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Two New Species of Copepods (Crustacea) Associated with the Sponge *Phyllospongia foliascens* (Pallas) from the Moluccas

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Abstract: *Spongicola tropicanus*, a new genus and species of the family Eunicicolidae, and *Asterocheres brevisurculus*, a new species of the family Asterocheridae, are described as copepods associated with the sponge *Phyllospongia foliascens* (Pallas) from the Moluccas. *Spongicola* is the second genus of the family and may be characterized by a two-segmented prosome, the absence of leg 3, and the presence of leg 5. *Asterocheres brevisurculus* may be characterized by one-segmented mandibular palp, short oral siphon, and 19-segmented female antennule.

Key words: *Spongicola* new genus, *Asterocheres*, new species, Copepoda, association, *Phyllospongia*, Moluccas

INTRODUCTION

While the cnidarians, polychaetes, crustaceans, mollusks, echinoderms, and tunicates are known to be the major hosts for the associated copepods with more than a hundred species of copepods reported from each of these invertebrate groups, only 47 species of copepods are known from the sponges (Humes, 1994). From the Moluccas only four species of copepods were recorded from one unidentified species of sponge by Humes (1996). They are *Asterocheres dysideae*, *Parasterocheres cristatus*, *Phyllocheres petalus*, and *Gomumucheres angularis*. These four species were described as new, with the latter three each belonging to a new genus.

In this paper, two new species of copepods, one of them belonging to a new genus, are described from the sponge *Phyllospongia foliascens* (Pallas) collected in the Moluccas. All copepod specimens studied in this paper were collected

by the late Arthur G. Humes in 1975, which were later transferred to the National Museum of Natural History, Smithsonian Institution. In the description of each species the source of specimens are followed from the Humes' collection note.

The copepod specimens were measured and dissected after soaking in lactic acid. The dissection was done using the reversed slide method. In the following descriptions, the body length does not include setae on the caudal rami. Roman and Arabic numerals represent spines and setae, respectively. All figures were drawn with the aid of a camera lucida.

DESCRIPTIONS

Order Cyclopoida Burmeister, 1834
Family Eunicicolidae Sars, 1918

Spongicola n. gen.

Diagnosis: Eunicicolidae. Body consisting of disc-shaped, expanded prosome and narrower urosome. Prosome divided into cephalothorax and metasome by complete corsal suture line. Urosome 4-segmented, with fifth pedigerous somite obsolete, completely fused with metasome. Antennule 7-segmented, with enlarged posterodistal seta on second segment. Antenna 3-segmented, with 2 terminal setae on third segment transformed to suckers. Labrum represented by a large sucker. Mandible 2-segmented; distal segment transformed to elongate shaft bent proximally and carrying large seta and 2 blades. Maxilla 2-segmented, with seta on proximal segment and spine on distal segment. Maxilliped 2-segmented, with seta on proximal segment and 3 setae (plus spinules) on distal segment. Legs 1 and 2 with 3-segmented exopod and 2-segmented endopod. No outer seta on basis of legs 1 and 2. Legs 3 and 4 absent. Leg 5

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lobate and located posteriorly on ventrolateral sides of metasome, with 3 terminal setae.

Etymology: The generic name *Spongicola* is a combination of *sponge*, a general name of the animal group, and *-cola*, a Latin ending used for many generic names of the associated copepods. It means “inhabiting to sponges”. The gender is masculine.

Type species: *Spongicola tropicanus* n. sp.

Spongicola tropicanus n. sp.
(Figs. 1-3)

Material examined: One ♀ collected from the sponge *Phyllospongia foliascens* (Pallas), in 5 m, Marsegoe Island (2° 59' 30" S, 128° 03' 30" E), by A. G. Humes, 15 May 1975. Holotype (dissected and mounted on a slide; USNM 6181667) has been deposited in the National Museum of Natural History, Smithsonian Institution.

Female: Body (Figs. 1, 2A) dorsoventrally flat, consisting of large, disc-shaped prosome and small urosome, with thin, easily flexible exoskeleton. Body length 677 µm. Prosome 543 × 480 µm, consisting of cephalothorax and 1-segmented metasome. Cephalothorax 337 µm long. Urosome (Fig. 2B) 4-segmented, consisting of genital double-somite and 3-segmented abdomen. Fifth pedigerous somite completely fused with metasome. Genital double-somite much wider than long, expanded laterally, 80 × 185 µm; genital area located dorsolaterally. Abdomen weakly tapering; three abdominal somites 30 × 82, 32 × 66, and 17 × 53 µm, respectively. Caudal ramus (Fig. 2C) as long as wide, 16 × 16 µm, armed with 7 naked setae, including small outer lateral seta; largest inner one of two median terminal setae 293 µm long, distinctly larger than other caudal setae; second largest outer one 73 µm long.

Rostrum not discernible, represented by weak longitudinal ridge on ventral surface of cephalic area (Fig. 1). Antennule (Fig. 2D) 7-segmented, strongly tapering, with armature formula 4, 14, 6, 3, 4 + 1 aesthetasc, 2 + 1 aesthetasc, and 7 + 1 aesthetasc. First segment much wider than long, with oblique keel on ventral surface and many spinules on anterior surface; its proximal seta densely plumose, other 3 setae naked or weakly plumose. Second segment armed with 9 anterior setae (seven of them weakly plumose, other 2 naked), 4 dorsal naked setae, and enlarged posterodistal seta; this enlarged seta 158 µm long, extending beyond tip of antennule, plumose with thick setules. Aesthetascs on fifth to seventh segments setiform. Antenna (Fig. 2E) 3-segmented. First segment approximately 73 × 54 µm, expanded distally, with 1 seta and setules near inner distal area. Second segment 46 × 38 µm, with 1 small inner distal seta. Third segment 83 × 25 µm (length measured along

median axis) with 3 setae in middle and terminally 2 suckers and 5 setae, 2 of latter claw-like and another 2 plumose; distal margin of third segment oblique to its axis.

Labrum represented by large sucker of 100 µm in diameter (Fig. 1A). Mandible (Fig. 2F) 2-segmented. First segment small and unarmed. Second elongated, curved proximally, with 1 plumose recurved seta and 2 distal spinulated, claw-like blades; its distal portion whip-like, evenly curved, with row of spinules. Maxillule (Fig. 2G) wider than long and armed with 1 large outer plumose seta, 2 terminal setae and 2 smaller inner subterminal setae; outer half of distal margin rimmed with membrane. Maxilla (Fig. 3A) 2-segmented. First segment with large, strongly curved spiniform seta. Second segment longer than wide, terminally with strong spine of 50 µm length. Maxilliped (Fig. 3B) 2-segmented. First segment with 2 rows of denticles and 1 row of spinules on posteroventral surface. Second segment much smaller than first segment, slightly longer than wide, and armed with 3 setae (1 dorsal, 1 spiniform subterminal, and 1 longest, plumose terminal setae) and 2 spinules (or small setae).

Legs 1 and 2 (Fig. 3C, D) with 3-segmented exopod and 2-segmented endopod. Legs 3 and 4 absent. Legs 1 and 2 with well developed, posteriorly expanded intercoxal plate marginated by membrane (or sclerotization); row of spinules near outer distal corner of coxa; 2 rows of spinules on outer area of basis; membrane on posterior margin between bases of rami. First and second exopodal segments of these legs ornamented with fin-like outer membranous flap; third segment with 2 such flaps. Terminal spine of third exopodal segment of these legs blade-like, marginated by membrane along outer margin. Endopodal segments of these legs ornamented with minute spinules on inner surface. Armature formula of legs 1 and 2 as follows:

Leg 1: coxa 0-0; basis 0-0; exp. 1-0; 1-1; 2,I,3; enp. 0-0; 3

Leg 2: coxa 0-0; basis 0-0; exp. 1-0; 0-1; 1,I,3; enp. 0-0; 2

Leg 5 (Fig. 3E) lobate, located near posterolateral corners of prosome (Fig. 1A), 17 × 15 µm, terminally with 2 naked and 1 spiniform setae. Leg 6 represented by 2 spiniform setae in genital area (Fig. 2B).

Male: Unknown.

Etymology: The specific name *tropicanus* is derived from the tropical origin of the type specimen.

Remarks: The Eunicolidae has hitherto been a monotypic family represented by the genus *Eunicicola* Kurz, 1877. This genus contains two known species *E. clausi* Kurz, 1877 associated the polychaete *Eunice clapedi* and *E. insolens* (T. and A. Scott, 1898) associated with *Eunice harassii*, both from the European seas. These two species of copepods were originally incompletely described (Sars,

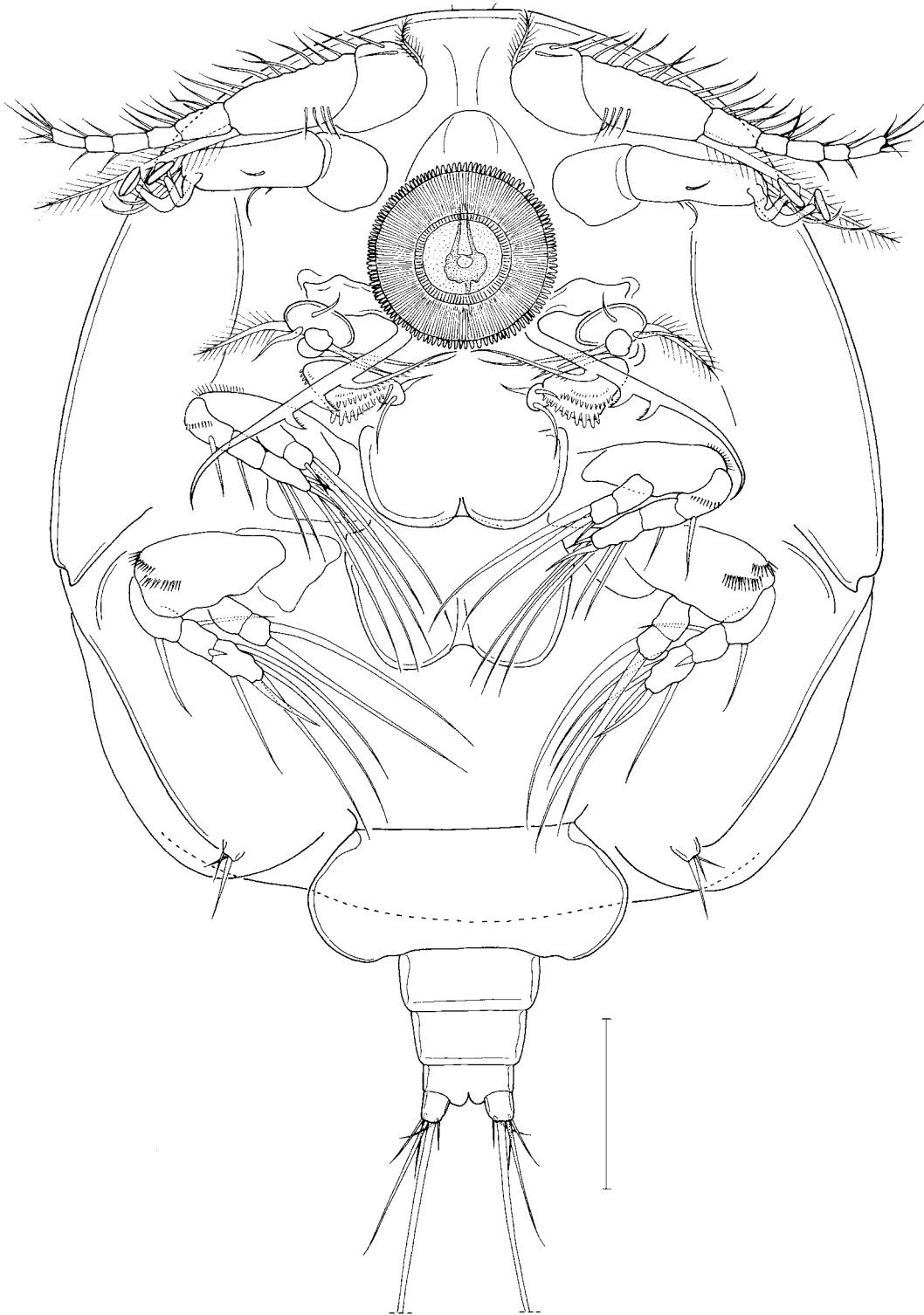


Fig. 1. *Spongicola tropicanus* n. gen. and n. sp. Habitus of female, ventral. Scale bar = 0.1 mm.

1918; Gotto, 1963) and were later redescribed respectively by Sars (1918) and Gotto (1963) on the basis of newly obtained specimens. While redescribing *E. insolens*, Gotto (1963) noted significant differences of this species from the

redescription of *E. clausi* by Sars (1918). The illustrated mouth organs and leg 1 of these species recorded by Sars and Gotto appear to be clearly different from each other. But nearly all differences reported between the two species

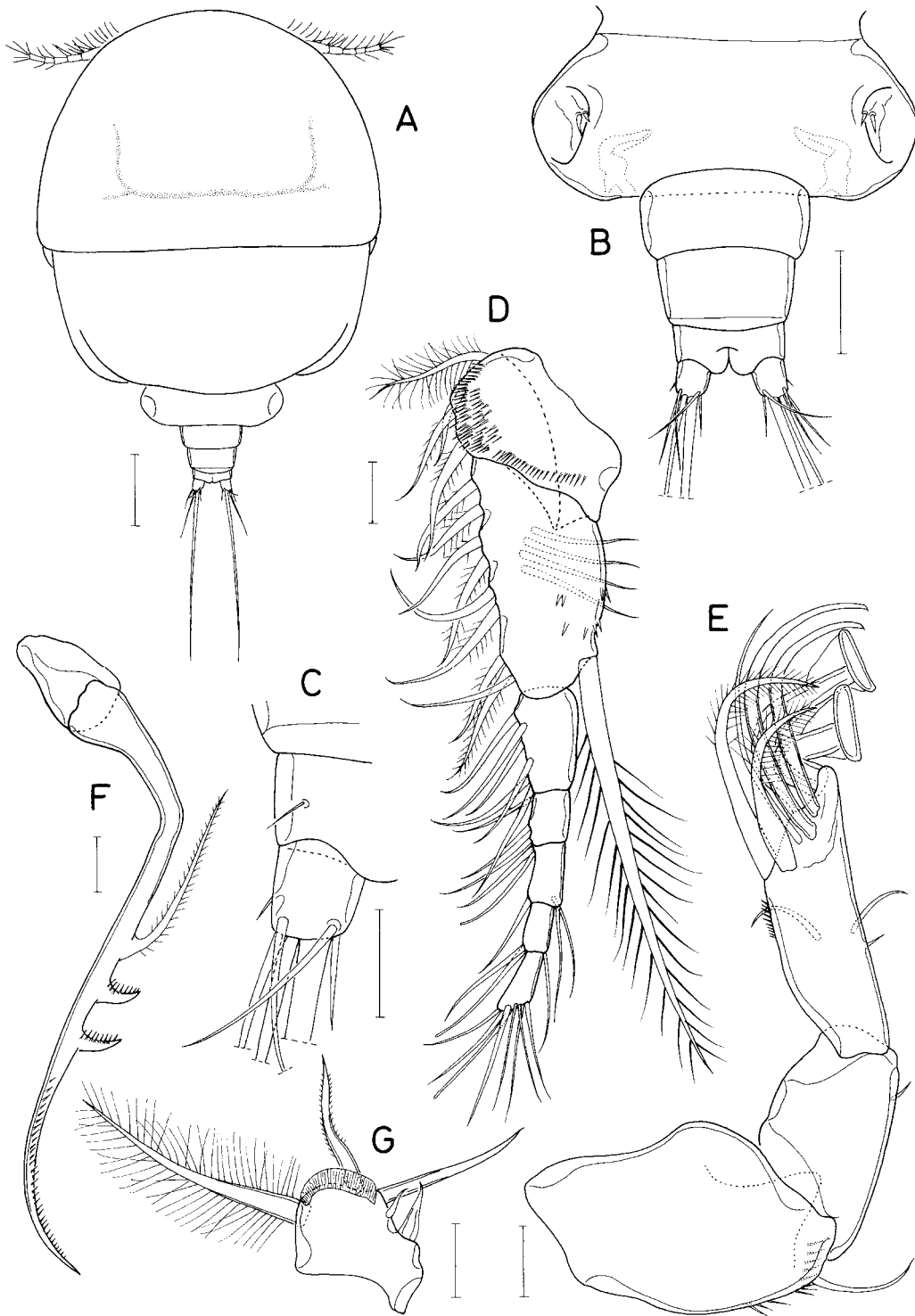


Fig. 2. *Spongicola tropicanus* n. gen. n. sp., female. A, Habitus, dorsal. B, Urosome, dorsal. C, Left caudal ramus, dorsal. D, Antennule, dorsal. E, Antenna. F, Mandible. G, Maxillule. Scale bars = 0.1 mm (A), 0.05 mm (B) and 0.02 mm (C-G).

turned out to be artifacts, because a re-examination of Sars' specimens of *E. clausi* performed by Gooding (1963) revealed that the mouth organs and legs 1 and 2 of these Norwegian specimens are almost identical to those of *E.*

insolens Gotto recorded. The only reliable difference of character between the two seems to be in leg 3 where the second exopodal segment (endopod absent) is armed with 3 setae in *E. clausi* but 2 in *E. insolens*.

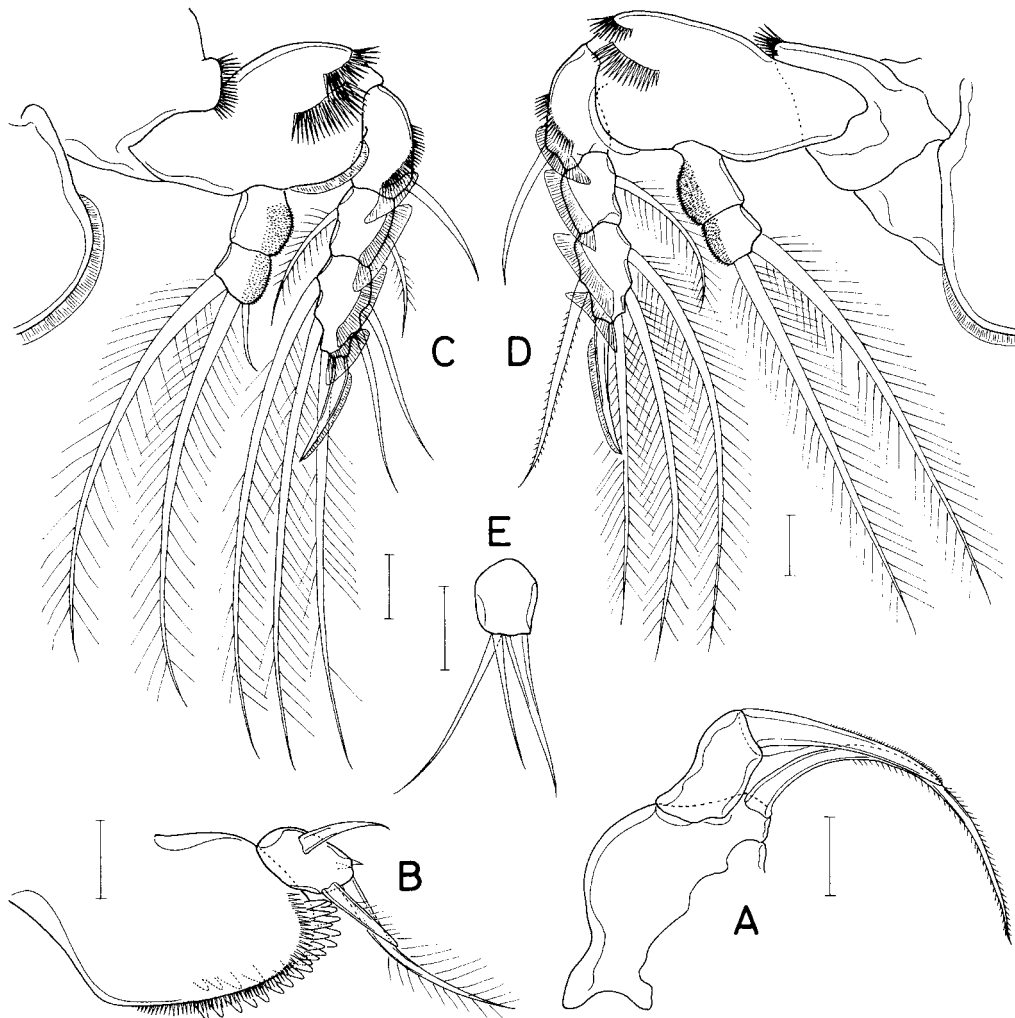


Fig. 3. *Spongicola tropicanus* n. gen. and n. sp., female. A, Maxilla. B, Maxilliped. C, Leg 1. D, Leg 2. E, Free segment of leg 5. Scale bars = 0.02 mm.

In contrast to the close similarity between the two species of *Eunicicola*, the new species from the Moluccas shows fundamental differences from the two. The species of *Eunicicola* possess leg 3 which is located immediately behind leg 2. Unlike this, in the new species, no leg is present just behind leg 2. Instead, a lobate rudimentary leg bearing terminally three setae is located at posterolateral side of metasome where is an area remotely separated from leg 2, and is thus considered a leg 5. In addition to the absence of leg 3 and the presence of leg 5, the new species shows other important differences from the species of *Eunicicola*. It possesses membranous flaps on the exopodal segments of legs 1 and 2, a prosome divided dorsally into the cephalothorax and metasome, an unarticulated distal segment (elongate shaft) of mandible, and no outer seta on the basis of legs 1 and 2. I consider these differences are sufficient to establish a new genus *Spongicola* to incorporate the new species.

Order Siphonostomatoida Burmeister, 1835

Family Asterocheridae Giesbrecht, 1899

Genus *Asterocheres* Boeck, 1859

Asterocheres brevisurculus n. sp.

(Figs. 4-6)

Material examined: Thirty-two ♀♀ and 8 ♂♂ collected from the sponge *Phyllospongia foliascens* (Pallas), in 5 m, Marsegoe Island (2°59'30"S, 128°03'30"E), collected by A. G. Humes, 15 May 1975. Holotype (♀, USNM 1081700), allotype (♂, USNM 1081701), and paratypes (30 ♀♀ and 6 ♂♂, USNM 1081702) have been deposited in the National Museum of Natural History, Smithsonian Institution. Dissected paratypes (1 ♀ and 1 ♂) are kept in the collection of the author.

Female: Body (Fig. 4A) with moderately expanded prosome. Body length of dissected specimen 872 µm.

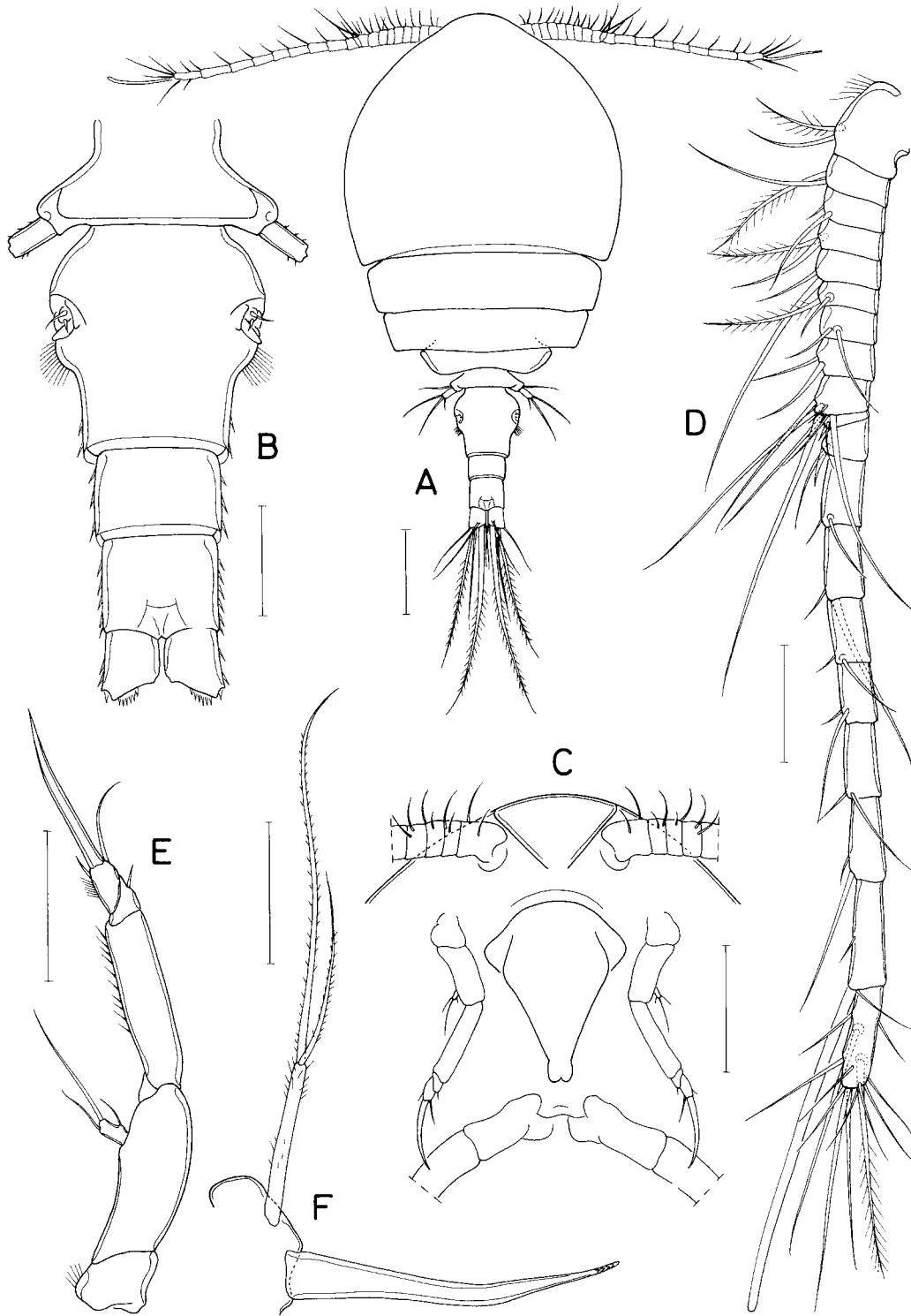


Fig. 4. *Asterocheres brevisurculus* n. sp., female. A, Habitus, dorsal. B, Urosome, dorsal. C, Cephalic area, ventral. D, Antennule. E, Antenna. F, Mandible. Scale bars = 0.2 mm (A), 0.02 mm (B, D-F) and 0.1 mm (C).

Mean body length 816 μm (769-872 μm) based on 10 specimens. Prosome 4-segmented, 605 μm long. Maximum width 468 μm . Cephalothorax 409 μm long. Third pedigerous somite with angular posterolateral coners. Urosome (Fig.

5B) 4-segmented. Fifth pedigerous somite 110 μm wide. Genital double-somite 105 \times 98 μm , consisting of roundly expanded anterior part and narrower posterior part, with setules on posterior edge of anterior expansion behind

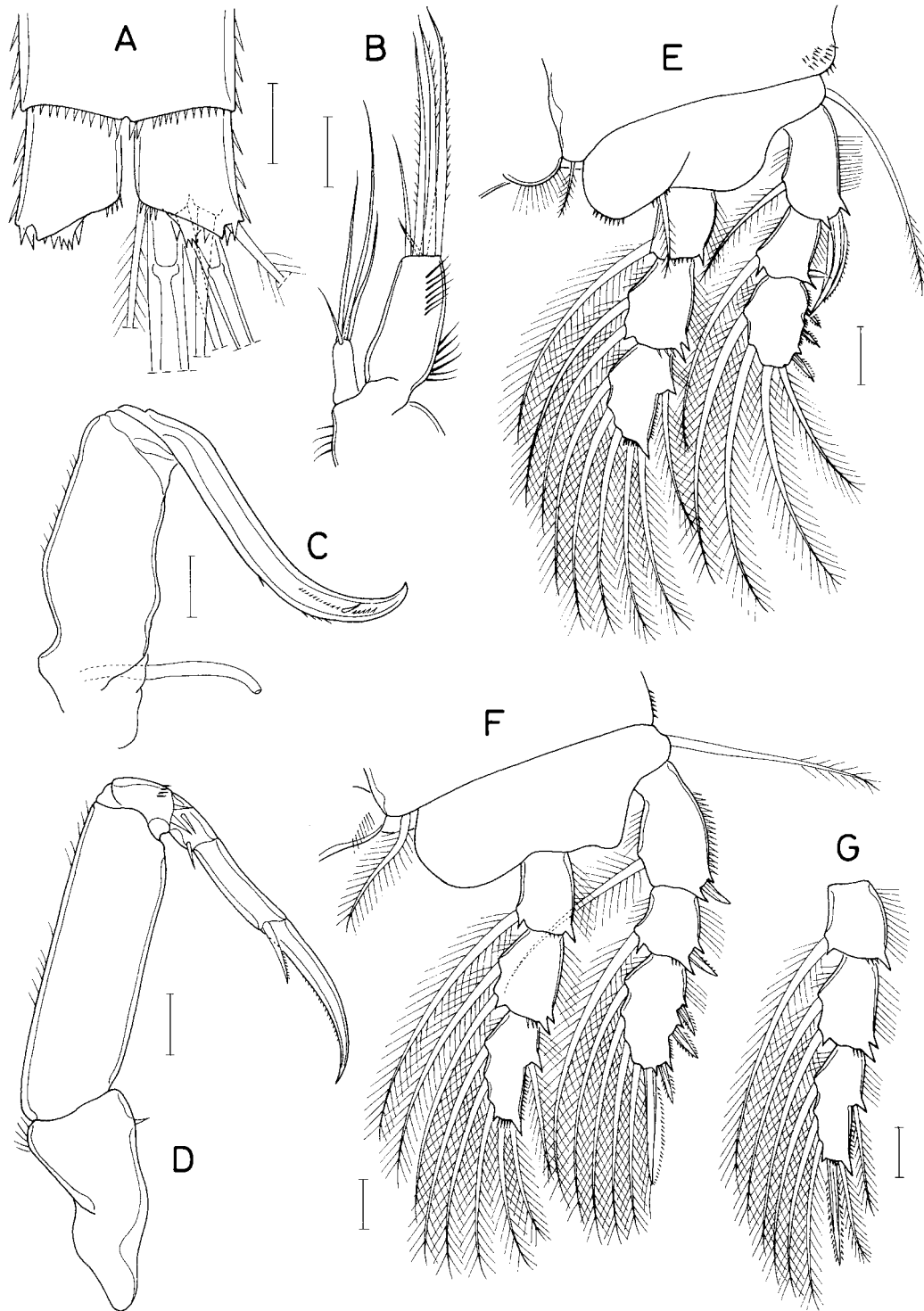


Fig. 5. *Asterocheres brevisurculus* n. sp., female. A, Caudal rami, ventral. B, Maxillule. C, Maxilla. D, Maxilliped. E, Leg 1. F, Leg 2. G, Endopod of leg 3. Scale bars = 0.02 mm.

genital areas. Genital area located at about 2/5 length of somite. Two abdominal somites 40×58 , and 43×53 μm , respectively, ornamented with scales on lateral margins. Posteroventral margin of anal somite ornamented with spinules (Fig. 2A). Caudal ramus 33×27 μm (ratio 1.22 :

1), its posterior margin oblique and ornamented with crenate membrane.

Rostrum triangular (Fig. 4C), its posterior apex diminishing. Antennule (Fig. 4D) 427 μm and 19-segmented, with armature formula 2, 2, 2, 2, 2 (5th), 2, 2, 2, 7, 2 (10th), 2, 2,

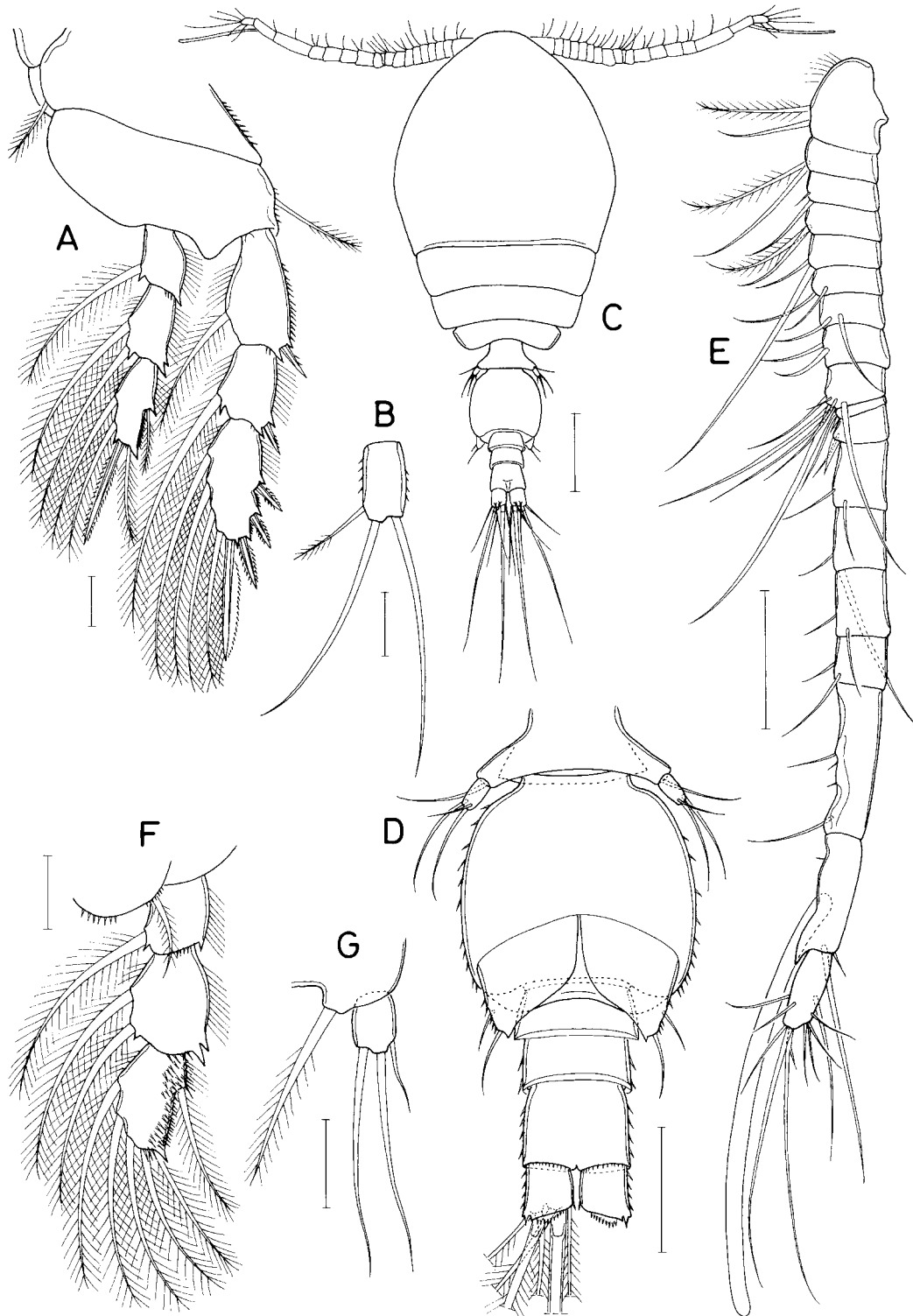


Fig. 6. *Asterocheres brevisurculus* n. sp. Female: A, Leg 4. B, Free segment of leg 5. Male: C, Habitus, dorsal. D, Urosome, ventral. E, Antennule. F, Endopod of leg 1. G, Free segment of leg 5. Scale bars = 0.02 mm (A, B, F, G), 0.1 mm (C) and 0.05 mm (D, E).

2, 2, 2 (15th), 2, 2, 2 + 1 aesthetasc, and 13. First segment with hairs on anterior margin. One of setae on each first, second, fourth, sixth, and last segments plumose. Antenna (Fig. 4E) with hairs on short coxa. Basis 55 μ m long and

unornamented. Exopod small, 10 \times 6 μ m, armed with 1 lateral and 2 unequal terminal setae. Endopod 3-segmented; first segment 58 μ m long, with spinules along outer margin; short second segment with small seta; third segment with 1

small and 1 longer setae. Terminal claw slightly curved, 56 μm long.

Oral siphon characteristically short, 137 μm long, strongly tapering, and extending before bases of maxilliped. Mandible (Fig. 4F) tapering, with pointed tip bearing 5 small teeth. Mandibular palp 1-segmented, narrow, 58 \times 5 μm , terminally armed with 1 larger (138 μm) and 1 smaller (73 μm) setae. Maxillule (Fig. 5B) bilobed. Outer lobe small 18 \times 8 μm , with 4 terminal setae. Inner lobe 38 \times 19 μm , with lateral setules and 5 terminal setae, one of latter distinctly smaller. Maxilla (Fig. 5C) 2-segmented. First segment with long aesthetasc-like duct proximally. Second segment as claw bearing small seta and spinules distally. Maxilliped (Fig. 5D) consisting of 5 segments and terminal claw. First segment with 1 small inner distal seta and setules on outer distal corner. Second segment with parallel alteral margins and setules along outer margin. Third and fourth segments short, each armed with 2 small setae. Fifth segment with distal seta. Claw 57 μm long, weakly curved, with fine spinules along concave margin.

Legs 1-4 (Figs. 5E-G, 6A) with 3-segmented exopod and endopod. Second endopodal segment legs 1-4 with bicuspid inner distal corner. Outer margin of first exopodal segment of legs 2-4 with fine spinules; that of leg 1 with hairs. Inner side of posterior margin of basis of leg 1 with spinules. Outer spine on first exopodal segment of leg 1 arched, 38 μm long, extending to base of proximal spine of third exopodal segment. Armature formula of legs 1-4 as follows:

Leg 1: coxa 0-1; basis 1-1; exp. I-1; I-1; III,4; enp. 0-1; 0-2; 1,2,3

Leg 2: coxa 0-1; basis 1-0; exp. I-1; I-1; III,I,4; enp. 0-1; 0-2; 1,2,3

Leg 3: coxa 0-1; basis 1-0; exp. I-1; I-1; III,I,4; enp. 0-1; 0-2; 1,1+1,3

Leg 4: coxa 0-1; basis 1-0; exp. I-1; I-1; III,I,4; enp. 0-1; 0-2; 1,1+1,2

Free segment of leg 5 (Fig. 6B) quadrangular, 24 \times 14 μm , armed with 3 setae (81, 73, and 27 μm , respectively) and ornamented with spinules on lateral margins. Leg 6 represented by 2 small setae in genital area (Fig. 4B).

Male: Body (Fig. 6C) narrower than that of female. Body length of dissected specimen 603 μm , Mean body length 614 μm (603-635 μm), based on 8 specimens. Prosome tapering posteriorly, 394 \times 297 μm . Cephalothorax 271 μm long. Urosome (Fig. 6D) 5-segmented. Fifth pedigerous somite 78 μm wide. Genital somite nearly circular, 90 \times 94 μm , with scales on lateral margins. Three abdominal somites 20 \times 50, 20 \times 44, and 31 \times 43 μm , respectively. Caudal ramus 23 \times 20 μm (ratio 1.15 : 1).

Rostrum as in female. Antennule 18-segmented, with 7 setae on ninth segment, 4 setae on sixteenth, 3 setae+1

aesthetasc on seventeenth, 10 setae on last, and 2 setae on other segments. One of terminal setae accompanied with setule proximally. Antenna, oral siphon, mandible, maxillule, maxilla as in female. Maxilliped with beak-like proximal process on inner margin of second segment.

Legs 1-4 armed as in female, but third endopodal segment of leg 1 (Fig. 6F) showing sexual dimorphism in having dense spinules on outer side. Leg 5 with free segment of 14 \times 10 μm ; its 3 terminal setae 51, 50, and 17 μm , respectively. Leg 6 represented by 2 setae on posterior corner of genital flap (Fig. 6D).

Etymology: The name *brevisurculus* is a combination of Latin words *brevis* (= short) and *surculus* (= sucker). It refers to the short oral siphon of the species.

Remarks: *Asterocheres* is the largest genus in the family Asterocheridae. Boxshall and Halsey (2004) counted 49 species in this genus, not including the following four newly described species: *A. pilosus*, *A. walteri*, and *A. urabensis* described by Kim (2004a) from the Pacific coast of Panama; *A. tubiporae* by Kim (2004b) from Madagascar. A number of species of this genus are incompletely described (Humes, 1996). Nevertheless, *A. brevisurculus* can be differentiated from the relatives by the following ways.

Species of *Asterocheres* having the following characters to which *A. brevisurculus* does not agree are eliminated from a comparison with the new species: 1) the ratio of the length to width of caudal ramus is recorded to be below 1.0 : 1 or over 1.5 : 1; 2) the mandibular palp is recorded to be a 2-segmented appendage; 3) the female antennule is 20- or more segmented; and 4) the oral siphon extends distinctly beyond the base of maxillipeds. The above screening leaves only two species, *A. indicua* Sewell, 1949 and *A. hongkongensis* Malt, 1991.

According to Sewell's (1949) original description, the body length of *A. indicus* is 0.71 mm in the female, the first abdominal somite is twice as long as wide, the anal somite is 1.5 times as long as preceding somite, the largest one of caudal setae is about equal in length to the two abdominal somites and caudal rami combined. These features are not agreeable to *A. brevisurculus*.

Malt (1991) described *Asterocheres hongkongensis* with omission of some taxonomically important appendages, such as the mandible. However, this species has, unlike *A. brevisurculus*, the smaller body (only 0.50 mm long), the anterior expansion of genital double-somite is not prominent, the genital areas are located dorsally on the somite, and the free segment of female leg 5 is about three times as long as wide and extends beyond the level of genital area.

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