

**A REVIEW OF THE BOPYRIDAE (CRUSTACEA: ISOPODA) OF SINGAPORE,
WITH THE ADDITION OF FOUR SPECIES TO THAT FAUNA**

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ABSTRACT. – The fauna of parasitic isopods of the family Bopyridae in Singapore is only poorly known, consisting of only seven species in as many genera in five subfamilies. A new small collection adds four species in as many genera, two of them belonging to a subfamily not previously recorded from Singapore. These are: *Pleurocrypta macrocephalon* Nierstrasz & Brender à Brandis, 1923 [incorporating *Pleurocrypta yatsui* (Pearse, 1930)] (subfamily Pseudioninae), infesting *Petrolisthes lamarckii* (Leach); *Parabopyrella bonnieri* (Nierstrasz & Brender à Brandis, 1923) (subfamily Bopyrinae), infesting *Alpheus strenuus* Dana; *Athelges takanoshimensis* Ishii, 1914; and *Pseudostegias dulcilacuum* Markham, 1982 (both subfamily Athelginae), both of the latter two species infesting *Diogenes pallescens* Whitelegge. A list of the 11 species now known from Singapore with their host species and citations is presented.

KEY WORDS – Bopyridae, Singapore.

INTRODUCTION

A collection made during the Fourteenth Marine Biology Workshop, Marine Flora and Fauna of Singapore, is the core of this report, to which was added another specimen from a different private collection. Material examined has been deposited in the museum reference collection of the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research at the National University of Singapore.

SYSTEMATICS

Bopyridae Rafinesque, 1815
Pseudioninae Codreanu, 1967

***Pleurocrypta* Hesse, 1865**

Type-species: *Pleurocrypta galataeae* Hesse, 1865 [by monotypy]

***Pleurocrypta macrocephalon* Nierstrasz & Brender à Brandis, 1923**
(Figs. 1, 2)

Pleurocrypta macrocephala Nierstrasz & Brender à Brandis, 1923: 79, 80, Fig. 12a–c [Unknown locality, Indonesia; infesting

Petrolisthes asiaticus Leach; female only]; Bourdon, 1976: 116, 220, 232–233, 240.

Probopyrus yatsui Pearse, 1930: 5, 6; Figs. 19–21 [Aburatsubo, Misaki, Japan; infesting *Petrolisthes japonicus* de Haan] – Shiino, 1933: 259 [Transferred to genus *Pleurocrypta*].

Pleurocrypta macrocephalon – Nierstrasz & Brender à Brandis, 1931: 174; Markham, 1974: 271; Table I.

Pleurocrypta yatsui – Shiino, 1933: 259–265; Fig. 4 [Tanabe Bay, Japan, infesting *Petrolisthes japonicus*]; Shiino, 1942: 52; Shiino, 1952: 35, 42; Okada & Uchida, 1960: 126, 127; Figs. 2a, b, Pl. 63; Codreanu et al., 1966: 1071; Bourdon, 1968: 219–222, 290, 300; Shiino, 1972: 8; Markham, 1974: 271; Table I; Shiino, 1974: 554; Bourdon, 1976: 166, 225–232, 240; Figs. 36–40, Table VII [northeast of Arzanah Island, United Arab Emirates, southern Persian Gulf; infesting *Pachycheles natalensis* (Krauss); Misaki, Japan; infesting *Petrolisthes japonicus*; Suez, Red Sea, Egypt; infesting *P. boscii* (Audouin)]; Bourdon, 1980b: 243; Markham, 1980: 624; Kim & Kwon, 1988a: 210–213, 215, 219, Fig. 7 [Sōgurp’o, Cheji Island, Korea; infesting *P. japonicus*]; Kim & Kwon, 1988b: 201, 205 [Sōgurp’o, Cheji Island, Korea; infesting *P. japonicus*]; Trilles, 1999: 337; Saito et al., 2000: 36–37; Kensley, 2001: 225.

Pleurocrypta (= *Probopyrus*) *yatsui* – Bourdon, 1965: 174.

Material examined. – Infesting *Petrolisthes lamarckii* (Leach, 1820), Under loose rocks, intertidal zone, near ferry pier, St John’s Island, Singapore, 01°13.3’N 103°50.8’E, 14 Apr.2006, J. C. Markham coll. & det. of host: 1 female, 1 male (ZRC).

Description. – **Female** (Fig. 1): Length (exclusive of pleopods) 3.41 mm, maximal width 2.20 mm, head length 1.08 mm, head width 1.64 mm, pleon length 0.49 mm; body distortion 13°. Body outline, including pleopods, oval. All body regions and segments distinct (Fig. 1A, B). No pigmentation.

Head oval, deeply embedded in first pereomere. Frontal lamina very broad and extending far beyond margins of head, long and overlapping much of anterior region of head, notched anteriorly. No eyes. Barbula (Fig. 1C) of two simple falcate projections on each side. Maxilliped (Fig. 1D) with anterior article much larger and produced into anteromedial corner but no palp; posterior article nearly triangular, produced only slightly into blunt plectron.

Pereon broadest across pereomeres 3 and 4. All pereomeres with convex anterior margins. Tergal plates on both sides of all pereomeres, those on shorter side reflexed dorsally. Coxal plates on both sides of pereomeres 1–4. oostegites completely enclosing brood pouch; first oostegites (Fig. 1E, F) with broader anterior article smoothly rounded anteriorly; lateral half of internal ridge produced into series of simple points; posterior article subrectangular, posterolateral point set off from margin by rounded notch but not extending beyond margin. Pereopods (Fig. 1G–J) doubling in size posteriorly, all articles present, all dactyli reduced, anterior ones retracting into receptacles.

Pleon of 6 pleomeres, first markedly narrower than last pereomere and each subsequent pleomere much narrower than that before (and final, minute, pleomere obscured by overlapping lateral plate of preceding pleomere), with posterior margin almost straight across. Lateral plates little extended. Five pairs of pleopods with broad rounded exopodites completely covering pleon dorsally and more slender endopodites aligned beneath them. Tiny uniramous uropods.

Male (Fig. 2): Length 1.08 mm, maximal width 0.49 mm, head length 0.23 mm, head width 0.33 mm, pleon length 0.20 mm. All body regions and pereomeres separated. Body outline oval, sides nearly parallel. Irregular eyespots and scattered small spot of pigment dorsally (Fig. 2A).

Head rounded and prominently extended far beyond pereon. Eyes near posterolateral margins. Antennae (Fig. 2B) of 3 and 6 articles, respectively, second ones extending far beyond margin of head, tufts of setae distally on some articles.

All pereomeres deeply separated laterally, most nearly straight across. Pereopods (Fig. 2C, D) of nearly same size, all with all articles separated; dactyli of first two pairs much larger than those of others.

Pleon abruptly narrower than last pereomere, subtriangular, completely fused but with slightly undulate margin indicating trace of segmentation. No appendages.

Remarks. – *Pleurocrypta macrocephalon* has been collected frequently, and various authors have published several illustrations of it. This is the first formal incorporation of *Pleurocrypta yatsui* into *P. macrocephalon*, though Bourdon (1976) suggested that it was probably deserved but avoided doing so explicitly only because the original description did not include a male. In light of the great amount of variability that Bourdon (1976) simultaneously documented among males of *P. yatsui* that he examined, that seems an insufficient reason. Significantly, Bourdon (1976), after illustrating and redescribing numerous specimens of *P. yatsui*, presented neither drawings nor description for *P. macrocephalon*, whose holotype he reexamined; instead he only catalogued the characters that the two species both share, namely “grosseur du céphalon, largeur de la lame frontale, lobes ciliés des maxillipèdes, lamelles céphaliques, bord postlatéral du premier péréionite tuberculiforme, présence de crêtes oostégales, abdomen ramassé.” It is unclear why he did not stress that *P. macrocephalon* would be the senior synonym if the two species were combined. The drawing of the type female of *P. macrocephalon* (Nierstrasz & Brender à Brandis, 1923: Fig. 12a) makes it appear to be immature, and the absence of a male reinforces that impression, so it would be expected to differ somewhat from more mature individuals of the same species. In the female, the peculiar notching of the frontal lamina has been previously seen in the type of *P. yatsui* (Pearse, 1930); the shape of the head and the proportions of the pleopods are also most similar to those of that type. The shapes of the coxal plates and the straight posterior margin of the pleon are like those of one female depicted by Bourdon (1976: Fig. 36). The shapes of the barbula and the pereopods are like some illustrated by Kim & Kwon (1988a) and Bourdon (1976). The structure of the first oostegite is like that shown by Nierstrasz & Brender à Brandis (1923) and some of those seen by Bourdon (1976). The maxilliped of the present female is unusual in completely lacking an indication of a palp, but Bourdon (1976: Fig. 38a) documented great variability among maxillipeds of the species, so that does not seem out of order. The present male falls well within the range shown by Bourdon (1976), and its antennae are also nearly identical.

This is the first record of the occurrence of *Pleurocrypta macrocephalon* in Singapore, though its previously reported range, except for the citations from the Red Sea and Persian Gulf (Bourdon, 1976), is from nearby regions of the western Pacific. All recorded hosts of *P. macrocephalon* are in the genus *Petrolisthes* except for the one record of a *Pachycheles*, another closely related porcellanid.

Petrolisthes lamarckii, a species known from a wide range across the Indo-West Pacific region, has been recorded to host at least two other bopyrid species, each belonging to a different genus. Bourdon (1976) found it bearing *Aporobopyrina lamellata* Shiino at Madagascar, Thailand and in the Philippines; and Shiino (1942) reported it hosting *Aporobopyrus ryukyuensis* Shiino at Palao. In addition, it has been reported three times as the host of unidentified bopyrid species, which may or may not belong to one or more of the three species now known to infest it. Thus,

Miyake (1942) found it infested at Jaluit Island, Marshall Islands; Ahmed & Mustaquim (1974) reported it infested at Karachi, Pakistan; and Haig (1983) did the same for material from the Seychelles.

In the original description, Nierstrasz & Brender à Brandis (1923) used the name *macrocephala* as if it were a feminine adjective corresponding with the gender of its genus. The same authors (Nierstrasz & Brender à Brandis, 1931) later emended it to *macrocephalon*, a neuter Greek noun used in apposition, not an adjective, and I accept that form here.

Bopyrinae H. Milne Edwards, 1840, emended R. Codreanu, 1967

***Parabopyrella* Markham, 1985**

Type-species: *Bopyrella mortenseni* Nierstrasz & Brender à Brandis, 1929 [by original designation]

***Parabopyrella bonnieri* (Nierstrasz & Brender à Brandis, 1923)
(Figs. 3, 4)**

Bopyrella bonnieri Nierstrasz & Brender à Brandis, 1923: 95–96; Fig. 20a–d [Type locality between Nusa Besi and Timor, Indonesia; infesting *Alpheus audouini* Coutière, subsequently corrected to *Alpheus edwardsi* (Audouin)]; Chopra, 1923: 541; Chopra, 1927: 121, footnote; Nierstrasz & Brender à Brandis, 1929: 32, 51; Nierstrasz & Brender à Brandis, 1931: 151, 176; Shiino, 1949: 47; Bourdon, 1968: 407, 408; Bourdon, 1980: 186, 188–190; Fig. 1 [Redescription of types. Correction of types' host's name]; Bourdon, 1982: 751, 752.

Parabopyrella bonnieri – Markham, 1985a: 67 [By implication].

Material examined. – Infesting *Alpheus strenuus* Dana, 1852. Labrador Beach, Singapore, 01°16'N 103°48'E, Feb.2000, A. Anker coll. and det. of host: 1 female, 1 male (ZRC).

Description. – *Female* (Fig. 3): Length 13.3 mm, maximal width 9.30 mm, head length 2.97 mm, head width 3.67 mm, pleon length 4.45 mm. Body distortion 20°. Body outline subovate, broadest across front. All body regions and segments separated, though some only faintly so. (Fig. 3A, B).

Head subtriangular, obliterating middle of first pereomere dorsally; anterior margin slightly notched on short side only. Faintly delineated short frontal lamina across all of



Fig. 1. *Pleurocrypta macrocephalon* Nierstrasz & Brender à Brandis, 1923, female: A, dorsal view; B, ventral view. C, left side of barbula; D, right maxilliped; E, right oostegite 1, external; F, same, internal; G, right pereopod 1; H, distal region of same; I, right pereopod 7; J, distal region of same. Scale bars: A–F = 1.00 mm; G, I = 0.36 mm; H, J = 0.09 mm.

anterior margin. Antennae (Fig. 3C) minute, of 3 and 5 articles respectively, setation obscure. No eyes. Barbula (Fig. 3D) with 2 curved projections on each side, outer one broad medially and tapering to sharp point; inner one more slender and uniform in width; no ornamentation in middle. Maxilliped (Fig. 3E) with subrectangular anterior article, subtriangular posterior one; palp (Fig. 3 F) forming anteromedial corner, deeply set into maxilliped and laterally separated from it but not articulating, bearing sparse tuft of setae along medial margin; plectron (Fig. 3G) triangular, ending in sharp forward-directed tip.

Pereon smoothly curved, broadest across pereomeres 3–4.

Pereomeres 1–4 with tergal bosses and small coxal plates on both sides. Oostegites incompletely covering brood pouch; first one (Fig. 3I, J) with anterior article much shorter than posterior one, produced anterolaterally into blunt projection extending beyond front margin, posterior article extending into prominent noncurved posterolateral point, internal ridge bearing many tiny simple projections of various lengths. Fifth oostegites much broader than long, their posterior margins fringed by setae posteriorly. Pereopods (Fig. 3K–N) small and inconspicuous, all of about same size, each with reduced dactylus, separated merus and carpus, carinate basis; tuft of setae on distal margin of each carpus and receptacle lobe on each propodus (Fig. 3L, N).

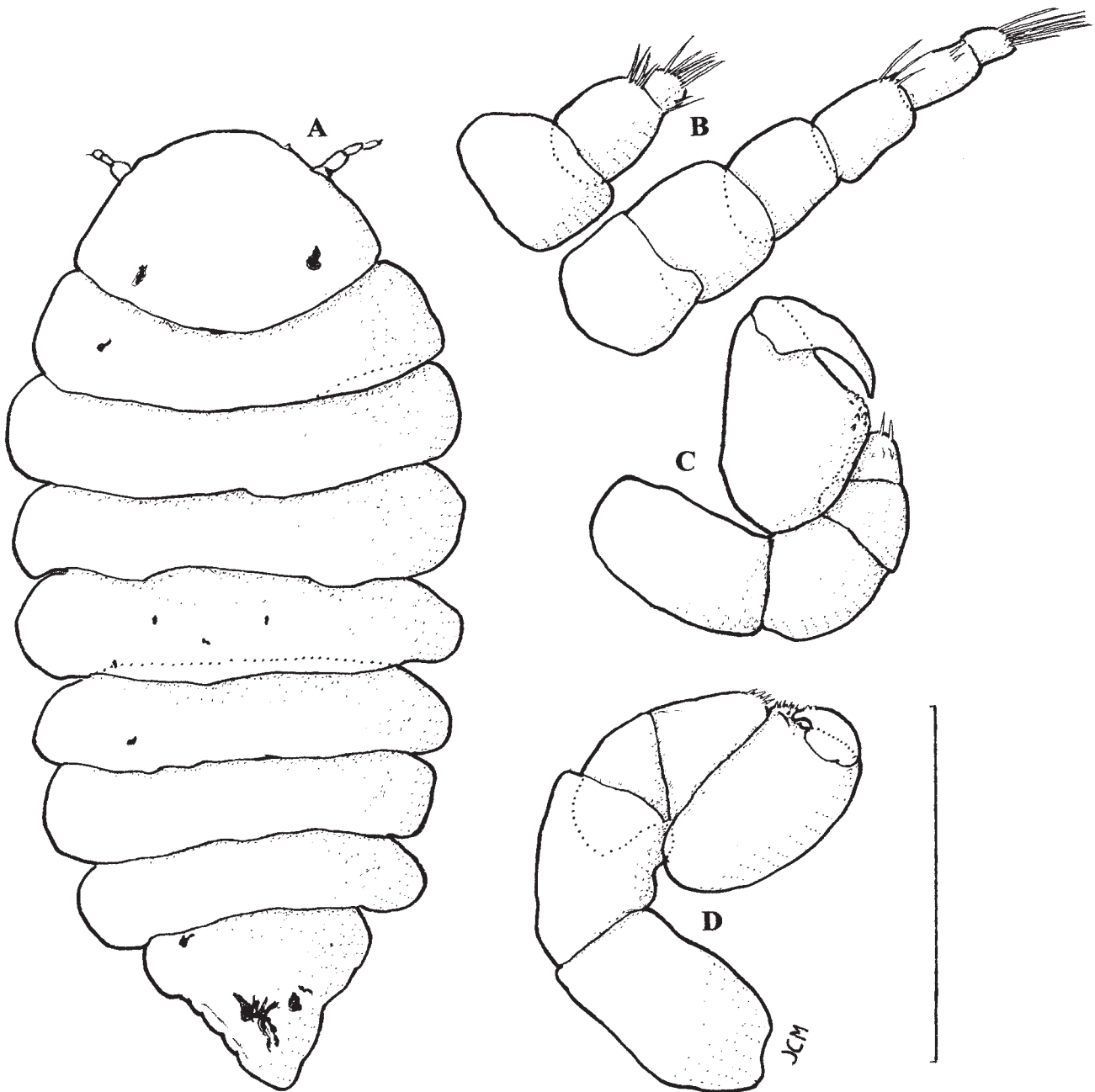


Fig. 2. *Pleurocrypta macrocephalon* Nierstrasz & Brender à Brandis, 1923, male: A, dorsal view; B, right antennae; C, right pereopod 1; D, left pereopod 7. Scale bars: A = 0.40 mm; C, D = 0.20 mm; B = 0.10 mm.

Pleon smoothly rounded, of six pleomeres, first five all of about same length, sixth nearly triangular. Separation of pleomeres indistinct dorsally, deep notches separating all laterally. Final pleomere produced into two posterior points. Five pairs of biramous pleopods (Fig. 3B, O) irregularly crinkled in appearance, with crenulate margins, all of about same size, pressed against ventral surface of pleon but only slightly covering it. No uropods or evident anal cone.

Male (Fig. 4): Length 3.50 mm, maximal width 2.07 mm, head length 0.36 mm, head width 0.70 mm, pleon length 0.92 mm, pleon width 1.44 mm. Body outline irregular. Eyes as irregular dark streaks and spots, no other pigment (Fig. 4A, B).

Head markedly narrower than first pleomere, only indistinctly separated from it, suboval in outline. Antennae (Fig. 4C) reduced, not extending at all beyond margin of head, of two articles apiece.

Pereon widest across pereomere 4, tapering slightly both ways from there. All pereomeres sharply set apart laterally. No midventral tubercles. Pereopods (Fig. 4D, E) slightly larger posteriorly; all dactyli small, but propodi larger posteriorly. Meri and carpi of pereopods 1–6 separate, of pereopod 7 fused.

Pleon abruptly wider than last pereomere, nearly semicircular in outline. Six pleomeres indicated laterally but fused both dorsally and ventrally, though traces of separation discernible on ventral surface. Five pairs of obscure sessile pleopods (Fig. 4F) visible only in transmitted light. No uropods, but medial notch on posterior margin between two short, blunt posterior extensions of final pleomere.

Remarks. – This is only the second discovery of *Parabopyrella bonnieri*, the type-specimens of which were well described (Nierstrasz & Brender à Brandis, 1923) and later redescribed (Bourdon, 1980a). The present material conforms well with most of the characters of the types, though the completely blank dorsal surface of the type female's pleon, depicted both times it was drawn, probably reflects inadequate lighting on the part of the illustrators rather than actual lack of admittedly indistinct segmentation. Particularly diagnostic for the female are the body shape and proportions, the structure of the maxilliped, the barbula, the shape of the first oostegite, the margins of the pleon and the structure and arrangement of the pleopods; males are alike in the shapes and proportions of the body regions and the structure of the pleopods.

Like the types, the present material infests a species of *Alpheus*. Arthur Anker, who collected and identified the host as *A. strenuus* Dana, advises me that that name represents a species complex subject to being broken up into more species in the future. It should be noted that the name *Alpheus edwardsi*, the host reported for the type-specimens, is probably also a complex of species and thus subject to future revision. *Alpheus strenuus* has been previously reported to host a different species, *Bopyrella thomsoni*

Bonnier, 1900, in Tonga (Bonnier, 1900) and again in Eniwetok (Danforth, 1970). The published accounts of *B. thomsoni*, however, make it clear that the present material is in no way assignable to that species; indeed, in erecting the genus *Parabopyrella* (Markham, 1985a), I excluded *Bopyrella thomsoni* and a few other described species of *Bopyrella* from it. Without explanation, Kensley (2001) referred to the species as *Parabopyrella thomsoni*, but I do not accept that generic placement. Chace (1988) cited *Alpheus strenuus* as the host of an “abdominal parasite” in the Sulu Archipelago, Philippines; though that parasite remains unidentified, it would clearly not have been the branchially infesting *Parabopyrella bonnieri*.

Athelginae Codreanu & Codreanu, 1956

Athelges Gerstaecker, 1862

Type species: *Phryxus paguri* Rathke, 1843 [by subsequent designation]

Athelges takanoshimensis Ishii, 1914

(Fig. 5)

Athelges takanoshimensis Ishii, 1914: 519–530; Pl. VII {Type-locality Takanoshima, Tokyo Bay, Japan; infesting *Eupagurus samuelis* Stimpson [= *Pagurus geminatus* McLaughlin]}; Nierstrasz & Brender à Brandis, 1923: 108; Shiino, 1934: 277, 278; Fig. 9 [Seto, Japan; infesting *P. geminatus* and *P. japonicus* (Stimpson)]; Shiino, 1936: 186, 188; Fig. 5 [Misaki, Japan; infesting unknown host and *P. geminatus*]; Shiino, 1937a: 299 [Hokkaido, Japan; infesting *P. pectinatus* (Stimpson)]; Shiino, 1939: 98 [Kasii, Hukuoka Prefecture, Kyusyu, Japan; infesting *Pagurus* sp.]; Shiino, 1953: 820; Fig.; Shiino, 1958: 68; plate III, Fig. 10 [Kasaoka, Inland Sea, and Tokyo Bay, Japan; infesting *P. geminatus*; also: Kominato, Japan; infesting *P. japonicus*]; Codreanu et al., 1965: 226, 238; Fig. 1, Table III; Shiino, 1965: 463; Fig. 1; Shiino, 1974: 553; Figs.; Markham, 1977a: 127; Markham, 1982: 373–375, 385; Fig. 27 [Hong Kong; infesting *Diogenes edwardsi* (de Haan) and *Pagurus* aff. *geminatus*]; Markham, 1986: 144; Fig. 1J; Kim & Kwon, 1988b: 119, 215–217, 219, 220, Fig. 10 [South, east and west coasts of Korea; infesting *Pagurus branchiomastus* (Thalwitzer), *P. geminatus* and *P. pectinatus* (Stimpson)]; Markham, 1990c: 555, 562, 563 [Hong Kong; infesting *Clibanarius* sp.]; Markham, 1992: 277, 292, 293, 299, Fig. 14, Table 1 [Hong Kong; infesting *Pagurus trigocheirus* Stimpson and *Diogenes* sp.]; Nishimura, 1983: 97; Huang, 1994: 530; Imahara, 1996: 70; Nagasawa et al., 1996: 3, 4, 6 [Northern Honshu, Japan; infesting *P. filholi* (de Man) and *P. maculosus* Komai & Imafuku]; Saito et al., 2000: 44–45; Huang, 2001: 326; Li, 2003: 139, 154, 157, Tables 1, 3; Markham, 2003a: 72, 74, 75; Williams, 2003: 18; Boyko, 2004: 677, 697–701, Figs. 14, 15 [Numerous localities, northeast coast of Taiwan; infesting *Dofleinia doederleini* (Doflein)]; Kochi Naturalist, 2007: n. p.; Figs. [Unspecified Japanese locality; attached to unidentified host]; Sterkh, 2007: 2.

Athelges takanoshimensis var. *tenuibranchiatus* Shiino, 1936: 187–188, Fig. 6; table [Type-locality Misaki, Japan; infesting host questionably called *Eupagurus triserratus* Ortmann [= *Lophopagurus (Australeremus) triserratus* (Ortmann)] and un-

identified host]; Codreanu et al., 1965: 238; tab. III; Markham, 1982: 373, 375 [Synonymized with *A. takanoshimensis*].

Athelges takanoshimensis [sic] *tenuibranchiatus* – Shiino, 1972: 9. *Athelges japonicus* Shiino, 1958: 69–71, Fig. 22 [Tokyo Bay, Japan; infesting *Eupagurus constans* Stimpson (= *Pagurus constans* (Stimpson)), *Pagurus lanuginosus* de Haan and *P. middendorffi* Brandt]; Oguro, 1961: 43–47; Figs. 4, 9–11 [Ak-keshi Bay, Japan; infesting *Pagurus pectinatus* (Stimpson); histological study of neurosecretory system]; Pike, 1961: 223; Codreanu et al., 1965: 226, 238, Fig. 1; tab. III; Shiino, 1972: 9; Markham, 1977: 126; Kim & Kwon, 1988b: 215, 217 [synonymized with *A. takanoshimensis*]; Volvenko, 1992: 320–325, Figs. 1–3, Tables 1, 2 [Gulf of Peter the Great, Sea of Japan; infesting *P. middendorffi*].

Athelges takanoshimensis [sic] *tenuibranchiatus* – Shiino, 1972: 9. *Atheleges* [sic] *takanoshimensis* – Morton & Morton, 1983: 98, 160, Fig. 9.6 (6); Williams, 2003: 17, Fig. 5.

Non *Athelges takanoshimensis* – Nishimura, 1983: 97; Fig. [Unreported locality, Japan; host not listed. Identity uncertain, possibly *Parathelges aniculi* Whitelegge].

Athelges takushinensis [sic] – Huang, 1989: 146–147; Fig. 109 [Zhejiang, China; infesting *Eupagurus* {? = *Pagurus* sp.}].

Athelges takunoshinensis [sic] – Wei, 1991: 146–147; Fig. 109.

Athelgathes [sic] *takanoshimensis* – Nunomura, 1995: 227; Fig. 21–203B; Imahara, 1996: 70.

Material examined. – Infesting *Diogenes pallescens* Whitelegge, 1897, P. A. McLaughlin, det. of host. On

intertidal rocks, south side of St John’s Island, Singapore, 01°13.40’N 103°50.65’E, 16 April 2006, J. C. Markham coll.: 4 females, 4 males (ZRC).

Remarks. – *Athelges takanoshimensis*, though not previously reported from Singapore, is to be expected there, because it is known from surrounding regions. The female illustrated (Fig. 5A) is quite similar in appearance to those previously reported. The male shown (Fig. 5B, C), however, differs in that its pleon is smoothly rounded rather than being pointed posteriorly. The material of *A. takanoshimensis* was collected at the same time and place and on the same species of host as *Pseudostegias dulcilacuum*, reported below.

***Pseudostegias* Shiino, 1933**

Type-species, by monotypy, *Pseudostegias setoensis* Shiino, 1933

***Pseudostegias dulcilacuum* Markham, 1982**

(Fig. 6)

Pseudostegias dulcilacuum Markham, 1982: 370–373, Figs. 25, 26 [Hong Kong; infesting *Diogenes* aff. *edwardsi* (de Haan); Markham, 1985b: 3, 53–55, 63, Figs. 26–28, tab. 1 [Phuket,

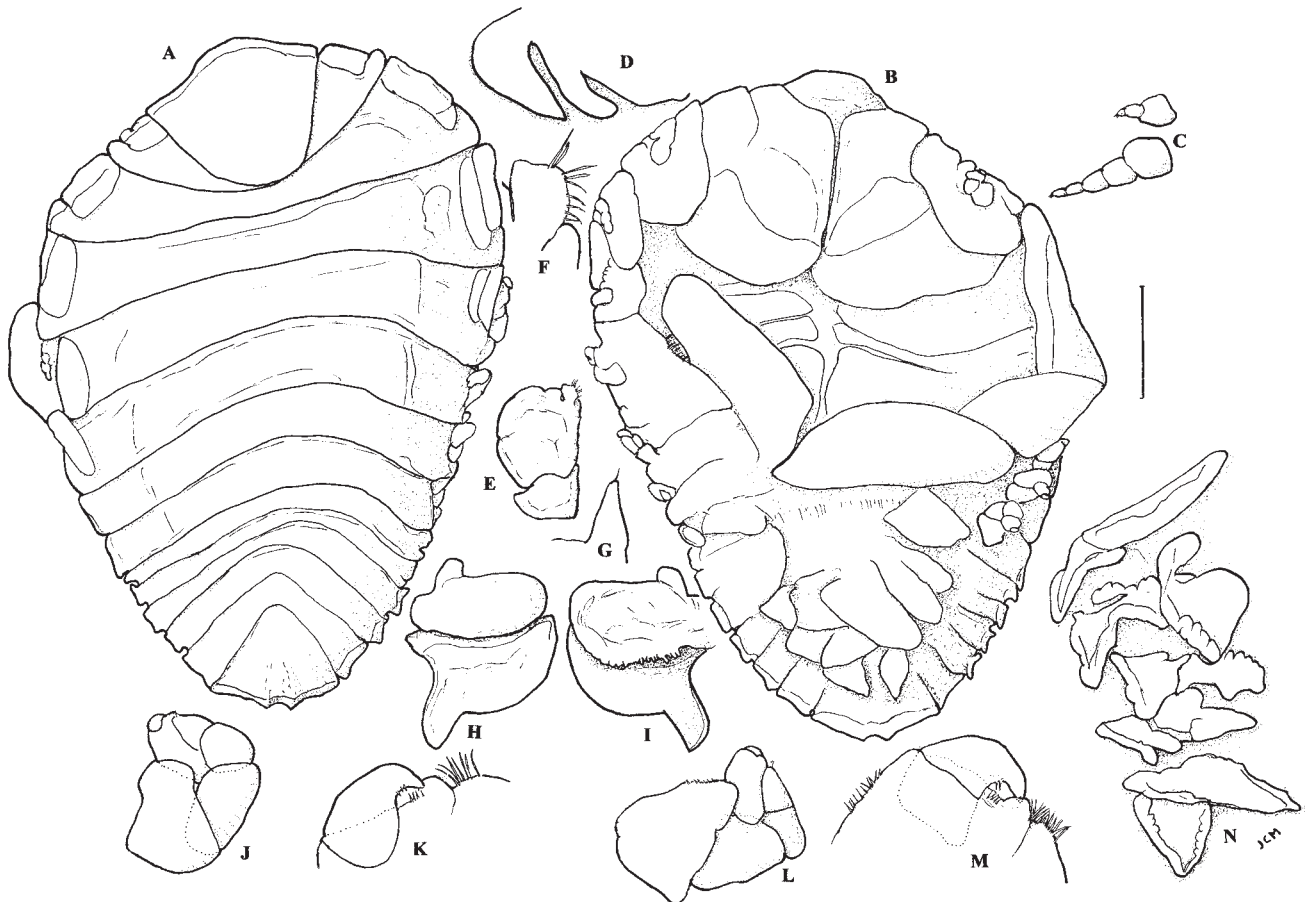


Fig. 3. *Parabopyrella bonnierii* (Nierstrasz & Brender à Brandis, 1923), female: A, dorsal view; B, ventral view; C, right antennae; D, right side of barbula; E, right maxilliped; F, palp of same; G, plectron of same; H, right oostegite 1, external view; I, same, internal view; J, right pereopod 1; K, distal region of same; L, right pereopod 7; M, distal region of same; N, right pleopods. Scale bars: A, B, E, H, I = 2.20 mm; D, N = 1.00 mm; C, F, G = 0.63 mm; K, M = 0.13 mm.

Thailand; infesting *Clibanarius merguensis* de Man]; Page, 1985: 201, 203; Kim & Kwon, 1988: 199, 214–215, 220, 215, Fig. 9 [West coast of Korea; infesting *Diogenes* sp.]; Markham, 1992: 299, Table 1; Li, 2003: 140, Table 2; Morton, 2003: 37, tab. 2.

Pseudostegias dulcilaenum [sic] – Page, 1985: 203.

Pseudostegias dulcilaenum [sic] – Huang, 1994: 530; Huang, 2001: 327.

Pseudostegias setoensis – Dunbar & Coates, 2000: 49, Fig. 1 [South Cooe Bay, Queensland; infesting *Clibanarius taeniatus* (H. Milne Edwards) and *C. virescens* (Krauss); non *Pseudostegias setoensis* Shiino, 1933] – Poore et al., 2002: 116.

? “...possibly *Pseudostegias*.” – Dunbar et al., 2005: 37; Fig. 17CC [Vita Levu, Fiji; host unspecified].

Material examined. – Infesting *Diogenes pallescens* Whitelegge, 1897, P. A. McLaughlin, det. of host. On intertidal rocks, south side of St John’s Island, Singapore, 01°13.40’N 103°50.65’E, 16 Apr. 2006, J. C. Markham coll.: 1 female (ZRC).

Remarks. – The single female in this collection was found infesting the same host as *Athelges takanoshimensis*, recorded above, collected at the same time and location; these are the first records of either of these species from Singapore, where the subfamily Athelginae was previously

unknown. The female examined (Fig. 6A–H) lies within the range of variation previously reported for *Pseudostegias dulcilaenum*. The female’s brood pouch contained six small unattached objects tentatively identified as hyperparasites, one of which is illustrated (Fig. 6I). Though it is difficult to discern much detail of their morphology, it is possible that they are *Duplorbis smithi* Nierstrasz, & Brender à Brandis, 1923, a parasitic barnacle in the Rhizocephala Akentrognida found hyperparasitizing bopyrids by Nierstrasz & Brender à Brandis (1923), or a similar species. The presence of these hyperparasites would explain the absence of a male with the evidently mature female.

Diogenes pallescens, including the two species incorporated into it by McLaughlin (2002), is widespread throughout the western Pacific region, but this is the first time it has been recorded as a bopyrid host. Upon reexamination of the material from Queensland, Australia, recorded as *Pseudostegias setoensis* by Dunbar & Coates (2000) on the basis of my identification, I have concluded that it should instead be assigned to *Pseudostegias dulcilaenum*, as indicated in the synonymy above.

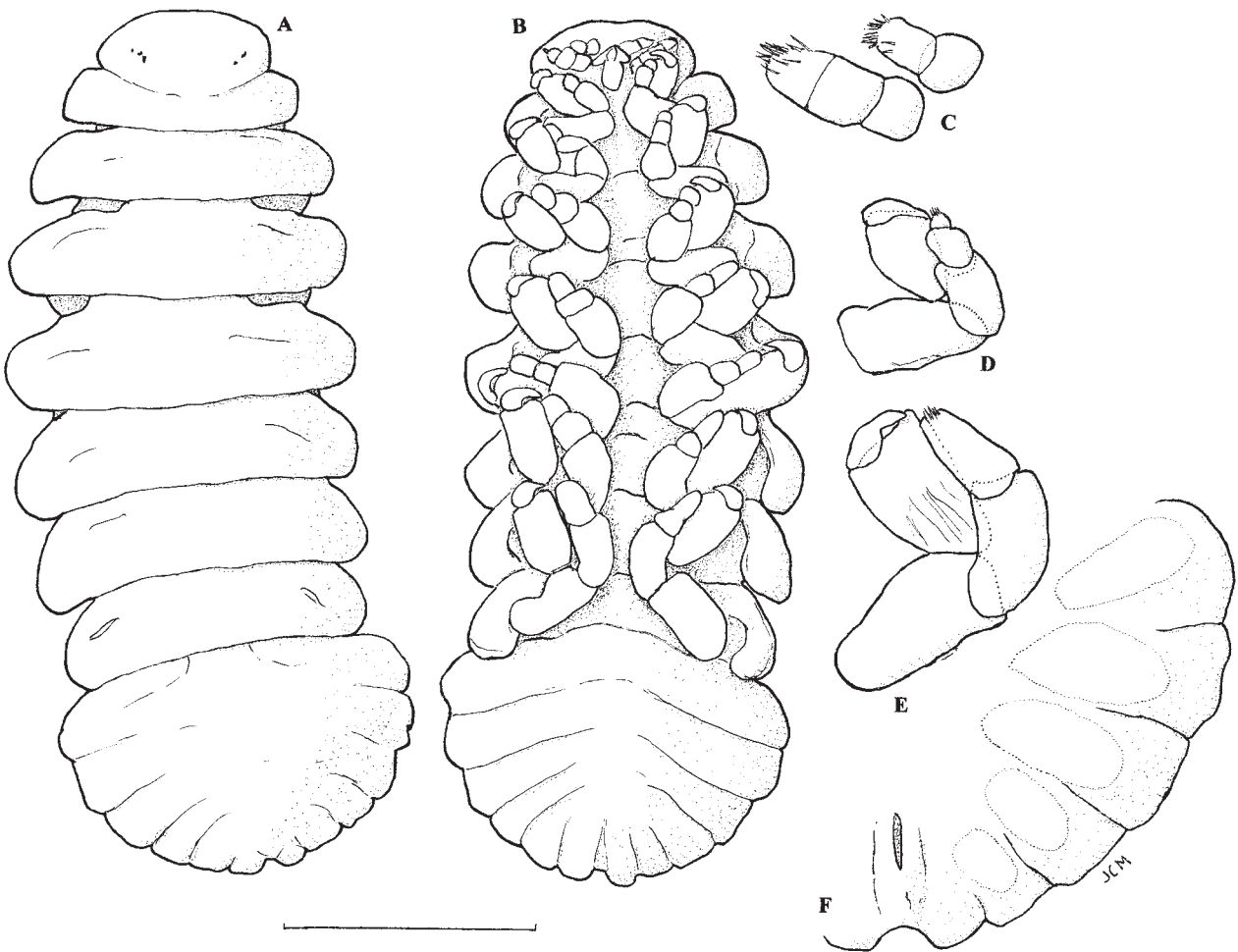


Fig. 4. *Parabopyrella bonnieri* (Nierstrasz & Brender à Brandis, 1923), male: A, dorsal view; B, ventral view; C, right antennae; D, right pereopod 1; E, right pereopod 7; F, left side of pleon in ventral view. Scale bars: A, B = 1.00 mm; D–F = 0.50 mm; C = 0.25 mm.

SPECIES OF BOPYRIDAE CURRENTLY KNOWN FROM SINGAPORE

With the addition of the four species of Bopyridae discussed above, the known bopyrid fauna of Singapore now stands at 11 species belonging to 11 genera in six subfamilies. It is highly probable that the number of species actually occurring in Singapore is much higher, in light of its location in the western tropical Pacific, the diversity of its marine habitats and the decapod crustaceans reported from there, several of which are known to harbor bopyrids elsewhere in their ranges. For comparison, the currently documented fauna of Hong Kong, which should be faunistically quite similar to Singapore, contains 39 bopyrid species (Markham, 1992; Li, 2003).

The following list catalogs the bopyrid species known from Singapore, their respective known ranges and the sources

documenting their occurrence in Singapore.

Subfamily Pseudioninae

Asymmetrione sallyae Williams & Schuerlein, 2005. Type-locality: Pulau Ubin, Singapore. Host in Singapore: *Diogenes avarus* Heller. Known range: Singapore. Reference: Williams & Schuerlein, 2005.

Pleurocrypta macrocephalon Nierstrasz & Brender à Brandis, 1923. Type-locality: Unknown specific locality, Indonesia. Host in Singapore: *Petrolisthes lamarckii* (Leach). Known range: Unknown locality, Indonesia; Misaki and Tanabe Bay, Japan; southern Persian Gulf; Suez, Red Sea, Egypt; Cheji Island, Korea. Reference: this paper.

Pseudione kensleyi Williams & Schuerlein, 2005. Type-locality: Pulau Ubin, Singapore. Host in Singapore: *Clibanarius infraspinus* Hilgendorf. Known range: Singapore. Reference: Williams & Schuerlein, 2005.

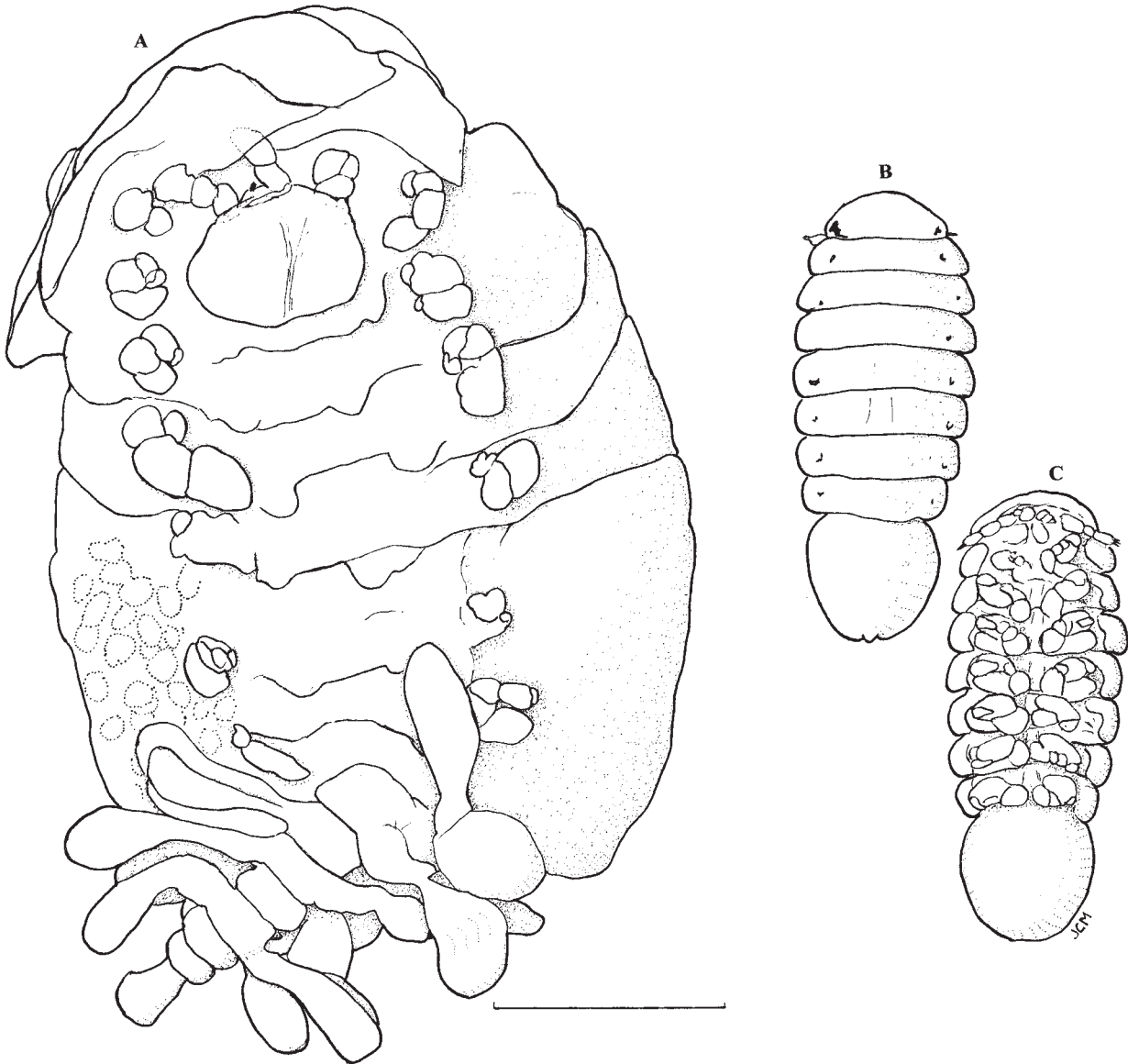


Fig. 5. *Athelges takanoshimensis* Ishii, 1914: A, female in dorsal view; B, male in dorsal view; C, male in ventral view. Scale bars: A = 1.00 mm; B, C = 0.55 mm.

Subfamily Bopyrinae

Parabopyrella bonnieri (Nierstrasz & Brender à Brandis, 1923). Type-locality: Near Timor, Indonesia. Host in Singapore: *Alpheus strenuus* Dana. Known Range: Sawu Sea, Indonesia; Singapore. Reference: this paper.

Schizobopyrina brachytelson (Nierstrasz & Brender à Brandis, 1923). Type-locality: Flores, Indonesia. Host in Singapore: *Perclimenes brevicarpalis* (Schenkel). Known Range: Flores and Kei Islands, Indonesia; Singapore. Reference: Bourdon & Stock, 1979.

Subfamily Orbioninae

Parapenaeon bonnieri (Nobili, 1906). Type-locality: Singapore. Host in Singapore: *Metapenaeus monoceros* (Fabricius). Known range: Singapore; Kakinda, Visakhatnam Coast and Gothani Estuary, India; Gulf of Thailand; Tawitawi Archipelago, Philippines. Reference: Nobili, 1906.

Subfamily Ioninae

Apocepon digitatum Stock, 1960. Type-locality: Siglap, Singapore. Host in Singapore: *Leucosia craniolaris* (Herbst). Known range: Singapore; South China Sea, China. Reference: Stock, 1960.

Subfamily Athelginae

Athelges takanoshimensis Ishii, 1914. Type-locality: Gulf of Tokyo, Japan. Host in Singapore: *Diogenes pallescens* Whitelegge. Known range: throughout Japan; Zhejiang, China; Hong Kong; around Korea; Taiwan; Singapore. Reference: this paper.

Pseudostegias dulcilacuum Markham. Type-locality: Hong Kong. Host in Singapore: *Diogenes pallescens* Whitelegge. Known range: Hong Kong; Phuket, Thailand; West coast of Korea; Singapore. Reference: this paper.

Subfamily Hemiarthrinae

Hypophryxus pikei Bruce, 1968. Type-locality: Zanzibar.

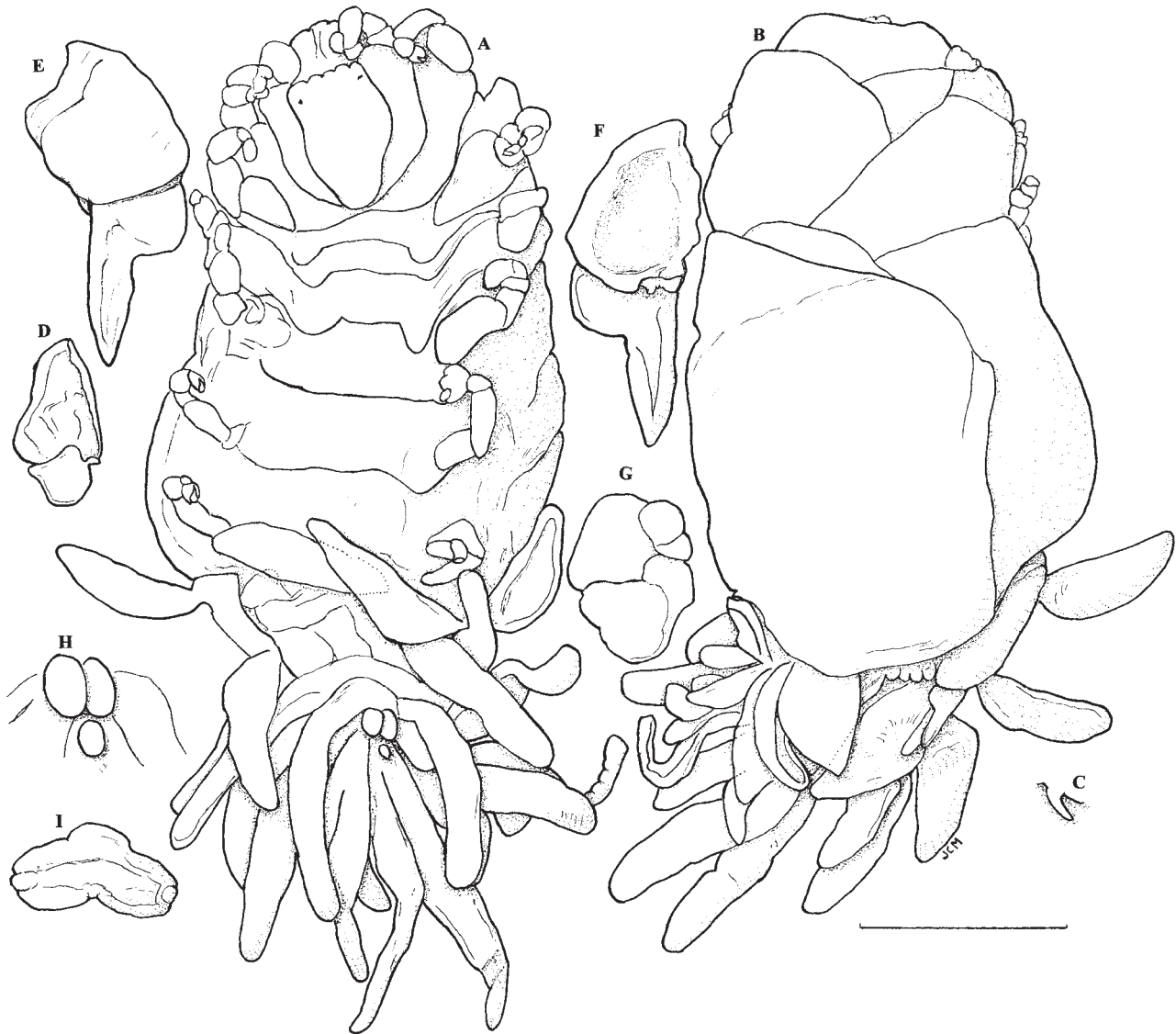


Fig. 6. *Pseudostegias dulcilacuum* Markham, 1982. A–H, female: A, dorsal view; B, ventral view; C, right side of barbula; D, right maxilliped; E, right oostegite 1, external view; F, same, internal view; G, right pereopod 1; H, bulbous lateral plates of pleomere 5 and pleotelson; I, possible hyperparasite removed from brood pouch. Scale bars: A, B, D–F = 2.00 mm, C, G–I = 1.00 mm.

Host in Singapore: *Ischnopontonia lophos* (Barnard).
Known range: Zanzibar; Singapore. Reference: Bruce,
1968.

Metaphrixus intutus Bruce, 1965. Type-locality: Zanzibar;
Host in Singapore: *Palaemonella rotumanus* Borradaile.
Known range: Zanzibar; Queensland, Australia; Singa-
pore. Reference: Bruce, 1979.

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