

Amphipoda (Crustacea) from Palau, Micronesia: Families Ampeliscidae, Ampithoidae, Aoridae, Colomastigidae and Cyproideidae

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Abstract

12 species of amphipod in 5 families, collected from shallow reefs in Palau by S. DeGrave during 2002, are reported here. Of these, five species are new to science and *Microdeutopus tridens* Schellenberg (1938) is redescribed and transferred to the genus *Bemlos* Shoemaker (1925). The collection included several additional species in the genera *Amphilochus* Bate, 1862, *Ampithoe* Leach (1814), *Bemlos*, *Byblis* Boeck (1871), *Colomastix* Grube (1861) and *Notopoma* Lowry & Berents (1996), that were either incomplete or juvenile and could therefore not adequately be described. In addition, two new species of *Plumithoe* Barnard & Karaman (1991) are erected from the literature. Other families collected in Palau will be considered in later contributions.

Keywords

Amphipoda, taxonomy, new species, Ampeliscidae, Ampithoidae, Aoridae, Colomastigidae, Cyproideidae, Palau, Micronesia

Introduction

During the 2002 Oxford University Museum Expedition to Palau, amphipods were collected and kindly made available to the author for study by Dr Sammy De Grave. The collection consisted of almost 50 species in 20 families. This first contribu-

tion describes species belonging to the families Ampeliscidae, Ampithoidae, Aoridae, Colomastigidae and Cyproideidae. Five species are new to science and are fully described here. In addition, two new species of *Plumithoe* Barnard & Karaman (1991) are erected from the literature.

Materials and methods

Specimens were dissected in alcohol and mounted on slides in glycerine for study. Drawing was accomplished using a drawing tube attached to a compound microscope. Type material is deposited in the Zoological Collection of the Oxford University Museum of Natural History (OUMNH.ZC).

Abbreviations used in figures. Hd = Head; A1, A2 = antenna 1, 2; Md = mandible, Mxp = maxilliped, G1, G2 = gnathopods 1,2; P3-P7 = pereopods 3-7; Ep 1-3 = epimera 1-3; U1-U3 = uropods 1-3; T = telson; M = male; F = female.

Systematic section

Family Ampeliscidae Costa, 1857

Ampelisca malakalensis sp. n.

urn:lsid:zoobank.org:act:27622D65-45A2-4FFD-BA7B-3C2C21E37A8C

http://species-id.net/wiki/Ampelisca_malakalensis

Figures 1–2

Type material. Holotype male, 6.0 mm. OUMNH.ZC.2002-24-0078, *Halimeda* Flat, flat bottom; from washings of *Halimeda* and sediment, 33 m depth; 07°17.444'N, 134°28.289'E; leg. S. De Grave & P. Colin, 31 May 2002.

Etymology. Named after a harbour near the type locality.

Description. Based on male holotype. 6.0 mm.

Head. *Head* about one and a half times longer than deep, anteroventral margin oblique. *Eyes*, two pairs each with a cuticular lens; lenses with pigment patches around or near them. *Antenna 1* a little more than half body length; peduncular articles 1 and 2 with numerous bunches of short setae on the posterior margin, peduncular article 2, one and a half times length of article 1; flagellum with 24 articles, reaching end of peduncular article 5 of antenna 2; articles 2–3 with field of long setae. *Antenna 2* equal to body length, peduncular articles 4 and 5 very long, article 5 a little longer than article 4, peduncular article 4 with bunches of short setae on the anterior margin; flagellum with 26 articles. *Mandible* palp article 2 swollen proximally, longer than article 3.

Pereon. *Gnathopod 1* coxa distally rounded without notch. *Gnathopod 2* coxa distally rounded, with small postero-distal notch. *Pereopods 3–4* with dactylus exceeding combined length of carpus and propodus. *Pereopod 5* basis posteroproximal margin

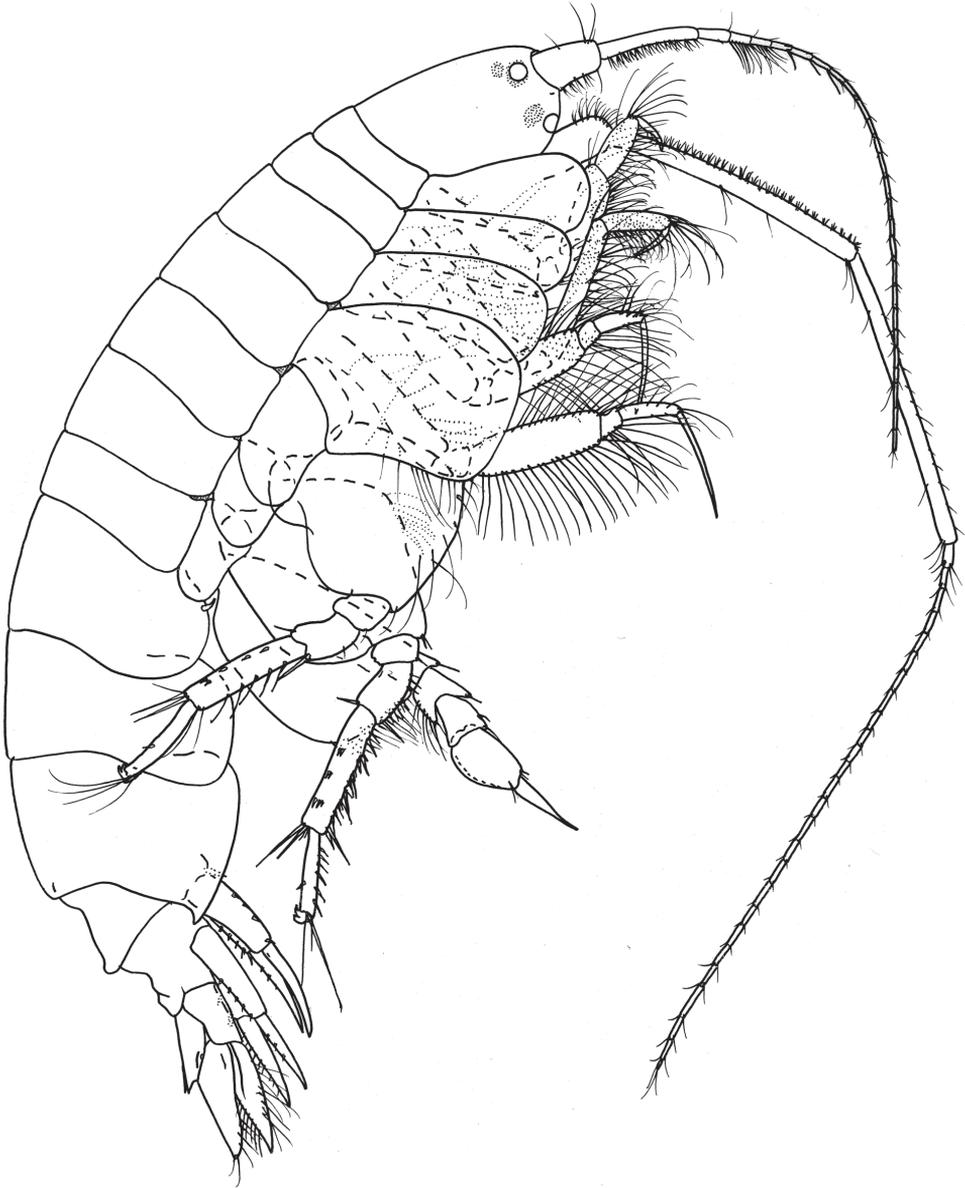


Figure 1. *Ampelisca malakalensis* sp. n., male.

with large discrete lobe. *Pereopod* 7 basis posterodistal lobe not reaching beyond ischium; propodus inflated, sub-ovoid, dactylus basally expanded.

Pleon. *Epimera* 1–2 rounded. *Epimeron* 3 with well developed posterodistal spine. *Uropod* 3 rami broadly lanceolate, inner margins serrate and with long fine setae. *Telson* a little less than twice as long as broad, cleft to four fifths its length bearing rows of mid-dorsal setae on each side and with distal margins bearing stout setae.

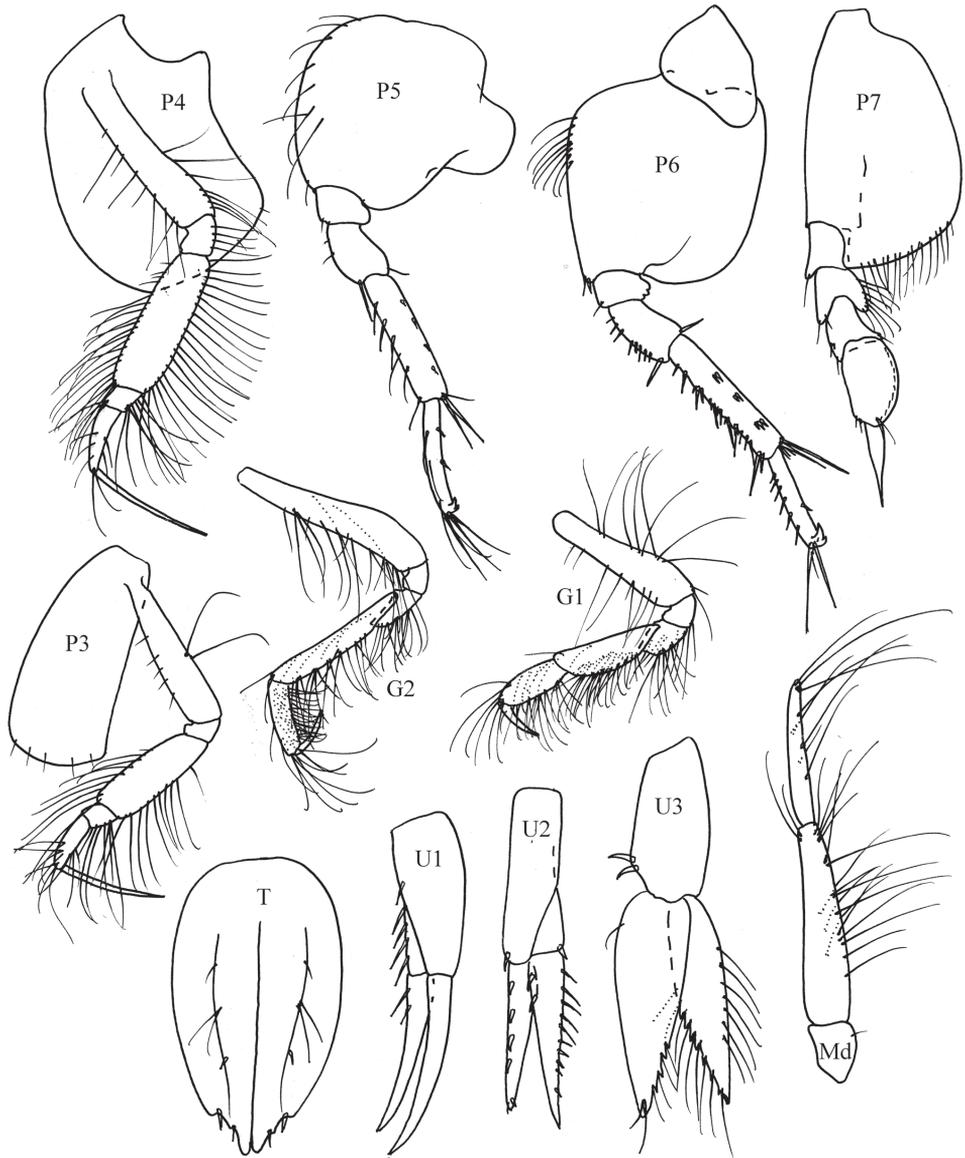


Figure 2. *Ampelisca malakalensis* sp. n., male.

Female. Unknown.

Remarks. *Ampelisca malakalensis* sp. n. resembles *A. melanesiensis* Myers from Fiji, but that species has a short antenna 1 the flagellum of which does not reach the end of peduncular article 5 of antenna 2. In having antenna 1 flagellum reaching the end of peduncular article 5 of antenna 2, this species is very close to *A. jüigurru* King from the Great Barrier Reef, but differs from that species in the much more elongated pedun-

cular articles 4 and 5 of antenna 2, the basally swollen mandible palp, the discretely lobed posterior margin of the basis of pereopod 5, the elongate and slender dactylus of pereopod 7, and in the scalloped distal margin of the telsonic lobes.

Habitat. On soft sediment with *Halimeda*.

Distribution. Known only from the type locality.

***Byblis levis* sp. n.**

urn:lsid:zoobank.org:act:746F29AE-0F26-4989-BA09-A1482D8157A1

http://species-id.net/wiki/Byblis_levis

Figures 3–4

Type material. Holotype female, 2.5 mm. OUMNH.ZC.2002-24-0079, Inside Pinchers, bait trap sample, sandy callianasid flat, 3 m depth; 07°20.407'N, 134°25.755'E; leg. S. De Grave & C. Burras, night 27th–28th May 2002.

Paratypes. 1 female, OUMNH.ZC.2002-24-0080, Malakal Channel, light trap sample, 2 m deep; 07°17.448'N, 134°28.070'E; leg. S. De Grave & C. Burras, night 21th–22th May 2002.

Etymology. Latin *levis* = lightly armed. In reference to the rather sparse setae of this species compared with other members of the genus

Description. Based on female holotype. 2.5 mm.

Head. *Head* less than one and a half times as long as deep, anteroventral margin oblique. *Eyes*, two pairs each with a cuticular lens; lenses with strong brown pigment patches around or near them. *Antenna 1* about half body length; peduncular article 2 more than twice times length of article 1; flagellum with 17 articles, reaching well beyond end of peduncular article 5 of antenna 2. *Antenna 2* equal to body length, peduncular article 4 a little longer than article 5, flagellum with 24 articles.

Pereon. *Gnathopods 1–2* coxa distally rounded without notch. *Pereopods 3–4* dactylus shorter than propodus. *Pereopod 5* basis posteroproximal margin with weak lobe. *Pereopod 7* basis posterodistal lobe reaching beyond ischium, weakly scalloped and bearing setae on distal and anterior margins; propodus slender, parallel-sided, dactylus spine-like.

Pleon. *Epimera 1–3* rounded. *Uropod 3* rami broadly lanceolate, inner margins proximally excavate and serrate. *Telson* one and a half times as long as broad, cleft to two fifths its length, distal margins broadly rounded

Male. Unknown

Remarks. Species of *Byblis* are only occasionally reported from shallow water, being characteristically found in depths of 20–300 metres. *Byblis* species are rather uniform in design, with character states being found in myriad combinations. This makes it difficult to assign *Byblis* species to groups and therefore difficult to compare a new species with existing species, since each species shares a different suite of characters with different species. The antennal length, distally rounded coxa 1–3, pereopod 7 basis shape and position and number of robust setae on the carpus and propodus, the rather short uropod 2, the slender, elongate uropod 3 rami, and the telson lacking dis-

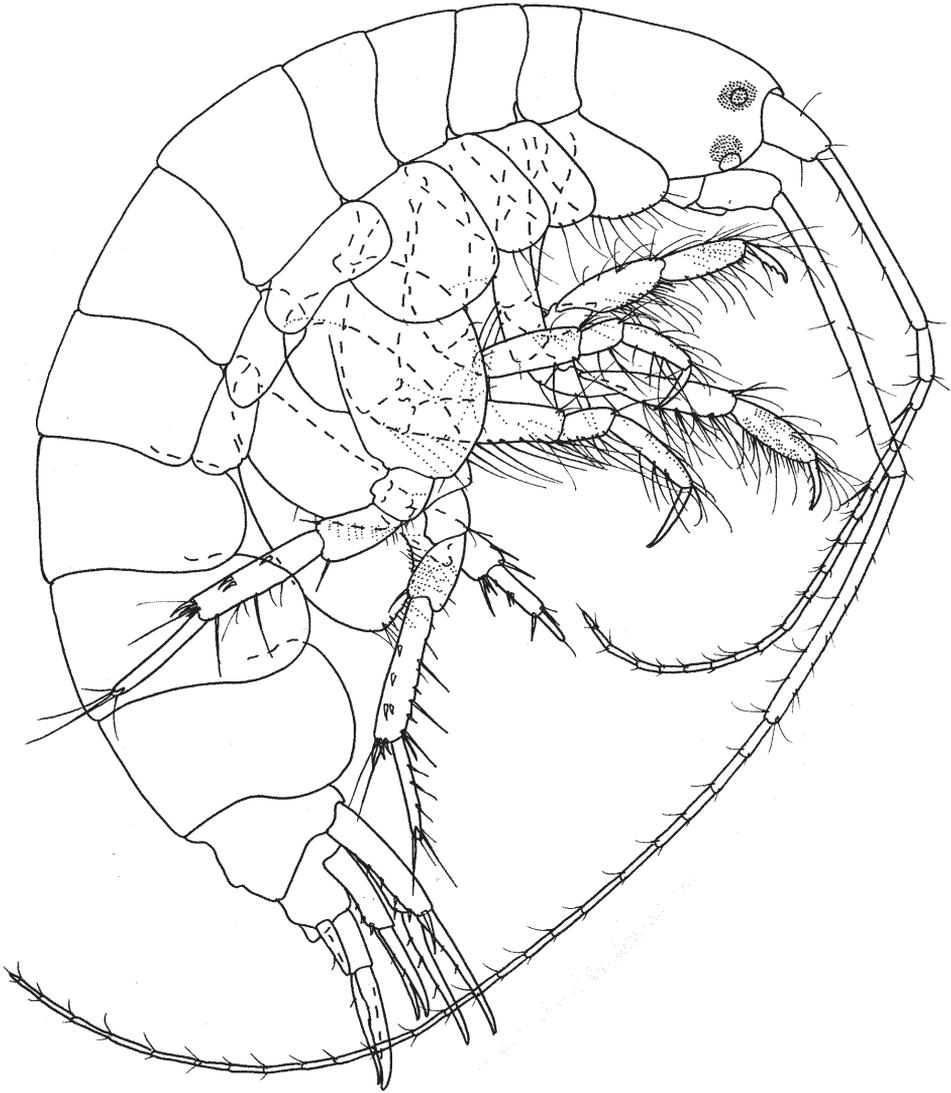


Figure 3. *Byblis levis* sp. n., female.

tal setae, when taken in combination distinguish *B. levis* sp. n. from all other described species. The possibility cannot be excluded that the material examined may not be fully mature. This could explain the scarcity of setae in the material.

Habitat. Sand flats in shallow water.

Distribution. Known only from the type locality.

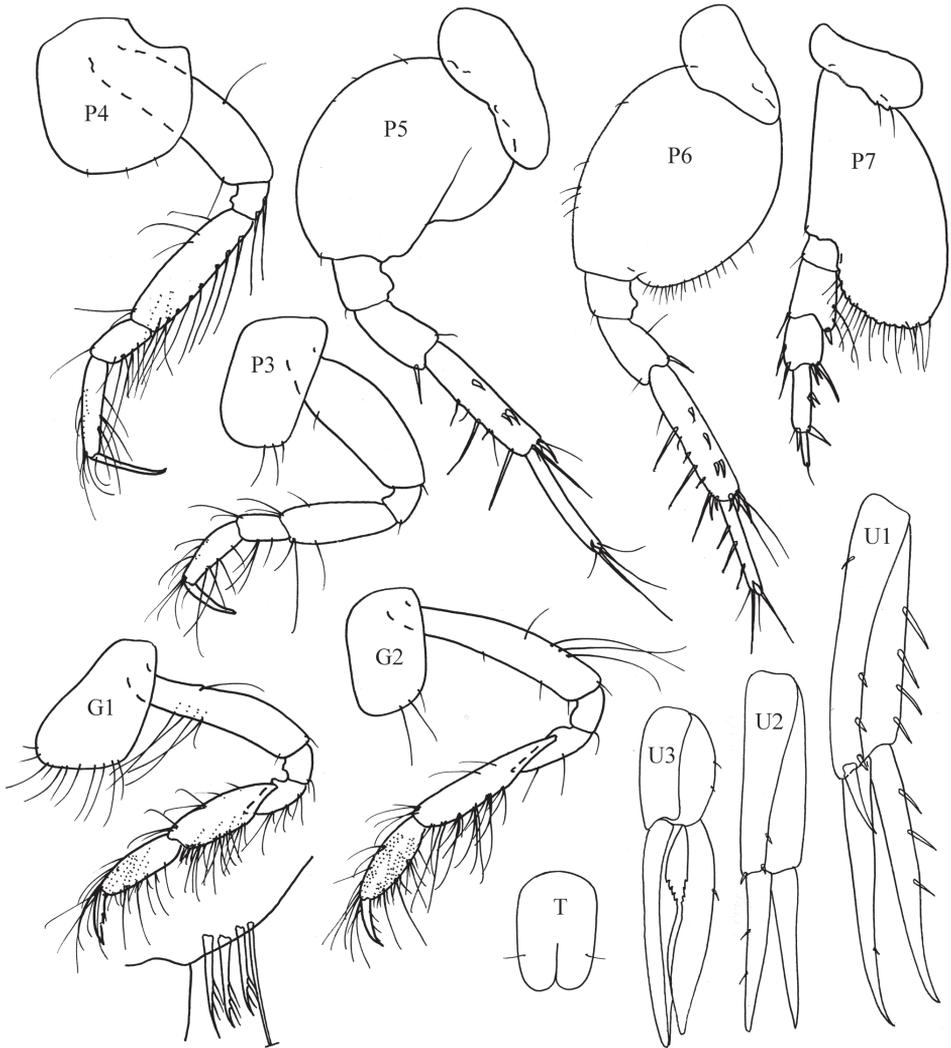


Figure 4. *Byblis levis* sp. n., female.

Ampithoidae Stebbing, 1899

***Ampithoe cookana* Peart, 2007**

http://species-id.net/wiki/Ampithoe_cookana

Figure 5

Ampithoe cookana Peart 2007b, 13, figs 7-10.—Hughes and Lowry 2009, 154, figs 1–2.

Material examined. 2 males, 10 females, 4 immature, OUMNH.ZC.2002-24-0081, Beluu Lukes Reef, drop off, 15 m depth; from *Meloplhus sarasinorum* Thiele, 1899

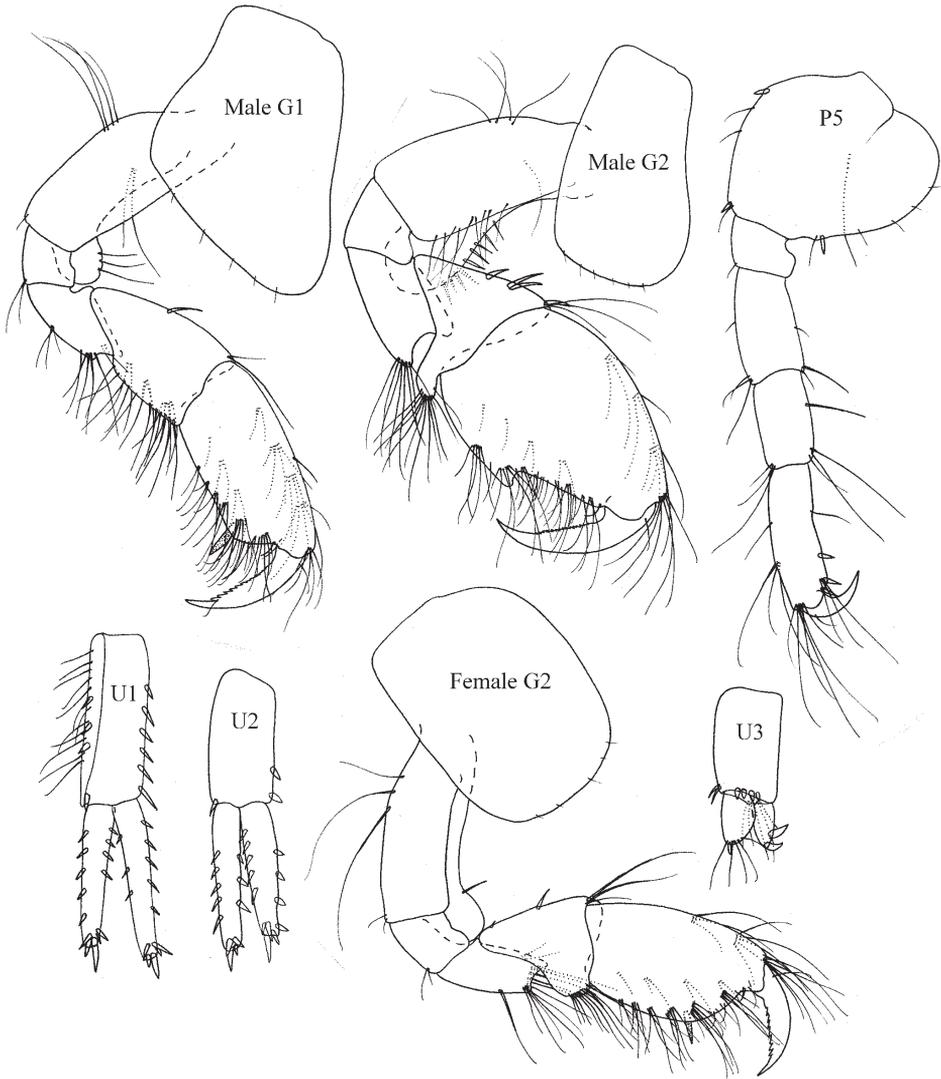


Figure 5. *Ampithoe cookana* Peart, male

(Porifera: Ancorinidae); 07°17.530'N, 134°30.870'E; leg. S. De Grave & C. Burras, 2 June 2002; 4 males, 7 females, OUMNH.ZC.2002-24-0082, Ngeritaal Pass, from *Polycarpa captiosa* (Sluiter, 1885) (Ascidiacea: Styelidae), 5 m depth; 07°19.223'N, 134°28.271'E; leg. S. De Grave & C. Burras, 20 May 2002.

Remarks. Present material agrees well with the original description of the species from the Cook Islands (Peart, 2007b) as well as with material from the Great Barrier Reef, Australia by Hughes and Lowry (2009). Specimens in the current collection from Palau reach a maximum length of 6.5 mm.

Distribution. Australia (New South Wales, Queensland); Palau.

***Ampithoe cf ramondi* Audouin**

http://species-id.net/wiki/Ampithoe_cf_ramondi

Figure 6

Material examined. 2 males, OUMNH.ZC.2002-24-0083, Ikedluches Reef, outer rubble slope, from unidentified gorgonian with dead base and small amount of algae, 20 m depth; 07°17.987'N, 134°28.756'E; leg. S. De Grave & C. Burras, 25 May 2002; 1 male 1 juvenile, OUMNH.ZC.2002-24-0084, Lighthouse Reef, intertidal collection, consolidated rubble collection; 07°16.658'N, 134°27.670'E; leg. S. De Grave & C. Burras, 26 May 2002.

Remarks. As pointed out by Myers (1985), *Ampithoe ramondi* represents a species complex that has yet to be elucidated. Present material agrees very well with material described from Fiji by Myers (1985) under the name *A. ramondi*. It shows some

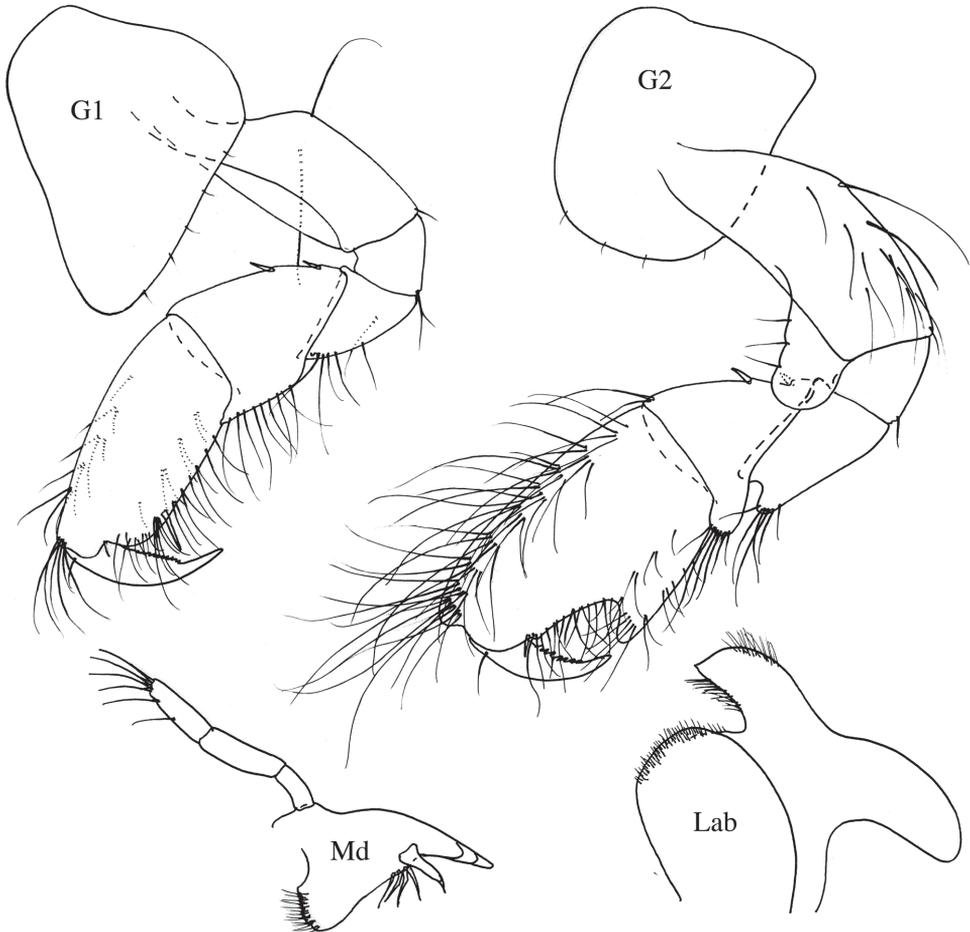


Figure 6. *Ampithoe cf ramondi* Audouin male

similarity with *A. katae* Peart (2007b), from the Great Barrier Reef, but it differs from that species in the more strongly produced posterodistal corner of the male gnathopod 2 merus and carpus and in the more elongate mandible palp article 3. In the latter character state it resembles *A. cookana* Peart, also from the Great Barrier Reef, but that species has a relatively weakly setiferous propodus anterior margin on the male gnathopod 2. For the moment this material, as well as material described from Fiji by Myers (1985), is simply referred to the *A. ramondi* complex.

Distribution. Australia (Queensland, Western Australia); Palau.

Cymadusa wistari Peart, 2007

http://species-id.net/wiki/Cymadusa_wistari

Figure 7

Cymadusa wistari Peart 2007a, 46, figs 37–40.—Hughes and Lowry 2009, 204, figs 31–32.

Material examined. 1 male, 13 females, OUMNH.ZC.2002-24-0085, Outside Pinchers, from floating algae (*Turbinaria ornata*), leaves on drifline; 07°19.839'N, 134°24.154'E; leg. S. De Grave & C. Burras, 22 May 2002; 3 females, .2002-24-0086, outside Risong, seagrass hand dredge of sediment, 1 m, 07°17.928'N, 134°28.671'E; leg. S. De Grave & C. Burras, 22 May 2002.

Remarks. Present material agrees well with the description of *Cymadusa wistari* Peart (2007a) from Heron Island. The only apparent difference is the longer setae on the anterior margin of the male gnathopod 2 carpus. It belongs to the '*C. filosa*' group of species.

Distribution. Australia (Queensland); Palau.

Paragrubia edgari Hughes & Lowry

http://species-id.net/wiki/Paragrubia_edgari

Figure 8

Paragrubia edgari Hughes & Lowry, 2009, 207, figs 33–34.

Paragrubia vorax.—Myers 1985, 33, figs 24–25 (not *Paragrubia vorax* Chevreux, 1901, 427, figs 50–55).

Material examined. 3 males, 4 females, OUMNH.ZC.2002-24-0087, Pkuklim Reef; *Halimeda* clumps on reef rubble, from *Halimeda* (Chlorophyta) washings, 6 m depth; 07°20.542'N, 134°34.023'E; leg. S. De Grave & C. Burras, 29 May 2002.

Remarks. Present material agrees well with the description of *P. edgari* Hughes & Lowry from Lizard Island, Great Barrier Reef. It also agrees with material from Fiji attributed by Myers (1985) to *P. vorax* Chevreux.

Distribution. Australia (Queensland); Fiji, Palau.

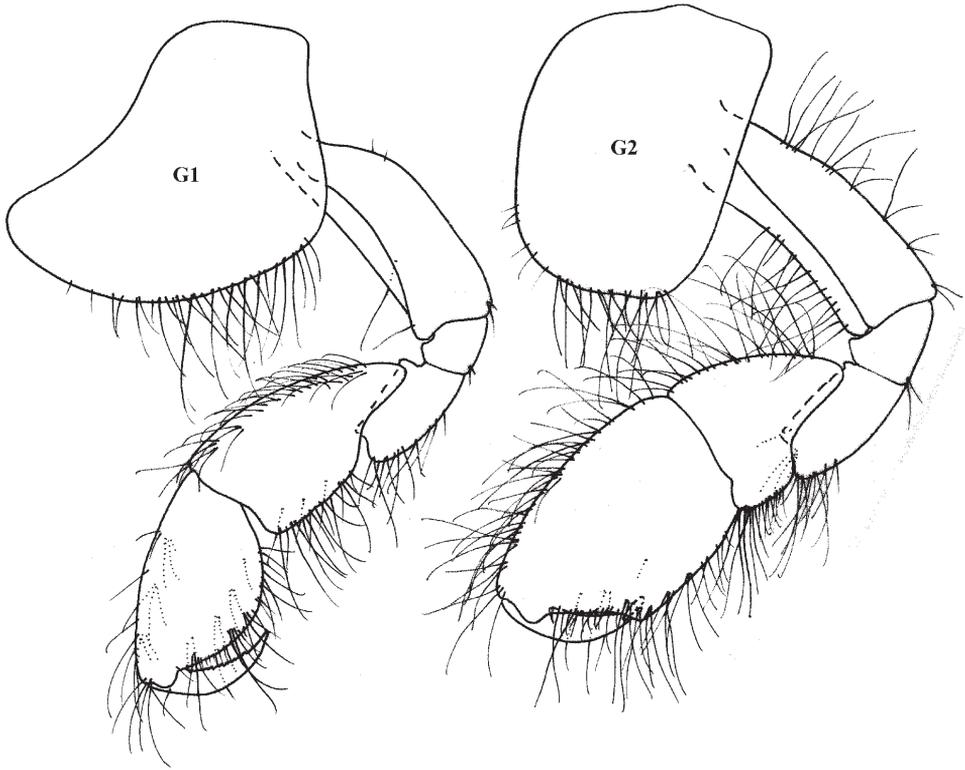


Figure 7. *Cymadusa wistari* Peart, male

Genus *Plumithoe* Barnard & Karaman (1991)

This genus currently contains three designated species (Poore and Lowry 1997). These are: *P. hirsuta* (Ledoyer, 1978), *P. plumicornis* (Ledoyer, 1979) and *P. quadrimana* (Haswell, 1879).

A fourth species *P. lata* sp. n. is described here, and two described materials previously allocated to *P. hirsuta* (Ledoyer), are raised to species status.

Plumithoe lata sp. n.

urn:lsid:zoobank.org:act:6D65FAC8-6806-473D-8D91-F540ED96E74A

http://species-id.net/wiki/Plumithoe_lata

Figures 9–10

Type material. Holotype male 2.2 mm OUMNH.ZC.2002-24-0088 Pkuklim Reef; clumps on reef rubble, from *Halimeda* (Chlorophyta) washings, 6 m depth; 07°20.542'N, 134°34.023'E; leg. S. De Grave & C. Burras, 29 May 2002. Paratypes. 2 males, 3 females, 1 imm, collecting data as for holotype.

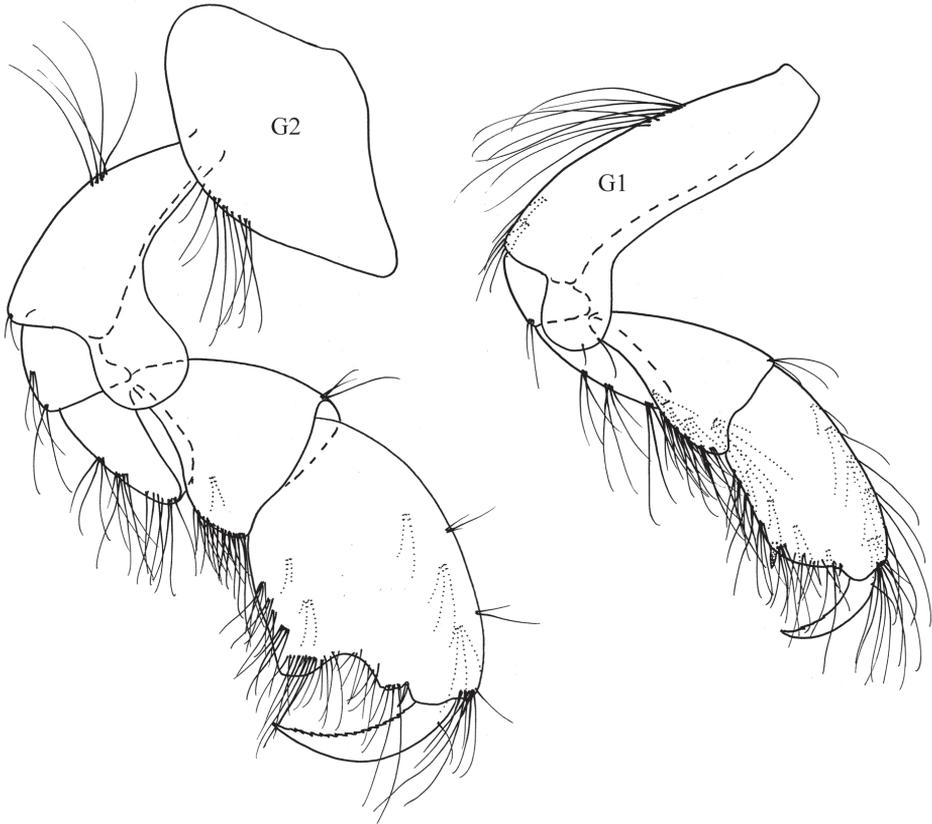


Figure 8. *Paragrubia edgari* Hughes & Lowry, male

Etymology. From the Latin ‘lata’ = wide, in reference to the expanded obtuse elongation of the coxa of the male gnathopod 1.

Description. Based on male holotype 2.2 mm.

Head. *Head* lateral lobes rounded, anterodistal margin scarcely excavate; eyes medium size. *Antenna 1* a little over half length of body; peduncular articles short; article 3 about half length of article 1; accessory flagellum absent; flagellum more than two times length of peduncle, with 14 articles. *Antenna 2* about two thirds length of antenna 1; peduncle short; articles 4 and 5 subequal; articles 3–5 bearing tufts of long setae on the posterior margin; flagellum with 10 articles. *Mandible* palp articles in the ratios (basi-distal) 2:3:3.

Pereon. *Gnathopod 1* coxa anterodistal margin strongly produced, obtuse; basis short, expanded, with large anterodistal flange; propodus longer than carpus, palm evenly rounded; dactylus overlapping palm. *Gnathopod 2* coxa unproduced, deeper than broad; basis robust, expanded, with strongly convex posterior margin and concave anterior margin, moderately produced anterodistal flange; carpus very reduced, cup-shaped, with strongly produced lobe between merus and posterior margin of propodus; propodus elongate, subrectangular, with strong, broad-based posterodistal spine,

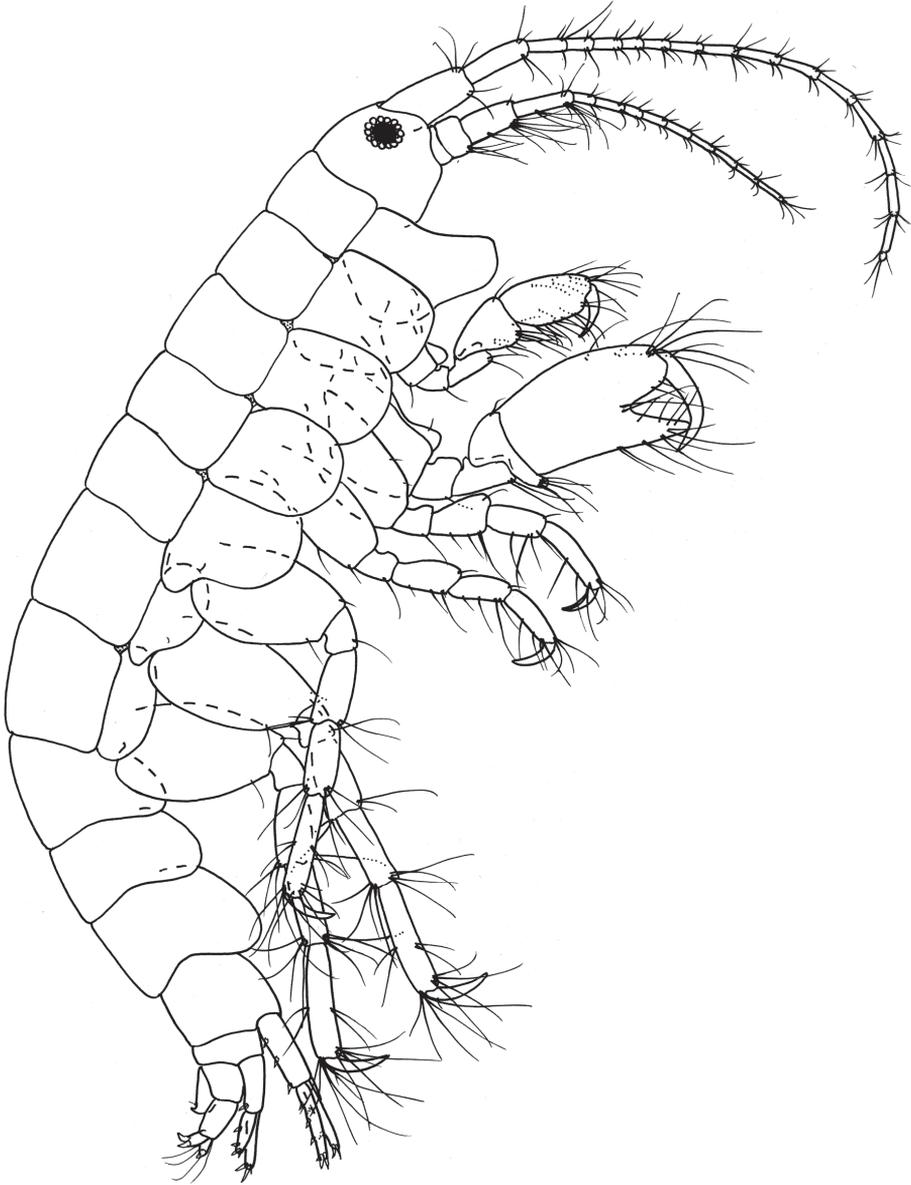


Figure 9. *Plumithoe lata* sp. n., male

separated from anterior dactylar lobe by deep triangular excavation; dactylus stout, falciform, slightly overlapping posterodistal spine. *Pereopods 3–4* basis elongate-ovoid; propodus without robust setae; dactylus about half length of propodus. *Pereopods 5–7* with pyriform basis. *Pereopod 7* scarcely longer than pereopod 6.

Pleon. *Epimeron 3* evenly rounded with minute notch bearing minute seta. *Uropod 1* peduncle longer than rami, with short distoventral spine; outer ramus longer than

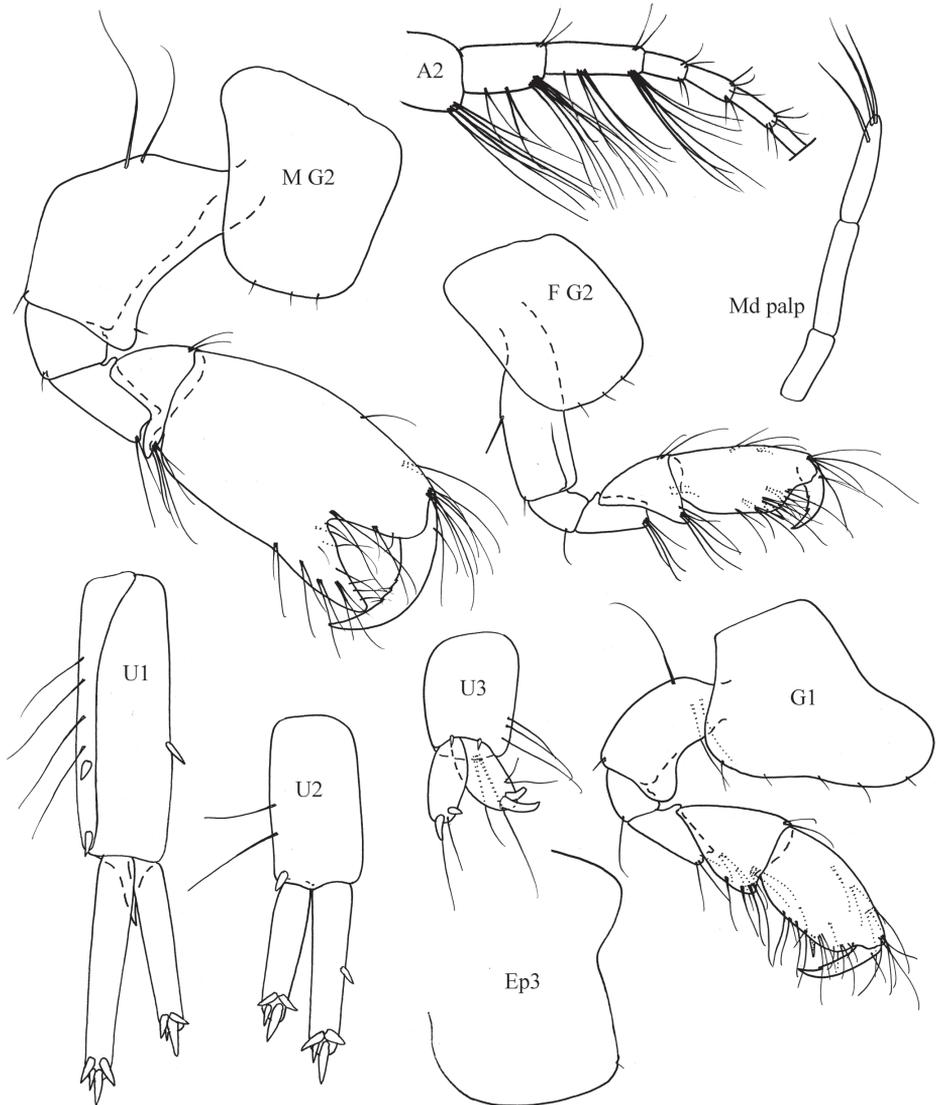


Figure 10. *Plumithoe lata* sp. n., male, female

inner, both rami lacking marginal robust setae. *Uropod 2* peduncle and inner ramus subequal in length; inner ramus longer than outer with one marginal robust seta. *Uropod 3* peduncle longer than rami; rami subequal, outer ramus with 2 recurved robust setae. *Telson* with small telsonic cusps.

Female (sexually dimorphic characters). *Gnathopod 2* basis elongate weakly expanded, lacking strong anterodistal flange; carpus subtriangular.

Remarks. *Plumithoe lata* sp. n. differs from *P. hirsuta* Ledoyer, from Mauritius and *P. madagascariensis* sp. n. from Madagascar, in the shape of the male gnathopod 1 coxa,

which is expanded both anterodistally and anteroproximally in *P. lata* sp. n. but only anterodistally in Madagascan material. It also differs from *P. hirsuta* Ledoyer in the straight robust spine on the propodus of the male gnathopod 2 (slender and curved in *P. hirsuta*). *P. lata* sp. n. also resembles *P. acuticoxa* sp. n. from Fiji, but Fijian material differs in having a slender basis (as in *A. pollex* var *hirsutus* from Mauritius) fringed with long setae in the male gnathopod 2 (a unique feature of Fijian material).

Habitat. Amongst *Halimeda*.

Distribution. Known only from the type locality.

***Plumithoe acuticoxa* sp. n.**

urn:lsid:zoobank.org:act:E94FBDCE-697C-41FA-A01B-EF965C1C0899

http://species-id.net/wiki/Plumithoe_acuticoxa

Ampithoe hirsuta Myers 1985, 22, figs 13–14.

not *Ampithoe pollex* var *hirsutus* Ledoyer 1978, 220, fig.8.

Type material. Holotype male (AM P35333) Makaluva Island, Viti Levu, Fiji, 13 August, 1979, coral debris from reef crest, A. A. Myers.

Etymology. Named after the shape of the coxa of the male gnathopod 1.

Remarks. A full description and figures of this species are provided by Myers (1985). *P. acuticoxa* sp. n. differs from all other described species of *Plumithoe* by its male gnathopod 2 basis fringed with long setae on the anterior margin. In its acute coxa 1, it differs from all described *Plumithoe* species except *P. quadrimana* (Haswell), but that species lacks a spine on the propodus of the male gnathopod 2. It differs from all other *Plumithoe* species except *P. hirsuta* Ledoyer in its very short article 3 of the mandible palp but differs from that species in the male coxa 1 and gnathopod 2 basis as described above.

Distribution. Fiji

***Plumithoe madagascariensis* sp. n.**

urn:lsid:zoobank.org:act:34AAABC2-6EFE-4699-937D-2B0D553F498A

http://species-id.net/wiki/Plumithoe_madagascariensis

Ampithoe pollex var *hirsutus* Ledoyer 1982, 122, fig. 41.

not *Ampithoe pollex* var *hirsutus* Ledoyer 1978, 220, fig.8.

Type material. Holotype male (Paris Museum), platier externe de Grand recif de Tulear, station MFE8, MT9, M. Peyrot-Clausade.

Etymology. Named after the Country in which is situated the type locality.

Remarks. A description and figures of this species can be found in Ledoyer (1982). *P. madagascariensis* sp. n. differs from *P. hirsuta* Ledoyer in its long mandible palp arti-

cle 3, the more shortened and expanded basis and straight propodal spine of the male gnathopod 2. It differs from *P. lata* sp. n. in the shape of the male coxa 1 which lacks posterior expansion and has a subtriangular anterodistal projection, in the presence of numerous robust setae on the propodus of pereopod 5 and in the more slender spine on the male gnathopod 2 propodus. It differs from *P. acuticoxa* sp. n. in its non-acute male coxa 1, in the more robust basis of the male gnathopod 2 that lacks long setae on its anterior margin, and in the long palp article 3 of the mandible palp.

Distribution. Madagascar.

Aoridae Stebbing, 1899

Bemlos tridens (Schellenberg), comb. n.

http://species-id.net/wiki/Bemlos_tridens

Figures 11–12

Microdeutopus tridens Schellenberg 1938, 74, fig. 38.

Material examined. 1 male, 4.0mm, OUMNH.ZC.2002-24-0090, Malakal Harbour channel, rubble tray left for 10 days; 07°19.014'N, 134°27.636'E; leg. S. De Grave & C. Burras, 2 June 2002; 1 male 2 females OUMNH.ZC.2002-24-0091, Omodes intertidal seagrass bed (sparse *Enhalus*) on rubble flat, hand netting; 07°19.439'N, 134°29.231'E; leg. S. De Grave & C. Burras, 23 May 2002.

Remarks. This material agrees very closely with the original description of Schellenberg (1938). The ratios of the mandible palp articles are slightly different at 4:7:11 (Schellenberg gives 2:3:4). Since Schellenberg's (1938) figures are extremely minimal and somewhat sketchy, and the species has never been reported since, additional figures are presented here.

Habitat. Coral rubble.

Distribution. Gilbert Islands (Schellenberg, 1938): Palau.

Globosolembos ovatus Myers, 1985

http://species-id.net/wiki/Globosolembos_ovatus

Lembos (*Globosolembos*) *ovatus* Myers 1985a, 354, figs 228–230.

Globosolembos ovatus—Myers 1985b, 47, figs 34–35.—Myers 1989, 66, table 1.—Myers 1995, 33.—Myers 2009, 263, figs 33–34.

Material examined. 1 male, OUMNH.ZC.2002-24-0092, Soint Point Cave, Koror island, light trap sample, no GPS; leg. S. De Grave & C. Burras, night 2nd–3rd June 2002.

Distribution. Australia; Papua New Guinea; Palau, Vanuatu, Fiji; Western Samoa; Society Islands.

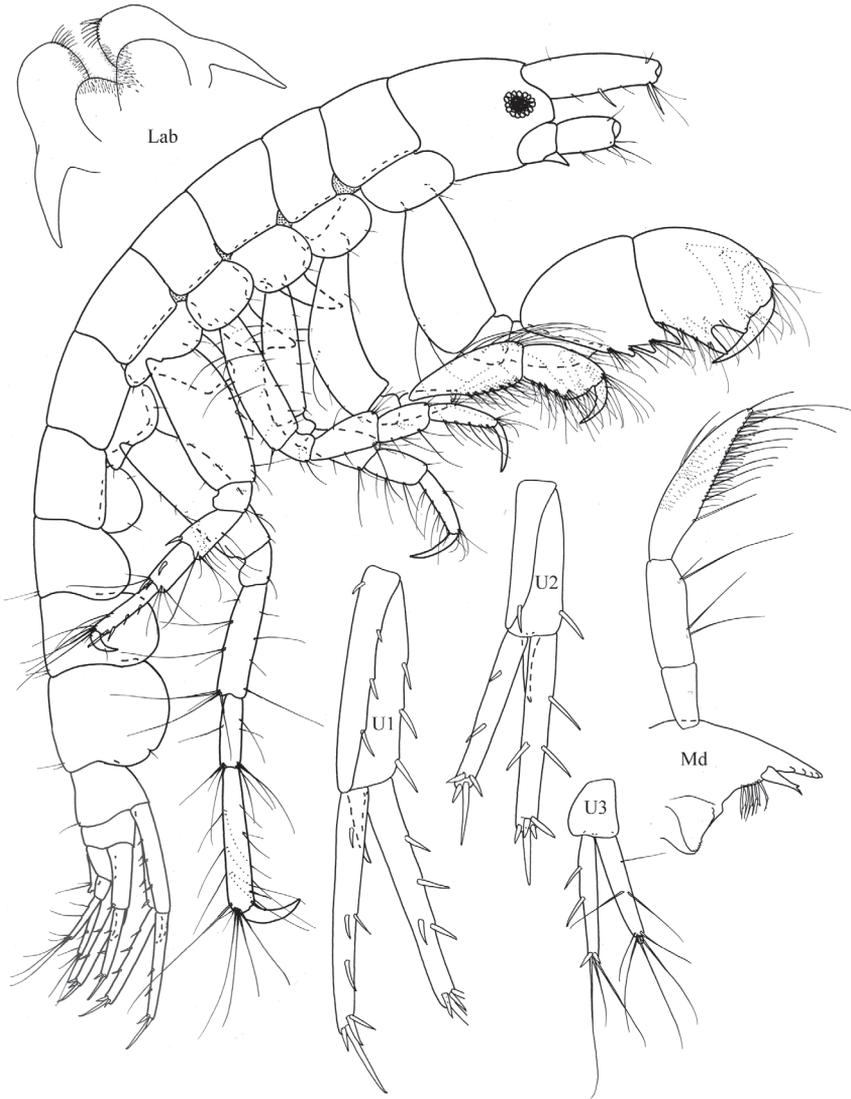


Figure 11. *Bemlos tridens* (Schellenberg) comb. n., male

Colomastigidae Stebbing, 1899

***Colomastix lecroyae* sp. n.**

urn:lsid:zoobank.org:act:D6E6C8C8-DCC0-4D27-AE09-27CEFAA7799E

http://species-id.net/wiki/Colomastix_lecroyae

Figures 13–14

Type material. Holotype male 2.5 mm, OUMNH.ZC.2002-24-0093, Outside Pinchers, rubble slope, from *Melophlus sarasinorum* Thiele, 1899 (Porifera: An-

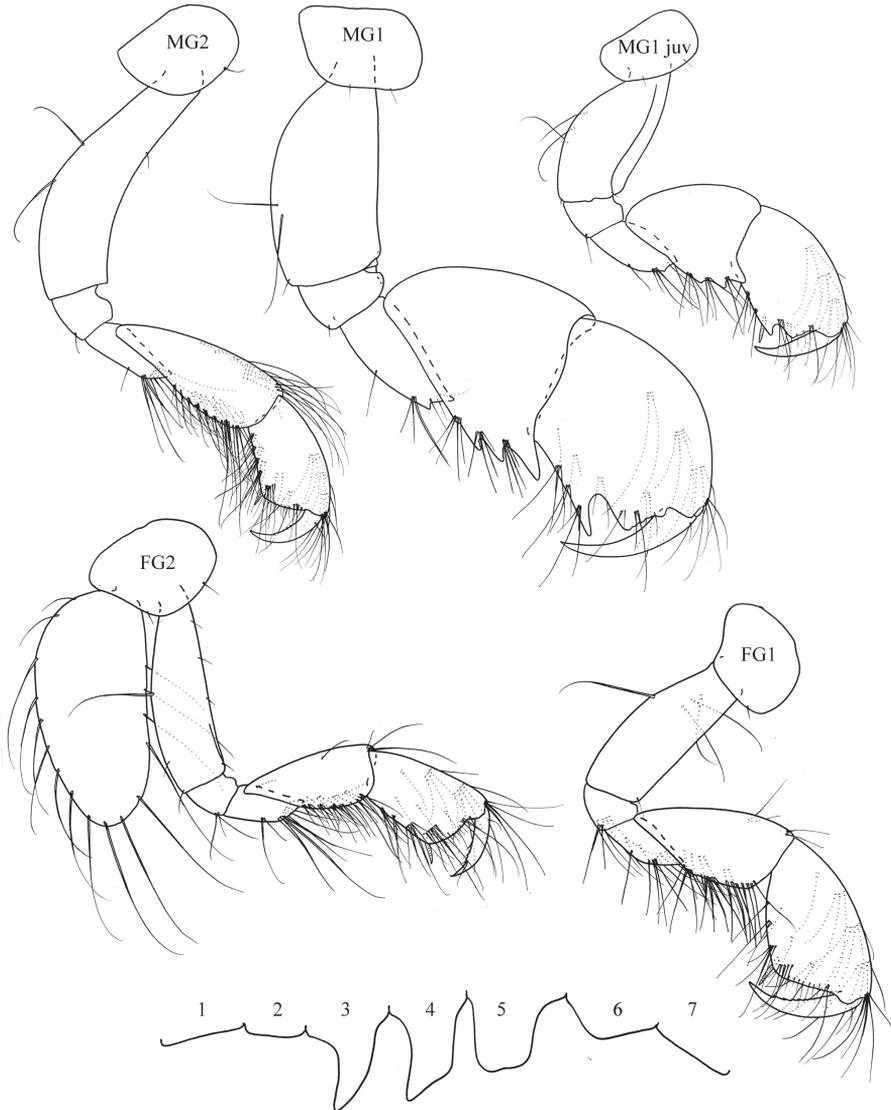


Figure 12. *Bemlos tridens* (Schellenberg), comb. n., male, female

corinidae), 10 m depth; 07°20.407'N, 134°25.755'E; leg. S. De Grave & C. Buras, 26 May 2002.

Etymology. Named for Sara LeCroy for her extensive and invaluable work on this genus of amphipods.

Description. Based on male holotype, 2.5 mm.

Head. *Head* longer than peron segment 1; interantennal plate extending far beyond anterodistal angle, anterior margin straight, with ventral spine. Antenna 1–2 marginal robust setae stout. *Antenna 2* very stout, weakly setiferous.

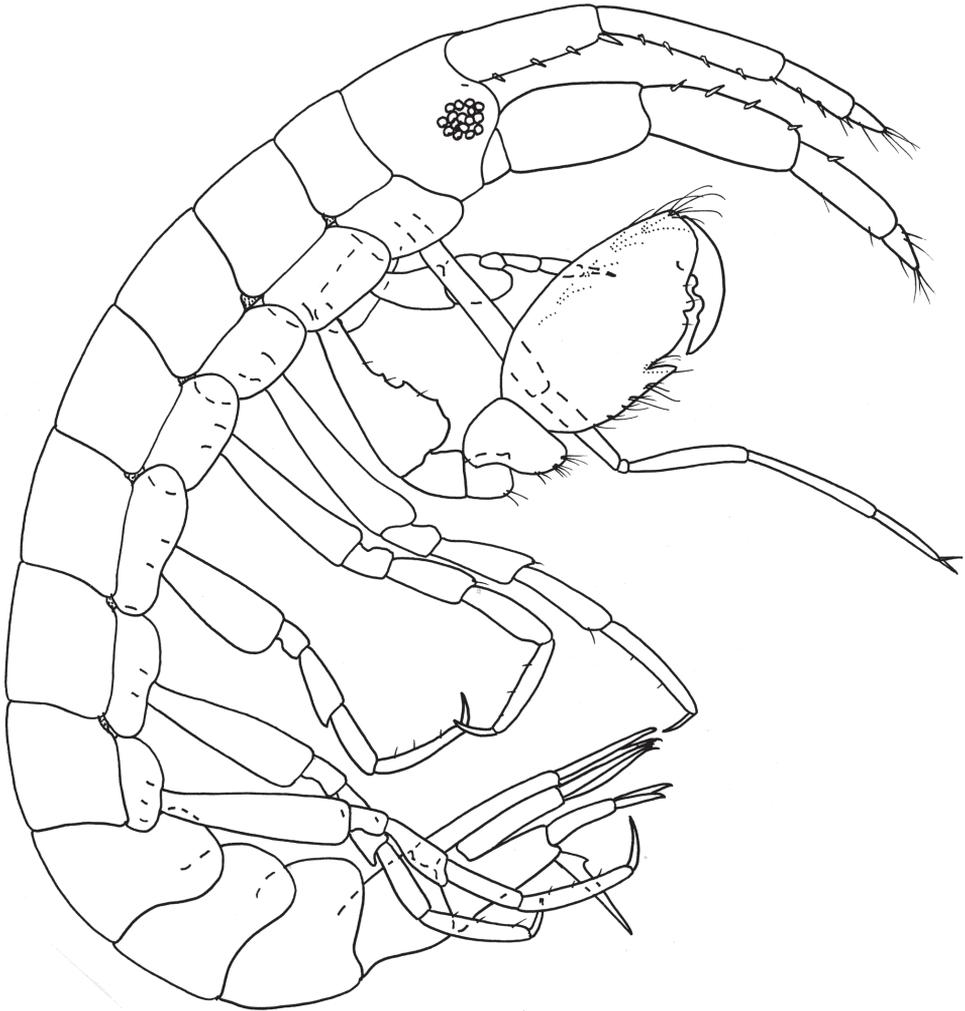


Figure 13. *Colomastix lecrovae* sp n., male

Pereon. *Gnathopod 1* coxa weakly produced; dactylus with two stout distal setae. *Gnathopod 2* coxa evenly rounded; basis grossly swollen distally, anterior margin irregularly scalloped; propodus sub-ovoid, posterior margin with medial spine, palm with small rounded lobe fitting concavity on posterior margin of dactylus. *Pereopods 3–4* with rounded anterodistal lobe. *Pereopods 5–7* basis weakly expanded distally.

Pleon. *Uropod 1* rami subequal, about two thirds length of peduncle; inner ramus with modified weakly hooked tip. *Uropod 2* rami subequal with each other and with peduncle; inner ramus with weakly curved, acute tip. *Uropod 3* rami lanceolate; inner ramus a little shorter than outer ramus and shorter than peduncle. Telson narrowly subtriangular, more than twice as long as broad, distally excavate, and with ventral proximal protrusion.

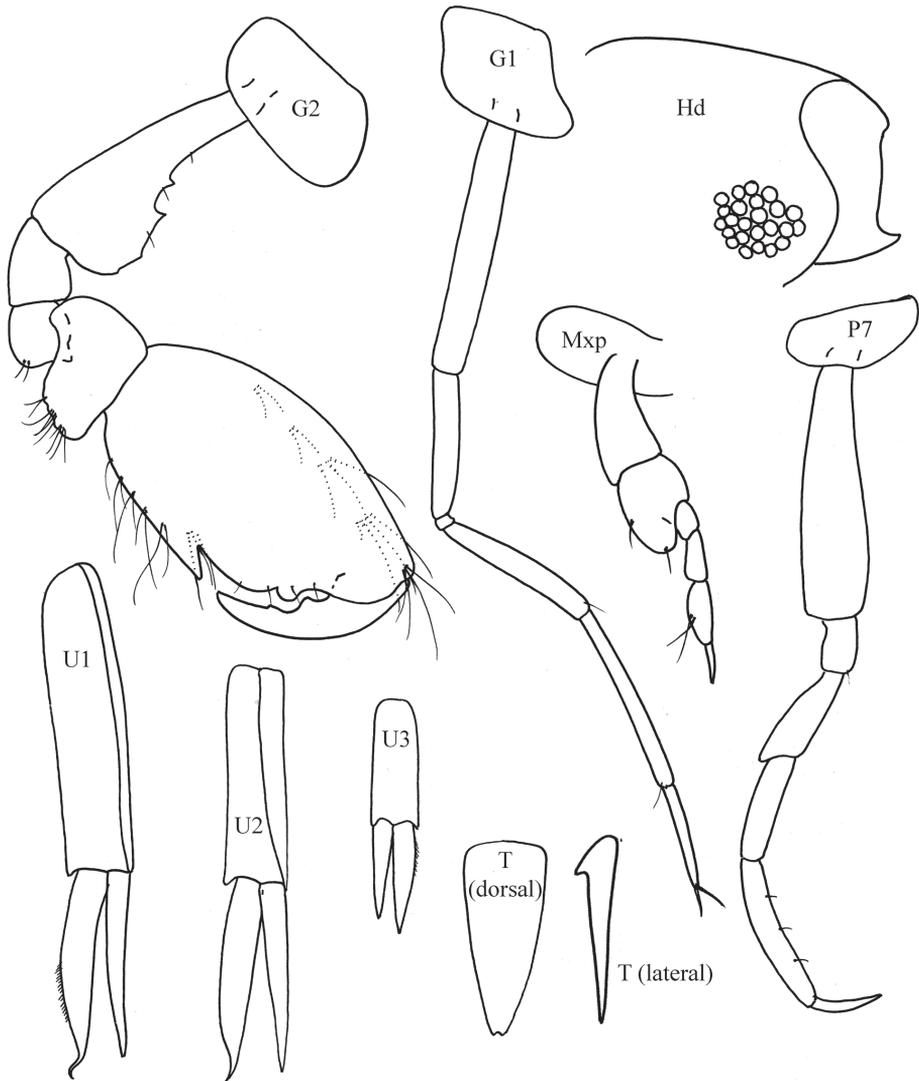


Figure 14. *Colomastix lecrovae* sp. n., male

Female. Unknown

Habitat. Among sponges.

Remarks. In the shape of the male gnathopod 2 this species resembles *C. truncatipes* Ledoyer from Madagascar, but in that species the basis of that appendage has an evenly rounded anterodistal margin, whereas in *C. lecrovae* sp. n. the margin is complexly scalloped. *C. truncatipes* also has very unequal rami on uropod 3, whereas they are almost subequal in *C. lecrovae* sp. n. The single male *Colomastix* sp. described by Ledoyer from New Caledonia is 1.9 mm in total length and appears to be immature.

It may be synonymous with *C. lecrovae* sp. n. but has a peculiar character in its bilobed inner lobe of the maxilliped.

Distribution. Known only from the type locality.

***Colomastix lunalilo* Barnard**

http://species-id.net/wiki/Colomastix_lunalilo

Colomastix lunalilo J.L. Barnard, 1970: 96–100, figs 51,52.–J. L. Barnard, 1971: 55, figs 24, 25.–Ledoyer 1979: 26, fig. 9(2).–Ledoyer 1982: 156–157, fig. 54.–Myers 1985: 56, fig. 41.–Lyons and Myers 1990: 1222, fig. 20.–Muller 1992: 426.–LeCroy 2009: 356–357, figs 5,6.

?*Colomastix lunalilo*.–Ledoyer 1978: 233, fig. 15(2).

not *Colomastix lunalilo*.–Hirayama 1990: 21–24, figs 1–3 (= *Colomastix japonica* Bulycheva, 1955).

not *Colomastix lunalilo*.–Kim and Kim 1987: 9, fig. 8 (= *Colomastix japonica* Bulycheva, 1955).

Material examined. 1 male, OUMNH.ZC.2002–24–0094, Seabear Site, drop off, from rubble (no further details), 16 m depth; 07°16.419'N, 134°31.435'E; leg. S. De Grave & C. Burras, 24 May 2002.

Remarks. The single male specimen collected agrees well with the original description of this species.

Distribution. Hawaii; French Polynesia; Fiji; Australia; ?Mauritius; Madagascar; Red Sea; Palau.

Cyproideidae Barnard, 1974

***Cyproidea excavata* sp. n.**

urn:lsid:zoobank.org:act:C2B98DCF-2197-4097-A721-F9A0EC4654EA

http://species-id.net/wiki/Cyproidea_excavata

Figure 15

Type material. Holotype unknown sex, 1.9 mm. OUMNH.ZC.2002–24–0095, Pkuklim Reef; *Halimeda* clumps on reef rubble, from *Halimeda* (Chlorophyta) washings, -6 m depth; 07°20.542'N, 134°34.023'E; leg. S. De Grave & C. Burras, 29 May 2002.

Other material. 1 specimen (unknown sex), dissected. Outside Risong channel, light trap sample, 50 feet deep; 07°17.903'N, 134°28.544'E; leg. S. De Grave & C. Burras, night 25th–26th May 2002.

Etymology. Named for the excavated palm of gnathopod 2.

Description. Based on holotype 1.9 mm.

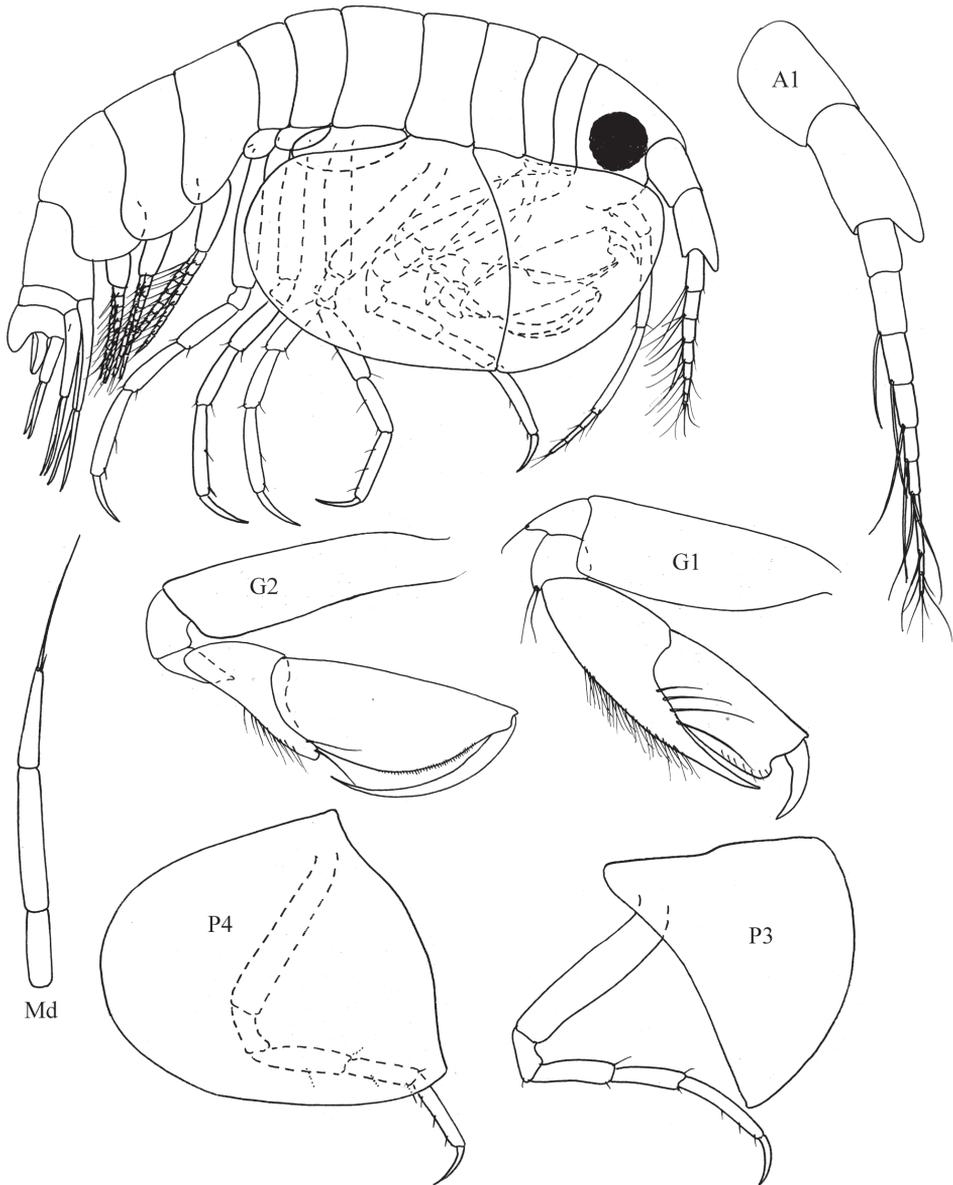


Figure 15. *Cyproidea excavata* sp. n., unknown sex

Head. *Eye* very large, round. *Antenna 1* less than one third body length; peduncular articles 1 and 2 subequal in length, article 2 with strong anterodistal spine overreaching half of flagellar article 1; flagellum with 7 articles each bearing a pair of long posterodistal setae. *Antenna 2* slender, longer than antenna 1; peduncular articles 4 and 5 subequal; flagellum shorter than peduncular article 5 with three articles. Mandible

palp slender, rod-shaped, article 3 shorter than article 2, narrowing distally with one long and one short distal seta.

Pereon. *Gnathopod 1* coxa vestigial; basis broad; ischium with posterodistal spine; carpus shorter than propodus with long posterodistal acute spine reaching tip of propodus; propodus subrectangular, palm with shallow excavation; dactylus overlapping palm. *Gnathopod 2* basis slender, carpus posterodistal margin with blunt spine extending along one third length of posterior margin of propodus; propodus longer and wider than carpus, subovoid; palm oblique; dactylus elongate, strongly curved, greatly overlapping palm. *Pereopod 3* coxa subtriangular. *Pereopod 4* coxa subovoid. *Pereopods 5–7* subequal in length.

Pleon. Urosomite 3 with dorsodistal hood extending over telson. Uropod 3 rami subequal a little longer than peduncle.

Habitat. In *Halimeda*

Remarks. *Colomastix excavata* sp. n. appears to be closest to *C. serratipalma* Schellenberg (1938) from New Caledonia, but in that species, on gnathopod 2, the spine on the postero-distal margin of the carpus is very slender throughout its length (broad based in *C. excavata* sp. n.) and the palm is evenly convex. *Cyproidea excavata* sp. n. differs from both *C. liodactyla* Hirayama (1978) and *C. cobia* Azman (2009) in gnathopod 1 which in those species has a serrated palm and spines on the posterior margin of the dactylus. It differs from *C. ornata* Haswell (1880) in the more slender propodus of gnathopod 1, the excavate palm of gnathopod 2, and the subequal rami of uropod 3.

Distribution. Known only from the type locality.

Acknowledgments

I am grateful to Dr Sammy De Grave, Oxford University Museum of Natural History, for making the material collected in Palau available to me for study.

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Two new species of the interstitial genus *Parvocythere* (Crustacea, Ostracoda, Cytheroidea) from Japan: an example of morphological variation

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Abstract

Two new species of the interstitial ostracod genus *Parvocythere*, *P. gottwaldi* **sp. n.** and *P. gracilis* **sp. n.**, are herein described. Although these two new species are clearly distinguishable by certain morphological differences in elements of the male copulatory organ, and the carapace, they share the following simplified characters of the appendages and male copulatory organ: antennular fourth podomere with no suture; reduced claws on the distal end of antenna; and asymmetric male copulatory organ. The morphological differences among known and new *Parvocythere* species suggest that the species of this genus can be classified into two groups by the presence/absence of the suture on the antennular fourth podomere. The “Group S” is characterised by the presence of the antennular suture, and all species of this group have a two-clawed antenna and symmetric male copulatory organ, characters which are generally seen in cytheroid ostracods. The species belonging to “Group N” are characterised by the absence of the suture, regarded as a pedomorphic character, show the following characters: two clawed or one clawed antenna, and symmetric or asymmetric male copulatory organ. The morphological variation within Group N includes reductive characters regarded as an adaptation to the narrow spaces of the interstitial environment of a sandy beach. These intrageneric morphological variations of the exclusively interstitial genus *Parvocythere* suggest the possibilities that Group N might be derived from Group S, and that some adaptive characters to an interstitial environment could have developed after the colonisation of these environments.

Keywords

Interstitial animal, Podocopa, taxonomy, antennular suture

Introduction

The genus *Parvocythere* Hartmann, 1959 includes 14 species (type species: *P. dentata* Hartmann, 1959), all of which are known as interstitial dwellers, inhabiting sedimentary interstices. This genus is characterised by a small body size, only two pairs of walking legs (Hartmann 1959, Marinov 1962), antennula consisting of short podomeres (Hartmann 1974) and (extremely) reduced eyes (Gottwald 1983). These diagnostic characters are regarded as a result of adaptation to the interstitial environments with no light and narrow space (Hartmann 1959, 1973). The genus *Parvocythere* is a suitable taxon for understanding the morphological evolution of interstitial ostracods.

Gottwald (1983) classified the *Parvocythere* species into the following two groups based on the morphology of the male copulatory organ: the *elongata* group characterised by four sclerotised frameworks circularly connected at the base of the capsule, short distal lobe and a short copulatory duct, and the *dentata* group characterised by the lack of circularly connected frameworks, bi- or tri-forked distal lobe and a strongly sclerotised long copulatory duct. This division, however, is controversial in view of the evolutionary clusters, because many morphological characters of the carapace and appendages are not shared within each group. Moreover, since it is known that the characters of male copulatory organ are frequently restricted by character displacement rather than phylogeny in Ostracoda (Tsukagoshi 1988), grouping based on male copulatory organ morphology such as the *elongata* and *dentata* groups should be done carefully.

Parvocythere japonica Watanabe, Tsukagoshi & Higashi, 2008 was so far known as the single species belonging to this genus in Japan. In the present paper, two new *Parvocythere* species from central Japan are described, and the evolutionary trend of the genus *Parvocythere* is discussed on the basis of the interspecific morphological variations among the *Parvocythere* species.

Materials and methods

Sediment samples were collected from littoral beaches at two sites in central Japan (Fig. 1): Daio-zaki, Shima City, Mie Prefecture (34°16.59'N, 136°53.83'E), and Koze, Odawara City, Kanagawa Prefecture (35°16.73'N, 139°12.75'E). The sediments were taken with a small scoop from the bottom of a hole dug with a shovel to depth of water table. The samples were washed five times in a bucket of fresh water in the laboratory, and the supernatant was then strained through a 25 µm mesh sieve. The specimens of *Parvocythere* were then picked out under a binocular microscope (SHZ-10, OLYMPUS), from the concentrate retained on the sieve.

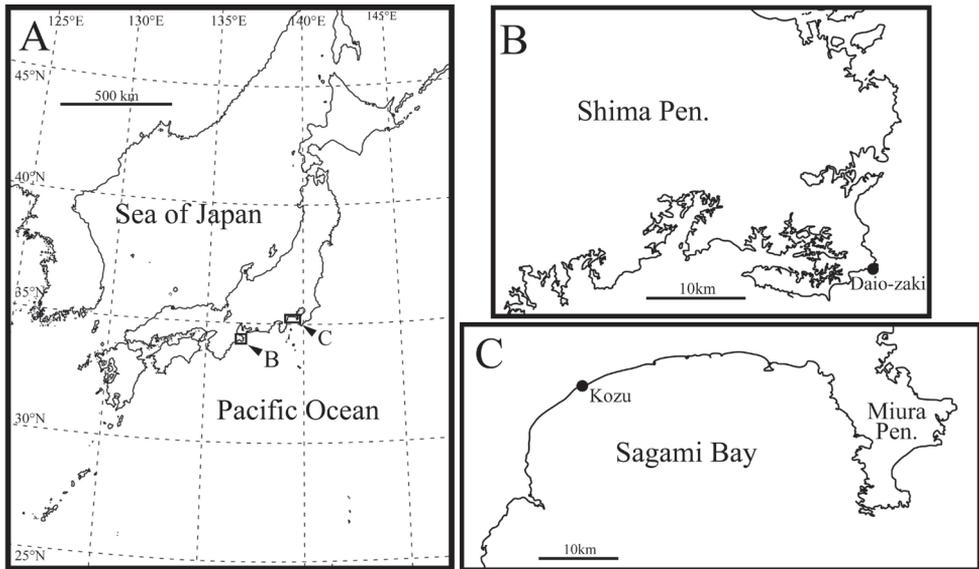


Figure 1. Sampling localities. **A** map of Japan **B** and **C** sampling sites.

The specimens were dissected under a binocular microscope, chitinous parts mounted on glass slides and the valves air-dried. The chitinous parts and the valves were observed and drawn using a differential interference contrast microscope with a camera lucida (BX 50, Olympus). The valves were osmium-coated with an osmium plasma coater (OPC 40, Nippon Laser), and were then observed under a SEM (JSM-5600LV, JEOL).

The type series is deposited in the collection of the Shizuoka University Museum, identified by a number with the prefix SUM-CO.

Taxonomy

Order Podocopida Sars, 1866

Superfamily Cytheroidea Baird, 1850

Family Parvocytheridae Hartmann, 1959

Genus *Parvocythere* Hartmann, 1959

Parvocythere gottwaldi sp. n.

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http://species-id.net/wiki/Parvocythere_gottwaldi

Figs 2–6

Type series. Holotype: adult male (SUM-CO-2023), right valve length 173 μm , height 88 μm , left valve length 174 μm , height 84 μm , appendages mounted on slide and valves

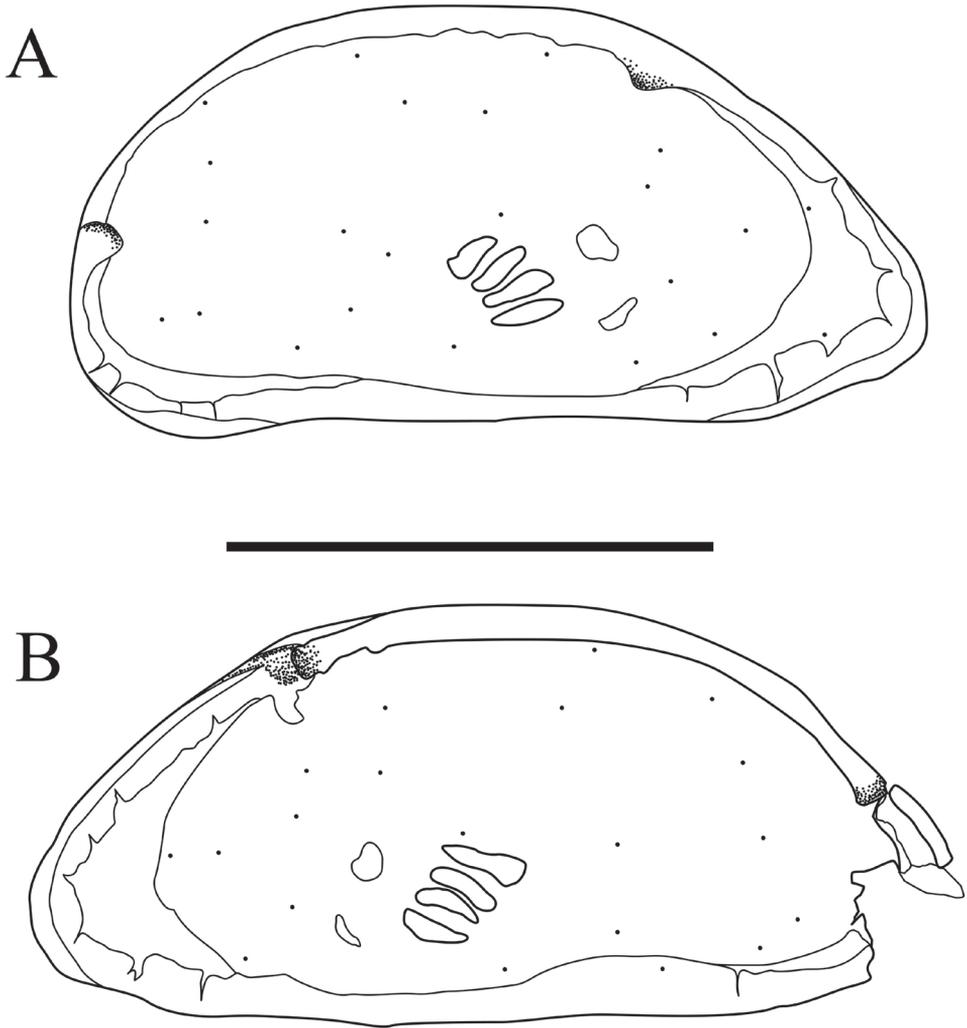


Figure 2. Carapaces of *Parvocythere gottwaldi* sp. n. Holotype (SUM-CO-2023). **A** right external view **B** left external view. Each of the carapace structures are transmitted images. Scale bar indicates 100 μ m.

preserved in a cardboard cell slide, Paratypes: 14 adult males (SUM-CO-2024–2037) and 12 adult females (SUM-CO-2038–2049). All illustrated specimens were collected from interstitial pore-water at the type locality on October 10, 2008.

Type locality. Daio-zaki, Shima City, Mie Prefecture, Pacific coast of central Japan, 34°16.59'N, 136°53.83'E (Fig. 1B), in sediments at approximately 20 cm depth. The sediment is mainly composed of clastic very coarse sand and granules.

Etymology. This species is named in honour of Dr Jochen Gottwald, in recognition of his significant contribution to our knowledge of interstitial ostracods.

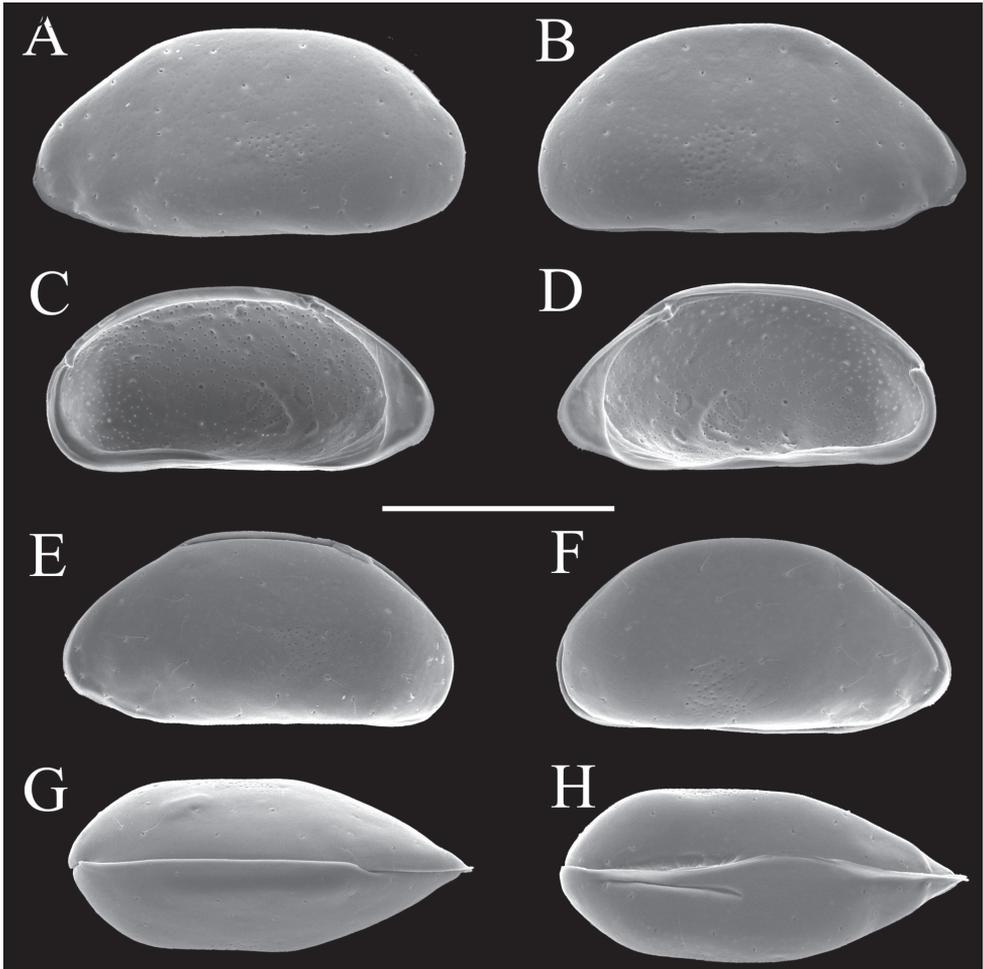


Figure 3. Carapaces of *Parvocythere gottwaldi* sp. n. **A–D, G** and **H** male specimens: **A** and **B** paratype (SUM-CO-2025) **C** and **D** paratype (SUM-CO-2026) **G** paratype (SUM-CO-2027) **H** paratype (SUM-CO-2028). **A** left external lateral view **B** right external lateral view **C** internal view of left valve **D** internal view of right valve **G** dorsal view **H** ventral view. **E** and **F** female specimens: **E** paratype (SUM-CO-2039) **F** paratype (SUM-CO-2040). **E** left external view **F** right external view. Scale bar indicates 100 μm .

Diagnosis. Carapace rounded trapezial in lateral view with very slight protrusion on antero-ventral area and sharp wrinkle-like groove running from middle to posterior in ventral area of both valves. Tapering anterior margin. Forty-two pore systems per valve. Seven and four marginal pores along anterior and posterior margins, respectively. Marginal infold broad in anterior but very narrow in posterior. Hingement modified pentodont type. No suture on middle of fourth podomere of antennula. Antenna with only one distal claw. Male copulatory organ asymmetric, with left organ (hemipenis) larger than right one. Left hemipenis bearing long copulatory duct single coiled

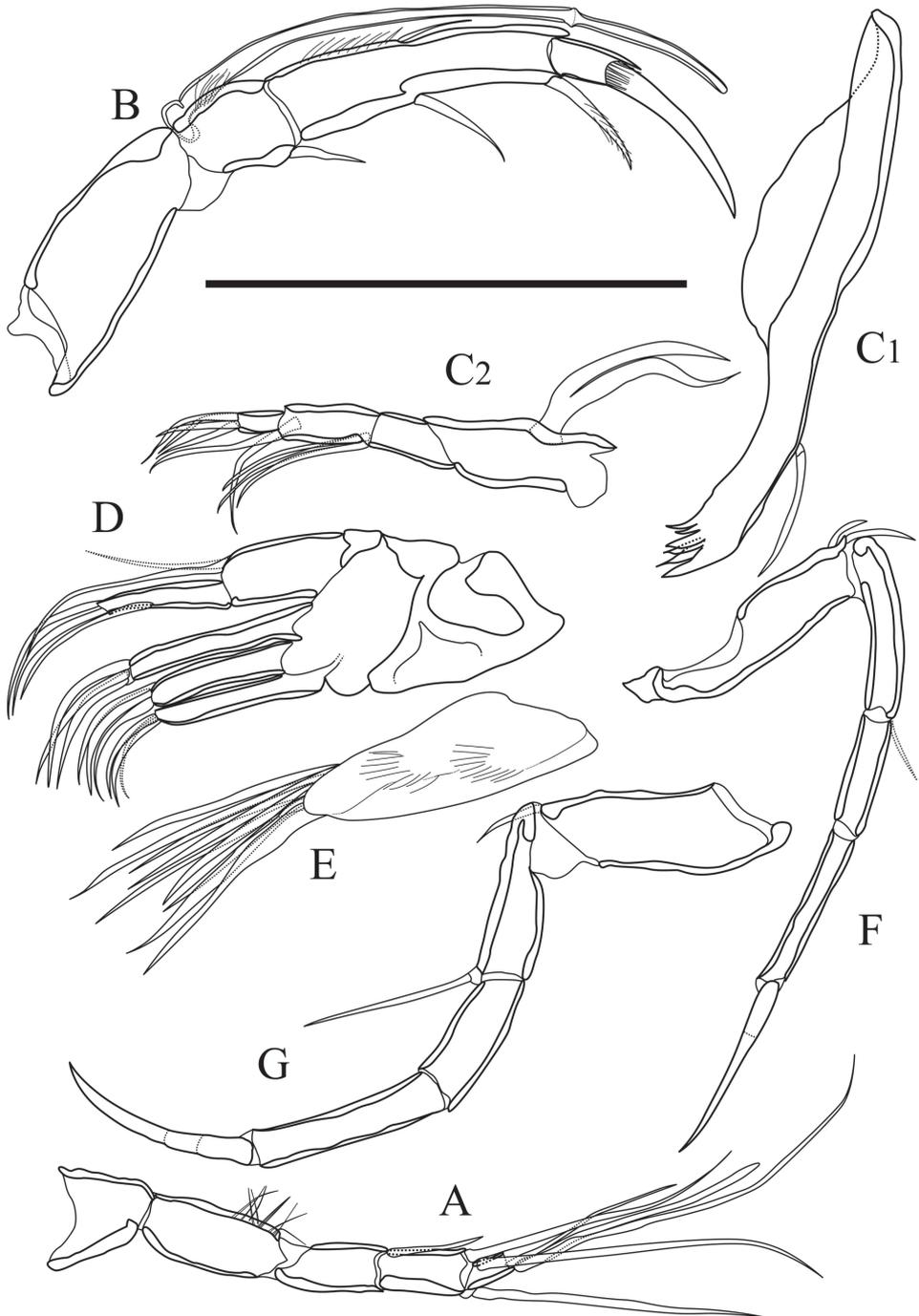


Figure 4. Appendages of *Parvocythere gottwaldi* sp. n. **A–D, F** and **G** holotype (SUM-CO-2023) **E** paratype (SUM-CO-2024). **A** antennula **B** antenna **C**₁ coxa of mandibula **C**₂ palp of mandibula **D** palp and endites of maxillula **E** branchial plate of maxillula **F** fifth limb **G** sixth limb. Scale bar indicates 50 μ m.

in distal part, short and stout claw-like dorsal ramus, two-pronged ventral ramus, and well-developed crescent-shaped distal lobe with thick seta on centre of proximal part. Right organ reduced and bearing much reduced copulatory duct and crescent-shaped distal lobe with thick seta on proximal part.

Description. Carapace (Figs 2 and 3). Carapace rounded trapezial in lateral view with very slight protrusion on antero-ventral area and sharp wrinkle-like groove running from middle to posterior in ventral area of both valves. Anterior margin tapers more than posterior margin. Dorsal margin slightly rounded. Ventral margin almost straight. Carapace surface generally smooth. All pore systems of simple type and 42 per valve. Seven and four marginal pores along anterior and posterior margins, respectively. Marginal infold broad in anterior area but very narrow in posterior area. Vestibula occupying large part of marginal infold. Inner surface covered with numerous pits. Hingement modified pentodont type. Right valve slightly overlapping left valve along hinge line. Four adductor muscle scars in oblique row. Mandibular scar visible beneath frontal scar.

Antennula (Fig. 4A). Five articulated podomeres. First podomere bare and short. Second podomere nine quarters as long as first podomere, with fine setae along antero-distal margin. Third podomere half as long as second podomere, with one medium seta on antero-distal end. Fourth podomere as long as third podomere, with two long setae on antero-distal end and one long seta on postero-distal end. Fifth podomere half as long as fourth podomere, with one long and one very long simple setae and one spatula-like long seta on distal end.

Antenna (Fig. 4B). Four articulated podomeres. First podomere with two segmented spinneret (exopodite) on distal end. Second podomere half as long as first podomere, with bunch of fine setae along middle of anterior margin and one medium seta on postero-distal end. Third podomere eight-thirds as long as second podomere, with numerous fine setae along antero-proximal margin, medium setae on middle of anterior margin and on middle of posterior margin, respectively, and one medium setulous seta on postero-distal end. Fifth podomere quarter length of fourth podomere, with numerous fine setae on distal margin and one stout claw on distal end.

Mandibula (Fig. 4C₁, C₂). Coxa (Fig. 4C₁) elongated, with one medium seta on antero-ventral part. Six coxal endites. Palp (Fig. 4C₂) consisting of four articulated podomeres. First podomere (basis) with bifurcated lamella (exopodite) on middle of dorsal margin. Second podomere two-thirds as long as first podomere, with three medium setae on ventro-distal end. Third podomere five-fourths as long as second podomere, with one stout medium seta on outside of distal end and one medium seta on ventro-distal end. Fourth podomere two-fifths as long as third podomere, with four setae on distal end.

Maxillula (Fig. 4D and E). Thin branchial plate (exopodite; Fig. 4E) with approximately nine plumose setae. Basal podomere with one palp and three endites (Fig. 4D). Palp consisting of two articulated podomeres: first podomere with one long and one medium seta on antero-distal end; second podomere eleven-tenth as long as first podomere, with one medium seta on middle of posterior margin and two medium setae on distal end. Endites with three setae, respectively.

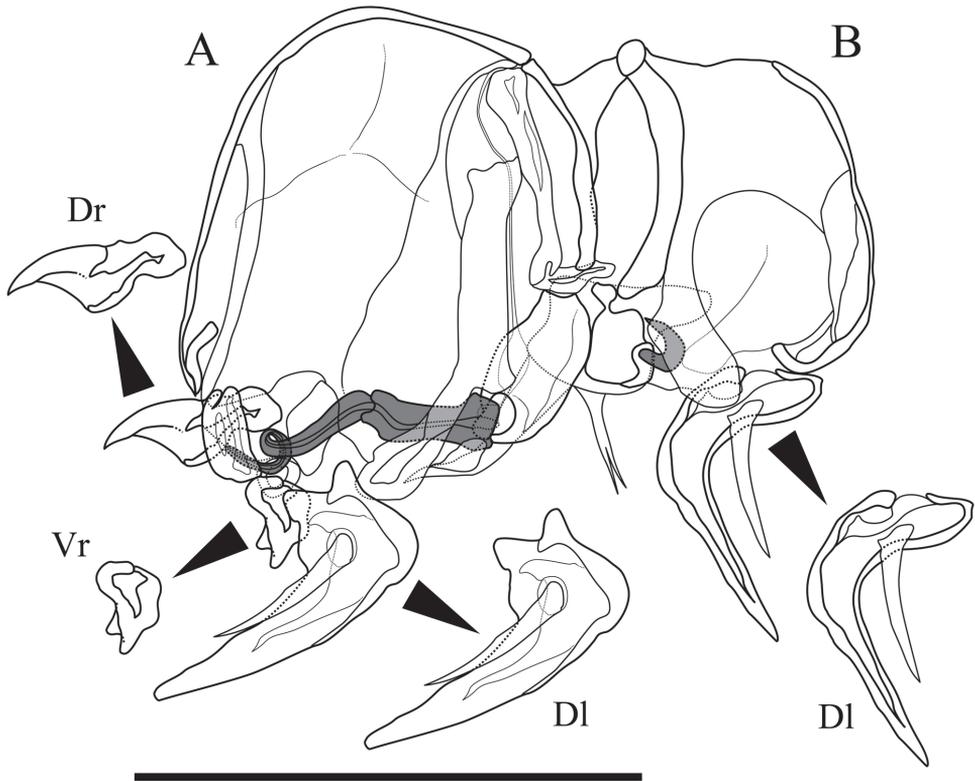


Figure 5. Male copulatory organs of *Parvocytthere gottwaldi* sp. n. Holotype (SUM-CO-2023). **A** external view of left organ **B** external view of right organ. Copulatory ducts are shaded. Abbreviation: **Dr** dorsal ramus **Vr** ventral ramus **Dl** Distal lobe. Scale bar indicates 50 μ m.

Fifth limb (Fig. 4F). Four articulated podomeres. First podomere with two short setae on antero-distal end. Second podomere five-sixths as long as first podomere, with one medium seta on antero-distal end. Third podomere four-fifths as long as second podomere. Fourth podomere three-halves as long as third podomere, with stout distal claw.

Sixth limb (Fig. 4G). Four articulated podomeres. First podomere with one short seta on antero-distal end. Second podomere four-fifth as long as first podomere, with one long seta on antero-distal end. Third podomere as long as second podomere. Fourth podomere seven-fifth as long as third podomere with stout distal claw.

Seventh limb. Absent.

Male copulatory organ (Fig. 5). Asymmetric. Right organ (Fig. 5B) smaller than left (Fig. 5A), with reduced components: square capsule with weakened framework; copulatory duct (Cd) extremely reduced; distal lobe (Dl) thin and crescent-shaped with thick seta on proximal part. Left organ bearing well-developed long copulatory duct (Cd) single coiled in distal part; short and stout claw-like dorsal ramus (Dr); two-

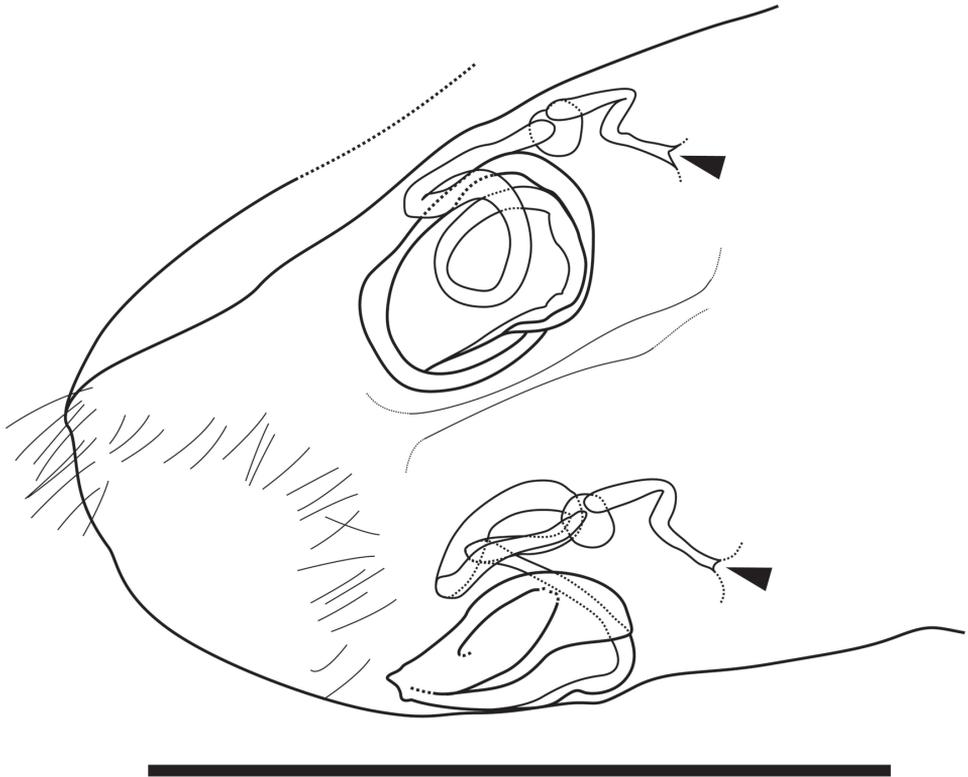


Figure 6. Caudal part of female of *Parvocythere gottwaldi* sp. n. Dorsal view (paratype, SUM-CO-2038). Arrows indicate openings. Scale bar indicates 50 μ m.

pronged ventral ramus (Vr); and crescent-shaped distal lobe (DI) with thick seta on centre of proximal part.

Genitalia of female (Fig. 6). Almost symmetric and consisting of rounded frame-work and winding duct with vesicle-like joint nearby opening. Duct opening on ventral side.

Eye. Absent.

Dimensions. See Table 1.

Table 1. Dimensions of valves of *Parvocythere gottwaldi* sp. n. from type locality.

		Length (μ m)			Height (μ m)		
		Mean	Observed range	<i>N</i>	Mean	Observed range	<i>N</i>
Male	Right valve	170	165–175	11	87	85–92	11
	Left valve	173	169–176	11	85	82–87	11
Female	Right valve	167	164–174	9	88	84–95	9
	Left valve	171	168–176	7	86	83–91	7

Occurrences. Type locality and Kozu, Odawara City, Kanagawa Prefecture, Pacific coast of central Japan (35°16.73'N, 139°12.75'E).

Remarks. *Parvocythere gottwaldi* sp. n. resembles *P. mauiensis* Hartmann, 1991 in the outline of carapace. The new species, however, can be distinguished from the other species by its antenna with only one distal claw and the asymmetric male copulatory organ. Although this new species is also similar to *P. spec. A*, as referred to in Gottwald (1983), in the characteristics of antenna and asymmetric male copulatory organ, the new species can be distinguished from *P. spec. A* by the tapering anterior margin of carapace and the copulatory duct (Cd) single coiled in the distal part.

***Parvocythere gracilis* sp. n.**

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http://species-id.net/wiki/Parvocythere_gracilis

Figs 7–11

Type series. Holotype: adult male (SUM-CO-2050), right valve length 170 µm, height 75 µm, left valve length 169 µm, height 73 µm, appendages mounted on slide and valves preserved in a cardboard cell slide, Paratypes: 7 adult males (SUM-CO-2051–2057) and 8 adult females (SUM-CO-2058–2065). All illustrated specimens were collected from interstitial pore-water at the type locality on April 16, 2010.

Type locality. Kozu, Odawara City, Kanagawa Prefecture, Pacific coast of central Japan, 35°16.73'N, 139°12.75'E in sediments at approximately 20 cm depth. The sediment is mainly composed of clastic granules and pebbles.

Etymology. The Latin *gracilis* (slender) refers to the slender aspect of the carapace of this species.

Diagnosis. Carapace elongated and bean-shaped in lateral view. Anterior margin slightly extending like thin plate in ventral and dorsal views. Middle of posterior margin of right valve slightly pointed in lateral view. Forty-two pore systems per valve. Six and two marginal pores along anterior and posterior margins, respectively. Marginal infold narrow in anterior and ventral, and very narrow in posterior. Hingement modified pentodont type. No suture on middle of fourth podomere of antennula. Antenna with only one stout claw and one tiny seta on distal end. Male copulatory organ asymmetry: left organ larger than right one. Left organ bearing long L-shaped copulatory duct, dorsal ramus with two small projections, blunt two-pronged ventral ramus, and well-developed crescent-shaped distal lobe with one conspicuous seta on its centre; right organ reduced and bearing extremely reduced copulatory duct and well-developed crescent-shaped distal lobe with thick seta on proximal part.

Description. Carapace (Figs 7, 8). Carapace elongated and bean-shaped in lateral view. Anterior margin gently rounded in lateral view. Anterior part slightly extending like thin plate in ventral and dorsal views. Posterior margin gently rounded in left valve and slightly pointed at middle height of right valve. Dorsal margin slightly rounded. Ventral margin almost straight. Carapace surface smooth. All pore-systems of simple

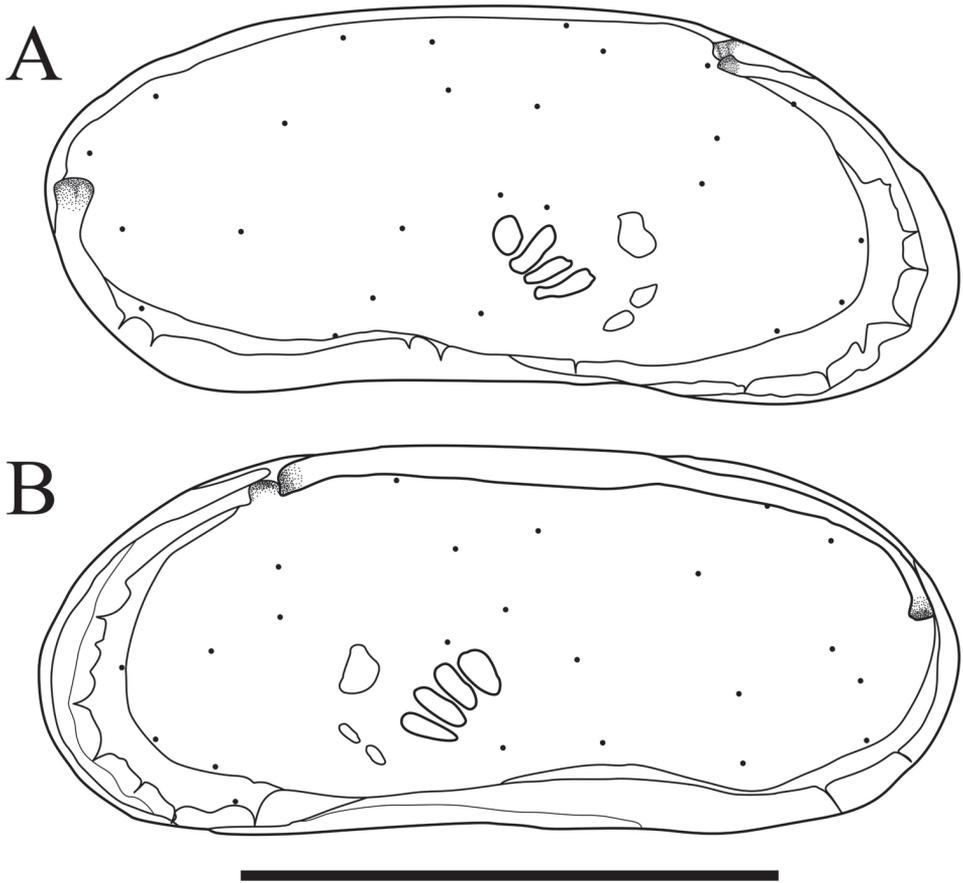


Figure 7. Carapaces of *Parvocythere gracilis* sp. n. Holotype (SUM-CO-2050). **A** right external view **B** left external view. The carapace structures are transmitted images. Scale bar indicates 100 μ m.

type and 42 per valve. Six and two marginal pores along anterior and posterior margins, respectively. Marginal infold narrow in anterior and ventral, and very narrow in posterior area. Vestibula occupying large part of marginal infold. Inner surface covered with numerous pits. Hingement modified pentodont type. Right valve slightly overlapping left valve along hinge line. Four adductor muscle scars in oblique row. Two separated mandibular scars visible beneath frontal scar.

Antennula (Fig. 9A). Five articulated podomeres. First podomere bare and short. Second podomere three times as long as first podomere and bare. Third podomere half as long as second podomere, with one medium seta on antero-distal end. Fourth podomere eleven-tenths as long as third podomere, with two very long setae on antero-distal end and one long seta on postero-distal end. Fifth podomere three-eighths as long as fourth podomere, with two long and one long spatula-like setae on distal end.

Antenna (Fig. 9B). Four articulated podomeres. First podomere with indistinct two-segmented spinneret (exopodite) on distal end. Second podomere half as long as

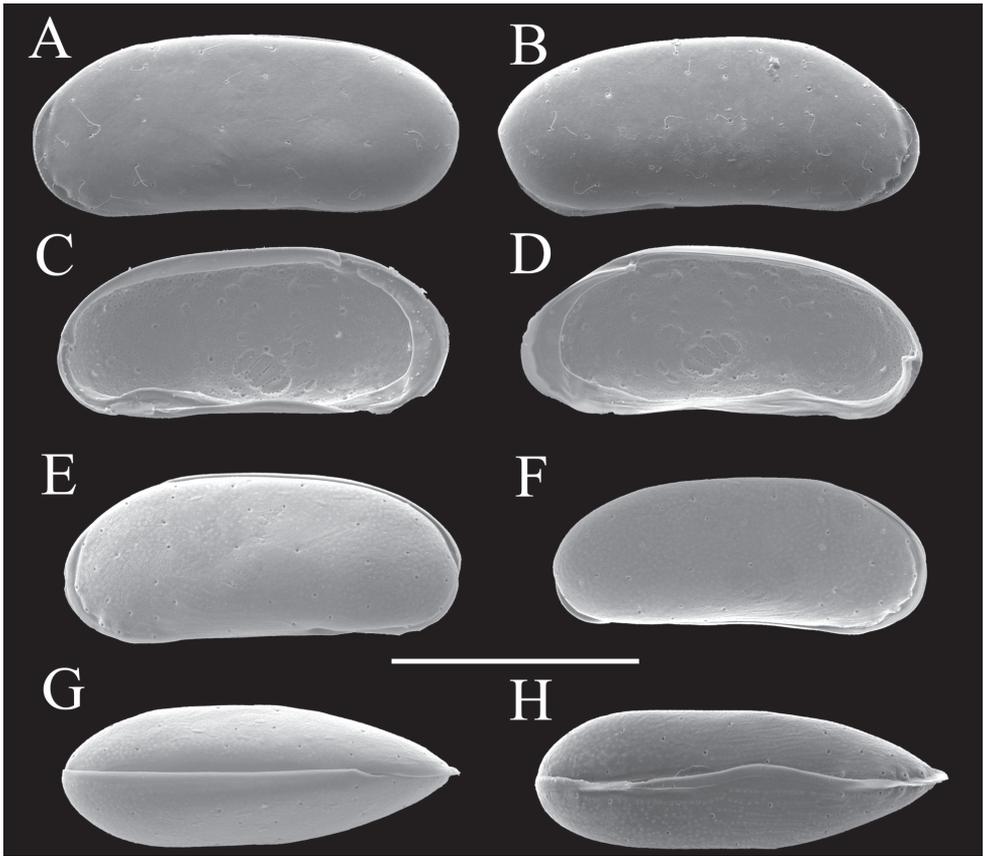


Figure 8. Carapaces of *Parvocythere gracilis* sp. n. **A–D** and **H** male specimens: **A** paratype (SUM-CO-2051) **B** paratype (SUM-CO-2052) **C** and **D** paratype (SUM-CO-2053) **H** paratype (SUM-CO-2054). **A** left external lateral view **B** right external lateral view **C** internal view of left valve **D** internal view of right valve **H** ventral view. **E–G** female specimens: **E** paratype (SUM-CO-2059) **F** paratype (SUM-CO-2059) **G** paratype (SUM-CO-2060). **E** left external view **F** right external view **G** dorsal view. Scale bar indicates 100 μm .

first podomere, with bunch of fine setae at middle of anterior margin and one short seta on postero-distal end. Third podomere five-halves as long as second podomere, with numerous fine setae along antero-proximal margin, one short seta on middle of anterior margin, one medium seta on middle of posterior margin, and one short and thick seta on postero-distal end. Fifth podomere two-sevenths as long as fourth podomere, with one stout claw and one very short seta on distal end.

Mandibula (Fig. 9C₁, C₂, C₃). Coxa (Fig. 9C₁) elongated, with one seta on antero-ventral part, two very short setae on postero-ventral part, and six coxal endites. Palp (Fig. 9C₂) consisting of four articulated podomere. First podomere (basis) with bifurcated lamella (exopodite; Fig. 9C₃) on middle of dorsal margin. Second podomere twice as long as first podomere, with three long setae on outside of distal margin. Third

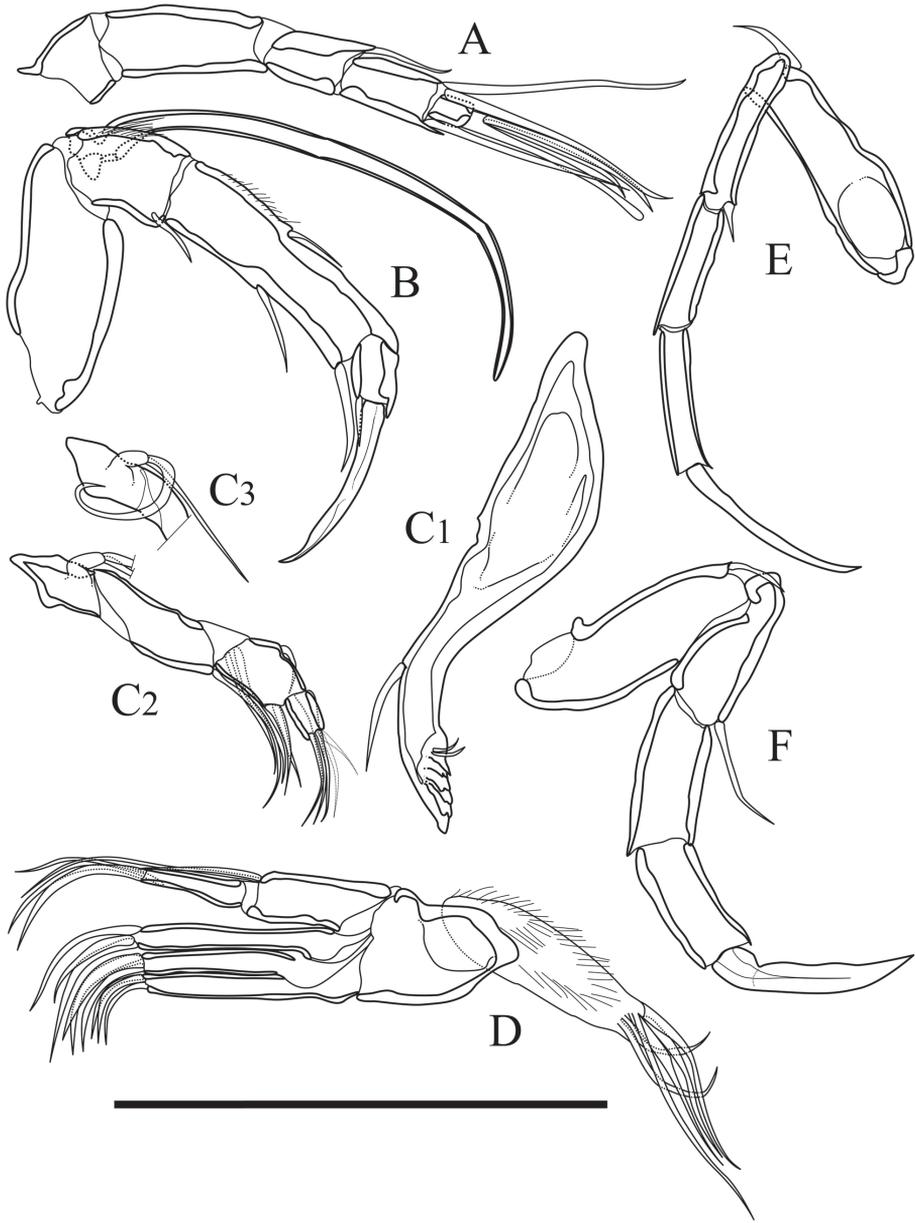


Figure 9. Appendages of *Parvocythere gracilis* sp. n. Holotype (SUM-CO-2050). **A** antennula **B** antenna **C₁** coxa of mandibula **C₂** palp of mandibula **C₃** proximal part of mandibular palp **D** maxillula **E** fifth limb **F** sixth limb. Scale bar indicates 50 μ m.

podomere two-thirds as long as second podomere, with one short seta on middle of dorsal margin, one medium seta on outside of distal end and two short setae on ventro-distal end. Fourth podomere four-sevenths as long as third podomere, with one short and three medium setae on distal end.

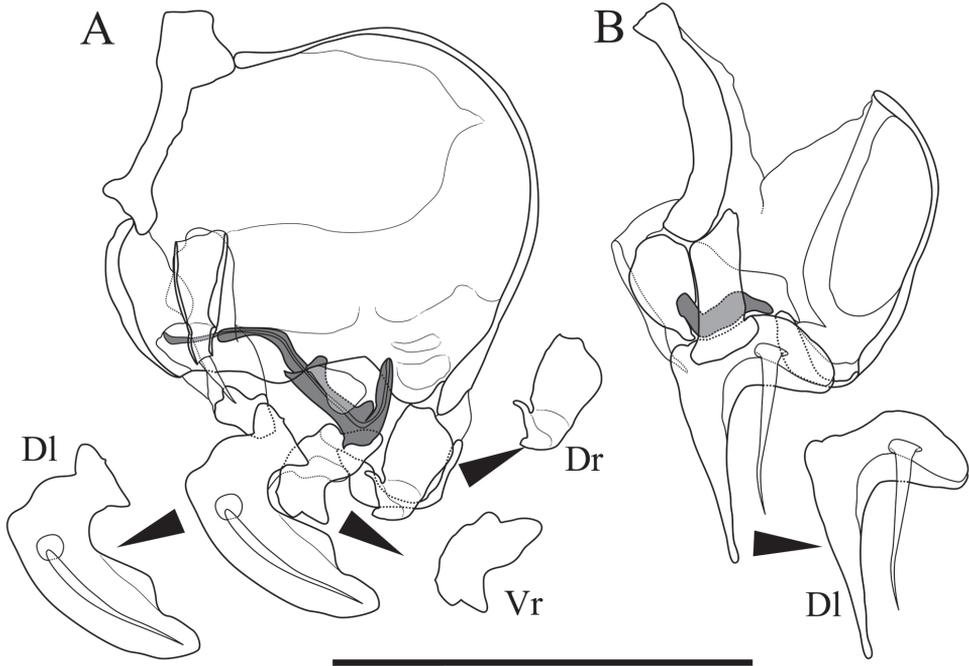


Figure 10. Male copulatory organs of *Parvocythere gracilis* sp. n. Holotype (SUM-CO-2050). **A** internal view of left organ **B** external view of right organ. Copulatory ducts are shaded. Abbreviation: **Dr** dorsal ramus **Vr** ventral ramus **DI** Distal lobe. Scale bar indicates 50 μ m.

Maxillula (Fig. 9D). Thin branchial plate (exopodite) with approximately six plumose setae. Basal podomere with one palp and three endites. Palp consisting of two articulated podomeres: first podomere with one long and one medium setae on antero-distal end; second podomere as long as first podomere, with one medium seta on middle of posterior margin and two medium setae on distal end. Endites with three setae at the distal end.

Fifth limb (Fig. 9E). Four articulated podomeres. First podomere with one short seta on antero-distal end. Second podomere four-thirds as long as first podomere, with one very short seta on antero-distal end. Third podomere nine-tenths as long as second podomere. Fourth podomere eleven-tenths as long as third podomere, with long distal claw.

Sixth limb (Fig. 9F). Four articulated podomeres. First podomere with one short seta on antero-distal end. Second podomere two-thirds as long as first podomere, with one medium seta on antero-distal end. Third podomere nine-tenths as long as second podomere. Fourth podomere as long as third podomere with well-developed stout distal claw.

Seventh limb. Absent.

Male copulatory organ (Fig. 10). Asymmetric. Right organ smaller than left, with reduced components: square capsule with weakened framework; copulatory duct (Cd)

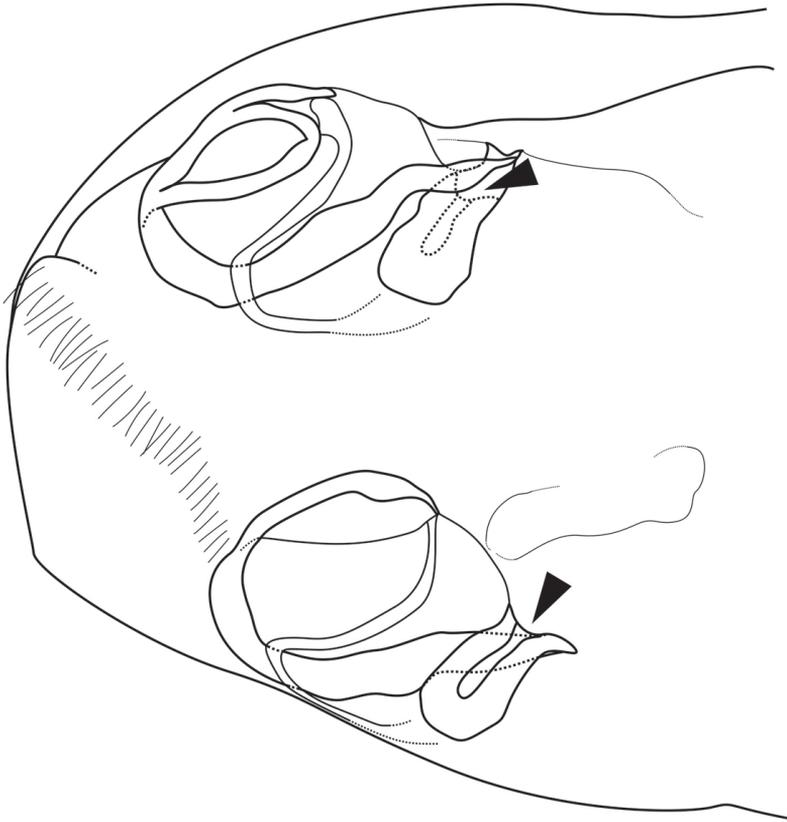


Figure 11. Caudal part of female of *Parvocythere gracilis* sp. n. Dorsal view (paratype, SUM-CO-2058). Arrows indicate openings. Scale bar indicates 50 μm .

extremely reduced; and distal lobe (Dl) thin and crescent-shaped with thick seta on proximal part. Left male copulatory organ bearing L-shaped long copulatory duct (Cd), dorsal ramus (Dr) with two projections, two-pronged blunt ventral ramus (Vr), and crescent-shaped and well-developed blunt-tipped distal lobe (Dl) with thick seta on centre.

Genitalia of female (Fig. 11). Symmetric and consisting of rounded frame-work, sigmoid duct connected with strongly sclerotised opening. Duct opening on ventral side.

Eye. Absent.

Dimensions. See Table 2.

Occurrences. Type locality and Daio-zaki, Shima City, Mie Prefecture, Pacific coast of central Japan, (34°16.59'N, 136°53.83'E).

Remarks. *Parvocythere gracilis* sp. n. resembles *P. galapagoensis* Gottwald, 1983, *P. schmidtii* Gottwald, 1983 and *P. subterranea* Gottwald, 1983 in the shape of carapace. The new species, however, is slenderer than the other species, and can be distinguished from them by the following reduced characters: no rib posterior to adductor muscle scars; no suture on middle of antennular fourth podomere; only one developed distal

Table 2. Dimensions of valves of *Parvocythere gracilis* sp. n. from type locality.

		Length (µm)			Height (µm)		
		Mean	Observed range	N	Mean	Observed range	N
Male	Right valve	166	163–170	4	73	71–75	4
	Left valve	164	162–169	5	71	70–73	5
Female	Right valve	158	156–159	4	70	69–71	4
	Left valve	154	152–157	6	68	67–68	6

claw of antenna; and asymmetric male copulatory organ. Although *P. gracilis* sp. n. also resembles *P. elongata* Hartmann, 1959 and *P. supralitoralis* Gottwald, 1983 in the shape of carapace and the reductive characters of antennula and antenna, only the new species has asymmetric male copulatory organ. Moreover, *P. gracilis* sp. n. is also similar to *P. dimorpha* Hartmann, 1974 in the shape of the carapace, the many characters of appendages and an asymmetric male copulatory organ but the new species differs from other species in the number of antennal distal claw, the thickness of sixth limb and the form of copulatory duct.

Discussion

The *Parvocythere* species, including the new species *P. gottwaldi* sp. n. and *P. gracilis* sp. n., are remarkably varied in the characters of antennula, antenna and male copulatory organ (Table 3).

Two character states are observed in the antennular fourth podomere of this genus: one is the presence of a suture on the middle of the podomere with two setae on its anterior and posterior sides; the other is the absence of the suture and setae (Fig. 12). As an exception, *Parvocythere directocostata* Hartmann, 1974 has a six-segmented antennula in which the fourth and fifth podomeres correspond to the sutured fourth podomere. The suture on antennular fourth podomere is observed in the following eight species: *P. dentata*, *P. fernandinensis* Gottwald, 1983, *P. galapagoensis*, *P. schmidti*, *P. subterranea*, *P. psammophila* Gottwald, 1983, *P. mauiensis* and *P. japonica*. On the other hand, no suture on the antennular fourth podomere is observed in the other eight species: *P. elongata*, *P. hartmanni* Marinov, 1962, *P. dimorpha*, *P. marginocostata* Hartmann, 1974, *P. supralitoralis*, *P. gottwaldi* sp. n., *P. gracilis* sp. n. and *P. spec. A*, referred in Gottwald (1983). These two groups are characterised by the presence/absence of suture on the antennular fourth podomere, the former group being called “Group S” and the latter group “Group N” in the present paper. The suture on the antennular fourth podomere is a character observed in the adult individuals of most of cytheroid taxa (see Maddocks 2000), therefore this character can be regarded as a plesiomorphy of the *Parvocythere* species. On the other hand, the lack of the suture is a character observed in juveniles up to the A-4 instar in all the podocopan superfami-

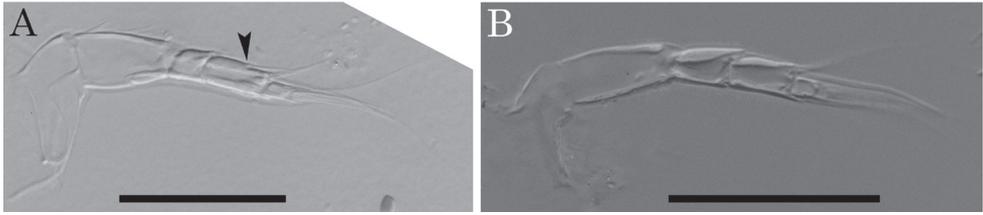


Figure 12. Morphological variations of antennule of *Parvocythere* species. **A** antennule of *Parvocythere japonica* (holotype) **B** antennule of *P. gottwaldi* sp. n. Arrow indicates suture on the middle of fourth podomere. Scale bars indicate 30 μm , respectively.

Table 3. Character states of *Parvocythere* species. Asterisked species have remarkably small length (<160 μm). Abbreviations: S, Group S; N, Group N; 1+1, one claw and one seta on distal end of antenna; sym, symmetric; asym, asymmetric; D, *dentata* group; E, *elongata* group.

Species	Body length (μm)	Suture on antennular 4th podomere	Grouping in this study	Number of antennal distal claw	Male copulatory organ	Grouping in Gottwald (1983)
<i>Parvocythere directocostata</i>	220	divided	S?	2	sym	D
<i>P. dentata</i>	190–210	present	S	2	sym	D
<i>P. fernandinensis</i>	185–193	present	S	2	sym	E
<i>P. galapagoensis</i>	197–220	present	S	2	sym	D
<i>P. schmidtii</i>	168–193	present	S	2	sym	D
<i>P. subterranea</i>	160–181	present	S	2	sym	D
<i>P. psammophila</i>	168	present	S	2	sym	D
<i>P. mauiensis</i>	217	present	S	2	-	-
<i>P. japonica</i>	170–190	present	S	2	sym	D
<i>P. marginocostata</i>	190–240	absent	N	2	sym	E
<i>P. dimorpha</i>	170–180	absent	N	2	asym	D
<i>P. hartmanni</i>	150–160	absent	N	1+1	sym	D
<i>P. supralitoralis</i> *	126–139	absent	N	1+1	sym	D
<i>P. gracilis</i> sp. n.	156–170	absent	N	1+1	asym	D
<i>P. elongata</i>	150–180	absent	N	1	asym	E
<i>P. spec. A</i> in Gottwald (1983)*	155	absent	N	1	asym	D
<i>P. gottwaldi</i> sp. n.	168–176	absent	N	1	asym	D

lies (Smith and Tsukagoshi 2005). This character can be regarded as apomorphy in *Parvocythere*. Moreover this character suggests that the ancestor of Group N had gone through heterochronic (pedomorphic) evolution in its antennula. The unique character of six-segmented antennula in *Parvocythere directocostata* can be understood as “division of segment 4” which is a plesiomorphic character in the podocopids (Smith and Tsukagoshi 2005), but it is hard to decide really whether this character would be the true ancestral state or secondarily occurring one.

Three states of antennal distal end are observed among the *Parvocythere* species (Gottwald 1983): 1) two claws (Fig. 13A and B); 2) one claw and one seta (Fig. 9B); 3) only one claw (Fig. 4B). Since the two distal claws of the antenna is the typical character in the cytheroids, this character state should be regarded as a plesiomorphy of *Parvocythere*. The other two morphotypes indicate a reduction or lack of one of the two distal claws, and the two states can be regarded as apomorphic characters in this genus. Although all species of the Group S retain the two antennal distal claws, the species of Group N show all three antennal character states: i.e., *P. dimorpha* and *P. marginocostata* own two claws; *P. hartmanni*, *P. supralitoralis* and *P. gracilis* sp. n. own a claw and a seta; *P. elongata*, *P. gottwaldi* sp. n. and *P. spec. A*, referred in Gottwald (1983), have only one claw (Table 3). The reductive distal claw therefore appears only in the species of Group N, and the degree of reduction is varied. The interstitial cobanocytherid species also have one claw and one seta on the distal end of the antenna (Hartmann 1959, Schornikov 1975, Gottwald 1983, Higashi and Tsukagoshi 2011). The reductive antennal distal claw is probably a character status related to the adaptation to the interstitial environment.

One of the paired male copulatory organs (hemipenes) is strongly reduced in *Parvocythere elongata*, *P. dimorpha* and *P. spec. A* referred in Gottwald (1983), belonging to Group N. Their right hemipenes are reduced in *P. elongata*, and *P. spec. A* (Gottwald 1983), but which specific side of the reductive hemipenis was not identified in *P. dimorpha* (Hartmann 1959, 1974, Gottwald 1983). *Parvocythere gottwaldi* sp. n. and *P. gracilis* sp. n. also have a reduced right organ (Figs 5 and 10). This character state should be an apomorphy because it cannot be observed in other cytheroids. The reduction of one of the hemipenes, of which the length is approximately one third of body length in *Parvocythere* species, seems to be relevant to the reduction of the body size for the adaptation to the narrow interstices of sediments (Hartmann 1973). On the other hand, all species of the Group S have a symmetric male copulatory organ (Fig. 13C), which can be observed in the almost all podocopans.

Regarding the carapace, the two groups do not show any remarkable character differences. The many species of Group N, however, are relatively small (< 160 µm of the carapace length) (see Table 3). Actually, the carapace length is within the range of 160–220 µm in Group S but of 126–180 µm in Group N, except for the large *P. marginocostata* (190–240 µm), so most species of Group N have smaller carapaces. The smaller body size can be regarded as an adaptive character to the interstitial life (e.g. Hartmann 1973, Maddocks 1976, Westheide 1987, Giere 2008). Group N thus includes many derived species which could have undergone miniaturisation.

The *Parvocythere* species can be divided into Group S, maintaining plesiomorphies, and Group N which includes derived species developing apomorphies as reductive appendages, male copulatory organs, and smaller carapace (Fig. 14). Although Gottwald (1983) classified the *Parvocythere* species into the two groups, i.e. the *elongata* group and the *dentata* group, based only on the morphology of the male copulatory organ, they have no character state shared within each group in their carapace and appendages. On the one hand, the two groups in the present study should reflect the evolu-

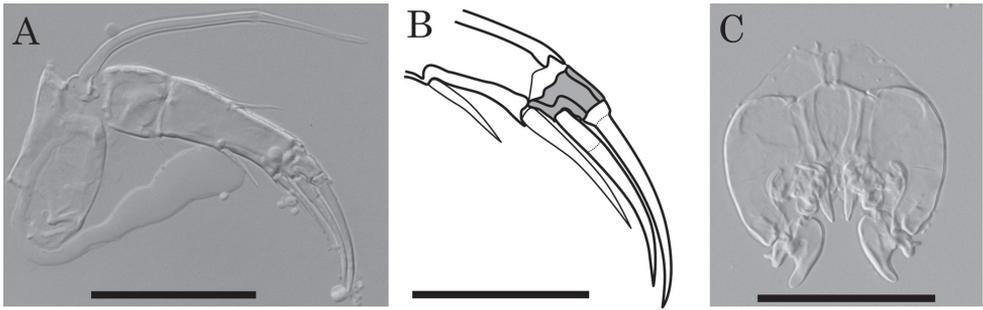


Figure 13. Antenna and male copulatory organ of *Parvocythere japonica* (holotype) as a representative of the Group S. **A** antenna **B** sketch of distal region of antenna **C** male copulatory organ. Shaded podomere is distal fourth podomere. Scale bars indicate 30 µm, 20 µm and 50 µm for **A**, **B** and **C** respectively.

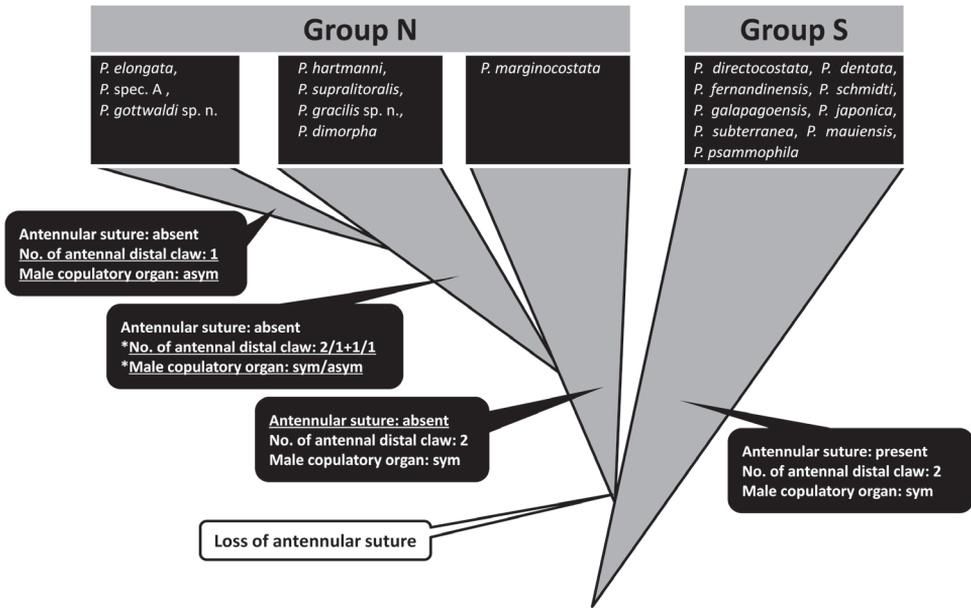


Figure 14. Schematic of inferred evolutionary relationships of the *Parvocythere* species. Triangles coloured in gray indicate each group of species. Species in blackly closed squares indicate them classified into each group. The characters of antennula, antenna and male copulatory organ are represented in the blackly closed balloons and under-lined characters are novel ones. Evolutionary change is represented in an open balloon. The species in the second step of Group N have only one of the reductive states: reductive one of two antennal distal claws or one of paired male copulatory organ (with an asterisk “*”).

tionary tendency of the genus *Parvocythere*. Group S shows many characters regarded as the plesiomorphies of the genus. This does not always provide evidence for the monophyly of the group, but suggests the possibility that the species of Group N were derived after the Group S. On the other hand, the lack of the suture on the middle of antennular fourth podomere is a unique character, and probably a synapomorphy in-

dicating monophyly of Group N. Moreover, the reduction of antennal distal claws and the asymmetric male copulatory organ, which are recognised only in Group N, can also be regarded as apomorphy. Therefore, *P. marginocostata*, the only species possessing two antennal distal claws, symmetric male copulatory organ and large body size in the Group N, should retain ancestral status in this group. The other species of Group N have some reductive characters, but the precise combination of those characters is not evident: *P. dimorpha* has the antenna with two distal claw and asymmetric male copulatory organs; *P. hartmanni* and *P. supralitoralis* have the antenna with a distal claw and a seta and symmetric male copulatory organ; *P. gracilis* sp. n. has the antenna with a distal claw and a seta and an asymmetric male copulatory organ (see Table 3). This suggests that homoplastic changes occurred in either the antennal distal claw or the male copulatory organ in Group N. However, the species which bear only one antennal distal claw, i.e. *Parvocythere elongata*, *P. spec. A* referred in Gottwald (1983) and *P. gottwaldi* sp. n., have exclusively asymmetric male copulatory organ. These species seem to be closely related to each other (probably monophyly), and are the most derived species in the genus *Parvocythere* (Fig. 14).

The genus *Parvocythere* is composed of only interstitial species and characterised by some reductive characters (e.g. small body size less than 250 μm of the length, only two paired walking legs and the absence of eyes), regarded as the result of an adaptation to the interstitial environment (Hartmann 1959, Hartmann 1973, Gottwald 1983). In the lineage of this exclusively interstitial genus, Group N is regarded to have been derived from a part of Group S. Thus, the apomorphic characters observed in species of Group N (i.e. no suture on the antennular fourth podomere, reduced/lack of one of distal claws on the antenna and asymmetric male copulatory organ) should be formed after this exclusively interstitial genus had been derived from a taxon inhabiting other habitats. In addition to this, the reduction/lack of one antennal distal claw and reduction of one of paired male copulatory organ could be expected to decrease the volume of the animal body. Actually, the species of Group N possessing these characters show a shorter valve length than the species of the Group S (Table 3). Consequently, the apomorphic characters found in the antenna and male copulatory organ of some Group N species can be related to miniaturisation, an adaptive evolutionary trend to the narrow interstitial habitat. The evolutionary process assumed by the morphological variation among the *Parvocythere* species therefore offers the possibility that some adaptive characters of interstitial animals occur after colonisation into the interstitial habitat.

Conclusion

The morphological comparison among *Parvocythere* species, including the two new species, suggests that Group N derived after Group S through the heterochronic change of antennula, and that the reduction of antennal distal claw and/or the forming of the asymmetric male copulatory organ occurred as an evolutionary tendency within

Group N (Fig. 14). These morphological variations among the exclusively interstitial *Parvocythere* species suggest that animal taxa specialised for the interstitial life could also evolve further characters related to their adaptation.

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Review of the Southeast Asian species of the *Aenictus javanus* and *Aenictus philippinensis* species groups (Hymenoptera, Formicidae, Aenictinae)

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Abstract

The Southeast Asian species of the *Aenictus javanus* and *Aenictus philippinensis* groups are revised. Six species (four named and two new species) of the *Aenictus javanus* group occurring in this area are: *A. doydeei* Jaitrong & Yamane, 2011, *A. duengkaei* Jaitrong & Yamane, **sp. n.**, *A. javanus* Emery, 1896, *A. longinodus* Jaitrong & Yamane, **sp. n.**, *A. nishimurai* Terayama & Kubota, 1993, and *A. piercei* Wheeler & Chapman, 1930. Four species (three named and one new species) are recognized in the *Aenictus philippinensis* group: *A. pangantihoni* Zettel & Sorger, 2010, *A. philippinensis* Chapman, 1963, *A. punctatus* Jaitrong & Yamane, **sp. n.**, and *A. rabori* Chapman, 1963. *A. piercei* is removed from the members of the *A. piercei* group sensu Jaitrong and Yamane (2011) and transferred to the *A. javanus* group. Lectotypes and paralectotypes are designated for *A. piercei* and *A. rabori*. Size variation occurs among individuals from single colonies of the *A. javanus* group, while the workers in the *A. philippinensis* group are clearly monomorphic.

Keywords

Aenictus javanus group, *Aenictus philippinensis* group, army ants, taxonomy, new species, Southeast Asia

Introduction

The genus *Aenictus* Shuckard, 1840 (subfamily Aenictinae) is one of the larger ant genera of the world. Currently 177 species and subspecies are listed (Bolton 2012). Jaitrong and Yamane (2011) established 12 species groups in the genus from the eastern part of the Oriental, Indo-Australian and Australasian regions, the groups being well defined on the basis of worker morphology.

The *Aenictus javanus* group is a small species group of the genus, defined by the following characteristics: antenna 10-segmented; mandible with 3 teeth including a large apical tooth; anterior margin of clypeus with several denticles; mesosoma in profile with dorsal margin almost flat. So far three species of the group, *Aenictus doydeei* Jaitrong & Yamane, 2011, *A. javanus* Emery, 1896 and *A. nishimurai* Terayama & Kubota, 1993 have been known, and all these are distributed only in Southeast Asia (Emery 1896, Forel 1909, Terayama and Kubota 1993, Jaitrong et al. 2011, Jaitrong and Yamane 2011). Jaitrong and Yamane (2011) included *Aenictus piercei* Wheeler & Chapman, 1930 in the “*Aenictus piercei* group”. However, after a careful examination of a specimen of *A. piercei* kept together with the two syntypes, we decided to remove this species from this group that will be renamed in a different paper as the *A. minutulus* group, and to transfer it to the *A. javanus* group because in most respects this specimen and the syntypes possess a set of characteristics observed in the *A. javanus* group.

The *Aenictus philippinensis* group is also a small species group of the genus, known only from the Philippines, consisting of three species: *Aenictus pangantihoni* Zettel & Sorger, 2010, *Aenictus philippinensis* Chapman, 1963 and *Aenictus rabori* Chapman, 1963 (Chapman 1963, Zettel and Sorger 2010, Jaitrong and Yamane 2011).

During our survey on the Asian *Aenictus* we found two new species of the *A. javanus* group from Thailand and a new species of the *A. philippinensis* group from Borneo and Java. In the present paper we revise these two groups in Southeast Asia and describe the three new species based on the worker caste. Morphological and bionomic information is presented for each species.

Materials and methods

This study is mainly based on the materials deposited in the SKY Collection at Kagoshima University (Japan) and The Natural History Museum of the National Science Museum (Thailand). Syntypes or paratypes were examined for the five named species of the *Aenictus javanus* and *A. philippinensis* groups. The holotype of *A. doydeei* Jaitrong & Yamane, 2011 was also examined. The type material of *A. philippinensis* Chapman, 1963 was not examined, but specimens from the type locality (Philippines, Negros) were examined.

Most morphological observations were made with a Nikon SMZ1000 stereoscope. Multi-focused montage images were produced using Helicon Focus 4.75 Pro from a series of source images taken by a Nikon EOS Kiss×4 digital camera attached to a

Nikon ECLIPSE E600 microscope. Workers of each species were measured for the following parts using a micrometer, recorded to the second decimal place.

The abbreviations used for the measurements and indices are as follows:

- CI** Cephalic index, $HW/HL \times 100$.
HL Maximum head length in full-face view, measured from the middle of anterior clypeal margin to the middle of the posterior margin of head.
HW Maximum head width in full-face view.
ML Mesosomal length measured from the point at which the pronotum meets the cervical shield to the posterior margin of metapleuron in profile.
PL Petiole length measured from the anterior margin of the peduncle to the posteriormost point of tergite.
SI Scape index, $SL/HW \times 100$.
SL Scape length excluding the basal of constriction and condylar bulb.
TL Total length, roughly measured from the anterior margin of head to the tip of gaster in stretched specimens.

Abbreviations of the type depositories are as follows:

- AMK** Ant Museum, Faculty of Forestry, Kasetsart University, Thailand.
BMNH The Natural History Museum, London, U.K.
KKIC Kasetsart Kampaengsaen Insect collection, Thailand.
MCSN Museo Civico di Storia Naturale “Giacomo Doria”, Genova, Italy
MCZC Museum of Comparative Zoology, Cambridge, MA, U.S.A.
MHNG Muséum d’Histoire Naturelle, Geneva, Switzerland.
NIAST The National Institute of Agro-Environmental Sciences, Tsukuba, Japan.
SKYC SKY Collection at Kagoshima University, Japan.
THNHM Natural History Museum of the National Science Museum, Thailand.
USC University of San Carlos, Cebu City, The Philippines.

The general terminology in the worker caste of the ants follows Hölldobler and Wilson (1990), and Bolton (1994). For the important characters in the genus *Aenictus* used in this paper, see Jaitrong and Yamane (2011).

Systematics

Revision of the *Aenictus javanus* group

Aenictus javanus group

Diagnosis. In the previous paper (Jaitrong and Yamane 2011) this species group was defined as follows: head in full-face view with occipital corner convex; occipital margin

lacking collar; antenna 10-segmented; antennal scape short, extending only half length of head; anterior clypeal margin roundly convex bearing 6-10 denticles; mandible subtriangular, masticatory margin with 3 teeth including the large apical tooth; frontal carina short, not extending beyond the level of posterior margin of torulus; parafrenal ridge absent; mesosoma in profile with dorsal margin almost flat; dorsal face of mesosoma meeting with lateral face at a right angle; propodeal junction angulated; propodeal declivity encircled with a thin rim. Subpetiolar process developed and triangular or subrectangular.

Head and first gastral segment entirely smooth and shiny except base of gastral tergite I and sternite I with dense small punctures. Body reddish brown to yellowish brown; typhlatta spot absent.

Remarks. This is a group of relatively small ants measuring 1.38-3.40 mm in total length. It is similar to the *A. piercei* group sensu Jaitrong and Yamane (2011) in terms of body size and coloration, but in the former the anterior clypeal margin has several denticles, while it lacks denticles in the latter.

A size variation exists among the specimens of single colonies. There is a general tendency that smaller specimens have a much weaker punctation, more elongate head and shorter antennal scape than larger specimens.

Checklist of species

- Aenictus doydeei* Jaitrong & Yamane, 2011
Aenictus duengkaii Jaitrong & Yamane, sp. n.
Aenictus javanus Emery, 1896
Aenictus longinodus Jaitrong & Yamane, sp. n.
Aenictus nishimurai Terayama & Kubota, 1993
Aenictus piercei Wheeler & Chapman, 1930

Key to species based on the worker caste

- 1 Basal margin of mandible with a distinct denticle behind large basal tooth (Fig. 2D); smaller species (HW 0.25–0.38 mm) (E. Thailand).....***A. duengkaii* sp. n.**
- Basal margin of mandible lacking denticle (Figs 1A, 3A, 4A, 6A); larger species (HW 0.40–0.65 mm).....**2**
- 2 Declivity of propodeum almost flat, with blunt lateral carinae, but not demarcated basally by a transverse carina (Philippines) (Fig. 6F)***A. piercei* Wheeler & Chapman**
- Declivity of propodeum shallowly concave, and margined with a thin carina both laterally and basally (Figs 1D, 5C)**3**
- 3 With head seen in profile occipital corner bluntly angulated (almost right-angled) (Java and Borneo) (Fig. 3D)***A. javanus* Emery**
- With head seen in profile occipital corner rounded (Figs 1E, 4D, 5B)**4**

- 4 Petiole distinctly longer than high; postpetiole almost as long as petiole (S. Thailand) (Fig. 4B, D) *A. longinodus* sp. n.
- Petiole almost as long as high; postpetiole slightly larger than petiole (Figs 1C, 5D, E) **5**
- 5 Lateral face of pronotum shiny but with reticulation (Vietnam, Laos, and Thailand) (Fig. 1E) *A. doydeei* Jaitrong & Yamane
- Lateral face of pronotum smooth and shiny; sculpture if any very superficial (Vietnam, Laos, and Thailand) (Fig. 5B)... *A. nishimurai* Terayama & Kubota

***Aenictus doydeei* Jaitrong & Yamane, 2011**

http://species-id.net/wiki/Aenictus_doydeei

Figs 1, 7A

Aenictus doydeei Jaitrong & Yamane, in Jaitrong et al. 2011: 319, figs 7–9.

Types. Holotype and 61 paratype workers from a plantation, 211 m, Sivilay Village, Naxaythong Dist., Vientiane, Laos, 18°16'10"N, 102°26'36"E, 10.VI.2010, W. Jaitrong leg., WJT10-LAO13 (AMK, BMNH, KKIC, MCZC, SKYC, THNHM, examined).

Measurements. Holotype: TL 3.40 mm; HL 0.70 mm; HW 0.65 mm; SL 0.40 mm; ML 1.00 mm; PL 0.28 mm; CI 93; SI 62.

Paratype workers (n = 9): TL 2.90–3.40 mm; HL 0.53–0.70 mm; HW 0.48–0.65 mm; SL 0.28–0.40 mm; ML 0.75–1.00 mm; PL 0.23–0.28 mm; CI 91–95; SI 55–62.

Description of worker (holotype and paratypes). Head in full-face view almost as long as broad, with sides convex and posterior margin almost straight or feebly concave; seen in profile occipital corner of head rounded. Antennal scape reaching midlength of head; antennal segment II longer and narrower than each of III–VI; terminal segment (X) about 2.5 times as long as broad. Anterior margin of clypeus bearing 9–10 denticles. Masticatory margin of mandible with 3 acute teeth including a large apical tooth; basal margin lacking denticles. Mesosoma seen from above broader anteriorly than posteriorly; promesonotum laterally edged, in profile weakly convex dorsally and sloping gradually to propodeal junction; in profile propodeum slightly lower than promesonotum and almost flat dorsally; suture between mesopleuron and metapleuron completely absent; propodeal junction angulate, right-angled; declivity of propodeum shallowly concave, encircled by a thin rim. Petiole almost as long as high, its dorsal outline slightly elevated posteriorly; subpetiolar process well developed, subrectangular, its ventral margin almost straight and longer than posterior margin; postpetiole seen in profile subrectangular and slightly larger than petiole.

Head entirely smooth and shiny. Dorsal surface of pronotum smooth and shiny, lateral face superficially reticulate and shiny; mesothorax, metapleuron and propodeum densely microreticulate. Petiole entirely microreticulate. Postpetiole microreticulate except for a small smooth and shiny area on dorsal surface.

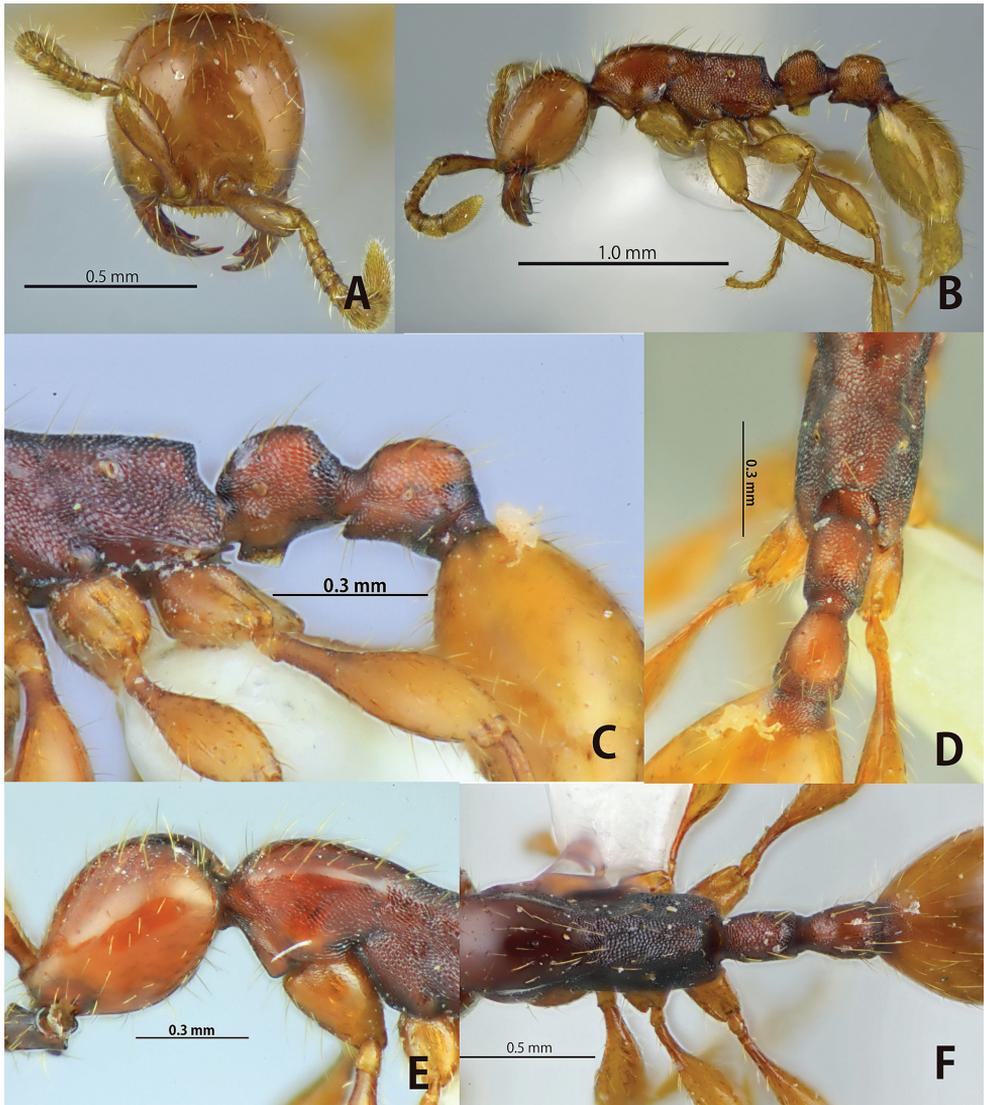


Figure 1. *Aenictus doydeei* (paratype). **A** Head in full-face view **B** habitus in profile **C** propodeal junction, petiole and postpetiole in profile **D** propodeal declivity with body in dorsal view **E** occipital corner of head in profile **F** dorsal view of body.

Head and mesosoma dorsally with relatively sparse standing hairs mixed with sparse short hairs; longest pronotal hairs 0.18–0.20 mm long. Head, mesosoma, petiole and postpetiole reddish brown; gaster yellowish brown; propodeum darker than other parts

Non-type material examined. VIETNAM: Dong Nai Prov., S. Cat Tien N.P., Crocodile Lake Trail, 18.X.2004, K. Eguchi leg., Eg04-VN-707 (SKYC). **THAILAND:** NE. Thailand, Loei Prov., Phu Rur Dist., disturbed area, 10.IV.2008, P.

Kosolpanyapiwat leg., PKK08-TH102 (SKYC, THNHM); Chaiyaphum Prov., Phu Kheao Dist., Agricultural area, 30.I.1999, W. Jaitrong leg., WJT99-AG22 (SKYC, THNHM); NE. Thailand, Nakhon Ratchasima Prov., Sakaerat ERS, 10.VII.1999, Sk. Yamane leg., TH99-SKY-19 (SKYC, THNHM).

Distribution. Vietnam (new record), Laos and Thailand (Fig. 7A).

Bionomics. The type series from Laos and three colonies from Thailand were collected from disturbed areas in the night. Thus *A. doydeei* is very probably nocturnal. Jaitrong et al. (2011) reported that this species preyed on *Pheidole plagiaria*.

Remarks. This species is closely related to *Aenictus javanus*, *A. longinodus*, and *A. nishimurai* in terms of body size and coloration. *A. doydeei*, however, is easily distinguished from *A. javanus* and *A. longinodus* as follows: occipital margin of head in profile rounded (Fig. 1E), while angled in *A. javanus* (Fig. 3D); petiole almost as long as high, but clearly longer than high in *A. javanus* and *A. longinodus* (Figs 3B, 4B, D). *A. doydeei* is most similar to *A. nishimurai*, but is clearly larger than *A. nishimurai* with a slight overlap, and has the lateral face of the pronotum that is smooth but reticulated (almost smooth in *A. nishimurai*). *A. doydeei* is sympatric with *A. nishimurai* in Vientiane province, Laos and in northeastern Thailand.

***Aenictus duengkaei* Jaitrong & Yamane, sp. n.**

urn:lsid:zoobank.org:act:DB41057D-3357-4A91-9A4A-25BCFA4926F8

http://species-id.net/wiki/Aenictus_duengkaei

Figs 2, 7A

Types. Holotype worker from E. Thailand, Chacheongsao Prov., Khao Ang Reu Nai, dry evergreen forest, 22.VIII.2003, Sk. Yamane leg., TH03-SKY-79 (THNHM). Twelve paratype workers, same data as holotype (BMHN, MCZC, SKYC, THNHM).

Measurements. Holotype: TL 1.90 mm; HL 0.43 mm; HW 0.38 mm; SL 0.20 mm; ML 0.58 mm; PL 0.15 mm; CI 88; SI 53.

Larger workers (paratypes, n = 5): TL 1.80–1.90 mm; HL 0.43–0.45 mm; HW 0.36–0.38 mm; SL 0.19–0.20 mm; ML 0.53–0.58 mm; PL 0.14–0.15 mm; CI 83–88; SI 52–53. Smaller workers (paratypes, n = 3): TL 1.50–1.55 mm; HL 0.40–0.43 mm; HW 0.25–0.28 mm; SL 0.15–0.16 mm; ML 0.45–0.48 mm; PL 0.10–0.13 mm; CI 63–65; SI 59–60.

Description of worker (holotype and paratypes). Head in full-face view distinctly longer than broad and subrectangular, with sides weakly convex or almost parallel, and posterior margin clearly concave; seen in profile occipital corner of head rounded. Antennal scape very short, not reaching midlength of head; antennal segment II clearly longer than each of III–VI; III–VI shorter than broad; terminal segment longer than VII+VIII+IX and about 1.6 times as long as broad. Anterior margin of clypeus bearing 5–7 denticles. Masticatory margin of mandible with 3 acute teeth including a large apical tooth; basal margin with 1–2 denticles behind large basal tooth. Mesosoma seen in profile almost flat dorsally; propodeal junction

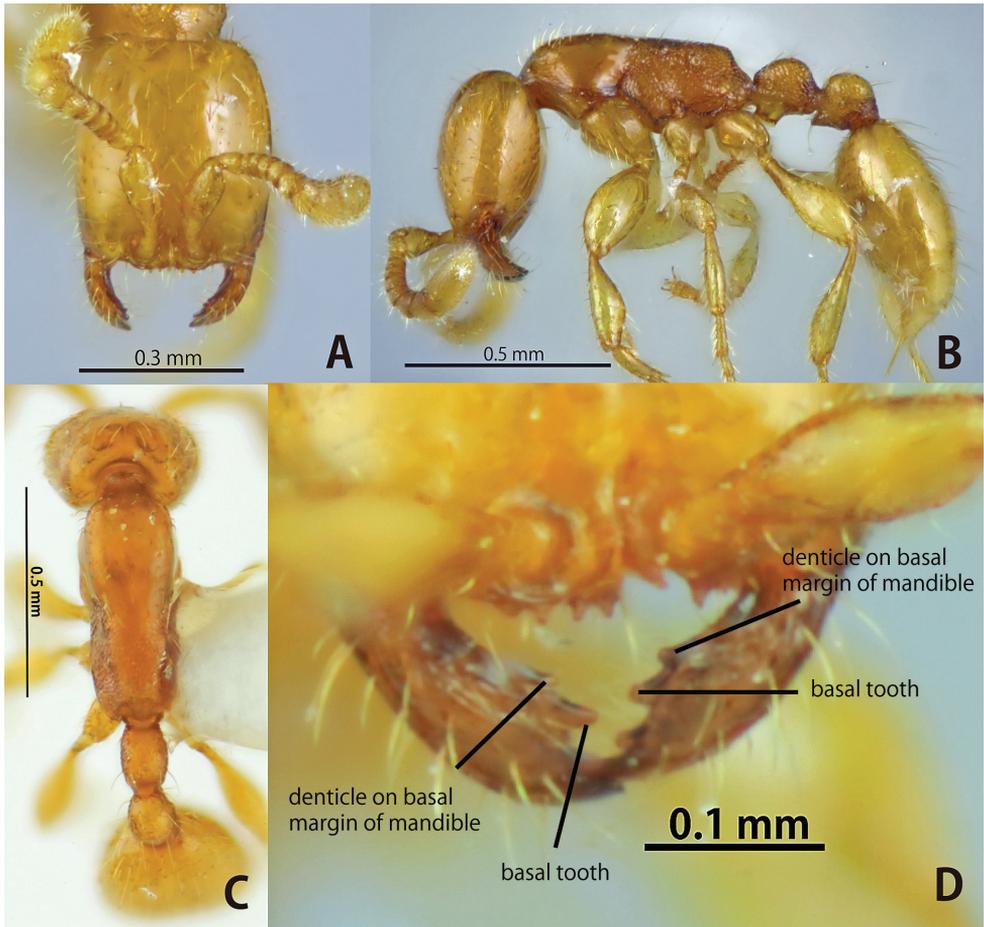


Figure 2. *Aenictus duengkaei* sp. n. (holotype). **A** Head in full-face view **B** habitus in profile **C** dorsal view of body; **D**, mandible and anterior clypeal margin.

angulate; declivity of propodeum almost flat, with blunt lateral carinae, but not demarcated basally by a transverse carina. Petiole round almost as long as high; subpetiolar process well developed, subrectangular, its ventral border almost straight and longer than posterior border; postpetiole slightly smaller than petiole and its dorsal outline roundly convex.

Head and antennal scape smooth and shiny; mandible extensively smooth but narrow zone along basal margin sculptured. Dorsal and lateral face of pronotum smooth and shiny except for anteriormost portion microreticulate; mesonotum smooth and shiny; mesopleuron superficially shagreened with smooth and shiny interspaces; metapleuron and propodeum shiny but microreticulate. Petiole entirely microreticulate but its dorsal face with a small area that is smooth (in larger specimens this area weakly sculptured). Postpetiolar node almost smooth and shiny.

Head with relatively sparse standing hairs; mesosoma dorsally with relatively dense standing hairs mixed with sparse short hairs over the surface; longest pronotal hairs 0.07–0.10 mm long. Head, gaster and legs yellowish brown; mesosoma, petiole and postpetiole reddish brown; mandible darker than elsewhere.

Etymology. The specific name is dedicated to Dr. Prateep Duengkae of the Faculty of Forestry, Kasetsart University, who helped us in collecting material in eastern Thailand.

Non-type material examined. THAILAND: E. Thailand, Chonburi Prov., Kasetsart Siracha campus, agriculture area, 20.III.2004, Wanishsakulpong leg., WJT04-E50 (THNHM).

Distribution. E. Thailand (Fig. 7A).

Bionomics. This species has been known only from eastern Thailand. The type series was collected from soil in a lowland dry evergreen forest (ca. 200 m), while the other colony (WJT04-E50) was collected from soil in an agricultural area. Thus, this species inhabits both primary and disturbed forests.

Remarks. *Aenictus duengkaei* is similar to *A. piercei* in terms of body size and coloration. Furthermore, the propodeal declivity is not margined basally with a carina in both species. However, *A. duengkaei* is easily separated from the latter by the condition of the mandible that has a distinct denticle on the basal margin, while the denticle is lacking in *A. piercei*.

Aenictus javanus Emery, 1896

http://species-id.net/wiki/Aenictus_javanus

Figs 3, 7B

Aenictus javanus Emery 1896: 245; Forel 1909: 222; Wilson 1964: 467 figs 36; Bolton 1995: 59.

Types. Two syntype males from Java, Buitenzorg [Bogor] (MCSN, examined).

Measurements. Non-type workers from the type locality (n = 8): TL 2.35–2.60 mm; HL 0.55–0.58 mm; HW 0.50–0.53 mm; SL 0.35 mm; ML 0.83–0.88 mm; PL 0.23–0.25 mm; CI 91; SI 67–70.

Description of worker (non-type workers from the type locality). Head in full-face view slightly longer than broad, subrectangular, with sides convex and posterior margin almost straight or feebly concave; seen in profile occipital corner of head angulated. Antennal scape reaching midlength of head; antennal segment II almost as long as each of III–V; terminal segment longer than VII+VIII+IX and 2.2 times as long as broad. Anterior margin of clypeus bearing 6–7 denticles. Masticatory margin of mandible with 3 acute teeth including a large apical tooth; basal margin lacking denticles. Promesonotum in profile weakly convex dorsally or almost flat and sloping gradually to propodeal junction; in profile propodeum almost flat dorsally; suture between mesopleuron and metapleuron almost absent; propodeal junction angulate, right-angled; declivity of propodeum shallowly concave, encircled by a thin rim. Peti-

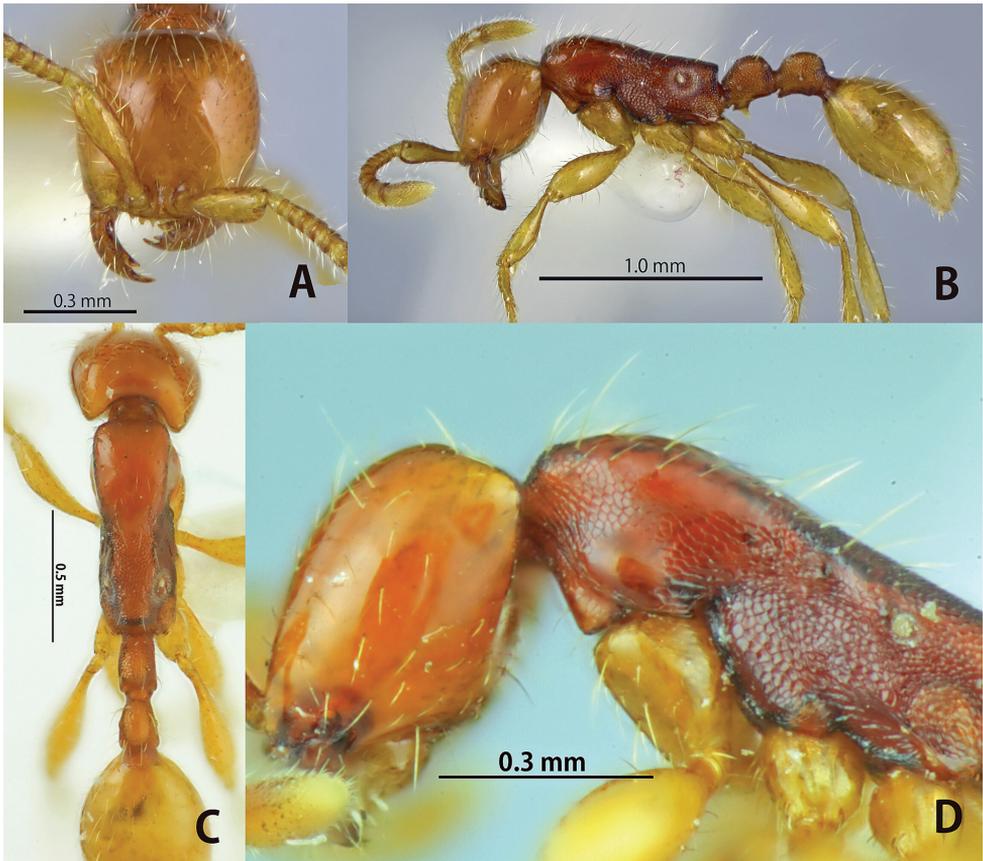


Figure 3. *Aenictus javanus* (non-type from Java). **A** Head in full-face view **B** habitus in profile **C** dorsal view of body **D** occipital corner of head.

ole distinctly longer than high, its dorsal outline slightly elevated posteriorly; subpetiolar process well developed, subrectangular, its ventral border almost straight or feebly concave and as long as posterior border; postpetiole almost as long as, its dorsal outline slightly convex.

Head including antennal scape smooth and shiny; mandible striate along basal margin and smooth in apical and peripheral parts. Dorsal surface of pronotum smooth and shiny, lateral face of pronotum superficially reticulate but shiny; anteriormost part of pronotum microreticulate; mesothorax, metapleuron and propodeum microreticulate. Petiole entirely microreticulate. Postpetiole microreticulate except for a small area on dorsal surface smooth and shiny.

Head and mesosoma dorsally with relatively sparse standing hairs mixed with sparse short hairs; longest pronotal hairs 0.15–0.18 mm long. Head yellowish brown to reddish brown, mesosoma, petiole and postpetiole reddish brown; gaster yellowish brown. Typhlatta spot absent.

Non-type material examined. **MALAYSIA:** Borneo, Sabah, Sandakan, Sepilok, Water Hole Trail, 30.V.2005, Alveron leg., A46 (SKYC); Borneo, Sabah, Sepilok forest, 27.I.1997, K. Eguchi leg., Eg97-BOR-506; Borneo, Sarawak, Lambir Hills N.P., 8 ha Plot, 11.VII.2004, H.O. Tanaka leg., TY04–801 (SKYC, THNHM). **BRUNEI:** Temburong, Kuala Belalong, Field Studies Centre, 19.II.1999, K. Eguchi leg., Eg97-BOR-225 (SKYC, THNHM). **INDONESIA:** W. Java, Bogor, Kebun Raya, 9.XII.1995, F. Ito leg., FI95–536 (SKYC, THNHM); same loc., 25.II.1997, F. Ito leg., FI97–06 (SKYC, THNHM).

Six workers from Java (2 pins, three on each pin, labeled as *typus*) identified as *A. javanus* by Auguste-Henri Forel (MHNG) were examined. This series should be the same as that cited in Forel (1909). These workers are not the *typus*.

Distribution. Borneo (Sabah, Sarawak, and Brunei) and Java (Bogor) (Fig. 7B).

Bionomics. All colonies of this species were collected from lowland rainforests.

Remarks. This species is closely related to *Aenictus doydeei*, *A. longinodus*, and *A. nishimurai* in terms of body size and coloration. Among these species is more closely related to *A. longinodus* than the others in having the long petiole. *A. javanus* can be separated from *A. longinodus* as follows: occipital margin of head in profile angulated, while rounded in *A. longinodus*; the lateral face of the pronotum that are reticulate but shiny (almost smooth in *A. longinodus*).

Aenictus longinodus Jaitrong & Yamane, sp. n.

urn:lsid:zoobank.org:act:69B819C3-94CE-47A3-8B62-3291A6BA2572

http://species-id.net/wiki/Aenictus_longinodus

Figs 4, 7B

Types. Holotype worker from S. Thailand, Trang Prov., Khao Chong Botanical Garden, evergreen forest, 8.XI.2003, W. Jaitrong, THNHM-I03–942 (= TH03-WJT-713, THNHM). Thirty-seven paratype workers, same data as holotype (BMHN, MCZC, MHNG, SKYC, THNHM).

Measurements. Holotype: TL 2.55 mm; HL 0.55 mm; HW 0.53 mm; SL 0.33 mm; ML 0.80 mm; PL 0.25 mm; CI 95; SI 62.

Larger workers (paratypes, n = 8): TL 2.45–2.60 mm; HL 0.55–0.58 mm; HW 0.53–0.55 mm; SL 0.33–0.35 mm; ML 0.80–0.88 mm; PL 0.25 mm; CI 95–96; SI 61–64. Smaller workers (paratypes, n = 4): TL 1.90–2.00 mm; HL 0.45–0.53 mm; HW 0.40–0.43 mm; SL 0.22–0.28 mm; ML 0.63–0.73 mm; PL 0.18–0.19 mm; CI 85–89; SI 56–61.

Description of worker (holotype and paratypes). Head in full-face view slightly longer than broad, with sides convex and posterior margin almost straight; seen in profile occipital corner of head rounded. Antennal scape reaching midlength of head; antennal segment II longer and narrower than each of III–VI; terminal segment about 2 times as long as broad. Anterior margin of clypeus bearing 7 denticles. Masticatory margin of mandible with 3 acute teeth including a large apical tooth; basal margin lacking denticles. Promesonotum seen in profile almost flat or weakly convex dorsally and sloping gradually to propodeal junction; in profile propodeum slightly lower than

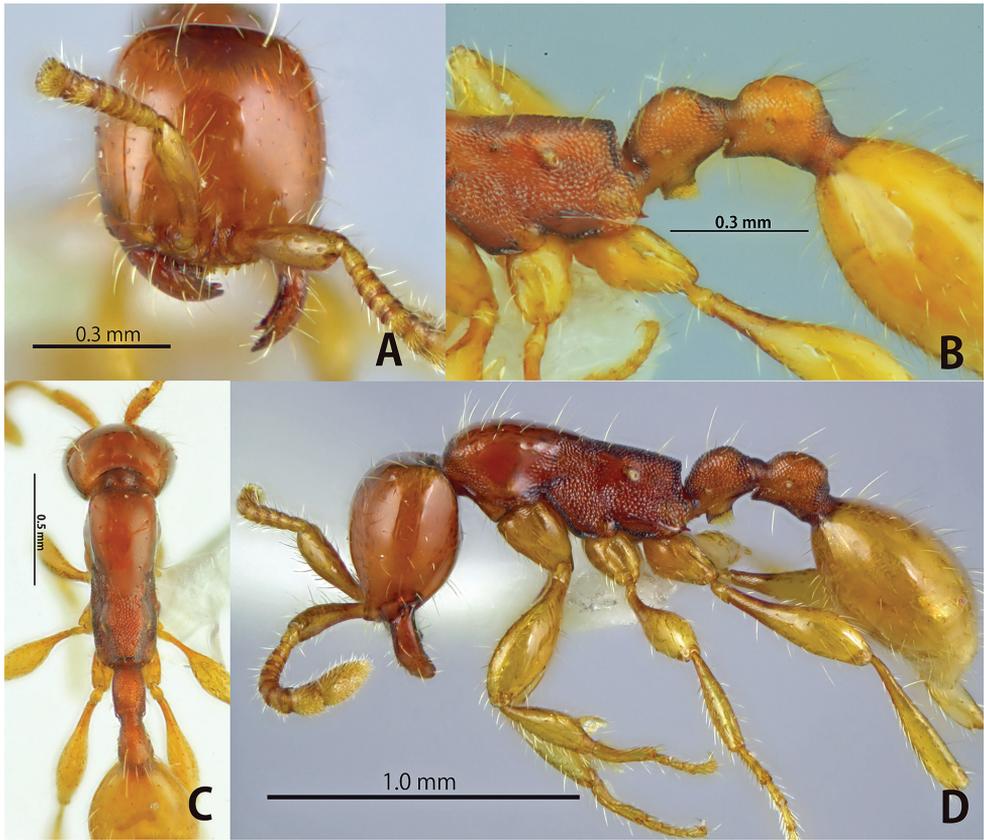


Figure 4. *Aenictus longinodus* sp. n. (paratype). **A** Head in full-face view **B** propodeal junction, petiole and postpetiole in profile **C** dorsal view of body **D** habitus in profile.

promesonotum and almost flat dorsally; propodeal junction angulate, right-angled; declivity of propodeum shallowly concave, encircled by a thin rim. Petiole longer than high, its dorsal outline convex; subpetiolar process well developed, subrectangular, its ventral margin almost straight or weakly convex and slightly longer than posterior margin; postpetiole seen in profile subrectangular and slightly shorter than petiole.

Head including antennal scape smooth and shiny; mandible striate along basal margin and smooth in apical and peripheral parts. Dorsal and lateral surface of pronotum smooth and shiny except for anteriormost part microreticulate; mesothorax, metapleuron and propodeum microreticulate. Petiole entirely microreticulate. Postpetiole microreticulate except for a small smooth and shiny area on dorsal surface.

Head and mesosoma dorsally with relatively sparse standing hairs mixed with sparse short hairs over the surface; longest pronotal hairs 0.13–0.15 mm long. Head, mesosoma, petiole and postpetiole reddish brown; gaster yellowish brown and paler than the other parts of body; propodeum darkest.

Etymology. The specific name refers to the long petiole.

Non-type material examined. THAILAND: S. Thailand, Nakhon Si Thammarat Prov., Nuppitam Dist., Khao Luang N.P., Krung Ching waterfall, rainforest, 20.V.2003, W. Jaitrong leg., THTHM-I03-3779 (= TH03-WJT330, THNHM); Trang Prov., Palian Dist., Ban Suso, Open area, 31.X.2011, W. Jaitrong leg., TH11-WJT-183 (SKYC, THNHM); Songkhla Prov., Ton Nga Chang W.S., 5.II.1998, N. Noon-anant leg., N98-3 (SKYC, THNHM); same loc., 29.X.1997, N. Noon-anant leg., N97-1 (SKYC, THNHM); Songkhla Prov., Hat Yai, Songkhlanakarin Campus, PSU forest, 21.X.2011, Sk. Yamane leg., TH11-SKY-166 (SKYC, THNHM).

Distribution. Malay Peninsula (S. Thailand) (Fig. 7B).

Bionomics. The type series, two colonies from Ton Nga Chang Wildlife Sanctuary (N98-3 and N97-1), and a colony from Khao Luang National Park (TH03-WJT330) were collected in lowland rainforests. A colony (TH11-WJT-183) was collected from an open area in the day, while a colony (TH11-SKY-166), just coming out of soil, was from a disturbed forest near a concrete road in the night. Thus, this species inhabits both primary and disturbed forests and is active in the day and night.

Remarks. This species is most similar to *A. javanus*. See under *A. javanus* for details.

Aenictus nishimurai Terayama & Kubota, 1993

http://species-id.net/wiki/Aenictus_nishimurai

Figs 5, 7A

Aenictus nishimurai Terayama and Kubota 1993: 70, figs 9-10; Jaitrong et al. 2011: 321, figs 10-12.

Types. Holotype and 10 paratype workers (NIAST, SKYC) from Thailand, Changmai Prov. [Chiangmai Prov.], Doi Suthep (1,500 m alt.), 18.VIII.1992, M. Terayama and S. Kubota leg. A paratype in SKYC was examined.

Measurements. Paratype: TL 2.40 mm; HL 0.58 mm; HW 0.48 mm; SL 0.25 mm; ML 0.75 mm; PL 0.20 mm; CI 83; SI 53.

Larger workers (non-types, n = 7): TL 2.66-2.90 mm; HL 0.60-0.65 mm; HW 0.53-0.58 mm; SL 0.33-0.35 mm; ML 0.83-0.90 mm; PL 0.23-0.25 mm; CI 88; SI 61-64. Smaller workers (non-types, n = 4): TL 1.95-2.25 mm; HL 0.48-0.50 mm; HW 0.38-0.43 mm; SL 0.20-0.25 mm; ML 0.55-0.65 mm; PL 0.15-0.18 mm; CI 79-85; SI 53-59.

Description of worker (paratype and non-type workers). Head in full-face view longer than broad, with sides slightly convex and posterior margin almost straight or feebly concave; seen in profile occipital corner of head rounded. Antennal scape reaching midlength of head; antennal segment II almost as long as broad; III-VIII each slightly broader than long; terminal segment 2.3 times as long as broad. Anterior margin of clypeus bearing 7-10 denticles. Masticatory margin of mandible with 3 acute teeth including a large apical tooth; basal margin lacking denticles. Mesosoma seen in profile

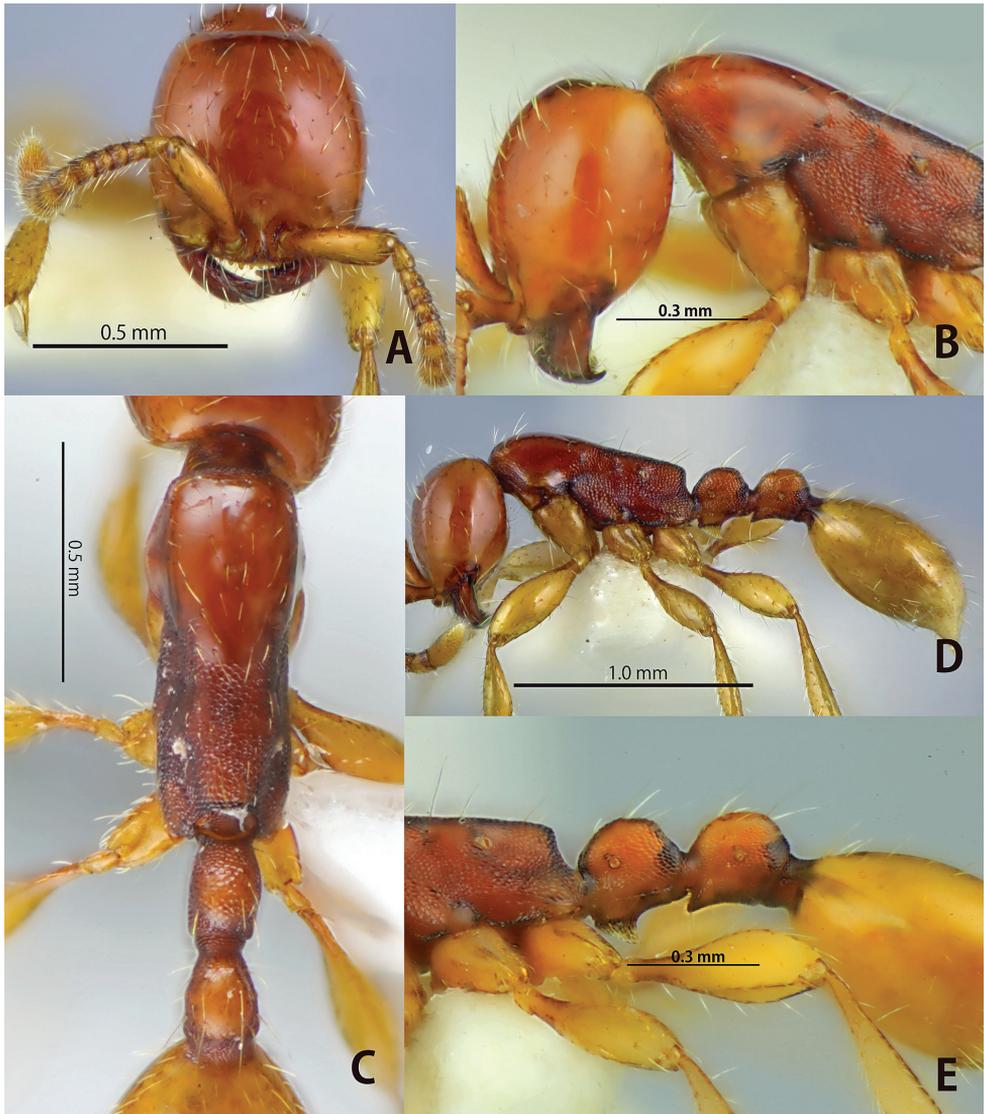


Figure 5. *Aenictus nishimurai* (non-type from Chiang Mai Province, N. Thailand). **A** Head in full-face view **B** head in profile showing occipital margin **C** dorsal view of body **D** habitus in profile **E** propodeal junction, petiole and postpetiole in profile.

weakly convex dorsally or almost flat; in profile propodeum almost flat dorsally; suture between mesopleuron and metapleuron absent; propodeal junction dully angulated, forming an almost right angle; declivity of propodeum shallowly concave, encircled by a thin rim. Petiole nearly as long as high, its dorsal outline convex; subpetiolar process well developed, subrectangular, its ventral margin nearly straight and longer than posterior margin; postpetiole seen in profile almost as long as petiole, with round node.

Head including antennal scape entirely smooth and shiny; mandible finely striate with outer zone smooth and shiny. Dorsal and lateral surface of pronotum smooth and shiny except for anteriormost part microreticulate; mesothorax, metapleuron, and propodeum microreticulate. Petiole entirely microreticulate. Postpetiole microreticulate except for smooth and shiny area on dorsal surface.

Head and mesosoma dorsally with relatively sparse standing hairs mixed with sparse short hairs; longest pronotal hairs 0.15–0.18 mm. Head yellowish brown; mesosoma, petiole and postpetiole reddish brown; gaster yellowish brown, but paler than head.

Non-type material examined. **VIETNAM:** N. Vietnam, Ha Tai Prov., Ba Vi N.P., 400–600 m alt., 12.XI.1999, K. Eguchi leg., Eg99-VN-107 (SKYC, THNHM); same loc., 11.XI.1999, K. Eguchi leg., Eg99-VN-84 (SKYC, THNHM); Bac Giang, Tay Yen Tu, 400 m alt., 23.V.2004, K. Eguchi leg., Eg04-VN-100 (SKYC). **LAOS:** Vientiane Prov., Pak Ngum Dist., Phang Dang Village, 14.VI.2010, W. Jaitrong leg., WJT10-LAO19, Sk. Yamane leg., LA10-SKY-56 (AMK, SKYC, THNHM). **THAILAND:** N. Thailand, Chiang Mai Prov., Mae Tang dist., 26.IV.2000, W. Jaitrong leg., WJT00-TH01 (SKYC, THNHM); W. Thailand, Kachanaburi Prov., Sai Yok N.P., 140 m alt., 30.VI.2002, Sk. Yamane leg., TH02-SKY-19 (SKYC, THNHM); NE. Thailand, Saraburi Prov., Phukae B.G., 1.VII.2002, Sk. Yamane leg., TH02-SKY-41 (SKYC, THNHM).

Distribution. Vietnam, Laos and Thailand.

Bionomics. No biological information is available for *A. nishimurai*. However, judging from the localities cited above this species is distributed from lowland to highland (200–1,500 m) and inhabits primary, secondary and disturbed forests.

Remarks. This species is most similar to *A. doydeei*. See under *A. doydeei* for details.

Aenictus piercei Wheeler & Chapman, 1930

http://species-id.net/wiki/Aenictus_piercei

Figs 6, 7B

Aenictus piercei Wheeler & Chapman, in Wheeler 1930: 209, fig. 7e–g; Wilson 1964: 474, figs 61–62; Bolton 1995: 60.

Types. Two syntype workers on a pin, the Philippines, Negros, Cadiz, 2.VI.1924, leg. Dr. Pierce (MCZC, examined). The worker located below on the pin is selected as the lectotype (Fig. 6B).

Measurements. Lectotype: TL 2.15 mm; HL 0.53 mm; HW 0.48 mm; SL 0.28 mm; ML 0.70 mm; PL 0.20 mm; CI 90; SI 58.

Paralectotypes (n = 2): TL 2.15 mm; HL 0.53–0.58 mm; HW 0.48–0.50 mm; SL 0.28–0.33 mm; ML 0.70–0.83 mm; PL 0.20–0.23 mm; CI 87–90; SI 58–65.

Description of worker (lectotype, paralectotype and a non-type worker). Head in full-face view slightly longer than broad, subrectangular, with sides feebly convex and posterior margin almost straight; seen in profile occipital corner of head rounded. Antennal scape reaching midlength of head; antennal segment II longer and narrower than

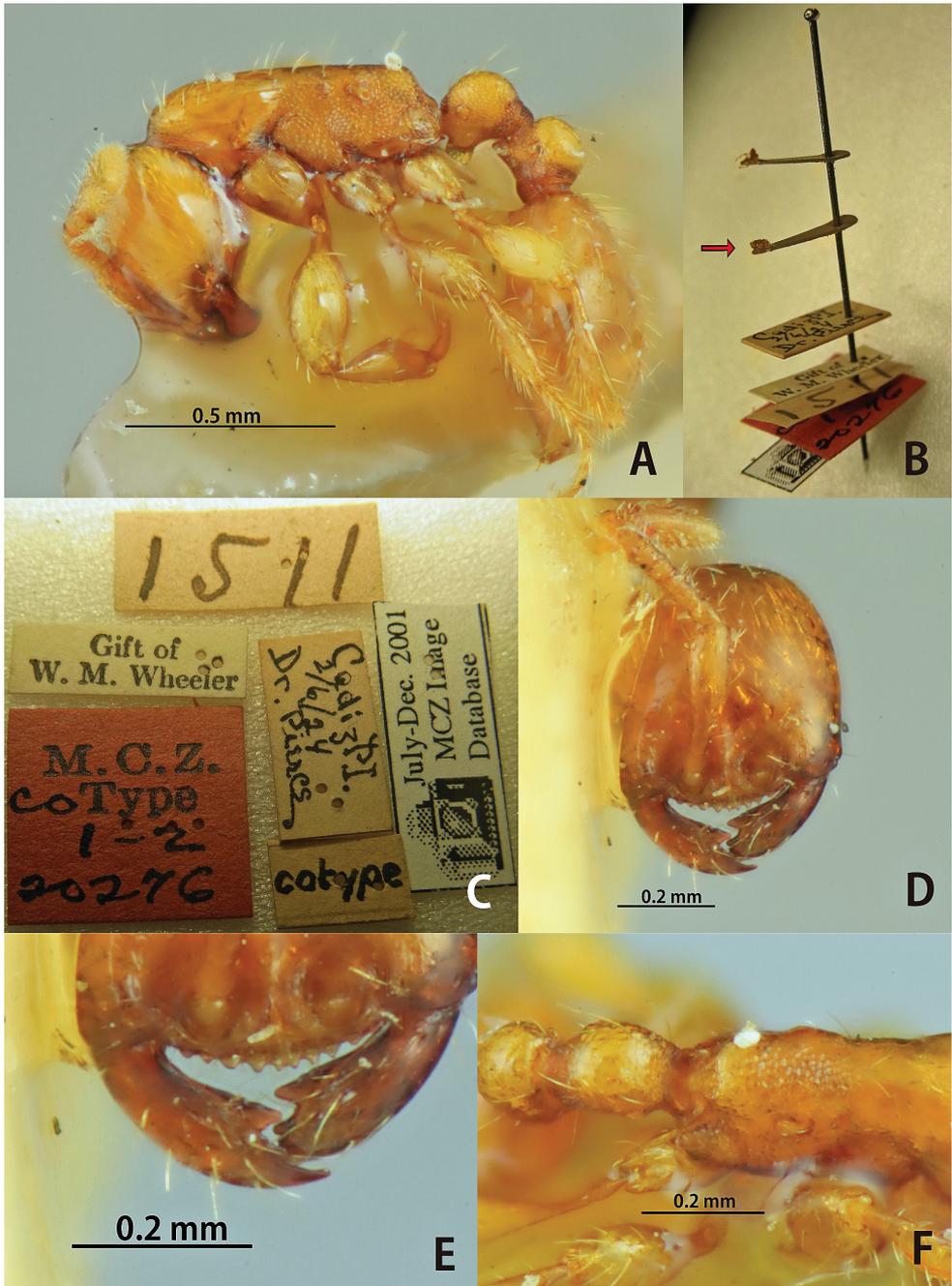


Figure 6. *Aenictus piercei* (A, B, C, F, lectotype; D, E, non-type from the type locality). **A** Habitus in profile **B** lectotype and paralectotype designated in the present paper (arrow indicating the lectotype) **C** labels of lectotype **D** head in full-face view **E** mandible and anterior clypeal margin **F** propodeal declivity in dorsal view.

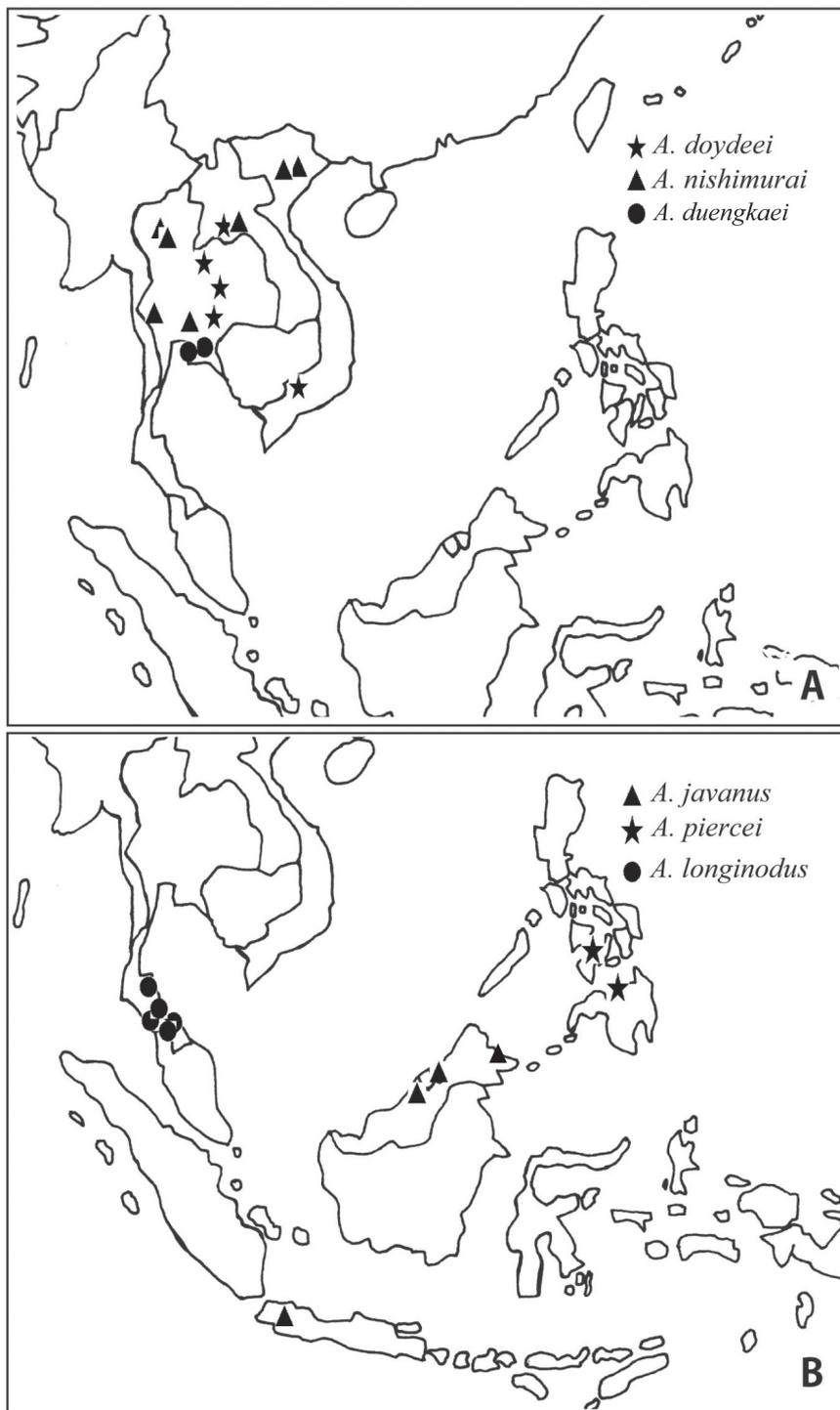


Figure 7. Distribution of the species of the *Aenictus javanus* group. **A** *A. doydeei*, *A. nishimurai*, and *A. duengkaei* sp. n. **B** *A. javanus*, *A. longinodus* sp. n., and *A. piercei*.

each of III–VI; terminal segment almost as long as VII+VIII+IX and 1.9 times as long as broad. Anterior margin of clypeus bearing 9–10 denticles (this observation is based on the single non-type worker, since in the lectotype mouth parts are buried in glue and the head of the paralectotype was missing). Masticatory margin of mandible with 3 acute teeth including large apical tooth; basal margin lacking denticles. Promesonotum in profile almost flat dorsally; in profile propodeum almost flat dorsally; propodeal junction angulate, right-angled; declivity of propodeum nearly flat, with blunt lateral carinae, but not demarcated basally by a transverse carina. Petiole almost as long as high, its dorsal outline convex; subpetiolar process well developed, subrectangular, its ventral margin slightly convex and longer than posterior margin; postpetiole almost as long as petiole.

Head including antennal scape entirely smooth and shiny. Mandible finely striate except along masticatory and outer margins. Pronotum entirely smooth and shiny except for anteriormost part microreticulate; mesonotum smooth and shiny; mesopleuron, metapleuron and propodeum microreticulate. Petiole entirely microreticulate. Postpetiole microreticulate except for a small smooth and shiny area on dorsal surface.

Head and mesosoma dorsally with relatively sparse standing hairs mixed with sparse short hairs; longest pronotal hairs 0.09–0.10 mm long. Entire body yellowish brown or reddish brown; legs palest.

Non-type material examined. We examined a worker collected from the same place by Chapman but in a different year (2/6/29). It bears a small piece of white paper with handwriting “cotype”, and a small piece of red paper. As this specimen was not mentioned in the original description, it is not part of the type series. However, all the three specimens belong to the same species without doubt.

Distribution. Philippines (Negros and Mindanao) (Fig. 7B).

Bionomics. Little is known about the bionomics of *A. piercei*. Nothing is mentioned by Wheeler (1930) on it. However, judging from the hitherto known localities (Negros and Mindanao) (see Wilson 1964) this species inhabits lowland (15–600 m) and is probably restricted to the Philippines. Wilson (1964) cited India, Solon (ca. 1400 m), as a locality of *A. piercei*, but the identification should be reconfirmed.

Remarks. This species is most similar to *A. duengkaei* (see under *A. duengkaei* for differences). According to Wilson (1964) the clypeus of *A. piercei* has an entire anterior margin without denticles. Following this information, Jaitrong and Yamane (2011) treated *A. piercei* as a member of their *Aenictus piercei* group (no denticles in this group). However, the non-type specimen mentioned above has nine denticles on the anterior clypeal margin. After carefully examining the type material of *A. piercei* we concluded that this species should be removed from the *A. piercei* group and that it is a member of the *A. javanus* group.

Revision of the *Aenictus philippinensis* group

Aenictus philippinensis group

Diagnosis. Jaitrong and Yamane (2011) defined this species group as follows: antenna 10-segmented; scape not reaching the posterolateral corner of head; anterior

clypeal margin convex in the middle, lacking denticles; mandible triangular, very densely with punctures; its masticatory margin with a large and sharp apical tooth followed by 6–8 small inconspicuous denticles; basal margin lacking denticles; frontal carinae fused at the level of antennal base to form a single carina, extending less than half length of head, and well developed anteriorly and poorly developed posteriorly; parafrenal ridge present, not reaching midlength of head; occipital margin forming a collar or carina; mesosoma in profile with promesonotum convex dorsally and sloping gradually to metanotal groove; mesopleuron clearly demarcated from metapleuron by a deep groove and from promesonotum by a distinct carina; metanotal groove relatively deep and distinct; propodeal junction angulated; declivity of propodeum concave, encircled with a rim; subpetiolar process weakly developed.

First gastral segment entirely smooth and shiny except the base of both tergite and sternite with dense small punctures. Body reddish brown to dark brown; typhlatta spot absent.

Remarks. This group consists of relatively large species measuring 4.05–4.60 mm in total body length, and is closely related to the *A. pachycerus* group and *A. hottai* group. However, the *A. philippinensis* group is separated from the other two by the mesonotum demarcated from the mesopleuron by a conspicuous ridge and the metanotal groove relatively deep and distinct. The sculpture of the head is variable, from entirely smooth to densely puncto-reticulate (see Jaitrong and Yamane 2011).

Worker caste is clearly monomorphic.

Check list of species

Aenictus pangantihoni Zettel & Sorger, 2010

Aenictus philippinensis Chapman, 1963

Aenictus punctatus Jaitrong & Yamane, sp. n.

Aenictus rabori Chapman, 1963

Key to species based on the worker caste

- 1 Frons of head smooth and shiny; mandible extensively smooth and shiny, with scattered punctures, or striae confined to periphery..... **2**
- Frons of head sculptured (superficially to very densely punctate); mandible almost entirely sculptured. **3**
- 2 With head seen in profile occipital corner produced as a small lobe (Fig. 11C); sides of head partly superficially shagreened with smooth and shiny interspaces; larger species (HW 0.83–0.85 mm; TL 4.35–4.45 mm) ***Aenictus rabori* Chapman**
- With head seen in profile occipital corner without such a lobe (Figs 8B, 9B, 10C); sides of head entirely smooth and shiny; smaller species (HW 0.78–0.80 mm; TL 4.00–4.10 mm) ***Aenictus pangantihoni* Zettel & Sorger**

- 3 Head entirely punctate, punctures fine and very dense; dorsal face of pronotum punctate (Borneo and Java)
 *Aenictus punctatus* Jaitrong & Yamane, sp. n.
- Head superficially reticulate, slightly shiny; dorsal face of pronotum almost smooth and shiny (Philippines) *Aenictus philippinensis* Chapman

***Aenictus pangantihoni* Zettel & Sorger, 2010**

http://species-id.net/wiki/Aenictus_pangantihoni

Figs 8, 12

Aenictus pangantihoni Zettel and Sorger 2010: 120, figs. 5–8, 13.

Types. Holotype (USC) and 56 paratype workers (NHMV, SKYC, THNHM) from Philippines, Camiguin, West of Mambajao, Katibawasan area, 350 m a.s.l., H. Zettel and C.V. Pangantihon leg. Four paratype workers in SKYC and THNHM were examined.

Measurements. Paratype (n = 4): TL 4.00–4.10 mm; HL 0.83–0.88 mm; HW 0.78–0.80 mm; SL 0.55–0.63 mm; ML 1.38–1.43 mm; PL 0.35–0.38 mm; CI 91–95; SI 75–78.

Description of worker (paratypes). Head in full-face view slightly longer than broad, with sides slightly convex and posterior margin almost straight; occipital margin forming a distinct carina; seen in profile occipital corner of head rounded. Antennal scape relatively short, slightly extending 2/3 of head length; antennal segment II slightly longer than each of III–VI; terminal segment almost as long as VII+VIII+IX. Frontal carinae short fused at the level of antennal base to form a single carina and slightly extending beyond the level of the posterior margin of torulus, poorly developed in posterior half. Parafrontal ridge short, extending less than 1/3 of head length, 0.17 mm long, seen in profile weakly developed in the middle. Masticatory margin of mandible with a large apical tooth followed by a series of 7–9 denticles of two sizes, the larger ones alternating with 1–3 of smaller size. Mesosoma in profile with promesonotum weakly convex dorsally and sloping gradually to metanotal groove; metanotal groove distinct and deep; upper portion of mesopleuron impressed; propodeum slightly lower than mesonotum; propodeal junction right-angled; declivity of propodeum shallowly concave, encircled with a distinct rim. Petiole subsessile, distinctly longer than high; subpetiolar process almost absent; postpetiole as long as petiole (including short pedicel) and almost as long as high, with its node rounded dorsally. Legs relatively short, seen from side with greatly swollen femora.

Head entirely smooth and shiny, except for hair pits; mandible smooth and shiny, with scattered punctures; antennal scape superficially shagreened. Pronotum smooth and shiny except for its anteriormost portion reticulate; lateral face of pronotum smooth and shiny, with a narrow ventral belt that is impressed and reticulate, this belt continuing posteriorly, running along posterior margin of the lateral face, approaching

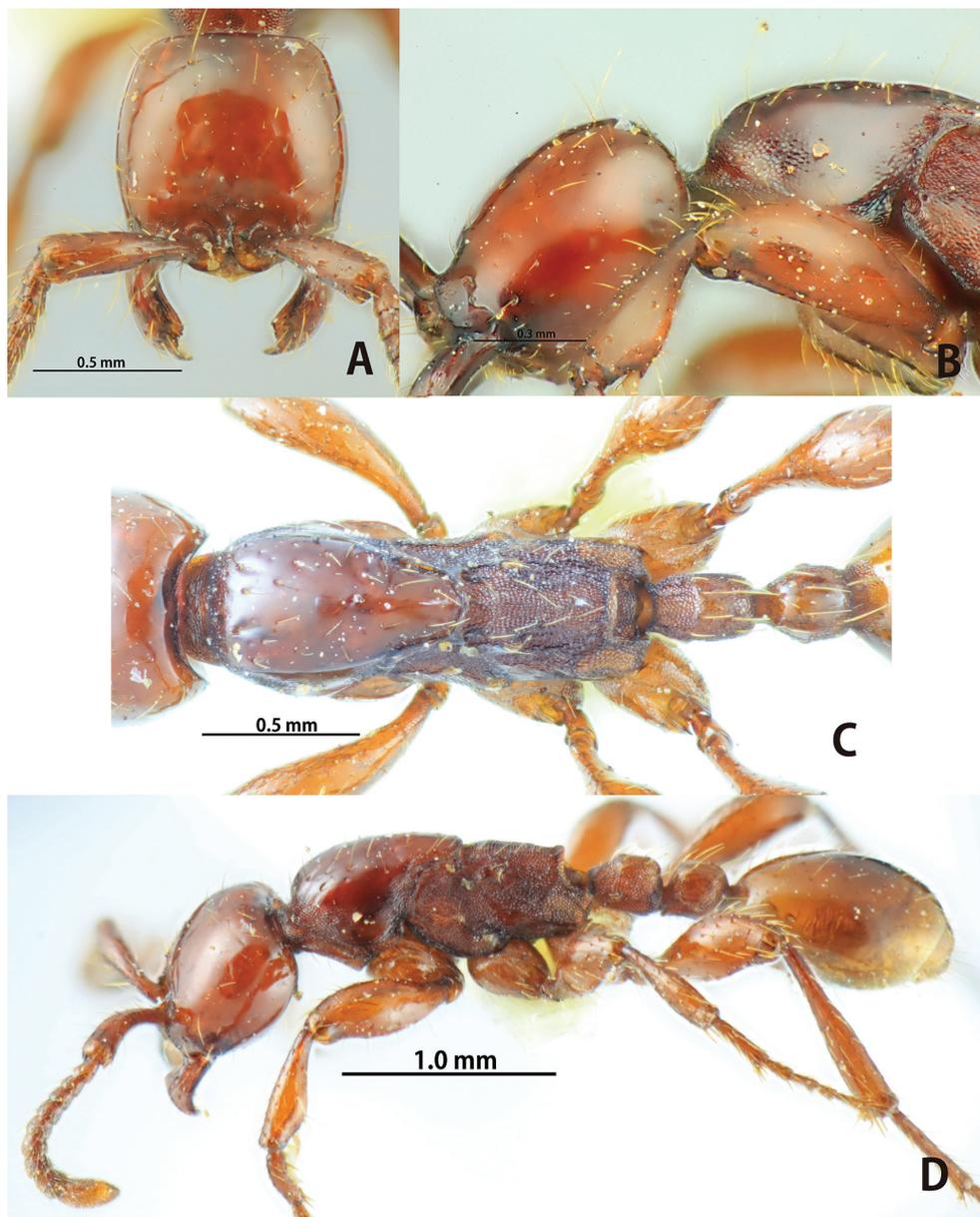


Figure 8. *Aenictus pangantihoni* (paratype). **A** Head in full-face view **B** occipital corner of head **C** dorsal view of body **D** habitus in profile.

dorsal face of pronotum; mesonotum smooth and shiny; mesopleuron, metapleuron and propodeum densely punctate/reticulate and mat except for isolated small shiny areas. Both petiole and postpetiole microreticulate except dorsal faces smooth and shiny. Femora superficially shagreened with smooth and shiny interspaces; tibiae superficially shagreened, partly smooth and shiny.

Head and mesosoma dorsally with relatively sparse standing hairs; longest pronotal hair 0.2–0.25 mm long. Entire body reddish brown.

Distribution. Philippines (Camiguin Island) (Fig. 12).

Bionomics. So far *A. pangantihoni* is known only from the type locality. The type material was collected from a trail lined with some bushes and trees in a pasture area at an elevation ca. 350 m (Zettel and Sorger 2010).

Remarks. *A. pangantihoni* is most similar in general appearance to *A. rabori*. However, it is easily distinguished from the latter as follows: smaller than *A. rabori* (HW 0.78–0.80 mm, TL 4.00–4.10 mm in *A. pangantihoni*; HW 0.83–0.85 mm, TL 4.35–4.45 mm in *A. rabori*); seen in profile occipital corner of head round, without protruding lobe (with a lobe in *A. rabori*); sides of head entirely smooth and shiny (partly superficially shagreened with smooth and shiny interspaces in *A. rabori*).

Aenictus philippinensis Chapman, 1963

http://species-id.net/wiki/Aenictus_philippinensis

Figs 9, 12

Aenictus philippinensis Chapman 1963: 247, fig. 2.

Types. Syntype workers from Philippines, Negros, Horns of Negros, 450 and 1,080 m (MCZC). We did not examine the type material of this species but specimens of a single colony from the type locality (Philippines, Negros) were examined.

Measurements. Non-type workers (n = 10): TL 3.70–4.00 mm; HL 0.83–0.88 mm; HW 0.74–0.80 mm; SL 0.55–0.60 mm; ML 1.18–1.25 mm; PL 0.26–0.33 mm; CI 89–91; SI 74–77.

Description of worker. Head in full-face view subretangular, slightly longer than broad, with sides weakly convex and posterior margin almost straight; occipital margin forming a narrow carina; seen in profile occipital corner of head rounded. Antennal scape relatively short, reaching only 2/3 of head length; antennal segment II almost as long as each of III–VI; terminal segment almost as long as VII+VIII+IX. Frontal carinae fused at the level of antennal base to form a single carina and extending beyond the level of the posterior margin of torulus, poorly developed in posterior half. Parafrontal ridge relatively long, extending less than 1/3 of head length, 0.25–0.28 mm long. Masticatory margin of mandible with a large apical tooth followed by a series of 6–7 denticles of same size. Mesosoma in profile with dorsally convex promesonotum and sloping gradually to metanotal groove; metanotal groove distinct and deep; mesopleuron relatively short, clearly demarcated from metapleuron by a deep groove; propodeum lower than mesonotum, weakly convex dorsally; propodeal junction right-angled; declivity of propodeum shallowly concave, encircled with a distinct rim. Petiole subsessile, slightly longer than high; subpetiolar process very low, its anteroventral corner bluntly angulate; postpetiole slightly longer than

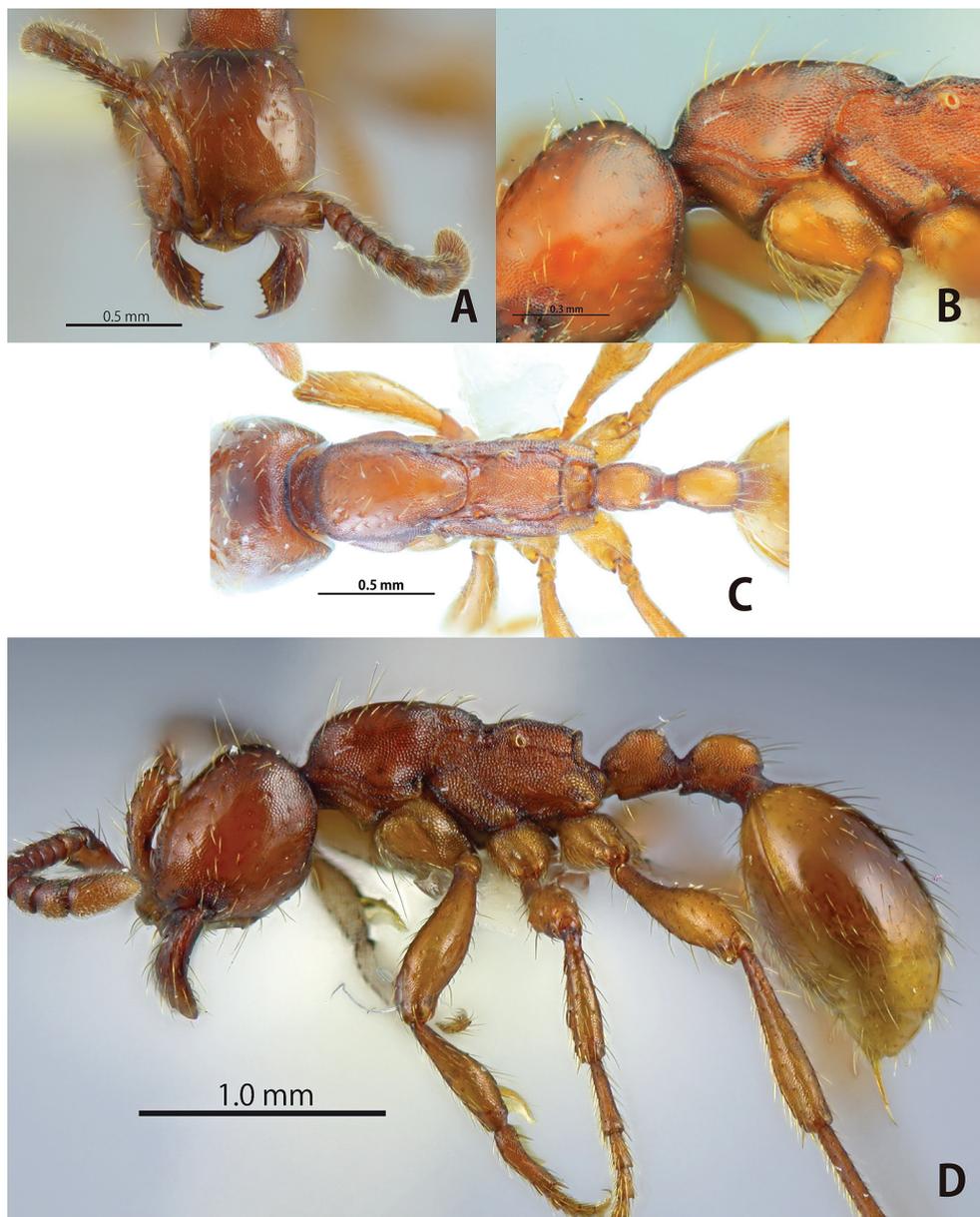


Figure 9. *Aenictus philippinensis* (non-type specimen from the Philippines). **A** Head in full-face view **B** occipital corner of head **C** dorsal view of body **D** habitus in profile.

petiole and slightly longer than high, with its dorsal outline convex. Legs relatively long with apical halves of femora and tibiae somewhat swollen.

Head superficially reticulate and shiny; mandible very finely striate except along masticatory margin; antennal scape superficially shagreened. Promesonotum finely

macroreticulate except dorsal face largely smooth and shiny; mesopleuron, metapleuron, and propodeum densely punctate/reticulate. Both petiole and postpetiole punctate except dorsal face of the latter smooth and shiny. Femora entirely superficially reticulate and shiny, partly smooth and shiny; tibiae weakly punctate.

Head and mesosoma dorsally with relatively sparse standing hairs mixed with short hairs over surface; longest pronotal hair 0.17–0.20 mm long. Entire body reddish brown.

Non-type material examined. Philippines: Negros Oriental, near Dumaguete, Apolong, Valencia, 26.XII.1998, Sk. Yamane leg., PH98-SKY-05 (SKYC, THNHM).

Distribution. Philippines (Negros) (Fig. 12).

Bionomics. *A. philippinensis* is very probably restricted to the Philippines and probably sympatric with *A. rabori* in at least Negros Oriental. Wilson (1964) cited the observation by Chapman: “the workers of a colony came from the hole in the ground, climbed up a nearby stump, and spent the next hour in which they were observed building a living pyramid in the center of the stump. Some tried to build out from the edge of the stump in a horizontal direction.” We found a colony under a stone near a road.

Remarks. *A. philippinensis* is similar to *A. punctatus* as they have sculptured head and mandible. However, they differ in some characters. The sculpturing on the head is much weaker in *A. philippinensis* (superficially reticulate and shiny) than in *A. punctatus* (finely punctate). Pronotal dorsum is smooth and shiny in *A. philippinensis*, but finely punctate in *A. punctatus*. Propodeal declivity is dorsally margined with a low rim in *A. philippinensis*; the rim is much more developed, in profile distinctly protruding posteriad in *A. punctatus*.

***Aenictus punctatus* Jaitrong & Yamane, sp. n.**

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http://species-id.net/wiki/Aenictus_punctatus

Figs 10, 12

Types. Holotype from Brunei, Tasek Merimbun, 13.II.1999, K. Eguchi leg. Eg99-BOR-078 (SKYC). Nineteen paratype workers, same data as holotype (BMNH, MCZC, MHNG, SKYC, THNHM).

Measurements. Holotype: TL 4.50 mm; HL 0.98 mm; HW 0.85 mm; SL 0.70 mm; ML 1.38 mm; PL 0.33 mm; CI 87; SI 82.

Paratypes (n = 9): TL 4.30–4.40 mm; HL 0.95–0.98 mm; HW 0.83–0.85 mm; SL 0.68–0.73 mm; ML 1.33–1.35 mm; PL 0.28–0.30 mm; CI 87; SI 82–85.

Description of worker (holotype and paratypes). Head in full-face view elliptical, clearly longer than broad, with sides convex and posterior margin almost straight or weakly convex; occipital margin forming a distinct carina; seen in profile occipital corner of head rounded. Antennal scape relatively long, extending 3/4 of head length; antennal segment II almost as long as each of III–VI; terminal segment slightly shorter than VII+VIII+IX. Frontal carinae short fused at the level of antennal base to form a single carina and slightly extending beyond 1/4 of head length, poorly developed in posterior

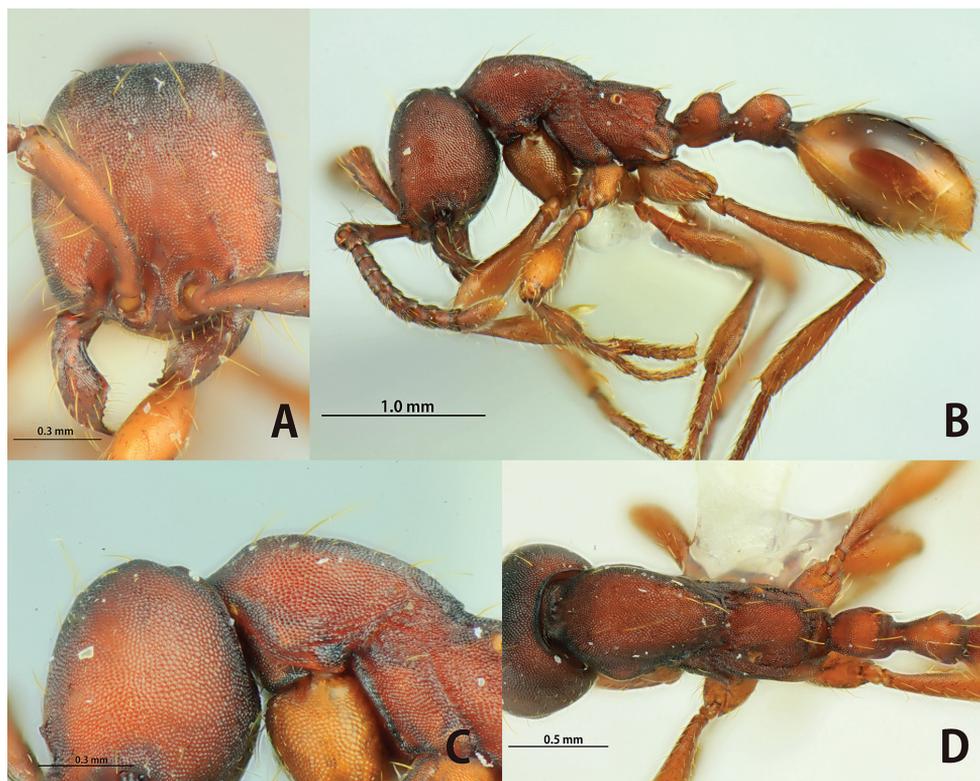


Figure 10. *Aenictus punctatus* sp. n. (holotype). **A** Head in full-face view **B** habitus in profile **C** occipital corner of head **D** dorsal view of body.

half. Parafrontal ridge short, extending less than $1/3$ of head length, 0.30–0.33 mm long. Masticatory margin of mandible with a series of 6–7 denticles of same size; basal margin of mandible lacking denticles. Mesosoma in profile with promesonotum convex dorsally and sloping gradually to metanotal groove; metanotal groove indistinct compared with those of the other members of the group; mesonotum demarcated from mesopleuron by a conspicuous ridge. Propodeum almost flat or weakly convex dorsally; declivity of propodeum shallowly concave, encircled with a developed rim; seen in profile dorsal portion of the rim protruding posteriad. Petiole subsessile, slightly longer than high, its dorsal outline elevated posteriorly; subpetiolar process very low, its ventral outline weakly convex; post-petiole longer and larger than petiole and slightly longer than high, with its dorsal outline convex. Legs relatively long with apical halves of femora and tibiae somewhat swollen.

Head entirely finely punctate; mandible very finely striate except along masticatory margin; antennal scape finely punctate. Pronotum entirely punctate; mesopleuron, metapleuron and lateral face of propodeum punctate; dorsal face of propodeum finely punctate. Petiole entirely punctate; postpetiole punctate with weakly sculptured and shiny anterior slope of node. Basal half of femora densely punctate but apical half superficially macroreticulate and shiny; tibiae macroreticulate and shiny.

Head and mesosoma dorsally with sparse standing hairs mixed with very short hairs; longest pronotal hair 0.25–0.28 mm long. Entire body dark reddish brown. Typhlatta spots absent.

Etymology. The species epithet “punctatus” is a Latin word meaning punctate. This refers to the finely punctate head of this species, while the head is reticulate or smooth and shiny in the other species of the *Aenictus philippinensis* group.

Non-type materials examined. Malaysia: Borneo, Sabah, Sepilok Forest, 27.VIII.1995, Sk. Yamane leg. (SKYC, THNHM); Borneo, Sabah, Danum Valley, 4.XII.1996, K. Eguchi leg., Eg96-BOR-155 (SKYC); Borneo, Sabah, Tawau, Gunong Rara 9.XI.1996, K. Eguchi leg., Eg96-BOR-323 (SKYC, THNHM); Borneo, Sarawak, Sg. Segerugok, Song, 22.IX.1993, A. Rahman leg. (SKYC); Borneo, Sarawak, Semengoh N.P., 18.IV.1993, Sk. Yamane leg. (SKYC, THNHM); Borneo, Sarawak, Miri, Lambir N.P., Head Quarter, 17.VIII.1995, H. Okido leg. (SKYC, THNHM); same loc., 8 ha plot, 30.VI.2004, Sk. Yamane leg., SR04-SKY-38 (SKYC, THNHM). **BRUNEI:** Tasek Merimbun, 17.II.1999, A. Tuah leg., Eg99-BOR-130 (SKYC, THNHM). **INDONESIA:** E. Kalimantan, Kutai N.P., Sangkima, 8.IX.1993, Sk. Yamane leg. (SKYC, THNHM); Java, Ujung Kulou, Cibon, 15.III.1997, F. Ito leg., FI97–182 (SKYC, THNHM).

Distribution. Borneo (Sabah, Sarawak, Brunei, and E. Kalimantan) and Java (Fig. 12).

Bionomics. All the members of the *A. philippinensis* group are probably restricted to the Philippines except for *A. punctatus* that is distributed on Borneo and Java. All of the materials of this species examined were collected from lowland rainforests. A colony from Sarawak was collected from rotten wood in September 1993. A colony from Lambir National Park (SR04-SKY-38) was collected at night.

Remarks. This species is closely related to *A. philippinensis*. See under *A. philippinensis* for details.

Aenictus rabori Chapman, 1963

http://species-id.net/wiki/Aenictus_rabori

Figs 11, 12

Aenictus rabori Chapman 1963: 249, fig. 1.

Types. Nine syntype workers (two on each of three pins, three on another) from Philippines, Negros, Horns of Negros, 1,080 m (MCZC, examined). One worker among them (top on a pin) is selected as lectotype (Fig. 11E).

Measurements. Lectotype: TL 4.50 mm; HL 0.85 mm; HW 0.83 mm; SL 0.65 mm; ML 1.48 mm; PL 0.35 mm; CI 97; SI 79.

Paralectotype (n = 8): TL 4.35–4.45 mm; HL 0.83–0.88 mm; HW 0.78–0.83 mm; SL 0.63–0.65 mm; ML 1.48–1.50 mm; PL 0.35–0.38 mm; CI 94–97; SI 76–79.

Description of worker (lectotype and paralectotypes). Head in full-face view slightly longer than broad, with sides convex and posterior margin nearly straight,

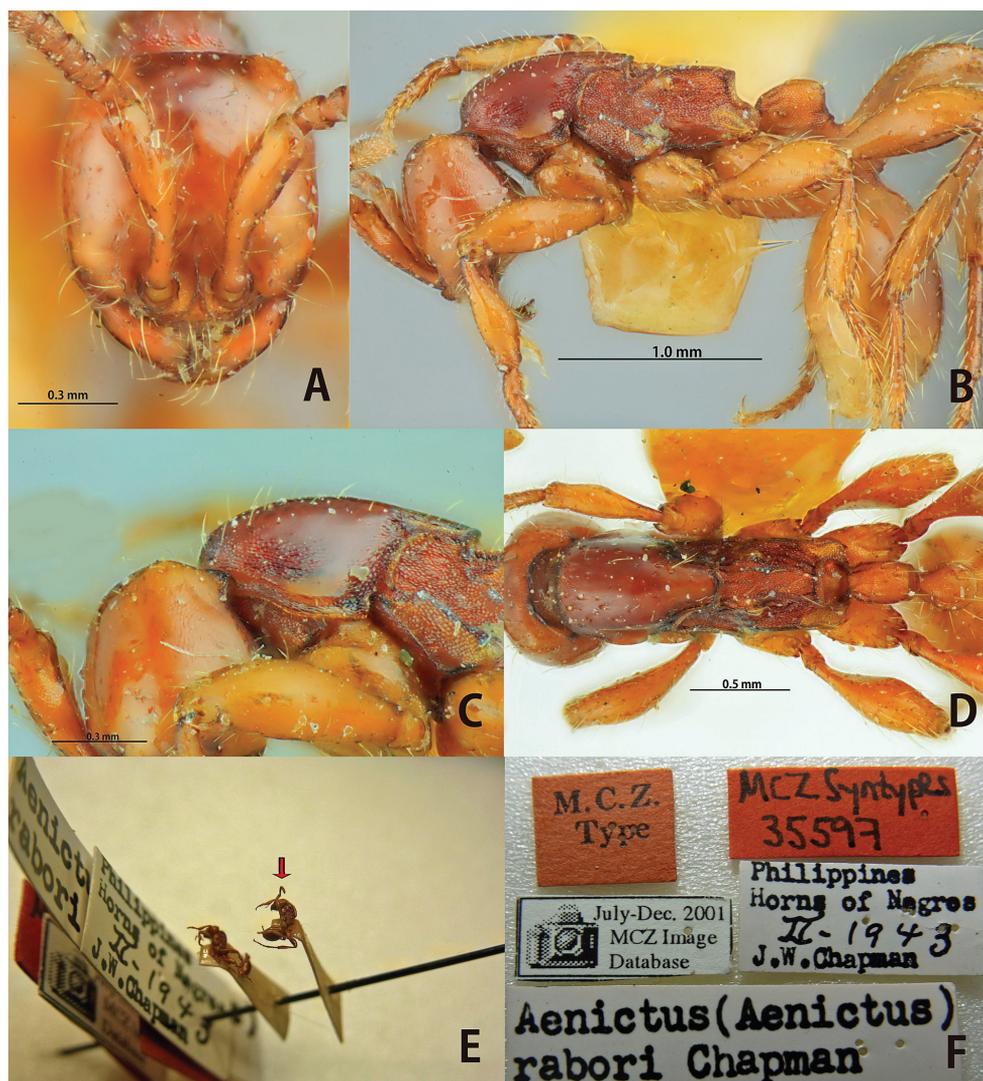


Figure 11. *Aenictus rabori* (lectotype). **A** Head in full-face view **B** habitus in profile **C** occipital corner of head **D** dorsal view of body **E** lectotype and paralectotype designated in the present paper (arrow indicating the lectotype) **F** labels of lectotype.

very weakly sinuate; occipital margin bearing a distinct carina; occipital corner of head with a protruding lobe (part of occipital carina). Antennal scape relatively short, reaching only $2/3$ of head length; antennal segment II slightly longer than each of III-VI; terminal segment slightly shorter than VII+VIII+IX. Frontal carinae short fused at the level of antennal base to form a single carina and much extending beyond the level of the posterior margin of torulus, poorly developed in posterior half. Parafrontal ridge short, extending less than $1/3$ of head length, 0.25–0.27 mm long, seen in profile weakly developed in posterior half. Masticatory margin of man-

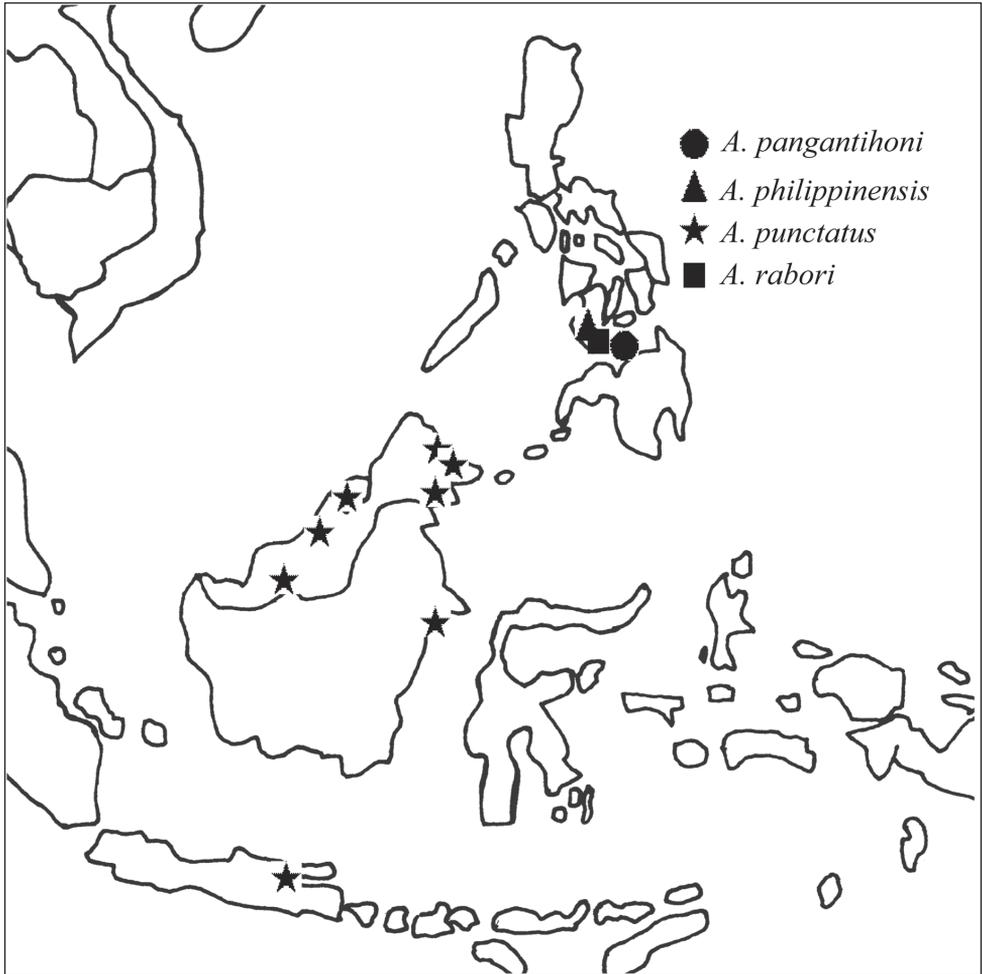


Figure 12. Distribution of the species of the *Aenictus philippinensis* group.

dible with a large apical tooth followed by a series of 4–5 denticles, which gradually reduce in size toward basal angle of mandible. Promesonotum in profile weakly convex dorsally and sloping gradually to metanotal groove; metanotal groove distinct and deep; upper portion of meso- and meta-pleuron impressed, much lower than promesonotum. Declivity of propodeum shallowly concave, encircled with a distinct rim that protrudes posteriad. Petiole sessile, distinctly longer than high; subpetiolar process almost absent; postpetiole slightly shorter than petiole and almost as long as high, with its node rounded dorsally. Legs relatively short, seen from side with greatly swollen femora.

Head entirely smooth and shiny, except for hair pits, area on the side of head anterior to occipital corner with superficial reticulation; mandible extensively smooth and shiny except for hair pits; antennal scape superficially shagreened. Pronotum smooth

and shiny, except for its anteriormost portion reticulate, narrow lateral margins distinctly reticulate, reaching back to posterior margin; mesonotum smooth and shiny; mesopleuron, metapleuron and propodeum densely punctuate/reticulate mixed with some rugae, mat except antero-ventral parts of meso- and metapleuron slightly shiny. Petiole microreticulate with dorsum more weakly sculptured; dorsum of postpetiole extensively smooth and shiny but other parts more or less reticulate. Femora entirely superficially reticulate and shiny; tibiae superficially shagreened partly smooth and shiny.

Head and mesosoma dorsally with relatively sparse long standing hairs; longest pronotal hair 0.25–0.27 mm long. Head, antennae, legs, and gaster yellowish brown; mandible, mesosoma, petiole, and postpetiole reddish brown.

Distribution. Philippines (Negros Island) (Fig. 12).

Bionomics. So far *A. rabori* is known only from the type locality. The colony observed by Chapman was foraging in a garden at 1,080 m in elevation (Chapman 1963).

Remarks. This species is closely related to *A. pangantihoni*. See under *A. pangantihoni* for details.

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Lithobius (Monotarsobius) monoforaminis sp. n., a new species of lithobiid centipede from central China (Chilopoda, Lithobiomorpha, Lithobiidae)

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Abstract

The present paper describes a new species *Lithobius (Monotarsobius) monoforaminis* sp. n. (Lithobiomorpha: Lithobiidae) recently discovered from Shaanxi and Shanxi provinces, Central China. Morphologically it resembles *L. (M.) minimus* Farzalieva, 2006 from Eastern Kazakhstan, but could be well distinguished from the latter having only one pore on the coxae of legs 12–15 and different plectrotaxy, and by lacking a wart on the male tibia 15. A key to the Chinese *Lithobius (Monotarsobius)* species is presented.

Keywords

Lithobiidae, *Lithobius (Monotarsobius) monoforaminis*, China, identification key

Introduction

The centipede subgenus *Lithobius* (*Monotarsobius*) Verhoeff, 1905 (Lithobiomorpha: Lithobiidae) comprises 114 species known from Asia, Europe, and North Africa (Pocock 1895; Trotzina 1895; Attems 1901, 1904; Dobroruka 1960, 1979; Zaleskaja 1978; Farzalieva and Zaleskaja 2002; Farzalieva 2006; Zapparoli 2006; Zapparoli and Edgecombe 2011; Dányi and Tuf 2012). It is characterized by the presence of fused tarsi of legs 1–13 and antennal articles fixed at 20 or thereabouts (Eason 1992).

Sixty-seven species and subspecies of Lithobiomorpha are hitherto known from China (Attems 1938, 1953; Takakuwa 1939, 1940, 1941, 1942; Takakuwa and Takashima 1949; Chamberlin and Wang 1952; Wang 1959, 1963; Zaleskaja 1978; Wang and Mauriès 1996; Zhang 1996; Eason 1992, 1997; Chao 2005; Zapparoli 2006; Ma et al. 2007a, 2007b, 2008a, 2008b, 2009; Pei et al. 2011), of which only nine belong to subgenus *Monotarsobius*. Herewith we describe a new species of *Monotarsobius* which was recently found in the Shaanxi and Shanxi provinces. This is the first reliable record of the subgenus in this region of China.

Methods

All specimens were hand-collected under leaf litter or stones. The material was examined with the aid of a Motic-C microscope, made in China. Colour description is based on specimens in 75% alcohol, and body length is measured from anterior margin of the cephalic plate to posterior end of postpedal tergite. Type specimens are deposited in the College of Life Sciences, Hebei University, Baoding, China. Terminology for external anatomy follows Bonato et al. (2010).

The following abbreviations are used in the text and tables: T, TT = tergite, tergites; S, SS = sternite, sternites; C = coxa, t = trochanter, P = prefemur, F = femur, Ti = tibia, a = anterior, m = median, p = posterior.

Taxonomy

Lithobiidae Newport, 1844

Lithobius (*Monotarsobius*) *monoforaminis* sp. n.

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http://species-id.net/wiki/Lithobius_monoforaminis

Material examined. Holotype. ♂ (Fig. 1), body length 7.7 mm, cephalic plate 0.76 mm long, 0.76 mm broad, Huashan Mountain, Huayin County, Xian City, Shaanxi Province, 34°31'N, 110°05'E, 438 m, 10 October 2005, leg. Yong-hua Gai, Hui-qin Ma.

Paratypes. 5 ♀♀, 3 ♂♂, same data as holotype.

Other materials. 13 ♀♀, 12 ♂♂, Yongji County, Yuncheng City, Shanxi Province, 34°51'N, 110°29'E, 388 m, 8 October 2005, leg. Yong-hua Gai, Hui-qin Ma.

Etymology. The specific name refers to the presence of a single pore on the coxae of legs 12–15.

Diagnosis. A *Lithobius* (*Monotarsobius*) species with antennae composed of 16–22 articles, commonly 20 articles; 6–7 ocelli on each side, arranged in two irregular rows, the two posterior ocelli comparatively large; Tömösváry's organ moderately small, slightly smaller than adjoining ocelli, or equal to adjoining ocelli; 2+2 coxosternal teeth; porodonts moderately slender, posterolateral to lateral tooth; posterior angles of all tergites without triangular projections; coxal pores 1111, round; female gonopods with 2+2 moderately small, coniform spurs; terminal claw tridentate; male gonopods short and small, with 1–2 long setae on the terminal segment.

Description. Body length: 6.9–8.6 mm, cephalic plate 0.75–0.96 mm long, 0.75–0.96 mm wide.

Colour: basal antennal articles pale yellow-brown to chocolate, transition to yellow brownish from the twelfth article onwards, distalmost one yellow-brownish; tergites yellow-brown; cephalic plate, TT 1, 14 and 15 pale yellow-brown; pleural region pale grey with a yellowish hue, SS pale grey to grey with a purple hue; distal part of forcipules brown, basal and proximal parts of forcipules, forcipular coxosternite and SS 14 and 15 pale yellow-brown; all legs pale purple to grey, basal tarsus pale purple, distal tarsus yellow-brown.

Antennae: composed of 16–22 articles, commonly 20+20 articles; basal article long about equal to wide, the second markedly longer than wide, following articles gradually shortening, distal article much longer than wide, up to 2.0–2.5 times as long as wide; abundant setae on the antennal surface, less so on the basal articles, gradually increase in density towards the fourth article, then more or less constant in number.

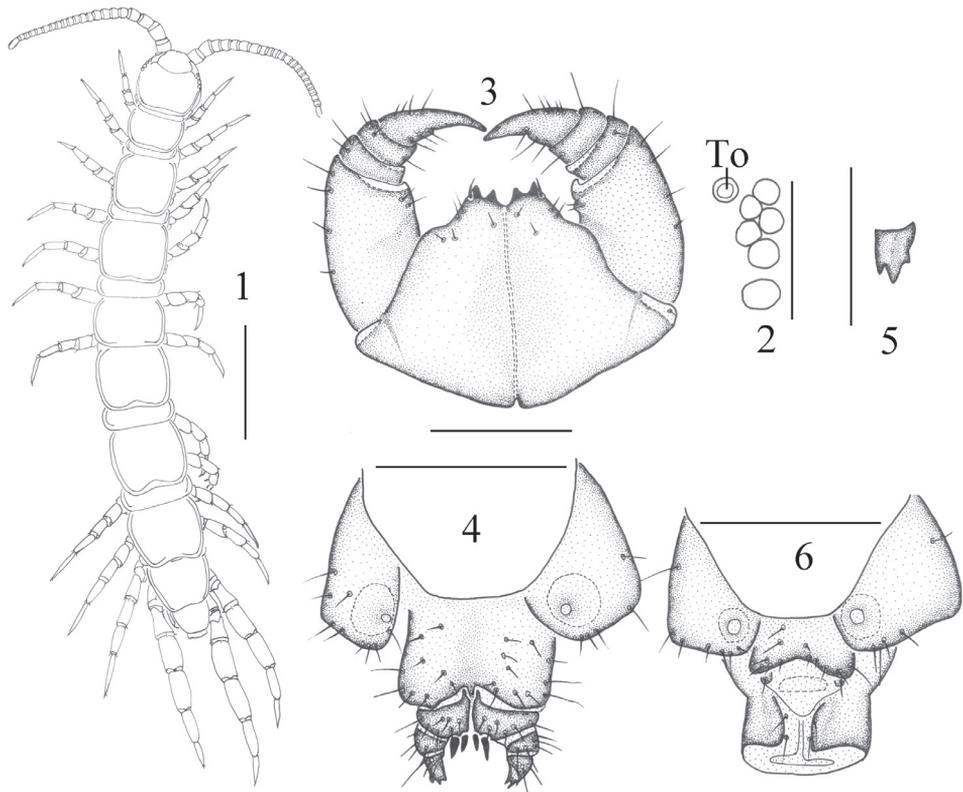
Cephalic plate: smooth, convex, pigment concentrated as close netlike vein, long equal to wide; tiny setae emerging from pores and long setae scattered sparsely over the whole surface; frontal marginal ridge with shallow anterior median furrow; posterior margin of cephalic plate straight (Fig. 1).

Ocelli: six–seven oval to rounded on each side (Fig. 2) situated in two irregular rows; terminal two comparatively large, other ocelli about equal in size; ocelli domed, translucent, usually darkly pigmented.

Tömösváry's organ: comparatively small (Fig. 2-To), nearly rounded; situated at anterolateral margin of cephalic plate, slightly smaller than the adjoining ocelli or equal in size.

Forcipular coxosternite: subtrapezoidal (Fig. 3), anterior margin narrow, external side lightly longer than internal side; median diastema moderately deep, V-shaped; anterior margin with 2+2 teeth; porodonts comparatively sharp, lying posterolateral to the lateral tooth (Fig. 3); some scattered setae on the ventral side of coxosternite.

Tergites: smooth, without wrinkles, backside slightly hunched; T 1 posterolaterally narrower than anterolaterally, generally trapeziform, narrower than T 3 and the



Figures 1–6. *Lithobius (Monotarsobius) monoforamini* sp. n., **1–3** holotype, male **1** habitus, dorsal view, scale 1 mm **2** ocelli and Tömösváry's organ (To), lateral view, scale 250 μ m **3** forcipular segment, ventral view, scale 500 μ m **4–5** paratype, female **4** posterior segments and gonopods, ventral view, scale 500 μ m **5** right gonopod, ventral view, scale 250 μ m **6** holotype, male: posterior segments and gonopods, ventral view, scale 500 μ m.

cephalic plate, T3 slightly narrower than the cephalic plate; posterior margin of T 1 slightly convex or straight, posterior margin of T 3 straight, posterior margin of TT 5, 8, 10, 12 and 14 slightly concave, posterior margin ridge of TT 3, 5, 8, 10 and 12 continuous; all posterior angles generally rounded, without triangular projections; lateral margin ridge of all tergites continuous; tiny setae scattered very sparsely over the surface.

Sternites: narrower posteriorly, generally trapeziform, comparatively smooth, setae emerging from pores scattered very sparsely over the surface, 1–3 slightly long setae on the surface of the anterior part of each sternite, 1–2 slightly long setae on the surface of the posterior part of each sternite.

Legs: strong, tarsi fused on legs 1–13, well-defined on legs 14 and 15; all legs with claws, fairly long, curved ventrad; anterior and posterior accessory spines on legs 1–14, the anterior one moderately slender, forming a small angle with the claw, the posterior

spine short and strong, forming a large angle with the claw; no accessory spines on legs 15. Short to comparatively long setae scattered very sparsely over the surface of all segments of all legs, more setae scattered on the surface of tarsus; legs 14 and 15 thicker and stronger than other legs in the male; tarsus 1 4.4–5.5 times as long as wide, tarsus 2 about 73.3%–95.7% length of tarsus on legs 15. Plectrotaxy as in Table 1.

Coxal pores: 1111, round; coxal pore field set in a relatively shallow groove, the fringe of coxal pore-field with slightly eminence.

Female S 15: generally trapeziform, anterior half being broader posterior margin straight, long setae scattered sparsely over the surface; the sternite of genital segment well chitinised, wider than long; posterior margin of genital sternite deeply concave between the condyles of gonopods, except for a small, median approximately fingerlike bulge; short to long setae sparsely scattered over the ventral surface of the genital segment. Female gonopod: first article fairly broad, bearing 6–8 long setae, arranged in 3 irregular rows; 2+2 moderately small, coniform spurs, inner spur smaller (Fig. 4); second article with 3–4 rather long setae arranged in 2 irregular rows on its ventral side and two stout dorsolateral setae; third article usually with 2–3 long setae on its ventral surface and one stout dorsolateral seta; terminal claw tridentate, outer and inner denticles smaller than the middle one (Fig. 5).

Male S 15: trapeziform, the anterior half being broader; posterior margin straight, long setae scattered sparsely over the surface. Male first genital sternite: wider than long, usually well chitinized; posterior margin quite deeply concave between the gonopods, no bulge medially; comparatively long setae evenly scattered on the ventral surface, few setae near the S 15; gonopods short and small, with 1–2 long setae, apically slightly chitinized (Fig. 6).

Habitat preferences. The specimens were collected under stones and in leaf litter in a Larix forest.

Remarks. *L. (M.) monoforaminiis* sp. n. is morphologically close to *L. (M.) minimus* Farzalieva, 2006 from Eastern Kazakhstan, with which it shares the following mutual characters: terminal claw of female gonopods tridentate, antennae commonly of 20 articles and two stout dorsolateral setae on the second article of female gonopod. The new species can

Table 1. Plectrotaxy of *Lithobius (Monotarsobius) monoforaminiis* sp. n.

legs	ventral					dorsal				
	C	t	P	F	Ti	C	t	P	F	Ti
1			p	am	m			p	ap	a
2–10			p	am	m			p	ap	ap
11			p	am	m			p	ap	ap
12			p	am	m			mp	p	p
13			mp	m	am			mp	p	p
14		m	mp	m		a		mp		
15		m	mp	m		a		mp		

be readily could be readily distinguished from the latter by having male tibia 15 without a distodorsal, elongate wart with a crater at apex and coxal pores and the 15th ventral plectrotaxy 01210 (vs. 01320). *L. (M.) monoforaminis* sp. n. differs from *L. (M.) ketmenensis* Farzalieva, 2006 and *L. (M.) amplinus* Farzalieva, 2006 by having fewer ocelli and coxal pores, different plectrotaxy and lacking modifications on male tibia 15.

Key to the Chinese species of *Lithobius (Monotarsobius)*

To assist in the identification of the Chinese species of *Lithobius (Monotarsobius)*, the following key is offered. This key emphasizes characters that can be examined without high-magnification microscopy; moreover, these characters are specific to the taxa occurring in China.

- 1 Four ocelli on each side of cephalic plate, 17+17 antennal articles *L. (M.) crassus* (Loksa, 1965)
- Five or more ocelli on each side of cephalic plate, not less than 18+18 antennal articles.....2
- 2 Five ocelli on each side of cephalic plate *L. (M.) alticus* (Loksa, 1965)
- Six or more ocelli on each side of cephalic plate3
- 3 Second article of female gonopod with dorsolateral setae4
- Second article of female gonopod without dorsolateral setae.....6
- 4 Second article of female gonopod with three dorsolateral setae, 2222–3443 coxal pores *L. (M.) crassipes* L. Koch, 1862
- Second article of female gonopod with two dorsolateral setae, 1111–2222 coxal pores5
- 5 1222–2222 coxal pores *L. (M.) ferganensis* (Trotzina, 1894)
- 1111 coxal pores *L. (M.) monoforaminis* sp. n.
- 6 Terminal claw of the female gonopod simple *L. (M.) ramulosus* (Takakuwa, 1941)
- Terminal claw of the female gonopod bidentate or tridentate7
- 7 Terminal claw of female gonopod tridentate.....8
- Terminal claw of female gonopod bidentate9
- 8 Tömösváry’s organ slightly smaller than adjoining ocellus; terminal ocellus largest *L. (M.) songi* Pei, Ma, Shi, Wu, Zhou, 2011
- Tömösváry’s organ slightly larger than adjoining ocellus or about same in size; terminal two ocelli largest *L. (M.) subspinipes* Ma, Pei, Zhu, Zhang, Liu, 2009
- 9 Tömösváry’s organ larger than largest ocellus, antennae 20–25 articles..... *L. (M.) holstii* (Pocock, 1895)
- Tömösváry’s organ about same size as the adjoining ocelli, antennae 19 articles *L. (M.) obtusus* (Takakuwa, 1941)

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