Pleustes behningi: Gurjanova, 1951, p. 641, fig. 438; J.L. Barnard, 1969b, p. 425; Kussakin, 1975, p. 65.
Parapleustes nautilus J.L. Barnard, 1969a, p. 199, fig. 55. NEW SYNONYMY

Material examined. 1 ov♀, 5.9 mm ("a", fully described); 4 juv, 2.4, 2.8, 2.9 ("c"), 2.9 mm: 2 m depth, attaching to a set net, Samani, Hokkaido, 5-VIII-1982, SI coll. —— 2 ♂♂, 4.4, 4.9 mm; 1 ov♀, 5.9 mm: 0.1 m depth, on boulders, Samani, Hokkaido, 31-V-1983, SI coll. —— 1 juv, 3.3 mm ("d"): 0.5 m depth, among *Sargassum* belt, Oshoro, Hokkaido, 28-III-1974, K. Kito coll. —— 1 ov♀, 7.1 mm; 1♂, 4.0 mm ("e"): 0.3 m depth, among *Phyllospadix* belt, Oshoro, Hokkaido, 28-II-1983, SI coll. —— 1♂, 3.8 mm: 0.3 m depth,

among *Sargassum* belt, Kikonai, Hokkaido, 28-IV-1983, SI coll. —— 1 ♂, 4.8 mm; 1 juv, 1.9 mm ("b"): among algae, Muroran, Hokkaido, 1-V-1983, T. Sato coll.

Female "a". Body (Fig. 3-A) 5.9 mm long, massive, compact, heavily chitinized, opaque; color reddish black when alive, whitish but pinkish along coxal margins after a few months preservation in 5%-formalin. Head (Fig. 3-B) about as long as first two pereonites combined. Rostrum short, reaching subbasal part of peduncular article 1 of antenna 1, with blunt apex. Lateral cephalic lobe

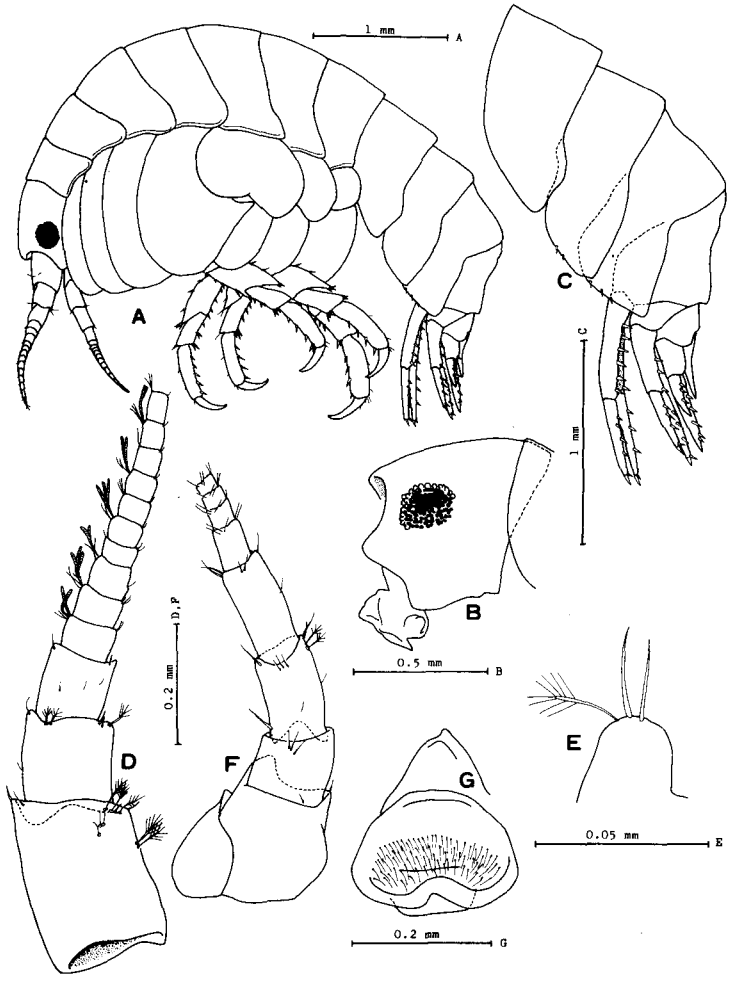

Fig. 3. *Parapleustes behningi*. Female "a". A, habitus; B, head; C, pleon; D, antenna 1 (L, inn); E, accessory flagellum; F, antenna 2 (L, out); G. labrum.

moderately produced forward, bluntly rounded at apex. Cheek moderately produced ventrally, rounded gently at apex. Superior and inferior antennal sines shallow. Eye small, oval, black. Back (Fig. 3-A) smooth. Pereonite 1 the shortest; pereonites 1-4 extending backward roundly at their posteroventral corners; pereonites 5-6 extending backward subacutely at their posteroventral corners; pereonite 7 with oblique ventral margin. Coxae 1-4 very deep, successively deeper. Epimeron 1 (Fig. 3-C) tapering posterodistally, bluntly rounded at apex, with sinuous posterior margin; epimeron 2 tapering at distal half, sinuous at posterior margin, provided with some spines medially on ventral margin; epimeron 3 subquadrate, gently rounded at anterior marign and mostly straight but minutely sinuous at posterior margin, weakly extending at posteroventral corner into a blunt angle, ornamented with some spines medially on ventral margin. Urosome as long as pleonites 2-3 combined; urosomite 1 the longest, about as long as pleonite 3; urosomite 2 very short, hidden behind urosomite 1 from dorsal view; urosomite 3 short, about 20% as long as urosomite 1.

Antenna 1 (Fig. 3-D) short, about 20% as long as body length. Peduncular article 1 as long as succeeding two articles combined, bearing some penicillate hairs on apical and subapical margins. Peduncular article 3 a little shorter than article 2. Primary flagellum slightly compressed, 1.2 times longer than peduncle, 13-articulate; first flagellar article longer than wide; second article wider than long and the others gradually becoming longer and narrower distally; first three articles furnished apically with two sets of armaments, one of which consists of setules and the other of setules and aesthetascs; each succeeding article alternately furnished with two sets of setules or two sets equal to the first three articles. Accessory flagellum (Fig. 3-E) fused with peduncular article 3, flattened and expanding. *Antenna 2* (Fig. 3-F) a little shorter than antenna 1. Peduncular article 2 stout, as long as succeeding two articles combined; gland cone short to reach half length of peduncular article 3. Peduncular article 3 a little shorter than article 4, extending slightly at inner side of apical margin. Peduncular articles 4-5 subequal in length; article 4 bearing a seta at both apicoventral and basoventral margins, furnished with several setules. Flagellum 90% as long as peduncle, 14-articulate; first flagellar article longer than wide; second article wider than long and the others gradually becoming longer and narrower distally; each article bearing two sets of apical setules.

Mouth parts. Labrum (Fig. 3-G) slightly incised. *Right mandible* (Fig. 4-A) Incisor with 7 denticles; accessory blades counting 9. Palp as long as body of mandible; article 2 furnished with several setae along posterior margin in space; article 3 armed with 11 pectinate spines along posterior margin, bearing a long stout seta and two short setae (or spines?) at apex. *Left mandible* (Fig. 4-B) similar to right one; incisor with 7 denticles; lacinia mobilis with 9 denticles. *Maxilla 1* (Fig. 4-D) Inner plate small, truncate, subapically with a plumose seta. Palp broad; proximal article expanding outward, armed with two setae on the expansion; distal article apically truncate, highly bristly, ornamented at apex

Fig. 4. *Parapleustes behningi*. Female "a". A, mandible (R, inn); B, incisor and lacinia mobilis (L, inn); C, labium (vr); D, maxilla 1 (R, vr); E, maxilla 2 (R, vr); F, maxilliped (R, vr); G, inner plate of maxilliped (R, vr).

with 5 highly pectinate spines, furnished with a setal row obliquely. *Maxilla 2* (Fig. 4-E) Inner plate oval, slightly bristly, bearing two plumose setae which are not so thick, furnished with two setal rows; ventral row sparse and consisting of very short setae, and dorsal row dense and consisting of long setae. Outer plate slender, about 60% as thick as inner one, slightly bristly, extending beyond inner plate, furnished along inner margin with two setal rows; ventral row consisting of thicker setae than those of dorsal one. *Maxilliped* (Fig. 4-F) Distal margin of coxa oblique, with a group of simple setae medially, subacute around distal portion; both coxae ordinarily fused with each other to 30% of length. Inner

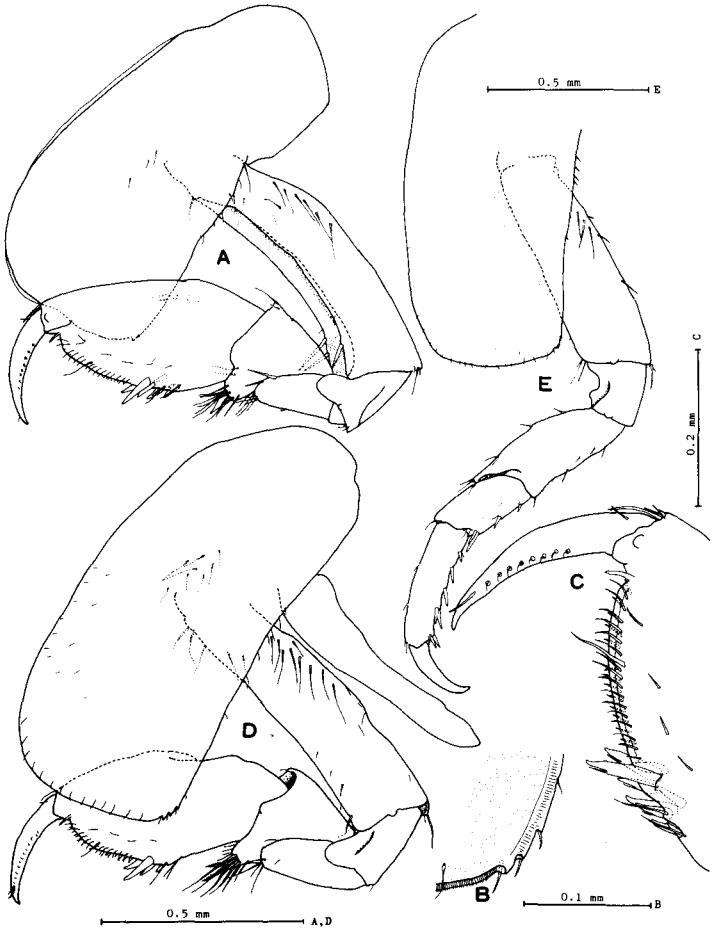

Fig. 5. *Parapleustes behningi*. Female "a". A, gnathopod 1 (L, out); B, posteroventral corner of coxa 1 (L, out); C, palm of gnathopod 1 (L, out); D, gnathopod 2 (L, out); E, pereopod 3 (L, out).

plate (Fig. 4-G) nearly reaching base of palp, armed with two stout spines on inner margin medially; apex with a seta, a long spine and 4 stumpy serrulate spines. Basis bearing a set of simple setae at distal edge of outer margin. Outer plate (Fig. 7-B) not reaching apex of palpal article 1; two slender spines arising from apex. Palpal articles 1-2 with a group of short simple setae respectively at distal edge of outer margin; palpal article 3 armed with 4 pectinate spines subapically; article 4 bearing a nail.

Ganathopod 1 (Fig. 5-A) Coxa 1 subquadrate, expanding distally, with a few small but distinct notches (Fig. 5-B) at posteroventral corner. Article 2

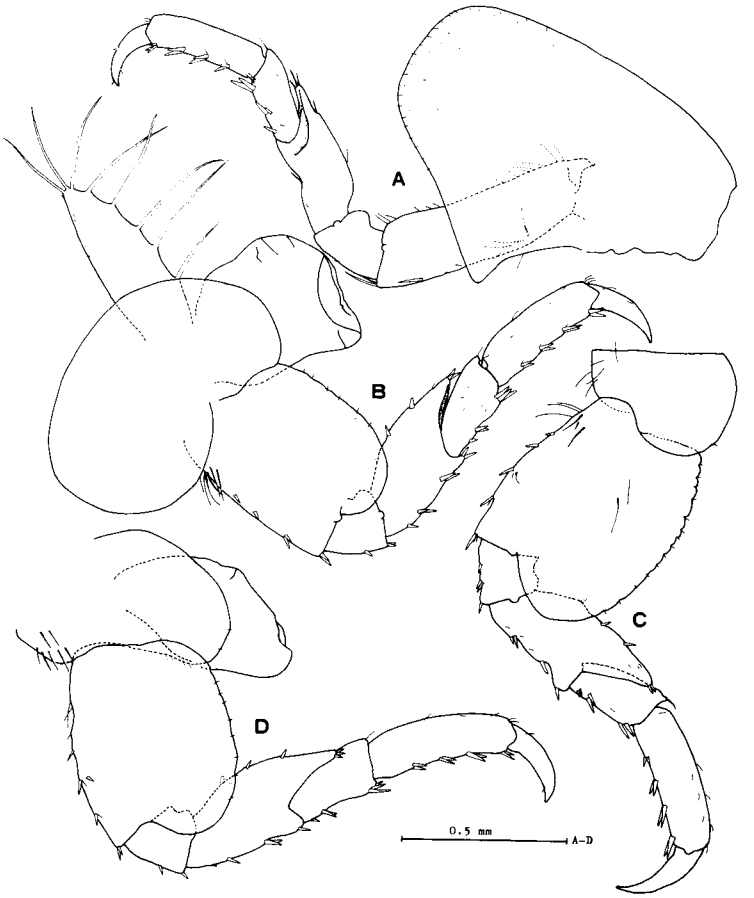

Fig. 6. *Parapleustes behningi*. Female "a". A-D, pereopods 4, 5, 7, 6 (L, out).

bearing three stout setae subapically on anterior margin. Article 4 toothless. Aricle 5 triangular, slightly produced posterodistally, bearing a setal bundle on the posterior lobe. Article 6 oval, as long as articles 3-5 combined, subchelate, with two setae on inner face; palm (Fig. 5-C) about as long as posterior margin, delimited by three groups of spines, smoothly connected with posterior margin; palmar margin smooth, without small tooth. Article 7 slightly shorter than palm. *Gnathopod 2* (Figs. 5-D, 7-C) Coxa 2 subquadrate, deeper than coxa 1. Article 6* without long seta on inner face.

Pereopod 3 (Figs. 5-E, 7-D) Coxa 3 subquadrate. Segmentation and principal armature as shown. Article 4 narrow, extending anterodistally to reach

* The article 6 of the gnathopod 2 of this specimen is somewhat shrivelling.

about 50% length of article 5. Articles 5-6 lined with a row of spines along posterior margin. Other armaments consisting of setules and setae. *Pereopod 4* (Figs. 6-A, 7-E) Coxa 4 subquadrate, excavate; posterior angle of the excavation strong, subacute. *Pereopod 5* (Fig. 6-B) broader and shorter than pereopod 3. Articles 4-6 combined 1.1 times longer than articles 1-3 combined. Article 2 posteriorly lobate, with spinose anterior margin and smooth posterior margin;

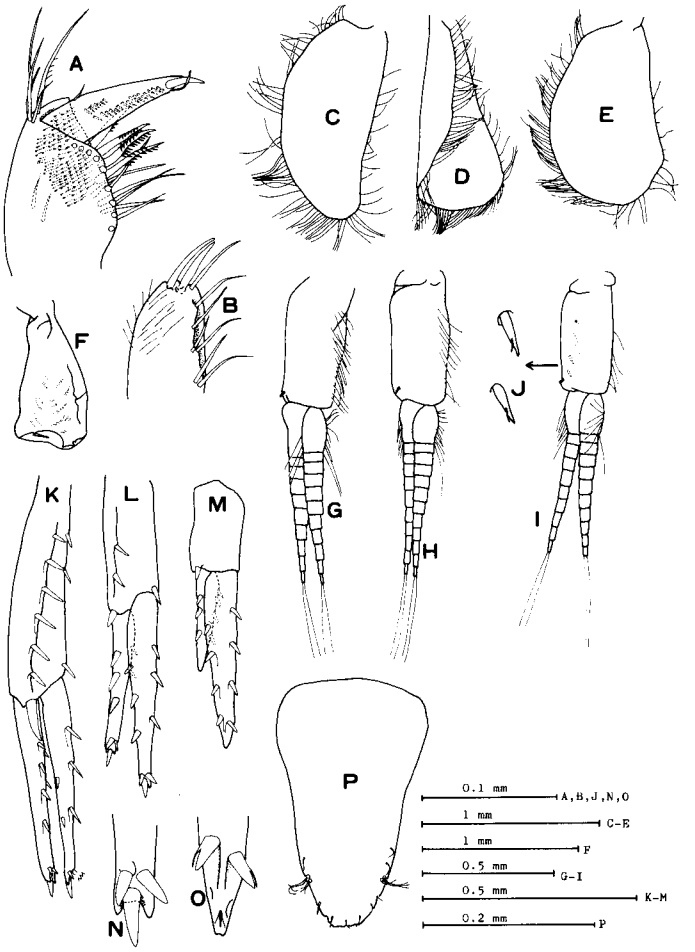

Fig. 7. *Parapleustes behningi*. Female "a". A, palpal articles 3-4 of maxilliped (R, vr; so); B, outer plate of maxilliped (R, vr); C-E, oostegites of gnathopod 2 and pereopods 3-4 (L); F, gill of pereopod 2 (L); G-I, pleopods 1-3 (L, ant; so); J, spines on peduncle of pleopod 3; K-M, uropods 1-3 (L, ds); N, inner ramus of uropod 2; O, inner ramus of uropod 3; P, telson (ds).

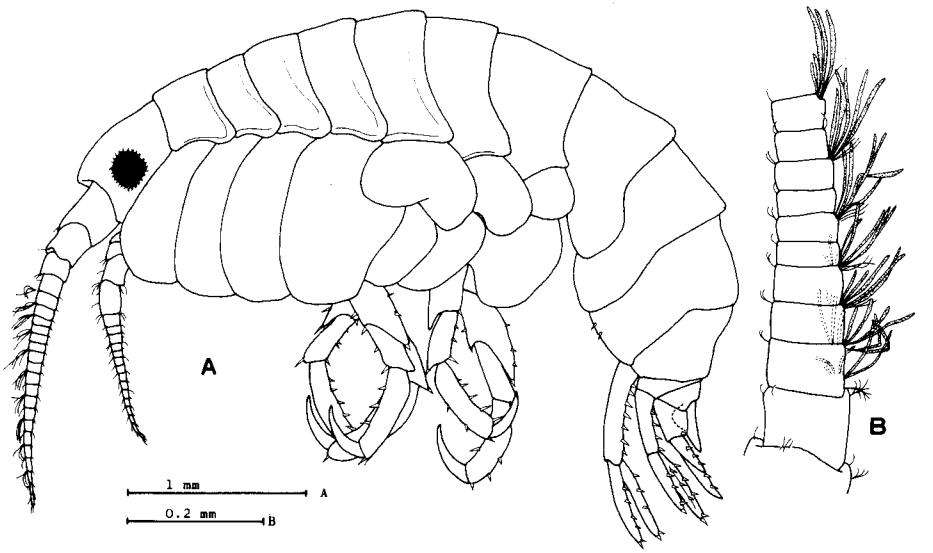

Fig. 8. *Parapleustes behningi*. Male "e". A, habitus; B, flagellum of antenna 1 (R, out).

posterior lobe extending distally not to reach distal margin of article 3. Article 4 broad, lined with a row of spines along both anterior and posterior margins; posterior lobe reaching about 80% length of article 5. Articles 5-6 spinose along anterior margin. *Pereopod 6* (Fig. 6-D) Coxa 6 posterolobate. *Pereopod 7* (Fig. 6-C) Coxa 7 circular. Article 2 with posterior lobe weakly scalloped along posterior margin, smooth along distal margin.

Pleopod 1 (Fig. 7-G) Peduncle furnished densely with a row of plumose setae along outer margin. Both rami 1.3 times longer than peduncle; 10 articles on inner ramus and 11 on outer one; proximal article long, furnished with plumose setae marginally. *Pleopod 2* (Fig. 7-H) a little shorter than pleopod 1. *Pleopod 3* (Fig. 7-I) about 90% as long as pleopod 1.

Uropod 1 (Fig. 7-K) Peduncle armed with a row of spines along outer ridge. Inner ramus 90% as long as peduncle, armed with a row of spines along both inner and outer ridges. Outer ramus only a little shorter than inner one. *Uropod 2* (Fig. 7-L, N) about 80% as long as uropod 1. Peduncle armed with three spines along outer ridge. Inner ramus as long as peduncle. Outer ramus 80% as long as inner one. *Uropod 3* (Fig. 7-M) about 60% as long as uropod 1. Inner ramus as long as peduncle, armed with two rows of spines. Outer ramus about half as long as inner one.

Telson (Fig. 7-P) long, about twice longer than peduncle of uropod 3 *in situ* (Fig. 3-C), 1.7 times longer than wide, subapically bearing a pair of setules; a pair of two penicillate hairs issued just behind the setules.

Male "e". Only major differences from the female are noted below.

Body (Fig. 8-A) 4.0 mm long, more compressed than female.

Antennae longer and wider than those of female. *Antenna 1* (Fig. 8-B) about 40% as long as body length. Primary flagellum about 2.2 times longer than peduncle, furnished with more of longer aesthetascs on flagellar articles 1-3, and alternately on succeeding articles.

Development. Although all appendages of several specimens having various body lengths were examined, only some remarkable variations in several characters are noted below. *6th articles of gnathopods 1-2* This appears oval in both adult female and male (Figs. 6-A, D, 9-Ae). The palmar margin of the article is a little longer than, or as long as the posterior margin, and is connected smoothly with the posterior margin. In a small-sized specimen (Fig. 9-Ab), however, the article seems to be subrectangular. Its palmar margin is rather shorter than the posterior margin, apparently bevelled, and connected with the posterior margin angularly. In a medium-sized specimen (Fig. 9-Ac), the shape of the article 6 appears to be an intermediate state between the large- and small-sized specimens. *Uropod* 3 (Fig. 9-Cb-e) is longer in larger specimens than in smaller ones. Especially the inner ramus becomes larger, and stumpy spines along both rami increase in number as the body length increases. *Pereopod 7* Article 2 is not scalloped but smooth posteriorly in the smallest specimen observed (Fig. 9-Bb), bearing only one minute notch on the posterior margin. In larger specimens (Fig. 9-Bc-e), however, the posterior margin is apparently scalloped. Article 4 is produced posterodistally to reach the distal margin of the article 5 in smaller specimens (Fig. 9-Bb, c), but does not reach the distal margin of the article 5 in larger specimens. In addition, the armature of pereopod 7 is more simple in smaller specimens. The number of spines increases gradually. This change is most evident in the anterior margin of the article 6.

Remarks. *Parapleustes behningi* was originally described by Gurjanova (1938) as *Neopleustes behningi*. She later transferred this species to the genus *Pleustes* (Gurjanova, 1951). Her assignment to *Pleustes* was probably based on its heavily chitinized cuticle and very short antennae 1-2. Indeed, at a glance, it looks like *Pleustes* species. However, her illustration shows that her *Pleustes behningi* obviously lacks a long rostrum and the exceedingly long and narrow lobes on the 5th articles of gnathopods 1-2, both of which are important diagnostic characters of *Pleustes*. The small specimens in the author's hands well correspond to the Gurjanova's figure of the animal, 1-1.5 mm long, from the Sea of Japan. However, the author's specimens apparently belong to *Parapleustes* by its obsolete rostrum and the shapes of gnathopods 1-2. J.L. Barnard (1969b) already recognized that *Pl. behningi* was incorrectly assigned, and said that it should be transferred to *Parapleustes*. On the other hand, J.L. Barnard (1969a) described *Parapleustes nautilus* which is, according to him, easily discernible from the other

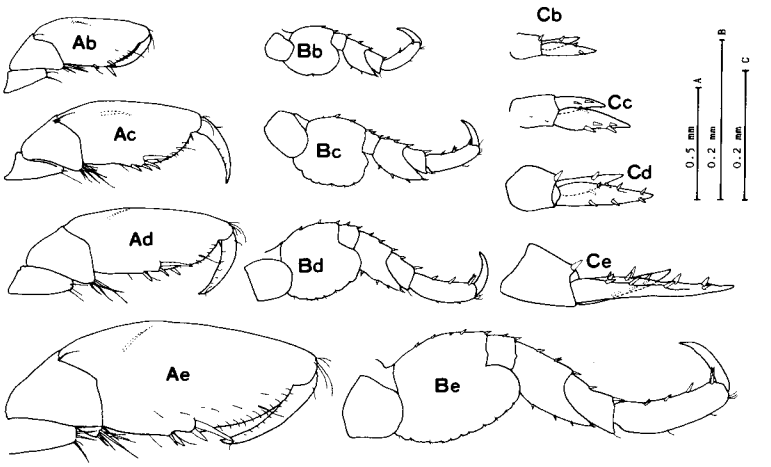

Fig. 9. *Parapleustes behningi*. Developmental changes in three appendages. A, gnathopod 1; B, pereopod 7; C, uropod 3. b: juv, 1.9 mm; c: juv, 2.9 mm; d: juv, 3.3 mm; e: ♂, 4.0 mm.

members of the genus by its rectangular shapes of the 6th articles of gnathopods 1-2. However, his figure well corresponds to the above mentioned Gurjanova's figure and the small specimens in the author's hands. Further, the shape of the article 6 of *P. behningi* gradually changes from subrectangular to oval as the animal grows (cf. above). Thus, it may be almost certain that *P. nautilus* of J. L. Barnard was the juvenile of *P. behningi* and should be treated as the junior synonym of the latter.

The present species resembles *Parapleustes aestuarius* Watling and Maurer, 1973, *P. assimilis* (Sars, 1882), *P. derzhavini* (Gurjanova, 1938), *P. major* (Bulycheva, 1952), *P. pugettensis* (Dana, 1853), *P. commensalis* Shoemaker, 1952, *P. bicuspoides* Nagata, 1965, *P. gracilis* Buchholz, 1874, and *P. triangulocularus* (Bulycheva, 1952) in the shape of gnathopods 1-2. But the former five species are apparently discernible from *P. behningi* by their longer antennae 1-2. *P. commensalis* is easily distinguishable by its special modification to a commensal life: its pereopods are specialized to grasp the pleopodal setae of mantis crabs. *P. bicuspoides*, whose antennae 1-2 are broken in the types so that we have yet insufficient information about that (Nagata, 1965b), is readily distinguishable from the present species by having two dorsal teeth on pleonites 1-2 and more slender pereopods 5-7. The figure of *P. gracilis* provided by Sars (1893) is very much similar to *P. behningi*, but both species are actually dissimilar to each other, even at a first glance. *P. triangulocularus* was said to be synonymous with *P. nautilus* (J.L. Barnard, 1969a). However, since little information is available about the detailed structures of *P. triangulocularus*, it is tentatively treated here as specifically distinct from *P. behningi*.

Distribution. Hitherto recorded from the Pacific coasts of U.S.S.R., and from California. This is the first record of this species from Japan.

Ecology. This species is probably a shallow water species, commonly found in intertidal and shallow subtidal zones, attaching onto sea algae or boulders. Ovigerous females occur from February to May.

Parapleustes derzhavini (Gurjanova, 1938)

(Figs. 10–16)

Neopleustes derzhavini Gurjanova, 1938, p. 317, fig. 31; 1951, p. 645, fig. 442.
Neopleustes derzavini[sic]: Kudrjaschov, 1980, p. 87.
Parapleustes derzhavini: Barnard and Given, 1960, p. 40.
Parapleustes derzhavini makiki J.L. Barnard, 1970, p. 227, figs. 151–152. NEW SYNONYMY

Material examined. 1♀, 5.3 mm: intertidal, Oshoro, Hokkaido, 22-IV-1982, SI coll. —— 1♀, 3.5 mm; 2 ov ♀♀, 5.2 mm each; 1 juv, 3.0 mm ("b"): 0.5 m depth, among *Sargassum* belt, Oshoro, Hokkaido, 13-V-1982, SI coll. —— 2 juv, 2.7, 3.4 mm: 0.5 m depth, among *Laminaria* belt, Oshoro, Hokkaido, 14-VI-1982, SI coll. —— 2♂♂ ?, 3.9 ("c"), 4.2 mm: 0.5 m depth, among *Sargassum* belt, Oshoro, Hokkaido, 14-VI-1982, SI coll. —— 1 juv, 3.3 mm: 0.5 m depth, among *Laminaria* belt, Oshoro, Hokkaido, 1-VII-1982, SI coll. —— 1 ov ♀, 3.3 mm: 0.5 m depth, among *Sargassum* belt, Oshoro, Hokkaido, 1-VII-1983, SI coll. —— 1♀, 5.6 mm; 2♂♂ ?, 4.0, 4.8 mm: 0.5 m depth, among algae, Oshoro, Hokkaido, 15-II-1983, SI coll. —— 3 ov ♀♀, 4.4, 4.8 ("d"), 5.0 ("a", fully described) mm: attaching to a set net, Samani, Hokkaido, 5-VIII-1982, SI coll. —— 1♂ ?, 4.4 mm: 0.5 m depth, among *Sargassum* belt, Kikonai, Hokkaido, 28-IV-1983, SI coll. —— 1 ov ♀, 7.4 mm: intertidal, among *Leathesia* and other algae scraped from the surface of boulders, Ohzuchi, Iwate Pref., 14-VI-1983, H. Hoshikawa coll.

Female "a". Body (Fig. 10-A) 5.0 mm long, moderately chitinized, lustrous; color whitish after a few months preservation in 5%-formalin. Head (Fig. 10-B) about as long as first two pereonites combined. Rostrum of medium length, reaching 30% length of peduncular article 1 of antenna 1, with blunt apex. Lateral cephalic lobe moderately produced forward, bluntly rounded at apex. Cheek large, with acute apex. Superior and inferior antennal sines relatively deep. Eye small, circular, with a black core surrounded by thick band of transparent facets. Back (Fig. 10-A) smooth. Coxae 1–4 of medium depth, successively deeper. Epimeron 1 (Fig. 10-C) tapering, with a minute tooth at apex. Epimeron 2 subquadrate, slightly sinuous at posterior margin, with a minute tooth at posteroventral corner, bearing some spines along ventral margin. Epimeron 3 subquadrate, sinuous at posterior margin, bearing a few spines along ventral margin, with a minute tooth at posteroventral corner. Urosome a little shorter than pleonites 2–3 combined; urosomite 1 the longest, as long as pleonite 3; urosomite 2 very short; urosomite 3 short, about 30% as long as urosomite 1.

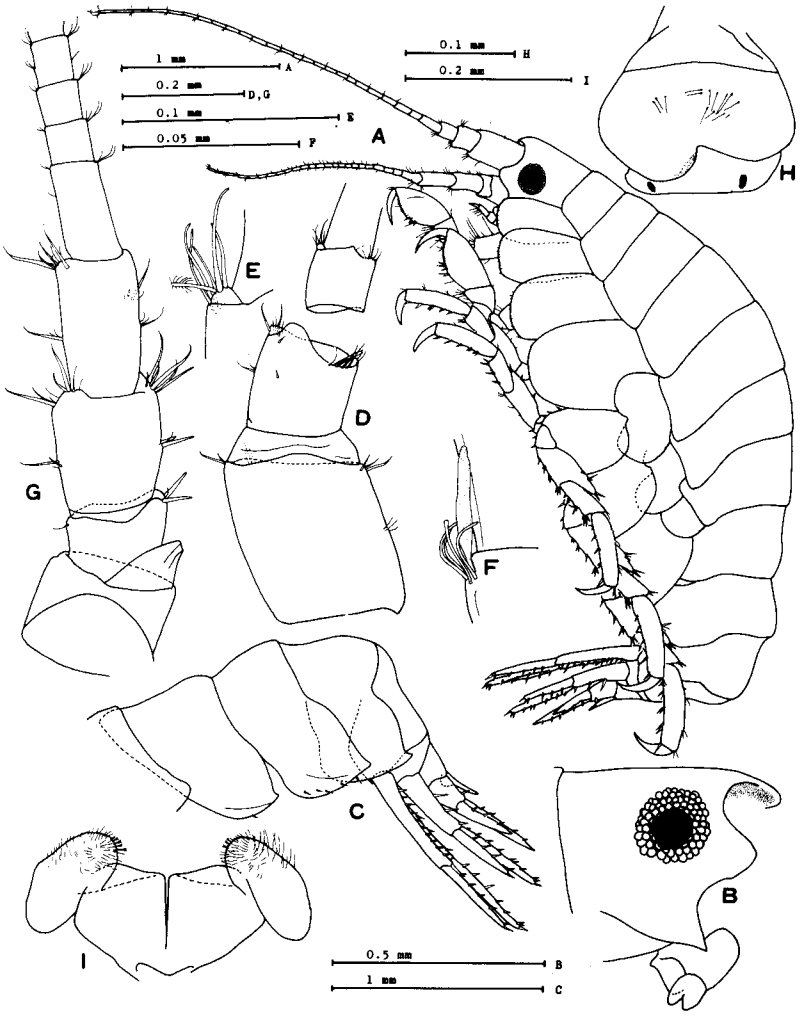

Fig. 10. *Parapleustes derzhavini*. Female "a". A, habitus; B, head; C, pleon; D, antenna 1 (R, out); E, accessory flagellum; F, armament of flagellar article of antenna 1; G, antenna 2 (R, out); H, labrum; I, labium (vr).

Antenna 1 (Fig. 10-D) about 60% as long as body length. Peduncular article 1 robust, about as long as succeeding two peduncular articles combined. Peduncular article 2 about 1.5 times longer than article 3, with outer distal margin bluntly produced. Primary flagellum thin, about 4 times longer than peduncle, 25-articulate; each flagellar article longer than wide; first five articles furnished apically with two sets of armaments, one of which consists of setules and the other

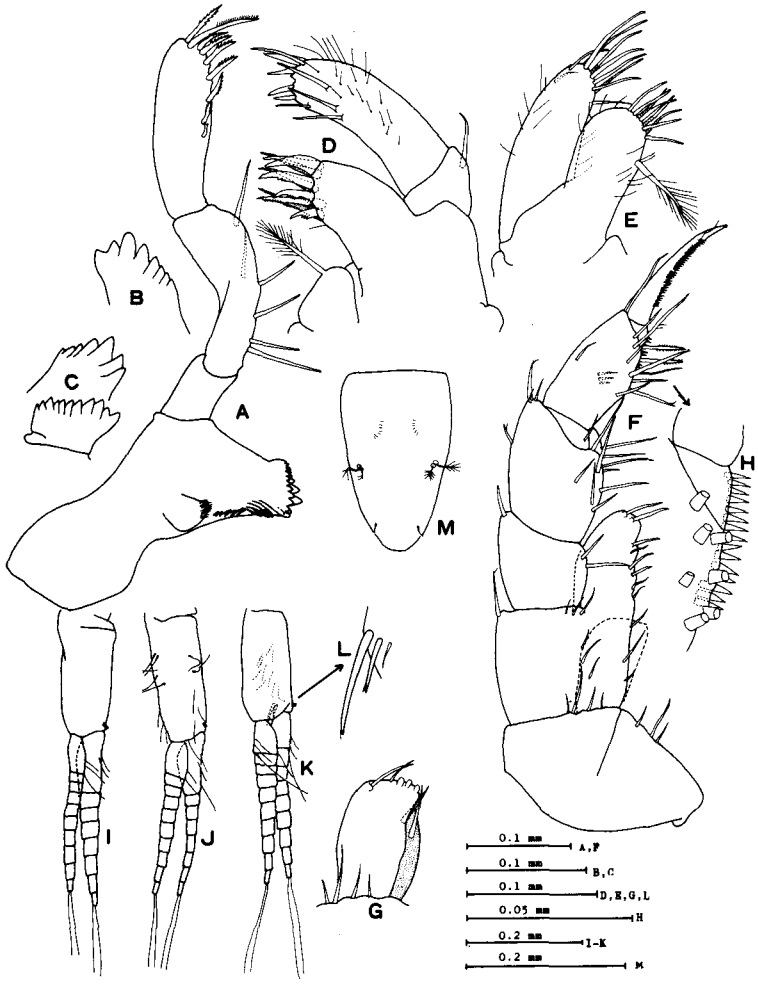

Fig. 11. *Parapleustes derzhavini*. Female "a". A, mandible (L, inn); B, incisor (R, inn); C, incisor and lacinia mobilis (L, inn); D, maxilla 1 (L, vr); E, maxilla 2 (R, vr); F, maxilliped (R, vr); G, inner plate of maxilliped (R, vr); H, triangular scales on palpal article 3 of maxilliped (so); I-K, pleopods 1-3 (R, ant; so); L, spines on peduncle of pleopod 3 (R, ant); M, telson (ds).

(Fig. 10-F) of setules and aesthetascs; each succeeding article alternately bearing two sets of setules or two sets equal to the first five articles. Accessory flagellum (Fig. 10-E) uniarticulate, small, not fused with peduncle. *Antenna 2* (Fig. 10-G) about 70% as long as antenna 1. Peduncle about as long as, but slightly longer than that of antenna 1 *in situ*. Gland cone of medium length, reaching half

length of peduncular article 3. Peduncular article 3 with two spines at apicodorsal edge and a spine on inner face. Peduncular article 4 robust, wider and a little shorter than article 5, bearing a spine at apicoventral edge and three spines on inner face, furnished with thick setae on both ventral and dorsal margins medially and apically. Peduncular article 5 furnished with thick setae. Flagellum twice longer than peduncle, 24-articulate; each article longer than wide, bearing two sets of apical setules.

Mouth parts. Labrum (Fig. 10-H) medially incised. *Left mandible* (Fig.

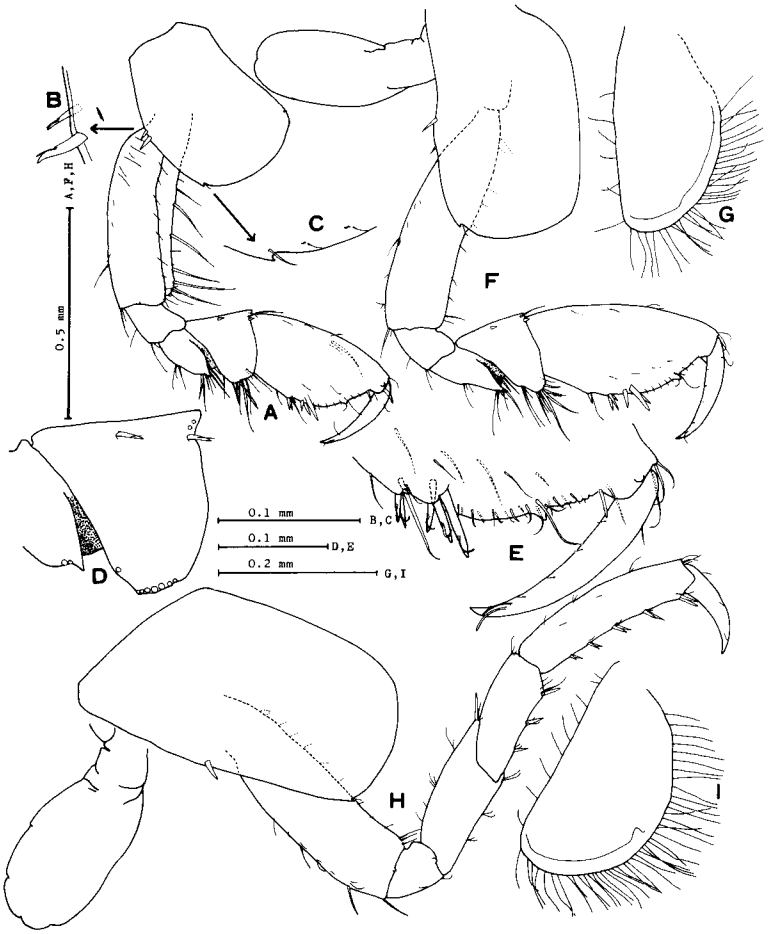

Fig. 12. *Parapleustes derzhavini*. Female "a". A, gnathopod 1 (R, out); B, lateral spines on coxa 1; C, posteroventral corner of coxa 1; D, articles 4–5 of gnathopod 1 (R, out; so); E, palm of gnathopod 1 (R, out); F, gnathopod 2 (R, out); G, oostegite of gnathopod 2 (R); H, pereopod 3 (R, out); I, oostegite of pereopod 3 (R).

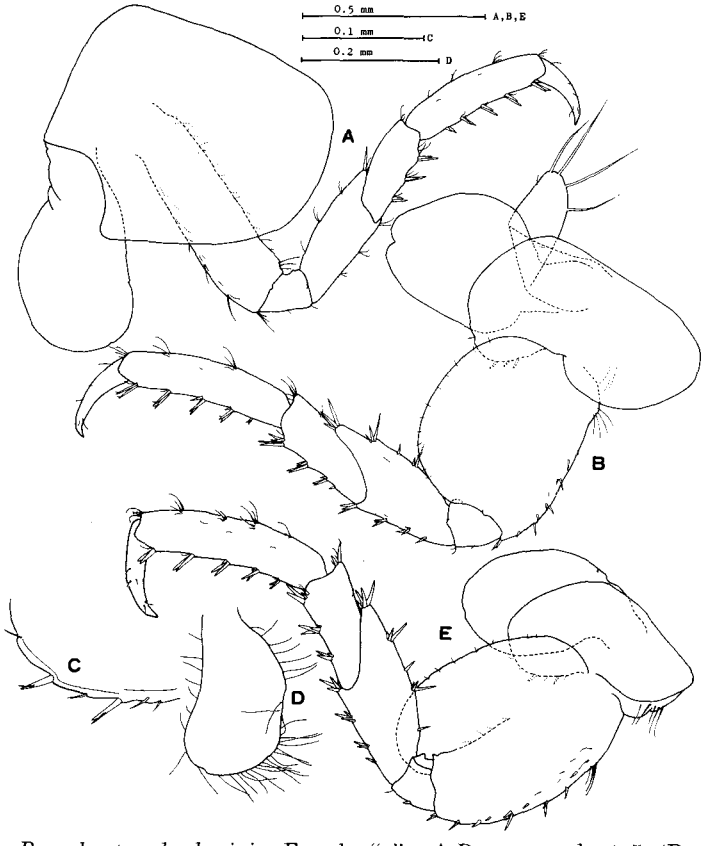

Fig. 13. *Parapleustes derzhavini*. Female "a". A-B, pereopods 4-5 (R, out); C, spines on coxa 5; D, oostegite of pereopod 5 (R); E, pereopod 6 (R, out).

11-A) Incisor (Fig. 11-C) with 7 denticles; lacinia mobilis with 11 denticles; accessory blades counting 8. Palp about 1.5 times longer than body of mandible; article 2 lined with a row of simple setae along posterior margin; article 3 armed with 7 pectinate spines along posterior margin, bearing a long stout seta and a pair of short setae at apex. *Right mandible* similar to left one; incisor (Fig. 11-B) with 8 denticles. *Maxilla 1* (Fig. 11-D) Inner plate small, oval, subapically with a plumose seta. Palpal proximal article with a simple seta; distal article digitate, sparsely bristly, armed with 4 strong spines at apex, furnished with a setal row obliquely. *Maxilla 2* (Fig. 11-E) Inner plate oval, furnished with two setal rows marginally, with a long thick plumose seta. Outer plate as thick as inner one, nearly extending beyond inner plate, furnished apicomarginally with two setal rows; both rows consisting of setae equal in thickness. *Maxilliped* (Fig.

11-F) Distal margin of coxa oblique, with a group of simple setae medially, subacute around distal portion; both coxae ordinarily fused with each other to 40% of length. Inner plate (Fig. 11-G) nearly reaching base of palp, armed with two spines on inner margin medially; apex with a seta, a long spine and three stumpy spines. Basis bearing a spine-seta at distal edge of outer margin. Outer plate reaching apex of palpal article 1; two slender spines arising from apex. Palp broad; article 1 with a spine at distal edge of outer margin; article 2 with a spine medially on outer margin and with three spines at distal edge of outer margin; article 3 armed with two pectinate spines subapically; a row of triangular thin scales (Fig. 11-H) located marginally around base of pectinate spines of article 3.

Gnathopod 1 (Fig. 12-A) Coxa 1 small, about 70% as deep as coxa 2, with round ventral margin, with a small but distinct notch (Fig. 12-C) at posteroventral corner, armed with a few strong spines (Fig. 12-B) medially on posterior margin. Article 2 lined with a row of thick setae along anterior margin. Article 4 with a tooth. Article 5 triangular, with a short and broad posterior lobe, bearing a spine medially and distally on anterior margin respectively. Article 6 oval, as long as articles 3-5 combined, subchelate, with a long seta on inner face; palm (Fig. 12-E) about as long as posterior margin, delimited by two groups of spines, smoothly connected with posterior margin; palmar margin with a small tooth medially, smooth proximal to the tooth and slightly scalloped distal to that. Article 7 as long as palm. *Gnathopod 2* (Fig. 12-F) Coxa 2 subquadrate, deeper than coxa

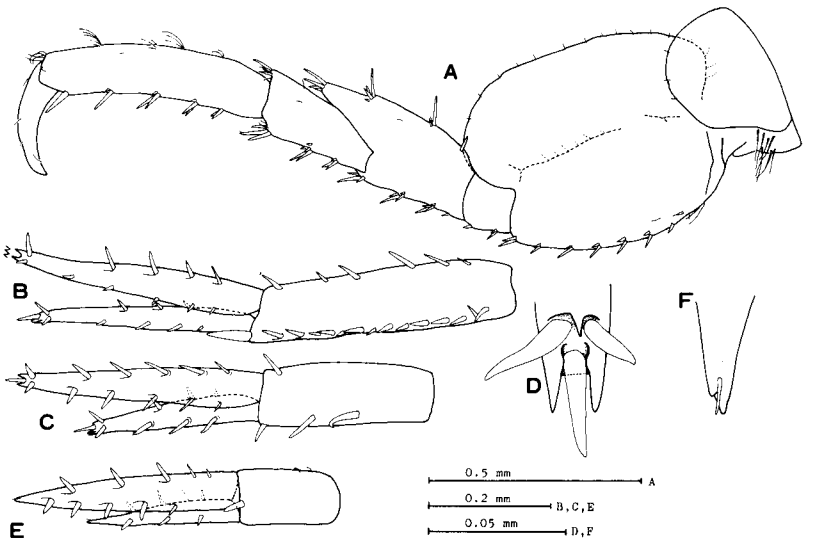

Fig. 14. *Parapleustes derzhavini*. Female "a". A, pereopod 7 (R, out); B-C, uropods 1-2 (R, ds); D, inner ramus of uropod 2; E, uropod 3 (R, ds); F, inner ramus of uropod 3.

1, armed with a strong spine medially on posterior margin. Article 2 sparsely setulose along anterior margin. Article 6 without long seta on inner face.

Pereopod 3 (Fig. 12-H, I) Coxa 3 similar to coxa 2. Segmentation and principal armature as shown. Article 4 extending anterodistally to reach 40% length of article 5, bearing a spine apically on the extension. Articles 5-6 lined with a row of spines posteriorly. Other armaments consisting of setae and setules. *Pereopod 4* (Fig. 13-A, D) Coxa 4 subquadrate, without spine, excavate; posterior angle of the excavation subacute, with round apex. *Pereopod 5* (Fig. 13-B) Coxa 5 posterolobate; posterior lobe slightly deeper than anterior one, with some spines and setules (Fig. 13-C) along ventral margin. Article 2 posteriorly lobate, with spinose anterior margin and smooth posterior margin; posterior lobe extending distally not to reach distal margin of article 3. Article 4 of medium width, lined with a row of spines along both anterior and posterior margins; posterior lobe reaching some 60% length of article 5. Articles 5-6 spinose along anterior margin. *Pereopods 6-7* (Figs. 13-E, 14-A) Coxa 6 strongly posterolobate, with some spines and setules on posterior lobe ventrally. Coxa 7 circular.

Pleopod 1 (Fig. 11-I) Peduncle sparsely furnished with several plumose setae. Both rami about 1.4 times longer than peduncle; outer ramus a little shorter than inner one; 8 articles on inner ramus and 10 on outer one; proximal article long, furnished with plumose setae marginally. *Pleopod 2* (Fig. 11-J) as long as pleopod 1. *Pleoped 3* (Fig. 11-K) 95% as long as pleopod 1.

Uropod 1 (Fig. 14-B) Peduncle armed with a dense row of spines along outer ridge, and with a sparse row of spines along inner ridge. Inner ramus as long as peduncle, armed with a row of long spines and with a row of short ones along inner and outer ridge respectively. Outer ramus a little shorter than inner one.

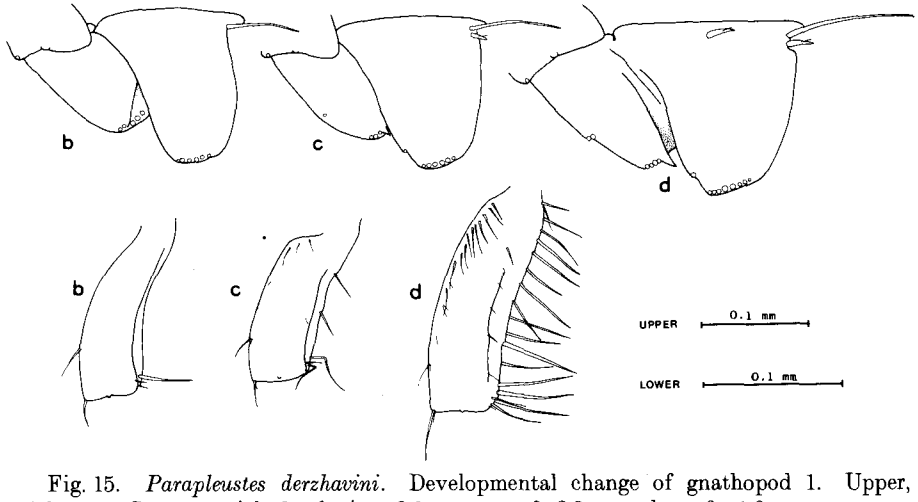

Fig. 15. *Parapleustes derzhavini*. Developmental change of gnathopod 1. Upper, articles 4-5; Lower, article 2. b: juv, 3.0 mm; c: ♂?, 3.9 mm; d: ov♀, 4.8 mm.

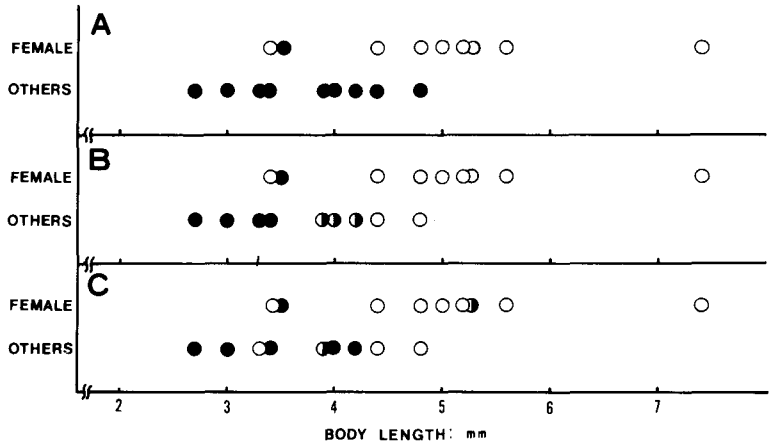

Fig. 16. *Parapleustes derzhavini*. Developmental change in three characters of gnathopod 1. A, setation of article 2: solid = weak, open = heavy (see Fig. 15, right). B, spination of article 5: solid = without spine, half-solid = with a spine, open = with two spines (see Fig. 15, left). C, tooth of article 4: solid = without tooth, half-solid = with a weak tooth, open = with a distinct tooth (see Fig. 15, left).

Uropod 2 (Fig. 14-C) 85% as long as uropod 1. Peduncle armed with a row of spines along outer ridge. Inner ramus (Fig. 14-D) 1.3 times longer than peduncle. Outer ramus as long as peduncle. *Uropod 3* (Fig. 14-E) about 60% as long as uropod 1. Inner ramus (Fig. 14-F) twice longer than peduncle, spinose along both ridges. Outer ramus about 70% as long as inner one.

Telson (Fig. 11-M) linguiform, 1.2 times longer than peduncle of uropod 3 *in situ* (Fig. 10-C), 1.6 times longer than wide, subapically bearing a pair of setules; a pair of two penicillate hairs issued medially near lateral margins.

Male?. No remarkable differences from the female can be seen.

Development. The present species shows considerable changes through its development in some structures of gnathopods 1-2. To examine the following three characters of the gnathopod 1, eighteen specimens of various body lengths were selected and compared: setation along the anterior margin of article 2; the presence of a tooth on article 4; the presence of stumpy spines on article 5. The results are summarized in Fig. 16. All mature females, namely those with oostegites, have heavily setose anterior margin of article 2 (except one specimen). Further, most of them have a tooth on article 4. On the other hand, all specimens without oostegites (including juveniles and possibly males) are smaller and possess weakly setulose article 2, and a tooth on article 4 tends to appear in larger specimens. Further, females with oostegites always have two stumpy spines on the article 5 of gnathopod 1, but among specimens without oostegites only larger

specimens tend to have these spines. Although not figured, a quite similar trend to gnathopod 1 was also found in gnathopod 2, except for the armament of the anterior margin of article 2, which was weakly setulose throughout its development.

Remarks. J.L. Barnard (1970) described a subspecies *Parapleustes derzhavini makiki* from Hawaii. According to him, this subspecies differs from the nominate subspecies in the following four points: 1) slightly longer article 5 of gnathopod 2, 2) wider posterior lobe of the article 5 of gnathopod 2, 3) lack of a pair of long setae at the anterodistal edge of the article 2 of gnathopod 2, and 4) possession of a tooth on the article 4 of gnathopod 2.

It was revealed from the author's research that the presence of the tooth on the gnathopods 1-2 is not a species-specific character, but is an ontogenetic variable of a single species. The author's specimens from northern Japan completely correspond to J.L. Barnard's figures of *P. d. makiki,* and differ from Gurjanova's figure in the above four characters. The differences, however, seem to be too minor to establish another species or subspecies. So it is appropriate to reduce *P. d. makiki* to a junior synonym of *P. derzhavini.*

The present species has close affinity to *P. aestuarius.* A small eye with a black core surrounded by a thick transparent band, long antennae 1-2, and oval 6 th articles of gnathopods 1-2 are common to *P. aestuarius* and the present species. Moreover, the structure of maxilliped and coxae with strong spines on posterior margin show close affinity of both species. The present species is, however, discernible from *P. aestuarius* in the shape of coxa 4, the number of the posteroventral notches of coxae 1-3, and the armaments on the posterior margins of articles 3-5 of pereopods 3-7.

Distribution. Hitherto recorded from the Pacific coasts of U.S.S.R., and from Hawaii. This is the first record from Japan.

Ecology. It is commonly found among sea algae of intertidal zone. Ovigerous females occur from May to August.

***Parapleustes dilatatus* n. sp.**

(Figs. 17-20)

Type series. Holotype: ♂, 4.7 mm: 0.5 m depth, among *Sargassum* belt, Oshoro, Hokkaido, 14-VI-1982, SI coll. —— Allotype: ov ♀, 6.0 mm: data same as the holotype. —— Paratypes: 1 ov ♀, 5.2 mm: data same as the holotype. —— 1 juv, 2.3 mm: 4 m depth, clinging to boulders, Oshoro, Hokkaido, 29-X-1982, SI coll. —— 1 ov ♀, 5.4 mm; 2 juv, 3.1, 3.4 mm: among *Mytilus* zone where surging waves are washing, Oshoro, Hokkaido, 30-X-1982, SI coll.

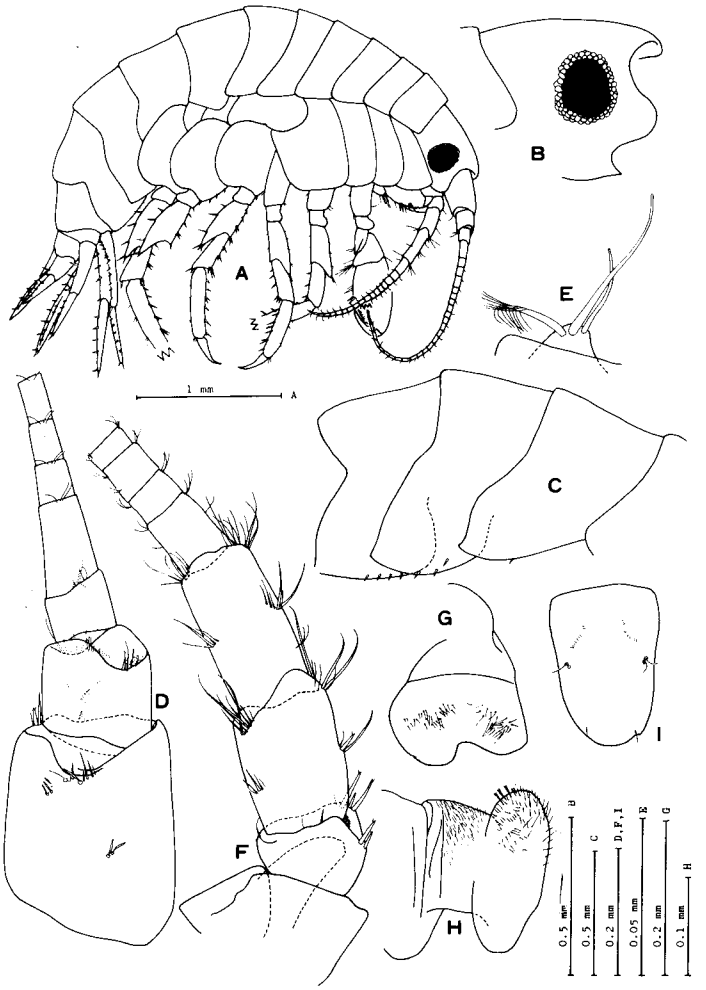

Fig. 17. *Parapleustes dilatatus* n. sp. Male (holotype). A, habitus; B, head; C, epimera 1-3; D, antenna 1 (L, out); E, accessory flagellum; F, antenna 2 (L, out), G, labrum; H, labium (vr); I, telson (ds).

Male (holotype). Body (Fig. 17-A) 4.7 mm long, moderately chitinized, lustrous; color from pale yellowish to pinkish green, and antennae 1-2 purple when alive. Head (Fig. 17-B) about as long as pereonites 3-4 combined. Rostrum of medium length, reaching 30% length of peduncular article 1 of antenna 1, with blunt apex. Lateral cephalic lobe moderately produced forward, circular. Cheek small, with acute apex. Superior antennal sinus relatively deep. Inferior antennal sinus as superior one, but somewhat smaller. Eye

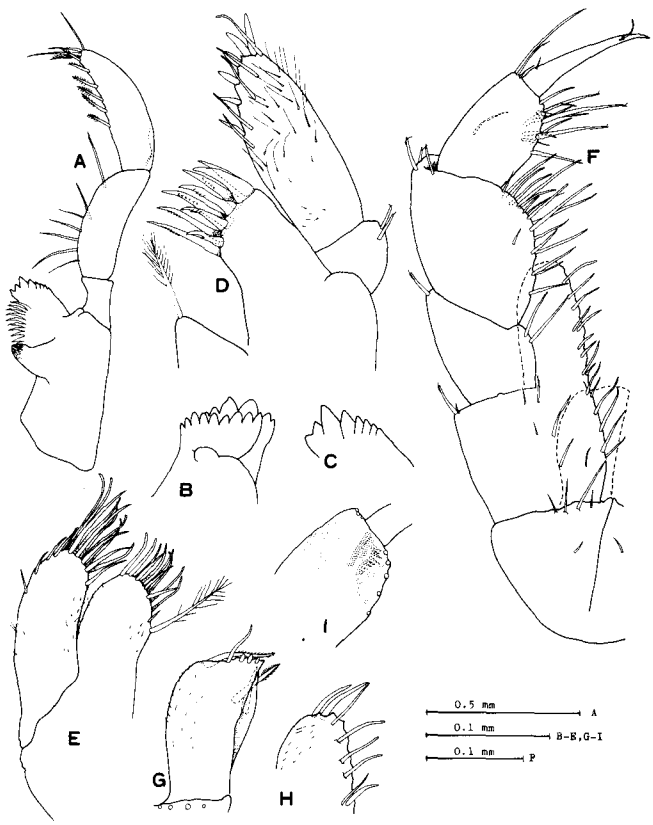

Fig. 18. *Parapleustes dilatatus* n. sp. Male (holotype). A, mandible (R, inn); B, incisor and lacinia mobilis (L, inn); C, incisor (R, inn); D, maxilla 1 (L, vr); E, maxilla 2 (R, vr); F, maxilliped (R, vr); G, inner plate of maxilliped (R, vr); H, outer plate of maxilliped (R, vr); I, palpal article 3 of maxilliped (R, vr; so).

large, oval, with a black core surrounded by transparent facets. Back (Fig. 17-A) smooth. Coxae 1-4 of medium depth, successively deeper. Epimeron 1 (Fig. 17-C) tapering. Epimeron 2 subquadrate, minutely sinuous at posterior margin, bearing a few spines along ventral margin, with minute extension at posteroventral corner. Epimeron 3 similar to epimeron 2, but at posterior margin more sinuous. Urosome about as long as pleonite 3; urosomite 1 the longest; urosomite 2 very short; urosomite 3 about half as long as urosomite 1.

Antenna 1 (Fig. 17-D) about half as long as body length. Peduncle reaching distal margin of peduncular article 4 of antenna 2 *in situ*. Peduncular article 1 robust, about twice longer than peduncular article 2. Peduncular article 2 about twice longer than peduncular article 3. Primary flagellum about three times

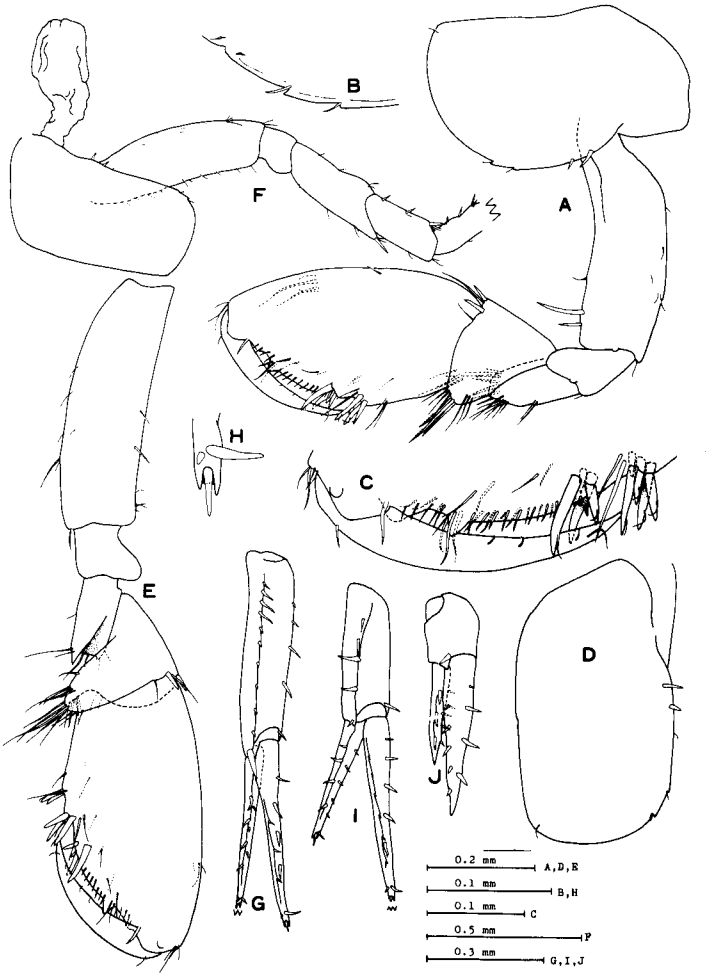

Fig. 19. *Parapleustes dilatatus* n. sp. Male (holotype). A, gnathopod 1 (L, out); B, posteroventral corner of coxa 1; C, palm of gnathopod 1 (R, out); D, coxa 2 (L, out); E, gnathopod 2 (R, out); F, pereopod 3 (L, out); G, uropod 1 (L, ds); H, inner ramus of uropod 1; I-J, uropods 2-3 (L, ds).

longer than peduncle, 27-articulate; each flagellar article longer than wide; first four articles furnished apically with two sets of armaments, one of which consists of setules and the other of setules and aesthetascs; each succeeding article alternately furnished with two sets of setules or two sets equal to the first four articles. Accessory flagellum (Fig. 17-E) uniarticulate, small, not fused with peduncle. *Antenna 2* (Fig. 17-F) about half as long as antenna 1. Gland cone long, reaching

distal margin of peduncular article 3. Peduncular article 3 with two groups of spines at apicodorsal edge. Peduncular article 4 twice longer than peduncular article 3, bearing a spine medially on dorsal margin. Peduncular article 5 a little longer than article 4. Flagellum about 1.3 times longer than peduncle, 18-articulate; first flagellar article longer than wide; second article wider than long and others gradually becoming longer and narrower distally; each article with two sets of apical setules.

Mouth parts. Labrum (Fig. 17-G) medially incised. *Right mandible* (Fig. 18-A) Incisor (Fig. 18-C) with 8 denticles; accessory blades counting 10. Palp twice longer than body of mandible; article 2 lined with a row of simple setae along posterior margin; article 3 armed with 7 pectinate spines along posterior margin, bearing a long thick seta and two short thin setae at apex, and bearing a seta at anterior part of base. *Left mandible* similar to right one; incisor (Fig. 18-B) with 7 denticles; lacinia mobilis with 9 denticles. *Maxilla 1* (Fig. 18-D) Inner plate small, triangular, with a plumose seta. Palp extending far beyond outer plate; proximal article bearing a pair of spines; distal article expanding medially, bristly, armed with 6 strong spines obliquely, furnished with a setal row parallel to the row of spines. *Maxilla 2* (Fig. 18-E) Inner plate oval, furnished with two setal rows apicomarginally, with a long plumose seta. Outer plate as thick as inner one, nearly extending beyond inner plate, furnished apicomarginally with two setal rows; ventral row consisting of slightly thicker setae than those of dorsal one. *Maxilliped* (Fig. 18-F) Distal margin of coxa oblique, with a group of simple setae medially, subacute around distal portion; both coxae fused with each other to 20% of length. Inner plate (Fig. 18-G) nearly reaching base of palp, armed with two spines on inner margin medially; apex with a seta, a long spine and three stumpy spines. Basis bearing a spine at distal edge of outer margin. Outer plate (Fig. 18-H) reaching apex of palpal article 1; two slender spines arising from apex. Palp broad; article 1 with a spine at distal edge of outer margin; article 2 with three spines at distal edge of outer margin; article 3 armed with two pectinate spines subapically; a row of triangular scales (Fig. 18-I) located on dorsal face around base of pectinate spines of article 3.

Gnathopod 1 (Fig. 19-A) Coxa 1 with anteroventral corner subrectangular, with two small but distinct notches (Fig. 19-B) on posteroventral corner, bearing a pair of strong spines on posterior margin medially. Article 2 ornamented with a pair of thick setae distally on anterior margin. Article 4 toothless. Article 5 triangular, with a short and broad posterior lobe, bearing two spines distally on anterior margin. Article 6 oval, longer than articles 3–5 combined, subchelate, with two long setae on inner face; palm (Fig. 19-C) as long as posterior margin, delimited by two groups of spines, smoothly connected with posterior margin; palmar margin smooth but slightly produced at distalmost portion into a broadly triangular cusp, with a small tooth near the cusp. Article 7 a little longer than palm. *Gnathopod 2* (Fig. 19-E) Coxa 2 (Fig. 19-D) subquadrate, similar in armature to coxa 1. Article 2 with anterior margin minutely setulose. Article 4

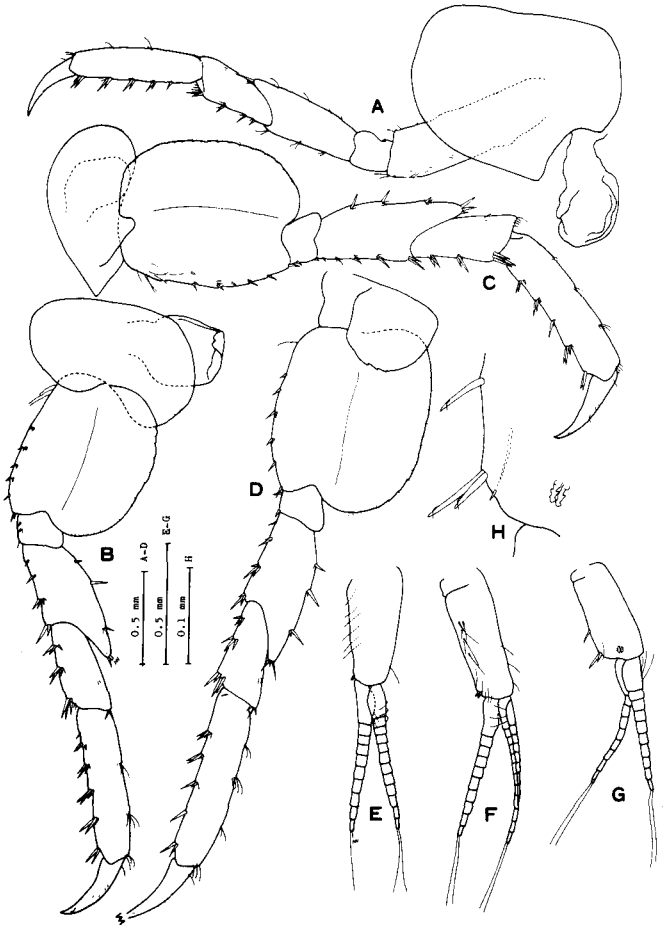

Fig. 20. *Parapleustes dilatatus* n. sp. Male (holotype). A-D, pereopods 4-7 (L, out); E-G, pleopods 1-3 (L, ant; so); H, spines on peduncle of pleopod 3 (L, ant).

with a distinct tooth. Article 5 triangular, shorter than that of gnathopod 1, with narrower and more produced posterior lobe than that of gnathopod 1. Article 6 bearing three groups of delimiting spines, without long seta on inner face.

Pereopod 3 (Fig. 19-F) Coxa 3 similar to coxa 2. *Pereopod 4* (Fig. 20-A) Coxa 4 subquadrate, without spine, excavate; posterior angle of the excavation almost right-angled, with blunt apex. Segmentation and principal armature as shown. Article 4 narrow, extending anterodistally to reach 45% length of article 5, bearing a spine apically on the extention. Articles 5-6 lined with a row of spines posteriorly. Other armaments consisting of setules and setae. *Pereopod 5* (Fig. 20-B) Coxa 5 posterolobate; posterior lobe deeper than anterior one,

without spine. Article 2 posteriorly lobate, smaller than those of pereopods 6-7, with spinose anterior margin and minutely scalloped posterior margin; posterior lobe extending distally not to reach distal margin of article 3. Article 4 of medium width, lined with a row of spines along both anterior and posterior margins; posterior lobe reaching about half length of article 5. Article 5 with spinose anterior margin, bearing a group of spines at posterior distal end. Article 6 spinose along anterior margin. *Pereopods 6-7* (Fig. 20-C, D) Coxa 6 strongly posterolobate, with anterior lobe subacutely produced ventrally. Coxa 7 circular.

Pleopod 1 (Fig. 20-E) Peduncle sparsely furnished with some plumose setae. Both rami about 1.3 times longer than peduncle; 10 articles on inner ramus and 12 on outer one; proximal article long. *Pleopod 2* (Fig. 20-F) as long as pleopod 1. *Pleopod 3* (Fig. 20-G) 85% as long as pleopod 1.

Uropod 1 (Fig. 19-G) Peduncle armed with a row of stumpy spines along outer ridge, around proximal portion of which long spines are arising, and armed with a sparse row of long spines along inner ridge. Inner ramus (Fig. 19-H) as long as peduncle, armed with two rows of spines. Outer ramus 85% as long as inner one. *Uropod 2* (Fig. 19-I) 85% as long as uropod 1. Peduncle armed with a row of spines along outer ridge. Inner ramus 1.4 times longer than peduncle. Outer ramus 65% as long as inner one. *Uropod 3* (Fig. 19-J) 60% as long as uropod 1. Inner ramus 2.4 times longer than peduncle, spinose along both ridges. Outer ramus 70% as long as inner one.

Telson (Fig. 17-I) linguiform, about 1.3 times longer than peduncle of uropod 3 *in situ* (Fig. 17-A), about 1.5 times longer than wide, subapically bearing a pair of setules; a pair of two penicillate hairs issued medially near lateral margins.

Female (allotype). Body 6.0 mm long. No remarkable differences from the male can be seen.

Remarks. The present new species has closest affinity to *Parapleustes derzhavini* by having large triangular scales on the palpal article 3 of maxilliped. This species also resembles *P. aestuarius*. However, the new species is easily discernible from these species by having larger and oval eyes in contrast with small and circular ones of the two species, and by having the far longer peduncle of antenna 2 than that of antenna 1. Further, it differs from *P. derzhavini* by having the shorter and wider flagellar articles of antennae 1-2, dilated palp of maxilla 1, modified structure of palm, coxae 1-3 with two notches, and coxae 5-6 without spines on anterior lobe, and from *P. aestuarius* in the armament of the 4 th articles of pereopods 3-7. The new species closely resembles *P. pugettensis* in its large and oval eyes and its shapes of the peduncles of antennae 1-2 whose apices reach to the same level *in situ* view. In spite of relatively poor information gained from figures (J.L. Barnard, 1952, 1956, 1959; Barnard and Given, 1960; Shoemaker, 1964), however, the conical and vestigial molar of *P. pugettensis*, which is weakly triturative at its small apex, makes itself conspicuously

distinct from the new species. The two species, moreover, differ from each other in the structure of the palp of maxilla 1.

Parapleustes gracilis Buchholz, 1874

(Figs. 21-24)

Parapleustes gracilis Buchholz, 1874, p. 269, tab. 7, fig. 1; Stebbing, 1906, p. 320; Sexton, 1910, p. 852, pl. 80, figs. 1-7; Stephensen, 1938, p. 257; 1944b, p. 86; Gurjanova,

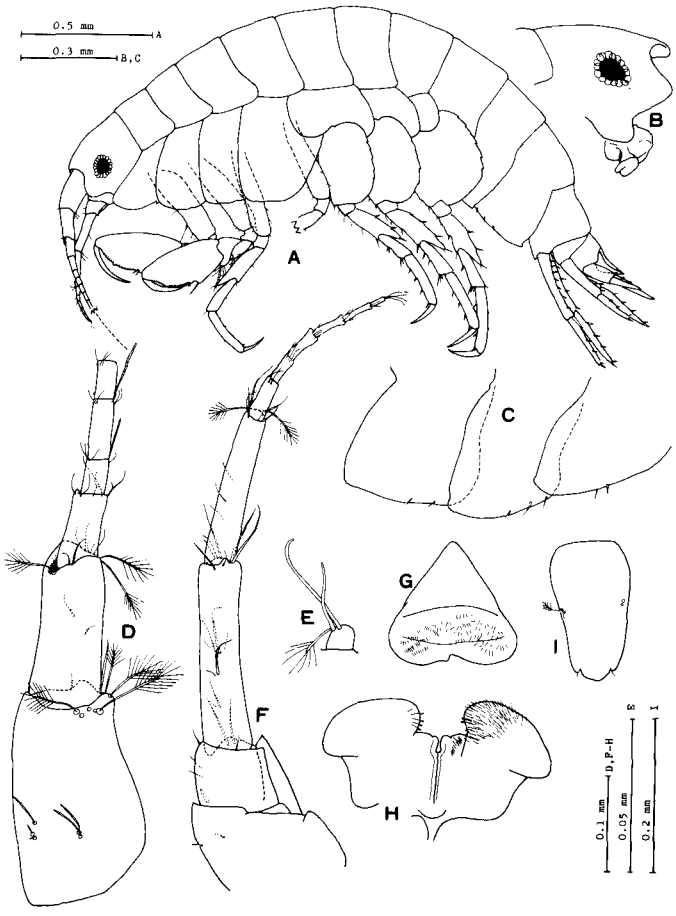

Fig. 21. *Parapleustes gracilis*. Female "a". A, habitus; B, head; C, epimera 1-3; D, antenna 1 (R, out); E, accessory flagellum; F, antenna 2 (R, out); G, labrum; H, labium (vr); I, telson (ds).

1951, p. 648, fig. 444.
Paramphithoë brevicornis Sars, 1882, p. 98, tab. 4, figs. 11-11a; 1893, p. 353, pl. 124, fig. 2.
Neopleustes brevicornis: Stebbing, 1906, p. 313.

Material examined. 2 ov ♀♀, 3.3, 3.4 ("a", fully described) mm: intertidal, among *Leathesia* and other algae scraped from the surface of boulders, Ohzuchi, Iwate Pref., 14-VI-1983, H. Hoshikawa coll.

Female "a". Body (Fig. 21-A) 3.4 mm long, weakly chitinized, translucent,

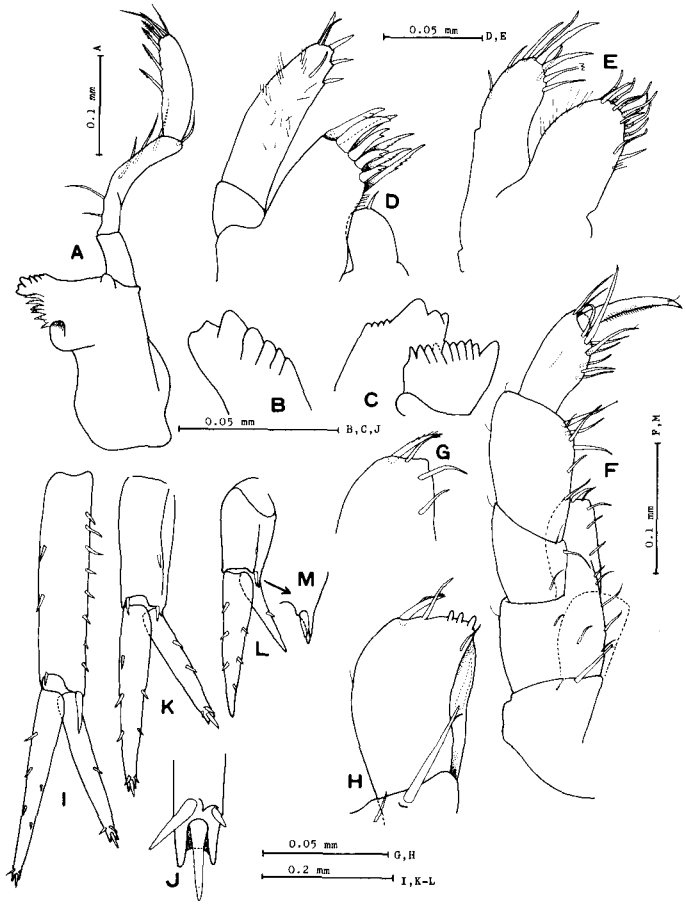

Fig. 22. *Parapleustes gracilis*. Female "a". A, mandible (R, inn); B, incisor (R, inn); C, incisor and lacinia mobilis (L, inn); D, maxilla 1 (R, vr); E, maxilla 2 (R, vr); F, maxilliped (R, vr); G, outer plate of maxilliped (R, vr); H, inner plate of maxilliped (R, vr); I, uropod 1 (R, ds); J, inner ramus of uropod 1; K-L, uropods 2-3 (R, ds); M, peduncular process of uropod 3 (R, ds).

lustrous; color whitish after a few months preservation in 5%-formalin. Head (Fig. 21-B) about as long as first two pereonites combined. Rostrum of medium length, with blunt apex. Lateral cephalic lobe moderately produced forward, bluntly rounded at apex. Cheek large, truncate, with round apex. Superior antennal sinus relatively deep. Inferior antennal sinus shallow. Eye small, oval, with a black core surrounded by relatively thick band of transparent facets. Back (Fig. 21-A) smooth. Coxae 1-4 of medium depth, successively deeper. Epimeron 1 (Fig. 21-C) tapering, with a minute round tooth at apex. Epimeron 2 subquadrate, slightly sinuous at posterior margin, bearing a few spines along ventral margin, with a minute round tooth at posteroventral corner. Epimeron 3 subquadrate, evenly curved backward at posterior margin, without tooth.

Antenna 1 (Fig. 21-D) short, about 30% as long as body length. Peduncle very much elongate, reaching distal margin of article 4 of antenna 2 *in situ*. Peduncular article 1 bearing several long penicillate hairs. Peduncular article 2 only a little shorter than article 1. Peduncular article 3 half as long as article 2. Primary flagellum thin, about 1.2 times longer than peduncle, 11-articulate; each flagellar article longer than wide; first two articles apically furnished with two sets of armaments, one of which consists of setules and the other of setules and aesthetascs; each succeeding article alternately furnished with two sets of setules or two sets equal to the first two articles. Accessory flagellum (Fig. 21-E) uniarticulate, small, not fused with peduncle. *Antenna 2* (Fig. 21-F) about 70% as long as antenna 1. Peduncle very much elongate. Gland cone long, reaching distal margin of peduncular article 3. Peduncular article 4 very long, longer than articles 1-3 combined. Peduncular article 5 a little shorter than article 4. Flagellum exceedingly short, about 1.1 times longer than peduncular article 4, 2-articulate; each flagellar article longer than wide, bearing two sets of apical setules.

Mouth parts. Labrum (Fig. 21-G) minutely incised. *Right mandible* (Fig. 22-A) Incisor (Fig. 22-B) with 7 denticles; accessory blades counting 6. Palp about 1.6 times longer than body of mandible; article 2 lined with a row of simple setae along posterior margin; article 3 armed with 4 pectinate spines along posterior margin, bearing a long stout seta and a pair of short setae at apex. *Left mandible* similar to right one; incisor (Fig. 22-C) with 7 denticles, distal three of which are large but proximal four minute; lacinia mobilis with 10 denticles. *Maxilla 1* (Fig. 22-D) Inner plate small, circular, with a short and very weakly plumose seta at apex. Palpal proximal article without seta; distal article digitate, slightly narrowing distally, sparsely bristly, armed with 4 strong spines at apex, furnished with two setae subapically. *Maxilla 2* (Fig. 22-E) Inner plate oval, slightly bristly, without long plumose seta, furnished with two setal rows; ventral row consisting of short setae. Outer plate slender, about 60% as thick as inner one, extending beyond inner plate, furnished apicomarginally with two setal rows; ventral row consisting of thicker setae than those of dorsal one. *Maxilliped* (Fig. 22-F) Distal margin of coxa oblique, with a long spine medial-

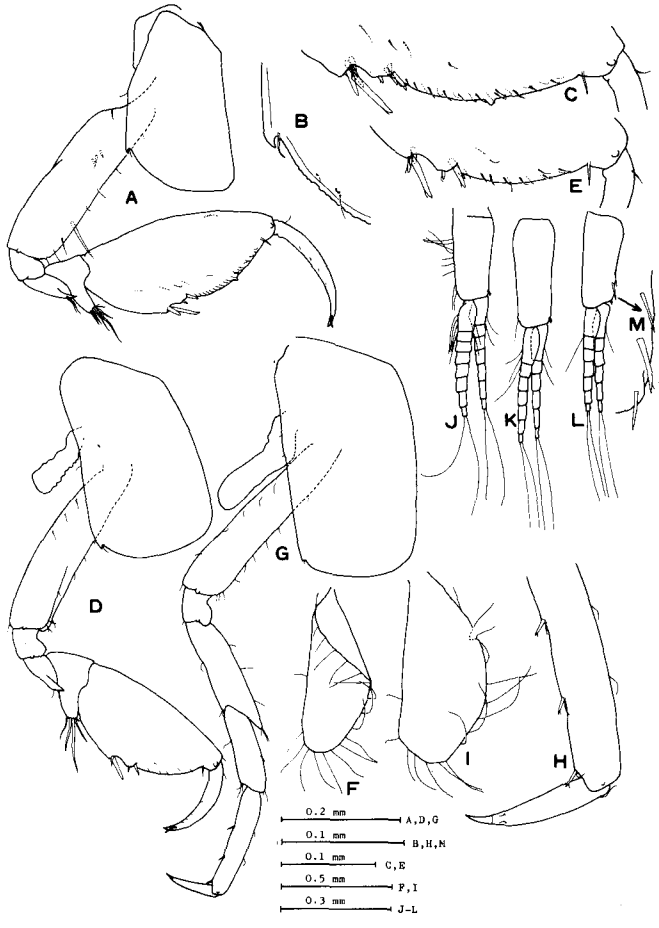

Fig. 23. *Parapleustes gracilis*. Female "a". A, gnathopod 1 (R, out); B, postero-ventral corner of coxa 1; C, palm of gnathopod 1 (R, out); D, gnathopod 2 (R, out); E, palm of gnathopod 2 (R, out); F, oostegite of gnathopod 2 (R); G, pereopod 3 (R, out); H, articles 6-7 of pereopod 3 (R, out); I, oostegite of pereopod 3 (R); J-L, pleopods 1-3 (R, ant; so); M, spines on peduncle of pleopod 3 (R, ant).

ly, subacute around distal portion; both coxae fused with each other to about 40% of length. Inner plate (Fig. 22-H) a little exceeding base of palp, armed with a spine medially on inner margin; apex with a long spine, a seta and three stumpy spines. Basis bearing a setule at distal edge of outer margin. Outer plate (Fig. 22-G) reaching apex of palpal article 1; a slender spine arising from apex. Palpal article 1 with a setule at distal edge of outer margin; article 2 with a setule medially and distally on outer margin respectively; article 3 without pectinate

spine as those of other members of the family; article 4 a little longer than article 3.

Gnathopod 1 (Fig. 23-A) Coxa 1 anteriorly produced, minutely undulatory along ventral margin, with a small but distinct notch (Fig. 23-B) at posteroventral corner. Article 2 with a long stout seta subapically on anterior margin. Article 4 with a strong tooth. Article 5 triangular, narrow, with a narrow and long posterior lobe. Article 6 very large, about as long as article 2, oval, subchelate; palm (Fig. 23-C) about as long as posterior margin, delimited by two groups of spines, connected with posterior margin with a difference in level; palmar margin smooth, with a small tooth medially. Article 7 as long as palm. *Gnathopod 2* (Fig. 23-D, F) Coxa 2 subquadrate. Article 2 sparsely setulose along anterior margin. Article 5 triangular, slightly broader than that of gnathopod 1. Article 6 smaller than that of gnathopod 1.

Pereopod 3 (Fig. 23-G, I) Coxa 3 similar to coxa 2. Segmentation and

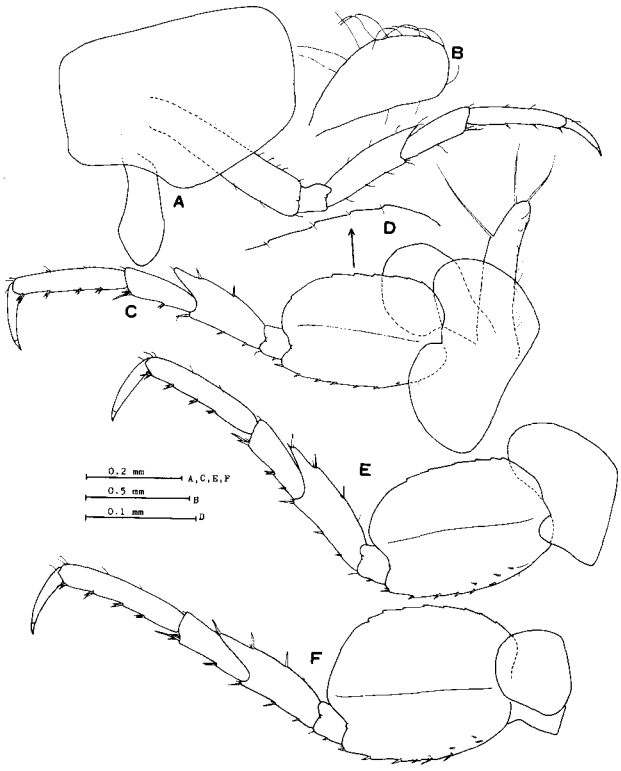

Fig. 24. *Parapleustes gracilis*. Female "a". A, pereopod 4 (R, out); B, oostegite of pereopod 4 (R); C, pereopod 5 (R, out); D, posterior margin of article 2 of pereopod 5 (R, out); E-F, pereopods 6-7 (R, out).

principal armature as shown. Article 4 narrow, extending anterodistally to reach about 40% length of article 5. Article 6 (Fig. 23-H) lined with a row of spines along posterior margin. Article 7 (Fig. 23-H) with a nail. Other armaments consisting of setules. *Pereopod 4* (Fig. 24-A, B) Coxa 4 subquadrate, shallowly excavate; posterior angle of the excavation very much rounded. *Pereopod 5* (Fig. 24-C) Coxa 5 posterolobate; posterior lobe deeper than anterior one. Article 2 posteriorly lobate, with spinose anterior margin and slightly serrulate posterior margin (Fig. 24-D); posterior lobe extending distally not to reach distal margin of article 3. Article 4 narrow, lined with a row of spines along both anterior and posterior margins; posterior lobe reaching about 60% length of article 5. Articles 5-6 spinose along anterior margin. *Pereopod 6* (Fig. 24-E) Coxa 6 strongly posterolobate; posterior lobe very much deeper and wider than anterior one. Article 2 slightly larger than that of pereopod 5. *Pereopod 7* (Fig. 24-F) Coxa 7 circular. Article 2 larger than that of pereopod 6, truncate distally.

Pleopod 1 (Fig, 23-J) Peduncle furnished with a row of plumose setae along outer margin. Inner ramus as long as peduncle; outer ramus a little longer than inner one; 7 articles on inner ramus and 8 on outer one; proximal article long, furnished with plumose setae marginally. *Pleopod 2* (Fig. 23-K) a little longer than pleopod 1. *Pleopod 3* (Fig. 23-L) as long as pleopod 1.

Uropod 1 (Fig. 22-I) Peduncle armed with a dense and a sparse row of spines along inner and outer ridge respectively. Inner ramus 90% as long as peduncle, sparsely spinose along both ridges. Outer ramus 80% as long as inner one, without any spine along inner margin. *Uropod 2* (Fig. 22-K) about 70% as long as uropod 1. Peduncle armed with a few spines along outer ridge. Inner ramus 1.4 times longer than peduncle. Outer ramus as long as peduncle, without any spine along inner ridge. *Uropod 3* (Fig. 22-L) about half as long as uropod 1. Peduncle bearing two spines along outer ridge, behind distal spine of which relatively long peduncular process is arising (Fig. 22-M). Inner ramus 1.7 times longer than peduncle. Outer ramus as long as peduncle, without spine along inner ridge.

Telson (Fig. 21-I) linguiform, about 1.3 times longer than peduncle of uropod 3 *in situ* (Fig. 21-A), about 1.8 times longer than wide, with two small notches subapically from which a setule is arising respectively; a pair of two penicillate hairs issued medially near lateral margins.

Remarks. Examining the type specimen of *Paramphithoë brevicornis* Sars, 1882, Sexton (1910) concluded that, in spite of several differences such as the relative length of the peduncular articles of antenna 1, *Parapleustes gracilis* Buchholz and *Pm. brevicornis* are synonymous. Although the author identified the present specimens as *P. gracilis* for the structures characteristic to the species (e.g. the shapes of gnathopods 1-2, pereopods 5-7 and antennae 1-2), they are somewhat different from the descriptions and the figures of both Sars and Sexton.

though the lobe is acuminate in Sexton's figure. However, the present specimens resemble Sexton's figure in the relative length of the peduncular articles of antenna 1. Further, they differ from figures of both Sars and Sexton in the gently rounded tip of telson, which seems somewhat attenuated in their figures.

The present species has gnathopod 1 larger than gnathopod 2. This is quite interesting because other species of the family Pleustidae ordinarily have gnathopod 2 as large as or larger than gnathopod 1. In addition, the present species has the second articles of pereopods 5-7 different from each other in the size and shape though these are generally of the same size and shape in this family. Furthermore, its very much elongated peduncles of antennae 1-2 and exceedingly short flagella make the present species distinct from the other species of the genus.

Distribution. Boreal. Hitherto recorded from Greenland, northern Norway, Barents Sea and Kara Sea. This is the first record of the species from the Pacific coasts.

Parapleustes longimanus **n. sp.**

(Figs. 25-28)

Type series. Holotype: ♀, 2.9 mm: intertidal, among *Leathesia* and other algae scraped from the surface of boulders, Ohzuchi, Iwate Pref., 14-VI-1983, H. Hoshikawa coll. —— Paratype: 1 juv, 2.2 mm: data same as the holotype.

Female (holotype). Body (Fig. 25-A) 2.9 mm long, compact, heavily chitinized, opaque; color whitish but pinkish along coxal margins after a few months preservation in 5%-formalin. Head (Fig. 25-B) about as long as first two pereonites combined. Rostrum short, reaching subbasal part of peduncular article 1 of antenna 1, with blunt apex. Lateral cephalic lobe moderately produced forward, bluntly rounded at apex. Cheek small, gently rounded. Superior and inferior antennal sines shallow. Eye small, oval, black. Back (Fig. 25-A) smooth. Pereonite 2 the shortest; pereonites 1-4 extending roundly at their posteroventral corners; pereonites 5-7 extending backward subacutely at their posteroventral corners. Coxae 1-4 very deep, as deep as each other. Epimeron 1 (Fig. 25-C) tapering posterodistally, bluntly rounded at apex, with sinuous posterior margin. Epimeron 2 tapering at distal half, slightly sinuous at posterior margin. Epimeron 3 subquadrate, gently rounded at anterior margin but at posterior margin straight, weakly extending at posteroventral corner into a blunt angle. Urosome a little longer than pleonite 3; urosomite 1 the longest, as long as pleonite 3; urosomite 2 very short; urosomite 3 short, 40% as long as urosomite 1.

Antenna 1 (Fig. 25-D) about 20% as long as body length. Peduncle nearly reaching distal margin of peduncular article 5 of antenna 2 *in situ*. Peduncular article 1 robust, very short, as long as wide. Peduncular article 2 half as long as article 1. Peduncular article 3 a little shorter than article 2. Primary flagellum

slightly compressed, about 1.5 times longer than peduncle, 8-articulate; each flagellar article longer than wide; first two articles apically furnished with two sets of armaments, one of which consists of setules and the other of setules and aesthetascs; each succeeding article alternately bearing two sets of setules or two sets equal to the first two articles. Accessory flagellum (Fig. 25-E) fused with peduncular article 3, flattened and expanding. *Antenna 2* (Fig. 25-F) a little shorter than antenna 1. Peduncular article 2 relatively small, a little smaller

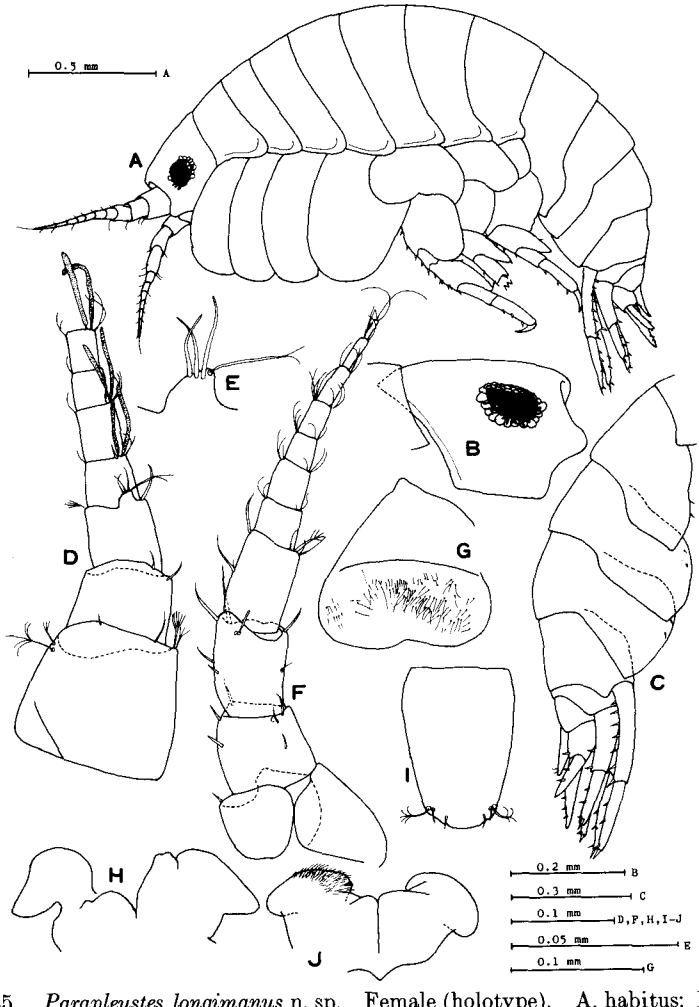

Fig. 25. *Parapleustes longimanus* n. sp. Female (holotype). A, habitus; B, head; C, pleon; D, antenna 1 (R, vr); E, accessory flagellum; F, antenna 2 (R, out); G, labrum; H, labium (vr); I, telson (ds).

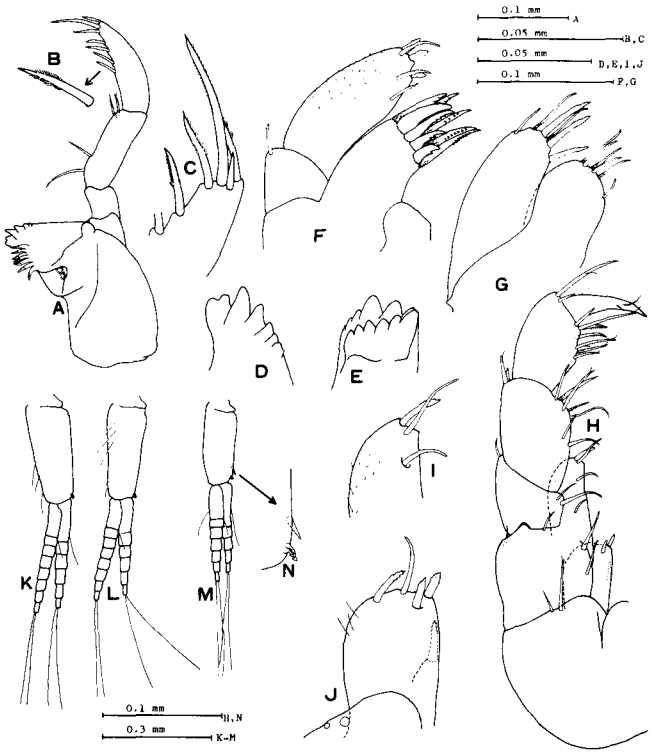

Fig. 26. *Parapleustes longimanus* n. sp. Female (holotype). A, mandible (R, inn); B, pectinate spine of mandible; C, apex of palpal article 3 of mandible (R, inn); D, incisor (R, inn); E, incisor and lacinia mobilis (L, inn); F, maxilla 1 (R, vr); G, maxilla 2 (R, vr); H, maxilliped (R, vr); I, outer plate of maxilliped (R, vr); J, inner plate of maxilliped (R, vr); K-M, pleopods 1-3 (R, ant; so); N, spine on peduncle of pleopod 3 (R, ant).

than article 3; gland cone very short, reaching basal part of article 3. Peduncular article 3 relatively large. Peduncular articles 4-5 subequal in length, bearing long setae along dorsal margin. Flagellum compressed, 70% as long as peduncle, 7-articulate; each article longer than wide, bearing two sets of apical setules.

Mouth parts. Labrum (Fig. 25-G) minutely incised. *Right mandible* (Fig. 26-A) Incisor (Fig. 26-D) with 7 denticles; accessory blades counting 7. Palp about 1.5 times longer than body of mandible; article 2 furnished with some setae at distal and proximal parts of posterior margin; article 3 falcate, armed with 6 finely pectinate (or plumose?) spines (Fig. 26-B) along posterior margin, bearing a long stout seta and a very short seta at apex. *Left mandible* similar to right one; incisor (Fig. 26-E) with 6 denticles; lacinia mobilis with 6 denticles. *Maxilla 1* (Fig. 26-F) Inner plate small, truncate, without seta. Palp broad, a little thicker than outer plate; proximal article a little expanding outward, armed with

a spine at the expansion; distal article sparsely bristly, armed with three ill-pectinate spines at apex, furnished with a setal row obliquely. *Maxilla 2* (Fig. 26-G) Inner plate oval, furnished apicomarginally with two setal rows, without long seta. Outer plate as broad as inner one, nearly extending beyond inner plate, furnished apicomarginally with two setal rows; ventral row consisting of thicker and ill-pectinate setae. *Maxilliped* (Fig. 26-H) Distal margin of coxa oblique, with a group of setae medially, gently rounded around distal portion; both coxae strongly fused with each other to 60% of length. Inner plate (Fig. 26-J) not reaching base of palp, armed with a spine on inner margin medially; apex with a relatively long spine, a seta and two stumpy serrulate spines. Basis bearing a setule at distal edge of outer margin, with a conspicuously produced hinge at distal margin. Outer plate (Fig. 26-I) short not to reach apex of palpal

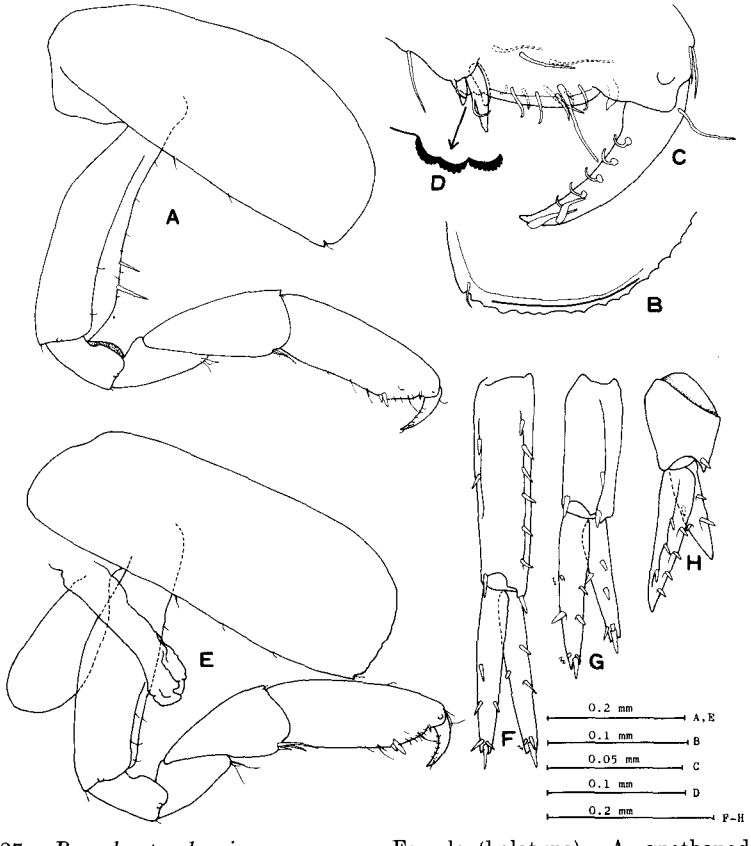

Fig. 27. *Parapleustes longimanus* n. sp. Female (holotype). A, gnathopod 1 (R, out); B, ventral margin of coxa 1 (R, out); C, palm of gnathopod 1 (R, out); D, proximal part of palm of gnathopod 1; E, gnathopod 2 (R, out); F-H, uropods 1-3 (R, ds).

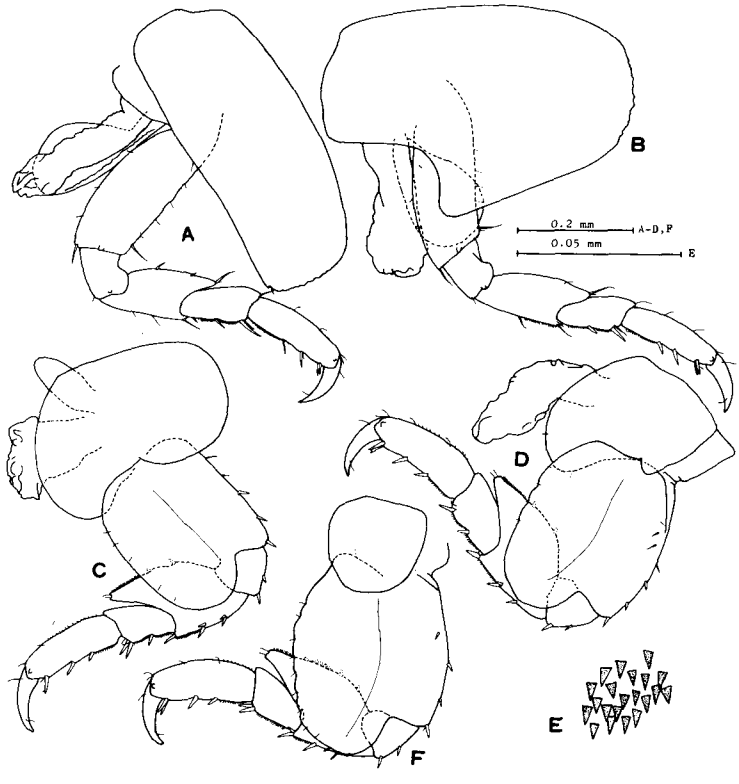

Fig. 28. *Parapleustes longimanus* n. sp. Female (holotype). A-D, pereopods 3-6 (R, out); E, triangular scales on article 2 of pereopod 6; F, pereopod 7 (R, out).

article 1; a slender spine arising from apex. Palpal article 1 short, with a setule at distal edge of outer margin; article 2 with a pair of spines at distal edge of outer margin; article 3 armed with two pectinate spines subapically.

Gnathopod 1 (Fig. 27-A) Coxa 1 narrow, elongate, slightly expanding distally, with ventral margin minutely undulatory (Fig. 27-B), having a minute and indistinct notch at posteroventral corner. Article 2 bearing two stout setae on anterior margin medially. Article 4 elongate, toothless. Article 5 strongly elongate, without posterior lobe. Article 6 strongly elongate, as long as articles 4-5 combined, subchelate; palm (Fig. 27-C) oblique, about 30% as long as posterior margin, delimited by a group of spines, angularly connected with posterior margin; palmar margin smooth but minutely scalloped (Fig. 27-D) around proximal portion, without small tooth. Article 7 as long as palm, with a row of hairs along inner margin. *Gnathopod 2* (Fig. 27-E) Coxa 2 a little longer than coxa 1, with both anterior and posterior margins parallel to each other. Article 2 without stout seta at anterior margin. Article 5 a little shorter than that of

gnathopod 1.

Pereopod 3 (Fig. 28-A) Coxa 3 similar to coxa 2. Segmentation and principal armature as shown. Articles 5-6 lined with a row of spines along posterior margin. Other armaments consisting of setae and setules. Article 5 and proximal part of article 6 densely covered with very thin triangular scales on posterior face. *Pereopod 4* (Fig. 28-B) Coxa 4 excavate, subquadrate; posterior angle of the excavation subacute, with round apex. *Pereopod 5* (Fig. 28-C) Coxa 5 large, posterolobate; posterior lobe deeper than anterior one. Acticles 4-6 combined short, 80% as long as articles 1-3 combined. Article 2 posteriorly lobate, with spinose anterior margin and smooth posterior margin; posterior lobe extending distally beyond distal margin of article 3. Article 4 highly broad, lined with a row of spines along anterior margin and with a row of stumpy spines along posterior margin; posterior lobe reaching 130% length of article 5. Articles 5-6 spinose along anterior margin. Triangular scales covering posterior and anterodistal margins of article 4, anterior margin of article 5, and posterior and anteroproximal margins of article 6. *Pereopod 6* (Fig. 28-D) Coxa 6 strongly posterolobate, with very tiny anterior lobe. Article 2 with minutely scalloped posterior lobe. *Pereopod 7* (Fig. 28-F) Coxa 7 circular. Article 2 with weakly scalloped posterior lobe.

Pleopod 1 (Fig. 26-K) Peduncle furnished sparsely with several plumose setae along outer margin. Inner ramus 1.1 times longer than peduncle; outer ramus a little longer than inner one; 6 articles on inner ramus and 8 on outer one; proximal article long, sparsely furnished with plumose setae. *Pleopod 2* (Fig. 26-L) 95% as long as pleopod 1. *Pleopod 3* (Fig. 26-M) 75% as long as pleopod 1.

Uropod 1 (Fig. 27-F) Peduncle armed with a row of spines along outer ridge and with a few spines along inner ridge. Inner ramus 75% as long as peduncle, armed with spines along both inner and outer ridges. Outer ramus as long as inner one. *Uropod 2* (Fig. 27-G) 75% as long as uropod 1. Peduncle armed with two spines on outer ridge. Inner ramus about 1.2 times longer than peduncle. Outer ramus as long as peduncle. *Uropod 3* (Fig. 27-H) 65% as long as uropod 1. Inner ramus about 1.8 times longer than peduncle. Outer ramus as long as peduncle.

Telson (Fig. 25-I) linguiform, about 1.5 times longer than peduncle of uropod 3 *in situ* (Fig. 25-C), about 1.5 times longer than wide, subapically bearing a pair of setules; a pair of two penicillate hairs issued just behind the setules.

Juvenile (paratype). Body 2.2 mm long.

Labium (Fig. 26-J) typical to the family, without inner lobe; margin between both outer lobes horizontal.

Remarks. The present new species closely resembles *Parapleustes behningi* in several characters such as robust body, color, short antennae 1-2, deep coxae, relatively short uropods, and so on. However, it is obviously distinctive from *P. behningi* by the appearance of gnathopods 1-2, the appearance of coxae, the

posterior lobes of pereopods 5-7 more distally extending, shorter pereopods 5-7 with broader 4th articles, possession of very thin queer triangular scales, rounded and more deeply fused coxae of maxilliped, and shorter telson. Further, minor differences are noticed in antennae 1-2, maxillae 1-2, maxilliped, pereopods 3-4, and pleopods 1-3. Despite the above differences, it is so similar in general appearance to *P. behningi*, that one cannot identify without dissection to which of species the observed specimens belong, if the gnathopods are benind the large coxal shield.

***Parapleustes tricuspis* n. sp.**

(Figs. 29-32)

Type specimen. Holotype: ♂?, 5.0 mm: 0.5 m depth, among *Laminaria* belt, Oshoro, Hokkaido, 14-VI-1982, SI coll.

Male? (holotype). Body (Fig. 29-A) weakly chitinized; color whitish after a few months preservation in 5%-formalin. Head (Fig. 29-B) about as long as pereonites 3-4 combined. Rostrum large, reaching half length of peduncular article 1 of antenna 1, with blunt apex. Lateral cephalic lobe produced forward, circular. Cheek moderately produced forward, with acute apex. Superior antennal sinus deep. Inferior antennal sinus shallow, small. Eye large, oblong, strongly posteriorly located, black. Pereonites 1-2 (Fig. 29-A) smaller than succeeding pereonites; pereonite 7 dorsally armed with a prominent tooth projecting backward. Coxae 1-4 of medium depth, successively deeper. Pleonites 1-2 (Fig. 29-C) dorsally armed with a prominent tooth projecting backward, respectively. Epimeron 1 spatulate. Epimera 2-3 subquadrate, sinuous at posterior margin, with a few spines, with round posteroventral corner not produced. Urosome as long as pleonites 2-3 combined; urosomite 1 three times longer than urosomites 2-3 combined; urosomite 2 very short; urosomite 3 short. Body aesthetascs (Fig. 29-A) issued from head and pereonites 1-2, from pereonites 4-6 medially in two rows, and from pereonite 7 and pleonites 1-2 medially and laterally in 4 rows.

Antenna 1 (Fig. 29-E) broken. Peduncular article 1 about 1.5 times longer than article 2, without tooth. *Antenna 2* (Fig. 29-F) long, about 40% as long as body length. Gland cone of medium length, reaching half length of peduncular article 3. Peduncular article 3 produced into triangular process on inner face, with a spine at dorsodistal edge and at the process respectively. Peduncular article 4 twice longer than article 3, produced at dorsodistal edge. Peduncular article 5 a little longer than article 4. Flagellum about 2.2 times longer than peduncle, 21-articulate; each article longer than wide, bearing two sets of apical setules.

Mouth parts. Labrum (Fig. 29-G) medially incised. *Left mandible* (Fig. 30-A) Incisor (Fig. 30-C) with 7 denticles; lacinia mobilis with 10 denticles;

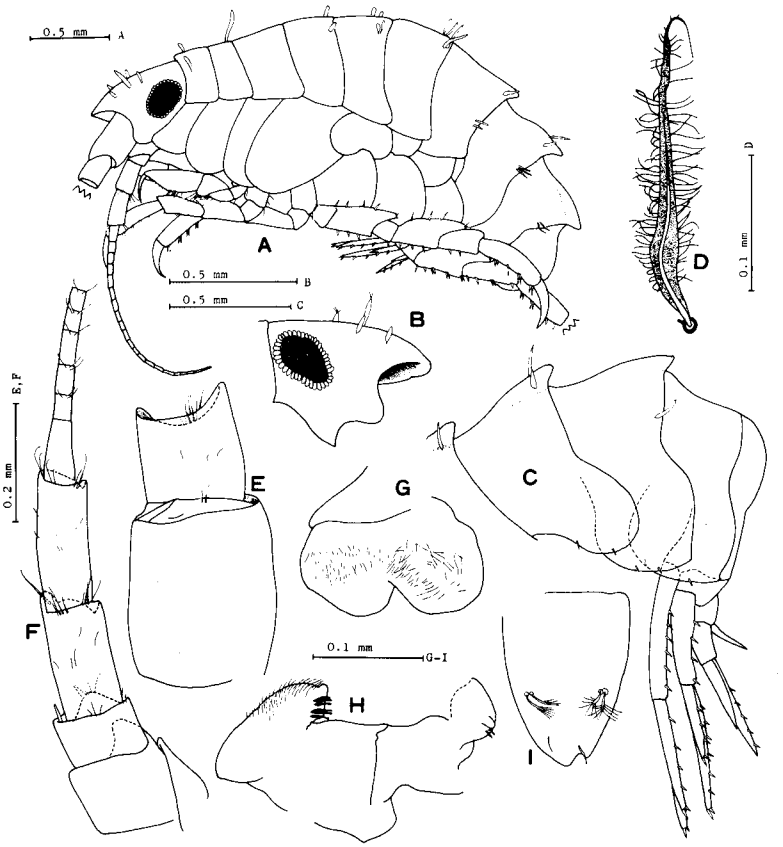

Fig. 29. *Parapleustes tricuspis* n. sp. Male? (holotype). A, habitus; B, head; C, pleon; D, body aesthetascs; E-F, antennae 1-2 (R, out); G, labrum; H, labium (vr); I, telson (ds).

accessory blades counting 6. Palp about 1.8 times longer than body of mandible; article 2 furnished with a setal row along posterior margin; article 3 relatively large, armed with 7 pectinate spines along posterior margin, bearing two long stout setae and a short seta at apex, and bearing a long seta at posterior part of base. *Right mandible* similar to left one; incisor (Fig. 30-B) with 9 denticles. *Maxilla 1* (Fig. 30-D) Inner plate small, circular, with a plumose seta. Palpal proximal article without seta; distal article digitate, bristly, armed with 4 strong spines at apex, furnished with a setal row obliquely. *Maxilla 2* (Fig. 30-E) Inner plate oval, furnished with two setal rows apicomarginally, with a long plumose seta. Outer plate a little thinner than inner one, nearly extending beyond inner plate, furnished with two setal rows; ventral row consisting of slightly thicker setae than those of dorsal one. *Maxilliped* (Fig. 30-F) Distal margin of coxa oblique, with

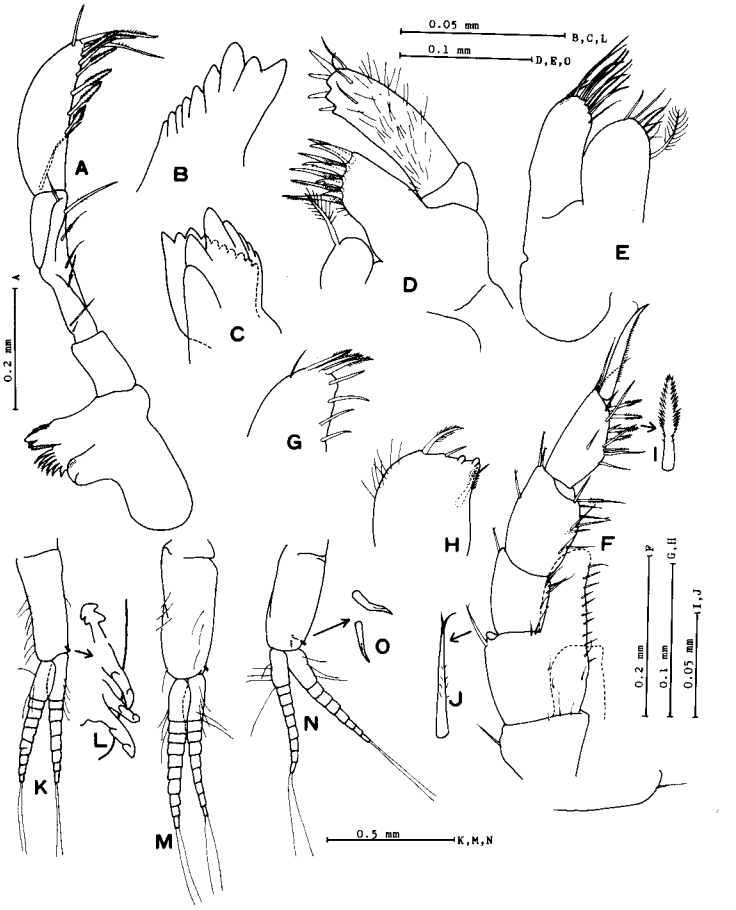

Fig. 30. *Parapleustes tricuspis* n. sp. Male? (holotype). A, mandible (L, out); B, incisor (R, out); C, incisor and lacinia mobilis (L, out); D, maxilla 1 (L, vr); E, maxilla 2 (R, vr); F, maxilliped (R, vr); G, outer plate of maxilliped (R, vr); H, inner plate of maxilliped (R, vr); I-J, spine and setae of maxilliped; K, pleopod 1 (R, ant; so); L, coupling spines of pleopod 1 (R, ant); M-N, pleopods 2-3 (R, ant; so); O, spines on peduncle of pleopod 3 (R, ant).

a group of simple setae medially, subacute around distal portion; both coxae ordinarily fused with each other to 30% of length. Inner plate (Fig. 30-H) not reaching base of palp, armed with a spine on inner margin medially; apex with a long spine, a seta and two stumpy spines. Basis bearing a seta (Fig. 30-J) at distal edge of outer margin. Outer plate (Fig. 30-G) reaching apex of palpal article 1; two plumose and slender spines arising from apex. Palpal article 1 with a seta at distal edge of outer margin; article 2 with a seta medially on outer

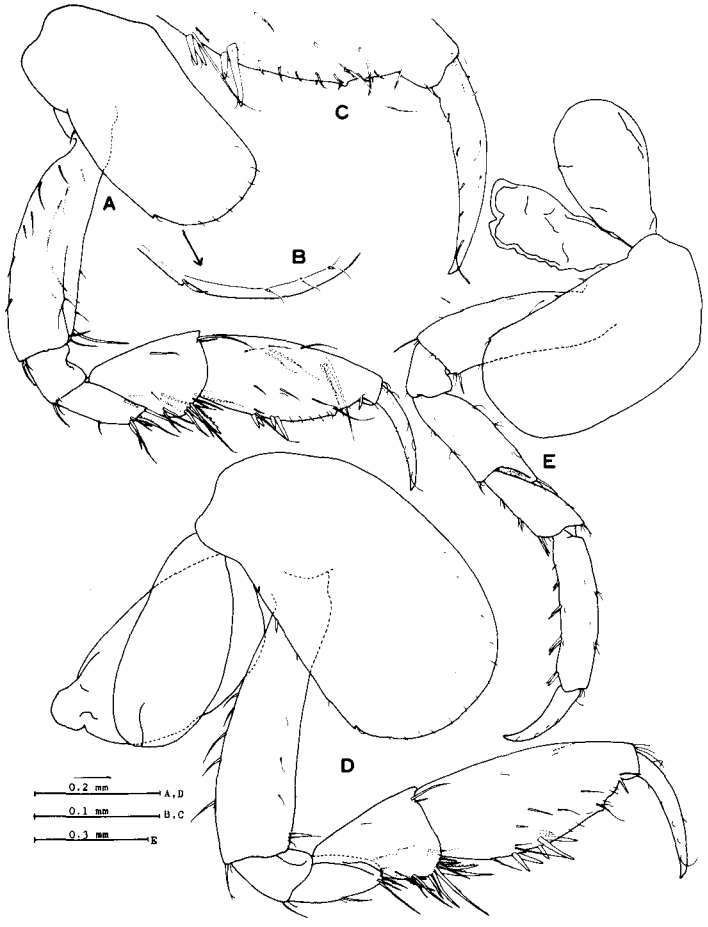

Fig. 31. *Parapleustes tricuspis* n. sp. Male? (holotype). A, gnathopod 1 (R, out); B, posteroventral corner of coxa 1; C, palm of gnathopod 1 (R, out); D, gnathopod 2 (R, out); E, pereopod 3 (R, out).

margin, and with a pair of setae at distal edge of outer margin; article 3 rather slender, armed with 4 pectinate spines (Fig. 30-I) subapically; article 4 a little longer than article 3.

Gnathopod 1 (Fig. 31-A) Coxa 1 with smooth ventral margin, with a small and indistinct notch (Fig. 31-B) at posteroventral corner, bearing a spine medially on posterior margin. Article 2 bearing a stout seta on anterior margin subapically. Article 4 toothless. Article 5 triangular, somewhat elongate, without posterior lobe. Article 6 oblong, as long as articles 3-5 combined, subchelate, with three long setae on inner face; palm (Fig. 31-C) about as long as posterior margin,

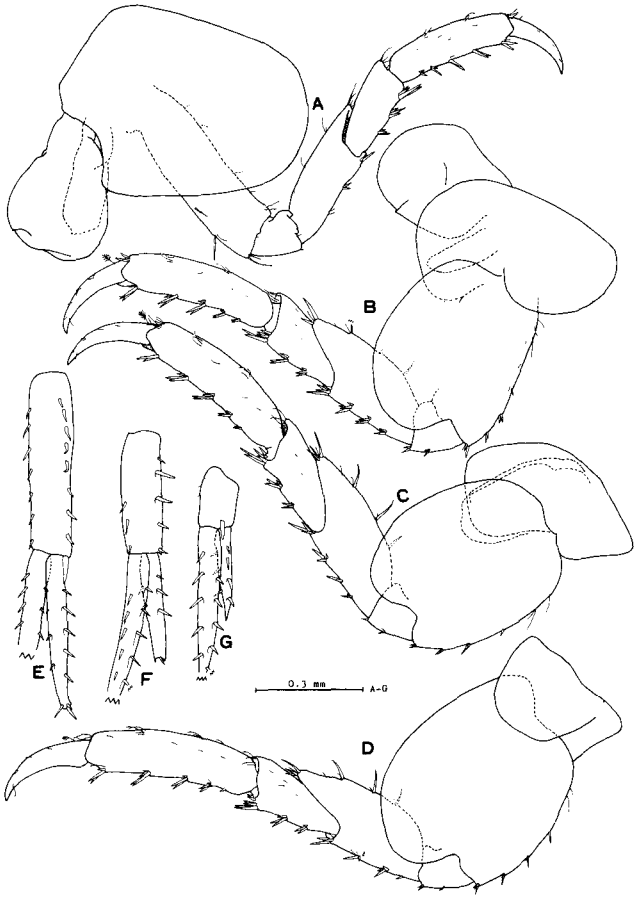

Fig. 32. *Parapleustes tricuspis* n. sp. Male? (holotype). A-D, pereopods 4-7 (R, out); E-G, uropods 1-3 (R, ds).

delimited by two groups of spines, smoothly connected with posterior margin; palmar margin smooth, with a low small tooth medially near article 7. Article 7 as long as palm. *Gnathopod 2* (Fig. 31-D) Coxa 2 expanding distally, with armament similar to coxa 1. Article 2 without stout seta at anterior margin. Article 6 without long seta on inner face.

Pereopod 3 (Fig. 31-E) Coxa 3 subquadrate, with armament similar to coxa 1. Segmentation and principal armature as shown. Article 4 extending anterodistally to reach some 40% length of article 5. Articles 5-6 lined with a row of spines along posterior margin. Other armaments consisting of setae and setules. *Pereopod 4* (Fig. 32-A) Coxa 4 subcircular, excavate; posterior angle of the excavation right-angled, with round apex. *Pereopod 5* (Fig. 32-B) Coxa 5

posterolobate; posterior lobe deeper than anterior one, with some spines and setules along ventral margin. Article 2 posteriorly lobate, with spinose anterior margin and smooth posterior margin; posterior lobe extending distally not to reach distal margin of article 3. Article 4 of medium width, lined with a row of spines along anterior margin and with a row of thick setae along posterior margin; posterior lobe reaching about 60% length of article 5. Articles 5–6 spinose along anterior margin. *Pereopods 6-7* (Fig. 32-C, D) Coxa 6 strongly posterolobate; posterior lobe subquadrate, with some spines and setules along ventral margin. Coxa 7 circular.

Pleopod 1 (Fig. 30-K) Peduncle furnished sparsely with a row of plumose setae along outer margin; 4 coupling spines (Fig. 30-L) arising from inner margin distally. (This condition may be aberrant.) Inner ramus about 1.1 times longer than peduncle; outer ramus a little longer than inner one; 8 articles on inner ramus and 10 on outer one; proximal article long, furnished with plumose setae marginally. *Pleopod 2* (Fig. 30-M) about 1.2 times longer than pleopod 1. *Pleopod 3* (Fig. 30-N) as long as pleopod 1.

Uropod 1 (Fig. 32-E) Peduncle armed with a row of spines along both ridges. Inner ramus 95% as long as peduncle, armed with a row of small spines along outer ridge. Outer ramus 85% as long as inner one, armed with a row of large spines along outer ridge and with a row of small spines along inner ridge. *Uropod 2* (Fig. 32-F) about 85% as long as uropod 1. Inner ramus twice longer than peduncle. Outer ramus as long as peduncle. *Uropod 3* (Fig. 32-G) about 55% as long as uropod 1. Inner ramus 2.7 times longer than peduncle. Outer ramus some 60% as long as inner one.

Telson (Fig. 29-I) linguiform, about 1.1 times longer than peduncle of uropod 3 *in situ* (Fig. 29-C), 1.4 times longer than wide, subapically bearing two setules; a pair of two penicillate hairs issued medially near lateral margins.

Remarks. The present new species is characterized by its queer shape of head, three prominent teeth on back, and its oblong 6th articles of gnathopods 1–2. *Parapleustes monocuspis* (Sars, 1893), *P. bicuspis* (Krøyer, 1838), *P. bicuspoides* Nagata, 1965, *P. corniger* (Shoemaker, 1964), *P. euacanthoides* (Gurjanova, 1972) and *P. gagarae* (Gurjanova, 1972) have a tooth (or a few teeth) on back. However, the new species apparently differs from these species in the appearance of head, possession of body aesthetascs, and the number and appearance of dorsal teeth.

Concluding remarks

The separation of the genera *Parapleustes* and *Pleustes* has been considered subjective (Barnard and Given, 1960, p. 39). However, this was because of the erroneous assignment of *Parapleustes behningi* to *Pleustes*. As mentioned in the present paper, *Parapleustes behningi* has been proved to belong to *Parapleustes*.

This treatment makes *Pleustes* so compact a group distinctive from *Parapleustes*.

On the other hand, *Parapleustes* seems to be a heterogeneous group. The six species of *Parapleustes* described above seem to be divisible into the following three species-groups.

1. *gracilis*-group: comprising *P. gracilis* only.
2. *behningi*-group: including *P. behningi* and *P. longimanus*.
3. *derzhavini*-group: including *P. derzhavini*, *P. dilatatus* and *P. tricuspis*.

The basis of this infrageneric grouping is mentioned below (cf. Table 1).

Table 1. Comparison of diagnostic characters among three species-groups within the genus *Parapleustes*

Characters	*gracilis*-group	*behningi*-group	*derzhavini*-group
1. peduncles of antennae 1-2	long	short	short
2. primary flagella	short	short	long
3. accessory flagellum	articulate	fused	articulate
4. posterior lobes of 5th articles of gnathopods 1-2	long and narrow	short and wide	short and wide
5. size difference of 6th articles between gnathopods 1 and 2	$1>2$	$1\leqq 2$	$1\leqq 2$
6. location of a pair of penicillate hairs on telson	medial	apical	medial

1) Antennae 1-2: The *derzhavini*-group has long antennae 1-2 about half as long as body length (Figs. 10-A, 17-A, 29-A). Although the antennae 1-2 of the *gracilis*- and the *behningi*-group are much shorter than that of the *derzhavini*-group, they differ from each other in several characters as follows: in the *behningi*-group, peduncles are of similar shape to the derzhavini-group and only flagella are shortened (Figs. 3-A, 25-A), whereas in the *gracilis*-group peduncles are very much elongated while flagella are highly shortened (Fig. 21-A, D, F). This modified state of the *gracilis*-group is more evident in antenna 2, the flagellum of which is only one-third as long as the peduncle.

2) Accessory flagellum: Among the three groups two types of accessory flagellum are recognizable. The first type is represented in the *gracilis*- and the *derzhavini*-group (Figs. 10-E, 17-E, 21-E): this type of accessory flagellum is articulated from the peduncular article 3. On the other hand, second type seen in the *behningi*-group is fused with the article 3, flattened and somewhat expanding (Figs. 3-E, 25-E).

3) Gnathopods 1-2: The *gracilis*-group differs in the shape of gnathopods 1-2 from the other two groups. The 5th articles of the gnathopods 1-2 of the *gracilis*-group (Fig. 23-A, D) is shorter than those of the other two groups, and have a longer and narrower posterior lobe for each, which is broad and short or absent in the two other groups. This character state of the *gracilis*-group also can be seen in the genus *Pleustes*. Moreover, it should be noted that the article 6 of

the *gracilis*-group (Fig. 23-A, D) is larger in gnathopod 1 than in gnathopod 2. This is quite interesting, considering that other species of the Pleustidae exhibit the article 6 of gnathopod 1 as large as, or a little smaller than that of gnathopod 2.

4) Telson: The structure of telson is divisible into two types among the three groups. The first type bears a pair of penicillate hairs medially on lateral margin (Figs. 11-M, 17-I, 21-I, 29-I), and in the second type the pair is apically located (Figs. 7-P, 25-I). The *gracilis*- and the *derzhavini*-group have the first type, and the *behningi*-group the second type.

A survey of literature shows that all the other species of *Parapleustes* so far described, except *P. triangulocularatus* which may belong to the *behningi*-group, may be assigned to the *derzhavini*-group, because the shapes of antennae 1-2 and gnathopods 1-2 of these species are of *derzhavini*-type as far as provided figures and/or descriptions are concerned. But this assignment is tentative, as the detailed structures of their accessory flagella and telsons are known from neither the descriptions nor the figures.

Acknowledgement

The author wishes to express his sincere gratitude to Prof. Mayumi Yamada (Hokkaido Univ.) for his critical reading of the manuscript. He is also indebted to Dr. Haruo Katakura (Hokkaido Univ,) for his valuable advice and critical revision of the manuscript. Cordial thanks are also due to Dr. Shunsuke F. Mawatari (Hokkaido Univ.), Dr. Nobuo Tsurusaki (Hokkaido Univ.), Dr. Hiroshi Morino (Ibaraki Univ.), Dr. Tatsunori Itô (Seto Marine Biological Laboratory, Kyoto Univ.), Dr. Akira Hirayama (Asia Univ.), Mr. and Mrs. Hiroshi Hoshikawa (Hokkaido Univ.), Dr. K. Kito (Sapporo Medical College), Dr. E.L. Bousfield (National Museum of Canada), Miss Tomomi Sato (Hokkaido Univ.), and Mr. Kazuro Shinta (Oshoro Marine Biological Station, Hokkaido Univ.).

References

Barnard, J.L. 1952. Some Amphipoda from central California. Wasmann J. Biol. **10**(1): 9-36.

——— 1956. Two rare amphipods from California with notes on the genus *Atylus*. Bull. S. California Acad. Sci. **55**: 35-43, pls. 12-14.

——— 1959. Estuarine Amphipoda. In: Ecology of Amphipoda and Polychaeta of New Port Bay, California by J.L. Barnard and D.J. Reish. Allan Hancock Found. Publ., Occ. Pap. **21**: 13-69, pls. 1-14.

——— 1969a. Gammaridean Amphipoda of the rocky intertidal of California: Monterey Bay to La Jolla. Bull. U.S. Nat. Mus. **258**: 1-230.

——— 1969b. The families and genera of marine gammaridean Amphipoda. Bull. U. S. Nat. Mus. **271**: 1-535.

——— 1970. Sublittoral Gammaridea (Amphipoda) of the Hawaiian Islands. Smiths. Cont. Zool. **34**: 1-286.

Barnard, J.L. and R.R. Given 1960. Common pleustid amphipods of southern California, with a projected revision of the family. Pacific Nat. **1**(17): 37-48.

Buchholz, R. 1874. 8. Crustaceen. Die zweite deutsche Nordoplarfahrt in den Jahren 1869 und 1870 unter Führung des Kapitän Karl Koldewey, 2, Wissensch. Ergeben., II. Zool.: 262-399, pls. 1-15 (not seen).

Gurjanova, E.F. 1938. Amphipoda, Gammaroidea of Siakhu Bay and Sudzukhe Bay (Japan Sea). Rept. Japan Sea Hydrobiol. Exped. Zool. Inst. Acad. Sci. USSR 1934 **1**: 241-404 (In Russian, not seen).

——— 1972. Some new species of amphipods (Amphipoda, Gammaridea) from the north-western part of Pacific and high Arctic. Trudy Zool. Inst., Akad. Nauk SSSR **52**: 129-200 (In Russian).

Hirayama, A. 1983. Taxonomic studies on the shallow water gammaridean Amphipoda of West Kyushu, Japan. 1. Acanthonotozomatidae, Ampeliscidae, Ampithoidae, Amphilochidae, Anamixidae, Argissidae, Atylidae and Colomastigidae. Publ. Seto Mar. Biol. Lab. **28**(1/4): 75-150.

Irie, H. and K. Nagata 1962. A list of the benthic Crustacea known in Ariake Sea. Bull. Fac. Fish., Nagasaki Univ. **13**: 18-24.

Kudrjaschov, V.A. 1980. On fauna of Amphipoda of the northern part of Zaliv Petra Velikogo. In: Pribreznyi Plankton i Benthos severnoi chasti Japonskogo Morja, O.G. Kussakin (ed.): 80-92 (In Russian).

Kussakin, O.G. 1975. A list of the macrofauna in the intertidal zone of the Kurile Islands, with remarks on zoogeographical structure of the region. Publ. Seto Mar. Biol. Lab. **22**(1/4): 47-74.

Lincoln, R.J. 1979. British marine Amphipoda: Gammaridea. British Museum (Natural History), London, 280 pp.

Nagata, K. 1960. Preliminary notes of benthic gammaridean Amphipoda from the *Zostera* region of Mihara Bay, Seto Inland Sea, Japan. Publ. Seto Mar. Biol. Lab. **8**(1): 163-182, pls. 13-16.

——— 1964. Gammaridea. In: Fauna and flora of the sea around the Amakusa Marine Biological Laboratory. Part V. Amphipod Crustacea: 1-27 (In Japanese).

——— 1965a. Studies on marine gammaridean Amphipoda of the Seto Inland Sea. I. Publ. Seto Mar. Biol. Lab. **13**(2): 131-170.

——— 1965b. Studies on marine gammaridean Amphipoda of the Seto Inland Sea. II. Publ. Seto Mar. Biol. Lab. **13**(3): 171-186.

——— 1965c. Studies on marine gammaridean Amphipoda of the Seto Inland Sea. III. Publ. Seto Mar. Biol. Lab. **13**(4): 291-326.

——— 1966. Studies on marine gammaridean Amphipoda of the Seto Inland Sea. IV. Publ. Seto Mar. Biol. Lab. **13**(5): 327-348.

Sars, G.O. 1882. Oversigt af Norges Crustaceer med foreløbige Bemaerkninger over de nye eller mindre bekjendte After, I: (Podophthalmata-Cumacea-Isopoda-Amphipoda). Forhandl. Vidensk.-Selsk. Christiania **18**: 1-124, pls. 1-6.

——— 1890-1895. Amphipoda. An account of the Crustacea of Norway with short descriptions and figures of all the species **1**: i-viii, 1-711, pls. 1-240, suppl. pls. 1-8.

Sexton, E.W. 1910. Notes on some Amphipoda from the north side of the Bay of Biscay, families Pleustidae and Eusiridae. Proc. Zool. Soc. London 1909: 848-879.

Shoemaker, C.R. 1964. Seven new amphipods from the West coast of North America with notes on some unusual species. Proc. U.S. Nat. Mus. **115**(3489): 391-430.

Stebbing, T.R.R. 1906. Amphipoda. I. Gammaridea. Tierreich **21**: 1-806.

Stephensen, K. 1938. The Amphipoda of N. Norway and Spitsbergen with adjacent waters. Fasc. 2. Tromsö Mus. Skrifter **3**(2): 141–278.