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***Periclimenes macrorhynchia* sp. nov., a new hydrozoan-associated pontoniine shrimp (Crustacea, Decapoda, Palaemonidae) from North East Kalimantan, Indonesia**

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Abstract

A new species of pontoniine shrimp belonging to the ‘*Periclimenes obscurus* species group’ is described from the Berau Islands, North East Kalimantan, Indonesia. Specimens were obtained from aglaopheniid hydrozoans of the genus *Macrorhynchia*. The new species is here described and figured. Its affinities with related species are discussed and a DNA-barcode is provided.

Key words: Crustacea, Decapoda, Palaemonidae, Pontoniinae, *Periclimenes*, new species, Hydrozoa, East Kalimantan, DNA-barcode, symbiont

Introduction

Within the large pontoniine genus *Periclimenes* Costa comprising over 150 species (De Grave & Fransen 2011), several species groups have been recognized. For some of these groups new genera were erected, e.g. *Ancylomenes* Okuno & Bruce, 2010 for the ‘*Periclimenes aesopius* species group’. For several of these species groups however, no solid morphological synapomorphies have been found to classify them in their own genus. Examples are the ‘*Periclimenes iridescens* species group’ known from the Atlantic and first distinguished by Heard & Spotte (1991), the ‘*Periclimenes diversipes* species group’ designated by Bruce (1989), the ‘*Periclimenes granulimanus* species group’ designated by Āuriš (2010), and the ‘*Periclimenes obscurus* species group’ which was designated by Bruce (1987).

A faunal survey for shallow-water pontoniine shrimps during a research expedition around the Berau Islands, East Kalimantan (September–October 2003), yielded specimens of a hitherto undescribed species which were collected from hydrozoans of the aglaopheniid genus *Macrorhynchia*. These specimens have affinities with both the *Periclimenes granulimanus* and *P. obscurus* species groups.

The new species is here described and figured. Its affinities with related species are discussed on the basis of comparative material and descriptions from the literature. A key to the species of both the *Periclimenes granulimanus* as well as the *P. obscurus* species groups is provided. DNA-barcodes of the new species and specimens of *P. batei* (Borradaile, 1917) are made available in GenBank.

Material and methods

Specimens were collected using SCUBA equipment during the LIPI-Naturalis East Kalimantan Expedition (Hoeksema 2004). Specimens were observed, measured and illustrated using a ZEISS Discovery-V8 dissecting microscope and a Leitz Ortholux II stereomicroscope, both with drawing tubes. Post processing of illustrations was done in Adobe Photoshop CS6.

To obtain CO1 barcodes the total genomic DNA was extracted from subsamples of eggs. Extraction was performed according to the protocol of the DNeasy Blood & Tissue Kit (QIAGEN, Hilden, Germany). The

incubation step lasted overnight for at least 16 hours. During the elution step, only 100 µl AE buffer was added instead of 200 µl buffer to increase the final DNA concentration in the eluate. To gain a higher concentration of DNA, the last step was repeated with the eluate. Standard primers (Folmer et al. 1994) were used. The PCR reaction was performed in a total reaction volume of 25 µl containing: 2.5 µl CoralLoad PCR buffer (10x; containing 15 mM MgCl₂) (QIAGEN), 0.5 µl dTNP (2.5 mM), 0.5 µl of each primer, and 0.25 µl Taq DNA polymerase (5 U/µl) (Qiagen). PCR was performed with 1 µl template for each sample and for some samples repeated with 2 µl template. The PCR conditions were as follows: initial denaturing for 1 min. at 94°C, followed by 39 cycles of 15 sec. at 94 °C, 1 min. at 40°C, 1 min. at 72°C with a final extension of 5 min. at 72°C. PCR products were tested on quality by performing an electrophoresis and visualized on a 1% agarose gel with the use of ethidium bromide staining. Usable products were sent to Macrogen, Amsterdam, where DNA sequences were generated on an Automatic Sequencer 3730xl. Sequences were edited using Sequencher (vers. 4.10.1).

The material is deposited in Museum Zoologicum Bogoriense, Research Center for Biology, Indonesian Institute of Sciences, Cibinong, Indonesia (MZB-LIPI) and Naturalis Biodiversity Center, formerly Rijksmuseum van Natuurlijke Historie (RMNH), Leiden. Post-orbital carapace length (pocl) is used as the standard measurement of size and indicated in mm. IWP refers to Indo-West Pacific.

Systematic account

Periclimenes O.G. Costa, 1844

Periclimenes macrorhynchia sp. nov.

(Figs. 1–8)

Material examined. 1 ovigerous female holotype pocl. 2.1 mm, MZB Cru 4193 (GenBank accession number: KT031403); 1 male allotype pocl 2.2 mm, RMNH.CRUS.D.57198 (GenBank accession number: KT031404); 4 ovigerous female paratypes pocl. 2.15–2.35 mm, MZB Cru 4194, 4 ovigerous females pocl. 2.05–2.38 mm, 1 non-ovigerous female pocl. 2.20 mm, 1 male pocl. 1.8 mm, paratypes RMNH.CRUS.D.57199: Indonesia, NE Kalimantan, Berau Islands, off Tanjung Batu, 02°14'47.6"N, 118°05'36.6"E, scuba diving, 13.x.2003, depth unknown, on hydrozoan *Macrorhynchia* spec., collected by J. van Egmond, stn BER.19.

Material examined for comparison. *Periclimenes batei* (Borradaile, 1917): 23 specimens, RMNH.CRUS.D.57200 (GenBank accession number: KT031405): Indonesia, N Sulawesi, E Sarena Besar, 1°27'34.1634"N 125°14'1.896"E, depth 18 m, on *Dendronephthya* spec., 31.i.2013, collected by B.T. Reijnen, stn LEM.03.

Periclimenes burrup Bruce, 2007: 1 male and 1 female paratype, RMNH.CRUS.D.50539: Western Australia, Burrup Peninsula, 20°31.586'S 116°51.088'E, 11 m, 27.x.1998, on *Dendronephthya* spec., Dampier Archipelago Survey Stn DAI/98/30.

Periclimenes hongkongensis Bruce, 1969: female holotype, RMNH.CRUS.D.33227: Hong Kong, Rocky Harbour, 22°20'N 114°21'E, depth 14 fms, 16.i.1965, on holothurian *Aphelodactyla andamensis* (Bell), Cape St. Mary, Cr. 2/65.

Periclimenes nomadophila Berggren, 1994: holotype female, allotype male, RMNH.CRUS.D.42892; 10 female paratypes, RMNH.CRUS.D.42893; 10 male paratypes, RMNH.CRUS.D.42894: Moçambique, outside Ilha dos Portugueses, close to the northern half of Inhaca Island, ca. 26°S 33°E, 17.iii.1992, from pelagic rhizomatous scyphozoans *Rhopilema nomadica* Galil.

Periclimenes obscurus Kemp, 1922: 7 specimens, RMNH.CRUS.D.42432: Thailand, Gulf of Thailand, S Thailand Surat Thani prov., in Don Sak River, 14.x.1991, don. Mrs. Somnuk Chaitiamvong, no. 5.

Periclimenes sinensis Bruce, 1969: holotype, RMNH.CRUS.D.33231: Hongkong, locality uncertain, collected before 1962, from *Umbelluliseria phanoregularis* (Burchardt).

Periclimenes toloensis Bruce, 1969: holotype male, RMNH.CRUS.D.33231: Hong Kong, Tolo Channel, Ap Island, trawled, 5–15 fms, 16.ii.1965, mud.

P. ? brucei: cf. Fransen (1994): 20 specimens, RMNH.CRUS.D.42886 and RMNH.CRUS.D.42889: Seychelles, Mahé, NE coast, North East Point, 4°35'S 55°28'E, 14 m, NIOP-E stn SEY.618.

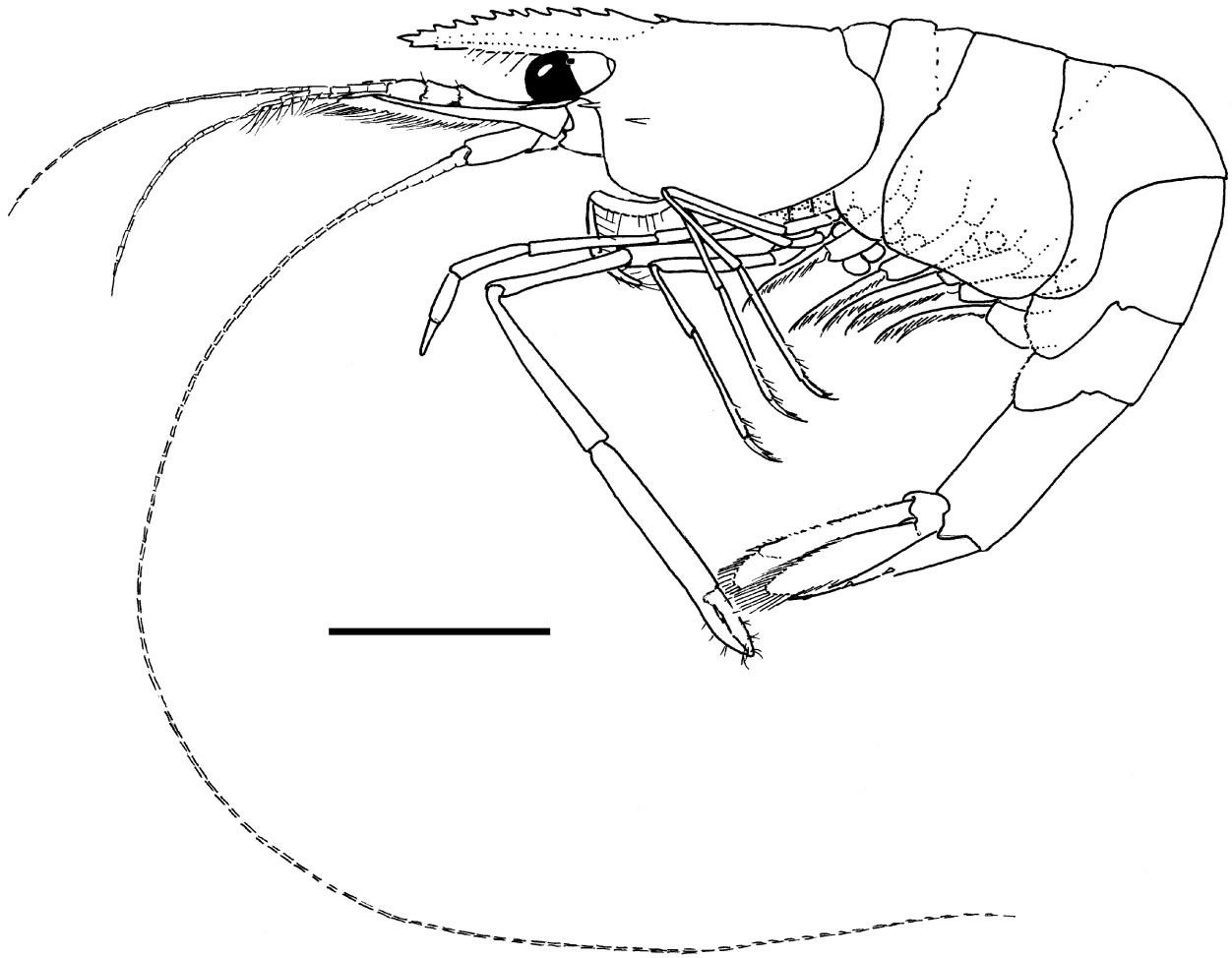


FIGURE 1. *Periclimenes macrorhynchia* sp. nov., ovigerous female holotype (MZB Cru 4193): habitus. Scale = 2 mm.

P. granulimanus Bruce, 1978: 11 specimens, RMNH.CRUS.D.57201: Indonesia, NE Sulawesi, Lembah Strait, Tanjung Kubur, 1°28'44.6874"N 125°14'59.1354"E, 15 m depth, 1.ii.2012, on hydrozoans on dead *Cirrhopathes* overgrown by sponges, zoantharians and hydrozoans, collected by C.H.J.M. Fransen, stn LEM.06.

P. laevimanus Āuriš, 2010: holotype ovigerous female, RMNH.CRUS.D.53129; allotype male, RMNH.CRUS.D.53130; 3 paratype specimens, RMNH.CRUS.D.53131: Vietnam, Nhatrang Bay, 12°10'06.0N 109°17'45.1E, sandy-mud bottom, 14 m depth, 23.ix.2008, on hydroid, cf. *Lytocarpia* sp., collected by I. Marin.

Description. Small sized, slender pontonine shrimp, with slender pereopods (fig. 1).

Carapace smooth. Rostrum (fig. 2a–c) well developed, slender, straight, reaching distal margin of antennular peduncle; lateral carina indistinct, situated near to proximally slightly convex ventral margin with 2 (seldom 3) subdistal teeth; ventral lamina not developed, with single row of plumose setae; dorsal margin slightly convex, elevated, strongly compressed, with 8–10 subequal teeth, slightly decreasing in size distally, posteriormost tooth situated at level of posterior margin of orbit, with indistinct suture at base; 2–4 plumose setae just in front of each dorsal tooth. Epigastric spine distinct, mobile. Supra-orbital spines absent. Inferior orbital angle well developed, produced, angular in lateral view. Antennal spine of moderate size, marginal, situated below inferior orbital angle. Hepatic spine about as large as antennal spine, situated well behind level of posterior orbital margin and slightly below level of antennal spine. Antero-lateral angle of carapace blunt, not produced.

Abdominal segments (fig. 1) smooth. Pleura of first to fifth somites broadly rounded. Third segment not produced posterodorsally. Sixth abdominal segment almost twice as long as fifth, posteroventral angle feebly produced, rounded, posterolateral angle acute.

Telson (fig. 2d, e) 1.1 times as long as sixth abdominal segment and 3.8 times longer than anterior width; lateral margins converge posteriorly; two pairs of submarginal dorsal spines present at 0.55 and 0.80 of telson

length, posterior margin with median acute tip, 0.30 of anterior width, with three pairs of spines. Lateral spines short, as long as dorsal spines. Intermediate spines well developed, about 0.17 of telson length, 2.2 times length of submedian spines. Uropods overreaching telson. Uropodal exopod longer than endopod, with small fixed distolateral tooth and distinct mobile spine medially, slightly longer than dorsal telson spines.

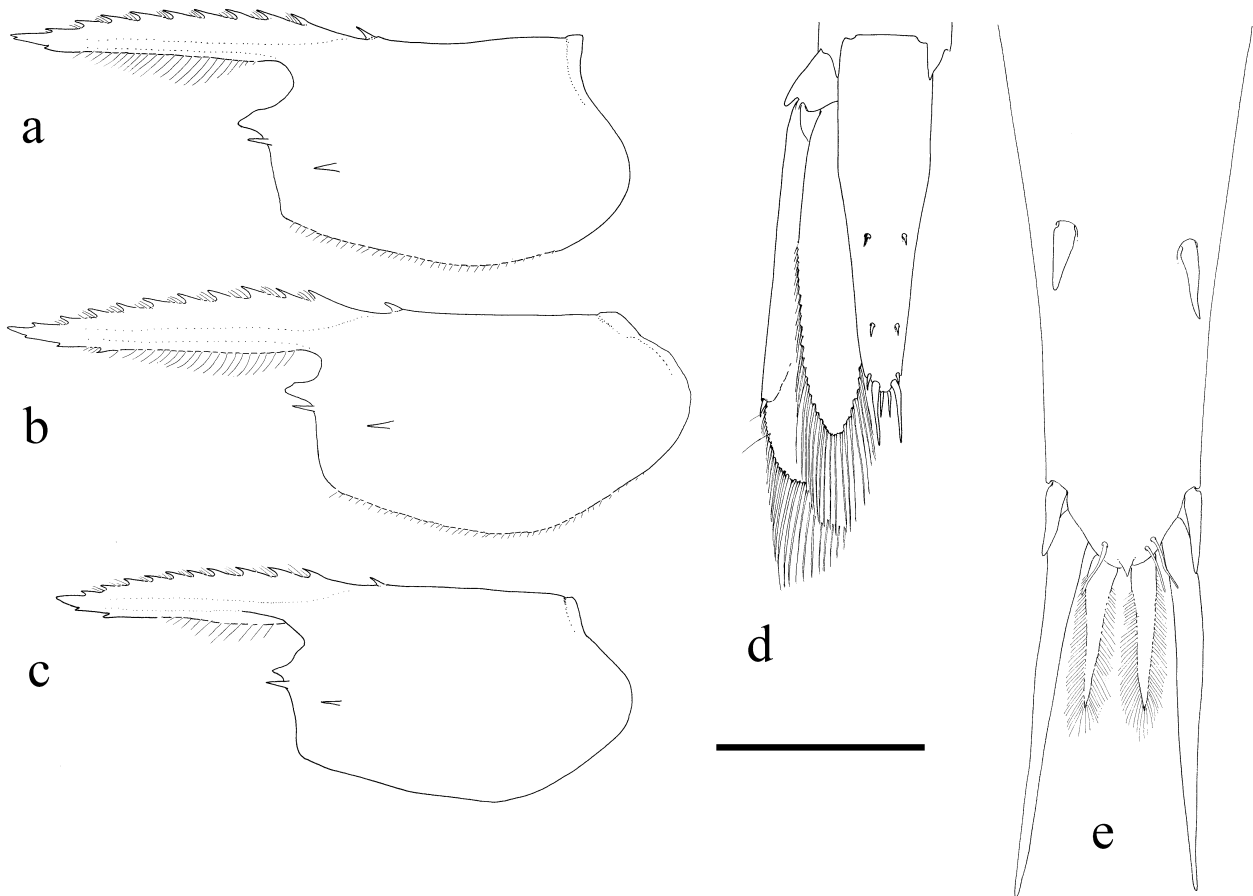


FIGURE 2. *Periclimenes macrorhynchia* sp. nov.: a, d, ovigerous female holotype (MZB Cru 4193); b, male allotype (RMNH.CRUS.D.57198); c, e, ovigerous female paratype (RMNH.CRUS.D.57199); a–c, rostrum and carapace, lateral view; d, telson and uropods; e, distal part telson. Scale a–c = 0.8 mm; d = 0.5 mm; e = 0.2 mm.

Eyes (fig. 1) well developed. Cornea globular, with distinct accessory pigment spot posterodorsally. Eyestalks almost twice as long as proximal width, slightly swollen proximally.

Antennular peduncle (fig. 3a) with proximal segment long, slender, 2.2 times longer than wide; stylocerite slender, acute, reaching almost to middle of segment; lateral margin slightly convex, anterolateral margin produced, angular, with acute distolateral tooth and row of plumose setae continuing proximally on distolateral margin of basal segment; ventral margin with small submedian tooth at about 0.4 of length of segment; medial margin with row of short plumose setae. Statocyst with statolith. Intermediate and distal segments short, distal segment slightly longer than intermediate segment, together equal to 0.54 of proximal segment length. Upper flagellum biramous, with first 5 segments fused; short ramus with 3 segments; aesthetascs present on short free ramus only. Longer free ramus slender. Lower flagellum slender, about as long as upper flagellum.

Antennal basicerite (fig. 3b) with acute lateral tooth. Ischiocerite and merocerite normal. Carpocerite short, reaching 0.4 of length of scaphocerite. Scaphocerite long, rather slender, with lamella distinctly overreaching distal margin of antennular peduncle. Lateral border straight, ending in acute large distolateral tooth. Lamella extending beyond distolateral tooth, feebly angulated distomedially, about 3.3 times longer than broad, with greatest width at about one half of its length.

Epistome, labrum and paragnath without special features.

Third thoracic sternite unarmed.

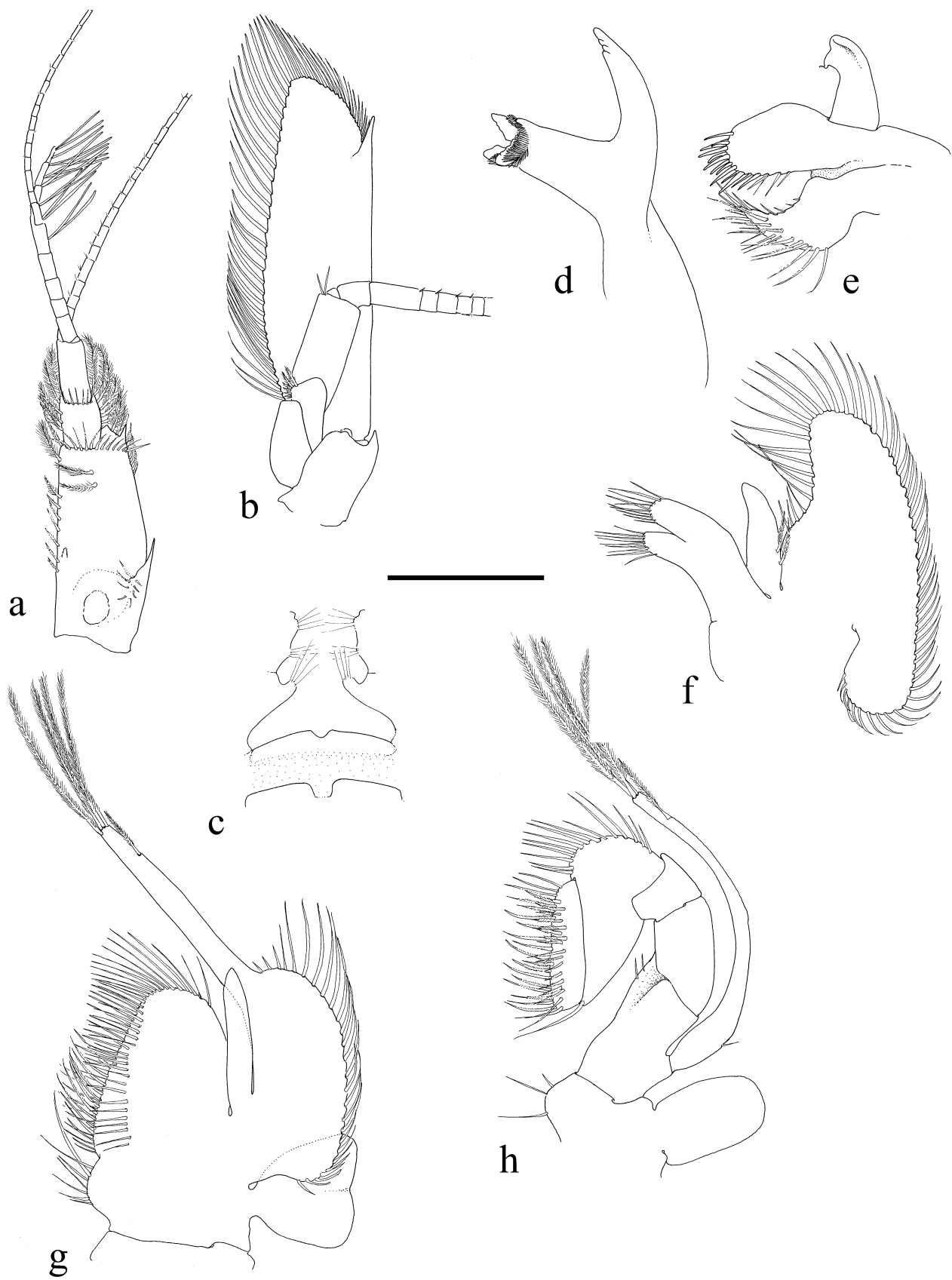


FIGURE 3. *Periclimenes macrorhynchia* sp. nov., ovigerous female paratype (RMNH.CRUS.D.57199): a, antennular peduncle, dorsal view; b, antennular peduncle, ventral view; c, fourth and fifth thoracic sternites, proximoventral view; d, left mandible; e, left maxillula; f, left maxilla; g, left first maxilliped; h, left second maxilliped. Scale a, b = 0.5 mm; c = 1 mm; d–h = 0.4 mm.

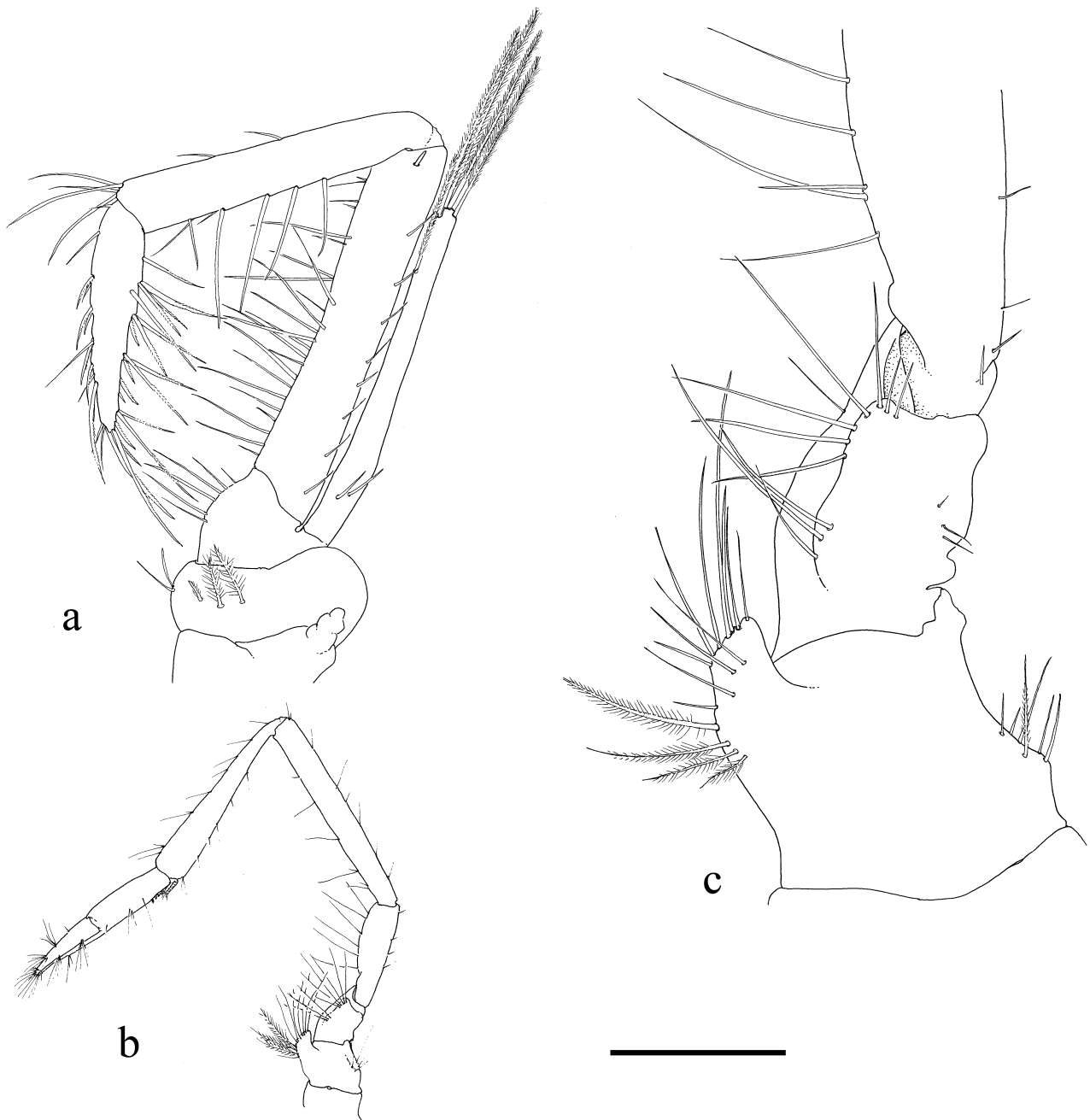


FIGURE 4. *Periclimenes macrorhynchia* sp. nov., ovigerous female paratype (RMNH.CRUS.D.57199): a, left third maxilliped; b, left first pereiopod; c, idem, detail basal joints. Scale a = 0.4 mm; b = 1 mm; c = 0.2 mm.

Fourth thoracic sternite (fig. 3c) with shallow broad lateral ridges with shallow median notch.

Fifth thoracic sternite (fig. 3c) with shallow lateral plates posteromedial of second pereiopods.

Sixth to eighth thoracic sternites broad, unarmed.

Mandible (fig. 3d) with cylindrical molar process with blunt teeth on strong chewing surface, with 2 short bands of few setae subdistally. Incisor process slender, with 3 (right) or 4 (left) teeth distally, of which lateralmost slightly enlarged. Mandible without palp.

Maxillula (fig. 3e) with upper lacinia rectangular with rows of few serrulate spines and slender setae medially; lower lacinia more slender, pointed, with serrulate setae distally; palp bilobed, medial lobe with single short recurved simple seta.

Maxilla (fig. 3f) with short tapering palp with few plumose setae laterally. Basal endite bilobed, distal lobe slightly broader than proximal lobe, both lobes with row of about 13 minutely serrate setae medially. Coxal endite

obsolete, median margin convex, without setae. Scaphognathite normal, widest centrally, about 2.4 times longer than broad, with marginal plumose setae.

First maxilliped (fig. 3g) with short, slender, tapering palp without setae. Basal region broad, separated from coxal region by notch, with median margin provided with setulose and slender simple setae. Coxal region strongly convex with few minutely serrulate setae medially. Caridean lobe with coarsely setulose plumose marginal setae. Flagellum of exopod well developed with 4 long plumose distal setae and one short subdistally. Epipod bilobed.

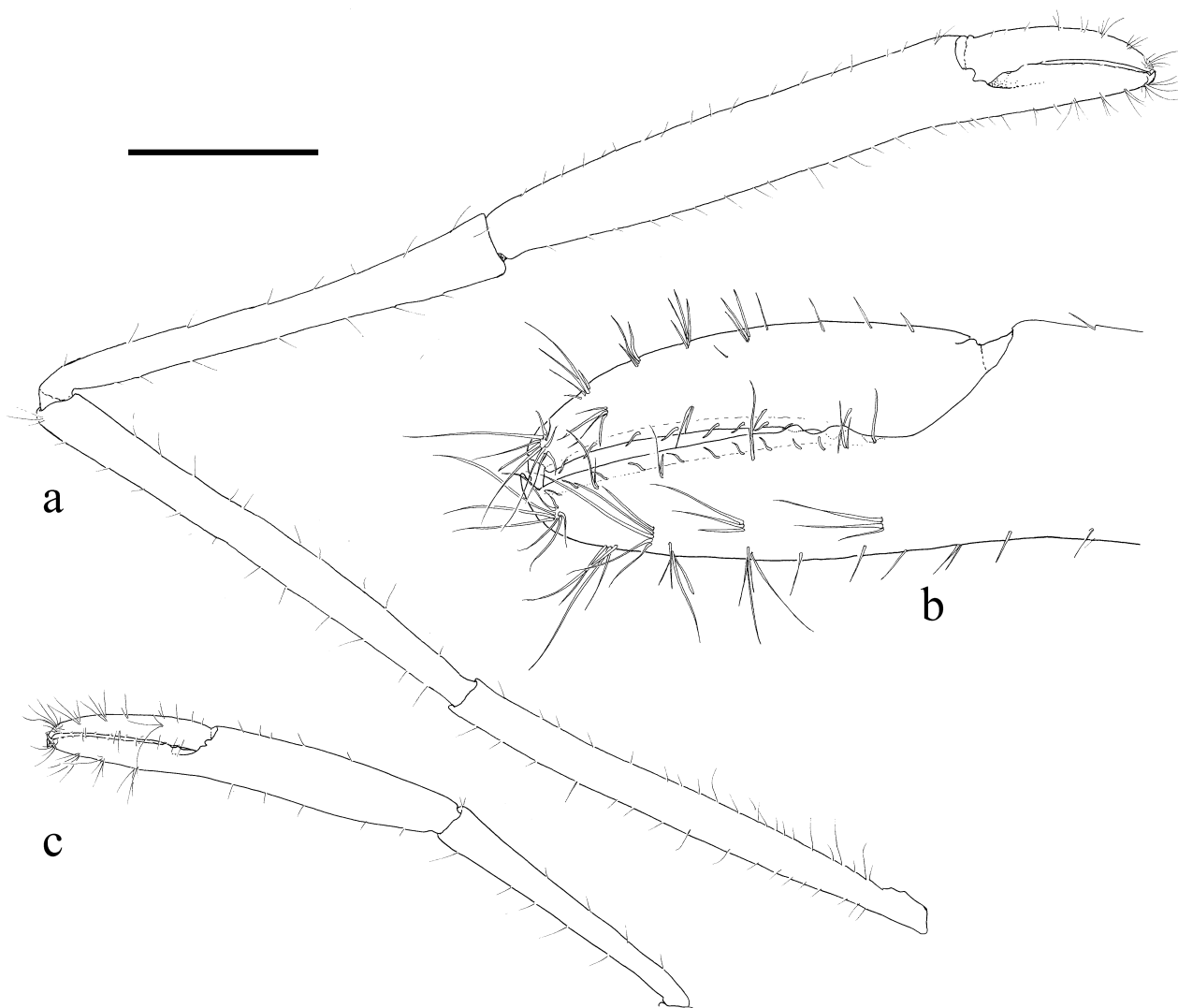


FIGURE 5. *Periclimenes macrorhynchia* sp. nov., ovigerous female paratype (RMNH.CRUS.D.57199): a, right major second pereiopod; b, idem, detail chela. Male allotype (RMNH.CRUS.D.57198): c, left major second pereiopod, chela and carpus. Scale a, c = 1 mm; b = 0.4 mm.

Second maxilliped (fig. 3h) with dactylar segment narrow, about 3.7 times longer than wide, straight medially, densely fringed with numerous coarsely serrulate, spiniform, and long curled finely serrulate setae medially. Propodal segment longer than dactylar segment twice as long as wide, with distomedial margin not produced, with few long serrulate setae. Carpus short, unarmed. Meral segment short, not excavate, without setae. Ischium completely fused to basis, excavate medially. Basis with long slender exopod about as long as length of endopod, with 4 long plumose setae distally and one shorter plumose seta subdistally. Coxa slightly produced medially, with few simple setae medially, small oblong epipod laterally.

Third maxilliped (fig. 4a) slender. Terminal segment 4.1 times longer than proximal width, 0.64 of length of penultimate segment, with rows of short serrulate setae medially and longer simple setae ventrolaterally. Penultimate segment slender, 6.5 times longer than wide with rows of long finely serrulate setae medially and

ventrolaterally. Ischiomerus 1.1 times as long as penultimate segment, 5.8 times as long as distal width, medial margin with row of long minutely serrulate setae, with one subdistal lateral spine; basis medially convex with few simple setae. Exopod reaching 0.8 of ischiomerus segment, with 4 distal and 1 subdistal plumose setae. Coxa slightly produced medially, with rounded lateral plate, with small arthrobranch.

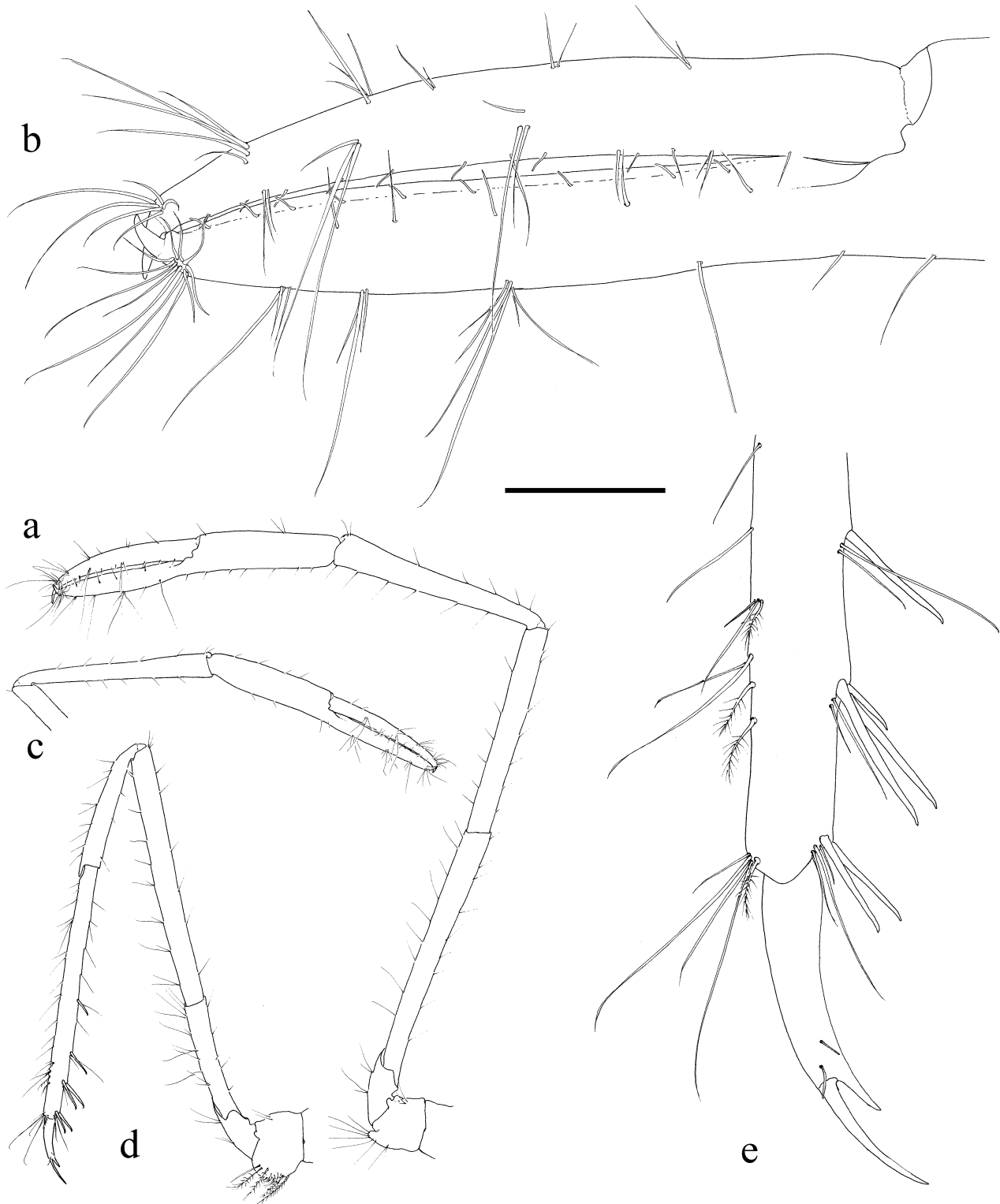


FIGURE 6. *Periclimenes macrorhynchia* sp. nov., ovigerous female paratype (RMNH.CRUS.D.57199): a, left minor second pereiopod; b, idem, chela; d, left third pereiopod; e, idem, detail dactylus and distal part propodus. Male allotype (RMNH.CRUS.D.57198): c, right minor second pereiopod. Scale a, c, d = 1 mm; b, e = 0.2 mm.

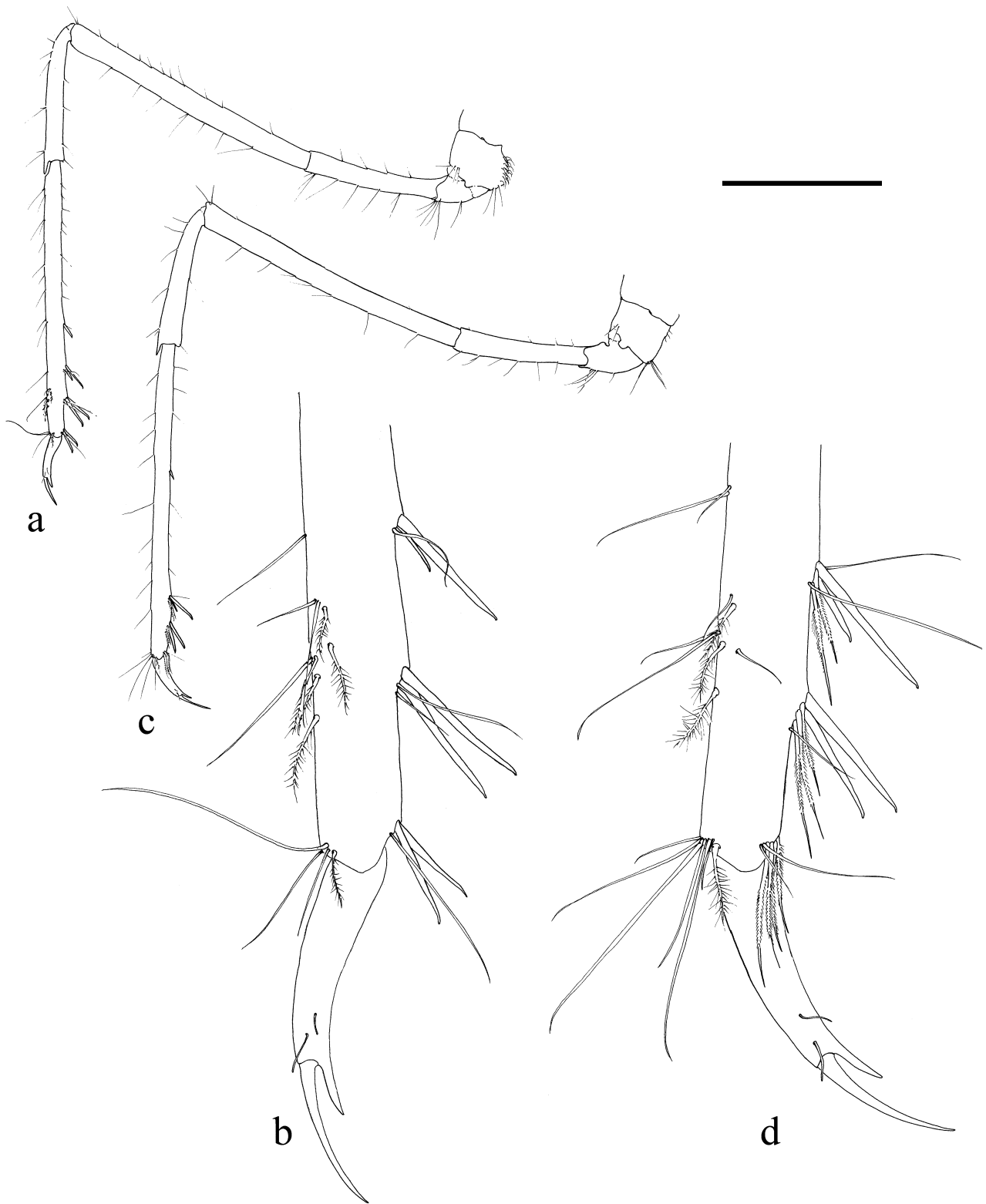


FIGURE 7. *Periclimenes macrorhynchia* sp. nov., ovigerous female paratype (RMNH.CRUS.D.57199): a, left fourth pereiopod; b, idem, detail dactylus and distal part propodus; c, left fifth pereiopod; d, idem, detail dactylus and distal part propodus. Scale a, c = 1 mm; b, d = 0.2 mm.

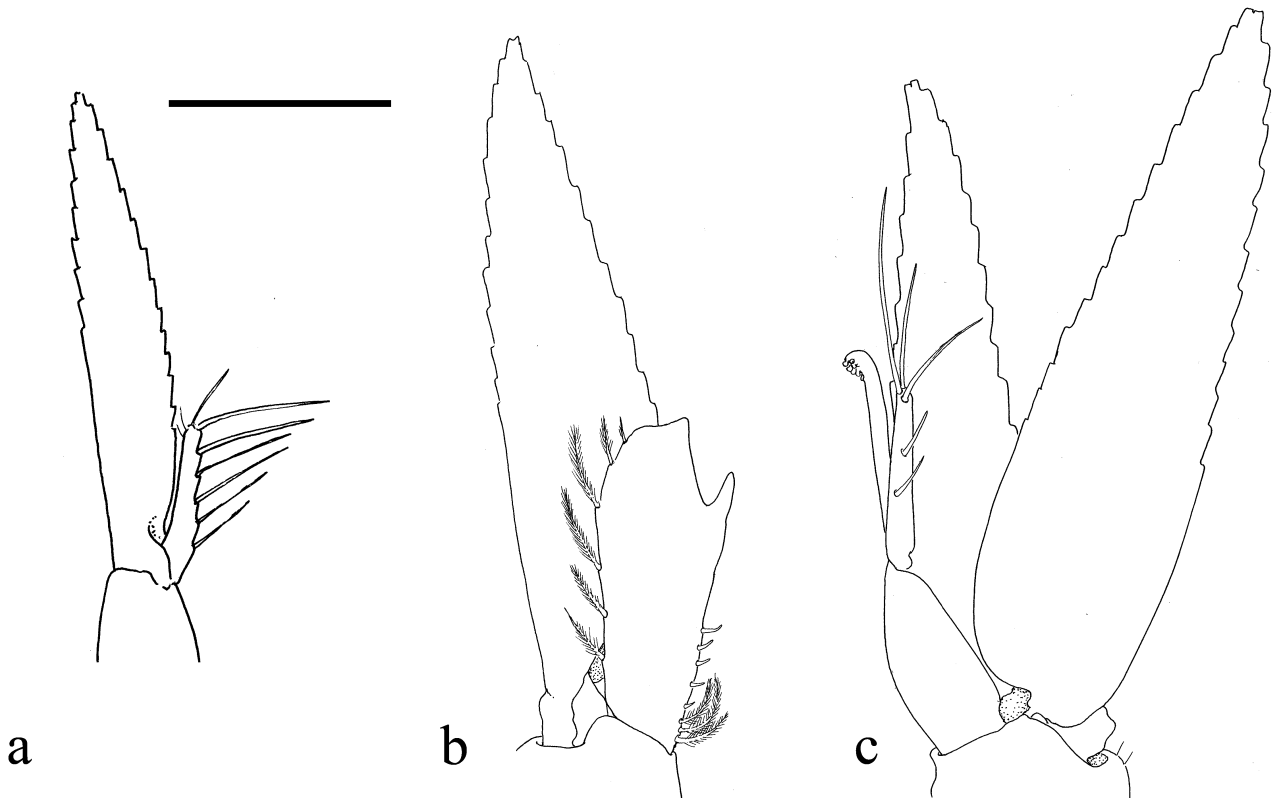


FIGURE 8. *Periclimenes macrorhynchia* sp. nov., ovigerous female paratype (RMNH.CRUS.D. 57199): a, right first pleopod. Male allotype (RMNH.CRUS.D.57198): b, left first pleopod; c, left second pleopod. Scale a = 1 mm; b, c = 0.4 mm.

First pereiopod (fig. 4b, c) slender, reaching to end of scaphocerite. Chela with palm subcylindrical, straight, 2.7 times longer than wide. Fingers as long as palm, straight not subspatulate, with brushes of few setae in distal part, cutting edges entire, tips of fingers hooked. Cleaning setae present proximally on palm and distoventral part of carpus. Carpus 1.1 times length of chela, 5.8 times longer than wide. Merus slightly longer than carpus, twice length of ischium. Ischium with medial setal ridge with few long simple setae. Basis with medial setose ridge. Coxa with distinct setose medial process.

Second pereiopods, unequal in length, dissimilar. Major second pereiopod (fig. 5a–c) extending beyond antennular peduncle with chela, carpus and distal half of merus. Chela with palm subcylindrical, straight, 6 times as long as wide, ventrally carinate. Fingers 0.37 of palm length. Dactylus as wide as fixed finger, fingers not gaping, both with brushes of setae in distal part, tips strongly hooked, cutting edges with 2 teeth proximally, distally entire. Carpus gradually increasing in width distally, merus and ischium unarmed, their length ratios of 0.93, 1.00 and 0.93 times length of palm. Basis with few setae medially. Coxa with small median setose process. Minor second pereiopod (fig. 6a–c) with fingers as long as subcylindrical palm, with setal brushes, fingers distally hooked, two shallow teeth in proximal part of cutting edge, distal part entire. Carpus gradually increasing distally, 0.8 times as long as chela; merus and ischium unarmed, merus as long as carpus, ischium 1.2 times as long as merus. Basis and coxa as in major chela.

The ambulatory pereiopods slender, similar in form, third pereiopod (fig. 6d) reaching with dactylus to distal margin of scaphocerite. Dactylus of third pereiopod (fig. 6e) long, slender, 0.26 of propodus length, 5.8 times as long as proximal width, with slender accessory tooth reaching to third of slightly curved unguis; flexor margin of corpus concave, entire. Propodus 14 times longer than wide, with two long distoventral spines, one pair even longer spines subdistally with a small spine in between, and one long spine proximally forming a grasping structure; with one small ventral spine at about 0.5 of propodus length. Carpus, merus and ischium 0.50, 1.02 and 0.48 of propodus length, unarmed. Fourth (fig. 7a, c) and fifth pereiopods (fig. 7b, d) similar as third; fourth with subdistal pair of spines, without the small one in between, proximalmost pair with one long outer and a shorter inner spine; fifth without distoventral pair of spines but with series of serrulate setae.

Endopod of first pleopod in ovigerous female (fig. 8a) short, 0.3 of length of exopod, with long plumose setae along its entire margin. Uropods extending beyond tip of telson. Protopodite unarmed laterally. Exopod with lateral border almost straight, slightly setose in proximal part, terminating in a small distolateral tooth with mobile spine medially, mobile spine 5 times as long as distolateral tooth.

Ovigerous females with about 50 eggs of ca. 0.35 mm in diameter.

Endopod of first pleopod in male (fig. 8b) short, almost half length of exopod, 2.5 times as long as wide, broadening distally; apex angulate; medial margin with obtuse, hooked, distally directed lobe at distal third; and 5 short simple setae and 3 long plumose setae in proximal part; lateral margin rounded with row of about 6 long plumose setae. Endopod of second pleopod in male (fig. 8c), 0.86 times length of exopod; appendix interna overreaching half of endopod length, slender, about 10 times longer than distal width, with group of cincinnuli distomedially; appendix masculina slightly stouter and shorter than appendix interna, with 3 long distal setae and 2 shorter setae along medial margin.

Size. Postorbital carapace length between 2.0–2.4 mm.

Colouration. Unknown.

Host. *Macrorhynchia* spec. (Hydrozoa, Leptothecata, Aglaopheniidae).

Etymology. The specific name refers to the hydrozoan host genus *Macrorhynchia* Kirchenpauer.

Variation. In 11 specimens two ventral rostral teeth were observed and in one of the larger ovigerous female specimens three ventral rostral teeth were present. Males are generally similar to females; they differ by their slightly smaller size and more slender body. The major second chela has the fingers 0.61 of the palm length. The minor second chela has the fingers as long as the palm.

Systematic position. Differences with species from the *P. obscurus* species group:

- *P. batei* (Borradaile, 1917). There is a difference between the descriptions of the holotype of *P. batei* by Borradaile (1917) and Holthuis (1959), and the present comparative material in the dentition of the rostrum. In the holotype only 6 teeth are present on the dorsal lamina, the epigastral tooth is absent. In the material of RMNH.CRUS.D.57200 all specimens except one juvenile have an epigastral tooth. In the other juvenile specimens the epigastral tooth is minute (fig. 9a). These juvenile specimens have 6 teeth on the rostrum proper as in the holotype of *P. batei*. According to Holthuis (1959) the type specimen of *P. batei* is not full-grown. Adult specimens of RMNH.CRUS.D.57200 usually have 7 or 8 dorsal teeth on the rostrum (fig. 9b) and a mobile epigastral tooth. The tooth in front of the epigastral tooth is situated just behind the orbit and has an indistinct suture basally. The fourth thoracic sternite (fig. 9c) has prominent lateral triangular ridges and a median V-shaped notch. The fifth thoracic sternite (fig. 9c) has shallow lateral plates posteromedial of the second pereopods with a broad median notch. The telson (fig. 9d) is similar to that of the new species, possessing a median acute tip on the posterior margin. The genetic distance with the CO1 sequences of the new species is ca. 22%.

The first pereopod (fig. 9e) is generally similar to that of the new species. The ischium (fig. 9f) has a medial setal ridge with few long simple setae as in the new species. The basis (fig. 9f) also has a medial setose ridge, but less prominent than in the new species. The coxa (fig. 9f) has a distinct setose medial process, but less developed than in the new species. The major second pereopod in juvenile specimens (fig. 10a) of RMNH.CRUS.D.57200 is as depicted for the holotype by Holthuis (1959) with the palm about 1.5 times the length of the fingers. In adult specimens the palm is about 4 times as long as the fingers (fig. 10b–d). In *P. batei* the carpus of the major second chela is distinctly shorter than the palm and merus while it is subequal in length in the new species. The minor second pereopod (fig. 10e) has a more slender chela. The carpus is as long as the merus and slightly longer than the palm. The propodus of the third pereopod (fig. 11a, c, d) has 4 single moderately long subdistal ventral spines in its distal 2/3rd while the new species has a subdistal pair of long spines with a smaller one in between followed by one long spine proximally and another single medium sized spine at about half the propodus length. In adult specimens the propodus is more slender than in the juvenile specimen which is also visible in the drawing of the holotype made by Holthuis (1959). The ambulatory pereopods bear many long setae while in the new species less and shorter setae are present. The accessory tooth of the dactylus (fig. 11b, e) is less than half the length of the unguis as in the new species.

- *P. burrup* Bruce, 2007 lacks the epigastral tooth which is present in the new species, and has the carpus of the major second chela distinctly shorter than the palm and merus while this is subequal in length in the new species. The species lacks the transverse ridges on the fourth thoracic segment while these are present in the new species.
- *P. delagoae* Barnard, 1958 has the fourth thoracic sternite with a low transverse ridge with median notch (Bruce, 1987) as is present in the new species. The major second chela (Bruce, 1987: fig. 9c) has the carpus distinctly shorter than the merus and the palm while it is of equal length in the new species.

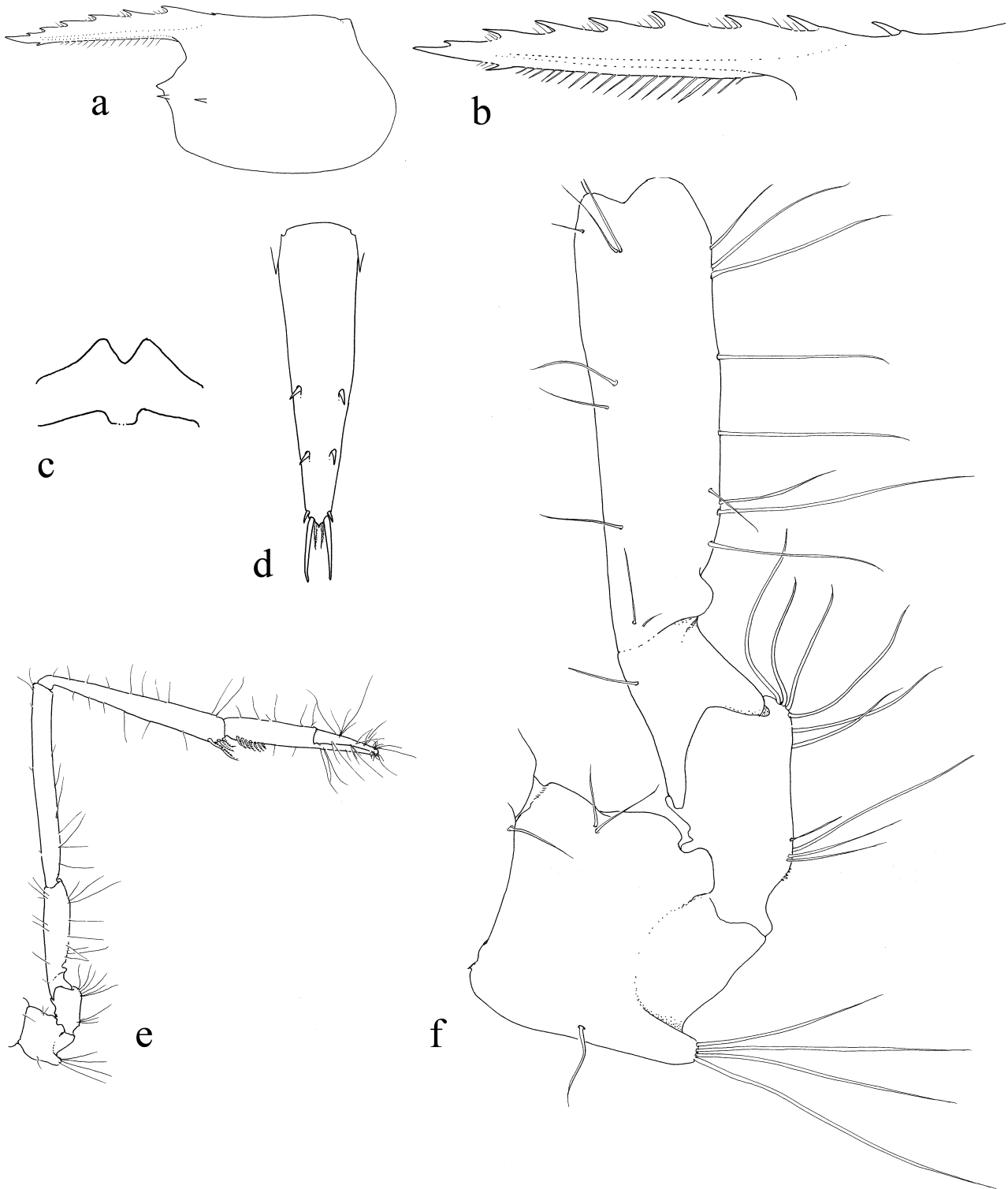


FIGURE 9. *Periclimenes batei* (Borradaile, 1917), RMNH.CRUS.D.57200. Juvenile specimen, pochl. 1.04 mm: a, rostrum and carapace. Adult male specimen, pochl. 2.0 mm: b, rostrum; c, fourth and fifth thoracic sternites, proximoventral view; d, telson; e, right first pereiopod; f, idem, detail basal segments. Scale a–d = 0.5 mm; e = 1 mm; f = 0.2 mm.

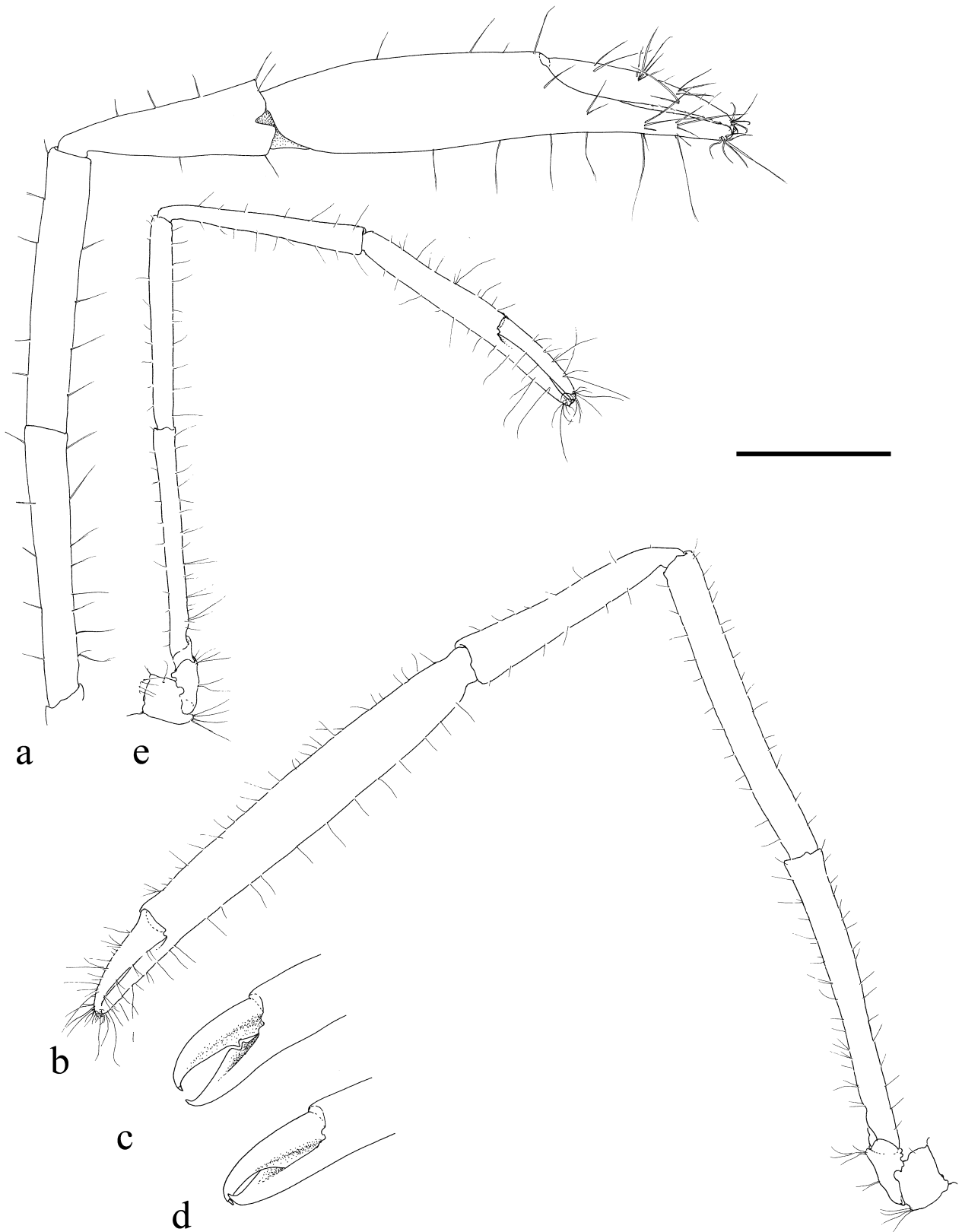


FIGURE 10. *Periclimenes batei* (Borradaile, 1917) RMNH.CRUS.D.57200. Juvenile specimen, pochl. 1.04 mm: a, left major second pereiopod. Adult male specimen, pochl. 2.0 mm: b, left major second pereiopod; c, idem, chela open, mediodorsal view; d, idem, chela closed; e, right minor second pereiopod. Scale a = 0.4 mm; b–e = 1 mm.

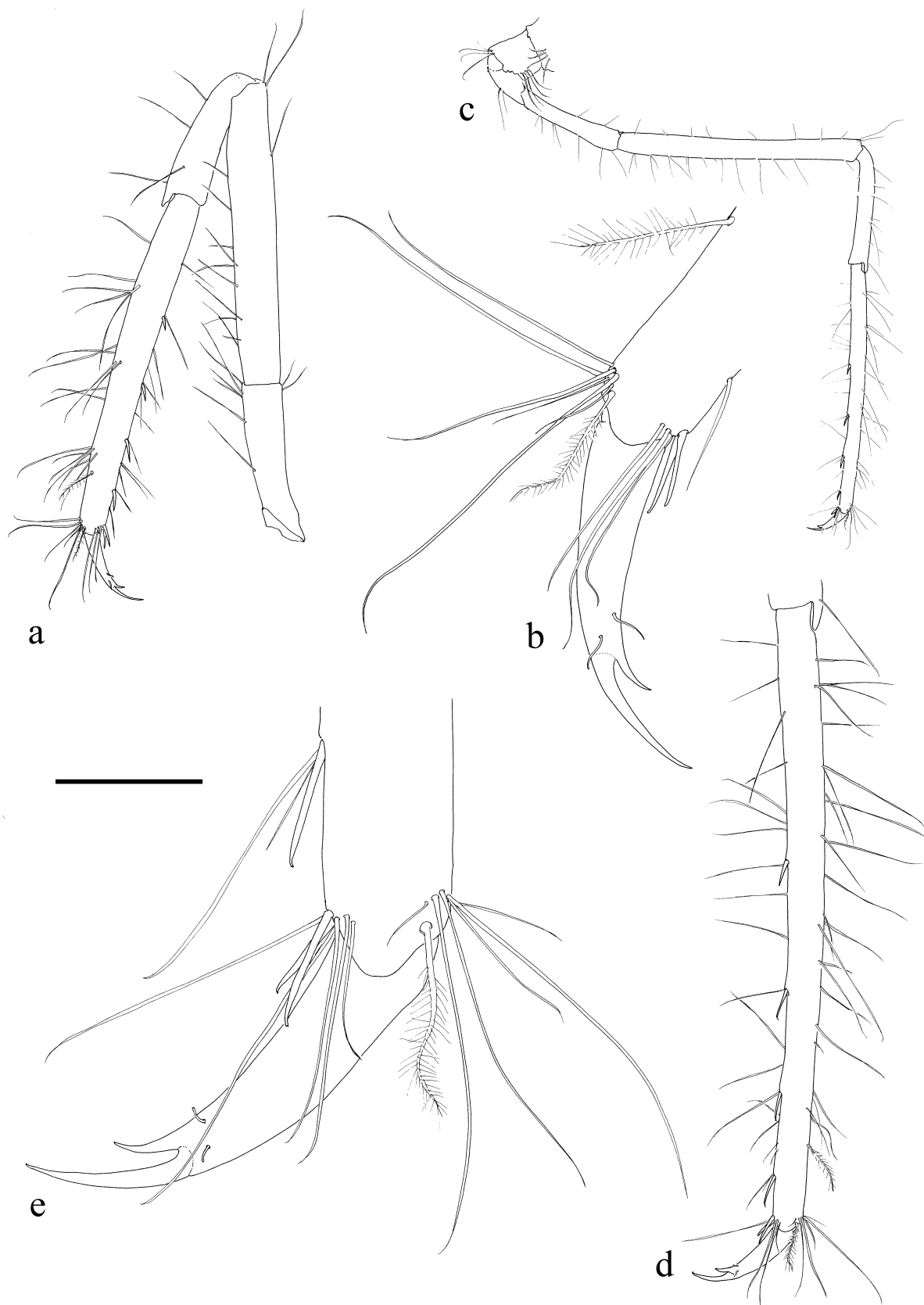


FIGURE 11. *Periclimenes batei* (Borradaile, 1917) RMNH.CRUS.D.57200. Juvenile specimen, pocl. 1.04 mm: a, left third pereiopod; b, idem, dactylus and distal part propodus. Adult male specimen, pocl. 2.0 mm: c, right third pereiopod; d, idem, propodus and dactylus; e, idem, dactylus and distal part propodus. Scale a, d = 0.4 mm; b, e = 0.1 mm; c = 1 mm.

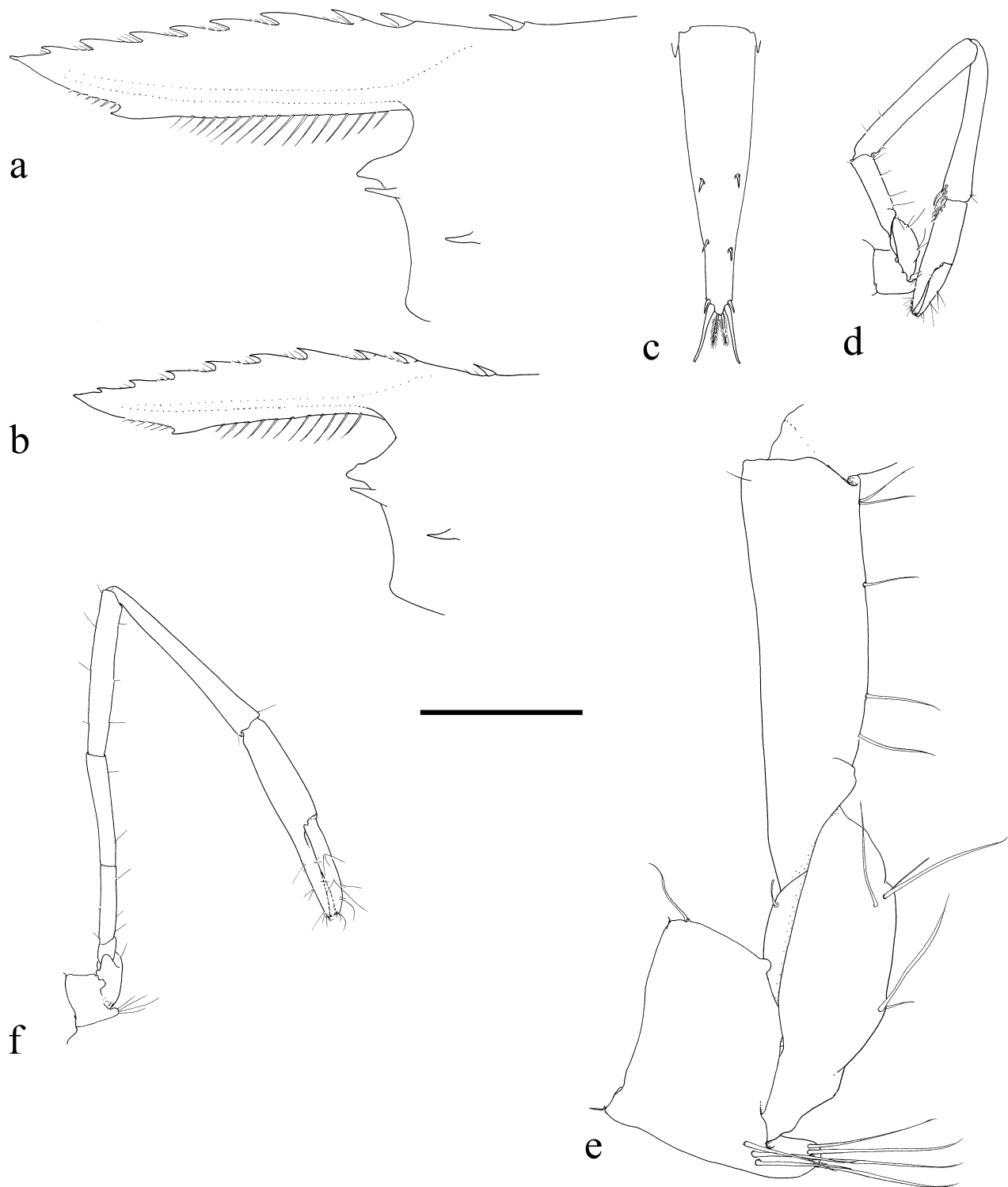


FIGURE 12. *Periclimenes obscurus* Kemp, 1922, RMNH.CRUS.D.42432. Ovigerous female, pochl. 2.5 mm: a, rostrum. Male, pochl. 2.0 mm: b, rostrum; c, telson; d, left first pereiopod; e, idem, detail basal segments; f, left second pereiopod. Scale a–c = 0.5 mm; d, f = 1 mm; e = 0.2 mm.

- *P. hongkongensis* Bruce, 1969 has the rostral lamina deep with 13–17 dorsal teeth and 3 or 4 ventral teeth (Bruce 1982: figs. 8A, C, 9A), while it is not deep in the new species which has 9–11 dorsal and two (seldom one) ventral teeth. The major second pereiopod (Bruce 1982: fig. 8D) has the carpus distinctly shorter than the palm and merus while it is about as long as palm and merus in the new species.

- *P. incertus* Borradaile, 1915 has the major second pereiopod short and robust with the carpus shorter than the palm and the merus, and the fingers typically gaping (Holthuis 1952: fig. 7e [as *P. impar*]) while the carpus is about as long as the palm and the merus and the chela never with the fingers gaping in the new species. *P. incertus* has the ambulatory dactyls (Kemp 1922: fig. 17d [as *P. impar*]; Bruce 1980: fig. 5B) robust, with the accessory tooth stout, subequal in length to the unguis while the dactylus is slender and the accessory tooth half the length of the unguis in the new species.

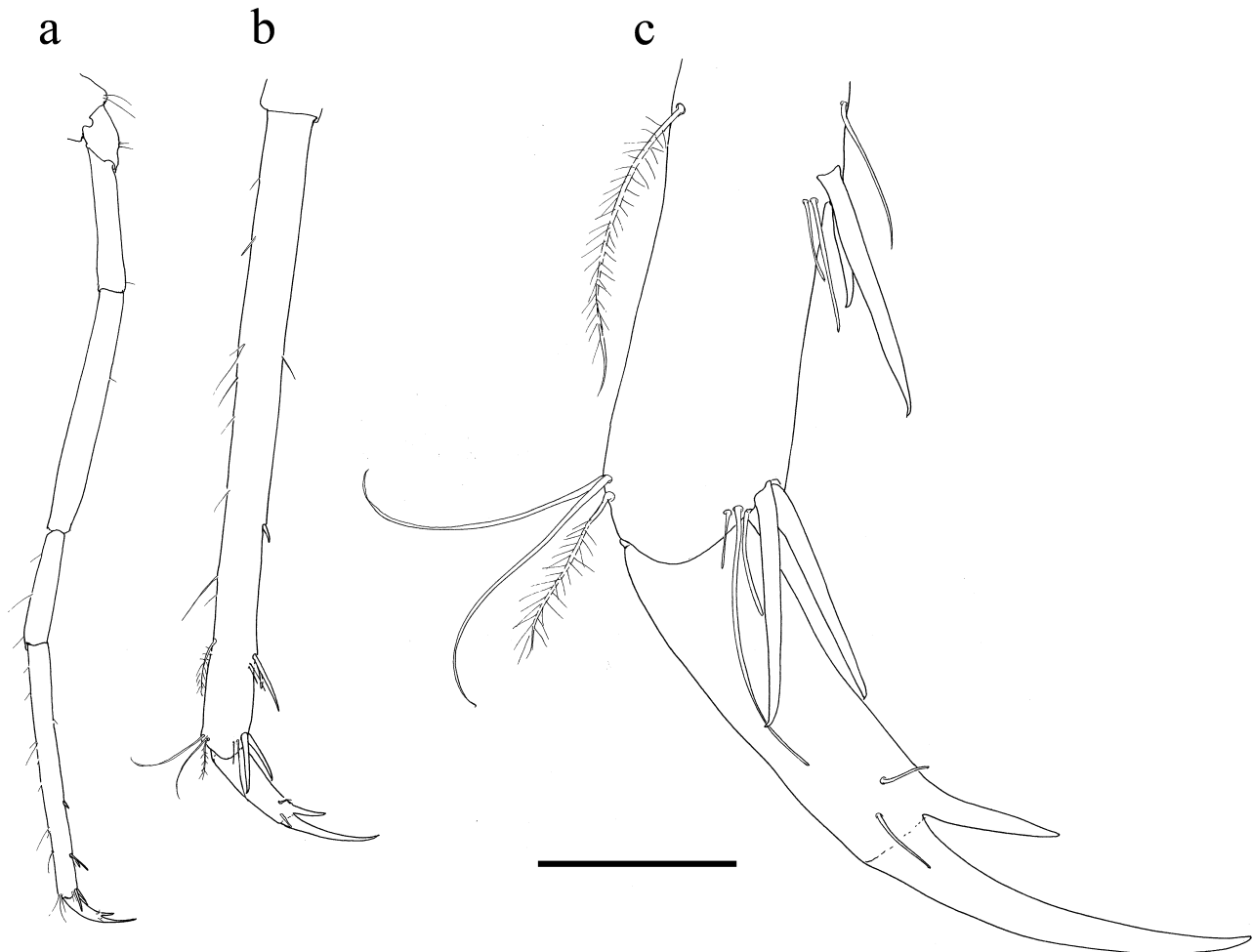


FIGURE 13. *Periclimenes obscurus* Kemp, 1922, RMNH.CRUS.D.42432. Male, pochl. 2.0 mm: a, left third pereiopod; b, idem, propodus and dactylus; c, idem, dactylus and distal part propodus. Scale a = 1 mm; b = 0.4 mm; c = 0.1 mm.

- *P. nomadophila* Berggren, 1994 has the carpus of the major second chela (Berggren 1994: fig. 4D) distinctly shorter than the palm and the merus while it is of about equal length in the new species. *P. nomadophila* has the ambulatory dactyl (Berggren 1994: fig. 5A–H) with or without a minute accessory tooth, ca 0.2 of the unguis length while the accessory tooth is well developed and about 0.5 of the unguis length in the new species.

- *P. obscurus* Kemp, 1922 has one (seldom two) well developed ventral tooth situated at about 2/3rd of the ventral margin of the rostrum (fig. 12a, b) while the new species usually has two small ventral spines in the distal fourth of the ventral rostral margin. The telson (fig. 12c) is similar to that of the new species. The ischium and basis of the first pereiopod (fig. 12 d, e) do have a median ridge but with only few setae. The coxa has a distinct setose medial process, but less developed than in the new species. *P. obscurus* has the second pereiopods (fig. 12f) subequal while the second pereiopods are unequal in the new species. The propodus of the third pereiopod (fig. 13a, b) has one pair of subdistal ventral spines of which the lateral spine is long and the medial about half the length of the lateral spine, a small ventral spine is present at about 2/3rd of the propodus length. The new species has a subdistal pair of long spines with a smaller one in between followed by one long spine proximally and another single medium sized spine at about half the propodus length. The unguis of the dactylus (fig. 13c) of the ambulatory pereiopods is as long as the corpus while it is about 0.65 of the corpus length in the new species.

- *P. sinensis* Bruce, 1969 has the rostrum (Bruce 1982: figs. 13A, C, 14A) with a series of 3–5 posterior dorsal teeth articulated and an epigastral tooth missing while in the new species only the posteriormost dorsal rostral tooth might be articulated and an epigastral tooth is present. The major second pereopod (Bruce 1982: fig. 13E) is short and robust and has the carpus distinctly shorter than the palm and merus while the major second pereopod is long and slender and has the carpus subequal in length to the palm and merus in the new species. The propodi of the ambulatory pereopods lack the pair of long subdistal spines with the small spine in between. The species lacks the transverse ridges on the fourth thoracic segment.
- *P. terangeri* Bruce, 1998 has the fourth thoracic sternite with a transverse ridge with keyhole shaped median notch while a low transverse ridge with median notch is present in the new species. *P. terangeri* has the dorsal telson spines slightly larger than the lateral terminal telson spines and situated at 0.45 and 0.65 of telson length while slightly smaller than lateral terminal spines and at 0.55 and 0.80 in the new species.
- *P. toloensis* Bruce, 1969 has only one ventral rostral tooth (Bruce 1982: fig. 16A) at about the level of the second distalmost dorsal tooth while two ventral teeth (seldom one) are present in the new species. *P. toloensis* has the fourth thoracic sternite unarmed while a transverse ridge with keyhole shaped median notch is present in the new species. *P. toloensis* has the dorsal telson spines minute, much smaller than the lateral terminal spines while they are almost of the same size as the lateral terminal spines in the new species. In *P. toloensis* the carpus of the major second pereopod (Bruce 1982: fig. 18D) is distinctly shorter than the merus and the palm while in the new species it is subequal in length with regards to merus and palm.
- *P. ? brucei* of which specimens were reported from the Seychelles by Fransen (1994) share more characters with the *P. obscurus* species group than with the *P. granulimanus* species group as was already remarked by Ďuriš (2010: 117). The specimens have a broad rectangular plate on the fourth thoracic sternite somewhat similar to the broad medial ridge in the new species. The carpus of the second pereopods however is much shorter than chela and merus in comparison with the new species. The subdistal ventral spine on the propodi of the ambulatory dactyli is single instead of double or triple in the new species. The dactyli of the ambulatory pereopods (Fransen 1994: fig. 86) have the accessory tooth less than a third of the unguis length while it has about half the length of the unguis in the new species.

Differences with species from the *P. granulimanus* species group:

The species of the *P. granulimanus* group, like the new species, have long slender second pereopods. The dactyli of the ambulatory pereopods are simple or indistinctly biunguiculate, while in the new species the dactyli are distinctly biunguiculate.

- *P. brucei* Ďuriš, 1990 has the major second pereopod (Ďuriš 2010: fig. 7) extremely long and slender, overreaching the scaphocerite by the proximal part of the merus, and with the carpus distinctly longer than the chela and the merus. In the new species the major second pereopod is overreaching the scaphocerite by half the carpus, and the carpus is about as long as the chela and the merus. In *P. brucei* the distal part of the propodi of the ambulatory pereopods is broadened bearing 4 pairs of subdistal spines while in the new species it is not broadened and bears one or two pairs of spines subdistally. *P. brucei* lacks the distoventral setose process in the coxa of the first pereopod while this is present in the new species.
- *P. granulimanus* Bruce, 1978 and *P. laevimanus* Ďuriš, 2010 have the carpus of the second pereopods distinctly shorter than the chela and the merus while it is about as long as chela and merus in the new species. Both species lack the distoventral setose process in the coxa of the first pereopod while this is present in the new species.
- *P. tonga* Bruce, 1988 does show the distoventral setose process in the coxa of the first pereopod like in most species of the *P. obscurus* group as well as the new species. *P. tonga* however, does not have an epigastric tooth (Bruce 1988: fig. 2B) which is present in the new species. *P. tonga* has one pair of dorsal spines on the telson (Bruce 1988: fig. 2F) while two are present in the new species. The second pereopods are tuberculate in *P. tonga* whereas these are smooth in the new species.

Key to species of the *Periclimenes obscurus* and *Periclimenes granulimanus* species groups

1. Ambulatory pereopods without or with minute accessory tooth 2
- Ambulatory pereopods with distinct accessory tooth 6
2. One pair of dorsal telson spines; carapace without epigastric spine; first pereopod coxa with ventral setose process, fingers with cutting edges distinctly gaping *P. tonga* Bruce, 1988 [associated with scyphozoans]
- Two pairs of dorsal telson spines; carapace with epigastric spine; fingers with cutting edges not distinctly gaping. 3
3. First pereopod coxa with ventral setose process; R. 9/2 *P. nomadophila* Berggren, 1994 [associated with scyphozoans]
- First pereopod coxa without setose process 4
4. Major second pereopod extremely long and slender, overreaching scaphocerite by proximal merus, carpus longer than both chela or merus; walking dactyli feebly biunguiculate with short distoventral tooth on corpus, propodi with long spines arranged to 4 distoventral pairs *P. brucei* Đuriš, 1990 [associated with antipatharians]
- Major second pereopod longer than minor one, both pereopods slender, overreaching scaphocerite by distal merus, carpus short – distinctly shorter than both chela or merus; walking dactyli simple or with rudimentary distoventral tooth on corpus, propodi with 1–3 single proximal spines in addition to 2–4 distoventral pairs of long spines 5
5. Major second pereopod smooth; minor second chela with cutting edges entire *P. laevimanus* Đuriš, 2010 [associated with hydroids]
- Major second pereopod granulate; minor second chela with 1–2 teeth on cutting edges *P. granulimanus* Bruce, 1978 [associated with antipatharians]
6. Carapace with isolated epigastric spine 7
- Carapace without epigastric spine 13
7. Ambulatory dactyli robust, with accessory tooth stout, subequal to unguis; R. 1+5/ 1 *P. incertus* Borradaile, 1915 [usually associated with sponges]
- Ambulatory dactyli slender, without or with slender accessory tooth, shorter than unguis 8
8. Second pereopods subequal, similar, carpus about as long as palm 9
- Second pereopods clearly unequal and dissimilar, carpus shorter than palm 10
9. Unguis of dactylus of ambulatory pereopods as long as corpus. R.1+6-9/1(rarely 2). *P. obscurus* Kemp, 1922 [associated with sponges and hydroids]
- Unguis of dactylus of ambulatory pereopods 0.65 times as long as corpus; R.1+6-10/2(rarely 3). *P. macrorhynchia* **sp. nov.** [associated with hydroids]
10. Rostral lamina deep, 13–17 dorsal teeth, 3 or 4 ventral teeth. *P. hongkongensis* Bruce, 1969 [associated with holothurians]
- Rostral lamina not deep, less than 11 dorsal teeth, 1 or 2 ventral teeth 11
11. Dorsal telson spines minute: major chela 4.3 times longer than wide, finger length 0.4 times palm: dactylus with accessory spine 0.5 times unguis; R. 1+8/1 *P. toloensis* Bruce, 1969 [associated with Gorgonaria and hydroids]
- Dorsal telson spines normal 12
12. Fourth thoracic sternite with transverse ridge with keyhole shaped median notch; R. 1+8-9/2. *P. terangeri* Bruce, 1998 [host not known]
- Fourth thoracic sternite lacking transverse ridge with median notch *P. delagoae* Barnard, 1958 [associated with ‘coral’]
13. First pereopod with carpus much shorter than chela; subequal to palm; R. 6/1 *P. batei* (Borradaile, 1917) [associated with Alcyonacea]
- First pereopod with carpus subequal to or longer than chela. 14
14. Second pereopods slender, subequal, with fingers of major chela subequal to palm, carpus more than half palm length; R. 9–10/2 *P. sinensis* Bruce, 1969 [associated with Alcyonacea]
- Second pereopods robust, markedly unequal, with fingers of major chela distinctly shorter than palm, major carpus ca half palm length; R. 8–11/1–2 *P. burrup* Bruce, 2007 [associated with Alcyonacea]

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Literature cited

- Barnard, K.H. (1958) Further additions to the crustacean fauna-list of Portuguese East Africa. *Memorias do Museu Dr. Alvaro de Castro*, 4, 3–23.
- Berggren, M. (1994) *Periclimenes nomadophila* and *Tuleariocaris sarec*, two new species of pontoniine shrimps (Decapoda: Pontoniinae), from Inhaca Island, Moçambique. *Journal of Crustacean Biology*, 14 (4), 782–802.
<http://dx.doi.org/10.2307/1548872>
- Borradaile, L.A. (1915) Notes on Caridea. *The Annals and Magazine of Natural History*, Series 8, 15, 205–213.
<http://dx.doi.org/10.1080/00222931508693629>
- Borradaile, L.A. (1917) The Percy Sladen Trust Expedition to the Indian Ocean in 1905, under the leadership of Mr. J. Stanley Gardiner, M.A. No. VIII. On the Pontoniinae. *Transactions of the Linnean Society of London*, Series 2, Zoology, 17, 323–396.
<http://dx.doi.org/10.1111/j.1096-3642.1917.tb00470.x>
- Bruce, A.J. (1969) Preliminary descriptions of sixteen new species of the genus *Periclimenes* Costa, 1844 (Crustacea, Decapoda, Natantia, Pontoniinae). *Zoologische Mededeelingen*, 43 (20), 253–278.
- Bruce, A.J. (1978) A report on a collection of pontoniine shrimps from Madagascar and adjacent seas. *Zoological Journal of the Linnean Society of London*, 62, 205–290.
<http://dx.doi.org/10.1111/j.1096-3642.1978.tb01039.x>
- Bruce, A.J. (1980) On some pontoniine shrimps from Nouméa, New Caledonia. *Cahiers de l'Indo-Pacifique*, 2, 1–39.
- Bruce, A.J. (1982) The pontoniine shrimp fauna of Hong Kong. In: Morton, B. & Tseng, C.L. (Eds), *Proceeding of the First International Marine Biological Workshop. The marine fauna of Hong Kong and southern China*, Hong Kong, 1 (for 1980), 223–284.
- Bruce, A.J. (1987) Re-descriptions of two little-known Indo-West Pacific palaemonid shrimps, *Periclimenes calmani* Tattersall and *P. delagoae* Barnard. *Journal of Natural History*, 21 (6), 1415–1432.
<http://dx.doi.org/10.1080/00222938700770891>
- Bruce, A.J. (1988) *Periclimenes tonga* sp. nov., a commensal shrimp associated with a scyphozoan host from Tonga (Crustacea: Decapoda: Palaemonidae). *Micronesica*, 21, 23–32.
- Bruce, A.J. (1989) *Periclimenes goniopora* sp. nov. (Crustacea: Decapoda: Palaemonidae), a new coelenterate-associated shrimp. *The Beagle, Records of the Museums and Art Galleries of the Northern Territory*, 6, 149–156.
- Bruce, A.J. (1998) Pontoniine shrimps from Moreton Bay, Queensland (Crustacea: Decapoda, Pontoniinae). *Memoirs of the Queensland Museum*, 42, 387–398.
- Bruce, A.J. (2007) Palaemonoid shrimps from the Dampier Archipelago (Crustacea: Decapoda), with a review of the Western Australian pontoniine shrimp fauna. *Records of the Western Australian Museum*, 73 (Supplement), 97–129.
- Costa, O.G. (1844) Su due nuovi generi di Crostacei decapodi macrouri. *Annali delle Accademia degli Aspiranti Naturalisti, Napoli*, 2, 285–292.
- De Grave, S. & Fransen, C.H.J.M. (2011) Carideorum Catalogus. The recent species of the dendrobranchiate, stenopodidean, procarididean and caridean shrimps (Crustacea: Decapoda). *Zoologische Mededeelingen*, 85 (9), 195–589.
- Đuriš, Z. (1990) Two new species of the palaemonid shrimp genus *Periclimenes* from the Maldive waters (Crustacea, Decapoda, Palaemonidae). *Acta Societatis Zoologicae Bohemoslovacae*, 54, 1–8.
- Đuriš, Z. (2010) *Periclimenes laevimanus* sp. nov. from Vietnam, with a review of the *Periclimenes granulimanus* species group (Crustacea: Decapoda: Palaemonidae: Pontoniinae) *Zootaxa*, 2372, 106–125.
- Folmer, O., Black, M., Hoeh, W., Lutz, R. & Vrijenhoek, R. (1994) DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology*, 3 (5), 294–299.
- Fransen, C.H.J.M. (1994) Marine palaemonoid shrimps of the Netherlands Seychelles Expedition 1992–1993. *Zoologische Verhandelingen*, 297, 85–152.
- Heard, R.W. & Spotte, S. (1991) Pontoniine shrimps (Decapoda: Caridea: Palaemonidae) of the northwest Atlantic. II. *Periclimenes patae*, new species, a gorgonian associate from shallow reef areas off the Turks and Caicos Islands and Florida Keys. *Proceedings of the Biological Society of Washington*, 104, 40–48.
- Hoeksema, B.W. (Ed.) (2004) *Marine biodiversity of the coastal area of the Berau region, East Kalimantan, Indonesia*. Progress report East Kalimantan Program - Pilot phase (October 2003), Naturalis, Leiden, 82 pp.
- Holthuis, L.B. (1952) The Decapoda of the Siboga Expedition. Part XI. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species II. Subfamily Pontoniinae. *Siboga Expeditie*, 39a10, 1–253.
- Holthuis, L.B. (1959) Results of the reexamination of the type specimens of some species belonging to the subfamilies Pontoniinae and Palaemoninae (Crustacea Decapoda Macrura). *Zoologische Mededeelingen*, 36 (11), 193–200.
- Kemp, S. (1922) Notes on Crustacea Decapoda in the Indian Museum, 15. Pontoniinae. *Records of the Indian Museum*, 24, 113–228.
- Okuno, J. & Bruce, A.J. (2010) Designation of *Ancylomenes* gen. nov., for the '*Periclimenes aesopius* species group' (Crustacea: Decapoda: Palaemonidae), with the description of a new species and a checklist of congeneric species. In: De Grave, S. & Fransen, C.H.J.M. (Eds.), *Contributions to shrimp taxonomy*. *Zootaxa*, 2372, 85–105.