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Pinnotherotonia rumphiusi gen. et sp. nov., a new furry bivalve-associated pontoniine shrimp (Crustacea: Decapoda: Palaemonidae) from Palau

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Abstract

A new genus and species of a furry, bivalve–associated pontoniine shrimp is described from Palau. This is the second pontoniine shrimp known to be associated with bivalves burrowing into soft bottom, and the first record of a venus clam (Bivalvia, Veneridae) as host for caridean shrimps.

Key words: Decapoda, Caridea, Pontoniinae, new genus, new species, Bivalvia, Veneridae, *Periglypta*, Palau

Introduction

Eleven genera of pontoniine shrimp are known as symbiotic in marine bivalves, and have been recorded from the following 10 bivalve families: Pteriidae, Pinnidae, Placunidae, Ostreidae, Spondylidae, Pectinidae, Isognomonidae, Cardiidae (including the Tridacninae), and Chamidae. Most bivalve hosts are epifaunal (or partly infaunal - Pinnidae), with only the cardiid *Vasticardium pectiniforme* (Born 1780), host for the pontoniine shrimp *Neoanchistus cardiodytes* Bruce, 1975, living fully, albeit shallowly buried in soft bottoms (Bruce 1975). Furthermore, mantle fusion, which may reduce access to the mantle cavity, is absent in the first 7 families (all Pteriomorpha), and present only in the Cardiidae and Chamidae, both of which have only limited (short) siphon development.

During the study of the pontoniine collection deposited in the University of Florida, Gainesville, FL, USA (UF), IM noted an ovigerous female of furry pontoniine shrimp associated with the venerid bivalve *Periglypta* Jukes-Browne, 1914. Venerids have not been previously recorded as hosts of pontoniines, and the specimen was found to represent a new genus and species. Postorbital carapace length (pcl, in mm) is used as a standard measurement of the size.

Systematics

Family Palaemonidae Rafinesque, 1815

Subfamily Pontoniinae Kingsley, 1878

Pinnotherotonia gen. nov.

Diagnosis. Medium-sized pontoniine shrimp with swollen, slightly depressed body; body and appendages densely covered with small, simple setae. Carapace swollen, without teeth; rostrum well developed, broad, reaching to distal margin of antennular peduncle, curved downward, dorsally and ventrally unarmed, ventral

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carina forming distinct keel between antennular segments, with slightly developed lateral carina. Abdominal somites unarmed, with tergites non-carinate; three last pleomeres small, with feebly developed rounded pleurae. Telson stout, strongly tapering, with two pairs of small, stout, dorsal spines, with posterior margin blunt, without distal spines, with a row of long, submarginal setae. Eyes large, swollen, thick, dorsally covered with simple setae; cornea slightly reduced, rounded, pigmented; eyestalk swollen, cylindrical. Antennule and antenna normal but significantly reduced, mostly covered by eyes and carapace; basal peduncular segment of antennule without ventromesial and distolateral teeth; scaphocerite of antenna reduced, ear-shaped, without distolateral tooth. Mandible well developed, without palp; maxillula with bilobed palp; maxilla normal, with tapering, simple palp; endites stout; basal endite simple, distally bluntly rounded, furnished with stiff, elongated setae; coxal endite well-developed, distally bluntly rounded, furnished with long simple setae; scaphognathite broad, furnished with short plumose setae; first maxilliped normal; epipod triangular, with medial notch; exopod slender, with expanded caridean lobe; basal and coxal endites completely fused; second maxilliped with normal ear-shaped epipod, exopod long and slender reaching to propodal segment, distolateral margin of propodus broadly rounded, dorsal margin convex, furnished with slender setae, dactylus about 3 times as long as broad; third maxilliped normal. Appendages robust, unarmed; first pereiopod normal; second pereiopod small, robust, equal in size and shape, with unarmed articles, with normal chela; third pereiopod robust, with biunguiculate dactylus; main unguis long and slender, with oblique tip bearing several small teeth; accessory unguis small, triangular. Uropod stout, exopod with bluntly-rounded distolateral angle, with stout curved distolateral spine.

Type species. *Pinnotherotonia rumphiusi* sp. nov., by present designation and monotypy.

Etymology. The genus is named to reflect its morphological similarity to the bivalve-associated crab genus *Pinnotheres* Bosque, 1802 (Decapoda: Brachyura, Pinnotheridae). Gender feminine.

Systematic position. The new genus can be clearly distinguished from all known pontoniine genera by the very broad rostrum reaching the distal segment of and almost completely covering the antennule; the absence of distolateral tooth on the scaphocerite of the antenna and the absence of distal spines on the telson. The new genus is most similar to the bivalve-associated genera *Conchodytes* Peter, 1852 and *Bruceonia* Fransen, 2002. *Conchodytes* can be clearly distinguished by its smooth body and appendages, relatively slender, distally compressed rostrum, the presence of large distolateral tooth on scaphocerite of antenna and distal spines on the distal margin of the telson. The monotypic *Bruceonia (B. ardea)* differs from *Pinnotherotonia rumphiusi* by feebly developed tapering rostrum, well-marked and produced inferior orbital angle of the carapace, the presence of well-developed ventromesial tooth on basicerite of antennula, well-developed distolateral tooth of scaphocerite, and well-developed distal spines on the telson. Such densely setose body and appendages are also rarely found within the Pontoniinae; the only known exceptions being the bivalve-associated *Pontonia pilosa* Fransen, 2002 and *Bruceonia ardeae* (Bruce, 1981), echinoid-associated *Sandimenes hirsutus* (Bruce, 1996), and coral-associated *Ischnopontonia lophos* (Barnard, 1962) and *Anapontonia denticauda* Bruce, 1966.

Pinnotherotonia rumphiusi sp. nov.

(Figs. 1–6)

Material examined. Holotype, ovigerous female, pcl 6.2 mm (UF 3032), Pacific Ocean, Palau, Koror Island, Iwayama Bay, in mantle cavity of *Periglypta crispata*, 0–10 meters, coll. G. Paulay, 01 July 1999.

Diagnosis. As for the genus.

Description. Medium-sized furry pontoniine shrimp with swollen, slightly depressed body (Fig. 1). Carapace (Fig. 2A, B) swollen, oval, densely covered with small setae, without teeth, with pterygostomial angle bluntly produced. Rostrum (Figs. 2C–E, 3A) robust, broad, not tapering, reaching to distal margin of antennular peduncle, curved downward, dorsally and ventrally unarmed, ventral carina forming distinct keel between antennular segments (Fig. 2E), with slightly developed lateral carina (Fig. 3A).

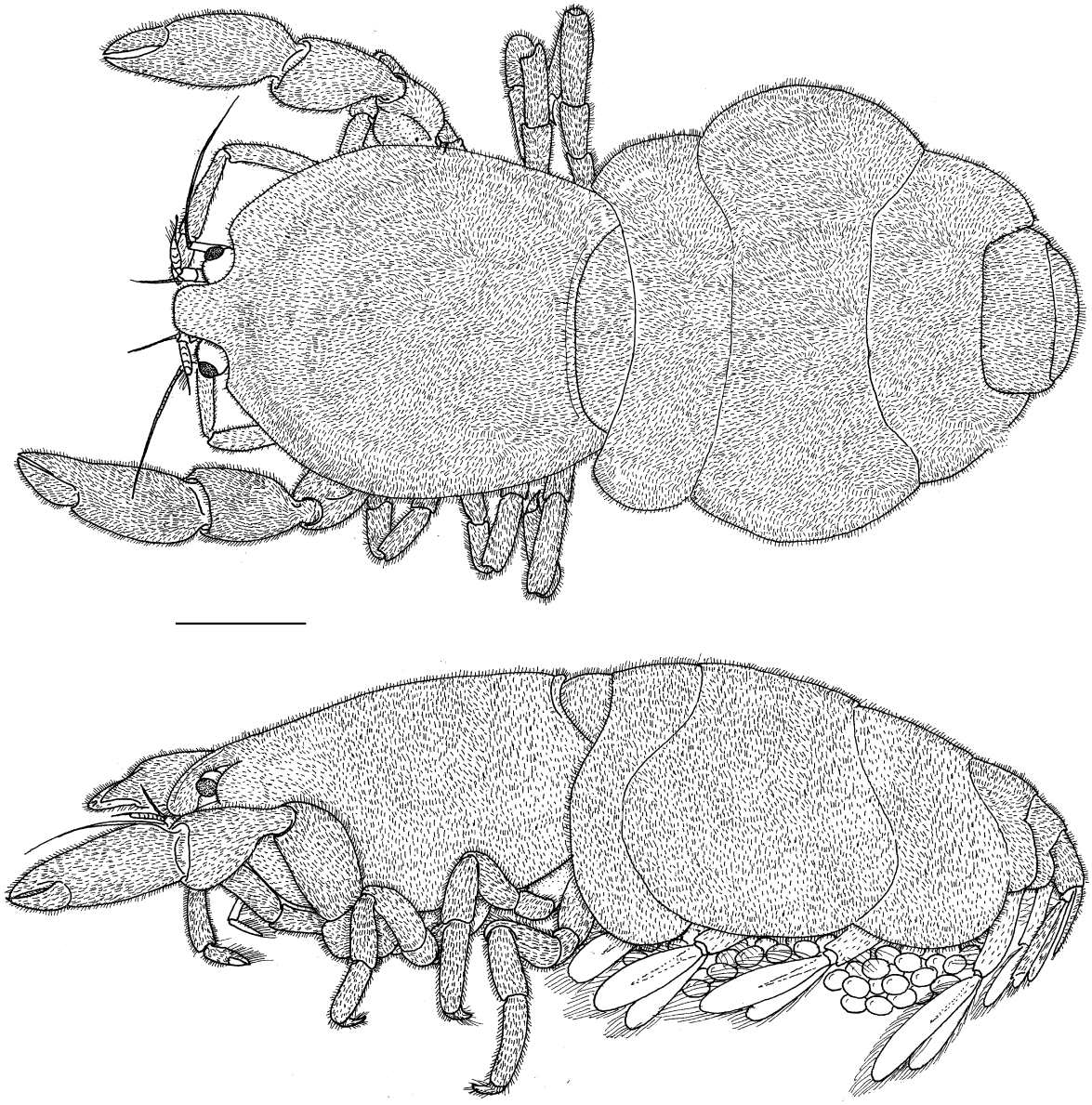

FIGURE 1. Holotype female of *Pinnotherotonia rumphiusi* **gen. et sp. nov.** Scale =1 mm.

Abdominal somites densely covered with setae, unarmed; tergites non-carinate, not posteriorly produced; pleurae of first to third pleomeres posteroventrally rounded; three last pleomeres small, with feebly developed pleurae (fig. 1B); distal and distoventral margins of sixth pleomere rounded (Fig. 3B). Telson (Fig. 3B, C) stout, densely covered with small setae, about 1.2 times as long as wide proximally, tapering distally, with two pairs of small, stout dorsal spines, each about 0.08 of telson length, inserted at about 0.3 and 0.7 telson length, respectively (Fig. 3C); posterior margin tapering, bluntly rounded (fig. 3C), without spines, with a row of long, submarginal setae (Fig. 3D).

Eyes (Fig. 2F) large, swollen, thick, dorsally covered with simple setae; cornea rounded, slightly reduced, pigmented; eyestalk stout, swollen, cylindrical, about as long as wide.

Antennule and antenna reduced, mostly covered by eyes and carapace (Fig. 2C, E). Antennule (Fig. 3G) stout, basal peduncular segment robust, about as long as its proximal width, with straight lateral margins, without ventromesial or distolateral tooth (Fig. 3H); stylocerite stout, bluntly rounded distally, almost reaching to the distal margin of basal segment; second and third segments stout, unarmed, about 0.5 times as long as wide; lateral flagellum thick, main ramus with 4 segments, accessory ramus with 2 segment; mesial flagellum filiform, with 6 segments. Antenna (Fig. 2B) stout; basicerite stout, about twice wider than long, with distolateral margin unarmed; carpocerite robust, slightly overreaching scaphocerite, about twice as long as wide; scaphocerite reduced, ear-shaped, without distolateral tooth, blade rounded distally.

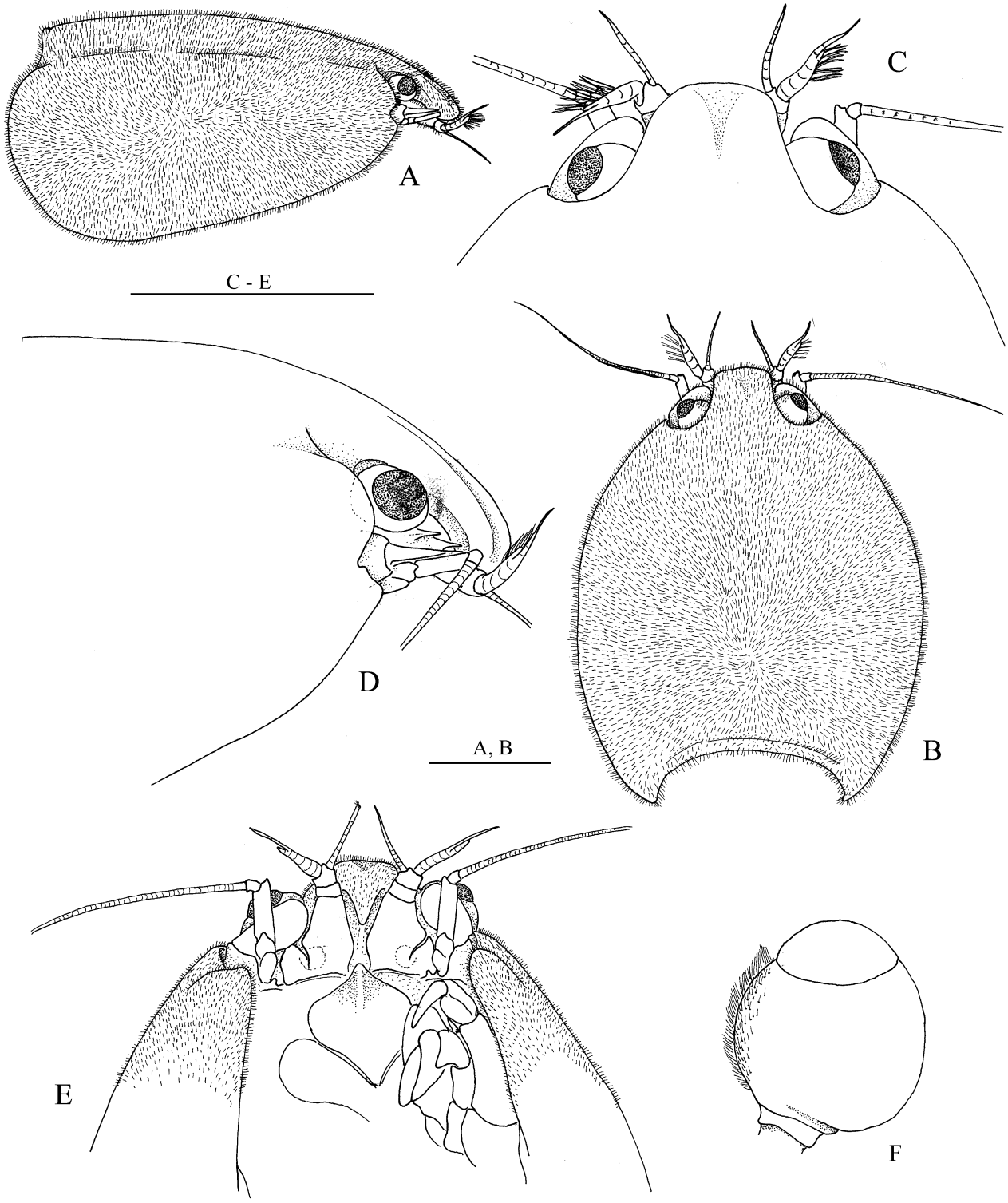

FIGURE 2. *Pinnotherotonia rumphiusi* **gen. et sp. nov.**, holotype. A, B, carapace; C, D, front of carapace; E, front of carapace, ventral view; F, eyes. Scale = 1 mm.

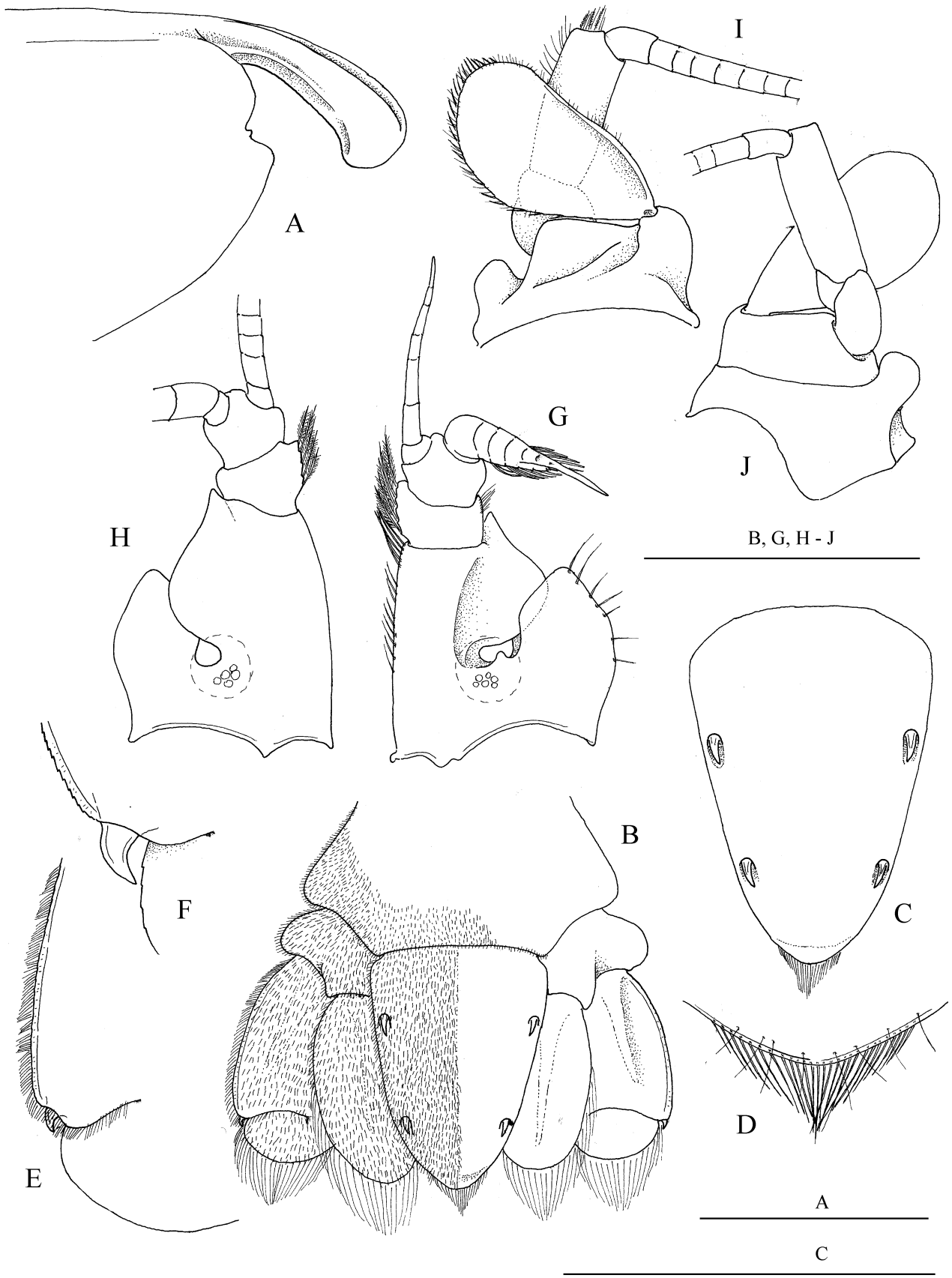

FIGURE 3. *Pinnotherotonia rumphiusi* **gen. et sp. nov.**, holotype. A, rostrum; B, telson and uropods; C, telson; D, same, distal margin; E, lateral margin of exopod of uropods; F, same, distolateral margin; G, H, antennule; I, J, antenna. Scale =1 mm.

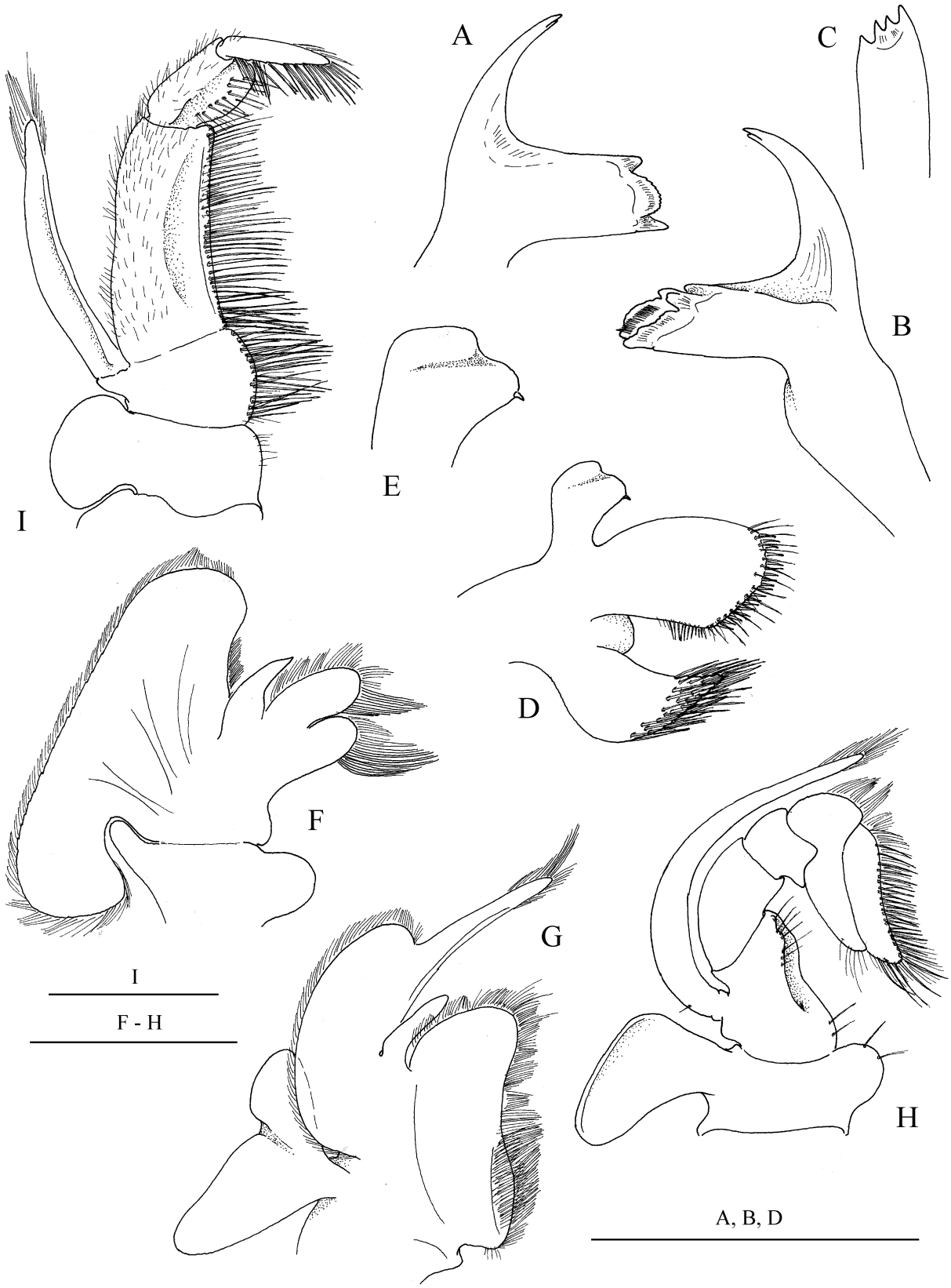

FIGURE 4. *Pinnotherotonia rumphiusi* **gen. et sp. nov.**, holotype. A, B, mandible; C, same, distal margin of the incisor process; D, maxillula; E, same, palp; F, maxilla; G, first maxilliped ; H, second maxilliped; I, third maxilliped . Scale = 1 mm.

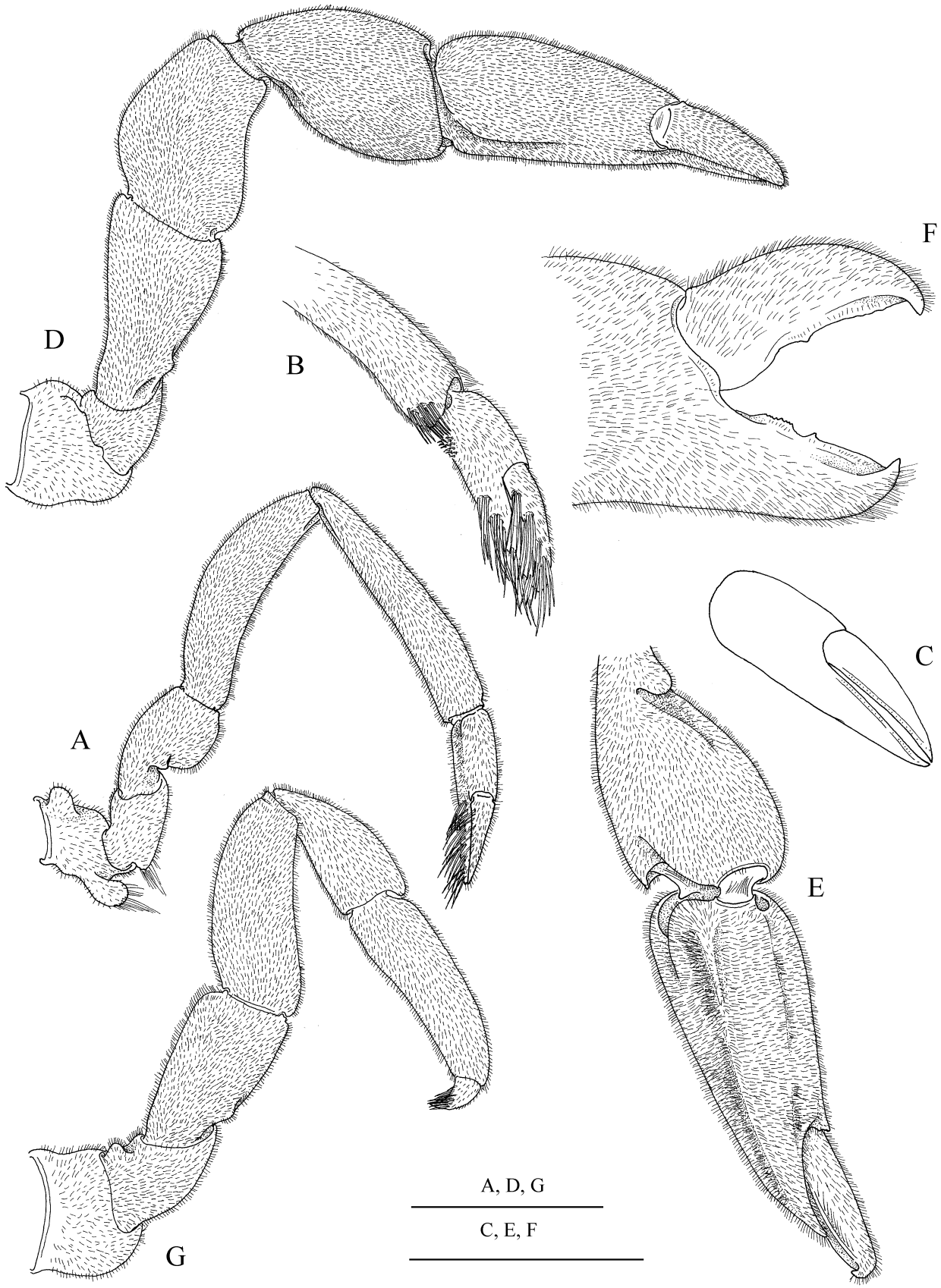

FIGURE 5. *Pinnotherotonia rumphiusi* **gen. et sp. nov**., holotype. A, first pereiopod; B, C, same, chela; D, second pereiopod; E, same, chela; F, same, fingers; G, third pereiopod. Scale = 1 mm.

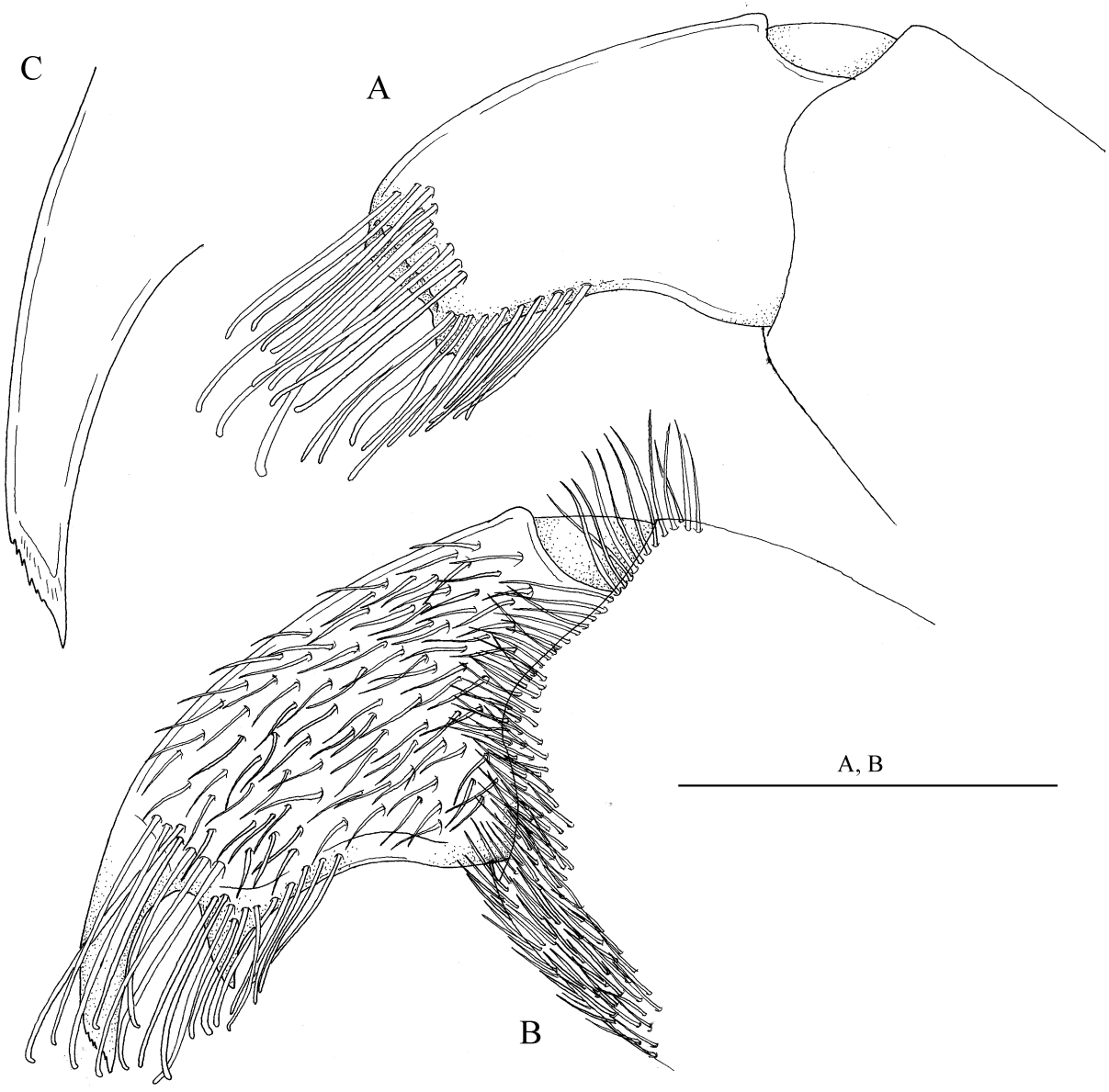

FIGURE 6. *Pinnotherotonia rumphiusi* **gen. et sp. nov.**, holotype. A, dactylus of third pereiopod; B, dactylus of fourth pereiopod; C, same, main unguis. Scale =1 mm.

Epistome with blunt medial carina; labrum suboval (Fig. 2E). Mandible (Fig. 4A–C) well developed, without palp; molar process well-developed, stout; incisor process slender, tapering distally, with four large triangular teeth distally (Fig. 4C). Maxillule (Fig. 4D) with well-developed, bilobed palp, dorsal lobe blunt, ventral lobe with small and curved spine (Fig. 4E); dorsal lacinia broad, expanded distally, distal margin bluntly rounded and covered with a row of small stout spines and numerous simple setae; ventral lacinia slender, not reaching to the distal margin of dorsal lacinia, with simple long setae distoventrally and marginally. Maxilla (Fig. 4F) normal, with tapering, simple palp; endites stout; basal endite simple, distally bluntly rounded, furnished with stiff, elongated setae; coxal endite well-developed, distally bluntly rounded, furnished with long simple setae; scaphognathite broad, furnished with short plumose setae. First maxilliped (Fig. 4G) normal; epipod triangular, with medial notch; exopod slender, with expanded caridean lobe; basal and coxal endites completely fused, excavated, furnished with long simple setae distally; palp slender, rounded distally, without distal setae. Second maxilliped (Fig. 4H) with robust segments; epipod normal, ear-shaped; exopod slender reaching to propodal segment, with long simple setae distally; distolateral margin of

propodus broadly rounded, dorsal margin convex, furnished with slender setae; dactylus about 3 times as long as broad, with numerous medium stout spines and numerous simple setae along distal margin. Third maxilliped (Fig. 4I) stout; epipod rounded, arthrobranch absent; exopod slender, overreaching antepenultimate segment; antepenultimate segment stout, about 3 times as long as wide, with basis and ischiomerus separated by oblique, well-marked suture; penultimate segment about three times as long as wide, with convex bluntly produced mesioventral margin; ultimate segment slender, equal to penultimate segment, about three times as long as wide, tapering distally, with tufts of long setae along ventrolateral margin, with several long setae distally.

First pereiopod (Fig. 4A) relatively slender, densely covered with small setae, segments unarmed; coxa, with well marked, rounded distoventral lobe; basis about 1.5 times as long as wide; ischium about twice as long as wide; merus slender, about 4 times as long as wide, with straight ventral and convex dorsal margins; carpus long and slender, widening distally, slightly longer than merus, about twice longer than chela, about 4.5 times as long as maximal width; palm about twice as long as wide, subcylindrical in cross-section; fingers (Fig. 5C) slender, subcylindrical, about 4 times as long as proximal width, with simple tips and straight cutting edges.

Second pereiopods equal in size and shape (Fig. 1A), with unarmed segments, densely covered with small setae (Fig. 5D); basis rectangular; ischium widening distally, about 1.5 times as long as maximum width; merus stout, about 1.2 times as long as maximum width, with concave ventral and convex dorsal margins; carpus stout, swollen, widening in medial part, about 1.2 times as long as maximum width; palm subcylindrical in cross-section, tapering distally, about twice as long as maximum width; fingers robust, about half of the length of palm, about 2.3 times as long as wide, with several small teeth in proximal half and straight cutting edges distally, with acute, curved tips.

Third pereiopod (Fig. 5G) stout, densely covered with small setae; basis rectangular, about as long as wide; ischium about 1.7 times as long as wide; merus about 2.3 times as long as wide, with straight ventral and convex dorsal margins; carpus stout, widening distally, about 1.5 times as long as merus, about half of the length of propodus, with bluntly projected distodorsal margin slightly overlapping carpo-propodal articulation, with straight ventral and convex dorsal margins; propodus about 3.2 times as long as wide, slightly tapering distally, ventrally unarmed, without distoventral teeth, with straight ventral and convex dorsal margins; dactylus (Fig. 6A) with broken unguis, stout, about 1.6 times as long as wide, with medial and proximal parts covered with small simple setae, with numerous long and simple, proximally-curved setae on distal and disto-ventral margins. Fourth and fifth pereiopods similar to third; dactylus of fourth pereiopod (Fig. 6B), stout, biunguiculate, with medial and proximal parts covered with small, simple setae, with numerous long and simple, proximally curved setae on distal and distoventral margins; main unguis (Fig. 6C) long and slender, smooth, with oblique tip bearing several small teeth, sharp distally; accessory unguis small, simple, triangular, with sharp and curved tip.

Pleopods densely covered with small setae, without specific differentiating features. Uropods stout, densely covered with small setae (Fig. 3B) not exceeding telson; lateral margin of uropodal exopod slightly convex (Fig. 3E), with bluntly rounded distolateral angle, with stout curved distolateral spine (Fig. 3F); dieresis simple.

Colouration. General appearance semi-transparent with orange-red mass of gonads and eggs in carapace and under abdomen respectively; the body and appendages covered with small, diffuse white dots (Fig. 7).

Etymology. The species is named after Georg Eberhard Rumphius (1627–1702), a German-born botanist employed by the Dutch East India Company, who published the first detailed observations on the natural history of the Moluccas, Indonesia, still referred to today. During the study of the fauna of Indonesia, Rumphius (1705) mentioned small, semi-translucent shrimps covered with small white dots and with slender, white legs living inside the lettered venus clam *Tapes literatus* (Linnaeus 1758) (Veneridae) at Amboina. These shrimps have never been identified, nor recorded again since. Fransen (2002) suggested that they could represent *Bruceonia ardeae*, a species with the same coloration. However, *B. ardeae* is known only from the epifaunal *Chama pacifica* Broperip, 1835 (Chamidae), not from infaunal, burrowing venerids. It is more probable, that Rumphius' shrimps represent *Pinnotherotonia rumphiusi* or a yet unidentified congener.

FIGURE 7. Holotype female of *Pinnotherotonia rumphiusi* **gen. et sp. nov.** on the mantle of the host shell *Periglypta crispata*.

Host. The species is known only from one specimen of *Periglypta crispata* (Deshayes 1853) (Veneridae). *Periglypta crispata* is the second most wide-ranging species of its genus, extending from the Red Sea and East Africa to the Line and Tuamotu Islands. It lives shallowly buried in coarse sands at least between 5-30 m depths. It is most common in lagoons, although also occurs on sheltered (or deep) outer reef slopes. It grows to a maximum length of 95 mm, although its close relative (and possible ecomorph) *Periglypta clathrata* (Deshayes 1853) reaches ~115 mm in length (Paulay, unpublished). These species are not frequently encountered alive, which may in part explain the lack of previous and other records on *P. rumphiusi*. Overall *Periglypta* comprises 10 currently-recognized species, 8 in the Indo-west Pacific and one each in the East Pacific and West Atlantic (Paulay, unpublished). GP has collected and opened dozens of specimens of *Periglypta* from across the Indo-west Pacific and only found commensal shrimp in this one specimen.

Distribution. Only known from the type locality, Palau.

Discussion

Bruce (1972b 1975 1981) reviewed known symbiotic associations between pontoniine shrimps and bivalves, while Fransen (2002) reviewed host diversity for species of *Pontonia* Latreille, 1829. Although these reviews are somewhat dated, only 5 new species of bivalve-associated pontoniine shrimps have been described since and no new host taxa recorded. These new associates are *Paranchistus serenei* Bruce, 1983 from Indonesia, in association with *Ostrea* sp. (Ostreidae) (Bruce 1983); *Neoanchistus nasalis* Holthuis, 1986 from Oman, in association with *Mimachlamys townsendi* (Sowerby 1895) (Pectinidae) (Holthuis 1986); *Conchodytes maculatus* Bruce, 1989 from western Australia, in association with *Pinctada maxima* (Jameson 1901) (Pteriidae) (Bruce 1989); *Conchodytes pteria* Fransen, 1994 from Seychelles in association with *Pteria loveni* (Dunker 1889) (Pteriidae) (Fransen 1994); *Pontonia pilosa* Fransen, 2002 from Cape Verde Islands in association with *Chama* sp. (Chamidae) (Fransen 2002); and 2 species described without host indication,

Conchodytes philippinensis Bruce, 1996 - from the Philippines (Bruce 1996) and *Paranchistus liu* Li, Bruce & Manning, 2004 – from the northern part of the South China Sea (Li, Bruce & Manning 2004).

Eleven genera of pontoniine shrimp are known as symbiotic in marine bivalves, and have been recorded from the following 10 families: Pteriidae, Pinnidae, Placunidae, Ostreidae, Spondylidae, Pectinidae, Isognomonidae, Cardiidae (including the Tridacninae), and Chamidae. *Pinnotherotonia rumphiusi* is the second species of pontoniine shrimp living inside burrowing bivalve shells; the only other example is *Neoanchistus cardiodytes* Bruce, 1975 associated with *Vasticardium pectiniforme* (Bruce 1975). Campos, Félix-Pico & García-Domínguez (1995) also reported the giant eggcockle *Laevicardium elatum* (Sowerby 1833) (Cardiidae) and the red clam *Megapitaria aurantiaca* (Sowerby 1831) (Veneridae) as occasional hosts for juveniles of pontoniine *Pontonia pinnae* Lockington, 1978 in the tropical Eastern Pacific, although mature specimens are always found in pen shells (*Pinna rugosa* Sowerby, 1835 and *Atrina tuberculosa* (Sowerby 1835), Pinnidae). Most bivalve-associated pontoniine shrimps live in the mantle cavity of epifaunal, pteriomorph bivalves. Pteriomorphs provide an accessible shelter: symbionts can readily enter the mantle cavity through the broad, open gape exposed above the substratum. Mantle fusion and burrowing are uncommon in the Pteriomorpha (scallops, oysters, mussels, etc), but typical of the Heterodonta (clams). Pinnids (Pteriomorpha) burrow partially, but their posterior margins rise above the sediment, have unfused mantles, and are thus widely open to the surrounding water. Infaunal existence and mantle fusion as well as siphon formation reduce access to the mantle cavity, and few shrimps have managed to invade heterodont bivalves. Notably these clam-dwelling shrimp live in heterodonts of large body size. *Periglypta* is the largest venerid in the oceanic Pacific (including Palau), and among the largest venerids on coral reefs. *Laevicardium elatum* and *Megapitaria aurantiaca* are also among the largest cockles and venerids (both >10 cm). Furthermore all these species are relatively shallow burrowers. Cardiids have short siphons, as do species of *Periglypta*.

Among 41 known bivalve-associated pontoniine species and 11 known genera, 33 species (~80%) and 10 genera are limited to the tropical Indo-West Pacific region. The remaining species belong to the Atlanto-East Pacific genus *Pontonia*, with 3 species (~7%) in the tropical Eastern Pacific (*P. margarita* Smith, 1869, *P. pinnae* Lockington, 1878 and *P. simplex* Holthuis, 1951) and 5 species (~13%) in the Atlantic basin (*P. manningi* Fransen, 2000, *P. mexicana* Guérin, 1856 and *P. domestica* Gibbes, 1850 – in the eastern tropical Atlantic, *P. pilosa* Fransen, 2002 - in Cape Verde Islands, *P. pinnophylax* (Otto 1821) and *P. manningi* Fransen, 2000 – in the western Atlantic). The strong difference in diversity and species composition between the Indo-west Pacific and Atlanto-East Pacific bivalve-associated pontoniine faunas is not the result of host availability, but likely reflects historical factors and dispersal limitation. All bivalve host families, and many of the genera occupied in the Indo-west Pacific also occur in the Atlantic and East Pacific, and include many large-bodied, epifaunal species in these regions as well.

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