

# Copepods (Crustacea, Copepoda, Cyclopoida) Associated with Marine Invertebrates from Thailand

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## ABSTRACT

Fifteen species of poecilostome copepods associated with marine invertebrates, including ten new species, are recorded from intertidal zone in Thailand. New species are *Hemicyclops cornutus* n. sp. and *Hemicyclops parapiculus* n. sp. in the family Clausidiidae, *Presynaptiphilus trifurcatus* n. sp. in the Synaptiphilidae, *Anchimolgus kantariensis* n. sp. and *Anchimolgus palmatus* n. sp. in the Anchimolgidae, *Kelleria vasfera* n. sp. in the Kelleridae, *Pseudanthessius stenosus* n. sp. and *Pseudanthessius phuketensis* n. sp. in the Pseudanthessiidae, *Doricidola pattayensis* n. sp., and *Lambanetes mollis* n. sp. in the Rhynchomolgidae. Five species are new records of Thailand: *Critomolgus gemmatus* (Humes, 1964), *Doricidola cuspis* (Humes, 1964), *Doricidola inaequalis* (Humes and Ho, 1966), *Indomolgus brevisetosus* (Humes and Ho, 1966), and *Lambanetes stichodactylae* Humes, 1982. The female of *Lambanetes stichodactylae* is described for the first time in the world.

**Keywords:** Copepoda, poecilostome Cyclopoida, new species, association, Thailand

## INTRODUCTION

Copepods associated with marine invertebrates have been very poorly investigated in Thailand. Ho and Kim (1990) reported six species of the family Synapticolidae associated with holothurians from Phuket: *Scambicornus brachysetosus* Reddiah, 1968, *S. affinis* Ho, 1982, *S. nicobaricus* (Sewell, 1949), *S. tuberatus* (Humes and Cressey, 1961), *S. pectinis*, and *Synapticola tripocula*, the latter two as new species. Ho and Yoosukh (1994) described *Ostrincola humesi* as new species parasitic in the oyster *Saccostrea cucullata* (Born) in the Gulf of Thailand. Ho and Kim (1995) reported *Conchylurus bombasticus* Reddiah, 1961, *Ostrincola portonoviensis* Reddiah, 1962, and *Lichomolgus similis* Ho and Kim, 1991 as parasites of the clam *Meretrix meretrix* (L.) from Phuket. Finally, Ho and Kim (2001) recorded *Doricidola similis* as a new species of the family Rhynchomolgidae associated with the squid *Sepiotheuthis lessoniana* Lesson from the Gulf of Thailand.

During a couple of international scientific conferences held in the past in Thailand, the authors could make short field

works to collect copepods at vicinities of conference places. One of them is the 10th International Conference on Copepoda at Pattaya in July 2008, and the other being the First Asian Marine Biology Symposium at Phuket in December 2012. A total of 15 species of poecilostome copepods were collected, including ten new species, as described below.

## MATERIALS AND METHODS

The copepods examined in the present study were recovered by washing, sweeping, and sucking. On the tidal flat the host animals were dug out with a stick and collected in plastic bags, with different species being placed in different bags and later being fixed in alcohol. On the coral reef and rocky shore, the copepods on the hosts (mainly hard corals) living in the shallow water were swept into a hand net using a small brush. Some copepods were sucked up directly from the host's burrows with a large pipette. The sucked material were filtered using a small hand net and later in the laboratory the copepods were sorted out from the filtrates.

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Before dissection for microscopic observation, copepod specimens were immersed in lactic acid. Dissections were done using the reversed slide method (Humes and Gooding, 1964). Dissected specimens were mounted on glass slides with Hoyer's mounting medium. Type specimens have been deposited in the Marine Biodiversity Institute of Korea (MABIK), Seocheon, Korea.

## SYSTEMATIC ACCOUNTS

Order Cyclopoida Burmeister, 1834

Family Clausidiidae Embleton, 1901

Genus *Hemicyclops* Boeck, 1873

### *Hemicyclops cornutus* n. sp. (Figs. 1–3)

**Material examined.** 1 ♀ (holotype) from invertebrate burrows on a tidal flat (Ban Pa Khok seagrass bed) on the north-eastern coast of Phuket Province, Thailand, 16 Dec 2012. Holotype (CR00233151, dissected and mounted on a glass slide) has been deposited in the MABIK, Seocheon, Korea.

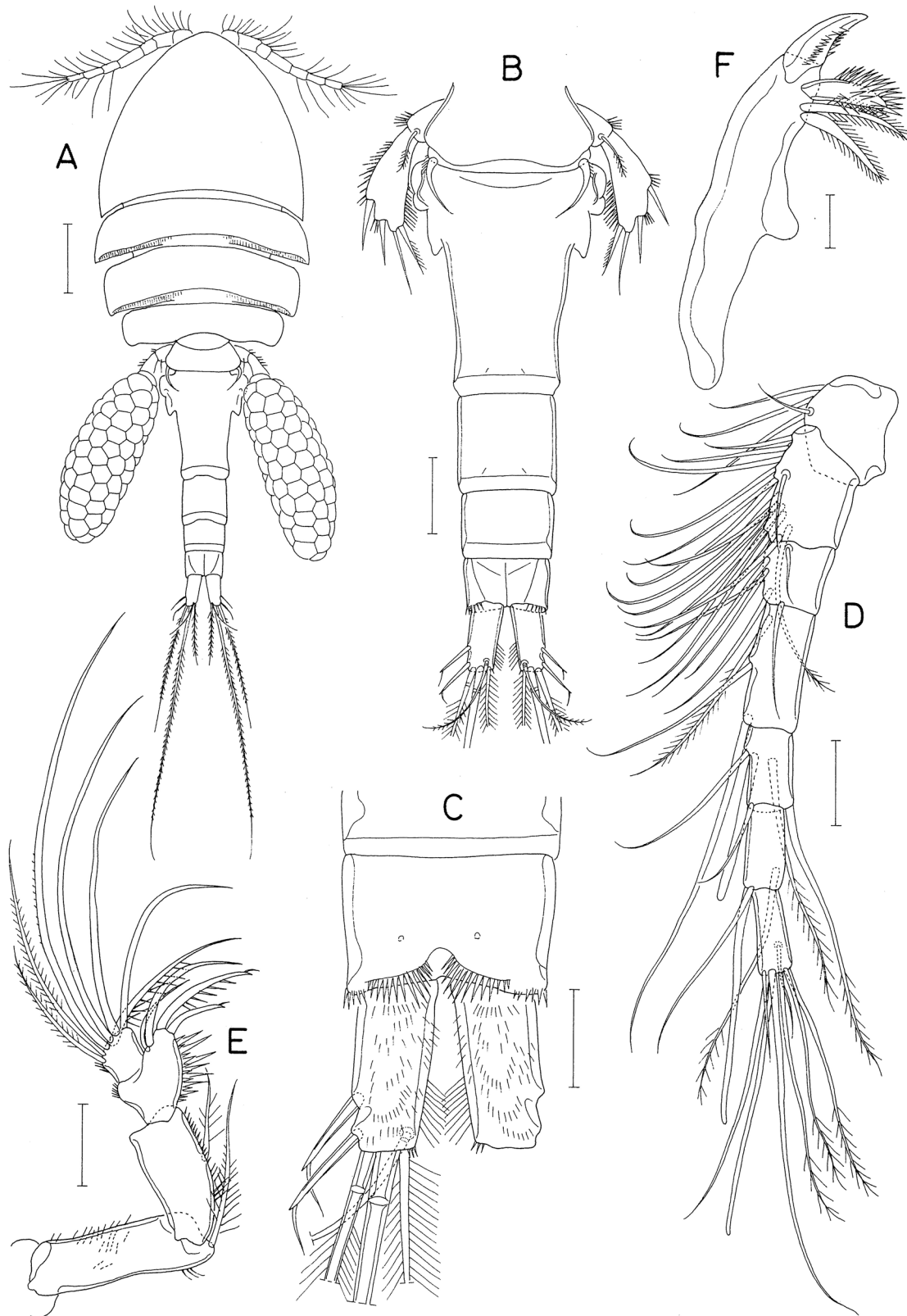
**Female.** Body (Fig. 1A) moderately broad, 1.77 mm long. Prosome fusiform, 931 µm long, and consisting of cephalothorax and 3 pedigerous somites. Greatest width of prosome 638 µm across second pedigerous somite. Cephalothorax 500 × 608 µm. Second and third pedigerous somites with angular posterolateral corners; their posterior margin fringed with narrow membrane. Third pedigerous somite with blunt posterolateral corners. Urosome (Fig. 1B) 5-segmented. Fifth pedigerous somite (first urosomite) 230 µm wide, with gently curved, horn-like spine (indicated by arrow in Fig. 2G) at each posterolateral corner of dorsal side; this spine spinulose at proximal outer margin, but smooth in remaining part. Genital double-somite 308 × 258 µm (length to width ratio 1.19 : 1), with anterolateral expansion; lateral margins of this expanded region complicated, with 3 curvatures (Fig. 3E); genital aperture locating laterally at this expanded region; posterior part of somite weakly narrowing posteriorly, with width of 140 µm across posterior region. Three free abdominal somites 126 × 129, 92 × 123, and 71 × 114 µm, respectively. Anal somite (Fig. 1C) with row of spinules along all posterior margins. Caudal rami (Fig. 1C) slightly divergent; each ramus rectangular, 85 × 40 µm (ratio 2.13 : 1), covered with fine setules on dorsal and ventral surfaces, and armed with 6 setae; outer seta (seta II) and outermost distal seta (seta VI) spiniform, not flexible, naked, and tipped by setule; other 4 setae pinnate; inner margin of ramus with long setules along distal third. Egg sac fusiform, 577 × 207 µm, distinctly shorter than urosome.

Rostrum not examined. Antennule (Fig. 1D) 359 µm long and 7-segmented, with armature formula 4, 15, 6, 3, 4+aes-

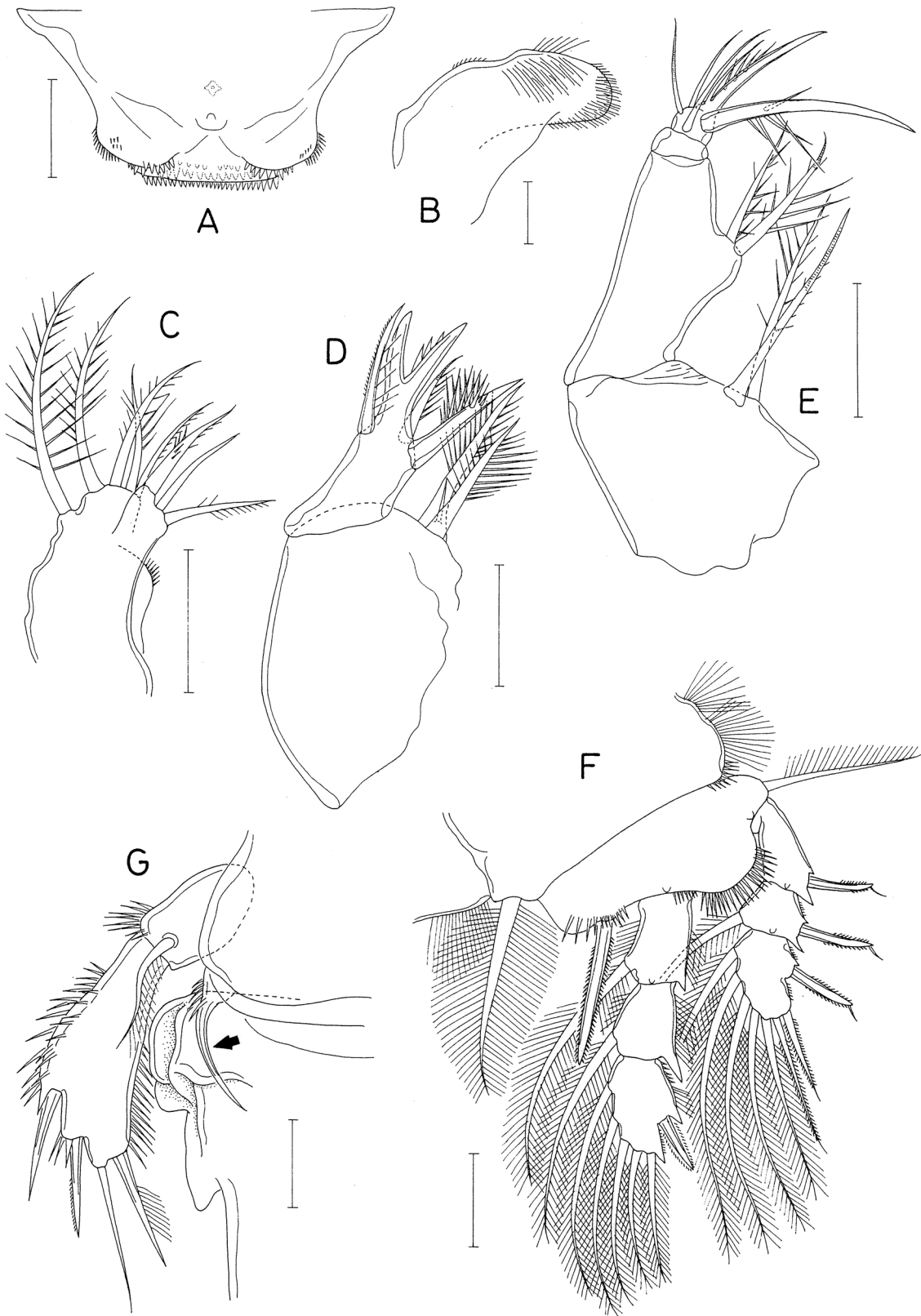
thetasc, 2+aesthetasc, and 7+aesthetasc; setae generally long and naked, except for following pinnate setae: 1 on second, fourth, and sixth segments each, 2 on fifth, and 3 on last. Antenna (Fig. 1E) 4-segmented; first segment longest, with scattered spinules and 1 pinnate seta at inner distal corner; second segment with spinulose inner margin and 1 pinnate seta on inner margin; third segment with dense spinules on inner margin, 4 setae at distinctly projected inner distal corner; terminal segment as long as wide, 25 × 25 µm, and armed with 7 setae, of which 2 outer ones weakly pinnate and one of remainings spinulose.

Labrum (Fig. 2A) as in general of the genus, with broad proximal part, narrower, spinulose distal part, and straight posterior margin. Mandible (Fig. 1F) with 4 elements distally: 1 claw-like thick element bearing 2 rows of fine spinules, 1 plate-like, densely spinulose element, and 2 pinnate setae. Paragnath (Fig. 2B) as small, unarticulated lobe bearing setules in distal region. Maxillule (Fig. 2C) distally bilobed, with patch of fine spinules on inner margin, and armed with 3 setae on inner lobe and 5 setae on outer lobe; most of setae on these lobes pinnate or spinulose. Maxilla (Fig. 2D) 2-segmented; basal segment with 2 thick setae on inner side, one of these setae with subsidiary setule at base; distal segment terminating in large, bifurcate process (with smooth outer branch and 3 cusps-bearing inner branch) and armed with 1 unilaterally pinnate seta and 2 spines: outer spine pinnate on inner margin and finely spinulose on outer margin; inner spine with patch of spinules near middle of outer margin. Maxilliped (Fig. 2E) 4-segmented; first segment broadest, with 2 large setae on inner margin; second segment longest, with 2 large setae on protrusion of inner margin; short third segment unarmed; terminal segment with 3 naked setae and 2 spines (terminal and inner ones); long inner spine with several long spinules near proximal third; terminal spine with several spinules on outer margin and 1 naked proximal seta; latter seta not articulated at base.

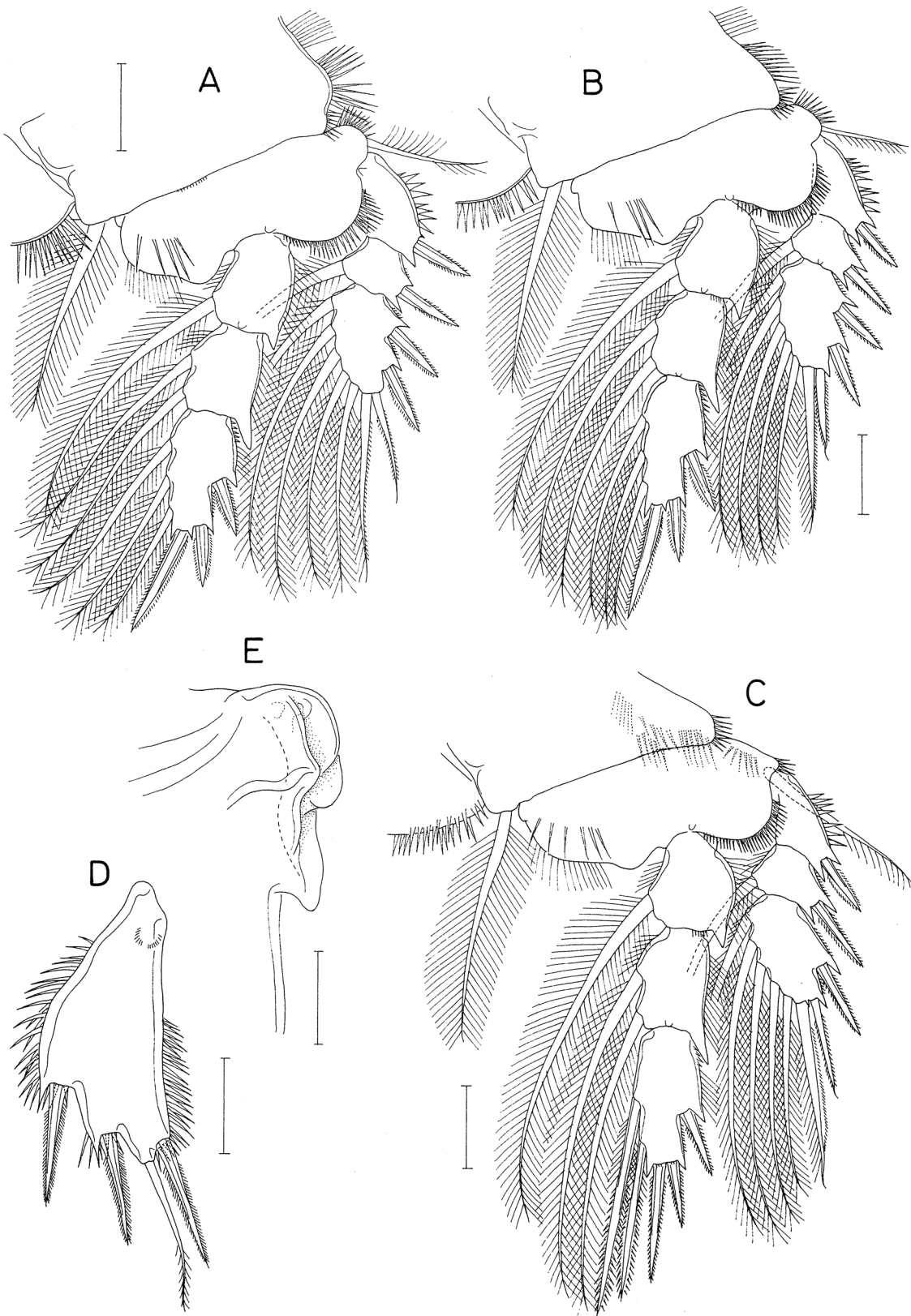
Legs 1–4 (Figs. 2F, 3A–C) with 3-segmented rami; endopods distinctly longer than exopods; coxa with setules on outer margin and patch of spinules at outer distal corner. Inner distal spine on basis of leg 1 large, spinulose, 78 µm long, and extending to distal border of second endopodal segment. Intercoxal plate with setules on posterior margin in leg 1, but with spinules in legs 2–4. Basis with row of spinules along distal margin between bases of rami and on inner side of anterior surface; inner side of distal margin with spinules in leg 1, but with setules in legs 2–4. Outer spines on leg 1 exopod tipped with setule. Outer distal corner of first and second endopodal segments of legs 1–4 projected, spiniform. Two inner spines on third endopodal segment of leg 4 elongate and pinnate in proximal 2/5 but spinulose in distal 3/5. Armature formula of legs 1–4 as follows:



**Fig. 1.** *Hemicyclops cornutus* n. sp., female. A, Habitus, dorsal; B, Urosome, dorsal; C, Anal somite and caudal rami, ventral; D, Antennule; E, Antenna; F, Mandible. Scale bars: A=0.2 mm, B=0.1 mm, C-E=0.05 mm, F=0.02 mm.



**Fig. 2.** *Hemicyclops cornutus* n. sp., female. A, Labrum; B, Paragnath; C, Maxillule; D, Maxilla; E, Maxilliped; F, Leg 1; G, Left side of fifth pedigerous somite and genital area, dorsal. Scale bars: A, C-G=0.05 mm, B=0.02 mm.



**Fig. 3.** *Hemicyclops cornutus* n. sp., female. A, Leg 2; B, Leg 3; C, Leg 4; D, Leg 5 exopod; E, Right genital aperture, dorsal. Scale bars: A–E=0.05 mm.

	Coxa	Basis	Exopod	Endopod
Leg 1:	0-1	1-I	I-0; I-1; I, II, 5	0-1; 0-1; I, 2, 3
Legs 2 & 3:	0-1	1-0	I-0; I-1; III, 1, 5	0-1; 0-2; I, II, 3
Leg 4:	0-1	1-0	I-0; I-1; II, I, 5	0-1; 0-2; I, II, II

Leg 5 (Fig. 2G) 2-segmented; basal segment with 1 unilaterally pinnate, dorsodistal seta and patch of spinules at outer distal corner; exopod (distal segment, Fig. 3D) narrow proximally but gradually broadened distally,  $142 \times 63 \mu\text{m}$  (ratio 2.25 : 1), ornamented with dense spinules on both lateral margins and armed with 3 spines and 1 seta on distal margin; lengths of spines 63, 56, and  $69 \mu\text{m}$ , respectively, from outer to inner. Leg 6 not discernible.

**Male.** Unknown.

**Etymology.** The specific name *cornutus* is derived from the Latin “*cornu*” (=horn) and alludes to the presence of a pair of dorsal, horn-like spines on the fifth pedigerous somite.

**Remarks.** Although only a single specimen is available to the present description of *Hemicyclops cornutus* n. sp., its outstanding feature, the presence of a pair of horn-like spines on the fifth pedigerous somite may clearly typify the new species. Only two species have previously been known to have a pair of similar elements each on postero-dorsal corner of the fifth pedigerous somite, as in the new species. They are *H. biflagellatus* and *H. acanthosquillae*, both described by Humes (1965) from Madagascar. Of these two species, *H. acanthosquillae* clearly differs from *H. cornutus* n. sp., because the former species has, most of all, an extraordinary form of the antenna in which the inner distal corner of the third segment is strongly projected. *Hemicyclops biflagellatus* is closely similar to *H. cornutus* n. sp. in sharing nearly all of significant characters, including the similar form of the hairy caudal rami. However, they are not of a same species. The most significant difference is displayed in the shape of the genital double-somite, in which the lateral margins of the anterolateral expansion are simple, rounded in *H. biflagellatus*, as Humes (1965) figured, but truncated, with 3 curvatures in *H. cornutus* n. sp. Other minor differences are as follows: (1) the posterolateral corners of the fourth pedigerous somite are sharply pointed in *H. biflagellatus*, but only angular in *H. cornutus*; (2) the caudal ramus is  $100 \times 41 \mu\text{m}$ , 2.44 times as long as wide in *H. biflagellatus*, compared to  $85 \times 40 \mu\text{m}$ , 2.13 times as long as wide in *H. cornutus*; (3) the dorsolateral element on the fifth pedigerous somite is a pinnate seta in *H. biflagellatus*, but a non-flexible, naked spine bearing a tuft of spinules proximally in *H. cornutus*; and (4) one (second inner element) of five elements on the third endopodal segment of leg 4 is a pinnate seta in *H. biflagellatus*, but all of these five elements are spines in *H. cornutus*.

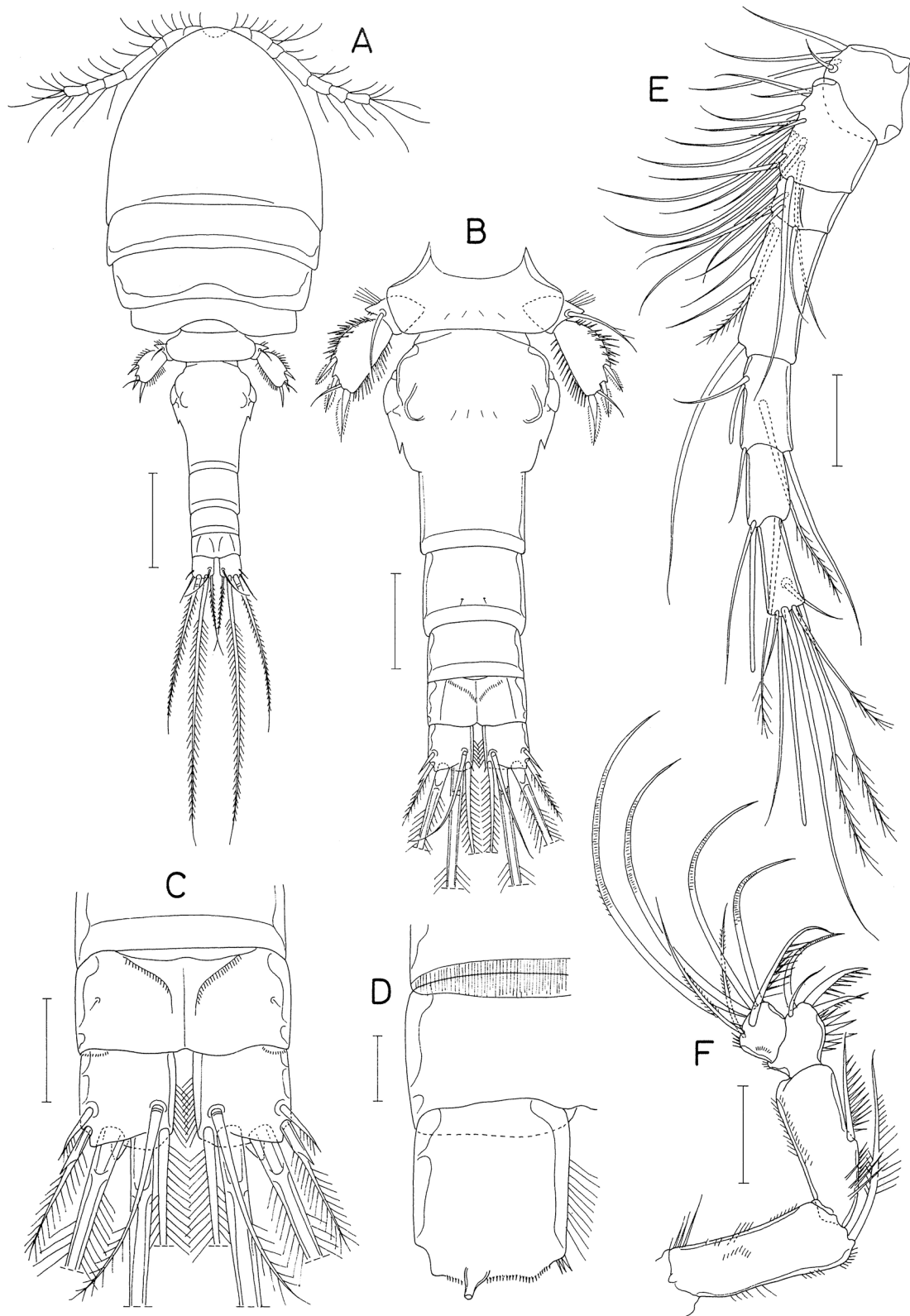
### *Hemicyclops parapiculus* n. sp. (Figs. 4–6)

**Material examined.** 1 ♀ (holotype) from invertebrate burrows on the Ban Pa Khok seagrass bed, northeastern coast of Phuket Province, Thailand, 16 Dec 2012. Holotype (CR00 233152, dissected and mounted on a glass slide) has been deposited in the MABIK, Seocheon, Korea.

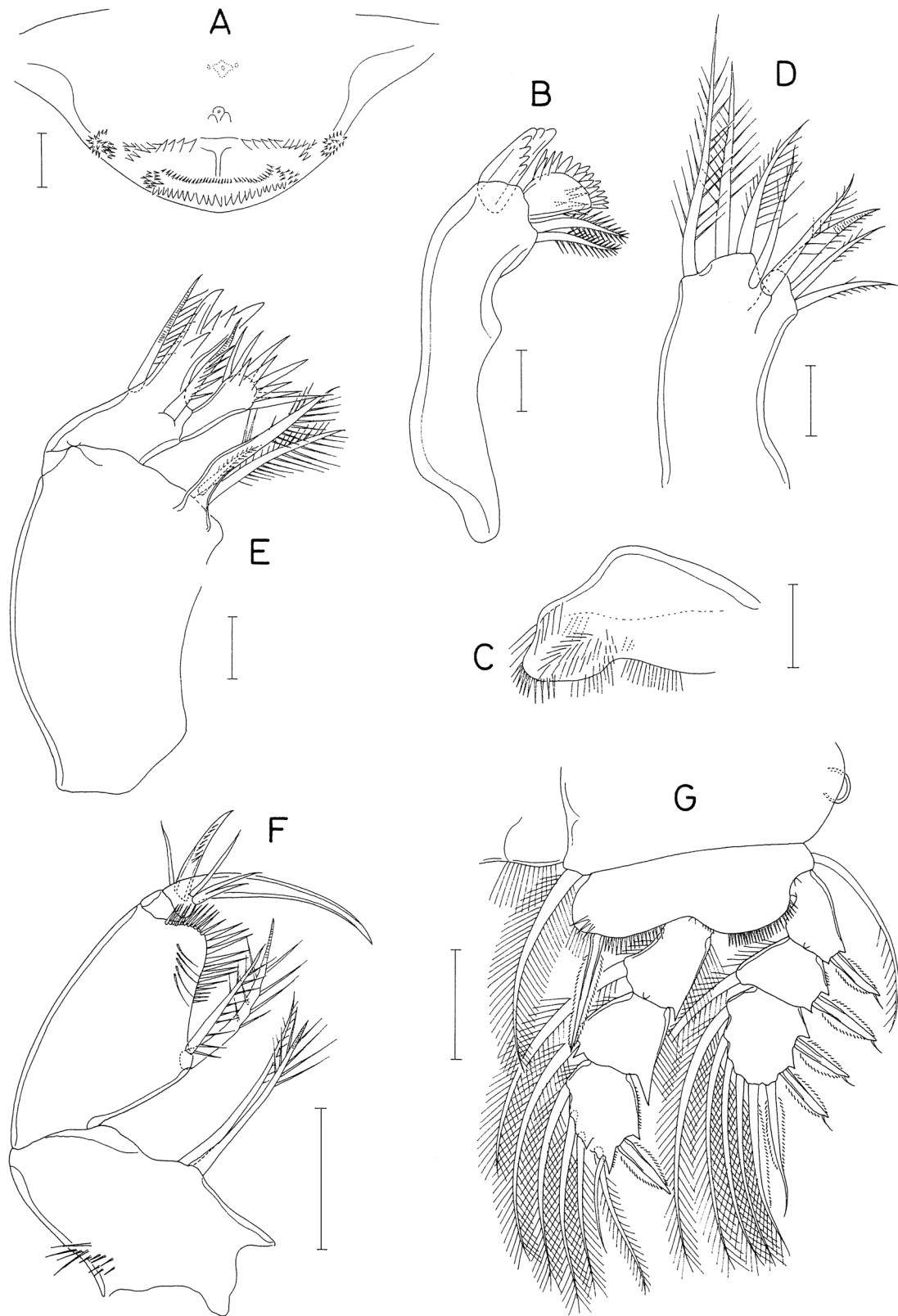
**Female.** Body (Fig. 4A) moderately narrow and 1.19 mm long. Prosome  $655 \times 465 \mu\text{m}$  and consisting of cephalothorax and second to fourth pedigerous somites. Posterolateral corners of prosomal somites not pointed. Cephalothorax  $385 \mu\text{m}$  long. Second and third pedigerous somites fringed with membrane along posterior margin. Urosome (Fig. 4B) 5-segmented. First urosomal somite (fifth pedigerous somite)  $185 \mu\text{m}$  wide, with smooth lateral and posterior margins. Genital double-somite (Figs. 4B, 6E)  $227 \mu\text{m}$  long, comprising roundly expanded anterior 63% and narrower distal 37%; greatest width of double-somite  $185 \mu\text{m}$ , and width of narrower distal part  $115 \mu\text{m}$ ; expanded anterior part with sharp point at subdistal region of its lateral margins; genital aperture locating at midlength of expanded anterior part. Three free abdominal somites  $78 \times 108$ ,  $60 \times 100$ , and  $50 \times 103 \mu\text{m}$ , respectively. Anal somite with short, transverse row of fine spinules along lateral side of posterodorsal margin (Fig. 4C). Caudal rami (Fig. 4C) quadrate,  $55 \times 48 \mu\text{m}$  (ratio 1.15 : 1) measured in ventral view, with setules on inner margin, tapered, tube-like ventrodorsal element bearing pore at tip (Fig. 4D), and finely spinulose posteroventral margin; outer lateral seta small,  $35 \mu\text{m}$  long and pinnate along inner margin; outermost distal seta (seta III) spiniform proximally and tipped with pinnate seta.

Rostrum short, with round posterior apex. Antennule (Fig. 4E)  $321 \mu\text{m}$  long; armature formula 4, 15, 6, 4, 4+aesthetasc, 2+aesthetasc, and 7+aesthetasc; pinnate setae: 1 on fourth, fifth, and sixth segments each, and 3 on terminal segment. Antenna (Fig. 4F) 4-segmented; first segment longest, with scattered setules and spinules and 1 long inner distal seta; second segment slightly shorter than first, with setules on outer margin, spinules on proximal part of inner margin and 1 seta (this seta spinulose on inner margin) at middle of inner margin; third segment with inflated inner distal corner, spinules on inner margin and 4 setae at inner distal region, 2 of these setae naked and remaining 2 spinulose; terminal segment  $22 \times 27 \mu\text{m}$ , slightly wider than long, and armed with 7 setae, 4 of them large and weakly geniculate.

Labrum (Fig. 5A) nearly hemispherical, with various spinules on distal and subdistal regions; posterior and lateral margins not defined. Mandible (Fig. 5B) with 2 massive elements and 2 setae distally. Paragnath (Fig. 5C) not articulated, slightly curved, with spinules and setules. Maxillule (Fig. 5D) distally bilobed, with 3 shorter setae (one of them broad) on

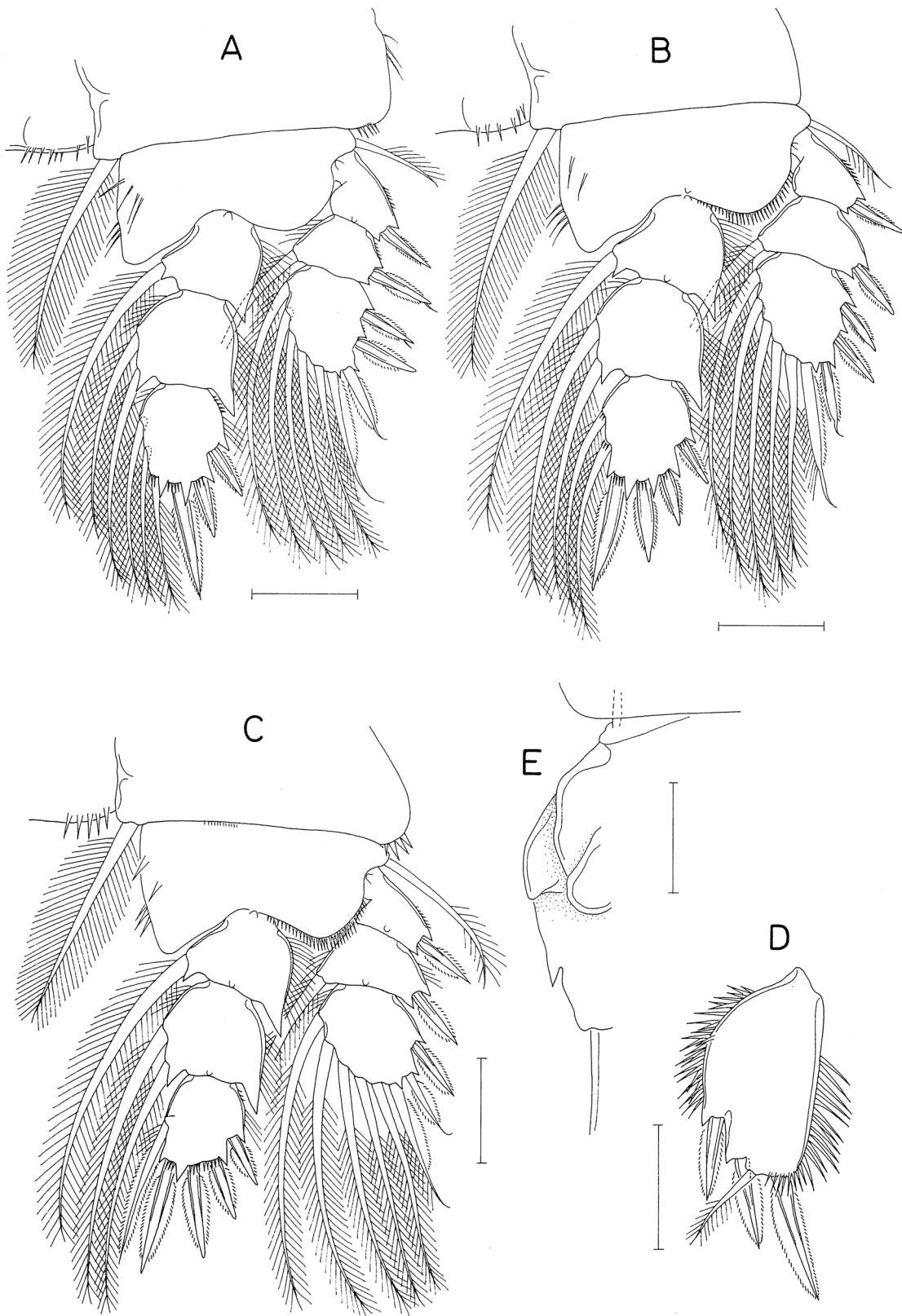


**Fig. 4.** *Hemicyclops parapiculus* n. sp., female. A, Habitus, dorsal; B, Urosome, dorsal; C, Anal somite and caudal rami, dorsal; D, Right side of anal somite and right caudal ramus, ventral; E, Antennule; F, Antenna. Scale bars: A=0.2 mm, B=0.1 mm, C, E, F=0.05 mm, D=0.02 mm.



**Fig. 5.** *Hemicyclops parapiculus* n. sp., female. A, Labrum; B, Mandible; C, Paragnath; D, Maxillule; E, Maxilla; F, Maxilliped; G, leg 1. Scale bars: A-E=0.02 mm, F, G=0.05 mm.





**Fig. 6.** *Hemicyclops parapiculus* n. sp., female. A, Leg 2; B, Leg 3; C, Leg 4; D, Leg 5 exopod; E, Left genital area, dorsal. Scale bars: A–E=0.05 mm.

narrower lobe and 5 longer seta on broader lobe. Maxilla (Fig. 5E) similar to that of preceding species; basal segment with 2 large setae and 1 small, weakly pinnate seta inserted to base of one of 2 larger setae. Maxilliped (Fig. 5F) with 2 large setae on inner margin and patch of spinules on outer side of first segment; second segment slightly inflated in middle, with 2 spinulose setae on inner margin and ornamented with row of large spinules on distal part of inner margin and row of several setules near inner distal corner; third segment small and unarmed; terminal segment terminating in long, smooth claw and proximally with 2 naked seta, 1 bifurcate seta, and 1 spinulose spine.

Leg 1 (Fig. 5G) with small tubercle on outer margin of coxa; inner distal spine on basis 54  $\mu\text{m}$  long; distal process on third endopodal segment pronounced, with fine spinules on its outer margin; outermost terminal seta on third endopodal segment naked and smaller than nearby setae; all of outer spines on exopod tipped with setule. Posterior margin of coxa of leg 1 with setules (Fig. 5G), but those of legs 2–4 with sparse spinules (Fig. 6A–C). Inner proximal spine on third endopodal segment of leg 4 pinnate proximally. Armature formula of legs 1–4 as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1:	0-1	1-I	I-0; I-1; III, I, 4	0-1; 0-1; I, 2, 3
Leg 2:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 3
Leg 3:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; II, II, 2
Leg 4:	0-1	1-0	I-0; I-1; II, I, 5	0-1; 0-2; I, II, II

Leg 5 two-segmented (Fig. 4B); basal segment (protopod) with angular outer distal corner, setulose outer margin and armed with 1 dorsal, naked seta; exopod (Fig. 6D) 83  $\times$  46  $\mu\text{m}$  (ratio 1.80 : 1), with densely spinulose lateral margins, and armed with 3 spines and 1 pinnate seta; lengths of distal spines on exopod 35, 38, and 53  $\mu\text{m}$ , respectively, from outer to inner. Leg 6 not discernible.

**Male.** Unknown.

**Etymology.** The specific name *parapiculus* refers to the close similarity of the new species to *Hemicyclops apiculus* Humes, 1995. The prefix *par* means “equal” in Latin.

**Remarks.** *Hemicyclops parapiculus* n. sp. is very closely related to *H. apiculus* Humes, 1995 described from Madagascar (Humes, 1995). These two species have in common almost all important characteristics, such as similar length : width ratio of caudal ramus, similar form of antenna and maxilliped, and similar armature on legs. The most significant difference between the two, which prevents them from being treated as conspecific, is in the shape of the genital double-somite. The narrower posterior part of the genital double-somite of *H. parapiculus* is relatively short, about 0.4 times as long as entire somite length, while the same part of *H. apiculus* is

longer, two-thirds as long as somite length (Humes, 1995). The anterior expansion of the genital double-somite of *H. parapiculus* bears a pointed, tooth-like process on both sides, whereas the same place of *H. apiculus* is bluntly angular, without a process.

As minor differences, the body length of the new species is 1.19 mm, which is compared to 1.36–1.50 mm in *H. apiculus*. The posterolateral corners of the second pedigerous somite is blunt in *H. parapiculus*, but tapered and pointed in *H. apiculus*, as figured by Humes (1995) for the latter species. The exopod of leg 5 is 83  $\times$  46 (ratio 1.80) in *H. parapiculus*, but 94  $\times$  60 (ratio 1.57) in *H. apiculus*. *H. parapiculus* n. sp. was found from invertebrate burrows on a tidal flat, but *H. apiculus* was discovered from washings of scleractinian corals. This habitat difference may be a suggestion that they are not conspecific.

It should be pointed out that *H. australis* Nicholls, 1944 appears close to *H. parapiculus* n. sp. In viewing of illustrations of Nicholls (1944) for *H. australis*, the genital double-somite and its short caudal rami are very similar in form to those of *H. parapiculus*. The shape of the antenna, in which the medio-distal corner of the third segment is unusually blunt, is also shared by the two species. However, a further comparison is impossible due to the incomplete original description for *H. australis*. In the illustrations of Nicholls (1944) the labrum of *H. australis* has a straight (vs. convex in *H. parapiculus*) posterior margin and the maxilliped of the female does not have a bifurcate seta on the terminal segment. These points may suggest that this species from South Australia differs from *H. parapiculus* in species level.

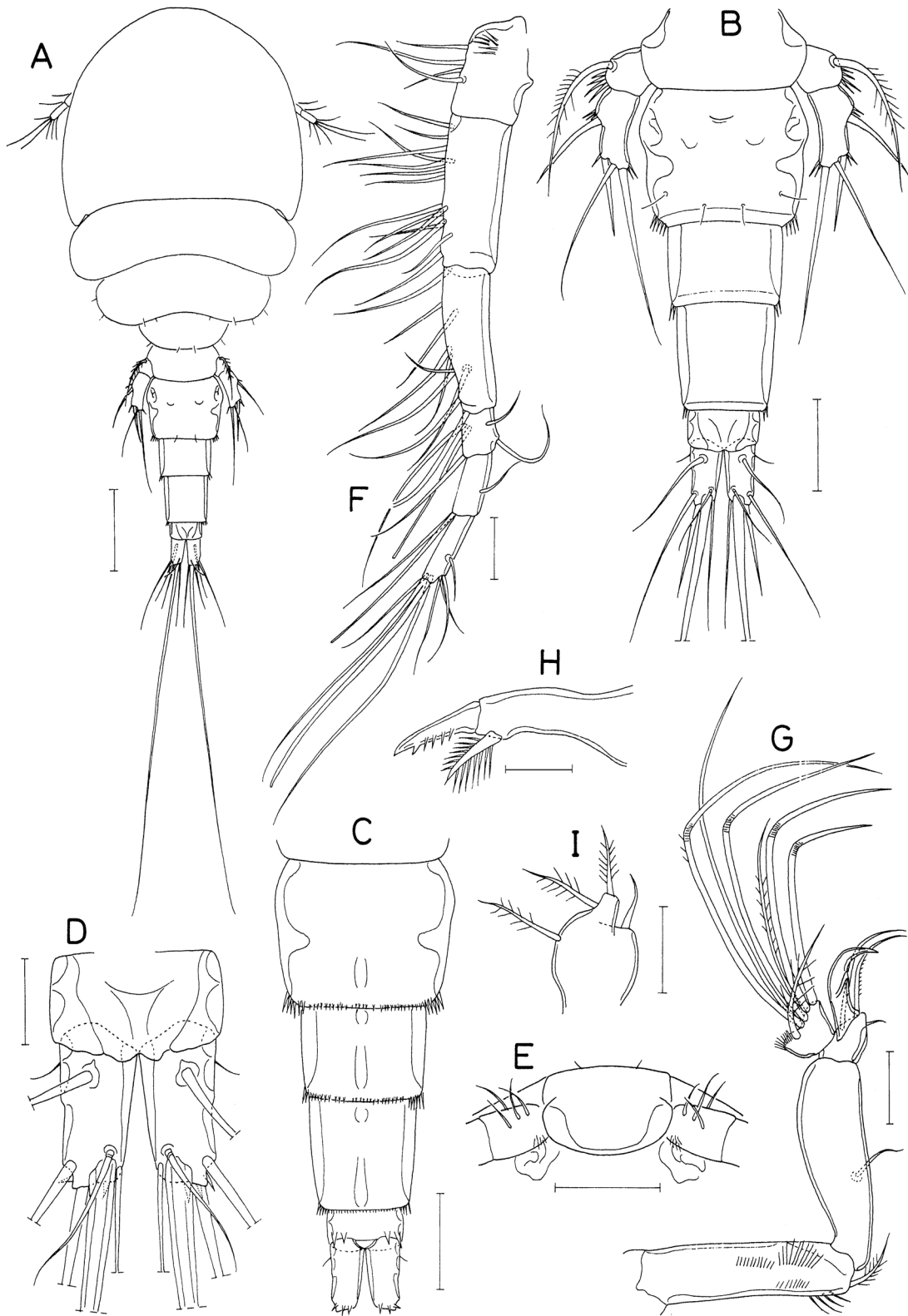
Family Synaptiphilidae Bocquet and Stock, 1957

Genus *Presynaptiphilus* Bocquet and Stock, 1960

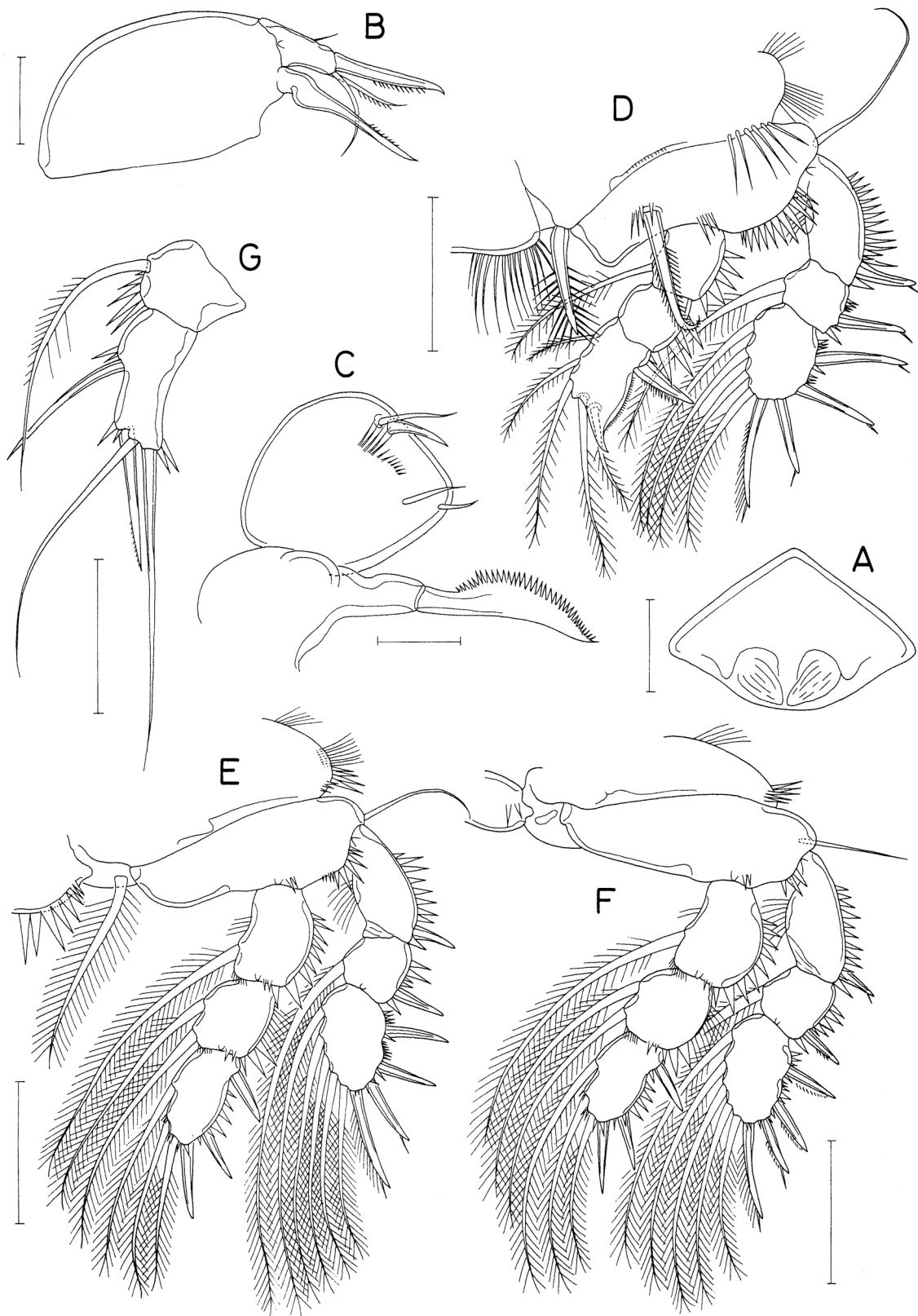
### *Presynaptiphilus trifurcatus* n. sp (Figs. 7–9)

**Material examined.** 1 ♀, 1 ♂ from a brittle star (genus *Amphiura*) dug out from the tidal flat, Ban Pa Khok seagrass bed, northeastern coast of Phuket Province, Thailand, 16 Dec 2012. Holotype (♀, CR00233153) and allotype (♂, CR00233154), both dissected and mounted each on a glass slide, have been deposited in the MABIK, Seocheon, Korea.

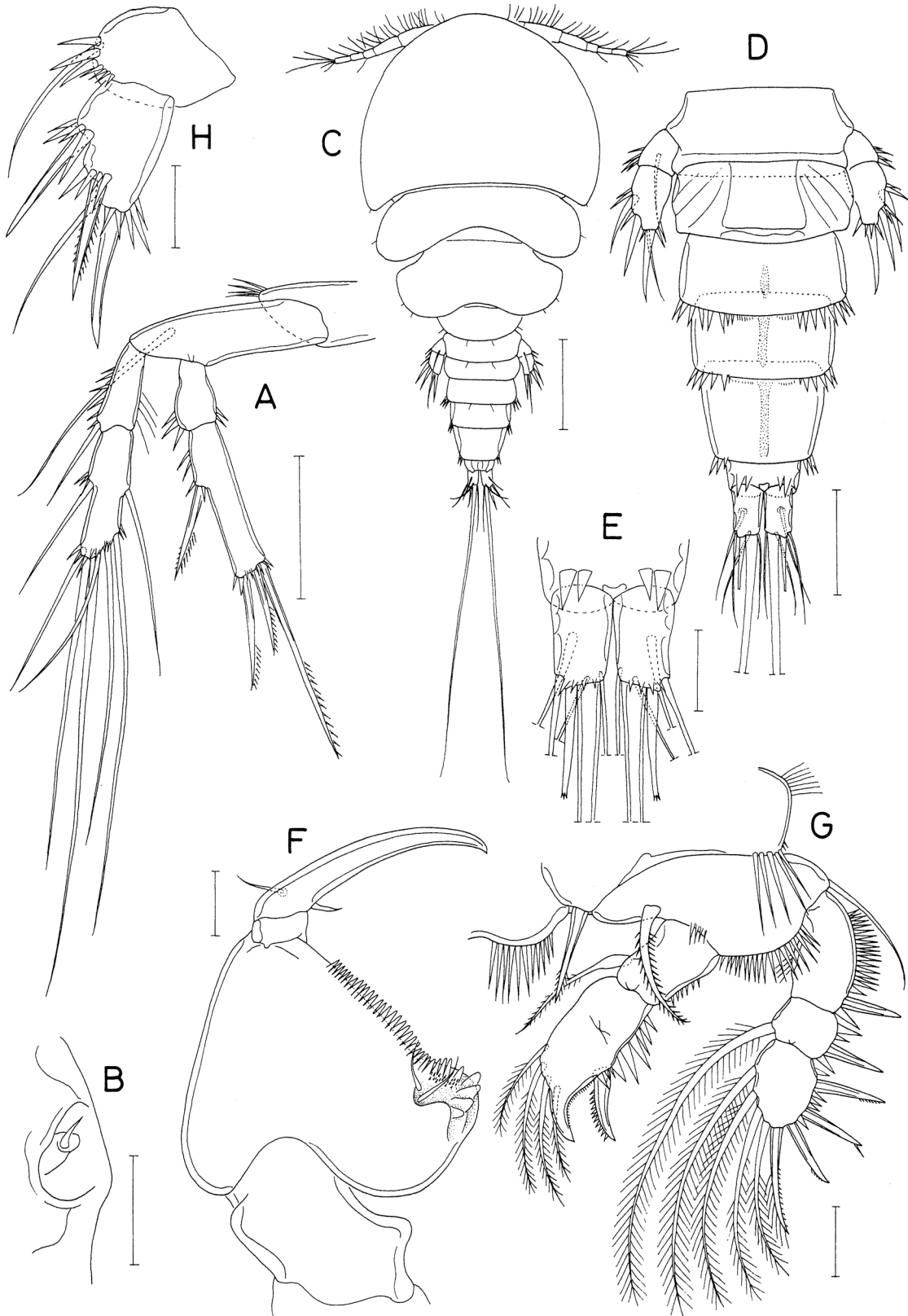
**Female.** Body (Fig. 7A) small, 692  $\mu\text{m}$  long. Prosome 425  $\times$  283  $\mu\text{m}$ , consisting of cephalothorax and second to fourth pedigerous somites. Cephalothorax 238  $\mu\text{m}$  long, wider than long, with blunt posterolateral corners. Second and third pedigerous somites with convex lateral margins, without corners. Fourth pedigerous somite reduced, much narrower than preceding somite. Urosome (Fig. 7B) 5-segmented. Fifth pedigerous somite (first urosomal somite) 90  $\mu\text{m}$  wide, with smooth lateral and posterior margins. Genital double-somite



**Fig. 7.** *Presynaptiphilus trifurcatus* n. sp., female. A, Habitus, dorsal; B, Urosome, dorsal; C, Genital double-somite and abdomen, ventral; D, Anal somite and caudal rami, dorsal; E, Rostral region, ventral; F, Antennule; G, Antenna; H, Mandible; I, Maxillule. Scale bars: A=0.1 mm, B, C, E=0.05 mm, D, F, G, I=0.02 mm, H=0.01 mm.



**Fig. 8.** *Presynaptiphilus trifurcatus* n. sp., female. A, Labrum; B, Maxilla; C, Maxilliped; D, Leg 1; E, Leg 2; F, Leg 3; G, Leg 5. Scale bars: A-C=0.02 mm, D-G=0.05 mm.



**Fig. 9.** *Presynaptiphilus trifurcatus* n. sp. Female: A, Leg 4; B, Right genital area. Male: C, Habitus, dorsal; D, Urosome, ventral; E, Caudal rami, ventral; F, Maxilliped; G, Leg 1; H, Leg 5. Scale bars: A, D=0.05 mm, B, E-H=0.02 mm, C=0.1 mm.

(Fig. 7B) rectangular,  $74 \times 92 \mu\text{m}$ , wider than long, with weak anterolateral expansion, spinulose posteroventral margin, and 2 pairs of sensillae on posterodorsal region; genital aperture locating dorsally at region of anterolateral expansion. Three free abdominal somites  $45 \times 62$ ,  $58 \times 53$ , and  $21 \times 39 \mu\text{m}$ , respectively. First and second free abdominal somites with spinules along posteroventral margin. Anal somite short, with 2 pair of denticles on posterior part of ventral surface (Fig. 7C); anal aperture large (Fig. 7D). Caudal ramus almost straightly directed backwards (Fig. 7C, D); each ramus  $37 \times 18 \mu\text{m}$  (measured in ventral view), 2.06 times as long as wide, armed with 7 naked setae, including setule-like outer proximal seta (seta I), and ornamented few spinules on posteroventral margin; one of caudal setae (seta II) located on proximal region of dorsal surface of ramus; outer one (seta IV) of 2 median terminal setae reduced, shorter than outermost terminal seta, but inner, nearby seta (seta V) large, more than 5 times as long as second longest seta (seta III).

Rostrum (Fig. 7E) nearly rectangular, much wider than long, with well-sclerotized posterior margin. Antennule (Fig. 7F)  $265 \mu\text{m}$  long and 6-segmented; armature formula 4, 15, 9, 4+aesthetasc, 2+aesthetasc, and 7+aesthetasc; all setae naked and all aesthetascs thin; first segment with additional patch of several setules at proximal region. Antenna (Fig. 7G) 4-segmented; first segment with 1 pinnate seta at inner distal corner and several rows of setules on distal half of surface; second segment nearly as long as first segment, with 1 naked seta on inner side; short third segment with produced inner distal corner and armed with 1 powerful claw and 3 setae, proximalmost one of latter small, setule-like; terminal segment wider than long and armed with 4 large, geniculate spiniform setae, 1 simple naked seta, and 2 pinnate setae.

Labrum (Fig. 8A) rhomboidal, wider than long, with tapering lateral margins and 1 pair of membranous lobes on posterior region of dorsal surface. Mandible (Fig. 7H) armed with 2 elements consisting of 1 subdistal seta and 1 distal spine bearing 1 subterminal cusp and 4 spinules. Paragnath not discernible. Maxillule (Fig. 7I) weakly bilobed distally and armed with 3 pinnate seta on outer lobe and 1 naked seta on inner lobe. Maxilla (Fig. 8B) 2-segmented; basal segment with elongate inner distal spine bearing minute spinules on distal part of outer margin; distal segment with 1 spinulose spine, 2 slender seta and 1 small, setule-like, subdistal seta. Maxilliped (Fig. 8C) peculiar and 2-segmented; basal segment with projected inner distal corner tipped by large, saw-like spine bearing serrate distal margin; distal segment almost rectangular and plate-like, with 1 pair (one of them being spiniform) of distal and 1 pair of inner, subdistal setae and 1 transverse, subdistal row of setules.

Legs 1–3 (Fig. 8D–F) with 3-segmented rami. Leg 4 (Fig. 9A) with 2-segmented rami. Posterior margin of coxa with

large setules in leg 1, but with spinules in legs 2 and 3, and naked in leg 4. Inner element of coxa being setulose spine in leg 1, pinnate seta in leg 2, but absent in legs 3 and 4. Outer seta of legs 1–4 naked. Inner spine on basis of leg 1 setiform and spinulose. Third endopodal segment of leg 1 with pointed process at distal apex. Distal endopodal segment of leg 4  $55 \times 14 \mu\text{m}$  (ratio 3.93 : 1). Armature formula of legs 1–4 as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1:	0-I	1-I	I-0; I-1; III, I, 4	0-1; 0-0; I, 2, 3
Leg 2:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; II, I, 3
Leg 3:	0-0	1-0	I-0; I-1; III, I, 5	0-1; 0-2; II, I, 3
Leg 4:	0-0	1-0	1-0; 2, 1 5	0-0; I, III

Leg 5 (Fig. 8G) 2-segmented; basal segment (protopod) with 1 large seta and several spinules on outer margin; distal segment (exopod)  $46 \times 21 \mu\text{m}$  (ratio 2.19 : 1), with 2 spines (outer and outer subdistal) and 2 distal setae, all of these 4 elements naked. Spines and inner distal seta accompanied with 2 spinules near base of these elements; inner one of terminal setae longest,  $107 \mu\text{m}$  long. Leg 6 (Fig. 9B) represented by 1 small, naked seta on genital operculum.

**Male.** Body (Fig. 9C) very similar to that of female, but smaller,  $518 \mu\text{m}$  long. Greatest width  $260 \mu\text{m}$ . Cephalothorax  $190 \mu\text{m}$  long and distinctly wider than long. Urosome (Fig. 9D) 6-segmented. Fifth pedigerous somite  $90 \mu\text{m}$  wide. Genital somite (Fig. 9B) rectangular,  $38 \times 87 \mu\text{m}$ , much wider than long, with indistinct genital opercula. Four abdominal somites  $35 \times 81$ ,  $31 \times 69$ ,  $41 \times 59$ , and  $15 \times 36 \mu\text{m}$ , respectively. First 3 abdominal somites with spinules along both sides of posteroventral margin. Anal somite ornamented as in female (Fig. 9E). Caudal ramus (Fig. 9E)  $25 \times 15 \mu\text{m}$  (ratio 1.67 : 1) and armed with 6 setae; seta I absent; outer one (seta IV) of 2 median terminal setae trifurcate at tip (Fig. 9E).

Rostrum, antennule and antenna as in female. Mouthparts, except for maxilliped, also as in female. Maxilliped (Fig. 9F) consisting of 3 segments and terminal claw; first segment unarmed; second segment greatly expanded proximally and strongly tapering distally, with inner hollow at proximal expansion receiving tip of terminal claw, 2 small setae and 4 broad, foliaceous spinules at hollow, and longitudinal row of spinules along inner margin distal to hollow; small third segment unarmed; terminal claw weakly curved and armed with 2 small setae proximally.

Leg 1 (Fig. 9G) with spinules (instead of setules as in female) on posterior margin of coxa; inner spine on coxa weakly pinnate distally; inner element on basis as spinulose seta. Leg 1 endopod 2-segmented; inner seta on proximal segment swollen proximally; distal segment armed with 1 outer spine and 4 inner setae (armature formula I, 4); distal

process more pronounced than that of female.

Leg 5 (Fig. 9H) stout; exopod  $31 \times 22 \mu\text{m}$  (ratio 1.41 : 1), tapering, armed with 3 spines (distal element being a strong spine rather than a long seta as in female) and 1 naked seta, and ornamented with more number of spinules than in female. Leg 6 absent (Fig. 9D).

**Etymology.** The specific name *trifurcatus* is derived from the trifurcate seta IV (outer one of two median terminal setae) on the caudal ramus in the male.

**Remarks.** All of four known species of the genus *Presynaptiphilus* Bocquet and Stock, 1960 are associates of the amphirid brittle stars. By having one spine and four setae on the distal segment of 2-segmented endopod of male leg 1, *Presynaptiphilus trifurcatus* n. sp. is easily differentiated from other four known species of *Presynaptiphilus*, because in its congeners leg 1 has a 3-segmented endopod (in *P. acrinidae* Bocquet and Stock, 1960) or the distal segment of 2-segmented endopod bears 1 spine and 5 setae (in *P. amphiopli* Humes and Hendler, 1972) or one spine and three setae (in *P. minutes* Kim, 2000 and *P. paraminutus* Shin and Kim, 2003).

The new species can be differentiated from its congeners on the basis of the female morphology. The endopod of female leg 1 is 3-segmented in all known species of the genus. The endopod of female leg 1 of the new species has 1, 0, and 6 elements, respectively, on the first to third segments (formula 0-1; 0-0; I, 5). This armature state is shared only with *P. amphiopli*, and in other congeners the formula is 0-0; 0-0; I, 5 (in *P. acrinidae*) or 0-1; 0-0; 1, 3 (in *P. minutes* and *P. paraminutus*). Therefore, the new species can be compared only with *P. amphiopli* which is known from the Atlantic coast of North America (Humes and Hendler, 1972). In addition to the difference in the armature of male leg 1, these two species show further differences in the female as follows: (1) the second free abdominal somite is wider than long in *P. amphiopli*, but longer than wide in the new species; (2) the posterior margin of the third pedigerous somite is deeply notched in *P. amphiopli*, but not notched, only weakly concave in the new species; (3) the posterior margin of the fourth pedigerous somite bears a complex ornamentation, with acute processes, spinules, and setules in *P. amphiopli*, but smooth in the new species; and (4) the first segment of the antenna bears a patch of numerous spinules in *P. amphiopli*, but only few spinules in the new species.

Family Anchimolgidae Humes and Boxshall, 1996

Genus *Anchimolga* Humes and Stock, 1972

***Anchimolga kantariensis* n. sp. (Figs. 10–12)**

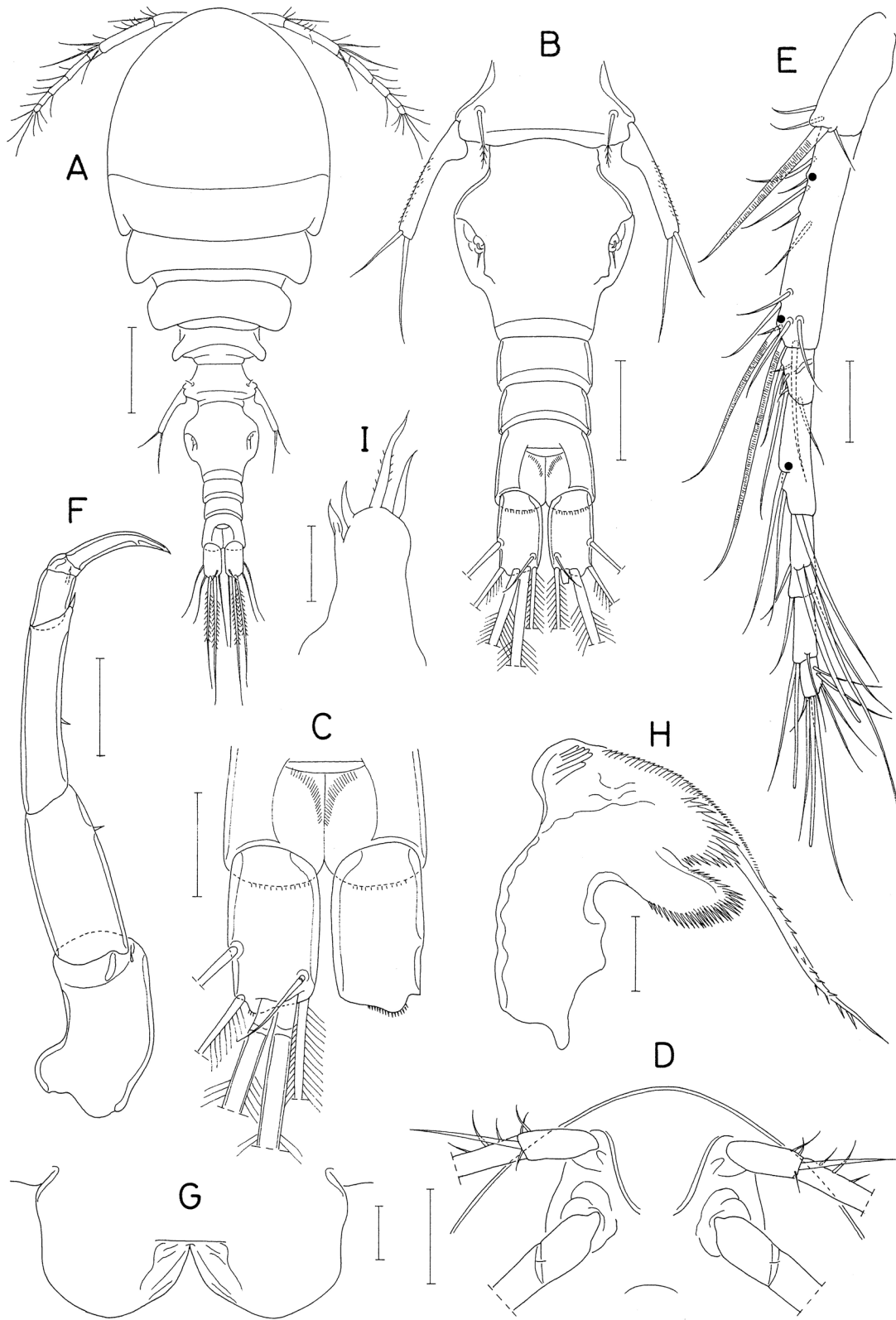
**Material examined.** 5 ♀♀, 8 ♂♂ from a scleractinian coral, on coral reef in Kantary Bay, southern coast of Phuket

Province, Thailand,  $7^{\circ} 48' 14''\text{N}$ ,  $98^{\circ} 24' 20''\text{E}$ , 15 Dec 2012. Holotype (♀, CR00233155), allotype (♂, CR00233156), and paratypes (3 ♀♀, 6 ♂♂, CR00233157) have been deposited in the MABIK, Seocheon, Korea. Dissected paratypes (1 ♀, 1 ♂) are retained in the collection of the senior author.

**Female.** Body (Fig. 10A) moderately broad, 1.35 mm long. Prosome  $769 \times 523 \mu\text{m}$ , tapering posteriorly. Cephalothorax  $548 \mu\text{m}$  long, with dorsal suture line delimiting cephalosome and first pedigerous somite; posterolateral corners round. Fourth pedigerous somite small, only slightly wider than next somite. Urosome (Fig. 10B) 5-segmented. Fifth pedigerous somite  $178 \mu\text{m}$  wide. Genital double-somite (Figs. 10B, 11H)  $193 \mu\text{m}$  long and  $178 \mu\text{m}$  in greatest width (measured at anterior 0.35 region); middle half of double-somite inflated laterally and invertedly trapezoidal; genital aperture large and locating in middle of double-somite. Three free abdominal somites  $52 \times 95$ ,  $40 \times 80$ , and  $78 \times 100 \mu\text{m}$ , respectively. Anal somite with row of fine spinules along posteroventral margin. Caudal ramus (Fig. 10C)  $82 \times 43 \mu\text{m}$  (ratio 1.91 : 1) with 6 setae and with fine spinules on posteroventral margin; outer lateral seta naked and locating at distal third of outer margin; inner dorsal seta (seta VII) naked and articulated at base; 4 distal setae pinnate.

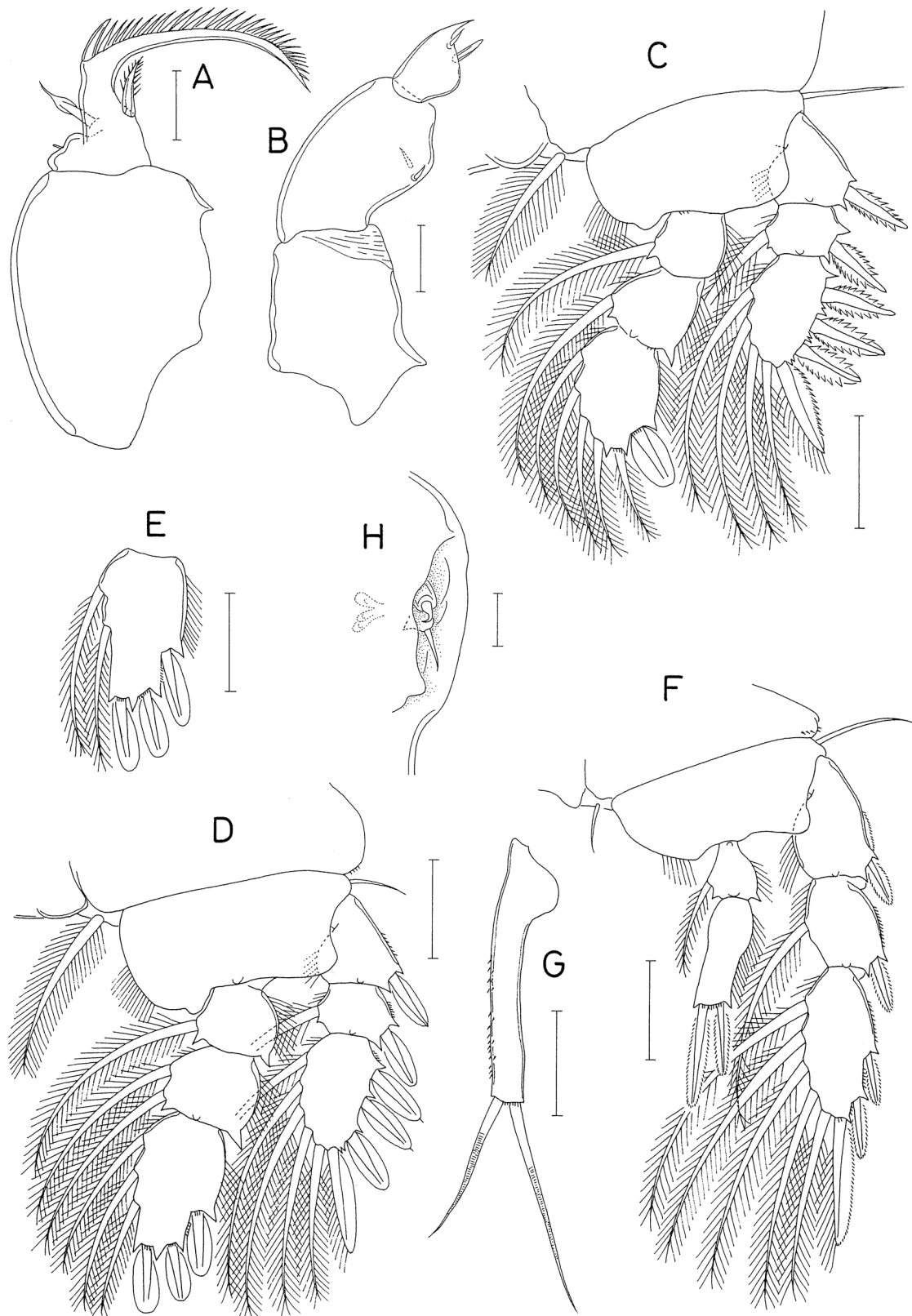
Rostrum (Fig. 10D) with posterior margin confluent with ventral surface of cephalothorax. Antennule (Fig. 10E) slender,  $425 \mu\text{m}$  long, and 7-segmented; armature formula 4, 13, 6, 3, 4+aesthetasc, 2+aesthetasc, and 7+aesthetasc; one of 4 setae on first segment much larger than other 3. Antenna (Fig. 10F) slender and 4-segmented; segments gradually narrowing from proximal to distal; first segment unarmed; second segment  $77 \mu\text{m}$  long, longer than first, with 1 small seta at distal fourth of inner margin; third segment  $94 \mu\text{m}$  long, elongate, 5 times as long as wide, and armed with 2 setae, one of which at proximal third of inner margin and the other at inner distal corner; last segment short,  $32 \mu\text{m}$  long, about 1/3 as long as third segment, and armed with 1 claw ( $58 \mu\text{m}$  long) and 1 small seta.

Labrum (Fig. 10G) unornamented, with broad posterior lobes. Mandible (Fig. 10H) with distinct proximal notch; inner margin bilobed and spinulose; distal lash thin and elongate; proximal region of outer margin protruding, with 5 slender digitiform processes. Maxillule (Fig. 10I) with 3 distal and 1 subdistal setae. Maxilla (Fig. 11A) with unarmed basal segment. Distal segment with large distal lash and 3 setae; distal lash perpendicular to axis of segment, with 1 proximal spine followed by row of spinules along distal margin and with smooth inner margin; inner seta spinulose, not longer than anterior seta; anterior seta flame-shaped distally; outer proximal seta minute. Maxilliped (Fig. 11B) 3-segmented; first segment unarmed; middle segment with 2 small inner

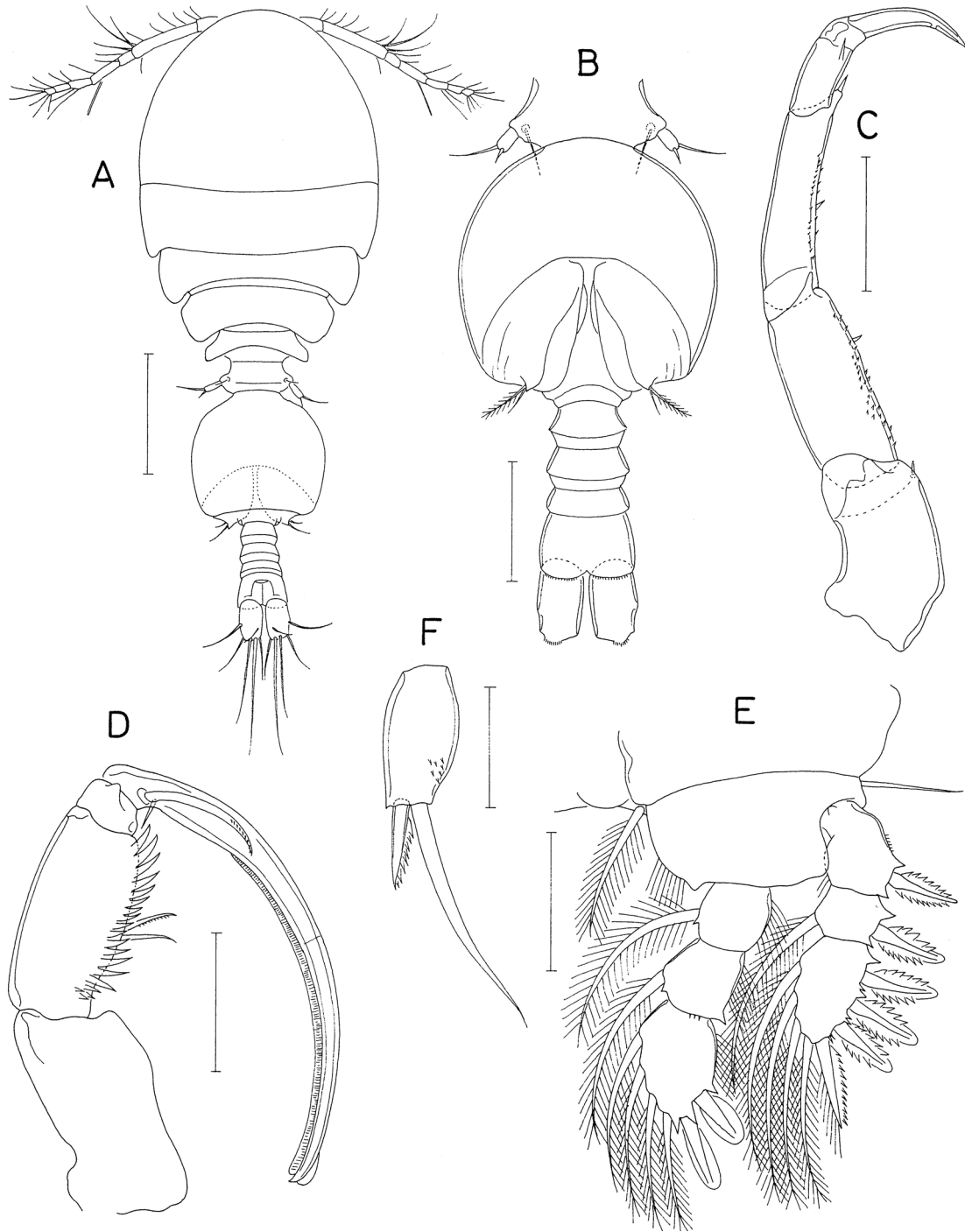


**Fig. 10.** *Anchimolgus kantariensis* n. sp., female. A, Habitus, dorsal; B, Urosome, dorsal; C, Caudal rami, dorsal; D, Rostral area, ventral; E, Antennule; F, Antenna; G, Labrum; H, Mandible; I, Maxillule. Scale bars: A=0.2 mm, B, D=0.1 mm, C, E, F=0.05 mm, G–I=0.02 mm.





**Fig. 11.** *Anchimolgus kantariensis* n. sp., female. A, Maxilla; B, Maxilliped; C, Leg 1; D, Leg 2; E, Third endopodal segment of leg 3; F, Leg 4; G, Leg 5 exopod; H, Right genital area, dorsal. Scale bars: A, B, H=0.02 mm, C–G=0.05 mm.



**Fig. 12.** *Anchimolgus kantariensis* n. sp., male. A, Habitus, dorsal; B, Urosome, ventral; C, Antenna; D, Maxilliped; E, Leg 1; F, Leg 5 exopod. Scale bars: A=0.2 mm, B=0.1 mm, C–E=0.05 mm, F=0.02 mm.

setae of similar size; terminal segment with 1 spine and 1 seta, and terminating in sharp process.

Legs 1–3 with 3-segmented rami (Fig. 11C, D). Outer spines on leg 1 exopod with serrate margins (Fig. 11C); other

spines of legs with smooth or finely serrate margins. Outer seta on basis of legs 1–4 naked. Leg 4 (Fig. 11F) with 3-segmented exopod and 2-segmented endopod; inner coxal seta small and naked; distal endopodal segment  $56 \times 22 \mu\text{m}$ , its 2

distal spines 53  $\mu\text{m}$  (inner) and 34  $\mu\text{m}$  (outer). Armature formula of legs 1–4 as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1:	0-1	1-0	I-0; I-1; III, I, 4	0-1; 0-1; I, 2, 3
Leg 2:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 3
Leg 3:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 2
Leg 4:	0-1	1-0	I-0; I-1; II, I, 5	0-1; II

Leg 5 consisting of 1 pinnate dorsolateral seta on fifth pedigerous somite and free exopod (Fig. 10B); exopod (Fig. 11G) slender, 126  $\times$  28  $\mu\text{m}$  (ratio 4.50 : 1), with distinct inner proximal swelling, fine spinules on outer margin and 2 naked distal setae; slender distal region of exopod 16  $\mu\text{m}$  wide; outer distal seta 74  $\mu\text{m}$  long and inner one 104  $\mu\text{m}$  long. Leg 6 represented by 2 small setae on genital operculum (Fig. 11H).

**Male.** Body (Fig. 12A) smaller than that of female, 1.05 mm long. Prosome 585  $\mu\text{m}$  long. Cephalothorax 404  $\times$  400  $\mu\text{m}$ . Urosome (Fig. 12B) 6-segmented. Fifth pedigerous somite 131  $\mu\text{m}$  wide. Genital somite (Fig. 12B) large, globular, 212  $\times$  217  $\mu\text{m}$ . Abdomen gradually broadening from proximal to distal. Four abdominal somites small, 31  $\times$  63, 34  $\times$  67, 21  $\times$  67, and 48  $\times$  79  $\mu\text{m}$ , respectively. Caudal ramus 67  $\times$  38  $\mu\text{m}$  (ratio 1.76 : 1).

Rostrum as in female. Antennule with 3 additional aesthetascs: 2 on second and 1 on fourth segments as indicated by dark dots in Fig. 10E. Antenna (Fig. 12C) shaped and armed as that of female, but with numerous, minute, additional spinules on inner margin of second and third segments.

Labrum, mandible, maxillule, and maxilla as in female. Maxilliped (Fig. 12D) consisting of 3 segments and terminal claw; first and third segments unarmed; second segment with 2 setae of similar length near middle of inner margin and longitudinal row of spinules along inner margin; terminal claw arched, as long as 3 combined proximal segments, with 1 minute and 1 large setae proximally and membrane along concave margin.

Leg 1 (Fig. 12E) with 2 spines and 4 setae on third endopodal segment. Legs 2–4 as in female. Exopod of leg 5 (Fig. 12F) small, nearly oval, 23  $\times$  12  $\mu\text{m}$  (ratio 1.92 : 1), with few minute spinules subdistally and armed distally with 1 serrate spine (15  $\mu\text{m}$  long) and 1 naked seta; seta about 3 times as long as spine. Leg 6 represented by 1 pinnate seta and 1 minute, naked seta on genital operculum (Fig. 12B).

**Etymology.** The specific name *kantariensis* is derived from “Kantary Bay” in Phuket, the type locality of the new species.

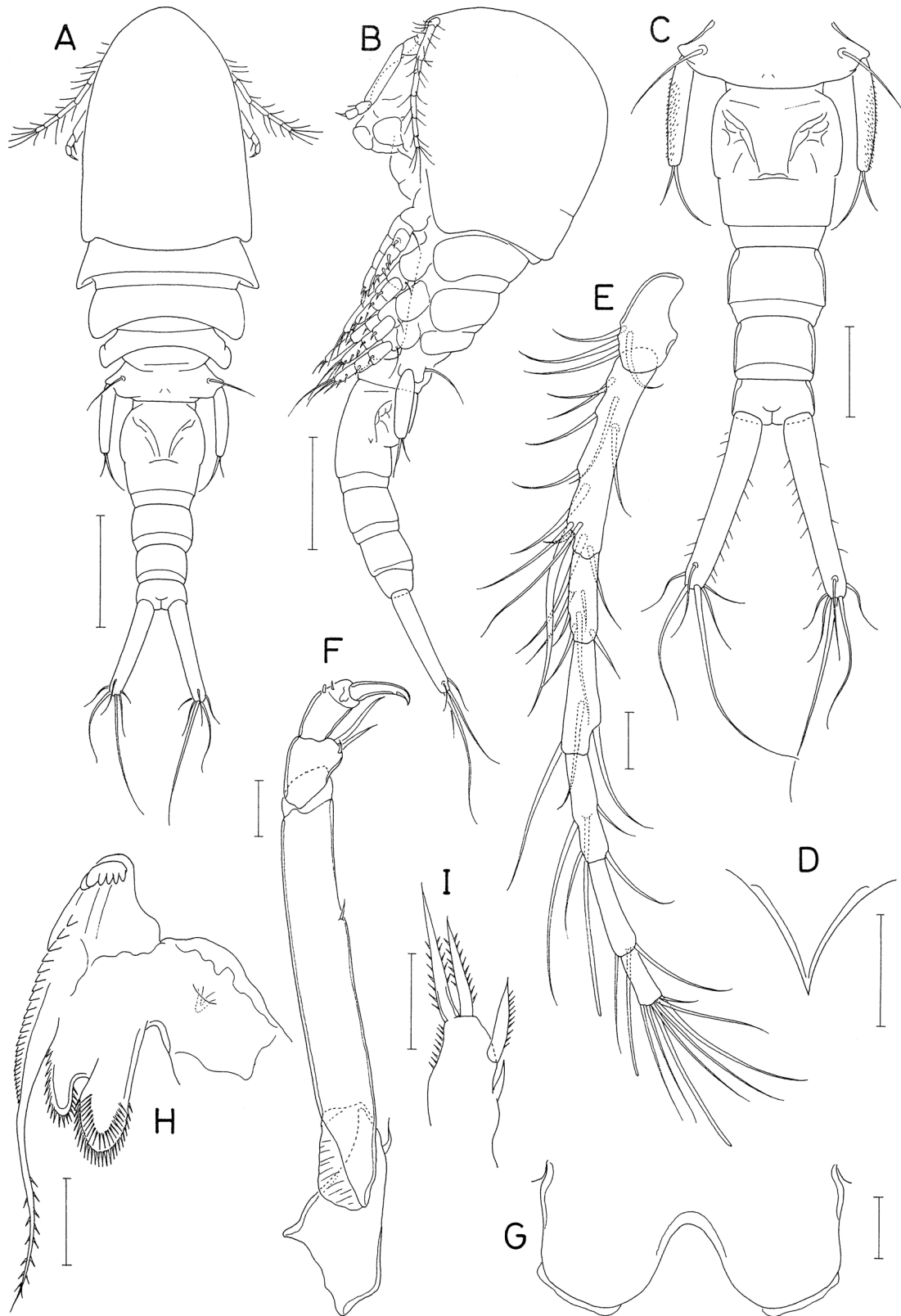
**Remarks.** In the genus *Anchimgolus* Humes and Stock, 1972 proportional lengths of the second to fourth segments of antenna are useful characters to distinguish species. In the antenna of *Anchimgolus kantariensis* n. sp. the third segment is about three times as long the terminal segment and the third segment is not shorter than the second segment. Similar form

of the antenna is shared by 4 congeners: *A. gratus* Humes, 1996, *A. pandus* Humes, 1978, *A. orectus* Humes, 1978, and *A. punctilis* Humes, 1978. Of these, the first two species are not related to the new species, because they have three outer spines on the third exopodal segment of leg 4 (armature formula III, I, 5, against to II, I, 5 as in the new species). *Anchimgolus orectus* also is clearly different from the new species in having a slender prosome, a longer caudal ramus of the female measuring 109  $\times$  40  $\mu\text{m}$ , with the ratio of 2.73 : 1, and a weak inner proximal expansion of leg 5 exopod of the female (Humes, 1978). *Anchimgolus punctilis* is very close to the new species and they share various similar morphological characters, except for only two features. First, the digitiform processes on the outer side of mandible are two in number in *A. punctilis*, but five in *A. kantariensis* n. sp. Second, the exopod of male leg 5 is 28  $\mu\text{m}$  long (longer than that of *A. kantariensis* n. sp., although the body is smaller) with parallel lateral margins in *A. punctilis*, compared to 23  $\mu\text{m}$  long, with convex lateral margins in *A. kantariensis* n. sp. The body length of *A. punctilis* is 1.01–1.22 mm in the female and 0.84–0.96 mm in the male (Humes, 1978), while it is 1.35 mm in the female and 1.05 mm in the male in *A. kantariensis*.

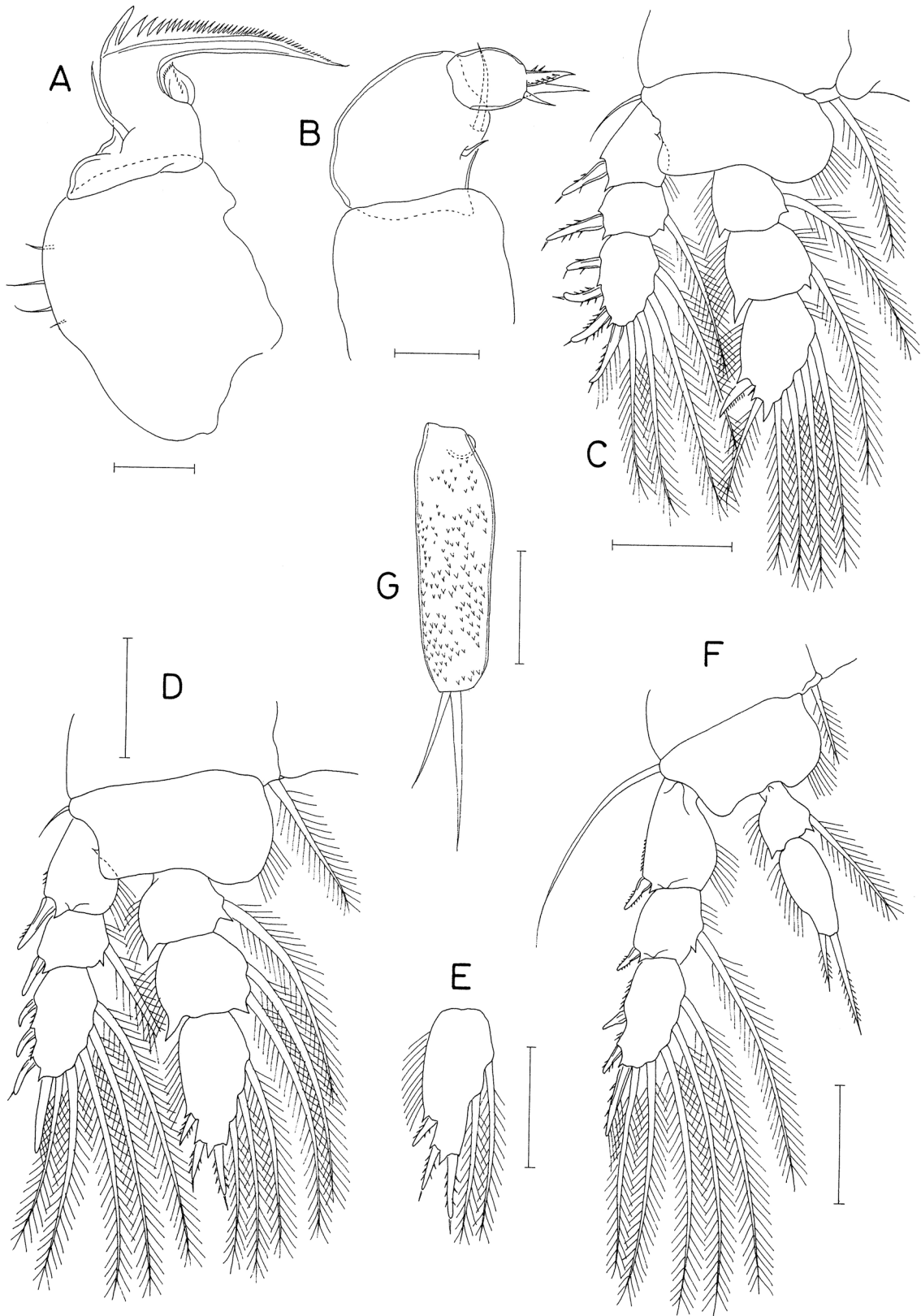
#### *Anchimgolus palmatus* n. sp. (Figs. 13, 14)

**Material examined.** 3 ♀♀ from a scleractinian coral, on coral reef in Kantary Bay, southern coast of Phuket Province, Thailand, 7° 48' 14" N, 98° 24' 20" E, 15 Dec 2012. Holotype (♀, CR00233158) and paratype (1 ♀, CR00233159) have been deposited in the MABIK, Seochon, Korea. Dissected paratype (1 ♀) is retained in the collection of the senior author.

**Female.** Body (Fig. 13A, B) narrow, 1.23 mm long. Prosome 635  $\mu\text{m}$  long and consisting of cephalothorax and second to fourth pedigerous somites. Greatest width of prosome 323  $\mu\text{m}$  measured across second pedigerous somite. Cephalothorax 419  $\times$  304  $\mu\text{m}$ , distinctly longer than wide, dorsally elevated, 365  $\mu\text{m}$  in dorsoventral depth, and dorsoventrally deeper than laterally wider, with nearly parallel lateral margins. Second pedigerous somite trapezoidal, with produced posterolateral corners. Urosome (Fig. 13C) 5-segmented. Fifth pedigerous somite 210  $\mu\text{m}$  wide, much wider than next somite, with tapering lateral margins. Genital double-somite 177  $\times$  144  $\mu\text{m}$ , longer than wide, with slightly broadened anterior half and narrower posterior half; genital apertures locating dorsally at about anterior 0.3 of somite length. Three free abdominal somites 77  $\times$  106, 67  $\times$  90, and 48  $\times$  90  $\mu\text{m}$ , respectively; all of these somites smooth without any ornamentation. Caudal rami divergent (Fig. 13C); each ramus elongate, 205  $\times$  33  $\mu\text{m}$  (ratio 6.21 : 1), armed with 6 distal and subdistal, naked setae and ornamented with fine, sparse setules on outer and inner



**Fig. 13.** *Anchimolgus palmatus* n. sp., female. A, Habitus, dorsal; B, Habitus, lateral; C, Urosome, dorsal; D, Rostrum; E, Antennule; F, Antenna; G, Labrum; H, Mandible; I, Maxillule. Scale bars: A, B=0.2 mm, C=0.1 mm, D=0.05 mm, E-I=0.02 mm.



**Fig. 14.** *Anchimolgus palmatus* n. sp., female. A, Maxilla; B, Maxilliped; C, Leg 1; D, Leg 2; E, Third endopodal segment of leg 3; F, Leg 4; G, Leg 5 exopod. Scale bars: A, B=0.02 mm, C-G=0.05 mm.

margins.

Rostrum (Fig. 13D) beak-like, as long as wide, with sharply pointed posterior apex. Antennule (Fig. 13E) slender, 263  $\mu\text{m}$  long, and 7-segmented; armature formula 4, 13, 6, 3, 4 + aesthetasc, 2 + aesthetasc, and 7 + aesthetasc; all of setae naked. Antenna (Fig. 13F) slender and 4-segmented; first segment with 1 inner distal seta; second segment elongate, about 127  $\mu\text{m}$  long, with 1 small seta at distal third of inner margin; third segment short, 22  $\mu\text{m}$  long with 3 setae, proximal one of them very small; terminal segment also short, 23  $\mu\text{m}$  long, and armed with 2 minute setae and terminal claw; terminal claw 23  $\mu\text{m}$  long, as long as segment and weakly curved.

Labrum (Fig. 13G) with broad median incision and broad posterior lobes fringed with membrane along posterior margin. Mandible (Fig. 13H) with deep proximal notch, strongly projected and bilobed inner margin (proximal lobe with 2 rows of spinules, and distal lobe with single row), and thin, spinulose distal lash; outer proximal region of blade strongly produced, with palm-like element bearing 5 or 6 blunt, digitiform processes. Maxillule (Fig. 13I) armed with 4 setae (2 distal and 2 lateral) and ornamented with spinules on distal region of outer margin; lateral proximal seta naked and other 3 setae spinulose. Maxilla (Fig. 14A) 2-segmented; basal segment unarmed but ornamented with several setules on outer subdistal region; distal segment armed with 2 setae: inner seta broad, foliaceous, with fine spinules and anterior seta naked and slender; outer proximal seta (seta III) absent; distal lash perpendicular to axis of segment, with 1 proximal spine followed by spinules along distal margin. Maxilliped (Fig. 14B) stout, curved and 3-segmented; first segment broadest and unarmed; middle segment with short inner margin and long, curved outer margin, and armed with 1 small and 1 longer, naked setae (longer one about 3 times as long as shorter one); terminal segment armed with 1 spinulose spine and 2 unequal, naked setae.

Legs 1 and 2 (Fig. 14C, D) and leg 3 with 3-segmented rami. Leg 4 (Fig. 14F) with 3-segmented exopod and 2-segmented endopod. Outer seta on basis of legs 1–3 small and naked; that of leg 4 also naked but large. All spines on leg 1 exopod spinulose and tipped with setule. Leg 3 similar to leg 2 but third endopodal segment (Fig. 14E) armed with 3 spines and 2 setae. Distal segment of leg 4 endopod  $44 \times 18 \mu\text{m}$  (ratio 2.44 : 1) and narrowing distally; its 2 terminal spines setiform, spinulose, and 26  $\mu\text{m}$  (outer) and 45  $\mu\text{m}$  long (inner). Armature formula of legs 1–4 as in preceding species.

Leg 5 consisting of 1 dorsolateral seta on fifth pedigerous somite and free exopod (Fig. 13C); exopod  $120 \times 35 \mu\text{m}$  (ratio 3.43 : 1), nearly rectangular, and spinulose on all surfaces, with small inner tubercle proximally and 2 naked distal setae (46 and 72  $\mu\text{m}$  long, respectively). Leg 6 not discernible.

**Male.** Unknown.

**Etymology.** The specific name of the new species *palmatus* alludes to the presence of a palmate element on the convex side of its mandible.

**Remarks.** About one-third of described species of *Anchimolgus* have a slender prosome, like *A. palmatus* n. sp. They share other similarities, such as the elongate caudal ramus and the elongate second segment of antenna. However, only four of them have the digitiform process(es) on the convex side of the mandible, as the new species. They are *A. compressus* Humes, 1996, *A. exsertus* Humes, 1991, *A. nasutus* Humes, 1996, and *A. tanaus* Humes, 1991. These species can be differentiated from the new species by their features, as follows:

*Anchimolgus compressus*: caudal ramus tapering; rostrum without posterior apex; maxillule with only 2 setae; and exopod of leg 5 short and 2.61 times as long as wide (Humes, 1996).

*Anchimolgus exsertus*: genital double-somite with strongly tapering anterior part; terminal segment of antenna distinctly longer than third segment; mandible with 3 digitiform processes on convex side; and leg 5 exopod subcuneate and 1.73 times as long as wide (Humes, 1991).

*Anchimolgus nasutus*: dorsolateral seta on fifth pedigerous somite large and longer than exopod of leg 5; rostrum elongate, with blunt posterior apex; terminal segment of antenna much longer than third segment; and mandible with 2 digitiform processes on convex side (Humes, 1996).

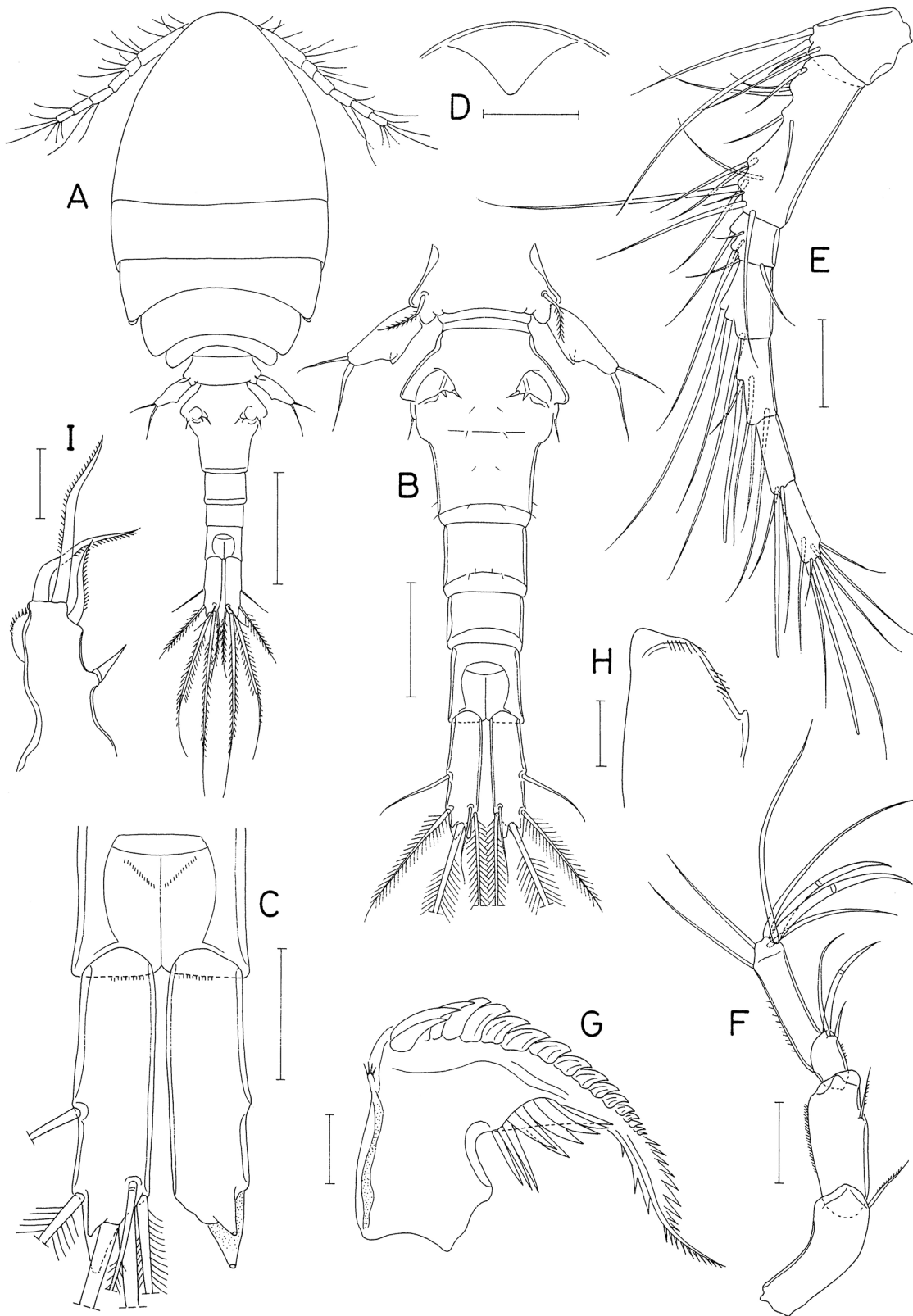
*Anchimolgus tanaus*: caudal ramus 10.6 times as long as wide ( $244 \times 23 \mu\text{m}$ ); anterior expansion of genital double-somite distinct, with convex lateral margins; mandible with only 1 digitiform process on convex side; and leg 5 exopod naked (Humes, 1991).

Family Kelleriidae Humes and Boxshall, 1996  
Genus *Kelleria* Gurney, 1927

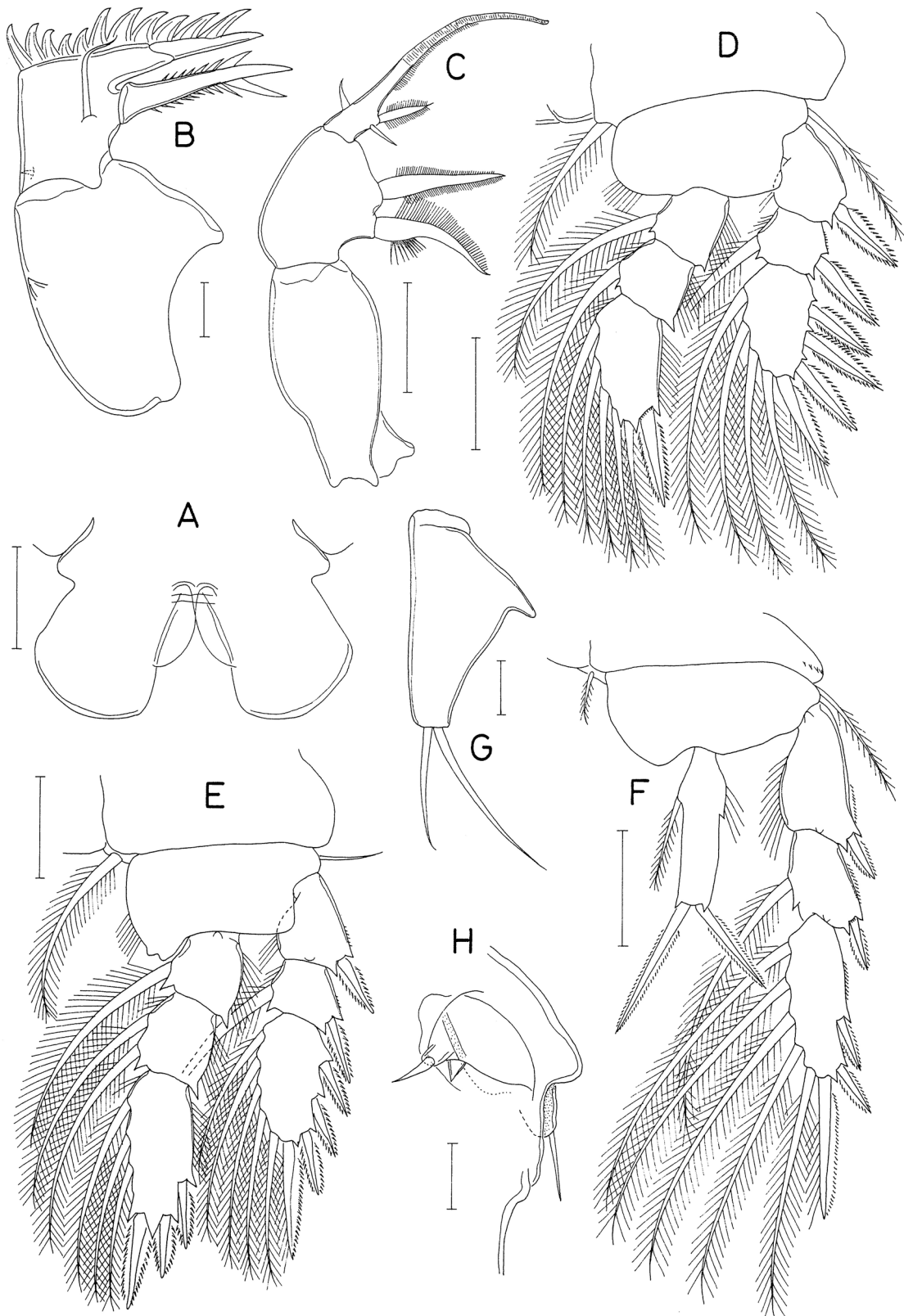
### ***Kelleria vasfera* n. sp. (Figs. 15, 16)**

**Material examined.** 2 ♀♀ from invertebrate burrows on sands of coral reef in Kantary Bay, southern coast of Phuket Province, Thailand,  $7^{\circ} 48' 14''\text{N}$ ,  $98^{\circ} 24' 20''\text{E}$ , 15 Dec 2012. Holotype (♀, CR00233160) has been deposited in the MABIK, Seocheon, Korea. Dissected paratype (1 ♀) is retained in the collection of the senior author.

**Female.** Body (Fig. 15A) narrow, 1.08 mm long. Prosome elliptical and  $615 \times 385 \mu\text{m}$ . Cephalothorax 438  $\mu\text{m}$  long, with dorsal suture line delimiting cephalosome and first pedigerous somite. Second pedigerous somite with posterolateral corners tipped with short membranous fringe. Urosome (Fig. 15B) 5-segmented. Fifth pedigerous somite 137  $\mu\text{m}$  wide.



**Fig. 15.** *Kelleria vasfera* n. sp., female. A, Habitus, dorsal; B, Urosome, dorsal; C, Caudal rami, dorsal; D, Rostrum; E, Antennule; F, Antenna; G, Mandible; H, Paragnath; I, Maxillule. Scale bars: A=0.2 mm, B=0.1 mm, C-F=0.05 mm, G-I=0.02 mm.



**Fig. 16.** *Kellera vasfera* n. sp., female. A, Labrum; B, Maxilla; C, Maxilliped; D, Leg 1; E, Leg 2; F, Leg 4; G, Leg 5 exopod; H, Right genital area, dorsal. Scale bars: A, C-F=0.05 mm, B, G, H=0.02 mm.



Genital double-somite  $178 \times 150 \mu\text{m}$ , with expanded anterior half and narrower posterior half; expanded anterior half with angular lateral apex, narrower posterior half gradually narrowing distally. Genital apertures located dorsally. Three free abdominal somites  $61 \times 75$ ,  $44 \times 67$ , and  $67 \times 65 \mu\text{m}$ , respectively. Anal somite with minute spinules along posteroventral margin; anal aperture large. Caudal rami (Fig. 15C) directed backwards; each ramus  $103 \times 32 \mu\text{m}$  (ratio 3.22 : 1), with 6 setae and 2 large, conical ducts bearing terminal pore; outer lateral seta (seta II) naked and locating at 0.6 of outer margin; other 5 setae pinnate; inner dorsal seta articulated at base.

Rostrum (Fig. 15D) strongly tapering and wider than long. Antennule (Fig. 15E)  $347 \mu\text{m}$  long, gradually narrowing distally, and 7-segmented; armature formula 4, 13, 6, 3, 4+aesthetasc, 2+aesthetasc, and 7+aesthetasc; setae generally long and all of them naked. Antenna (Fig. 15F) 4-segmented; first segment with 1 inner distal seta; second segment similar in length to first segment, with fine spinules along outer margin and 1 subdistal seta on inner margin; third segment short and armed with 2 setae and 1 setiform claw; terminal segment  $80 \times 22 \mu\text{m}$  (ratio 3.64 : 1), armed with 2 slender claws and 5 long setae, and ornamented with fine spinules on outer margin.

Labrum (Fig. 16A) with large posterior lobes and deep median incision; each lobe slightly broadened distally, with broad membrane on proximal half of inner margin. Mandible (Fig. 15G) with shallow proximal notch; inner margin oblique, not distinctly demarcated from distal lash, with about 9 large spines, proximal 3 of them being slender; convex margin with small knob tipped with 4 or 5 minute spinules, and followed by about 17 thick teeth (these teeth becoming gradually smaller from proximal to distal); distal lash spinulose on both margins. Paragnath (Fig. 15H) tapering in distal half, with 1 small, dentiform process laterally and setules subdistally. Maxillule (Fig. 15I) with serrate membrane on distal region of outer margin and armed with 1 lateral, 1 subdistal, and 2 large distal setae; lateral seta naked and articulated at base; other 3 setae weakly pinnate unilaterally. Maxilla (Fig. 16B) 2-segmented; basal segment with 1 small, tooth-like tubercle on outer side; distal segment armed with large inner spine, slender, naked anterior seta, and minute outer, proximal seta, and terminating in straight, rigid distal lash; distal lash almost perpendicular to proximal part of segment, articulated near middle, and armed with large teeth along distal margin (proximal third and fourth teeth smaller than other teeth and distal 3 teeth locating distal to articulation); inner spine extending slightly over distal lash, with 7 spinules on distal margin and about 10 spinules on proximal margin; spinules on both margins of inner spine becoming larger from proximal to distal. Maxilliped (Fig. 16C) 3-segmented. First segment longest but unarmed. Second segment with protrud-

ed inner margin bearing 2 large setae; proximal seta with about 10 spinules a proximal part of proximal margin and row of setules along distal margin; distal seta setulose along both margins. Terminal segment terminating in elongate setiform process and armed with 1 pinnate seta and 2 smaller naked setae.

Legs 1 and 2 (Fig. 16D, E) and leg 3 with 3-segmented exopod and endopod. Leg 4 (Fig. 16F) with 3-segmented exopod and 1-segmented endopod. Leg 3 similar to leg 2, but its third endopodal segment armed with 3 spines and 2 setae (formula I, II, 2). Outer seta on basis of legs 2 and 3 small and naked; those of legs 1 and 4 larger and pinnate. Inner distal corner of basis of leg 2 weakly bilobed. Leg 4 endopod  $67 \times 21 \mu\text{m}$  (ratio 3.19 : 1), with small dentiform process at proximal 0.4 of inner margin; inner seta not extending to distal end of segment; 2 distal spines large,  $65 \mu\text{m}$  (inner) and  $46 \mu\text{m}$  long (outer); both outer and inner distal corners pointed. Armature formula of legs 1–4 as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1:	0-1	1-0	I-0; I-1; III, I, 4	0-1; 0-1; I, 1, 4
Leg 2:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 3
Leg 3:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 2
Leg 4:	0-1	1-0	I-0; I-1; II, I, 5	0, II, 1

Leg 5 consisting of 1 pinnate dorsolateral seta on fifth pedigerous somite and free exopod; exopod (Fig. 16G) approximately  $82 \times 47 \mu\text{m}$ , with strongly projected inner margin tipped with digitiform process and 2 naked distal setae. Leg 6 (Fig. 16H) probably represented by 1 seta, 1 conical process, and laterally positioned, seta-tipped knob in genital region.

**Male.** Unknown.

**Etymology.** The specific name *vasfera* is a combination of Latin words *vas* (a duct) and *fero* (to bear). It alludes to the presence of a pair of tapering, duct-like distal structures on the caudal ramus of the new species, although it is probable that the duct-like structures are common at least in the genus *Kelleria*.

**Remarks.** The exopod of leg 5 in *Kelleria* is armed distally with two spines (formula II) in six species, or one spine plus one seta (I,1) in five species, or two setae (2) in seven species. In having two setae on the exopod of leg 5, *Kelleria vasfera* n. sp. can be compared with the latter seven species, as follows: *K. andamanensis* Sewell, 1949; *K. camortensis* Sewell, 1949; *K. corioensis* Arnott and McKinnon, 1981; *K. gradata* Stock, 1967; *K. grandisetiger* Kim, 2006; *K. multioviger* Kim, 2009; and *K. purpurocineta* Gurney, 1927. Of these seven, only the last two species have, like the new species, a prominent inner process on the exopod of leg 5. *K. vasfera* n. sp. differs from *K. corioensis* and *K. purpurocineta*, because the latter two species have the following characters.

In *K. corioensis*, the body length is at most 0.85 mm in the female (vs. 1.08 mm in *K. vasfera*); the mandible with seven large and five or six smaller spines (vs. about 10 subequal spines in *K. vasfera*) on the concave margin; the distal process of the second maxillary segment is armed with nine unequal teeth (vs. eleven subequal teeth in *K. vasfera*); and the inner proximal seta on the terminal maxilliped segment is elongate (vs. short in *K. vasfera*).

In *K. purpurocineta*, as figured in the original description (Gurney, 1927), the inner margin of the mandible bears several large proximal spines followed by row of small spinules (vs. spinules are subequal in *K. vasfera*); the inner spine (originally seta I) on the second maxillary segment bears 3 large proximal spinules followed by small spinules (vs. becoming progressively larger distally in *K. vasfera*); and the endopod of leg 4 bears no pointed process on the outer margin (vs. present in *K. vasfera*).

Family Pseudanthessiidae Humes and Stock, 1972  
Genus *Pseudanthessius* Claus, 1889

***Pseudanthessius stenosus* n. sp. (Figs. 17, 18)**

**Material examined.** 2 ♀♀ from invertebrate burrows on sands of coral reef in Kantary Bay, southern coast of Phuket Province, Thailand, 7° 48' 14" N, 98° 24' 20" E, 15 Dec 2012. Holotype (♀, CR00233161) has been deposited in the MABIK, Seocheon, Korea. Dissected paratype (♀) is retained in the collection of the senior author.

**Female.** Body (Fig. 17A) slender, 1.25 mm long. Prosome 704 µm long. Cephalothorax 473 × 342 µm, distinctly longer than wide and divided by dorsal suture line into cephalosome and first pedigerous somite. Urosome (Fig. 17B) 5-segmented. Fifth pedigerous somite 112 µm wide and laterally tapering. Genital double-somite 162 × 106 µm (ratio 1.53 : 1), consisting of moderately expanded anterior and narrower posterior parts; genital aperture locating laterally near halfway of lateral margin. Three free abdominal somites 53 × 57, 32 × 49, and 66 × 42 µm, respectively. Anal somite distinctly longer than wide and unornamented, without spinules or setules. Caudal rami close to each other and elongate; each ramus 170 × 17 µm, 10 times as long as wide, slightly broadened at distal region, and armed with 6 setae; outer lateral seta located at 0.73 of ramus length; all of setae pinnate.

Rostrum (Fig. 17C) tapering, as long as its basal width, with round posterior apex. Antennule (Fig. 17D) 320 µm long and 7-segmented; armature formula 4, 13, 6, 3, 4+aesthetasc, 2+aesthetasc, and 7+aesthetasc; all of setae naked and one of subdistal setae on second segment distinctly larger than others; terminal segment short, half as long as penultimate segment. Antenna (Fig. 17E) 4-segmented; first segment with

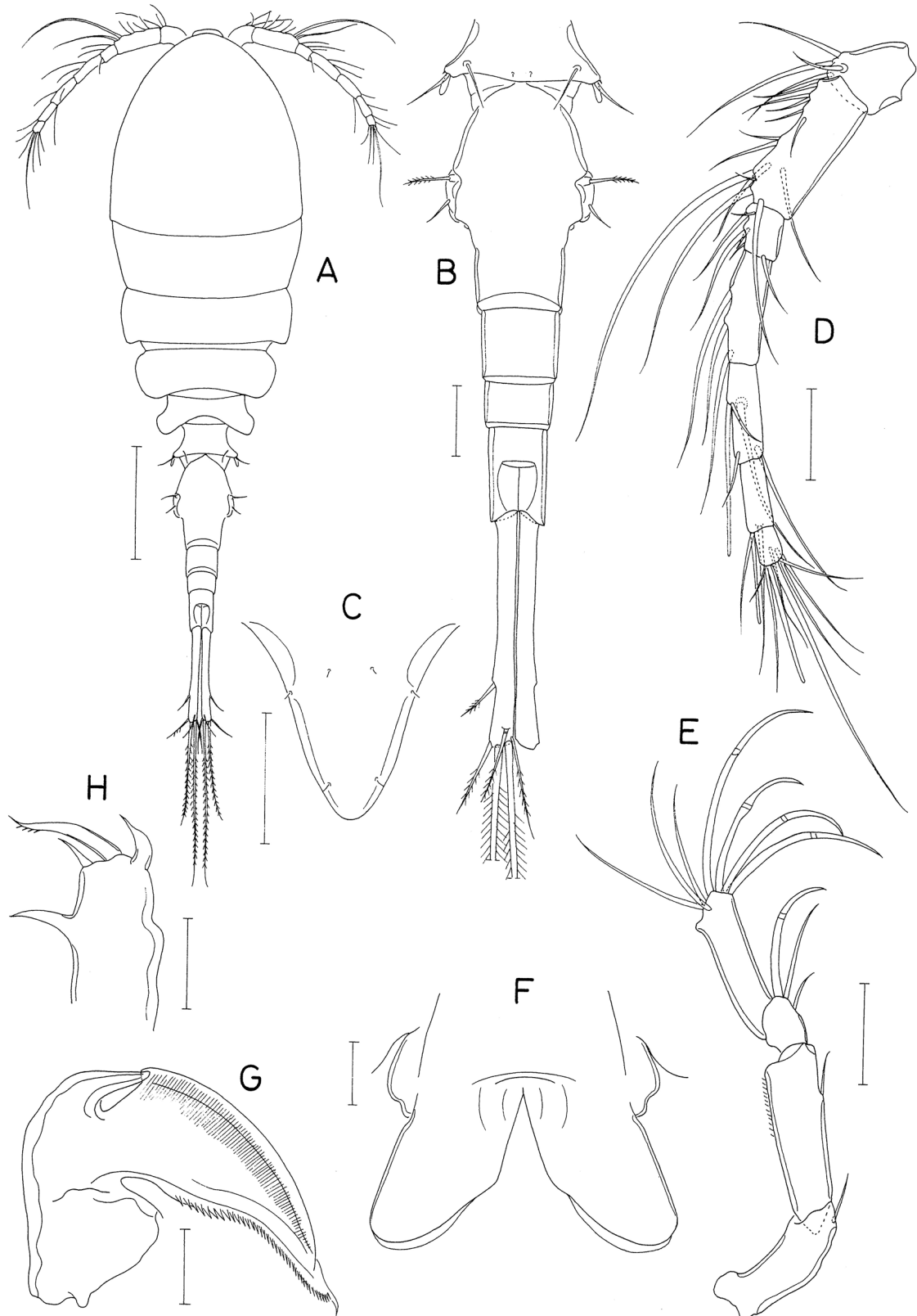
1 inner distal seta; second segment distinctly longer than first, with fine spinules on distal half of outer margin and 1 subdistal seta on inner margin; third segment with 1 slender claw and 2 setae; terminal segment 3.1 times as long as wide and armed with 4 slender claws (2 middle ones shorter than other 2) and 3 setae.

Labrum (Fig. 17F) with elongate, divergent, tapering posterior lobes fringed with narrow membrane along posterior margin and with deep median incision. Mandible (Fig. 17G) consisting of short proximal part and tapering blade, with deep but narrow proximal notch; inner margin not differentiated; convex outer side with large, well-sclerotized, distally-directed process; inner margin of blade serrate; outer convex margin of blade smooth. Maxillule (Fig. 17H) armed with 1 lateral, setiform process and 3 distal setae, median one of latter larger than other 2, with several minute spinules distally; outermost one of distal setae broad, process-like, with articulation at base. Maxilla (Fig. 18A) 2-segmented; basal segment unarmed; distal segment with large inner spine bearing membranous fringe along inner (proximal) margin and spinules along distal half of outer (distal) margin, spiniform anterior seta tipped with 1 seta and 1 small dentiform process, and terminating in long, thin, spinulose distal lash; distal region of second segment near base of distal lash with 1 large, tooth-like process and 3 small denticles; outer proximal seta (seta III) absent. Maxilliped (Fig. 18B) 3-segmented; first segment unarmed; second segment with slightly inflated inner margin, 2 unequal setae, and several oblique rows of minute spinules; terminal segment tapering, distally forming pointed claw, with 2 setae proximally.

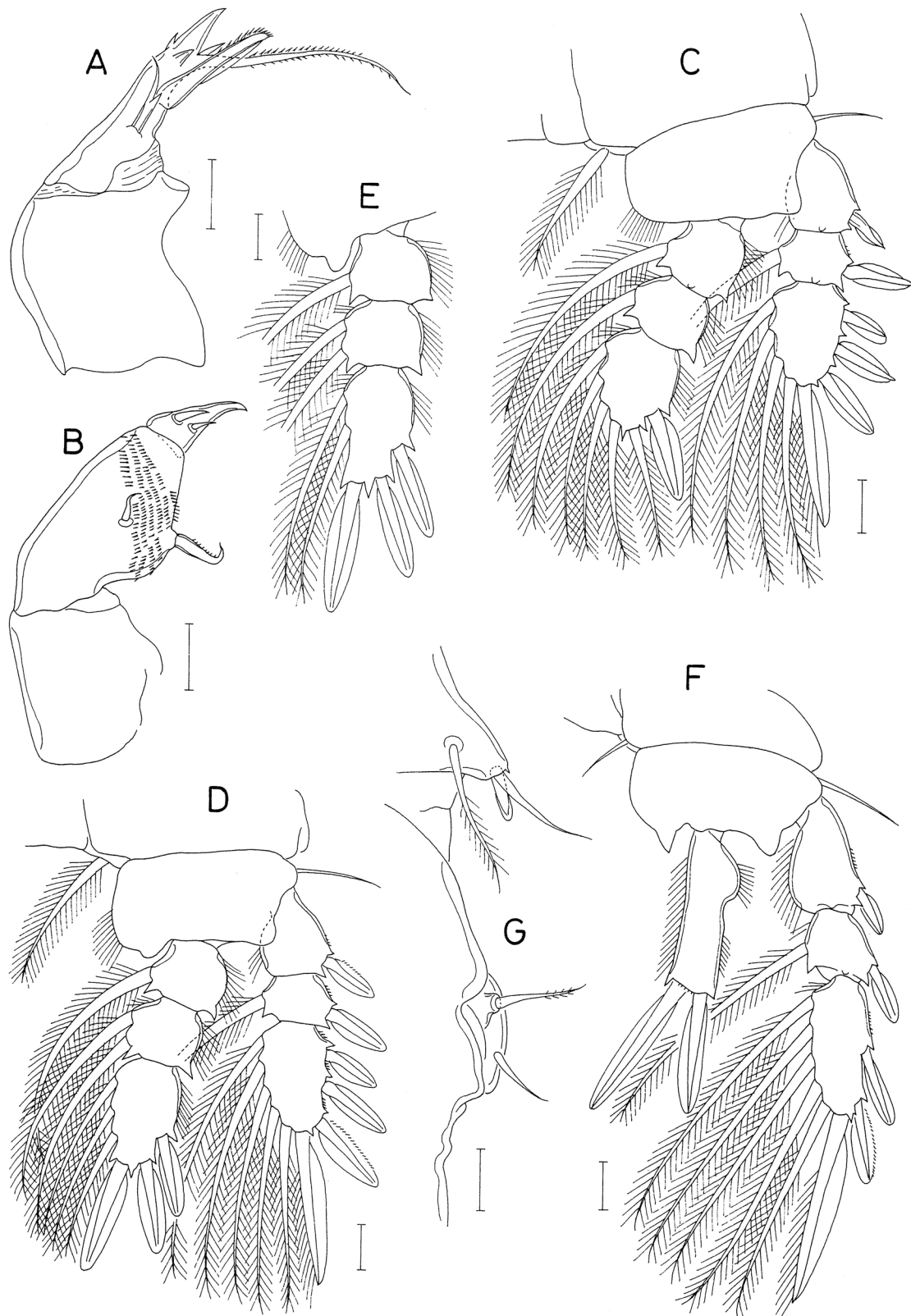
Legs 1 and 2 (Fig. 18C, D) and leg 3 with 3-segmented rami. Leg 4 (Fig. 18F) with 3-segmented exopod and 1-segmented endopod. Leg 3 similar to leg 2, but its third endopodal segment armed with 3 spines and 2 setae (Fig. 18E). Outer seta on basis of legs 1–4 thin and naked. Inner coxal seta of legs 1–3 large and pinnate, but that of leg 4 small and naked. Leg 4 with conical process at inner distal corner of basis; endopod 69 × 23 µm (ratio 3.0 : 1), with inflated proximal third of outer margin; both lateral margins setulose; 2 distal setae large, 64 µm (inner) and 51 µm (outer). Armature formula of legs 1–4 as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1:	0-1	1-0	I-0; I-1; III, I, 4	0-1; 0-1; I, 1, 4
Leg 2:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 3
Leg 3:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 2
Leg 4:	0-1	1-0	I-0; I-1; II, I, 5	II

Leg 5 (Fig. 18G) represented by produced lateral region of fifth pedigerous somite bearing pinnate proximal seta and 2 distal elements (short spine of 18 µm long and longer, naked



**Fig. 17.** *Pseudanthessius stenosis* n. sp., female. A, Habitus, dorsal; B, Urosome, dorsal; C, Rostrum; D, Antennule; E, Antenna; F, Labrum; G, Mandible; H, Maxillule. Scale bars: A=0.2 mm, B-D=0.05 mm, E-H=0.02 mm.



**Fig. 18.** *Pseudanthessius stenosis* n. sp., female. A, Maxilla; B, Maxilliped; C, Leg 1; D, Leg 2; E, Leg 3 endopod; F, Leg 4; G, Right side of first two urosomites, dorsal. Scale bars: A–G=0.02 mm.

seta). Leg 6 represented by 2 setae on genital operculum (Fig. 18G).

**Male.** Unknown.

**Etymology.** The specific name *stenosus* is derived from the Greek *stenos* (=narrow), alluding to the narrow body of the new species.

**Remarks.** One of diagnostic features of *Pseudanthessius stenosus* n. sp. is the possession of elongate caudal rami which are ten times as long as wide. Similarly elongate caudal rami being more than seven times as long as wide are known in several species of the genus, as follows: *P. aestheticus* Stock, Humes and Gooding, 1964; *P. concinnus* Thompson and A. Scott, 1903; *P. deficiens* Stock, Humes and Gooding, 1964; *P. dentatus* Kim, 2000; *P. dubius* Sars, 1918; and *P. thorelli* (Brady and Robertson, 1875). *Pseudanthessius deficiens* and *P. dubius* cannot be confused with the new species, because they have a 4-segmented urosome. The remaining four species can be differentiated from the new species by their features, as follows:

*Pseudanthessius aestheticus*: the mandible is simple, with a smooth convex margin; the maxillule is armed only with three (not four) distal setae; leg 4 endopod is  $96 \times 23 \mu\text{m}$  in size (vs.  $69 \times 23 \mu\text{m}$  in the new species); and leg 5 consists of three simple setae (Stock et al., 1964).

*Pseudanthessius concinnus*: leg 4 endopod has one lanceolate spine and one plain spine distally (Thompson and Scot, 1903); and last two urosomal somites are subequal in length (Stock et al., 1964).

*Pseudanthessius dentatus*: the mandible has three spines on concave margin; the posterodorsal margin of the fifth pedigerous somite is fringed with membrane; leg 4 endopod bears a notch and a point on the outer margin; the anterior seta (seta II) on the second maxillary segment is specialized, tipped with three processes and one seta (Kim, 2000).

*Pseudanthessius thorelli*: this species was redescribed by Stock and Weinberg (1985). According to the latter authors, the genital double-somite is evenly tapering towards distal border; the abdominal somites are ornamented with spinules on posteroventral margin; the outer lateral seta on the caudal ramus is positioned at about 60% of the ramus length (vs. at 73% in the new species).

***Pseudanthessius phuketensis* n. sp. (Figs. 19, 20)**

**Material examined.** 1 ♀ (holotype) from invertebrate burrows on sands of coral reef in Kantary Bay, southern coast of Phuket Province, Thailand,  $7^{\circ} 48' 14''\text{N}$ ,  $98^{\circ} 24' 20''\text{E}$ , 15 Dec 2012. Holotype (CR00233162, dissected and mounted on a glass slide) has been deposited in the MABIK, Seocheon, Korea.

**Female.** Body (Fig. 19A) slender,  $942 \mu\text{m}$  long. Prosome

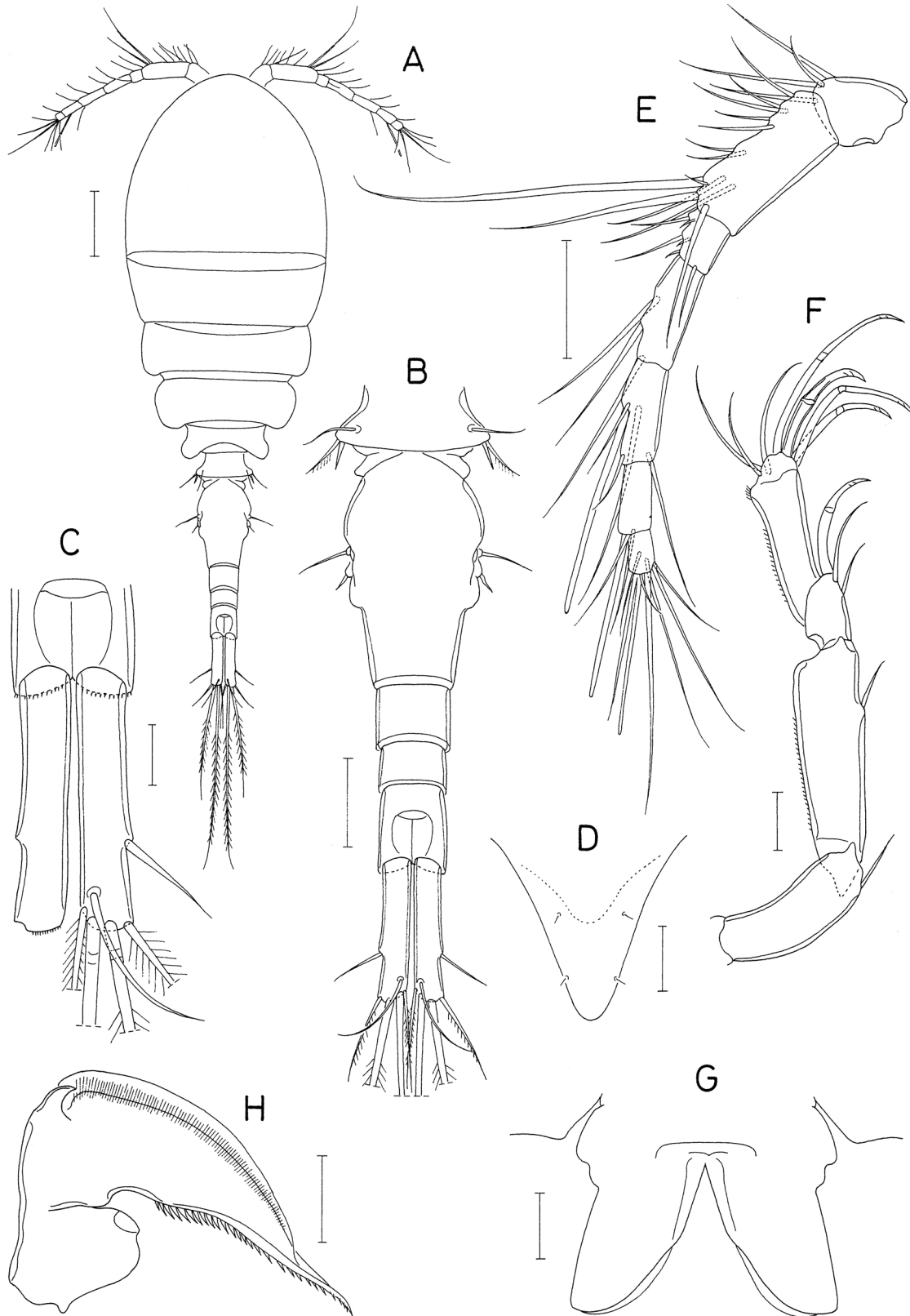
$581 \times 308 \mu\text{m}$ . Cephalothorax  $385 \mu\text{m}$  long, with dorsal suture line delimiting cephalosome and first pedigerous somite. Urosome (Fig. 19B) 5-segmented. Fifth pedigerous somite  $88 \mu\text{m}$  wide and laterally tapering. Genital double-somite  $134 \times 81 \mu\text{m}$  (ratio 1.65 : 1), with slightly expanded anterior 0.6 and narrower, weakly tapering posterior 0.4. Genital aperture locating laterally near midlength of somite. Three free abdominal somites  $35 \times 43$ ,  $25 \times 40$ , and  $46 \times 38 \mu\text{m}$ , respectively. Anal somite (Fig. 19B) with fine spinules along posteroventral margin. Caudal rami (Fig. 19C) straight, close to each other; each ramus  $88 \times 17 \mu\text{m}$ , 5.18 times as long as wide; outer lateral seta naked and locating at 0.69 of ramus length; inner dorsal seta (seta VII) naked and lacking basal articulation; other 4 setae pinnate.

Rostrum (Fig. 19D) strongly tapering, as long as its basal width, with round posterior apex. Antennule (Fig. 19F)  $248 \mu\text{m}$  long and 7-segmented; armature formula 4, 13, 6, 3, 4+ aesthetasc, 2+aesthetasc, and 7+aesthetasc; all of setae naked; one of distal setae on second segment very large. Antenna (Fig. 19F) 4-segmented; first segment with 1 inner distal seta; second segment distinctly longer than first, with fine spinules on outer margin and 1 subdistal seta on inner margin; third segment with 1 claw and 2 setae; terminal segment 3.0 times as long as wide and armed with 4 claws (second outer one broader and stronger than other 3 spines) and 3 setae.

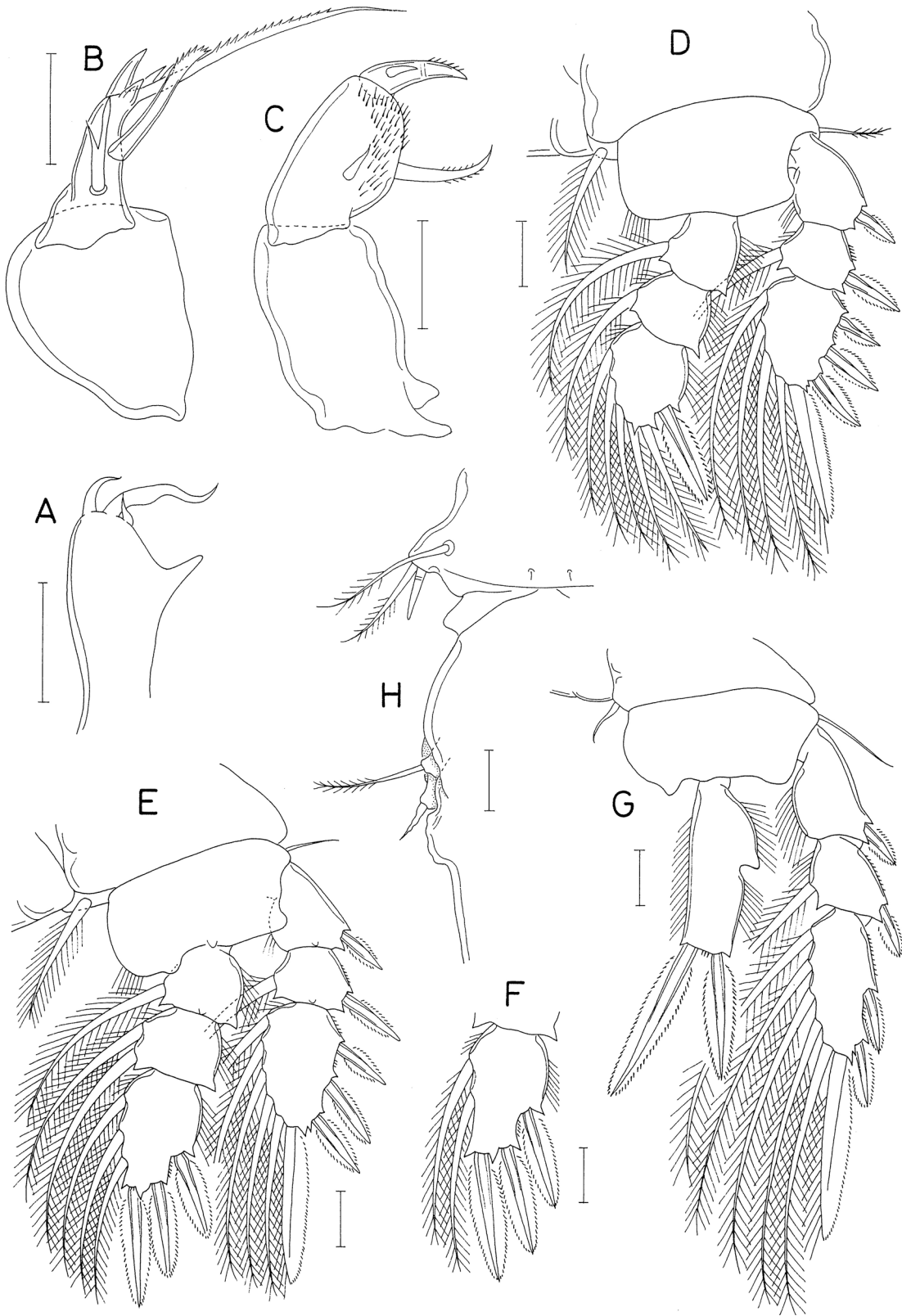
Labrum (Fig. 19G) very similar to that of preceding species. Mandible (Fig. 19H) consisting of short proximal part and tapering blade, with deep proximal notch; inner margin not differentiated; convex outer side with claw-like process; inner margin of blade serrate and outer convex margin of blade smooth; distal lash short. Maxillule (Fig. 20A) with 1 digitiform process on lateral margin and 3 naked, unequal, distal setae. Maxilla (Fig. 20B) similar to that of preceding species; inner spine of distal segment serrate on distal part of distal margin; anterior seta bifurcate; distal part of segment near base of distal lash with 2 tooth-like processes. Maxilliped (Fig. 20C) 3-segmented; first segment longest but unarmed; second segment with 2 very unequal setae and scattered spinules on inner side; terminal segment narrow and tapering, with 1 small proximal seta and several spinules on distal region of distal margin.

Legs 1 and 2 (Fig. 20D, E) and leg 3 segmented and armed as in preceding species. Outer seta on basis of leg 1 weakly pinnate, and those of legs 2–4 naked. Terminal segment (Fig. 20F) of leg 3 endopod with 3 spines and 2 setae as in preceding species. Leg 4 (Fig. 20G) endopod  $63 \times 25 \mu\text{m}$  (ratio 2.52 : 1), with blunt process on outer margin; 2 distal spines  $62 \mu\text{m}$  (inner) and  $46 \mu\text{m}$  long (outer). Armature formula of legs 1–4 as in preceding species.

Leg 5 (Fig. 20H) represented by produced lateral region of



**Fig. 19.** *Pseudanthessius phuketensis* n. sp., female. A, Habitus, dorsal; B, Urosome, dorsal; C, Caudal rami, dorsal; D, Rostrum; E, Antennule; F, Antenna; G, Labrum; H, Mandible. Scale bars: A=0.1 mm, B, E=0.05 mm, C, D, F-H=0.02 mm.



**Fig. 20.** *Pseudanthessius phuketensis* n. sp., female. A, Maxillule; B, Maxilla; C, Maxilliped; D, Leg 1; E, Leg 2; F, Third endopodal segment of leg 3; G, Leg 4; H, Left side of first two urosomites, dorsal. Scale bars: A-H=0.02 mm.

fifth pedigerous somite, bearing pinnate proximal seta and 2 distal elements (short, naked spiniform seta and pinnate seta). Leg 6 (Fig. 20H) represented by 2 setae (pinnate anterior seta and smaller, naked, undulated posterior seta) on genital operculum.

**Male.** Unknown.

**Etymology.** The specific name is derived from the type locality of the new species, Phuket.

**Remarks.** In a key to species of *Pseudanthessius* Claus, 1889 given by Stock et al. (1964), there were six species having a moderately long caudal ramus which is more than four times but not more than 7.5 times as long as wide, as *P. phuketensis* n. sp. They are *P. aestheticus* Stock, Humes and Gooding, 1964; *P. gracilis* Claus, 1889; *P. graciloides* Sewell, 1949; *P. latus* Illg, 1950; *P. nemertophilus* Gallien, 1936; and *P. weberi* A. Scott, 1909. In addition, other three species with the similar form of the caudal ramus have been described since, i.e., *P. dentatus* Kim, 2000, *P. limatus* Humes, 1978 and *P. procurrans* Humes, 1966. Of these 9 species, *P. gracilis*, *P. graciloides*, *P. latus*, and *P. nemertophilus*, all of them having the antenna in which the terminal segment is less than twice as long as wide, may be excluded from a further comparison with the new species. The remaining 5 species may be distinguished from the new species, by having the following features.

*Pseudanthessius aestheticus*: the mandible is simple, without any process or tooth on the convex side; the maxillule is armed only with 3 distal setae, without a lateral element; and leg 4 endopod is  $96 \times 23 \mu\text{m}$  in size (vs.  $639 \times 25 \mu\text{m}$  in *P. phuketensis* n. sp.).

*Pseudanthessius dentatus*: the mandible has 3 spines on concave margin (vs. a row of spinules in *K. phuketensis*); the posterodorsal margin of the fifth pedigerous somite is fringed with membrane (vs. none in *K. phuketensis*); the anterior seta (seta II) on the second maxillary segment is specialized, tipped with three processes and one seta (vs. bifurcate in *K. phuketensis*).

*Pseudanthessius limatus*: the genital double-somite bears a dentiform process on the lateral margin (vs. none in *K. phuketensis*); the maxillule is armed only with three apical setae; and leg 4 endopod lacks a process on the outer margin.

*Pseudanthessius procurrans*: the cephalothorax is broad; the terminal segment of the antenna is armed with two unequal claws and five setae (vs. four claws and three setae in *K. phuketensis*); leg 4 endopod lacks a process on the outer margin; and the mandible lacks a tooth-like process on the convex side (Humes, 1966).

*Pseudanthessius weberi*: the maxilla lacks an inner element on the second segment; and the mandible with simple convex side, without a tooth-like process (A. Scott, 1909).

Family Rhynchomolgidae Humes and Stock, 1972

Genus *Critomolgus* Humes and Stock, 1983

***Critomolgus gemmatus* (Humes, 1964)**

**Material examined.** 2 ♀♀, 1 ♂ from 1 *Stichodactyla gigantea* (Forskål) on the tidal flat, Ban Pa Khok seagrass bed, northeastern coast of Phuket Province, Thailand,  $8^{\circ} 01' 23'' \text{N}$ ,  $98^{\circ} 24' 55'' \text{E}$ , 16 Dec 2012.

**Remarks.** In the female the body length is 1.27 mm. The caudal ramus is  $58 \times 42 \mu\text{m}$  (ratio 1.38 : 1). Leg 5 is exopod  $131 \times 49 \mu\text{m}$  (ratio 2.67 : 1) and bears with numerous minute scales on the outer surface. The specimens from Phuket showed no other significant differences from the original description of this species.

Genus *Doridicola* Leydig, 1853

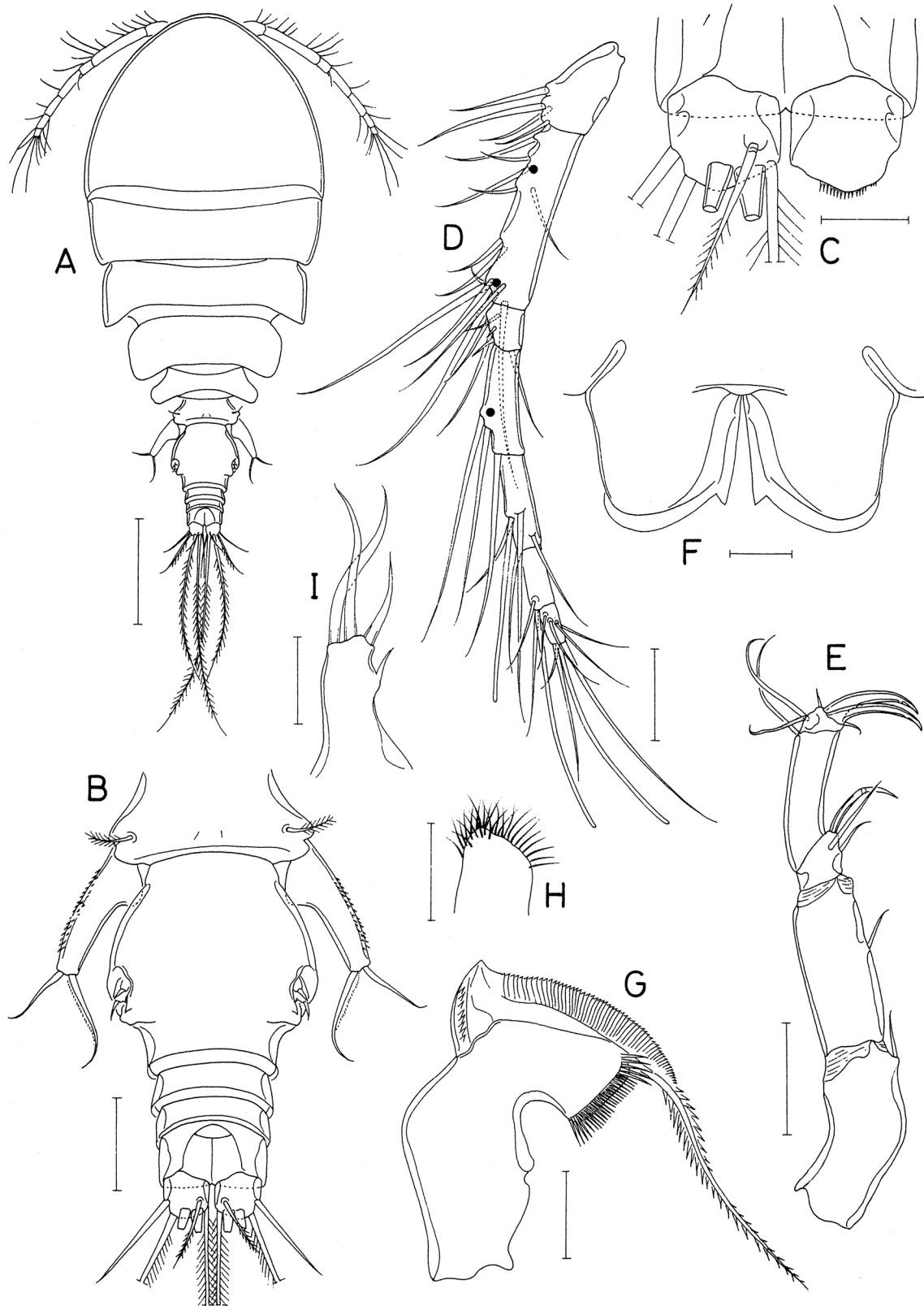
***Doridicola pattayensis* n. sp. (Figs. 21–23)**

**Material examined.** 4 ♀♀, 3 ♂♂ from washings of the zoanthid coral *Palythoa tuberculosa* (Esper), intertidal, Pattaya, in the Gulf of Thailand,  $12^{\circ} 54' 48'' \text{N}$ ,  $100^{\circ} 51' 24'' \text{E}$ , 18 Jul 2008. Holotype (♀, CR00233163), allotype (♂, CR00233164), and paratypes (2 ♀♀, 1 ♂, CR00233165) have been deposited in the MABIK, Seocheon, Korea. Dissected paratypes (1 ♀, 1 ♂) are retained in the collection of the senior author.

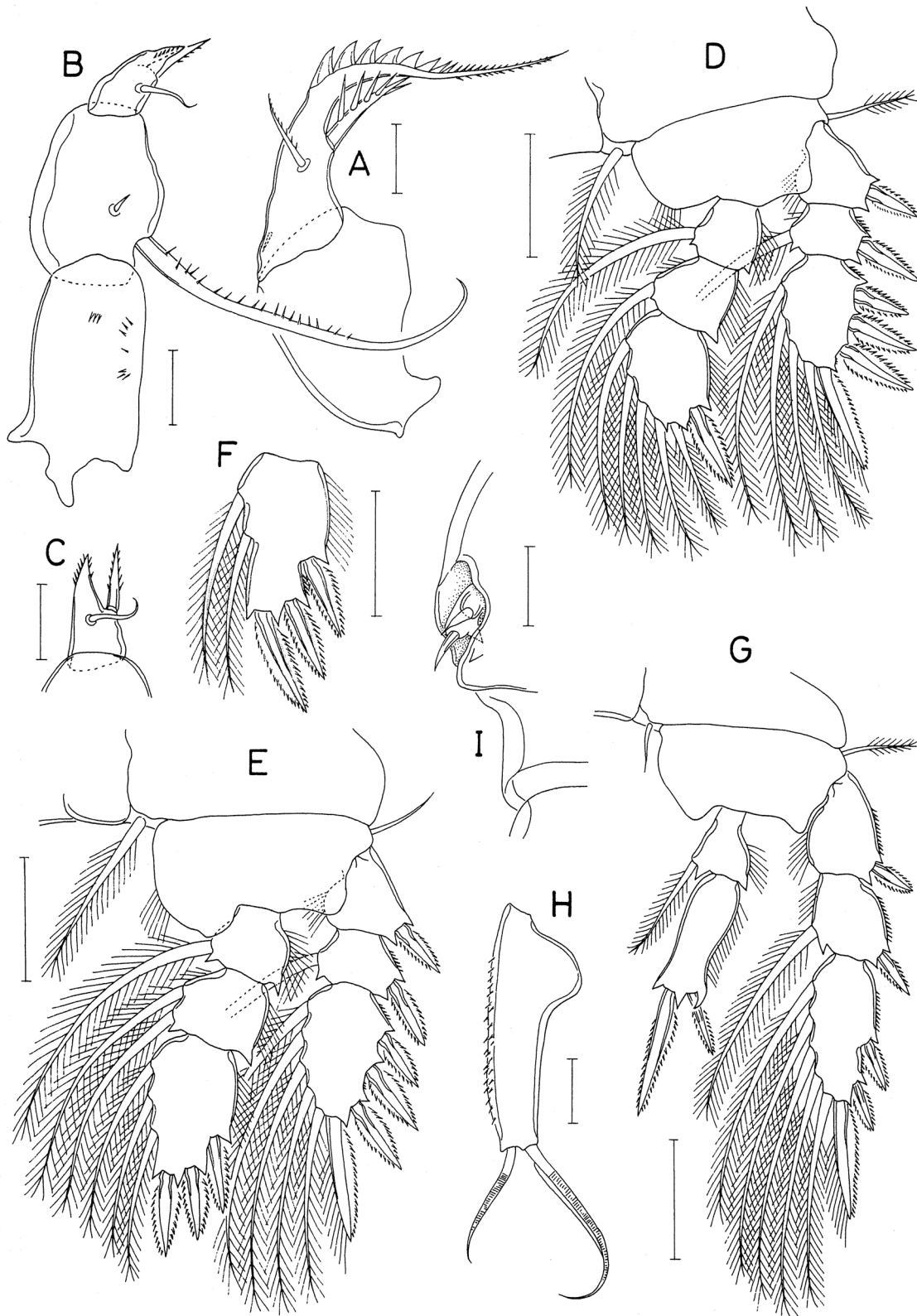
**Female.** Body (Fig. 21A) narrow, 1.00 mm long (other 2 measured females 0.83 and 0.84 mm, respectively). Prosome  $737 \times 458 \mu\text{m}$ . Cephalothorax  $455 \mu\text{m}$  long and divided dorsally by suture line into cephalosome and first pedigerous somite. Second pedigerous somite with slightly projected, angular posterolateral corners. Urosome (Fig. 21B) 5-segmented, short and stout, about 0.36 times as long as prosome. Fifth pedigerous somite  $112 \mu\text{m}$  wide. Genital double-somite  $115 \times 115 \mu\text{m}$ , as long as wide, and consisting of expanded anterior 0.75 and narrower posterior 0.35; genital aperture locating at 0.55 of somite length. Three free abdominal somites  $19 \times 66$ ,  $16 \times 62$ , and  $26 \times 59 \mu\text{m}$ , respectively. Anal somite unornamented. Caudal ramus (Fig. 21C) very short,  $27 \times 25 \mu\text{m}$  (ratio 1.08 : 1) with 6 setae and with fine spinules on posteroventral margin; outer lateral seta naked; outermost distal seta (seta III) pinnate only along inner margin; other 4 setae bilaterally pinnate.

Rostrum hemicircular, with round posterior apex. Antennule (Fig. 21D) slender,  $336 \mu\text{m}$  long, and 7-segmented; armature formula 4, 13, 6, 3, 4+aesthetasc, 2+aesthetasc, and 7+aesthetasc; all of setae naked. Antenna (Fig. 21E) 4-segmented; first segment slightly curved, with 1 seta at inner distal corner; second segment as long as first, with 1 seta on

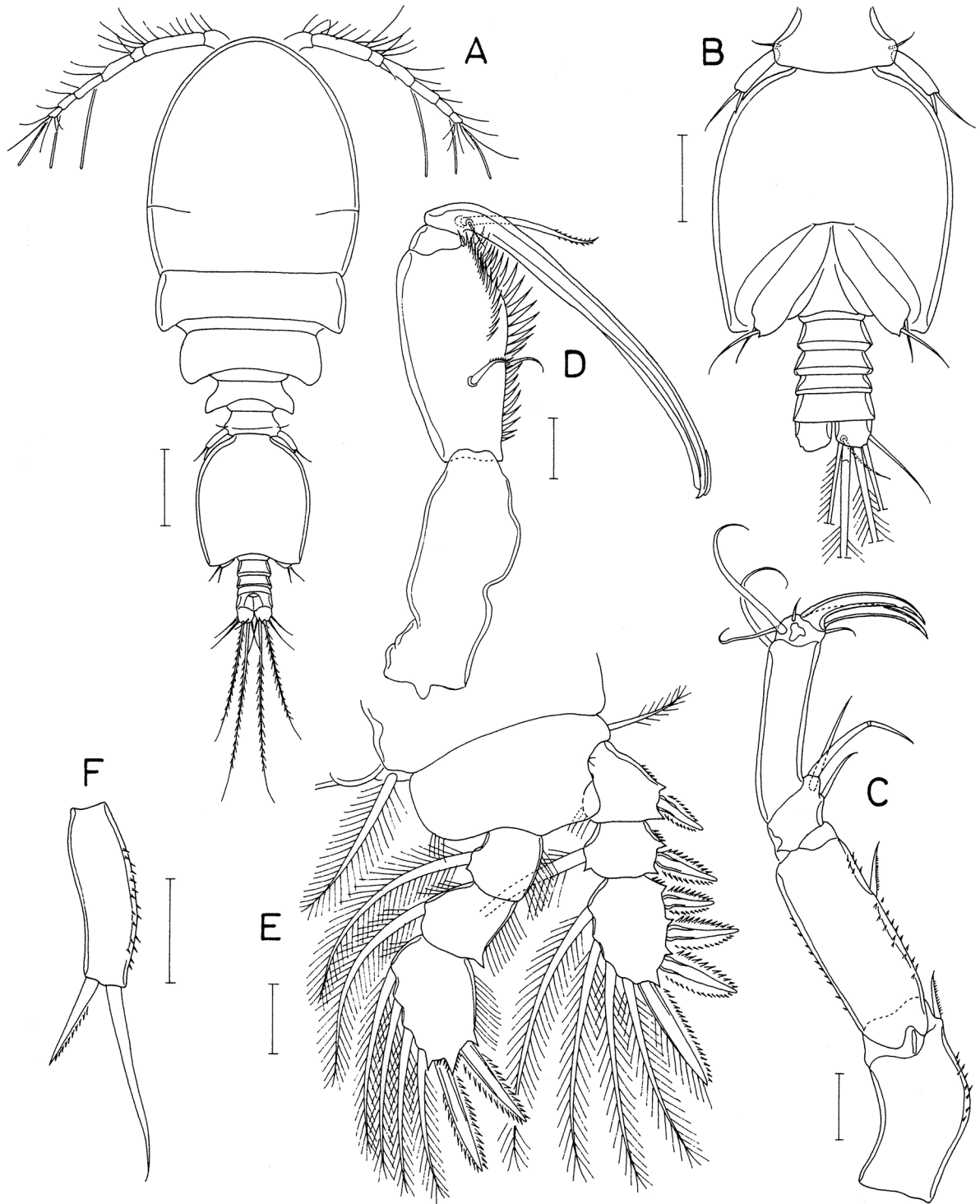




**Fig. 21.** *Dordicola pattayensis* n. sp., female. A, Habitus, dorsal; B, Urosome, dorsal; C, Caudal rami, dorsal; D, Antennule; E, Antenna; F, Labrum; G, Mandible; H, Paragnath; I, Maxillule. Scale bars: A=0.2 mm, B, D, E=0.05 mm, C, F-I=0.02 mm.



**Fig. 22.** *Dericicola pattayensis* n. sp., female. A, Maxilla; B, Maxilliped; C, Terminal segment of maxilliped; D, Leg 1; E, Leg 2; F, Third endopodal segment of leg 3; G, Leg 4; H, Exopod of leg 5; I, Left genital aperture, dorsal. Scale bars: A-C, H, I=0.02 mm, D-G=0.05 mm.



**Fig. 23.** *Doridicola pattayensis* n. sp., male. A, Habitus, dorsal; B, Urosome, ventral; C, Antenna; D, Maxilliped; E, Leg 1; F, Leg 5 exopod. Scale bars: A=0.1 mm, B-F=0.02 mm.

inner margin; short third segment with 1 slender claw and 2 setae; terminal segment  $66 \times 17.5 \mu\text{m}$ , about 3.8 times as long

as wide, with 2 claws of similar length (slender inner one  $45 \mu\text{m}$  long and outer one slightly broader and  $44 \mu\text{m}$  long) and

5 setae, one of latters inserting to base of inner spine.

Labrum (Fig. 21F) with broad posterior lobes and deep median incision; inner distal corner of lobes pointed. Mandible (Fig. 21G) with broad proximal notch; inner margin distinct, perpendicular to distal lash, and densely spinulose; outer proximal region of blade projected, with row of small denticle; cutting edge finely serrate; distal lash elongate and spinulose on both margins. Paragnath (Fig. 21H) lobate, bearing setules distally. Maxillule (Fig. 21I) armed with 1 small, setiform lateral element and 3 distal, naked setae. Maxilla (Fig. 22A) with unarmed basal segment; distal segment with minute outer proximal seta, weakly spinulose anterior seta, 5-spinules-bearing inner spine, and elongate distal lash; distal lash with 6 proximal teeth followed by fine spinules on outer margin. Maxilliped (Fig. 22B) 3-segmented; first segment with several, scattered spinules; second segment slightly swollen, with 1 small and 1 extremely large setae, latter 104  $\mu\text{m}$  long, about 20 times as long as shorter seta, and unilaterally spinulose; terminal segment (Fig. 22C) armed with 1 naked seta and 1 spinulose spine and terminating in spinulose, spiniform process.

Legs 1 and 2 (Fig. 22D, E) and leg 3 with 3-segmented rami. Leg 4 (Fig. 22G) with 3-segmented exopod and 2-segmented endopod. Leg 3 similar to leg 2, but its third endopodal segment (Fig. 22F) with 3 spines and 2 setae. Inner coxal seta of leg 4 small and naked. Distal segment of leg 4 endopod  $59 \times 21 \mu\text{m}$ , about 2.8 times as long as wide, distally with 3 pointed processes and 2 unequal spines; outer spine 27  $\mu\text{m}$  long and inner one 55  $\mu\text{m}$  long. Armature formula of legs 1–4 as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1:	0-1	1-0	I-0; I-1; III, I, 4	0-1; 0-1; I, 1, 4
Leg 2:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 3
Leg 3:	0-1	1-0	I-0; I-1; III, I, 5	0-1; 0-2; I, II, 2
Leg 4:	0-1	1-0	I-0; I-1; II, I, 5	0-1; II

Leg 5 consisting of 1 pinnate dorsolateral seta on fifth pedigerous somite and free exopod; exopod (Fig. 22H)  $81 \times 29 \mu\text{m}$ , 2.79 times as long as its greatest width, with prominent inner proximal swelling, scattered spinules on outer surface and 2 distal setae; outer seta 41  $\mu\text{m}$  long, and inner seta 66  $\mu\text{m}$  long, with thin membranous fringe along outer margin. Leg 6 represented by 1 small seta, 1 small spine and 1 dentiform process on genital operculum (Fig. 22I).

**Male.** Body (Fig. 23A) narrower than that of female and 775  $\mu\text{m}$  long (other 2 examined specimens 744 and 697  $\mu\text{m}$ , respectively). Prosome  $495 \times 277 \mu\text{m}$ . Cephalothorax 313  $\mu\text{m}$  long; dorsal suture line between cephalosome and first pedigerous somite very faint and limited to lateral sides. Urosome (Fig. 23B) 6-segmented. Fifth pedigerous somite 71  $\mu\text{m}$  wide.

Genital somite large,  $146 \times 137 \mu\text{m}$ . Four abdominal somites small,  $17 \times 43$ ,  $14 \times 45$ ,  $11 \times 43$ , and  $15 \times 47 \mu\text{m}$ , respectively. Caudal ramus (Fig. 23B)  $18 \times 20 \mu\text{m}$ , slightly wider than long.

Rostrum as in female. Antennule with 3 additional aesthetascs, 2 on second and 1 on fourth segments, as indicated by dark dots in Fig. 21D. Antenna (Fig. 23C) with spinules on inner margin of 2 proximal segments and on outer margin of second segment; setae on 2 proximal segments finely spinulose along their inner margin.

Labrum, mandible, paragnath, maxillule, and maxilla as in female. Maxilliped (Fig. 23D) consisting of 3 segments and terminal claw; first segment unarmed; second segment slightly expanded around 0.6 region of segment length, with 2 small setae near 0.4 region and 2 longitudinal rows of spinules, one of latters limited to distal half of segment; small third segment unarmed; terminal claw elongate, proximally with 1 seta and 1 setule.

Leg 1 (Fig. 23E) armed with 2 spines and 4 setae on third endopodal segment, otherwise same as that of female. Legs 2–4 as in female.

Leg 5 exopod (Fig. 23F) small,  $36 \times 11 \mu\text{m}$ , 3.27 times as long as wide, slightly curved, and armed distally with 1 spinulose spine and 1 naked seta. Leg 6 (Fig. 23B) represented by 2 thin, unequal setae on genital operculum.

**Etymology.** The specific name is derived from Pattaya, the type locality of the new species.

**Remarks.** Ten species of the genus *Doridicola* Leydig, 1853 share with *D. pattayensis* n. sp the following combination of characters in the female: the caudal ramus is less than 1.5 times as long as wide and the exopod of leg 5 has an inner proximal swelling. Of these 10 species, five have the antenna bearing very unequal (in thickness or length) pair of terminal claws, unlike the new species. The remaining 5 species are distinguishable from the new species by having the following features.

*Doridicola antheliae* (Humes and Stock, 1973): expanded anterior part of genital double-somite with parallel lateral margins; two terminal claws of antenna of female short and thick, only 28 and 21  $\mu\text{m}$  long, respectively (Humes and Stock, 1973).

*Doridicola cinctus* (Humes and Stock, 1973): genital double-somite constricted at region of genital aperture; leg 5 exopod of female tapering; two terminal claws of antenna of female 36 and 32  $\mu\text{m}$ , respectively (Humes and Stock, 1973).

*Doridicola parvicaudatus* Kim, 2003: two terminal claws of antenna longer than its terminal segment; two setae on second segment of female maxilliped equal in length; leg 5 exopod of male  $47 \times 10 \mu\text{m}$ , 4.7 times as long as wide (Kim, 2003).

*Doridicola securiger* (Humes, 1964): mandible narrow,

without protuberance on its convex side; proximal expansion of leg 4 endopod of female much more prominent than in *D. pattayensis* n. sp.; three free abdominal somites of female 52, 40, and 43  $\mu\text{m}$  long, respectively (compared to 19, 16, and 26  $\mu\text{m}$  long in *D. pattayensis*) (Humes, 1964).

*Doridicola sensilis* (Humes, 1964): mandible slender, without protuberance on convex side; two setae on the second segment of maxilliped in female 28 and 18  $\mu\text{m}$ , respectively, not so extremely different in length; leg 5 exopod of female 109  $\mu\text{m}$  long (Humes, 1964).

The possession by the new species of the two greatly unequal setae on the second segment of the female maxilliped is remarkable; one of these setae is extremely enlarged, about 20 times as long as the other. Similar form of the maxilliped is possessed by a few species, such as *D. singularipes* (Humes and Ho, 1968), which are otherwise not similar to the new species.

Species of *Doridicola* are associated with various invertebrates, but only a single species, *D. inaequalis* (Humes and Ho, 1966), was known previously to live on the zoanthid corals (Ho and Kim, 2001). Thus, *D. pattayensis* n. sp. is the second species of the genus found on the zoanthid corals.

***Doridicola inaequalis* (Humes and Ho, 1966)**

**Material examined.** 26 ♀♀, 7 ♂♂ from washings of the zoanthid coral *Palythoa tuberculosa* (Esper), intertidal, Pattaya, in the Gulf of Thailand, 12° 54'48"N, 100° 51'24"E, 18 Jul 2008.

**Female.** The mean body length is 938  $\mu\text{m}$  (815–1,023  $\mu\text{m}$ ), based on 10 specimens. The body length of dissected specimen is 1.01 mm. The cephalothorax is 446 × 525  $\mu\text{m}$ . The genital double-somite is 131 × 120  $\mu\text{m}$ . The caudal ramus is 48 × 32  $\mu\text{m}$  (ratio 1.50 : 1). Two setae on the second segment of maxilliped are equal in size; the terminal segment of the maxilliped bears 1 spiniform process, 1 small spine and 2 setae. The outer seta on the basis of legs 1–4 are weakly pinnate. Leg 5 exopod is 97 × 27  $\mu\text{m}$  (ratio 3.57 : 1).

**Male.** The mean body length is 815  $\mu\text{m}$  (777–857  $\mu\text{m}$ ), based on 6 specimens. Leg 5 exopod is 28 × 13  $\mu\text{m}$  (ratio 2.15 : 1) and armed distally with 1 spine (18  $\mu\text{m}$ ) and 1 seta (40  $\mu\text{m}$ ).

**Remarks.** This species was originally recorded as an associate of species of *Palythoa*, a zoanthid coral genus (Humes and Ho, 1966). Later, Kim (2003) reported this species from New Caledonia.

***Doridicola cuspis* (Humes, 1964)**

**Material examined.** 3 ♀♀, 2 ♂♂ from 1 *Stichodactyla gigantea* (Forskål) on a tidal flat on the northeastern coast of Phuket, Thailand, 8° 01'23"N, 98° 24'55"E, 16 Dec 2012.

**Remarks.** The body length of a dissected female is 1.52 mm, not significantly different from those of type specimens of Humes (1964). This species is characteristic in having greatly expanded cephalothorax which is much wider than the second pedigerous somite.

Genus *Indomolgus* Humes and Ho, 1966

***Indomolgus brevisetosus* Humes and Ho, 1966**

**Material examined.** 1 ♂ from washings of the zoanthid coral *Palythoa tuberculosa* (Esper), intertidal, Pattaya, in the Gulf of Thailand, 12° 54'48"N, 100° 51'24"E, 18 Jul 2008.

**Remarks.** The body length of the observed single male is 2.33 mm. The caudal ramus is 246 × 81  $\mu\text{m}$  (ratio 3.04 : 1). Leg 5 exopod is 60 × 33  $\mu\text{m}$  (ratio 1.82 : 1), a measurement quite different from that of type specimens of Humes and Ho (1966), probably due to the difference of viewing angles. This is the first record on this species outside of Madagascar.

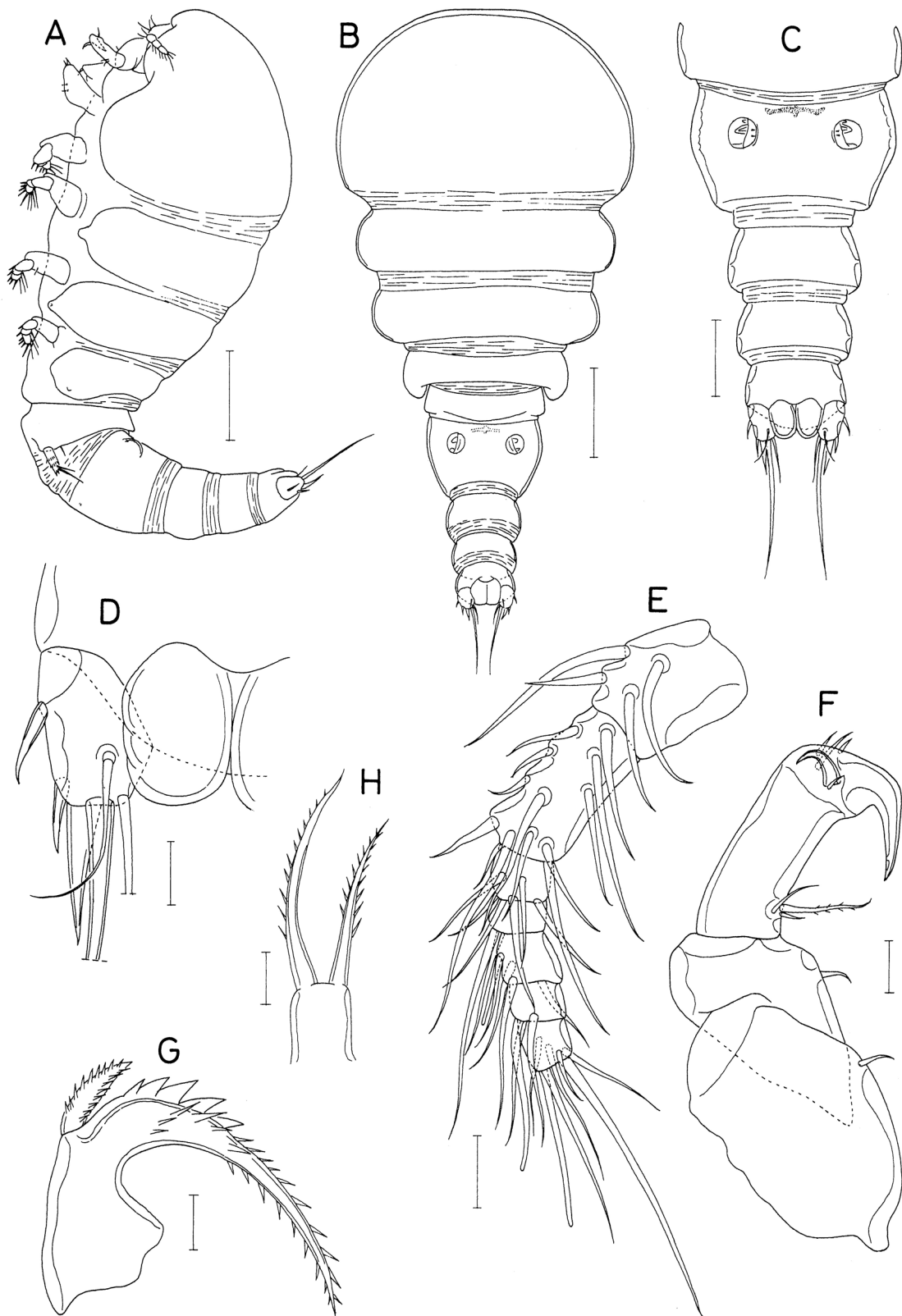
Genus *Lambanetes* Humes, 1982

***Lambanetes stichodactylae* Humes, 1982 (Figs. 24, 25)**

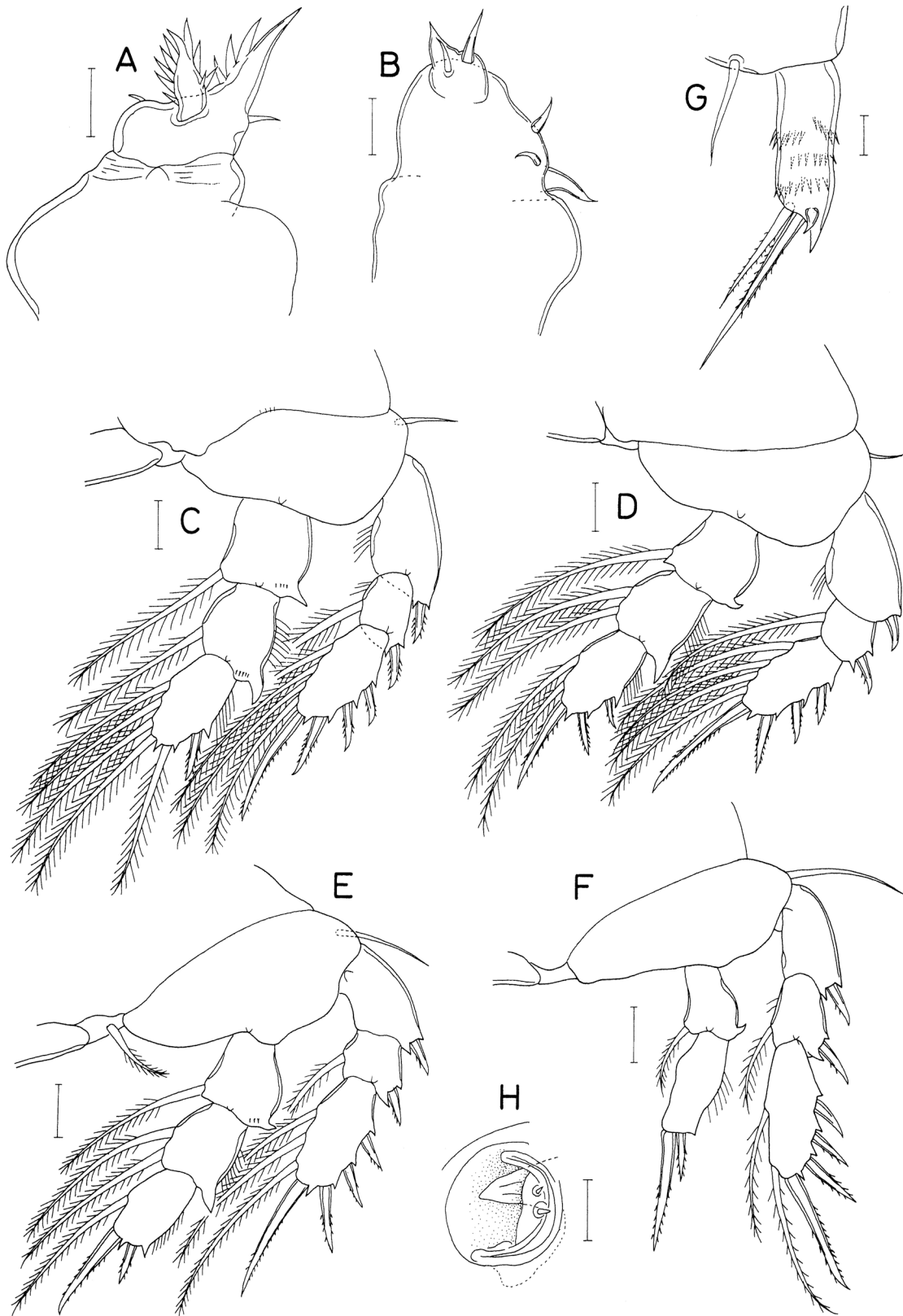
**Material examined.** 3 ♀♀, 10 ♂♂ from *Stichodactyla gigantea* (Forskål) on the tidal flat, Ban Pa Khok seagrass bed, northeastern coast of Phuket Province, Thailand, 8° 01' 23"N, 98° 24'55"E, 16 Dec 2012.

**Female.** Body tapering (Fig. 24B), with dorsally directed urosome (Fig. 24A). Body length 1.35 mm. Greatest width 656  $\mu\text{m}$ . Exoskeleton moderately hard. Prosome 531  $\mu\text{m}$  long. All prosomal somites with rounded lateral margins. Cephalothorax 451  $\mu\text{m}$  long, 1.45 times as wide as long. Second to fourth pedigerous somites 574, 503, and 365  $\mu\text{m}$  wide, respectively. Fourth pedigerous somite with posterolateral protrusions. Urosome (Fig. 24C) 5-segmented. Fifth pedigerous somite 267  $\mu\text{m}$  wide. Genital double-somite (Fig. 24C) 172 × 263  $\mu\text{m}$ , with convex lateral margins; genital aperture circular and located dorsally, slightly anterior to midway. Three free abdominal somites 96 × 171, 77 × 147, and 77 × 131  $\mu\text{m}$ , respectively. Anal region with 2 balloon-like swellings (Fig. 24C). Caudal ramus (Fig. 24D) 47 × 38  $\mu\text{m}$  (ratio 1.24 : 1), strongly tapering, with 6 setae; setae II-IV spiniform and 27, 23, and 51  $\mu\text{m}$ , respectively; seta V largest, 181  $\mu\text{m}$  long, 3.85 times as long as caudal ramus; all setae naked.

Rostrum absent. Antennule (Fig. 24E) 7-segmented, with thick, crowded setae; armature formula 4, 13, 6, 2, 4+aesthetasc, 2+aesthetasc, and 7+aesthetasc; all setae naked. Antenna (Fig. 24F) 3-segmented; first and second segments broad, each with 1 seta on inner margin; third segment much



**Fig. 24.** *Lambanetes stichodactylae* Humes, female. A, Habitus, left; B, Habitus, dorsal; C, Urosome, dorsal; D, Left caudal ramus, dorsal; E, Antennule; F, Antenna; G, Mandible; H, Maxillule. Scale bars: A, B=0.2 mm, C=0.1 mm, D-F=0.02 mm, G, H=0.01 mm.



**Fig. 25.** *Lambanetes stichodactylae* Humes, female. A, Maxilla; B, Maxilliped; C, Leg 1; D, Leg 2; E, Leg 3; F, Leg 4; G, Leg 5; H, Genital aperture. Scale bars: A-H=0.02 mm.

narrower than 2 proximal segments, about 2.3 times as long as wide, proximally with 3 setae on inner margin and distally with 4 small setae and 2 strongly curved claws, proximal one of latter much smaller than terminal one and directed laterally.

Labrum with tapering pasteromedian process. Mandible (Fig. 24G) with narrow blade; convex side with large, serrate spine bearing 2 rows of spinules; convex margin distal to spine with 5 denticles followed by row of spinules; concave margin also spinulose. Maxillule (Fig. 24H) lobate, with 2 distal spinulose setae. Maxilla (Fig. 25A) 2-segmented; basal segment very broad and unarmed; distal segment terminating in acute process bearing 3 broad spinules along proximal part of convex margin, armed with 2 setae (small setae I and III) and large anterior spine (originally seta II) bearing about 10 broad spinules along margins. Maxilliped (Fig. 25B) incompletely 2-segmented; basal segment leaf-like, with 3 unequal setae on inner side; small distal segment armed with 1 spine and 1 seta, and terminating in spiniform process.

Legs 1–3 (Fig. 25C–E) with 3-segmented rami; leg 4 (Fig. 25F) with 3-segmented exopod and 2-segmented endopod. Inner seta on coxa present only on leg 3. Distal segment of leg 4 endopod  $38 \times 17 \mu\text{m}$ ; its 2 distal spines  $42 \mu\text{m}$  (inner) and  $17 \mu\text{m}$  (outer). Armature formula of legs 1–4 as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1:	0-0	1-0	I-0; I-1; III, I, 4	0-1; 0-1; I, 1, 4
Leg 2:	0-0	1-0	I-0; I-1; III, I, 4	0-1; 0-2; I, II, 2
Leg 3:	0-1	1-0	I-0; I-1; III, I, 3	0-1; 0-2; 0, II, 1
Leg 4:	0-0	1-0	I-0; I-1; III, I, 2	0-1; II

Leg 5 (Fig. 25G) locating ventrally on somite and consisting of 1 outer lateral seta on somite and free exopod; exopod  $65 \times 22 \mu\text{m}$  (length measured to tip of distal process), about 3 times as long as wide, terminating in 2 unequal, spiniform processes, ornamented with 3 transverse rows of spinules on outer surface, and armed distally with 2 weakly spinulose setae; outer seta  $45 \mu\text{m}$  long and inner seta  $65 \mu\text{m}$  long. Leg 6 represented by 2 minute setae on genital operculum (Fig. 25H).

**Male.** Generally as in original description by Humes (1982).

**Remarks.** Humes (1982) originally described this species, based only on the male. Therefore, the above description is the new record on the female of *Lambanetes stichodactylae*. The females from Phuket show no difference from male type material of Humes (1982) in the armature of rami of legs 2–4, in the ornamentation of the anterior spine on the second maxillary segment, and in the form of leg 5 exopod. Some discrepancies appearing in the ornamentation of the distal process (claw) of the distal maxillary segment (with three spinules in the female, but with six spinules as illustrated by

Humes (1982) and the presence of the inner coxal seta in the female from Phuket are considered to be variations or sexual dimorphisms within the species.

### *Lambanetes mollis* n. sp. (Figs. 26–28)

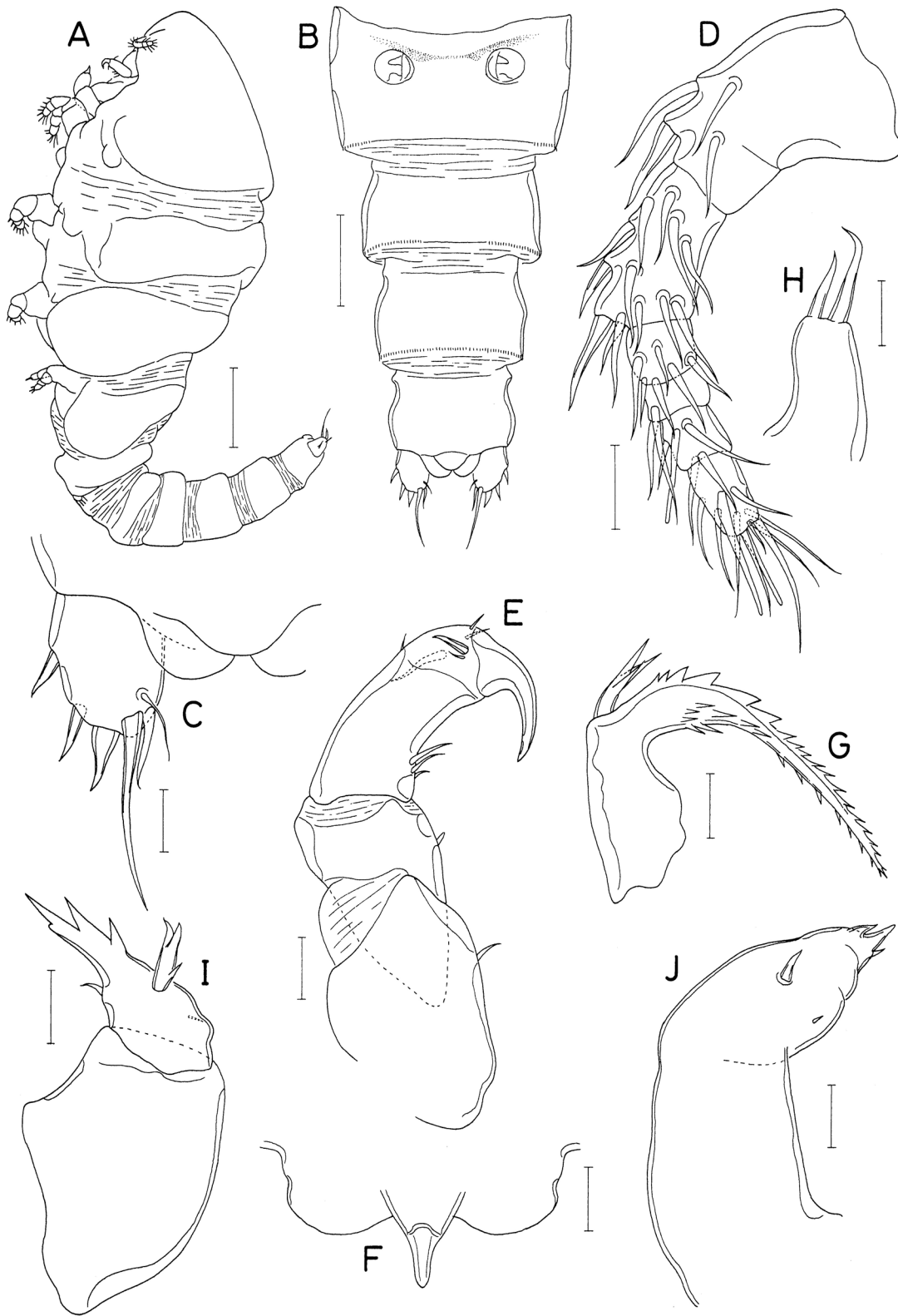
**Material examined.** 1 ♀, 7 ♂♂ from *Stichodactyla gigantea* (Forskål) on the tidal flat, Ban Pa Khok seagrass bed, northeastern coast of Phuket Province, Thailand,  $8^{\circ}01'23''\text{N}$ ,  $98^{\circ}24'55''\text{E}$ , 16 Dec 2012. Holotype (♀, CR00233166, dissected and mounted on a glass slide) and paratypes (6 ♂♂, CR00233167) have been deposited in the MABIK, Seocheon, Korea. Dissected paratype (1 ♂) is retained in the collection of the senior author.

**Female.** Body (Fig. 26A) inflated and flexed, with soft exoskeleton. Length 1.82 mm. Prosoma 1.10 mm long. Cephalothorax wider than long. Urosome directed dorsally and 5-segmented. Genital double-somite  $170 \times 269 \mu\text{m}$ , 1.58 times as wide as long, with slightly convex lateral margins and row of minute spinules along posteroventral and posterolateral margins; genital aperture circular and locating dorsally at anterior third of somite length (Fig. 26B). Three free abdominal somites  $115 \times 195$ ,  $103 \times 167$ , and  $103 \times 141 \mu\text{m}$ , respectively. First and second free abdominal somites with row of minute spinules along posterior margin. Anal somite (Fig. 26B) with well-developed anal operculum and posterior inflations. Caudal ramus (Fig. 26C)  $46 \times 38 \mu\text{m}$ , 1.21 times as long as wide, with 6 setae; setae II–VII 17, 19, 21, 66, 28, and  $25 \mu\text{m}$  long, respectively; setae II–IV spiniform; seta V less than twice as long as ramus; all setae naked.

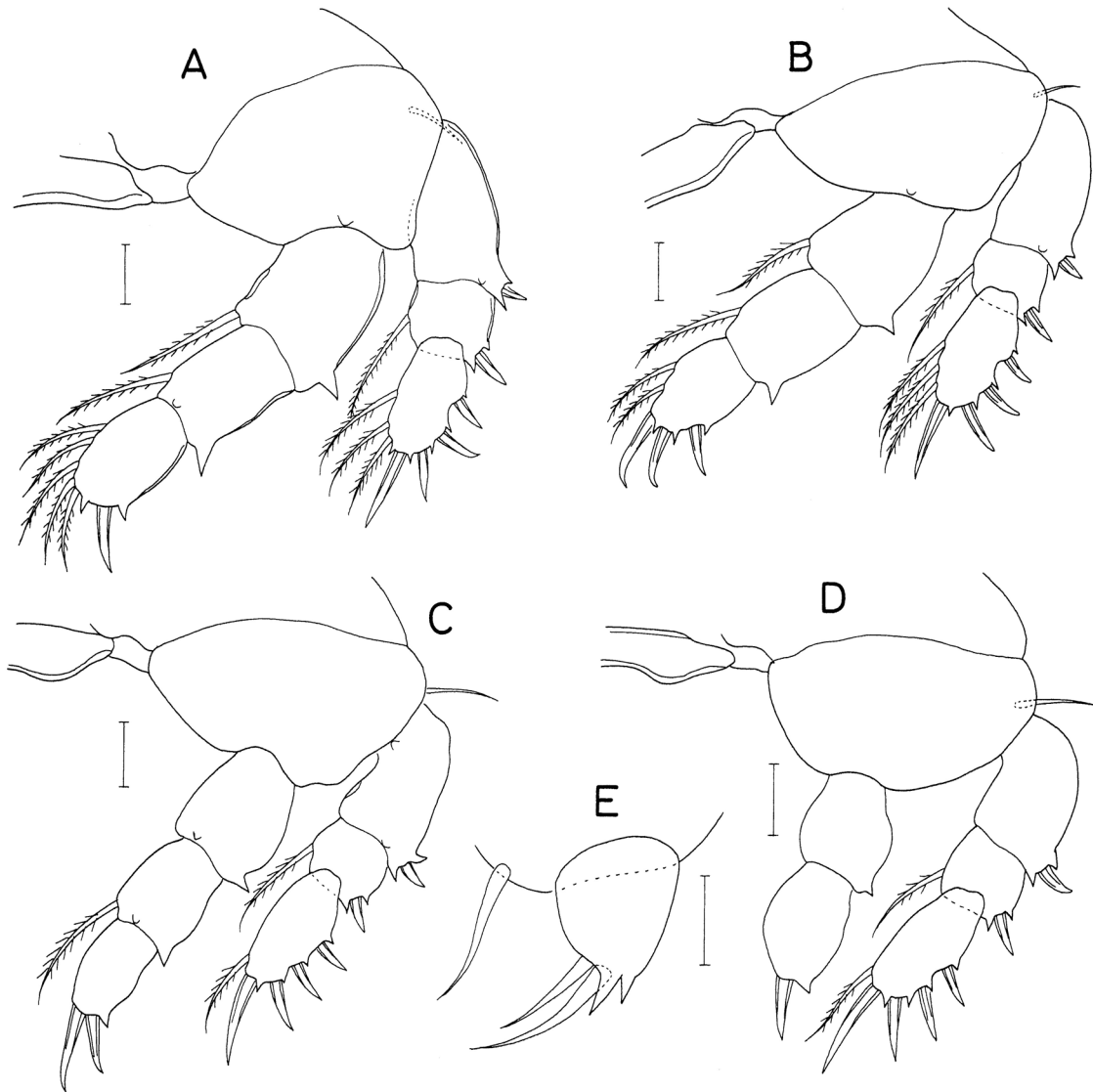
Rostrum absent. Antennule (Fig. 26D) 6-segmented; armature formula 4, 13, 6, 2, 4+aesthetasc, and 9+2 aesthetascs; all setae naked. Antenna (Fig. 26E) 3-segmented; first and second segments each with 1 small seta on inner margin; third segment about 1.75 times as long as wide and armed proximally with 3 setae on inner margin and distally with 5 setae and 2 claws; proximal one of claws small and directed laterally; terminal claw much larger and strongly curved.

Labrum (Fig. 26F) weak but with well-sclerotized, tapering posteromedian process. Mandible (Fig. 26G) narrow; spine on outer, convex side trifurcate; convex and concave margins serrate; several spinules present on dorsal surface near proximal region of distal lash. Maxillule (Fig. 26H) with 2 naked distal setae. Maxilla (Fig. 26I) 2-segmented; basal segment unarmed; distal segment terminating in process bearing 3 spines, and proximally with 2 small setae and 1 spine, the latter with 3 spinules (1 proximal and 2 distal). Maxilliped (Fig. 26J) unsegmented, with trace of segmentation near middle, and armed with 2 very unequal setae (one of them minute and transparent) near distal third and distally with 2 spiniform processes and 1 small seta.





**Fig. 26.** *Lambanetes mollis* n. sp., female. A, Habitus, left; B, Genital double-somite and abdomen, dorsal; C, Left caudal ramus, dorsal; D, Antennule; E, Antenna; F, Labrum; G, Mandible; H, Maxillule; I, Maxilla; J, Maxilliped. Scale bars: A=0.2 mm, B=0.1 mm, C-F, I, J=0.02 mm, G, H=0.01 mm.



**Fig. 27.** *Lambanetes mollis* n. sp., female. A, Leg 1; B, Leg 2; C, Leg 3; D, Leg 4; E, Leg 5. Scale bars: A-E=0.02 mm.

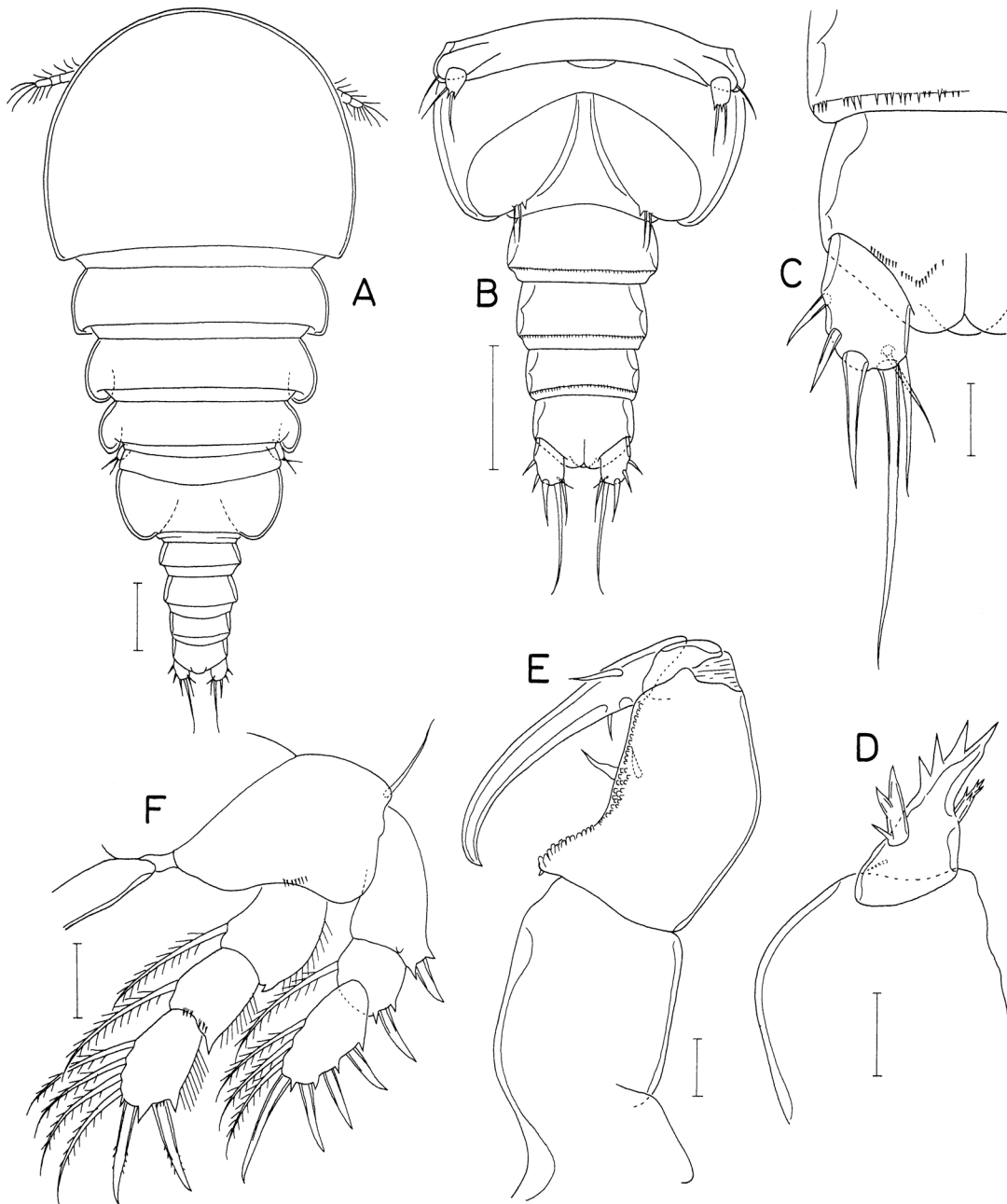
Legs 1–3 (Fig. 27A–C) with 3-segmented rami. Leg 4 (Fig. 27D) with 3-segmented exopod and 2-segmented endopod. All of these legs without inner seta on coxa. First endopodal segment of legs 3 and 4 unarmed. Distal segment of leg 4 endopod  $35 \times 23 \mu\text{m}$ . Armature formula of legs 1–4 as follows:

	Coxa	Basis	Exopod	Endopod
Leg 1:	0-0	1-0	I-0; I-1; III, 1, 3	0-1; 0-1; I, 1, 4
Leg 2:	0-0	1-0	I-0; I-1; III, 1, 3	0-1; 0-1; I, II, 2
Leg 3:	0-0	1-0	I-0; I-1; III, I, 1	0-0; 0-1; II
Leg 4:	0-0	1-0	I-0; I-1; III, I, 1	0-0; I

Leg 5 (Fig. 27E) consisting of 1 outer seta on fifth pedi-

gerous somite and free exopod; exopod  $41 \times 27 \mu\text{m}$ , 1.52 times as long as wide, terminating in 2 dentiform processes, with 2 naked distal setae. Leg 6 not seen,

**Male.** Body (Fig. 28A) straight and not inflated. Mean body length 0.95 mm (0.85–1.01 mm), based on 8 specimens. Length of dissected specimen 1.00 mm. Prosome 654  $\mu\text{m}$  long. Cephalothorax 388  $\times$  462  $\mu\text{m}$ , with angular posterolateral corners. Second to fourth pedigerous somites 381, 343, and 300  $\mu\text{m}$  wide, respectively. Third and fourth pedigerous somites with rounded, posteriorly protruded posterolateral corners. Urosome (Fig. 28B) 6-segmented. Fifth pedigerous somite 238  $\mu\text{m}$  wide. Genital somite (Fig. 28B) 117  $\times$  250  $\mu\text{m}$ , about twice as wide as long. Four abdominal somites 52  $\times$  122, 54  $\times$  106, 38  $\times$  90, and 52  $\times$  81  $\mu\text{m}$ , respectively. First to



**Fig. 28.** *Lambanetes mollis* n. sp., male. A, Habitus, dorsal; B, Urosome, ventral; C, Right side of distal part of abdomen, ventral; D, Maxilla; E, Maxilliped; F, Leg 1. Scale bars: A, B=0.1 mm, C–E=0.02 mm, F=0.01 mm.

third abdominal somites with row of minute spinules along posterior border. Anal somite (Fig. 28B) with row of minute spinules near base of caudal rami. Caudal ramus (Fig. 28C)  $35 \times 25 \mu\text{m}$ , 1.40 times as long as wide; setae II–VII 18, 19, 38, 86, 38, and  $27 \mu\text{m}$ , respectively; longest seta V about 2.5 times as long as ramus.

Rostrum absent. Antennule, antenna, labrum, mandible, and maxillule as in female. Maxilla (Fig. 28D) similar to that

of female, but inner seta (seta I) spiniform, with several spinules; distal process with 3 or 4 (usually 3) spines (probability about 1 : 1); anterior spine with 3 or 4 (usually 3) spinules. Maxilliped (Fig. 28E) consisting of 3 segments and terminal claw; first segment longest but unarmed; second segment with projected inner proximal corner, 2 inner setae slightly distal to midlength of segment, and small scales along inner margin; small third segment unarmed; terminal claw extending to

proximal border of second segment, strongly curved in distal part, with 2 proximal setae.

Leg 1 (Fig. 28F) with third endopodal segment armed with 2 spines and 4 setae (armature formula I, I, 4), otherwise same as that of female. Legs 2–4 as in female.

Leg 5 (Fig. 28B) exopod  $25 \times 17 \mu\text{m}$ , 1.47 times as long as wide. Three setae on leg 5 feebly pinnate and longer than exopod. Leg 6 (Fig. 28B) represented by 1 dentiform process and 2 weakly pinnate setae on genital operculum.

**Etymology.** The specific name *mollis* is a Latin meaning “soft”, alluding to the soft, flexible body of the female of the new species.

**Remarks.** Three known species of *Lambanetes* Humes, 1982 including *L. mollis* n. sp., are distinguishable by their armature of legs 1–4. In the female, all rami of legs 1–3 and the exopod of leg 4 of *L. gemmulatus* Humes, 1982 have fewer setae than those of *L. stichodactylae*. The reduction of armature occurs further in both sexes of *L. mollis* in which the first endopodal segment of legs 3 and 4 lacks the inner seta (vs. armature formula 0-0, not 0-1 as in two congeners) and the distal segment of leg 4 endopod has only one spine (vs. armature formula 0, I, 0, not 0, II, 0 as in two congeners).

Besides the difference in leg armature, other appendages of *L. mollis* show differences from those of two congeners. The spine on the convex side of the mandible is trifurcate in *L. mollis*, but smooth in *L. gemmulatus* or crenate, with many spinules in *L. stichodactylae*. The anterior spine (originally seta II) of the distal segment of the maxilla of the female is bifurcate, with a proximal spinule in *L. mollis*, but bears five spinules in *L. gemmulatus* (see illustration by Humes, 1982) or about ten spinules in *L. stichodactylae* (see Fig. 25A of the present paper). The exopod of leg 5 of the female is 1.52 times as long as wide in *L. mollis*, but 2.12 times (in *L. gemmulatus*) or 2.95 times (in *L. stichodactylae*) as long as wide. The antennule of *L. mollis* is 6-segmented in both sexes, unlike 7-segmented condition in two congeners. The form of and ornamentation of the distal process (claw) of the maxillary distal segment, relative lengths of caudal setae, and the form of maxilliped also show differences among the three species.

Family Synapticolidae Humes and Boxshall, 1996  
Genus *Scambicornus* Heegaard, 1944

### *Scambicornus affinis* Ho, 1982

**Material examined.** 70 ♀♀, 35 ♂♂ from sea cucumbers on coral reef in Kantary Bay, southern coast of Phuket Province, Thailand, 7° 48' 14" N, 98° 24' 20" E, 15 Dec 2012.

**Remarks.** *Scambicornus affinis* Ho, 1982 was originally described as an associate of *Stichopus japonica* Selenka

from Japan (Ho, 1982). Ho and Kim (1990) redescribed it from four species of sea cucumbers from Phuket, Thailand, *Holothuria leucospilota* (Brandt), *H. scabra* Jaeger, *H. atra* (Jaeger), and *Opheodesoma clarki* (Heding). According to Ho (1982) and Ho and Kim (1990), this species is closely related to *S. idoneus* (Humes and Cressey, 1961).

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