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Two new species of *Brueelia* Kéler, 1936 (Ischnocera, Philopteridae) parasitic on Neotropical trogons (Aves, Trogoniformes)

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Abstract

Two new species of *Brueelia* are described and illustrated. These new species and their type hosts are: *Brueelia sueta* ex *Pharomachrus pavoninus* (Spix, 1824), the Pavonine Quetzal and *Brueelia cicchinoi* ex *Trogon viridis* Linnaeus, the White-tailed Trogon. Both new species differ from the only *Brueelia* described on *Trogon mexicanus* by many morphological features, including those present in the male genitalia and female vulvar margin. Partial sequences of the mitochondrial cytochrome oxidase I (COI) gene for these two new species differ from one another by 13.6% uncorrected p-distance. Whereas *B. cicchinoi* is only 0.3% divergent from previously published COI sequences identified as *Brueelia* sp. from the Mexican *T. melanocephalus* Gould, 1936 and *T. massena* Gould, 1938. We also found *B. cicchinoi* on *T. melanurus*, *T. collaris* and *Pharomachrus pavoninus*. Thus *B. cicchinoi* is found on multiple trogoniform hosts across an extremely large geographic distribution and has one of the largest number of host associations among *Brueelia* species.

Keywords

Chewing lice, *Brueelia*, trogons, Philopteridae, new species

Introduction

According to Price et al. (2003), *Brueelia* Kéler, 1936 (Ischnocera) is the most speciose genus of parasitic lice within the Philopteridae (Phthiraptera), with about 280 species currently described. Members of this genus parasitize the largest avian order, Passeriformes, but they also occur on Piciformes and Coraciiformes. Thus, due to the extremely large number of potential hosts, worldwide distribution, and complicated taxonomy there are probably hundreds of undescribed *Brueelia* species waiting to be discovered and described.

The only *Brueelia* species parasitic on trogons (Aves, Trogoniformes), *B. insolita*, was described by Cicchino (1983) from *Trogon mexicanus* Swainson, 1827 collected in Guatemala, and this taxon was transferred to *Trogoninirmus* Eichler, 1944 by Price et al. (2003) without justification. Perhaps the authors simply assumed that trogons could not harbor species of *Brueelia*. However, the original description of *Brueelia insolita* is indubitably a *Brueelia* species (Cicchino 1983: 284) rather than a *Trogoninirmus* (Price et al., 2003: 245). A molecular phylogenetic study published by Johnson et. al. (2002) includes *Brueelia* specimens collected from two *Trogon* species and those specimens are genetically differentiated from all other *Brueelia* included in the study but fall phylogenetically within *Brueelia* parasitizing Passeriformes. This paper describes two additional species of *Brueelia* collected from Neotropical trogons.

Methods

Specimens used in this study have been collected by the junior author and/or his colleagues using the Ethyl Acetate fumigation technique as described in Bueter et al (2009) and were mounted on slides following the procedures of Palma (1978). Nomenclature of the abdominal setae, different somatic features and abbreviations for the body measurements (given in millimeters) follow those proposed by Cicchino and Castro (1996). The abbreviations used were: HL, head length at midline; PAW, preantennal width; TW, temple width; PL, prothorax length; PW, prothorax width; PTL, pterothorax length; PTW, pterothorax width; AL, abdominal length; AW abdominal width (taken at segment V); GL, male genitalia length; and TL, total length. Host names were standardized following Dickinson (2003).

Using laboratory methods described by Bueter et al. (2009) we sequenced a 382 base pair (bp) portion of the mitochondrial cytochrome oxidase I (COI) gene from each of the new *Brueelia* species, including one *B. sueta* sp. n. from *P. pavoninus* and three individuals of *B. cicchinoi* sp. n. from three different host species (*T. viridis*, *T. melanurus*, and *P. pavoninus*) to assess and document their genetic distinctiveness. We made one minor modification to the voucher DNA extraction protocol. Rather than completely remove the louse head from the body for proteinase K digestion, we used a sterilized syringe needle to only partially cut the head from the body. This modification produced DNA vouchers better suited for morphological analysis and also minimized the chances of losing the head during extraction and slide mounting. The DNA sequences and their associated DNA voucher number are deposited in GenBank (JN384116-JN384119). We also incorporated the two COI sequences from *Brueelia* sp. collected from *Trogon massena* (AY149386) and *T. melanocephalus* (AY149387), from México published by Johnson et al. (2002) and put all of these trogon *Brueelia* COI sequences into a phylogenetic context using COI sequences from Bueter et al. (2009).

We used PAUP* (version 4.0b10; Swofford 2003) to calculate uncorrected p-distances between trogon *Brueelia* sequences and to conduct a maximum parsimony (MP) heuristic search and MP bootstrap analysis of the combined Bueter et al. (2009) and trogon *Brueelia* COI dataset. We conducted a MP heuristic search with TBR branch swapping, stepwise addition, and 100 random addition replicates. For the MP bootstrap analysis we performed 1000 bootstrap replicates with one random addition per replicate.

Holotypes of the new species are deposited in the Museu de Zoologia, University of São Paulo, São Paulo, Brazil (MZUSP) and paratypes are deposited in both MZUSP and the Field Museum of Natural History, Chicago, USA (FMNH). Other specimens studied are held in the Price Institute of Phthirapteran Research, University of Utah, Salt Lake City, USA (PIPeR). For material collected in 2005 and 2007 host specimen vouchers are deposited in the Museu Paraense Emilío Goeldi (MPEG) and FMNH and are indicated by field numbers and specimen numbers.

Taxonomic treatment

Brueelia Kéler, 1936

Type species *Brueelia rossittensis* Kéler, 1936 = *Brueelia brachythorax* (Giebel, 1874).
Type host: *Bombycilla garrulus* (Linnaeus, 1758) (Passeriformes, Bombycillidae).

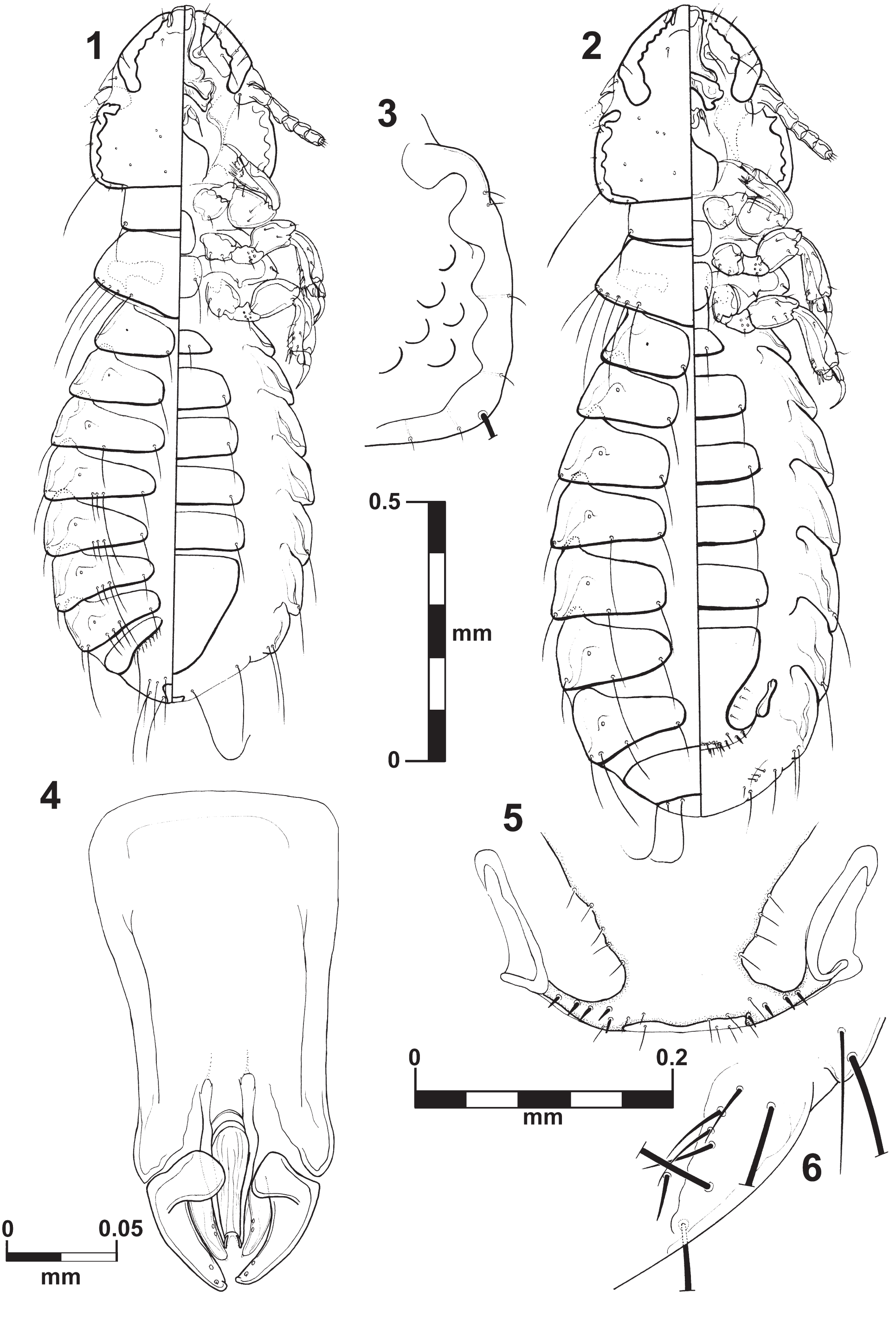
Brueelia sueta Valim & Weckstein, sp. n.

urn:lsid:zoobank.org:act:476AC361-B912-4BDC-8373-483E37D76E49
http://species-id.net/wiki/Brueelia_sueta
Figs 1–6; 13–14

Type host: *Pharomachrus pavoninus* (Spix, 1824) – Pavonine Quetzal

Diagnosis. This species is unique in the thickness of the temporal carina (Fig. 3) and by the shape of the anterior ventral plate (Figs 13–14) in both sexes. It is morphologically close to *B. insolita* due the absence of postspiracular setae on segment IV in females, but they differ significantly in characters such as shape of the vulvar margin (with a notch in *B. insolita*); number of setae on gonapophysis (six in *B. insolita*), and more spiniform setae on vulvar margin. The males of both species can be distinguished by the shape of genitalia and the tendency to have two setae postspiracular accessories on tergites V–VIII (whilst *B. insolita* has only one).

Male. Habitus as in fig. 1. Body pigmentation uniform, all plates barely yellowish slightly more pigmented on some details of the pleural areas. Head oval shaped, as long



Figures 1–6. *Brueelia sueta* sp. n.: male, dorso-ventral views (**1**); female, dorso-ventral views (**2**); temporal carina (**3**); male genitalia (**4**); female vulvar margin (**5**); female gonapophysis (**6**).

as wide. Small hyaline margin distinguishable; anterior dorsal head plate not completely surrounded by the dorsal preantennal suture. Preantennal margin slightly convex; marginal carina thickened with its inner margin sinuate, and completely pigmented (Figs 13–14). Tracks of cybarial muscles practically indistinct. Frontoclypeal suture with its nodal area well defined. Tracks of insertion of the mandibular adductor muscles well marked. Gular plate well pigmented with a broad rhombic silhouette. Temples forming an acute angle at level of the marginal temporal setae 3; temporal carina pigmented and thick, with its inner margin deeply sinuate (Fig. 3); eye imbedded within thickened carina making its distinction on margin of the head difficult (Fig. 3). Pterothorax with 5–7 marginal setae on each side; pterothoracic apodeme well developed, not reaching the lateral margin of the pterothorax. Mesosternal and metasternal plates not fused, both slightly longer than wide, only the metasternal plate bearing two long setae. Abdomen with tergites II–VIII lightly and uniformly pigmented. Tergal chaetotaxy: postspiracular long on IV–VIII; two small accessory setae on V–VIII (atypical specimens with only one seta in one side); and one sutural seta on II–VIII. Tergite IX+X (from the lateral to meson) with one short, one long and six (rarely seven) short setae. Paratergal chaetotaxy: II–III 0; IV–V 1; VI–VII 2; VIII 4. Sternal plates II–VI yellowish, typically with one pair of setae on each, subgenital plate uniformly pigmented. Genitalia (Fig. 4): basal plate wide, with sub-parallel lateral borders; straight and broad subtriangular paramera, with rhombic tips (Fig. 4); lateral sclerites of the endomeral complex long (2/3 of the paramera length) subtriangular with their posterior edge smooth, bearing 2 sensillae each.

Body measurements (n = 4): HL, 0.33–0.35; PAW, 0.27–0.28; TW, 0.35–0.36; PL, 0.13–0.14; PW, 0.24–0.25; PTL, 0.15–0.16; PTW, 0.34–0.35; AL, 0.71–0.80; AW 0.48–0.52; GL, 0.23; and TL, 1.25–1.35.

Female. Habitus as in figure 2. Pigmentation of the head, thorax and abdomen much as for male, differing in body size, terminalia and tergal chaetotaxy (one long postspiracular seta on V–VIII). Pterothorax with 4–6 marginal setae on each side. Tergites II–VIII divided medially, IX+X entire and uniformly pigmented. Subgenital plate uniformly pigmented, lacking posterior notch, with 3–5 small setae each side (Fig. 5). Gonapophysis commonly with 4 setae (Figs 6). Vulva with 4–5 short and spiniform setae, and 3–6 (rarely 2) long and thin setae on each side (Fig. 5).

Body measurements (n = 4): HL, 0.37–0.38; PAW, 0.30–0.31; TW, 0.38–0.39; PL, 0.13–0.16; PW, 0.26–0.27; PTL, 0.14–0.16; PTW, 0.37–0.38; AL, 0.94–1.10; AW 0.50–0.59; and TL, 1.52–1.67.

Type material. Male holotype, ex *Pharomachrus pavoninus*, JAP766 MPEG 62493; BRAZIL: Amazonas, Maraã, Lago Cumapi (01°43'48.6"S; 65°52'45.5"W), 31.VII.2007, J.D. Weckstein col., at MZUSP. Paratypes: 3 males and 4 females (one female DNA voucher Brsp.Phpa.1.4.2011.19), same data as holotype. 1 male and 1 female (DNA voucher) paratypes at FMNH.

Etymology. The epithet derives from *suetus* (L.), which means: wont; accustomed; usual. It makes reference to the fact of the genus *Brueelia* is a common parasite on trogons, rather than *insolitus* (L., unusual) as believed by Cicchino (1983) who described one species of this louse genus from this host group.

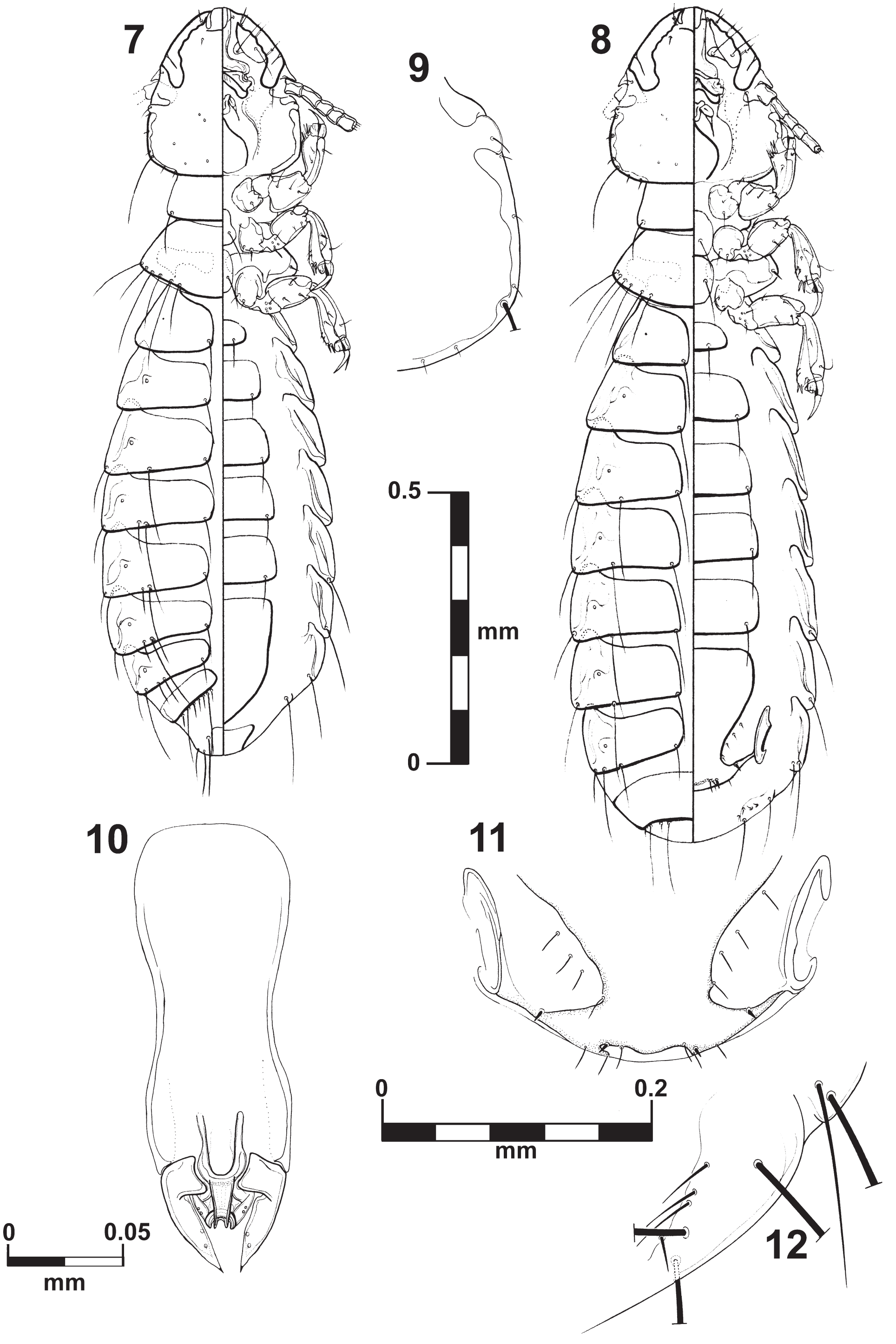
Brueelia cicchinoi **Valim & Weckstein, sp. n.**
urn:lsid:zoobank.org:act:5EF8725E-FAE3-4B43-B4F0-2EC82E090B62
http://species-id.net/wiki/Brueelia_cicchinoi
Figs 7–12; 15–16

Type host: *Trogon viridis* Linnaeus, 1766 – White-tailed Trogon

Diagnosis. The shape of the anterior ventral plate is unique in this species (Figs 15–16). It is morphologically close to *B. insolita* by the thickness of the temporal carina and by the presence of setae on the mesosternal plate; but they can be distinguished by the shape of the anterior ventral plate. The males of this species can be distinguished by the distinct genital architecture and by the presence of two long setae on tergite IX+X (only one in *B. insolita* and *B. sueta* sp. n.). In females, the presence of postspiracular setae on segment IV; the chaetotaxy of vulvar margin; and lacking of the notch on vulvar margin are the most distinctive characters. This species can be promptly distinguished from the *B. sueta* sp. n. by the thickness of the temporal carina, genitalia and tergal chaetotaxy in males; and by the presence of postspiracular setae on tergite IV and vulvar chaetotaxy in females.

Male. Habitus as in fig. 7. Body pigmentation uniform, all plates barely yellowish in color. Head oval shaped, slightly longer than wide. Hyaline margin indistinguishable; anterior dorsal head plate not completely surrounded by the dorsal preantennal suture. Preantennal margin slightly convex; marginal carina thickened with its inner margin sinuate (Figs 15–16). Tracks of cybarial muscles practically indistinct. Frontoclypeal suture with its nodal area well defined. Tracks of insertion of the mandibular adductor muscles faintly marked. Gular plate well pigmented with a broad rhombic silhouette. Temples more rounded; temporal carina pigmented and thinner, with its inner margin only superficially sinuate (Fig. 9); eye distinct from the temporal carina (Fig. 9). Pterothorax with 5–6 marginal setae on each side; pterothoracic apodeme well developed, not reaching the lateral margin of the pterothorax. Mesosternal and metasternal plates not fused, both slightly longer than wide and bearing two long setae each. Abdomen with tergites II–VIII lightly and uniformly pigmented. Tergal chaetotaxy: postspiracular long on IV–VIII; one small accessory setae on V–VIII (atypical specimens lack this seta on one side); and one sutural seta on II–VIII. Tergite IX+X (from the lateral to meson) with one short, one long, three short, one long, and one short setae. Paratergal chaetotaxy: II–III 0; IV–V 1; VI–VII 2; VIII 3. Sternal plates II–VI yellowish, typically with one pair of setae on each, subgenital plate uniformly pigmented. Genitalia (Fig. 10): basal plate wide, with concavity on lateral borders; straight and broad subtriangular paramera, with pointed tips (Fig. 10); lateral sclerites of the endomeral complex short (1/3 of the paramera length) and subtriangular with their posterior edge smooth, bearing 2 sensillae each.

Body measurements (n = 5), ex *Trogon viridis*: HL, 0.30–0.31; PAW, 0.23–0.24; TW, 0.28–0.30; PL, 0.11–0.14; PW, 0.20; PTL, 0.12–0.16; PTW, 0.27–0.28; AL, 0.77–0.87; AW 0.37–0.42; GL, 0.19–0.21; and TL, 1.27–1.38.



Figures 7–12. *Brueelia cicchinoi* sp. n.: male, dorso-ventral views (**7**); female, dorso-ventral views (**8**); temporal carina (**9**); male genitalia (**10**); female vulvar margin (**11**); female gonapophysis (**12**).

Body measurements (n = 3), ex *Trogon massena*: HL, 0.31–0.33; PAW, 0.24–0.25; TW, 0.29–0.30; PL, 0.12–0.13; PW, 0.20–0.21; PTL, 0.13; PTW, 0.29–0.31; AL, 0.83–0.93; AW 0.39–0.47; GL, 0.20–0.21; and TL, 1.34–1.48.

Body measurements (n = 1), ex *Trogon melanocephalus*: HL, 0.33; PAW, 0.26; TW, 0.31; PL, 0.13; PW, 0.21; PTL, 0.14; PTW, 0.32; AL, 0.91; AW 0.50; GL, 0.19; and TL, 1.46.

Body measurements (n = 2), ex *Trogon collaris*: HL, 0.30–0.31; PAW, 0.23–0.24; TW, 0.29–0.30; PL, 0.11–0.13; PW, 0.19–0.21; PTL, 0.15; PTW, 0.28–0.30; AL, 0.83–0.84; AW 0.39–0.43; GL, 0.18–0.20; and TL, 1.37–1.38.

Female. Habitus as in figure 8. Pigmentation of the head, thorax and abdomen much as for male, differing in body size, terminalia and tergal chaetotaxy. Pterothorax with 5–6 marginal setae on each side. Tergites II–VIII divided medially, IX+X entire and uniformly pigmented. Subgenital plate uniformly pigmented, lacking posterior notch, with 3–4 small setae each side (Fig. 11). Gonapophysis commonly with 3 setae (Figs 12). Vulva with 2–3 short and spiniform setae and 2–3 long and thin setae on each side (Fig. 11).

Body measurements (n = 3), ex *Trogon viridis*: HL, 0.32–0.33; PAW, 0.26; TW, 0.32; PL, 0.12–0.13; PW, 0.21–0.22; PTL, 0.13–0.15; PTW, 0.30–0.31; AL, 0.98–1.07; AW 0.44–0.46; and TL, 1.53–1.61.

Body measurements (n = 2), ex *Trogon melanurus*: HL, 0.34–0.36; PAW, 0.26–0.27; TW, 0.33–0.34; PL, 0.15–0.16; PW, 0.23; PTL, 0.15; PTW, 0.33; AL, 0.98–1.05; AW 0.46–0.47; and TL, 1.56–1.60.

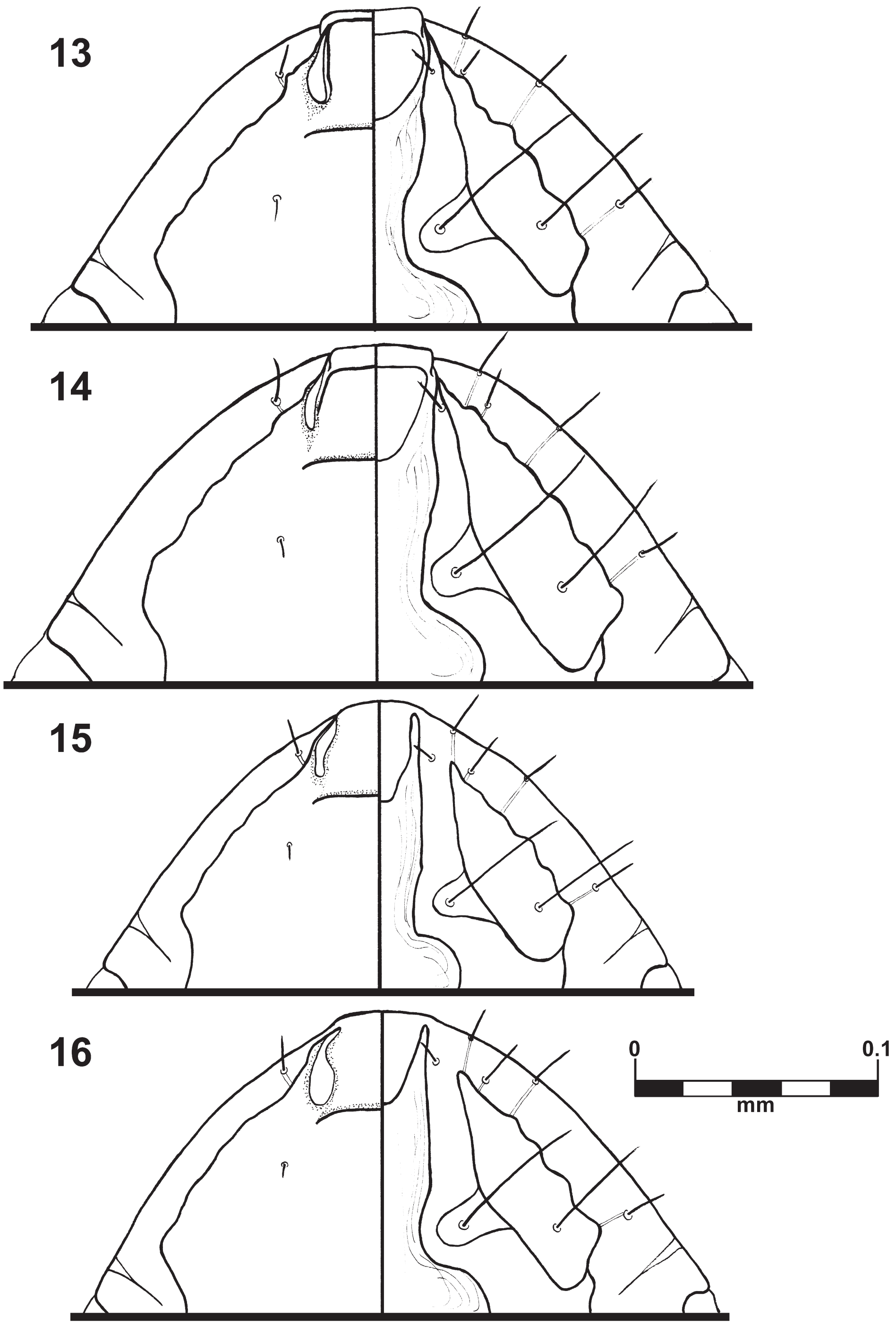
Body measurements (n = 3), ex *Trogon massena*: HL, 0.34; PAW, 0.26–0.28; TW, 0.32–0.33; PL, 0.13; PW, 0.21–0.23; PTL, 0.15–0.16; PTW, 0.32–0.33; AL, 1.01–1.10; AW 0.46–0.47; and TL, 1.59–1.69.

Body measurements (n = 1), ex *Trogon melanocephalus*: HL, 0.35; PAW, 0.27; TW, 0.33; PL, 0.14; PW, 0.22; PTL, 0.14; PTW, 0.34; AL, 1.09; AW 0.49; and TL, 1.68.

Body measurements (n = 3), ex *Trogon collaris*: HL, 0.33–0.34; PAW, 0.26–0.27; TW, 0.32–0.33; PL, 0.13; PW, 0.20–0.22; PTL, 0.14–0.17; PTW, 0.32–0.33; AL, 1.01–1.08; AW 0.48–0.54; and TL, 1.58–1.66.

Type material. Male holotype, ex *Trogon viridis*, JAP765 FMNH 456563; BRAZIL: Amazonas, Maraã, Lago Cumapi (01°43'48.6"S; 65°52'45.5"W), 31.VII.2007, J.D. Weckstein col., at MZUSP. Paratypes: 4 males and 3 females (one female DNA voucher Brsp.Trvi.1.4.2011.20), same data as holotype. 2 males and 1 female (DNA voucher) paratypes at FMNH.

Other specimens studied not regarded as types. 1 male and 1 female (female DNA voucher Brsp.Phpa.4.4.2011.16), ex *Pharomachrus pavoninus*, JAP315 MPEG 62491; BRAZIL: Amazonas, Japurá, Rio Mapari (02°02'31.5"S; 67°17'16.6"W), 17.VII.2007, J.D. Weckstein col., at FMNH; 2 females (one female DNA voucher Brsp.Trme.4.4.2011.13), ex *Trogon melanurus*, AMZ415 MPEG 59344; BRAZIL: Amazonas, Barcelos, Rio Aracá (0°25'12"S; 62°56'13"W), 4.XII.2005, C.C. Ribas col., at MZUSP; 4 males and 4 females (one pair of specimens DNA vouchers Trsp.Trmas.3.29.1999.4 and Trsp.Trmas.4.7.1999.9), ex *Trogon massena*; MÉXICO: Campe-



Figures 13–16. *Brueelia sueta* sp. n.: male preantenal region, dorso-ventral views (**13**); female preantenal region, dorso-ventral views (**14**); *Brueelia cicchinoi* sp. n.: male preantenal region, dorso-ventral views (**15**); female preantenal region, dorso-ventral views (**16**).

che, 24 km S Sivituc (18°14' N; 90°12' W), 6.III.1998, D.H. Clayton col., at PIPeR; 1 male and 2 females (one female DNA voucher Trsp.Trmel.5.4.1999.5); ex *Trogon melanocephalus*; MÉXICO: Campeche, 24 km S Sivituc (18°14' N; 90°12' W), 9.III.1998, D.H. Clayton col., at PIPeR; 2 males and 3 females (FMNH-INS 28922, 28923); ex *Trogon collaris*; PERU: Madre de Dios, Hacienda Amazonia, near Atalaya ridged, 330m above hacienda, 5.VIII.1985, D.H. Clayton col. (#85-076 and 85-077), at FMNH.

Etymology. This species is named after Armando C. Cicchino (Universidad Nacional de Mar del Plata, Mar del Plata, Argentina) in recognition of his more than thirty years of contributions to the taxonomy and systematics of the genus *Brueelia* and chewing lice in general.

Remarks. Although we described herein a new *Brueelia* species from *Pharomachrus pavoninus*, this same host species, from a different locality, also harbored *B. cicchinoi* sp. n. Nevertheless, we are certain that this record of *B. cicchinoi* on the host *P. pavoninus* is a reliable host-parasite association because: (1) the pair of *Brueelia* specimens collected from *P. pavoninus* are morphologically identical with those collected from *T. viridis*; (2) both individuals of *P. pavoninus* were collected on different days and at different localities; (3) no *Trogon* spp. were deloused or collected on the day that JDW collected *B. cicchinoi* sp. n. from *P. pavoninus*; (4) specimens of *B. cicchinoi* sp. n. collected from *P. pavoninus* and *T. viridis* are genetically identical (see below); (5) our specimens are only 1 bp different and thus nearly genetically identical to *Brueelia* sp. collected from two other *Trogon* species (see below) collected in México. Lastly, although the type host of *B. cicchinoi* sp. n., *T. viridis* MPEG 62484, was collected in the Amazonian Imerí area of endemism between the Rio Japurá and Rio Negro, we also found *B. cicchinoi* sp. n. on *T. melanurus* MPEG 59344) from the Imerí area of endemism between the Rio Branco and the Rio Negro and on *P. pavoninus* MPEG 62491 from the Napo area of endemism south of the Rio Japurá. Although we do not have a male specimen of *B. cicchinoi* sp. n. from *T. melanurus* we are also certain of this host association because the two specimens studied from *T. melanurus* are morphologically and genetically indistinguishable from those collected from *T. viridis*. Thus, *B. cicchinoi* sp. n. is apparently a relatively widespread trogon parasite found on at least six species of trogons: *Trogon viridis*, *T. melanurus*, *T. collaris*, *T. massena* (see below), *T. melanocephalus* (see below), and *Pharomachrus pavoninus*.

Brueelia insolita Cicchino, 1983

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

Brueelia insolita Cicchino, 1983: 284, Figs 7–13; Type host *Trogon mexicanus*; Soloma, Huehuetenango, GUATEMALA.
Trogoninirmus insolitus, Price et al. 2003: 245 (incorrectly included in *Trogoninirmus*).

Diagnosis. This species is readily distinguished from the other species herein described by the size and shape of the male genitalia and the conspicuous central notch present on the vulvar margin in females. Its head carina and body chaetotaxy are close to that found on *B. cicchinoi* sp. n.

Male body measurements (n=1): HL, 0.34 (0.32); PAW, 0.28 (0.25); TW, 0.33 (0.31); PL, 0.13 (0.12); PW, 0.23 (0.21); PTL, 0.15; PTW, 0.34 (0.33); AL, 0.78 (0.70); AW 0.48 (0.46); GL, 0.26; and TL, 1.34 (1.26).

Female body measurements (n=6): HL, 0.37–0.38 (0.34); PAW, 0.29–0.31 (0.27); TW, 0.36–0.37 (0.33); PL, 0.13–0.15 (0.12); PW, 0.23–0.25 (0.22); PTL, 0.15–0.18 (0.15); PTW, 0.34–0.36 (0.32); AL, 0.99–1.12 (0.94); AW 0.54–0.57 (0.52); and TL, 1.58–1.69 (1.54).

Specimens studied. 1 male and 6 females, ex *Trogon mexicanus*, DB703; GUATEMALA: Huehuetenango, Soloma, 12.IX.1958, D. Baepler col., at PIPeR.

Remarks. Unexpectedly we had the opportunity to discover and analyze specimens from the same lot as those used by Cicchino (1983). As these additional specimens agree completely with the description provided by that author and his description is very precise for recognizing this taxon no redescription is necessary. However the type series of *B. insolita* is based only on a pair of specimens, and thus here we present additional morphometric data for this newly analyzed material. The original measurements provided by Cicchino (1983) for his male *B. insolita* were similar to the measurements of the specimens from PIPeR and his measurements of the female specimen fell within our measurements to two decimals. Cicchino's original measurements are provided in parenthesis.

Discussion

Based on a MP bootstrap analysis of the partial mitochondrial COI sequences, support for the monophyly of trogon *Brueelia* was only 56%. However, all 48 of the MP trees (TL=913, CI=0.36, RI=0.70) indicated that *Brueelia* parasitizing trogons were monophyletic. Furthermore, uncorrected p-distances indicate that the morphologically diagnosable *Brueelia* species, *B. sueta* sp. n. and *B. cicchinoi* sp. n., are differentiated genetically as well. Uncorrected p-distances between them range from 13.4–13.6%, whereas uncorrected p-distances within *B. cicchinoi* sp. n. from the five different host taxa *Trogon viridis*, *T. melanurus*, *T. massena*, *T. melanocephalus*, and *Pharomachrus pavoninus* are extremely small and range from 0–0.3%. *Brueelia cicchinoi* sp. n. from Amazonian *T. viridis*, *T. melanurus*, and *Pharomachrus pavoninus* are identical across 382 bp of COI. However, these three specimens differ by a single bp from the Mexican *Brueelia* sp. from *T. massena* and *T. melanocephalus* sequenced by Johnson et al. (2002). Thus, the similarity of these COI sequences and the morphological features of the *Brueelia* sp. from *T. massena* and *T. melanocephalus* are consistent with these Mexican specimens being *B. cicchinoi* sp. n. as well.

Our data in combination with data published by Johnson et al. (2002) suggests that *B. cicchinoi* sp. n. is a relatively widespread trogon parasite. In addition to parasitizing at least six species of trogons including *Trogon viridis*, *T. melanurus*, *T. collaris*, *T. mas-*

sena, *T. melanocephalus*, and *Pharomachrus pavoninus*, *B. cicchinoi* sp. n. is found from North America as far south as Departamento Madre de Dios, Peru and east to eastern Amazonas, Brazil and thus includes the Inambari, Napo, and Imerí Amazonian areas of endemism. This broad louse distribution is extraordinary because it crosses a number of major avian biogeographic barriers including the Andes. In general, the Trogonidae are not long distance migrants, although *Pharomachrus* is a known altitudinal migrant (Collar 2001) and genetic data indicates that widespread trogon taxa such as *T. viridis* are not crossing the Andes (Dacosta and Klicka 2008). Thus the lice are not being carried across these barriers by the birds. However, the distribution of Trogonidae is more or less continuous across the lowlands and highlands of Central and South America, which suggests that perhaps the lack of host specificity of *B. cicchinoi* allows it to use a variety of trogon taxa that inhabit different elevations and habitat types (e.g. highlands and dry forest) as a bridge between geographic regions. This might explain the large geographic distribution of this parasite and lack of genetic divergence between individuals in México and Amazonia despite the host taxa having much more limited distributions. Additional collections across the Neotropics will help us to better understand this pattern and the potential process of parasites dispersing while their hosts are relatively sedentary.

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RESEARCH ARTICLE

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A key to species of subgenus *Lithochlaenius* (Coleoptera, Carabidae, Chlaeniini, *Chlaenius*), with descriptions of three new species

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Abstract

Three new species of genus *Chlaenius* Bonelli subgenus *Lithochlaenius* Kryzhanovskij are described from China: *Chlaenius chuanqianensis* Liu & Liang, **sp. n.** (type locality: Xishui, Guizhou Province), *C. linwensini* Liu & Liang, **sp. n.** (type locality: Fujian Province), and *Chlaenius propeagilis* Liu & Kavanaugh, **sp. n.** (type locality: Gaoligongshan, Yunnan Province). Seven species of the subgenus are redescribed: *C. agiloides* Jedlička, *C. formosensis* Lorenz, *C. agilis* Chaudoir, *C. leishanensis* Kirschenhofer, *C. noguchii* Bates, *C. rambouseki* Lutshnik, and *C. wrasei* Kirschenhofer. Additional taxonomic changes include the following: *Chlaenius formosanus* Jedlička is treated as a junior synonym of *C. rambouseki* Lutshnik and *C. anchomenoides* Bates, **syn. n.** and *C. nuristanus* Jedlička as junior synonyms of *C. agilis* Chaudoir, **syn. n.** *Chlaenius latro* LaFerté-Sénectère is considered a *nomen nudum* stat. n. and unavailable, leaving *C. agilis* Chaudoir as the next available name. *Chlaenius nuristanus* aberration *rubridipes* Jedlička is also an unavailable name. *Chlaenius formosensis* Lorenz (=*C. formosanus* Habu) is returned to species status stat. n. A key to adults of the 10 known species of subgenus *Lithochlaenius* is provided.

Keywords
Coleoptera, Carabidae, *Chlaenius*, *Lithochlaenius*, new species, new synonymy, key

Introduction

Lithochlaenius Kryzhanovskij (1976) is one of the subgenera included in genus *Chlaenius* Bonelli (1810) of the carabid tribe Chlaeniini. This subgenus was erected for adults with cordate pronota and long, narrow metepisterna. Members of this subgenus are very similar to those of subgenus *Stenochlaenius*, with which they share a cordate pronotum, but from which they differ in having a pubescent body (body glabrous in *Stenochlaenius* adults).

To date, nine species of the subgenus have been described from Asia, namely, *Chlaenius agiloides* Jedlička (1935) (Type locality: Wenxian, Gansu, China), *C. agilis* Chaudoir (1856) (Nord Industan, India), *C. anchomenoides* Bates (1889) (Goorais Valley, Pakistan), *C. formosanus* Jedlička (1935) (Kosempo, Taiwan, China), *C. formosensis* Lorenz (1998) (Urai, Taiwan, China), *C. leishanensis* Kirschenhofer (2005) (Leishan, Guizhou, China), *C. noguchii* Bates (1873) (Kawachi, Japan), *C. rambouseki* Lutshnik (1933) (Ussuri, Far East, Russia), and *C. wrasei* Kirschenhofer 1997 (Wenxian, Gansu, China). Recently, after studying *Chlaenius* specimens in the collection of the National Zoological Museum of China (Beijing) and in several other museums, we determined that two of these, *C. anchomenoides* Bates and *C. formosanus* Jedlička, were just junior synonyms of other species names, and that some specimens collected from Guizhou, Sichuan, Yunnan, and Fujian provinces represented three new species. In this presentation, the new synonymic relationships are formally proposed and descriptions of the three new species are provided.

To date, no key including all known species of *Lithochlaenius* has been published. Based on our study of type specimens and/or original descriptions, we provide here a key to aid identifications of adults of all known species, including the three new ones described in this paper.

Materials and methods

We measured all available specimens for each species except for those with plentiful specimens, for which five males and five females were measured, including smallest and largest specimens for each sex (determined by visual inspection of the assembled samples). Measurements were made with the aid of a Nikon SMZ1500 stereoscopic dissecting microscope with a micrometer. Body length (BL) was measured as the linear distance along the midline from the apex of the longer mandible to the apex of the longer elytron. Other measurements, and abbreviations used for them in this paper, are as follows: HW = maximum head width including the eyes; EYL = eye length measured along the longitudinal diameter of the eye (dorsal–lateral view); PL = length of pronotum measured along median line; PW = pronotum width at its widest point; EL = elytron length from base to apex; EW = width across both elytra at widest point (equal to body width).

Wherever we refer to abdominal ventral plates, we use the numbering system that recognizes the generally accepted segmental homologies in Carabidae. Thus the first visible sternum (i.e. the sternum divided medially by the hind coxae) in *Chlaenius* adults is sternum II and the last visible sternum is sternum VII.

All photographs were taken through a Nikon stereoscopic dissecting microscope fitted with a Canon 450D camera, and were edited by Helicon Focus and Photoshop software.

Specimens examined in the course of this study were deposited at the following collections:

BMNH	Natural History Museum, London, U.K.
CASC	California Academy of Sciences, San Francisco, U.S.A.
CCCC	Private Collection of Changchin Chen, Tianjin, China
HBUM	Museum of Hebei University, Baoding, China
IZCAS	National Zoological Museum of China, Institute of Zoology, Beijing, China
MNHN	Museum National d'Histoire Naturelle, Paris, France
NMPC	Narodni Muzeum, Prirodovedecke Muzeum, Prague, Czech Republic
OMNH	Osaka Museum of Natural History, Osaka, Japan
SIECAS	Institute of Plant Physiology & Ecology, Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences, Shanghai, China
ZRAS	Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia

Taxonomy

Subgenus *Lithochlaenius* Kryzhanovskij, 1976
http://species-id.net/wiki/Lithochlaenius

Hemichlaenius Lutshnik, 1933:169 (nec Bates, 1892:307). Type species *Chlaenius rambouseki* Lutshnik, 1933; Kryzhanovskij, 1976:11

Lithochlaenius Kryzhanovskij, 1976:9. Type species *Chlaenius rambouseki* Lutshnik, 1933; Morita, 1993:161

Agilochlaenius Kirschenhofer, 1997:116. Type species *Chlaenius latro* LaFerté–Sénectère, 1851; Kirschenhofer, 2000:58

Diagnosis. Antennomere 3 distinctly longer than antennomeres 1 and 2 combined (Fig. 9); pronotum distinctly cordate (Fig. 1), disk glabrous or sparsely pubescent, each hind angle with single seta (Fig. 2); scutellar setiferous pore puncture present (Fig. 3); venter densely pubescent laterally, sparsely pubescent or glabrous medially (Fig. 4);

prosternal intercoxal process punctate, bordered at apex; metepisterna long and narrow (Fig. 10); basal margination of elytra incomplete, absent from medial portion; anterior tarsomere 4 short and deeply emarginate apically (more distinctly so in male, Figs 5–8); aedeagus tubular, ejaculatory orifice long, extended to basal fifth of aedeagus, lamella short (Figs 11, 117–145); gonostylus of female ovipositor smooth, with one setiferous pore near apex and one slender spine at basal inner margin (Figs 12–15).

Description. Length 12.0–18.0 mm, width 4.6–6.4 mm. Head and pronotum black, with green, blue or coppery metallic luster; elytra black, with blue or coppery luster in a few species; ventral surface black; legs black, brown or yellow; antennae yellow, brown, or dark brown.

Head with vertex nearly glabrous, or sparsely and coarsely punctate behind posterior level of eye; eyes moderately prominent; genae pubescent; antennae long, antennomere 1 (scape) coniform (Figs 52–53, 57–59), cylindrical (Figs 56, 60), or elongate-ovoid (Figs 54–55, 61–65); antennomere 3 sparsely setose, distinctly longer than antennomeres 1 and 2 combined (Fig. 9); mandibles triangular, hooked at apex; labrum with six setigerous punctures near apex; maxillary and labial palpi cylindrical, slightly compressed at apex; maxillary palpi glabrous; penultimate labial palpomere with a few setae, apical labial palpomere glabrous; glossal sclerite with two subapical setae; tooth of mentum bifid or emarginate at apex, with one pair of setae near the base; gula glabrous, slightly rugose.

Pronotum cordate (Fig. 1), widest at apical one-third, front angles obtuse, hind angles acute; lateral margins bordered; disk glabrous or sparsely pubescent, base longitudinally rugose, punctate; basal foveae small, deep, rugose, pubescent; hind angles each with one seta (Fig. 2).

Elytra moderately convex, oblong, with distinct isodiametric microsculpture at least laterally; scutellar striae long, with basal setiferous pore present (Fig. 3); at least outer intervals pubescent (Figs 80–93), pubescence on intervals 8 and 9 generally denser than on others; wings full-sized, functional.

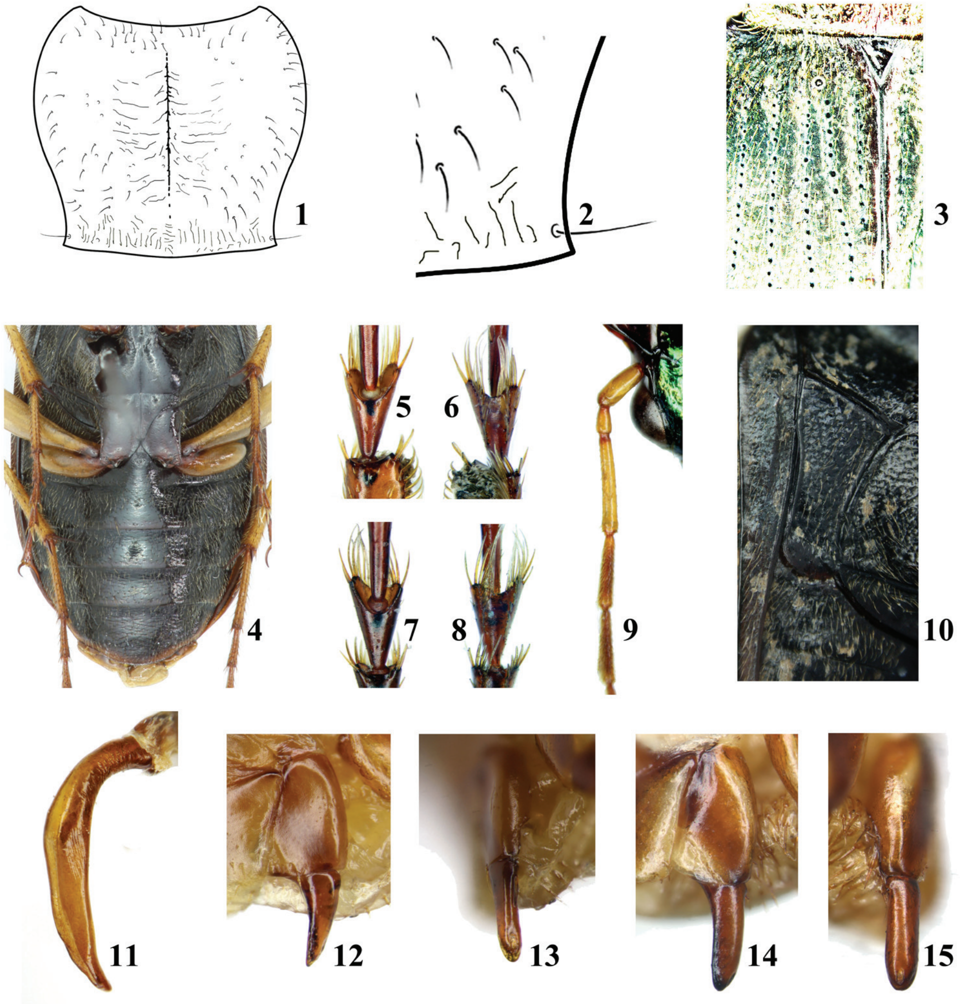
Abdominal sterna densely pubescent laterally, sparsely pubescent or glabrous medially (Fig. 4); sterna IV to VI with single long seta at each side; sternum VII with one seta at each side in male, two in female; apex of sternum VII more rounded in male than in female.

Pro- and mesosterna and pro-, mes-, and metepisterna densely pubescent; metasternum pubescent laterally, nearly glabrous medially; prosternal intercoxal process punctate and bordered at apex; scutellum triangular, glabrous.

Anterior femora without tooth; tarsomeres short, sparsely setose dorsally; anterior tarsomere 4 short and triangular, deeply emarginate (more so in male), with two rows of long setae ventrally (Figs 5–8); basal three anterior tarsomeres dilated in male.

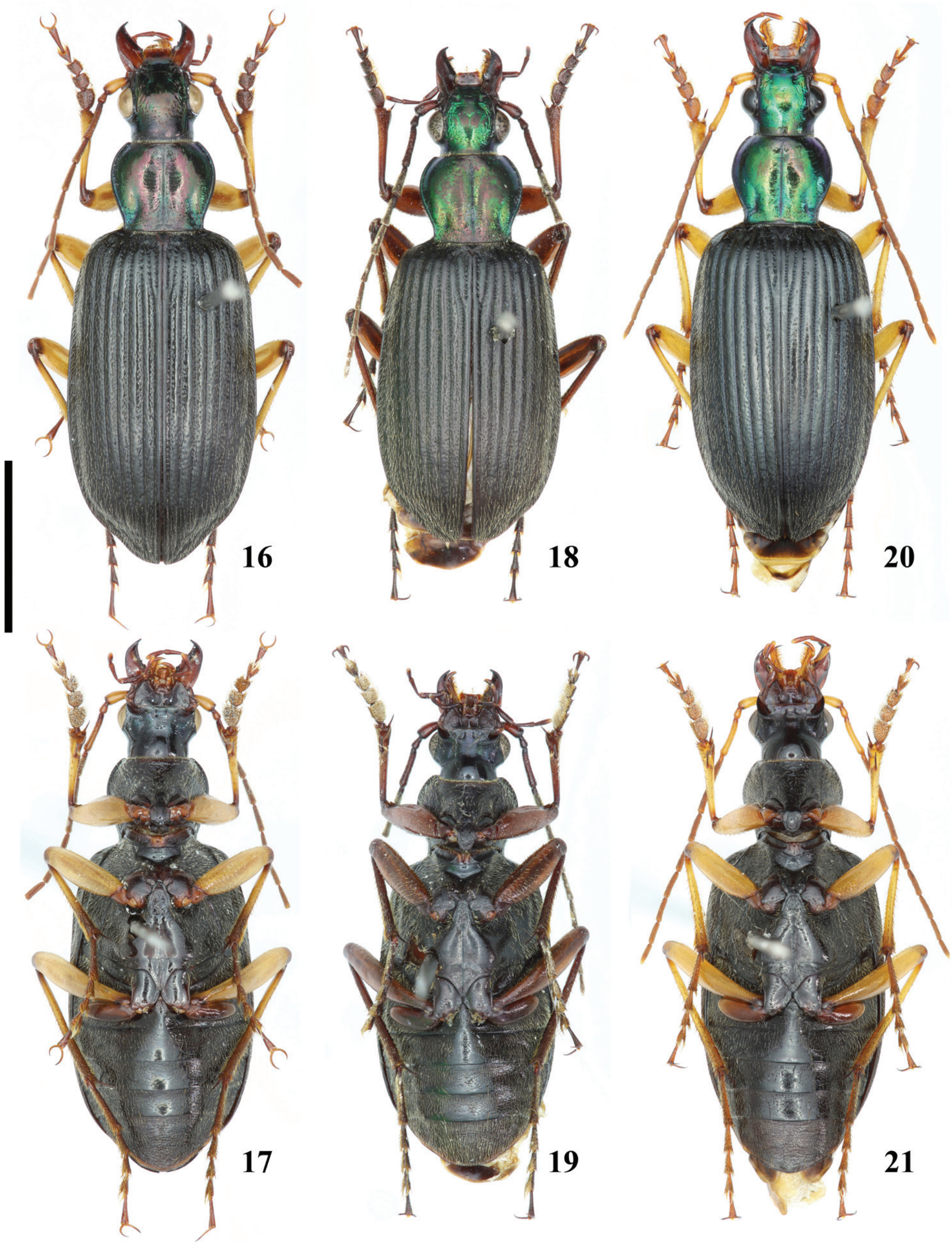
Male genitalia with aedeagus tubular, simple; ejaculatory orifice long (Fig. 11); apical lamella short, rounded or slightly truncated at apex. Gonostylus of female ovipositor smooth, with one setiferous pore near apex and a long slender spine at basal inner margin, outer margin without or with a very short spine (Figs 12–15).

Geographical Distribution. China (Heilongjiang, Liaoning, Shaanxi, Gansu, Henan, Hubei, Hunan, Zhejiang, Fujian, Taiwan, Jiangxi, Guangdong, Hainan,



Figures 1–15. Character states of *Chlaenius* (*Lithochlaenius*) spp. **Figs 1–13** *Chlaenius rambouseki* Lutshnik **1** pronotum **2** site of hind angle seta **3** elytral base showing the site of basal pore **4** abdominal sterna showing the pubescence **5** male anterior tarsomere 4 in dorsal view **6** male anterior tarsomere 4 in ventral view **7** female anterior tarsomere 4 in dorsal view **8** female anterior tarsomere 4 in ventral view **9** antennomeres 1–5 showing antennomere 3 distinctly longer than 1 and 2 ones combined **10** metepisternum **11** aedeagus, showing the basic structure of the aedeagus in *Lithochlaenius* species **12** female gonostylus in ventral view **13** female gonostylus in lateral view **14** female gonostylus of *C. propeagilis* sp. n. in ventral view **15** female gonostylus of *C. propeagilis* sp. n. in lateral view.

Guangxi, Guizhou, Sichuan, Yunnan, Tibet), North Korea, Japan, Russia (Far East), Afghanistan, Pakistan, India. The known localities of *Lithochlaenius* species are shown in Fig. 158. Based on the work of Andrewes (1930) and Paik et al. (2006), members of this subgenus also occur in Indo-China (Laos, Cambodia, Vietnam), but we have not studied specimens from those countries.



Figures 16–21. Habitus of *Chlaenius* (*Lithochlaenius*) spp **16** *Chlaenius chuanqianensis* sp. n., holotype, male, dorsal view **17** *Chlaenius chuanqianensis* sp. n., holotype, male, ventral view **18** *Chlaenius linwensini* sp. n., holotype, male, dorsal view **19** *Chlaenius linwensini* sp.n., holotype, male, ventral view **20** *Chlaenius propeagilis* sp. n., holotype, male, dorsal view **21** *Chlaenius propeagilis* sp. n., holotype, male, ventral view. Scale line = 5.0 mm.

Biology. Members of this subgenus are typically collected on sandy beaches of rivers or streams (Figs 146–153). Adults of some species (e. g., *C. agiloides*, *C. rambouseki*) have been observed feeding on mollusks, worms, and dragonfly larvae at night (Figs 154–157). A few species have also been collected in light traps.

Remarks. Based on the metallic body surface, single supraorbital seta, antennomere 3 longest and antennomeres 4–11 densely pubescent, *Lithochlaenius* species can be recognized as a member of the genus *Chlaenius*. Members of this subgenus are similar to those of subgenus *Stenochlaenius* in shape of the pronotum, but the latter are much smaller and have a glabrous body surface.

As presently conceived, the subgenus can be divided into two species groups: 1) the *rambouseki* group, members of which have all elytral intervals densely and more or less equally pubescent, and males have aedeagi slender in dorsal view; and 2) the *agilis* group, members of which have at least elytral intervals 1–5 glabrous medially with pubescence restricted to the strial depressions, intervals 6–9 densely pubescent, and males have aedeagi generally stouter in dorsal view. Most species of the subgenus have restricted geographical ranges, and only C. *rambouseki* is more broadly distributed.

In his treatment of the North American species of genus *Chlaenius*, Bell (1960) suggested that his *solitarius* species group, which included *C. cordicollis* Kirby, *C. leucoscelis* Chevrolat, *C. prasinus* Dejean, *C. purpureus* Chaudoir, and *C. solitarius* Say, represented a distinct group within his subgenus *Chlaenius* sensu stricto. He noted that the range of this group extends south into South America and that "Related forms occur in the Old World". In the paper in which he proposed *Lithochlaenius* as a replacement name for *Hemichlaenius* Lutshnik, Kryzhanovskij (1976:16) cited Bell's paper and suggested that *C. solitarius* might be a North American representative of that subgenus. Robert Davidson (personal communication) shares the view that species of Bell's *solitarius* group, and at least five additional species in Middle and South America, are likely related to some if not all *Lithochlaenius* species. All of these New World species share most of the diagnostic features of *Lithochlaenius* and all of them have elytral pubescence as seen in members of the *rambouseki* group. However, members of all these New World species are distinguished in having the lateral and basal elytral margins smoothly continuous around the humeri without forming any trace of an angle and the elytral epipleura and basal regions smoothly continuous around the humeri, not separated by a carina of any kind. These were the main features that Bell used to distinguish members of his *solitarius* group. In contrast, members of all the Asian species of *Lithochlaenius* that we have studied have a distinct humeral angle formed at the junction of the lateral and basal elytral margins and a more or less distinctly carinate separation of the (lateral) epipleural from the basal (anterior vertical) elytral surfaces. Hence, Asian *Lithochlaenius* specimens could not be identified as members of the *solitarius* groups using Bell's (1960) key. There is also greater variation in the development of the elytral basal margin (from complete to partially interrupted) and in the length and shape of the apical lamella of the male aedeagus among New World species than we have seen among the Asian *Lithochlaenius* species. Consequently, we suggest that placement of any New World species in subgenus *Lithochlaenius* would be premature at this time and should await a more comprehensive, worldwide treatment of genus *Chlaenius* and analyses of phylogenetic relationships among the included species, species groups, and subgenera.

Key to the species of subgenus *Lithochlaenius*

1	All intervals punctate, pubescent, slightly convex (Figs 88–89, 93); aedeagus slender, basal portion rugose (*rambouseki* group)..**2**
–	At least basal half of intervals 1–5 smooth and glabrous medially, distinctively convex (Figs 80–87, 90–92); aedeagus usually stout, basal portion smooth (*agilis* group)..**3**
2	Intervals dull, with dense and regular punctures (Figs 89, 93); antennomere 1 elongate ovoid (Figs 61, 65); apical lamella of aedeagus thin (Figs 137, 145)... ....***C. rambouseki* Lutshnik**
–	Intervals shining, with sparse and irregular punctures (large and small punctures mixed) (Fig. 88); antennomere 1 cylindrical (Fig. 60); apical lamella of aedeagus thick (Figs 134–135)..***C. agiloides* Jedlička**
3	Antennomere 1 with apical end much thicker than basal end, coniform (Figs 52–53, 57–59)..**4**
–	Antennomere 1 with apical end as thick as basal end, elongate-ovoid (Figs 54, 55, 62–64) or cylindrical (Fig. 56)..**8**
4	Intervals 1–7 glabrous medially, with a row of pubescence laterally (near striae) (Fig. 86); legs dark brown or brown (Fig. 29); apex of sternum VII subtruncate (Figs 105, 106); aedeagus slender, depressed, apical lamella bent ventrally (Figs 129–130)..***C. noguchii* Bates**
–	Intervals 6–7 pubescent, intervals 1–5 glabrous medially, with a row of pubescence laterally (near striae) (Figs 80–81, 85, 87); aedeagus stout............**5**
5	Tibiae and femora bi-colored, with tibiae black or dark brown (Figs 26–27), femora yellow or light brown; lamella of aedeagus rounded at apex (Fig. 127), thickened, and bent ventrally (Fig. 128).......***C. leishanensis* Kirschenhofer**
–	Tibiae and femora concolorous, yellow or brown (Figs 16–19, 30–31).......**6**
6	All antennomeres brown or dark brown (Fig. 18); hind trochanters brown, nearly the same color as hind femora (Fig. 19); elytra with basal three-fourths of intervals 1–5 glabrous medially; lamella of aedeagus sub-truncate at apex (Fig. 119), thick (Fig. 120)....................***C. linwensini* Liu & Liang, sp. n.**
–	At least antennomere 1 yellow or brown, paler than the rest (Figs 16, 30); hind trochanters much darker than hind femora (Figs 17, 41); elytra with entire lengths of intervals 1–5 glabrous medially; lamella of aedeagus rounded at apex (Figs 117, 131), thin (Figs 118, 132)..**7**
7	Antennomeres 1–3 brown, color paler than antennomeres 4–11 (Fig. 30); apical lamella of aedeagus bent ventrally (Fig. 132)..... ***C. wrasei* Kirschenhofer**

– Only antennomere 1 yellow or brown, color paler than antennomeres 2–11 (Fig. 16); apical lamella of aedeagus straight (Fig. 118) .... ***C. chuanqianensis* Liu & Liang, sp. n.**

8 Intervals 1–7 glabrous medially (Fig. 84); antennomere 1 cylindrical (Fig. 56); lamella of aedeagus subtruncate at apex (Fig. 125) .... ***C. formosensis* Lorenz**

– At most intervals 1–5 glabrous medially (Figs 82–83, 90–92); antennomere 1 elongate ovoid (Figs 54–55, 62–64); lamella of aedeagus round at apex (Figs 121, 123, 138, 140, 142) **9**

9 Male with media lobe of aedeagus gradually bent near base (Fig. 122), lamella triangular at apex, left side of media lobe nearly straight in dorsal view (Fig. 121) .... ***C. propeagilis* Liu & Kavanaugh, sp. n.**

– Male with media lobe of aedeagus abruptly bent near the base (Figs 124, 139, 141, 143), lamella rounded at apex, left side of media lobe expand laterally in dorsal view (Figs 123, 138, 140, 142) .... ***C. agilis* Chaudoir**

The *agilis* group

***Chlaenius* (*Lithochlaenius*) *chuanqianensis* Liu & Liang, sp. n.**

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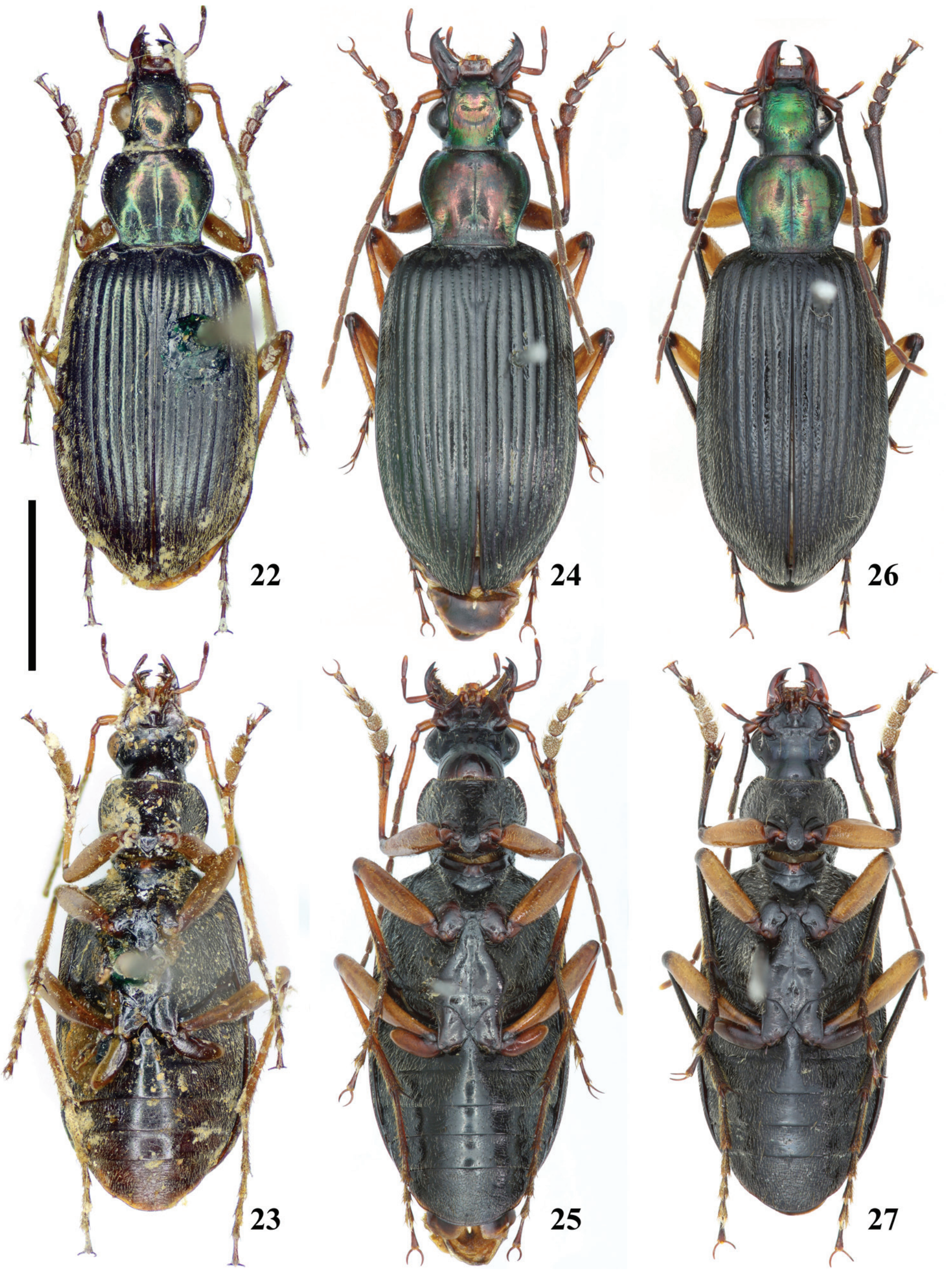
http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_chuanqianensis
Figs 16–17, 52, 66, 80, 94–95, 117–118, 146, 150, 158

Types. Holotype: male (IZCAS), "China, Guizhou, Xishui County, Dabaitang, 600m"/ "IOZ & Guizhou Univ. Joint Expedition, 2000.9.24, Liang H.B" / ""Holotype, *Chlaenius* (*Lithochlaenius*) *chuanqianensis* Liu & Liang sp. n."" [red label]. Paratypes: Total 14 specimens. 1 female (IZCAS), "China, Guizhou, Xishui County, Dabaitang, 550m"/ "IOZ & Guizhou Univ Joint Expedition, 2000.9.27, Liang H. B."; 1 female (HBUM), "China, Guizhou, Xishui County, Dabaitang"/ "2000. IX. 25–29, collector Ren G. D."; 1 male (IZCAS), "China, Guizhou, Xishui County, Chengzhai, Hongqi village, 28.419033, 106.273766"/ "2009.10.8, Liu Y. & Shi H. L."; 1 female (IZCAS), "Sichuan, Ya-an"; / ""1990.VII.3, Xie Weiping collector"; 1 male (IZCAS), "Sichuan, Xinjin" / ""1981.VI.13, Liu Hongjiang collector"; 1 female (IZCAS), "Sichuan, Anxian"; 1 male (IZCAS), "Sichuan, Shehong" / ""1980.7.7"; 3 males and 3 females (IZCAS), "Sichuan, Yajiang, Hekou Town, Shanbeihou, Yalongjiang, N30.00020, E101.01526" / "2009.5.28 N, Liang Hongbin coll."; 1 female (IZCAS), "Sichuan, Yajiang, Hekou Town, Shanbeihou, Yalongjiang, E30.00020, N101.01526"/ "2009.5.27, Day, Liang Hongbin coll.". Each paratype with an additional yellow label: ""Paratype, *Chlaenius* (*Lithochlaenius*) *chuanqianensis* Liu & Liang sp. n."".

Diagnosis. Antennomere 1 coniform (Fig. 52); color of antennomere 1 yellow or brown; intervals 1–5 glabrous medially, with one row of pubescence laterally (Fig. 80); aedeagus stout, apical lamella round (Fig. 117), thin and straight in lateral view (Fig. 118).



Figures 22–27. Habitus of *Chlaenius* (*Lithochlaenius*) spp **22** *C. agilis* Chaudoir, holotype, dorsal view **23** *C. agilis* Chaudoir, holotype, ventral view **24** *C. formosensis* Lorenz, male, in CCCC, dorsal view **25** *C. formosensis* Lorenz, ventral view **26** *C. leishanensis* Kirschenhofer, male, in IZCAS, dorsal view **27** *C. leishanensis* Kirschenhofer, male, in IZCAS, ventral view. Scale line = 5.0 mm.

Description. Total length = 16.0–17.0 mm (mean = 16.8), width = 5.60–6.13 mm (mean = 5.86); HW = 2.60–2.95 mm (mean = 2.82), EYL = 0.95–1.10 mm (mean = 1.03), ratio Ant3/Ant1 = 1.56–1.72 (mean = 1.64), PL/PW = 0.76–0.84 (mean = 0.81), EL/EW = 1.68–1.91 (mean = 1.79), EL/ PL = 1.37–1.49 (mean = 1.42).

Head and pronotum black with green or coppery metallic luster; elytra black; ventral surface black; mandibles and trochanters dark brown; antennomere 1, femora, tibiae yellow to brown; antennomeres 2–11, palpi and tarsi dark brown to nearly black.

Head with vertex smooth medially, coarsely punctate behind eyes; labrum slightly emarginate at apex; antennomere 1 coniform (Fig. 52). Pronotum with disk smooth, very sparsely punctate along midline in a few specimens; lateral furrow sparsely pubescent and coarsely punctate; medial longitudinal furrow deep, impunctate; basal foveae narrow, deep, sparsely pubescent and punctate. Elytral intervals convex, intervals 1–5 glabrous medially, with a row of setae laterally (Fig. 80), pubescent in apical one-fifth in a few specimens, intervals 6–9 pubescent throughout; striae deep, punctate; humeral angles obtuse (Fig. 66). Abdominal sterna IV–VI sparsely pubescent medially, densely pubescent laterally; sternum VII narrowly rounded apically in both sexes (Figs 94–95). Lamella of aedeagus round at apex (Fig. 117), thin and straight in lateral view (Fig. 118).

Etymology. The Latinized name *chuanqianensis* refers to type localities of this new species in "chuanqian" regions, of which "chuan" refers to Sichuan Province and "qian" refers to Guizhou Province).

Geographical distribution. Fig. 158. Known only from Guizhou and Sichuan Provinces, China.

Remarks. Mensural data cited in the description were obtained from the holotype and all paratypes.

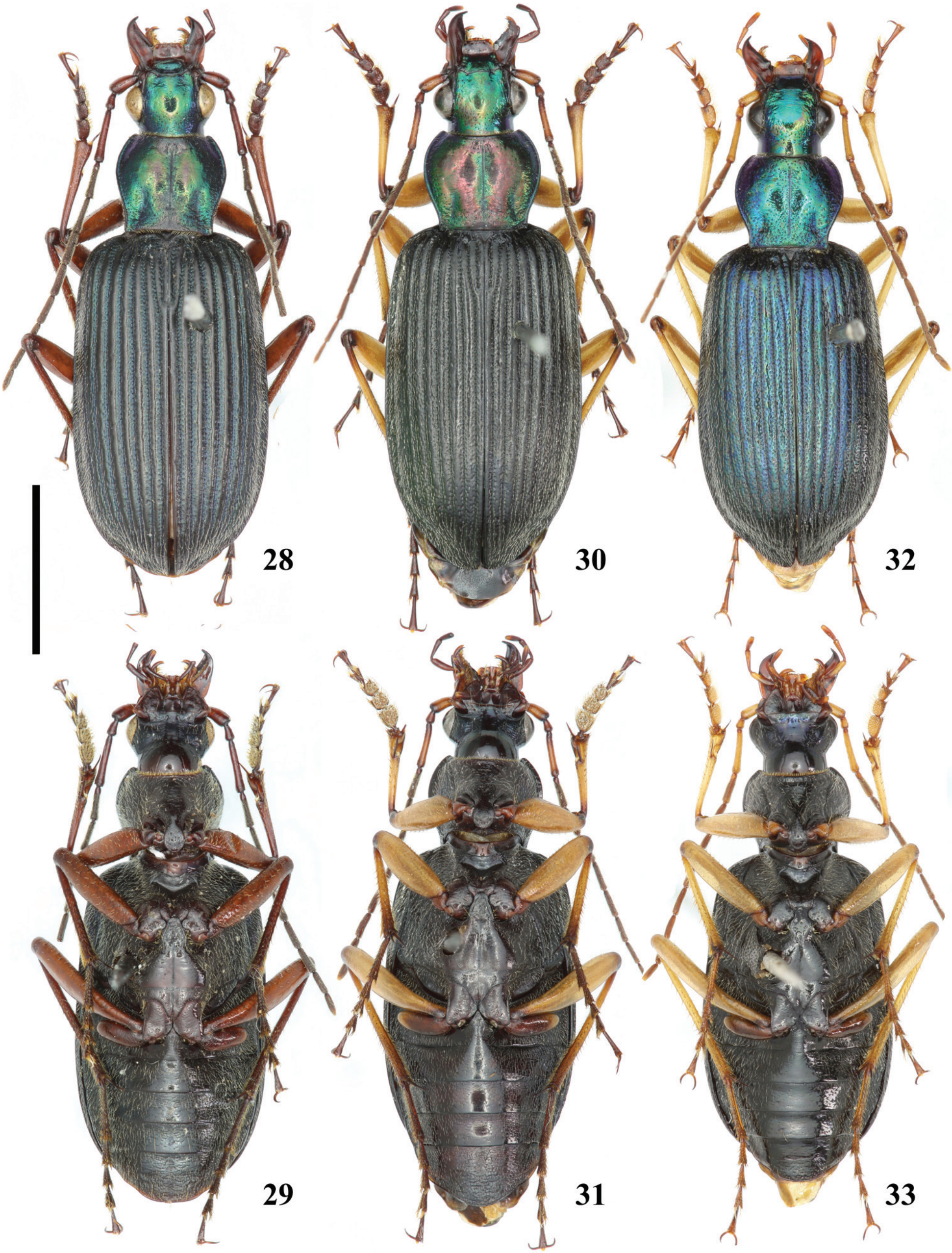
Members of this species are most similar to those of *C. wrasei* in shape of antennomere 1 and elytral pubescence, but differ from the latter in color of antennomere 1 (paler than antennomere 3 in *C. chuanqianensis*, antennomeres 1 and 3 concolorous in *C. wrasei*) and orientation of the apical lamella of the aedeagus of males (straight in *C. chuanqianensis*, bent ventrally in *C. wrasei*).

They are also similar to *C. leishanensis* members in pubescence of elytral intervals, but different from the latter in having yellow tibiae (black or dark brown in *C. leishanensis*), and males have a thin aedeagal lamella of the aedeagus (lamella thick in *C. leishanensis* males).

Chlaenius (*Lithochlaenius*) *linwensini* Liu & Liang, sp. n.

urn:lsid:zoobank.org:act:EE7D65D7-2C84-497B-AA28-F62D7DACD5E7
http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_linwensini
Figs 18–19, 53, 67, 81, 96–97, 119–120, 158

Types. Holotype: male (IZCAS), "Fujian, Jianyang, Huangkeng, Guiling, 270–340m""/ ""1960.III.26, Zhang Yiran collector""/ ""Holotype, *Chlaenius* (*Lithochlae-*



Figures 28–33. *Chlaenius* (*Lithochlaenius*) spp **28** *C. noguchii* Bates, male, in IZCAS, dorsal view **29** *C. noguchii* Bates, male, in IZCAS, ventral view **30** *C. wrasei* Kirschenhofer, male, in IZCAS, dorsal view **31** *C. wrasei* Kirschenhofer, male, in IZCAS, ventral view **32** *C. agiloides* Jedlička, male, in IZCAS, dorsal view **33** *C. agiloides* Jedlička, male, in IZCAS, ventral view. Scale line = 5.0 mm.

nius) *linwensini* Liu & Liang sp. n.""[red label]. Paratypes: Total 6 specimens. 1 male (IZCAS), "Fujian: Jianyang, Huangkeng, Guiling, 270–340m""/ ""1960.III.26, Zhang Yiran collector""; 1 female (IZCAS), "Fujian, Chong"an, Xingcun Sangang, 740m, light trap""/ "1960.VII.15, Zhang Yiran collector""; 1 female (IZCAS), "Fujian: Chong-an, San-gang""/ "1979.VIII.5, Song Shimei collector""; 1 male (SIECAS), "Fujian, Chong"an, Xingcun""/ "1960.VI.27, Jin Lin collector""; 1 male (SIECAS), "Fujian: Chong"an, Xingcun""; 1 male (IZCAS), "Fujian: Dehua, Chenguan, 510–550m""/ ""1960.VI.2, collector Ma Chenling"". Each paratype with an additional yellow label: "Paratype, *Chlaenius* (*Lithochlaenius*) *linwensini* Liu & Liang sp. n."".

Diagnosis. Antennomere 1 coniform (Fig. 53); all antennomeres concolorous; basal two-thirds of intervals 1–5 glabrous medially, with irregular setae laterally (Fig. 81); lamella of aedeagus subtruncate at apex (Fig. 119), thickened and bent ventrally (Fig. 120).

Description. Total length = 14.50–16.50 mm (mean = 15.71), width = 5.33–5.87 mm (mean = 5.60); HW = 2.40–2.85 mm (mean = 2.71), EYL = 1.00–1.15 mm (mean = 1.05), ratio Ant3/Ant1= 1.37–1.61 (mean = 1.50), PL/PW = 0.82–0.90 (mean = 0.86), EL/EW = 1.67–1.81 (mean = 1.76), EL/ PL = 1.27–1.41 (mean = 1.35).

Head and pronotum black, with green or coppery metallic luster; elytra black; ventral surface black; antennae, palpi, femora, and tibiae brown; mandibles, trochanters, and tarsi dark brown.

Head with vertex smooth medially, coarsely punctate and sparsely pubescent behind eye; labrum slightly emarginate at apex; antennomere 1 strongly coniform (Fig. 53). Pronotum with disk smooth medially, very sparsely punctate and pubescent along the middle line; lateral furrow very sparsely punctate; basal foveae small, deep, coarsely punctate and sparsely pubescent. Elytral intervals convex, basal two-thirds of intervals 1–5 glabrous medially, with irregularly arranged setae laterally (Fig. 81), apical one-third of intervals 1–5 sparsely pubescent medially, intervals 6–9 densely pubescent; striae deep, punctate; humeral angle obtuse (Fig. 67). Abdominal sterna IV–VI sparsely pubescent medially, densely pubescent laterally; sternum VII broadly rounded apically in male, narrowly truncate apically in female (Figs 96–97). Lamella of aedeagus truncate at apex (Fig. 119), thick and bent ventrally (Fig. 120).

Etymology. The Latinized name *linwensini* refers to Mr. Lin Wensin, an excellent insect collector who died during a recent collecting trip to Hainan, China.

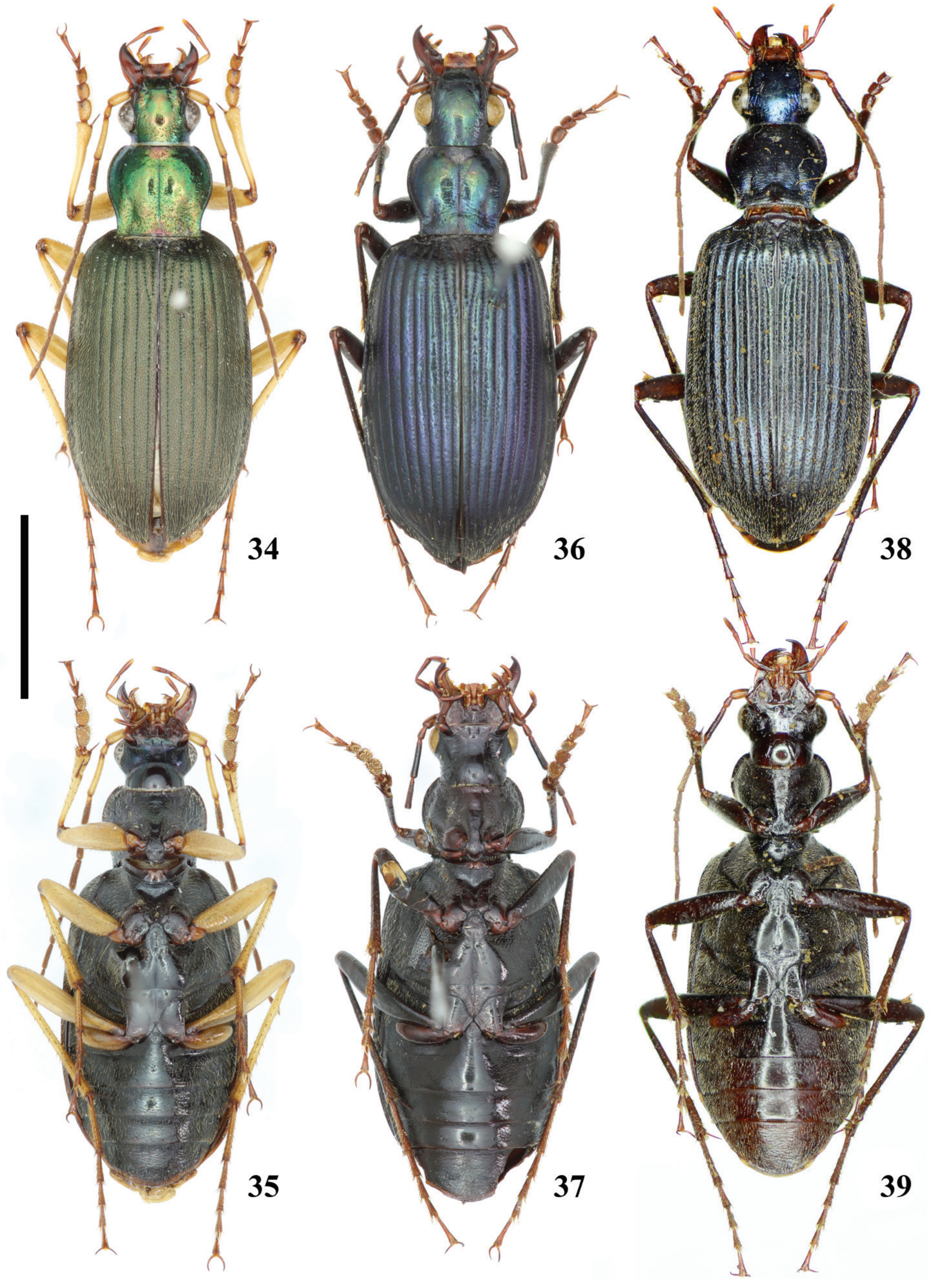
Geographical distribution. Fig. 158. Known only from Fujian Province, China.

Remarks. Mensural data cited in the description were obtained from the holotype and all paratypes.

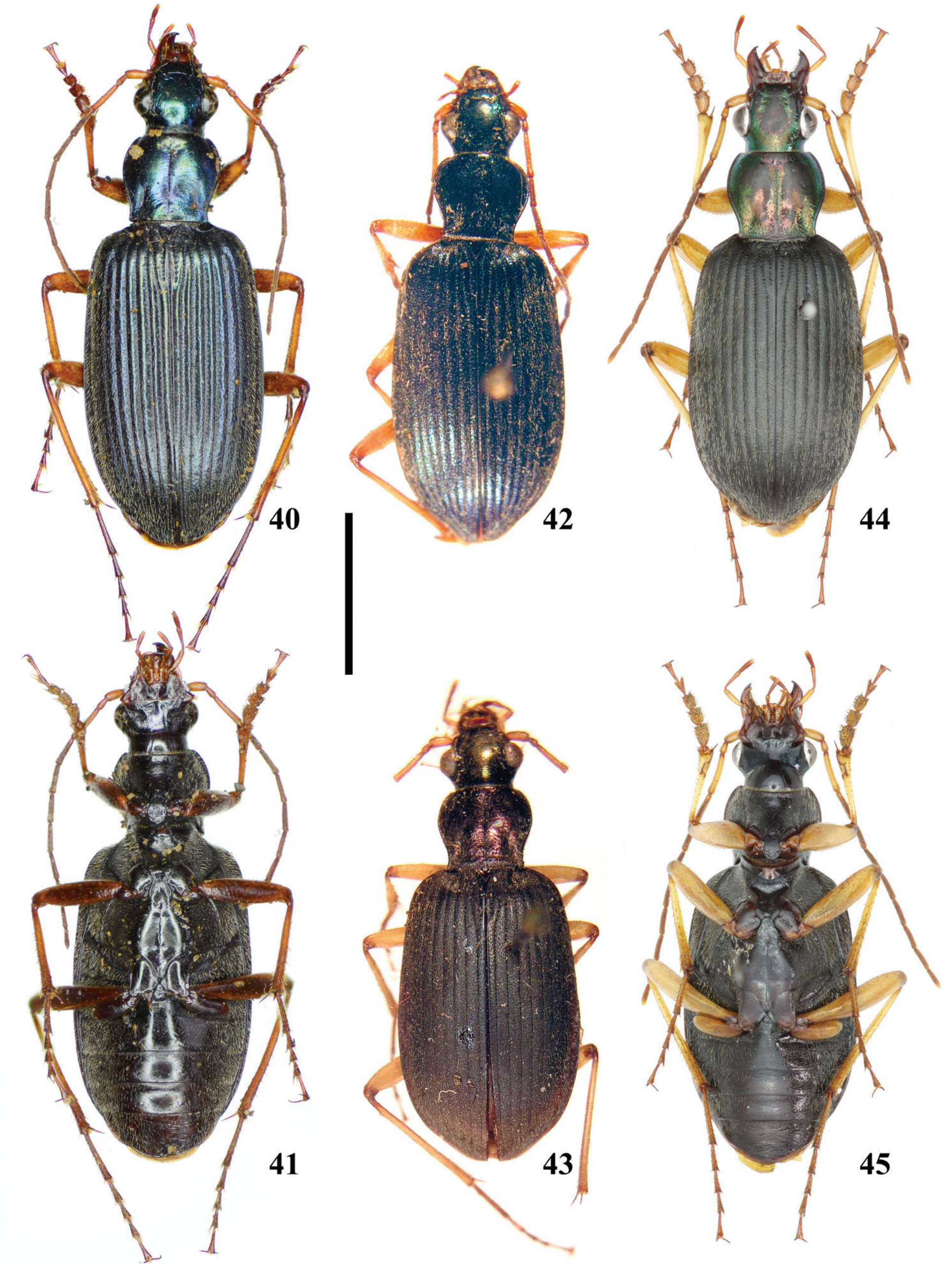
Male members of this species are similar to those of *C. formosensis* in the shape of the lamella of aedeagus, but males and females differ from those of the latter in having antennomere 1 coniform (cylindrical in *C. formosensis*), elytral intervals 6–7 pubescent throughout (glabrous medially in *C. formosensis*), and males have the aedeagus convex ventrally in the middle portion (straight in *C. formosensis* males).

***Chlaenius* (*Lithochlaenius*) *propeagilis* Liu & Kavanaugh, sp. n.**
urn:lsid:zoobank.org:act:0DB721CA-0192-49D6-BD14-A9320D1D574C
http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_propeagilis
Figs 14–15, 20–21, 54, 68, 82, 98–99, 121–122, 148, 158

Types. Holotype: male (IZCAS), "Southwest Yunnan, Gongshan, Dulongjiang, 0.5km N of Dizhengdang, 28.08442,98.32652"/ "1880 m, 2004.10.29, David Kavanaugh Coll."/ "Holotype *Chlaenius* (*Lithochlaenius*) *propeagilis* Liu & Kavanaugh sp. n." [red label]. Paratypes: Total 452 specimens (IZCAS, CASC): 1 male, "China, Yunnan Provin. Gongshan County, Cikai town, along street, N27°44'43", E98°39'53""/ "1500 m, 2006.5.5, Liang H.B, Ba Weidong"; 2 males, "China, Yunnan, Gongshan County, Cikai Township, Nu Jiang at Dashaba, N27.73845, E098.67092"/ "1430 m, 8–9 October 2002, Stop #DHK 2002–40, D.H. Kavanaugh, P.E. Marek & H.B. Liang collectors"; 17 males and 11 females, "China, Yunnan Provin. Gongshan County, Cikai town, Pulahe, N27°46'08", E98°39'12""/ "1510 m, 2002.9.21–24, Liang Hongbin, Ba Weidong"; 1 male and 1 female, "China, Yunnan, Gongshan, Cikai Township, 3.3 airkm NW of Gongshan above hydropower diversion dam, 1530 m"/ "N27.77175, E098.64924, 24 September 2002, Stop # DHK 2002–028, D.H. Kavanaugh collector"; 2 males, "China, Yunnan Prov. Gongshan, Cikai Town, Pulahe joint of Nujiang, 27.74843N, 98.66498E"/ "1530m, 2004.10.23, D. Kavanaugh, Dong D.Z."; 6 males and 6 females, "China, Yunnan Provin. Gongshan County, Cilou (Power Station), N27°46'14", E98°39'16""/ "1510m, 2002.5.6, Liang H.B, Ba Weidong, Yang Guodong, Li X.Q"; 5 males and 3 females, "China, Yunnan Provin. Gongshan County, Cikai town, Gazu Station, N27°44'35", E98°36'17""/ "1600–1750 m, 2002.5.5, Liang H.B, Ba Weidong"; 2 males, "China, Yunnan Provin. Gongshan County, Cikai town to Qiqi Station, N27.43086, E98.34150"/ "1700–2000m, 2002.4.29, Liang Hongbin, Ba W.D."; 7 males and 26 females, "China, Yunnan, Gongshan, Cikai Township, 3.0 airkm N of Gongshan on Pula He at hydropower diversion dam, 1500 m"/ "N27.77055°, E098.65446°, 24 September 2002, Stop # DHK 2002–027, D.H. Kavanaugh, P.E. Marek & D.Z. Dong collectors"; 3 males and 4 females (CASC), "CHINA, Yunnan Province, Gaoligong Shan, Nujiang Prefecture, Gongshan County, Qiqi He just above hydroelectric plant, 1500m"/ "N27.75748°, E98.66073°, 22 July 2000, Stop #00–269, D.H. Kavanaugh, Liang H.-B., & Dong D.-Z. collectors"; 2 males and 4 females, "China, Yunnan, Gongshan, Bingzhongluo Township, 34km N of Gongshan at junction of Shuangla He and Nu Jiang, 1550m"/ "E27.96918°, E098.66198°, 25 September 2002, stop # DHK 2002–039, D.H. Kavanaugh, P.E. Marek & D.Z. Dong collectors"; 4 males and 6 females, "China, Yunnan Prov. Gongshan, Bingzhongluo, Shuangla He, beach, 27.96817N, 98.66187E"/ "1520 m, 2004.10.22, D. Kavanaugh collector"; 12 males and 10 females, "China, Yunnan, Gongshan, Bingzhongluo, Shuanglahe, riverside, N27°58'59", E98°39'15""/ "1588 m, 2002.9.22–26, Liang H.B. Li Xiangqian"; 2 males and 5 females, "China, Yunnan, Gongshan, Bingzhongluo, Shuanglahe, riverside, N27°58'59", E98°39'15""/ "1588 m, 2002.7.20, Ba Weidong"; 5 males and 2 female, "China, Yunnan Prov. Gongshan, Dulongjiang, 0.5 km N of Dizhengdang, 28.08442N, 98.32652E"/ "1880 m, 2004.10.29; D. Kavanaugh, Dong D.Z."; 7 males and 4 females, "China, Yunnan Provin. Gongshan County, Dulongjiang, Kongdang, headlamp, 27.87764N, 98.33618E"/ "1510m, 2006.8.27, David Kavanaugh"; 12 males and 17 females, "China, Yunnan Provin. Gongshan, Dulongjiang, Xianjiudang village, 27.94092N, 98.33340E"/ "1580m, 2004.11.4, D. Kavanaugh, Dong D.Z.";1 male, "China, Yunnan, Fugong County, Shangpa Town, west bank of Nu Jiang, 1185 m, N26.90668, E098.86339"/ "13 October 2002, Stop #DHK 2002–047, D.H. Kavanaugh, P.E. Marek & H.B. Liang, D.Z. Dong collectors"; 5 males and 3 females, "China, Yunnan Prov. Fugong, Shangpa Town, Nujiang, River, 26.90650N, 98.86397E"/ "1175 m, 2004.4.20, Liang H.B. coll."; 9 males and 4 females, "China, Yunnan Prov. Fugong, Shangpa Town, Beach of Nujiang, 26.90650N, 98.86397E"/ 1175 m, 2005.8.20, Liang H.B. Zhang J.F. Dong D.Z."; 7 males and 5 females, "China, Yunnan Prov. Fugong, Shangpa Town, Mugujia, riverside, 26.86203N, 98.87142E"/ 1177 m, 2005.8.22, Dong Dazhi collector"; 1 male and 2 females, "China, Yunnan Prov. Fugong, Shangpa, Mugujia, round waterfall, 26.86203N, 98.87142E"/ 1177 m, 2005.8.22, Liang H.B. Zhang J.F."; 1 female, "China, Yunnan, Fugong, Lumadeng Township, 2km airkm S of Aludi on Nu Jiang, 1245 m, N27.09037, E098.87359"/ "20 September 2002, Stop # DHK 2002–022, D.H. Kavanaugh & H.B. Liang collectors"; 1 female, "China, Yunnan Prov., Fugong, Pihe at junction of Nujiang River, 26.53177N, 98.89753E"/ "1060 m, 2004.4.20, D. Kavanaugh, C. Griswold"; 2 males and 6 females, "China, Yunnan, Lushui, Liuku, west bank of Nu Jiang, 960 m, N25.854, E098.852/ "15 October 2002, stop # DHK 2002–050, D.Z. Dong collector"; 1 male and 2 females, "China, Yunnan Provin. Lushui, Beach of Nujiang River, under stone, N25°51'20", E98°50'58""/ 800 m, 2002.9.19, Liang Hongbin"; 2 males and 2 females (CASC), "CHINA, Yunnan Province, Gaoligongshan Mountains, Nujiang Prefecture, Lushui County, Salween River, 17 km N of Liuku, 970m"/ "25°58.7'N/98°50.4'E, 21 October 1998, Stop #98–120, D.H. Kavanaugh & C.-L. Long collectors"; 2 females (CASC), "CHINA, Yunnan Province, Nujiang Prefecture, Lushui County, Liuku Township, Liuku, 800m"/ "25.86010°N, 98.85155°E, 25–26 June 2000, Stop #00–7, D.H. Kavanaugh & Liang H.-B. collectors"; 4 males and 5 females (CASC), "CHINA, Yunnan Province, Nujiang Prefecture, Lushui County, San jiang Township, Nu Jiang, 790m"/ "25.72964°N, 98.87180°E, 26 June 2000, Stop #00–9, D.H. Kavanaugh & Liang H.-B. collectors"; 7 male and 7 females, "China, Yunnan Prov. Baoshan, Longyang, Bawan, Dongfengqiao, 24.98742N, 98.87047E"/ "670 m, 2005.6.1, D. Kavanaugh, Dong D.Z."; 15 male and 16 females, "China, Yunnan Prov. Baoshan, Longyang, Bawan, Dongfengqiao, 24.98535N, 98.87382E"/ "670 m, 2005.5.29–6.1, Liang H.B. Dong D.Z."; 1 male, "China, Yunnan Prov. Tengchong, Mangbang, Longwenqiao, 25.02329N, 98.67710E"/ "1290 m, 2006.6.5, Liang H.B. Hu P."; 6 males and 7 females, "China, Yunnan Prov. Tengchong, Mangbang, Longwenqiao, beach, 25.02396N, 98.67675E"/ "1285 m, 2006.6.5, David Kavanaugh"; 3 males and 1 female, "China, Yunnan Province, Tengchong, Shangying, N25°02'29.7", E98°40'22.9"" / "1335 m, 2003.10.19, Liang H.B, Shi X.C."; 2 males and 8 females, "China, Yunnan Prov. Tengchong Co., Wuhe Town, Longjiangqiao, 24.89499N, 98.67510E"/ "1205 m, 2005.V.24, Kavanaugh D. Dong D.Z."; 1 female, "China, Yunnan Province, Tengchong, Wuhe Township, Longjiang Bridge on Longchuanjiang"/ "N24.89889, E098.67667, 1215 m, 28 October 2003, under rocks, Dong D.Z. collector"; 17 males and 9 females, "China, Yunnan Prov. Tengchong, Wuhe, Longjiangqiao, beach, 24.89176N, 98.67551E"/ "1230 m, 2006.6.3, Kavanaugh D. Brett R."; 4 males and 4 females, "China, Yunnan Prov. Tengchong Co., Wuhe Town, Longjiangqiao, 24.89284N, 98.67439E"/ "1210 m, 2005.V.24, Liang H.B. Yang J.L"; 1 male, "China, Yunnan Prov. Tengchong, Wuhe, Longjiangqiao, beach, 24.89293N, 98.67489E"/ "1220 m, 2006.6.3, Liang H.B. Hu P."; 3 males, "China, Yunnan Province, Tengchong Co. Qushi Township, Shuang He Cun, N25.32555, E098.60861"/ "1464 m, 21 October 2003, under rocks, Dong D.Z. collector"; 2 males, "China, Yunnan Prov. Tengchong, Qushi, Xiangyangqiao, beach, 25.21221N, 98.57836E"/ "1500 m, 2006.V.24, David Kavanaugh"; 2 females, "China, Yunnan Prov. Tengchong, Qushi, Xiangyangqiao, beach, 25.23939N, 98.62723E"/ "1440 m, 2006.V.24, David Kavanaugh"; 11 males and 14 females (CASC), "CHINA, Yunnan Province, Gaoligongshan Mountains, Baoshan Prefecture, Tengchong County, Longchuan River at Longkou village"/ "25°16.9'N, 98°35.5'E, 1500 m, 25 October 1998, Stop #98–126, D.H. Kavanaugh, C.E. Griswold, & C.-L. Long collectors"; 6 males and 1 female, "China, Yunnan Prov. Tengchong, Qushi, Longkou, beach, 25.28175N, 98.59246E"/ "1500 m, 2006.6.6, David Kavanaugh"; 5 males and 1 female (CASC), "CHINA, Yunnan Province, Gaoligongshan Mountains, Baoshan Prefecture, Tengchong County, Longchuan River at Longkou village"/ "25°16.9'N, 98°35.5'E, 1500 m, 2 November 1998, Stop #98–128, D.H. Kavanaugh, C.E. Griswold, C.-L. Long, R. Li, & H.-X. He collectors"; 3 males and 5 females, "China, Yunnan Prov. Tengchong, Qushi, Qinqiao, 25.27236N, 98.60093E"/ "1460 m, 2006.6.2–6, David Kavanaugh, Brett R."; 4 males and 4 females, "China, Yunnan Province, Tengchong, Zhoujiapo Village, N25.33222, E098.67611"/ "1740 m, 24 October 2003, under rocks Dong D.Z. collector"; 3 males, "China, Yunnan Prov. Tengchong, Jietou, Yonganqiao, beach, 25.32502N, 98.70459E"/ "1470 m, 2006.V.24, Liang H.B."; 2 males and 1 female, "China, Yunnan Prov. Tengchong, Jietou, Yonganqiao, beach, 25.32504N, 98.60959E"/ "1470 m, 2006.5.24, Kavanaugh D. Brett R."; 1 male, "China, Yunnan Prov. Tengchong, Hehua, Dengma, on beach, 24.92346N, 98.38612E"/ "1105 m, 2006.6.2, Kavanaugh D. Brett R."; 3 males and 1 female, "China, Yunnan Province, Jingping Co., Mengla Town, Mengla-daqiao, River side 22°39'45.7",103°04'44.7""/ "312m, 2003.12.15, day, Liang H B, Boris Kataev Colls."; 12 males and 10 females (IZCAS), "Yunnan, Jingdong, 1100m"/ "1982.IV.29–V.2, Yu P.Y.& Liao S.B."; 1 female, "Yunnan, Honghe Prefecture, Lvchun, Huanglianshan, 2009.V. 16, Bai X. X. coll." 2 males and 1 female, "Yunnan, Menglun, Xishuanbanna Botanical Garden", "2005.5.22, light trap, Zheng Guo leg."; 3 males and 5 females, "China, Sichuan, Yajiang, Hekou Town, Shabeihou, Yalongjiang, N30.00020,E101.01526"/ "2583m, 2009.5.27–28,



Figures 34–39. *Chlaenius* (*Lithochlaenius*) spp **34** *C. rambouseki* Lutshnik, male, collected from Ussuri region, in IZCAS, dorsal view **35** *C. rambouseki* Lutshnik, male, collected from Ussuri region, in IZCAS, ventral view **36** *C. anchomenoides* Bates, cotype, male, in BMNH, dorsal view **37** *C. anchomenoides* Bates, cotype, male, in BMNH, ventral view **38** *C. nuristanus* Jedlička, paratype, male, in MNHN, dorsal view **39** *C. nuristanus* Jedlička, paratype, male, in MNHN, ventral view. Scale line = 5.0 mm.



Figures 40–45. *Chlaenius* (*Lithochlaenius*) spp **40** *C. nuristanus* a. *rubridipes* Jedlička, paratype, male, in MNHN, dorsal view **41** *C. nuristanus* a. *rubridipes* Jedlička, paratype, male, in MNHN, ventral view **42** *C. agiloides* Jedlička, holotype, male, in NMPC, dorsal view **43** *C. formosanus* Jedlička, holotype, male, in NMPC, dorsal view **44** *C. rambouseki* Lutshnik, from Taiwan, male, in IZCAS, dorsal view **45** *C. rambouseki* Lutshnik, from Taiwan, male, in IZCAS, ventral view. Scale line = 5.0 mm.

Liang H.B."; 1 female (IZCAS), "China, Tibet, Bomi Yi"ong, Tangmai bridge, Beach of Yi"ong Zangbo, 30.09633N, 95.06577E"/ "2035m, 2006.8.30 N, Liang H.B., Song Z.S.". Each paratype with an additional yellow label: "Paratype *Chlaenius* (*Lithochlaenius*) *propeagilis* Liu & Kavanaugh sp. n."

Diagnosis. Antennomere 1 elongate ovoid (Fig. 54); color of antennomeres 1–3 lighter than antennomeres 4–11; intervals 1–5 almost glabrous medially, with one or two rows of pubescence at each lateral side, more evenly pubescent near apex (Fig. 82); apical lamella of aedeagus moderately triangular (Fig. 121), thick and reflexed in lateral view (Fig. 122).

Description. Total length = 15.50–17.00 mm (mean = 15.71), width = 5.60–6.13 mm (mean = 5.81); HW = 2.75–2.95 mm (mean = 2.82), EYL = 1.00–1.15 mm (mean = 1.09), ratio Ant3/Ant1 = 1.73–1.93 (mean = 1.81), PL/PW = 0.78–0.85 (mean = 0.83), EL/EW = 1.62–1.79 (mean = 1.73), EL/ PL = 1.29–1.45 (mean = 1.36).

Head and pronotum black with green or coppery metallic luster; elytra black; ventral surface black, with some slight metallic reflection; coxae almost black; mandibles dark brown; antennomeres 4–11, palpomere, trochanters, tibiae at both ends, and tarsomeres reddish or brown; antennomeres 1–3, femora and middle portions of tibiae yellow or yellowish-brown.

Head rugose near eyes and occiput, vertex sparsely rugose; eyes prominent; antennomere 1 elongate–ovoid (Fig. 54); labrum concave at apex, with distinct microsculpture; mentum tooth emarginate apically.

Pronotum cordate, moderately convex; lateral margins bordered; disk almost smooth, sparsely rugose and setose near base and lateral margins; basal foveae moderately deep.

Elytra widest at mid-length; humeral angle obtuse (Fig. 68); striae deep, punctate; intervals moderately convex, intervals 1–5 almost glabrous medially, with a row of pubescence laterally, intervals more evenly pubescent near apex (Fig. 82); intervals 6–9 pubescent throughout and with intervals 7–9 more densely pubescent than 6.

Abdominal sterna bordered, densely pubescent laterally; sterna IV–VI sparsely pubescent medially; sternum VII rugose–pubescent, with apex narrowly rounded or subobtuse in males (Fig. 98), more broadly rounded in female (Fig. 99).

Apical lamella of aedeagus moderately triangular (Fig. 121), thick and bent ventrally (Fig. 122). Gonostylus (Figs 14–15).

Etymology. The Latinized name *propeagilis* refers to the similarity of members of this species to those of *C. agilis*.

Geographical distribution. Fig. 158. Known only from southeastern Tibet and Yunnan Province, China.

Remarks. Mensural data cited in the description were based on measurements obtained from 5 males and 5 females selected for maximum variation.

Specimens of *Chlaenius* (*Lithochlaenius*) collected from western Yunnan were initially determined as *Chlaenius agilis* Chaudoir. However, after comparison of the male genitalia with those of type specimens of *C. agilis*, we are convinced that they represent a distinct new species. Males differ from those of *C. agilis* in having the median lobe of aedeagus gradually bent near the base in lateral view (Fig. 122), whereas *C. agilis* males have the median lobe abruptly bent with a depression near the base (Fig. 124).

This species is clearly very closely related to *C. agilis*. At present, the known ranges of these two species are broadly disjunct (Fig. 158). We know of no locality records for any *Chlaenius* (*Lithochlaenius*) species from the intervening area (i.e., between northcentral India and southeastern Tibet and western Yunnan Province. Whether this distributional gap represents a real disjunction or is only an artifact of inadequate collecting in the area to date can only be determined from additional sampling efforts in the region. It would be particularly informative to determine whether or not any populations representing the *propeagilis/agilis* lineage occur in the region and, if so, whether or not males display intermediate genitalic traits.

***Chlaenius* (*Lithochlaenius*) *agilis* Chaudoir**

http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_agilis
Figs 22–23, 36–41, 46–49, 55, 62–64, 69, 76–78, 83, 90–92, 100, 113–115, 123–124, 138–143, 147, 158

Chlaenius latro LaFerté-Sénectère, 1851:250 (unavailable). Nomen nudum **stat. n.**
Chlaenius agilis Chaudoir, 1856:246; 1876:193; Kryzhanovskij, 1976:12
Chlaenius anchomenoides Bates, 1889:212; Kirschenhofer, 1997:116; Kirschenhofer, 2005:490. **syn. n.**
Chlaenius nuristanus Jedlička, 1956:194; Kirschenhofer, 2005:490. **syn. n.**
Chlaenius nuristanus a. *rubridipes* Jedlička, 1956:194 (not available, ICZN Articles 10A and 45.6.2).
Stenochlaenius anchomenoides Bates: Mandl, 1972:104

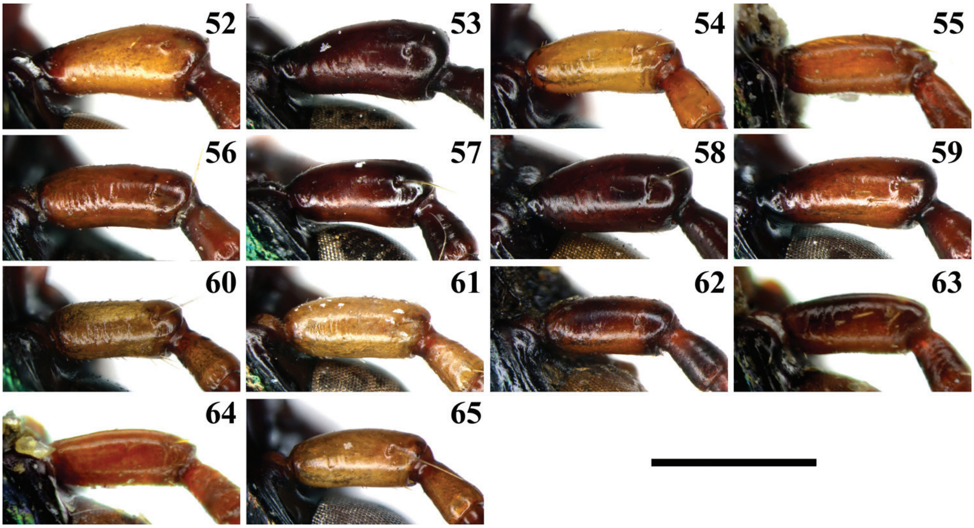
Specimens examined. Total 15 specimens. **India:** type: male (MNHN), "*agilis* Chaud, Ind. orient bor. C. Boys."/ "TYPE *agilis*"/ "Ex Musaeo Chaudoir"/ "agilis Chd"; Cotype: female (MNHN), "*agilis* Chaud, Ind. orient bor. C. Boys."/ "TYPE agilis"/ "Ex Musaeo Chaudoir"/ "agilis Chd" ; Cotype: male (MNHN), "*agilis* Chaud, Ind. orient bor. C. Boys."/ "*latro*"; 2 males and 3 females (CASC), "Bajaura, Kongra district (Indes Angl.)"/ "G. Babault, Juin 1914"/ "van Dyke collection"/ "*Chlaenius agilis*, Chaud., H.E. Andrewes det.". 1 female (CASC), "W. Almora Divn, Kumaon U.P., Apr. 1917, HGC."/ "Van Dyke Collection". **Pakistan:** Cotype: 2 males (BMNH), "Goorais valley, 7000ft, V. 87"/ "H. E. Andrews Coll. B. M. 1945–97"/ "Ex coll. R. Oberthür"/ "*Chlaenius anchomenoides* Bates, cotype, H. E. Andrews det."/ "Co-type". **Afghanistan**: 1 female (MNHN), "J. Klapperich, Bashgultal, 1100m, Nuristan, 22.4.53, Afghanistan"/ "*Chlaenius nuristanus* sp. n, det. ING. JEDLICKA"/ "Type";

Figures 46–51. Labels of *Chlaenius* (*Lithochlaenius*) spp **46** holotype, *Chlaenius agilis* Chaudoir (see Figs 22–23) **47** Cotype, *C. anchomenoides* Bates (see Figs 40–41) **48** Paratype, *C. nuristanus* Jedlička (see Figs 42–43) **49** Cotype, *C. nuristanus* Jedlička (see Figs 44–45) **50** Holotype, *C. agiloides* Jedlička (see Fig 48 **51** Holotype, *C. formosanus* Jedlička (see Fig 49).

Paratype: 2 males (MNHN), "J. Klapperich, Asmar, 900m, Kunartal, 3.4.53, O-Afghanistan"/ "*Chlaenius nuristanus* sp.n, det. ING. JEDLICKA"/ "PARATYPE"; Type: 1 male (MNHN), "J. Klapperich, Asmar, 900m, Kunartal, 3.4.53, O-Afghanistan"/ "*Chlaenius nuristanus* a. *rubridipes* n. det. ING. JEDLICKA"/ "TYPUS"; Cotype: 1 male (MNHN), "J. Klapperich, Asmar, 900m, Kunartal, 3.4.53, O-Afghanistan"/ "*Chlaenius nuristanus* a. *rubridipes* n. det. ING. JEDLICKA"/ "Cotype".

Diagnosis. Antennomere 1 elongate ovoid (Figs 55, 62–64); basal two-thirds of intervals 1–5 glabrous medially, with one row of pubescence laterally near striae (Figs 83, 90–92); aedeagus abruptly bent near base (Figs 124, 139, 141, 143).

Description. Total length = 15.50–16.00 mm (mean = 15.50), width = 5.60–6.10 mm (mean = 5.73); HW = 2.75–2.95 mm (mean = 2.82), EYL = 1.00–1.15 mm (mean =1.00), ratio Ant3/Ant1 = 1.67–1.83 (mean = 1.71), PL/PW = 0.84–0.85 (mean = 0.85), EL/EW = 1.63–1.73 (mean = 1.71), EYL/ PL = 1.15–1.44 (mean = 1.34). Mensural data cited in the description were obtained from type and cotype specimens examined.



Figures 52–65. Antennomere 1 of *Chlaenius* (*Lithochlaenius*) species **52** *C. chuanqianensis* sp. n., holotype **53** *C. linwensini* sp. n., holotype **54** *C. propeagilis* sp. n., holotype **55** *C. agilis* Chaudoir, holotype **56** *C. formosensis* Lorenz, CCCC **57** *C. leishanensis* Kirschenhofer, IZCAS **58** *C. noguchii* Bates, IZCAS **59** *C. wrasei* Kirschenhofer, IZCAS **60** *C. agiloides* Jedlička, IZCAS **61** *C. rambouseki* Lutshnik from Ussuri region, IZCAS **62** *C. anchomenoides* Bates, paratype **63** *C. nuristanus* Jedlička, paratype **64** *C. nuristanus* a. *rubridipes* Jedlička, paratype **65** *C. rambouseki* Lutshnik from Taiwan, CCCC. Scale line = 1.0 mm.

Head, pronotum and elytra black, with green or blue metallic luster; ventral surface black; mandibles and trochanters dark brown; palpomeres, femora, and tarsomeres brown to dark brown; antennae and tibiae yellow to brown (Figs 22–23, 36–41).

Head with vertex smooth or very sparsely punctate behind eyes; antennomere 1 elongate ovoid (Figs 55, 62–64); labrum slightly emarginate at apex. Pronotum with disk smooth; basal foveae deep, sparsely punctate and pubescent (Figs 22, 36, 38, 40). Elytra with intervals convex, basal two-thirds of intervals 1–5 glabrous medially, with one row of pubescence laterally near striae (Figs 83, 90–92), intervals 6–9 and apical one-third of intervals 1–5 densely pubescent; striae deep, punctate; humeral angle obtuse (Figs 69, 76–78). Abdominal sterna IV–VI sparsely pubescent medially; sternum VII rugose–pubescent, narrowly rounded apically in males (Figs 100, 113–114), broadly rounded apically in females (Fig. 115). Aedeagus abruptly bent near base, apical lamella round (Figs 123, 138, 140, 142), thin and slight bent ventrally (Figs 124, 139, 141, 143).

Color variation. Color of antennae, palpomeres, femora, and tibiae varied from medium brown to dark brown or even black among different individuals (Figs 22–23, 36–41).

Geographical distribution. Fig. 158. Known only from eastern Afghanistan, Pakistan, and northern India.

Remarks. Mensural data cited in the description were obtained from type and cotype specimens examined. The name *Chlaenius agilis* Chaudoir was once treated as a junior synonym of *Chlaenius latro* LaFerté–Sénectère (Csiki 1931, Kirschenhofer

1997). However, in his work, LaFerté–Sénectère (1851) did not provide a specific description of *Chlaenius latro*. This means that *Chlaenius latro* LaFerté–Sénectère is a *nomen nudum*, and therefore, unavailable.

Kirschenhofer (2005) considered *Chlaenius nuristanus* Jedlička to be a junior synonym of *Chlaenius anchomenoides* Bates. We have examined the types and/or cotypes of *C. agilis* Chaudoir, *C. anchomenoide*s, *C. nuristanus* and its aberration *C. nuristanus* a. *rubridipes*, and found no significant differences between them, except for variation in the color of antennae and legs. The aedeagi are abruptly bent near the base in all dissected males (Figs 124, 139, 141, 143).

Mandl (1972:104) assigned *Chlaenius anchomenoides* to genus *Stenochlaenius*. Based on the pubescent elytral intervals and incomplete elytral basal margin in members of *C. anchomenoides*, we do not agree with this assignment.

***Chlaenius* (*Lithochlaenius*) *formosensis* Lorenz**

http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_formosensis
Figs 24–25, 56, 70, 84, 101–102, 125–126, 158

Chlaenius noguchii formosanus Habu, 1965:86 (*nec* Jedlička, 1935:5)
Chlaenius formosanus: Morita, 1993:161
Chlaenius formosensis Lorenz, 1998:339 (replacement name); Kirschenhofer, 2005:491

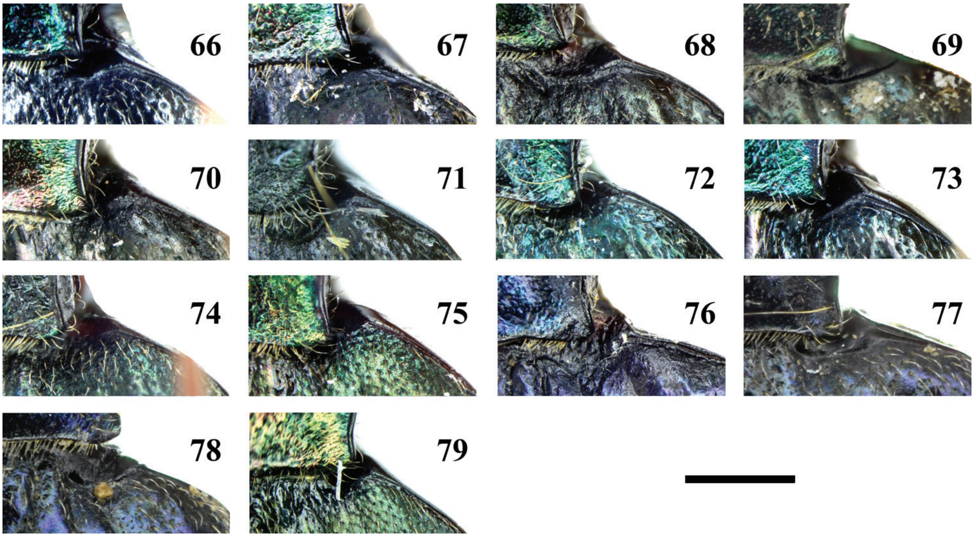
Specimens examined. Total 24 specimens: **China:** 8 males and 12 females (CCCC), "Taiwan Prov., Hsinchu, Wufeng, 1996.08.03, Chen C.C. coll."; 3 males and 1 female (CCCC), "Taiwan Prov., Hsinchu, Wufeng, 1998.4.11, Chen C.C. coll.

Diagnosis. Antennomere 1 cylindrical (Fig. 56); antennomeres 1–3 brown; intervals 1–7 convex, glabrous medially, with one row of pubescence laterally (Fig. 84); apex of sternum VII rounded (Figs 101–102); lamella of aedeagus slightly truncate at apex (Fig. 125), thick, bent ventrally (Fig. 126).

Description. Total length = 16.0–17.0 mm (mean = 16.45), width = 5.87–6.40 mm (mean = 5.99); HW = 2.90–3.00 mm (mean = 2.96), EYL = 1.10–1.15 mm (mean = 1.12), ratio Ant3/Ant1 = 1.71–1.88 (mean = 1.76), PL/PW = 0.81–0.88 (mean = 0.85), EL/EW = 1.68–1.86 (mean = 1.76), EL/ PL = 1.32–1.48 (mean = 1.39).

Head and pronotum black, with green or coppery metallic luster; elytra black; ventral surface black; mandibles, trochanters, and tarsomeres dark brown; antennae, palpomeres, femora, and tibiae yellow to brown.

Head with vertex nearly glabrous, very sparsely punctate and pubescent near eyes; Antennomere 1 cylindrical (Fig. 56); labrum slightly emarginate at apex. Pronotum with disk convex, nearly smooth, glabrous; basal foveae small, deep, finely punctate, sparsely pubescent. Elytra with intervals convex, intervals 1–7 glabrous medially, with a row of pubescence laterally near striae (Figs 24, 84), intervals 8 and 9 with decumbent pubescence throughout; striae deep, punctate; humeral angle obtuse (Fig. 70). Abdominal sterna IV-VI nearly glabrous medially, densely pubescent laterally; sternum



Figures 66–79. Humeral region of elytra of *Chlaenius* (*Lithochlaenius*) spp **66** *C. chuanqianensis* sp. n., holotype **67** *C. linwensini* sp. n., holotype **68** *C. propeagilis* sp. n., holotype **69** *C. agilis* Chaudoir, holotype **70** *C. formosensis* Lorenz, CCCC **71** *C. leishanensis* Kirschenhofer, IZCAS **72** *C. noguchii* Bates, IZCAS **73** *C. wrasei* Kirschenhofer, IZCAS **74** *C. agiloides* Jedlička, IZCAS **75** *C. rambouseki* Lutshnik from Ussuri region, ZCAS **76** *C. anchomenoides* Bates, paratype **77** *C. nuristanus* Jedlička, paratype **78** *C. nuristanus* Jedlička, paratype **79** *C. rambouseki* Lutshnik from Taiwan, CCCC. Scale line = 1.0 mm.

VII broadly rounded at apex in both sexes (Figs 101–102). Aedeagus with lamella subtruncate at apex (Fig. 125), thick and bent laterally (Fig. 126).

Geographical distribution. Fig. 158. Known only from Taiwan.

Remarks. Mensural data cited in the description were based on measurements obtained from 5 males and 5 females selected for maximum variation.

This species was first described as a subspecies of *C. noguchii*. Later, Morita (1993) upgraded it to a distinct species. However, the name *C. formosanus* was preoccupied by another *Chlaenius* species of Jedlička, and therefore Lorenz (1998) renamed it *C. formosensis*.

Kirschenhofer (2005:491) considered *Chlaenius formosensis* Lorenz to be a junior synonym of *C. formosanus* Jedlička (= *Chlaenius rambouseki* Lutshnik, see below) with no comparison. Based on Habu"s original description (type unavailable according to Morita), named specimens of *C. formosensis* in Morita's collection (corresponding author and checked by HBL in 2009), and specimens in Chen Chanchin's collection, we treat *C. formosensis* as a distinct species. Its members differ from those of *C. rambouseki* in having the vertex of the head and pronotal disk glabrous (both sparsely punctate and pubescent in *C. rambouseki*), intervals 1–7 glabrous medially (wholly pubescent in *C. rambouseki*), and the male aedeagus stout (slender in *C. rambouseki*).

Chlaenius formosensis adults are similar to those of *C. noguchii* in elytra pubescence, but differ from the latter in having antennomere 1 cylindrical (coniform in *C. nogu-*

Figures 80–93. Elytral intervals of *Chlaenius* (*Lithochlaenius*) spp **80** *C. chuanqianensis* sp. n., holotype **81** *C. linwensini* sp. n., holotype **82** *C. propeagilis* sp. n., holotype **83** *C. agilis* Chaudoir, holotype **84** *C. formosensis* Lorenz, CCCC **85** *C. leishanensis*, IZCAS **86** *C. noguchii* Bates, IZCAS **87** *C. wrasei* Kirschenhofer, IZCAS **88** *C. agiloides* Jedlička, IZCAS **89** *C. rambouseki* Lutshnik from Ussuri region, IZCAS **90** *C. anchomenoides* Bates, paratype **91** *C. nuristanus* Jedlička, paratype **92** *C. nuristanus* Jedlička, paratype **93** *C. rambouseki* Lutshnik from Taiwan, CCCC. Scale line = 1.0 mm.

chii), pronotal disk smooth (finely punctate in *C. noguchii*), and male aedeagus stout (slender in *C. noguchii*).

Chlaenius (*Lithochlaenius*) *leishanensis* Kirschenhofer

http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_leishanensis
Figs 26–27, 57, 71, 85, 103–104, 127–128, 149, 158

Chlaenius leishanensis Kirschenhofer, 2005:490

Specimens examined. Total 14 specimens: **China:** 1 male and 1 female (IZCAS), "Guizhou Prov. Leigongshan, Fangxiang, 2005.6.2–3, 1000–1100m, Ge Deyan collector"; 1 female (IZCAS) "Guizhou Prov. Leigongshan, Fangxiang, 900m, 2005.5.31, Xu Fangling and Cao Lingzhen collectors"; 1 male (IZCAS), "Guizhou, Leigongshan, Xiaodanjiang, 920–970m, 2005.6.3, Yang Zaihua collector"; 1 female (HBUM), "Guizhou, Daozhen, Xiannvdong, 2004.8.24–26, Yang Xiujuan and Hua Huiran collector"; 1 female (HBUM), "Guangxi, Yuanbaoshan, Xiangfen, 2004.7.19, Yu Yang and Gao Chao collector"; 1 female (IZCAS), "Guangxi, Longsheng"/ "1980.VI.11 Song Shimei coll."; 1 male and 2 females (IZCAS), "Guangxi, Yangshuo, 1980.10"; 1 male and 2 females (IZCAS), "China, Hubei Prov. Shennongjia, Honghua Riverside, light trap, 31°24'20", 110°28'40""/ "835m, 2003.8.10, night, Liang Hongbin coll."; 1 female (IZCAS), "Beibei" [Chongqing] / ""1940.VIII.10".

Diagnosis. Antennomere 1 coniform (Fig. 57); color of antennomere 1 lighter than other antennomeres; basal half of intervals 1–5 glabrous medially, with pubescence laterally (Figs 26, 85); lamella of aedeagus rounded at apex (Fig. 127), thickened and bent ventrally (Fig. 128).

Description. Total length = 15.00–18.00 mm (mean = 16.50), width = 5.33–6.13 mm (mean = 5.78); HW = 2.55–3.00 mm (mean = 2.79), EYL = 0.95–1.10 mm (mean = 1.04), ratio Ant3/Ant1 = 1.53–1.73 (mean = 1.62), PL/PW= 0.80–0.89 (mean = 0.86), EL/EW = 1.64–1.89 (mean = 1.76), EL/ PL = 1.26–1.46 (mean = 1.35).

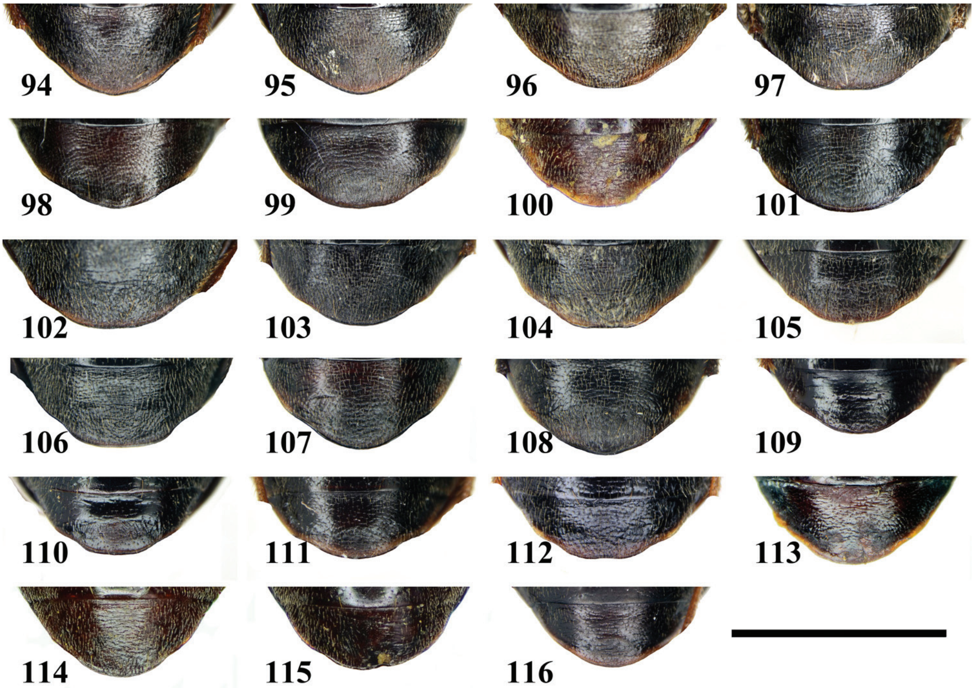
Head and pronotum black, with green or coppery metallic luster; elytra black; ventral surface black; antennomeres 2–11, palpomeres, trochanters, tibiae, and tarsomeres dark brown to black; antennae and femora yellow to light brown.

Head with vertex coarsely punctate and pubescent behind eyes; antennomere 1 coniform (Fig. 57); clypeus and labrum slightly emarginate at apex. Pronotum with disk smooth in most specimens, but sparsely punctate along middle line in a few specimens; basal foveae small, deep, pubescent, very sparsely punctate. Elytra with basal half of intervals 1–5 smooth and glabrous medially, pubescent laterally (Figs 26, 85), intervals 6–9 and apical portion of intervals 1–5 densely pubescent; striae deep, punctate; humeral angle rounded (Fig. 71). Abdominal sterna IV-VI sparsely pubescent medially, densely pubescent laterally, apex of sternum VII rounded in male (Fig. 103), nearly truncate in female (Fig. 104). Aedeagus stout, lamella rounded at apex (Fig. 127), thickened and bent laterally (Fig. 128).

Geographical distribution. Fig. 158. Known from Guangxi, Guizhou, Chongqing and Hubei Provinces, China.

Remarks. Mensural data cited in the description were obtained from all cited specimens.

Males of this species (Fig. 128) are similar to those of *C. formosensis* (Fig. 126) in form of the aedeagus in lateral view, but differ from the latter in having the lamellar apex rounded (Fig. 127; nearly truncate in *C. formosensis*, Fig. 125). Both males and females of *C. leishanensis* have elytral intervals 6–7 densely pubescent throughout, whereas *C. formosensis* adults have those intervals glabrous medially.



Figures 94–116. Abdominal sternum VII (ventral aspect) of *Chlaenius* (*Lithochlaenius*) species **94** *C. chuanqianensis* sp. n., male, holotype **95** *C. chuanqianensis* sp. n., female, paratype **96** *C. linwensini* sp. n., male, holotype **97** *C. linwensini* sp. n., female, paratype **98** *C. propeagilis* sp. n., male, holotype **99** *C. propeagilis* sp. n., female, paratype **100** *C. agilis* Chaudoir, male, holotype **101** *C. formosensis* Lorenz, male **102** *C. formosensis* Lorenz, female **103** *C. leishanensis* Kirschenhofer, male **104** *C. leishanensis* Kirschenhofer, female **105** *C. noguchii* Bates, male **106** *C. noguchii* Bates, female **107** *C. wrasei* Kirschenhofer, male **108** *C. wrasei* Kirschenhofer, female **109** *C. agiloides* Jedlička, male **110** *C. agiloides* Jedlička, female **111** *C. rambouseki* Lutshnik, from Ussuri region, male **112** *C. rambouseki* Lutshnik from Ussuri region, female **113** *C. anchomenoides* Bates, male, paratype **114** *C. nuristanus* Jedlička, male, paratype **115** *C. nuristanus* Jedlička, female, paratype **116** *C. formosanus* Jedlička from Taiwan, male. Scale line = 1.0 mm.

Chlaenius (*Lithochlaenius*) *noguchii* Bates

http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_noguchii
Figs 28–29, 58, 72, 86, 105–106, 129–130, 158

Chlaenius noguchii Bates, 1873:251; Chaudoir, 1876:192; Kryzhanovskij, 1976:12; Kirschenhofer, 1997:116; Kirschenhofer, 2005:491

Specimens examined. Total 47 specimens: **Japan:** 10 males and 11 females (IZCAS), "Shiga, Takashima, Biwa Lake, 2008.3.30, Liang H.B. coll."; 1 male and 1 female (IZCAS), "Yadorigi-zawa, Tanzawa, Kanagawa"; 1 male (IZCAS), "Sado-shima Island"/

Figures 117–130. Aedeagi of *Chlaenius* (*Lithochlaenius*) species **117** *C. chuanqianensis* sp. n., holotype (dorsal view) **118** *C. chuanqianensis* sp. n., holotype (left lateral view) **119** *C. linwensini* sp. n., holotype (dorsal view) **120** *C. linwensini* sp. n., holotype (left lateral view) **121** *C. propeagilis* sp. n., holotype (dorsal view) **122** *C. propeagilis* sp. n., holotype (left lateral view) **123** *C. agilis* Chaudoir, holotype (dorsal view) **124** *C. agilis* Chaudoir, holotype (left lateral view) **125** *C. formosensis* Lorenz, holotype (dorsal view) **126** *C. formosensis* Lorenz, holotype (left lateral view) **127** *C. leishanensis* Kirschenhofer (dorsal view) **128** *C. leishanensis* Kirschenhofer (left lateral view) **129** *C. noguchii* Bates (dorsal view) **130** *C. noguchii* Bates (left lateral view). Scale lines: A = 1.0 mm (Figs 117, 119, 121, 123, 125, 127, 129); B = 0.5 mm (Figs 118, 120, 122, 124, 126, 128, 130).

"1968.VIII.20"; 2 males and 2 females (CASC), "Harima Japan May 1916"; 1 female (CASC), "Hozukyo Kyoto 1951.9.21"; 4 males and 2 females (CASC); "Kobe V-1912"/ "L. Gressitt Collector"; 1 female (CASC), "Kyoto, Yase, Oct. 21, 1951, Col. T. Horio"; 2 females (CASC), "Mimasaka Japan VII. J. E. Lewis"; 2 males and 2 females (CASC), "Mimasaka Japan VII-1912"/ "Coll. by J. C. Thompson"; 1 male and 1 female (CASC), " Nikko Japan VII.30.23"/ "ECVan Dyke collector"; 2 females (CASC), "Nikko Hondo Japan VII-1912"/ "Coll. by J. C. Thompson"; 1 female (CAS), Tokyo, Japan VI-6-31."/ "L. Gressitt Collector".

Diagnosis. Antennomere 1 coniform (Fig. 58); intervals 1–7 strongly convex, carinate, glabrous medially (Fig. 86).

Description. Total length = 14.50–16.00 mm (mean = 15.33), width = 5.07–5.60 mm (mean = 5.33); HW = 2.50–2.90 mm (mean = 2.67), EYL = 1.00–1.10 mm (mean = 1.02), ratio Ant3/Ant1 = 1.56–1.88 (mean = 1.72), PL/PW = 0.83–0.90 (mean = 0.86), EL/EW = 1.75–1.91 (mean = 1.80), EL/ PL = 1.29–1.40 (mean = 1.35).

Head and pronotum black with strong green or bluish green metallic luster; elytra black with very weak blue luster; ventral surface black; legs, antennae, mandibles and palpomere dark brown.

Head with vertex coarsely punctate behind eyes; antennomere 1 coniform (Fig. 58); clypeus and labrum nearly truncate at apex; mentum tooth emarginate. Pronotum with disk finely punctate, nearly glabrous; basal foveae deep, finely pubescent and punctate (punctations much smaller than those on vertex). Elytra with intervals strongly convex, intervals 1–7 carinate, smooth and glabrous medially, with a row of punctation laterally (Fig. 86), intervals 8–9 flat, densely pubescent and punctate; striae deep, punctate; humeral angle obtuse (Fig. 72). Abdominal sterna IV-VI sparsely pubescent medially; apex of sternum VII more distinctly truncate in female than in male (Figs 105–106). Aedeagus slender, flattened (Fig. 130), lamella broadened to the left side, asymmetric (Fig. 129), thin and bent ventrally (Fig. 130).

Geographical distribution. Fig. 158. Confirmed only from Japan.

Remarks. Mensural data cited in the description were based on measurements obtained from 5 males and 5 females selected for maximum variation.

This species may well be endemic to Japan, and its reported occurrence in Korea (Kwon and Lee 1986) and Vietnam (Paik et al. 2006) requires further clarification. The slender aedeagus of males of this species is very different from the stout aedeagi of other species of the *agilis* group.

Chlaenius (*Lithochlaenius*) *wrasei* Kirschenhofer

http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_wrasei
Figs 30–31, 59, 73, 87, 107–108, 131–132, 158

Chlaenius noguchii wrasei Kirschenhofer, 1997:116, 118
Chlaenius wrasei Kirschenhofer, 2005:491

Specimens examined. Total 41 specimens. **China:** 15 males and 6 females (IZCAS), "China, Shaanxi Prov., Zhouzhi, Houzhenzi, Shaliangzi, 33.88923°N, 108.01553°E"/ "907m, 2007.5.24, Shi Hongliang coll."; 1 male and 1 female (IZCAS), "Shaanxi, Liuba, 1981.4"; 1 male and 1 female (IZCAS), "Shaanxi, Zhenba, 1981.4"; 1 female (IZCAS), "Shaanxi, Zhenba, 1985.7.19, Wang Shufang collector"; 1 male (IZCAS), "Shaanxi, Huaxian, 1980.5.4"; 1 male (IZCAS), "Shaanxi, Pingli, 1980.6.27"; 1 male and 1 female (IZCAS), "Shaanxi, Zhouzhi, Louguantai, light trap, 34.05378°N, 108.29294°E"/ "680m, 2008.6.22–26, Jiang Jianguo coll."; 3 males and 5 females

Figures 131–145. Aedeagi of *Chlaenius* (*Lithochlaenius*) species **131** *C. wrasei* Kirschenhofer (dorsal view) **132** *C. wrasei* Kirschenhofer (left lateral view) **133** *C. agiloides* Jedlička (dorsal view) **134** *C. agiloides* Jedlička, holotype (left lateral view) **135** *C. agiloides* Jedlička (left lateral view).136) *C. rambouseki* Lutshnik from Ussuri region (dorsal view) **137** *C. rambouseki* Lutshnik from Ussuri region (left lateral view) **138** *C. anchomenoides* Bates, paratype (dorsal view) **139** *C. anchomenoides* Bates, paratype (left lateral view) **140** *C. nuristanus* Jedlička, paratype (dorsal view, black leg) **141** *C. nuristanus* Jedlička, paratype (left lateral view) **142** *C. nuristanus* Jedlička, paratype (dorsal view, yellow leg) **143** *C. nuristanus* Jedlička, paratype (left lateral view) **144** *C. rambouseki* Lutshnik from Taiwan (dorsal view) **145** *C. rambouseki* Lutshnik from Taiwan (left lateral view). Scale lines: A = 1.0 mm (Figs 131, 133, 136, 138, 140, 142, 144); B = 0.5 mm (Figs 132, 134, 135, 137, 139, 141, 143, 145).

(HBUM), "Shaanxi, Gaolan County, Minzhu Township, 2003.7.4–5, Liu Yushuangand Yuan Caixia collectors; 1 male (IZCAS), "Hubei Prov. Xinshan, Xiakou, 140m"/ "1994.V.2, Li Wenzhu coll."; 1 female (IZCAS), "Hubei Prov., Enshi, 437m"/ "light trap, 1980.V.26"; 1 female (IZCAS), "Ganshu Prov., Kangxian, Yangbalingchang, 1020m 1999.VII.10, Wang Hongjian coll."

Diagnosis. Antennomere 1 coniform (Fig. 59); antennomeres 1–3 brown; intervals 1–5 glabrous medially with one row of pubescence laterally near striae (Fig. 87); apical lamella of aedeagus moderately rounded (Fig. 131), thin and moderately reflexed in lateral view (Fig. 132).

Description. Total length = 16.00–17.00 mm (mean = 16.4), width = 5.33–6.13 mm (mean = 5.68); HW = 2.70–2.95 mm (mean = 2.80), EYL = 1.00–1.05 mm (mean =1.01), ratio Ant3/Ant1 = 1.42–1.65 (mean = 1.52), PL/PW = 0.78–0.80 (mean = 0.79), EL/EW = 1.74–1.90 (mean = 1.80), EL/ PL= 1.37–1.47 (mean = 1.41).

Head and pronotum black with green and coppery metallic luster; elytra black; ventral surface black; antennomeres 4–11, trochanters, palpomeres, and tarsomeres dark brown; antennomeres 1–3, femora, tibiae yellow to brown.

Head with vertex sparsely pubescent and coarsely punctate behind eyes; antennomere 1 coniform (Fig. 59); labrum nearly truncate at apex. Pronotum with disk nearly smooth, very sparsely punctate near midline in a few specimens; basal foveae narrow, deep, sparsely punctate, pubescent. Elytra with intervals convex, glabrous medially, pubescent laterally (Fig. 87), intervals 6–9 densely pubescent; striae deep, punctate; humeral angle obtuse (Fig. 73). Abdominal sterna IV-VI nearly glabrous medially, sternum VII narrowly rounded at apex (107–108). Aedeagus stout (Fig. 132), lamella rounded at apex (Fig. 131), thin and slightly bent ventrally (Fig. 132).

Geographical distribution. Fig. 158. Known from Shaanxi, Gansu, and Hubei Provinces, China.

Remarks. Mensural data cited in the description were based on measurements obtained from 5 males and 5 females selected for maximum variation.

Chlaenius wrasei was first described as a subspecies of *C. noguchii* by Kirschenhofer. Later (Kirschenhofer 2005), he upgraded this taxon to status as a distinct species. We agree with this decision, given that the pubescent elytral intervals 6–7 of adults and stout aedeagus of males are very different from those of *C. noguchii*.

Members of *C. wrasei* are similar to those of *C. leishanensis* in having antennomere 1 coniform and pronotum nearly impunctate, but differ from the latter in having intervals 1–5 wholly glabrous medially (only the basal portions of these intervals are glabrous medially in *C. leishanensis*), tibiae concolorous with femora (tibiae much darker than femora in *C. leishanensis*), and lamella of aedeagus thin and less bent ventrally (thickened and more markedly bent in *C. leishanensis*).

The *rambouseki* group

Chlaenius (*Lithochlaenius*) *agiloides* Jedlička

http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_agiloides

Figs 32–33, 42, 50, 60, 74, 88, 109–110, 133–135, 150, 155, 157–158

Chlaenius agiloides Jedlička, 1935:5; Kirschenhofer, 1997:116; Kirschenhofer, 2005:490

Specimens examined. Total 603 specimens. **China:** 2 males (CCCC), "Yunnan, Weixi, Tacheng, light trap, 2006.8.22, Chen Jianren collector"; 2 females (IZCAS), "Sichuan, Wolong, 1900m, 1980.VIII.25, Liu Youjiao collector"; 1 male and 1 female

Figures 146–**151.** Photographs of habitats for *Chlaenius* (*Lithochlaenius*) spp **146** *Chlaenius chuanqianensis* sp. n., Dabaitang, Xishui county, North Guizhou, China **147** *C. anchomenoides* Bates, Goorais valley, Pakistan (Provided by Dr. Muhammad Abbas in Pakistan Museum of Natural History) **148** *C. propeagilis* sp. n., Gaoligongshan, Yunnan, China **149** *C. leishanensis* Kirschenhofer, Xiaodanjiang, Leigongshan, Leishan county, Southeast Guizhou, China **150** *C. chuanqianensis* sp. n. and *C. agiloides* Jedlička, Jinshajiang, Sichuan **151** *C. rambouseki* Lutshnik, Ussri river, Heilongjiang, China.

(IZCAS), "Sichuan, Wolong, 1980.6.29, Bai Jiuwei collector"; 2 females (IZCAS), "Sichuan, Baoxing, 1400m"/ "1995.VIII.14, Yu Peiyu collector"; 4 males and 5 females (SIECAS), "Sichuan, Shimian, 2007.VII.20, alt. 900m, Liu, Zhang, Zhou & Bi"; 213 males and 204 females (IZCAS), "China, Sichuan Prov., Batang, Zhubalong, Sanjiacun, Jinshajiang, N29.84109, E99.02390"/2480m, 2009.6.1, Yuan Feng, Zhai

Figures 152–157. Photographs of habitats for *Chlaenius* (*Lithochlaenius*) spp **152** *Chlaenius rambouseki* Lutshnik, Baisha county, Hainan Island, China **153** *C. rambouseki* Lutshnik, Yuanbaoshan, Guangxi, China **154** *C. rambouseki* Lutshnik adult walking on concrete wharf of Ussri river at night **155** *C. agiloides* Jedlička adults mating at night **156** Assorted molluscs, show one food of *C. rambouseki* Lutshnik from Hainan Island **157** Adults of *C. agiloides* Jedlička preying on dragonfly nymph at night.

Hui and Yang Ganyan collectors"; 71 males and 98 females (IZCAS), "China, Sichuan Prov.,, Yajiang, Hekou Town, Shanbeihou, Yalongjiang, N30.00020, E101.01526"/ "2583m, 2009.5.27, Liang Hongbin collector".

Diagnosis. Antennomere 1 cylindrical (Fig. 60); antennomeres 1–3 yellow; intervals punctate, pubescent (Fig. 88); lamella of aedeagus rounded at apex (Fig. 133), thick in lateral view (Figs 134–135).

Description. Total length = 14.00–17.00 mm (mean = 15.10), width = 5.33–5.87 mm (mean = 5.60); HW = 2.40–2.85 mm (mean = 2.59), EYL = 0.95–1.00 mm (mean = 0.97), ratio Ant3/Ant1= 1.94–2.21 (mean = 2.08), PL/PW = 0.86–0.90 (mean = 0.88), EL/EW = 1.62–1.74 (mean = 1.68), EL/ PL = 1.30–1.39 (mean = 1.34).

Head, pronotum and elytra black, with blue or greenish blue metallic luster; ventral surface black; antennomeres 4–11, mandibles, palpomeres, trochanters, and tarsomeres brown; antennomeres 1–3, femora, and tibiae yellow.

Head convex, vertex punctate and pubescent behind eyes; antennomere 1 cylindrical (Fig. 60); labrum slightly emarginate or truncate at apex; mentum tooth emarginate apically. Pronotum with disk convex, sparsely punctate and pubescent medially, more densely punctate along midline, near lateral margins, and near base; basal foveae deep, punctate and pubescent. Elytra with intervals convex, wholly punctate and pubescent (Fig. 88), punctation and pubescence less dense in the basal half of intervals 1–4 than in other areas; striae moderately deep, punctate; humeral angle rounded or obtuse (Fig. 74). Abdominal sterna IV-VI sparsely pubescent medially; apex of sternum VII narrowly rounded in male (Fig. 109), slightly truncate in female (Fig. 110). Apical lamella of aedeagus moderately rounded (Fig. 133), thick in lateral view (Figs 134–135).

Geographical distribution. Fig. 158. Known only from Sichuan and Yunnan Provinces, China.

Remarks. Mensural data cited in the description were based on measurements obtained from 5 males and 5 females selected for maximum variation.

Members of this species are very similar to *C. rambouseki* in having the elytra wholly pubescent, but differ from the latter in having shiny elytral intervals (dull in *C. rambouseki*), regular and uniform punctation on intervals (mixed large and small interval punctuation in *C. rambouseki*), and thick apical lamella of aedeagus in males (thin in *C. rambouseki* males). In many *C. agiloides* members, the dorsal surface has a blue metallic luster rather than the green luster of *C. rambouseki* members.

Chlaenius (*Lithochlaenius*) *rambouseki* Lutshnik

http://species-id.net/wiki/Chlaenius_(Lithochlaenius)_rambouseki
Figs 1–13, 34–35, 43–45, 51, 61, 65, 75, 79, 89, 93, 111–112, 116, 136–137, 144–145, 151, 152–154, 156, 158

Chlaenius rambouseki Lutshnik, 1933:172; Kirschenhofer, 2005:491
Chlaenius formosanus Jedlička, 1935:5. **NEW SYNONYMY**; Kirschenhofer, 1997:116; Kirschenhofer, 2005:490

Specimens examined. Total 66 specimens. **China:** 4 males and 5 females (IZCAS), "Heilongjiang, Hulin, Bank of Ussri River, 45.976578°N, 133.669942°E"/ "55m, 2009.5.20–24, night, Liu Ye collector"; 3 males and 8 females (OMNH), "Manchuria Fengtian (=Liaoning, Shenyang), 1942.V"/ "N. Tosawa collection, June 1978"; 1 female (HBUM), "Shaanxi, Langao County, Minzhu, 2003.7.4, Yuan Caixia and Liu

Yushuang collectors"; 1 male (HBUM), "Henan, Songxian, Baiyunshan, 2008.7.14–17, Ren Guodong and Wu Qiqi collectors"; 1 female (IZCAS), "Fujian, Jiangyang, Huangkeng, Guilin, 270–340m"/ "1960.4.8, Ma Chenlin collector"; 1 male (CCCC), "China, Taiwan Prov., Hsinchu, Wufong, 1996.08.03, Chen C.C. coll."; "1 male and 1 female (CCCC), "Taiwan Prov., Hsinchu, Wufong, 1998.4.11"; 3 males and 1 female (CCCC), "China, Taiwan Prov., Pingtung, Yitun, 2009.4.23"; 1 males and 1 female, "China, Taiwan, Pingtung, Yitun, 2008.6.29", Chen C.C."; 1 male (CCCC), "Taiwan, Pingtung, Manchou Harbor, 2008.10.30"; 1 female (CCCC), „China, Taiwan Prov., Yilan, 2007.6.10, Chen C.C."; 1 male (CCCC), "China, Taiwan Privin., Chen C.C. collector"; 1 male (IZCAS), "Jiangxi, Liantang, light trap, 1956.8.8"; 1 male and 1 female (IZCAS), "Jiangxi, Liantang, 1956.6.10"; 1 male (IZCAS), "Jiangxi, Dayu, Lannijing, 550m, 1985.8.22, Liao Subai collector"; 1 male (IZCAS), "Jiangxi, Shangrao, 1980.8.7"; 1 male (IZCAS), "Hunan, Chansha, Yuelushan, 1955.7.15, Wang Linyao collector"; 2 males and 1 female (IZCAS), "Guangxi, Rongshui County, Yuanbaoshan, Tiantou village, 2009.10.26, Liu Ye and Shi Hongliang collectors"; 1 female (IZCAS), "Guangxi, Nanning, 1987.10.30, Zhou Zhihong collector"; 2 females (IZCAS), "Guangxi, Longsheng, Sanmen, 1983.4.8"; 1 male (HBUM), "Guangxi, Tian-e County, 2002.9.14–19, Bai Ming collector" 1 female (IZCAS), "Chongqing, Beibei, 1940.8.10"; 1 female (IZCAS), "China, Guizhou, Xishui County, Dabaitang, 600m"/ "2000.9.28, Liang H.B"; 1 male (HBUM), "Guizhou, Daozhen, Xiannvdong, Yang Xiujuan and Hua Huiran collectors"; 1 female (IZCAS), "Yunnan, Kunming, 1980.5"; 3 males and 3 females (IZCAS), "China, Hainan Prov., Baisha, Nankai, 19.08001°N, 109.41058°E"/ "259m, 2008.11.20 N, Shi H.L. collector"; 1 male and 4 females (IZCAS), "China, Hainan Prov., Baisha, Nankai River, bank, 19.08040°N, 109.41267°E"/ "255m, 2009.11.20 N, Liang Hongbin collector". **Russia:** 1 male and 1 female (ZRAS)**,** "Ussuri River, S of Bikin, Zvenjevaja [in Russian], 1982.7.28, Kabakov leg."/ "*Chlaenius rambouseki* Lutshn. det. B. Kataev 2005". **North Korea:** 1 male and 1 female (IZCAS), Mt. Maedok Ridge, alt. 1538m Punso, Ryanggang province, North Korea"/ "NL40°100, EL128°20, 2007.7.1–20".

Diagnosis. Antennomere 1 elongate-ovoid (Figs 61, 65); antennomeres 1–3 more yellow; all intervals pubescent (Figs 89, 93); apical lamella of aedeagus moderately rounded (Figs 136, 144), thin in lateral view (Figs 137, 145).

Description. Total length = 14.00–17.50 mm (mean = 15.60), width = 4.80–6.00 mm (mean = 5.60); HW = 2.40–2.95 mm (mean = 2.63), EYL = 0.95–1.00 mm (mean = 0.96), ratio Ant3/Ant1 = 1.96–2.10 (mean = 2.04), PL/PW = 0.86–0.90 (mean =0.87), EL/EW = 1.65–1.73 (mean = 1.68), EYL/ PL = 1.29–1.40 (mean = 1.35).

Head and pronotum black, with green or coppery metallic luster; elytra black in general, but with slight coppery luster in a few specimens; ventral surface black; antennomeres 4–11, mandibles, palpomeres, trochanters, and tarsomeres brown; antennomeres 1–3, femora and tibiae yellow.

Head convex, vertex punctate and pubescent behind eyes; antennomere 1 elongate–ovoid (Figs 61, 65); labrum slightly emarginate at apex; mentum with tooth emarginate apically. Pronotum with disk convex, sparsely punctate and pubescent

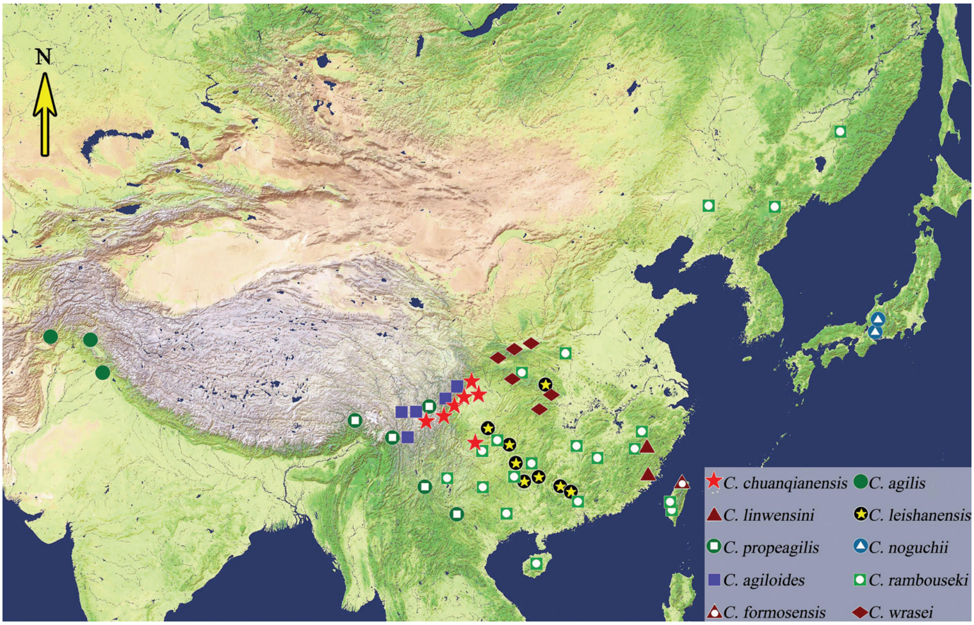


Figure 158. Map showing the known geographical distributions of *Chlaenius* (*Lithochlaenius*) spp.

along midline; basal foveae deep, coarsely punctate, pubescent. Elytra with intervals slightly convex, regularly punctate and pubescent (Figs 89, 93); striae shallow, punctate; humeral angle obtusely angulate (Figs 75, 79). Abdominal sterna densely pubescent; apex of sternum VII broadly rounded in both sexes (Figs 111–112, 116). Apical lamella of aedeagus rounded (Figs 136, 144), thickened in lateral view (Figs 154, 137, 145).

Geographical distribution. Fig. 158. Broadly distributed across southern and central China, from Yunnan in the west to Hainan Island and Taiwan in the south, and northwest to North Korea and Primorski Krai in the Russian Far East.

Remarks. Mensural data cited in the description were based on measurements obtained from 5 males and 5 females selected for maximum variation.

We compared a photograph of the holotype (type lost according Kryzhanovskij 1976) and specimens of *C. formosanus* from Taiwan with identified specimens of *C. rambouseki* Lutshnik from Ussuri River, and no significant difference was found between them.

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RESEARCH ARTICLE

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A new marine interstitial *Psammogammarus* (Crustacea, Amphipoda, Melitidae) from Gura Ici Island, off western Halmahera (North Moluccas, Indonesia), and an overview of the genus

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Abstract

Psammogammarus wallacei **sp. n.** is described from the shallow marine interstitial of a sand and coral rubble beach on the Gura Ici islands (North Moluccas; Indonesia). This is the first record of this circumtropical genus from SE Asia, with the geographically closest relative inhabiting the Ryukyu archipelago in Japan. The new species is highly distinctive by the display of sexual dimorphism on pleopod II, with the medial margin of the male proximal article of exopod provided with a comb of short, blunt curved spinules; no other representative of the genus is known to display sexually-dimorphic appendages aside of the gnathopods. The new species is also noteworthy by the outline of the palm margin of male gnathopod II, hardly excavated, and by showing a carpus broader than long. An overview of the genus *Psammogammarus* with 14 species to date is provided.

Keywords

Shallow marine interstitial, sandy beaches, genus review, *Psammogammarus*, sexual dimorphism

Introduction

In October and November 2009, a marine expedition was organized by NCB Naturalis, the Research Centre for Oceanography of the Indonesian Institute of Sciences (RCO-LIPI), and students of Universitas Khairun, Ternate, North Moluccas. The main goal of the expedition was to investigate the community structure and species composition of coral reef biotas off western Halmahera, in particular around the volcanic islands of Ternate and Tidore. In the wake of this survey a shore party sampled beaches and inland brackish wells for subterranean invertebrates. Several types of coastal sediments were probed, such as beaches of homogeneous black volcanic sand, coral rubble bars, fine silt between stones in bays, and very shallow coral reef flats filled with sand and thick packets of coral fragments. Although the research was based at LIPI's field station at Ternate, a two day survey was held at the more southwardly located Gura Ici islands (Fig. 1).

Between the copepod and peracarid crustaceans encountered in the thick layers of coarse beach sand in this island group a typical shallow marine interstitial gammaridean amphipod was found, belonging to the melitid genus *Psammogammarus* S. Karaman, 1955. This group is widespread in tropical and subtropical marine beach

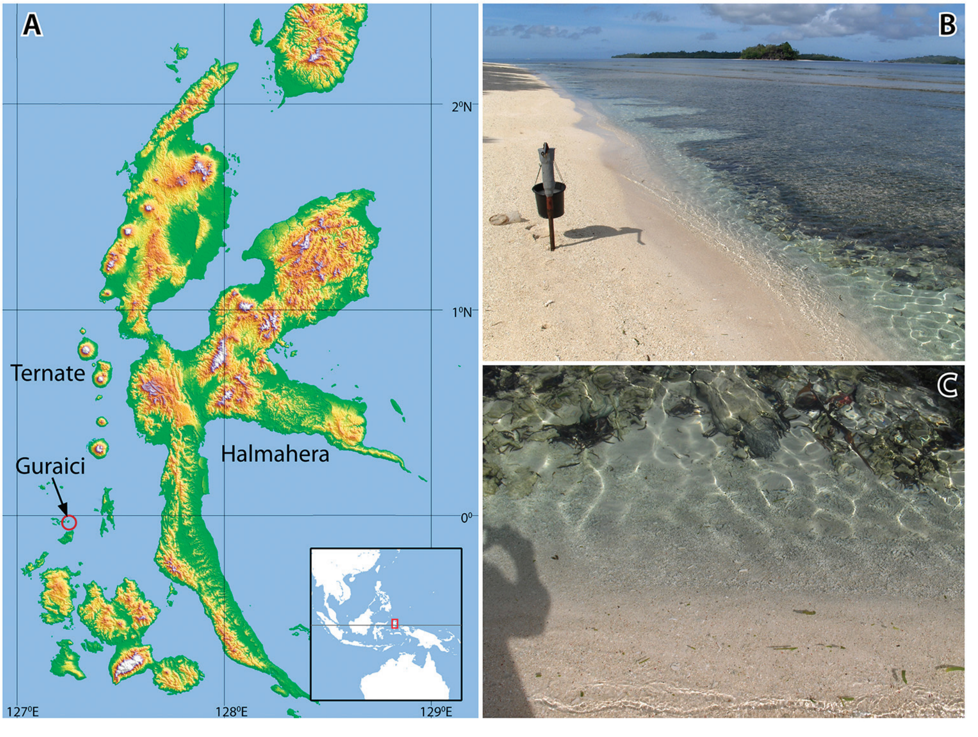

Figure 1. Location and habitat of *Psammogammarus wallacei* sp. n. **A** Gura Ici islands (Guraici = local spelling), low islands consisting of calcareous coral rises and mangrove fringed sand flats **B** groundwater pump with perforated pipe at 50 cm in the sediment (coarse sand and degraded coral) **C** shoreline at low tide, leaving a permanent narrow channel between the beach and the reef flat.

environments and can only be dug out or pumped from groundwater. Its occurrence begins, from a landward view, in anchialine cave waters in coastal localities, such as known from Bonaire (Vonk and Stock 1987) and the Red Sea (Stock and Nijssen 1965; Jaume and Garcia 1992), down to depths of around 1200 m at the Balearic Sea slope (Cartes and Sorbe 1999).

It is remarkable that *Psammogammarus* has not been found in Australia despite quite intensive sampling there in exactly the same shallow marine sediments in which it occurs in many other tropical seas of the world (Yerman and Krapp Schickel 2008).

Material and methods

The marine stygofaunal research carried out in the North Moluccas concentrated on collecting subterranean species in diverse habitats at different places on the islands. We sampled in coastal areas, wells, small brackish lakes, beaches, and mangrove fringes of Ternate, Hiri, Tidore, Maitara, Guraici Islands, and the west and east side of northern Halmahera. Sampling gear consisted of a biophreatical Bou-Rouch groundwater pump and steel pipes (see Bou 1974), a Cvetkov net (Cvetkov 1968), a dip net, and a shovel. On beaches the pump was placed near to the waterline. When the marine groundwater flow was not steady and the pipe holes or pump cylinder were clogged with sand and silt, the pump was placed directly in the sea. Low tide was the preferable time to sample but since the tidal difference was only 1–2 m and locations logistically restricted, sampling was performed at all tides. In some cases, ground water was filtered that accumulated in holes dug with a hand shovel. In wells we used a 0.30 mm mesh size Cvetkov net, and in scooping up sand from shallow marine reef flats hand nets of various mesh sizes. The 2% formalin-preserved samples (short time for hardening tissue) were sorted later in the LIPI Ternate field station laboratory under a dissecting microscope and transferred to 70% ethanol. Some samples with abundant specimens were directly stored in 96% ethanol. Before study, specimens were treated with lactic acid to soften the cuticle and remove internal tissues to facilitate observation. Drawings were prepared using a camera lucida on Olympus BH2 and Leica DM 2500 microscopes equipped with Nomarski differential interference contrast. Material preserved on slides was mounted in lactophenol and the coverslips sealed with nail varnish. Body measurements were derived from the sum of the maximum dorsal dimensions (including telescoped portions) of head, pereonites, pleosomites and urosomites, and exclude telson length. Material is deposited in the Crustacea collection of the Zoological Museum of the University of Amsterdam (ZMA).

Following Watling (1989), the term "spine" in descriptions is restricted for rigid armature elements with a hollow central core that do not articulate basally to the body integument. Gnathopods I and II, and pereiopods V to VII appear abbreviated elsewhere as G1–G2 and P5–P7, respectively; uropods I–III, as U1–U3; exp1 and exp2 denote proximal and distal segment, respectively, of the 2-segmented exopod of uropod III.

Taxonomy

Order Amphipoda Latreille, 1816
Suborder Gammaridea Latreille, 1802
Family Melitidae Bousfield, 1973
Genus *Psammogammarus* S. Karaman, 1955

***Psammogammarus wallacei* sp. n.**
urn:lsid:zoobank.org:act:5E679036-2477-4485-BAD0-6F6D452D2288
http://species-id.net/wiki/Psammogammarus_wallacei
Figs 2–8

Material examined. Collected by R. Vonk and Mr. Sumadijo, 9 November 2009. Gura Ici islands, north beach of Pulau Lelei, thick coral rubble bar at waterline bordering shallow reef flat (stn. 09–60; 0°01'38.64"N, 127°14'38.53"E); B-Rh pump placed on slope of coral bar, pipe 50 cm depth, 50 l filtered. **Holotype:** Adult male (with penile papillae) 2.65 mm retaining all limbs except U3, completely dissected and mounted on single slide [ZMA, amph. 206076]. **Paratypes:** five adult males of 2.53, 2.54, 2.55, 2.57 and 2.63 mm; two brooding females (oostegites developed, setose) 2.60 and 2.98 mm; two juveniles 1.79 and 1.87 mm. All in single vial [ZMA, amph. 206075].

Diagnosis. Male G2 palm margin only slightly excavated, devoid of mid-palmar strong robust setae; carpus broader-than-long. Uropod III exp2 longer than exp1; endopod elongated, more than 50% length of exp1. Protopod of U1 with one basofacial robust seta. Distomedial angle of U2 protopod provided with transverse comb of 4 robust setae. Telson with two lateral and one distal robust setae. Posteroventral angle of epimeral plate III pointed but weakly produced. Armature (robust setae) on ventral margins of epimeral plates as 1-(2 or 3)-3. Coxal endite (= inner plate) of maxillule provided with 6 setae; basal endite (= outer plate) with 9 robust setae. Oblique row on inner plate of maxilla composed of 4 setae. Basal endite (= inner plate) of maxilliped provided with three robust setae; ischial endite (= outer plate) with 4. Basis of P7 weakly expanded, with sub-parallel anterior and posterior margins. Pleopod II sexually-dimorphic.

Etymology. Species name after the 19th century British naturalist Alfred R. Wallace, who was based in Ternate during his explorations of the Moluccas.

Description. Adult male. Eyeless. *Body* (Fig. 2A) elongate and slender, unpigmented, somites devoid of relevant armature or sculpturing except for robust seta present on posteroventral angle of urosomite III (Fig. 8B). *Head* lacking rostrum; lateral lobes evenly rounded; antennal sinus hardly indicated, unnotched. *Pereiopodal coxae* narrow, hardly overlapping. *Epimeral plates* (Fig. 8A) with acute posteroventral angles, that of epimeral plate III more produced than rest; armature of ventral margin of plates (flagellate robust setae) as 1-3-3 or 1-2-3; posterior margin of plates each with single simple seta implanted adjacent to posterodistal angle.

Antennule short, about half as long as body length (Fig. 2A). Peduncle segments relative length as 100: 77: 43; proximal segment provided with stout flagellate robust

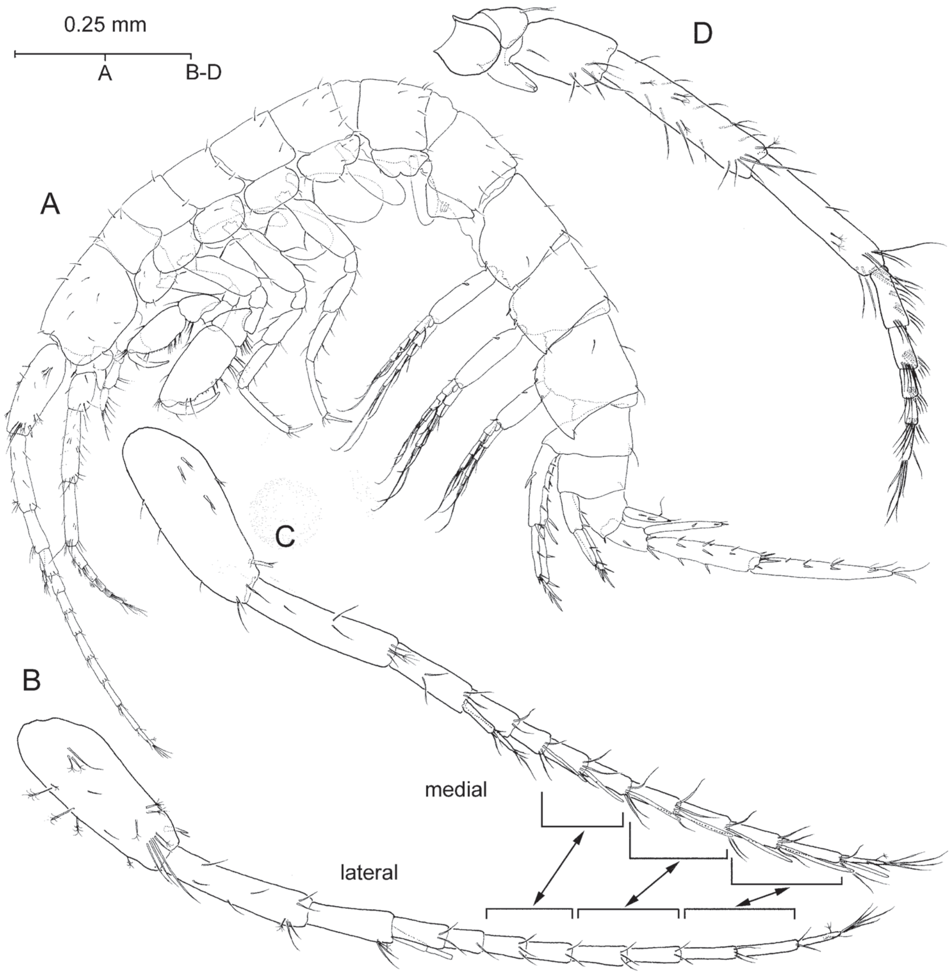

Figure 2. *Psammogammarus wallacei* sp. n., male paratype 2.53 mm, P5-P7 wanting. **A** body, lateral **B** left antennule, lateral **C** same showing medial armature **D** right antenna, lateral. Arrows pointing at serially-homologous pairs of articles of main flagellum of antennule.

seta subdistally on ventromedial margin (Fig. 2B, C). Main flagellum about as long as peduncle, with armature on medial and lateral margins exactly as depicted; armature of two most proximal articles and terminal article differing from rest as figured. Accessory flagellum 2-articulate, overreaching distal margin of proximal article of main flagellum.

Antenna (Fig. 2A, D) shorter, about three-quarters length of antennule. Gland cone slender, straight, pointing anteriorly; relative length of three distal segments of peduncle as 48: 100: 88. Flagellum short, slightly longer than distal segment of peduncle.

Labrum trapezoidal. *Paragnaths* (Fig. 8D) with distinct, well developed inner lobes; outer lobes each with 4 stout tricuspidate setae on tip.

Left mandible (Fig. 3A) incisor with 5 rounded teeth, lacinia with 4 teeth; spine row composed of 7 elements; molar columnar, molar seta shorter than right mandible counterpart. Palp 3-segmented, distal segment shorter than middle segment, provided with 6 stiff simple setae along medial margin but not in a regular row; middle segment with three flagellate stiff setae on medial margin. *Right mandible* (Fig. 3B) differing from left counterpart in almost quadrate lacinia with distal margin finely denticulated except for two larger rounded denticles at one angle; spine row comprising 5+3 elements.

Maxillules (Fig. 3C) symmetrical, coxal endite (= inner plate) with 4+2 marginal setae; basal endite (= outer plate) with 9 robust setae distally, 4 of which bicuspid and placed conforming an inner row, rest denticulated and conforming outer row. Endopod (= palp) faintly 2-segmented, distal segment slightly expanded distally, with 4 broad, short denticulated robust setae on distal margin, and 1–2 denticulated setae subdistally on outer surface of segment.

Maxilla (Fig. 3D) inner plate with oblique row of 4 plumose setae; distal margin with 4 pinnate setae and 4 simple setae with blunt tip provided with pore; two pinnate setae subdistally on medial margin of plate as figured. Outer plate distal margin with 10 simple setae with blunt tip, two shorter, ordinary simple setae, plus seta with a few pinnules proximally as figured.

Maxilliped (Fig. 3E) basal endite (= inner plate) subrectangular, straight distal margin provided with three short subtriangular robust setae, two of which smooth, third with two rounded denticles; other armature on endite comprising subterminal oblique row of 5 pinnate setae on anterior surface, and three simple setae subterminally on posterior surface. Ischial endite (= outer plate) with convex outer margin; straight inner margin with 6 simple setae with blunt tip; distal margin oblique, with 4 pectinate robust setae. Other relevant armature on endite comprising submarginal row of 4 simple setae with blunt tip running subparallel to inner margin on posterior surface. Merus-dactylus (= palp) as in Fig. 3E, F, with claw (= dactylus+unguis) as long as propodus.

Coxal gills on gnathopod II and pereiopods III-VI (Fig. 2A); gills II (Fig. 4D) and III-IV (Fig. 5B) each longer than basis of corresponding pereiopod, gills V-VI (Fig. 6A, B) shorter than basis; gill VI reduced. Gill II narrow, sausage-shaped, rest ovoid; all provided with short stalk.

Gnathopod I (Fig. 4A-C) propodus clearly longer than carpus, elongate (1.9 times as long as broad), with parallel anterior and posterior (= lateral and medial) margins. Palm margin oblique, convex, finely serrated, with submarginal row of about 10 short flagellate robust setae along medial side. Palm angle not produced, ordinarily with two unequal flagellate robust setae, but extraordinarily with 3–4 (Fig. 4C). Coxa (Fig. 4B) slightly broader than long, with evenly rounded anterior margin; posterior margin slightly excavated.

Gnathopod II (Fig. 4D) propodus elongate (1.9 times as long as broad) with subparallel anterior and posterior margins; palm angle hardly produced, with two unequal flagellate robust setae; palm margin (Fig. 4E) finely serrated, half adjacent to palm angle hardly excavated, with submarginal row of ca. 9 short flagellate robust setae along medial side. Merus posterodistal angle slightly produced, but lacking pointed tip. Carpus triangular, short, less than half length of propodus.

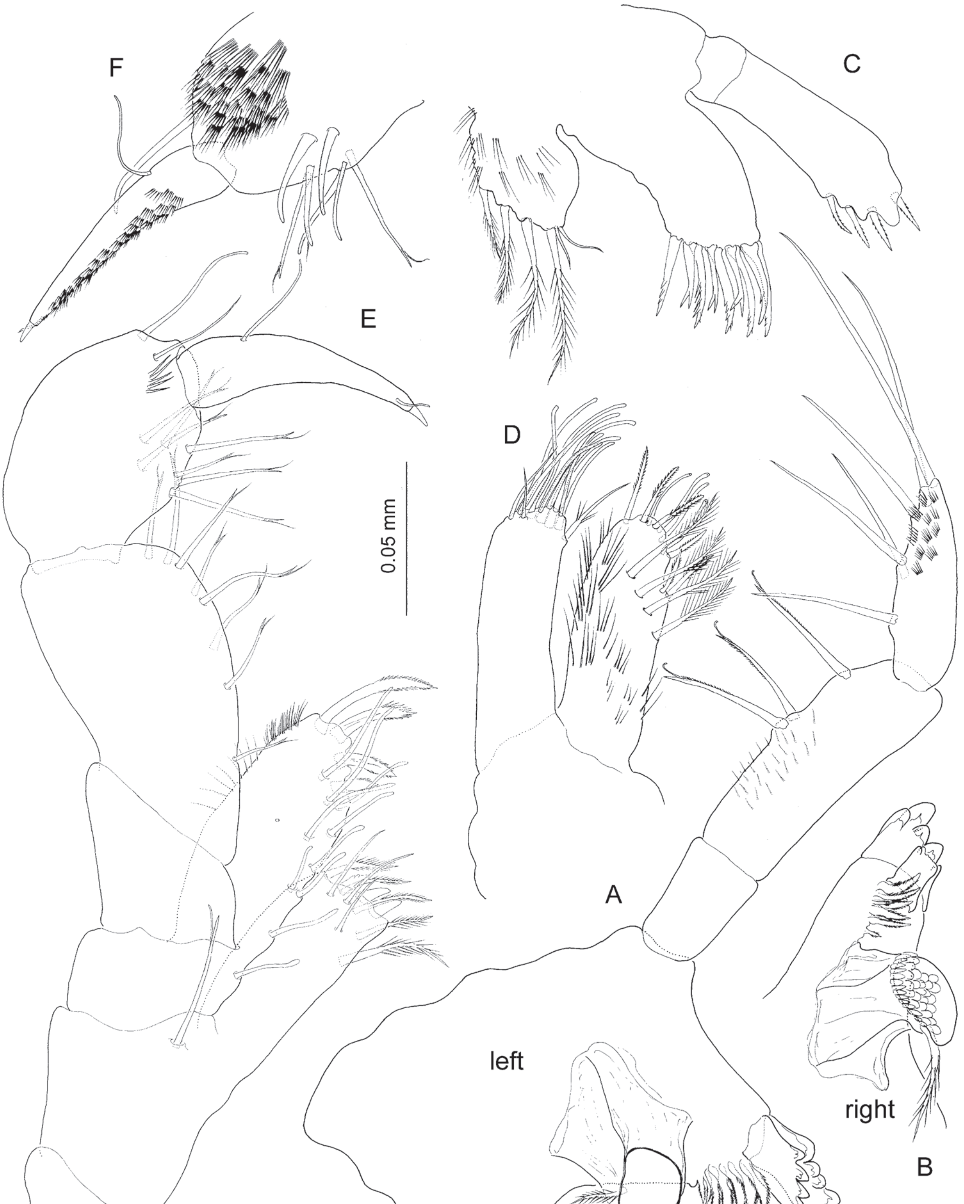

Figure 3. *Psammogammarus wallacei* sp. n., male holotype. **A** left mandible **B** right mandible **C** maxillule **D** maxilla **E** maxilliped, posterior **F** inset of distal segments of palp of latter, anterior.

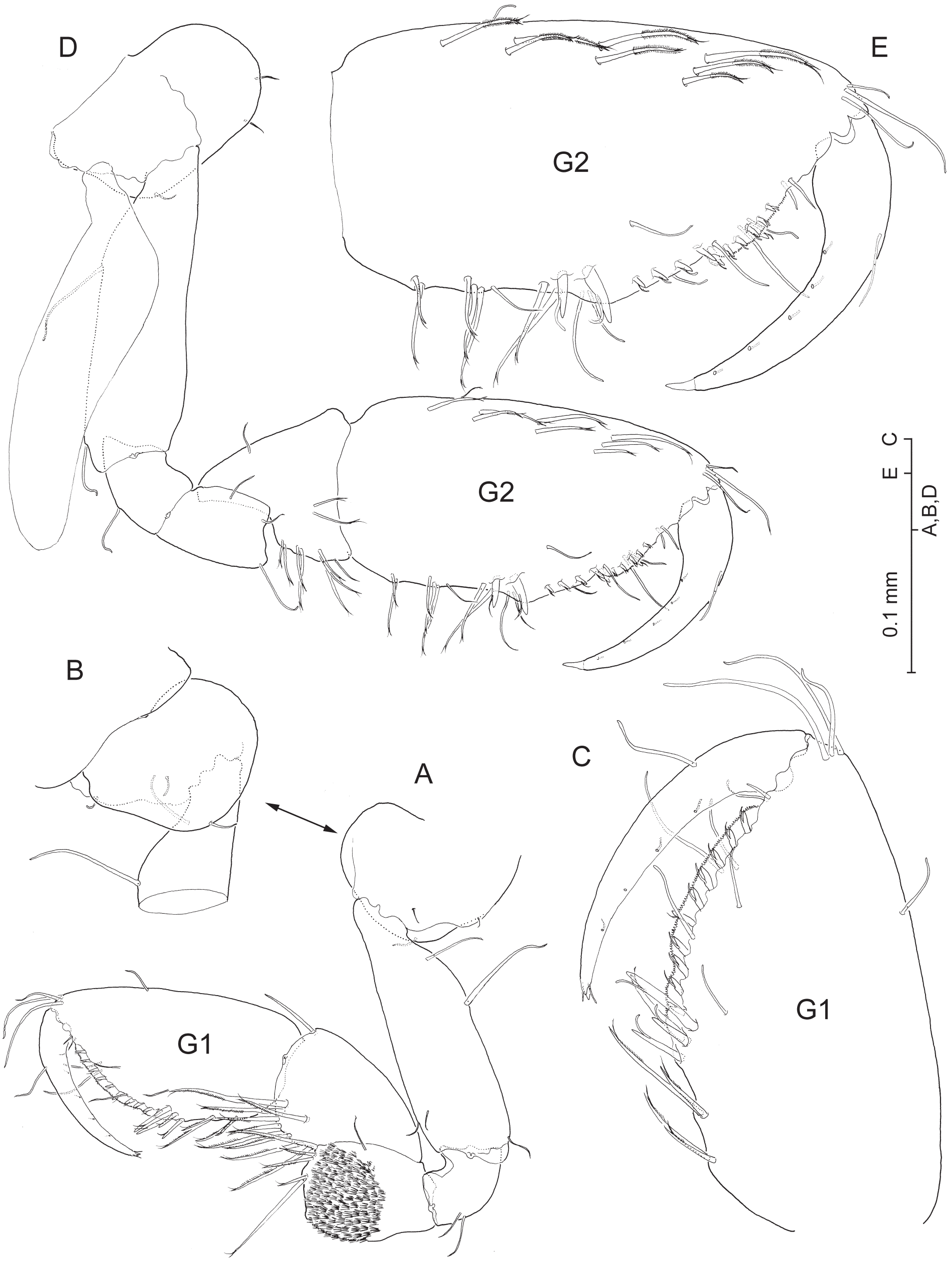

Figure 4. *Psammogammarus wallacei* sp. n., male holotype. **A** right gnathopod I, medial **B** inset of coxa, lateral **C** palm, medial **D** left gnathopod II, medial; palm, medial. Notice that C and E are not at same scale.

Pereiopods III-IV (Fig. 5A, B) subsimilar, with coxae much broader than long, subrectangular, expanded anteriorly into evenly rounded lobe and posterior margin not excavated, straight.

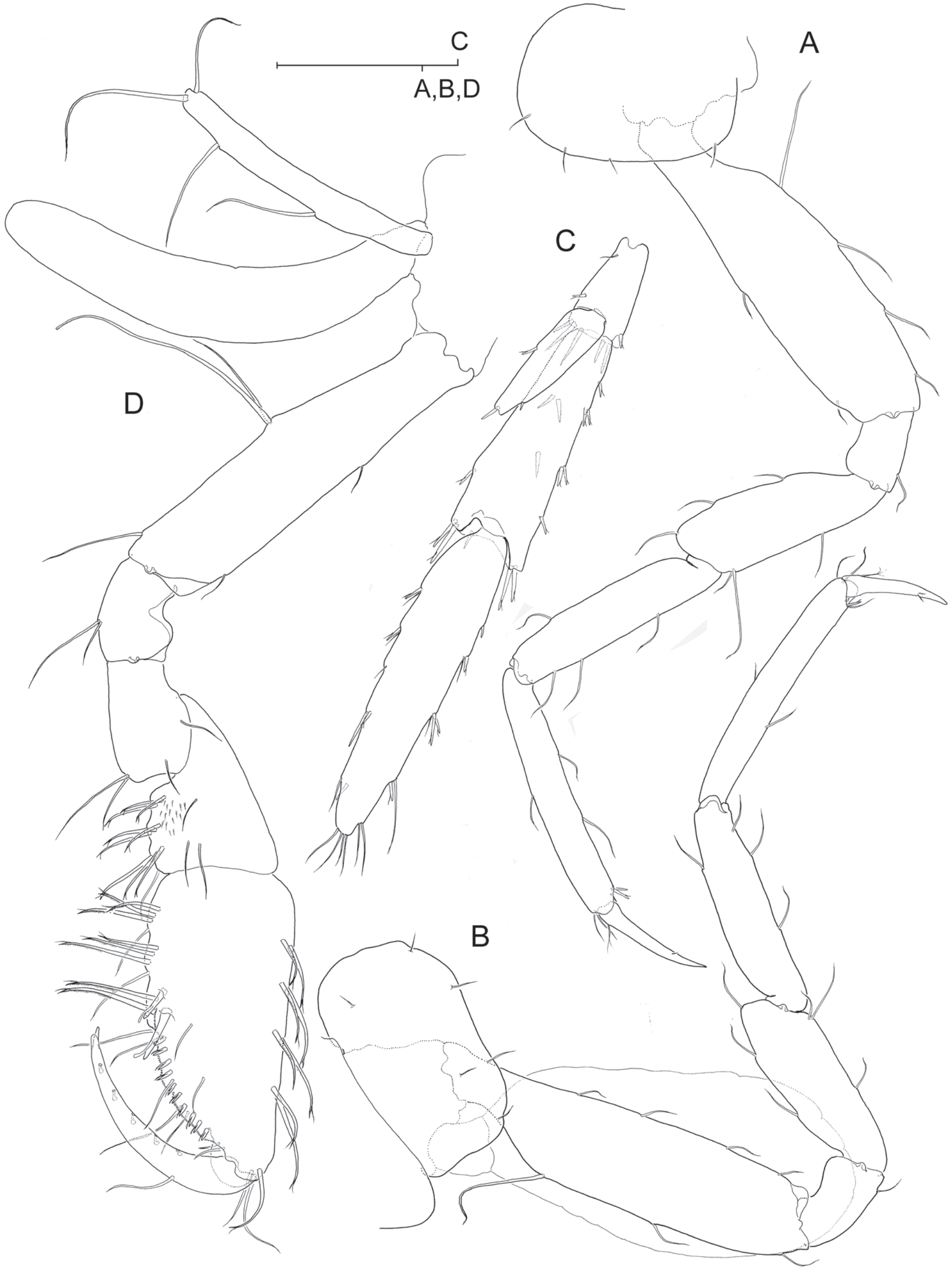

Figure 5. *Psammogammarus wallacei* sp. nov., male holotype. **A** left pereiopod III with coxal gill omitted, lateral **B** right pereiopod IV, lateral **C** right uropod III, dorsal **D** left gnathopod II of female paratype 2.98 mm showing coxal gill and oostegite, coxal plate omitted, medial. [Scale bars: 0.25 mm (C); 0.1 mm (A, B, D)]

Pereiopods V-VII unequal in length, P5 (Fig. 6A) shortest, P6 (Fig. 6B) longer than P7 (Fig. 6C). Basis of each pereiopod only moderately expanded, with subparallel margins and with posterodistal angle distinct but not overhanging. Nail (dactylus + unguis) of P6 more slender and clearly longer than those of P5 and P7. Unguis reduced in all limbs. Coxa V with expanded, evenly rounded anterior lobe.

Pleopods progressively shorter towards posterior, biramous, rami multi-articulate, apparently similar at first sight, but differing remarkably in minute details as follows. Protopods each with two retinacles, and with flagellate robust seta placed proximolaterally on anterior surface of segment (pleopods I-II; Fig. 7A, B), or on lateral margin (pleopod III; Fig. 7D). Protopod of pleopod I devoid of any other armature; protopod of pleopod II with seta on anterodistal margin (Fig. 7B, C); protopod of pleopod III with seta on distolateral angle (Fig. 7D, E). Short, subtriangular process protruding posterodistally on each protopod, those on pleopods I-II with smooth surface (Fig. 7A, C), that on pleopod III microspinulate (Fig. 7E). Proximal article of endopod of pleopod I with one reduced smooth seta proximally on anterior surface (Fig. 7A); seta absent from rest of pleopods (Fig. 7B, D); proximal seta on medial margin of article apparently unicuspid (Fig. 7A), vs. seta bifid on pleopods II-III (Fig. 7C, E). Proximal article of exopod of pleopod II sexually-dimorphic: proximal two-thirds of medial margin with row of short, curved denticles with rounded tip, and row of ordinary setules along distal third of margin (Fig. 7B, C).

Uropods I-II strongly dissimilar in length (Fig. 8B), biramous, exopod shorter than endopod, and with margins of both protopod and rami provided with flagellate robust setae. *Uropod I* (Fig. 8C) protopod much longer than exopod, provided with stout basofacial robust seta and with pair of robust setae on each posterodistal angle, medial pair appreciably longer than lateral counterpart. Posterolateral margin of segment provided with 4 short robust setae, posteromedial margin with three. Exopod with 5 distal robust setae and with robust seta on posterolateral margin; endopod with 4 distal setae and with robust seta about midway on both margins, aside of reduced simple seta on anteroproximal surface of segment. *Uropod II* (Fig. 6D) protopod about as long as exopod, with one robust seta on distolateral angle and with transverse row of 4 robust setae on distomedial angle (see Fig. 8B). Margins of segment each with single robust seta about midway. Exopod with 4 distal robust setae and robust seta about midway of posterolateral margin; endopod with 5 distal robust setae and two robust setae along posteromedial margin. Lateral margin of exopod and medial margin of endopod each minutely serrated (Fig. 6D). *Uropod III* (Figs 2A; 5C) strongly elongated, all segments somewhat flattened, foliaceous, provided with numerous flagellate robust setae as figured. Protopod short; proximal segment of exopod about 2.2 times as long as protopod, distal segment exceedingly longer (1.5×) than proximal segment. Endopod elongate, pointed, much longer than protopod and attaining about 57% length of proximal exopodal segment; one robust seta on tip.

Telson (Fig. 6E) cleft almost until base, slightly longer than broad, tip of each lobe shallowly excavated, provided with simple seta. Three flagellate robust setae on each lobe, one placed subdistally while other two proximally on lateral margin as figured.

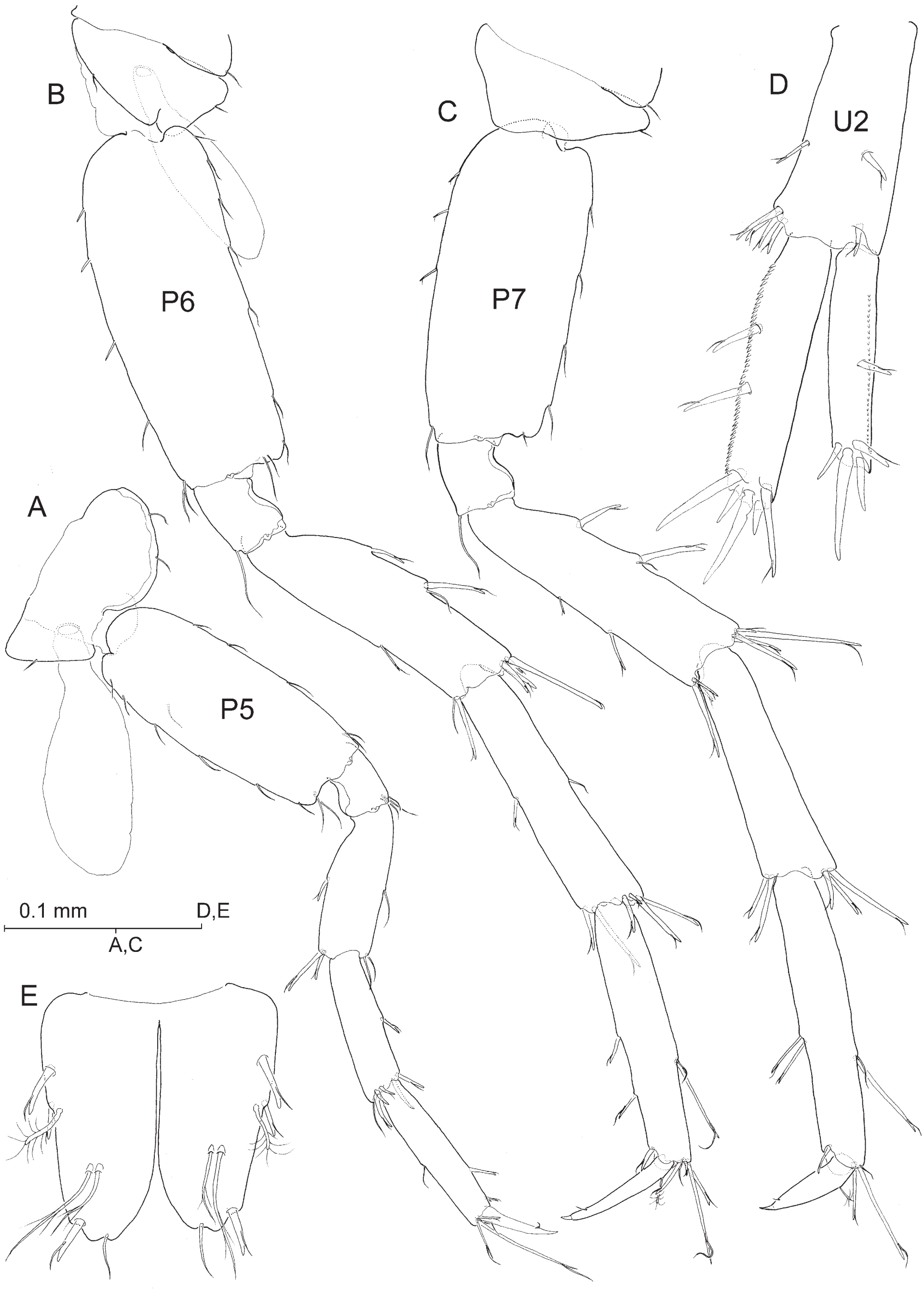

Figure 6. *Psammogammarus wallacei* sp. n., male holotype. **A** right pereiopod V, lateral **B** left pereiopod VI, lateral **C** left pereiopod VII, lateral **D** right uropod II, posterior **E** telson, dorsal.

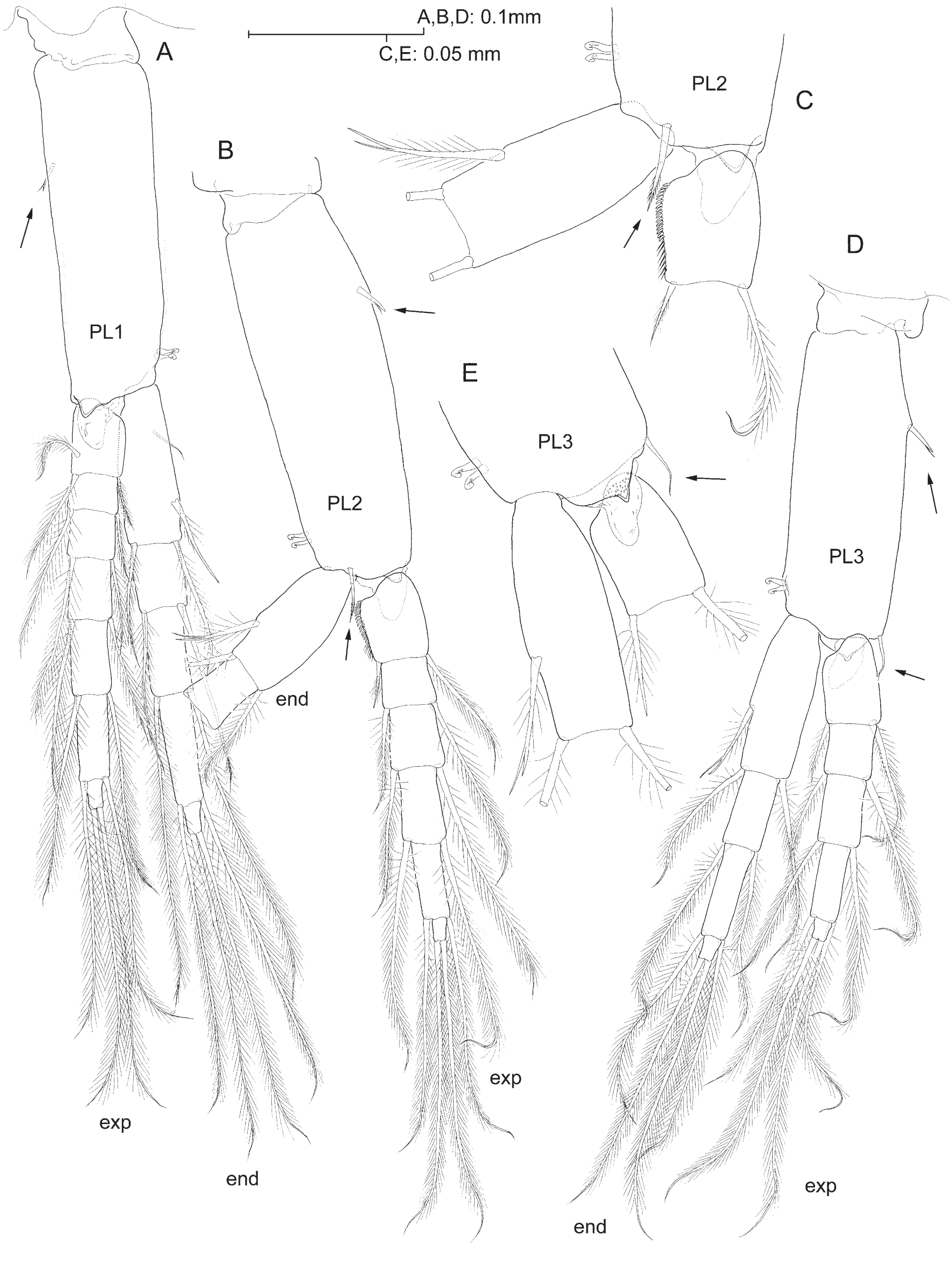

Figure 7. *Psammogammarus wallacei* sp. n., male holotype. **A** left pleopod I, posterior **B** left pleopod II with distal portion of endopod omitted, endopod unnaturally bent to expose medial margin of proximal article of exopod, anterior view **C** detail of latter, anterior **D** left pleopod III, anterior **E** detail of distal portion of protopod of right pleopod III, posterior. Arrows pointing at armature elements of protopod.

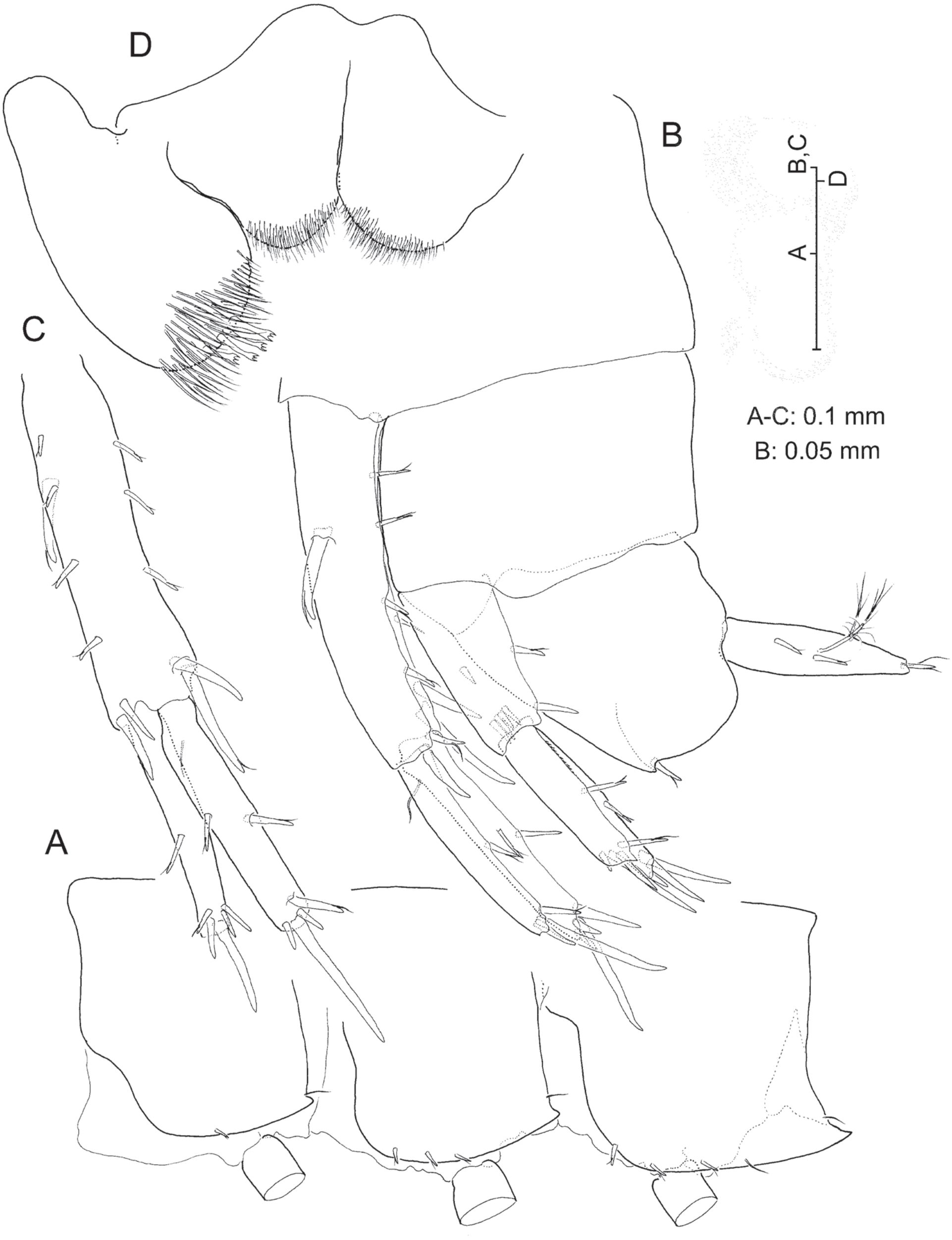

Figure 8. *Psammogammarus wallacei* sp. n., male holotype. **A** left epimeral plates, lateral **B** urosome, lateral (uropod III wanting) **C** left uropod I, posterior **D** paragnaths.

One penicillate seta disposed adjacent to one of lateral robust setae as in Figs 8B and 6E. Pair of long setae on dorsal surface of each lobe as figured.

Adult female. As male except for *gnathopod II*, which displays more elongated carpus and evenly convex palm margin of protopod (compare Figs 4D, E and 5D). In addition, proximal article of exopod of *pleopod II* unmodified. *Oostegites* present on gnatopod II and pereiopods III-V, linear, provided with few sparsely set marginal setae (Fig. 5D). Condition of *uropod III* unresolved since none of two females collected retained it.

Remarks. The combined display of a basic gammaridean body plan, linear oostegites, antennae without calceoli, no sternal gills, G1 smaller than G2, both lacking integumentary rugosities, G1 of melitoid type, dispariramous uropod III with a reduced endopod and a 2-segmented exopod with both segments highly elongated and about the same length, and paragnaths with distinct inner lobes, relates the new taxon from Indonesia with a reduced cluster of melitid genera of mostly stygobytic habits known as the Eriopisa-group. The discrimination between several of the components in this complex proved to be controversial (Karaman and Barnard 1979; Stock 1980; Karaman 1984; Stock and Sánchez 1987), holding currently *Eriopisa*, *Flagitopisa*, *Nedsia*, *Norcapensis*, *Psammogammarus*, *Tunisopisa* and *Victoriopisa*.

The new taxon differs markedly from *Victoriopisa* Karaman & Barnard, 1979, a genus from coastal lagoons and marine shallow waters comprising 9 species, in displaying the proximal articles of the antennary flagellum not fused; the ventral margin of epimeral plate II devoid of a row of long setae; the P7 basis not broadly expanded, similar to P6; and the propodus of G1 longer than carpus (vs. carpus equal or longer than propodus in *Victoriopisa*) (see Lowry and Springthorpe 2005 and references therein; Ortiz and Lalana 1989; Lim et al. 2010).

Eriopisa Stebbing, 1890, comprising two species, viz. *E. elongata* (Bruzelius, 1859) from the deep Atlanto-Mediterranean and *E. incisa* McKinney, Kalke and Holland 1978 from shallow muddy bottoms on the Gulf of Mexico, differs in the notched head lobe; the forwardly pointed coxal plate of G1; the broadly expanded basis of P7, dissimilar to P6; the carpus of G1 as long as or longer than propodus; and the epimeral plate II bearing a row of long setae along ventral margin (McKinney et al. 1978; Lincoln 1979). Two taxa currently included in *Eriopisa*, viz. *E. inaequicaudata* Ledoyer, 1982 from the Tulear reef in Madagascar and *E. mochimae* van der Ham & Vonk, 2003 from a sandy beach in Venezuela and coral rubber bars in Curaçao, do not display the diagnostic forwardly pointed coxa I, notched head lobe, setose ventral margin of epimeral plate II, and the P7 basis is similar to P6; they should not be considered as members of the genus, nor even of the *Eriopisa*-group since their U3 exp2 is hardly elongated (Ledoyer 1982; van der Ham and Vonk 2003).

Flagitopisa Karaman, 1984, comprising two species from wells and river alluvia in the Philippines, differs in the presence of sternal gills on the first pleonite; the uniarticulate condition of the antennulary accessory flagellum; the high number of robust setae on the basal endite of maxilliped (11 vs. 3 in the new taxon, and up to 6 in the rest of taxa of the *Eriopisa*-group); and the G1 carpus, which is longer than propodus (Sawicki et al. 2005).

Nedsia Barnard & Williams, 1995, including 11 species from Australian inland groundwaters, displays a G1 carpus longer than propodus; a broadly expanded, foliaceous U3 exopod; and a 2-segmented mandibular palp (see Bradbury 2002 and references therein).

Norcapensis Bradbury & Williams, 1997, a monotypic genus from subterranean waters of W Australia, differs in the fusion of the proximal articles of the antennal flagellum; the carpus of G1 longer than propodus; and the huge G2 propodus, with a short posterior margin and a strongly oblique palm margin.

Tunisopisa Stock, 1980, a monotypic genus from wells in Tunisia, displays a non-elongated exp2 of U3 but is traditionally included in the *Eriopisa*-group. This taxon shows a presumed unsegmented maxillulary endopod; a broadly expanded, foliaceous U3 exopod; a G1 propodus longer than carpus; and a peculiar palm of G1, provided with a series of transverse integumentary ridges (Gauthier 1936).

The new Indonesian species is assigned to *Psammogammarus* after its P7 basis, similar to P6, and the proportions of the two distal segments of the mandibular palp, with segment 3 much shorter than segment 2. Only some species in *Nedsia* among members of the *Eriopisa*-group show a slender or weakly broadened basis of P7 approaching the nearly linear basis of P7 of the new taxon, but all *Nedsia* members display a 2-segmented mandibular palp.

Psammogammarus wallacei sp. n. differs at first glance from a highly distinctive group of three species of non-interstitial habits, inhabitants of anchialine caves and wells, namely *Ps. burri* Jaume & Garcia, 1992 from the Balearic Is., *Ps. longidactylus* Vonk & Stock, 1987 from Bonaire (Netherlands Antilles), and *Ps. longiramus* (Stock & Nijssen, 1965) from Entedebir Is. (Red Sea). This cluster is characterised by the common display of a male G2 with non-excavated, evenly convex palm margin and an elongated, longer-than-broad carpus.

Psammogammarus gracilis (Ruffo & Schiecke, 1975), from the shallow infralittoral interstitial medium of Malta (Mediterranean), shows a highly characteristic bisinusoid conformation of the male G2 palm margin. This feature differs markedly from the condition displayed in the rest of *Psammogammarus*, including the new species, where the palm margin is either excavated or evenly convex.

A third cluster of *Psammogammarus*, of interstitial habits, displays a male G2 palm margin strongly excavated, namely: *P. coecus* S. Karaman, 1955 from the western Mediterranean and Adriatic shallow infralittoral; *P. garthi* (Barnard, 1952) from a tidal pool at Baja California (Mexico); *P. initialis* Stock & Sánchez, 1987 and *P. stocki* Vonk, 1990, both from beaches and tidal pools at Tenerife (Canary Is.); *P. mawatarii* Tomikawa, Kakui and Yamasaki 2010 from a tidal pool in southern Japan; and *P. spinosus* Stock & Vonk, 1992 from a beach at the Cape Verde Islands. Additional remarkable differences between these and other *Psammogammarus* species vs. *P. wallacei* sp. n. are shown in Table 1. Intraspecific variation has been accounted for. For instance *P. burri* possesses the rather high number of 19 setae on the coxal endite (=outer plate) of the maxillule (character 13, Table 1). However, this number is fixed within the other 6 specimens used for this study. Another research that focussed on variation within bo-

Table 1. Main diagnostic features of *Psammogammarus* species.

		P. wallacei sp. n.	*P. bluefieldensis*	*P. burri*
1	male G2, outline of palm margin	excavated	?	convex
2	male G2, mid-palmar strong robust setae	0	?	3
3	male G2, carpus	broader>long	?	longer>broad
4	U3 exopod, relative length of segments	exp2 > exp1	exp2 < exp 1	exp2 < exp1
5	U3 end, % length of exp1	57	34	23
6	U1 protopod, basofacial robust setae	1	2	1
7	U2 protopod, robust setae on distolateral angle	1	1	1
8	U2 protopod, robust setae on distomed. angle	4	2	3
9	telson, lateral robust setae	2	0	3
10	telson, distal robust setae	1	?	0
11	epimeral plate III, posteroventral angle	weakly produced	strongly produced	quadrate
12	epimeral plates, ventral margin (robust setae)	1-(2 or 3)-3	?	2-4-4
13	maxillule, setae on coxal endite	6	4	19
14	maxillule, basal endite (robust setae)	9	7	16
15	maxilla inner lobe, no. setae on oblique row	4	3	16
16	maxilliped, basal endite (robust setae)	3	3	3
17	maxilliped, ischial endite (robust setae)	4	?	7
18	P7 basis, outline	weakly expanded	weakly expanded	weakly expanded
19	P7 basis, margins	subparallel	subparallel	subparallel
20	pleopod II, sexual dimorphism	yes	?	No

	P. coecus	*P. caesicolus*	*P. garthi*	*P. gracilis*	*P. initialis*
1	excavated	excavated	excavated	excavated	excavated
2	1?	0	0	0	0
3	broader>long	broader>long	broader>long	broader>long	broader>long
4	exp2 > exp1	exp2 < exp1	exp2 = exp1	exp2 = exp1	exp2 > exp1
5	54	72	20	19	89
6	2	3	2	0	1
7	1	3	1	0	1
8	2	4	2?	1	4
9	2 or 3	3	1–2 setae	1	3
10	2 or 3	1	2 setae	2	3–4 spines
11	strongly produced	quadrate	strongly produced	rounded	weakly produced
12	0-0-0	0-1-1	?	0-0-0	0-1-2
13	7	6	5	5	14
14	9	9	9	7	9
15	6	5	5	3	15
16	3	6	3	0	3
17	7	4	0?	?	11
18	weakly expanded	weakly expanded	weakly expanded	weakly expanded	moderately expanded
19	subparallel	subparallel	subparallel	subparallel	convex
20	No	no	?	?	no

	P. longidactylus	*P. longiramus*	*P. mawatarii*	*P. scopulorum*	*P. spinosus*	*P. stocki*
1	convex	convex	excavated	?	excavated	excavated
2	0	0	0	?	0	0
3	longer>broad	longer>broad	broader>long	?	broader>long	broader>long
4	exp2 < exp1	exp2 < exp1	exp2 > exp1	exp2 < exp1	exp2 < exp1	exp2 = exp1
5	117	110	27	96	36	19
6	1	1	1	1	1	0
7	0	1	1	1	1	1
8	2	2	2	2	2	1
9	2	4	1	2	2	3
10	2	2	1	0	2	0
11	weakly produced	weakly produced	rounded	strongly produced	rounded	rounded
12	0-1-2	?	0-0-0	0-1-1	0-0-0	1-1-1
13	14	15	5	7	5	4
14	9	9	9	9	7	7
15	12	12	4	5	4	4
16	3	3	3	3	3	0
17	6	8	4	4	4	0
18	broadly expanded	moderately expanded	weakly expanded	weakly expanded	weakly expanded	weakly expanded
19	convex	subparallel	subparallel	subparallel	subparallel	subparallel
20	no	?	?	?	?	yes?

gidiellid amphipods also confirmed only small variation is present in this feature – in one case out of seven 6 spines present instead of 7 (Vonk et al. 1999).

Only *P. caesicolus* Stock, 1980 from Curaçao and Bonaire displays a shallowly excavated male G2 palm margin approaching the condition found in the new species. This species shares also with the new taxon the display of a reduced armature on both the coxal endite of the maxillule and the inner plate of the maxilla, a comb of 4 robust setae on the distomedial angle of U2 protopod, an elongate U3 endopod, and a robust seta on tip of telson (see Table 1). But they differ markedly in the exp2 of U3, which is shorter than exp1 in *P. caesicolus* vs. longer in the new species; in the presence of 2–3 basofacial spines on the protopod of U1 in *P. caesicolus* vs. only one in the new species; in the armature of epimeral plates, devoid of robust setae in *P. caesicolus* vs. a 1-(2 or 3)-3 arrangement in the new species; and in the armature of palm angle of G2 in both sexes, with 4 robust setae in male and three in female *P. caesicolus*, vs. two robust setae in both sexes in the new species.

Two species of *Psammogammarus* are known only from a single female, but their morphology enables an easy separation from the new taxon. Thus, *P. scopulorum* Stock, 1983, a coarse sand bar inhabitant of Los Roques archipelago in Venezuela differs markedly from the new species in the telson armature, devoid of lateral robust setae; the reduced marginal armature on both protopod and rami of U1 and U2; the comparatively longer U3 endopod (attaining 96% length of proximal segment of exopod, vs. 57% in the new species); the relative length of the U3 exopodal segments, with exp1 longer than exp2 (vs. the reverse in the new species); and the armature of epimeral plates, with 0-1-1 robust setae compared to 1-(2 or 3-3) in the new species (see Table 1; Stock 1983).

Psammogammarus bluefieldensis Ortiz, Lalana & Beltrán, 1993, from shallow muddy bottoms of the Caribbean coast of Nicaragua, differs from the rest of members of the genus in the display of a comparatively shallowly excavated telson (cleft only to almost midway compared to almost at base in the rest of species) and a 3-articulate accessory flagellum of antennule. In addition, it differs from the new species in the U1 and U2 rami, devoid of marginal armature; the shorter U3 endopod (attaining only 34% length of exp1, vs. 57% in the new species); and the U3 exp2, much shorter than exp1 (63% length of exp1, vs. exp2 longer than exp1 in the new species), among other distinctive features (see Table 1).

The new species from Indonesia displays a faint sexual dimorphism on pleopod II, where the male displays a rake conformed of short and blunt curved spinules along the medial margin of the proximal article of the exopod (Fig. 7B, C). Vonk (1990: 274 and fig. 1f) also noticed the presence of a unusual swelling placed in exactly the same position in the male pleopod II of *P. stocki* Vonk, 1990. Furthermore, Stock and Vonk (1987: 246) stated "(male) pleopods normally segmented, not transformed" in the description of *P. longidactylus*, and the same holds for *P. caesicolus* Stock, 1980 (Stock 1980: 377). We have checked directly for the condition of pleopod II in at least two species of *Psammogammarus* of which we had material available for study. *P. burri* Jaume & Garcia, 1993, a member of the cluster of species characterised by the display of a male G2 with an evenly convex, non-excavated palm margin and an elongated carpus, displays a non-sexually dimorphic pleopod, as stated in the original description. Likewise, a single male specimen of *Psammogammarus* cf. *caecus* –belonging to the cluster that displays a male G2 with a strongly excavated palm and a short, broader-than-long carpus– showed an unmodified pleopod II. This specimen was gathered with the other two at the Balearic Sea slope (552–1263 m depth) and represents the first record of the genus in deep waters (Cartes and Sorbe, 1999). We thus discard that sexual dimorphism in pleopod II could be relevant in the taxonomic refinement of the genus, its value remaining limited to a mere species-level autapomorphic trait.

Discussion

Ternate is situated in the centre of maximum marine species diversity, the Coral Triangle (Hoeksema 2007). The ranges of many marine benthic species overlap in this area. Most of these species have a larval phase during which dispersal through currents takes place. The low sea level stand during the Last Glacial Maximum (LGM) and the direction of inter-oceanic currents from the Pacific to the Indian Ocean are considered important in determining the ranges of reef coral species (Hoeksema 2007).

Because subterranean amphipods are known to be poor dispersers, their distribution patterns are expected to depend more on plate tectonics than on oceanic currents (Holsinger 1991; Stock 1993; Myers and Lowry 2009). Nevertheless, the subterranean beach environments may be very dynamic, even at secluded spots, and their fauna may move with the sediment, suggesting at least some dispersal within coastal areas (Vonk and Sánchez 1993; Vonk and Nijman 2006). However, the present study on *Psammogammarus wallacei* sp. n. and its closest relatives suggests that the fauna of southeastern Asia is still very poorly known (cf. Holsinger 1993), despite recent studies (e.g. Myers and Lowry 2009).

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