

## BATHYPELAGIC SHRIMP OF THE GENUS *PASIPHAEA* (DECAPODA: CARIDEA: PASIPHAEIDAE) FROM WATERS AROUND TAIWAN, WITH DESCRIPTIONS OF FOUR NEW SPECIES

Tomoyuki Komai<sup>1</sup>, Chia-Wei Lin<sup>2,\*</sup>, and Tin-Yam Chan<sup>3</sup>

<sup>1</sup> Natural History Museum and Institute, Chiba, 955-2 Aoba-cho, Chuo-ku, Chiba 260-8682, Japan

<sup>2</sup> Department of Biology, National Museum of Marine Biology and Aquarium, 2 Houwan Road, Checheng, Pingtung, 944, Taiwan, R.O.C.; and Institute of Marine Biodiversity and Evolutionary Biology, National Dong Hwa University, No. 1, Sec. 2, Da Hsueh Rd., Shoufeng, Hualien 97401, Taiwan, R.O.C.

<sup>3</sup> Institute of Marine Biology and Center of Excellence for Marine Bioenvironment and Biotechnology, National Taiwan Ocean University, Keelung 20224, Taiwan, R.O.C.

### ABSTRACT

The bathypelagic shrimp genus *Pasiphaea* Savigny, 1816 (Caridea: Pasiphaeidae) has been previously known from Taiwan from only three species. However, recent deep-sea surveys around the island have collected numerous specimens comprising ten species, of which four are new to science: *P. aequus* n. sp., *P. alcocki* (Wood-Mason and Alcock, 1891), *P. exilimanus* n. sp., *P. falx* n. sp., *P. japonica* Omori, 1976, *P. mclaughlinae* Hayashi, 2006, *P. levicarinata* Hanamura, 1994, *P. orientalis* Schmitt, 1931, *P. sirenkoi* Burukovsky, 1987 and *P. taiwanica* n. sp. The four new species are fully described and illustrated, and compared with allied congeners. *Pasiphaea orientalis* is redescribed, as this species is endemic to Taiwan and its original description is inadequate. Amongst the three new records of Taiwan, *P. levicarinata* is also recorded for the first time from the northwestern Pacific.

KEY WORDS: Caridea, *Pasiphaea*, Taiwan

DOI: 10.1163/193724011X615550

### INTRODUCTION

Shrimps of the pasiphaeid genus *Pasiphaea* Savigny, 1816 are important components in the mesopelagic to benthopelagic community in the world's oceans, including the Polar seas. Sixty-three species are currently known in the genus. Although De Grave and Fransen (2011) listed 66 species, amongst them *P. meringnaudei* Kensley, 1977 and *P. berentsae* Kensley, Tranter and Griffin, 1987 are considered to be synonymous with *P. barnardi* Yaldwyn, 1971 (Hanamura and Evans, 1994; Hayashi, 2006a); and *P. balssi* Burukovsky and Romensky, 1987 has been synonymized with *P. rathbunae* (Stebbing, 1914) by Hayashi (2006a). Thanks to the revisionary studies by Hayashi (1999, 2004, 2006a, b), identities of many previously described taxa have been clarified, although several species remains to be redescribed. Currently, three informal species groups are recognized in the genus, viz., the *P. sivado* (Risso, 1816) group (Hayashi, 1999, 2006b), the *P. cristata* Bate, 1888 group (Hayashi, 2004) and the *P. alcocki* (Wood-Mason and Alcock, 1891) group (Hayashi, 2006a). However, these three informal species groups do not covered all the species in the genus. The affinities of the remaining species are still unclear. The *P. sivado* group is characterized by the possession of a sharp posterodorsal tooth on the sixth pleomere, the truncate posterior margin of the telson, the presence of two or more spines on the ventral margin of the first pereopod, and the

pleurobranch on the eighth thoracomere reduced or absent. The *P. cristata* group is diagnosed by the non-deeply forked posterior margin of the telson and the usual lack of ventral spines on the merus of the first pereopod. The *P. alcocki* group is characterized by the deeply forked posterior margin of the telson. In the latter two groups, the pleurobranch on the eighth thoracic somite is well developed. Recent studies have shown that the genus is highly diverse particularly in tropical waters, and discovery of new species is still continuous from all oceans (Timofeev, 1997; Hayashi and Yaldwyn, 1998; Hayashi, 1999, 2004, 2006a, b; Komai and Chan, in press).

From the waters around Taiwan, previously only three species have been reported (Schmitt, 1931; Hayashi, 2006a, b). However, recent extensive deep-sea samplings around the island have collected abundant specimens of *Pasiphaea*. Close examinations revealed as many as ten species are represented in the Taiwanese material, four of them being new to science. The present work reports these findings.

The specimens are deposited in the National Taiwan Ocean University, Keelung (NTOU), National Museum of Marine Biology and Aquarium (NMMB), and the Natural History Museum and Institute, Chiba (CBM). Carapace length (cl) is used as the standard measurement, expressed in mm, and measured dorsally from the frontal margin to the posterodorsal margin of the carapace. The station (stn) designation are preceded by a prefix indicating the actual

\* Corresponding author; e-mail: y9300923@ms8.hinet.net

type of collecting equipment, as follows: otter trawl le Drezen type Solo Hard Bottom 12.4 m (CD); 4 m French beam trawl (CP), 2.5 m French beam trawl (PCP) and Izakks Kid mid-water trawl (IK). Those specimens collected from fishing ports were caught by commercial trawlers.

#### SYSTEMATICS

Pasiphaeidae Dana, 1852  
*Pasiphaea* Savigny, 1816  
*Pasiphaea aequus* n. sp.  
 (Figs. 1-3, 21A)

Material Examined.—Holotype: Donggang fishing port, Pingtung County, 4 Jun 1995, male (cl 29.2 mm) [NTOU M00130].

Paratypes: Dasi fishing port, Yilan County, 7 Jul 2011, 1 male (cl 34.8 mm) [NTOU M01161]; Donggang fishing port, Pingtung County, 4 Jun 1995, 4 ovigerous female (cl 27.3-29.4 mm) [NTOU M00131]; 5 Aug 1996, 1 male (cl 31.6 mm), 5 ovigerous females (cl 28.2-32.2 mm) [CBMZC 3859]; 18 Dec 1999, 4 ovigerous females (cl 27.3-32.7 mm) [NTOU M00132]; 19 May 2011, 1 female (cl 23.9 mm) [NMMBCD 0036]; 19 Aug 2011, 2 females (cl 28.5, 34.00 mm) [NMMBCD 0037]; data unknown, 1 male (cl 26.3 mm), 1 ovigerous female (cl 33.5 mm) [NMMCD 0039].

Non-type specimen: "TAIWAN 2010," stn CP 451, 21°47.514'N, 121°22.90'E, 2848-2853 m, 7 May 2010, 1 female (cl 28.7 mm) [NTOU M01069].

Diagnosis.—Rostrum relatively small, triangular in lateral view, terminating in acute tip, directed forward, slightly falling short of frontal margin. Carapace with dorsal surface rounded except for very short carina supporting rostrum, dorsal margin in lateral view faintly sinuous; branchiostegal sinus shallow; branchiostegal tooth marginal. First pleomere rounded dorsally; second to fifth somites flattened dorsally; sixth somite bluntly carinate in anterior 0.7, flattened in posterior 0.3. Telson about 0.9 times as long as sixth pleomere, faintly grooved in dorsal midline; posterior margin truncate or very slightly concave medially. First pereopod with fingers about 0.6 times as long as palm; palm with 2 spiniform setae on mesial face ventrally; merus with 2-6 spines on ventral margin, no minute spiniform setae on dorsal margin distally; ischium and basis devoid of spinules, ventrodiscal angle of basis produced into relatively large tooth. Second pereopod with fingers 0.8-0.9 times as long as palm; merus with 9-16 spines on ventral margin; ischium and basis devoid of spinules, ventrodiscal angle of basis sharply pointed, spiniform. Pleurobranch on eighth thoracic somite normally developed, lamellate.

Description.—Body (Figs. 1, 2A-D) very strongly compressed laterally; integument firm.

Rostrum (Figs. 1, 2B) relatively small for genus, triangular, slightly falling short of frontal margin of carapace, tapering to acute apex directed forward; dorsal margin nearly straight; anterior margin faintly convex inferiorly. Carapace (Figs. 1, 2A, B) about 2.4 times longer than deep, rounded dorsally except for short carina supporting rostrum; frontal margin slightly convex; dorsal margin slightly sinuous in lateral view; lateral face with faint hepatic groove and low

branchial ridge; suborbital lobe roundly triangular; antennal lobe rounded; branchiostegal tooth small, marginal; branchiostegal sinus shallow.

Pleon (Figs. 1, 2C, D) with first somite rounded dorsally; second to fifth somites flattened dorsally. No posterodorsal median tooth on third to sixth somites; posterodorsal margin of fifth somite deeply concave. First pleuron rounded; second pleuron broadly rounded; third to fifth pleuron each with somewhat produced anteroventral angle; ventral margin of fifth pleuron nearly straight. Sixth somite about 1.8 times longer than fifth somite, about 1.5 times longer than deep; dorsal surface bluntly carinate in anterior 0.6, flattened in posterior 0.4, posterodorsal margin convex; lateral face with weak ridge in anterior half. Telson (Fig. 2E, F) about 0.9 times as long as sixth somite; dorsal surface slightly grooved in midline; posterior margin truncate or slightly concave medially, armed with 4 or 5 pairs of spines including one pair at lateral angles.

Cornea (Figs. 1, 2A) darkly pigmented, slightly wider than eyestalk. Antennular peduncle (Fig. 1) moderately stout, slightly overreaching midlength of antennal scale; stylocerite strongly compressed laterally, reaching or slightly overreaching dorsodistal margin of first segment of peduncle, terminating in sharp point dorsodistally. Antenna (Figs. 1, 3A) with basicerite bearing moderately strong ventrolateral distal tooth; antennal scale overreaching thickened aesthetasc-bearing portion of outer antennular flagellum, strongly narrowing distally, about 0.5 times as long as carapace, about 4.2 times longer than wide, lateral margin evenly convex, terminating in small tooth distinctly overreaching very narrow, obliquely subtruncate distal lamella.

Mouthparts typical of genus (not dissected). Third maxilliped (Figs. 1, 3B) reaching or slightly falling short of distal margin of antennal scale; ultimate segment 1.7 times longer than penultimate segment (= carpus); antepenultimate segment with sinuous dorsal margin; exopod slightly falling short of distal margin of antepenultimate segment.

First pereopod (Fig. 3C) overreaching antennal scale by 0.4 length of chela. Fingers strongly curved distally, crossing, about 0.6 times as long as palm, cutting edges finely pectinate. Palm about 4.5 times longer than wide, bearing 2 widely separated minute spiniform setae on mesial face adjacent to flexor margin (Fig. 3D). Carpus with extensor distal margin produced in subacute triangular process, flexor distal margin similarly produced in acute triangular process. Merus with 2-6 spines on ventral margin, but without spiniform setae on dorsal margin distally. Ischium unarmed on ventral margin. Basis with sharp ventrodiscal tooth, ventral margin evenly concave. Exopod reaching proximal 0.4 of merus.

Second pereopod (Fig. 3E) overreaching first pereopod by half-length of fingers. Fingers strongly curved distally, 0.8-0.9 times as long as palm, cutting edges finely pectinate. Palm tapering distally, 3.9-4.0 times longer than greatest width. Carpus with triangular tooth on distolateral margin dorsally, flexor distal margin produced in sharp, spine-like tooth. Merus with 9-16 spines on ventral margin, no spiniform setae on dorsal margin distally. Ischium unarmed on ventral margin. Basis with acute ventrodiscal tooth. Exopod reaching proximal 0.2-0.3 of merus.

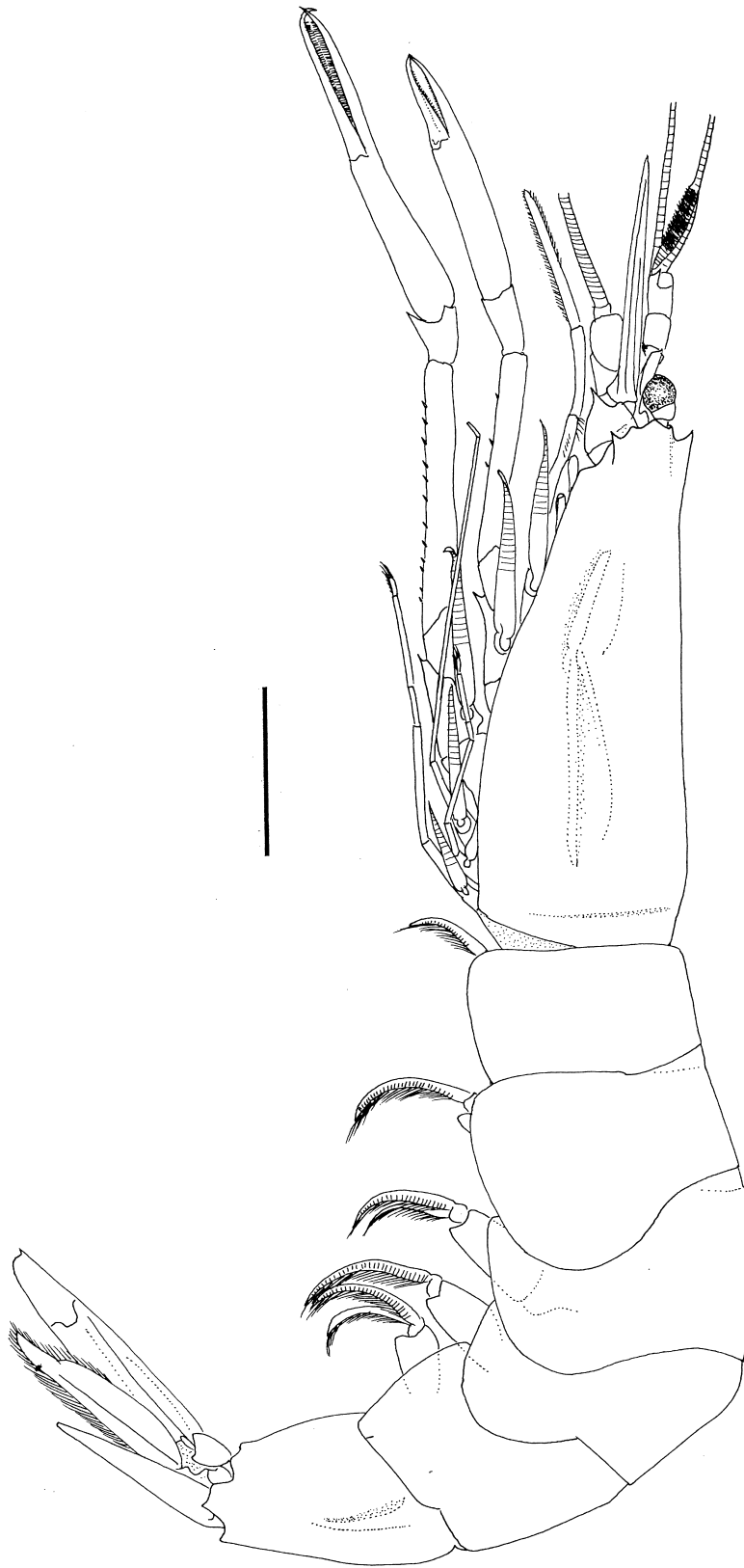


Fig. 1. *Pasiphaea aequus* n. sp., holotype, male (cl 29.2 mm), NTOU M00130, entire animal in lateral view. Scale bar: 10 mm.

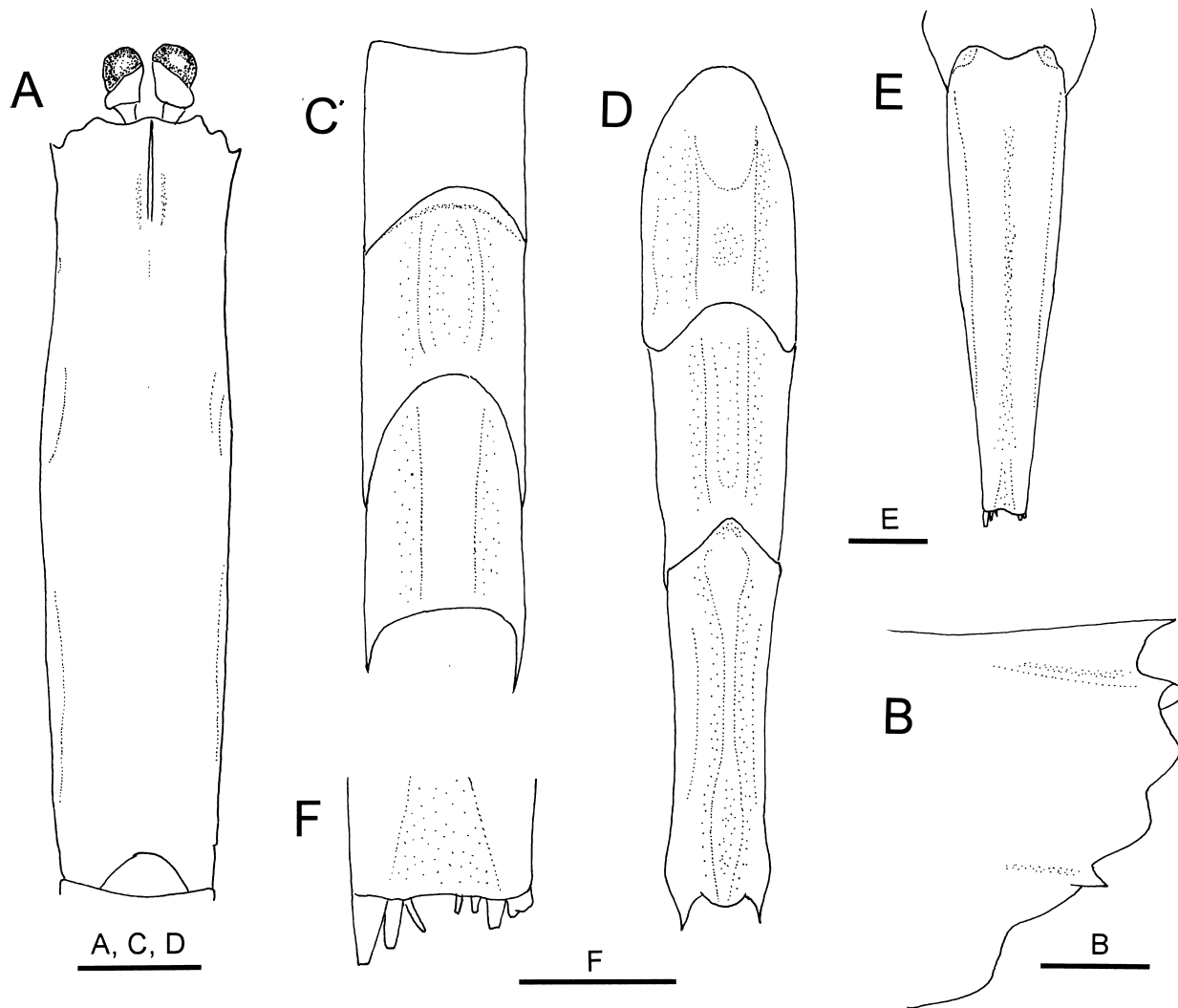


Fig. 2. *Pasiphaea aequus* n. sp., holotype, male (cl 29.2 mm), NTOU M00130. A, Carapace and eyes, dorsal view; B, Anterior part of carapace, right side, lateral view; C, First to third pleomeres, dorsal view; D, Fourth to sixth pleomeres, dorsal view; E, Telson, dorsal view; F, Posterior margin of telson, dorsal view (armature damaged). Scale bars: 5 mm for A, C, D; 2 mm for B, E; 1 mm for F.

Third pereiopod (Fig. 3F) very slender, reaching far short of distal margin of merus of second pereiopod by tip of merus; ischium unarmed; exopod reaching proximal 0.2 of merus. Fourth pereiopod (Fig. 3G) shortest, reaching ventrodistal tooth of basis of second pereiopod; exopod reaching proximal 0.2-0.3 of merus. Fifth pereiopod (Fig. 3H) falling far short of midlength of merus of second pereiopod; exopod overreaching merus.

Branchial formula typical of genus (Table 1); pleurobranch on eighth thoracic somite smaller than smallest arthrobranch, but distinctly lamellate.

Pleopods and uropod (Fig. 1) also typical of genus, without distinctive feature.

Size.—Largest male cl 34.8 mm and largest female cl 33.5 mm, smallest ovigerous female cl 27.3 mm.

Color.—General overall appearance whitish translucent, with some scattered red dots (Fig. 21A). Eyes dark brown. Distal parts of antennal and antennular flagella light red. Fin-

gers of first and second pereiopods sometimes also slightly reddish. Tips of uropods reddish.

Distribution.—Known with certainty only from off north-eastern and southwestern Taiwan, mesopelagic to a depth of about 500 m (see “Remarks”).

Etymology.—The Latin “*aequus*,” meaning flat, refers to the flat, plateau-like dorsal surface of the second to fifth pleomeres.

Remarks.—Affinities among the four new species described in this study and close relatives are discussed in the account of *Pasiphaea taiwanica* n. sp. *Pasiphaea aequus* is one of the two large species of this genus in Taiwan. The other local large species is *P. levicarinata*. *Pasiphaea aequus* appears to be mostly restricted to southern Taiwan and much less common than *P. levicarinata*. All except one specimen of this species were collected by commercial trawlers operated to a depth of about 500 m. The specimen collected at much greater depths from station CP 451 (though the shrimp

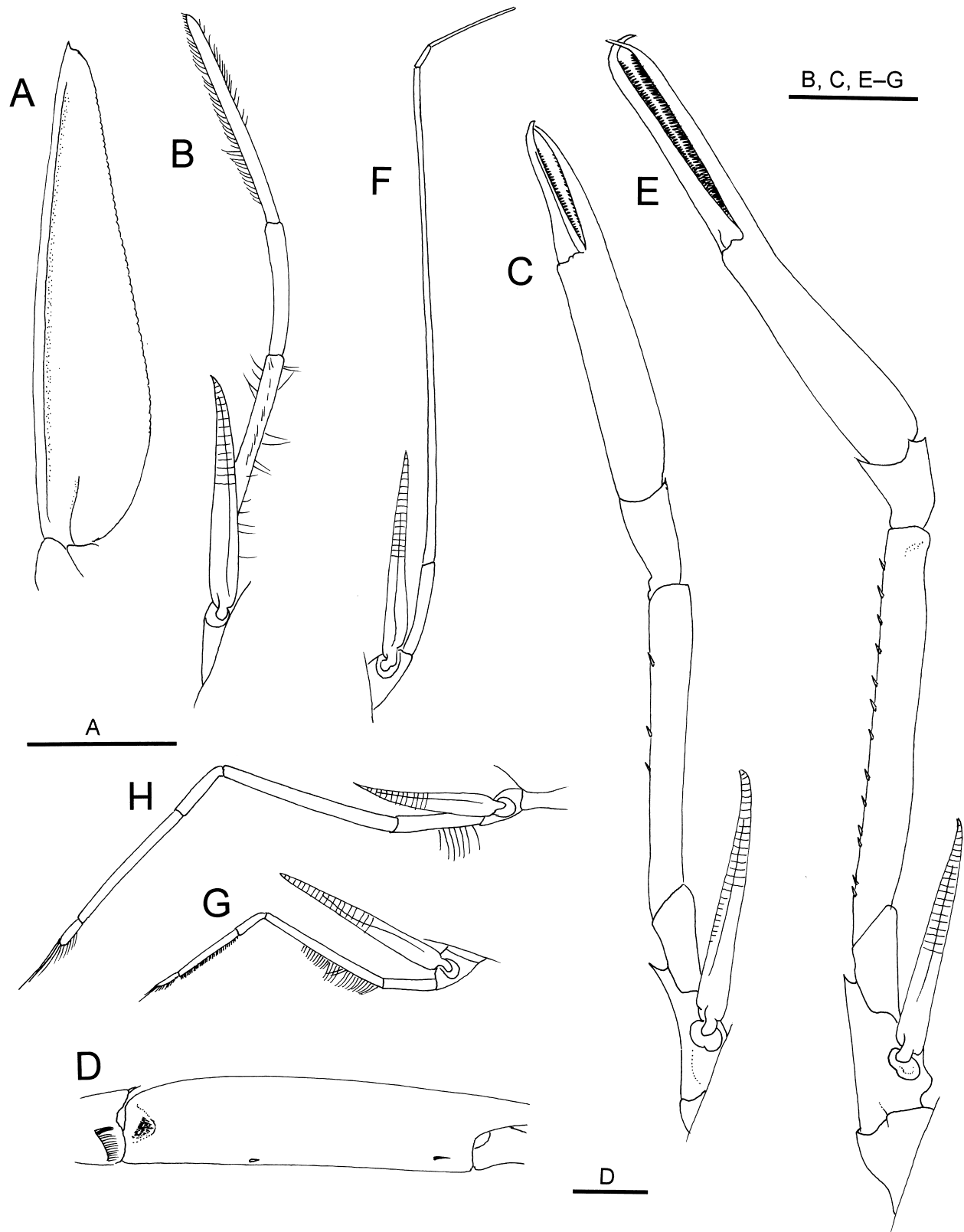


Fig. 3. *Pasiphaea aequus* n. sp., holotype, male (cl 29.2 mm), NTOU M00130. A, Left antennal scale, dorsal view (marginal setae omitted); B, Left third maxilliped, lateral view; C, Left first pereiopod, lateral view; D, Same, palm, mesial view; E, Left second pereiopod, lateral view; F, Right third pereiopod, lateral view (distal part of propodus broken off); G, Left fourth pereiopod, lateral view; H, Left fifth pereiopod, lateral view. Setae on exopods of thoracic appendages are omitted. Scale bars: 5 mm for A-C, E-H; 2 mm for D.

Table 1. Branchial-exopod formula of the four new species of *Pasiphaea* described in this study.

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
Pleurobranch	0	0	0	1	1	1	1	1
Arthrobranch	0	0	0	1	1	1	0	0
Podobranch	0	0	0	0	0	0	0	0
Epipod	0	0	0	0	0	0	0	0
Exopod	0	0	1	1	1	1	1	1

is mesopelagic and might actually be caught at shallower depths) has the telson missing and with 16-19 meral spines on the ventral margin of the merus of the second pereiopod, as compared to 9-16 ventral spines in the others. Thus, it is not certain if the CP 451 specimen truly belong to *P. aequus*.

*Pasiphaea alcocki* (Wood-Mason and Alcock, 1891)  
(Figs. 4, 21B, C)

*Parapasiphaea Alcocki* Wood-Mason and Alcock, 1891: 196 [type locality: Bay of Bengal].

*Pasiphaea (Phye) Alcocki* – Wood-Mason, 1892: pl. 3-fig. 5.

*Phye Alcocki* – Wood-Mason, 1893: 164; Alcock and McArdle, 1901: pl. 52-fig. 6.

*Pasiphaea (Phye) alcocki* – Alcock, 1901: 61.

*Pasiphaea alcocki* – Hayashi, 2006a: 197 (with full synonymy), figs. 1, 2A-P, 3A-E.

Material Examined.—Dasi fishing port, Yilan County, 21 Mar 1984, 2 ovigerous females (cl 15.4, 16.1 mm), 4 females (cl 14.3-16.0 mm) [NTOU M01091]; 2 Nov 1995, 2 ovigerous females (cl 17.8-18.0 mm), 8 females (cl 15.2-19.0 mm) [NTOU M00128]; 27 May 1997, 1 female (cl 15.3 mm) [NTOU M01092]; Dec 1997, 1 female (cl 16.2 mm), 2 damaged specimens (cl 14.1, 16.2 mm) [NTOU M01093]; 20 May 1998, 1 female (cl 21.3 mm) [NTOU M01094]; 28 May 1998, 1 ovigerous female (cl 17.3 mm) [CBM-ZC 4495]; 19 Jan 1999, 4 ovigerous females (cl 17.3-18.0 mm), 2 females (cl 13.7, 16.0 mm) [NTOU M01095]; 1 Oct 1999, 1 ovigerous female (cl 19.0 mm) [NTOU M01096]; 7 Oct 1999, 2 ovigerous females (cl 19.3-20.7 mm), 2 females (cl 13.9-17.5 mm) [NTOU M01097]; 7 Jan 2000, 1 male (cl 14.4 mm), 1 ovigerous female (15.9 mm), 3 females (cl 16.0-17.7 mm) [NTOU M01098]; 12 Apr 2000, 1 ovigerous female (cl 17.0 mm) [NTOU M01099]; 12 Mar 2001, 4 females (cl 15.3-16.5 mm) [NTOU M01100]; 30 Mar 2001, 1 male (cl 16.4 mm), 1 ovigerous female (cl 18.7 mm), 7 females (cl 15.2-19.4 mm), 1 cephalothorax (cl 18.7 mm) [NTOU M01101]. “TAIWAN 2000” stn CP 30, 22°10.0’N, 120°15.9’E, 794-850 m, 30 Jul 2000, 1 female (cl 13.4 mm) [NTOU M01081]; stn CP 61, 24°47.5’N, 122°17.4’E, 1134-1134 m, 4 Aug 2000, 1 female (cl 12.4 mm), 1 damaged specimen (cl 12.4 mm) [NTOU M01082]. “TAIWAN 2001” stn CP 71, 24°52.33’N, 122°03.10’E, 600 m, 6 May 2001, 2 ovigerous females (cl 15.9, 17.4 mm), 1 female (cl 17.7 mm), 1 juvenile (cl 9.8 mm) [NTOU M01083]; stn CP 72, 24°52.28’N, 122°04.50’E, 760 m, 6 May 2001, 3 ovigerous females (cl 17.4-19.0 mm) [NTOU M01084]; stn CP 120, 24°51.79’N, 122°02.54’E, 520-640 m, 31 Jul 2001, 2 females (cl 15.4, 20.0 mm) [NTOU M01085]; stn CD 131, 22°17.26’N, 120°5.55’E, 732-839 m, 22 Aug 2001, 2 females (cl 13.3,

15.1 mm) [NTOU M01086]. “TAIWAN 2005” stn PCP 329, 22°20.881’N, 120°6.715’E, 691-710 m, 4 Oct 2005, 1 female (cl 13.8 mm) [NTOU M01087]. “TAIWAN 2006” stn PCP 363, 22°09.305’N, 121°07.353’E, 1262-1269 m, 24 Aug 2006, 1 female (cl 15.0 mm) [NTOU M01088]. “TAIWAN 2008” stn PCP 437, 22°18.736’N, 121°4.335’E, 1179-1203 m, 12 Jul 2008, 1 male (cl 16.1 mm) [NTOU M01089]. “TAIWAN 2010” stn PCP 454, 22°21.047’N, 120°6.132’E, 692-743 m, 24 Jul 2010, 2 ovigerous females (cl 14.9, 16.0 mm) [NTOU M01090].

Diagnosis.—Body integument not firm. Rostrum (Fig. 4A) triangular with anterior margin gently concave to nearly straight, tip directed forward, not reaching frontal margin of carapace. Carapace (Fig. 4A) with dorsal margin slightly sinuous in lateral view, anterior two-thirds slightly sloping down; branchiostegal sinus shallow; branchiostegal tooth submarginal, exceeding well beyond anterolateral margin. First to fifth pleomeres rounded dorsally; sixth pleomere bluntly carinate dorsally. Telson shorter than sixth pleomere, shallowly grooved in dorsal midline; posterior margin deeply forked, each terminal margin with 8-10 spines including prominent one located at posterolateral angle (Fig. 4C). First pereiopod with fingers 0.9-1.0 times as long as palm; palm with 2-4 minute spiniform setae on mesial face ventrally; merus with 1-5 spines on ventral margin; ischium and basis devoid of spinules, ventrodorsal angle of basis angular or bluntly pointed. Second pereiopod with fingers 1.2-1.3 times longer than palm; merus with 7-14 spines on ventral margin; ischium and basis devoid of spinules, ventrodorsal angle of basis sharply pointed, spiniform. Pleurobranch on eighth thoracic somite normally developed, lamellate.

Size.—The Taiwanese material has the largest male cl 16.4 mm and largest female cl 21.3, with smallest ovigerous female cl 14.9 mm.

Color.—General overall appearance reddish or half red and half white (Fig. 21B, C). Carapace always reddish. Pleon and pereiopods from reddish to densely covered with minute red dots. Eyes dark brown.

Distribution.—Bay of Bengal, Arabian Sea, Indonesia, Philippines and Taiwan (eastern and southern coasts); mesopelagic to bottom depths of 185-1733 m.

Remarks.—This species is redescribed by Hayashi (2006b) on the basis of material from the Philippines, Indonesia and Taiwan. Our examination of the present abundant specimens has shown that the carination of the carapace is variable in this species, although Hayashi (2006) described that the carapace was dorsally carinate. Only in the spawning molts, the carapace is sharply carinate, whereas in males and non-spawning females, the dorsal midline of the carapace is rounded or at most bluntly carinate in the anterior half. Nevertheless, this species is easily recognizable by the combination of the characters mentioned under “Diagnosis.”

It is remarkable that 30 of 81 specimens (37%) examined in this study are parasitized by ellobiopsid protozoan. The parasite causes deformation and reduction of the frontal region of the rostrum (Fig. 4B, also see Butler, 1980).

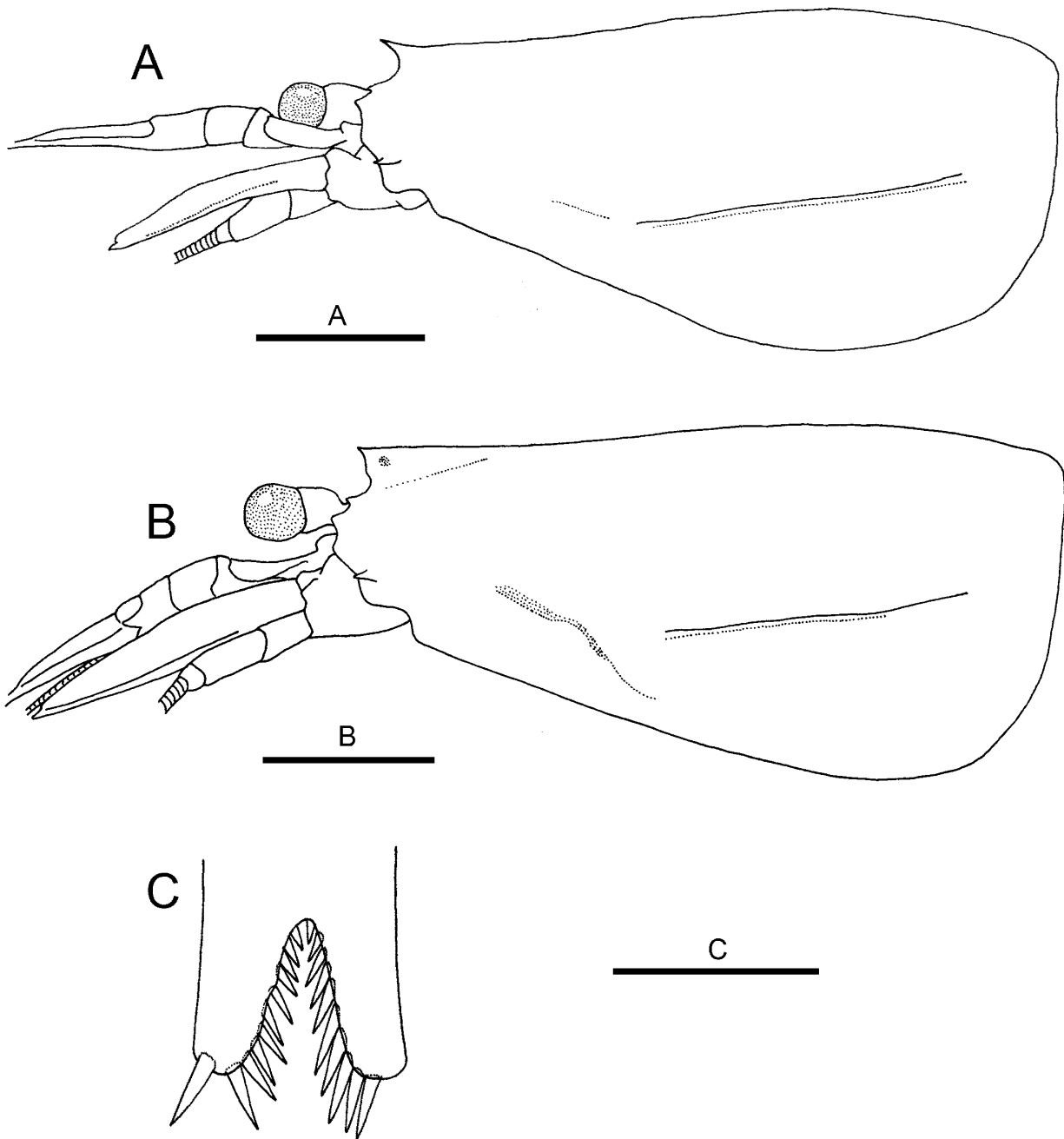


Fig. 4. *Pasiphaea alcocki* (Wood-Mason, 1891). A, Ovigerous female (cl 20.7 mm), NTOU M01097; B, C, Female (cl 21.3 mm), NTOU M01094. A, Carapace, left side, lateral view; B, Carapace, left side, lateral view, with ellobiosid parasite removed from rostrum (indicated by the scar); C, Posterior margin of telson, dorsal view. Scale bars: 5 mm for A, B; 1 mm for C.

*Pasiphaea exilimanus* n. sp.  
(Figs. 5-7, 21D)

Material Examined.—Holotype: “TAIWAN 2001” stn CD 123, 24°50.58’N, 122°17.31’E, 690-700 m, 21 Nov 2001, ovigerous female (cl 19.3 mm) [NTOU M01133].

Paratypes: “TAIWAN 2000” stn DW 17, 22°24.2’N, 120°10.4’E, 451-545 m, 29 Jul 2000, 1 female (cl 13.9 mm) [NTOU M01071]. “TAIWAN 2001” stn CD 123, 24°50.58’N, 122°17.31’E, 1175-1255 m, 1 Aug 2001, 1 ovigerous female (cl 18.9 mm) [NTOU M01134]; stn CD 131, 22°17.26’N, 120°5.55’E, 732-839 m, 22 Aug

2001, 1 male (cl 22.8 mm) [NTOU M01072]; stn CP 132, 22°20.98’N, 120°6.73’E, 690-700 m, 21 Nov 2001, 1 female (cl 18.7 mm) [NTOU M01073]; stn CD 135, 22°17.21’N, 120°0.28’E, 961-1112 m, 22 Nov 2001, 1 male (cl 21.3 mm) [NTOU M01074]; stn IK 181, 22°21.09’N, 119°36.6’E, 1335-1618 m, 25 Aug 2001, 2 males (cl 20.9, 22.4 mm) [NTOU M01075]; stn IK 182, 22°17.02’N, 119°29.98’E, 1645-1946 m, 26 Aug 2001, 1 ovigerous female (cl 21.0 mm) [CBM-ZC 10468]; stn CP 183, 21°58.22’N, 119°27.99’E, 2519-2556 m, 26 Aug 2001, 1 male (cl 20.9 mm) [NTOU M01076]; stn CP 192,

22°17.19'N, 120°1.01'E, 960-1302 m, 28 Aug 2001, 1 male (cl 20.9 mm), 1 ovigerous female (cl 21.3 mm), 1 female (20.8 mm) [NTOU M01077]. "TAIWAN 2003" stn IK 204, 21°47.35'N, 120°29.7'E, 1110 m, 29 May 2003, 2 males (cl 19.2, 20.0 mm), 1 ovigerous female (cl 22.3 mm), 2 females (cl 20.4, 20.6 mm) [NTOU M01078]. "TAIWAN 2008" stn PCP 447, 22°12.384'N, 120°14.423'E, 813-819 m, 14 Jul 2008, 1 male (cl 21.0 mm) [NTOU M01079]. Cold seep cruise, stn T-CP 02, 22°11.203'N, 119°54.169'E, 1173-1370 m, 6 June 2009, 1 female (cl 20.2 mm) [NTOU M01070]. "TAIWAN 2010" stn PCP 460, 22°20.815'N, 120°00.603'E, 889-964 m, 26 Jul 2010, 1 ovigerous female (cl 21.6 mm) [NTOU M01080].

**Diagnosis.**—Body integument moderately firm. Rostrum directed slightly dorsally, terminating in sharp tooth, reaching or slightly falling short of frontal margin; anterior margin evenly concave, slightly sinuous or straight. Carapace with dorsal surface almost rounded except for short ridge supporting rostrum, in lateral view dorsal margin very slightly sinuous; branchiostegal sinus shallow; branchiostegal tooth submarginal, exceeding well beyond anterolateral margin. First to sixth pleomeres rounded dorsally; no posterodorsal median tooth on third or sixth somite. Telson 0.7-0.8 times as long as sixth pleomere, shallowly grooved in dorsal midline; posterior margin truncate or very slightly concave medially. First pereopod with fingers 0.9-1.0 in length to palm; palm with 5-6 minute spiniform setae; merus with 2-9 spines on ventral margin; ischium and basis devoid of spinules, ventrodiscal angle of basis sharply pointed, spiniform; second pereopod with fingers 1.2-1.3 times longer than palm; merus with 15-20 spines on ventral margin; ischium and basis devoid of spinules, ventrodiscal angle of basis sharply pointed, spiniform. Pleurobranch on eighth thoracic somite normally developed, lamellate.

**Description.**—Body (Figs. 5, 6A-C) strongly compressed laterally; integument moderately firm.

Rostrum (Figs. 5, 7A) moderately small, directed slightly dorsally, tapering to spiniform tip, reaching or slightly falling short of frontal margin; dorsal margin nearly straight; anterior margin evenly concave, slightly sinuous or straight. Carapace (Figs. 5, 6A, 7A) rounded dorsally except for short carina supporting rostrum; frontal margin broadly triangular; dorsal margin slightly sinuous in lateral view; lateral face with shallow hepatic groove and low branchial ridge; suborbital lobe rounded; antennal lobe broadly rounded; branchiostegal tooth small, submarginal, reaching well beyond anterolateral margin, directed forward; branchiostegal sinus shallow.

All pleomeres (Figs. 5, 6B, C) rounded dorsally; no posterodorsal median tooth on third to sixth somites. Posterodorsal margin of fifth somite deeply concave. First pleuron subrectangular with rounded ventral angles; second pleuron broadly rounded; anteroventral angles of third to fifth pleura slightly produced anteriorly; ventral margin of fifth pleuron slightly concave. Sixth somite about 1.9 times longer than fifth somite, 1.9 times longer than deep; lateral arcuate ridge poorly delimited; posterodorsal margin slightly convex. Telson (Figs. 6D, E) about 0.7 times as long as sixth somite; dorsal surface shallowly grooved in midline; poste-

rior margin truncate, armed with 4 or 5 pairs of spines including 1 pair at lateral angles.

Cornea (Figs. 5, 6A) darkly pigmented, wider than eye-stalk. Antennular peduncle (Fig. 5) moderately stout, distinctly overreaching midlength of antennal scale; stylocerite strongly compressed laterally, slightly falling short of dorsodistal margin of first segment of peduncle, terminating in sharp point dorsodistally. Antenna (Figs. 5, 7B) with basicerite bearing moderately strong ventrolateral distal tooth; antennal scale not reaching thickened aesthetasc-bearing portion of outer antennular flagellum, about 0.4-0.5 times as long as carapace, 3.4-3.6 times longer than wide, lateral margin evenly convex, terminating in small tooth which distinctly overreaching rounded distal lamella.

Mouthparts typical of genus (not dissected). Third maxilliped (Fig. 7C) overreaching base of distolateral tooth of antennal scale; ultimate segment 1.8 times longer than penultimate segment (= carpus); antepenultimate segment with sinuous dorsal margin; exopod reaching midlength of penultimate segment.

First pereopod (Fig. 7D) overreaching antennal scale by half-length of chela. Fingers weakly curved distally, crossing, 0.8-0.9 times as long as palm; cutting edges finely pectinate. Palm 4.0-4.5 times longer than wide, bearing row of 5 or 6 minute spiniform setae on mesial face adjacent to flexor margin (Fig. 7E). Carpus with rounded extensor distal margin; flexor distal margin weakly produced in small tooth. Merus with 2-9 spines on ventral margin, with few minute spiniform setae on dorsal margin distally. Ischium unarmed on ventral margin. Basis bearing small ventrodiscal tooth, ventral margin evenly concave. Exopod reaching midlength of merus.

Second pereopod (Fig. 7F) overreaching first pereopod by 0.3 length of fingers. Fingers weakly curved distally, 1.2-1.4 times longer than palm; cutting edges finely pectinate. Palm slender, tapering distally. Carpus with acute or subacute triangular process on distolateral margin dorsally, flexor distal margin produced into slender, spine-like tooth. Merus with 13-20 spines on ventral margin. Ischium unarmed on ventral margin. Basis with small ventrodiscal tooth. Exopod reaching proximal 0.3 of merus.

Third pereopod (Fig. 7G) very slender, falling short of distal margin of merus of second pereopod; ischium unarmed; exopod reaching beyond proximal 0.2 of merus. Fourth pereopod (Fig. 7H) shortest, reaching ventrodiscal tooth of basis of second pereopod; exopod slightly overreaching distal margin of merus. Fifth pereopod (Fig. 7I) not reaching midlength of merus of second pereopod; exopod reaching proximal 0.3 of merus.

Branchial formula typical of genus (Table 1); pleurobranch on eighth thoracic somite smaller than smallest arthrobranch, but distinctly lamellate.

Pleopods and uropod (Fig. 5) also typical of genus.

**Size.**—Largest male cl 22.4 mm and largest female cl 22.3 mm, smallest ovigerous female cl 18.9 mm.

**Color.**—General overall appearance reddish or half red and half white, with dense red dots (Fig. 21D). Ventral part of carapace and pleomeral pleura often more reddish or with red dots more prominent; dorsal half of carapace, pleomeral





Fig. 5. *Pasiphaea exilimanus* n. sp., holotype, ovigerous female (cl 19.3 mm), NTOU M01133, entire animal in lateral view. Scale bar: 10 mm.

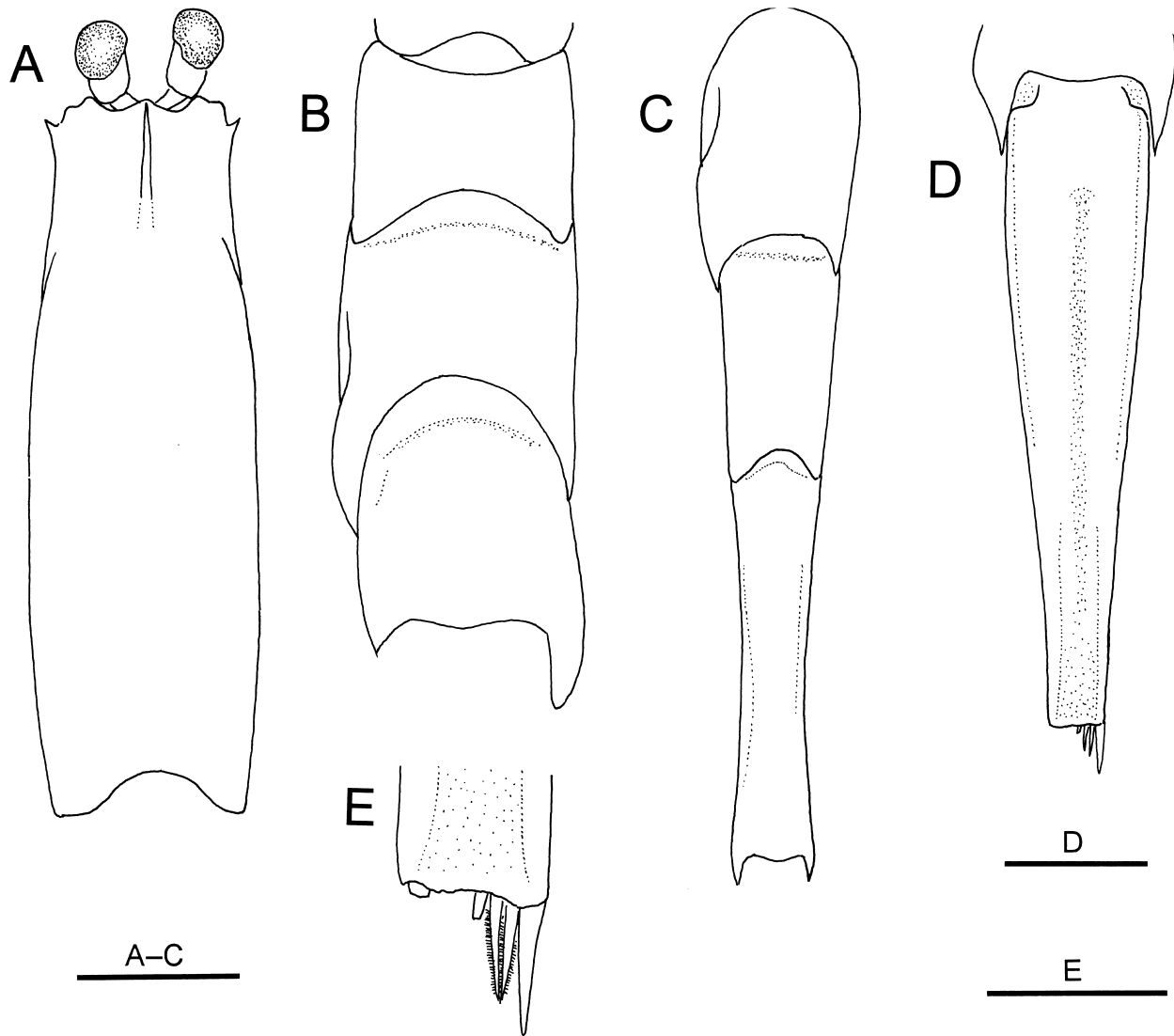


Fig. 6. *Pasiphaea exilimanus* n. sp., holotype, ovigerous female (cl 19.3 mm), NTOU M01133. A, Carapace and eyes, dorsal view; B, First to third pleomeres, dorsal view; C, Fourth to sixth pleomeres, dorsal view; D, Telson, dorsal view; E, Posterior margin of telson, dorsal view (armature damaged). Scale bars: 5 mm for A-C; 2 mm for D, E; 1 mm for E.

tergites and basal segments of pereiopods lighter in color and sometimes even mostly whitish translucent. Eyes dark brown. Eggs vermilion.

Distribution.—Known only from the northeastern and southwestern coasts of Taiwan, mesopelagic to bottom depths of 451 to 2556 m.

Etymology.—Combination of the Latin *exilis* (= slender) and *manus* (= hand), in reference to the relatively slender palm of the second pereiopod of this new species. Used as a noun in apposition.

Remarks.—Affinities among the four new species described in this study and close relatives are discussed in the account of *Pasiphaea taiwanica* n. sp.

*Pasiphaea falx* n. sp.  
(Figs. 8-10, 21E, F)

Material Examined.—Holotype: “TAIWAN 2010” stn PCP 453, 21°0.438’N, 120°9.814’E, 611-714 m, 24 Jul 2010, ovigerous female (cl 23.8 mm) [NTOU M01135].

Paratypes: “TAIWAN 2001” stn CP 137, 22°12.92’N, 120°25.93’E, 316-477 m, 23 Nov 2001, 1 female (cl 24.0 mm) [NTOU M01063]; stn IK 181, 22°21.09’N, 119°36.6’E, 1335-1618 m, 25 Aug 2001, 1 ovigerous female (cl 15.6 mm), 1 female (cl 11.7 mm) [NTOU M01064]. “TAIWAN 2003” stn IK 204, 21°47.35’N, 120°29.7’E, 1110 m, 29 May 2003, 1 male (cl 22.8 mm), [NTOU M01065]. “TAIWAN 2005” stn IK 305, 22°10.596’N, 120°14.026’E, 852-800 m, 15 Aug 2005, 1 female (cl 22.5 mm) [NTOU M01066]. “TAIWAN 2008,” stn PCP 447, 22°12.384’N, 120°14.423’E, 813-819 m, 14 Jul 2008, 1 female (cl 24.2 mm) [CBM-ZC 10469]; stn IK 448, 22°8.265’N, 120°17.095’E, 627-804 m, 14 Jul 2008,

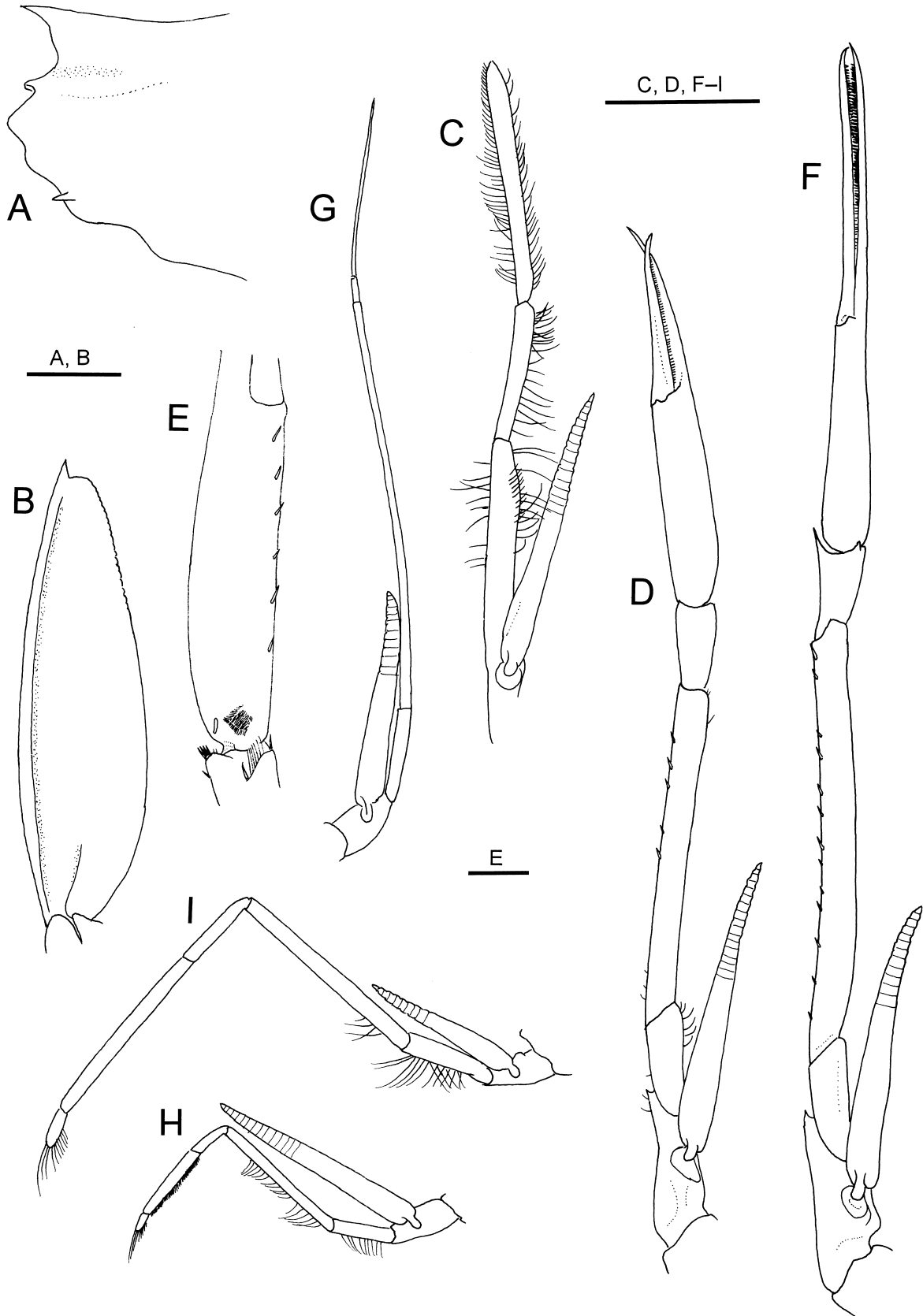


Fig. 7. *Pasiphaea exilimanus* n. sp., holotype, ovigerous female (cl 19.3 mm), NTOU M01133. A, Anterior part of carapace, left side, lateral view; B, Left antennal scale, dorsal view (marginal setae omitted); C, Left third maxilliped, lateral view; D, Left first pereiopod, lateral view; E, Same, palm, mesial view; F, Left second pereiopod, lateral view; G, Right third pereiopod, lateral view (distal part of propodus broken off); H, Left fourth pereiopod, lateral view; I, Left fifth pereiopod, lateral view. Setae on exopods of thoracic appendages are omitted. Scale bars: 5 mm for C, D, F-I; 2 mm for A, B; 1 mm for E.

2 ovigerous females (cl 23.4, 23.5 mm) [NTOU M01067]. Cold seep cruise, stn T-CP 02, 22°11.203'N, 119°54.169'E, 1173-1370 m, 6 June 2009, 1 male (cl 22.7 mm) [NTOU M01062].

**Diagnosis.**—Body integument firm. Rostrum elongate slender, acuminate, directed slightly dorsally (angle against horizontal plane of carapace about 30°), distinctly overreaching frontal margin of carapace, even reaching midlength of eye-stalks. Carapace with dorsal margin sharply carinate in anterior one-fourth, rounded in posterior three-fourths, dorsal margin in lateral view slightly sinuous; branchiostegal sinus shallow; branchiostegal tooth submarginal, far exceeding anterolateral margin. First pleomere rounded dorsally; second somite flattened or slightly sulcate dorsally; third somite flattened or slightly sulcate dorsally, but posterior 0.2 bluntly carinate; fourth somite flattened dorsally, anterior half of median part faintly depressed; fifth somite with anterior half of median part faintly sulcate, posterior half slightly elevated; sixth somite bluntly carinate dorsally; no posterodorsal median tooth on third or sixth pleomere. Telson subequal in length to sixth pleomere, shallowly grooved in dorsal midline; posterior margin truncate. First pereopod with fingers 0.7-0.8 times as long as palm; palm with 4-5 spiniform setae on mesial face ventrally; merus with 3-8 spines on ventral margin; ischium and basis devoid of spinules, ventrodorsal angle of basis sharply pointed, spiniform. Second pereopod with fingers 0.9 times as long as palm; merus with 5-19 (usually 10-19) spines on ventral margin; ischium and basis devoid of spinules, ventrodorsal angle of basis sharply pointed, spiniform. Pleurobranch on eighth thoracic somite normally developed, lamellate.

**Description.**—Body (Figs. 8, 9A-C) strongly compressed laterally; integument firm. Rostrum (Figs. 8, 10A) elongate, sickle-like, far overreaching frontal margin of carapace (even reaching midlength of eyes), directed slightly dorsally; dorsal margin slightly convex; anterior margin concave inferiorly. Carapace (Figs. 8, 9A, 10A) 2.0-2.1 times longer than deep, rounded dorsally except for sharply carinate anterior 0.2; frontal margin slightly convex; dorsal margin slightly sinuous in lateral view; lateral face with shallow hepatic groove and low branchial ridges; suborbital lobe obtuse; antennal lobe rounded; branchiostegal tooth small, submarginal, directed somewhat ventrally; branchiostegal sinus shallow.

Pleon (Figs. 8, 9B, C) with first somite rounded dorsally; second to fifth somites flattened dorsally; dorsal plateau on third somite narrowed posteriorly to low blunt carina, that on fourth somite shallowly depressed medially, that on fifth somite slightly sulcate in anterior half, slightly elevated in posterior half. No posterodorsal median tooth on third to sixth somites; posterodorsal margin of fifth somite deeply concave. First pleuron rounded; second pleuron broadly rounded; third to fifth pleura each with slightly produced anteroventral angle; ventral margin of fifth pleuron distinctly sinuous. Sixth somite about 1.7-1.8 times longer than fifth somite, about 1.6 times longer than deep; dorsal surface bluntly carinate, posterodorsal margin produced in rounded lobe; lateral face with distinct, arcuate ridge almost over entire length. Telson (Fig. 9D, E) subequal in length to sixth somite; dorsal surface slightly grooved in midline; posterior

margin truncate or slightly concave medially, armed with 4 or 3 pairs of setulose spines flanked by slightly longer, much stouter pair at lateral angles.

Cornea (Figs. 8, 9A) darkly pigmented, slightly wider than eyestalk. Antennular peduncle (Fig. 8) moderately stout, slightly overreaching midlength of antennal scale; stylocerite strongly compressed laterally, falling short of dorsodistal margin of first segment of peduncle, terminating in sharp point dorsodistally. Antenna (Figs. 8, 10B) with basicerite bearing moderately strong ventrolateral distal tooth; antennal scale reaching thickened aesthetasc-bearing portion of outer antennular flagellum, moderately narrowing distally, about 0.5 times as long as carapace, about 3.8 times longer than wide, lateral margin evenly convex, terminating in a small tooth which distinctly overreaching the very narrow, obliquely rounded distal lamella.

Mouthparts typical of genus (not dissected). Third maxilliped (Fig. 10C) slightly overreaching distal lamella of antennal scale; ultimate segment 1.6 times longer than penultimate segment (= carpus); antepenultimate segment with faint convexity on dorsal margin distally. Exopod slightly overreaching distal margin of antepenultimate segment.

First pereopod (Fig. 10D) overreaching antennal scale by 0.7-0.8 length of chela. Fingers strongly curved distally, crossing, 0.7-0.8 times as long as palm, cutting edges finely pectinate. Palm 4.0-4.5 times longer than wide, bearing row of 4-5 minute spiniform setae on mesial face adjacent to flexor margin (Fig. 10E). Carpus with dorsodistal margin produced in blunt process, ventrodorsal margin similarly produced in blunt process. Merus with 3-8 spines on ventral margin, but with some minute spiniform setae on dorsal margin distally. Ischium unarmed on ventral margin. Basis with sharp ventrodorsal tooth, ventral margin evenly concave. Exopod reaching proximal 0.4 of merus.

Second pereopod (Fig. 10G) overreaching first pereopod by half length of fingers. Fingers gently curved distally, about 0.9 times as long as palm, cutting edges finely pectinate. Palm tapering distally, 5.0-5.5 times longer than greatest width. Carpus with triangular tooth on distolateral margin dorsally, dorsodistal margin produced in sharp, spine-like tooth. Merus with 5-19 (usually 10-19) spines on ventral margin. Ischium unarmed on ventral margin; basis with acute ventrodorsal tooth; exopod reaching proximal 0.2-0.3 of merus.

Third pereopod (Fig. 10H) very slender; ischium unarmed; exopod reaching proximal 0.2 of merus. Fourth pereopod (Fig. 10I) shortest; exopod almost reaching distal margin of merus. Fifth pereopod (Fig. 10J) slightly falling short of midlength of merus of second pereopod; exopod reaching proximal 0.2 of merus.

Branchial formula typical of genus (Table 1); pleurobranch on eighth thoracic somite smaller than smallest arthrobranch, but distinctly lamellate.

Pleopods and uropod (Fig. 8) also typical of genus, without distinctive feature.

**Size.**—Largest male cl 22.8 mm and largest female cl 24.2 mm, smallest ovigerous female cl 15.6 mm.

**Coloration.**—General overall appearance reddish or half red and half white (Fig. 21E, F). Body either entirely vermilion or whitish translucent and densely covered with red dots,

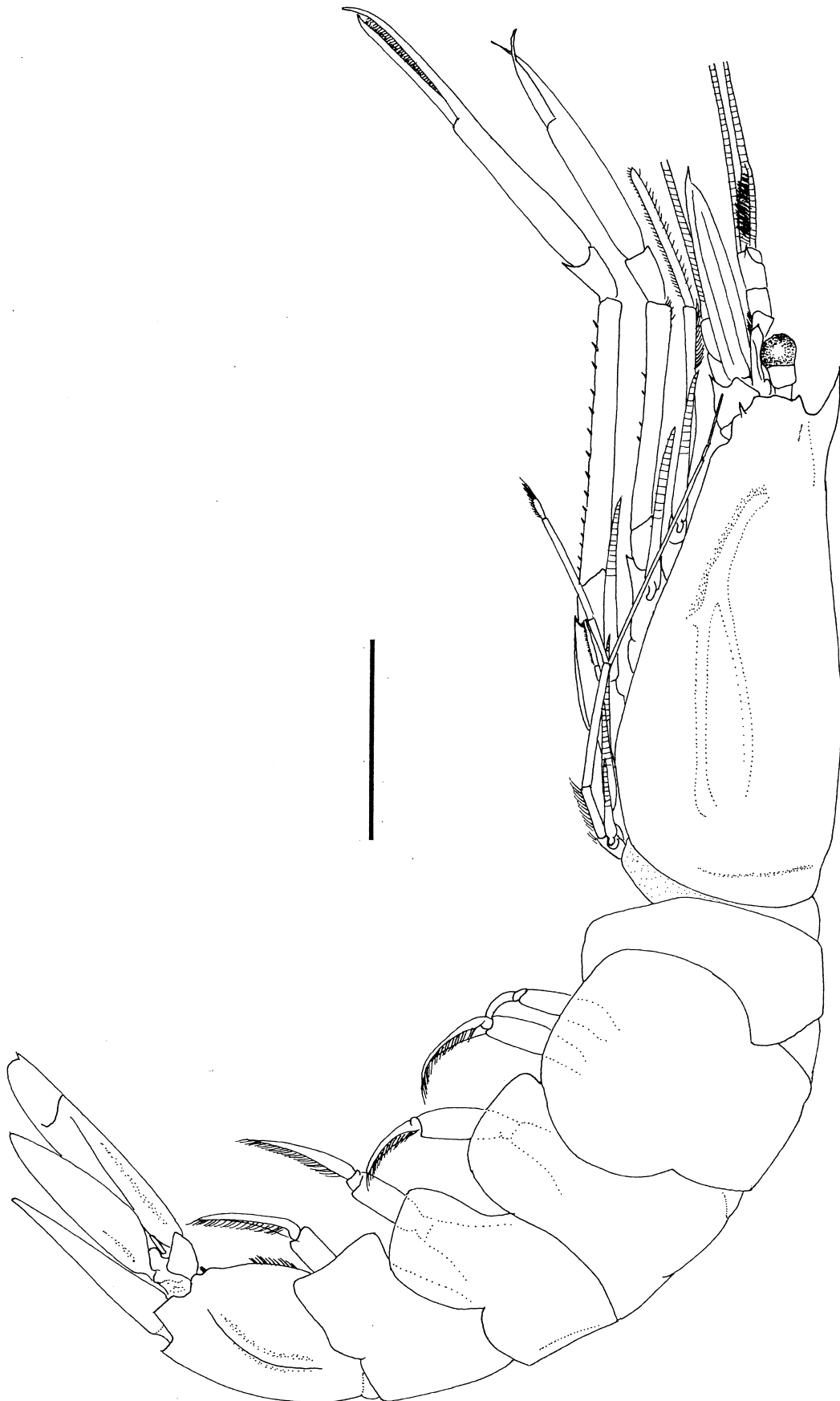


Fig. 8. *Pasiphaea falx* n. sp., holotype, ovigerous female (cl 23.8 mm), NTOU M01135, entire animal in lateral view. Scale bar: 10 mm.

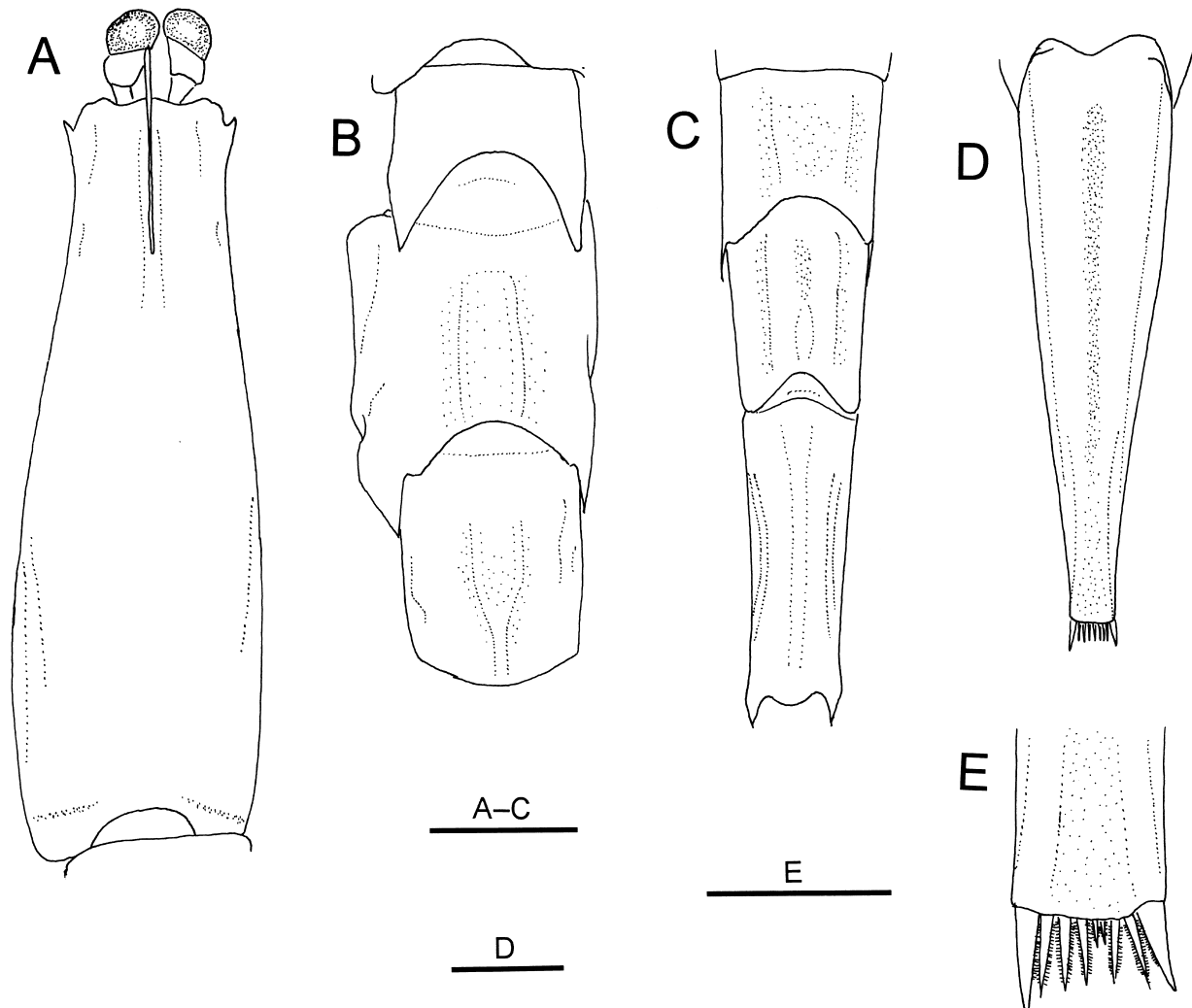


Fig. 9. *Pasiphaea falx* n. sp., holotype, ovigerous female (cl 23.8 mm), NTOU M01135. A, Carapace and eyes, dorsal view; B, First to third pleomeres, dorsal view; C, Fourth to sixth pleomeres, dorsal view; D, Telson, dorsal view; E, Posterior margin of telson, dorsal view. Scale bars: 5 mm for A-C; 2 mm for D, E; 1 mm for E.

with ventral carapace, pleomeral pleura and tail fan more reddish. Eyes dark brown.

Distribution.—Known only from southwestern Taiwan, mesopelagic to bottom depths of 316-1618 m.

Etymology.—The specific name, *falx* (= sickle), refers to the characteristic shape of the rostrum. Used as a noun in apposition.

Remarks.—Affinity of this new species is discussed in detail in the account of *Pasiphaea taiwanica* n. sp. *Pasiphaea falx* superficially resembles *P. amplidens* Bate, 1888, which has been assigned to the *P. cristata* group (Hayashi, 2004) in having an elongate, sickle-like rostrum, but it is easily distinguished from the latter in the dorsally flattened second

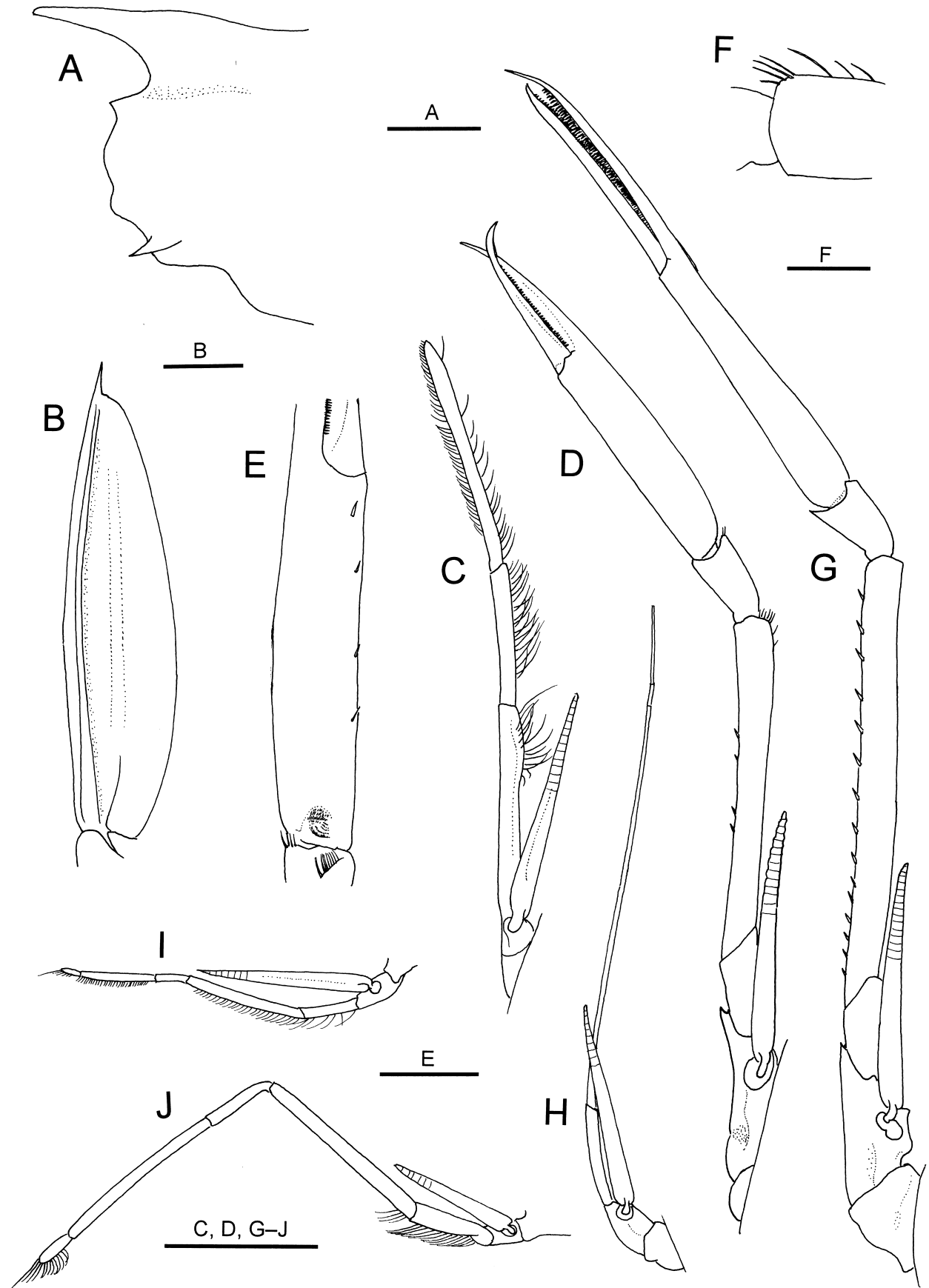
to fifth pleomeres and the possession of two or more spines on the merus of the first pereiopod. In *P. amplidens*, the second to fifth pleomeres are dorsally rounded, and the merus of the first pereiopod is usually unarmed or rarely has one or two spines (Komai et al., 2000; Hayashi, 2004).

*Pasiphaea japonica* Omori, 1976  
(Figs. 11, 22A)

*Pasiphaea sivado*: Kubo, 1965: 605, unnumbered fig. [Not *Pasiphaea sivado* (Risso, 1816).]

*Pasiphaea japonica* Omori, 1976: 250, figs. 1-8 [type locality: off Iwase, Toyama Bay, Japan]; Miyake, 1982: 26, pl. 9-fig. 6; Hayashi, 1990: 400, figs. 191, 192b, g, 193b; 1999: 198

Fig. 10. *Pasiphaea falx* n. sp., holotype, ovigerous female (cl 23.8 mm), NTOU M01135. A, Anterior part of carapace, left side, lateral view; B, Left antennal scale, dorsal view (marginal setae omitted); C, Left third maxilliped, lateral view; D, Left first pereiopod, lateral view; E, Same, palm, mesial view; F, Same, distal part of merus, lateral view; G, Left second pereiopod, lateral view; H, Right third pereiopod, lateral view (distal part of propodus broken off); I, Left fourth pereiopod, lateral view; J, Left fifth pereiopod, lateral view. Setae on exopods of thoracic appendages are omitted. Scale bars: 5 mm for C, D, G-J; 2 mm for A, B, E; 1 mm for F.



(with full synonymy), fig. 20; 2007: 224, figs. 91, 92c, d, 93b; Burukovsky, 1993: 38, figs. 2, 14-19.

**Material Examined.**—Dasi fishing port, Yilan County, 31 Dec 1984, 1 ovigerous female (cl 16.6 mm) [NTOU M01050]; 25 Nov 1994, 2 males (cl 16.5, 17.8 mm), 12 ovigerous females (cl 15.7-17.6 mm), 4 females (cl 15.0-16.8 mm) [NTOU M00134]; 25 Nov 1994, 1 ovigerous female (cl 16.1 mm) [NTOU M00135]; 13 Jan 1995, 1 male (cl 15.6 mm) [NTOU M00138]; 13 Jun 1995, 6 males (cl 13.2-19.0 mm), 1 ovigerous female (cl 16.1 mm), 13 females (cl 14.5-16.0 mm) [NTOU M00137]; 28 Sep 2007, 2 males (cl 17.0, 17.2 mm) [NTOU M00999]; 5 Mar 2011, 2 males (cl 10.5, 15.8 mm), 7 ovigerous females (cl 14.2-15.6 mm), 3 females (cl 11.5-15.39 mm) [NTOU M01051]; 30 May 2011, 2 males (cl 14.1, 15.4 mm) [NTOU M00139]; 30 Jun 2011, 1 ovigerous female (cl 15.2 mm) [NTOU M01138]. “TAIWAN 2003” stn IK 200, 21°58.2'N, 120°35.24'E, 371 m, 28 May 2003, 1 female (cl 13.2 mm) [NTOU M01046]; stn IK 201, 22°36'N, 120°28.86'E, 667 m, 28 May 2003, 1 female (cl 17.3 mm) [NTOU M01047]; stn IK 222, 24°20.986'N, 121°50.049'E, 931-1101 m, 28 Aug 2003, 1 male (cl 17.1 mm), 3 females (cl 9.47-15.6 mm) [NTOU M01048]. “TAIWAN 2004” stn IK 240, 25°10.97'N, 122°34.22'E, 955-1098 m, 24 Jul 2004, 4 males (cl 15.5-15.9 mm), 1 ovigerous female (cl 15.2 mm), 1 female (cl 13.0 mm) [NTOU M01049].

**Diagnosis.**—Body integument moderately firm. Rostrum (Fig. 11A) short, narrow triangular with acute tip in lateral view, directed anterodorsally, not reaching frontal margin of carapace. Carapace (Fig. 11A) dorsally rounded except for rostrum; dorsal margin nearly straight in lateral view; branchiostegal sinuous very shallow. All pleomeres rounded dorsally; third somite unarmed on posterodorsal margin; sixth somite armed with small, sharp posteromedian tooth. Posterior margin of telson truncate, with 4 pairs of spines (Fig. 11B). First pereopod with fingers about 0.9 times as long as palm; palm with 2 spiniform setae on mesial face ventrally; merus bearing 5-12 spines on ventral margin; ischium and basis without spines, ventrodistal angle of basis produced into sharp tooth. Second pereopod with

fingers subequal in length to palm; palm moderately slender; merus bearing 14-23 spines on ventral margin; ischium and basis without spines, ventrodistal angle of basis produced into acute tooth. Pleurobranch on eighth thoracic somite rudimentary.

**Size.**—The Taiwanese material has the largest male with a cl of 19.0 mm, largest female cl 17.6 mm, and smallest ovigerous female cl 14.2 mm.

**Color.**—General overall appearance whitish translucent, only with few red dots on dorsal carapace, tips of antennal scales, pleomeral pleura and tail fan (Fig. 22A). Fingers of first and second pereopods reddish. Eyes black brown. Eggs whitish translucent.

**Distribution.**—Indo-West Pacific and known with certainty from Japan, Taiwan (northeastern and southwestern coasts), Indonesia, Réunion, Madagascar, and South Africa; mesopelagic to a bottom depth of 1098 m.

**Remarks.**—*Pasiphaea japonica* is rather common in northeastern Taiwan and can be easily recognized from the other species of the genus in Taiwan by its small size and the almost entirely transparent white color.

*Pasiphaea levicarinata* Hanamura, 1994  
(Figs. 12-13, 22B, C)

*Pasiphaea sinensis* – Hanamura, 1987: 15, fig. 2. [Not *Pasiphaea sinensis* Hayashi and Miyake, 1971.]

*Pasiphaea* species 1 – Wadley and Evans, 1991: 14, 2 unnumbered figs.

*Pasiphaea levicarinata* Hanamura, 1994: 167, figs. 1, 2 [type locality: Australia, 18°30'S, 117°23'E]; Burukovsky, 1996: 843 (table); Davie, 2002: 358.

**Material Examined.**—Dasi fishing port, Yilan County, 13 Jun 1995, 9 ovigerous females (cl 27.2-36.5 mm), 1 female (cl 32.1 mm) [NTOU M00126]; 2 Nov 1995, 12 males (cl 26.0-34.0 mm), 37 ovigerous females (cl 26.6-35.6 mm), 3 females (cl 20.2-30.1 mm) [NTOU M00125]; 1 Mar 1997, 1 ovigerous female (cl 33.2 mm) [NTOU M00124]; 25 Nov 1999, 1 female (cl 25.7 mm) [NTOU M01105]; 8 Dec 1999, 3 males (cl 28.8-35.7 mm), 2 ovigerous females (cl 31.5,

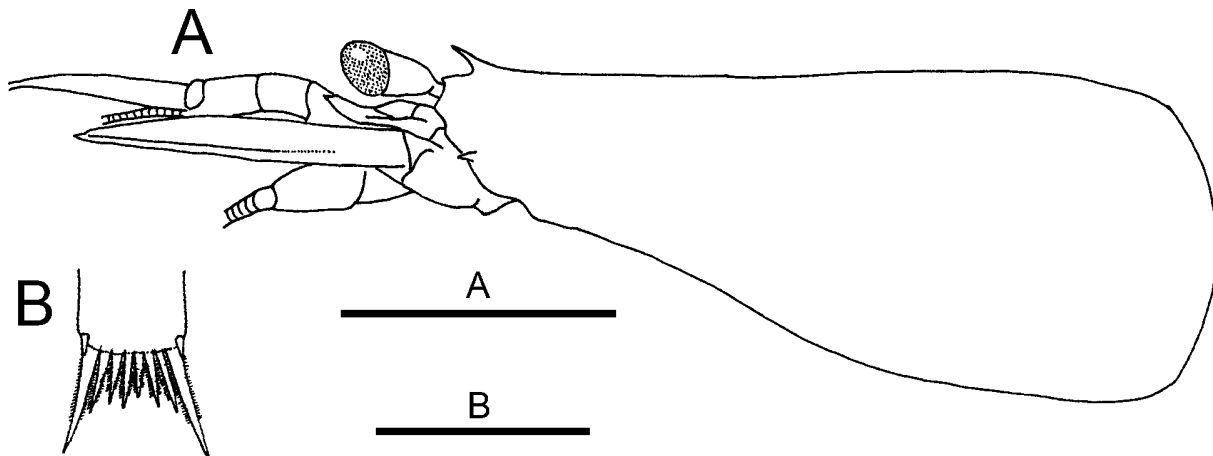


Fig. 11. *Pasiphaea japonica* Omori, 1976, male (cl 15.6 mm), NTOU M00138. A, Carapace, left side, lateral view; B, Posterior margin of telson, dorsal view. Scale bars: 5 mm for A; 1 mm for B.



36.9 mm) [NTOU M00127]; 7 Jan 2000, 4 females (cl 28.3–36.1 mm) [NTOU M00123]; 28 Sep 2007, 2 males (cl 32.69, 33.53 mm) [NTOU M01106]; 5 Mar 2011, 1 ovigerous female (cl 31.5 mm) [NTOU M01107]; 8 Mar 2011, 1 male (cl 31.3 mm) [NTOU M01108]; 30 May 2011, 1 male (cl 26.9 mm) [NTOU M00129]; 30 Jun 2011, 1 male (cl 29.5 mm), 1 ovigerous female (cl 26.7 mm) [NTOU M01137]. Donggang fishing port, Pingtung County, 26 Nov 1994, 1 female (cl 30.0 mm) [NTOU M01109]; 4 Jun 1995, 1 ovigerous female (cl 30.4 mm) [NTOU M01110]. “TAIWAN 2001” stn CD 122, 24°52.02'N, 122°01.33'E, 423–538 m, 1 Aug 2001, 1 ovigerous female (cl 36.5 mm) [NTOU M01102]; stn CP 195, 24°52.02'N, 122°3.11'E,

605–572 m, 11 Sep 2001, 1 male (cl 33.0 mm) [CBM-ZC 10467]. “TAIWAN 2004” stn CP 247, 24°52.13'N, 122°2.42'E, 487–540 m, 28 Aug 2004, 1 male (cl 34.0 mm) [NTOU M01103]; stn CP 248, 24°51.74'N, 122°2.43'E, 516–557 m, 28 Aug 2004, 1 male (cl 28.0 mm) [NTOU M01000]. “TAIWAN 2006” stn PCP 402, 22°21.157'N, 120°6.088'E, 686–735 m, 7 Nov 2006, 1 female (cl 33.7 mm) [NTOU M01104].

Diagnosis.—Body integument firm. Rostrum (Fig. 12A) subtruncate or subtriangular, with slightly to moderately produced acute tip, not reaching frontal margin of carapace; anterior margin nearly vertical, straight or faintly sinuous. Carapace (Fig. 12A, B) with sharp dorsal carina extending

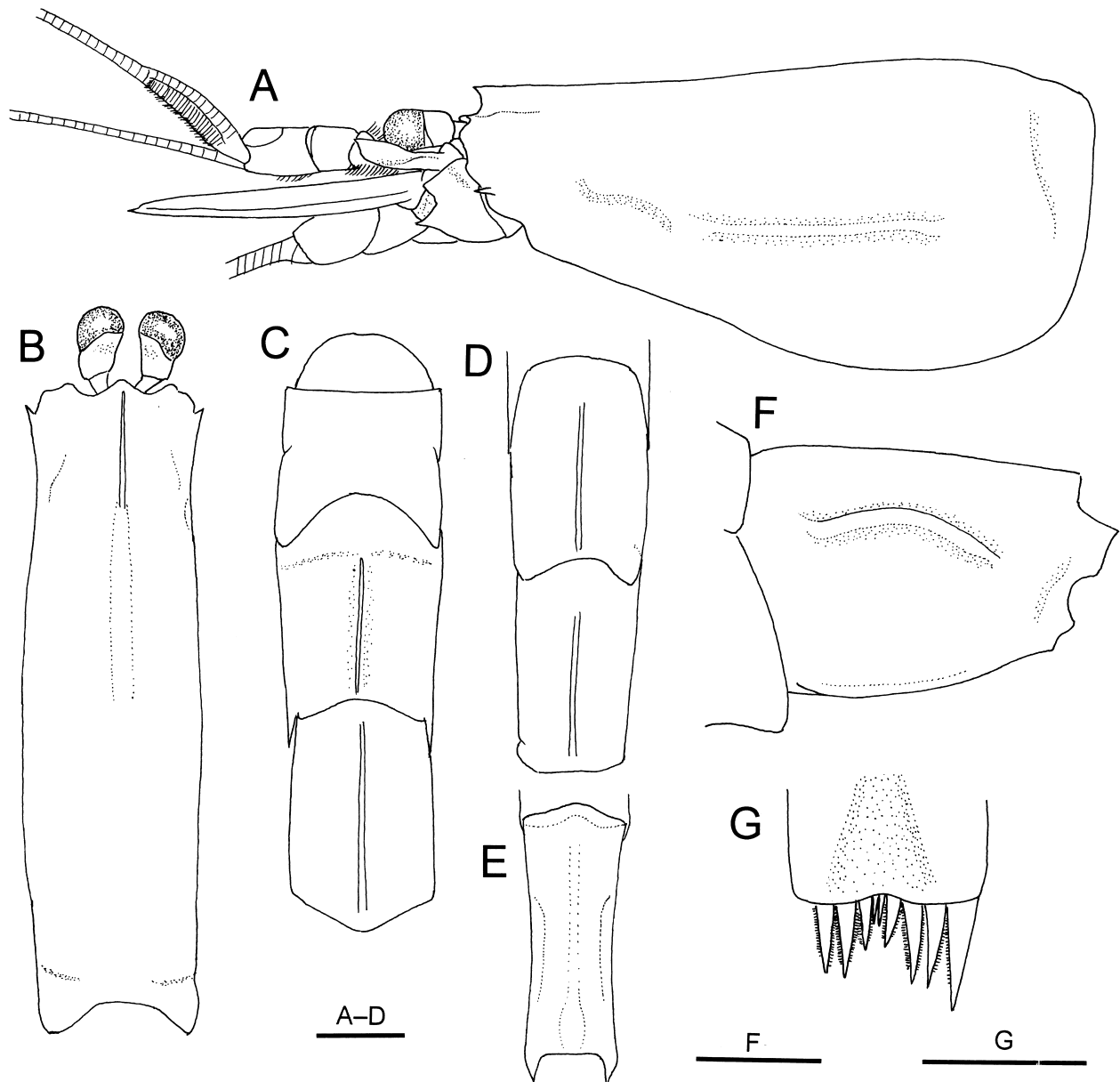


Fig. 12. *Pasiphaea levicarinata* Hanamura, 1994. A–F, Male (cl 33.0 mm), CBM-ZC 10467; G, Female (cl 30.2 mm), NTOU M00123. A, Carapace and thoracic appendages (antennular and antennal flagella partially omitted), left side, lateral view; B, Carapace and eyes, dorsal view; C, First to third pleomeres, dorsal view; D, Fourth and fifth pleomeres, dorsal view; E, Sixth pleomere, dorsal view; F, Same, lateral view; G, Posterior margin of telson, dorsal view. Scale bars: 5 mm for A–F; 1 mm for G.

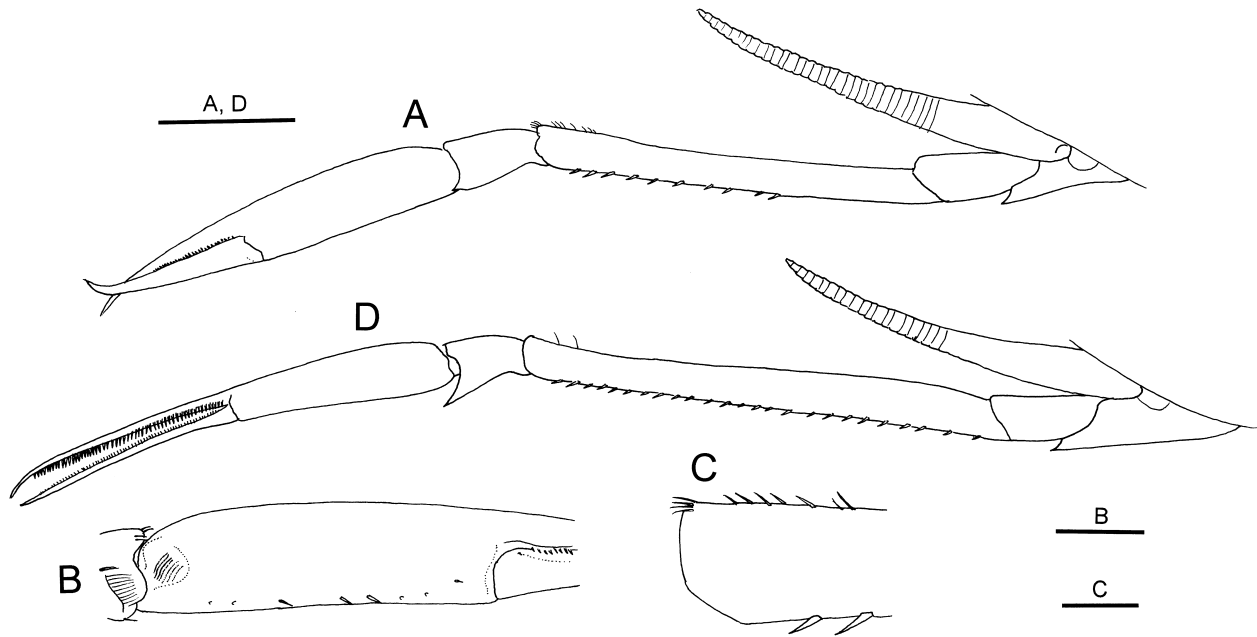


Fig. 13. *Pasiphaea levicarinata* Hanamura, 1994, male (cl 33.0 mm), CBM-ZC 10467. A, Left first pereiopod, lateral view; B, Same, palm, mesial view; C, Same, distal part of merus, lateral view; D, Left second pereiopod, lateral view. Scale bars: 5 mm for A, D; 2 mm for B; 1 mm for C.

to anterior 0.2-0.3, remaining dorsal surface rounded; dorsal margin in lateral view faintly sinuous; branchiostegal sinus shallow; branchiostegal tooth submarginal, far exceeding anterolateral margin. First pleomere (Fig. 12C) almost rounded or bluntly carinate; second to fifth somites (Fig. 12C, D) sharply carinate dorsally; sixth somite (Fig. 12E) rounded in anterior four-fifths, nearly flat in posterior one-fifth. Telson subequal in length to sixth pleomere, shallowly grooved in dorsal midline; posterior margin truncate or slightly concave (Fig. 12G). First pereiopod (Fig. 13A) with fingers 0.8-0.9 times as long as palm; palm with 5-7 minute spiniform setae on mesial face ventrally (Fig. 13B); merus with 7-14 spines on ventral margin and with several minute spiniform setae on dorsodistal margin and dorsal margin distally (Fig. 13C); ischium and basis devoid of spinules, ventrodorsal angle of basis sharply pointed, spiniform. Second pereiopod (Fig. 13D) with fingers 1.1-1.2 times longer than palm; merus with 21-30 spines on ventral margin and several spiniform setae on distal 0.15-0.20 of dorsal margin; ischium and basis devoid of spinules, ventrodorsal angle of basis sharply pointed, spiniform. Pleurobranch on eighth thoracic somite normally developed, lamellate.

**Size.**—The Taiwanese material has the largest male cl 35.7 mm, largest female cl 36.9 mm, and smallest ovigerous female cl 26.6 mm.

**Color.**—General overall appearance whitish to reddish, with body always covered with numerous red dots (Fig. 22B, C). Eyes dark brown. Fingers of first and second pereiopods always reddish. Eggs whitish translucent, becoming milky white when near hatching.

**Distribution.**—At present only known with certainty from northwestern Australia and Taiwan (northeastern and southwestern coasts), mesoplagic to a bottom depth of 1000 m.

**Remarks.**—Although Hanamura (1994) stated that the sixth pleomere was carinate in the anterior two-thirds in this species, in the present specimens the anterior part of the dorsal surface is slightly elevated but not forming sharp edge.

*Pasiphaea levicarinata* has not been assigned to any of the three informal species groups currently recognized in *Pasiphaea* (Hayashi, 1999, 2004, 2006a). Nevertheless, the species can be easily distinguished by a combination of the following characters: carapace dorsally rounded except for short anterior carina supporting rostrum; second to fifth pleomeres sharply carinate dorsally; posterior margin of telson truncate; meri of first and second pereiopod armed with 7-14 and 21-30 spines on ventral margin, respectively.

The present material represents the first record of this species in Taiwan as well as from the northwestern Pacific. In Taiwan, *P. levicarinata* is actually quite common and can be easily separated from the other local species of this genus in having a large body size.

*Pasiphaea mclaughlinae* Hayashi, 2006  
(Fig. 14)

*Pasiphaea mclaughlinae* Hayashi, 2006b: 342, figs. 1-3 [type locality: off SE coast of Taiwan, bottom depths 1222-1226 m].

**Material Examined.**—“TAIWAN 2001” stn CP 126, 22°13.82'N, 121°1.80'E, 1222-1226 m, 21 Aug 2001, male holotype (cl 16.1 mm) [NTOU M01060, ex-MNHN-Na 16064]; stn IK 180, 22°26.77'N, 119°53.6'E, 1159-1450 m, 25 Aug 2001, 2 ovigerous females (cl 13.6, 16.1 mm) [NTOU M01052]; stn IK 181, 22°21.09'N, 119°36.6'E, 1335-1618 m, 25 Aug 2001, 1 female (cl 10.2 mm) [NTOU M01053]. “TAIWAN 2003” stn IK 200, 21°58.2'N, 120°35.24'E, 371 m, 28 May 2003, 1 female (cl 9.1 mm) [NTOU M01054]; stn IK 201, 22°36'N, 120°28.86'E, 667 m, 28 May 2003, 5 males (10.5-13.9 mm), 1 ovigerous fe-

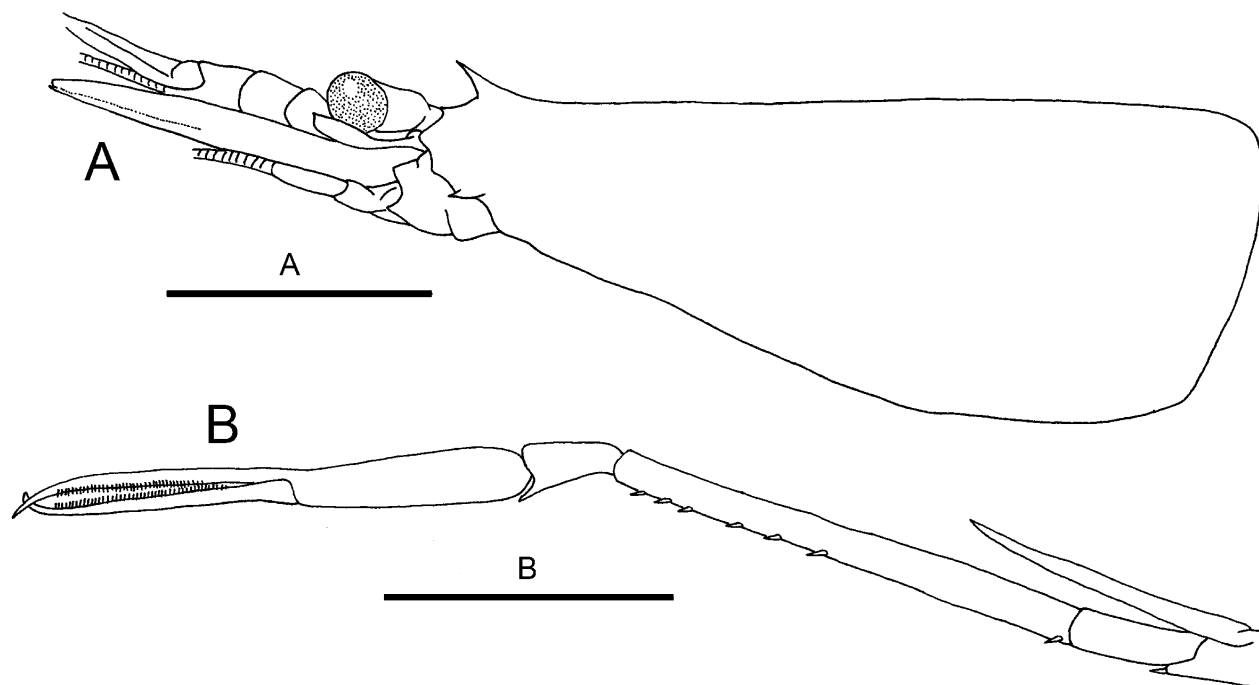


Fig. 14. *Pasiphaea mclaughlinae* Hayashi, 2006, ovigerous female (cl 16.1 mm), NTOU M01052. A, Carapace, left side, lateral view; B, Left second pereiopod, lateral view. Scale bars: 5 mm for A, B.

male (cl 16.6 mm), 39 females (cl 9.4-15.5 mm), 2 juveniles (cl 8.0, 9.2 mm), 3 damaged specimens [NTOU M01055]; stn IK 202, 22°4.95'N, 120°27.77'E, 859 m, 28 May 2003, 2 males (cl 9.8, 12.2 mm), 5 females (cl 8.8-11.2 mm) [NTOU M01056]. "TAIWAN 2005" stn IK 297, 22°31.945'N, 121°4.811'E, 892-1033 m, 10 Aug 2005, 4 males (cl 12.8-14.1 mm), 6 females (cl 11.0-13.8 mm) [NTOU M01057]. "TAIWAN 2006" stn PCP 355, 22°17.036'N, 121°5.232'E, 1190-1193 m, 3 Jun 2006, 1 female (cl 11.3 mm) [NTOU M01058]; stn IK 367, 22°02.1'N, 121°08.44'E, 1297-936 m, 24 Aug 2006, 2 females (9.5, 11.0 mm) [NTOU M01059].

**Diagnosis.**—Body integument moderately firm. Rostrum (Fig. 14A) short, narrowly triangular with acute tip in lateral view, directed anterodorsally, not reaching frontal margin of carapace. Carapace (Fig. 14A) dorsally rounded except for rostrum; dorsal margin nearly straight; branchiostegal sinuous very shallow. First pleomere dorsally rounded, second to fifth somites flat dorsally; sixth somite rounded in anterior three-fourths, flat in posterior one-fourth, bearing sharp posteromedian tooth. Posterior margin of telson truncate. First pereiopod with fingers 0.8-0.9 times as long as palm; palm with 2 widely separated spiniform setae on mesial face ventrally; merus with 4-6 spines on ventral margin; ischium and basis without spines, ventrodistal angle of basis produced into sharp tooth. Second pereiopod (Fig. 14B) with fingers subequal in length to palm; palm moderately slender; merus bearing 5-8 spines on ventral margin; ischium and basis without spines, ventrodistal angle of basis produced into acute tooth. Ischium of third pereiopod unarmed. Pleurobranch absent on eighth thoracic somite.

**Size.**—Largest male cl 16.1 mm, largest female cl 16.6 mm, smallest ovigerous female cl 13.6 mm.

**Color.**—Unknown.

**Distribution.**—So far still only known from off southern Taiwan, mesopelagic to depths of 371-1618 m.

**Remarks.**—This species was described on the basis of two specimens from waters off Taiwan (Hayashi, 2006). In the possession of a sharp posterodorsal tooth on the sixth pleomere, *Pasiphaea mclaughlinae* is similar to *P. japonica* among the local species, but can be readily distinguished from the latter by the less numerous meral spines on the second pereiopod (five to eight versus 14 to 23) and the flat dorsal surfaces of the second to fifth pleomeres. In addition, there is no pleurobranch on the eighth thoracic somite in *P. mclaughlinae*, whereas a rudimentary pleurobranch is present on that somite in *P. japonica*.

*Pasiphaea orientalis* Schmitt, 1931  
(Figs. 15-16, 22D)

*Pasiphaea orientalis* Schmitt, 1931: 267, pl. 32-figs. 1, 5 [type locality: "Ryukyusho, Takao, Formosa" (Kaoshiung, SW Taiwan)]; Burukovsky and Romensky, 1987: 58 (table); Burukovsky, 1996: 843 (table).

[Not] *Pasiphaea orientalis* – Hanamura, 1987: 15, fig. 1; Davie, 2002: 359.

**Material Examined.**—Donggang fishing port, Pingtung County, 28 July 1985, 2 males (cl 14.1, 15.6 mm) [NTOU M00113]; 29 Oct 1988, 1 male (cl 13.7 mm) [NTOU M00110]; 19 Jan 1989, 1 ovigerous female (cl 14.8 mm) [NTOU M00111]; 3 Mar 1991, 4 males (cl 14.9-15.7 mm), 5 ovigerous females (cl 13.7-15.0 mm), 2 females (cl 9.7, 13.8 mm) [NTOU M00114]; 26 Jan 1994, 1 male (cl

14.8 mm), 11 ovigerous females (cl 12.8-16.5 mm), 9 females (cl 11.0-15.0 mm) [NTOU M00107]; 26 Jan 1994, 1 ovigerous female (cl 15.7 mm) [NTOU M00109]; 26 Jan 1994, 1 ovigerous female (cl 14.5 mm) [NTOU M01061]; 21 Oct 1995, 1 male (cl 15.9 mm) [NTOU M00112]; 5 Aug 1996, 2 males (cl 13.6, 14.0 mm), 2 females (cl 12.5, 16.6 mm) [CBM-ZC 2819]; 18 Dec 1999, 9 males (cl 13.6-16.4 mm), 4 ovigerous females (cl 15.0-15.6 mm), 2 females (10.0, 10.7 mm) [NTOU M00108]; 19 May 2011, 1 female (cl 14.5 mm) [NMMBCD 0038]; 19 Aug 2011, 1 ovigerous female (cl 16.2 mm), 1 female (cl 16.5 mm) [NMMBCD 0039]; data unknown, 1 ovigerous female (cl 15.8 mm), 1 female (cl 15.5 mm) [NTOU M01059].

**Diagnosis.**—Body integument moderately firm. Rostrum short, narrow triangular with acute tip in lateral view, directed anterodorsally, not reaching frontal margin of carapace. Carapace dorsally rounded except for rostrum; dorsal margin in lateral view slightly sinuous; branchiostegal sinuous obsolete. Pleon with first to fifth somites rounded dorsally; third somite with strong posteromedian tooth; sixth somite also rounded dorsally, bearing sharp posteromedian tooth. Posterior margin of telson truncate, with 3 or 4 pairs of spines. First pereopod with fingers slightly shorter than palm; palm with 2 widely separated spiniform setae on mesial face ventrally; merus with 7-10 spines on ventral margin; ischium and basis without spines, ventrodorsal angle of basis produced into sharp tooth. Second pereopod with fingers subequal in length to palm; palm moderately slender; merus bearing 15-16 spines on ventral margin; ischium and basis without spines, ventrodorsal angle of basis produced into acute tooth. Ischium of third pereopod unarmed. Pleurobranch on eighth thoracic somite reduced to minute, non-lamellate bud.

**Redescription.**—Body (Fig. 15A, C) strongly compressed laterally; integument moderately firm. Rostrum (Fig. 15A, B) small, directed obliquely dorsally, triangular, reaching or slightly falling short of frontal margin; dorsal margin nearly straight; anterior margin concave inferiorly. Carapace (Fig. 15A, B) subequal in length to anterior three pleomeres combined; dorsal surface rounded except for short carina supporting rostrum; frontal margin broadly triangular; dorsal margin slightly sinuous in lateral view; lateral face with shallow hepatic groove and low branchial ridge; suborbital lobe relatively well produced, roundly triangular; antennal lobe broadly rounded; branchiostegal tooth small, submarginal, reaching well beyond anterolateral margin, directed forward or slightly ventrad; branchiostegal sinus very shallow, inconspicuous.

All pleomeres (Fig. 15C) rounded dorsally; third somite with strong posteromedian tooth; sixth somite with posteromedian tooth; no posteromedian tooth on fourth and fifth somites. Posterodorsal margin of fifth somite deeply concave. First pleuron rounded; second pleuron broadly rounded; anteroventral angles of third to fifth pleura slightly produced anteriorly; fifth pleuron generally rounded. Sixth somite (Fig. 15D) about 1.4 times longer than fifth somite, 1.6 times longer than deep; lateral arcuate ridge weak; posterolateral process narrowing distally to acute or subacute point. Telson (Fig. 15E, F) subequal in length to sixth somite; dorsal surface shallowly grooved in midline; poste-

rior margin truncate, armed with 4 pairs of spines including one prominent pair at lateral angles (lateralmost spines more than twice length of median, setulose pairs).

Cornea (Fig. 15A) darkly pigmented, wider than eye-stalk. Antennular peduncle (Fig. 15A) moderately stout, distinctly overreaching midlength of antennal scale; stylocerite strongly compressed laterally, reaching dorsodistal margin of first segment of peduncle, terminating in sharp point dorsodistally. Antenna (Fig. 15A) with basicerite bearing moderately strong ventrolateral distal tooth; antennal scale reaching thickened aesthetasc-bearing portion of outer antennular flagellum, 0.4-0.5 times as long as carapace, 4.0-4.5 times longer than wide, lateral margin evenly convex, terminating in a small tooth which distinctly overreaching rounded distal lamella.

Mouthparts typical of genus (not dissected). Third maxilliped (Fig. 16A) relatively slender, slightly overreaching base of distolateral tooth of antennal scale; ultimate segment about 2.0 times longer than penultimate segment (= carpus); antepenultimate segment with nearly straight dorsal margin; exopod slightly falling short of distal end of antepenultimate segment.

First pereopod (Fig. 16B) overreaching antennal scale by length of fingers. Fingers weakly curved distally, crossing, 0.9-1.0 times as long as palm; cutting edges finely pectinate. Palm 3.5-3.6 times longer than wide, bearing 2 minute spiniform setae on mesial face adjacent to flexor margin (Fig. 16C). Carpus with subacutely pointed extensor distal margin; flexor distal margin produced in acute tooth. Merus with 7-10 spines on ventral margin, without minute spiniform setae on dorsal margin distally. Ischium unarmed on ventral margin. Basis with slender ventrodorsal tooth, ventral margin evenly concave. Exopod not reaching midlength of merus.

Second pereopod (Fig. 16D) overreaching first pereopod by length of fingers. Fingers curved distally, 1.1-1.2 times longer than palm; cutting edges finely pectinate. Palm tapering distally, 3.9 times longer than wide. Carpus with subacute triangular process on distolateral margin dorsally, flexor distal margin produced in slender, spine-like tooth. Merus with 15-16 spines on ventral margin. Ischium unarmed on ventral margin. Basis with slender ventrodorsal tooth. Exopod reaching beyond proximal 0.2 of merus.

Third pereopod (Fig. 16E) very slender, reaching distal margin of merus of second pereopod; ischium unarmed; exopod reaching proximal 0.2 of merus. Fourth pereopod (Fig. 16F) shortest; exopod not reaching distal margin of merus. Fifth pereopod (Fig. 16G) reaching midlength of merus of second pereopod; exopod slightly overreaching distal end of ischium.

Branchial formula summarized in Table 2; pleurobranch on eighth thoracic somite strongly reduced to minute, non-lamellate bud.

Pleopods and uropod (Fig. 15C) typical of genus.

**Size.**—Largest male cl 16.4 mm, largest female cl 16.6 mm, smallest ovigerous female cl 12.8 mm.

**Color.**—General overall appearance whitish translucent, almost no red dots on body (Fig. 22C). Fingers of first and second pereopods slightly reddish.

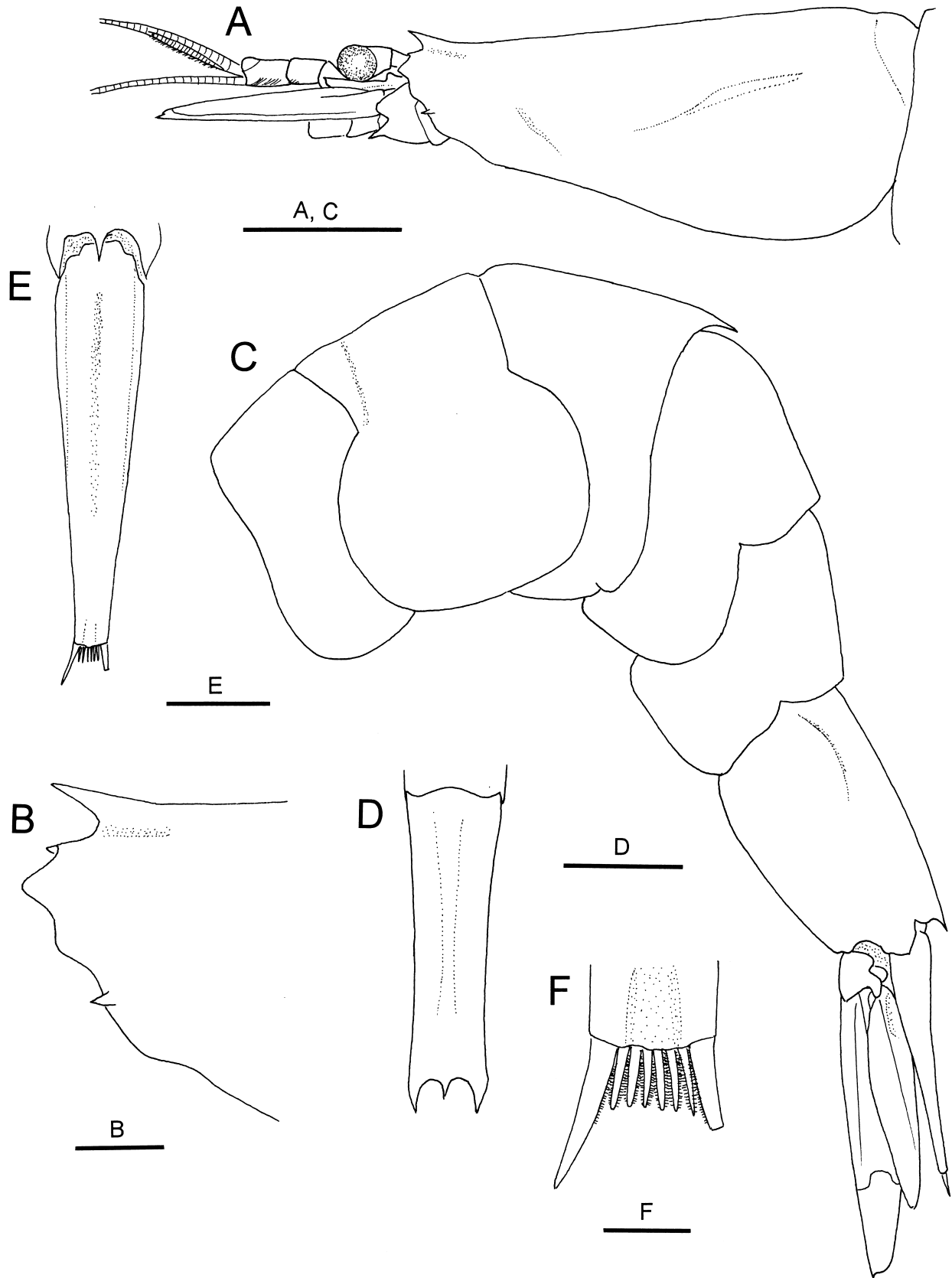


Fig. 15. *Pasiphaea orientalis* Schmitt, 1931, female (cl 16.6 mm), CBM-ZC 2819. A, Carapace and thoracic appendages (antennular and antennal flagella partially omitted), left side, lateral view; B, Anterior part of carapace, left side, lateral view; C, Pleon, telson and uropods, left side, lateral view (setae omitted); D, Sixth pleomere, dorsal view; E, Telson, dorsal view; F, Posterior margin of telson, dorsal view. Scale bars: 5 mm for A, C; 2 mm, for D, E; 1 mm for B; 0.5 mm for F.

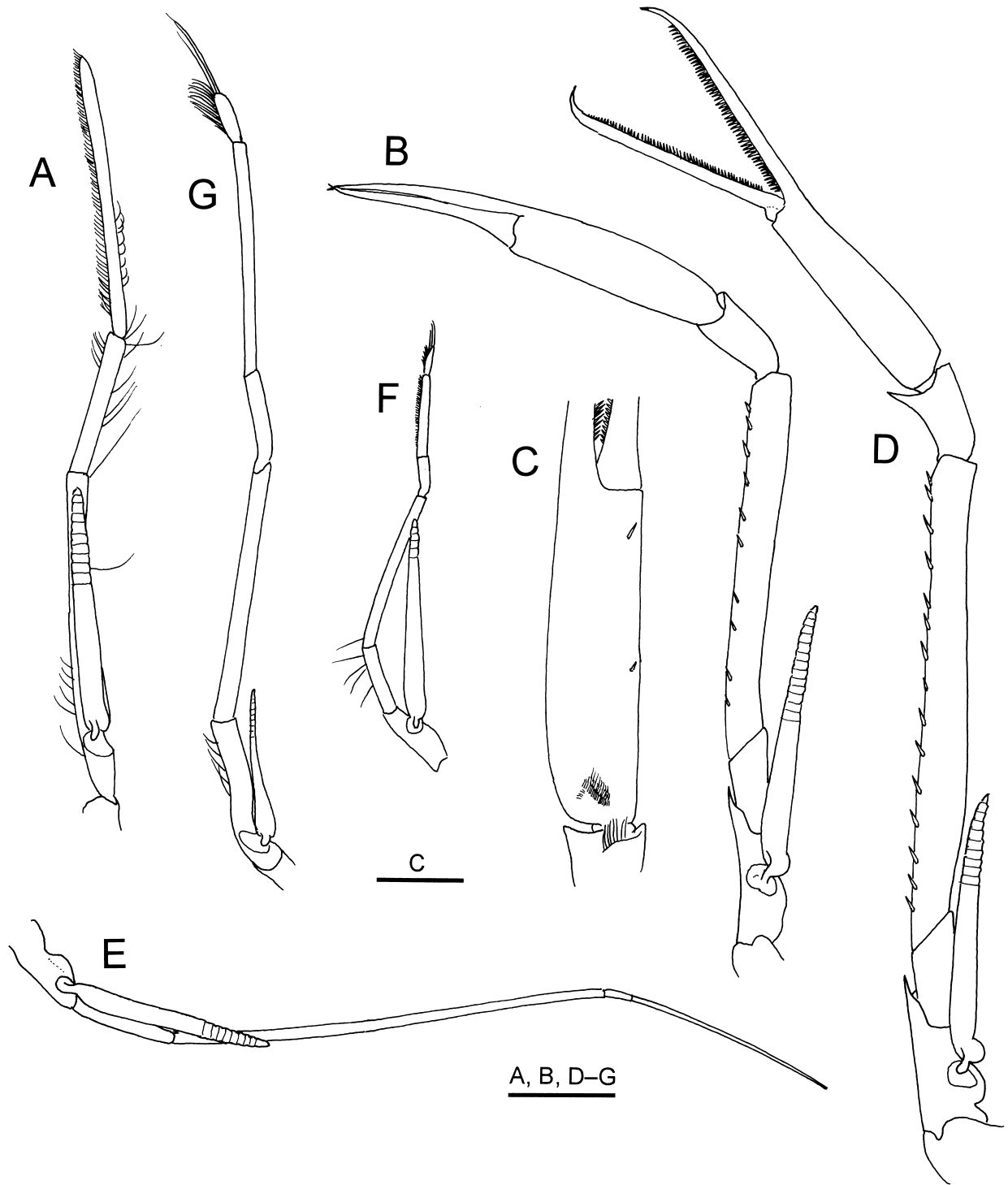


Fig. 16. *Pasiphaea orientalis* Schmitt, 1931, female (cl 16.6 mm), CBM-ZC 2819. A, Left third maxilliped, lateral view; B, Left first pereiopod, lateral view; C, Same, palm, mesial view; D, Left second pereiopod, lateral view; E, Right third pereiopod, lateral view; F, Left fourth pereiopod, lateral view; G, Left fifth pereiopod, lateral view. Setae on exopods of thoracic appendages are omitted. Scale bars: 5 mm for A-C, E-H; 2 mm for D.

**Distribution.**—Only known with certainty from off southwestern Taiwan (see “Remarks”); mesopelagic to a depth of about 350 m.

**Remarks.**—*Pasiphaea orientalis* is unique in the genus in having a strong posterodorsal tooth on the third pleomere.

This species exhibits strong affinity to species of the *P. sivado* group (though Hayashi (1999) did not include it in that group) by sharing the following characters: rostrum triangular with pointed apex, arising behind frontal margin of carapace; sixth pleomere armed with posterodorsal median tooth; posterior margin of telson truncate, armed with

Table 2. Branchial formula of *Pasiphaea orientalis* Schmitt, 1931. r: rudimentary.

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
Pleurobranch	0	0	0	1	1	1	1	r
Arthrobranch	0	0	0	1	1	1	0	0
Podobranch	0	0	0	0	0	0	0	0
Epipod	0	0	0	0	0	0	0	0
Exopod	0	0	1	1	1	1	1	1

four pairs of spines; and pleurobranch on eighth thoracic somite strongly reduced to minute, non-lamellate bud.

*Pasiphaea orientalis* is rather common in southwestern Taiwan and appears to be restricted there. Hanamura (1987, followed by Davie, 2002) reported this species from north-western Australia. Although the Australian material does bear a posterodorsal tooth on the third pleomere, this tooth is considerably shorter than that in the Taiwanese population. Moreover, there is an additional pair of subterminal lateral spines at the posterior margin of the telson, and the sixth pleomere is distinctly shorter in the Australian material. It is highly likely that the Australian population represents a different and undescribed species. Thus, *P. orientalis* is still considered to be endemic to Taiwan.

*Pasiphaea sirenkoi* Burukovsky, 1987  
(Fig. 17)

*Pasiphaea sirenkoi* Burukovsky, 1987: 37, figs. 1-1-5 [type locality: Vietnam]; Hayashi, 2004: 361, fig. 21; 2007: 228, figs. 92h, I, 93e.

*Pasiphaea unispinosa* – Hayashi, 1990: 403, figs. 192e, j, 193. [Not *Pasiphaea unispinosa* Wood-Mason, 1892.]

Material Examined.—“TAIWAN 2003” stn IK 201, 22°36'N, 120°28.86'E, 667 m, 28 May 2003, 1 cephalothorax (cl 24.6 mm) [NTOU M01068].

Diagnosis.—Body integument moderately firm. Rostrum (Fig. 17A) triangular in lateral view, terminating in acute tip, directed obliquely upward, nearly reaching frontal mar-

gin; anterior margin slightly sinuous. Carapace (Fig. 17A) with blunt ridge on anterior 0.2, remaining dorsal surface rounded; dorsal margin in lateral view faintly sinuous; branchiostegal sinus absent; branchiostegal tooth submarginal, exceeding anterolateral margin. First pereiopod (Fig. 17B) with fingers about 0.8 times as long as palm; palm with 2 minute spiniform setae on mesial face ventrally; merus unarmed on ventral margin; ischium and basis devoid of spinules, ventrodorsal angle of basis produced into sharp tooth. Second pereiopod with fingers 0.9 times as long as palm; merus with 1 spine located at distal 0.4 of ventral margin; ischium and basis devoid of spinules, ventrodorsal angle of basis produced into sharp tooth. Ischium of third pereiopod unarmed. Pleurobranch on eighth thoracic somite normally developed, lamellate.

Size.—The only Taiwanese specimen available has cl 24.6 mm and with sex undetermined.

Color.—Unknown.

Distribution.—Japan, Taiwan, South China Sea and New Caledonia; mesopelagic to bottom depths of 590-772 m.

Remarks.—Although the present specimen is damaged with the whole pleon missing, it agrees well with the original description of *Pasiphaea sirenkoi* given by Burukovsky (1987) and the account of *P. sirenkoi* provided by Hayashi (2004), particularly in the lack of a branchiostegal sinus on the carapace as well as the number and position of the meral spine on the second pereiopod.

The first pereiopods are dissimilar in the present specimen, with the left palm being unusually slender, but this seems to be due to regeneration after damage.

The present specimen represents the first record of *P. sirenkoi* from Taiwan, though the occurrence of this species in the area was expected.

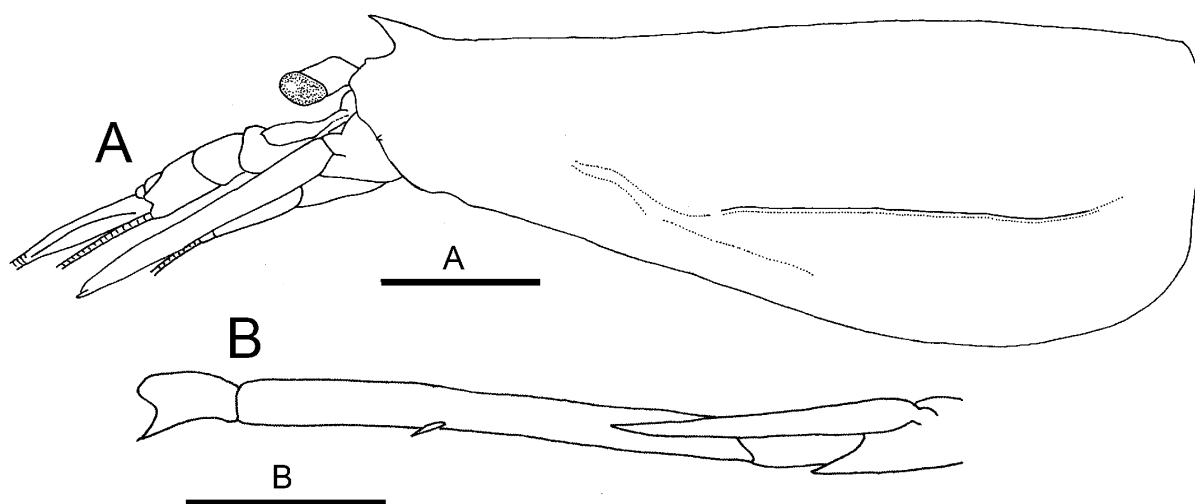


Fig. 17. *Pasiphaea sirenkoi* Burukovsky, 1987, sex indetermined (cl 24.6 mm), NTOU M01068. A, Carapace, left side, lateral view; B, Left second pereiopod, lateral view, chelae missing. Scale bars: 5 mm for A, B.

*Pasiphaea taiwanica* n. sp.  
(Figs. 18-20)

Material Examined.—Holotype: "TAIWAN 2003" stn IK 204, 21°47.35'N, 120°29.7'E, 1110 m, 29 May 2003, female (cl 25.9 mm) [NTOU M01136].

Diagnosis.—Body integument moderately firm. Rostrum relatively large, directed forward, terminating in sharp tooth, reaching frontal margin; anterior margin faintly sinuous inferiorly. Carapace with dorsal surface rounded except for short carina supporting rostrum, dorsal margin in lateral view slightly sinuous; branchiostegal sinus deep; branchiostegal tooth small and submarginal, far exceeding anterolateral margin. First pleomere rounded dorsally; second, third and fifth somites flat dorsally; fourth somite rounded in anterior half, flattened in posterior half; sixth somite rounded dorsally in anterior 0.7, flattened in posterior 0.3; no posterodorsal median tooth on third or sixth somite. Telson 0.9 times as long as sixth pleomere, shallowly grooved in dorsal midline; posterior margin truncate, armature missing. First pereopod with fingers about 0.6 times as long as palm; palm with 5 minute spiniform setae on mesial face ventrally; merus with 8 spines on ventral margin; ischium and basis devoid of spinules, ventrodorsal angle of basis sharply pointed, spiniform. Second pereopod with fingers 0.9 times as long as palm; merus with 18 spines on ventral margin; ischium and basis devoid of spinules, ventrodorsal angle of basis sharply pointed, spiniform. Pleurobranch on eighth thoracic somite normally developed, lamellate.

Description.—Body (Fig. 18) strongly compressed laterally; integument moderately firm. Rostrum (Figs. 18, 20A) relatively large, directed slightly dorsally, tapering to acute tip, reaching frontal margin; dorsal margin slightly sinuous; anterior margin faintly sinuous. Carapace (Figs. 18, 19A, 20A) rounded dorsally except for short ridge extending from rostrum to anterior 0.2 of carapace length; frontal margin slightly convex; dorsal margin slightly sinuous in lateral view; lateral face with shallow hepatic groove and low branchial ridge; antennal lobe rounded; branchiostegal tooth small, submarginal, reaching far beyond anterolateral margin; branchiostegal sinus deep.

Pleon (Figs. 18, 19B-E) without sharp middorsal carina. First pleomere rounded dorsally; second, third and fifth somites flattened dorsally (third somite rounded in anterior 0.3, flat in posterior 0.7); no posterodorsal median tooth on third to sixth somites. Posterodorsal margin of fifth somite deeply concave. First pleuron rounded ventrally; second pleuron broadly rounded; third to fifth pleura each with anteroventral angle slightly directed anteriorly; ventral margin of fifth pleuron slightly sinuous. Sixth somite about 1.9 times longer than fifth somite, 1.9 times longer than deep; lateral ridge clearly discernible, arcuate; posterodorsal margin slightly convex. Telson (Fig. 19F, G) subequal in length to sixth somite; dorsal surface shallowly grooved along midline; posterior margin truncate, armature missing.

Cornea (Figs. 18, 19A) darkly pigmented, distinctly wider than eyestalk. Antennular peduncle (Fig. 18) moderately stout; stylocerite strongly compressed laterally, far falling short of dorsodistal margin of first segment of peduncle, terminating in sharp point dorsodistally; third segment with

small spiniform tooth distolaterally. Antenna (Fig. 18) with basicerite bearing moderately strong ventrolateral distal tooth; antennal scale damaged, distal part broken off.

Mouthparts typical of genus (not dissected). Third maxilliped (Fig. 20B) moderately long; ultimate segment 1.6 times longer than penultimate segment (= carpus); antepenultimate segment with sinuous dorsal margin; exopod slightly overreaching distal margin of antepenultimate segment.

First pereopod (Fig. 20C) moderately long. Fingers strongly curved distally, crossing, about 0.6 times as long as palm; cutting edges finely pectinate. Palm about 3.6 times longer than wide, bearing row of 5 minute spiniform setae on mesial face adjacent to flexor margin (Fig. 20D). Carpus with rounded, slightly produced extensor distal margin, flexor distal margin weakly produced in small tooth. Merus with 8 spines on ventral margin, without spiniform setae on dorsal margin distally. Ischium unarmed on ventral margin. Basis with small ventrodorsal tooth, ventral margin slightly concave. Exopod reaching midlength of merus.

Second pereopod (Fig. 20E) only slightly overreaching first pereopod. Fingers hooked distally, about 0.9 times longer than palm; cutting edges finely pectinate. Palm tapering distally, 3.9 times longer than wide. Carpus with acute triangular process on distolateral margin dorsally, flexor distal margin produced into slender, spine-like tooth. Merus with 18 or 19 spines on ventral margin. Ischium unarmed on ventral margin. Basis with small ventrodorsal tooth. Exopod reaching proximal 0.3 of merus.

Third pereopod broken off; ischium unarmed. Fourth pereopod (Fig. 20F) shortest; exopod slightly overreaching distal margin of merus. Fifth pereopod (Fig. 20G) slightly falling short of midlength of merus of second pereopod; exopod reaching proximal 0.2 of merus.

Branchial formula typical of genus (Table 1); pleurobranch on eighth thoracic somite smaller than smallest arthrobranch, but distinctly lamellate.

Pleopods and uropod (Fig. 18) also typical of genus.

Size.—Only known specimen (female) cl 25.9 mm.

Color.—Unknown.

Distribution.—Only known from off southwestern Taiwan, mesopelagic at depth of 1110 m.

Etymology.—This new species is named after its type-locality, Taiwan.

Remarks.—In the genus *Pasiphaea*, three informal species groups are recognized (Hayashi, 1999, 2004, 2006a), viz. *P. sivado* group, *P. cristata* group and *P. alcocki* group. However, the following 11 species have not been assigned to any of these groups: *P. burukovskyi* Wasmer, 1993, *P. chacei* Yaldwyn, 1962, *P. diaphana* Burukovsky and Romensky, 1980, *P. emarginata* Rathbun, 1902, *P. flagellata* Rathbun, 1906, *P. kaiwiensis* Rathbun, 1906, *P. levicarinata*, *P. longitaenia* Kensley, Tranter and Griffin, 1987, *P. notosivado* Yaldwyn, 1971, *P. orientalis*, *P. truncata* Rathbun, 1906 and *P. westindica* Tchesunov, 1984. The four new species described in this study also cannot be assigned to the three species groups. The above 10 species except *P. orientalis* share the following characters: sixth pleomere lacking pos-



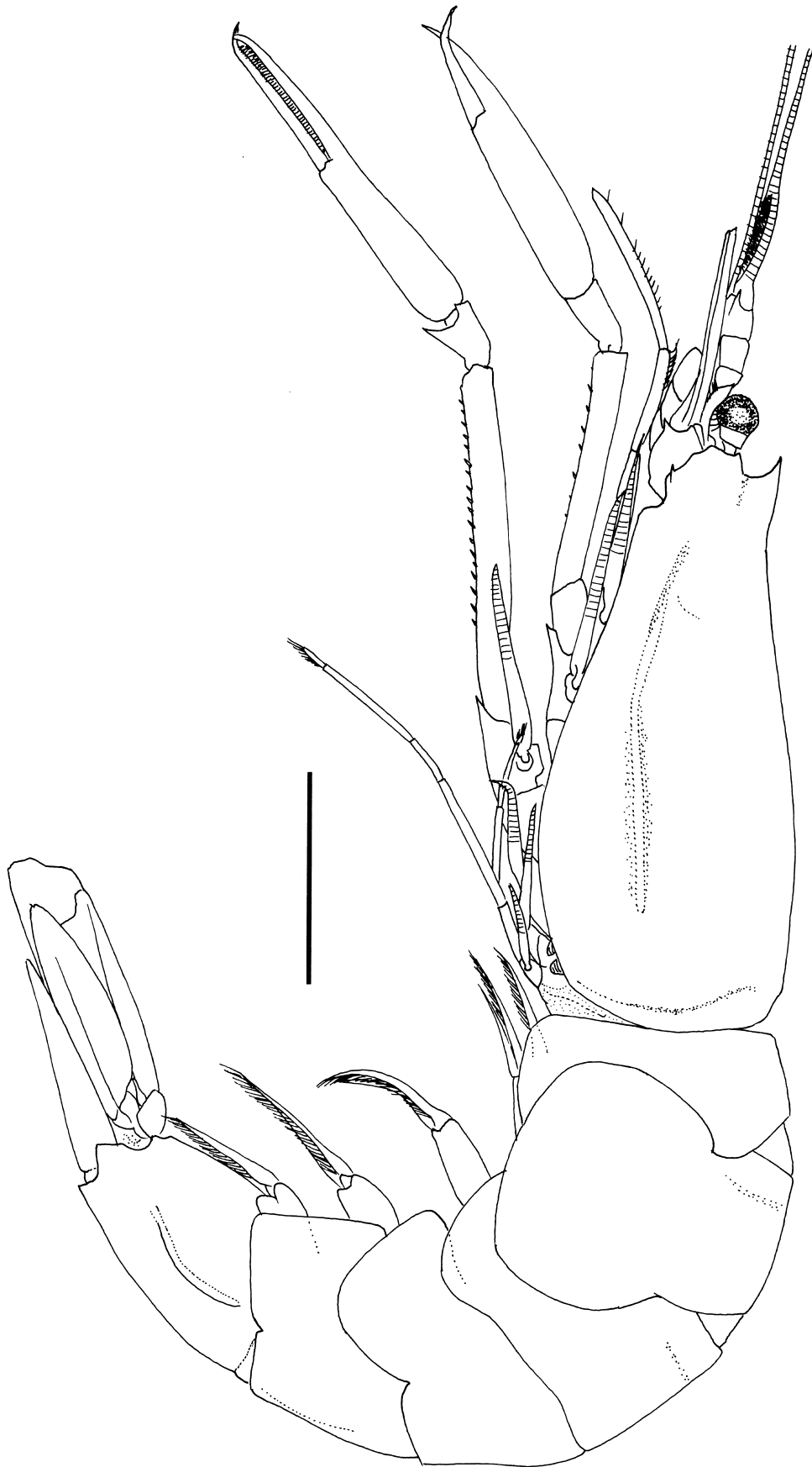


Fig. 18. *Pasiphaea taiwanica* n. sp., holotype, male (cl 25.9 mm), NTOU M01136, entire animal in lateral view. Scale bar: 10 mm.

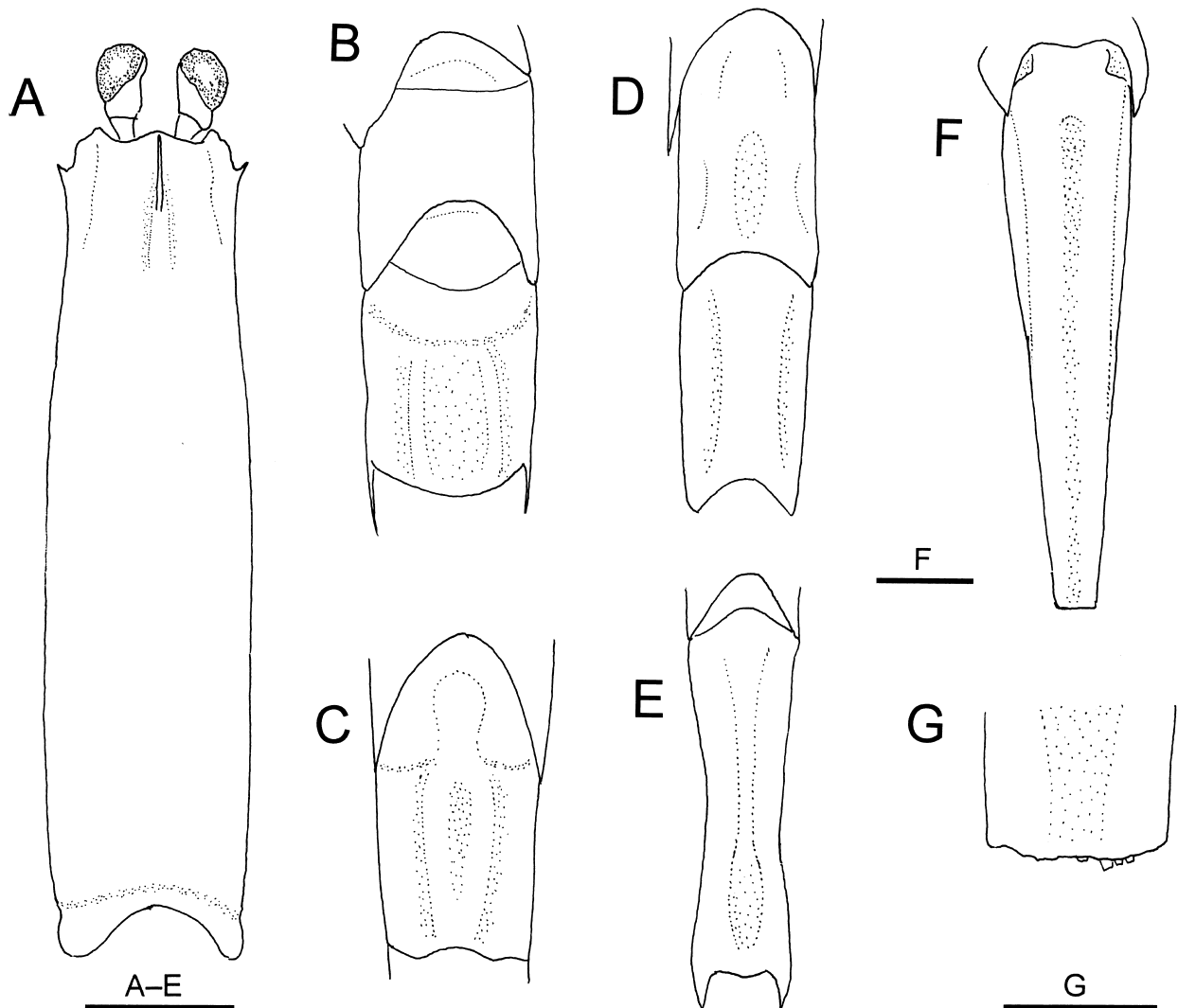


Fig. 19. *Pasiphaea taiwanica* n. sp., holotype, male (cl 25.9 mm), NTOU M01136. A, Carapace and eyes, dorsal view; B, First and second pleomeres, dorsal view; C, Third pleomere, dorsal view; D, Fourth and fifth pleomeres, dorsal view; E, Sixth pleomere, dorsal view; F, Telson, dorsal view; G, Posterior margin of telson, dorsal view (armature damaged). Scale bars: 5 mm for A-E; 2 mm for F; 1 mm for G.

terodorsal tooth; posterior margin of telson not deeply concave, bearing less than 7 pairs of spines; merus of second pereiopod usually armed with one or more spines on ventral margin; pleurobranch on eighth thoracic somite normally developed, lamellate. Amongst them, *Pasiphaea emarginata*, *P. levicarinata* and *P. westindica* are characterized by the sharply carinate third to fifth pleomeres (Rathbun, 1904; Tchesunov, 1984; Hanamura, 1994; this study). The other eight species and the four new species have the third to fifth pleomeres dorsally rounded or flattened. *Pasiphaea notosivado* differs from the other species, as well as the four new species, in having a dorsally carinate carapace (Yaldwyn, 1971). *Pasiphaea kaiwiensis* appears unique among these species in the shallowly notched posterior margin of the telson (versus truncate), fewer spines on the ventral margin of

the merus of the first pereiopod (0-1 versus 2 or more) and the fingers of the first pereiopod subequal in length with the palm (versus distinctly shorter than the palm) (Rathbun, 1906). *Pasiphaea truncata* is characteristic in having a sharply carinate sixth pleomere (Rathbun, 1906) (versus rounded or bluntly carinate). As mentioned above, *P. orientalis* is unique in the genus in having a strong posterodorsal tooth on the third pleomere, even though it appears closely related to the *P. sivado* group (see "Remarks" under *P. orientalis*). Consequently, detailed comparisons are made only among the four new species described in this study with *P. burukovskiyi*, *P. chacei*, *P. diaphana*, *P. flagellata* and *P. longitaenia* (Table 3).

*Pasiphaea aequus* n. sp., *P. falx* n. sp., and *P. taiwanica* n. sp. are characterized by the dorsally flattened second to fifth

Fig. 20. *Pasiphaea taiwanica* n. sp., holotype, male (cl 25.9 mm), NTOU M01136. A, Anterior part of carapace, left side, lateral view; B, Left third maxilliped, lateral view; C, Left first pereiopod, lateral view; D, Same, palm, mesial view; E, Left second pereiopod, lateral view; F, Left fourth pereiopod, lateral view; G, Left fifth pereiopod, lateral view. Setae on exopods of thoracic appendages are omitted. Scale bars: 5 mm for B, C, E-G; 2 mm for A, D.

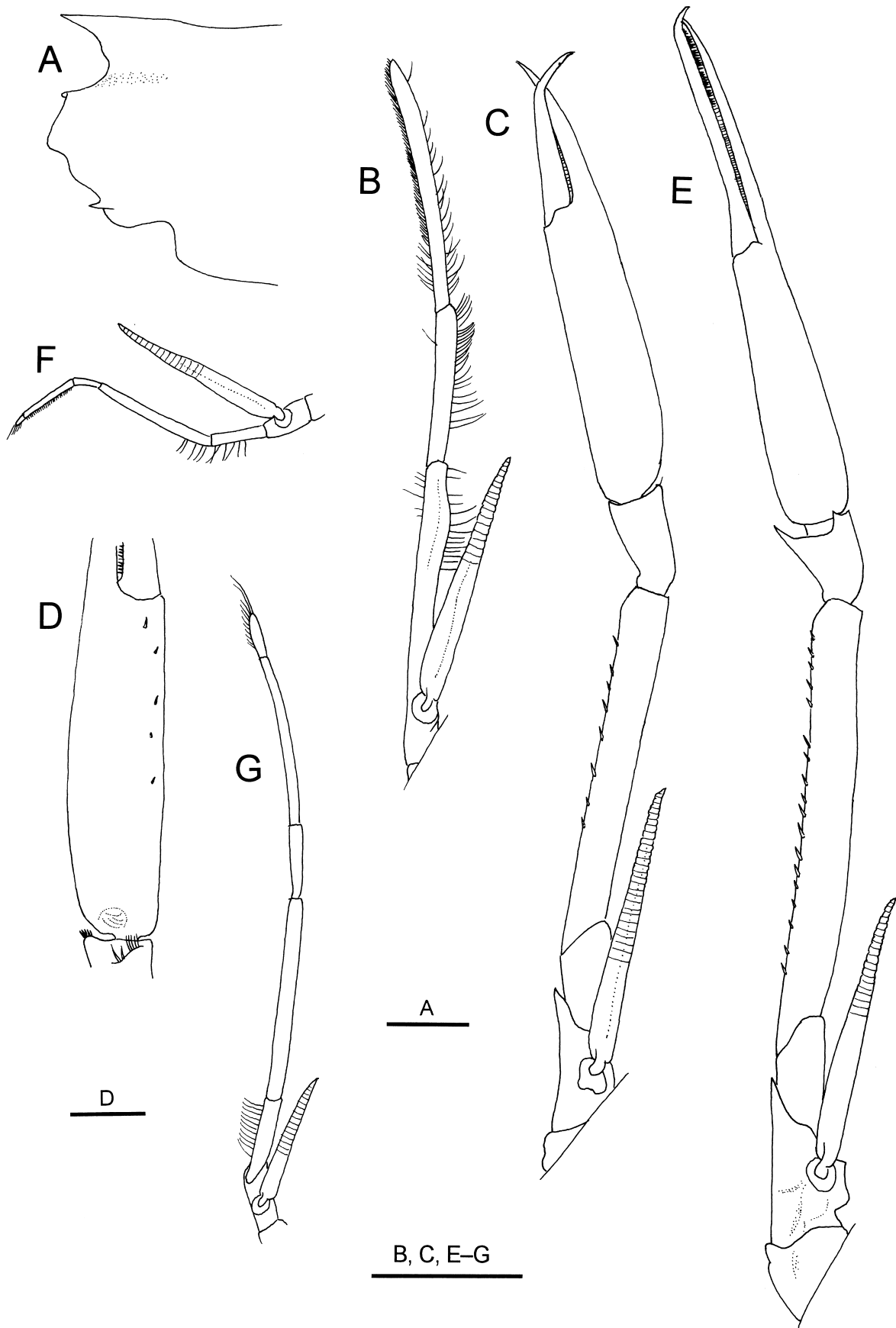


Table 3. Distinguishing characters amongst the new species described in this study and their closely related species.

Characters/species	<i>P. aequus</i> n. sp.	<i>P. exilimanus</i> n. sp.	<i>P. falx</i> n. sp.	<i>P. ravanatica</i> n. sp.	<i>P. burukovskyi</i>	<i>P. chacei</i>	<i>P. diaphana</i>	<i>P. flagellata</i>	<i>P. kanwensis</i>	<i>P. longitaenia</i>
Rostrum	relatively small, slightly falling short of frontal margin of carapace	moderately large, reaching or slightly falling short of frontal margin of carapace	elongate, distinctly overreaching frontal margin of carapace	moderately large, reaching frontal margin of carapace	moderately large, falling short of frontal margin of carapace	elongate, far overreaching frontal margin of carapace	relatively small, falling short of frontal margin of carapace	falling short of frontal margin of carapace	falling short of frontal margin of carapace	relatively small, falling short of frontal margin of carapace
Branchiostegal sinus	shallow (Fig. 2B)	shallow (Fig. 7A)	shallow (Fig. 10A)	deep (Fig. 20A)	deep	deep	shallow	no data	no data	very shallow or obsolete
Dorsal surfaces of second to sixth abdominal somites	second to fifth each with dorsal plateau, sixth somite bluntly carinate in anterior 0.6, flat in posterior 0.4	all somites dorsally rounded	second to fifth each with dorsal plateau, sixth somite bluntly carinate	second to fifth each with dorsal plateau, sixth somite rounded in anterior 0.7, flat in posterior 0.3	second broadly and shallowly sulcate in posterior four-fifths, third shallowly sulcate in middle portion and remaining parts rounded, fourth dorsally rounded on anterior one-fourth, and somewhat depressed and flattened posteriorly, fifth and sixth rounded	all somites dorsally rounded	all somites dorsally rounded	second to fifth somites not carinate, sixth somite bluntly carinate	second to sixth somites all not carinate	second to fifth somites dorsally rounded, sixth somite bluntly carinate
Telson	shallowly grooved dorsally, posterior margin truncate or faintly concave	shallowly grooved dorsally, posterior margin truncate or faintly concave	shallowly grooved dorsally, posterior margin truncate	shallowly grooved dorsally, posterior margin truncate	not grooved dorsally, posterior margin truncate	shallowly grooved dorsally, posterior margin truncate	shallowly grooved dorsally, posterior margin truncate	deeply grooved dorsally, posterior margin truncate	not grooved dorsally, posterior margin cut in very shallow V-shape	shallowly grooved dorsally, posterior margin truncate
Antennal scale shape and LW	strongly narrowed distally, ca. 4.2 times longer than wide, distal lamella obliquely subtruncate	moderately narrowed distally, 3.4-3.6 times longer than wide, distal lamella rounded	moderately narrowed distally, ca. 3.8 times longer than wide, distal lamella obliquely subtruncate	broken	no data	moderately narrowed distally, ca. 3.3 times longer than wide, distal lamella rounded	no data	no data	no data	strongly narrowed distally, ca. 4.2 times longer than wide, distal lamella obliquely subtruncate
First pereopod										
Fingers length/palm length	ca. 0.6	0.8-0.9	0.7-0.8	0.6	0.7	two-thirds	0.8-0.9	three-fourths	subequal	two-thirds
Palm length/width	4.0-4.5	4.0-4.5	4.0-4.5	3.6	no data	5.1	3.6	no data	no data	4.2
Spiniform setae on mesial face of palm	2	5-6	4-5	5	5-6	5-7	no data	no data	no data	no data
Meral spines	2-6	2-9	3-8	8	2-4	0-12 (usually 2-9)	10	3-4	0-1	9-12
Second pereopod										
Fingers length/palm length	0.8-0.9	1.2-1.3	0.9	0.9	1	subequal	ca. 0.9	slightly longer	one and a half to one and two-thirds	subequal
Palm length/width	3.8-3.9	4.5-4.8	5.0-5.5	3.9	no data	ca. 6.0	ca. 4.2	no data	no data	ca. 4.5
Source	this study	this study	this study	this study	Wasmer (1993)	Yaldwyn (1962)	Burukovsky and Romensky (1980); Burukovsky (1993)	Rathbun (1906)	Rathbun (1906)	Kensley et al. (1987)

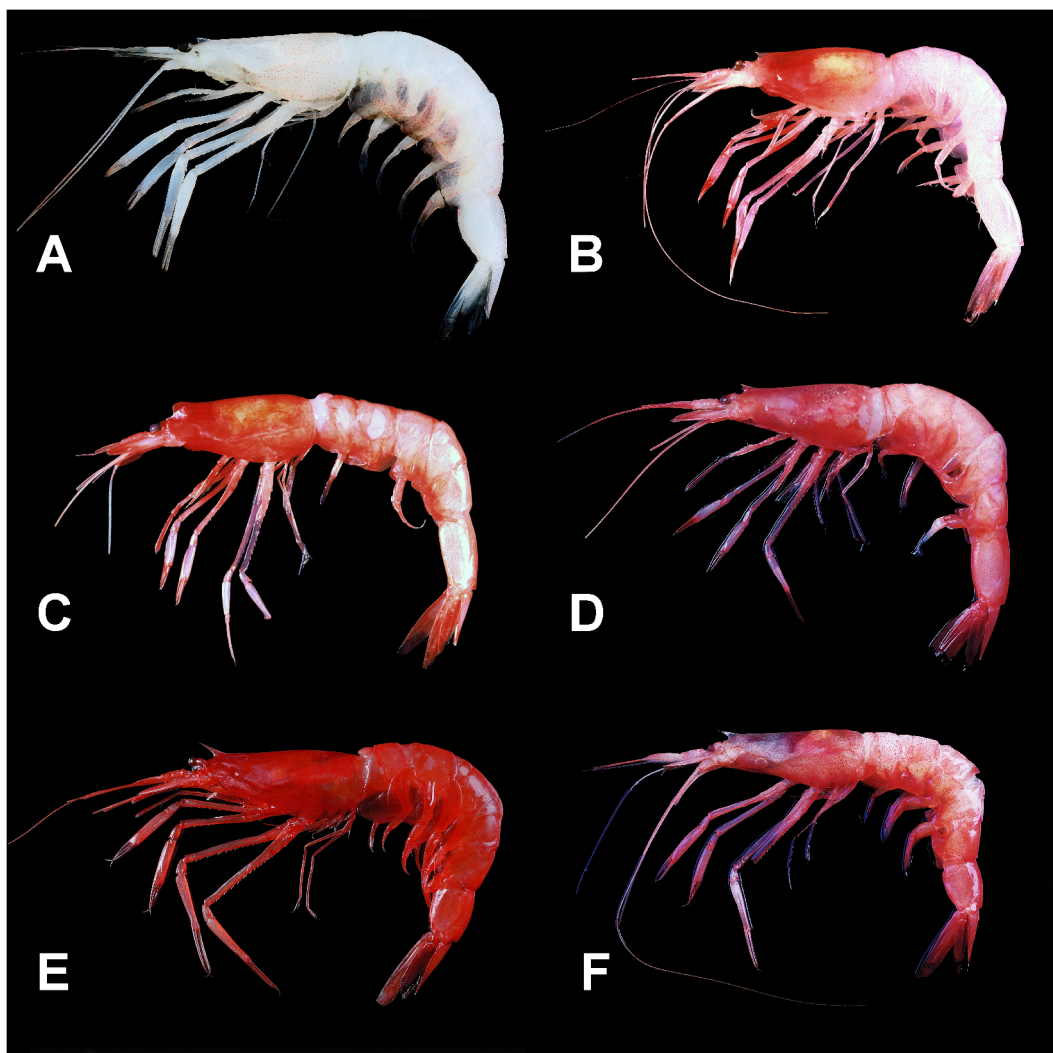


Fig. 21. A, *Pasiphaea aequus* n. sp., paratype male (cl 34.8 mm), NTOU M01161; B, *P. alcocki* (Wood-Mason, 1891), female (cl 15.1 mm), NTOU M01086; C, *P. alcocki* (Wood-Mason, 1891), female (cl 13.7 mm), rostrum infested by ellobiopsid parasite, NTOU M01095; D, *P. exilimanus* n. sp., paratype female (cl 20.2 mm), NTOU M01070; E, *P. falx* n. sp., paratype female (cl 22.5 mm), NTOU M01066; F, *P. falx* n. sp., paratype male (cl 22.7 mm), NTOU M01062.

pleomeres, and this character distinguishes these three new species from *P. chacei*, *P. diaphana* and *P. longitaenia*. The latter three species all have dorsally rounded second to fifth pleomeres. *Pasiphaea burukovskyi* appears unique among the species under consideration in the dorsal configuration of the second to fifth pleomeres (Wasmer, 1993; see Table 3). For *P. flagellata* the condition of the tergites of the second to fifth pleomeres was not specifically described (only described as “not carinate” by Rathbun, 1906). Nevertheless, *P. flagellata* differs from these three new species in the deeply grooved dorsal surface of the telson (versus only shallowly grooved) and the fingers of the second pereiopod slightly longer than the palm (versus 0.8-0.9 times as long as the palm). Furthermore, *P. aequus* is readily distinguished from *P. falx* and *P. taiwanica* in the relatively small rostrum, the relatively narrow antennal scale and the fewer spiniform setae on the mesial face of the palm of the first pereiopod (2 versus 4 or 5). *Pasiphaea falx* is characteristic in having an elongate rostrum distinctly overreaching the frontal margin

of the carapace, and in this regard, superficially resembles *P. chacei*. Details of the condition of the dorsal surface of the sixth pleomere also differentiate *P. falx* from *P. aequus* and *P. taiwanica* (see Table 3). *Pasiphaea taiwanica* further differs from *P. aequus* and *P. falx* in the deep branchiostegal sinus of the carapace and the relatively stout palm of the first pereiopod.

In having dorsally rounded second to fifth pleomeres, *P. exilimanus* is comparable to *P. chacei*, *P. diaphana* and *P. longitaenia*. This new species is distinguishable from the latter three species in the proportionally longer fingers of the second pereiopod (1.2-1.4 times longer than the palm versus at most subequal in length with the palm). As mentioned above, *P. chacei* is characteristic in having an elongate rostrum distinctly overreaching the frontal margin of the carapace (Yaldwyn, 1962). *Pasiphaea exilimanus* further differs from *P. longitaenia* in the clearly defined branchiostegal sinus on the carapace and the relatively wide antennal scale with a rounded distal lamella. In *P.*

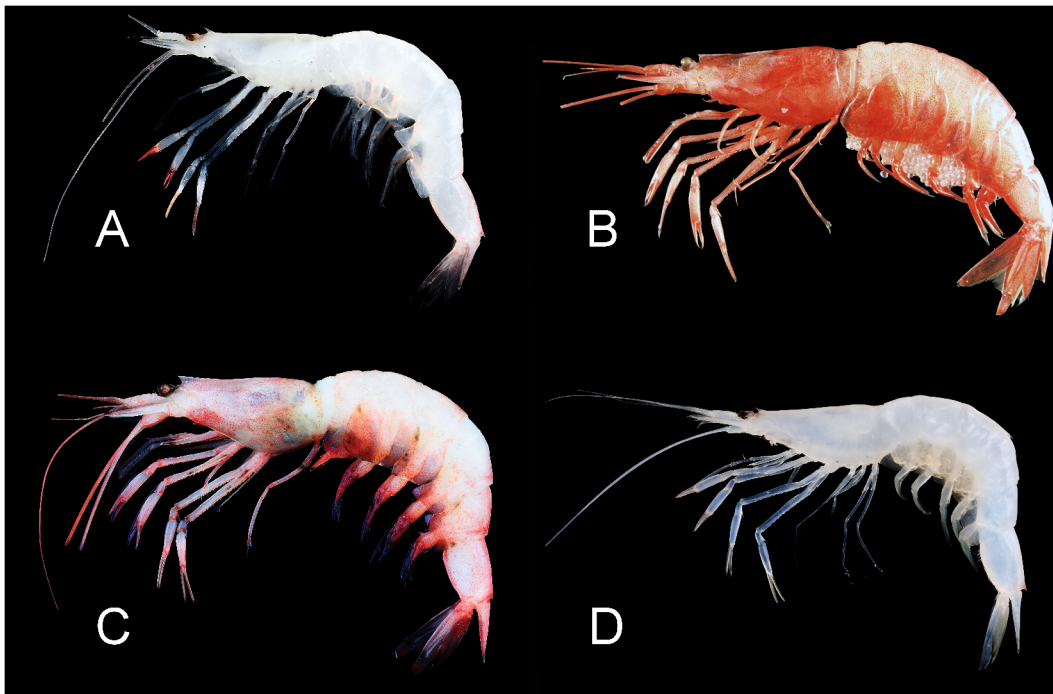


Fig. 22. A, *Pasiphaea japonica* Omori, 1976, ovigerous female (cl 15.2 mm), NTOU M0113; B, *P. levicarinata* Hanamura, 1994, Dasi fishing port, Yilan County, 9 Jan 1989, ovigerous female (specimen not located); C, *P. levicarinata*, male (cl 26.9 mm), NTOU M00129; D, *P. orientalis* Schmitt, 1931, ovigerous female (cl 15.9 mm), NMMBCD 00397.

*longitaenia*, the branchiostegal sinuous on the carapace is poorly defined or even absent; the distal lamella of the antennal scale is obliquely subtruncate (Kensley et al., 1987). *Pasiphaea flagellata* is most similar to *P. exilimanus* in the proportionally long fingers of the second pereiopod (Rathbun, 1906), though it remains unclear if the second to fifth pleomeres are really rounded dorsally in the former species. Nevertheless, *P. exilimanus* differs from *P. flagellata* in the rounded dorsal surface of the sixth pleomere (versus bluntly carinate) and the shallowly grooved dorsal surface of the telson (versus deeply grooved; Rathbun, 1906).

#### ACKNOWLEDGEMENTS

We sincerely thank the three referees for reviewing the manuscript and offering useful comments for improvements. This work was supported by the National Science Council, and Academia Sinica, Taiwan, R.O.C.

#### REFERENCES

- Alcock, A. 1901. A Descriptive Catalogue of the Indian Deep-sea Crustacea Decapoda Macrura and Anomala, in the Indian Museum. Being a Revised Account of the Deep-sea Species Collected by the Royal Indian Marine Survey Ship Investigator. Trustees of the Indian Museum, Calcutta. iv, 286 pp., pls. 1-3.
- , and S. G. McArdle. 1901. Crustacea, Part XIX. Illustrations of the Zoology of the Royal Indian Marine Surveying Steamer "Investigator". Trustees of the Indian Museum, Calcutta. pls. 49-55.
- Bate, C. S. 1888. Report on the Crustacea Macrura collected by H.M.S. Challenger During the Years 1873-76. Report on the Scientific Results of the Voyage of H.M.S. Challenger During the Years 1873-76 Under the Command of Captain George S. Nares, R.N., F.R.S. and the Late Captain Frank Tourle Thomson, R.N. Vol. XXIV: Zoology. Neill and Company, Edinburgh.
- Burukovsky, R. N. 1987. On the taxonomic status of two bathypelagic species (Crustacea, Decapoda, Pasiphaeidae). Zoologicheskii Zhurnal 66: 37-41. [In Russian with English abstract.]
- . 1993. Shrimps of genus *Pasiphaea* (Crustacea, Decapoda, Pasiphaeidae) from the western part of the Indian Ocean. Byulleten Moskovskogo Obschestva Ispytatelei Prirody, Otdel Biologicheskii 98(2): 33-40. [In Russian with English abstract.]
- . 1996. Shrimps of the genus *Pasiphaea*: systematics and some remarks on new findings (Decapoda, Caridea). Zoologicheskii Zhurnal 75(6): 841-847. [In Russian with English abstract.]
- , and L. L. Romensky. 1980. A new species of shrimps from the genus *Pasiphaea*. Zoologicheskii Zhurnal 59: 1096-1098. [In Russian with English abstract.]
- , and ———. 1987. Description of *Pasiphaea balssi* sp. n., a new species of shrimps from South Atlantic (Crustacea, Decapoda, Pasiphaeidae), and polytomous key for identification of the shrimps in the genus. Byulleten Moskovskogo Obschestva Ispytatelei Prirody, Otdel Biologicheskii 92(6): 51-60. [In Russian with English abstract.]
- Butler, T. H. 1980. Shrimps of the Pacific Coast of Canada. Canadian Bulletin of Fisheries and Aquatic Sciences 202: i-ix, 1-280.
- Davie, P. J. F. 2002. Crustacea: Malacostraca: Phyllocarida, Hoplocarida, Eucarida (Part 1). Zoological Catalogue of Australia. Vol. 19.3A. A. Wells and W. W. K. Houston (volume eds.). CSIRO Publishing, Melbourne. 551 pp.
- De Grave, S., and C. H. J. M. Fransen. 2011. Carideorum catalogus: the recent species of the dendrobranchiate, stenopodidean, procarididean and caridean shrimps (Crustacea: Decapoda). Zoologische Mededelingen 85: 195-580.
- , N. D. Pentcheff, S. T. Ah Yong, T.-Y. Chan, K. A. Crandall, P. C. Dworschak, D. L. Felder, R. M. Feldmann, C. H. J. M. Fransen, L. Y. D. Goulding, R. Lemaitre, M. E. Y. Low, J. W. Martin, P. K. L. Ng, C. E. Schweizer, S. H. Tan, D. Tshudy, and R. Wetzer. 2009. A classification of living and fossil genera of decapod crustaceans. Raffles Bulletin of Zoology, Supplement 21: 1-109.
- Hanamura, Y. 1987. Caridean shrimps obtained by R.V. "Soela" from north-west Australia, with description of a new species of *Leptochela* (Crustacea: Decapoda: Pasiphaeidae). The Beagle, Records of the Museums and Art Galleries of the Northern Territory 4(1): 15-33.
- . 1994. A new species of *Pasiphaea* Savigny (Crustacea: Caridea: Pasiphaeidae) from north-western Australian waters. The Beagle, Records of the Museums and Art Galleries of the Northern Territory 11: 167-173.

- , and D. R. Evans. 1994. Deepwater caridean shrimps of the families Ophlophoridae and Pasiphaeidae (Crustacea: Decapoda) from western Australia, with an appendix on a lophogastridan mysid (Mysidacea). *Crustacean Research* 23: 46-60.
- Hayashi, K. 1990. Prawns, shrimps and lobsters from Japan (55). Family Pasiphaeidae – genus *Pasiphaea* 2. *Aquabiology* 70: 400-403.
- . 1999. Crustacea Decapoda: revision of *Pasiphaea sivado* (Risso, 1816) and related species, with descriptions of one new genus and five new species (Pasiphaeidae), pp. 267-302. In, A. Crosnier (ed.), *Résultats des Campagnes MUSORSTOM*. Vol. 20. Mémoires du Muséum national d'Histoire naturelle. Vol. 180.
- . 2004. Revision of the *Pasiphaea cristata* Bate, 1888 species group of *Pasiphaea* Savigny, 1816, with descriptions of four new species and referral of *P. australis* to *Alainopasiphaea* Hayashi, 1999 (Crustacea: Decapoda: Pasiphaeidae), pp. 319-373. In, B. A. Marshall and B. Richer de Forges (eds.), *Tropical Deep-sea Benthos*. Vol. 23. Mémoires du Muséum national d'Histoire naturelle. Vol. 191.
- . 2006a. Revision of the *Pasiphaea alcocki* species group (Crustacea, Decapoda, Pasiphaeidae), pp. 193-241. In, B. Richer de Forges and J.-L. Justine (eds.), *Tropical Deep-sea Benthos*, Vol. 24. Mémoires du Muséum national d'Histoire naturelle. Vol. 193.
- . 2006b. A new species of the *Pasiphaea sivado* species group from Taiwan (Decapoda, Caridea, Pasiphaeidae). *Zoosystema* 28(2): 341-346.
- . 2007. Caridean shrimps (Crustacea: Decapoda: Pleocyemata) from Japanese Waters Part 1. Ophlophoroidea, Nematocarcinoidea, Atyoidea, Stylodactyloidea, Pasiphaeoidea and Psalidopodoidea. Seibutsukenkyusha Co. Ltd., Tokyo. 292 pp. [In Japanese.]
- , and J. C. Yaldwyn. 1998. A new species of the genus *Pasiphaea* from the South Indian Ocean (Crustacea, Decapoda, Pasiphaeidae). *Zoosystema* 20(3): 511-519.
- Kensley, B. 1977. The South African Museum's Meiring Naude cruises. Part 5: Crustacea, Decapoda, Reptantia and Natantia. *Annals of the South African Museum* 74: 13-44.
- , H. A. Tranter, and D. J. G. Griffin. 1987. Deepwater decapod Crustacea from eastern Australia (Penaeoidea and Caridea). *Records of the Australian Museum* 39: 263-331.
- Komai, T., and T. Y. Chan. in press. A new species of the bathypelagic shrimp genus *Pasiphaea* Savigny, 1816 (Crustacea: Decapoda: Caridea) from off Hawaii, Central Pacific. *Bulletin of Marine Science*.
- , T. Kikuchi, K. Nakaguchi, and A. Go. 2000. Pelagic shrimps (Crustacea: Decapoda: Penaeoidea and Caridea) from the Ohsumi Islands and southern Kyushu, Japan, collected by TRV "Toyoshio-maru" during cruises in 1996-1998. *Journal of the Faculty of Applied Biological Science, Hiroshima University* 38: 131-149.
- Kubo, I. 1965. Macrura, pp. 591-629. In, Y. Okada (ed.), *New Illustrated Encyclopedia of the Fauna of Japan*. Part II. Hokuryukan Publishing Co. Ltd., Tokyo. [In Japanese.]
- Miyake, S. 1982. Japanese Crustacean Decapods and Stomatopods in Color. Vol. 1. Hoikusha Publishing, Higashi-osaka. vii + 261 pp., 56 pls. [In Japanese.]
- Omori, M. 1976. The glass shrimp, *Pasiphaea japonica* sp. nov. (Caridea, Pasiphaeidae), a sibling species of *Pasiphaea sivado*, with notes on its biology and fishery in Toyama Bay, Japan. *Bulletin of the National Science Museum, Series A (Zoology)* 2(4): 249-266.
- Rathbun, M. J. 1904. Decapod crustaceans of the northwest coast of North America. In, M. J. Rathbun, H. Richardson, S. J. Holmes, and L. J. Cole (eds.), *Harriman Alaska Expedition with Cooperation of Washington Academy of Sciences* Vol. 10. Doubleday, Page & Co., New York. 210 pp.
- . 1906. The Brachyura and Macrura of the Hawaiian islands. *Bulletin of the Bureau of Fisheries* 23: 827-930, pls. 1-24.
- Risso, A. 1816. *Histoire naturelle des Crustacés des environs de Nice*. Librairie Grecque-Latine-Allemande, Paris. 175 pp., Plates 1-3.
- Savigny, J.-C. 1816. *Mémoires sur les Animaux sans Vertèbres*. Vol. 1. Paris. pp. 1-117, 12 pls.
- Schmitt, W. L. 1931. Two new species of shrimp from the Straits of Formosa. *Lingnan Science Journal* 10: 265-268, pl. 32.
- Stebbing, T. R. R. 1914. South African Crustacea (Part VII of S. A. Crustacea, for the Marine Investigations in South Africa). *Annals of the South African Museum* 15: 1-55, pls. 1-12.
- Tchesunov, A. V. 1984. A new and rare mesopelagic species of the genus *Pasiphaea* (Crustacea, Decapoda) from the tropic and subtropic Atlantic. *Zoologicheskyy Zhurnal* 63: 993-1003.
- Timofeev, V. V. 1997. New finding of shrimp species of the genus *Pasiphaea* (Crustacea, Decapoda, Pasiphaeidae) with description of *Pasiphaea arabica* sp. n. from the western Indian Ocean. *Zoologicheskyy Zhurnal* 76: 142-146.
- Wadley, V., and D. Evans. 1991. Crustaceans from the Deepwater Trawl Fisheries of Western Australia. *Western Australian Museum*. 44 pp.
- Wasmer, R. A. 1993. Pelagic shrimps (Crustacea: Decapoda) from six USNS Eltanin cruises in the southeastern Indian Ocean, Tasman Sea, and the southwestern Pacific Ocean to the Ross Sea. *Antarctic Research Series* 58: 49-91.
- Wood-Mason, J. 1892. Illustrations of the zoology of the royal Indian marine surveying steamer "Investigator." Crustacea (partie 1), pls. 1-5.
- , and A. Alcock. 1891. Natural history notes from H. M. Indian Marine Survey Steamer "Investigator," Commander R. F. Hoskyn, R. N. commanding. No. 21. Notes on the results of the last season's deep-sea dredging. *Annals and Magazine of Natural History* 7(6): 186-202.
- , and A. Alcock. 1893. Natural history notes from H. M. Indian Marine Survey Steamer "Investigator," Commander R. F. Hoskyn, R. N. commanding. No. 22. On the results of the deep-sea dredging during the season 1890-91. *Annals and Magazine of Natural History* 11(6): 161-173, pls. 10, 11.
- Yaldwyn, J. C. 1962. A new *Pasiphaea* (Crustacea, Decapoda, Natantia) from southern Californian waters. *Bulletin of the Southern California Academy of Sciences* 61: 15-24.
- . 1971. Preliminary descriptions of a new genus and twelve new species of natant decapod Crustacea from New Zealand. *Records of the Dominion Museum* 7(10): 85-94.

RECEIVED: 6 July 2011.

ACCEPTED: 26 September 2011.