TWO NEW SPECIES OF *HEMICYCLOPS* (COPEPODA, CLAUSIDIIDAE) AND A NEW SPECIES OF *PARAMACROCHIRON* (COPEPODA, MACROCHIRONIDAE) FROM INDONESIAN WATERS

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ABSTRACT

Three new species of copepods, *Hemicyclops javaensis*, *H. minutus*, and *Paramacrochiron amboinense*, are described from Indonesian coastal waters, based on specimens collected from the Java Sea and from Ambon Bay.

H. javaensis can be distinguished from other species of *Hemicyclops* by the segmentation and armature of the antennule, the segmentation of the antenna, the presence of a blunt, barbed spine on the inner margin of the basis of the first and third swimming legs, the form of the fifth leg, the long caudal rami, and the spinous dorsal surface of the urosome.

H. minutus can be distinguished from its congeners by a combination of features in the segmentation of the antennule and antenna, the presence of one plumose seta on the first segment of the maxilliped and the very short third segment (claw) of that appendage, the form of the fifth and sixth legs, and the small size of the body.

P. amboinense is the seventh species known of its genus, following *P. sewelli* Reddiah, 1968 and *P. japonicum* Humes, 1970. The present species is distinguishable from other congeners by characteristics of the fifth leg, the segmentation and armature of the antennule, the segmentation of the antenna, and the small size of its body.

RÉSUMÉ

Trois espèces nouvelles de copépodes, *Hemicyclops javaensis*, *H. minutus*, et *Paramacrochiron amboinense*, sont décrites des eaux côtières indonésiennes, à partir de spécimens récoltés dans la mer de Java et dans la baie d'Ambon.

H. javaensis se distingue des autres espèces d'*Hemicyclops* par la segmentation et l'armature de l'antennule, la segmentation de l'antenne, la présence d'une épine barbelée, émoussée à son extrémité, insérée au bord interne du basipodite de la première et de la troisième pattes thoraciques, la forme de la cinquième patte, les longues rames furcales et la surface dorsale épineuse de l'urosome.

H. minutus se différencie de ses congénères par une combinaison de caractères de la segmentation de l'antennule et de l'antenne, la présence d'une soie plumeuse sur le premier segment du

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Crustaceana 78 (8): 917-929

maxillipède et le très court troisième segment (croc) de cet appendice, la forme de la cinquième et de la sixième pattes, et la petite taille du corps.

P. amboinense est la septième espèce connue de ce genre, après *P. sewelli* Reddiah, 1968 et *P. japonicum* Humes, 1970. La présente espèce est distincte des autres congénères par les caractéristiques de la cinquième patte, la segmentation et l'armature de l'antennule, la segmentation de l'antenne, et la petite taille de son corps.

INTRODUCTION

The genus *Hemicyclops* represents a group of clausidiid copepods found predominantly in temperate and tropical regions of the world oceans. All species appear to be intertidal forms or inhabitants of shallow waters, and some live in association with other animals. Many species of this genus were recorded from coastal and intertidal zones in association with various invertebrates, others were not apparently associated with a host (Humes, 1984).

In their revisionary work, Vervoort & Ramirez (1966) recognized 22 species in *Hemicyclops.* Since then seven more species have been described, viz., *H. perinsignis* Humes, 1973, *H. columnaris* Humes, 1984, *H. mortoni* Boxshall & Humes, 1987, *H. ctenidis* Ho & Kim, 1990, *H. gomsoensis* Ho & Kim, 1991, and *H. japonicus* Itoh & Nishida, 1993. The two new species to be described below are the 2nd and 3rd species of *Hemicyclops* from Indonesian waters, the other one being *H. leggei* (Thompson & Scott, 1903) collected from dredge washings (13 m depth) at the Aru Islands (A. Scott, 1909).

Currently, the genus *Paramacrochiron* Sewell, 1949 consists of six species, *P. maximum* (Thompson & Scott, 1903), *P. pacificum* (Wilson, 1950), *P. ennorense* Reddiah, 1968, *P. sewelli* Reddiah, 1968, *P. rhizostomae* Reddiah, 1968, and *P. japonicum* Humes, 1970.

This paper deals with descriptions and illustrations of the two new species of Clausidiidae Embleton, 1901 and one of Paramacrochironidae Humes & Boxshall, 1996 in Indonesian waters. All type specimens have been deposited in the Museum Zoologicum Bogoriense, Indonesia. Abbreviation used are: A1, antennule; A2, antenna; Ur1-Ur6, urosomal somites 1-6; P1-P6, swimming legs 1-6; Re, exopod; Ri, endopod; TL, total length; CR, caudal rami; Ms1-Ms6, metasomal somites 1-6. All figures were drawn with the aid of a camera lucida.

Hemicyclops javaensis n. sp. (figs. 1-2)

Material examined. — Holotype, adult male, 2.03 mm TL, collected off Tegal, Java Sea, central Java (06°40′S 109°10′E), vertical haul of 0.1 mm mesh plankton net, 8 m depth to surface, at night, 3 June 1994.

Male. — Body long, greatest width on posterior end of cephalosome, length of prosome 1.58 times its width, and 1.65 times length of urosome excluding

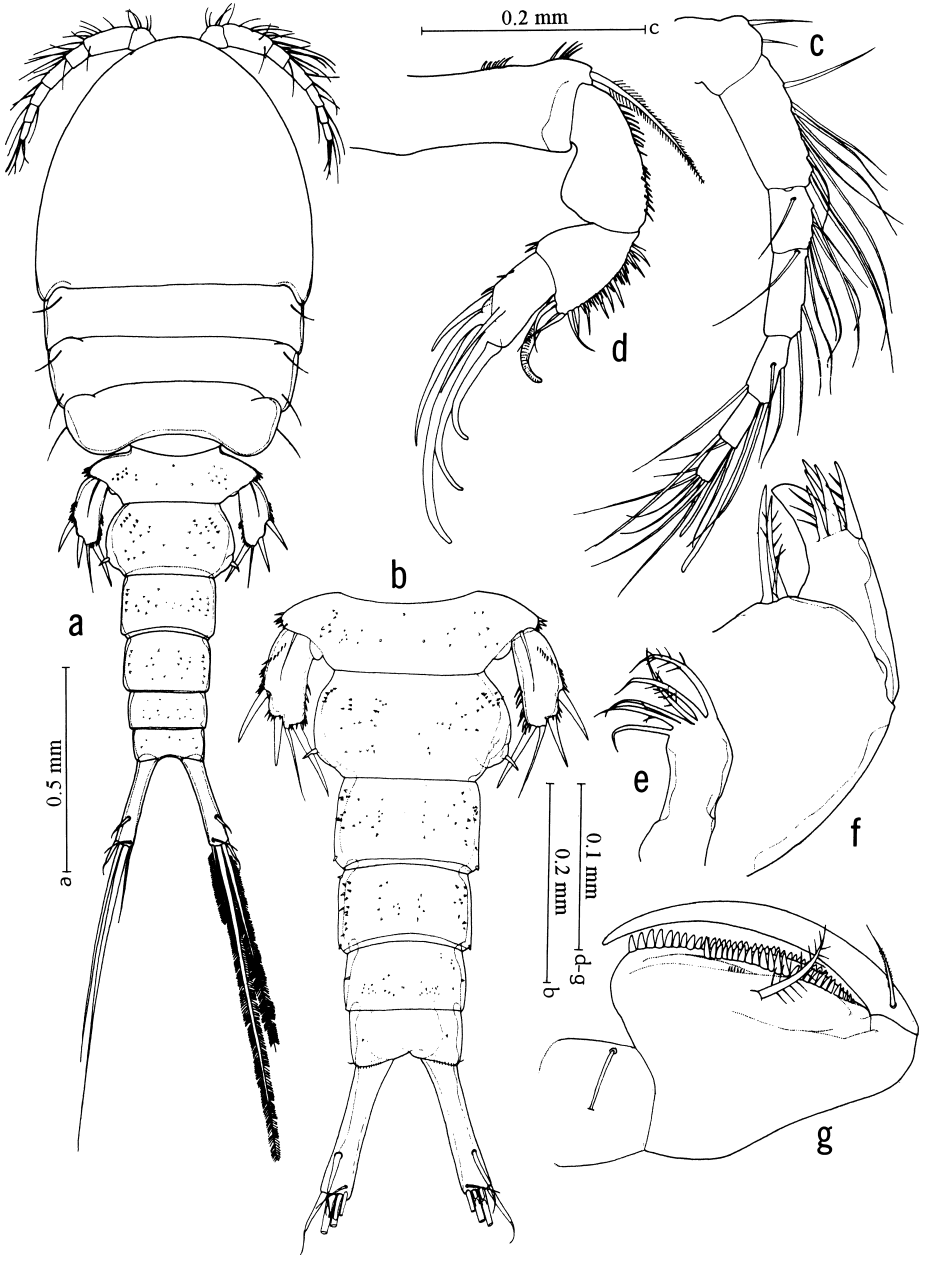

Fig. 1. *Hemicyclops javaensis* n. sp., male holotype. a, whole animal, dorsal view; b, urosome, dorsal view; c, antennule; d, antenna; e, maxillule; f, maxilla; g, maxilliped.

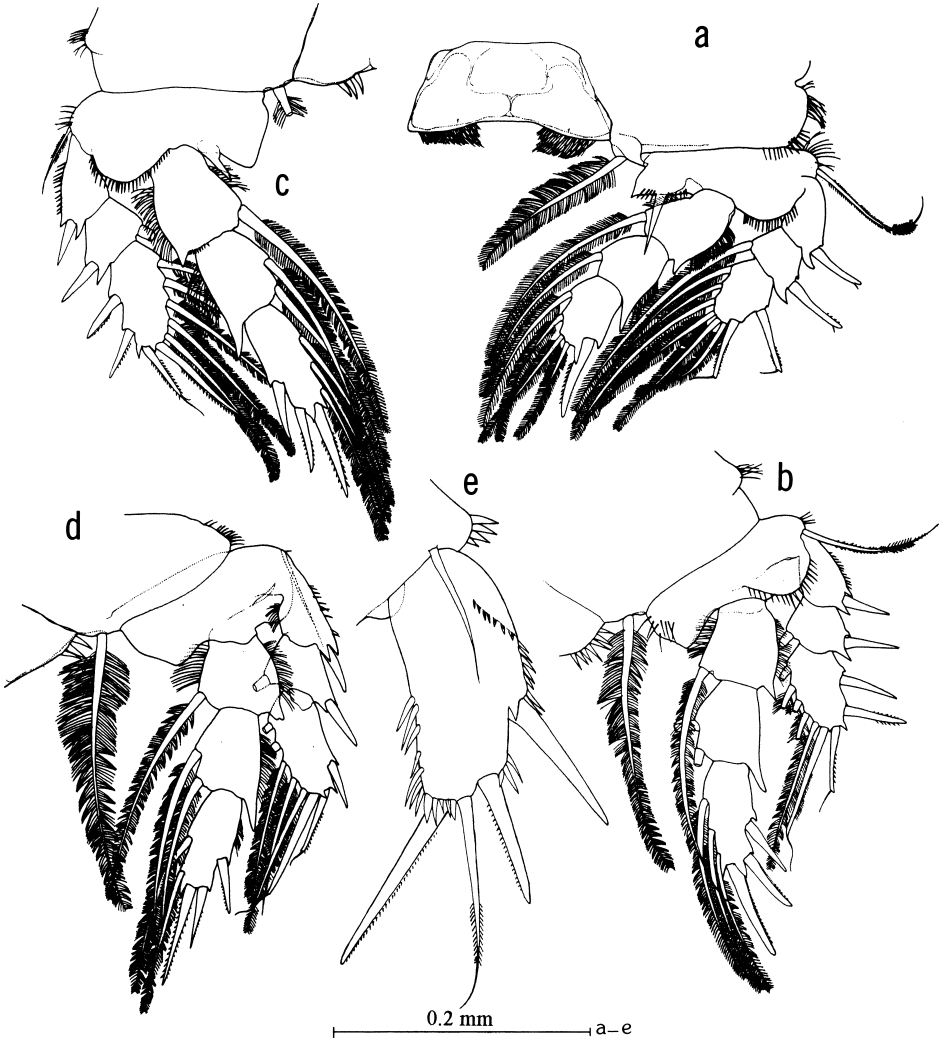

Fig. 2. *Hemicyclops javaensis* n. sp., male holotype. a-e, 1st-5th legs.

caudal setae. Cephalon narrowly rounded in dorsal view, rostrum with broad posteroventral margin. Urosome with groups of dorsal spinules, genital somite wider than long, onion-shaped. Length ratio of four postgenital somites from anterior to posterior, 29.9:27.6:24.2:18.3. CR, 5 times as long as wide; 2nd innermost caudal seta very long, 0.7 times length of prosome.

A1 7-segmented, length 0.4 times that of prosome, length ratio of segments 1-7, 17:24:12:17:13:8:9. Formula for setal armature, 4, 15, 7, 4, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. A2, 4-segmented, 1st segment longest, with seta on outer distal corner and tuft of small hairs at midlength on inner margin. Second

segment with a long seta on outer distal corner and row of spinules on outer margin. Third segment with 2 small spines on inner distal corner, row of irregular spinules along outer margin, 4 short setae and 1 spinous seta on outer distal corner. Distal segment terminating in 5 long spinous setae, 1 naked seta, and with 3 spinules on inner distal corner. Maxillule bilobate with 4 spines on smaller lobe and 2 spines on larger lobe. Maxilla 2-segmented, 1st segment with 2 large, barbed spines and minute, naked spine on basal segment. Second segment with stout inner claw and 4 basal spines. Maxilliped 3-segmented, 1st segment with 2 plumose setae; 2nd segment widely expanded at base with seta and 3 rows of denticles on inner edge, 1 row of spinules on distal half, and 2 medial setae. Distal segment produced into claw, bearing plumose seta proximally.

P1-P4 with endopods longer than exopods. Armature as follows (Roman numerals represent spines, Arabic numerals indicate setae):

P1	coxa 0-1; basis 1-I; Re I-0, I-1, II-6; Ri 0-1, 0-1, I-4
P2 and P3	coxa 0-1; basis 1-0; Re I-0, I-1, III-6; Ri 0-1, 0-2, III-3
P4	coxa 0-1; basis 1-0; Re I-0, I-1, III-5; Ri 0-1, 0-2, III-2

Spines of Re of P1-P4 typically with pectinate terminal part. P1 with blunt, barbed spine on inner surface of basis. This area of basis bearing row of spinules in P1-P2, but naked in P3-P4. P5, 2-segmented, 1st segment with row of 4 spines on outer distal corner and 1 plumose seta; 2nd segment 2.6 times as long as wide, with row of spines at midlength on outer and inner margins, and row of triangular spines on dorsal surface, 2 outer spines, and terminating in a barbed spine and 1 plumose seta. P6 consisting of posteroventral flap on genital somite, armed with single barbed seta.

Female unknown.

Remarks. — The present species, *H. javaensis* is easily identifiable by the long CR and a combination of the setation of A1. There are no other congeners that have such long CR although the CR of some species, such as *H. subadhaerens* Gooding, 1960 and *H. carinifer* Humes, 1965, are more than 4 times as long as wide. In addition, the body lengths of the males of *H. subadhaerens* (2.05 mm) and *H. carinifer* (1.60 mm) so far reported, are mostly larger and smaller, respectively, than that of *H. javaensis* (2.03 mm), and could be useful in practical identification. Another distinctive character of the new species is the extreme spination of the dorsal surface of the urosome.

Etymology. — The specific name *javaensis* refers to Java, in the vicinity of which the species was collected. It is an adjective agreeing in gender with the (feminine) generic name.

Hemicyclops minutus n. sp. (figs. 3-4)

Material examined. — Holotype, adult male, 1.42 mm TL, collected off Tegal, Java Sea, central Java, vertical haul of 0.1 mm mesh plankton net, from 8 m depth to surface, at night, 3 June 1994.

Male. — Prosome elliptical in dorsal view; greatest width at posterior end of cephalosome. Ratio of length to width of prosome 2.6:1, prosome 1.24 times as long as urosome excluding caudal setae. Genital somite 1.6 times as wide as long. Four postgenital somites each wider than long, anal somite shortest. CR, 2.7 times as long as wide, gradually narrowing distally, 2nd innermost seta longest, longer than urosome and CR combined.

A1, 7-segmented, length 0.44 times length of prosome; length ratio of segments 15.8:23.7:11.8:17.1:13.2:10.5:7.9. Formula for armature 5, 12, 6, 4, 4 + 1 aesthete, 2 + 1 aesthete, 5 + 1 aesthete. A2, 4-segmented, 1st segment with one long and 2 short setae on outer distal corner, and tuft of small hairs at basis of inner margin. Second segment with a finely barbed seta on distal 1/3, and row of spinules along outer margin. Third segment with 3 large spines on outer margin and rows of spinules on inner and outer margins. Fourth segment with 1 barbed and 6 plumose apical setae. Mandible terminating in 2 stout processes and 2 barbed spines, at midlength of segment a tuft of hairs. Maxillule bilobate, with 3 spines on shorter lobe and 5 spines on longer lobe. Maxilla 2-segmented, 1st segment with 2 large barbed spines and one minute, naked spine on basal segment; 2nd segment with 2 barbed spines and 2 stout processes, which are ramified distally. Maxilliped 3-segmented, 1st segment with a plumose seta; 2nd segment widely expanded at base, with 3 rows of spinules; 3rd segment produced into a claw and bearing a minute seta proximally.

Armature of the legs as follows (Roman numerals representing spines, Arabic numerals indicating setae):

P1 coxa 0-1; basis 1-0; Re I-0, I-1, II-6; Ri 0-1, 0-1, I-5
P2 coxa 0-1; basis 1-0; Re I-0, I-1, III-6; Ri 0-1, 0-2, III-3
P3 coxa 0-1; basis 1-0; Re I-0, I-1, IV-5; Ri 0-1, 0-2, III-3
P4 coxa 0-1: basis 1-0; Re I-0, I-1, III-5; Ri 0-1, 0-2, V-0.

Inner margin of basis of P1-P4 each bearing row of spinules. P5, 2-segmented, segments about equal in length. First segment with one plumose spine and 2 rows of spines of unequal length at distal corner. Second segment 1.5 times as long as wide, with 2 rows of unequal spines at midlength on outer margin, 1 row of inner spines on distal end, 1 row of triangular spines on dorsal surface near basal end, 2 stout outer spines, 1 terminal spine, and 1 plumose seta. Terminal spine having barbed inner edge and hairs on outer edge. P6 consisting of posteroventral flap on genital somite, bearing 1 stout barbed spine and 1 seta.

Female unknown.

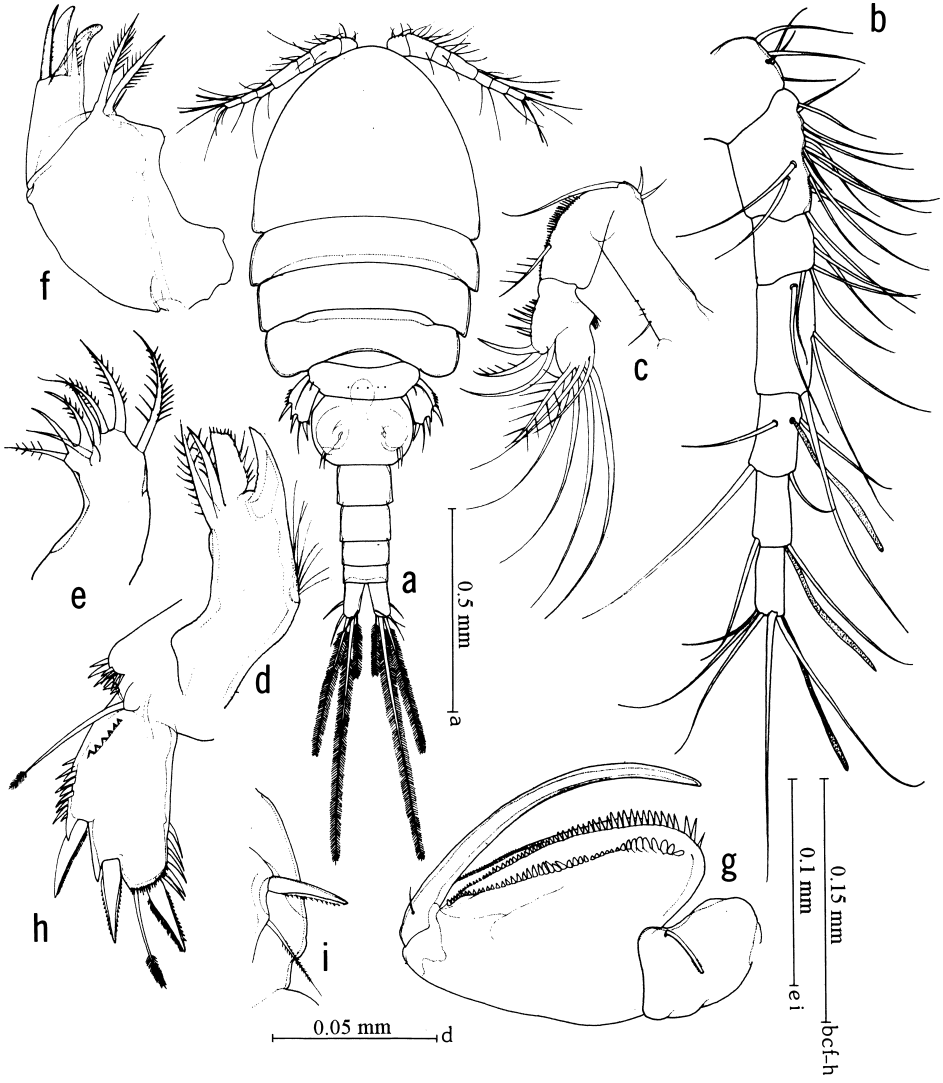

Fig. 3. *Hemicyclops minutus* n. sp., male holotype. a, whole animal, dorsal view; b, antennule; c, antenna; d, mandible; e, maxillule; f, maxilla; g, maxilliped; h, 5th leg; i, 6th leg.

Remarks. — By a combination of several characters, the new species *H. minutus* can be distinguished from its 29 congeners. *H. leggei* (Thomson & Scott, 1903), which is based solely on a male specimen, is distinguished from the male of *H. minutus* in having 2 setae on the 1st segment of the maxilliped. *H. minutus* can be separated from *H. australis* Nicholls, 1944 by a combination of characters in the setation of the A1, the segmentation of the A2, and by the urosome and the stout claw on the distal segment of the maxilliped.

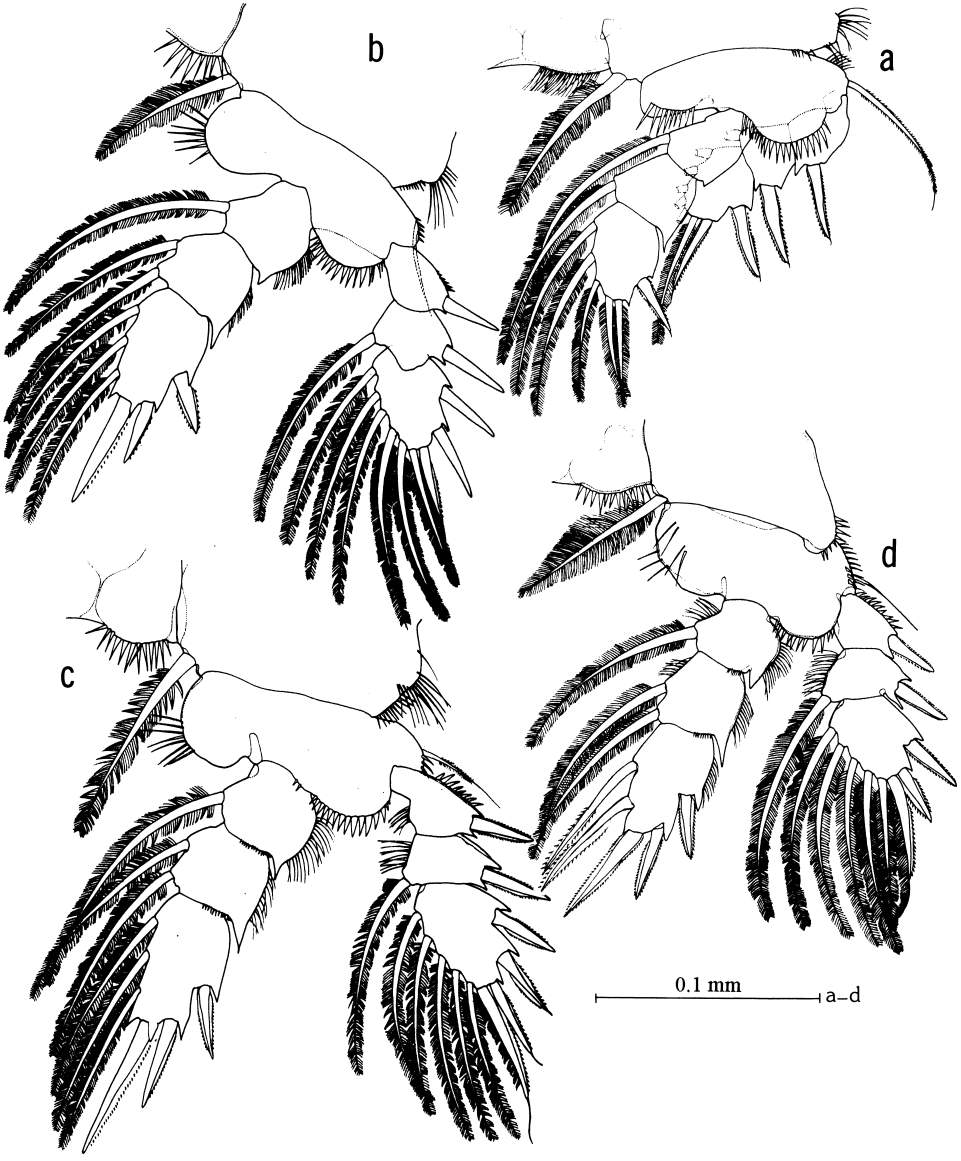

Fig. 4. *Hemicyclops minutus* n. sp., male holotype. a-d, 1st-4th legs.

The present species is closely similar to *H. japonicus* Itoh & Nishida, 1993, in the comparatively short CR and the presence of 1 seta on the 1st segment of the maxilliped, but is distinguished from the latter by a combination of characters: the setation of the A1, the segmentation of the A2, the last metasomal somite being rounded, the onion shape of the genital somite, the length to width ratio of the CR, and the shape of P1-P6.

Etymology. — The specific name *minutus* refers to the small size of the body. The name is an adjective agreeing in gender with the (masculine) generic name (see code ICZN, 1999: 35, Art. 30.1.4.3).

Paramacrochiron amboinense n. sp. (figs. 5-6)

Material examined. — Holotype, adult female, 2.38 mm, collected from Ambon Bay, surface tow, 0.33 mm mesh plankton net, at night, 13 March 1995.

Female. — Body moderately slender. Ratio length to width of prosome 1.67:1. Ratio of length of prosome to that of urosome 1.87:1. Ms1 sharply pointed at posterolateral end, Ms2 and Ms3 rounded. Ms5 prominently protruding, bearing a long P5, shorter than genital complex. Urosome composed of 4 somites, with proportional lengths 31.6:19.4:14:35. Genital complex 1.4 times as long as wide, with lateral margins bulging in proximal half. CR moderately elongate, gradually narrowing distally, 2.44 times as long as wide. Ovisac short.

A1, 7-segmented with proportional lengths of segments 18.6:29:8.7:12.8:13.9: 8.7:8.1. A2 strong, 4-segmented, length ratio of segments 25.6:30.8:20.5:23.1. First segment with 1 short inner seta on distal corner; 2nd segment with 1 short inner seta at 2/3 length of segment; 3rd segment shortest, with 2 short inner setae near basal end, 2 plumose setae on distal corner, and 3 short terminal setae; 4th segment ending in strong, recurved claw. Mandible with on its convex margin a spiniform scale with spinules, followed by row of slender spinules, and on its concave margin beyond the indentation a row of about 14 strong spinules plus another row of 3-4 such spinules; lash long and barbed. Maxilla with an armed 1st segment, 2nd segment with a naked seta on posterior surface, and inner distal spine bearing 5 spinules; lash long and spinulous. Maxilliped strong, 3-segmented, 1st segment elongate, without seta; 2nd segment with 2 inner lateral setae; 3rd segment small, armed with 2 claws and 1 seta. Apical claw armed with 4 thick inner marginal processes.

P1-P4 with 3-segmented rami, endopods longer than exopods, except for Ri of P4, which consists of a single, long segment. Armature as follows (Roman numerals representing spines, Arabic numerals indicating setae):

P1 coxa 0-1; basis 1-0; Re I-0, I-1, III-I-4; Ri 0-1, 0-1, I-5
P2 coxa 0-1; basis 1-0; Re I-0, I-1, III-I-5; Ri 0-1, 0-2, I-II-3
P3 coxa 0-1; basis 1-0; Re I-0, I-1, III-I-5; Ri 0-1, 0-2, I-II-2
P4 coxa 0-1; basis 1-0; Re I-0, I-1, II-I-5; Ri II

Inner coxal seta of P1-P4 plumose, and inner margin of basis in all four legs with hairs. Ri of P4 narrowed proximally and broadened distally, with both sides slightly unequal and ornamented with hairs, furnished with 2 asymmetrical terminal processes, inner one 0.6 times length of outer one, both with barbules.

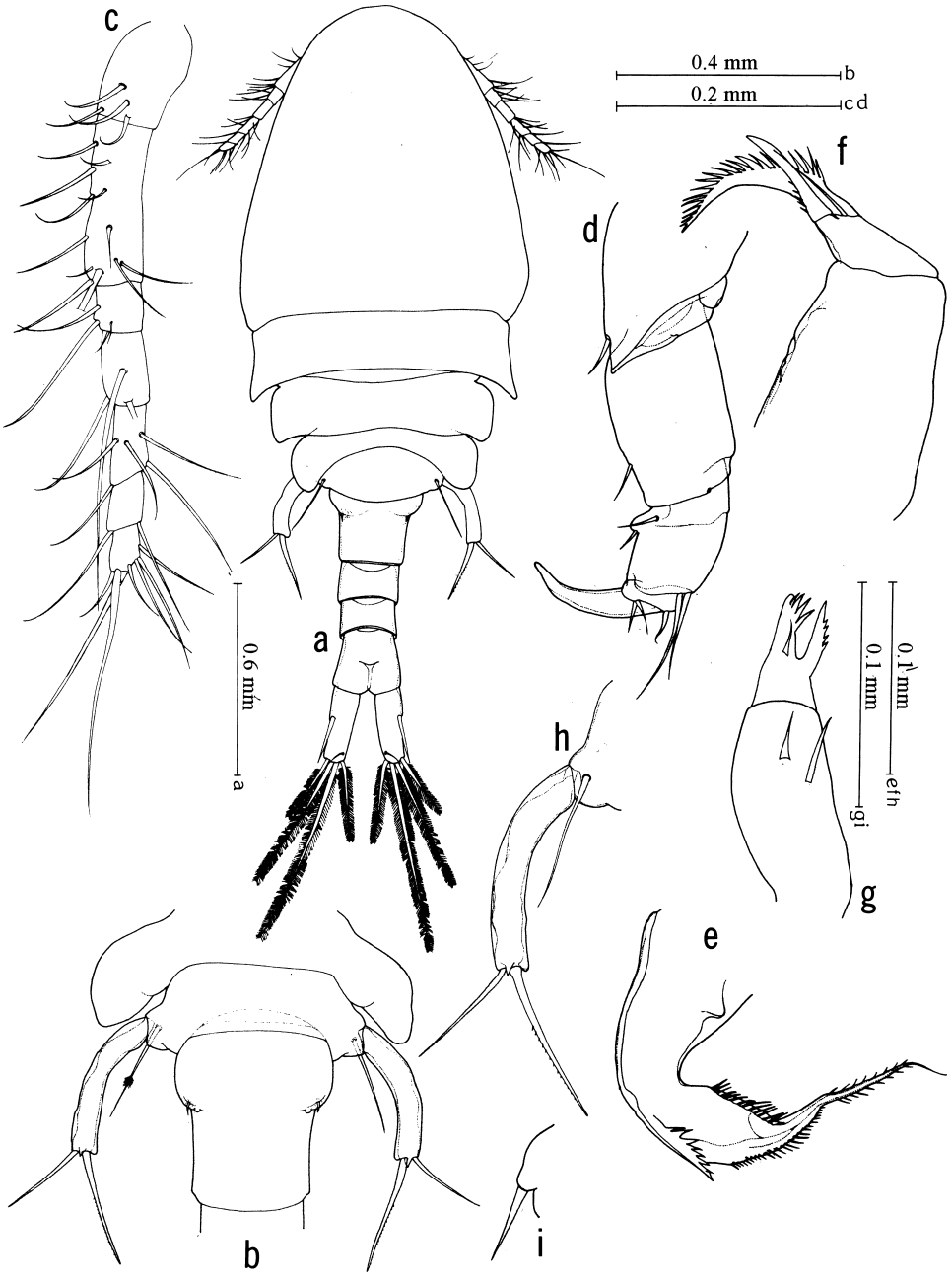

Fig. 5. *Paramacrochiron amboinense* n. sp., female holotype. a, whole animal, dorsal view; b, Ms5 and genital complex, dorsal view; c, antennule; d, antenna; e, mandible; f, maxilla; g, maxilliped; h, 5th leg; i, 6th leg.

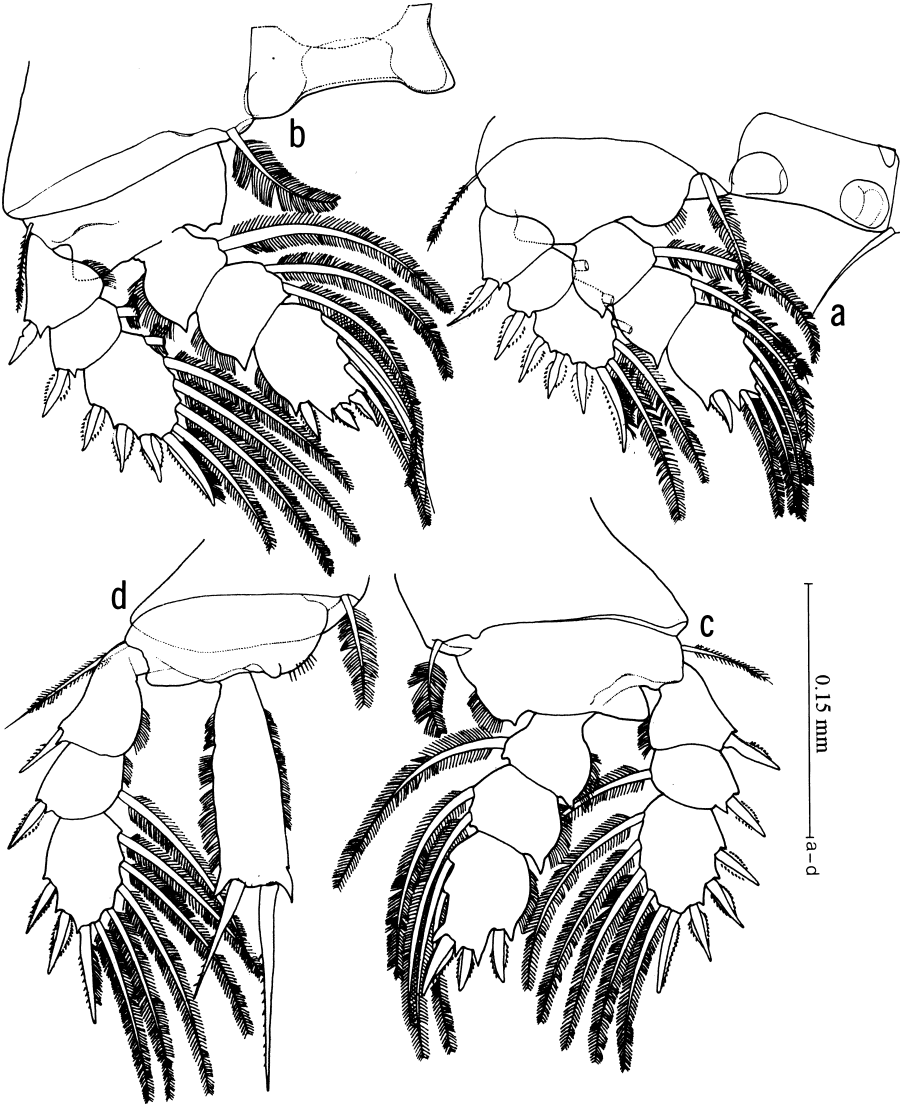

Fig. 6. *Paramacrochiron amboinense* n. sp., female holotype. a-d, 1st-4th legs.

P5 elongate, unornamented, more than 6.5 times as long as wide, at midlength segment curved inwards, with 2 terminal elements, outer edge of longer one with a few barbules along its middle region. P6 represented by process near the area of attachment of each egg sac.

Male unknown.

Remarks. — Humes (1970) stated that information on many details of the external anatomy is lacking in existing descriptions and figures of the known species of *Paramacrochiron*. The distinction of *P. amboinense* from the known

TABLE I
Body length of the known species of *Paramacrochiron* and the new species here described

Species	Female (mm)	Male (mm)
P. ennorense Reddiah, 1968	2.89	2.35
P. rhizostomae Reddiah, 1968	2.80	2.10
P. sewelli Reddiah, 1968	2.41	2.35
P. maximum (Thompson & Scott, 1903)	3.50	2.70
P. pacificum (Wilson, 1950)	3.25	3.00
P. japonicum Humes, 1970	3.28	2.69
P. amboinense n. sp.	2.38	unknown

species is based primarily on certain features of the females. The body of female *P. ennorense* is longer (2.89 mm) than that of the new species, the egg sacs reach only a little beyond the 2nd postgenital somite, and the free segment of P5 has a length:width ratio of 4.5:1, with the 2 elements unarmed. The female of *P. maximum* (3.50 mm) is larger than that of *P. japonicum* (3.28 mm). The egg sac of *P. maximum* is short, not reaching the end of the 1st postgenital somite, Ri of P4 has an outer marginal notch and bears 2 plumose elements; the genital somite lacks an anterior, rounded lateral expansion. The egg sac in *P. japonicum* is elongate, extending a little beyond the CR. The endopod of P4 is narrow proximally and broadened distally, with both sides slightly irregular and ornamented with hairs. The 2nd segment of A2 in *P. pacificum* has a short outer process, the length:width ratio of Ri4 is 3:1, and its 2 terminal elements are plumose; the outer spines on Re4 are aciculate rather than having serrated fringes and the 2 elements of the free segment of P5 are plumose. The body of the female *P. rhizostomae* (2.80 mm) is longer than that of the female *P. amboinense*, the free segment of P5 is a little longer than the genital somite, and the terminal process of the maxilliped is bent at a right angle. The body of *P. sewelli* is slightly longer than that of the new species (2.41 mm) and the 2nd segment of A1 has a prominent outer protuberance.

Etymology. — The specific name *amboinense* refers to Ambon Bay, where the species was collected. It is an adjective agreeing in gender with the (neuter) generic name.

REFERENCES

BOXSHALL, G. A. & A. G. HUMES, 1987. A new species of *Hemicyclops* (Copepoda: Poecilostomatoida) associated with an echiuran worm in Hong Kong. Asian mar. Biol., **4**: 61-66.

GOODING, R. U., 1960. North and South American copepods of the genus *Hemicyclops* (Cyclopoida: Clausidiidae). Proc. U.S. natn. Mus., **112**(3434): 159-195.

HO, J.-S. & I.-H. KIM, 1990. *Hemicyclops ctenidis*, a new poecilostomatoid copepod (Clausidiidae) associated with a polychaete in Korea. Korean Journ. Zool., **33**: 231-237.

— — & — —, 1991. Two new species of the genus *Hemicyclops* (Copepoda, Poecilostomatoida, Clausidiidae) from crab burrows in the Yellow Sea. Korean Journ. Zool., **34**: 289-299.

HUMES, A. G., 1965. New species of *Hemicyclops* (Copepoda, Cyclopoida) from Madagascar. Bull. Mus. comp. Zool., Harvard, **134** (6): 159-259.

— —, 1970. *Paramacrochiron japonicum* n. sp., a cyclopoid copepod associated with a medusa in Japan. Publs Seto mar. biol. Lab., **18** (4): 223-232.

— —, 1973. *Hemicyclops perinsignis*, a new cyclopoid copepod from a sponge in Madagascar. Proc. biol. Soc. Washington, **86** (25): 315-328.

— —, 1984. *Hemicyclops columnaris* sp. n. (Copepoda, Poecilostomatoida, Clausidiidae) associated with a coral in Panama (Pacific side). Zoologica Scripta, **13**: 33-39.

ITOH, H. & S. NISHIDA, 1991. Occurrence of *Saphirella*-like copepods in Tokyo Bay. In: Proc. 4th Internatn. Conf. Copepoda. Bull. Plankton Soc. Japan, (Spec. Vol.): 397-403.

— —, 1993. A new species of *Hemicyclops* (Copepoda, Poecilostomatoida) from a dredged area in Tokyo Bay, Japan. Hydrobiologia, **254**: 149-157.

— —, 1995. Copepodid stages of *Hemicyclops japonicus* Itoh & Nishida (Poecilostomatoida, Clausidiidae) reared in the laboratory. Journ. Crust. Biol., **15** (1): 134-155.

KIM, I.-H. & J.-S. HO, 1992. Copepodid stages of *Hemicyclops ctenidis* Ho and Kim, 1990 (Clausidiidae), a poecilostomatoid copepod associated with a polychaete. Journ. Crust. Biol., **12** (4): 631-646.

NICHOLLS, A. G., 1944. Littoral Copepoda from South Australia (II) Calanoida, Cyclopoida, Notodelphyoida, Monstrilloida and Caligoida. Rec. South Australian Mus., **8** (1): 1-62.

REDDIAH, K., 1968. Three new species of *Paramacrochiron* (Lichomolgidae) associated with Medusae. Crustaceana, (Suppl.) **1**: 193-209.

THOMPSON, I. C. & A. SCOTT, 1903. Report on the Copepoda collected by Professor Herdman, at Ceylon in 1902. Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Manaar, (suppl. Repts.), **7**: 227-307.

VERVOORT, W. & F. RAMIREZ, 1966. *Hemicyclops thallassius* nov. spec. (Copepoda Cyclopoida) from Mar del Plata, with revisionary notes on the family Clausidiidae. Zool. Meded., Leiden, **41** (13): 197-220.

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