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Joeropsididae Nordenstam, 1933 (Crustacea, Isopoda, Asellota) from the Lizard Island region of the Great Barrier Reef, Queensland, Australia

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Abstract

The marine isopod family Joeropsididae (Asellota) is documented for the Lizard Island region of the Great Barrier Reef, Australia. Fifteen species of *Joeropsis* are recorded, including ten new species; descriptive notes are provided for five species that lacked adequate material for description. A revised family and genus diagnosis is presented together with comments on the most useful characters for species identification and a key to *Joeropsis* of the Lizard Island region.

Keywords

Isopoda, Asellota, *Joeropsis*, coral reef, Australia, southwestern Pacific, taxonomy

Introduction

The family Joeropsididae Nordenstam, 1933 and the genus *Joeropsis* Koehler, 1885 both have a global distribution, being absent only from polar waters (Schotte et al. 2011). *Joeropsis* is well represented in tropical regions worldwide, with more than 58% (53 of 86, including undescribed Australian species) of the known species from shallow (< 50 metres) coastal waters and coral reefs. Of the known species, only seven have been reported from depths greater than 300 metres, with *Joeropsis antarctica* Menzies & Schultz, 1968 recorded from 1,408 metres off the South Shetland Islands, Antarctica.

Joeropsis appears to be ubiquitous in coral-reef habitats with previous records indicating diversity in the order of two to six species in any region or locality. For example six species are known from coral reefs of the Seychelles and its territories (Kensley and Schotte 2002), two species from the Mascarene Islands (Müller 1991a), three species from the Society Islands (Müller 1989) and four species from Easter Island (Kensley 2003). The collecting methods used by those workers did not involve SCUBA so were restricted to the intertidal or very shallow (<2 metres) depths, or were from ship-based dredges or sleds. Collection methods used during the Census of Marine Life CReefs (see http://www.aims.gov.au/creefs) Lizard Island expeditions obtained a far higher number of both specimens and species, indicating the species diversity for this genus on Australian coral reefs may be in the order of 10 to 15 species per region to approximately 30 metres depth.

Knowledge of the Australian fauna rests with the single contribution of Just (2001), later summarised by Poore and Lew Ton (2002), totalling three species in three genera, all from the Bass Strait and Tasmania, south-eastern Australia. A fourth species was described from Macquarie Island, Australia Territory in the Southern Ocean (Hale 1937). No species of Joeropsididae had been recorded from tropical waters anywhere in Australia prior to this work.

Material and methods

Sampling. Shallow coral-reef habitats can be broadly divided into two convenient categories: inter-tidal reef flat and sub-tidal outer reef to about 30 metres. Algae can be regarded as a sub-category of both. Both categories are sampled in much the same way. Samples of dead coral substrate (including fossil or compacted reef, eroded and dead coral heads; coral rubble was particularly productive) were collected by hand into a 20–25 litre plastic bucket and moderately broken up in the laboratory, the water laced with a few drops of concentrated formaldehyde and left to stand for 5–30 minutes. Small samples were collected in 250 μm or 350 μm mesh bags and processed the same way. The sample was then elutriated (= rinsed) using a seawater hose with the washings passed through a wet sieve or fine-mesh net and either sorted immediately under a microscope or fixed in formaldehyde or ethanol for later sorting. Other methods included ethanol rinsing and freshwater rinsing of samples.

Sand samples were collected by gently scraping and excavating by hand into a 'ziplok' plastic bag, usually taking a volume of less than one litre, then formalin rinsed in a tray and sieved through a net. Mobile sand at the base of gullies or bommies[1], and sand accumulation on top of bommies or ridges were particularly productive.

[1] 'Bommie' (contracted from bombora, in turn derived from the Dharuk Aboriginal word bumbora) refers to the large free–standing coral outcrops, often a massive *Porites* colony, usually extending to just below low-tide level; these structures can reach 10 metres in height. Used widely on collection data labels; Bommie Bay, Lizard Island is named for these structures.

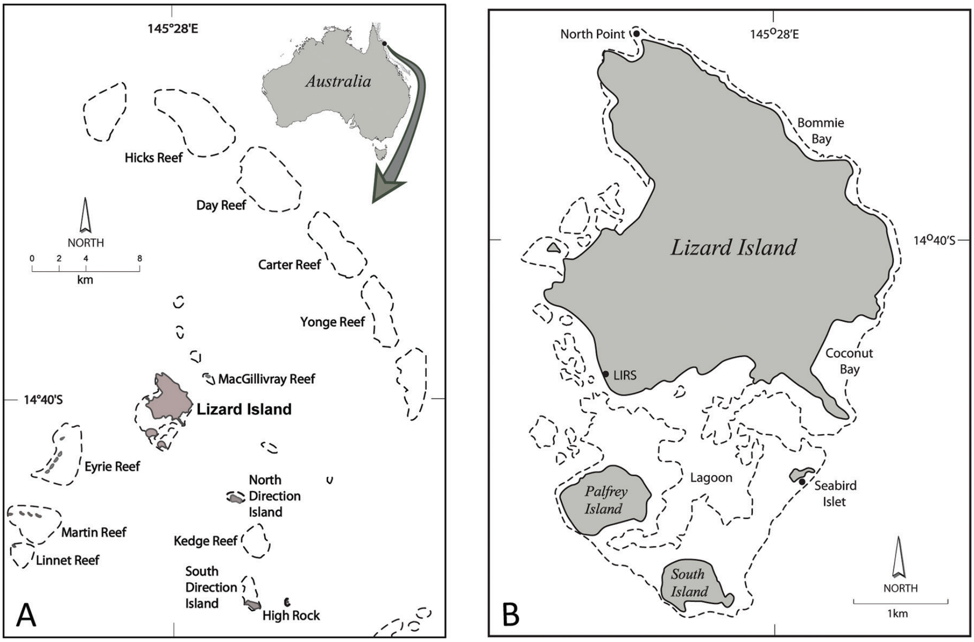

Figure 1. CReefs collecting sites in the Lizard Island region with names of major collecting sites. **A** Lizard Island group and nearby islands and reefs **B** Lizard Island group. LIRS = Lizard Island Research Station.

These techniques were used for sampling both intertidal reef flats and subtidal reef slopes to 30 metres, by snorkelling or using SCUBA. Shallow (<2 metres) subtidal sand samples were only taken by SCUBA, being impractical to sample while snorkelling.

Principal sites are shown in Figure 1. Sampling was carried out under GBRMPA Permit G08–27858.1 and General Fisheries Permit (QLD DPI) 95152.

Descriptions. Conventions largely follow Bruce (2009a, 2009b) with some minor changes in terminology. The dactylar ungui of Asellota are traditionally referred to as 'claws' and that term is used here. Pleopods 4 and 5 are simple lobes and never feature in species identification or in the characterisation of higher taxa; furthermore they are tiny and difficult to extract and are routinely not figured. Pereopods 1–7 are closely similar and only pereopods 1, 2 and 7, or 1 and 7 are illustrated. Pleopod 1 has the rami fused—width measurements refer to the paired rami. Width in all cases refers to maximum width, unless otherwise specified. All species descriptions are based on the holotype.

Dissections. CReefs samples were all preserved in high-grade ethanol (a requirement of the CReefs program), without first fixing in formalin. Such material is initially brittle and over time remains very fragile. Dissections from a single specimen, particularly of small species (<2 mm) resulted in effective destruction of the specimen and dissected appendages are often broken. Consequently, descriptions given here may be from several specimens, and for those species represented by few specimens dissection was strictly minimised. Species represented by single specimens or few damaged specimens have not been described, but have been included in order to document overall species diversity in the region of Lizard Island. Microslide preparations were made using CMCP-9 or Lactic Acid stained with lignin pink, the appendages being remounted in Gurr's Aquamount; or whole animals stained and partly cleared in CMCP-9 and then dissected and mounted in Aquamount. Transferring minute mounted appendages from Lactic Acid to Aquamount resulted in some losses of appendages. Some dissections failed.

Names. Classical names were derived using Brown (1956) except where otherwise stated; Aboriginal names were taken from Anonymous (1965).

Abbreviations

LIRS Lizard Island Research Station;
MTQ Museum of Tropical Queensland, Townsville;
QM Queensland Museum, Brisbane;
SMF Senckenberg Institute, Frankfurt;
RS robust seta/e.

Primary collectors

NLB Niel L. Bruce;
MB-P Magda Błażewicz-Paszkowycz (University of Lodz, Poland);
CB Chad Buxton;
JC Julian Caley (Australian Institute of Marine Science, Townsville).

Systematics

Family Joeropsididae Nordenstam, 1933

Jaeropsinae Nordenstam, 1933: 190.
Iaeropsinae. – Nierstrasz 1941: 288.
Jaeropsidae. – Menzies 1962: 63. – Menzies and Glynn 1968: 75.
Joeropsididae. – Sivertsen and Holthuis 1980: 96. – Wilson 1997: 86. – Kussakin 1999: 10. – Just 2001: 303.

Diagnosis. Male. Body dorsoventrally flattened; lateral margins normally parallel, occasionally tapering posteriorly. Pereonites of subequal length; lateral margins covering coxae in dorsal view, entire, smooth or finely serrate. Pereopods all ambulatory, all similar; pereopod 1 with 2 dactylar claws, pereopods 2–7 with 2 or 3 dactylar claws. Eyes dorsolateral, sessile. Anterior margin of cephalon with strong median concavity. Pseudorostrum present, inserted into cephalic concavity, rarely joined along straight line. Pleon with no free pleonites. Pleotelson subequal in width to pereonite 7. Antenna 1 shorter than cephalon, peduncular article 1 expanded, longer than articles 2 and 3 combined; flagellum shorter than peduncle, with 3–5 articles. Antenna 2 peduncle geniculate, with article 6 and flagellum folding laterally and posteriorly under lateral margin of expanded article 5; first 4 articles short, article 4 more or less embedded into 3, article 5 longer than 1–4 combined, expanded laterally, article 6 0.5–0,8 as long as article 5, generally widening distally; antennal scale absent; flagellum with enlarged, normally conjoint article 1. Mandible molar a long, slender, pointed projection (often with small accessory denticles); incisor of 4–6 large teeth; lacinia mobilis absent; spine row present. Maxilliped sub-quadrate, covering entire mouthpart field, distally margin convex, with distinct distomesial concavity; palp with at least article 2 mesially expanded, epipod half length of endite or less. Pleopod 2 rami with longer or shorter lateral fringe of modified cuticular scales. Pleopod 3 exopod biarticulate, longer than endopod, with lateral fringe of modified cuticular scales; endopod with 3 plumose setae. Pleopod 4 exopod vestigial. Uropods biramous, inserted ventrally on pleotelson usually within distinctive insinuation in pleotelson margin; peduncle broader than long and mesially expanded; rami shorter than peduncle. Anus outside pleopodal chamber, between bases of uropodal peduncles, partly or entirely covered by pleopod 1.

Female. Pleopod 2 with lateral fringe of cuticular scales; partly or entirely covering anus. Female spermathecal duct opening on anterior surface of pereonite 5, oviduct opening ventrally on pereonite 5 mesially to coxa. Oostegites on pereopods 1–5.

Included genera. *Joeropsis* Koehler, 1885, *Rugojoeropsis* Just, 2001 and *Scaphojoeropsis* Just, 2001.

Remarks. Only a few species of the family Joeropsididae had been described by the 1990s. By 1950 eleven species of *Joeropsis* had been named, and a further 13 species had been described by 1975. In a period of high activity in the late twentieth century (see Poore and Bruce 2012), notably by Hans-Georg Müller and Brian Kensley, a further 29 species were named (see Schotte et al. 2011), all the while the family remaining with the single genus. In 2001 Jean Just described the first new genera within the Joeropsididae, and at that point there were 69 known species and two subspecies (Just 2001).

The family is readily recognised, including in the field, by the compact body shape, with a characteristically robust and reflexed antenna 2, and small, ventrolaterally inserted uropods with a peduncle that is large in relation to the tiny rami.

The mouthpart morphology suggests that the highly mobile joeropsidids are carnivorous. The mandibles usually possess a five-cusped incisor with acute cusps, completely lacks a lacinia mobilis, has a prominent spine row of simple or finely serrate spines and a blade-like molar process, all characters that are analogous to the mouthparts of the scavenging or predatory isopod family Cirolanidae. These characters are not unique to the family, but the maxilliped morphology with the large endite, small palp and epipod, and mesially excavate distal margin does appear to be unique.

The phylogenetic relationships of the Joeropsididae remain unsettled. Three analyses have included representatives of the family (Wilson 1994; Rapuach et al. 2009; Lins et al. 2012) but none had the Joeropsididae as the primary focus. Wilson (1994), using morphological data, included the Joeropsididae as a potential outgroup for the Janiridae, and found that the Joeropsididae was sister to *Jaera*+*Iais* (Wilson 2004, figs 1 and 2), but those clades lacked supporting apomorphies. In contrast both Raupach et al. (2009) and Lins et al. (2012), using molecular data, found that the Joeropsididae are closer to the Acanthaspidiidae. Raupach et al. (2009) showed the Joeropsididae as sister group to the Acanthaspidiidae (including *Ianthopsis*) and that Joeropsididae+Acanthaspidiidae are sister to *Iarthrippa* (part of Janiridae) (Raupach et al. 2009, fig. 1, strict consensus tree), or sister to *Iarthrippa* (Raupach et al. 2009, fig. 2, 50% majority rule tree), with Joeropsididae+*Iarthrippa* sister to Acanthaspidiidae+*Ianthopsis*. Lins et al. (2012) found that the Joeropsididae is sister group to the Acanthaspidiidae (Fig. 1). These analyses uphold the monophyly of the Joeropsididae, and indicate a close but unresolved relationship to both the Acanthaspidiidae and Janiridae.

Key to the genera of Joeropsididae

1	Body lateral margins straight; maxillipedal palp article 2 only with distomesial lobe, not widest distally	**2**
–	Body lateral margins converging posteriorly; maxillipedal palp articles 2 and 3 widest distally, each with distomesial lobe	***Scaphojoeropsis***
2	Body dorsal surfaces coarsely granular and nodulose	***Rugojoeropsis***
–	Body dorsal surfaces smooth or finely granular, with or without longitudinal carinae	***Joeropsis***

Genus *Joeropsis* Koehler, 1885

Joeropsis Koehler, 1885: 7. – Kensley and Schotte 1989: 87; Wilson 1997: 86; Kussakin 1999: 12; Just 2001: 304; Kensley and Schotte 2002: 1428.

Jæropsis. – Richardson 1905: 476; Stebbing 1905: 50.

Jaeropsis. – Vanhöffen 1914: 531(unjustified emendation). – Nordenstam 1933: 191. – Menzies and Barnard 1959: 10; Menzies 1962: 64; Menzies and Glynn 1968: 76.

Iaeropsis. – Nierstrasz 1941: 288 (unjustified emendation).

Diagnosis. Body lateral margins parallel, with or without dorsal sculpture. Cuticle polished, smooth or finely granular. Pseudorostrum with overhanging apex. Upper lip evenly rounded, less than twice as wide as long. Mandible incisor with 5 or 6 strong subequal evenly spaced cusps; spine row setae long, in regular row, with or without lobe on right mandible spine row. Lower lip, lobes longer than wide, distally tapering, pointed. Maxillipeds endite reaching to end of or beyond palp article 3; palp about half length of endite; palp article 3 without mesial lobe, article 4 much longer than article 3. Pereopod 1 with 2 dactylar claws, pereopods 2–7 with 2 or 3 dactylar claws.

Female. Pleopod 2 (operculum) with at most a few short simple setae apically.

Type species. *Joeropsis brevicornis* Koehler, 1885, by monotypy. Menzies (1962) incorrectly stated the type species to be *J. curvicornis* (Nicolet, 1849) as did Menzies and Glynn (1968). The original orthography on the heading page of Koehler (1885) was *Joeropsis*, thereafter *Jœropsis* [œ] not *Jæropsis* [æ], the derivation from *Jaera* notwithstanding; the two spellings can be indistinguishable depending on the font used, but my interpretation is that in some cases the spelling is ambiguous. I follow the first use—*Joeropsis*.

Remarks. Most older diagnoses (e.g. Menzies and Barnard 1959) contain little diagnostic information. Wilson (1997) provided the first restrictive diagnosis. Just (2001) gave the most recent generic diagnosis. A full synonymy was given by Kussakin (1999) for family and genus, though spelling changes were largely ignored, and the synonymy includes two identical spellings.

A number of authors have, over the years, recorded species of *Joeropsis* from widely disparate locations, some commenting on variation, occasionally establishing subspecies. In most such cases the identity of records remote from the type locality or core distribution have to be regarded with caution and scepticism. The records in the literature, particularly earlier than the 1980s, often lack adequate illustrative and descriptive data. Giving just one example, *Joeropsis curvicornis* (Nicolet, 1849) was recorded from Chile (original record), Sri Lanka (Stebbing 1905) and New Zealand (when *J. neozelanica* Chilton, 1891 was considered a junior synonym) but these records are highly unlikely to be the one species.

Maxilliped palp article 3 in most species lacks a distomesial lobe or process, the exception being *Joeropsis sanctipauli* Kensley, 1989, which has a small distomesial lobe (Kensley 1989, fig. 3H). Most species of *Joeropsis*, including all Australian species (those described here and by Just [2001]) have a distomesial lobe only on maxilliped palp article 2, the exception being *Joeropsis mije* sp. n., which also has a small distolateral lobe on palp article 1 (Fig. 15D, E).

The mandible incisor has five or six distally acute cusps, usually of similar size. Exceptions are *Joeropsis indica* Müller, 1991b and *Joeropsis makrogenys* sp. n., both of which have markedly asymmetric mandibular incisors, with a truncate mesial cusp on the left mandible with the remaining cusps set on a lobe; in *J. indica* the right mandible cusps are of the usual form, but in *J. makrogenys* the right mandible proximal or posterior cusp is conspicuously wide and broadly rounded.

Species recognition. Species within a region are most readily identified by their characteristic colour pattern. Colour pattern is consistent, though shade and density of colour may vary, particularly on preservation. Some species will share similar colour patterns, and for old preserved specimens that have lost the colour pattern morphological characters can be used, the most obvious in the first instance being shape of the pseudorostrum. Other characters that are useful include shape of head (lateral margins narrowing anteriorly, concave, straight; serrate or not), body compactness, antenna 1 and antenna 2 (serrate or not; articles lobed or not; relative width of antenna 2 articles 5 and 6); details of the maxilliped (notably the distal margin of the endite and details of the maxilliped palp), pleotelson shape and serrations of the lateral margins; in some cases the male pleopod 1 will separate species but the differences are often subtle. Eyes are always dorsolateral in position, but vary in size and may be marginal or sub-marginal in position. A small number of species show dorsal sculpting in the form of carinae or low nodules, ventral keels may be present and the uropods may be with (most species) or without (few species) a distomesial spine. Supporting characters can be seen in body proportions and uropods. Generally the mandible is similar throughout the genus, but two species, *Joeropsis indica* Müller 1991b and *J. makrogenys* sp. n. have the proximal cusps on the left mandible incisor set on a lobe, and both species have a comparatively large labrum; additionally the mandibular incisor right proximal cusp is broadly rounded in *J. makrogenys*. Pereopods and pleopods are generally uniform throughout the genus, although there are differences in pereopod proportions and setation, including the number of dactylar claws on pereopods 2–7 (2 or 3 claws, and 2 claws with a stiff seta).

Sexual dimorphism. Males and females of *Joeropsis* are generally similar, other than for the primary sexual characters. There are some instances of secondary sexual variation, for example the strongly dimorphic antenna 2 in *Joeropsis mije* sp. n. and *J. minuta* Müller, 1989 (see Müller 1989, fig. 15F, G), while in *Joeropsis panstikta* sp. n. the males have fewer spines on the pleotelson in comparison to the female.

Key to the Lizard Island species of *Joeropsis*

This key applies to the named species, 10 of the 15 recorded species in the region. Identifications should be checked against the remarks given for the listed but undescribed species. Inter-reef habitats beyond diving depth are highly likely to have further undescribed species.

1	Pereonites 5–7 with sub-median dorsal carinae .... ***J. tropida* sp. n.**
–	Body without longitudinal dorsal carinae **2**
2	Body dorsally coloured on all pereonites and pleotelson **3**
–	Body with dorsal coloured bands on head only or some pereonites or variously patterned with one or more clear pereonites **4**
3	Body dorsally evenly dark brown, surfaces moderately setose; (pseudorostrum anteriorly rounded) .... ***J. adusta* sp. n.**
–	Body dorsally reddish brown, head always darker than rest of body; surfaces smooth; (pseudorostrum anteriorly rounded) .... ***J. panstikta* sp. n.**
4	Head only with transverse dark-brown band **5**
–	Head and some other somites coloured **7**
5	Pseudorostrum anteriorly concave; maxilliped endite without excavate distomesial angle .... ***J. makrogenys* sp. n.**
–	Pseudorostrum not anteriorly concave; maxilliped endite with excavate distomesial angle **6**
6	Body 4.7 as long as wide; lateral margins of head not strongly serrate; pseudorostrum lateral margins converging, apex narrowly subtruncate; pleotelson lateral margins each with 5 serrations .... ***J. wattora* sp. n.**

– Body 3.1 as long as wide; lateral margins of head strongly serrate; pseudorostrum anteriorly narrowed, narrowly rounded; pleotelson lateral margins each with 8 serrations .... ***J. varanus* sp. n.**
7 Pseudorostrum anteriorly acute.. **8**
– Pseudorostrum rounded, angled or excavate (not anteriorly acute).............. **9**
8 Body with four transverse dark bands on head and posterior of pereonites 1, 2 and 4; head and pereonites 1–4 lateral margins serrate..... ***J. jiigurru* sp. n.**
– Body with head only with diffuse band; pereonites without distinct bands (male antenna 2 article 5 near circular in outline) .... ***J. mije* sp. n.**
9 Head lateral margins anteriorly narrowed; body dorsally with sparse chromatophores, pereonite 5 clear; pseudorostrum anteriorly rounded.... ***J. goobita* sp. n.**
– Head lateral margins sub-parallel; head band short, diffuse, chromatophores present on pereonites 1–4 and 6 and 7, pereonite 5 clear; pereonites 6 and 7 always paler than 1–4; pseudorostrum anteriorly narrowly excavate........ ***J. specca* sp. n.**

***Joeropsis adusta* sp. n.**

http://zoobank.org/8960F365-4D4E-4B3F-A2EB-D2D56ED92CF4
Figs 2–4

Material. *Holotype*. ♂ (1.6 mm), 'High Rock', east of South Direction Island, 14.82428°S, 145.55270°E, 11 September 2010, clean coral rubble 6.0 m, stn LI10-134C, coll. CB (MTQ W33715).

Paratypes. 13 ♂ (1.1–1.6 mm; 3 damaged), 31 ♀ (11 ovig 1.4–1.8; 20 non-ovig. 1.1–1.7mm), same data as holotype (MTQ W33033). ♂ (2.0 mm), ♀ (ovig 2.2 mm), 2 imm. (1.6, 1.2 mm), Seabird Islet, patch reef, in from lagoon entrance, 14.68900°S, 145.46710°E, 11 April 2008, dead coral heads 1.0–2.0 m, stn CGLI-18A, coll. NLB & MB-P (MTQ W13975).

Additional material. 3, Bommie Bay, Lizard Island, 14.66127°S, 145.47130°E, 2 September 2010, dead coral, 6.5 m, stn LI10-57D, coll. CB (MTQ W32756). 12, Bommie Bay, Lizard Island, 14.66127°S, 145.47130°E, 2 September 2010, dead coral on bommie, 3 m, stn LI10-057A, coll. CB (MTQ W32743). 1, Bommie Bay, Lizard Island, 14.66127°S, 145.47130°E, 2 September 2010, coral rubble at base of bommie, 6 m, stn LI10-057B, coll. CB (MTQ W32747). 7, Bommie Bay, Lizard Island, 14.66157°S, 145.47160°E, 8 September 2010, dead coral, 8 m, stn LI10-101B, coll. CB (MTQ W32937). 1, Bommie Bay, Lizard Island, 14.66157°S, 145.47160°E, 8 September 2010, dead coral on wall, 10 m, stn LI10-100C, coll. CB (MTQ W32556). 1, High Rock, 14.82553°S, 145.55170°E, 6 September 2010, fine coral rubble, 6 m, stn LI10-091D, coll. CB (MTQ W32903). 2, High Rock, east of South Direction Island, 14.82462°S, 145.5520°E, 6 September 2010, dead *Acropora* plates, 4 m, stn LI10-092B, coll. CB (MTQ W32921). 1, 'Washing Machine', northwest Lizard Island, 14.6482°S, 145.4570°E, 2 September 2010, coral rubble at base of reef, 12 m, stn LI10-056C, coll. CB (MTQ W32730). 9, Yonge Reef, 14.57735°S, 145.61050°E,

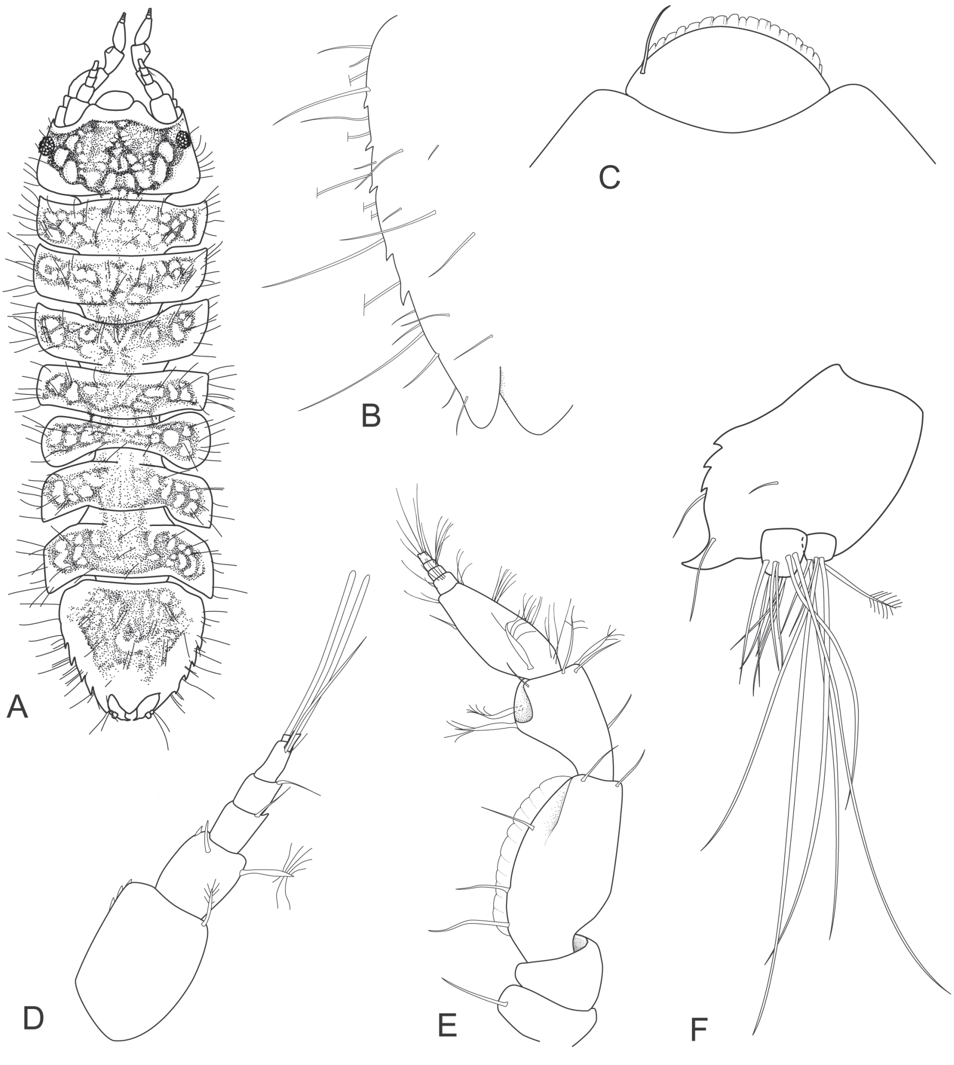

Figure 2. *Joeropsis adusta* sp. n. **A** holotype; remainder male paratype MTQ W33033. **A** dorsal view **B** pleotelson lateral margin **C** pseudorostrum **D** antenna 1 **E** antenna 2 **F** uropod.

10 September 2010, lee side (western) of reef, coral rubble, 10 m, stn LI10-127A, coll. CB (MTQ W32992). 2, Yonge Reef, 14.57735°S, 145.61050°E, 10 September 2010, lee side (western) of reef, coarse coral rubble, 25 m, stn LI10-127F, coll. CB (MTQ W31809). ♀ (non-ovig. 1.3 mm), Yonge Reef, 14.61383°S, 145.6182°E, 18 February 2009, back reef, small coral rubble on sand, 15 m, stn LIZ09-10F, coll. MB-P & NLB (MTQ W34025).

Also examined. *Joeropsis salvati* Müller, 1989; holotype (microslides—SMF 17697) and paratypes (SMF 17690, part; ♀ 1.6 mm, 2 imm 1.2, 0.9 mm).

Description. *Body* 3.6 as long as greatest width, dorsal surfaces matte, dull, moderately setose. *Cephalon* length 0.6 width, lateral margins converging anteriorly, smooth. *Pseudorostrum* 0.5 as long as proximal width, anterior margin rounded. *Eyes* lateral, with ~8 ommatidia, colour orange. *Pereonites* compact, close to each other, without dorsal carinae; *tergite lateral margin* subtruncate (those of pereonite 5 rounded), lateral margins smooth; median keels on sternites 5–7 (or on 6 and 7 or 7 only), keels weakly developed. *Pleotelson* width 1.1 length, dorsal surface with weak and indistinct sub-lateral ridges, caudomedial lobe narrowly rounded; lateral margins weakly convex, each with 5 spines.

Antenna 1 with 5 articles; article 1 1.3 as long as wide, distolateral angle not lobed, weakly serrated, distomesial margin not serrate; article 2 0.5 as long as article 1, 1.2 as long as wide; lateral margins of articles 1 and 2 without cuticular scales; article 3 0.6 as long as article 2; article 4 0.8 as long as article 3; article 5 1.1 as long as article 3, 2.5 as long as proximal width, distally with 2 aesthetascs. *Antenna 2* peduncle article 5 4.2 as long as article 3, 1.9 as long as wide, lateral margin convex, with small cuticular scales, mesial margin straight; article 6 1.4 as long as width, distally expanded, distal width 2.3 proximal width, 0.6 as long as article 5, lateral margin without cuticular scales, mesial margin with 4 simple setae, distodorsal surface without setae; flagellum with 5 articles, article 1 1.1 as long as peduncle article 6, 2.6 as long as combined lengths of remaining articles.

Mandible palp article 2 with 2 long biserrate setae (terminally spatulate), article 3 with 5 long pectinate setae. Right incisor with symmetrical cusps, margins convex, distally acute; left incisor similar to right. *Molar process* distal half finely serrate. Right mandible spine row composed of 9 spines; left spine row divided by truncate lobe, without lacinoid spine. *Maxilla 1* lateral lobe with 12 strongly serrate RS; mesial lobe with 2 long, simple RS. *Maxilla 2* lateral lobe with 4 long, curved, finely serrate setae (2 short, 2 long); middle lobe with 4 long serrate setae, mesial lobe with 3 long simple setae and many long setules. *Maxilliped endite* 2 as long as greatest width, extending to middle of palp article 4, distal margin evenly rounded, mesially with 2 large serrations, with shallow distomesial concavity, with 4 mesial tubercular RS, distomesial margin with 3 coupling setae. *Maxilliped palp* article 2 2.3 as long as article 1, mesial lobe extending to distal margin of article 3, distomesial margin with 1 simple seta; article 3 0.5 as long as article 2, distomesial margin with 1 simple seta; article 4 4.6 as long as wide, mesial margin weakly concave, distally with 4 setae; article 5 0.2 as long as 4, with 4 terminal setae.

Pereopod 1 basis 3.6 as long as wide, inferior margin with 1 proximal simple seta; ischium 0.7 as long as basis, 2.6 as long as wide; merus 0.7 length of ischium, 2.0 as long as wide; carpus 1.0 as long as ischium, 2.8 as long as wide; propodus 3.5 as long as wide, superior margin with 2 simple setae, inferior margin with 3 acute RS; dactylus 0.5 as long as propodus, with 2 claws. Pereopods 2–7 sub-similar, more slender than pereopod 1, each with 3 claws. *Pereopod 7* basis 2.7 as long as wide; superior margin with 1 short proximal simple seta; ischium 0.8 as long as basis, 3.1 as long as wide, superior margin strongly convex at midpoint, superior margin with 1 simple seta (distal

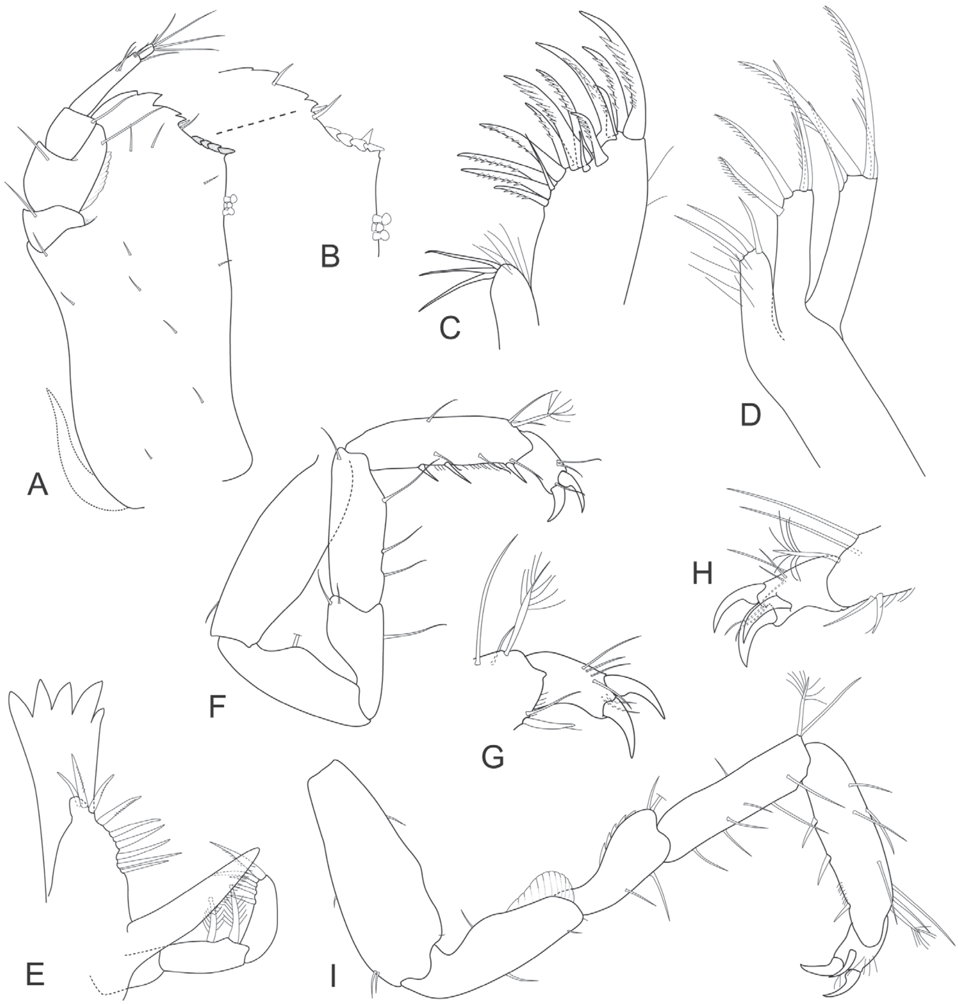

Figure 3. *Joeropsis adusta* sp. n. Male paratype MTQ W33033. **A** maxilliped **B** maxilliped, endite distomesial angle **C** maxilla **D** maxillula **E** mandible **F** pereopod 1 **G** pereopod 1, dactylus **H** pereopod 7 dactylus **I** pereopod 7.

margin with cuticular scale fringe), inferior distal angle with 1 seta; merus 0.6 as long as ischium, 1.9 as long as wide, superodistal angle with 2 simple setae (and short cuticular scale-spines); carpus 0.9 as long as ischium, 3.6 as long as wide, inferior margin with 7 setae, superior distal angle with 1 prominent pappose seta; propodus 1.1 as long as ischium, 3.7 as long as wide, inferior margin with 3 acute RS, superior margin with 6 simple setae; dactylus 0.4 as long as propodus.

Pleopod 1 2.6 as long as greatest width, lateral margin strongly concave, apical lobe broadly rounded, with long marginal setae, lateral margin with slender setae, distolateral lobe acute, not extending to distal margin. *Pleopod 2* protopod 2.3 as long as midwidth, lateral margin mid-half strongly convex, without setae, distal margin straight or weakly concave, with long marginal cuticular scales, apex narrowly rounded; *stylet* in retracted position extending beyond apex. *Pleopod 3* endopod 2.2 midwidth; exopod article 1 2.5 as long as wide, not extending to endopod apex, lateral margin fringed with cuticular scale-spines; article 2 0.5 as long as article 1, lateral and mesial margins with spine-like cuticular scale-setae (laterally; mesial with cuticular scale-setae).

Uropod peduncle extending slightly beyond margin of pleotelson, mediodistal corner strongly produced and acute, distolateral margin with 2 simple submarginal setae, mesial margin finely serrate. Exopod 0.7 as wide as endopod, 1.3 as long as wide, with 8 simple setae. Endopod 1.0 as long as wide, 0.3 as long as peduncle proximolateral margin, apex with 8 long simple setae.

Female. *Pleopod 2* 1.2 as long as proximal width, lateral margins strongly convex, posterior margins straight, apex with 3 sub-apical simple setae.

Size. Males 1.1–1.6 mm, mean 1.4 mm (n=11); ovigerous females 1.4–1.8 mm, mean 1.5 mm (n=11), non-ovigerous females 1.1–1.7 mm, mean 1.4 mm (n=10); all from type series.

Colour pattern. All somites with dark brown chromatophores, darker and more dense on the anterior part of the head. In fresh specimens there is an anterior marginal band clear of chromatophores that together with the clear pseudorostrum, antenna 1 and antenna 2 gives the impression of a white margin to the front of the head. Some brown chromatophores are present on the female operculum.

Variation. The number of pleotelson marginal teeth varied from 1 to 5 (n=24) in males with 4 (23%) or 5 (39%) most frequent; 4–6 (n=22) in ovigerous females with 5 (73%) most frequent and 4 and 6 occurring twice each.

Remarks. Within the Great Barrier Reef and nearby regions *Joeropsis adusta* sp. n. can be identified by being entirely dark brown with a moderately setose dorsal surface, antennular article 1 without distolateral lobe, antenna 2 article 5 not expanded with weakly convex margins and an anteriorly rounded pseudorostrum.

There are a number of species of coral reef *Joeropsis*, some as yet undescribed, that are largely or entirely dark brown in colour. Among these are *Joeropsis salvati* Müller, 1989 from the Society Islands, *Joeropsis lentigo* Kensley & Schotte, 2002 from the Seychelles and *Joeropsis bicornis* Kensley, 2003 from the subtropical Easter Island.

Joeropsis adusta sp. n. differs from the closely similar *J. salvati* in the uropod having an apical spine (weak or absent in *J. salvati*, Fig. 4D), antenna 1 article 1 without distolateral lobe (with lobe), antenna 2 article 5 with straight mesial margin (angled), distally wide uropod (uropod margins sub-parallel) and the pseudorostrum anteriorly rounded (subtruncate to weakly concave, but variable). Müller (1989, fig. 78) illustrated the uropod as lacking a terminal spine, but that is not the case. Re-examinations of the holotype slides shows that the illustrated uropod is damaged, while the other uropod has a small terminal spine (Fig. 4D); a small spine is also present in two of the three paratypes examined (not visible in the third specimen).

Joeropsis bicornis has a distinct head band, the brown chromatophores are more diffuse than in *Joeropsis adusta* and the uropod lacks a terminal spine (present in *J. adusta*).

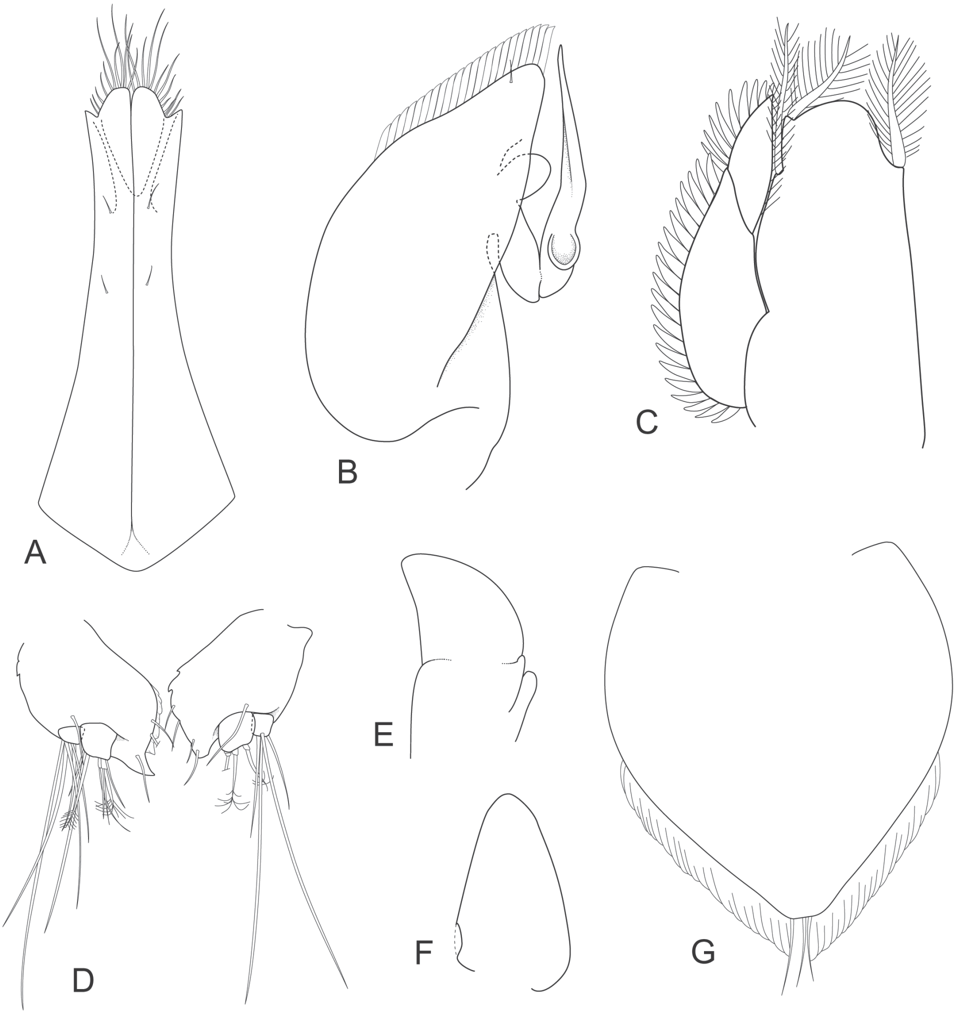

Figure 4. *Joeropsis adusta* sp. n. Male and female paratypes MTQ W33033. **A–C, E, F** pleopods 1–5 respectively **G** female pleopod 2 **D** *Joeropsis salvati* Müller, 1989, holotype, SMF 17690, uropods.

Joeropsis adusta sp. n. is closely similar to *J. lentigo*, but morphological comparisons are not possible as the species was only briefly diagnosed with a figure of the habitus, and small figures of the male pleopod 1 and uropod, and there were no comparative comments. *J. adusta* differs in being dark brown (vs red–brown in *J. lentigo*), having a distally wider somewhat club-shaped uropod, the mesial margin of which is feebly serrate (smooth in *J. lentigo*), fewer marginal spines on the pleotelson (1–5 vs 3–6), more dense chromatophores (though this is probably variable) and a longer clear band on the anterior margin of the head.

Joeropsis adusta sp. n. is the only entirely dark-brown setose species recorded from the Lizard Island region, and fresh material can be identified on that basis. Other largely brown species are either more pale (e.g. *J. panstikta* sp. n., described herein), lack the abundant dorsal setae or have distinct clear areas such as a single pereonite (usually pereonite 5) or certain tergite lateral margin, or darker patches. Characters of the head, pleotelson spines, pseudorostrum shape, setosity and details of the appendages should all be compared to other species where possible.

Distribution. Fringing reef at North Point and Seabird Islet, Lizard Island, South Direction Island and back reef of Yonge Reef (Fig. 1); 1 to 25 metres.

Etymology. The epithet taken from the Latin *adustus*, meaning singed or scorched (to brown).

Joeropsis goobita sp. n.

http://zoobank.org/3B2755A8-6C20-4A50-918F-191B65240AD3

Figs 5–7

Material. *Holotype*. ♂ (1.6 mm), Seabird Islet, Lizard Island, 14.69497°S, 145.4657°E, 23 February 2009, outer reef front, dead coral heads, 6–8 m, stn LIZ09-19B, coll. MB-P & NLB (MTQ W31841).

Paratypes. 4 ♂ (1.6, 1.6, 1.5 [dissected, 3 slides], 1.5, 1.3 mm), 8 ♀ (ovig. 1.6 [dissected, 2 slides], non-ovig. 1.7, 1.4, 1.5, 1.5, 1.3, 1.0. 0.9 mm), same data as holotype (MTQ W31251). ♂ (1.6 mm), ♀ (non-ovig. 1.3 mm), North Point, Lizard Island, 14.64553°S, 145.45335°E, 12 April 2008, compacted dead *Acropora*, 0.5 m, stn CGLI-20C, coll. NLB (MTQ W13977). ♂ (1.6 mm), Seabird Islet, in from lagoon entrance, 14.68900°S, 145.46710°E, patch reef, 11 April 2008, dead coral heads 1.0–2.0 m, stn CGLI-18A, coll. NLB & MB-P. (MTQ W31842). ♂ (1.7 [whole mount], 1.6, 1.5, 1.5 mm), ♀ (non-ovig. 1.6, 1.6, 1.5 mm), juv. (1.0 mm), Yonge Reef, 14.62317°S, 145.6201°E, 13 February 2009, reef pass, dead coral heads, 5 m, stn LIZ09-11A, coll. NLB & MB-P (MTQ W31843). ♂ (1.4, 1.3 mm), ♀ (ovig. 1.6, 1.4, 1.3, non-ovig. 1.6, 1.5 mm), Day Reef, 14.48356°S, 145.5459°E, 13 February 2009, outer reef, coral heads in gully, 10 m, LIZ09-04B, coll. MB-P. (MTQ W31844).

Additional material. 5, not measured, Day Reef, 14.47119 °S, 145.5297°E, 13 February 2009, outer reef, dead coral on vertical wall, 10–12 m, stn LIZ09-03A, coll. MB-P (MTQ W31845). ♂ (in 2 pieces), Day Reef, 14.48283°S, 145.5564°E, 19 February 2009, outer reef front, dead *Acropora* slab, 10 m, stn LIZ09-13C, coll. NLB & MB-P (MTQ W31846). 1, Yonge Reef, 14.57735°S, 145.61050°E, 10 September 2010, lee side (western) of reef, coral rubble, 10 m, stn LI10-127A, coll. CB (MTQ W33716)

Description. *Body* 2.6 as long as greatest width, appearing dorso-ventrally flat, dorsal surfaces matte, dull, moderately setose. *Cephalon* length 0.5 width, lateral margins converging anteriorly or weakly concave, finely serrate (posterior half). *Pseudorostrum* 0.5 as long as proximal width, anterior margin rounded. *Eyes* lateral, with 12

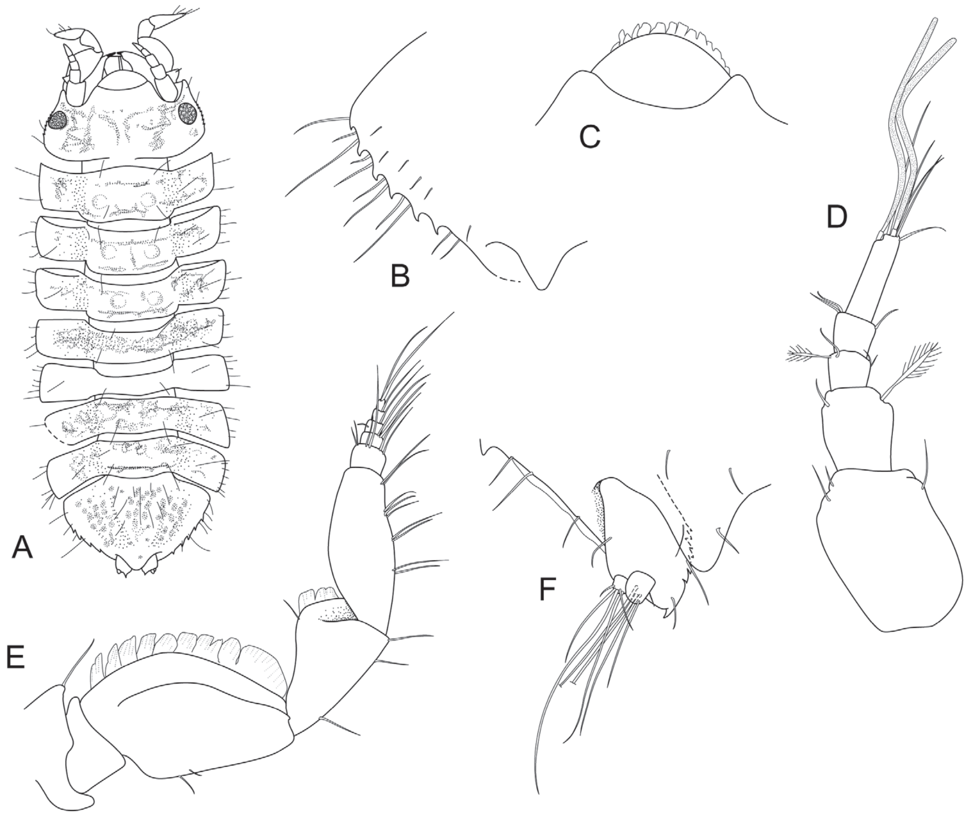

Figure 5. *Joeropsis goobita* sp. n. **A** holotype; remainder male paratype (1.7 mm MTQ W31843). **A** dorsal view **B** pleotelson lateral margin **C** pseudorostrum **D** antenna 1 **E** antenna 2 **F** uropod.

ommatidia, colour orange (when live). *Pereonites* not compact, widely spaced, without dorsal carinae; *tergite lateral margin* subtruncate, lateral margins smooth; median keels weak, not carinate. *Pleotelson* width 1.4 length; dorsal surface with single median and paired submedian low ridges, caudomedial lobe sub-acute; lateral margins convex, each with 5–6 spines.

Antenna 1 with 5 articles; article 1 1.3 as long as wide, distolateral angle not lobed, not serrated, distomesial margin not serrate; article 2 0.5 as long as article 1, 1.2 as long as wide; lateral margins of articles 1 and 2 without cuticular scales; article 3 0.4 as long as article 2; article 4 1.1 as long as article 3; article 5 2.4 as long as article 3, 3 as long as proximal width, distally with 2 aesthetascs. *Antenna 2* article 5 3.8 as long as article 3, 1.6 as long as wide, lateral margin strongly convex, with prominent cuticular scales, mesial margin straight; article 6 1.5 as long as width, distally expanded, distal width 2.2 proximal width, 0.6 as long as article 5, lateral margin with cuticular scales on distal one-third, mesial margin with 3 simple setae, distodorsal surface without setae; antenna 2 flagellum with 6 articles, article 1 1.1 as long as peduncle article 6, 2.2 as long as combined lengths of remaining articles.

Mandible palp article 2 with 2 long biserrate setae, article 3 with 3 long pectinate setae. Right incisor with symmetrical cusps, margins convex, distally acute; left mandible incisor similar to right incisor. *Molar process* distal half finely serrate. Right mandible spine row composed of 7 spines; left spine row without lacinoid spine. *Maxilla 1* (not figured) lateral lobe with 9 strongly serrate RS, and 3 simple RS; mesial lobe with 5 long, simple RS. *Maxilla 2* (not figured) lateral lobe with 4 long, curved, finely serrate setae (2 short, 2 long); middle lobe with 4 long serrate setae (2 short, 2 long), mesial lobe with 4 long simple setae and many long setules. *Maxilliped endite* 2 as long as greatest width, extending beyond palp, distal margin evenly rounded, smooth, with shallow distomesial concavity, with 4 mesial tubercular RS, distomesial margin with 3 coupling setae. *Maxilliped palp* article 2 1.6 as long as article 1, mesial lobe absent, distomesial margin with 1 simple setae; article 3 0.6 as long as article 2, distomesial margin with 4 simple setae; article 4 3.1 as long as wide, mesial margin weakly concave, distally with 4 setae; article 5 0.2 as long as 4, with 4 terminal setae. *Epipod* 2.3 as long as basal width, distally narrowly rounded; 0.8 as long as palp, 0.4 as long as endite.

Pereopod 1 basis 2.3 as long as wide, inferior margin with 1 simple seta; ischium 0.8 as long as basis, 2.6 as long as wide; merus 0.7 length of ischium, 1.5 as long as wide; carpus 1.0 as long as ischium (1.04), 2.1 as long as wide; propodus 3.1 as long as wide, superior margin with 2 simple setae (and prominent penicillate seta at distal angle); inferior margin with 2 acute RS, dactylus 0.5 as long as propodus, with 2 claws. Pereopods 2–7 sub-similar, more slender than pereopod 1, each with 3 claws. *Pereopod 7* basis 2.9 as long as wide; superior margin with 2 short simple setae; ischium 0.8 as long as basis, 2.7 as long as wide, superior margin weakly convex at midpoint, superior margin with 2 simple setae, inferior distal angle with 0 setae; merus 0.7 as long as ischium, 1.8 as long as wide, superodistal angle with 2 simple setae; carpus 0.9 as long as ischium, 3.2 as long as wide, inferior margin with 2 setae (distal one-third with cuticular scale-setae), superior distal angle with 1 prominent pappose seta; propodus 1.2 as long as ischium, 4.5 as long as wide, inferior margin with 2 acute RS, superior margin with 2 simple setae (and distal penicillate seta); dactylus 0.3 as long as propodus.

Pleopod 1 2.2 as long as greatest width, lateral margin strongly concave, apical lobe broadly rounded, with long marginal setae, lateral margin with slender setae, distolateral lobe narrowly rounded, not extending to distal margin. *Pleopod 2* protopod 2 as long as midwidth, lateral margin mid-half weakly convex, without setae, distal margin weakly concave, with long marginal cuticular scales, apex acute; *stylet* in retracted position not reaching apex. *Pleopod 3* endopod 1.2 midwidth (medially fused to protopod); exopod article 1 3.0 as long as wide, not extending to endopod apex, lateral margin weakly fringed with cuticular scale-setae; article 2 0.4 as long as article 1, lateral margin with short cuticular scale-setae.

Uropod peduncle extending well beyond margin of pleotelson, mediodistal corner weakly produced and acute, distolateral margin 1 simple submarginal setae, mesial margin smooth. Exopod 0.5 as wide as endopod, 1.5 as long as wide, with 5 simple setae. Endopod 1.3 as long as wide, 1.0 as long as peduncle proximolateral margin, apex with 5 long simple setae.

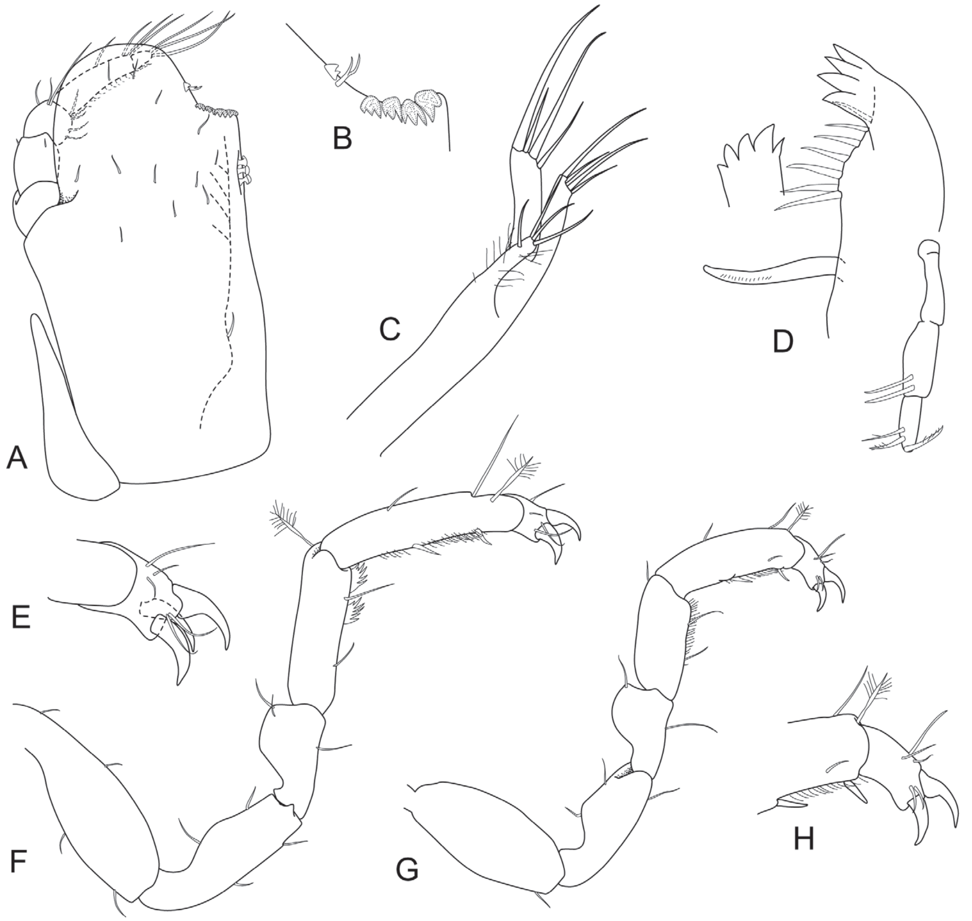

Figure 6. *Joeropsis goobita* sp. n. **A–D** female paratype (ovig. 1.6 mm) **E–H** male paratype (1.6 mm MTQ W31251). **A** maxilliped **B** maxilliped, endite distomesial angle **C** maxilla **D** mandible **E** pereopod 7 dactylus **F** pereopod 7 **G** pereopod 1, **H** pereopod 1 dactylus.

Female. *Pleopod 2* 1.3 as long as proximal width, lateral margins weakly convex, posterior margins weakly sinuate, with long cuticular scale-setae, apex with 2 subapical simple setae.

Colour pattern. Head and pereonites 1–4, 6, 7 and pleotelson with loosely spread chromatophores, pereonite 5 clear; pereonites 4 and 6 slightly darker than other pereonites in some specimens. If chromatophores are contracted specimens appear more pale than figured specimen.

Size. Males 1.3–1.7 mm (mean= 1.5 mm, *n*=14); ovigerous females 1.3–1.6 mm (mean= 1.5 mm, *n*=4), non-ovigerous females 0.9–1.6 mm (mean= 1.4 mm, *n*=12).

Remarks. *Joeropsis goobita* sp. n. may be recognized by the setose body surfaces, the relatively short (0.5 long as wide) and anteriorly narrowed head, loosely scattered chromatophores over the dorsum giving a finely spotted and translucent appearance,

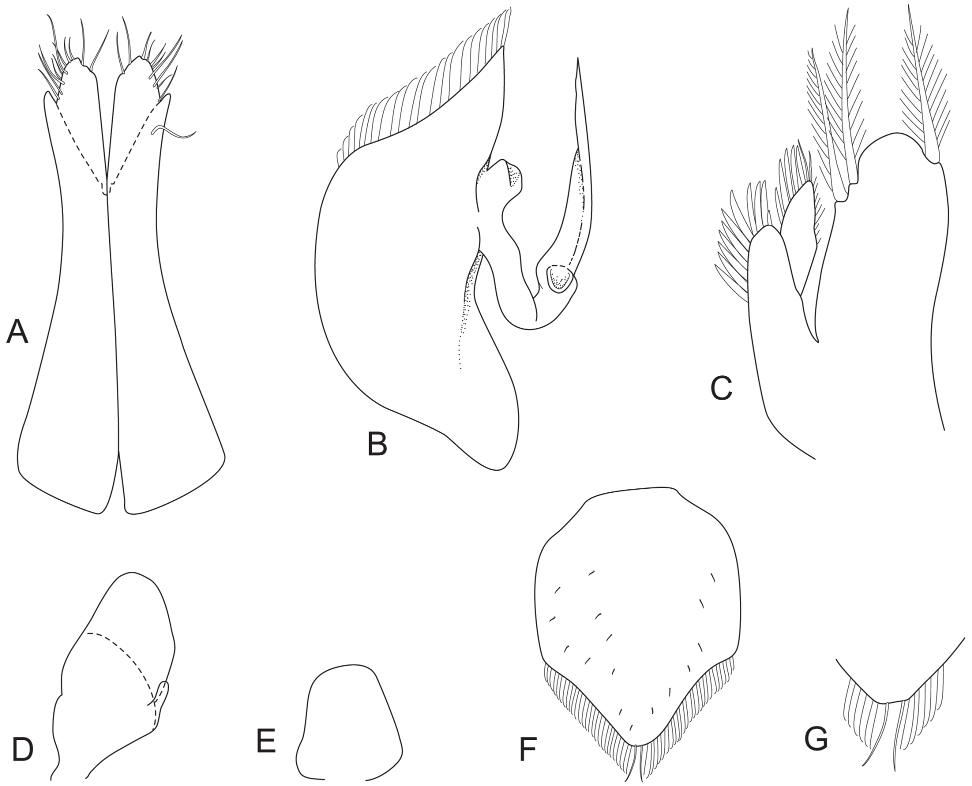

Figure 7. *Joeropsis goobita* sp. n. **A–C** male paratype (1.5 mm) **D–E** female paratype (1.7 mm MTQ W31251). **A–E** pleopods 1–5 respectively **F** female pleopod 2 **G** female pleopod 2 apex.

except for pereonite 5, which is clear; there is no distinct head band and the pseudorostrum is short and anteriorly rounded. The body is noticeably flat in appearance.

Distribution. North Point, Lizard Island and off Seabird Islet; Day and Yonge Reefs (Fig. 1); depths probably intertidal to 12 m.

Etymology. The epithet is an Aboriginal word meaning small; noun in apposition.

Joeropsis jiigurru sp. n.

http://zoobank.org/38472B0C-31F5-4A8A-A615-7B84A9FEB407

Figs 8–10

Material. All material from the Lizard Island region, northern Great Barrier Reef, Queensland.

Holotype. ♂ (1.9 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, coral rubble under bommie overhang, 15 m, stn LIZ09-16B, coll. NLB & MB-P (MTQ W33666).

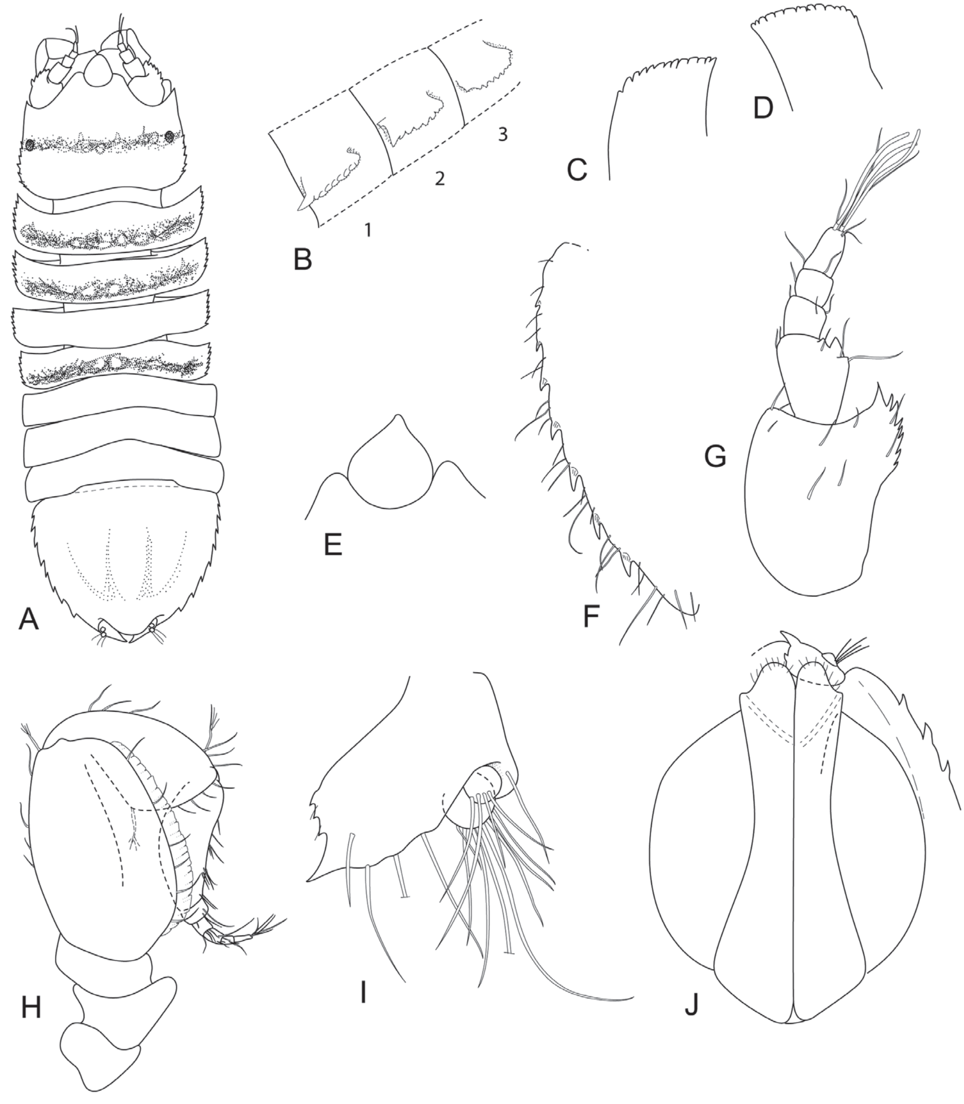

Figure 8. *Joeropsis jiigurru* sp. n. **A–F, J** holotype; remainder male paratype (1.9 mm) MTQ W33668. **A** dorsal view **B** median keels on sternites 1–3 on pleotelson lateral margin **C** coxa 2, **D** coxa 6 **E** pseudorostrum **F** pleotelson lateral margin **G** antenna 1 **H** antenna 2 **I** uropod **J** pleopods 1 and 2, *in situ*.

Paratypes. ♀ (ovig. 1.3 mm), Day Reef, 14.48539°S, 145.5464°E, 19 February 2009, outer reef front, coral rubble in gully, 17 m, stn LIZ09-12F, coll. NLB & MB-P (MTQ W33667). ♂ (1.9 mm), Yonge Reef, 14.57735°S, 145.61050°E, 10 September 2010, inner reef front, silty coral rubble under bommie overhang, 5 m, stn LI10-127B, coll. CB (MTQ W33668).

Description. *Body* 2.9 as long as greatest width, dorsal surfaces polished in appearance, without setae. *Cephalon* length 0.7 width, lateral margins straight, finely serrate (proximal half). *Pseudorostrum* 1.2 as long as proximal width, anterior margin

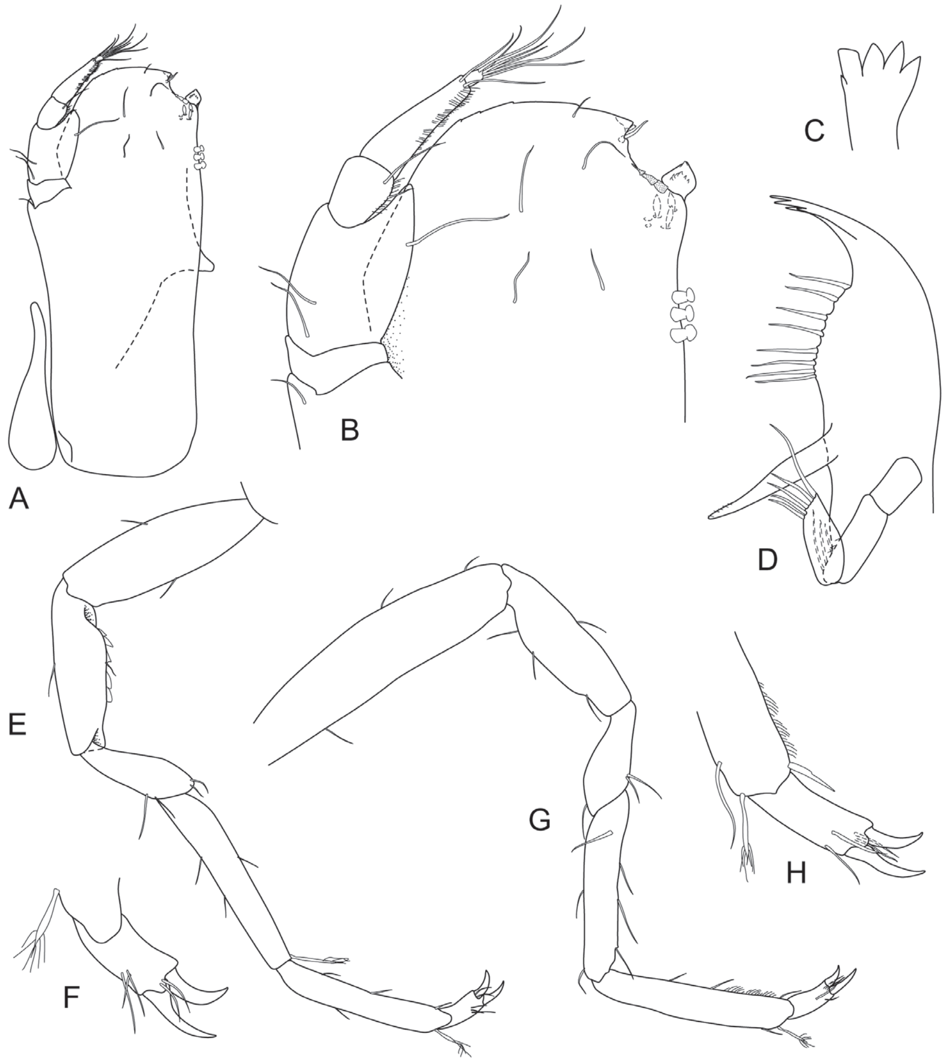

Figure 9. *Joeropsis jiigurru* sp. n. Female paratype MTQ W33667. **A** maxilliped **B** maxilliped, endite distomesial angle **C** left mandible incisor **D** right mandible maxilla maxillula **E** pereopod 7 **F** pereopod 7 dactylus **G** pereopod 1, **H** pereopod 1 dactylus.

acute (lateral margin anteriorly concave). *Eyes* sublateral, with 4 ommatidia, colour dark brown. *Pereonites* compact, close to each other (posteriorly compact, anteriorly spaced), without dorsal carinae; *tergite lateral margin* subtruncate (tergite lateral margin 1–5 serrate), lateral margins 1–4 finely serrate; median keels on sternites 1–6, keels well developed (on sternites 1–3; serrate). *Pleotelson* width 0.9 length; dorsal surface with single median and paired submedian low ridges, caudomedial lobe broadly rounded; lateral margins weakly convex, each with 8 spines.

Antenna 1 with 5 articles; article 1 1.2 as long as wide, distolateral angle strongly lobed, strongly serrated, distomesial margin not serrate; article 2 0.8 as long as article

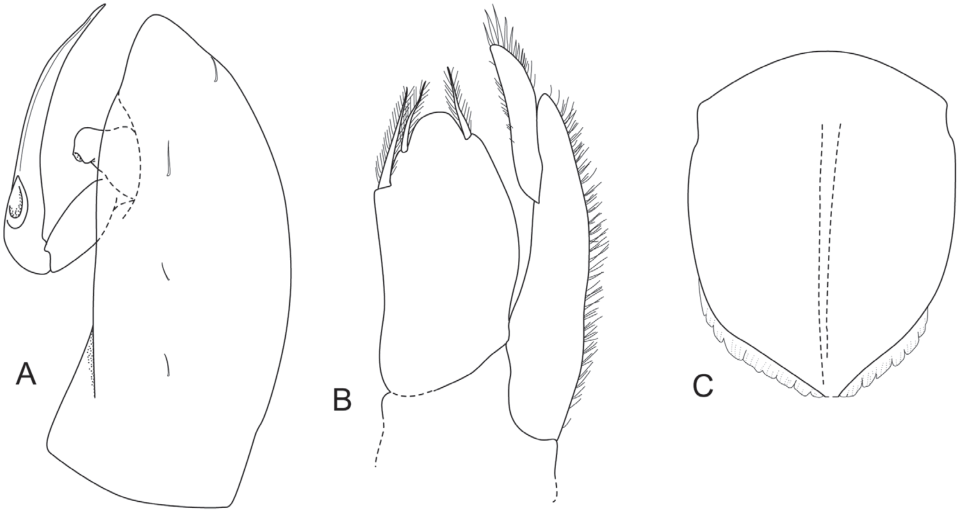

Figure 10. *Joeropsis jiigurru* sp. n. Male paratype MTQ W33668. **A** pleopod 2 **B** pleopod 3 **C** female paratype MTQ W33667, pleopod 2.

1, 0.8 as long as wide; lateral margins of articles 1 and 2 with cuticular scales on distal margins; article 3 0.4 as long as article 2; article 4 0.4 as long as article 3; article 5 1.3 as long as article 3, 1.6 as long as proximal width, distally with 3 aesthetascs. *Antenna 2* peduncle article 5 1.7 as long as articles 1–4 combined, 2.9 as long as article 3, 1.7 as long as wide, lateral margin convex, with prominent cuticular scales, mesial margin weakly convex; article 6 1.7 as long as width, distally expanded, distal width 2.2 proximal width, 0.7 as long as article 5, lateral margin without cuticular scales, mesial margin with 10 simple setae, distodorsal surface without setae; flagellum with 6 articles, article 1 0.7 as long as peduncle article 6, 1.6 as long as combined lengths of remaining articles.

Mandible palp article 2 with 3 long biserrate setae, article 3 with 5 long pectinate setae. Right incisor with 5 cusps (4 large, 1 small), margins convex, distally acute; left mandible incisor similar to right incisor. *Molar process* distal quarter finely serrate. Right mandible spine row composed of 8 spines; left spine row not divided by truncate lobe, without lacinoid spine. *Maxilliped* endite 2.3 as long as greatest width, extending to distal margin of palp article 4, distal margin evenly rounded, smooth, with shallow distomesial concavity, with 3 mesial tubercular RS (and 1 triangular RS), distomesial margin with 3 coupling setae. *Maxilliped palp* article 2 4.8 as long as article 1, mesial lobe extending to distal margin of article 3, distomesial margin with 1 simple seta; article 3 0.4 as long as article 2, distomesial margin with 2 simple setae; article 4 2.9 as long as wide, mesial margin weakly concave, distally with 2 setae; article 5 0.1 as long as 4, with 7 terminal setae. *Epipod* 4.3 as long as basal width, distally narrowly rounded; 1.0 as long as palp, 0.4 as long as endite.

Pereopod 1 basis 4.4 as long as wide, inferior margin with 2 simple setae; ischium 0.6 as long as basis, 2.3 as long as wide; merus 0.6 length of ischium, 0.5 as long as wide; carpus 1.0 as long as ischium, 5.1 as long as wide; propodus 5.6 as long as wide, superior margin 2 simple setae; inferior margin with 2 acute RS, dactylus 0.4 as long as propodus, with 2 claws. Pereopods 2–7 sub-similar, more slender than pereopod 1, each with 2 claws. *Pereopod 7* basis 3.2 as long as wide; superior margin with 1 short simple seta; ischium 0.8 as long as basis, 3.1 as long as wide, superior margin weakly convex at midpoint, superior margin with 2 simple setae (and cuticular scales), inferior distal angle with 0 setae; merus 0.6 as long as ischium, 2.3 as long as wide, superodistal angle with 2 simple setae; carpus 1.0 as long as ischium, 5.5 as long as wide, inferior margin with 2 setae, superior distal angle with 1 prominent pappose seta; propodus 1.0 as long as ischium, 6.3 as long as wide, inferior margin with 2 acute RS, superior margin with 1 simple setae (and distal penicillate seta); dactylus 0.4 as long as propodus.

Pleopod 1 2.4 as long as greatest width, lateral margin weakly concave, apical lobe broadly rounded, with short marginal setae, lateral margin with slender setae, distolateral lobe narrowly rounded, not extending to distal margin. *Pleopod 2* protopod 2.6 as long as midwidth, lateral margin mid-half weakly convex, without setae, distal margin weakly convex, without marginal cuticular scales, apex broadly rounded; *stylet* in retracted position extending beyond apex. *Pleopod 3* endopod 2.4 midwidth; exopod article 1 3.6 as long as wide, extending to endopod apex, lateral margin densely fringed with cuticular scale-setae; article 2 0.5 as long as article 1, lateral and mesial margins with short cuticular scale-setae and with spine-like cuticular scale-setae (spine-like distally only).

Uropod peduncle extending slightly beyond margin of pleotelson, mediodistal corner weakly produced and acute, distolateral margin with 4 simple submarginal setae, mesial margin finely serrate. Exopod 0.7 as wide as endopod, 1.1 as long as wide, with 5 simple setae. Endopod 0.8 as long as wide, 0.3 as long as peduncle proximolateral margin, apex with 9 long simple setae.

Female. *Pleopod 2* 1.3 as long as proximal width with weak median longitudinal carina, lateral margins straight, posterior margins straight, with cuticular scales.

Colour pattern. White with narrow transverse red–brown band on head and posterior of pereonites 1, 2 and 4; interocular head band occupies 10% of head length.

Size. Males 1.9 mm, ovigerous female 1.3 mm.

Remarks. *Joeropsis jiigurru* sp. n. is most readily recognized by the distinctive colour pattern of four narrow transverse bands, running between the eyes and across pereonites 1, 2 and 4. The eyes are noticeably small, the lateral margins of the head and tergite lateral margin 2–4 are serrate, the pleotelson is relatively broad, with eight well-developed teeth on each lateral margin, the pseudorostrum is anteriorly acute, and the pereopods are relatively slender, with all pereopods with two dactylar claws. The male holotype has well-developed serrated mid-sternal keels—an apparently unique character for the genus.

Distribution. Lizard Island region: Hicks, Day and Yonge Reefs (Fig. 1); at depths 5 to 17 metres.

Etymology. The epithet is the Aboriginal name for Lizard Island in the language of the Dingaal people (DERM Lizard Island http://www.derm.qld.gov.au/parks/lizard-island/culture.html); noun in apposition.

Joeropsis makrogenys **sp. n.**
http://zoobank.org/F1B1094E-2FFA-47BB-B925-401D8197AC7A
Figs 11–13

Joeropsis sandybrucei. – Bruce 2009b: 805 (part, Lizard Island specimens).

Material. *Holotype*. ♂ (3.0 mm), ♀ (ovig. 2.5 mm), Lizard Island, 14.6867°S, 145.4551°E, 30 August 2010, 3 m, shallow lagoon, LI10-037, coll. I. Marin (MTQ W32671).

Paratypes. 3 ♂ (2.3 mm [dissected]; imm. 1.2 1.1 mm), 4 ♀ (non-ovig. 2.5 [dissected], 2.2, 2.0, 1.9 mm), 5 mancas (1.2, 1.2 1.1, 1.1, 1.0 mm), 'High Rock', east of South Direction Island, 14.82428°S, 145.55270°E, 11 September 2010, reef slope, clean coral rubble, 6 m, LI10-134C, coll. CB (MTQ W34010). ♂ (2.2 mm), ♀ (ovig. 3.1, non-ovig. 2.5 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, dead coral heads on reef edge, 5–7 m, LIZ09-16E, coll. NLB & MB-P (MTQ W31289). ♂ (1.3 mm), Yonge Reef, 14.62317°S, 145.6201°E, 13 February 2009, reef pass, dead coral heads, 5 m, stn LIZ09-11A, coll. NLB & MB-P (MTQ W34011). ♀ (non-ovig. 1.3 mm), Day Reef, 14.48283°S, 145.5564°E, 19 February 2009, outer reef front, small rubble in gully, 7.5 m, stn LIZ09-13A, coll. MB-P & NLB (MTQ W34012). ♀ (non-ovig. 2.3 mm), Yonge Reef, 14.60681°S, 145.6311°E, 20 February 2009, outer reef front, dead coral, 30 m, stn LIZ09-15B, coll. S. Smith & JC (MTQ W31286). ♂ (2.1, imm 1.1 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, dead coral heads on reef edge, 5–7 m, LIZ09-16E, coll. NLB & MBP (MTQ W34013). ♀ (ovig. 2.3 mm), MacGillivray Reef, 14.64792°S, 145.48660°E, 1 September 2010, 14 m, reef slope, coral rubble, LI10-041, coll. M. Capa (MTQ W32691). ♂ (1.6 mm), Day Reef, 14.47045°S, 145.52840°E, 5 September 2010, 17 m, outer reef, dead coral heads, LI10-077B, coll. CB (MTQ W34014). ♀ (non-ovig. 2.6 mm), Lizard Island, 14.6867°S, 145.4551°E, 30 August 2010, 3 m, shallow lagoon, LI10-037, coll. I. Marin (MTQ W34015). ♀ (ovig. 2.8 mm), north side of Lizard Island, 'Washing Machine', 14.65383°S, 145.46340°E, 27 August 2010, coral rubble, 5 m, LI10-017C, coll. CB (MTQ W34016). ♀ (non-ovig 3.0 mm), imm/manca (0.9 mm), Lizard Island, 'Bommie Bay', 14.66157°S, 145.46160°E, 8 August 2010, 12 m, coral rubble, LI10-100A, coll. CB (MTQ W34017). ♂ (2.2 mm), imm. (1.3 mm), Lizard Island, 'Bommie Bay', 14.66157°S, 145.47160°E, 8 September 2010, 8 m, dead coral heads, LI10-101B, coll. CB (MTQ W34018). ♀ (non-ovig. 2.1 mm), Lizard Island, 'Bommie Bay', 14.6615°S, 145.4717°E, 9 September 2010, 10 m, silty coral in cave, LI10-111, coll. M. Wakeford (MTQ W32952).

Additional material. Lizard Island, non-type specimens from Bruce (2009): 2 ♂ (2.3, 2.1 mm), 8 ♀ (ovig. 3.9, 3.6, 3.5, 3.2, 3.2, 2.8; non-ovig. 3.2, 3.1 mm), imm. (1.2 mm), 14.6890°S, 145.4671°E, patch reef, lagoon entrance in from Seabird Islet, 11 April 2008, dead coral heads, 1.0–2.0 m, stn CGLI-018A, coll. NLB & MB-P (MTQ W13805). ♀ (imm. 1.6 mm), patch reef, in lagoon entrance from Seabird Islet, 14.6890°S, 145.4671°E, 19 April 2008, medium small rubble, 1.0–3.0 m, CGLI-

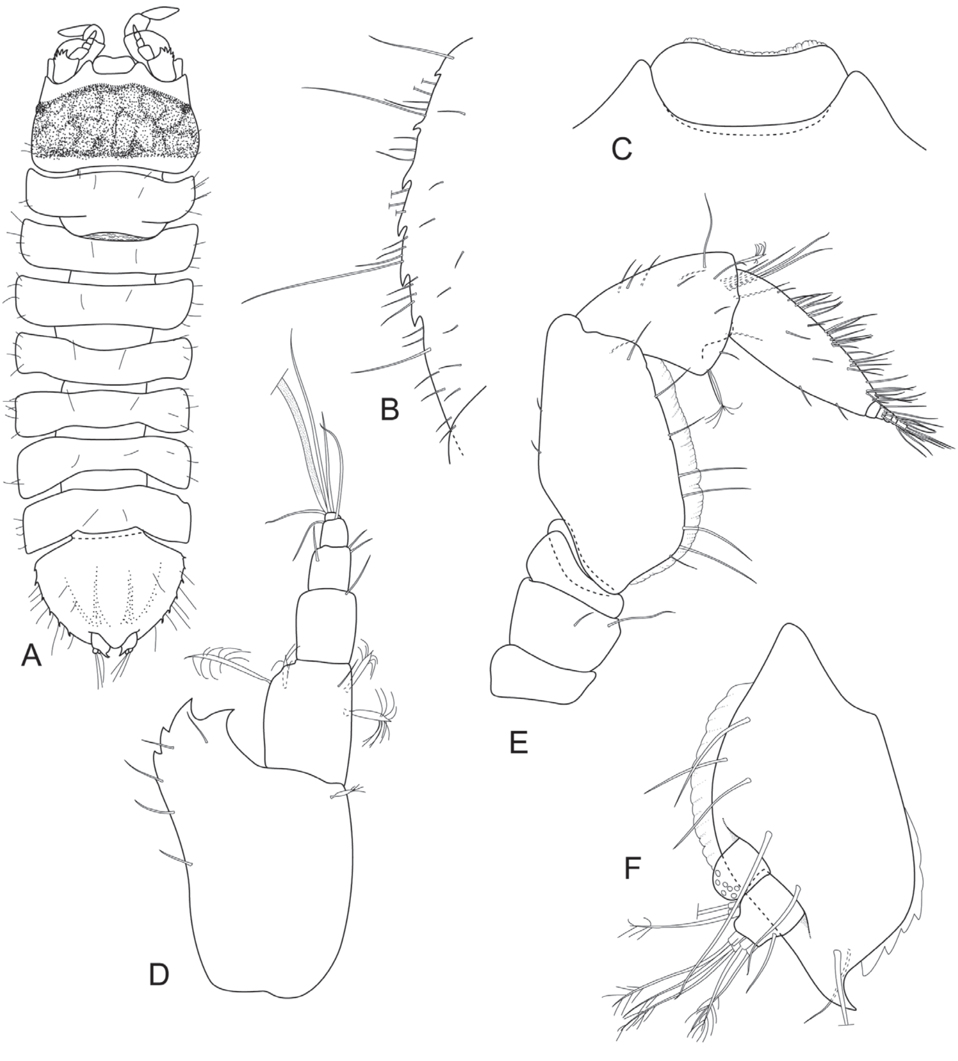

Figure 11. *Joeropsis makrogenys* sp. n. **A, C** holotype; remainder male paratype (2.3. mm) MTQ W34010. **A** dorsal view **B** pleotelson lateral margin **C** pseudorostrum **D** antenna 1 **E** antenna 2 **F** uropod.

041B, coll. NLB (MTQ W13806). ♂ (1.6 mm), ♀ (ovig. 2.6 mm), North Point, 14.64553°S, 145.45335°E, 12 April 2008, dead coral heads, 1.0–1.5 m, CGLI-20A, coll. NLB (MTQW13807). ♂ (2.0 mm), ♀ (ovig. 2.9 mm), patch reef off LIRS, Casuarina Beach, 14.68039°S, 145.44530°E, 15 April 2008, dead corals, 1.0 m, CGLI-031B, coll. NLB (MTQ W13808). **Papua New Guinea, Madang**: 19 ♂, ♀ and imm., 5°08.4'S, 145°50.9'E, 28 April 1989, south of Wongat Island, barrier reef back reef, coarse *Halimeda* covered rubble, 7 m, stn. 14B, coll. NLB & Rosella Ueba (MTQ W19759). 1 specimen, Wongat Island, 5°08.1'S, 145°50.6'E, 1 May 1989, semi-exposed, rubble among alcyonarians, NW corner, 1–2 m, Stn 16, coll. NLB (MTQ

W19769). 1 specimen, Masamoz Reef, 5°08.1'S, 145°50.3'E, 24 April 1989, dead plates and *Acropora* rubble, 12 m, stn 10A, coll. NLB & M. Jebb (MTQ W19772).

Also examined. *Joeropsis indica* Müller, 1991b, holotype (specimen lacking head and pleotelson + microslide) (SMF 18191) and female paratype (microslide only) (SMF 18192), Beruwala [approx. 37 km south of Colombo], Sri Lanka, 8–16 May 1989, coll. H.-G. Müller.

Description. *Body* 3.4 as long as greatest width, dorsal surfaces finely granular, with few setae. *Cephalon* length 0.7 width, lateral margins weakly sinuate, smooth. *Pseudorostrum* 0.4 as long as proximal width, anterior margin concave. *Eyes* lateral, with 12–16 ommatidia, colour black. *Pereonites* not compact, widely spaced, without dorsal carinae; *tergite lateral margin* subtruncate, lateral margins smooth; median keels weak, not carinate. *Pleotelson* width 1.2 length, dorsal surface with single median and paired submedian low ridges, caudomedial lobe narrowly rounded; lateral margins convex, each with 6 spines.

Antenna 1 with 6 articles; article 1 1.4 as long as wide, distolateral angle strongly lobed, strongly serrated, distomesial margin not serrate; article 2 0.5 as long as article 1, 1.3 as long as wide; lateral margins of articles 1 and 2 without cuticular scales; article 3 0.7 as long as article 2; article 4 0.6 as long as article 3; article 5 0.4 as long as article 3, 1.0 as long as proximal width, distally with 2 aesthetascs. *Antenna 2* peduncle article 5 1.9 as long as articles 1–4 combined, 5.3 as long as article 3, 2.1 as long as wide, lateral margin distal three-quarters straight, with prominent cuticular scales, mesial margin angled; article 6 1.3 as long as width, distally expanded, distal width 2.1 proximal width, 0.5 as long as article 5, lateral margin without cuticular scales, mesial margin with 3 simple setae, distodorsal surface with few simple setae; flagellum with 6 articles, article 1 1.1 as long as peduncle article 6, 4 as long as combined lengths of remaining articles.

Mandible palp article 2 with 3 long biserrate setae, article 3 with 5 long pectinate setae. Left mandible incisor with lateral cusp thick, produced, distally truncate and mesial cusps rounded, 'fish-tail' shape; right incisor with symmetrical cusps, margins convex, distally acute and mesial-most cusp wide, distally subtruncate. *Molar process* distal half finely serrate. Right mandible spine row composed of 6 spines; left mandible spine row composed of 9 spines, not divided by truncate lobe; with lacinoid spine. *Maxilla 1* lateral lobe with 10 strongly serrate RS, and 3 simple RS; mesial lobe with 3 long, simple RS. *Maxilla 2* lateral lobe with 4 long, curved, finely serrate setae (2 short, 2 long); middle lobe with 4 long serrate setae (2 short, 2 long), mesial lobe with 4 long simple setae and many long setules. *Maxilliped endite* 2.1 as long as greatest width, extending to distal margin of palp article 3, distal margin entirely oblique, smooth, without distomesial concavity, with 4 mesial tubercular RS, distomesial margin with 3 coupling setae. *Maxilliped palp* article 2 2.6 as long as article 1, mesial lobe short, distomesial margin with 2 simple setae; article 3 0.7 as long as article 2, distomesial margin with 3 simple setae; article 4 2.7 as long as wide, mesial margin weakly concave, distally with 5 setae; article 5 0.2 as long as 4, with 8 terminal setae.

Pereopod 1 basis 2.3 as long as wide, inferior margin with 4 simple setae (short) inferior margin with 1 simple seta; ischium 0.7 as long as basis, 2.2 as long as wide;

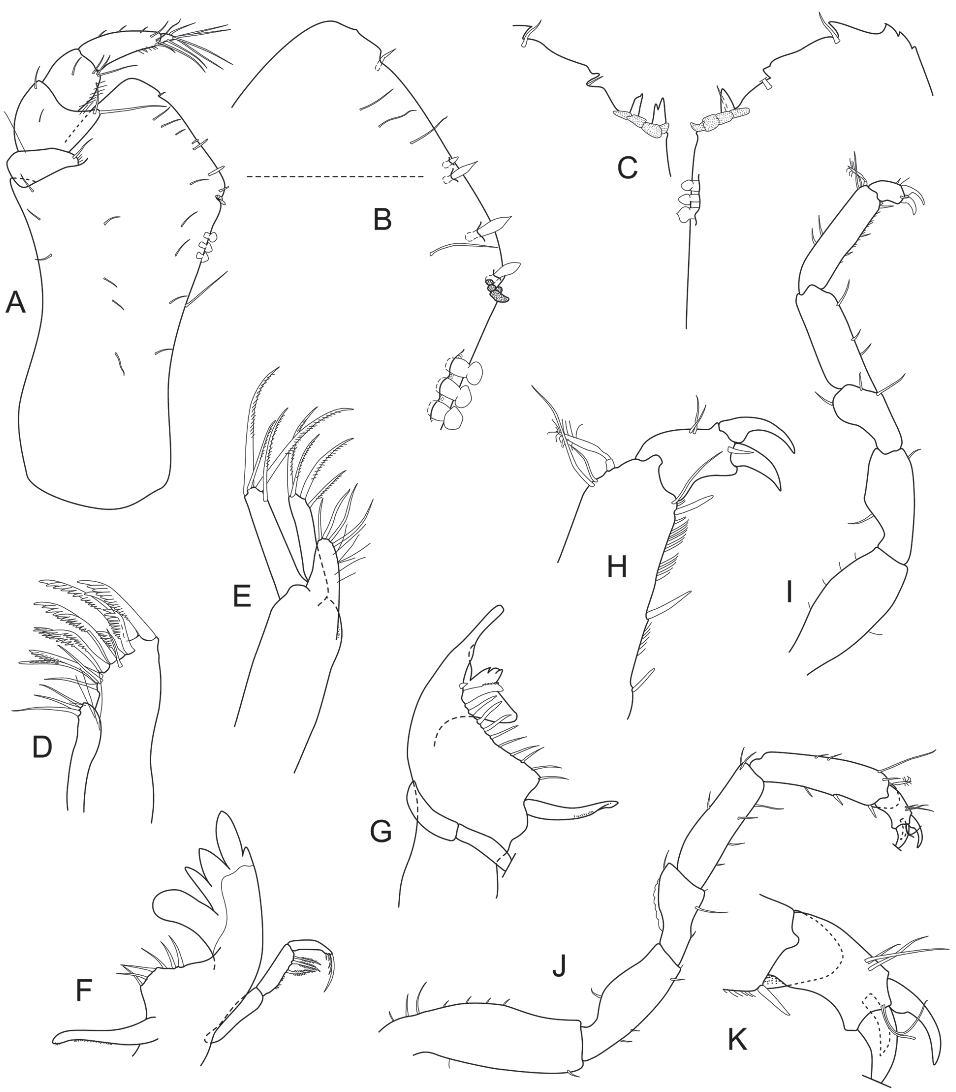

Figure 12. *Joeropsis makrogenys* sp. n. Male paratype (2.3 mm) MTQ W34010, except **C**. **A** maxilliped **B** maxilliped endite, distomesial margin **C** *Joeropsis indica* Müller, 1991: distomesial margins left and right maxilliped endites **D** maxillula **E** maxilla **F** right mandible **G** left mandible **H** pereopod 1 dactylus **I** pereopod 1 **J** pereopod 7 **K** pereopod 7 dactylus.

merus 0.7 length of ischium, 1.4 as long as wide; carpus 1.1 as long as ischium, 2.7 as long as wide; propodus 4.4 as long as wide, superior margin 4 simple setae; inferior margin with 3 acute RS, dactylus 0.5 as long as propodus, with 2 claws (and acute robust seta). Pereopods 2–7 sub-similar, more slender than pereopod 1, each with 3 claws. *Pereopod 7* basis 3.2 as long as wide; superior margin with 7 short simple setae, inferior margin with 2 simple setae; ischium 0.6 as long as basis, 2.5 as long as wide, superior margin convex, with 1 simple seta, inferior distal angle with 1 seta; merus 0.6 as long as ischium, 1.6 as long as wide, superodistal angle with 1 simple seta (superior margin with weak cuticular scales); carpus 1.1 as long as ischium, 3.3 as long as wide, inferior margin with 4 setae, superior distal angle with 2 prominent setae; propodus 1.1 as long as ischium, 3.7 as long as wide, inferior margin with 3 acute RS, superior margin with 4 simple setae (3 short, 1 long); dactylus 0.4 as long as propodus.

Pleopod 1 2.3 as long as greatest width, lateral margin strongly convex, apical lobe broadly rounded, with short and long marginal setae, lateral margin with slender setae, distolateral lobe acute, not extending to distal margin. *Pleopod 2* protopod 2.3 as long as midwidth, lateral margin mid-half weakly convex, without setae, distal margin weakly concave, with long marginal cuticular scales, apex narrowly rounded; *stylet* in retracted position reaching apex. *Pleopod 3* endopod 2.5 midwidth; exopod article 1 2.6 as long as wide, not extending to endopod apex, lateral margin fringed with cuticular scale-spines; article 2 0.6 as long as article 1, lateral and mesial margins with spine-like cuticular scale-setae (mesial margin with setae).

Uropod peduncle extending slightly beyond margin of pleotelson, mediodistal corner strongly produced and acute, distolateral margin 3 simple submarginal setae, mesial margin finely serrate. Exopod 0.7 as wide as endopod, 1.3 as long as wide, with 7 simple setae. Endopod 1.2 as long as wide, 3.3 as long as peduncle proximolateral margin, apex with 0 long simple setae (with 7 pedunculate penicillate setae).

Female. *Pleopod 2* 1.2 as long as proximal width, lateral margins weakly convex, apex with 4 sub-apical simple setae.

Size. Males 1.3–2.3 mm, mean 2.0 mm (n=6); ovigerous females 2.3–3.1 mm, mean 2.7 mm (n=3), non-ovigerous females 1.3–3.07 mm, mean 2.2 mm (n=11); all from type series.

Colour pattern. Head with long dark-brown band extending to lateral margins, and occupying 76% of head length; anterior margin of colour band weakly indented; all other somites white or clear.

Variation. Pleotelson with six acute teeth (serrations) on lateral margin; anterior most tooth sometimes small and inconspicuous.

Remarks. *Joeropsis makrogenys* sp. n. is characterised by a brown head band occupying more than 70% of the head length; short, sub-quadrate, anteriorly concave pseudorostrum; antennula article 1 distolateral angle strongly serrate, large and asymmetrical mandible incisors, and the maxilliped endite with a smooth and obliquely angled distomesial margin, lacking a distinct mesial notch. The mandible and spine row morphology is unique within the genus, and the broadly rounded posterior incisory cusp of the right mandible can usually be seen under stereomicroscopy, in both adults and juveniles.

The colour pattern and mandibular morphology is unique, but is similar to that of *Joeropsis indica* Müller, 1991b. Comparing the type specimens of *J. indica* to *J. makrogenys* sp. n. shows that the left mandible incisor of *J. indica* is similar to that of *J. makrogenys*, but the right mandible of *J. indica* lacks the broad cusp; the maxilliped endite of *J. indica* (Fig. 12B) distal margin is serrated but not oblique and, contrary

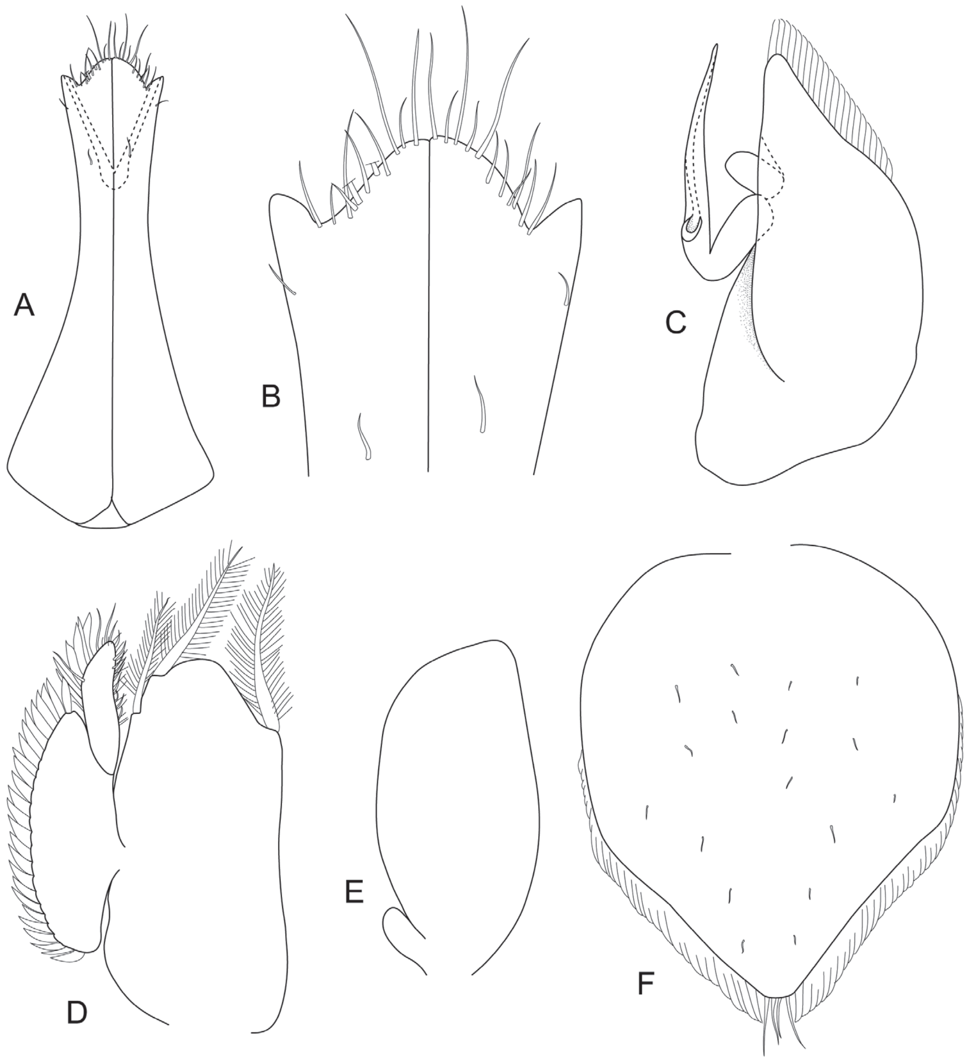

Figure 13. *Joeropsis makrogenys* sp. n. **A–E** male paratype (2.3 mm) MTQ W34010. **A** pleopod 1 **B** pleopod 1, apex **C** pleopod 2 **D** pleopod 3 **E** pleopod 4 **F** female paratype MTQ W34010 pleopod 2.

to Müller's (1991b) description, does have distolateral tubercular spines; antenna 1 article 2 is clearly not serrated and the uropods have a weak terminal spike.

The similar *Joeropsis sandybrucei* Bruce, 2009 differs from *J. makrogenys* sp. n. in having the distolateral margin of antennula article 1 smooth (vs serrate), shorter pseudorostrum with mesially angled lateral margins, the maxilliped endite distal margin not oblique, and both mandible incisors have symmetrical acute cusps. The misidentified non-type material of *J. sandybrucei* is here re-identified; *J. sandybrucei* has not been collected at Lizard Island.

Distribution. Lizard Island and nearby islands and reefs, South Direction Island, Hicks, Day and Yonge Reefs (Fig. 1); intertidal to 14 metres, with one sample from 30 metres; also Madang, Papua New Guinea.

Etymology. The epithet combines the Greek words makros (long) and genys (jaw) alluding to the long cusp on the mandible incisor.

Joeropsis mije **sp. n.**
http://zoobank.org/61FE99A9-D559-4F88-A7B0-69C197A97CE4
Figs 14–16

Material. All material from the Lizard Island region, including outer barrier reefs.

Holotype. ♂ (1.8 [part dissected], 1.4 mm), Yonge Reef, 14.60681°S, 145.6311°E, 20 February 2009, outer reef front, dead coral, 30 m, stn LIZ09-15B, coll. S. Smith & JC (MTQ W31908, including dissection slide).

Paratypes. ♀ (ovig 1.4 mm [dissected]), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, small coral heads and rubble, 15 m, coll. MB-P & NLB, stn LIZ09-16C coll. NLB & MB-P (MTQ W31911). ♀ (non-ovig 1.1 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, dead coral heads on reef edge, 5–7 m, LIZ09-16E, coll. NLB & MB-P (MTQ W31909). 2 ♂ (1.2, 1.0 mm), Day Reef, 14.48356°S, 145.5459°E, 13 February 2009, outer reef, fine rubble, 10 m, stn LIZ09-04C, coll. MB-P (MTQ W31910). ♂ (1.1 mm, poor condition), Day Reef, 14.48356°S, 145.5459°E, 13 February 2009, outer reef, coral heads in gully, 10 m, LIZ09-04B, coll. MB-P (MTQ W31906). ♀ (ovig. 1.3 mm), Day Reef, 14.47119°S, 145.5297 °E, 13 February 2009, outer reef, coral rubble in cave on vertical wall, 10–12 m, stn LIZ09-03B, coll. MB-P (MTQ W31907). ♂ (1.1 mm), Day Reef, 14.48283°S, 145.5564°E, 19 February 2009, outer reef front, small rubble in gully, 7.5 m, stn LIZ09-13A, coll. MB-P & NLB (MTQ W31284). ♂ (1.6 mm), Yonge Reef, 14.61383°S, 145.6182°E, 18 February 2009, back reef, small coral rubble on sand, 15 m, stn LIZ09-10F, coll. MB-P & NLB (MTQ W31283; microscope slide). ♂ (1.0 mm), ♀ (non-ovig 1.2 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, coral rubble under bommie overhang, 15 m, stn LIZ09-16B, coll. NLB & MB-P (MTQ W31912).

Also examined. *Holotype* of *Joeropsis minuta* Müller, 1989. ♂ (1.0 mm), Französisch Polynesien, Iles du Vent, Mooréa. Temae, Islet Riff, NE vom Flughafen, tote Korallen nahe Strand, 2 m, Tiefe, tote Korallen, 31 March 1988, coll. H.-G. Müller (SMF 17689); 6 ♂ and ♀ paratype dissection, 6 microslides (SMF 17692). Near of airport, Tema'e, Mooréa, French Polynesia, *c*. 17.49°S, 149.76°W.

Description. *Body* 2.9 as long as greatest width, dorsal surfaces smooth, with few setae. *Cephalon* length 0.6 width, lateral margins weakly concave, finely serrate (at mid-length). *Pseudorostrum* 1.5 as long as proximal width (with longitudinal ridge), anterior margin acute. *Eyes* lateral, with 12 ommatidia, colour orange. *Pereonites* not compact, widely spaced, without dorsal carinae; *tergite lateral margin* truncate, lateral margins

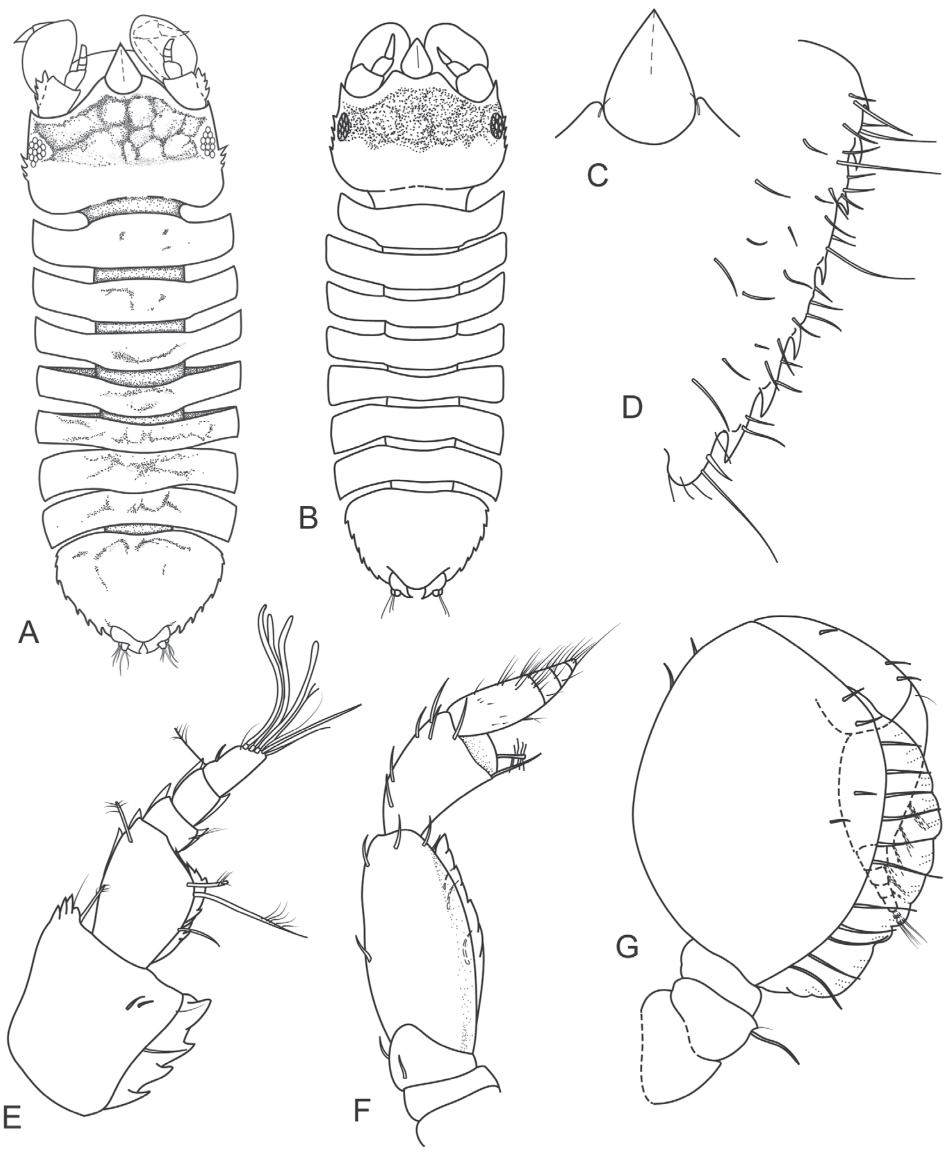

Figure 14. *Joeropsis mije* sp. n. **A, C** holotype (1.8 mm MTQ W31908) **E, F** female (ovig 1.4 mm MTQ W31911) **B, D, G** male (1.6. mm MTQ W31283). **A**, dorsal view **B** dorsal view, immature male **C** pseudorostrum **D**, pleotelson lateral margin **E** antenna 1 **F** antenna 2 **G** male antenna 2.

smooth; median keels not observed. *Pleotelson* width 1.4 length; dorsal surface with weak and indistinct sub-lateral ridge, caudomedial lobe broadly rounded, not extending posteriorly beyond uropods; lateral margins weakly convex, each with 6–7 spines.

Antenna 1 with 5 articles; article 1 1.0 as long as wide, distolateral angle not lobed, strongly serrated, distomesial margin weakly serrate; article 2 0.8 as long as article 1, 1.3 as long as wide; lateral margins of articles 1 and 2 with weak cuticular scales on distal margins; article 3 0.2 as long as article 2; article 4 1.7 as long as article 3 (articles 3 and 4 distal angles acute); article 5 2.7 as long as article 3, 1.9 as long as proximal width. *Antenna 2* peduncle article 5 1.8 as long as articles 1–4 combined, 4.8 as long as article 3, 1.2 as long as wide, lateral margin strongly convex, with prominent cuticular scales (and evenly spaced marginal setae), mesial margin convex; article 6 1.4 as long as width, distally weakly expanded, distal width 1.6 proximal width, 0.5 as long as article 5, lateral margin without cuticular scales, mesial margin with 12 simple setae, disto-dorsal surface with scattered simple setae; flagellum with 5 articles, article 1 0.8 as long as peduncle article 6, 2.1 as long as combined lengths of remaining articles.

Mandible palp article 2 with 2 long biserrate setae, article 3 with 3 long pectinate setae. Right incisor with symmetrical cusps, margins convex, distally acute. *Molar process* distal quarter finely serrate. Right mandible spine row composed of 9 spines. *Maxilla 1* lateral lobe with 12 strongly serrate RS, and 2 simple RS; mesial lobe with 4 long, simple RS. *Maxilla 2* lateral lobe with 4 long, curved, finely serrate setae (2 short, 2 long); middle lobe with 4 long serrate setae (2 short, 2 long), mesial lobe with 4 long simple setae and many long setules. *Maxilliped endite* 2.3 as long as greatest width, extending beyond palp, distal margin subtruncate, with 4 prominent serrations, with shallow distomesial concavity, with 3 mesial tubercular RS (and laterally with 1 distal rounded and finely serrated RS), distomesial margin with 2 coupling setae. *Maxilliped palp* article 2 3.6 as long as article 1, mesial lobe extending to article 4, distomesial margin with 3 simple setae; article 3 0.3 as long as article 2 (with ventral lobe), distomesial margin with 1 simple seta; article 4 4.2 as long as wide, mesial margin straight, distally with 2 setae; article 5 0.1 as long as 4, with 2 terminal setae.

Pereopod 1 ischium 2.3 as long as wide; merus 0.6 length of ischium, 1.7 as long as wide; carpus 0.8 as long as ischium, 2.2 as long as wide; propodus 3.8 as long as wide, superior margin 2 simple setae (and prominent penicillate seta at distal angle); inferior margin with 2 acute RS, dactylus 0.5 as long as propodus, with 2 claws. *Pereopods 2–7* sub-similar, more slender than pereopod 1, each with 3 claws. *Pereopod 7* ischium 2.4 as long as wide, superior margin weakly convex at midpoint, with 1 simple seta, inferior distal angle with 1 seta; merus 0.6 as long as ischium, 1.7 as long as wide, superodistal angle with 2 simple setae; carpus 0.8 as long as ischium, 2.1 as long as wide, inferior margin with 1 simple seta, superior distal angle with 2 prominent pappose setae; propodus 1.0 as long as ischium, 3.3 as long as wide, inferior margin with 3 acute RS, superior margin with 2 simple setae; dactylus 0.6 as long as propodus.

Pleopod 1 2.0 as long as greatest width, lateral margin strongly concave with mid-length straight, apical lobe broadly rounded, with short marginal setae, lateral margin with slender setae, distolateral lobe blunt, not extending to distal margin. *Pleopod 2* protopod 2.3 as long as midwidth, lateral margin mid-half weakly convex, without setae (with fine cuticular scales), distal margin straight, without marginal cuticular scales (with setae), apex acute; *stylet* in retracted position extending beyond apex. *Pleopod 3* endopod 2.3 midwidth (medially fused to protopod); exopod article 1 3.5 as long as

Figure 15. *Joeropsis mije* sp. n. **A, I** male (1.6 mm MTQ W31283); **B–H** male (1.8 mm MTQ W31908). **A** uropod **B** right maxilliped, distal margin **C** left maxilliped, distomesial margin **D** maxilliped **E** maxilliped palp **F** maxillula **G** maxilla **H** maxilla, mesial lobe setae **I** mandible.

wide, extending beyond apex, lateral margin densely fringed with cuticular scale-setae; article 2 0.5 as long as article 1, lateral and mesial margins with short cuticular scale-setae (mesial margin with 3 setae).

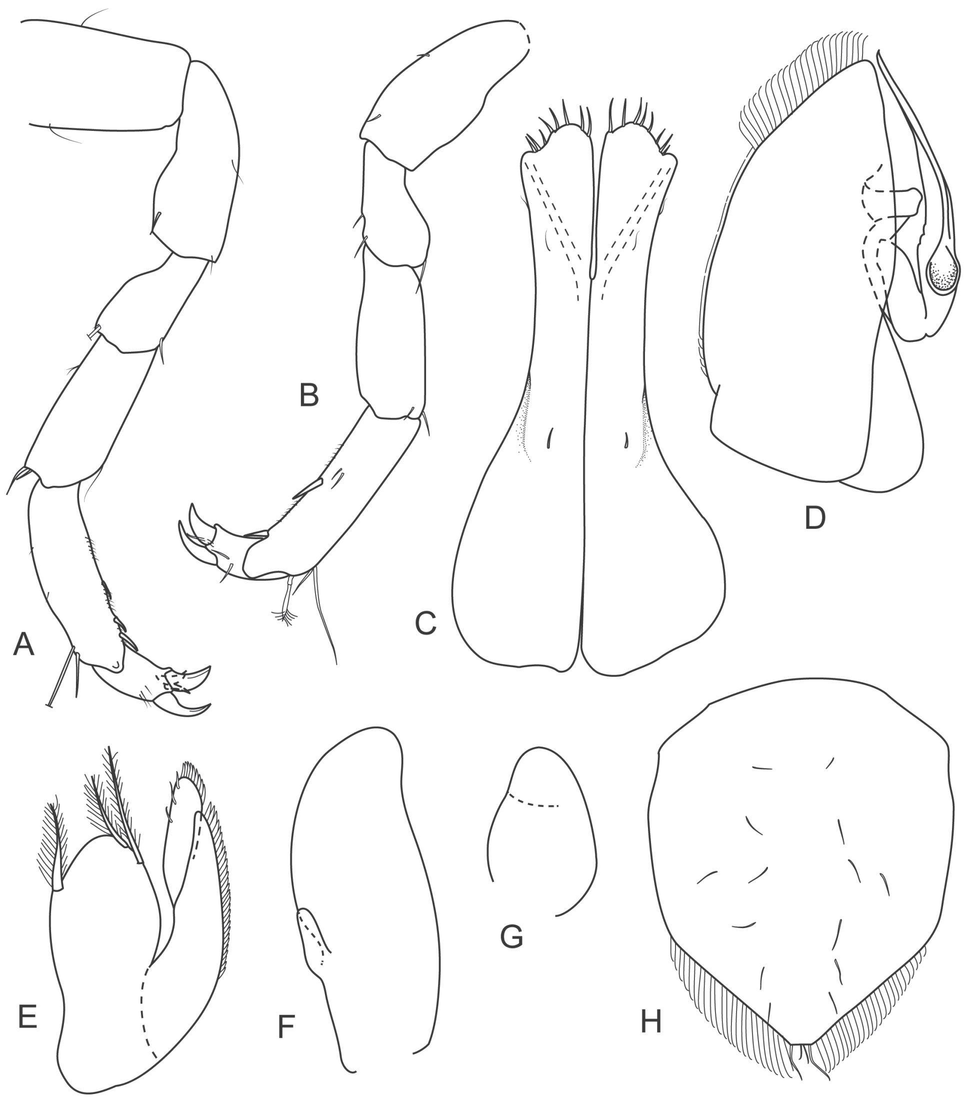

Figure 16. *Joeropsis mije* sp. n. **A–D** male (1.6. mm MTQ W31911) **E–H** female (1.6 mm) MTQ W30468 **A** pereopod 7 **B** pereopod 1 **C–G** pleopods 1–5 respectively **H** pleopod 2.

Uropod peduncle extending well beyond margin of pleotelson, mediodistal corner strongly produced and acute, distolateral margin with 4 simple submarginal setae, mesial margin serrate. Exopod 0.5 as wide as endopod, 0.9 as long as wide, with 4 simple setae. Endopod 1.0 as long as wide, 0.8 as long as peduncle proximolateral margin, apex with 3 long simple setae.

Female. *Pleopod 2* 1.3 as long as proximal width, lateral margins weakly convex, posterior margins straight, apex with 2 sub-apical simple setae (surface with sub-mesial row of setae). *Antenna 2* peduncle article 5 not broadly expanded.

Colour pattern. Head with diffuse, low-density transverse dark-brown band across the anterior 50% of the head; dorsal surfaces otherwise with few and faint chromatophores, mostly on pereonites 5–7 and anterior of pleotelson.

Size. Males 1.0–1.8 mm (average 1.2 mm, *n*=8); ovigerous females 1.3–1.4 mm and non-ovigerous females 1.1–1.2 mm.

Remarks. *Joeropsis mije* sp. n. is the smallest of the currently known Australian species of this genus and is best identified by the small size, acute pseudorostrum, diffuse dark brown head band, head lateral margin with two to four serrations just posterior to the eye, and the presence of only a few chromatophores over the dorsum; males are distinctive in having antenna 2 peduncle article 5 with an almost circular outline, a character readily observed in dorsal view.

Joeropsis minuta Müller (1989, fig. 30) is closely similar to *J. mije* sp. n. but the latter can be distinguished by the following characters (state for *J. minuta* in parentheses): head lateral margin weakly convex (mid-lateral margin weakly concave), pseudorostrum 2.5 as long that wide (as long as wide), pereonites widely spaced with lateral margins not in contact (closely spaced, pereonites 1–4 overlapping slightly) and pleotelson caudomedial lobe not extending posteriorly beyond uropods (extending beyond uropods).

Distribution. Hicks, Day and Yonge Reefs (Fig. 1); depths 10 to 15 metres.

Etymology. The epithet is an Aboriginal word meaning little, alluding to the small size of this species; noun in apposition.

Joeropsis panstikta **sp. n.**

http://zoobank.org/A1F931ED-3628-4786-AF77-BAE879DE4C5C

Figs 17–19

Material. *Holotype*. ♂ (3.4 mm), Yonge Reef, 14.60681°S, 145.6311°E, 20 February 2009, outer reef front, dead coral, 30 m, stn LIZ09-15B, coll. S. Smith & JC (MTQ W31276).

Paratypes. 7 ♂ (3.3, 3.3, 3.2 [dissected], 3.1 [dissected], 2.8 2.3, 2.1 mm), ♀ 4 (ovig. 3.2 [dissected], non-ovig. 2.9, 2.8, 2.1 mm) same data as holotype (MTQ W31277). 4 ♀ (ovig. 3.0), Yonge Reef, 14.57972°S, 145.61010°E, 20 April 2008, passage, dead *Acropora* head, 17 m, stn CGLI-046A, coll. MB-P (MTQ W13980). ♂ (2.4 mm), 2 ♀ (non-ovig. 3.4, 3.0 mm), Yonge Reef, 14.61383 °S, 145.6182°E, 18 February 2009, back reef, small coral rubble on sand, 15 m, stn LIZ09-10F, coll. MB-P & NLB(MTQ W31278). ♀ (non-ovig. 3.4 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, dead coral heads on reef edge, 5–7 m, LIZ09-16E, coll. NLB & MB-P (MTQ W31279). 3 ♂ (3.3, 2.5, 2.3 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, small rubble on sand, base of reef edge, 8 m, stn LIZ09-16F, coll. NLB & MB-P (MTQ W31280). ♂ (3.3 mm), Day Reef, 14.47503°S, 145.5366°E, 22 February 2009, outer reef edge, coral rubble, 30 m, stn CWLI-050, coll. S. Smith (MTQ W31281). 16, not measured

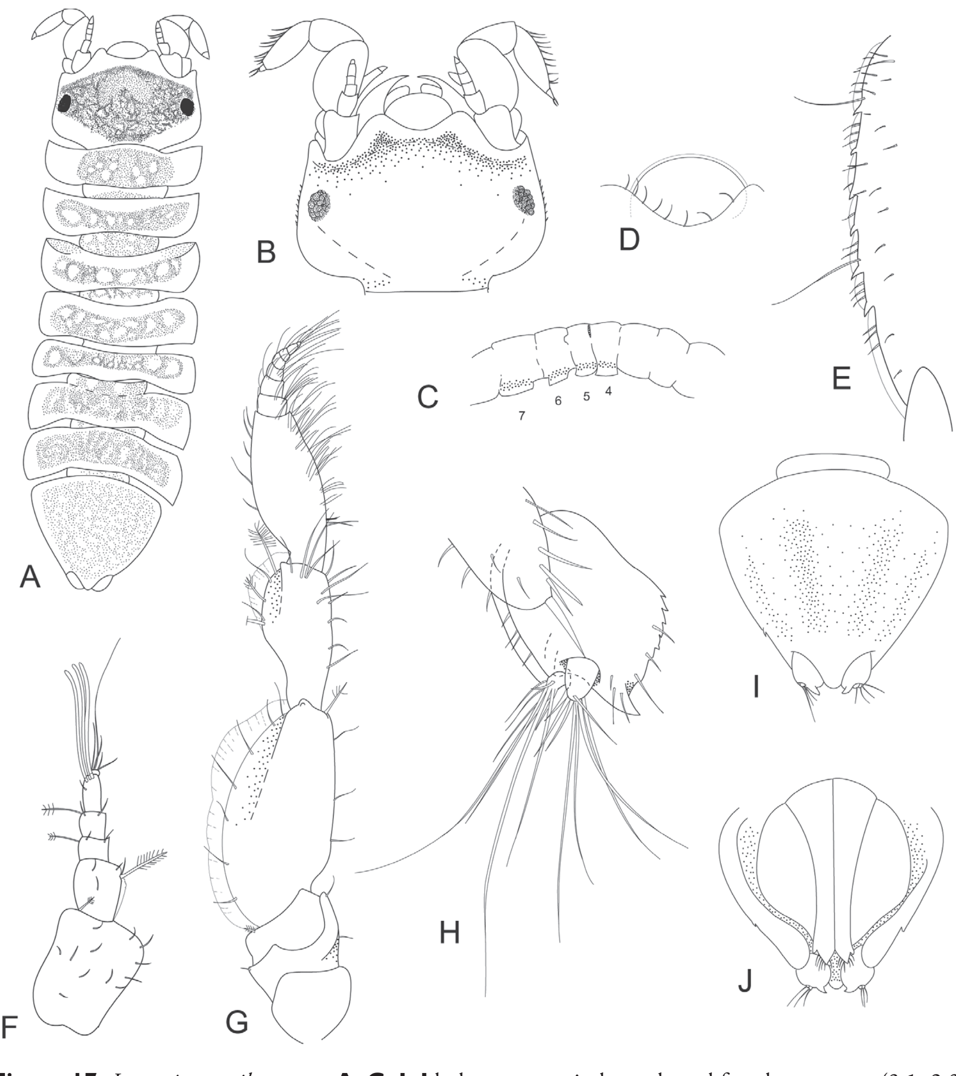

Figure 17. *Joeropsis panstikta* sp. n. **A–C, I, J** holotype; remainder male and female paratypes (3.1, 2.3 mm) MTQ W31277. **A** dorsal view **B** head, dorsal view **C** sternal carinae (sternites numbered) **D** pseudorostrum **E** female, pleotelson lateral margin **F** antenna 1 **G** antenna 2 **H** uropod **I** pleotelson, dorsal view **J** pleon, ventral view.

(♂ 3.2 mm [dissected]), Day Reef, 14.48356°S, 145.5459°E, 13 February 2009, outer reef, coral heads in gully, 10 m, LIZ09 04B, coll. MB-P (MTQ W31195).

Additional material. ♂ (2.7 mm), ♀ (ovig. 3.2, non-ovig. 3.3 mm), Day Reef, 14.50239°S, 145.5089°E, 21 February 2009, outer reef slope, large coral rubble, 30 m, stn CWLI048, coll. JC & K. Mills (MTQ W34165). 9, not measured, Yonge Reef, 14.62317°S, 145.6201°E, 13 February 2009, reef pass, dead coral heads, 5 m, stn LIZ09-11A, coll. NLB & MB-P (MTQ W31218). 1, not measured, Day Reef, 14.47119 °S, 145.5297 °E, 13 February 2009, outer reef, dead coral on vertical wall, 10–12 m, stn LIZ09-03A, coll. MB-P (MTQ W30465). 7, not measured, Day Reef, 14.47119 °S, 145.5297 °E, 13 February 2009, outer reef, coral rubble in cave on vertical wall, 10–12 m, stn LIZ09-03B, coll. MB-P (MTQ W30466). 7, not measured, Day Reef, 14.50525°S, 145.5612°E, 22 February 2009, outer reef front. coral rubble, 27–29 m, stn LIZ09-17A, coll. Shawn Smith & JC (MTQ W31103). 1, not measured, Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, dead coral heads on spur, 16 m, stn LIZ09-16D, coll. MB-P & NLB (MTQ W31287). ♂ (3.0 mm), Day Reef, 14.48539°S, 145.5464°E, 19 February 2009, outer reef front, coral rubble in gully, 17 m, stn LIZ09-12F, coll. NLB & MB-P (MTQ W31081). ♂, ♀ and half specimen (unmeasured) Hicks Reef, 14.48051°S, 145.4873°E, 14 February 2009 , outer reef, coral rubble, 2–18 m, stn CWLI-020, coll. C. Watson & Kade Mills (MTQ W31382). ♂ (1.7 mm), Day Reef, 14.48356°S, 145.5459°E, 13 February 2009, outer reef, fine rubble, 10 m, stn LIZ09-04C, coll. MB-P (MTQ W31700). Juvenile, off Coconut Beach, Lizard Island, 14.68441°S, 145.47197°E, 17 February 2009, reef front., small rubble on sand between bommies, 4.5 m, stn LIZ09-09C, coll. NLB & MB-P (MTQ W31285).

Description. *Body* 3.5 as long as greatest width, dorsal surfaces smooth, with few setae. *Cephalon* length 0.7 width, lateral margins weakly concave, smooth. *Pseudorostrum* 0.6 as long as proximal width, anterior margin rounded. *Eyes* sublateral, with 16 ommatidia, colour dark brown. *Pereonites* not compact, widely spaced, without dorsal carinae; *tergite lateral margin* subtruncate, lateral margins smooth; median keels on sternites 4–7, keels well developed. *Pleotelson* width 1.2 length; dorsal surface with weak and indistinct sub-lateral ridges, caudomedial lobe narrowly rounded; lateral margins weakly convex, each with 1–2 spines.

Antenna 1 with 7 articles; article 1 1.4 as long as wide, distolateral angle weakly lobed, not serrated, distomesial margin weakly serrate; article 2 0.6 as long as article 1, 1.4 as long as wide; lateral margins of articles 1 and 2 without cuticular scales; article 3 0.4 as long as article 2; article 4 0.9 as long as article 3; article 5 0.8 as long as article 3, 2.6 as long as proximal width, distally with 1 aesthetasc (further 2 short articles present). *Antenna 2* peduncle article 5 1.6 as long as articles 1–4 combined, 3.8 as long as article 3, 1.6 as long as wide, lateral margin convex, with prominent cuticular scales, mesial margin straight; article 6 2.1 as long as width, distally weakly expanded, distal width 1.9 proximal width, 0.7 as long as article 5, lateral margin with cuticular scales on distal one-third, mesial margin with 8 simple setae, distodorsal surface with few simple setae; flagellum with 8 articles, article 1 1.1 as long as peduncle article 6, 1.9 as long as combined lengths of remaining articles.

Mandible palp article 2 with 3 long biserrate setae (terminally spatulate), article 3 with 9 long pectinate setae. Right incisor with symmetrical cusps, margins convex, distally acute; left mandible incisor similar to right incisor. *Molar process* distal half finely serrate. Right mandible spine row composed of 8 spines; divided by truncate lobe; left spine row without lacinoid spine. *Maxilla* 1 lateral lobe with 11 strongly serrate RS, and 2 simple RS; mesial lobe with 3 long, simple RS. *Maxilla* 2 lateral lobe with

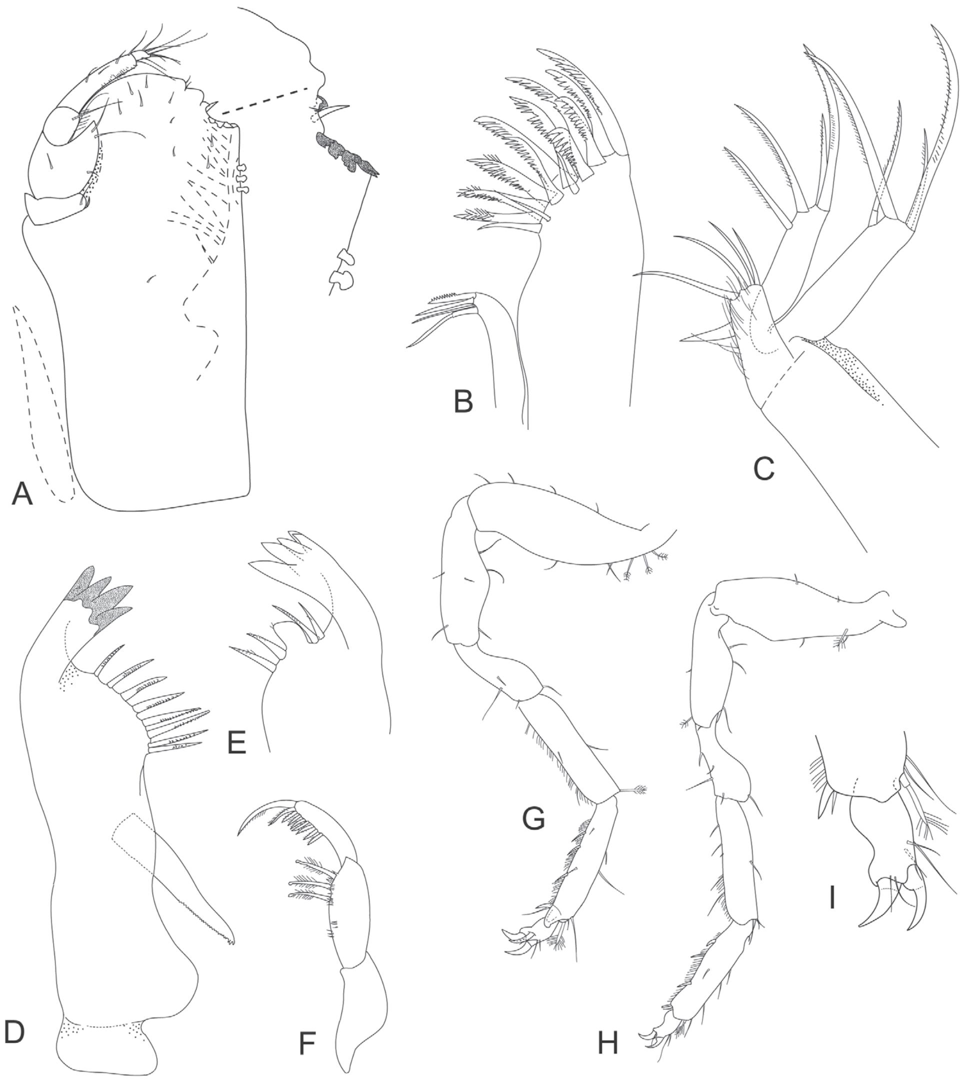

Figure 18. *Joeropsis panstikta* sp. n. Male paratype (3.1 mm) MTQ W31277. **A** maxilliped **B** maxilla **C** maxillula **D** right mandible **E** left mandible **F** mandible palp **G** pereopod 7 **H** pereopod 1 **I** pereopod 1 dactylus.

4 long, curved, finely serrate setae; middle lobe with 4 long serrate setae, mesial lobe with 4 long simple setae and many long setules. *Maxilliped endite* 1.9 as long as greatest width, extending to distal margin of palp article 4, distal margin evenly rounded, mesially with 2 large serrations, with shallow distomesial concavity, with 4 mesial tubercular RS, distomesial margin with 3 coupling setae. *Maxilliped palp* article 2 3.7 as long as article 1, mesial lobe extending to distal margin of article 3, distomesial margin

with 2 simple setae; article 3 0.5 as long as article 2, distomesial margin with 2 simple setae; article 4 4.0 as long as wide, mesial margin weakly concave, distally with 7 setae; article 5 0.2 as long as 4, with 4 terminal setae.

Pereopod 1 basis 3.0 as long as wide, superior margin with 1 simple seta; ischium 0.7 as long as basis, 3.4 as long as wide; merus 0.6 length of ischium, 2.1 as long as wide; carpus about 1.0 (0.95)as long as ischium, 4.2 as long as wide; propodus 4.2 as long as wide, superior margin 4 simple setae (and 1 distal penicillate seta); inferior margin with 4 acute RS, dactylus 0.3 as long as propodus, with 2 claws. Pereopods 2–7 sub-similar, more slender than pereopod 1, each with 3 claws. *Pereopod 7* basis 2.9 as long as wide; superior margin with 3 short simple setae; ischium 0.7 as long as basis, 2.8 as long as wide, superior margin with 2 simple setae, inferior distal angle without setae; merus 0.6 as long as ischium, 1.5 as long as wide, superodistal angle with 1 simple seta; carpus 0.9 as long as ischium, 3.9 as long as wide, inferior margin with 1 seta (distal three-quarters with cuticular scale-setae), superior distal angle with 1 prominent pappose seta; propodus 1.0 as long as ischium, 5.0 as long as wide, inferior margin with 5 acute RS, superior margin with 2 simple setae (and distal penicillate seta); dactylus 0.4 as long as propodus.

Pleopod 1 2.4 as long as greatest width, lateral margin distally concave, apical lobe triangular, with long marginal setae, lateral margin stiff and slender setae, distolateral lobe acute, extending beyond distal margin. *Pleopod 2* protopod 2.4 as long as midwidth, lateral margin mid-half weakly convex, without setae, distal margin weakly concave, with long marginal cuticular scales, apex narrowly rounded; *stylet* in retracted position reaching apex. *Pleopod 3* endopod 1.3 midwidth (fused to protopod); exopod article 1 2.5 as long as wide, not extending to endopod apex, lateral margin weakly fringed with cuticular scale-setae; article 2 0.8 as long as article 1, lateral and mesial margins with long cuticular scale-setae (mesial only, lateral very weakly scaled).

Uropod peduncle extending slightly beyond margin of pleotelson, mediodistal corner strongly produced and acute, distolateral margin 3 simple submarginal setae, mesial margin serrate. Exopod 0.6 as wide as endopod, 1.4 as long as wide, with 9 simple setae (3 long). Endopod 1.3 as long as wide, 0.4 as long as peduncle proximolateral margin, apex with 9 long simple setae.

Female. *Pleopod 2* 1.3 as long as proximal width, lateral margins weakly convex, posterior margins sinuate (with cuticular scale-setae), apex with 2 sub-apical simple setae. Pleotelson lateral margins each with 7 teeth.

Colour pattern. All pereonites with reddish-brown chromatophores; head with long and darker band of chromatophores occupying 77% of head length, anterior margin of head band weakly and evenly convex, posterior margin forming blunt triangle; pereonite 1 lateral margins clear, narrow marginal clear area on tergite lateral margin 2–4.

Size. Males 2.1–3.4 mm (mean 2.9 mm, *n*=14); ovigerous females 3.0–3.2 mm (*n*=2), non-ovigerous females 2.1–3.4 mm (mean 2.9 mm, *n*=6).

Variation. Male pleotelson margin with 1 or 2 teeth only; females and small males usually with 7 teeth on each margin, with the anterior 2 or 3 teeth smaller than the posterior 3 or 4 teeth.

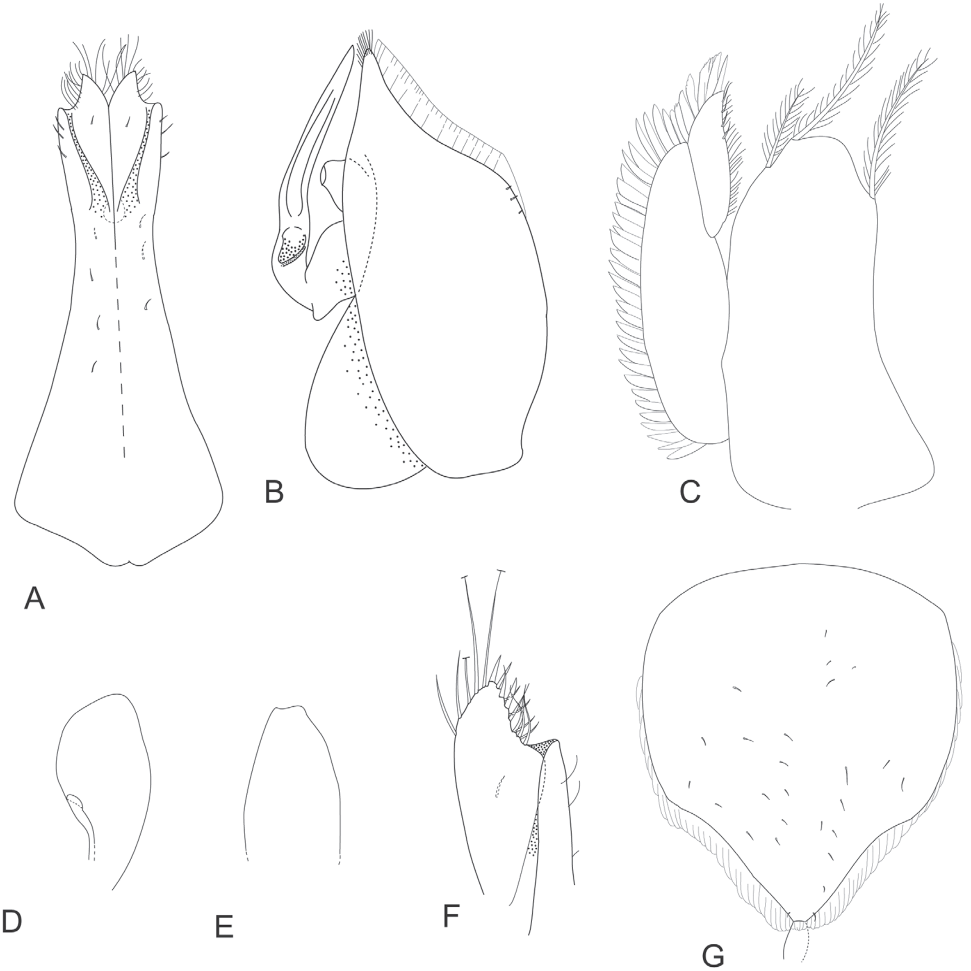

Figure 19. *Joeropsis panstikta* sp. n. **A–C, F** male paratype (3.1 mm) **D, F, G** female (3.0 mm) paratype; both MTQ W31277. **A–E** pleopods 1–5 respectively **F** pleopod 2 apex **G** female pleopod 2.

Remarks. *Joeropsis panstikta* sp. n. is common on the outer reefs of the northern Great Barrier Reef and is also one of the largest species present, reaching a size of 3.4 mm. The entire dorsum is covered by clustered reddish-brown chromatophores, with a darker brown head, and the colour pattern together with anteriorly rounded pseudorostrum and large size allows for identification of this species.

Distribution. Frequent at Hicks, Day and Yonge Reefs; once only at Coconut Beach, Lizard Island (Fig. 1); depths 5 to 30 metres.

Etymology. The epithet is a contraction of the Greek 'pantostikta' (παντός+στικτο), meaning 'spotted all over'.

***Joeropsis specca* sp. n.**
http://zoobank.org/AE88E898-9E84-4D14-8005-1DAAB7E6E4C4
Figs 20–22

Material. *Holotype*. ♂ (2.2 mm), Martin Reef, 14.75600°S, 145.36271°E, 30 August 2010, reef flat, dead corals, 5 m, LI10-35, coll. J. Reimer (MTQ W33804).

Paratypes. 5 ♂ (2.8, 2.6 [broken; dissected], 2.0, 1.9, 1.8 mm), 7 ♀ (ovig 2.7, 2.0 mm, non-ovig. 2.7, 2.5[dissected], 2.4, 1.9, 1.8 mm), same data as holotype (MTQ W32664).

Description. *Body* 4.0 as long as greatest width, dorsal surfaces finely granular, with few setae. *Cephalon* length 0.6 width, lateral margins weakly sinuate, smooth. *Pseudorostrum* 0.7 as long as proximal width, anterior margin narrowly truncate, apex narrowly excavate. *Eyes* lateral, with 12–14 ommatidia, colour dark brown. *Pereonites* compact, close to each other, without dorsal carinae (with low tubercle, visible only with relief lighting); *tergite lateral margin* rounded, lateral margins smooth; median keels not observed. *Pleotelson* width 1.0 length, dorsal surface with weak and indistinct sub-lateral ridges, caudomedial lobe sub-acute; lateral margins convex, each with 6–7 spines.

Antenna 1 with 5 articles (may be a 6th fused terminal article); article 1 1.3 as long as wide, distolateral angle weakly lobed, with serrations, distomesial margin not serrate; article 2 0.7 as long as article 1, 1.5 as long as wide; lateral margins of articles 1 and 2 with weak cuticular scales on distal margin of article 2; article 3 0.4 as long as article 2; article 4 0.7 as long as article 3; article 5 1.3 as long as article 3, 1.7 as long as proximal width, distally with 3 aesthetascs. *Antenna 2* peduncle article 5 1.6 as long as articles 1–4 combined, 1.8 as long as wide, lateral margin weakly convex, with prominent cuticular scales, mesial margin straight; article 6 1.8 as long as width, distally not expanded, distal width 1.3 proximal width, 0.8 as long as article 5, lateral margin without cuticular scales, mesial margin with 4 simple setae, distodorsal surface with few simple setae; flagellum with 8 articles, article 1 1.2 as long as peduncle article 6, 1.9 as long as combined lengths of remaining articles.

Mandible palp article 2 with 3 long biserrate setae (terminally spatulate), article 3 with 8 long pectinate setae. Right incisor with symmetrical cusps, margins convex, distally acute; left mandible incisor similar to right incisor. *Molar process* distal third finely serrate. Right mandible spine row composed of 9 spines; left mandible spine row composed of 10 spines, divided by truncate lobe, without lacinoid spine. *Maxilla* 1 lateral lobe with 11 strongly serrate RS, and 2 simple RS; mesial lobe with 3 long, simple RS. *Maxilla* 2 lateral lobe with 4 long, curved, finely serrate setae; middle lobe with 4 long serrate setae, mesial lobe with 4 long simple setae and many long setules. *Maxilliped endite* 2.1 as long as greatest width, extending to distal margin of palp article 4, distal margin evenly rounded, with 4 prominent serrations, with shallow distomesial concavity, with 4 mesial tubercular RS, distomesial margin with 3–4 coupling setae. *Maxilliped palp* article 2 2.3 as long as article 1, mesial lobe extending to distal margin of article 3, distomesial margin with 1 simple seta; article 3 0.5 as long as article 2,

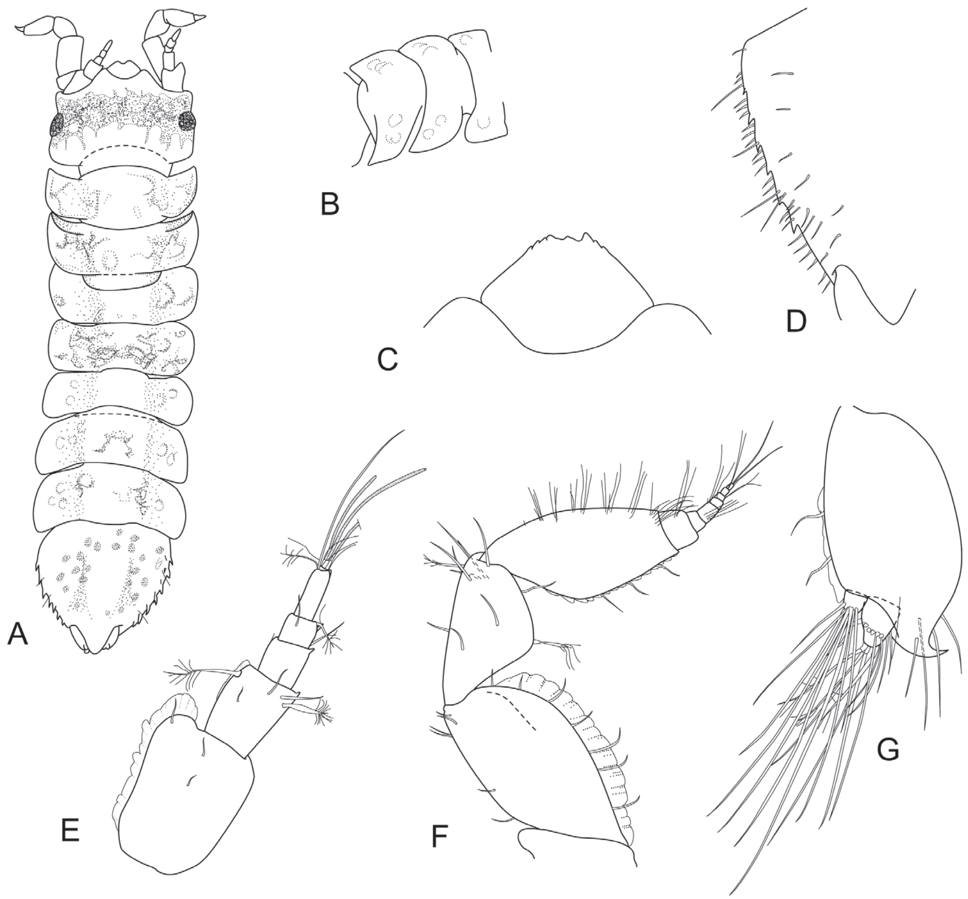

Figure 20. *Joeropsis specca* sp. n. **A, B** holotype **C–G** male paratype (2.6 mm) MTQ W32664. **A** dorsal view **B** oblique view, pereonites 5–7 **C** pseudorostrum **D** pleotelson lateral margin **E** antenna 1 **F** antenna 2 **G** uropod.

distomesial margin with 2 simple setae (and mesial row of dense cuticular scale-setae); article 4 3.4 as long as wide, mesial margin weakly concave, distally with 4 setae; article 5 0.2 as long as 4, with 8 terminal setae. *Epipod* 2.7 as long as basal width, distally acute; 0.9 as long as palp, 0.5 as long as endite.

Pereopod 1 basis 3.2 as long as wide, superior margin with 4 simple setae, inferior margin with 2 simple setae; ischium 0.7 as long as basis, 3.1 as long as wide, superior margin with 3 simple setae, inferior margin with 1 simple seta; merus 0.6 length of ischium, 1.9 as long as wide, superior margin with 1 simple setae, inferior margin with 1 simple seta; carpus 0.8 as long as ischium, 3.9 as long as wide, superior margin with 2 simple setae, inferior margin with 2 simple seta; propodus 3.7 as long as wide, superior margin 2 simple setae (and prominent penicillate seta at distal angle); inferior margin with 3 acute RS, dactylus 0.4 as long as propodus, with 2 claws. Pereopods 2–7 sub-similar, more slender than pereopod 1, each with 3 claws (mesial claw slender). *Pereopod 7* basis 314 as long as wide; superior margin with 4 short simple setae, inferior margin without setae; ischium 0.8 as long as basis, 3.3 as long as wide, superior margin convex, with 3 simple setae, inferior distal angle with 1 seta; merus 0.4 as long as ischium, 2.1 as long as wide, superodistal angle with 1 simple seta, inferior margin with 1 simple seta; carpus 0.8 as long as ischium, 4.9 as long as wide, inferior margin with 3 setae, superior distal angle without prominent pappose setae; propodus 0.8 as long as ischium, 5.2 as long as wide, inferior margin with 3 acute RS, superior margin with 4 simple setae and 1 distal pappose seta; dactylus 0.5 as long as propodus.

Pleopod 1 2.5 as long as greatest width, lateral margin weakly concave, apical lobe broadly rounded, with long marginal setae, lateral margin with slender setae, distolateral lobe acute, not extending to distal margin. *Pleopod 2* protopod 2.5 as long as midwidth, lateral margin mid-half weakly convex, with setae (short setae and cuticular scales), distal margin weakly concave, with long marginal cuticular scales, apex narrowly rounded; *stylet* in retracted position extending beyond apex. *Pleopod 3* endopod 2.7 midwidth; exopod article 1 3.1 as long as wide, extending to endopod apex, lateral margin fringed with cuticular scale-spines; article 2 0.4 as long as article 1, lateral and mesial margins with spine-like cuticular scale-setae (lateral only, mesial with 6 fine setae).

Uropod peduncle extending slightly beyond margin of pleotelson, mediodistal corner strongly produced and acute, apex with 4 simple setae, distolateral margin with 2 simple submarginal setae, mesial margin smooth. *Exopod* 0.6 as wide as endopod, 1.0 as long as wide, with 8 simple setae. *Endopod* 1.3 as long as wide, 0.3 as long as peduncle proximolateral margin, apex with 10 long simple setae (and 3 penicillate setae).

Female. *Pleopod 2* 1.3 as long as proximal width, lateral margins weakly convex, posterior margins weakly concave, apex with 2 sub-apical simple setae.

Colour pattern. Head with relatively short diffuse, low-density, irregular transverse dark-brown band across the mid 30–48% of the head; dorsal surfaces otherwise with few and faint chromatophores on pereonites 1–4 and 6, 7 and pleotelson; pleonite 5 clear, head and pereonite 4 consistently darkest, pereonites 1 and 2 with chromatophores but variable and pereonites 6 and 7 consistently paler than anterior pereonites.

Size. Males 1.8–2.8 mm (average 2.7 mm, *n*=6); ovigerous females 2.0 and 2.7 mm and non-ovigerous females 1.8–2.7 mm (average 2.3 mm, *n*=5).

Variation. Male pleotelson margin (*n*=7) with 6 (21%) or 7 (64%) teeth, the largest male with 2 mid-marginal teeth only; females with 7 (100%, *n*=7) teeth on each margin. Colour varies from near black to pale brown.

Remarks. *Joeropsis specca* sp. n. may be identified by the colour pattern, in conjunction with a pseudorostrum with straight lateral margins that converge mesially to a narrowly excavate apex, relatively large eyes, pleotelson margins each with 5 or 6 spines and the rounded tergite lateral margin.

There are many shallow-water species of *Joeropsis* that present an irregular pattern of chromatophores over most of the dorsum. In several such species pereonite 5 is without chromatophores: these species include, for example, *J. dimorpha* Kensley & Schotte, 2002 (Seychelles), *J. faurei* Müller, 1991a (Réunion Island), *J. gertrudae* Mül-

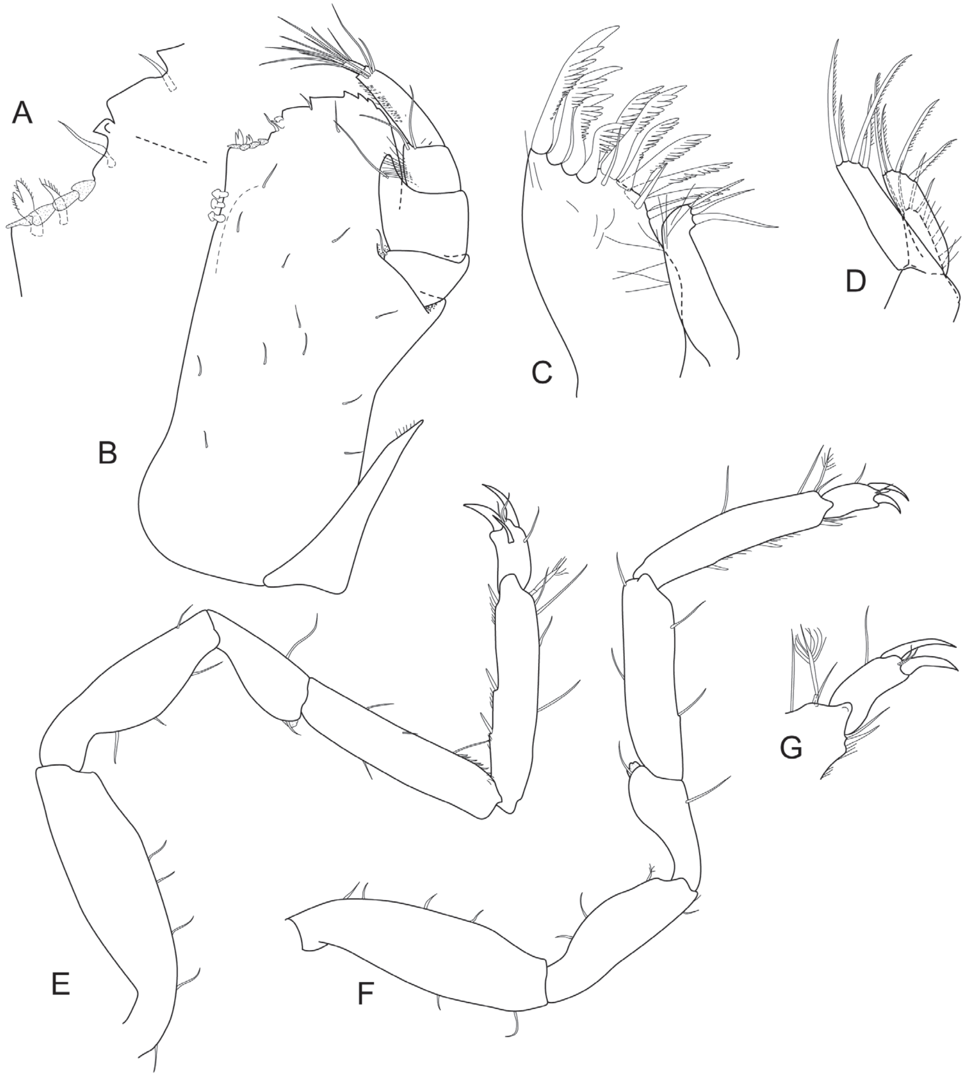

Figure 21. *Joeropsis specca* sp. n. All male paratype (2.6 mm) MTQ W32664. **A** maxilliped endite distomesial margin **B** maxilliped **C** maxillula **D** maxilla **E** pereopod 7 **F** pereopod 1 **G** pereopod 7 dactylus.

ler, 1989 (Mooréa), *J. trilabes* Kensley, 2003 (Easter Island) and *J. bicornis* Kensley, 2003 (Easter Island). The intensity (how dark) and density of the patterning does vary, and the arrangement of the chromatophores may not allow for species separation on its own. Critical characters to reference in separating these species are morphological (see 'Species recognition', p. MS 9), in particular the shape of the pseudorostrum, details of the maxilliped, antennula and antenna, and the serration of the lateral margins of both the head and pleotelson.

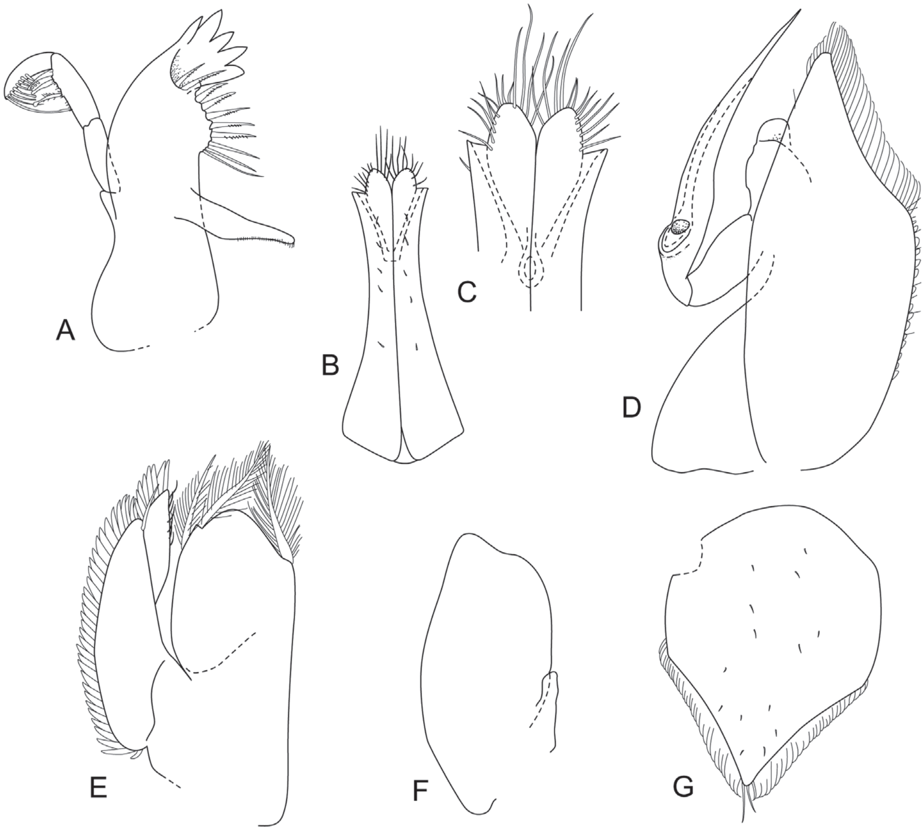

Figure 22. *Joeropsis specca* sp. n. All MTQ W32664 **A–F** male paratype (2.6 mm). **A** left mandible **B** pleopod 1 **C** pleopod 1 apex **D** pleopod 2 **E** pleopod 3 **F** pleopod 4 **G** female (2.5 mm) pleopod 2.

Distribution. Known only from the type locality, Martin Reef (midway between Lizard Island and the mainland, Fig. 1); at a depth of 5 metres.

Etymology. The epithet is the Anglo-Saxon *specca* meaning speckled.

Joeropsis tropida sp. n.

http://zoobank.org/F3D029AC-3C68-4A72-AEA9-B8E7FD3679DC
Figs 23, 24

Material. *Holotype*. ♀ (non-ovig. 2.4 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, *Halimeda* sand in groove, 10–12 m, stn LIZ09-16A, coll. NLB & MB-P (MTQ W33713).

Paratypes. 2 ♀ (ovig. 2.0 [dissected], non-ovig. 1.8 mm), same data as holotype (MTQ W33714).

Description. *Body* 3.7 as long as greatest width, dorsal surfaces polished in appearance, without setae. *Cephalon* length 0.6 width, lateral margins weakly concave, smooth. *Pseudorostrum* 1.2 as long as proximal width, anterior margin acute (lateral margins weakly concave). *Eyes* lateral, with 12 ommatidia, colour dark brown. *Pereonites* compact, close to each other (posteriorly), 1–7 with paired sub-median carinae; *tergite lateral margin* subtruncate, lateral margins smooth; median keels on sternites 2–7, keels well developed (on sternites 2–4 and 6 and 7). *Pleotelson* width 1.1 length, dorsal surface with prominent rounded median ridge and paired submedian depressions, caudomedial lobe broadly rounded; lateral margins convex, each with 5–7 spines.

Antenna 1 with 7 articles; article 1 1.4 as long as wide, distolateral angle not lobed, with cuticular scales, distomesial margin not serrate; article 2 0.6 as long as article 1, 1.5 as long as wide; lateral margins of articles 2 with prominent cuticular scales; article 3 0.1 as long as article 2; article 4 2.6 as long as article 3; article 5 2.5 as long as article 3, 1.5 as long as proximal width, distally with 3 aesthetascs. *Antenna 2* peduncle article 5 2.0 as long as articles 1–4 combined, 5.1 as long as article 3, 1.9 as long as wide, lateral margin convex, with small cuticular scales, mesial margin weakly convex; article 6 2 as long as width, distally expanded, distal width 1.7 proximal width, 0.6 as long as article 5, lateral margin without cuticular scales, mesial margin with 11 simple setae, distodorsal surface with scattered simple setae; flagellum with 4 articles, article 1 0.7 as long as peduncle article 6, 2.1 as long as combined lengths of remaining articles.

Mandible palp article 2 with 2 long biserrate setae, article 3 with 7 long pectinate setae (serrations not seen due to mount conditions). Right incisor with symmetrical cusps, margins convex, distally acute; left mandible incisor similar to right incisor. *Molar process* entirely smooth. Right mandible spine row composed of 10 spines; not divided by truncate lobe, without lacinoid spine. *Maxilla 1* lateral lobe with 12 strongly serrate RS, and 1 simple RS; mesial lobe with 3 long, simple RS. *Maxilla 2* lateral lobe with 4 long, curved, finely serrate setae; middle lobe with 3 long serrate setae, mesial lobe with 3 long simple setae and many long setules. *Maxilliped endite* 2.2 as long as greatest width, extending to distal margin of palp article 4, distal margin subtruncate, smooth, with shallow distomesial concavity, with 4 mesial tubercular RS, distomesial margin with 3 coupling setae. *Maxilliped palp* article 2 2.3 as long as article 1, mesial lobe extending to article 4, distomesial margin with 1 simple seta; article 3 0.6 as long as article 2, distomesial margin with 2 simple setae; article 4 3.1 as long as wide, mesial margin straight, distally with 3 setae; article 5 0.2 as long as 4, with 6 terminal setae. *Epipod* 3.8 as long as basal width, distally narrowly rounded; as long as palp, 0.4 as long as endite.

Pereopod 1 basis 3 as long as wide, superior margin with 2 simple setae; ischium 0.6 as long as basis, 2.6 as long as wide; merus 0.7 length of ischium, 2.1 as long as wide; carpus 1.2 as long as ischium, 4.8 as long as wide; propodus 5.2 as long as wide, superior margin 2 simple setae; inferior margin with 2 acute RS, dactylus 0.4 as long as propodus, with 2 claws (and acute robust seta). Pereopods 2–7 sub-similar, more slender than pereopod 1, each with 2 claws (and acute robust seta). *Pereopod 7* basis 3.1 as long as wide; superior margin with 4 short simple setae; ischium 0.7 as long as basis, 2.8 as long as wide, superior margin weakly convex at midpoint, superior margin

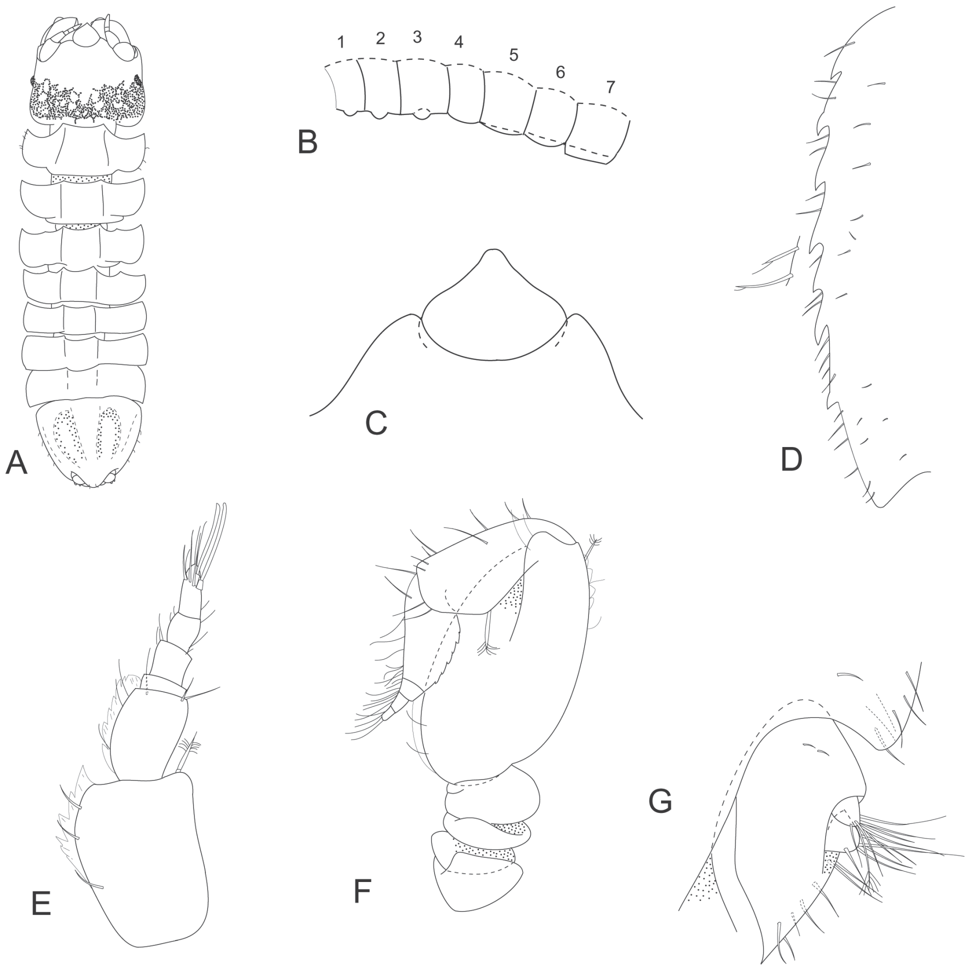

Figure 23. *Joeropsis tropida* sp. n. **A, B** holotype; remainder female paratype MTQ W33714. **A** dorsal view **B** sternal keels (sternites numbered) **C** pseudorostrum **D** pleotelson lateral margin **E** antenna 1 **F** antenna 2 **G** uropod.

with 2 simple setae, inferior distal angle with 2 setae; merus 0.7 as long as ischium, 2.5 as long as wide, superodistal angle with 1 simple seta; carpus 1.1 as long as ischium, 4.9 as long as wide, inferior margin with 2 setae, superior distal angle with 1 prominent pappose seta (and 2 simple setae); propodus 1.2 as long as ischium, 5.1 as long as wide, inferior margin with 2 acute RS, superior margin with 2 simple setae (and distal penicillate seta); dactylus 0.4 as long as propodus.

Pleopod 2 1.2 as long as proximal width, lateral margins weakly convex, posterior margins weakly concave (with long cuticular scale-setae), apex with 2 sub-apical simple setae. *Pleopod 3* endopod 2.2 midwidth (partly fused to protopod); exopod article 1 3.6 as long as wide, extending to endopod apex, lateral margin weakly fringed with

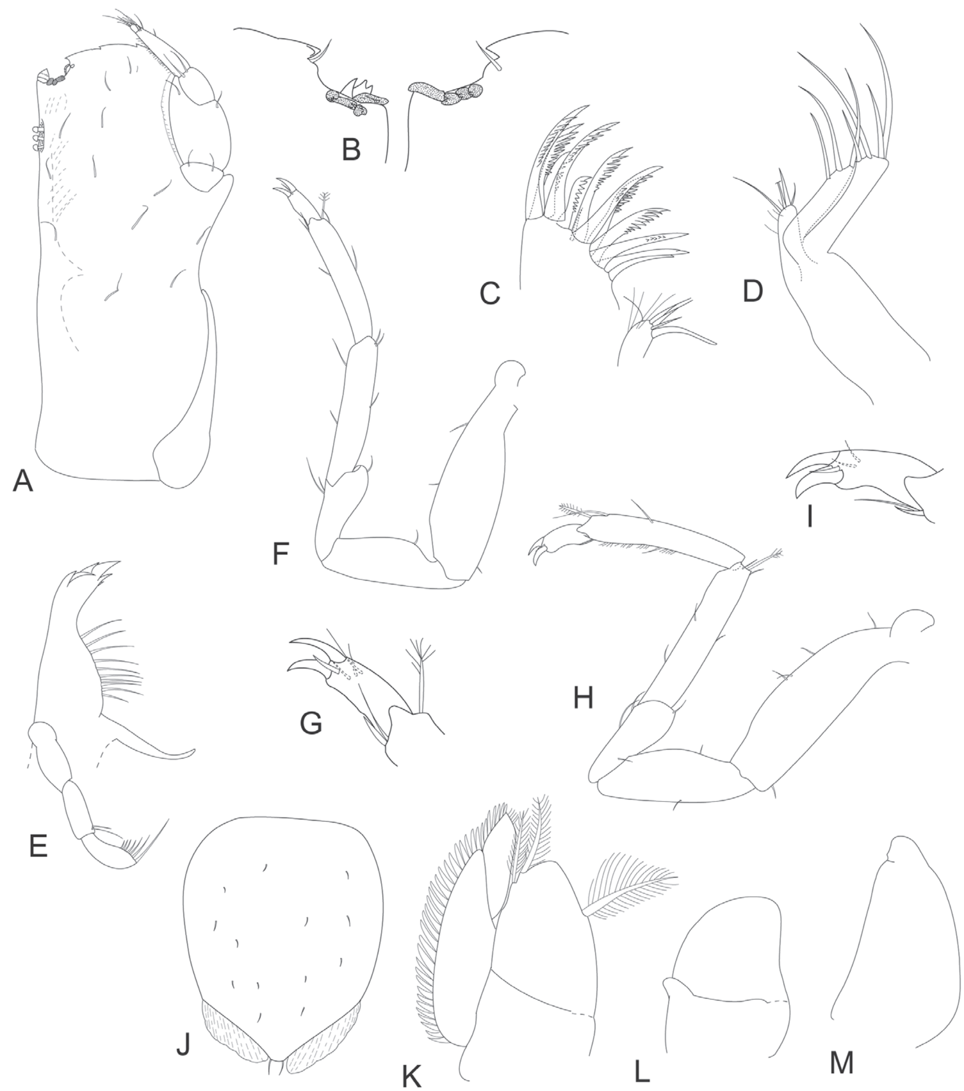

Figure 24. *Joeropsis tropida* sp. n. All female paratype MTQ W33714. **A** maxilliped **B** distomesial angles, maxilliped endites **C** maxillula **D** maxilla **E** left mandible **F** pereopod 7 **G** pereopod 7 dactylus **H** pereopod 1 **I** pereopod 1 dactylus **J–M** pleopods 2–5 respectively.

cuticular scale-setae; article 2 0.4 as long as article 1, lateral and mesial margins with short cuticular scale-setae.

Uropod peduncle extending to margin of pleotelson, mediodistal corner weakly produced and acute, distolateral margin 4 simple submarginal setae, mesial margin smooth. Exopod 0.7 as wide as endopod, 1.0 as long as wide, with 8 simple setae. Endopod 0.8 as long as wide, 0.3 as long as peduncle proximolateral margin, apex with 7 long simple setae.

Male. Not known.

Colour pattern. White with narrow reticulate transverse brown band on posterior of head; interocular head band occupies 37% of head length.

Variation. Pleotelson marginal spines from 5 to 7 per margin.

Remarks. *Joeropsis tropida* sp. n. is the only known carinate species on the Great Barrier Reef, and the only carinate species from coral reef habitats. Undescribed carinate species are present at Ningaloo Reef, Western Australia and also at Rodrigues Island, Mauritius (personal observation).

Joeropsis bicarinata Just, 2001 is similar, but lacks the brown head band, has far more strongly developed dorsal carinae that also extend onto the pleotelson, is far larger (to 5.5 mm) and occurs on the shelf and slope of southeastern Australia at depths from 102 to 400 metres.

Species of *Joeropsis* usually show two types of dactylar morphology, that is all pereopods with two dactylar claws or pereopod 1 with two dactylar claws and pereopods 2–7 with three dactylar claws. *Joeropsis tropida* has all pereopods with two dactylar claws, but also has all pereopods with a dactylar robust seta in what would otherwise be the position of the third dactylar claw. This character is unique among those species for which the dactylus morphology has been recorded.

Distribution. Known only from the type locality, Hicks Reef (Fig. 1).

Etymology. From the Latin *tropidos* meaning keeled, alluding to the keeled dorsum of this species.

Joeropsis varanus **sp. n.**

http://zoobank.org/00007DE5-065F-48C6-A702-545F2FA2DA8C
Figs 25–27

Material. *Holotype*. ♂ (3.0 mm), North Point, Lizard Island, 14.64553°S, 145.45335°E, 12 April 2008, compacted dead *Acropora*, 0.5 m, stn CGLI-20C, coll. NLB (MTQ W31921).

Paratypes. ♂ (2.0 mm; dissected, two slides), Seabird Islet, Lizard Island, 14.69497°S, 145.4657°E, 23 February 2009, outer reef front, dead coral heads, 6–8 m, stn LIZ09-19B, coll. MB-P & NLB (MTQ W31923). Juv. (1.3 mm), same data as holotype (MTQ W13976). Juv. (1.8 mm), same data as holotype (MTQ W31922).

Description. *Body* 3.1 as long as greatest width, dorsal surfaces smooth, without setae. *Cephalon* length 0.6 width, lateral margins evenly weakly convex, strongly serrate (anterior 4 teeth prominent). *Pseudorostrum* 0.6 as long as proximal width, anterior margin acute. *Eyes* sublateral, with ~18 ommatidia, colour dark brown. *Pereonites* compact, close to each other, without dorsal carinae; *tergite lateral margin* subtruncate, lateral margins smooth; median keels not observed. *Pleotelson* width 1.3 length; dorsal surface with single median and paired submedian low ridges, caudomedial lobe narrowly rounded; lateral margins convex, each with 8 spines (prominent).

Antenna 1 with 5 articles; article 1 1.2 as long as wide, distolateral angle not lobed, with serrations, distomesial margin not serrate; article 2 0.5 as long as article 1, 1.3 as

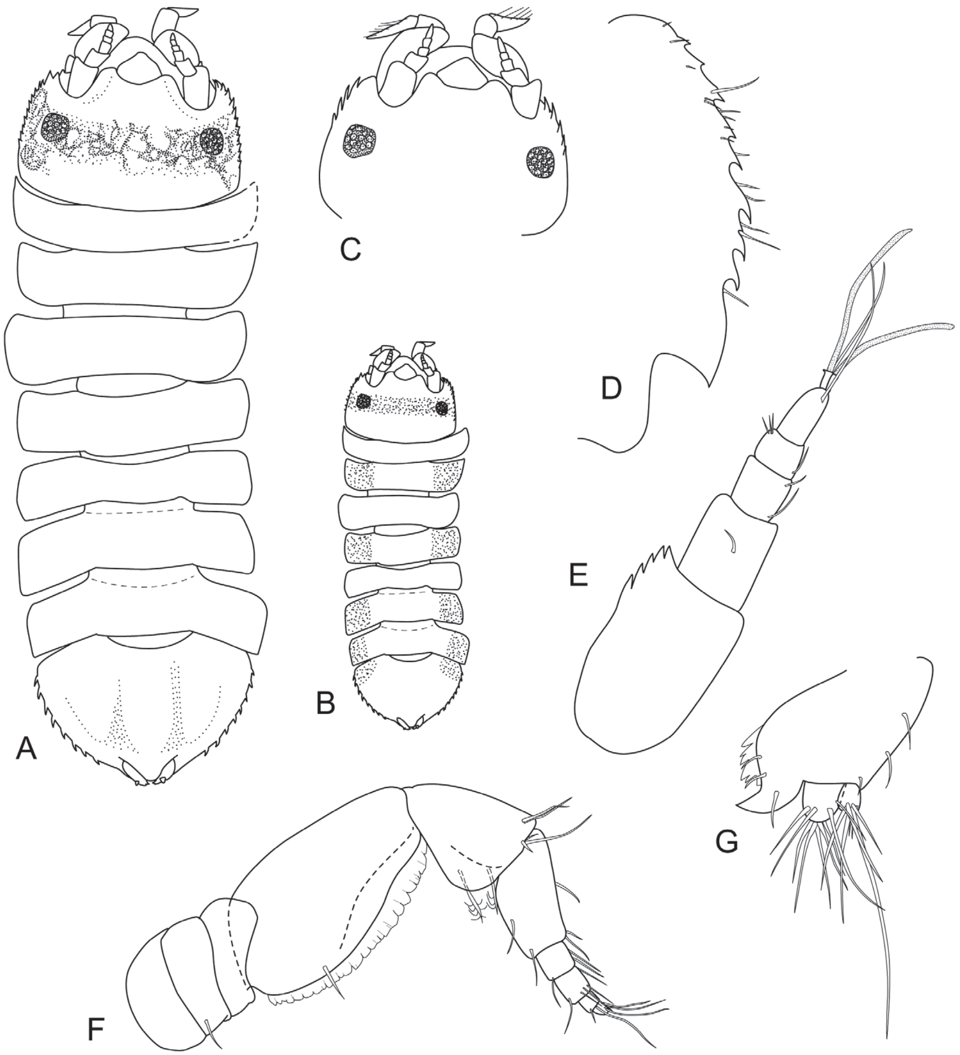

Figure 25. *Joeropsis varanus* sp. n. **A, C** holotype **A** dorsal view **B** dorsal view, immature (1.8 mm), coxal pattern, MTQ W31922; **C** head, dorsal view **D–G** male paratype (2.0 mm) MTQ W31923 **D** pleotelson lateral margin **E** antenna 1 **F** antenna 2 **G** uropod.

long as wide; lateral margins of articles 1 and 2 without cuticular scales; article 3 0.6 as long as article 2; article 4 0.7 as long as article 3; article 5 1.2 as long as article 3, 2.0 as long as proximal width, distally with 2 aesthetascs (and 2 simple setae). *Antenna 2* peduncle article 5 1.3 as long as articles 1–4 combined, 4.3 as long as article 3, 1.8 as long as wide, lateral margin weakly convex, distally concave, with small cuticular scales, mesial margin weakly convex; article 6 1.2 as long as width, distally weakly expanded, distal width 1.8 proximal width, 0.5 as long as article 5, lateral margin without cuticular scales, mesial margin with 2 simple setae, distodorsal surface without setae; flagellum with 5 articles, article 1 0.8 as long as peduncle article 6, 1.2 as long as combined lengths of remaining articles.

Mandible palp article 2 not observed. Right incisor with symmetrical cusps, margins convex, distally acute; left mandible incisor similar to right incisor. *Molar process* entirely smooth. Right mandible spine row composed of 8 spines; left mandible spine row composed of 9 spines, not divided by truncate lobe; without lacinoid spine. *Maxilla 1* lateral lobe with 12 strongly serrate RS, and 2 simple RS; mesial lobe with 3 long, simple RS. *Maxilla 2* lateral lobe with 4 long, curved, finely serrate setae; middle lobe with 4 long serrate setae, mesial lobe with 1 serrate and 3 long simple setae and many long setules. *Maxilliped endite* 2.1 as long as greatest width, extending to middle of palp article 4, distal margin evenly rounded, finely serrate (laterally), with shallow distomesial concavity, with 3 mesial tubercular RS (plus 1 triangular RS and one serrate RS at distomesial angle), distomesial margin with 4 coupling setae. *Maxilliped palp* article 2 2.6 as long as article 1, mesial lobe extending to mid-margin of article 3, distomesial margin with 3 simple setae; article 3 0.5 as long as article 2, distomesial margin with 1 simple seta; article 4 4.2 as long as wide, mesial margin straight, distally with 3 setae; article 5 0.2 as long as 4, with 5 terminal setae.

Pereopod 1 basis 3.2 as long as wide, superior margin with 1 simple seta; ischium 0.8 as long as basis, 3.1 as long as wide (superior margin with 3 stiff setae); merus 0.5 length of ischium, 1.8 as long as wide; carpus 1.1 as long as ischium, 5 as long as wide (inferior margin with 3 long stiff setae); propodus 5.2 as long as wide, superior margin 3 simple setae (and prominent penicillate seta at distal angle); inferior margin with 3 acute RS (distal three-quarters with cuticular scale-setae), dactylus 0.4 as long as propodus, with 2 claws. Pereopods 2–7 sub-similar, more slender than pereopod 1, each with 3 claws. *Pereopod 7* basis 3.7 as long as wide; superior margin with 1 short simple seta, inferior margin with 3 simple setae; ischium 0.7 as long as basis, 3 as long as wide, superior margin weakly convex at midpoint, with 2 simple setae, inferior distal margin with 1 seta; merus 0.7 as long as ischium, 1.7 as long as wide, superodistal angle with 2 simple setae, inferior margin with 2 simple setae; carpus 1.1 as long as ischium, 4.4 as long as wide, inferior margin with 5 simple setae, superior margin with 1 simples seta, distal angle with 1 prominent pappose seta; propodus 1.1 as long as ischium (1.13), 5.8 as long as wide, inferior margin with 3 acute RS, superior margin with 4 simple setae; dactylus 0.5 as long as propodus.

Pleopod 1 1.9 as long as greatest width, lateral margin weakly concave, apical lobe narrowly rounded with strongly oblique mesial margin, with long marginal setae, lateral margin with slender setae, distolateral lobe acute, not extending to distal margin. *Pleopod 2* protopod 2.7 as long as midwidth, lateral margin mid-half weakly convex, without setae, distal margin weakly concave, with long marginal scales, apex narrowly rounded; *stylet* in retracted position reaching apex. *Pleopod 3* endopod 2.6 midwidth; exopod article 1 4.4 as long as wide, extending beyond apex, lateral margin densely fringed with cuticular scale-setae; article 2 0.4 as long as article 1, lateral and mesial margins with long cuticular scale-setae (lateral only).

Uropod peduncle extending slightly beyond margin of pleotelson, mediodistal corner strongly produced and acute, distolateral margin with 2 simple submarginal setae,

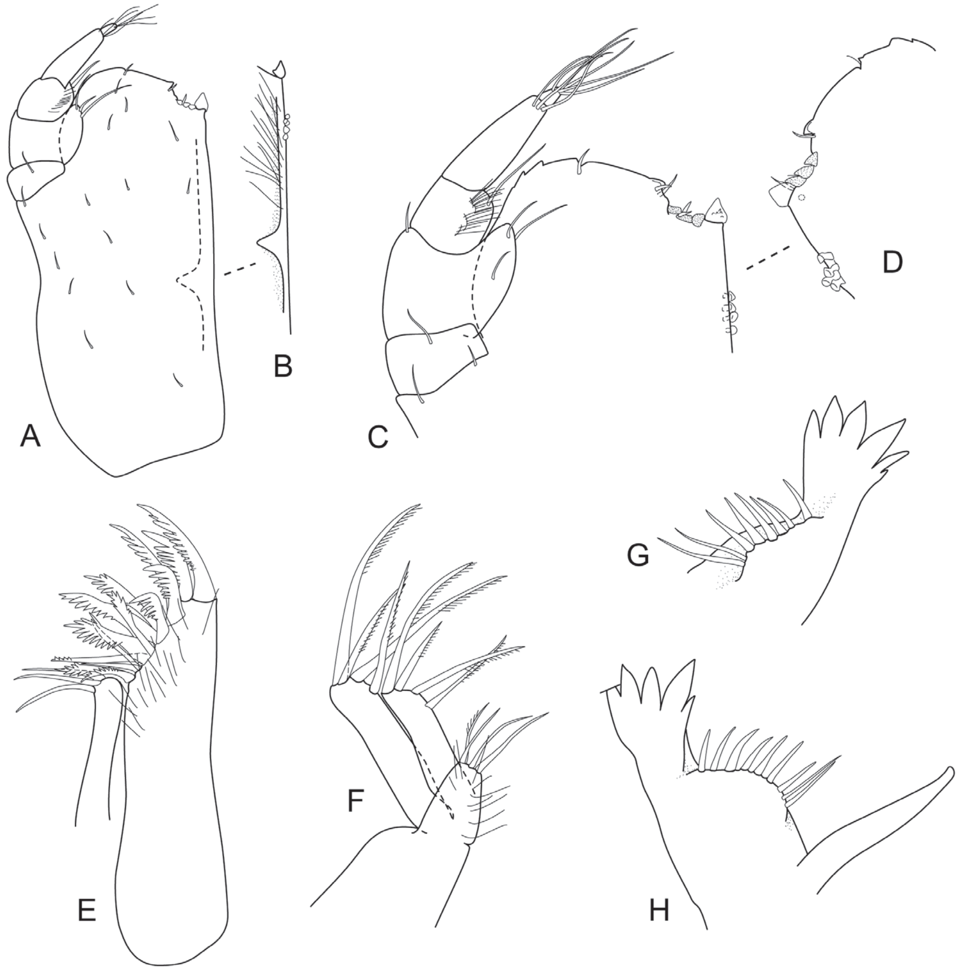

Figure 26. *Joeropsis varanus* sp. n. All male paratype (2.0 mm) MTQ W31923. **A** maxilliped **B** maxilliped, superomesial margin **C** right maxilliped **D** left maxilliped, distomesial margin **E** maxillula **F** maxilla **G** right mandible **H** left mandible.

mesial margin serrate. Exopod 0.5 as wide as endopod, 1.2 as long as wide, with 5 simple setae. Endopod 0.9 as long as wide, 0.3 as long as peduncle proximolateral margin, apex with 8 long simple setae.

Female. No females present in material.

Colour pattern. Head with narrow, brown band running between the eyes and to lateral margin, occupying 30% of head length. Pereonites and pleotelson clear in holotype, in smaller male paratype tergite lateral margin of pereonite 2 with chromatophores; in the juvenile (MTQ W31922) tergite lateral margin of pereonites 2, 4, 6, 7 and anterior of pleotelson with chromatophores.

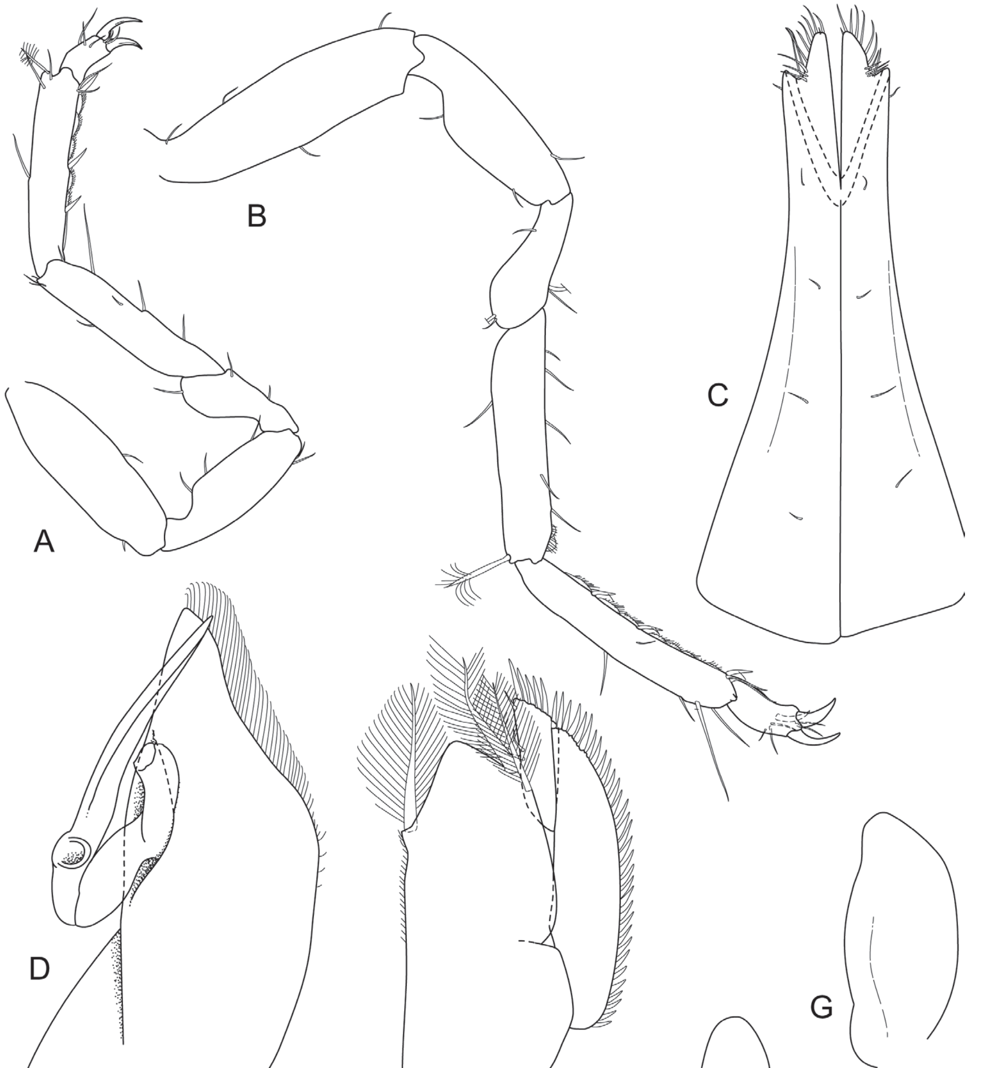

Figure 27. *Joeropsis varanus* sp. n. All male paratype (2.0 mm) MTQ W31923. **A** pereopod 1 **B** pereopod 7 **C–E** pleopods 1–3 respectively **F** pleopod 5 **G** pleopod 4.

Size. Adult males 2.0–3.0 mm.

Remarks. *Joeropsis varanus* sp. n. may be identified by the short interocular head band, lateral margins of the head with strong serrations, pleotelson lateral margin with eight serrations and an acute pseudorostrum. The pereopods of *J. varanus* are more slender than in many other species.

Distribution. Fringing reef at North Point and Seabird Islet, Lizard Island (Fig. 1); intertidal to 8 metres.

Etymology. The epithet is the genus name for the Sand Monitor, *Varanus gouldi*, from which Lizard Island got its English name.

Joeropsis wattora sp. n.

http://zoobank.org/096B65CB-3A76-48BA-98F3-4EF77FD55511

Figs 28–30

Material. *Holotype*. ♂ (2.2 mm), Lizard Island, 14.6867°S, 145.4551°E, 30 August 2010, 3 m, shallow lagoon, LI10-037, coll. I. Marin (MTQ W34019).

Paratypes. ♂ (1.2 mm), off Palfrey Is, 14.68687°S, 145.43764°E, 16 April 2008, 7 m, hard, current swept bottom, CGLI-035, coll. MB-P (MTQ W13978). ♂ (1.6, imm 1.5 mm), ♀ (non-ovig. 2.2 [part dissected], 1.7 [dissected], 1.7, 1.6, 1.5 mm), same data as holotype (MTQ W32678).

Description. *Body* 4.6 as long as greatest width, dorsal surfaces finely granular, without setae. *Cephalon* length 0.8 width, lateral margins straight, smooth. *Pseudorostrum* 0.7 as long as proximal width, anterior margin narrowly truncate. *Eyes* sublateral, with 8–12 ommatidia, colour black. *Pereonites* not compact, widely spaced, without dorsal carinae; *tergite lateral margin* subtruncate, lateral margins smooth; median keels on sternites 5–7, keels well developed. *Pleotelson* width 1.1 length, dorsal surface with single median and paired submedian low ridges, caudomedial lobe broadly rounded; lateral margins weakly convex, each with 5 spines.

Antenna 1 with 6 articles; article 1 1.5 as long as wide, distolateral angle strongly lobed, strongly serrated, distomesial margin with single serration; article 2 0.6 as long as article 1, 1.4 as long as wide; lateral margins of articles 1 and 2 without cuticular scales; article 3 0.5 as long as article 2; article 4 0.9 as long as article 3; article 5 1.5 as long as article 3, 3.09 as long as proximal width, distally with 2 aesthetascs. *Antenna 2* peduncle article 5 1.8 as long as articles 1–4 combined, 3.7 as long as article 3, 2.6 as long as wide, lateral margin weakly convex, with small cuticular scales, mesial margin straight; article 6 1.4 as long as width, distally weakly expanded, distal width 1.9 proximal width, 0.6 as long as article 5, lateral margin without cuticular scales, mesial margin with 6 simple setae, distodorsal surface with scattered simple setae; flagellum with 6 articles, article 1 0.8 as long as peduncle article 6, 2 as long as combined lengths of remaining articles.

Mandible palp both damaged in dissections; right incisor with symmetrical cusps, margins convex, distally acute; left mandible incisor similar to right incisor. *Molar process* distal third finely serrate. Right mandible spine row composed of 8 spines; left mandible spine row composed of 9 spines, left mandible spine row divided by truncate lobe; without lacinoid spine. *Maxilla 1* lateral lobe with 10 strongly serrate RS, and 3 simple RS; mesial lobe with 4 long, simple RS. *Maxilla 2* lateral lobe with 4 long, curved, finely serrate setae (2 short, 2 long); middle lobe with 4 long serrate setae (2

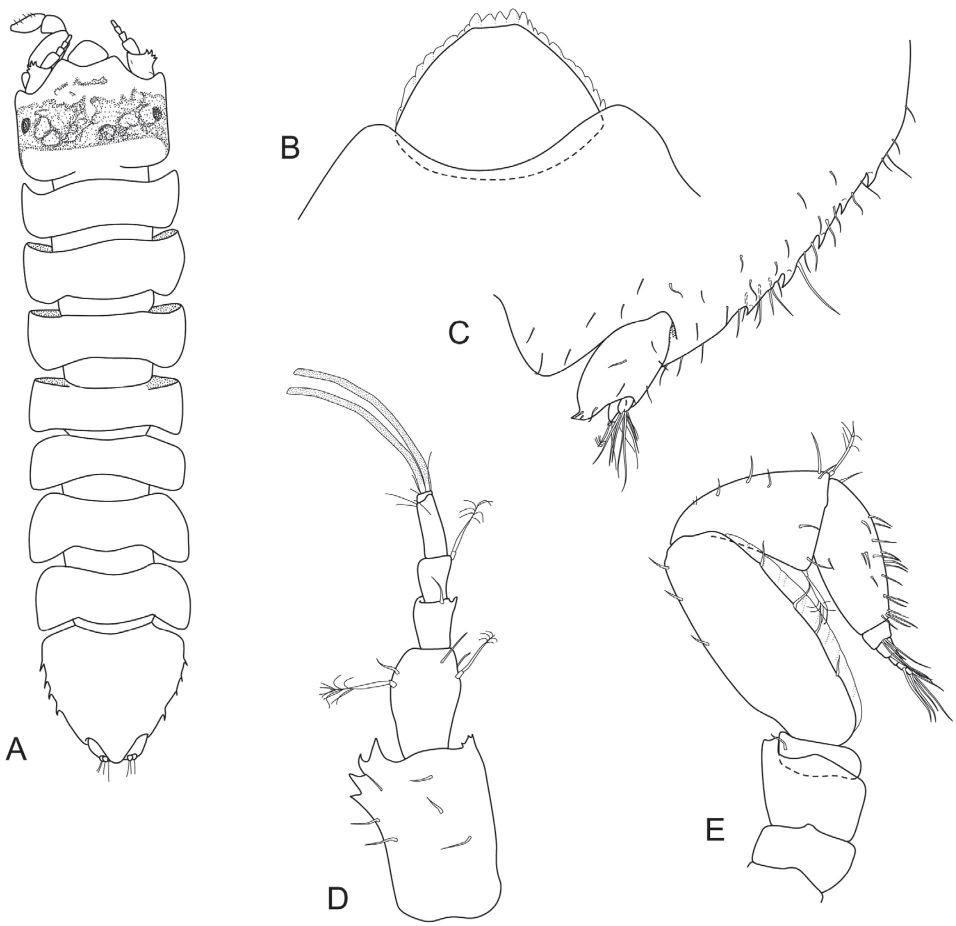

Figure 28. *Joeropsis wattora* sp. n. **A, B** holotype; **C** paratype (2.2 mm), **D, E** female paratype (1.7 mm) MTQ W32678. **A** dorsal view **B** pseudorostrum **C** pleotelson lateral margin **D** antenna 1 **E** antenna 2.

short, 2 long), mesial lobe with 4 long simple setae and many long setules. *Maxilliped endite* 2.2 as long as greatest width, extending to middle of palp article 4, distal margin subtruncate, finely serrate, with shallow distomesial concavity, with 4 mesial tubercular RS, distomesial margin with 3 coupling setae. *Maxilliped palp* article 2 1.4 as long as article 1, mesial lobe extending to mid-margin of article 3, distomesial margin with 2 simple setae; article 3 0.7 as long as article 2, distomesial margin with 1 simple seta; article 4 5.4 as long as wide, mesial margin weakly concave, distally with 4 setae; article 5 0.2 as long as 4, with 8 terminal setae. *Epipod* 3.6 as long as basal width, distally acute; 1.1 as long as palp, 1.9 as long as endite.

Pereopod 1 basis 3.4 as long as wide, superior margin with 3 simple setae, inferior margin with 3 simple setae; ischium 0.7 as long as basis, 3.3 as long as wide superior margin with 1 simple seta, inferior margin with 2 simple setae; merus 0.6 length of ischium, 1.9 as long as wide superior margin with 1 simple seta, inferior margin with 1 simple

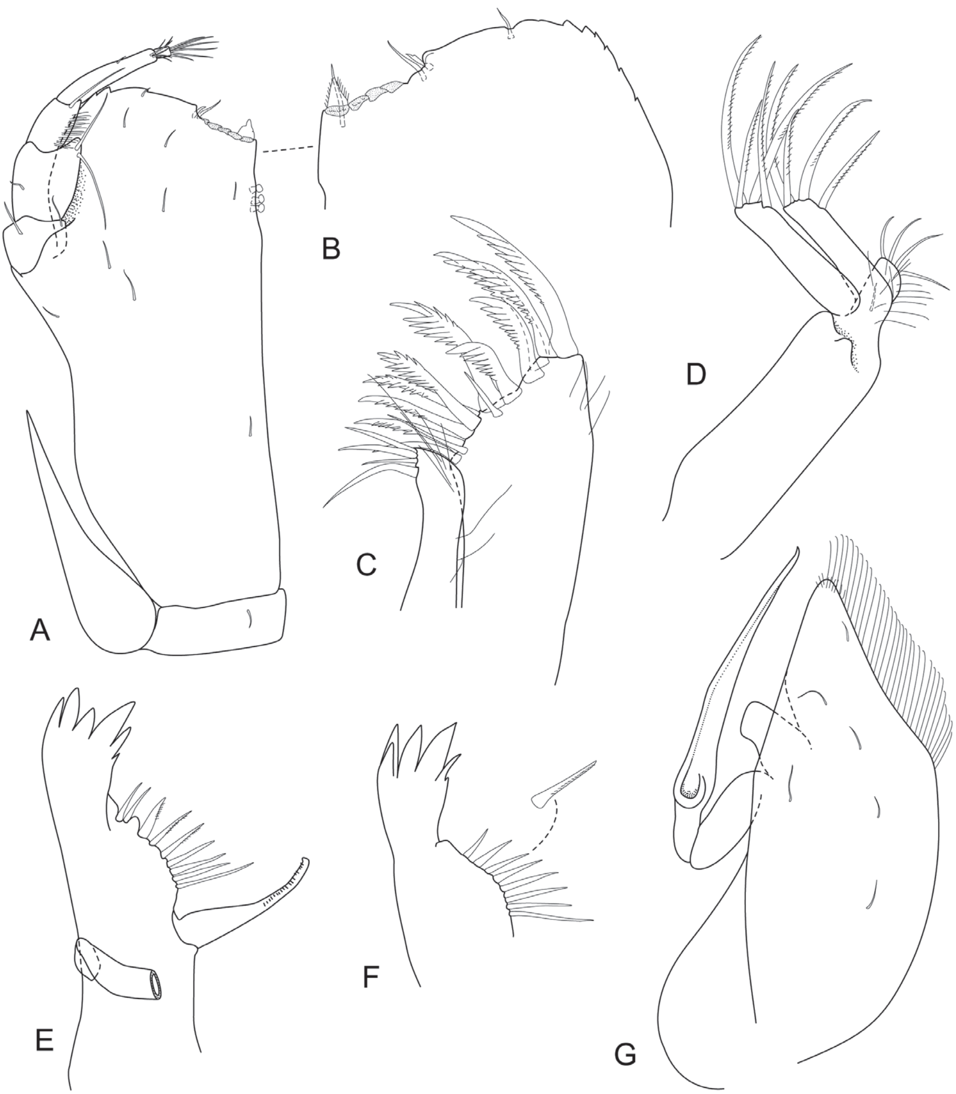

Figure 29. *Joeropsis wattora* sp. n. Female paratype (1.7 mm) MTQ W32678. **A** maxilliped **B** maxilliped endite, distomesial margin **C** maxillula **D** maxilla **E** left mandible **F** right mandible **G** pleopod 2.

seta and 1 submarginal simple seta; carpus 1.1 as long as ischium, 3.95 as long as wide, superior margin with 1 short simple seta, inferior margin with 4 simple seta; propodus 5.3 as long as wide, superior margin 2 simple setae (1 brush-tipped; distal angle only); inferior margin with 2 acute RS, dactylus 0.4 as long as propodus, with 2 claws. Pereopods 2–7 sub-similar, more slender than pereopod 1, each with 3 claws. *Pereopod 7* basis 3.4 as long as wide; superior margin with 5 short simple setae; ischium 0.8 as long as basis, 3.4 as long as wide, superior margin weakly convex at midpoint, superior margin with 2 simple setae, inferior distal angle with 0 setae (inferior margin with 2 setae); merus 0.6 as

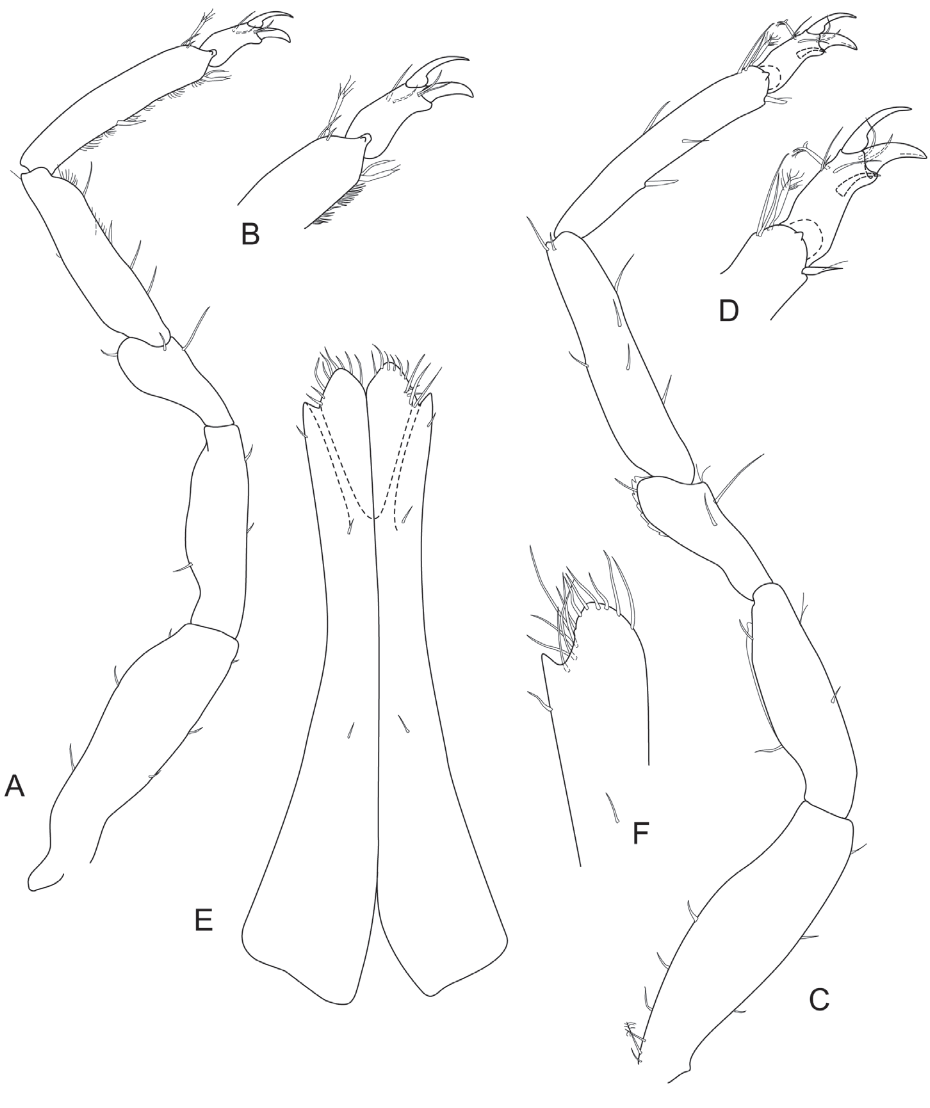

Figure 30. *Joeropsis wattora* sp. n. **A–D** female paratype (2.2 mm) MTQ W32678 **E, F** holotype. **A** pereopod 1 **B** pereopod 1 dactylus **C** pereopod 7 **D** pereopod 7 dactylus **E** pleopod 1 pleopod 1 apex.

long as ischium, 1.9 as long as wide, superodistal angle with 1 simple seta (weak cuticular scales), inferior margin with 3 simple seta; carpus 0.9 as long as ischium, 4.8 as long as wide, inferior margin with 4 setae, superior distal angle with 3 simpee setae; propodus 1.1 as long as ischium, 6.3 as long as wide, inferior margin with 2 acute RS, superior margin with 3 simple setae and prominent pappose seta; dactylus 0.4 as long as propodus.

Pleopod 1 2.4 as long as greatest width, lateral margin strongly concave, apical lobe narrowly rounded, mesial margin weakly oblique, with long marginal setae, lateral margin with slender setae, distolateral lobe acute, not extending to distal margin.

Pleopod 2 protopod 2.6 as long as midwidth, lateral margin mid-half weakly convex, without setae, distal margin weakly concave, with long marginal cuticular scales, apex narrowly rounded; *stylet* in retracted position extending beyond apex.

Uropod peduncle extending slightly beyond margin of pleotelson, mediodistal corner weakly produced and acute, distolateral margin 2 simple submarginal setae, mesial margin smooth. Exopod 0.8 as wide as endopod, 1.4 as long as wide, with 8 simple setae. Endopod 1.3 as long as wide, 0.4 as long as peduncle proximolateral margin, apex with 6 long simple setae.

Female. Female dissection of pleopods failed.

Size. Males 1.3–2.2 mm, mean 1.4 mm (*n*=3); non-ovigerous females 1.5–2.1 mm, mean 2.7 mm (*n*=5); all from the type series.

Remarks. The colour pattern of *Joeropsis wattora* sp. n. is closely similar to species such as *J. makrogenys* sp. n. and *J. sandybrucei*, both with a wide, dark brown head band. *J. wattora* can be identified by the elongate body (4.7 as long as wide) with widely spaced pereonites, anteriorly narrowed pseudorostrum (the pseudorostrum is anteriorly concave in both *J. makrogenys* sp. n. and *J. sandybrucei*) and the small size (mean adult length 1.6 mm).

Variation. Pleotelson spines range from 3 to 5 per margin, with large specimens having 3 or 4 spines.

Distribution. Lizard Island lagoon and off Palfrey Island, Lizard Island Group (Fig. 1); 3–7 metres.

Etymology. The epithet wattora is an Aboriginal word meaning long, in the sense of elongate; noun in apposition.

Species not described

The following species lacked adequate material for description. In most cases the principal differentiating characters from other species in the region (and elsewhere) are a combination of size, colour pattern, setosity and shape of the pseudorostrum.

Joeropsis sp. 9

Material. (1.9 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, dead coral heads on bommies, 5–6 m, stn LIZ09-16H, coll. NLB & MB-P (MTQ W34020).

Remarks. The colour pattern of a short head band, and short band on pereonite 4 with very few chromatophores laterally is unique; the pseudorostrum is laterally rounded and anteromedially weakly concave, the eyes are small and marginal and the pleotelson margins have 4 and 5 spines on each margin (counted under compound microscope). The single specimen lacks both antenna and pereopod 1. Despite the apparently unique colour pattern the species cannot be described without further material.

Joeropsis sp. 11

Material. ♂ (1.5 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, dead coral heads on reef edge, 5–7 m, LIZ09-16E, coll. NLB & MB-P (MTQ W34021). ♀ (non-ovig. 1.4 mm), Day Reef, 14.48356°S, 145.5459°E, 13 February 2009, outer reef, fine rubble, 10 m, stn LIZ09-04C, coll. MB-P (MTQ W31200). ♀ (1.2 mm), Day Reef, 14.48283°S, 145.5564°E, 19 February 2009, outer reef front, small rubble in gully, 7.5 m, stn LIZ09-13A, coll. MB-P & N. Bruce (MTQ W34022).

Remarks. No specimen has antenna. The dorsum is finely and sparsely speckled with black chromatophores, with further speckling ventrally. The pseudorostrum is laterally angled and appears to have marginal cuticular scales.

Joeropsis sp. 12

Material. ♀ (non-ovig. 3.2 mm), Hicks Reef, 14.44803°S, 145.4992°E, 21 February 2009, outer reef front, dead coral heads on reef edge, 5–7 m, LIZ09-16E, coll. NLB & MB-P (MTQ W31288).

Remarks. The single specimen lacks both antenna. The dorsum is more setose than in other species and is covered in pale-brown chromatophores, these being more dense on the head forming a short (40% head length) band; the pseudorostrum is evenly rounded, the uropods have a prominent terminal spine and the pleotelson lateral margins each have 6 spines. There are no other similar species in the region; *Joeropsis adusta* sp. n. is smaller, less densely setose, and appears evenly dark brown; *J. salvati* Müller, 1989 is smaller still, and has a slightly truncate pseudorostrum.

Joeropsis sp. 15

Material. ♂ (3.0 mm), Day Reef, 14.47045°S, 145.52840°E, 5 September 2010, outer reef, dead corals, 17 m, LI10-077B, coll. CB (MTQ W32849). ♀ (non-ovig. 2.0 mm), Day Reef, 14.47045°S, 145.52840°E, 5 September 2010, 17 m, outer reef, dead coral heads, LI10-077B, coll. CB (MTQ 34023).

Remarks. A relatively large species, with a prominent, posteriorly acute keel on sternite 7 that extends posteriorly over pleopods in both the male and female specimen. The male has a short diffuse head band, and weak mottling on the tergite lateral margin of pereonites 2, 5 and 7, laterally on pereonite 7 and very lightly at anterolateral angles of the pleotelson. The female pleopod 2 differs from other species in having a distinct subterminal inflection to the lateral margins. The pseudorostrum is anteriorly concave. The male specimen lacks antenna.

Joeropsis sp. 16

Material. 3♂ (2.1, 1.7, 1.5 mm), Bommie Bay, Lizard Island, 14.66157°S, 145.47160°W, 8 September 2010, dead coral, 8 m, stn LI10-101B, coll. CB (MTQ W34024).

Remarks. These specimens are similar to *Joeropsis adusta* sp. n. differing primarily in having a sub-quadrate pseudorostrum that has a weakly convex anterior margin and being reddish–brown rather than dark brown. *Joeropsis lentigo* Kensley & Schotte, 2002, from the Seychelles, is also similar, differing in having the anterior margin of the pseudorostrum more strongly convex. The latter species is not described in sufficient detail to make further comparisons.

Acknowledgements

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RESEARCH ARTICLE

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Description of new species of *Stenaelurillus* Simon, 1886 from the Western Ghats of India with the redescription of *Stenaelurillus lesserti* Reimoser, 1934 and notes on mating plug in the genus (Arachnida, Araneae, Salticidae)

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Abstract

A new species of the jumping spider genus *Stenaelurillus* Simon, 1886, *S. albus* **sp. n.**, is described from the Western Ghats of India, one of the biodiversity hotspots of the world. Detailed morphological descriptions, diagnostic features and illustrations of copulatory organs of both sexes are given. Detailed redescription, diagnosis and illustration of *S. lesserti* Reimoser, 1934 are provided. The occurrence of a mating plug in the genus is reported.

Keywords

Mating plug, new species, paternity, redescription, Western Ghats

Introduction

The salticid spider genus *Stenaelurillus*, which is considered a senior synonym of *Philotheroides* Strand, 1934 (Prószyński 1984), was erected by Simon in 1886 to accommodate three species: *S. nigricaudus* Simon, 1886 (from Senegal), *S. nigritarsus* Simon, 1886 (from Algeria), which later became a junior synonym of *S. nigricaudus* (Szűts & Scharff, 2005) and *S. triguttatus* Simon, 1886 (from Tibet). Wesolowska (2014) reviewed the Asian species of the genus and synonymised *S. hainanensis* Peng, 1995 with *S. minutus* Song & Chai, 1991 and considered *S. setosus* Thorell, 1895 as a *nomen nudum*. Presently the genus has 27 valid species, mostly from Africa (21 species) with only two representatives from India, *S. lesserti* Reimoser, 1934 (known from both sexes) and *S. sarojinae* Caleb & Mathai, 2014 (known only from female) (World Spider Catalog 2014). The current paper provides the description of a new species of the genus *Stenaelurillus* from the Western Ghats, one of the biodiversity hotspots of the world (Myers et al. 2000), in the Kerala region of southern India with the redescription of *S. lesserti* Reimoser, 1934.

Material and methods

The specimens were preserved in 70% ethanol and studied under a Zeiss Stemi 2000-C stereomicroscope. All measurements are in millimetres (mm) and were made with an ocular micrometer. Length of palp and leg segments are given as: total (femur, patella, tibia, metatarsus (except palp), tarsus). Spine positions are as follows: prolateral, dorsal, retrolateral and ventral. Comparison of the new *Stenaelurillus* species with all other described species is based only on available literature. Drawings were made by the aid of a drawing tube attached to the microscope. Field photos were taken with Canon EOS 6D with Canon Macro photo lens MP-E65 mm 1:2.8 lens attached. The microphotographic images were taken by Leica DFC295 digital camera attached to Leica M205 C stereomicroscope with the software package Leica Application Suite (LAS), version 4.3.0. All specimens are deposited in a reference collection housed at the Division of Arachnology, Department of Zoology, Sacred Heart College, Thevara, Cochin, Kerala, India (ADSH).

Abbreviations

ALE–anterior lateral eye, AME–anterior median eye, CD–copulatory duct, CO–copulatory opening, E–embolus, PLE–posterior lateral eye, PME–posterior median eye , RPT–retrobasal process of tegulum, RTA–retrolateral tibial apophysis, S–spermatheca, T–tegulum, TA–terminal apophysis, VTA1 & VTA2–ventral tibial apophyses 1 & 2; VPT–ventral process of tegulum, WS–weakly sclerotized part of copulatory duct.

Taxonomy

Salticidae Blackwall, 1841
Aelurillinae Simon, 1901

Stenaelurillus Simon, 1886

Diagnosis. Medium sized spiders. Prosoma of all the known *Stenaelurillus* species has two white transverse stripes. Both male and female have strong bristles on the ocular area. Male palp with a short, not coiled and visible embolus, and tegulum with characteristic retrobasal process. RTA is simple and strongly sclerotized. Epigyne is simple, with thick-walled copulatory openings and short copulatory ducts, and is often accompanied by accessory glands (Szűts and Scharff 2005).

Type species. *Stenaelurillus nigricaudus* Simon, 1886, by original designation.

Distribution. Africa, Asia (World Spider Catalog 2014).

Stenaelurillus albus sp. n.

http://zoobank.org/29A9E0C0-1472-47A2-A9BB-22B4D84C8C01
Figs 1A–B, 2A–G, 3A–C, 7A, 8A–I, 9A–F

Type material. Holotype: Male (ADSH 83503Ai): India, Kerala, Ernakulam, Kurisumudi (10°12'33.36"N, 76°30'08.85"E) in Malayatoor (10°11'43.76"N, 76°29'48.45"E), 94 m. alt., Pradeep M. S., 04. XII. 2013, by hand; Paratypes: 8 females, 6 males (ADSH 83503Aii), same data as holotype.

Diagnosis. Males of *S. albus* sp. n. can be separated from all other described congeners by uniformly dark dorsal opisthosoma without any pattern (Figs 1A, 8A), paired creamy white areas at the anterior part of the bulbus, (Fig. 2E, arrows) and palpal femur with a single disto-dorsal spine (Figs 2A, 2C); females are most similar to *S. abramovi* Logunov, 2008 as both possess wide copulatory openings (Logunov 2008, Fig. 4 and herein Figs 3A, 9E), but can be distinguished by the presence of small and 'vase'- shaped spermathecae (Figs 3B, 9F) and copulatory ducts with weakly sclerotized anterior part (Fig. 3B).

Description. MALE (holotype, Figs 1A, 8A–F): Prosoma black with white lateral bands of nearly uniform thickness; thoracic region dorsally with paired white longitudinal bands extending back from the rear eyes. Eye field black; anterior row of eyes encircled by black hairs. Clypeus densely covered with white hairs, which is a continuation with that on the lateral margins of carapace. Chelicerae short, vertical, brownish with a thick mid-dorsal transverse layer of white hairs; promargin with two, one large and one small, and retromargin with one large teeth. Fangs short, pale brown. Maxillae, labium and sternum yellowish-brown. Opisthosoma oval; dorsum uniformly shiny black without any pattern; lateral opisthosoma and venter dull yellow with several broken black striations and spots. Trochanters III and IV and coxae III and IV

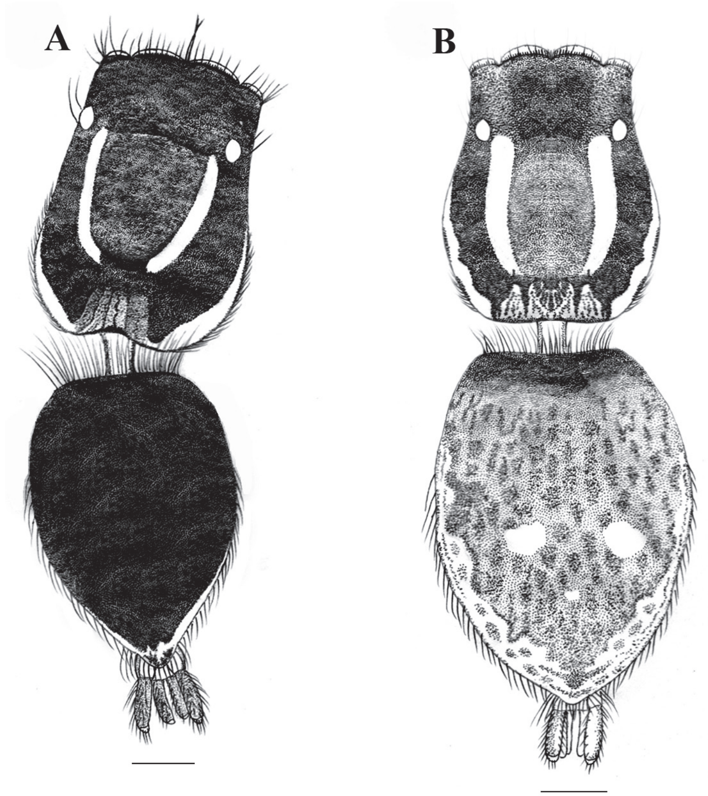

Figure 1. *Stenaelurillus albus* sp. n. **A** Male habitus, dorsal view **B** Female habitus, dorsal view. Scale bars: **A** = 0.58 mm; **B** = 0.68 mm.

yellowish-brown; trochanters I and II and coxae I and II black; all tarsi brown; all other leg segments dull yellow with broad black patches giving a blackish appearance to the legs. Body length 5.89. Prosoma length 2.98, width (at the middle) 2.08, height (at the middle) 1.72. Opisthosoma length 2.91, width (at the middle) 1.98, height (at the middle) 1.45. Eye diameter: AME 0.44. ALE 0.22. PME 0.06. PLE 0.23. Eye interdistance: AME–AME 0.04. PME–PME 1.35. PLE–PLE 1.33. AME–ALE 0.06. ALE–PLE 0.41. ALE–PME 0.27. PME–PLE 0.14. Clypeus height at AMEs 0.36, at ALEs 0.64. Chelicera length 0.65. Measurements of palp and legs. Palp 1.78 [0.70, 0.32, 0.16, 0.60], I 4.25 [1.40, 0.81, 0.90, 0.60, 0.54], II 4.14 [1.45, 0.75, 0.84, 0.59, 0.51], III 6.60 [2.02, 1.14, 1.33, 1.51, 0.60], IV 6.26 [1.94, 0.87, 1.28, 1.53, 0.64]. Leg formula: 3412. Spination. Palp. 0100, 0000, 0000, 0000; legs: femur I 1500, II 1520 (right 1510), III 0300 (right 1300), IV 1500; patellae I–IV 1000; tibia I 2000, II 2022, III 2122, IV 2033 (right 2023); metatarsus I 2014, II 2022, III 3523 (right 3423), IV 2423; tarsi I–IV 0000. Copulatory organ (Figs 2A–G, 8G–I): Palpal segments pale yellow, the basal 1/4th of femur with black striations; femur disto-dorsally with a short spine and dorsally and laterally with a fringe of long yellowish-white hairs,

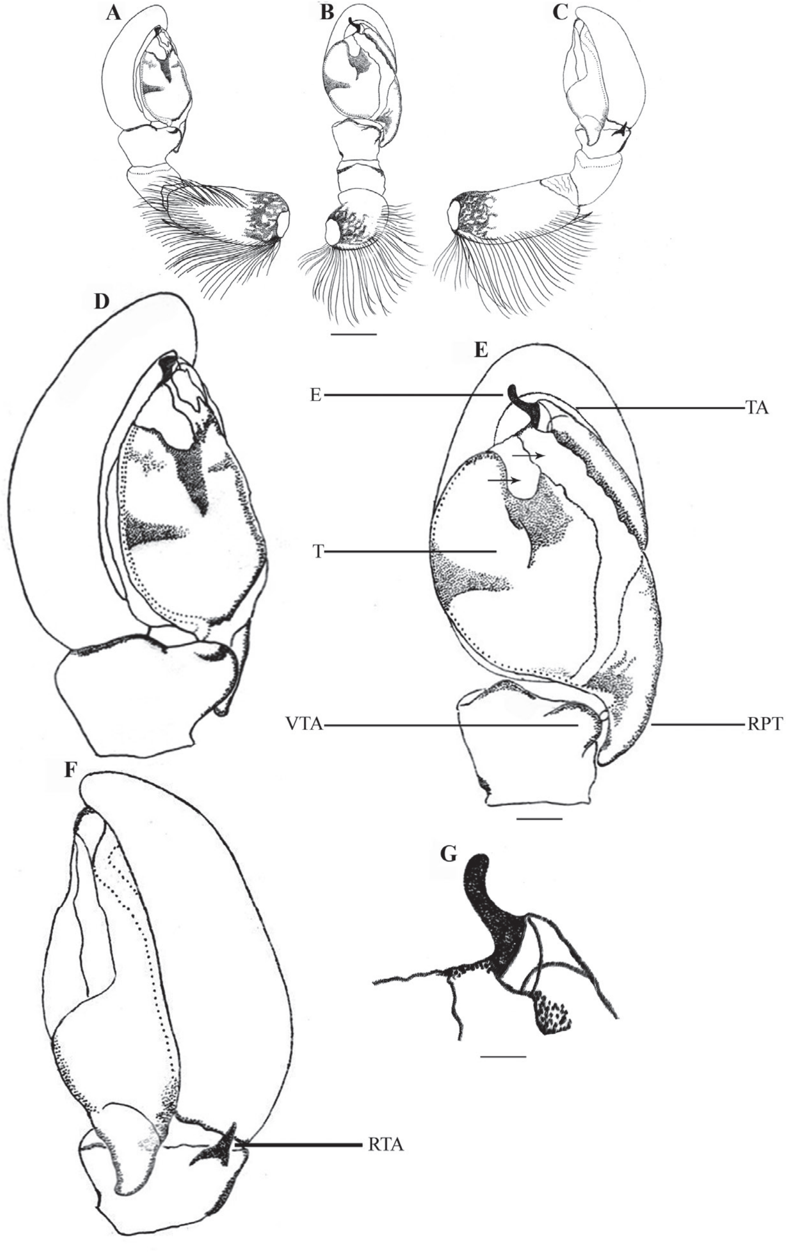

Figure 2. *Stenaelurillus albus* sp. n. Left male palp. **A** Palp entire, prolateral view **B** Same, ventral view **C** Same, retrolateral view **D** Palp enlarged, prolateral view **E** Same, ventral view **F** Same, retrolateral view **G** Embolic division of the bulb, ventral view. E = Embolus; RPT = Retrobasal process of tegulum; RTA = Retrolateral tibial apophysis; T = Tegulum; TA = Terminal apophysis. Scale bars: **A–C** = 0.34 mm; **D–F** = 0.08 mm; **G** = 0.02 mm.

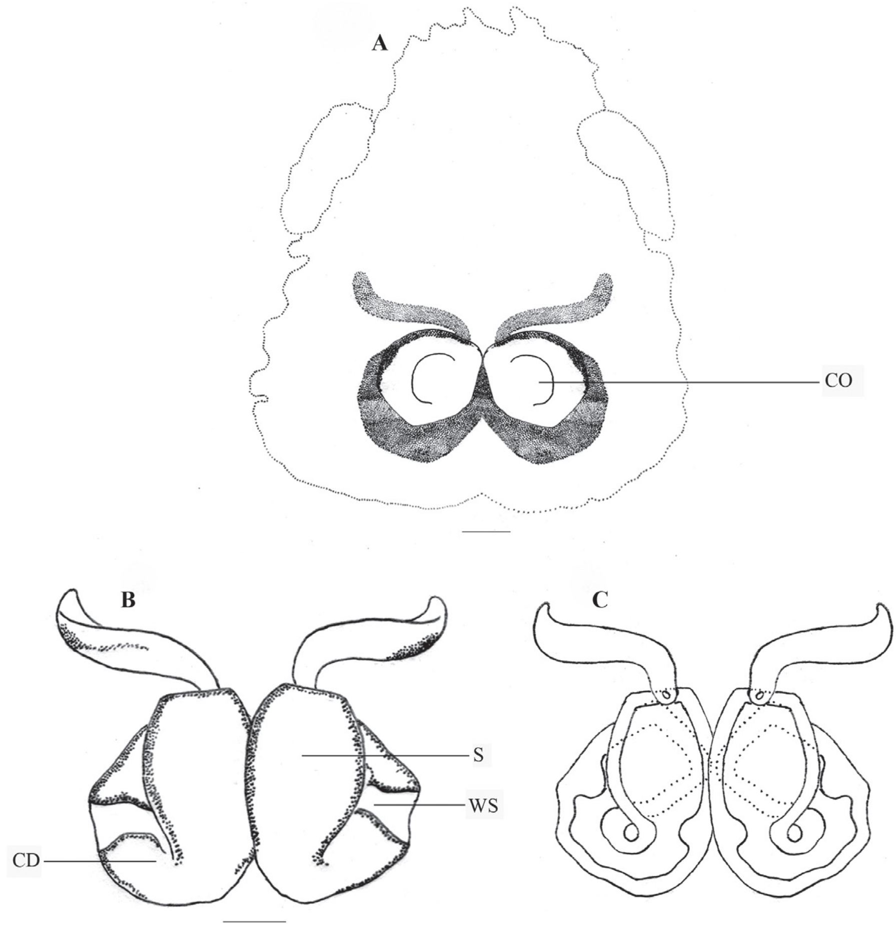

Figure 3. *Stenaelurillus albus* sp. n. Female copulatory organ. **A** Epigyne **B, C** Internal duct system. CO = Copulatory opening; CD = Copulatory duct, S = Spermatheca; WS = Weakly sclerotized part of copulatory duct. Scale bars: **A** = 0.11 mm; **B–C** = 0.03 mm.

dorsal and prolateral ones are prominent; patella and tibia disto-dorsally with a long black hair; patella ventro-laterally covered with short yellowish-white hairs; cymbium dark and dorsally with a few long black hairs. Bulb brown; anterior edge of the bulbus has two creamy-white regions, the distal one runs retrolaterally to near the antero-lateral edge of the ventral tibial apophysis (Fig. 2E, arrows); retro-basal process of tegulum not fused with the tibia; embolus short with blunt end and is prolaterally directed (Figs 2D–E, 2G); conductor apparently absent; terminal apophysis short, directed at eleven o'clock position (Figs 2E, 2G). VTA short with blunt end and directed at two o'clock position (Fig. 2E); RTA simple with broad base and pointed end and directed at one o'clock position (Fig. 2F).

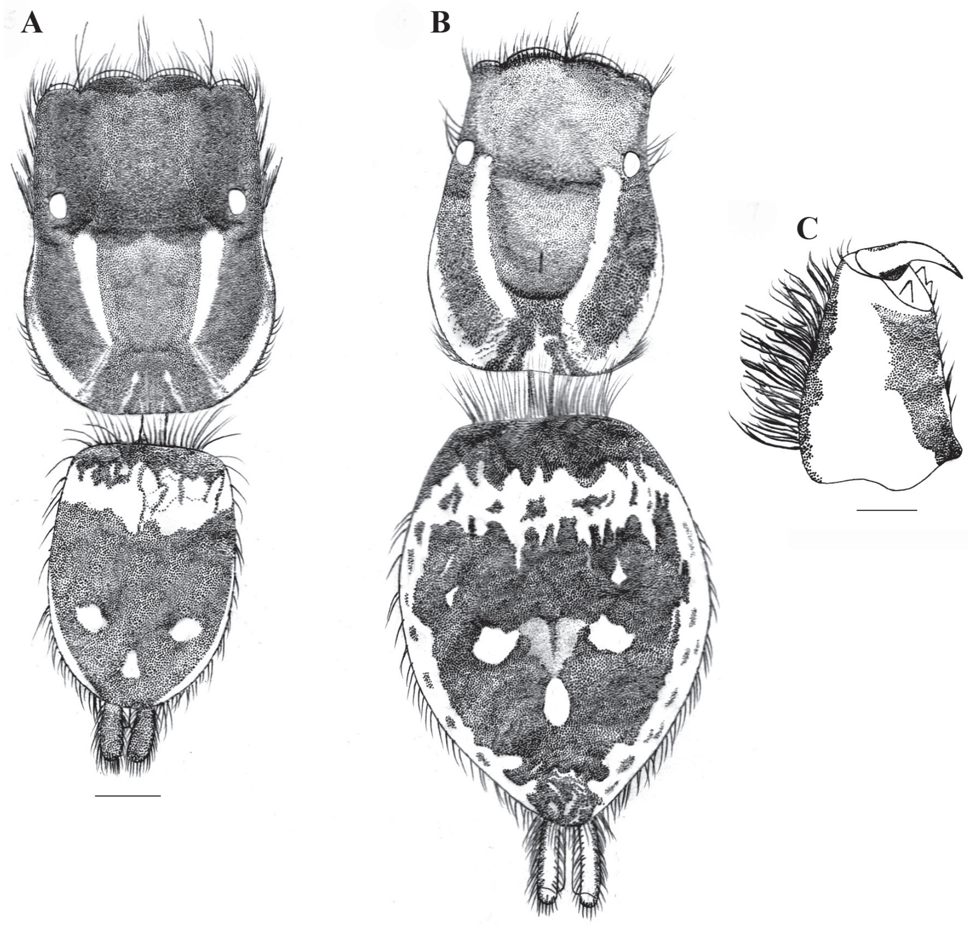

Figure 4. *Stenaelurillus lesserti* Reimoser, 1934. **A** Male habitus, dorsal view **B** Female habitus, dorsal view **C** Male right chelicera, retrolateral view. Scale bars: **A** = 0.38 mm; **B** = 0.65 mm; **C** = 0.08 mm.

FEMALE (Paratype, Figs 1B, 9A–D): Prosoma black with dull yellow lateral bands, the thoracic part of which is broader; thoracic region dorsally with paired white longitudinal bands extending back from the rear eyes. Eye field black; anterior row of eyes encircled with dull yellow hairs. Clypeus black; Chelicerae short, vertical and dull yellow; promargin with two, one large and one small, and retromargin with one large teeth. Maxillae, labium and sternum yellowish-brown. Opisthosoma widely oval; dorsum black with several dull yellow patches, the posterior three are prominent, which together forming an inverted triangle; lateral opisthosoma and venter dull yellow with several broken black striations and spots. Leg segments dull yellow with black patches and narrow transverse stripes. Palpal segments yellow with black patches; patella, tibia and tarsus dorsally with long black hairs. Body length 6.82. Prosoma length 2.99, width (at the middle) 2.29, height (at the middle) 1.94. Opisthosoma length 3.83,

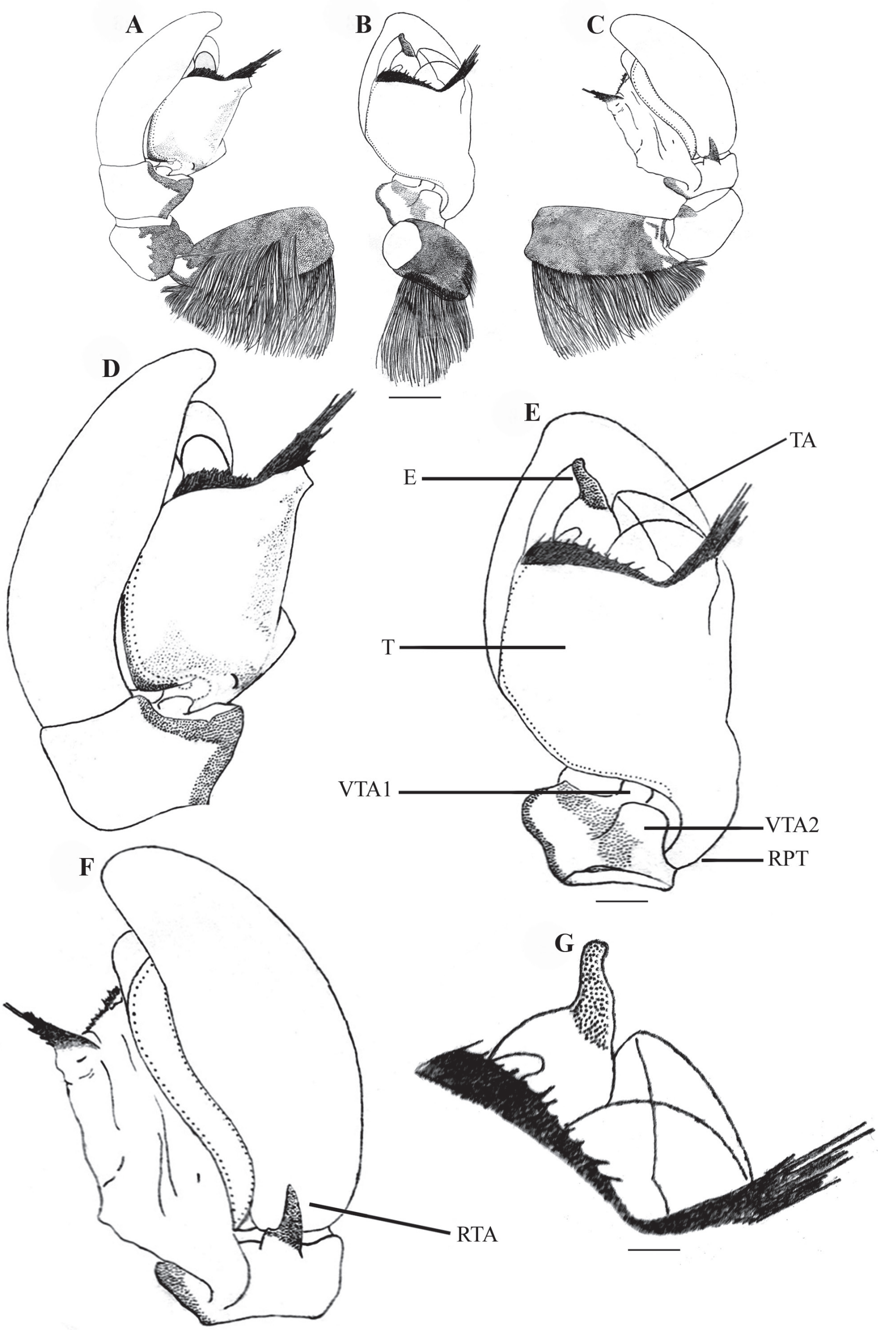

Figure 5. *Stenaelurillus lesserti* Reimoser, 1934. Left male palp. **A** Palp entire, prolateral view **B** Same, ventral view **C** Same, retrolateral view **D** Palp enlarged, prolateral view **E** Same, ventral view **F** Same, retrolateral view **G** Embolic division of the bulb, ventral view. E = Embolus; RPT = Retrobasal process of tegulum; RTA = Retrolateral tibial apophysis, T = Tegulum; TA = Terminal apophysis; VTA 1 & 2 = Ventral tibial apophyses 1 & 2. Scale bars: **A–C** = 0.26 mm; **D–F** = 0.08 mm; **G** = 0.02 mm.

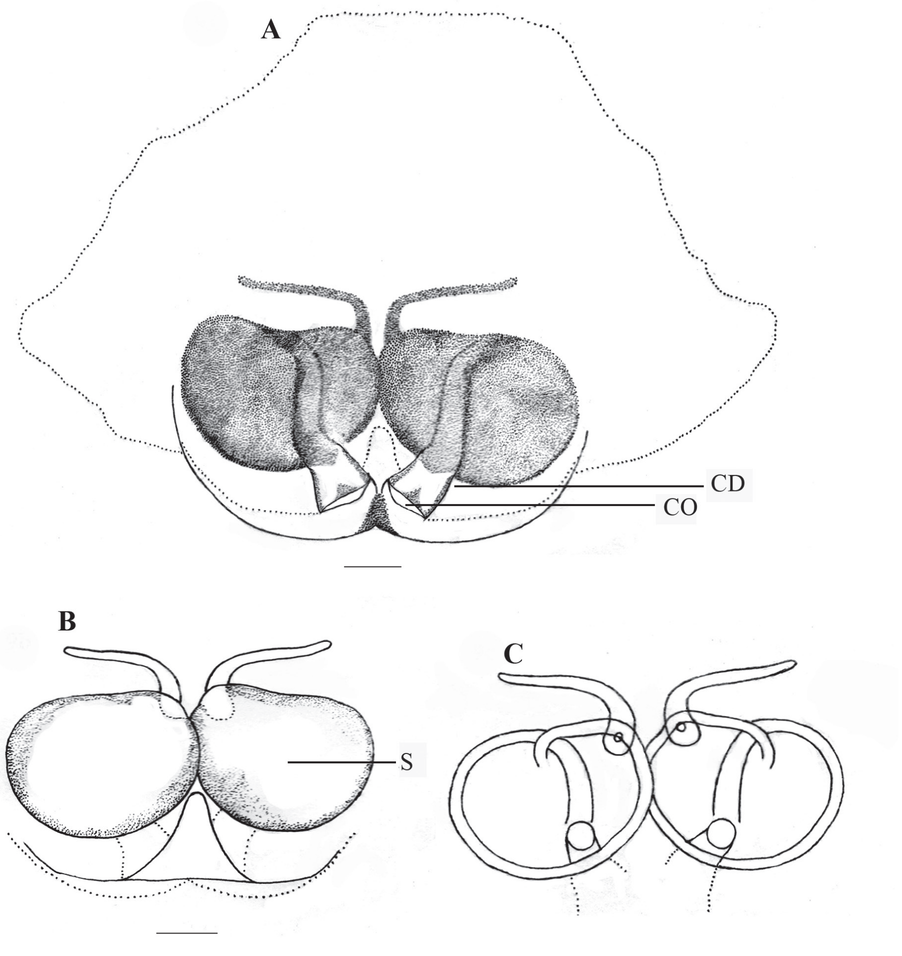

Figure 6. *Stenaelurillus lesserti* Reimoser, 1934. Female copulatory organ. **A** Epigyne **B, C** Internal duct system. CO = Copulatory opening; CD = Copulatory duct; S = Spermatheca. Scale bars: **A** = 0.09 mm; **B–C** = 0.07 mm.

width (at the middle) 2.84, height (at the middle) 2.27. Eye diameter: AME 0.53. ALE 0.24. PME 0.06. PLE 0.21. Eye interdistance: AME–AME 0.05. PME–PME 1.50. PLE–PLE 1.45. AME–ALE 0.07. ALE–PLE 0.50. ALE–PME 0.31. PME–PLE 0.19. Clypeus height at AMEs 0.38; at ALEs 0.41. Chelicera length 0.63. Measurements of palp and legs. Palp 1.99 [0.69, 0.29, 0.33, 0.68], I 4.06 [1.42, 0.72, 0.86, 0.52, 0.54], II 3.76 [1.28, 0.76, 0.77, 0.47, 0.48], III 6.95 [2.18, 1.05, 1.48, 1.65, 0.59], IV 6.78 [1.97, 0.95, 1.39, 1.77, 0.70]. Leg formula: 3412. Spination. Palp 0100, 0000, 0000, 1020; legs: femora I–II 0700, III 2700, IV 0700; patellae I–II 1000, III–IV

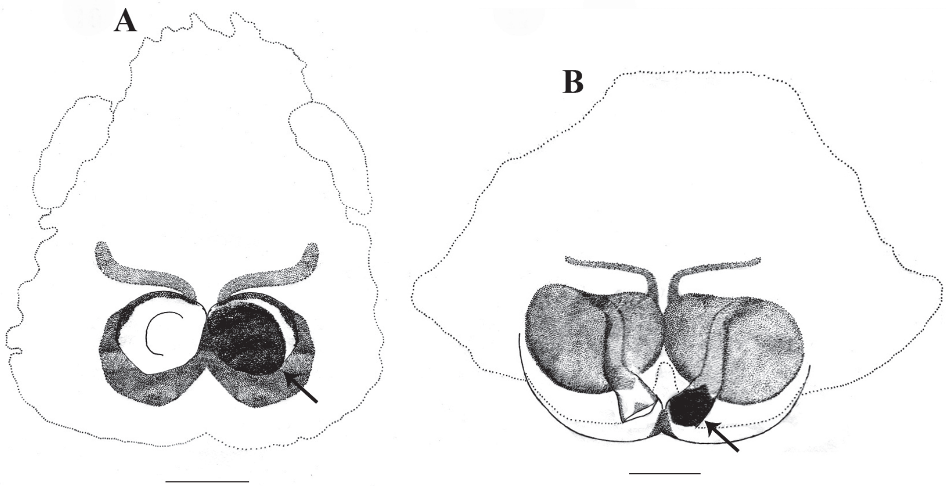

Figure 7. *Stenaelurillus* spp. Epigyne with mating plugs. **A** Epigyne of *Stenaelurillus albus* sp. n. showing mating plug (arrow) **B** Epigyne of *Stenaelurillus lesserti* Reimoser, 1934 showing mating plug (arrow). Scale bars: **A** = 0.21 mm; **B** = 0.19 mm.

1010; tibia I 3004, II 1004, III 4133, IV 4143; metatarsus I 3003, II 3013, III 3234, IV 4054; tarsi I–IV 0000. Copulatory organ (Figs 3A–C, 9E–F): Spermathecae small with a characteristic vase- shape (Figs 3B, 9F). Copulatory opening wide (Figs 3A, 9E) and nearly half the size of the spermathecae. Anterior part of copulatory duct near the copulatory opening is weakly sclerotized (Fig. 3B).

Variation. Male: Body length 4.61–5.89 (n = 7). Female: Body length 5.43–6.82 (n = 8).

Etymology. The specific epithet is an adjective and is derived from the whitish part of the tegulum: Latin *Albus* = white. Gender musculine.

Habitat. Rocky area covered with litter in a deciduous forest (Fig. 12A).

Distribution. At present known only from the type locality.

Stenaelurillus lesserti Reimoser, 1934

Figs 4A–C, 5A–G, 6A–C, 7B, 10A–J, 11A–F

Stenaelurillus lesserti Reimoser, 1934: 504, figs 25–26 (Description and illustration of ♂ and ♀); Prószyński 1984: 139 (Illustration of ♀); Wesolowska 2014: 248, figs 1A–B, 2A–F, 3A–D (Re-examined the original type series of *S. lesserti*; description and illustration of ♂ and ♀).

Material examined. (ADSH 83503Ai)–4 males, 5 females: India, Kerala, Ernakulam, Cherukadu (10°08'22.48"N, 76°40'02.14"E) in Bhoothathankettu Forest Reserve (10°08'22.79"N, 76°40'02.09"E), 37 m. alt., Pradeep M. S., 10. X. 2013, by hand.

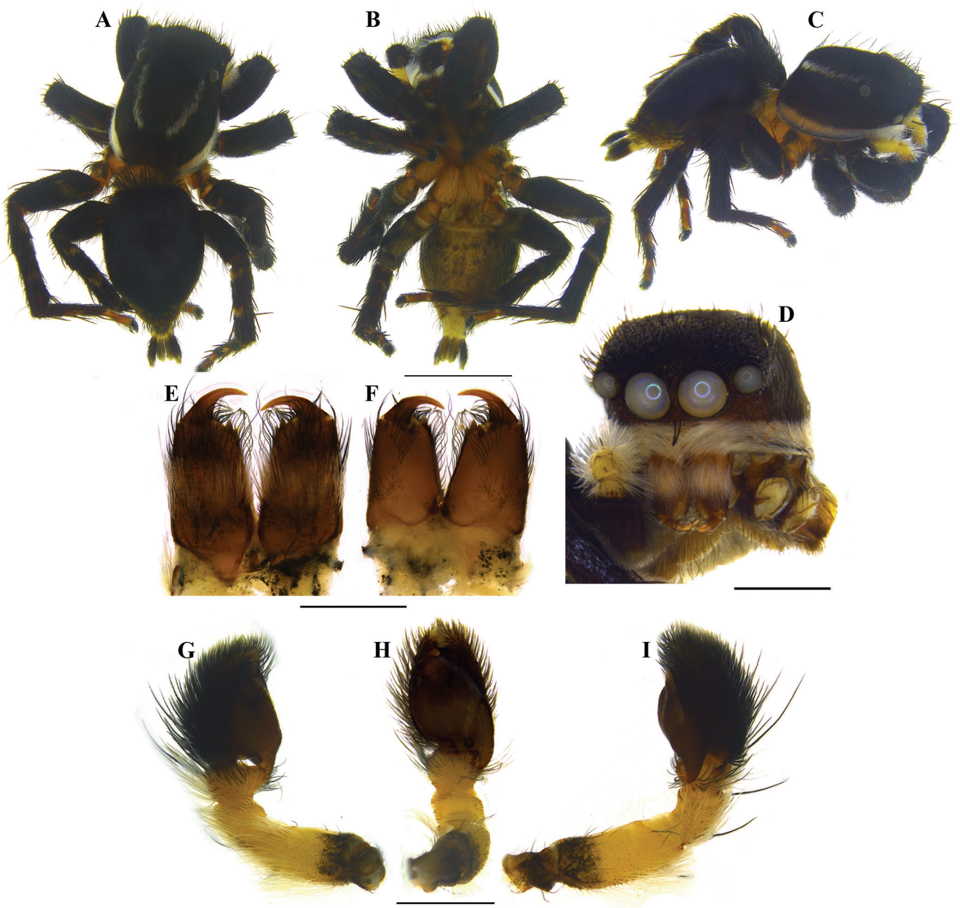

Figure 8. *Stenaelurillus albus* sp. n. **A** Male habitus, dorsal view **B** Same, ventral view **C** Same, prolateral view **D** Same, frontal view **E** Male chelicerae, dorsal view **F** Same, ventral view **G** Left male palp, prolateral view **H** Same, ventral view **I** Same, retrolateral view. Scale bars: **A–C** = 2 mm; **D** = 1 mm; **E–F** = 0.5 mm; **G–I** = 0.5 mm.

Diagnosis. Males of *S. lesserti* Reimoser, 1934 can be separated from all other described congeners by a transverse fringe of very thin, hard projections resembling hairs at the anterior edge of the harder shield covering the bulbus (Figs 5D–G, 10H–J); females by the presence of unusually enlarged and kidney-shaped spermathecae and the relative position of the copulatory openings (Figs 6A–B, 11E–F).

Redescription. MALE (Figs 4A, 4C, 10A–G): Prosoma black, thoracic part with broad yellowish-white lateral bands; thoracic region dorsally with paired white longitudinal bands extending back from the rear eyes. Eye field black with covering of violet scales; anterior row of eyes encircled with red and yellow scales and black hairs. Clypeus covered with transverse layers of orange-red, black and green scales and two layers of greyish-black and red hairs. Chelicerae short, yellowish-brown; dorso-laterally

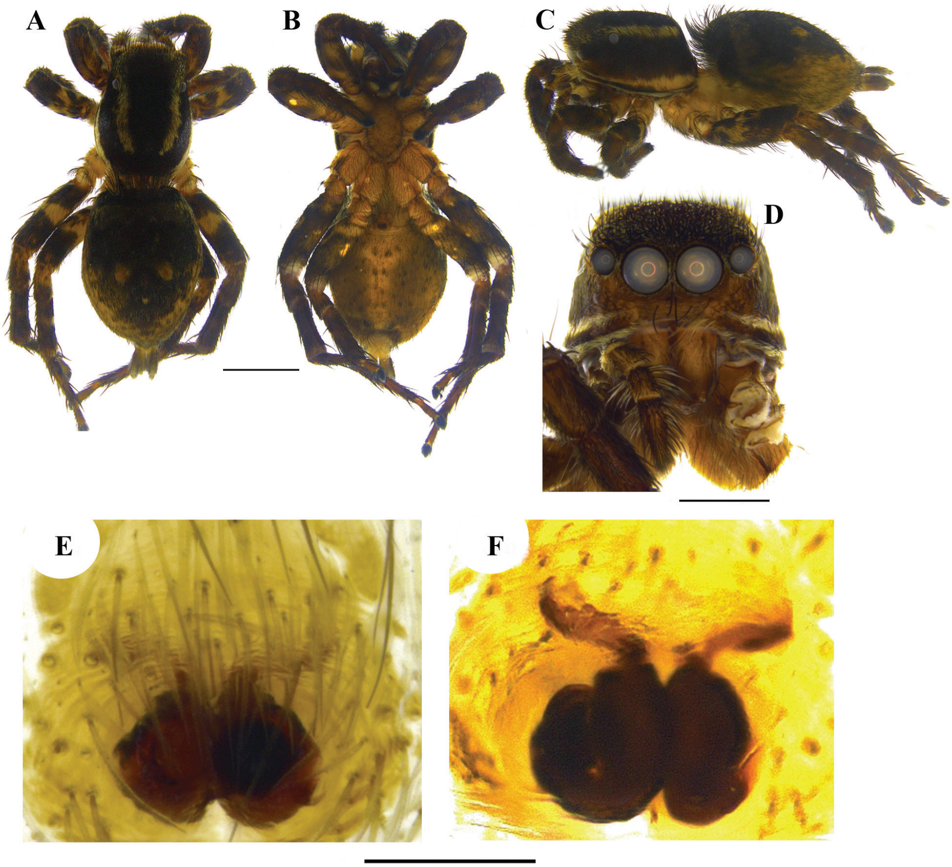

Figure 9. *Stenaelurillus albus* sp. n. **A** Female habitus, dorsal view **B** Same, ventral view **C** Same, retrolateral view **D** Same, frontal view **E** Epigyne **F** Internal duct system. Scale bars: **A–C** = 2 mm; **D** = 1 mm; **E–F** = 0.2 mm.

covered with thick layer of red, yellow and green hairs; promargin with two, one large and one small, and retromargin with one large teeth (Fig. 4C). Fangs short, yellow. Maxillae and labium black. Opisthosoma U–shaped; dorsum black with an anterior broad transverse white band and posterior three white spots, which together forming an inverted triangle; lateral opisthosoma pale yellow with several broken longitudinal black striations, while venter pale yellow without any striations or spots. Sternum and coxae pale yellow; coxa I retrolaterally black; femur I pro and retrolaterally black with a prolateral red stripe at the middle (Fig. 10G); femur I prolaterally and dorsally provided with a fringe of black hairs, the dorsal one prominent; ventrally with a row of short white hairs; all other leg segments pale yellow with black patches and narrow transverse black stripes. Body length 3.80. Prosoma length 2.08, width (at the middle) 1.47, height (at the middle) 1.27. Opisthosoma length 1.72, width (at the middle) 1.15, height (at the middle) 0.99. Eye diameter: AME 0.34. ALE 0.19. PME 0.04.

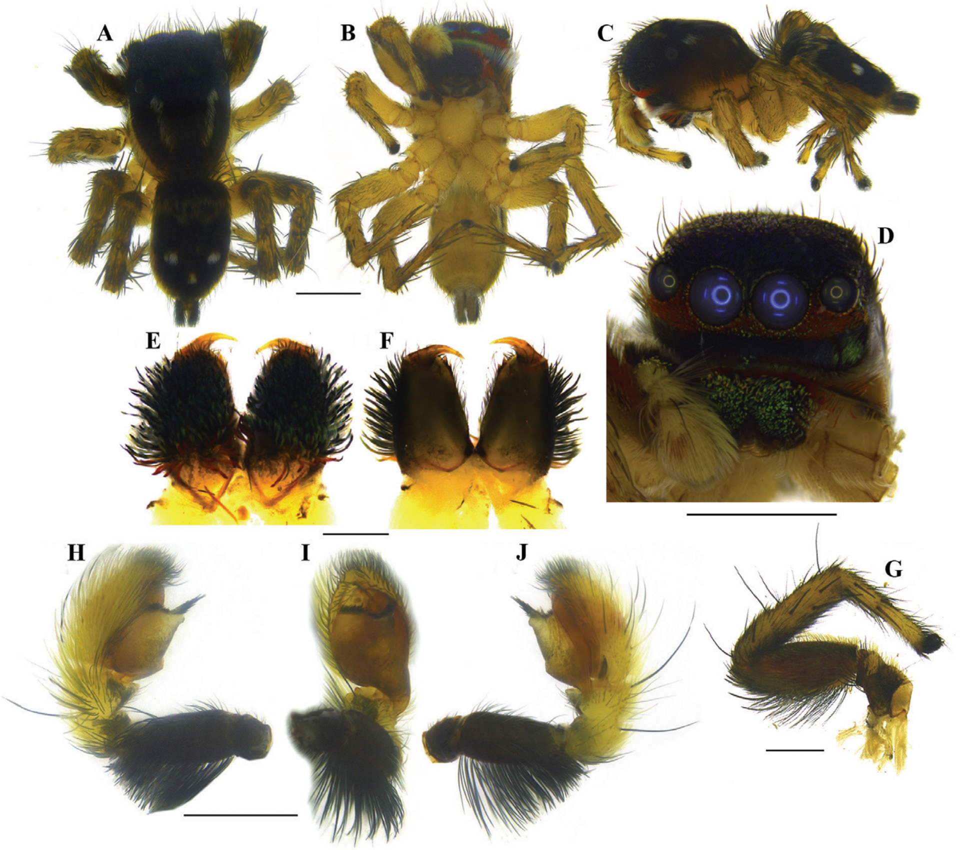

Figure 10. *Stenaelurillus lesserti* Reimoser, 1934. **A** Male habitus, dorsal view **B** Same, ventral view **C** Same, retrolateral view **D** Same, frontal view **E** Male chelicerae, dorsal view **F** Same, ventral view **G** Male left leg I, prolateral view **H** Left male palp, prolateral view **I** Same, ventral view **J** Same, retrolateral view. Scale bars: **A–C** = 1 mm; **D** = 1 mm; **E–F** = 0.2 mm; **G** = 0.5 mm; **H–J** = 0.5 mm.

PLE 0.18. Eye interdistance: AME–AME 0.04. PME–PME 1.15. PLE–PLE 1.07. AME–ALE 0.07. ALE–PLE 0.45. ALE–PME 0.28. PME–PLE 0.17. Clypeus height at AMEs 0.22, at ALEs 0.42. Chelicera length 0.31. Measurements of palp and legs. Palp 1.44 [0.53, 0.19, 0.16, 0.56], I 3.2 [1.07, 0.52, 0.69, 0.44, 0.48], II 2.91 [0.99, 0.45, 0.59, 0.43, 0.45], III 4.68 [1.45, 0.70, 0.94, 1.03, 0.56] IV 4.48 [1.25, 0.75, 0.76, 1.22, 0.50]. Leg formula: 3412. Spination. Palp. 0000 0000 0000 0000; legs: femur I 0700, II 0710, III 0700, IV 0600, patellae I–II 1000, III–IV 1010; tibia I 3004, II 3014, III 3143, IV 4143; metatarsus I 2014, II 2024, III 4043, IV 5062; tarsi I–IV 0000. Copulatory organ (Figs 5A–G, 10H–J): Femur black, provided prolaterally and dorsally with a bunch of black hairs (Figs 5A–C, 10H–J), the dorsal one is prominent. Patella and tibia pale yellow with ventral black patch. Cymbium and bulb pale yellow; the anterior edge of the harder shield covering the bulbus is provided with a transverse fringe of very thin, hard projections resembling hairs, which are distinctly longer at the

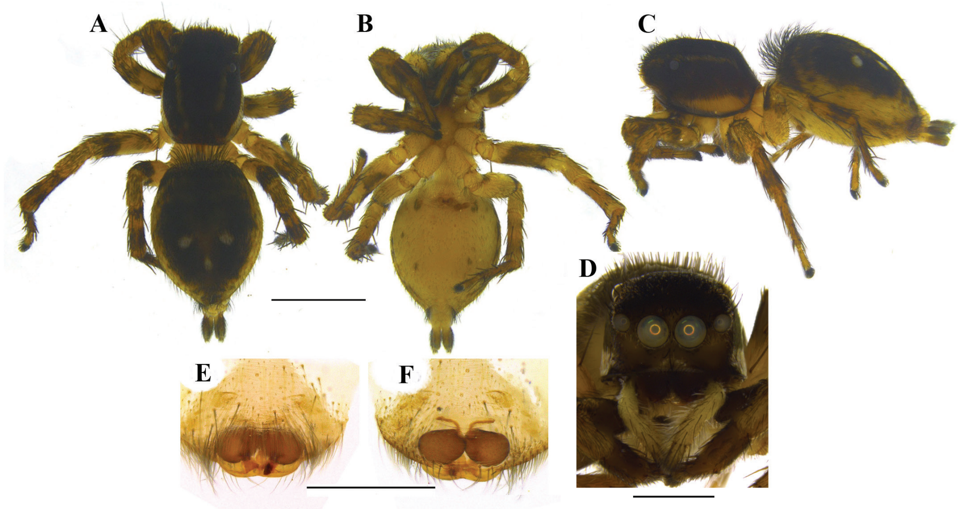

Figure 11. *Stenaelurillus lesserti* Reimoser, 1934. **A** Female habitus, dorsal view **B** Same, ventral view **C** Same, retrolateral view **D** Same, frontal view **E** Epigyne **F** Internal duct system. Scale bars: **A–C** = 2 mm; **D** = 1 mm; **E–F** = 0.5 mm.

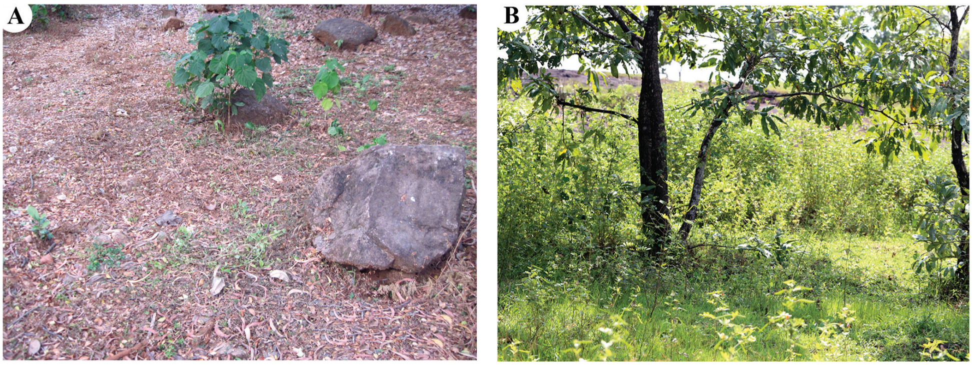

Figure 12. Habitats of *Stenaelurillus* spp. **A** View of the type locality of *S. albus* sp. n. **B** View of the collection site of *S. lesserti* Reimoser, 1934.

retrolateral angle (Figs 5D–F); embolus short with blunt end, retrolaterally directed with prolaterally directed tip (Figs 5E, 5G); conductor apparently absent; terminal apophysis short, directed at ten o'clock position (Figs 5E, 5G). Tibia with two ventral apophyses (Fig. 5E); VTA 1 is the smallest; VTA 2 with a flattened end (Fig. 5E); both VTA 1 & 2 directed at one o'clock position (Fig. 5E); RTA simple with broad base, pointed end, directed at eleven o'clock position (Fig. 5F).

FEMALE (Figs 4B, 11A–D): Prosoma black, thoracic part with broad yellowish-white lateral bands; thoracic region dorsally with paired white longitudinal bands extending back from the rear eyes. Eye field black; anterior row of eyes encircled by pale yellow hairs. Clypeus black. Chelicerae short and black; promargin with two, one large and one small, and retromargin with one large teeth. Fangs short, black. Maxillae and labium black. Opisthosoma widely oval; dorsum black with an anterior broad transverse white band and posterior three white spots, which together forming an inverted triangle; lateral opisthosoma pale yellow with several broken longitudinal black striations while venter pale yellow without any striations or spots. Sternum and coxae pale yellow; coxa I retrolaterally black; all other leg segments pale yellow with black patches and narrow transverse black stripes. Palp: posterior 1/4th of femur black; rest of femur and other segments pale yellow. Body length 6.46. Prosoma length 2.97, width (at the middle) 1.86, height (at the middle) 1.49. Opisthosoma length 3.49, width (at the middle) 2.69, height (at the middle) 1.90. Eyes diameter: AME 0.41. ALE 0.22. PME 0.04. PLE 0.15. Eye interdistance: AME–AME 0.02. PME–PME 1.31. PLE–PLE 1.14. AME–ALE 0.05. ALE–PLE 0.38. ALE–PME 0.21. PME–PLE 0.16. Clypeus height at AMEs 0.27, at ALEs 0.44. Chelicera length 0.56. Measurements of palp and legs. Palp 1.5 [0.52, 0.25, 0.24, 0.49], I 3.28 [1.14, 0.58, 0.61, 0.44, 0.51], II 3.16 [1.12, 0.54, 0.58, 0.49, 0.43], III 5.49 [1.75, 0.84, 1.09, 1.14, 0.67], IV 5.13 [1.53, 0.66, 1.07, 1.26, 0.61]. Leg formula: 3412. Spination. Palp. 0100 0000 0000 2231; legs: femur I 0600, II 0700, III 2600, IV 0600; patellae I–II 1000, III–IV 1010; tibia I 1005, II 2004, III 4043, IV 4343; metatarsi I–II 2014, III 3324, IV 3323; tarsi I–IV 0000. Copulatory organ (Figs 6A–C, 11E–F): Copulatory opening is nearly diamond shaped (Fig. 6A) and placed near the posterior margin of the epigyne (Figs 6A, 11E). Spermathecae are much enlarged and kidney shaped (Figs 6B, 11F).

Variation. Male: (n = 4) Body length 3.24–3.80. Female: (n = 5) Body length 6.15–6.46.

Habitat. Rocky area having patches of grass and herbaceous vegetation in a semi-evergreen forest (Fig. 12B).

Distribution. India, Sri Lanka (Wesolowska 2014).

Distribution in India. Kerala (new record) and Tamilnadu (Reimoser 1934).

Note. Mating plugs, which are supposed to function as paternity protection devices (Uhl et al. 2010; Herberstein et al. 2012), are not very unusual in the animal kingdom and their presence have been described in a number of spider families including Salticidae. Mating plugs are reported in a total of 10 genera and 17 species of salticid spiders (Uhl et al. 2010). Mating plug was observed in the copulatory opening of the two *Stenaelurillus* species described in this paper. The left copulatory opening of both *S. albus* sp. n. and *S. lesserti* were found to be sealed with amorphous secretions (whether male or female origin is unclear) (Figs 7A–B, arrows). Compared to *S. lesserti*, the mating plug of *S. albus* sp. n. is more prominent and covering nearly the whole area of the left copulatory opening and the surrounding epigynal region.

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RESEARCH ARTICLE

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Review of Chinese species of the leafhopper genus *Scaphoidella* Vilbaste, 1968 (Hemiptera, Cicadellidae, Deltocephalinae), with description of a new species

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Abstract

The Chinese leafhopper species of the genus *Scaphoidella* Vilbaste are reviewed, and one new species *Scaphoidella dietrichi* **sp. n.** is described and illustrated. Two species are recorded from China for the first time: *Scaphoidella clavatella* Dai & Dietrich, 2011 and *Scaphoidella zhangi* (Viraktamath & Mohan, 2004). A key based on the male genitalia is given to distinguish Chinese species of this genus and a map provided their geographic distribution. The type specimens of the new species is deposited in the Institute of Entomology, Guizhou University, Guiyang, China (GUGC).

Keywords

Homoptera, morphology, taxonomy, distribution, China

Introduction

The leafhopper genus *Scaphoidella* was established by Vilbaste (1968) for *S. arboricola* Vilbaste from the Maritime Territory of Russia. It belongs to the tribe Scaphoideini of subfamily Deltocephalinae (Zahniser & Dietrich, 2013). Recently, Dai and Dietrich (2011) reviewed this genus and described ten new species from Thailand and Vietnam and at the same time, two new combinations *Scaphoidella zhangi* (Viraktamath & Mohan, 2004), and *S. punctulata* (Melichar, 1903) were proposed (both previously placed in the genus *Scaphoideus*), the species *S. datianensis* Xing, Dai & Li, 2008 was placed in the genus *Monobazus*, and *S. transversa* Li & Xing, 2009 was excluded from *Scaphoidella* and treated as a *species incertae sedis*. The species *S. denticlestyla* Xing & Li, 2010 (see Chen, Li and Jin 2010) and *S. brevissima* Dai, Xing & Li (2011) in *Scaphoidella* (not listed in the checklist of Dai and Dietrich (2011)) are discussed below, bringing the total of known species to 20, including eight from China.

In this paper, a new species: *Scaphoidella dietrichi* sp. n. is described and illustrated from Yunnan Province, China, and *S. clavatella* Dai & Dietrich, 2011 and *S. zhangi* (Viraktamath & Mohan, 2004) are recorded from China for the first time. The type specimens of the new species is deposited in the Institute of Entomology, Guizhou University, Guiyang, China (GUGC). The genus *Scaphoidella* now contains 21 species including 11 from China. A key is given to separate the Chinese species.

Material and methods

Terminology of morphological and genital characters follow Zhang and Dai (2006) and Dai and Dietrich (2011). Male specimens were used for the description and illustration. External morphology was observed under a stereoscopic microscope and characters were measured with an ocular micrometer. Color pictures for adult habitus were obtained by KEYENCE VHX-1000 system. The genital segments of the examined specimens were macerated in 10% NaOH and drawn from preparations in glycerin jelly using a Leica MZ 12.5 stereomicroscope. Illustrations were scanned with Canon CanoScan LiDE 200 and imported into Adobe Photoshop 8 for labeling and plate composition.

Taxonomy

Scaphoidella Vilbaste

Scaphoidella Vilbaste, 1968: 133; Zhang and Dai 2006: 841; Li, Dai and Xing 2011: 199; Dai and Dietrich 2011: 458.

Type species. *Scaphoidella arboricola* Vilbaste, 1968.

For the relationship and diagnosis of *Scaphoidella* Vilbaste see Dai and Dietrich (2011: 458).

Distribution. Oriental Region and Palaearctic Region (see Discussion).

Checklist of species of *Scaphoidella*

S. acaudata Zhang & Dai, 2006 Distribution: China (Yunnan, Guizhou).
S. arboricola Vilbaste, 1968 Distribution: Russia (Maritime Territory); China (Zhejiang, Henan).
S. bifurcata Dai & Dietrich, 2011 Distribution: Thailand (Chaiyaphum, Ubon Ratchathani, Phetchabun).
S. brevissima Dai, Xing & Li, 2011 Distribution: China (Henan).
S. clavatella Dai & Dietrich, 2011 Distribution: Thailand (Loei); China (Guangxi, Yunnan).
S. cornuta Dai & Dietrich, 2011 Distribution: Thailand (Loei, Phetchabun).
S. coronoida Dai & Dietrich, 2011 Distribution: Thailand (Chiang Mai, Loei).
S. denticlestyla Xing & Li, 2010 Distribution: China (Guizhou).
S. dietrichi Xing & Li, sp. n. Distribution: China (Yunnan).
S. digitatus Dai & Dietrich, 2011 Distribution: Thailand (Ubon Ratchathani, Khonkaen).
S. dimidiatus Dai & Dietrich, 2011 Distribution: Thailand (Chaiyaphum, Loei, Phetchabun).
S. dongnaiensis Dai & Dietrich, 2011 Distribution: Vietnam (Dongnai).
S. flangenella Dai & Dietrich, 2011 Distribution: Thailand (Ubon Ratchathani).
S. lamella Dai & Dietrich, 2011 Distribution: Thailand (Loei, Phetchabun, Phitsanulok, Sakon Nakhon, Ubon Ratchathani).
S. punctulata (Melichar, 1903) Distribution: Sri Lanka.
S. stenopaea Anufriev, 1977 Distribution: Russia (Amur Province, Maritime Territory); China (Shaanxi, Shandong, Heilongjiang, Liaoning, Gansu, Inner Mongolia, Hebei, Shanxi).
S. undosa Zhang & Dai, 2006 Distribution: China (Henan, Hunan, Jiangxi, Hubei, Guizhou, Zhejiang, Anhui).
S. unihamata (Li & Kuoh, 1993) Distribution: China (Zhejiang, Hunan, Fujian, Guangxi).
S. viraktamathi Dai & Dietrich, 2011 Distribution: Thailand (Phetchabun, Sakon Nakhon).
S. wideaedeaga (Wang & Li, 2004) Distribution: China (Yunnan, Xizang); Thailand (Loei).
S. zhangi (Viraktamath & Mohan, 2004) Distribution: India (Meghalaya, West Bengal); Thailand (Loei); China (Guizhou).

Key to species (males) of *Scaphoidella* from China

1	Pygefer side with conspicuous spine on dorsal margin (Figs 19, 37)	**2**
–	Pygefer side without spine on dorsal margin	**3**
2	Pygofer side with caudal margin round, without spine (Fig. 19)	***S. clavatella***

– Pygofer side with ventrally directed spine on caudal margin (Fig. 37)... ***S. zhangi***
3 Subgenital plate with lateral macrosetae arranged irregularly (Zhang and Dai 2006: Figs 5, 15).. **4**
– Subgenital plate with lateral macrosetae in single row **5**
4 ygofer process long; subgenital plate tapered apically; basal processes of aedeagus extending to near apex of shaft (Zhang and Dai 2006: Figs 4–6)....... ***S. undosa***
– Pygofer process short; subgenital plate rounded apically; basal processes of aedeagus extending beyond shaft (Zhang and Dai 2006: Figs 14–16)..... ***S. arboricola***
5 Pygofer side with caudal process (Fig. 13; Zhang and Dai 2006: Figs 33, 44)... **6**
– Pygofer side without caudal process **8**
6 Apex of aedeagal shaft with pair of lateral processes; preatrium short (Zhang and Dai 2006: Figs 28, 29) .... ***S. stenopaea***
– Apex of aedeagal shaft without processes; preatrium very long (Fig. 17; Zhang and Dai 2006: Fig. 37) **7**
7 Style apical process moderately long (Fig. 18) .... ***S. brevissima***
– Style apical process very long (Zhang and Dai 2006: Fig. 39) .. ***S.unihamata***
8 Apical margin of aedeagal shaft with many small spines on both sides (Figs 34, 35)... ***S. dietrichi* sp. n.**
– Aedeagal shaft without small spinose processes **9**
9 Aedeagal shaft in lateral view distinctly broadened near midlength; stem of connective nearly 1/3 length of arms (Zhang and Dai 2006: Figs 47, 50) .... ***S. wideaedeaga***
– Aedeagal shaft in lateral view slender and not broadened near midlength; stem of connective and arms of approximately equal length (Figs 28, 29; Zhang and Dai 2006: Figs 57,58).. **10**
10 Preatrium of aedeagus very long; style apical process with teeth (Figs 29, 30)... .... ***S. denticlestyla***
– Preatrium of aedeagus short; style apical process without teeth (Zhang and Dai 2006: Figs 55, 57)... ***S. acaudata***

Chinese *Scaphoidella* species

Scaphoidella acaudata Zhang & Dai, 2006

Scaphoidella acaudata Zhang & Dai, 2006: 850, figs 51–58; Li, Dai and Xing 2011: 199, plate 5–194, figs 1–6.

Material examined. 1♂, China: Guizhou Prov., Bailidujuan, 18 October 2007, coll. Yujian Li (GUGC); 1♂, Yunnan Prov., Longling, Longxin, 10 June 2011, coll. Jiankun Long (GUGC).

Distribution. China (Yunnan, Guizhou) (Fig. 43).

Scaphoidella arboricola **Vilbaste, 1968**

Scaphoidella arboricola Vilbaste, 1968: 133, plate 110, figs 1–8; Zhang and Dai 2006: 850, figs 1–10.

Distribution. Russia (Maritime Territory); China (Zhejiang, Henan) (Fig. 43).

Scaphoidella brevissima **Dai, Xing & Li, 2011**

Figs 1–2, 13–18

Scaphoidella brevissima Dai, Xing & Li, 2011: 1, figs 1–10.

Material examined. China: 1♂ (Holotype), Henan Prov., Luanchuan County, Heyu, 19 August 2008, coll. Jichun Xing (GUGC); 1♂, Henan Prov., Xixia County, Taiping, 30 July 2010, coll. Hu Li and Zhihua Fang (GUGC).

Distribution. China (Henan) (Fig. 43).

Note. This species was described from China (Henan) based on the male holotype (GUGC).

Scaphoidella clavatella **Dai & Dietrich, 2011**

Figs 3–4, 19–24

Scaphoidella clavatella Dai & Dietrich, 2011: 468. figs 51–55.

Material examined. 1♂, China: Guangxi Autonomous Region, Daxin County, Detianpubu, 11 May 2012, coll. Zhihua Fan (GUGC); 1♂1♀, Yunnan Prov., Menghai, 13 July 2013, coll. Jichun Xing (GUGC).

Distribution. Thailand (Loei); China (Guangxi, Yunnan) (Fig. 43).

Note. This species was described from Thailand (Loei) based on two male specimens (QSBG and INHS). This species is here recorded from China for the first time.

Scaphoidella denticlestyla **Xing & Li, 2010**

Figs 5–6, 25–30

Scaphoidella denticlestyla Xing & Li (in Chen et al.), 2010: 138, Figs 7–14 ; Li, Dai and Xing 2011: 200, plate 5–195, figs 1–8.

Material examined. China: 1♂ (Holotype), Guizhou Prov., Mayanghe, Maojia, 5 October 2007, coll. Yujian Li (GUGC); 1♂, Guizhou Prov., Mayanghe, Maojia, 6 October 2007, coll. Qiongzhang Song (GUGC).

Figures 1–8. *Scaphoidella* species. **1, 2** *Scaphoidella brevissima* Dai, Xing & Li **1** ♂, dorsal view **2** ♂, lateral view **3, 4** *Scaphoidella clavatella* Dai & Dietrich **3** ♂, dorsal view **4** ♂, lateral view **5, 6** *Scaphoidella denticlestyla* Xing & Li **5** ♂, dorsal view **6** ♂, lateral view **7, 8** *Scaphoidella zhangi* (Viraktamath & Mohan) **7** ♂, dorsal view **8** ♂, lateral view.

Distribution. China (Guizhou) (Fig. 43).

Note. This species was described from China (Guizhou) based on two male specimens deposited in GUGC. As the original figures of Xing & Li (in Chen et al. 2010 and Li et al. 2011) are not very perfect the male genitalia are redrawn here by the first author.

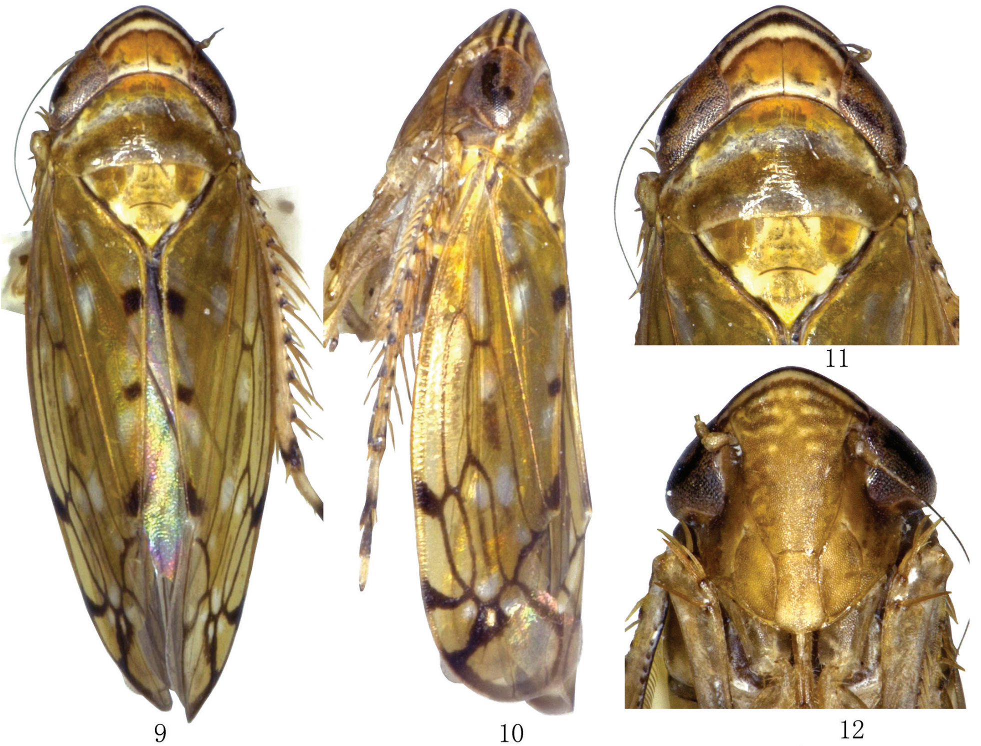
Scaphoidella dietrichi Xing & Li, sp. n.

http://zoobank.org/414D9E83-6DF9-4F74-BECC-55886B131911

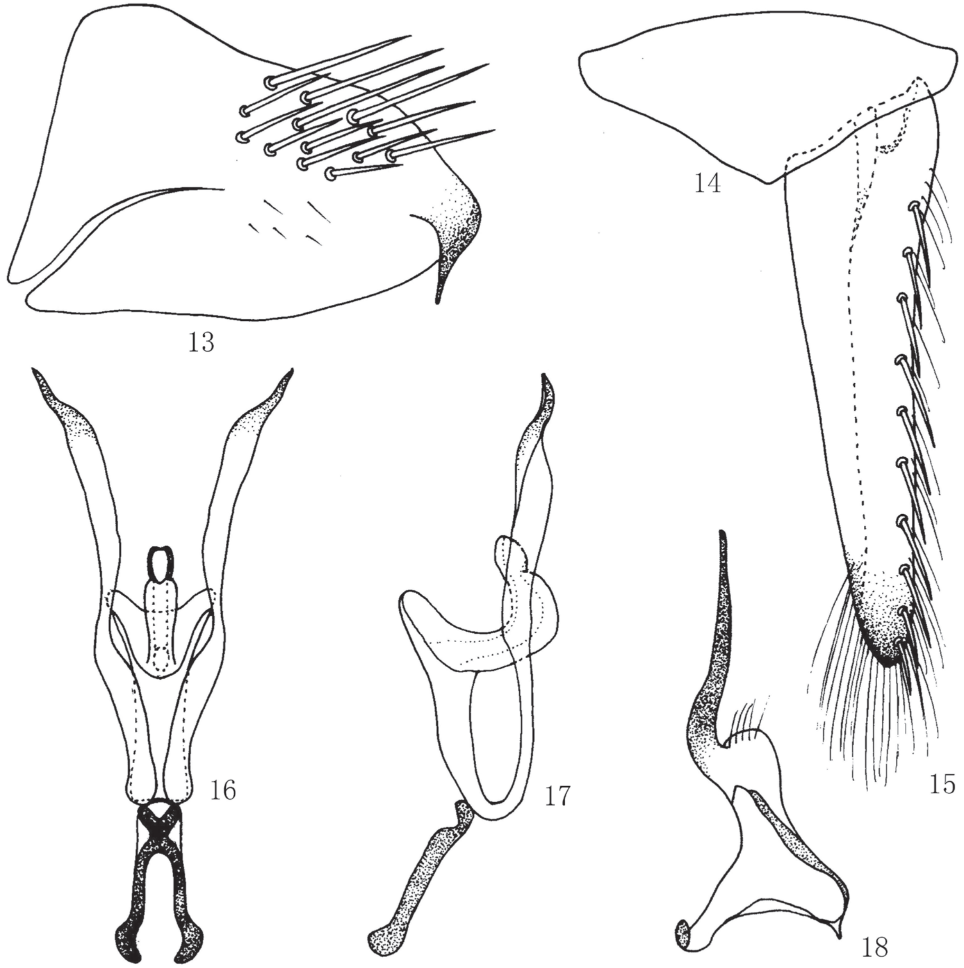
Figs 9–12, 31–36

Description. Body ochraceous. Head with piceous submargial band on anterior margin, one transverse arcuate band between eyes anteriorly, narrowly margined with piceous, orange red (Figs 9, 11). Face with thin, arcuate, piceous submarginal band (Fig. 12). Pronotum with anterior brown and posterior submarginal chocolate brown transverse bands (Fig. 11). Forewing ochraceous, with hyaline spots (Figs 9, 10).

Vertex shorter than pronotum, shorter medially than next to eye. Pronotum longer than scutellum (Fig. 11). External features as in generic description (see Dai and Dietrich 2011: 458).

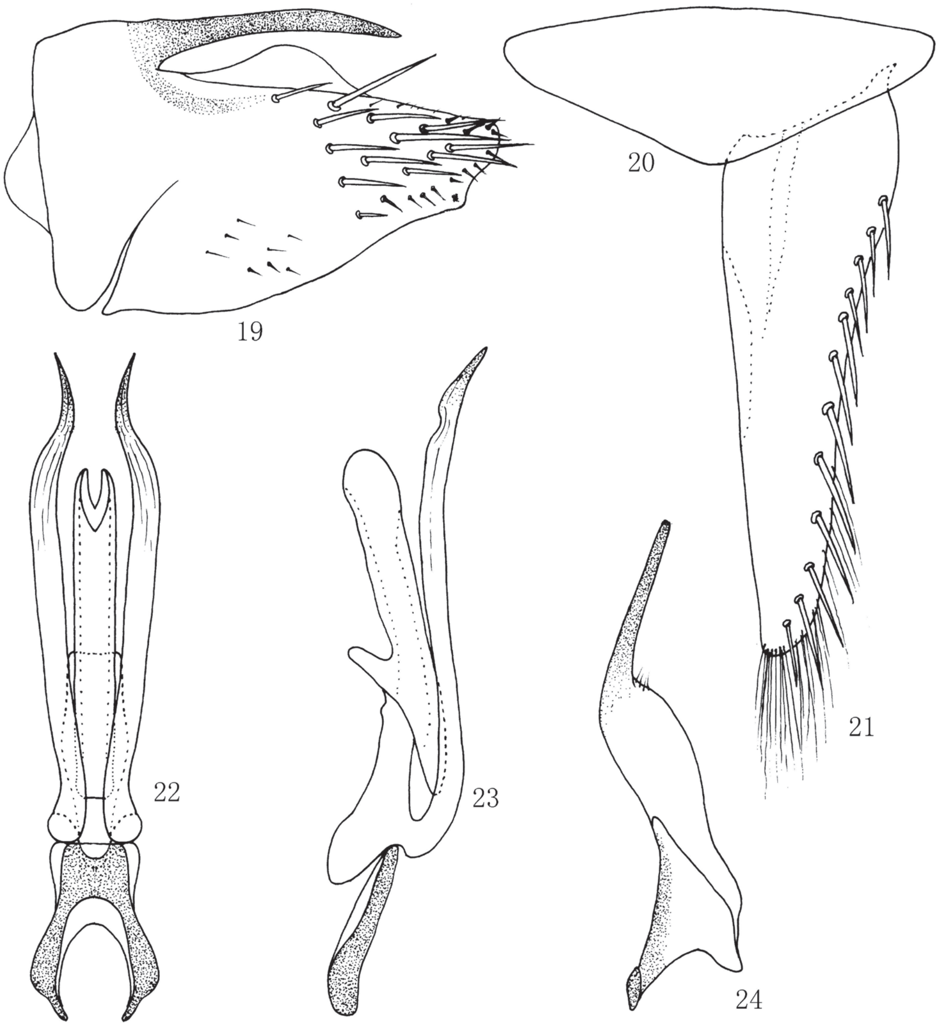


Figures 9–12. *Scaphoidella dietrichi* sp. n., ♂. **9** dorsal view **10** lateral view **11** head and thorax, dorsal view **12** face.



Figures 13–18. *Scaphoidella brevissima* Dai, Xing & Li, **13** Male pygofer side, lateral view **14** Valve, ventral view **15** Subgenital plates, ventral view **16** Aedeagus and connective, ventral view **17** Aedeagus and connective, lateral view **18** Style, dorsal view.

Male genitalia. Pygofer in lateral aspect tapering posteriorly from midlength, with many short and long macrosetae dorsally, without caudal process (Fig. 31). Valve large, subtriangular (Fig. 32). Subgenital plate elongate, narrowing to rounded apex, uniseriate row of macrosetae along ventrolateral margin and additional hair-like setae at apex (Fig. 33). Aedeagal shaft curved dorsally, its apical margin with many small spines on both sides, gonopore apical, preatrium very long; basal processes slender, tapering apically, extended to near apex of aedeagal shaft (Figs 34, 35). Connective Y-shaped, articulated with aedeagus, its stem nearly 1/3 length of arms (Fig. 34). Style elongate, with prominent subapical lobe, apophysis slender and narrowed distally, equal to 1/2 length of style (Fig. 36).



Figures 19–24. *Scaphoidella clavatella* Dai & Dietrich, **19** Male pygofer side, lateral view **20** Valve, ventral view **21** Subgenital plates, ventral view **22** Aedeagus and connective, ventral view **23** Aedeagus and connective, lateral view **24** Style, dorsal view.

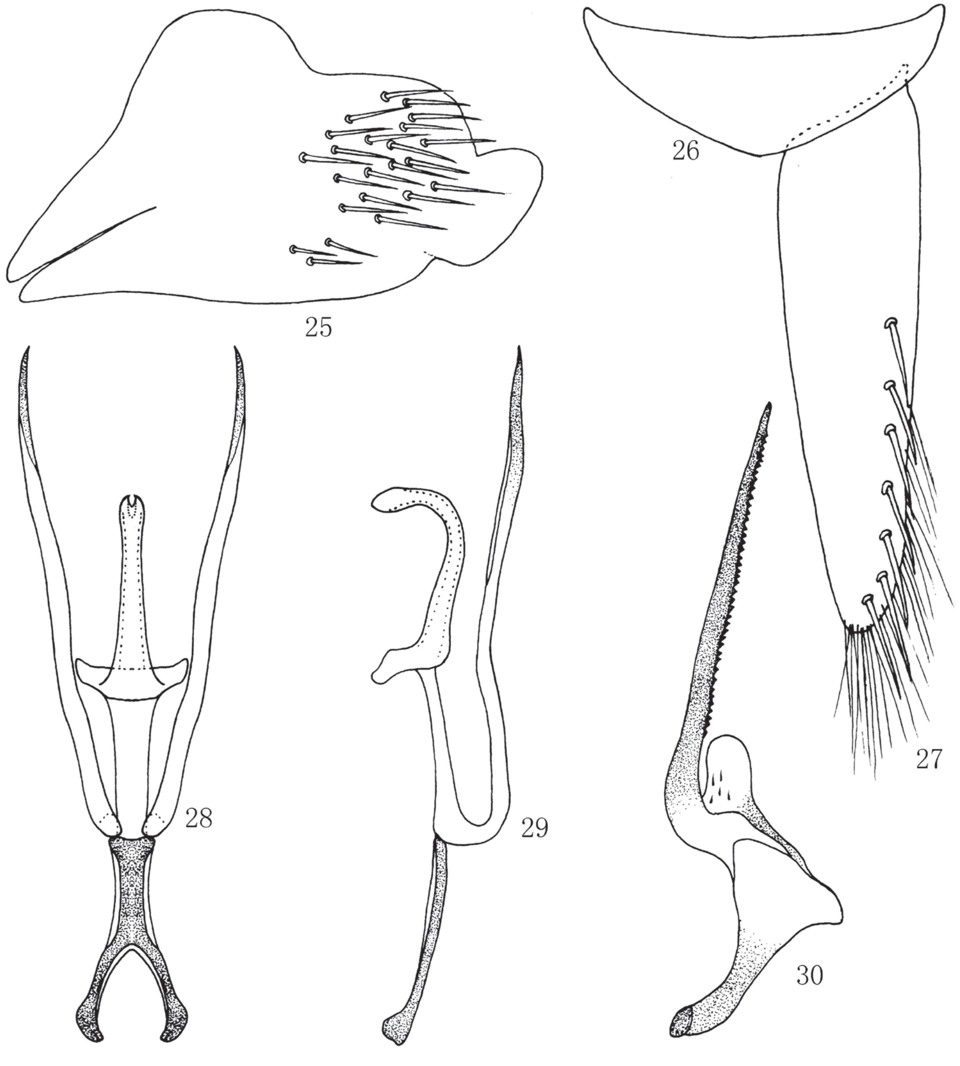
Measurement. Length (including tegmen): ♂, 4.4 mm.

Type material. Holotype ♂, China: Yunnan Prov., Xishuangbanna, Menglun, 28 July 2012, coll. Weibin Zheng (GUGC).

Host. Grasses.

Distribution. China (Yunnan) (Fig. 43).

Diagnosis. This species is similar to *Scaphoidella zhangi* (Viraktamath & Mohan, 2004), but can be distinguished from the latter by the male pygofer without caudal process and spine on dorsal margin, apical margin of aedeagal shaft with many small spinose processes on both sides, and aedeagal shaft curved dorsally.

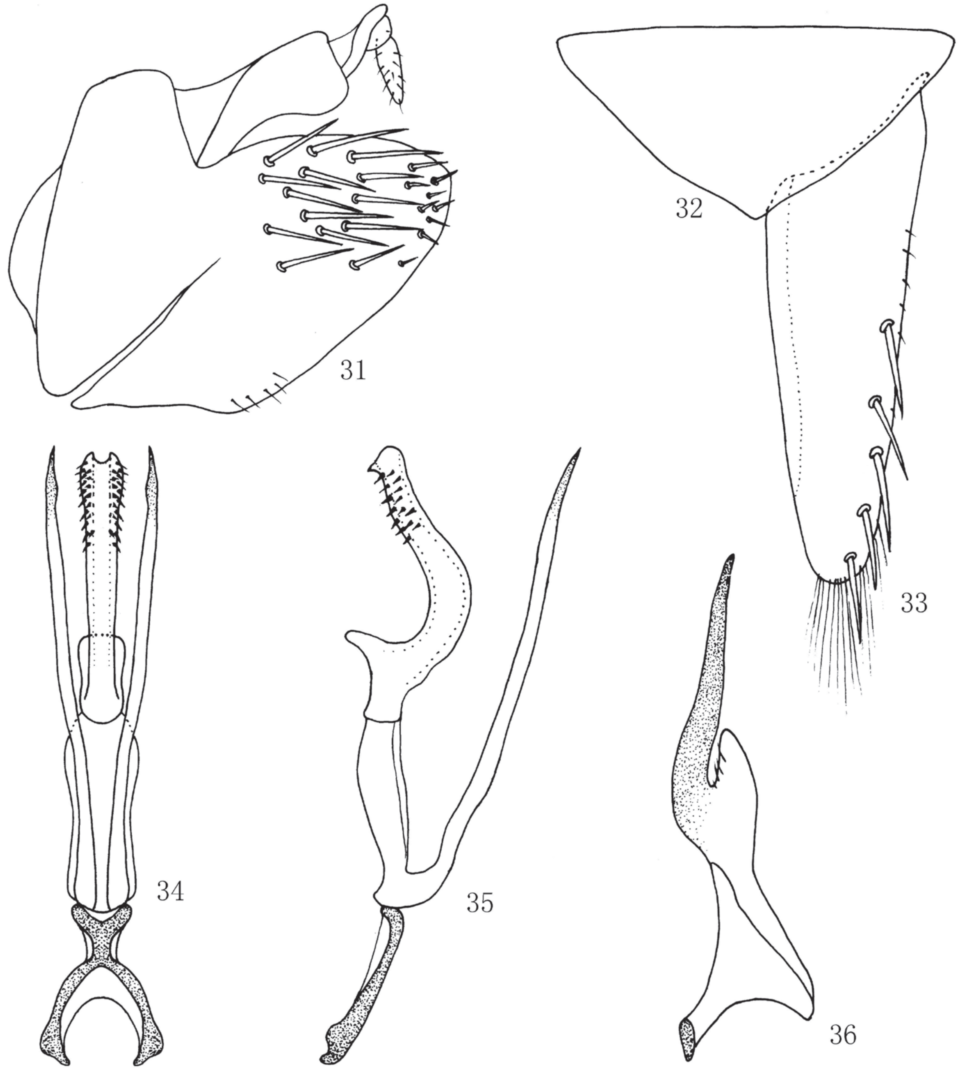


Figures 25–30. *Scaphoidella denticlestyla* Xing & Li, **25** Male pygofer side, lateral view **26** Valve, ventral view **27** Subgenital plates, ventral view **28** Aedeagus and connective, ventral view **29** Aedeagus and connective, lateral view **30** Style, dorsal view.

Etymology. This new species is named after Dr. C. H. Dietrich (INHS) in recognition of his good work on leafhoppers.

Scaphoidella stenopaea Anufriev, 1977

Scaphoidella stenopaea Anufriev, 1977: 213, figs 13–19; Zhang and Dai 2006: 847, figs 23–29; Li, Dai and Xing 2011: 201, plate 5-196, figs 1–6.



Figures 31–36. *Scaphoidella dietrichi* sp. n., **31** Male pygofer side, lateral view **32** Valve, ventral view **33** Subgenital plates, ventral view **34** Aedeagus and connective, ventral view **35** Aedeagus and connective, lateral view **36** Style, dorsal view.

Material examined. 3♂♂4♀♀, China: Inner Mongolia Autonomous Region, Zhalantun, 26 August 1996, coll. Zizhong Li; 2♂♂3♀♀, Gansu Prov., Zhenyuan, 1 August 2007, coll. Wei Cao; 4♂♂2♀♀, Hebei Prov., Chengde, Wulingshan, 14 August 2010, coll. Lixia Xie; 2♂♂, Shanxi Prov., Lishan, Dahelinchang, 23 July 2012, coll. Jichun Xing. All GUGC.

Distribution. Russia (Amur Province, Maritime Territory); China (Shaanxi, Shandong, Heilongjiang, Liaoning, Gansu, Inner Mongolia, Hebei, Shanxi) (Fig. 43).

Scaphoidella undosa Zhang & Dai, 2006

Scaphoidella undosa Zhang & Dai, 2006: 844, figs 11–22; Li, Dai and Xing 2011: 204, plate 5-199, figs 1–7.

Material examined. 1♂2♀♀, China: Guizhou Prov., Kuankuoshui, 24 August 2001, coll. Zizhong Li; 1♂, Guizhou Prov., Congjiang County, Yueliangshan, 20 July 2006, coll. Zaihua Yang; 1♂1♀, Zhejiang Prov., Tianmushan, 22 July 2009, light trap coll. Zehong Meng; 1♂, Guizhou Prov., Kuankuoshui, 11 August 2010, coll. Hu Li; 2♂♂1♀, Guizhou Prov., Kuankuoshui, 14 August 2010, coll. Jichun Xing; 2♂♂, Guizhou Prov., Kuankuoshui, 17 August 2010, coll. Hu Li and Zhihua Fan; 2♂♂, Anhui Prov., Jinzhai County, Tianma, 31 July 2013, coll. Bin Li. All GUGC.

Distribution. China (Henan, Hunan, Jiangxi, Hubei, Guizhou, Zhejiang, Anhui) (Fig. 43).

Scaphoidella unihamata (Li & Kuoh, 1993)

Scaphoideus unihamatus Li & Kuoh, 1993: 39, figs 7–12.

Scaphoidella inermis Cai & He, 2001: 205, figs 89–96, synonymised by Zhang and Dai 2006: 848.

Scaphoidella unihamata (Li & Kuoh), comb. n. by Zhang and Dai 2006: 848, figs 30–40; Li, Dai and Xing 2011: 203, plate 5–198, figs 1–5.

Material examined. China: 1♂ (Holotype), Fujian Prov., Sanming, 6 September 1978, coll. Zhonglin Ge; 2♂♂, Fujian Prov., Sanming, 6 September 1978, coll. Zhonglin Ge; 1♂, Guangxi Autonomous Region, Huaping, 19 May 2012, coll. Zhihua Fan. All GUGC.

Distribution. China (Zhejiang, Hunan, Fujian, Guangxi) (Fig. 43).

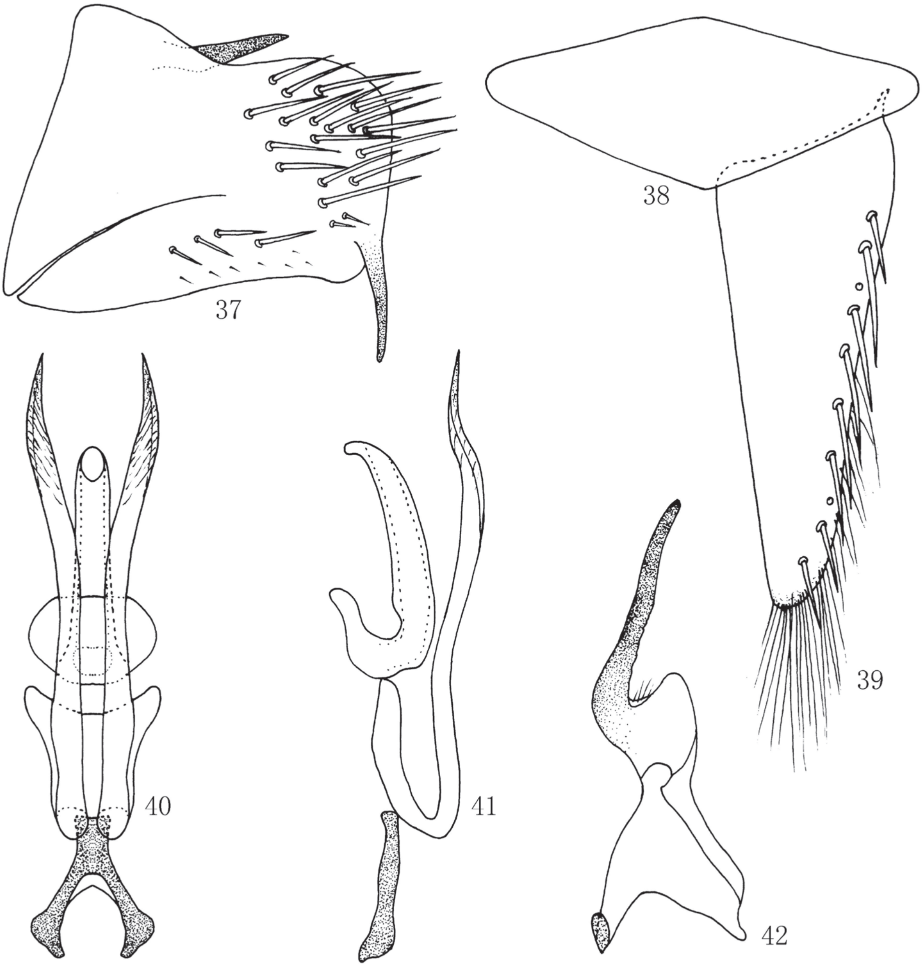
Scaphoidella wideaedeaga (Wang & Li, 2004)

Scaphoideus wideaedeagus Wang & Li, 2004: 17, figs 14–19.

Scaphoidella wideaedeaga (Wang & Li), comb. n. by Zhang and Dai 2006: 849, figs 41–50; Li, Dai and Xing 2011: 205, plate 5-200, figs 1–6; Dai and Dietrich 2011: 472.

Material examined. China: 1♂ (Holotype), Yunnan Prov., Tengchong, 4 July 2002, coll. Renhuai Dai; 1♂1♀, Yunnan Prov., Gaoligongshan, Baihualing, 14 June 2011, coll. Yujian Li; 1♂, Yunnan Prov., Ruili City, Nongdao, 15 July 2013, coll. Weicheng Yang; 1♂, Yunnan Prov., Gaoligongshan, Baihualing, 5 August 2013, coll. Zhihua Fan. All GUGC.

Distribution. China (Yunnan, Xizang) (Fig. 43), Thailand (Loei).



Figures 37–42. *Scaphoidella zhangi* (Viraktamath & Mohan), **37** Male pygofer side, lateral view **38** Valve, ventral view **39** Subgenital plates, ventral view **40** Aedeagus and connective, ventral view **41** Aedeagus and connective, lateral view **42** Style, dorsal view.

Scaphoidella zhangi (Viraktamath & Mohan, 2004)

Figs 7–8, 37–42

Scaphoideus zhangi Viraktamath & Mohan, 2004: 45, figs 218–227.
Scaphoidella zhangi comb. n. by Dai and Dietrich 2011: 471.

Material examined. 1♂, China: Guizhou Prov., Luodian County, Bamao, 20 October 2002, coll. Renhuai Dai (GUGC).

Distribution. India (Meghalaya, West Bengal); Thailand (Loei); China (Guizhou) (Fig. 43).

Note. This species is here recorded from China for the first time.

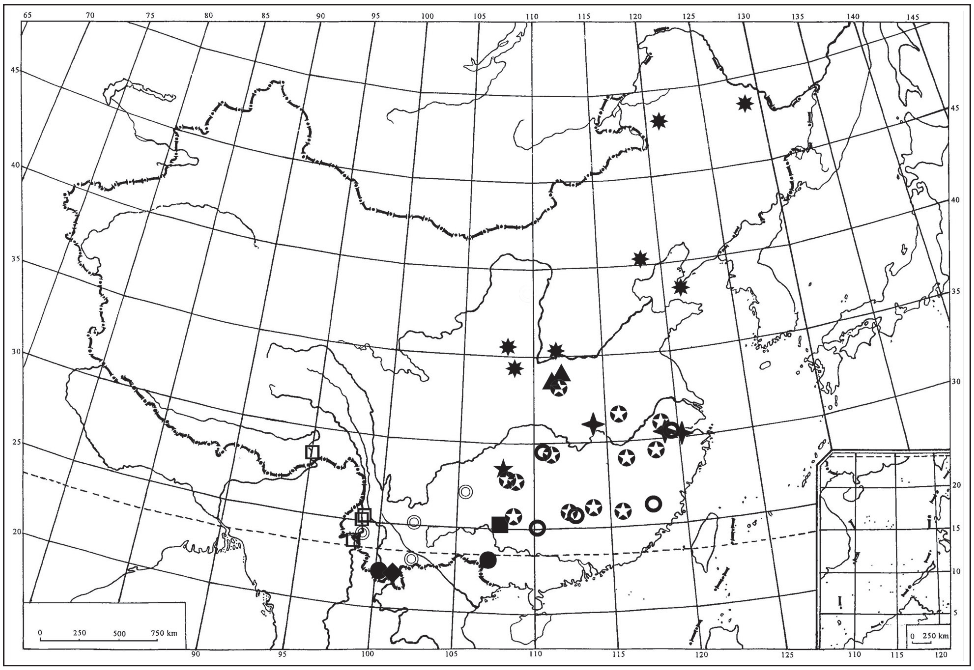


Figure 43. Geographic distribution of *Scaphoidella* species in China: *S. acaudata* (◎); *S. arboricola* (✦); *S. brevissima* (▲); *S. clavatella* (●); *S. denticlestyla* (★); *S. dietrichi* sp. n. (◆); *S. stenopaea*(✹); *S. undosa* (**O**); *S. unihamata* (✪); *S. wideaedeaga* (□); *S. zhangi* (■).

Discussion

Chinese species of *Scaphoidella* are mainly distributed in southern China (*S. acaudata*, *S. clavatella*, *S. denticlestyla*, *S. dietrichi*, *S. unihamata*, and *S. zhangi*) with *S. brevissima* and *S. stenopaea* distributed in the Palaearctic Region (northern China and also Inner Mongolia). The following Chinese species occur in both regions: *S. arboricola*, *S. undosa*, and *S. wideaedeaga*. Until now, six species: *S. acaudata*, *S. brevissima*, *S. denticlestyla*, *S. dietrichi*, *S. undosa*, and *S. unihamata* are endemic to China and *S. stenopaea*, *S. undosa*, and *S. unihamata* appear to be widespread. It is highly likely that there are undiscovered species in China.

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RESEARCH ARTICLE

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Pseudoexeirarthra, a new genus from New Zealand (Coleoptera, Staphylinidae, Pselaphinae), with descriptions of seven new species

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Abstract

A new endemic genus and seven new species of New Zealand pselaphine staphylinid beetles of the supertribe Faronitae are described as follows: *Pseudoexeirarthra* Park & Carlton, **gen. n.** (type species: *Sagola spinifer* Broun); *P. sungmini* Park & Carlton, **sp. n.**; *P. kwangguki* Park & Carlton, **sp. n.**; *P. youngboki* Park & Carlton, **sp. n.**; *P. seiwoongi* Park & Carlton, **sp. n.**; *P. parkeri* Park & Carlton, **sp. n.**; *P. hlavaci* Park & Carlton, **sp. n.**; *P. nomurai* Park & Carlton, **sp. n**. Three species, *S. spinifer* Broun, *S. colorata* Broun, and *S. puncticollis* Broun, are transferred to the genus *Pseudoexeirarthra*. Six species are synonymized: *S. dilucida* Broun, *S. guinnessi* Broun, *S. longicollis* Broun, *S. longula* Broun, and *S. rectipennis* Broun under *P. spinifer* (Broun); *S. insueta* Broun under *S. colorata* (Broun). A lectotype is designated for *P. spinifer* (Broun). A key, habitus photographs, line drawings of diagnostic characters, and distribution maps are provided for each species.

Keywords

Taxonomy, biogeography, Faronitae, Faronini, redescription

Introduction

Sagola Sharp, 1874, the largest genus of the supertribe Faronitae, has been considered to be a paraphyletic assemblage of species (Chandler 2001). *Sagola* was recently revised by Park and Carlton (2014) as well as other extant genera, *Exeirarthra* (Park and Carlton 2011) and *Stenosagola* (Park and Carlton 2013). Three species, *S. spinifer* Broun, *S. puncticollis* Broun, and *S. colorata* Broun are distinctive morphologically and can be easily separated from the other *Sagola* species by the absence of anterior and posterior frontal foveae, absence of promesocoxal foveae, presence of an inverted triangle-shaped process along the anterior margins of abdominal tergites IV–VI, and female sternite VIII bearing a pseudosternite. Based on these characters, a new genus, *Pseudoexeirarthra* gen. n. is established to accommodate the three previously described species and seven new species.

Materials and methods

Approximately four hundred specimens were studied from the Field Museum of Natural History (FMNH), Chicago, IL, USA; Louisiana State Arthropod Museum (LSAM), Baton Rouge, LA, USA; Natural History Museum (NHM), London, United Kingdom; Lincoln University (LUNZ), Lincoln, New Zealand; New Zealand Arthropod Collection (NZAC), Auckland, New Zealand; Auckland Museum, Auckland, New Zealand (AMNZ); personal collection of Donald S. Chandler (DSC), Durham, NH, USA; personal collection of John T. Nunn (JTN), Dunedin, New Zealand.

Holotypes of species described herein are deposited in the New Zealand Arthropod Collection (NZAC), Auckland. Paratype and additional specimen depositions are indicated parenthetically. Specimen label data for types are transcribed verbatim. Data for other specimens are standardized for consistency.

Seven specimens were mounted on permanent slides to aid in observation of internal characters and fine external characters not apparent when using a dissecting microscope. Permanent microscopic slides were prepared using the techniques described by Hanley and Ashe (2003). Terminology for the foveal system and enumeration of abdominal sclerites follows Chandler (2001). Numbering of abdominal sclerites indicates actual segment counts (i.e., not ventrites) for consistency with Chandler's system, but meso- metathoracic ventral sclerites are referred to as ventrites (*sensu* Beutel and Leschen 2010).

New Zealand maps were produced by modifying the map of Crosby et al. (1976) and adding appropriate symbols using Adobe Photoshop®. The area codes for the New Zealand biotic regions follow the system of Crosby et al. (1998). Multiple specimens from the same locality are indicated by a single symbol.

Each figure of an aedeagus illustrates the organ in dorsal view with the median lobe oriented forward (up on page). Right and left are indicated based on this orientation, not the morphological orientation when inside the body, which would be reversed.

Taxonomy

***Pseudoexeirarthra* Park & Carlton, gen. n.**
http://zoobank.org/950B4AD1-52D2-4BBD-90A6-4F57AE86FCA5

Type species. *Sagola spinifer* Broun, 1895: 75; here designated.

Diagnosis. Members of *Pseudoexeirarthra* can be separated from those of all other faronite genera by the following combination of characters: body length 1.8–2.8 mm; frontal sulcus broad and shallow, reaching level of the midline of eyes (Fig. 2A); lacking anterior and posterior frontal foveae (Fig. 2A); prosternum with lateral procoxal foveae (Fig. 2B); mesoventrite lacking promesocoxal foveae (Fig. 2C); tergites IV–VI with inverted triangle-shaped process on anterior margins (Fig. 2D); sternites IV–VI with basolateral foveae; female sternite VIII with pseudosternite (Fig. 2F); female sternite IX bearing pair of small process that each bear two long setae (Fig. 2G).

Description. Body length 1.8–2.8 mm. Body reddish, antennae, legs, maxillary palpi and elytra paler (Fig. 1A–J). Head. Antennae gradually clavate, reaching posterior margin of prothorax. Head bluntly triangular and longer than wide (Fig. 1A–J). Apex of left mandible thicker than right (Fig. 2E). Frontal sulcus broad and shallow, reaching level of the midline of eyes, lacking anterior and posterior frontal foveae (Fig. 2A). Prosternum bearing median and lateral procoxal foveae (Fig. 2B). Mesoventrite lacking promesocoxal foveae, bearing lateral mesoventral and lateral mesocoxal foveae (Fig. 2C). Metaventrite with pair of lateral metaventral foveae (Fig. 2C). Tergites IV–VI with inverted triangle-shaped process on anterior margins (Fig. 2D). Aedeagus with bulky and round phallobase (Fig. 3A–J). Parameres bearing setae along mesal margin for one-third to two-thirds length of parameres (Fig. 3A–J). Female sternite VIII with pseudosternite (Fig. 2F). Female sternite IX bearing pair of small process that each bear two long setae (Fig. 2G).

Etymology. The generic name refers to the superficial similarity to the genus *Exeirarthra* Broun.

Comments. Members of this genus lack distinct external secondary sexual characters except on abdominal sternite IX. Male sternite IX is fragile, and partially concealed by sternite VIII, rendering it simple and reduced in appearance. Females possess a more robust, heart-shaped or rounded sternite IX that bears two pairs of long setae that are usually visible in ventral view. Female genitalia, including spermathecae, apparently are membranous and were not observed after clearing specimens using 10% potassium hydroxide.

Key to species of *Pseudoexeirarthra* gen. n.

Note. The key is largely based on male genitalia because most specimens are indistinguishable based on the external morphology. Antennal shape and eye size are apparently unique within species. However, apparent variations may result from viewing at inconsistent orientations among specimens. These characters are difficult to interpret consistently when performing identifications, but still useful in comparing types or specimens in series.

1	Elytra as long as wide (Fig. 1E), abdominal tergite IV lacking patch of microtrichia .... ***Pseudoexeirarthra kwangguki* sp. n.**
–	Elytra longer than wide, abdominal tergite IV with transverse patches of microtrichia **2**
2 (1)	Left paramere at least twice as wide as right paramere at midpoint (Fig. 3A). .... ***P. spinifer* (Broun)**
–	Let paramere close to as wide as right paramere at midpoint **3**
3 (2)	Median lobe of genitalia at least 3 times as wide as either paramere (Fig. 3D) .... ***P. sungmini* sp. n.**
–	Median lobe of genitalia at most slightly more than twice as wide as either paramere 4
4 (3)	Parameres broader than median lobe of genitalia (Fig. 3C) .... ***P. puncticollis* (Broun)**
–	Parameres narrower than median lobe of genitalia **5**
5 (4)	Median lobe of genitalia with acute spine at one-third length (Fig. 3J) .... ***P. nomurai* sp. n.**
–	Median lobe of genitalia lacking branch **6**
6 (5)	Apical lobe of genitalia triangular (Fig. 3G) .... ***P. seiwoongi* sp. n.**
–	Apical lobe of genitalia bluntly rounded **7**
7 (6)	Left paramere longer than right (Fig. 3H) .... ***P. parkeri* sp. n.**
–	Right paramere longer than left **8**
8 (7)	Major apical lobe of genitalia rectangular (Fig. 3B) .... ***P. colorata* (Broun)**
–	Major apical lobe of genitalia inverted triangular apically **9**
9 (8)	Major apical lobe of genitalia with slightly wider apical margin (Fig. 3F) .... ***P. youngboki* sp. n.**
–	Major apical lobe of genitalia with distinctly wider apical margin (Fig. 3I) .... ***P. hlavaci* sp. n.**

***Pseudoexeirarthra spinifer* (Broun)**

Figs 1A, 2, 3A, 4

Sagola spinifer Broun, 1895: 75. Hudson 1923: 365; 1934: 183. Raffray 1924: 233. Newton and Thayer 2005. Nomura and Leschen 2006: 244.

Sagola dilucida Broun, 1914: 157. Hudson 1923: 365; 1934: 184. Newton and Thayer 2005. Nomura and Leschen 2006: 242. **syn. n.**

Sagola guinnessi Broun, 1911: 502. Hudson 1923: 365; 1934: 184. Raffray 1924: 232. Newton and Thayer 2005. Nomura and Leschen 2006: 242. **syn. n.**

Sagola longicollis Broun, 1911: 498. Hudson 1923: 365; 1934: 183. Raffray 1924: 232. Newton and Thayer 2005. Nomura and Leschen 2006: 243. **syn. n.**

Sagola longula Broun, 1912: 625. Hudson 1923: 365; 1934: 183. Raffray 1924: 232. Newton and Thayer 2005. Nomura and Leschen 2006: 243. **syn. n.**

Sagola rectipennis Broun, 1921: 489. Hudson 1923: 365; 1934: 184. Newton and Thayer 2005. Nomura and Leschen 2006: 243. **syn. n.**

Type material. Lectotype. New Zealand: Waikato (WO): 1♂ (BMNH), glued on rectangular card, "2723." [white label, handwritten]; "Mount. Pirongia" [white label, printed]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "Sagola spinifer" [white label, handwritten]; "LECTOTYPE ***Pseudoexeirarthra spinifer*** (Broun) Desig. Park and Carlton 2013" [red label, printed]. *The lectotype designation is required because Broun did not explicitly designate a type specimen, and his comments suggest that three specimens were examined (Broun, 1875: 75). This designation will fix the identity of the species and facilitate its recognition by future workers. **Paralectotypes (1 male, 1 female). New Zealand: Waikato (WO):** 1♀ (BMNH), glued on rectangular card, "Type" [red label, printed]; "2723." [white label, handwritten]; "Pirongia" [white label, printed]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "Sagola spinifer" [white label, handwritten]; "PARALECTOTYPE ***Pseudoexeirarthra spinifer*** (Broun) Desig. Park and Carlton 2013" [yellow label, printed]. 1♂ (NZAC), glued on rectangular card, "Pirongia" [white label, printed]; "var. 2723." [white label, handwritten]; "S. spinifer antennae." [white label, handwritten]; "Broun" [white label, handwritten]; " N.Z. Arthropod Collection, NZAC Private Bag 92710 New Zealand" [yellow label, printed]; "PARALECTOTYPE ***Pseudoexeirarthra spinifer*** (Broun) Desig. Park and Carlton 2013" [yellow label, printed].

Holotype of *Sagola dilucida*: New Zealand: Auckland (AK): 1♀ (BMNH), glued on rectangular card, "Type" [red label, printed]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "Epsom. Jany.1912." [white label, handwritten]; "3520.♂" [white label, handwritten]; "Sagola dilucida" [white label, handwritten]. The original label indicates the specimen is male, but it is female.

Holotype of *Sagola guinnessi*: New Zealand: Taupo (TO): 1♂ (BMNH), glued on rectangular card, "Type" [red label, printed]; "3373." [white label, handwritten]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "Erua. 5.3.1912." [white label, handwritten]; "Sagola guinnessi." [white label, handwritten]. The original label indicates the specimen is female, but it is male.

Holotype of *Sagola longicollis*: New Zealand: Taupo (TO): 1♀ (BMNH), glued on rectangular card, "Type" [red label, printed]; "3369" [white label, handwritten]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "Mahuia. Jany.1911." [white label, handwritten]; "Sagola longicollis." [white label, handwritten].

Holotype of *Sagola longula*: New Zealand: Auckland (AK): 1♀ (BMNH), glued on rectangular card, "Type" [red label, printed]; "15." [white label, handwritten]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "auckland. N.Z. Lawson" [white label, handwritten]; "Sharp Coll. 1905-313." [white label, printed]; "Sagola longula." [white label, handwritten].

Syntype of *Sagola rectipennis*: New Zealand: Otago Lakes (OL): 1♂ (BMNH), glued on rectangular card, "3997.♂" [white label, handwritten]; "New Zealand Broun

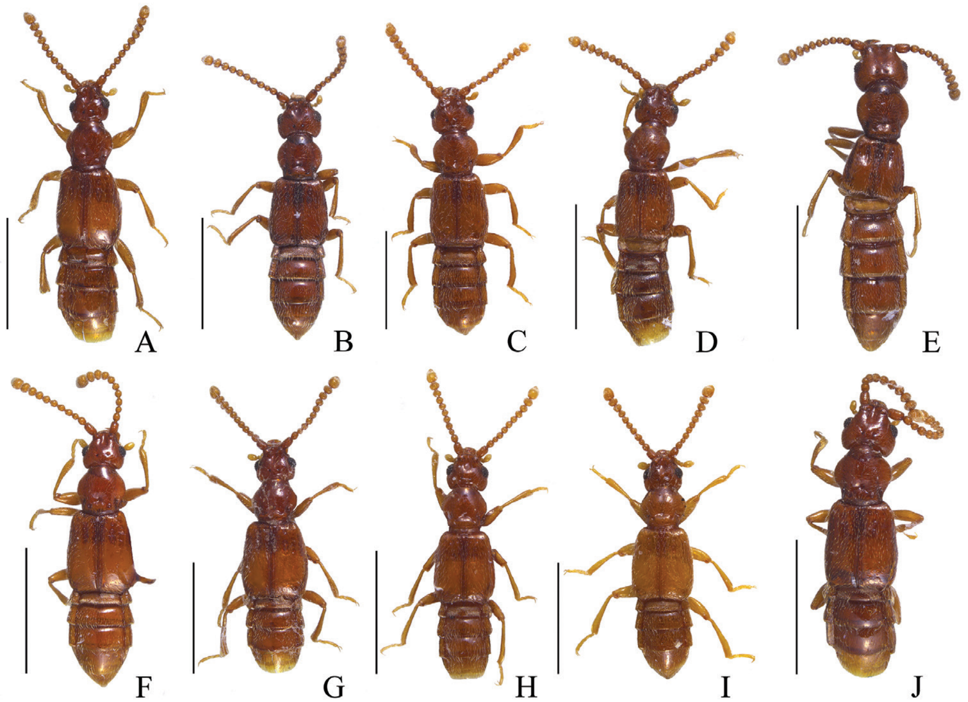

Figure 1. Habiti, dorsal view: **A** *Pseudoexeirarthra spinifer* (Broun) **B** *P. colorata* (Broun) **C** *P. puncticollis* (Broun) **D** *P. sungmini* sp. n. **E** *P. kwangguki* sp. n. **F** *P. youngboki* sp. n. **G** *P. seiwoongi* sp. n. **H** *P. parkeri* sp. n. **I** *P. hlavaci* sp. n. **J** *P. nomurai* sp. n. Scale bars = 1 mm.

Coll. Brit. Mus. 1922-482." [white label, printed]; "Mt. Alfred. 9.2.1914" [white label, handwritten]; "Sagola ♂. rectipennis" [white label, handwritten]. 1♂ (BMNH), glued on rectangular card, "3997.♂" [white label, handwritten]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "Mt. Alfred. 9.2.1914" [white label, handwritten]; "Sagola rectipennis" [white label, handwritten]. 1♂ (BMNH), glued on rectangular card, "3997.♂" [white label, handwritten]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "Mt. Alfred. 9.2.1914" [white label, handwritten].

Additional material (n = 198; 95 males, 103 females). New Zealand: Auckland (AK): 1♂ 1♀, Waitakere Ra, Cascade-Kauri Park, Up. Kauri tr, 170 m, 8 XII 1984–25 I 1985, kauri-podo-hdwd, A. Newton, M. Thayer 680, FIT&window trap (DSC); 1♂, Lynfield, Tropicana dr, 14 VIII 1976, G. Kuschel, litter (NZAC); 1♂ 1♀, Lynfield, 7 IX 1980, G. Kuschel, litter (NZAC); 2♀♀, Woodhill, 27 II 1976, C. F. Butcher, pit trap (NZAC); 1♂, Lynfield, 16 IV 1977, G. Kuschel (NZAC); **Bay of Plenty (BP):** 1♀, Orete Forest, Te Puia Hut, 230 m, 29 I 1993, R. M. Emberson, litter (NZAC); 1♂1♀, Lottin Pt Rd, Waenga Bush, 24 XI 1992–29 I 1993, R. C. Henderson, Malaise trap (NZAC); 1♂, Lottin Pt Rd, Waenga, 27 I 1993, R. C. Henderson, litter (NZAC); 1♂, Te Koau, Main Ridge, 220 m, 23 IX 1992, J. S. Dugdale, litter (NZAC); 1♂, Te

Koau, Twin Puriri's, 31 I–15 III 1993, R. C. Henderson, pit trap (NZAC); 1♂, Papatea, 13 X–23 XI 1992, G. Hall, pit trap (NZAC); 1♂, Mamaku Ra, 18 I 1972, G. W. Ramsay, litter (NZAC); 1♀, Te Koau, Bush Track, 23 IX 1992, J. S. Dugdale, litter (NZAC); 1♀, Mount Te Aroha, summit, 19 XI 2005, J. Nunn, moss (NZAC); 1♀, Kaimai-Mamaku Forest Park, Mt. Te Aroha summit rd, 450 m, 37°31.43'S, 175°44.01'E, 19 XI 2005, mixed broadleaf forest with many tree ferns, nikau palms, FMHD#2005-016, FIT, A. Newton, M. Thayer, ANMT site 1144 (FMNH); **Buller (BR):** 5♂♂ 6♀♀, Nelson Lakes NP, Mt. Robert, Speargrass tr, 875 m, 41°49.47'S, 172°48.31'E, 17 XII 2005, *Nothofagus* forest, FMHD#2005-110, litter, A. Solodovnikov, D. Clarke, ANMT site 1161 (FMNH); 22♂ 12♀♀, (1♂, slide-mounted), Lewis Pass NR, 11.9 km ese Spring Junction, 540 m, 17 XII 1984–21 I 1985, *Nothofagus* forest, A. Newton, M. Thayer, 715, window trap (FMNH); 8♂♂ 14♀♀, Nelson Lakes NP, Lake Rotoroa, Braeburn tr, 470 m, 16 XII 1984–7 I 1985, *Nothofagus* forest, A. Newton, M. Thayer 712, window trap (FMNH); 4♂♂ 8♀♀, Nelson Lakes NP, n slope Mt. Robert, Pinchgut tr, 950 m, 14 XII 1984–6 I 1985, *Nothofagus* forest, A. Newton, M. Thayer 707, window trap (FMNH&DSC); 2♀♀, Nelson Lakes NP, n slope Mt. Robert, Pinchgut tr, 950 m, 14 XII 1984–6 I 1985, *Nothofagus* forest, A. Newton, M. Thayer 707, litter (FMNH); 1♂2♀♀, Nelson Lakes NP, Lake Rotoiti, St. Arnaud tr, 645 m, 14 XII 1984–6 I 1985, *Nothofagus* forest, A. Newton, M. Thayer 705, window trap (FMNH); 1♂, Nelson Lakes NP, Mt. Robert Rd, 660 m, 26 XII 1984–6 I 1985, *Leptospermum-Nothofagus* forest, A. Newton, M. Thayer 722, FIT&window trap (DSC); 1♂, Lewis Pass NR, 13.2 km s Lewis Pass, 650 m, 17 XII 1984–21 I 1985, *Nothofagus* forest, A. Newton, M. Thayer 713, FIT&window trap (DSC); 2♂♂, Mt. Misery, Ecology Div Stn, 460 m, 24–26 I 1977, J. S. Dugdale, water trap (NZAC); 1♀, Greymouth, Boddytown, 8 II 1984, J.C. Watt, litter (NZAC); 2♂♂, Rd to Mt. Robert, 762 m, Lake Rotoiti, 3 V 1966, J. I. Townsend, moss (NZAC); **Central Otago (CO):** 1♂ 1♀, Waipori, 610 m, Stony Stream, 2 XI 1979, J. C. Watt, moss (NZAC); 1♀, Piano Flat, Waikaia Forest, 25 IV 2007, washed soil beech forest (JTN); **Coromandel (CL):** 2♀♀, Cuvier I, Northwest Ridge, 25 II–2 III 1982, G. Hall, malaise trap (NZAC); 1♂, Cuvier I, 25 II–2 III 1982, G. Hall, pit trap (NZAC); 1♂, Great Barrier I, Little Windy Hill, 100 m, 25 II–19 III 2003, K. Parsons, malaise trap (AMNZ); 1♂ 3♀♀, Great Barrier I, Little Windy Hill, 13 XII 2002–17 I 2003, P. Sutton, Malaise (AMNZ); 1♂ 1♀, Cuvier I, Ridge Tr, 100 m, 10–18 XI 1999, J. W. Early, S. E. Thorpe, malaise trap (AMNZ); 1♂, Great Barrier I, Little Windy Hill, 17 I–27 II 2003, K. Parsons, malaise trap (AMNZ); 1♂, Great Barrier I, Little Windy Hill, 220 m, 7 XI–11 XII 2001, P. Sutton, J. Gilbert, malaise trap (AMNZ); 3♀♀, Great Barrier I, Little Windy Hill, 220 m, 11 XII 2001–18 I 2002, P. Sutton (AMNZ); 1♀, Cuvier I, Pumphouse Stream, 120 m, 14 XI 1999, J. W. Early, S.E. Thorpe, litter (AMNZ); 1♀, Great Barrier I, Little Windy Hill, 220 m, 21 II 2001–26 III 2002, P. Sutton, malaise trap (AMNZ); 1♀, Great Barrier I, Little Windy Hill, 220 m, 18 I–21 II 2002, P. Sutton, malaise trap (AMNZ); **Fiordland (FD):** 2♂♂, Lake Hauroko, Southland, 2 II 1966, J. I. Townsend, moss (NZAC); 1♂, Secretary I, Gut Bay, 24 XI 1981, C.F. Butcher, beech litter and rotten wood (NZAC); 1♂, Fiordland NP,

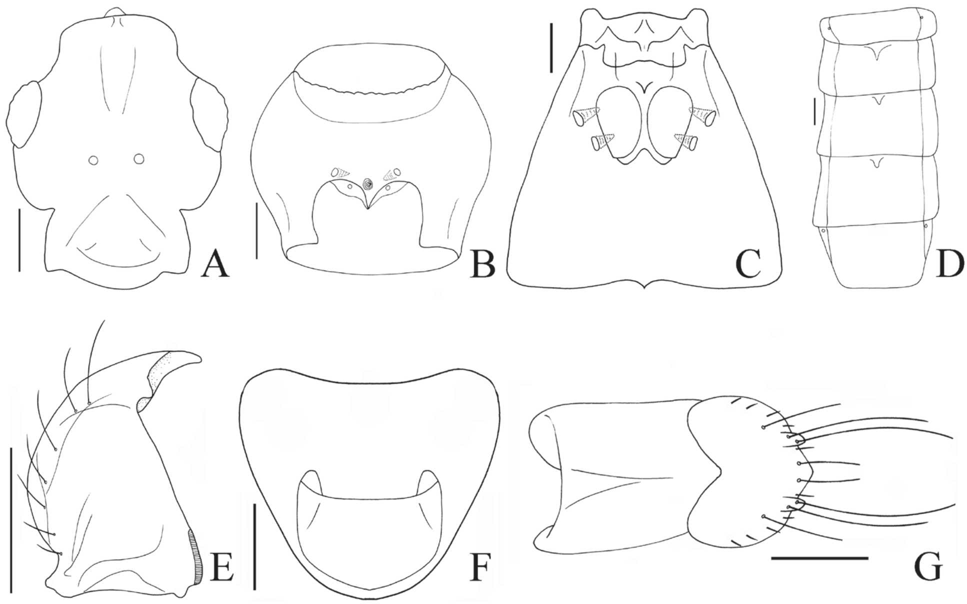

Figure 2. *Pseudoexeirarthra spinifer* (Broun): **A** head, dorsal view **B** prosternum, ventral view **C** meso- and metaventrite, ventral view **D** abdomen, dorsal view **E** left mandible, dorsal view **F** female sternite VIII, dorsal view **G** female sternite IX, ventral view. Scale bars = 0.1 mm.

Monowai Lake, 4km sw Monowai, 11–14 III 2010, J. W. Early, yellow pan traps, *Nothofagus solandri* forest (DSC); 1♂ 1♀, Fiordland NP, Milford Sound rd, Smithy Creek Campground area, 400 m, 44°57.07'S 168°01.16'E, 9 XII 2005, *Nothofagus fusca* & *N. menziesii* open forest, FMHD#2005-089, litter, M. Thayer, A. Newton, ANMT site 1170 (FMNH); 1♀, Secretary I, 850 m, 30 XI 1981, C.F. Butcher, pit trap (NZAC); **Gisborne (GB):** 1♂, Urewera NP, Waikaremoana rd, s end Matanunui Ridge, 720 m, 38°44.40'S, 177°05.81'E, 22 XI–23 XII 2005, mixed broadleaf (incl. *Nothofagus fusca*)-podocarp, FMHD#2005-028, FIT, M. Thayer, A. Solodovnikov, ANMT site 1149 (FMNH); 1♀, Lake Waikaremoana, 17 I 1972, G. W. Ramsay, litter; 1♀, Urewera NP, at large, #021, 6–8 III 2000, C. Carlton, A. Weir (LSAM); 1♀, Urewera NP, Lake Waikremoana, nr Caravan Park, shoreline toetoe, FIT, 23 III 2000, C. Carlton, A. Weir, #078 (LSAM); **Northland (ND):** 1♀, Paihia Opua SF, 22 I 1981, G. Kuschel, litter and rotten wood (NZAC); 1♀, Waipoua SF, Waipoua Stm, 70 m, 16–21 III 1978, S. Peck, J. Peck, malaise trap (FMNH); **Nelson (NN):** 2♂♂ 1♀, 0.6 km e Gowanbridge, 330 m, 18 XII 1984–7 I 1985, *Nothofagus* forest, A. Newton, M. Thayer 717, FIT&window trap (DSC); 1♂, Kahurangi NP, Cobb Ridge, above Cobb Reservoir, 1050 m, 41°06.35'S, 172°41.66'E, 29 XI–18 XII 2005, *Nothofagus* forest, FMHD#2005-051, FIT, A. Newton, M. Thayer, A. Solodovnikov, ANMT site 1159 (FMNH); 1♂, Kahurangi NP, Arthur Range, above Flora Saddle, 1000 m, 41°11.35'S, 172°44.46'E, 29 XI–18 XII 2005, *Nothofagus* forest, FMHD#2005-046, litter, A. Newton, M. Thayer, ANMT site 1156 (FMNH); 1♀, Cobb Ridge, east of Cobb Reservoir, 990 m, 2 I 1985, *Nothofagus* forest, A. Newton, M. Thayer 728, litter (DSC); 1♂ 1♀, Canaan Harwoods tr, 4 II 1965, L. P. Marchant, litter (NZAC); 1♂, Dovedale, 11 X 1963, J. I. Townsend, litter (NZAC); 2♀♀, Lake Rotoiti, 19 II 1965, L. P. Marchant, moss (NZAC); 1♀, Lake Rotoiti, 27 VII 1965, A. K. Walker, moss (NZAC); **Otago Lakes (OL):** 1♂ 1♀, 44.5 km nw Wanaka, 350m, Matukituki Valley, 44'29S 168'47E, #079, *Nothofagus* forest litter, 18 I 1998, C. Carlton, R. Leschen (LSAM); 1♂ 1♀, Makarora Bush, Makarora, 7–9 XI 1997, J. Nunn (JTN); 1♂ 1♀, Paradise, 2 II 1984, J. C. Watt, wood mould (NZAC); 1♂, Upper Makarora, 17 I 1968, F. A. Alack, litter (NZAC); 1♀, 10.5 km nw Glenorchy, *Nothofagus* forest, 44°47'S, 169°27'E, FIT #143, 19–24 I 1998, C. Carlton, R. Leschen (LSAM); **Rangitikei (RI):** 1♀, Ruahine Ra, Armstrong Saddle, 1370 m, 26 XII 1983, J. C. Watt, litter (NZAC); 1♀, Ruahine Ra, Triplex, 10 II 1980, C. F. Butcher, litter (NZAC); **Marlborough Sounds (SD):** 3♂♂ 2♀♀, Wairau V, Schroders Ck, 7 IX 1966, J. I. Townsend, litter 66/295 (NZAC); 1♀, Upper Wairau Valley, 731 m, 5 IX 1966, J. I. Townsend, moss (NZAC); 3♀♀, Head Fabians Valley, 23 X 1963, J. I. Townsend, litter (NZAC); 1♂, Rainbow SF, Connors Ck, 825 m, 21 XII 1981, J. W. Early, sweeping (NZAC); **Southland (SL):** 2♀♀, Catlins SF Park, 15 II 1982, C.F. Butcher, J. S. Dugdale, litter (NZAC); 1♀, Owaka Glenomaru Reserve, 18 I 1978, S. Peck, J. Peck, litter (FMNH); **Taupo (TO):** 1♂, Kaimanawa North Forest Park, 850m, 11 III 1978, J. S. Dugdale, moss (NZAC); 1♂, Kaimanawa N Forest Park Saddle, 20 II 1978, J. S. Dugdale, litter (NZAC); 1♀ (slide-mounted), Erua, 27 I 1982, C. F. Butcher, litter and moss (NZAC); 1♀, Erua, 16 XII 1961, G. Kuschel, litter (NZAC); **Westland (WD):** 1♂, Doughboy Creek, 6 km sw Mahitai, 5 II 1984, J. C. Watt, wood mould (NZAC); 1♀, Hokitika Gorge, 29 I 1978, S. Peck, litter (FMNH); 1♀, Jacksons Bay, 23 IX 1979, A. K. Walker, moss (NZAC); **Wanganui (WI):** 1♂ 1♀, nr Glow-worm Cave, Table Hill rd nr Apiti, 8 II 1997, J. Nunn (JTN); 1♂, Ashhurst Domain, Ashhurst, 23 X 1998, J. Nunn, litter (JTN); **Wellington (WN):** 3♂♂ 1♀, Mana Island, 4–6 II 1994, J. Nunn, decayed wood (JTN); 1♂, Tararua Ra, e Basin Logan, 1300 m, 6 XII 1984, R. C. Craw, turf plants (NZAC); 1♂, Pakuratahi Forks, 8 VII 1994, J. Nunn, litter (JTN); 1♀, Tararua Ra, Dundas Hut Ridge, 990 m, 13 II 1985, C. F. Butcher, litter (NZAC); 1♀, n Titahi Bay, Rocky Bay, 28 XII 1980, J. C. Watt, litter and humus (NZAC); 1♀, Tararua Forest Park, Waitewaewae tr, 220 m, 40°51.98'S, 175°15.319'E, 26 XI–21 XII 2005, broadleaf-podo forest, FMHD#2005-034, FIT, A. Newton, M. Thayer, ANMT site 1152 (FMNH); **Waikato (WO):** 1♂, Pirongia Forest Park, Mahaukura tr, 270 m, 37°58.22'S, 175°06.52'E, 18 XI–27 XII 2005, broadleaf forest, FMHD#2005-009, FIT, A. Newton, M. Thayer, et al., ANMT site 1142 (FMNH).

Diagnosis. This species is distinguished from the other species of this genus by the following combination of characters: body length 2.3–2.8 mm; eyes large, as long as temples (Fig. 1A); antennomeres 3–7 subquadrate, 8–10 weakly transverse; median lobe of male genitalia divided in apical third, broadest at base (Fig. 3A); parameres asymmetrical, left much broader basally than right (Fig. 3A).

Redescription. Length 2.3–2.8 mm. Body reddish brown, antennae, legs, maxillary palpi and elytra paler (Fig. 1A). Head bluntly rectangular, longer than wide,

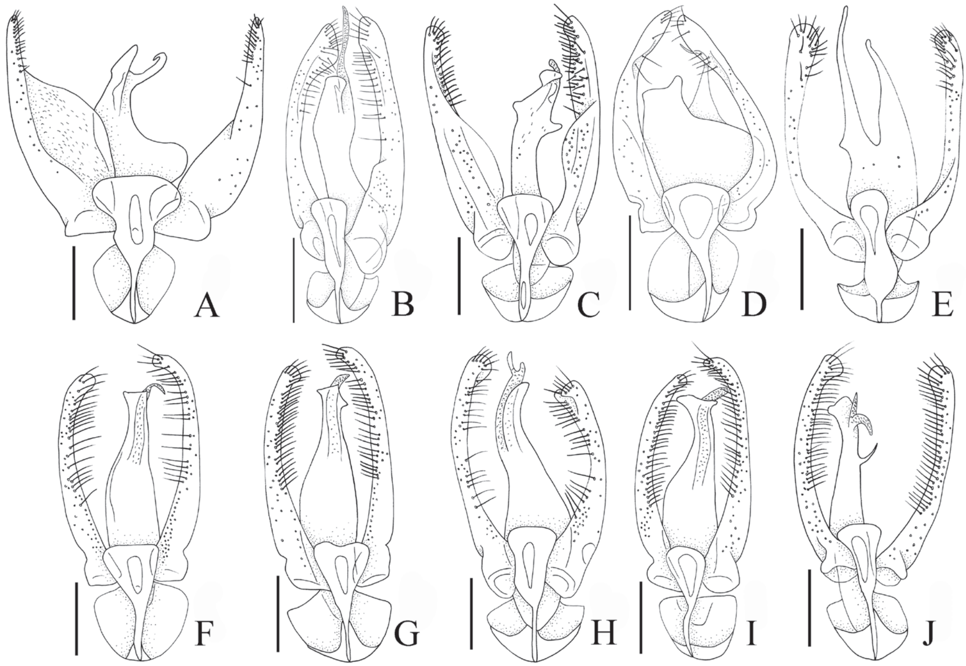

Figure 3. Aedeagi, dorsal view: **A** *Pseudoexeirarthra spinifer* (Broun) **B** *P. colorata* (Broun) **C** *P. puncticollis* (Broun) **D** *P. sungmini* sp. n. **E** *P. kwangguki* sp. n. **F** *P. youngboki* sp. n. **G** *P. seiwoongi* sp. n. **H** *P. parkeri* sp. n. **I** *P. hlavaci* sp. n. **J** *P. nomurai* sp. n. Scale bars = 0.1 mm.

widest across eyes (Fig. 2A). Antennomere 1 approximately 1.5 times as long as wide, 2 longer than wide, 3–7 subquadrate, 8–10 weakly transverse. Eyes each large and prominent, as long as temple (Fig. 2A). Prosternum as long as wide, widest at apical one-third (Fig. 2B). Elytra longer than wide (Fig. 1A). Hind wings fully developed. Meso- metaventrites trapezoidal, longer than wide (Fig. 2C). Tergite IV with pair of transverse patches of microtrichia reaching middle. Median lobe of genitalia divided, broadest at base (Fig. 3A). Phallobase symmetrical and rounded (Fig. 3A). Parameres asymmetrical, left paramere much broader at middle than right (Fig. 3A).

Type locality. Mount Pirongia (WO), New Zealand.

Distribution. Auckland (AK), Bay of Plenty (BP), Buller (BR), Central Otago (CO), Coromandel (CL), Fiordland (FD), Gisborne (GB), Northland (ND), Nelson (NN), Otago Lakes (OL), Rangitikei (RI), Marlborough Sounds (SD), Southland (SL), Taupo (TO), Westland (WD), Wanganui (WI), Wellington (WN), Waikato (WO) (Fig. 4: black circles).

Habitat. Most specimens were collected using malaise, flight intercept, window traps, or by sifting leaf litter in broadleaf, podocarp, hardwood and *Nothofagus* forests.

Comments. Specimens of *Pseudoexeirarthra spinifer* can be separated from those of the other species by the large eyes, fully developed hind-wings, shapes of antennomeres, and genitalia. The type specimens of *Sagola dilucida*, *S. guinnessi*, *S. longicollis*, *S. longula* and *S. rectipennis* share these diagnostic characters. For these reasons, we have placed these names in synonymy with *P. spinifer*.

Pseudoexeirarthra colorata **(Broun)**

Figs 1B, 3B, 4

Sagola colorata Broun, 1914: 156. Hudson 1923: 365; 1934: 184. Newton and Thayer 2005. Nomura and Leschen 2006: 241.

Sagola insueta Broun, 1914: 157. Hudson 1923: 365; 1934: 184. Newton and Thayer 2005. Nomura and Leschen 2006: 242. **syn. n.**

Type material. Holotype. New Zealand: Mid Canterbury (MC): 1♀ (BMNH), glued on rectangular card, "Type" [red label, printed]; "3519." [white label, handwritten]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "McClennans. 25.3.1912." [white label, handwritten]; "Sagola colorata." [white label, handwritten].

Holotype of *Sagola insueta*. New Zealand: Mid Canterbury (MC): 1♀ (BMNH), glued on rectangular card, "Type" [red label, printed]; "3521." [white label, handwritten]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "Rakaia. 6.7.1912." [white label, handwritten]; "Sagola insueta" [white label, handwritten].

Additional material (n = 23; 21 males, 2 females). New Zealand: Dunedin (DN): 1♂, Nicol Creek, Leith Valley, 25 V 2006, J. Nunn, litter (JTN); 1♂, Vauxhall, 13 IX 2001, J. Nunn, FIT (JTN); 1♂, The Tunnels, Silverpeaks, 2 VI 2001, J. Nunn, moss and litter (JTN); 1♂, Vauxhall, 26 II 2011, 45°54.24'S, 170°31.89'E, 167 m, J. Nunn, washes soil (JTN); 1♂, Town Belt, 26 VII 1997, J. Nunn, decayed wood (JTN); 1♂, Vauxhall, 27 I 2000, J. Nunn, FIT (JTN); **Fiordland (FD):** 6♂ 1♀, Lake Hauroko, 2 XI 1966, J. I. Townsend, litter (NZAC); 1♂, Hollyford Camp, 10 XII 1966, A. K. Walker, litter (NZAC); **Mid Canterbury (MC):** 7♂♂, Banks Peninsula, Hay Scenic Res, Pigeon Bay, 25 m, 11 XII 1984–22 I 1985, Podocarp-hdwd forest, A. Newton, M. Thayer 702, window trap (FMNH); 1♂, Craigieburn SF, 850 m, #023, 42°10.8'S, 171°42'E, *Nothofagus* litter, 9 I 1998, C. Carlton, R. Leschen (LSAM); 1♀, McLellans Bush, Mt. Hutt, 11 I 2008, J. Nunn, on sooty mould on beech bole (JTN).

Diagnosis. This species is distinguished from the other species of this genus by the following combination of characters: body length 2.2–2.5 mm; eyes large, two-thirds length of temples (Fig. 1B); antennomeres 2–7 longer than wide, 8–10 subquadrate; median lobe of male genitalia divided, minor lobe longer than major lobe and covered with small tubercles (Fig. 3B); parameres symmetrical, setae present from apices to middle (Fig. 3B).

Redescription. Length 2.2–2.5 mm. Body reddish brown, antennae, legs, maxillary palpi and elytra paler (Fig. 1B). Head rectangular, longer than wide, widest across eyes (Fig. 1B). Antennomere 1 approximately 1.5 times longer than wide, 2–7 longer than wide, 8–10 subquadrate. Eyes large and prominent, two-thirds length of temples. Prosternum as long as wide, widest at apical one-third. Elytra longer than wide

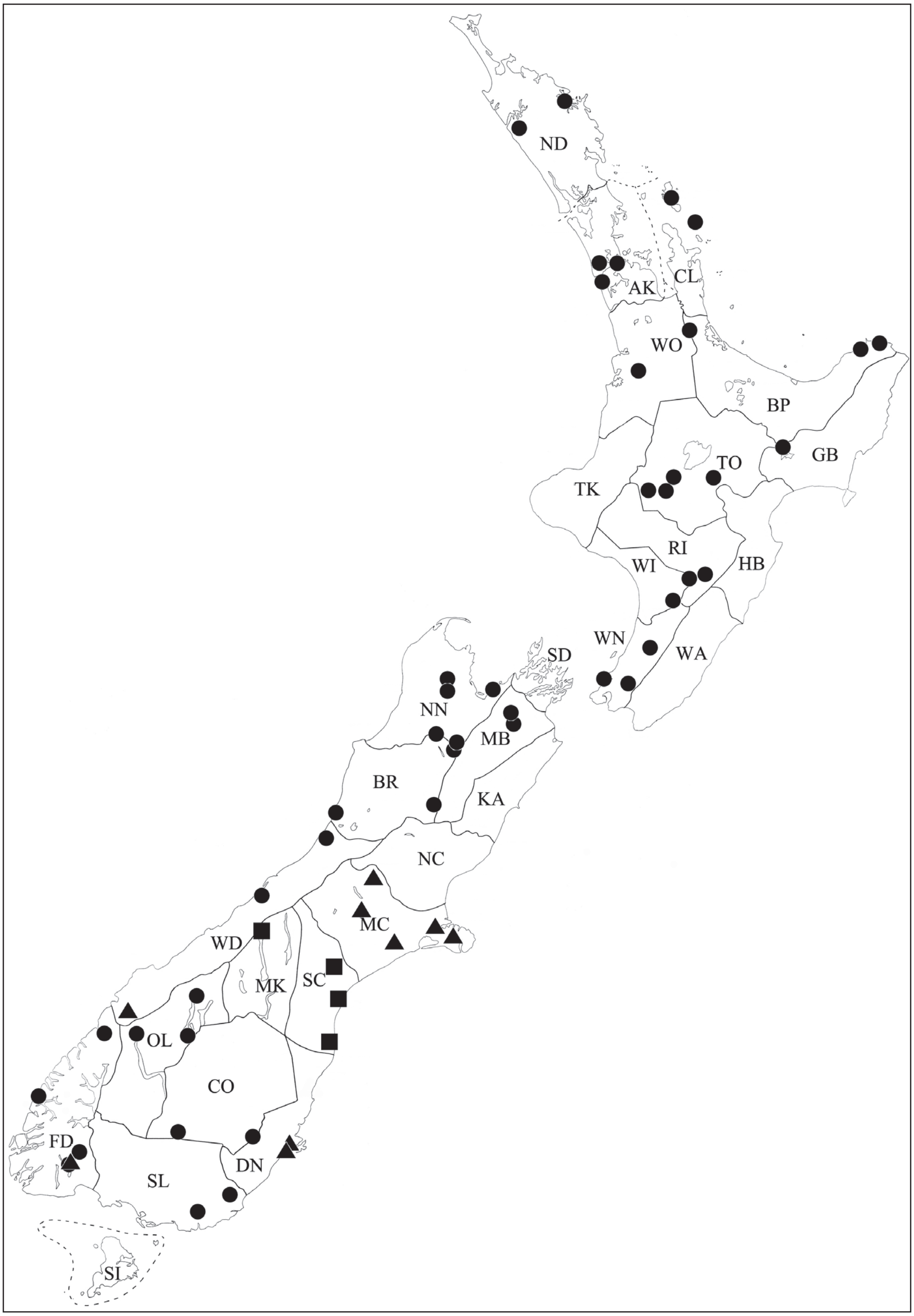

Figure 4. Known collection localities of *Pseudoexeirarthra* gen. n. *P. spinifer* (Broun): black circles; *P. colorata* (Broun): black triangles; *P. puncticollis* (Broun): black squares.

(Fig. 1B). Hind wings fully developed. Meso- and metaventrites trapezoidal, longer than wide. Tergite IV with pair of transverse patches of microtrichia reaching middle. Median lobe of genitalia divided, minor lobe longer than major lobe and covered with small tubercles (Fig. 3B). Phallobase symmetrical and rounded (Fig. 3B). Parameres symmetrical, setae present from apices to middle (Fig. 3B).

Type locality. McClennan's Bush, near Methven (MC), New Zealand.

Distribution. Dunedin (DN), Fiordland (FD), Mid Canterbury (MC) (Fig. 4: black triangles).

Habitat. Specimens were collected using flight intercept traps, and by soil washing or sifting leaf and wood litter.

Comments. The type specimen of *Sagola insueta* shares the diagnostic characters of *Pseudoexeirarthra colorata*. For this reason, we have placed *S. insueta* in synonymy with *P. colorata*.

***Pseudoexeirarthra puncticollis* (Broun)**

Figs 1C, 3C, 4

Sagola puncticollis Broun, 1911: 499. Hudson 1923: 365; 1934: 183. Raffray 1924: 232. Newton and Thayer 2005. Nomura and Leschen 2006: 243.

Type material. Holotype. New Zealand: South Canterbury (SC): 1♂ (BMNH), glued on rectangular card, "Type" [red label, printed]; "3370." [white label, handwritten]; "New Zealand Broun Coll. Brit. Mus. 1922-482." [white label, printed]; "Timaru. -Wallace." [white label, hand written]; "Sagola puncticollis" [white label, handwritten].

Additional material (n = 34; 29 males, 5 females). New Zealand: Mackenzie (MK): 8♂♀, White Horse Hill, Mt. Cook, 26 X 2009, J. Nunn, litter in podocarp forest (JTN); 1♂, White Horse Hill, Mt. Cook, 25 X 2009, J. Nunn, litter in podocarp grove (JTN); **South Canterbury (SC):** 18♂♀, Gunns Bush, Waimate, 23 XII 2006, washed soil in broadleaf forest, J. Nunn (JTN); 1♂ 1♀, Orari Gorge SR, Geraldine, 7 VI 2009, J. Nunn, washed soil in broadleaf forest (JTN); 1♀ (slide-mounted), Pioneer Park, Raincliff, 9 VIII 2009, J. Nunn, washed soil in totara and kahikatea forest (JTN); 1♂, Kelceys Bush, Waimate, 20 I 1966, J. I. Townsend, moss; 1♀, Mt. Dalgety, 1737 m, 19 I 1966, G. W. Ramsay, J. I. Townsend, moss (NZAC).

Diagnosis. This species is distinguished from the other species of this genus by the following combination of characters: body length 2.3–2.6 mm; eyes one-half lengths of temples (Fig. 1C); antennomeres 2–5 longer than wide, 6–10 subquadrate; median lobe of male genitalia divided, major lobe triangular, minor lobe slightly longer and unequally laterally tuberculate near apex (Fig. 3C); parameres nearly symmetrical, setae present from apices to middle (Fig. 3C).

Redescription. Length 2.3–2.6 mm. Body reddish brown, antennae, legs, maxillary palpi and elytra paler (Fig. 1C). Head round, as long as wide, widest across eyes (Fig. 1C). Antennomere 1 approximately 1.5 times longer than wide, 2–5 longer than wide, 6–10 subquadrate. Eyes one-half lengths of temples. Prosternum as long as wide, widest at apical one-third. Elytra longer than wide (Fig. 1C). Hind wings fully developed. Meso- and metaventrites trapezoidal, longer than wide. Tergite IV with pair of transverse patches of microtrichia reaching middle. Median lobe of genitalia divided, apical lobe triangular, minor lobe slightly longer covered with tubercles (Fig. 3C). Phallobase symmetrical and rounded (Fig. 3C). Parameres symmetrical, setae present from apices to middle (Fig. 3C).

Type locality. Timaru (SC), New Zealand.

Distribution. Mackenzie (MK), South Canterbury (SC) (Fig. 4: black squares).

Habitat. Specimens were collected by soil washing and sifting moss litter in broadleaf or podocarp forests.

Pseudoexeirarthra sungmini **sp. n.**

http://zoobank.org/3FF61CCF-3FB8-440D-9579-E83F7C5EED9B
Figs 1D, 3D, 5

Type material. Holotype. New Zealand: Nelson (NN): 1♂ (NZAC), aedeagus dissected and mounted in balsam on a clear plastic card, "NEW ZEALAND NN Mt Arthur/Flora Sdl Tck, c1400m 28-Nov-05", "On mossy overhangs by gully. D Clarke, J Nunn", "HOLOTYPE ***Pseudoexeirarthra sungmini*** Park and Carlton des. 2013". **Paratype (1 male): New Zealand: Nelson (NN):** 1♂, Cobb, L. Sylvester, 1329 m, 31 III 1969, J. S. Dugdale, litter (NZAC).

Etymology. This species is named after Dr. Sung Min Boo, Professor of Biology, Chungnam National University (Daejeon, South Korea), world algal systematist and, an enthusiastic supporter of this study.

Diagnosis. This species is distinguished from other the species of this genus by the following combination of characters: body length 1.9–2.1 mm; eyes two-thirds length of temples (Fig. 1D); antennomeres 2–4 longer than wide, 5–7 subquadrate, 8–10 weakly transverse; median lobe of male genitalia divided, broadest near base, major lobe short with semicircular depression anteriorly, minor lobe triangular and longer (Fig. 3D); parameres symmetrical, setae limited to apical fourth (Fig. 3D); only known from Nelson (Fig. 5: black circles).

Description of male. Length 1.9–2.1 mm. Body reddish brown, antennae, legs, maxillary palpi and elytra paler (Fig. 1D). Head round, as long as wide, widest across eyes (Fig. 1D). Antennomere 1 approximately 1.5 times longer than wide, 2–4 longer than wide, 5–7 subquadrate, 8–10 weakly transverse. Eyes two-thirds length of temples. Prosternum as long as wide, widest at one-third length. Elytra longer than wide (Fig. 1D). Hind wings fully developed. Meso- and metaventrites trapezoidal, longer than wide. Tergite IV with pair of transverse patches of microtrichia reaching middle. Median lobe of genitalia divided, broadest near base, major lobe short with semicircular depression anteriorly, minor lobe triangular and longer (Fig. 3D). Phallobase symmetrical and rounded (Fig. 3D). Parameres nearly symmetrical, setae limited to apical fourth (Fig. 3D).

Figure 5. Known collection localities of *Pseudoexeirarthra* gen. n. *P. sungmini* sp. n.: black circles; *P. kwangguki* sp. n.: black triangle; *P. youngboki* sp. n.: black square; *P. seiwoongi* sp. n.: black stars; *P. parkeri* sp. n.: white circles.

Distribution. Nelson (NN) (Fig. 5: black circles).

Habitat. Specimens were collected by sifting moss and leaf litter.

Pseudoexeirarthra kwangguki sp. n.

http://zoobank.org/5F206EEA-7E3C-4153-931E-905C0A1D1164

Figs 1E, 3E, 5

Type material. Holotype. New Zealand: Stewart Island (SI): 1♂ (NZAC), aedeagus dissected and mounted in balsam on a clear plastic card, "**New Zealand: SI:** Table Hill, 366–610m 15 II 1968, G. Kuschel Moss 68/52" , "HOLOTYPE ***Pseudoexeirarthra kwangguki*** Park and Carlton des. 2013". **Paratypes (2 females): New Zealand: Stewart Island (SI):** 2♀♀ (1♀, slide-mounted), same data as holotype (NZAC).

Etymology. This species is named for Dr. Kwang-Guk An, Professor of Biology, Chungnam National University (Daejeon, South Korea), freshwater ecosystem specialist, and an enthusiastic supporter of this study.

Diagnosis. This species is distinguished from the other species of this genus by the following combination of characters: body length 1.8–2.0 mm; eyes one-half lengths of temples (Fig. 1E); elytra subquadrate (Fig. 1E); hind wings represented by small pads; tergite IV without patch of microtrichia (Fig. 1E); antennomeres 3–6 subquadrate, 7–10 weakly transverse; median lobe of male genitalia deeply divided (Fig. 3E); parameres nearly symmetrical, setae limited to apical fourth (Fig. 3E); known from Stewart Island (Fig. 5: black triangle).

Description. Length 1.8–2.0 mm. Body reddish brown, antennae, legs, maxillary palpi and elytra paler (Fig. 1E). Head round, as long as wide, widest across eyes (Fig. 1E). Antennomere 1 approximately 1.5 times longer than wide, 2 longer than wide, 3–6 subquadrate, 7–10 weakly transverse. Eyes one-half length of temples. Prosternum as long as wide, widest at one-third length. Elytra as long as wide (Fig. 1E). Hind wings represented by small pads. Meso- metaventrites trapezoidal, as long as wide. Tergite IV without patch of microtrichia. Median lobe deeply divided (Fig. 3E). Phallobase symmetrical and rounded (Fig. 3E). Parameres symmetrical, setae at apical fourth (Fig. 3E).

Distribution. Stewart Island (SI) (Fig. 5: black triangle).

Habitat. Specimens were collected by sifting moss litter.

Pseudoexeirarthra youngboki sp. n.

http://zoobank.org/18C67D5D-A05D-4874-9AF2-F69ACB9F562C

Figs 1F, 3F, 5

Type material. Holotype. New Zealand: Mid Canterbury (MC): 1♂ (NZAC), aedeagus dissected and mounted in balsam on a clear plastic card, "**NEW ZEALAND: MC:** Banks Peninsula, Ahuriri Scen. Res., 450m, 43°39.971'S, 172°37.427'E, 3 XII

2005, mixed broadleaf w/emergent podocarp; FMHD#2005-069, berl., leaf & log litter, A. Newton, M. Thayer & A. Solodovnikov; ANMT site 1162" , "HOLOTYPE ***Pseudoexeirarthra youngboki*** Park and Carlton des. 2013". **Paratypes (n = 18; 8 males, 10 females): New Zealand: Mid Canterbury (MC):** 6♂♂ 6♀♀, same data as holotype (FMHD); 1♂, Banks Peninsula, Ahuriri SR, 450 m, 43°39.971'S, 172°37.427'E, 3–6 XII 2005, mixed broadleaf w/emergent podocarp, FMHD#2005-069, FIT, A. Newton, M. Thayer, ANMT site 1162 (FMHD); 4♀♀, Bank Peninsula, Mt. Sinclair SR, 775 m, 43°42.977'S, 172°51.098'E, 3–16 XII 2005, ridgetop mixed broadleaf w/emergent *Podocarpus tatara*, FMHD#2005-070, FIT, A. Newton, M. Thayer, ANMT site 1163 (FMNH); 1♂, Prices Valley, 3–24 IV 1981, J. W. Early, yellow pan trap (LUNZ).

Etymology. This species is named after Dr. Young Bok Cho, curator of Natural History Museum of Hannam University (Daejeon, South Korea), carrion and rove beetles specialist, and an enthusiastic supporter of this study.

Diagnosis. This species is distinguished from the other species of this genus by the following combination of characters: body length 1.9–2.2 mm; eyes large, two-thirds lengths of temples (Fig. 1F); antennomeres 2–8 longer than wide, 9–10 weakly transverse; median lobe of male genitalia divided, apex of major lobe rectangular, minor lobe thin, longer than major lobe and bearing small tubercles (Fig. 3F); parameres symmetrical, but right slightly longer than left with setae from before midpoint apices (Fig. 3F).

Description. Length 1.9–2.2 mm. Body reddish brown, antennae, legs, maxillary palpi and elytra paler (Fig. 1F). Head round, as long as wide, widest across eyes (Fig. 1F). Antennomere 1 approximately 1.5 times longer than wide, 2–8 longer than wide, 9–10 weakly transverse. Eyes large and prominent, two-thirds length of temples. Prosternum as long as wide, widest at one-third length. Elytra longer than wide (Fig. 1F). Hind wings fully developed. Meso- metaventrites trapezoidal, longer than wide. Tergite IV with pair of transverse patches of microtrichia reaching middle. Median lobe of genitalia divided, apex of major lobe rectangular, minor thin, lobe longer than major lobe and bearing small tubercles (Fig. 3F). Phallobase symmetrical and rounded (Fig. 3F). Parameres nearly symmetrical, with right slightly longer than left, with setae extending from apices to anterior to midpoints (Fig. 3F).

Distribution. Mid Canterbury (MC) (Fig. 5: black square).

Habitat. Specimens were collected using flight intercept or yellow pan traps, or by sifting moss and leaf litter in broadleaf and podocarp forests.

Pseudoexeirarthra seiwoongi **sp. n.**

http://zoobank.org/18C2A952-BD29-431A-A32E-71E550D0DB48

Figs 1G, 3G, 5

Type material. Holotype. New Zealand: Wellington (WN): 1♂ (NZAC), aedeagus dissected and mounted in balsam on a clear plastic card, "NEW ZEALAND WN 4 km along Waiotauru Rd. 16/11/91 Tararua FP", "1159" , "HOLOTYPE ***Pseudoexeirarthra***

seiwoongi Park and Carlton des. 2013”. The original label does not record who collected the specimen, but it was collected by J. Nunn. **Paratype (1 male): New Zealand: Mid Canterbury (MC):** 1♂, Banks Penin., Peraki Saddle Scen Res, 500 m, 11 XII 1984, hdwd-podo.elfin forest, A. Newton, M. Thayer 701, log and leaf litter (FMNH).

Etymology. This species is named after Dr. Sei-Woong Choi, Professor at Mokpo National University (Mokpo, South Korea), world moth specialist, and an enthusiastic supporter of this study.

Diagnosis. This species is distinguished from the other species of this genus by the following combination of characters: body length 1.9–2.1 mm; eyes large, as long as temples (Fig. 1G); antennomeres 2–7 longer than wide, 8 subquadrate, 9–10 weakly transverse; median lobe of male genitalia divided, major lobe with triangular apex, minor lobe longer with small tubercles (Fig. 3G); parameres nearly symmetrical, but right paramere slightly longer than left with setae from apices to midpoints (Fig. 3G).

Description of male. Length 1.9–2.1 mm. Body reddish brown, antennae, legs, maxillary palpi and elytra paler (Fig. 1G). Head bluntly rectangular, longer than wide, widest across eyes (Fig. 1G). Antennomere 1 approximately 1.5 times longer than wide, 2–7 longer than wide, 8 subquadrate, 9–10 weakly transverse. Eyes large and prominent, as long as temples. Prosternum as long as wide, widest at one-third length. Male elytra longer than wide (Fig. 1G). Hind wings fully developed. Meso- metathorax trapezoidal, longer than wide. Male tergite IV with pair of transverse patches of microtrichia reaching middle. Median lobe of genitalia divided, major lobe triangular apically, minor lobe longer with small tubercles (Fig. 3G). Phallobase symmetrical and rounded (Fig. 3G). Parameres nearly symmetrical, but right slightly longer than left with setae from apices to midpoints (Fig. 3G).

Distribution. Mid Canterbury (MC), Wellington (WN) (Fig. 5: black stars).

Habitat. The paratype was collected by sifting leaf and moss litter.

Pseudoexeirarthra parkeri **sp. n.**

http://zoobank.org/A3BAFA02-D9AE-4179-A0D7-551EA676B919
Fig. 1H, 3H, 5

Type material. Holotype. New Zealand: Dunedin (DN): 1♂ (NZAC), aedeagus dissected and mounted in balsam on a clear plastic card, “NEW ZEALAND DN Rocklands 21 Nov 1981 C.F. Butcher”, “Sweeping tussock nr stream”, “N.Z. Arthropod Collection, NZAC Private Bag 92170 AUCKLAND New Zealand” , “HOLOTYPE ***Pseudoexeirarthra parkeri*** Park and Carlton des. 2013”. **Paratypes (n = 16; 12 males, 4 females): New Zealand: Central Otago (CO):** 2♂♂, Carrick Range, Watts Rock, 1400 m, 11 III 1979, J. C. Watt, litter (NZAC); **Mid Canterbury (MC):** 1♂ 2♀♀, Bealy Spur, 750 m, 1 VI 1981, C. A. Muir, moss and rotten logs (NZAC); **Otago Lakes (OL):** 4♂♂, E Matukituki V, 400 m, J. W. Early, 30 I–4 II 1987, yellow pan tap (LUNZ); 1♂, Mt. Aspiring NP, Glacier Burn, 30 I 1987, J. W. Early, 400 m, sweeping *Nothofagus* forest (LUNZ); **Westland (WD):** 3♂♂ 1♀ (1♀, slide-mounted), Klondyke Corner, Arthurs Pass, 25 X 1970, D. S. Horning, litter (NZAC); 1♂, Mt. Tuhua, 1067 m, e side of L. Kaniere, 20 X 1984, C. F. Butcher, litter and mats (NZAC); 1♀, Okarito Trig, 150 m, 15 I 1982, J. W. Early, sweeping ferns and kiekie in rimu forest (LUNZ).

Etymology. This species is named after Dr. Joseph Parker, world pselaphine beetle specialist, and an enthusiastic supporter of this study.

Diagnosis. This species is distinguished from the other species of this genus by the following combination of characters: body length 1.8–2.0 mm; eyes large, as long as temples (Fig. 1H); antennomeres 3 subquadrate, 4–5 longer than wide, 6–8 subquadrate, 9–10 weakly transverse; median lobe of male genitalia divided, apically bifurcate minor lobe longer than curved major lobe and bearing small tubercles (Fig. 3H); parameres asymmetrical, left longer than right with setae extending from apices to near bases (Fig. 3H).

Description. Length 1.8–2.0 mm. Body reddish brown, antennae, legs, maxillary palpi, elytra paler (Fig. 1H). Head round, as long as wide, widest across eyes (Fig. 1H). Antennomere 1 approximately 1.5 times longer than wide, 2 longer than wide, 3 subquadrate, 4–5 longer than wide, 6–8 subquadrate, 9–10 weakly transverse. Eyes large and prominent, as long as temples. Prosternum as long as wide, widest at one-third length. Elytra longer than wide (Fig. 1H). Hind wings fully developed. Meso- metathorax trapezoidal, longer than wide. Tergite IV with pair of transverse patches of microtrichia reaching middle. Median lobe of genitalia divided, apically bifurcate minor lobe longer than curved major lobe and bearing small tubercles (Fig. 3H). Phallobase symmetrical and rounded (Fig. 3H). Parameres asymmetrical, left paramere longer than right with setae extending from apices to bases (Fig. 3H).

Distribution. Central Otago (CO), Dunedin (DN), Mid Canterbury (MC), Otago Lakes (OL), Westland (WD) (Fig. 5: white circles).

Habitat. Specimens were collected using yellow pan traps, by sweeping, or by sifting forest litter.

Pseudoexeirarthra hlavaci **sp. n.**

http://zoobank.org/6DD193A1-531D-4CC8-9881-E568FF7B466A

Fig. 1I, 3I, 6

Type material. Holotype. New Zealand: Dunedin (DN): 1♂ (NZAC), aedeagus dissected and mounted in balsam on a clear plastic card, “New Zealand DN Leith Saddle / Leith trig tck, 420m 26 Sep 2011”, “Washed soil sample. temperate cloud forest”, “NZMS 260 144: 173868 430m”, “Voucher specimen “Beetles of Dunedin” project. JT Nunn coll.”, “HOLOTYPE ***Pseudoexeirarthra hlavaci*** Park and Carlton des. 2013”. **Paratypes (n = 29; 11 males, 18 females): New Zealand: Dunedin (DN):** 2♂♂, Swampy Summit, Dunedin, 29 X 2000, J. Nunn, tussock litter (JTN); 1♂, Leith Saddle, Swampy Spur Tck, 14 X 2001, J. Nunn, surface soil (JTN); 1♂, Waitati, 2 VIII 2008, washed soil sample in broadleaf forest (JTN); 1♂, Grahams Bush, Mt Cargill, 6 XII 2002, J. Nunn, FIT (JTN); 1♀, Swampy Summit, Dunedin, 7 I 2000, J. Nunn, shrubbery (JTN); 1♀, Cloud Forest of Leith tr, 30 XI 2003, J. Nunn,

Figure 6. Known collection localities of *Pseudoexeirarthra* gen. n. *P. hlavaci* sp. n.: black circles; *P. nomurai* sp. n.: black triangle.

moss from tree trunk (JTN); 1♀, Grahams Bush, Mt. Cargill, 9 XII 2001, J. Nunn, podocarp-kamahi-griselinia litter (JTN); 1♀, Careys Creek near Waitati, 12 IV 2008, J. Nunn, washed soil in kanuka forest (JTN); 1♀, Swallow tr, Herbert Forest, 28 VII 2007, washed soil, J. Nunn (JTN); 1♀, Waipori Falls, 17 V 1998, *Nothofagus* forest litter (JTN); **Southland (SL):** 3♂♂, Papatowai, 9 II 1989, J. Nunn (JTN); 1♂ 3♀♀, Bog Burn, Waterloo Burn tck, 4 VI 2007, J. Nunn, washed soil in *Nothofagus* forest (JTN); 1♂, Purakaunui Falls, Catlins, 24 VI 2006, J. Nunn, soil sample in *Nothofagus* forest (JTN); 1♂, Pourakina River Walk, 27 X 2002, J. Nunn, bracket fungus (JTN); 2♀♀, Princhester Base Hut, Takitimu Forest, 4 VI 2007, J. Nunn, washed soil beech forest, 425 m (JTN); 3♀♀ (1♀, slide-mounted), Blacks Gully, Blue Mtns, 390 m, 2 XII 2006, J. Nunn, washed soil in *Nothofagus* forest (JTN); 2♀♀, Tautuku, 8 III 1989, J. Nunn (JTN); 1♀, Rakahouka, 2 IX 2007, J. Nunn, washed soil (JTN).

Etymology. This species is named after Mr. Peter Hlaváč, world pselaphine beetle specialist, and an enthusiastic supporter of this study.

Diagnosis. This species is distinguished from the other species of this genus by the following combination of characters: body length 2.3–2.6 mm; eyes large, as long as temples (Fig. 1I); antennomere 2 longer than wide, 3 subquadrate, 4 longer than wide, 5–8 subquadrate, 9–10 weakly transverse; median lobe of male genitalia divided, major lobe truncate and broadest at apex, minor lobe longer with small tubercles (Fig. 3I); parameres nearly symmetrical, right paramere slightly longer than left with setae present on mesal margins in apical two-thirds (Fig. 3I).

Description. Length 2.3–2.6 mm. Body reddish brown, antennae, legs, maxillary palpi and elytra paler (Fig. 1I). Head round, as long as wide, widest across eyes (Fig. 1I). Antennomere 1 approximately 1.5 times longer than wide, 2 longer than wide, 3 subquadrate, 4 longer than wide, 5–8 subquadrate, 9–10 weakly transverse. Eyes large and prominent, as long as temples. Prosternum as long as wide, widest at one-third length. Elytra longer than wide (Fig. 1I). Hind wings fully developed. Meso-metaventrites trapezoidal, longer than wide. Tergite IV with pair of transverse patches of microtrichia reaching middle. Median lobe of genitalia divided, major lobe truncate and broadest at apex, minor lobe longer with small tubercles (Fig. 3I). Phallobase symmetrical and rounded (Fig. 3I). Parameres nearly symmetrical, right paramere slightly longer than left with setae present on mesal margins in apical two-thirds (Fig. 3I).

Distribution. Dunedin (DN), Southland (SL) (Fig. 6: black circles).

Habitat. Specimens were collected mostly by soil washing in *Nothofagus* and broadleaf forests.

Pseudoexeirarthra nomurai sp. n.

http://zoobank.org/47CD99FE-DC17-4B90-BF07-0A3D41065E4E
Figs 1J, 3J, 6

Type material. Holotype. New Zealand: North Canterbury (NC): 1♂ (NZAC), aedeagus dissected and mounted in balsam on a clear plastic card, “NEW ZEALAND

NC Arthur Pass Kellys Creek, 8 Nov 2005 R Leschen S Nomura", "ex litter RL1007 42°47'S 171°34'E", "N.Z. Arthropod Collection, NZAC Private Bag 92170 AUCKLAND New Zealand", "HOLOTYPE ***Pseudoexeirarthra nomurai*** Park and Carlton des. 2013".

Etymology. This species is named after Dr. Shûhei Nomura, co-collector of the holotype, world pselaphine beetle specialist, and an enthusiastic supporter of this study.

Diagnosis. This species is distinguished from other species of this genus by the following combination of characters: body length 2.0 mm; eyes one-half length of temples (Fig. 1J); antennomeres 2–7 longer than wide, 8 subquadrate, 9–10 weakly transverse; median lobe of male genitalia divided with acute lateral spine at two-thirds length, major lobe subtruncate, minor lobe deeply bifurcate and with small tubercles (Fig. 3J); parameres nearly symmetrical, setae expending from apices to basal third (Fig. 3J).

Description of male. Length 2.0 mm. Body reddish brown, antennae, legs, maxillary palpi and elytra paler (Fig. 1J). Head round, as long as wide, widest across eyes (Fig. 1J). Antennomere 1 approximately 1.5 times longer than wide, 2–7 longer than wide, 8 subquadrate, 9–10 weakly transverse. Eyes one-half length of temples. Prosternum as long as wide, widest at one-third length. Elytra longer than wide (Fig. 1J). Hind wings fully developed. Meso- metaventrites trapezoidal, longer than wide. Tergite IV with pair of transverse patches of microtrichia reaching middle. Median lobe of male genitalia divided with acute lateral spine at two-thirds length, major lobe subtruncate, minor lobe deeply bifurcate and with small tubercles (Fig. 3J). Phallobase symmetrical and rounded (Fig. 3J). Parameres nearly symmetrical, setae expending from apices to basal third (Fig. 3J).

Distribution. North Canterbury (NC) (Fig. 6: black triangle).

Habitat. The holotype was collected by sifting leaf litter.

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RESEARCH ARTICLE

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New species and records of *Chimarra* (Trichoptera, Philopotamidae) from Northeastern Brazil, and an updated key to subgenus *Chimarra* (*Chimarrita*)

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Abstract

Two new species of *Chimarra* (*Chimarrita*) are described and illustrated, *Chimarra* (*Chimarrita*) *mesodonta* **sp. n.** and *Chimarra* (*Chimarrita*) *anticheira* **sp. n.** from the *Chimarra* (*Chimarrita*) *rosalesi* and *Chimarra* (*Chimarrita*) *simpliciforma* species groups, respectively. The morphological variation of *Chimarra* (*Curgia*) *morio* is also illustrated. *Chimarra* (*Otarrha*) *odonta* and *Chimarra* (*Chimarrita*) *kontilos* are reported to occur in the northeast region of Brazil for the first time. An updated key is provided for males and females of the all species in the subgenus *Chimarrita*.

Keywords

Biodiversity, caddisflies, *Curgia*, description, Neotropics, phylogenetic relationships, taxonomy

Introduction

Philopotamidae Stephens, 1829 is a cosmopolitan family with approximately 1,270 described species in 19 extant genera. The family is comprised of three subfamilies: Rossodinae Özdikmen & Darilmaz, 2008 (endemic to Madagascar, with 16 species); Philopotaminae Stephens, 1829 (present in all biogeographic regions, >400 species) and the most diverse subfamily, Chimarrinae Rambur, 1842 (cosmopolitan, *ca.* 800 species). Chimarrinae contains three genera: *Edidiehlia* Malicky, 1993 (Oriental, monospecific); *Chimarrhodella* Lestage, 1925 (Neotropical, 12 species); and one of the largest caddisfly genera, *Chimarra* Stephens 1829 (cosmopolitan, *ca.* 780 species) (Wahlberg et al. 2014). The genus *Chimarra* is characterized by foretibial spurs reduced to one (spur formula 1:4:4), and by an anal loop in the hindwing, in which the 2A vein is looped to join the 1A vein (Blahnik 1998). *Chimarra* is divided into four subgenera, the cosmopolitan *Chimarra* Stephens, 1829, and the three primarily Neotropical subgenera *Curgia* Walker, 1860, *Chimarrita* Blahnik, 1997, and *Otarrha* Blahnik, 2002. Wahlberg and Johanson's (2014) analysis confirmed the monophyly of the genus *Chimarra* and hypothesized an early Cretaceous origin, approximately 138 million years ago. They suggested the genus first arose in the Neotropical region, with a subsequent radiation through the Oriental, Palaearctic and Australasian regions, secondarily to the Nearctic region, and with several independent colonization events in the Afrotropics.

The genus *Chimarra* currently comprises 247 Neotropical described species (45 in Brazil) and was revised by Flint (1998) and Blahnik (1997, 1998, 2002). Subsequent descriptions of new species were provided by Bueno-Soria et al. (2001), Santos and Nessimian (2009), and Blahnik and Holzenthal (2012). There are 102 Neotropical species recognized in the subgenus *Chimarra*, 93 in the subgenus *Curgia*, 32 in the subgenus *Otarrha*, and 18 in the subgenus *Chimarrita*, and 4 *incertae sedis* species. In Brazil, there are 45 recorded species in the genus, 27 of these in the subgenus *Curgia*, 2 in *Otarrha*, 3 in *Chimarra*, 12 in *Chimarrita*, and 1 *incertae sedis* species, *C. usitatissima* Flint, 1971.

The subgenus *Chimarrita* was previously divided into 3 species groups by Blahnik (1997): *C.* (*Chimarrita*) *maldonadoi*, *C.* (*Chimarrita*) *rosalesi* and *C.* (*Chimarrita*) *simpliciforma* groups. Recently Kjer et al. (2014) infered a phylogeny of the genus *Chimarra* using molecular data. Most of the subgeneric groups established by Blahnik based on morphological characters were recovered, but Kjer et al. (2014) did not support the placement of the *maldonadoi* Group in the subgenus *Chimarrita*, but rather considered the group *incertae sedis*, within the genus.

Males in the subgenus bear a partially to nearly separated tergum X, have very short knoblike and basally fused preanal appendages, the anteroventral margin of segment IX projected and tapering, usually to end acute apex, an elongate and narrow ventral process on segment IX, and a phallotheca with several short curved phallic spines or a single elongate spine almost always with slight helical twist. Females belonging to the subgenus *Chimarrita* can be easily diagnosed by the presence of an elongate tergum IX and segment VIII without anterolateral apodemes.

In this paper descriptions, diagnoses, and illustrations of two new species of *Chimarra* (*Chimarrita*) are provided, which fall within the *C. rosalesi* and *C. simpliciforma* groups. An updated key for males and females of the subgenus *Chimarrita* is also presented, and a description of the morphological variations of *Chimarra* (*Curgia*) *morio*. New records of *Chimarra* (*Otarrha*) *odonta* Blahnik, 2002, and *Chimarra* (*Chimarrita*) *kontilos* Blahnik, 1997, are reported for the first time from the northeast region of Brazil.

Material and methods

Ultraviolet light alcohol pan traps, UV lights placed in front of a white bed sheet, and Malaise traps were used to collect adults (Calor and Mariano 2012, Blahnik and Holzenthal 2004). Specimens collected by Malaise and pan traps were preserved in 80% ethanol. Other specimens were collected using ethyl acetate kill jars and pinned. Genitalia were cleared in lactic acid following Blahnik et al. (2007) or in a heated solution of 10% KOH (Blahnik and Holzenthal 2004). Prepared genitalia were transferred to micro vials with glycerin and examined with optical microscopy at 40–400 × magnification. Structures were traced in pencil with the use of a camera lucida (drawing tube) mounted on a microscope. Digitally scanned pencil sketches were used as a template and rendered in Adobe Illustrator® CS5. Morphological terminology follows that established by Blahnik (1997).

The phylogenetic placement of the new species was compared with the previous phylogeny of the subgenus *Chimarrita* presented by Blahnik (1997) using the same characters with the addition of the following characters of the male genitalia:

Character 37: lobes of tergum X (shape); 0 = not roundly inflated apically (Fig. 2D), 1 = roundly inflated apically, club-shaped (Fig. 4D).

Character 38: ventral margin of tergum X; 0 = without a subapical small projection (Fig. 2C), 1 = with a subapical small projection (Fig. 4C).

Character 39: ventral apex of phallotica (shape); 0 = without an excision (Fig. 4E), 1 = with an excision (see Fig. 15E in Blahnik and Holzenthal 2012).

Character 40: inferior appendage (apex); 0 = not distinctly curved mesally (Fig. 4G), 1 = distinctly curved mesally (see Fig. 14C in Blahnik and Holzenthal 2012).

Character 41: inferior appendage (shape, lateral view); 0 = without a markedly undulate aspect (Fig. 4C), 1 = with a markedly undulated aspect, bent downward basally, upward at midlength, subapically rounded downward and apically upward (see Fig. 14A in Blahnik and Holzenthal 2012).

We also corrected an error in the coding of character 36 from Blahnik (1997) (female genitalia: sternum IX) of the species *Chimarra camura* that was modified from state “0” (not sclerously fused to segment VIII) to “2” (sclerously fused to segment VIII, broadly fused at base). As previously coded the state "0" for this species contradicted Blahnik’s (1997) description and illustrations. In addition, species or life stages were added to the matrix (male and female of *Chimarra curvipenis* and *Chimarra latiforceps* and the female of *Chimarra camella*). The matrix can be found in the Suppl. material 1.

The matrix was rebuilt using Nexus Data Editor (NDE), version 5.0 (Page 2001). The phylogenetic analysis was carried out in Tree analysis using New Technology (TNT), version 1.1 (Goloboff et al. 2008). For the TNT Maximum Parsimony analysis, an exhaustive search was used (implicit enumeration option). *Chimarrhodella ulmeri* was designed outgroup species. Characters 32, 33 and 36 were ordered, all other characters were unordered. All character were unweighted. Bootstrap analysis was implemented based on a thousand replicate samples.

Types and additional material are deposited in the Museu de Zoologia, Universidade de São Paulo, São Paulo State, Brazil (MZSP), Museu de Zoologia da Universidade Federal da Bahia, Bahia State, Brazil (UFBA, Collection of Aquatic Insects), and University of Minnesota Insect Collection, Minnesota, USA (UMSP), as indicated in the species descriptions. New records are indicated with bold type in the Distribution section.

Results

The analysis resulted in a single parsimonious tree with a tree length of 75, consistency index of 0.640, rescaled consistency index of 0.854, retention index of 0.546, and homoplasy index of 0.360. The tree is presented in Fig. 1, with the synapomorphies and autapomorphies presented below the respective nodes. Bootstrap support values higher or equal to 50% are indicated above the respective nodes. The tree largely reflected the topology presented by Blahnik (1997) with additional characters solving the clade (*C. majuscula* (*C. anticheira*, *C. latiforceps*) *C. heligma*, (*C. camura*, (*C. curvipenis*, *C. camella*))) but with low support (<50%). There was a reduction of the previous support value (61%) of the clade (*C. tortuosa*, *C. kontilos*) because of the similarities of the inferior appendage of *C. kontilos*, *C. heligma* and *C. curvipenis* (character 41). Phylogenetic results concerning the new species are discussed under Remarks.

Species descriptions

Chimarra (*Chimarrita*) *rosalesi* Group

Synapomorphies recognized for this species group, both in the female genitalia are: segment VIII greatly reduced and membranous dorsally, and sternum IX not fused ventrally to segment VIII (Blahnik 1997). Similarities among males of the group are: anteroventral margin of segment IX elongate, usually tapering to acute apex, sometimes abruptly narrowed preapically; preanal appendages usually basally fused, sometimes flattened and button-like; and phallic apparatus with spines (1 or more) usually short, curved and emerging more apically (Blahnik 1997). Currently, the *C. rosalesi* Group comprises 7 species. The 6 previously described species are all distributed in the Amazon basin: *C. chela*, *C. neblina* (Venezuela and Amazonas states of Brazil), *C. forcipata*, *C. pusilla*, *C. rosalesi* (Venezuela), and *C. prolata* (Ecuador). *Chimarra mesodonta* sp. n. unlike the others was recorded from outlying fragment of the Atlantic Forest, Bahia State, Brazil.

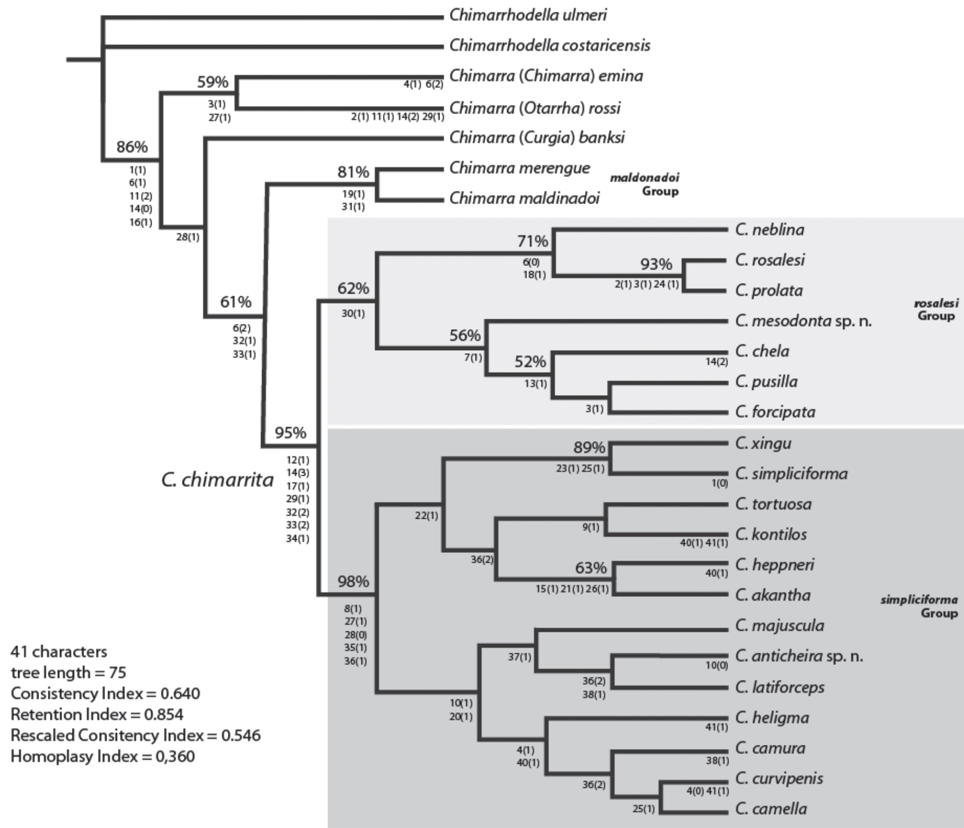

Figure 1. Cladogram for *Chimarra* (*Chimarrita*) species. Characters and character states are shown below and bootstrap support when >50% are shown above the base of clades.

***Chimarra* (*Chimarrita*) *mesodonta* Vilarino & Calor, sp. n.**

http://zoobank.org/21106F6A-FBB4-4ED7-B8FF-2FCAFD41768F
Figs 2A–G, 3A–B

Diagnosis. According to the phylogenetic analysis, *C. mesodonta* has a sister relationship with the clade (*C. chela* (*C. pusilla*, *C. forcipata*)) based on the presence of short phallic spines with a pronounced helical twist, but differs from these species by not sharing the flattened and button like preanal appendages. Among the species contained in this clade, this new species most closely resembles *C. forcipata* by the overall aspect mainly in lateral view, and by both possess a mesally a mesally directed acute projection on the inferior appendage. *Chimarra mesodonta* can be distinguished from *C. forcipata* by the following characters: R1 of the hind wing is not fused to the subcosta (fused in *C. forcipata*); tergum X is shorter, and in lateral view slightly longer than the dorsal portion of segment IX (nearly 2× longer than segment IX in *C. forcipata*); preanal appendage is not flattened (flattened in *C. forcipata*); the ventral process is not strongly tapered, having apex subacute to truncate (strongly tapered and acute in *C.*

forcipata); in ventral view the apex of inferior appendage is broad and a projection is formed in the medial margin (apex strongly narrowed and with the projection formed apically in *C. forcipata*); and the phallus bears 2 large helically curved spines (several small spines in *C. forcipata*).

Description. *Adult.* Forewing length 3.2–3.7 mm (males, n=5), 3.4–3.9 mm (females, n=6). Overall color (in alcohol) light brown. Forewing venation typical for *Chimarra*; Rs straight *s*, *r*, *r-m* and *m* of forewing unpigmented and linearly arranged, *m-cu* and apex of Cu2 also unpigmented; 2A apparently forked to 1A and 3A. Hind wing, R1 not fused to Sc; Rs 4-branched; M 3-branched. Posterior setal head warts large, triangular, meeting broadly on medial portion. Second segment of maxillary palp shorter than 3rd segment. Male pretarsal claws symmetrical, unmodified.

Male genitalia. Segment IX synsclerous; lateral view, anteroventral margin expanded, apex narrowed, acute; ventral process elongate, narrow, subacute, somewhat curved. Tergum X short, fused to segment IX; with short weakly sclerotized mesal lobe apically excavated, tergum X fully divided dorsally, separated ventrally until the length of mesal lobe, forming 2 separate, simple, lateral lobes with numerous sensilla. Preanal appendage very short, rounded, button-like, fused near base of tergum X. Inferior appendage short, triangular in lateral aspect; in ventral view, strongly rounded basally, tapered apically, apex rounded, medial margin forming tooth-like projection. Phallotheca tubular, slightly bent at middle, with rounded phallobase; with internal membranous structures and bearing 2 distinct curved phallic spines. Phallotremal sclerite complex could not be distinguished.

Female genitalia. Sternum VII without ventral process. Segment VIII synsclerous, triangular in lateral aspect, dorsally membranous, very reduced; lateral suture line not evident, only demarcated by difference in texture and pigmentation of ventral portion, more granulous; anteroventral margin with subacute, deflected ventral process, posteroventral margin also with short ventral process. Sternum IX elongate, lightly sclerotized basally, with elongate, narrow, paired, ventral sclerites; sternum membranous between paired sclerites, and laterally from base to apex. Tergum IX elongate, narrow, nearly straight, sparsely setose, anteroventrally with short apodeme. Segment X with elongate basal portion, furrowed dorsally, with basal and inner margins more sclerotized, apically with small setose lobes, each with apical cercus. Vaginal apparatus largely membranous, anteriorly with weakly sclerotized structure.

Holotype, male (alcohol)**. BRAZIL: Bahia:** Santa Teresinha, Pedra Branca, Serra da Jibóia, 12°51'016"S, 39°28'48"W, el. 679 m, 07.viii.2009, UV Light Pan trap, Calor A.R. & Lecci L.S. (MZUSP).

Paratypes. BRAZIL: Bahia: same data as holotype, 2 males (alcohol) (UFBA); same, 12°51'00.6"S, 39°28'48.3"W, el. 678 m, 08.viii–28.ix.2009, Malaise trap, 1 female (alcohol) (UFBA); same, 04.ii.2010, Calor A.R. & Lecci L.S., 2 males, 2 females (alcohol) (UMSP); same, 10.vii.2010, UV Light Pan trap, Calor A.R. & Lecci L.S., 1 male (alcohol) (UFBA); same, 12°51'00.6"S, 39°28'48.3"W, el. 678 m, 19.vii.2009, Calor A.R. & Lecci L.S., 3 males (alcohol) (UFBA); Varzedo, Fazenda Vão da Serra, Riacho 2, 12°50'58.4"S, 39°28'04.0"W, el. 414 m, 08.ii.2014, UV Light Pan trap, Calor A.R. & Vilarino A., 16 males, 6 females (alcohol) (UFBA).

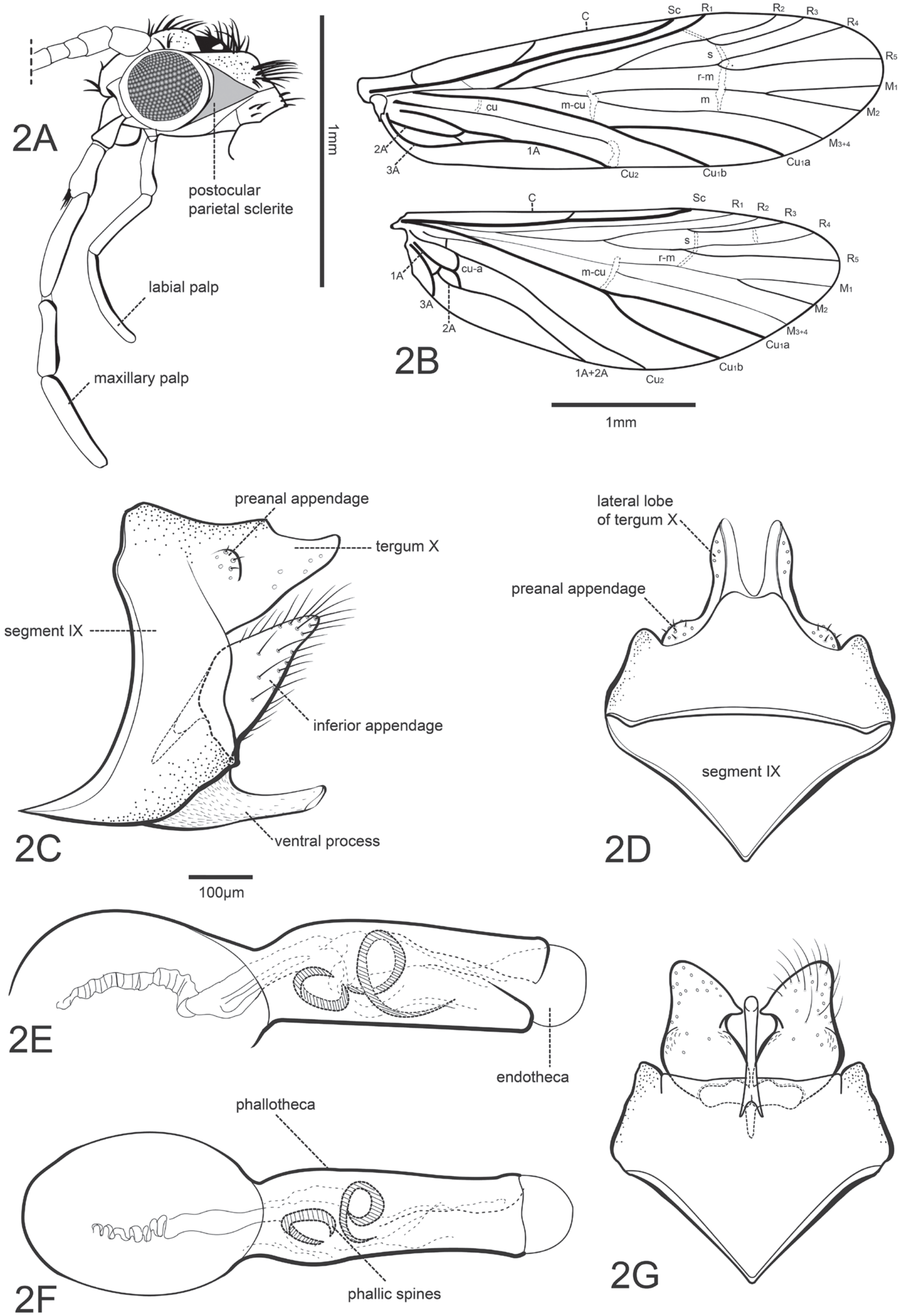

Figure 2. *Chimarra* (*Chimarrita*) *mesodonta* sp. n., male: **A** head, postocular parietal sclerite, maxillary and labial lateral **B** wing venation **C** genitalia, lateral **D** segment IX and tergum X, dorsal **E** phallic apparatus, lateral **F** dorsal **G** segment IX, inferior appendage, ventral.

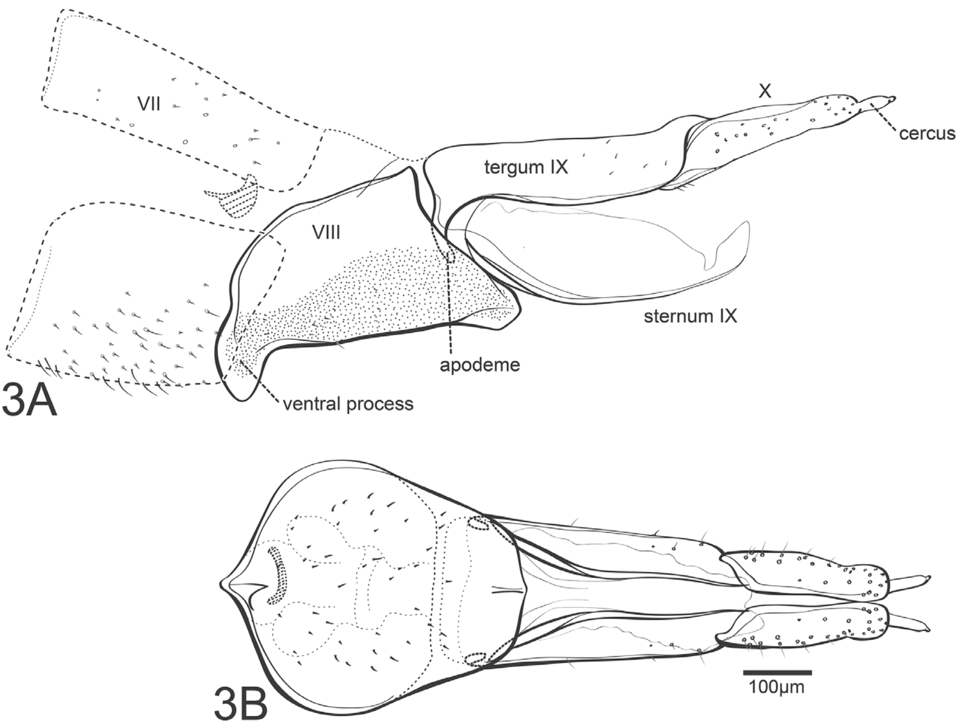

Figure 3. *Chimarra* (*Chimarrita*) *mesodonta* sp. n., female: **A** lateral **B** ventral.

Etymology. The species name is derived from the Greek *meso*, middle, and *donti*, tooth, referring to the median tooth present in the inferior appendages.

Remarks. The aperture between the lateral lobes of tergum X can be wider depending on the specimen examined. Also, membranous structures of the endotheca and the lightly sclerotized mesal lobe of tergum X vary in shape depending on the preparation. When cleared in lactic acid, the basal portion of the endotheca shows some sclerotization and may be considered a rod of the phallotremal sclerite complex. Concerning the phylogenetic relationships, the new species shares character 30(1), segment VIII of female genitalia much narrowed or obsolete dorsally, with the *C. rosalesi* Group *sensu* Blahnik (1997). The shared character 7(1), phallic spines short, with pronounced helical twist, supports the clade (*Chimarra mesodonta* (*C. chela* (*C. pusilla*, *C. forcipata*))). However, the new species does not posses character 13(1), preanal appendages flattened and button-like, a character shared by the other three species.

Chimarra (*Chimarrita*) *simpliciforma* Group

Species belonging to this group are recognized by the presence of a single and elongate spine that emerges from the base of phallotheca. Females in the group have reduced or absent apodemes in tergum IX and sternum IX sclerously fused to segment VIII (Blahnik 1997). The *C. simpliciforma* Group currently contains 12 species, with 11 previously described species distributed through the Amazon Region: *C. akantha*, *C. tortuosa* (Amazonas State of Brazil), *C. simpliciforma* (Amazonas State of Brazil, Guyana, Surinam, and Venezuela), *C. xingu* (Pará State of Brazil), *C. heppneri* (Peru); and through Southeastern Brazil: *C. camella* (Minas Gerais, Rio de Janeiro and São Paulo States) *C. camura*, *C. majuscula* (Rio de Janeiro and São Paulo states), *C. curvipenis*, *C. heligma* (Minas Gerais), *C. kontilos* (Bahia, Espírito Santo, Minas Gerais, Rio de Janeiro and São Paulo states), *C. latiforceps* (Minas Gerais and São Paulo states).

***Chimarra* (*Chimarrita*) *anticheira* Vilarino & Calor, sp. n.**

http://zoobank.org/A1A073CB-3F97-430D-B851-A23AF4BCCCD2

Figs 4A–G, 5A–B

Diagnosis. This species is very similar to *Chimarra latiforceps* Blahnik & Holzenthal, 2012, mainly by the general shape of tergum X that form apically clavate lobes. *Chimarra anticheira* can be distinguished from *C. latiforceps* by the presence of a dorsally directed apical thumb-like projection on the inferior appendage (absent in *C. latiforceps*). Additionally, the posterolateral margin of tergum IX is more angulate and the tergum X slightly shorter than in *C. latiforceps*. The phallotheca in *C. anticheira* is less curved than *C. latiforceps* and the apicoventral portion of the phallotheca is rounded in *C. anticheira*, whereas it is excavated in *C. latiforceps*, also the apex of the phallic spine is angularly truncate (tapered in *C. latiforceps*).

Description. Forewing length 4.4–5.0 mm (males, n=5), 4.8–5.2 mm (females, n=5). Overall color (in alcohol) nearly uniformly medium brown. Forewing venation typical for *Chimarra*: Rs straight *s*, *r*, *r-m* and *m* of forewing unpigmented and linearly arranged, *m-cu* and apex of Cu2 also unpigmented; 2A apparently forked to 1A and 3A. Hind wing R1 not fused to Sc; Rs 4-branched, M 3-branched. Posterior setal head warts narrowly meeting on medial portion. Maxillary palps relatively short, 2nd segment longer than 3rd segment, 4th segment slightly bulbous. Male pretarsal claws symmetrical, unmodified.

Male genitalia. Tergum VIII short, forming sclerotized strip over segment IX. Segment IX synsclerous, anterodorsal margin excavate, rounded, posterolateral margin angularly projecting at level of inferior appendages, tapering to pointed apex; anteroventral margin expanded, with apex rounded in ventral aspect; ventral process elongate, narrow, acute, almost straight. Tergum X short, fused to segment IX, in dorsal view with apex mesally divided by rounded excision, extending about half of tergum length, forming paired lobes apically; apical lobes and lateral margins of tergum with many sensilla. Preanal appendage small, rounded, knob-like, positioned close to base of tergum X. Inferior appendage elongate, linear in lateral view, apex with thumb-like dorsally directed projection; in ventral view, appendages mesally curved, with submedial projection on mesal surface. Phallotheca tubular, with rounded phallobase; phallic

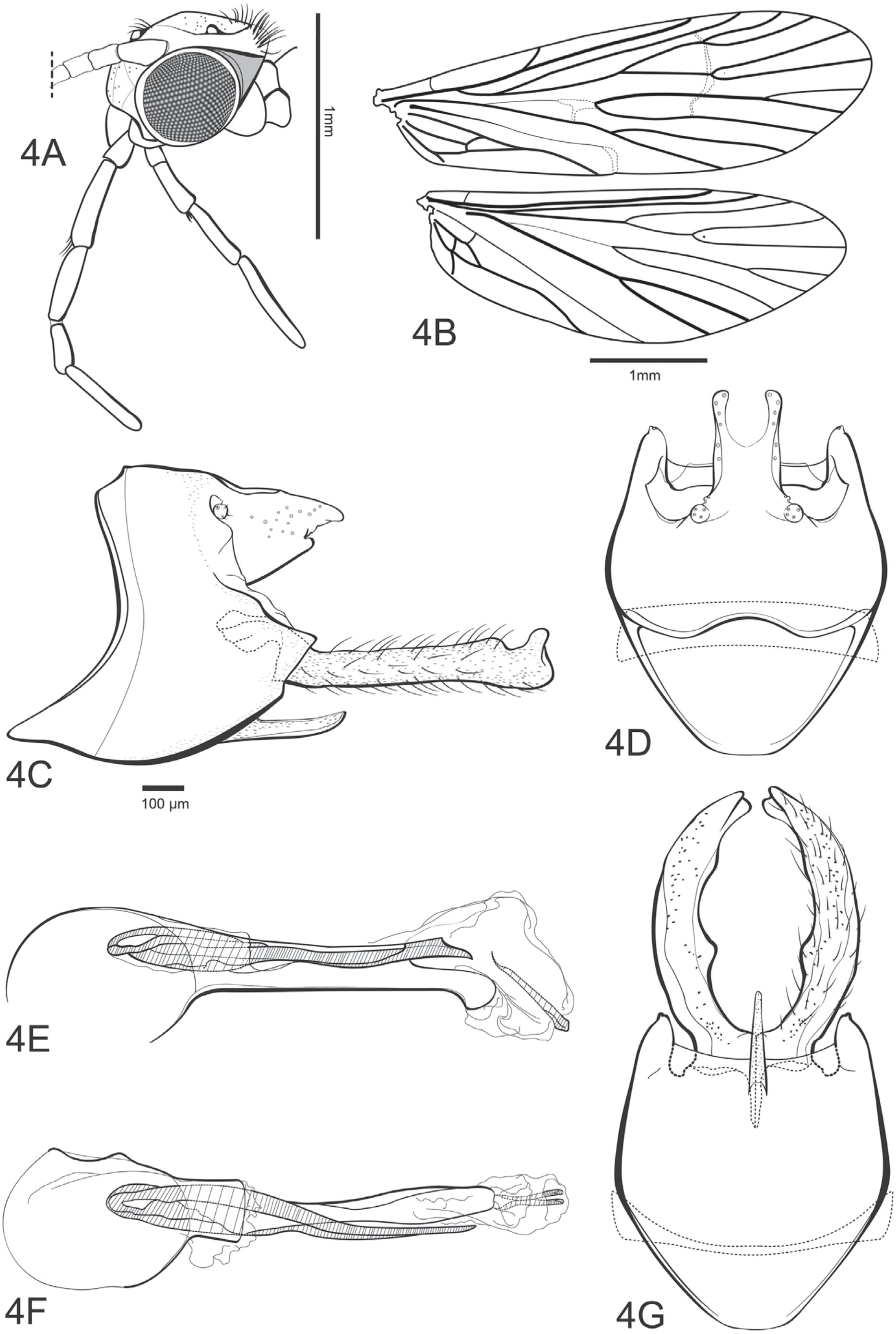

Figure 4. *Chimarra* (*Chimarrita*) *anticheira* sp. n., male: **A** head, postocular parietal sclerite, maxillary and labial lateral **B** wing venation **C** genitalia, lateral **D** segment IX and tergum X, dorsal **E** phallic apparatus, lateral **F** dorsal **G** segment IX, inferior appendage, ventral.

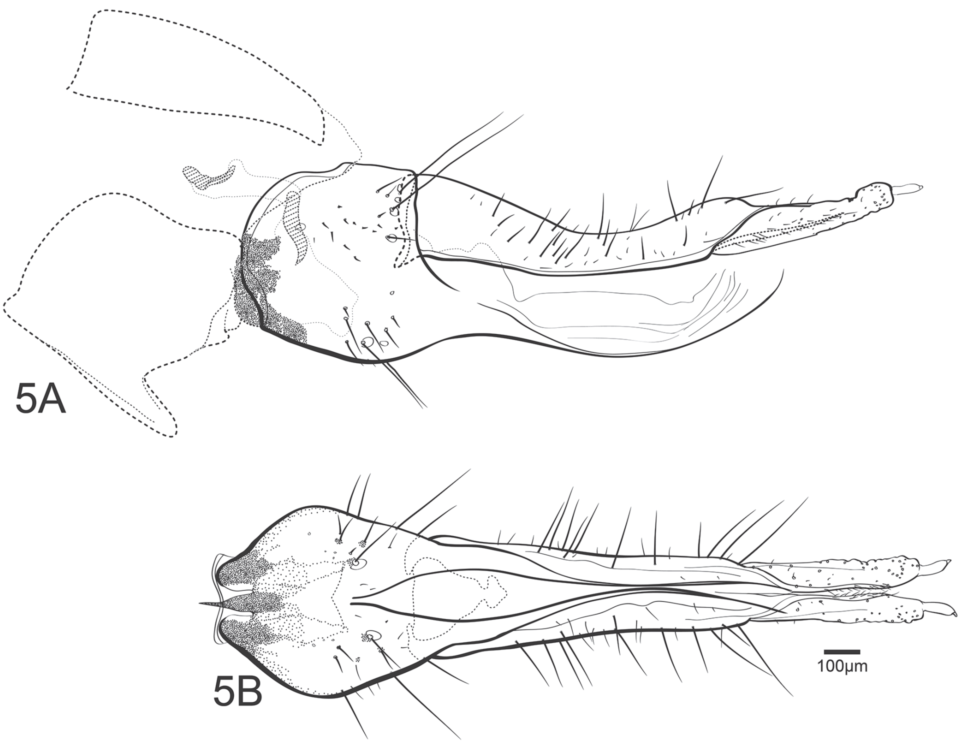

Figure 5. *Chimarra* (*Chimarrita*) *anticheira* sp. n., female: **A** lateral **B** ventral.

spine single, elongate, emerging near phallobase, apparently fused with ventral portion of phallotheca, apex ventrally projecting, angularly truncate, pointed; endotheca forming sheath on basal half. Phallotremal sclerite complex appearing very narrow, elongate, apparently bifid sclerotized rod.

Female genitalia. Sternum VII with ventral process; process large, projecting, subacute, emerging close to middle of segment in lateral aspect. Segment VII synsclerous, short dorsally, anterolateral margin rounded, excavated dorsally and ventrally; segment fused ventrally to sternum IX; anteroventral margin of segment, as viewed ventrally, with short, narrow mesal emargination, margins of emargination distinctly sclerotized; segment bearing dorsal and ventral rounded unpigmented regions, usually around the larger setae. Sternum IX elongate, with paired, angular projections continuous posteriorly with elongate, narrow ventral sclerites; sternum membranous ventrally between the sclerites, and laterally from base until the apex. Tergum IX elongate, narrow, slightly curved, moderately setose, anteroventrally with short apodeme. Segment X with elongate basal portion, furrowed dorsally, with mesal tract of setae in furrow; apically with pair of small, rounded, setose lobes, each with short apical cercus. Vaginal apparatus largely membranous, with anterior sclerite forming ring and with pair of more elongate sclerites posteriorly.

Holotype, male (alcohol)**. BRAZIL: Bahia:** Varzedo, Fazenda Baixa Grande, Riacho Cai Camarão, Propriedade do Sr. Getúlio Rodrigues Leal, 12°57'45.1"S, 39°27'12.1"W, el. 280 m, 27.iii.2012, UV Light Pan trap, Quinteiro F.B., Duarte T., Garcia I. (MZUSP).

Paratypes. BRAZIL: Bahia: same data as holotype, 2 males (alcohol) (UFBA); 12°57'39.2"S, 39°26'53.7"W, el. 252 m, 28.vi.2013, UV Light Pan trap, Calor A.R., Medeiros A. & Gomes V., 1 male (alcohol) (UFBA); 12°57'35.9"S, 39°26'54.9"W, el. 303 m, light, Calor A.R., Medeiros A. & Gomes V., 1 male, 3 females (alcohol) (UMSP); 12°57'35.9"S, 39°26'54.9"W, el. 303 m, 27.viii.2013, UV Light Pan trap, Calor A.R., Gomes V. & Zanata, A., 1 male (alcohol) (UFBA); 12°57'40.5"S, 39°26'54.7"W, el. 276 m, 09.ii.2014, UV Light Pan trap, Calor A.R. & Vilarino A., 3 males, 4 females (alcohol) (UFBA); 12°57'45.3"S, 39°27'13.1"W, el. 280 m, Calor A.R. & Vilarino A., 9 males (alcohol) (UFBA); Riacho Cachoeira da Serra (Monte Cruzeiro); 12°53'06.5"S, 39°26'47.1"W, el. 244 m, 08.ii.2014, Calor A.R. & Vilarino A., 1 male (alcohol) (UFBA); RPPN Guariru, Propriedade Flávio Pantaroto, 12°51'32.5"S, 39°27'59.5"W, el. 513 m, 07.ii.2014, UV Light Pan trap, Calor A.R. & Vilarino A., 9 females (alcohol) (UFBA); 12°51'33.1"S, 39°28'00.9"W, el. 524 m, Calor A.R. & Vilarino A., 17 males (alcohol) (UFBA); Cachoeira do Averaldo, 12°55'04.6"S, 39°26'39.7"W, el. 273 m, 09.ii.2014, Calor A.R. & Vilarino A., 2 males, 2 females (alcohol) (UFBA); Santa Teresinha, Pedra Branca, Serra da Jibóia, Riacho das torres, lajedo, 12°51'00.6"S, 39°28'48.3'W, el. 678 m, 10.vi.2010, UV Light Pan trap, Calor, A.R., 2 males, 2 females (alcohol) (UFBA); 28.ix.2009, light and sweep net, Calor A.R. & Cruz A.L. leg., 1 female (alcohol) (UFBA).

Etymology. The species name derives from the Greek word *anticheira*, which means thumb, referring to the diagnostic thumb-like projection present on the inferior appendages.

Remarks. Intra-specific variation may be observed in several structures. In some individuals the mesally formed projection on the inferior appendage is more prominent and there may also be a second subapical smaller projection. Membranous structures of the endotheca can vary in shape depending upon the preparation and some convoluted parts of phallic spines may be difficult to discern. The phylogenetic analysis resulted in a clade (*C. majuscula* (*C. anticheira*, *C. latiforceps*)) based on the shared character 37(1), lobes of tergum X roundly inflated apicaly, club-shaped, and *C. anticheira* as sister taxon of *C. latiforceps* based on the characters 36(2), female genitalia with stemum IX sclerously fused to segment VIII, broadly fused at base, and 38(1), male genitalia with ventral margin of tergum X with a small projection subapically.

Chimarra (*Curgia*) *morio* Burmeister, 1839

Figs 6A–F

Chimarrha morio Burmeister, 1839: 911 [Type locality: Brasilien; ZIUH, now lost; female; in *Chimarrha*]. — Ulmer 1905: 94. *Chimarra morio* (Burmeister). —

Walker 1852: 8l [bibliography]. — Fischer 1961: 67 [bibliography]. — Flint 1998: 14 [male; redescription; variation; distribution; in *morio* group]. — Paprocki et al. 2004: 14 [checklist]. — Dumas et al. 2009: 313 [checklist]. — Calor 2011: 323 [checklist].

Chimarra martinmoselyi Botosaneanu, 1980: 98 [replacement name for *Chimarra moselyi* Ross, 1956, preoccupied by *Chimarra moselyi* Denning, 1947. Type locality: Argentina [sic, recte: Brazil], Petrópolis, Rio de Janeiro; BMNH; male]. — Flint 1998: 14 [to synonymy].

Observed intraspecific variation. In his redescription, Flint (1998) analyzed specimens from diverse localities (Santa Catarina, Rio de Janeiro, São Paulo and also Bahia states) reporting wide variations, mainly in the shape and size of the inferior appendages. For the variant from Bahia, Flint (1998) the described inferior appendages and ventral process as longer, and tergum VII and tergum X as slightly bifid, but he did not provide any illustrations of this variant. Analysis of material from Bahia from the same locality reported by Flint and from other localities revealed other variations: Segment IX is opened dorsally forming a U-shape; in lateral aspect, the posterolateral margin of segment IX is slightly projected at level of inferior appendage. Tergum X in addition to being bifid is also constricted near the base, forming 2 small lateral lobes; the preanal appendages are elongated and tapered, with a small ventral projection; and the inferior appendages are rounded in ventral aspect, and have a medial and apical point on the lateral margin visible in lateral aspect.

Distribution. Brazil (Bahia, Paraná, Rio de Janeiro, Santa Catarina, São Paulo).

Material examined. BRAZIL: Bahia: Camacan, RPPN Serra Bonita, Riacho 1 trilha nova, 15°23'35.4"S, 39°33'50.1"W, el. 720 m, 01.iv.2011, UV Light Pan trap, Quinteiro F.B. & França D., 1 male (alcohol) (UFBA); same, 30.iii.2011, UV Light Pan trap, Quinteiro F.B. & França D., 1 male (alcohol) (UFBA); córrego 3, trilha 15°23'03"S, 39°34'00"W, el. 723 m, 29.x.2008, light, Calor A.R., Mariano R. & Mateus, 17 males, 9 females (alcohol) (UFBA); Elísio Medrado, Reserva Jequitibá, GAMBA, Córrego Caranguejo, 12°52'146"S, 39°28'337"W, el. 496 m, 08.xi.2010, Calor A.R., Quinteiro F.B., França D., Mariano R. & Costa A., 21 males (alcohol) (UFBA); Varzedo, Fazenda Baixa da Areia, Propriedade do Sr. Getúlio, Riacho Cai Camarão, 12°57'45.5"S, 39°26'55"W, el. 280 m, 27.iii.2012, Quinteiro F.B., Duarte T. & Garcia I., 44 males (alcohol) (UFBA); Riacho Cachoeira da Serra, 12°53'06.5"S, 39°26'47.0"W, el. 244 m, 08.ii.2014, UV Light Pan trap, Calor A.R. & Vilarino A., 2 males (alcohol) (UFBA); RPPN Guariru, 12°51'32.5"S, 39°27'59.5"W, el. 513 m, 07.ii.2014, UV Light Pan trap, Calor A.R. & Vilarino A., 2 males (alcohol) (UFBA); Santa Teresinha, Pedra Branca, córrego das torres, lajedo 12°51'016"S, 39°28'48"W, el. 679 m, 07.viii.2009, UV Light Pan trap, Calor A.R. & Lecci L.S., 2 males (alcohol) (UFBA).

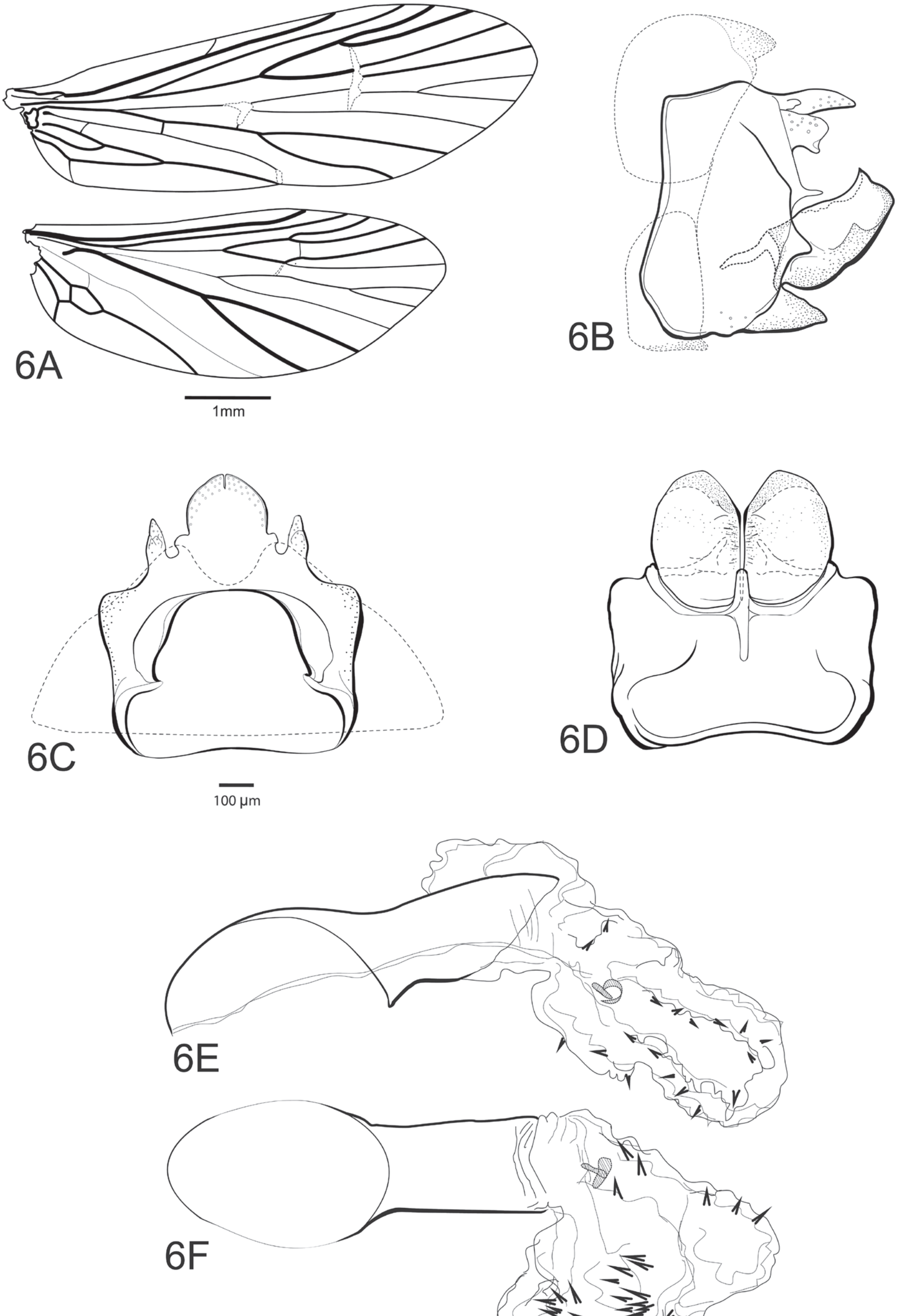

Figure 6. *Chimarra* (*Curgia*) *morio*. Male: **A** wing venation; male genitalia **B** lateral aspect **C** segment IX and tergum X, dorsal **D** segment IX, inferior appendage, ventral **E** phallic apparatus, lateral **F** dorsal.

New records

Chimarra (*Otarrha*) *odonta* Blahnik, 2002

Chimarra (*Otarrha*) *odonta* Blahnik, 2002: 85 [Type locality: Brazil, São Paulo, Est. Biol. Boracéia; MZUSP; male; female]. — Paprocki et al. 2004: 14 [checklist]. — Dumas et al. 2009: 364 [checklist]. — Calor 2011: 323 [checklist]. — Dumas et al. 2010: 8 [distribution]. — Barcelos-Silva et al. 2012: 1279 [distribution].

Distribution. Brazil (Bahia [new record], Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo).

Material examined. BRAZIL: Bahia: Camacan, RPPN Serra Bonita, riacho 1 trilha nova, 15°23'40"S, 39°33'44"W, el. 720 m, 31.iii.2011, UV Light Pan trap, Quinteiro F.B., França D. & Barreto H., 1 male (alcohol) (UFBA); Santa Teresinha, Pedra Branca, Riacho das Torres, 12°51'00"S, 39°28'48"W, el. 679 m, 28.ix.2009 – 04.iii 2010, Malaise trap, Calor A.R. & Dias E.S., 4 males (alcohol) (UFBA); Elísio Medrado, Reserva Jequitibá, GAMBA, Córrego Caranguejo, 12°52'146"S, 39°28'337"W, el. 496 m, 08.xi.2010, Calor A.R., Quinteiro F.B., França D., Mariano R. & Costa A., 3 males, 1 female (alcohol) (UFBA); same, 12°52'21.5"S 39°28'56.5"W, 07.xi.2010, Silva-Neto, Araujo, 1 male (alcohol) (UFBA); same, 12°52'040"S, 39°28'276"W, el. 232 m, 30.iii.2012, UV Light Pan trap, Quinteiro F.B., Duarte T. & Garcia I., 1 male (alcohol) (UFBA).

Chimarra (*Chimarrita*) *kontilos* Blahnik, 1997

Chimarra (*Chimarrita*) *kontilos* Blahnik, 1997: 227 [Type locality: Brazil, Espírito Santo, Caixa d'Agua, Santa Teresa; MZUSP; male; female; in *simpliciforma* group]. — Blahnik et al. 2004: 5 [distribution]. — Paprocki et al. 2004: 14 [checklist]. — Dumas et al. 2009: 363 [checklist]. — Calor 2011: 323 [checklist].

Distribution. Brazil (Bahia [new record], Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo).

Material examined. BRAZIL: Bahia: Camacan, RPPN Serra Bonita, Riacho 1 trilha nova, 15°23'35.4"S, 39°33'50.1"W, el. 720 m, 01.iv.2011, UV Light Pan trap, Quinteiro F.B. & França D., 1 male (alcohol) (UFBA).

Key for males and females of *Chimarra* (*Chimarrita*) (modified from Blahnik 1997)

Blahnik (1997) established the subgenus for 18 species (currently 16 species, with species of *C. maldonadoi* Group moved to *incertae sedis*). Subsequently, two new species and the female of *C. camella* were described by Blahnik and Holzenthal (2012). Here, two additional new species are described. An updated key of *Chimarra* (*Chimarrita*) is presented, now including all 20 known species (19 females).

1 Inferior appendages (claspers) present; genitalia not elongate, attenuate (males) **2**

– Inferior appendages absent; genitalia elongate, attenuate (females) **21**

2(1) Phallic apparatus with spine(s) emergent from apex of phallotheca (see fig. 6E in Blahnik 1997) (elongate only in *C. prolata*, see fig. 8E in Blahnik 1997) (*C. rosalesi* Group) **3**

– Phallic apparatus with single spine, usually very elongate, emerging from base of phallotheca (see fig 18E in Blahnik 1997) (*C. simpliciforma* Group) **9**

3(2) Phallic apparatus with spines not curved, or only slightly curved (see fig. 7E in Blahnik 1997) **4**

– Phallic apparatus with one or more helically curved, short spines (see fig. 5E in Blahnik 1997) **6**

4(3) Tergum X, in dorsal view, not elongate, cleft all the way to base; phallotheca short, slightly curved; inferior appendage elongate, narrow, apically acute (see fig. 7 in Blahnik 1997) .... ***C. neblina* Blahnik**

– Tergum X, in dorsal view, elongate narrow, cleft only in apical half; phallotheca elongate, tubular **5**

5(4) Inferior appendage elongate, tapering to acute apex; phallic apparatus with elongate spine, emerging apically; anteroventral margin of segment IX dramatically elongate, apex acute (see fig. 8 in Blahnik 1997) .... ***C. prolata* Blahnik**

– Inferior appendage, in dorsal view, with broadly rounded mesal projection at apex; phallic apparatus with short spines; ventral margin of segment IX elongate, acute, but not dramatically so (see fig. 10 in Blahnik 1997) .... ***C. rosalesi* Flint**

6(5) Inferior appendage, in lateral view, with deeply incised apex, producing curved, acute dorsal lobe, and shorter, acute ventral lobe (chelate, like lobster claw); anteroventral margin of segment IX with an obtuse apex (see fig. 5 in Blahnik 1997) .... ***C. chela* Blahnik**

– Inferior appendage without a incised apex, apex tapering (see fig. 6C in Blahnik 1997); anteroventral margin of segment IX with an acute apex (see fig. 6B in Blahnik 1997) **7**

7(8) Inferior appendage, in dorsal/ventral views, apically with rounded incurvature and acute apex; phallic apparatus with one curved spine (see fig. 9 in Blahnik 1997) .... ***C. pusilla* Blahnik**

– Inferior appendage, in dorsal/ventral views, with mesal acute projection; phallic apparatus with more than one curved spines (Fig. 2F, G) **8**

8(9) Inferior appendage, in dorsal/ventral views, strongly tapered apically, mesal projection emerging apically; phallic apparatus with several small curved spines; ventral process, in lateral view, very narrow and acute; preanal appendages flattened (see fig. 6 in Blahnik 1997) .... ***C. forcipata* Blahnik**

– Inferior appendage, in dorsal/ventral views, not strongly tapered, rounded apically, mesal projection emerging mesally about half appendage length; phallic apparatus with 2 large curved spines; ventral process, in lateral view, subacute and not strongly narrow; preanal appendages not flattened, slightly emergent (Fig. 2) .... ***C. mesodonta* sp. n.**

9(2) Phallotheca very elongate, narrow; phallic spine enormously elongate and sinuously curved, longer than phallotheca (see fig. 19E in Blahnik 1997) **10**

– Phallotheca only moderately elongate; phallic spine shorter and less sinuously curved, although often equaling length of phallotheca (see fig. 11E in Blahnik 1997) **12**

10(9) Inferior appendage with apex angularly incurved, apex not acute; apicoventrally with small, sclerous bidentate projection; phallotheca extremely elongate; phallic spine with retrorse, whip-like projection at apex (see fig. 16 in Blahnik 1997) .... ***C. kontilos* Blahnik**

– Inferior appendage with apex incurved and acute; phallotheca and phallic spine shorter; apex of phallic spine without retrorse, whip-like projection (see Fig. 14 in Blahnik and Holzenthal 2012) **11**

11(10) Tergum X with a small lateral, sensilla-bearing projection; inferior appendages strongly incurved apically; phallotheca strongly curved (see fig. 14 in Blahnik and Holzenthal 2012)........... ***C. curvipenis* Blahnik & Holzenthal**

– Tergum X without lateral sensilla-bearing projection; inferior appendages lightly incurved apically; phallotheca not strongly curved (see fig. 19 in Blahnik 1997) .... ***C. tortuosa* Blahnik**

12(9) Phallic spine short, much shorter than phallotheca; inferior appendage, in lateral view, abruptly and dramatically narrowed in apical half, apex dorsoventrally flattened; in dorsal/ventral views, with apex angularly incurved and rounded (see fig. 15 in Blahnik 1997).......................... ***C. heppneri* Blahnik**

– Phallic spine elongate, nearly as long as phallotheca (see fig. 18E in Blahnik 1997); inferior appendage not as above... **13**

13(12) Phallic apparatus with numerous, short, sclerous spines; inferior appendage, in lateral view, wide at apex and shallowly incised, forming subequal dorsal and ventral lobes; dorsal lobe with short, sclerous, mesally directed hook; ventral lobe with acute apex (see fig. 11 in Blahnik 1997)............ ***C. akantha* Blahnik**

– Phallic apparatus without short, sclerous spines (see fig. 18E in Blahnik 1997); inferior appendage not as above (if bilobed at apex, then without dorsal hook-like process) **14**

14(13) Phallotheca angularly flexed at base (see fig. 17E in Blahnik 1997); posterior margin of segment IX, in lateral view, very angularly protruding at level of inferior appendages (see fig. 17A in Blahnik 1997) **15**

– Phallotheca with slight curvature, but not angularly flexed at base; posterior margin of segment IX nearly linear, not (or only slightly) protruding (see fig. 18A in Blahnik 1997) **20**

15(14) Apex of inferior appendage attenuate and curled inward; apex of lateral lobes of tergum X forming a spine-like lateral projection (see fig. 14D in Blahnik 1997) .... ***C. heligma* Blahnik**

– Apex of inferior appendage bluntly rounded, not attenuate; apex of lateral lobes of tergum X not as above (see fig. 13D in Blahnik 1997) **16**

16(15) Apex of inferior appendage distinctly cupped; tergum X with sensillate lateral protrusion (see figs 12B, D in Blahnik 1997)................. ***C. camella* Blahnik**

– Apex of inferior appendage flattened or angulate, not distinctly cupped; sensilla of tergum X not on rounded lateral protrusion (see figs 13B, D in Blahnik 1997).. **17**

17(16) Lateral lobes of tergum X with apex forming 2 points, inferior appendage only moderately elongate; in dorsal/ventral views, angularly incurved at apex, apex dorsoventrally flattened (see fig. 13A, B, D in Blahnik 1997) .... ***C. camura* Blahnik**

– Lateral lobes of tergum X with apex enlarged and rounded, club-shaped; inferior appendage distinctly elongate; in dorsal/ventral views, slightly incurved at apex, apex not dorsoventrally flattened (see fig. 17D in Blahnik 1997)...... **18**

18(17) Lateral lobes of tergum X very inflated apically, excision between the lobes about the same width as the apical portion of the lobes; apex of inferior appendage, flattened , apex without projection (see fig. 17B, D in Blahnik 1997)... ***C. majuscula* Blahnik**

– Lateral lobes of tergum X narrow, slightly inflated apically, excision between the lobes about twice wider than the apical portion of the lobes; apex of inferior appendage broader and truncate (see fig. 15A, C in Blahnik and Holzenthal 2012) or with a dorsal thumb-like projection (Fig. 4)............. **19**

19(18) Phallotheca almost linear, apicoventral portion rounded; inferior appendages, in lateral view, with apicodorsal thumb-like projection (Fig. 4) .... ***C. anticheira* sp. n.**

– Phallotheca curved, bulbous, with apicoventral portion excavated; inferior appendage with truncate apex, without projection (see fig. 15E in Blahnik and Holzenthal 2012)....................... ***C. latiforceps* Blahnik & Holzenthal**

20(14) Inferior appendage simple, short, apex rounded (see fig. 20D in Blahnik 1997)... ***C. xingu* Blahnik**

– Inferior appendage with apex bifurcate, forming acute dorsal and ventral lobes (see fig. 18A in Blahnik 1997).......................... ***C. simpliciforma* Flint**

21(1) Segment VIII with ventral process and very reduced or obsolete dorsally; segment VII lacking ventral process (see figs 9G, 10G in Blahnik 1997) (*C. rosalesi* Group) **22**

– Segment VIII lacking ventral process and short, but not obsolete dorsally; segment VII with ventral process (see fig. 17G in Blahnik 1997) (*C. simpliciforma* Group).. **27***

22(21) Tergum IX extremely elongate (8 or more times as long as high); ventral process short (see fig. 7G in Blahnik 1997)... **23**

– Tergum IX elongate but not extremely so (approximately 6 times as long as high, or less); ventral process prominent (see fig. 5G in Blahnik 1997)..... **24**

23(22) Segment VIII, in lateral view, with anterior margin angular; segment subquadrate in shape (see fig. 10G in Blahnik 1997)................ ***C. rosalesi*** **Flint**

– Segment VIII, in lateral view, with anterior margin linear; segment triangular in shape (see fig. 7G in Blahnik 1997)........................... ***C. neblina*** **Blahnik**

24(22) Segment VIII, in lateral view, with posterior margin nearly linear, not produced; ventral surface of segment not elongate; ventral process elongate, prominent, nearly as long as segment (see fig. 6G in Blahnik 1997)..... ***C. forcipata*** **Blahnik**

– Segment VIII, in lateral view, with posterior margin produced; ventral surface of segment elongate; ventral process not elongate, much shorter than segment (see fig. 9G in Blahnik 1997).. **25**

25(24) Segment VIII, in lateral view, with posterior margin angularly produced, segment subquadrate in shape (see fig. 9G in Blahnik 1997).............. ***C. pusilla*** **Blahnik**

– Segment VIII, in lateral view, with posterior margin nearly linearly produced; subtriangular in shape (see fig. 5G in Blahnik 1997)................................ **26**

26(29) Segment VIII, with two ventral processes an anterior and a small posterior one (Fig. 3)... ***C. mesodonta*** **sp. n.**

– Segment VIII, with only one anterior ventral process (see fig. 5G in Blahnik 1997).. ***C. chela*** **Blahnik**

27(25) Tergum IX moderately elongate, angularly downcurved from base (point of maximum flexion almost exactly in middle); sternum IX, in lateral view, with basodorsal angle posteriorly directed; sternum IX, in lateral view, narrow at point of articulation with segment VIII; ventral process of segment VII located posteriorly (see fig. 18G in Blahnik 1997)....................................... **28**

– Tergum IX moderately to distinctly elongate, less angularly downcurved (point of maximum flexion closer to apex than base, fig. 17G in Blahnik 1997); sternum IX, in lateral view, with basodorsal angle anteriorly or dorsally directed; sternum IX narrow or wide at point of articulation with segment VIII; ventral process of segment VII located either at posterior apex, or preapically (see fig. 15G in Blahnik 1997)... **29**

28(27) Segment VIII with anterior margin more or less uniformly rounded (see fig. 20G in Blahnik 1997).. ***C. xingu*** **Blahnik**

– Segment VIII with distinct bulge in anterior margin (see fig. 18G in Blahnik 1997).. ***C. simpliciforma*** **Flint**

29(27) Ventral process of segment VII distinctly preapical (see fig. 17G in Blahnik 1997).. **30**

– Ventral process of segment VII at or near posterior margin (see fig. 15G in Blahnik 1997)... **37**

30(29) Segment IX with anteroventral margin moderately or weakly indentate, apodeme very small or somewhat developed, when anteroventral margin moderately indentate apodeme more developed and not pointed (see fig. 13G in Blahnik 1997).. **31**

– Segment IX with anteroventral margin strongly indentate, with apodeme very narrow, small and pointed (see fig. 14G in Blahnik 1997)................**36**

31(30) Basodorsal angle of sternum IX very angular and conspicuously sclerous; segment VIII, in lateral view, apparently narrowly connected to sternum IX (see fig. 17G in Blahnik 1997)...***C. majuscula*** Blahnik

– Basodorsal angle of sternum IX less distinct and segment IX more broadly connected to sternum IX (see fig. 13G in Blahnik 1997) **32**

32(31) Segment IX with anterior margin distinctly trapezoidal and extending about half length of the segment VIII (in lateral view); apodeme very reduced, almost obsolete (see fig 16G in Blahnik 1997)................ ***C. kontilos*** **Blahnik**

– Segment IX with anterior margin not distinctly trapezoidal and extending much less than half length of the segment VIII (in lateral view); apodeme developed (see fig 13G in Blahnik 1997) **33**

33(32) Segment IX with anterior margin smooth, without indentation, not extending over segment VIII (in lateral view); apodeme small and narrow (see fig. 13G in Blahnik 1997) ....***C. camura*** **Blahnik**

– Segment IX with anterior margin weakly indentate or not indentate, extending slightly over segment VIII (in lateral view); apodeme a little broader (Fig. 5A)..**34**

34(33) Segment VIII with anteroventral margin with rounded mesal emargination extending almost entire length of segment (in ventral view); anterolateral margin almost straight not elongate (in lateral view) (see fig. 16 in Blahnik and Holzenthal 2012)....................... ***C. curvipenis*** **Blahnik & Holzenthal**

– Segment VIII with anteroventral margin with subquadrate mesal emargination, extending about half length of segment (in ventral view); anterolateral margin elongate rounded overall (in lateral view) (Fig. 5A).......................**35**

35(34) Ventral process of segment VII curved; apodeme longer, about half height of tergum IX (see fig. 17 in Blahnik and Holzenthal 2012)..............................
.... ***C. latiforceps*** **Blahnik & Holzenthal**

– Ventral process of segment VII not curved; apodeme smaller than half height of tergum IX (Fig. 4A)..***C. anticheira*** **sp. n.**

36(30) Segment VIII with conspicuous, sclerous lateral suture line, segment IX with anteroventral margin extending more than half way across segment VIII, apodeme small and narrow (see fig. 14G in Blahnik 1997) .... ***C. heligma*** **Blahnik**

– Segment VIII without lateral suture line, segment IX with anteroventral margin extending less than half way across segment VIII; apodeme strongly reduced (see fig. 18 in Blahnik and Holzenthal 2012) ......***C. camella*** **Blahnik**

37(29) Ventral margin of segment VIII with distinct ventral bulge, extending angularly to posterior angle of sternum IX (see fig. 15G in Blahnik 1997) ....
....***C. heppneri*** **Blahnik**

– Ventral margin of segment VIII straight or only slightly rounded, if rounded then not extending to posterior angle of stemum IX (see fig. 11G in Blahnik 1997)...**37**

38(37) Segment VIII, in lateral view, with posterior margin extending nearly linearly from dorsal margin to posterior angle of stemum IX (see fig. 19G in Blahnik 1997); ventral margin of segment VIII straight, or nearly so; fusion of sternum IX with segment VIII not marked by conspicuous basal suture............ .... ***C. tortuosa* Blahnik**

– Segment VIII, in lateral view, with posterior margin less distinctly linear; ventral margin of segment VIII slightly rounded; fusion of stemum IX with segment VIII marked by conspicuous basal suture (see fig. 11G in Blahnik 1997).. ***C. akantha* Blahnik**

* These species are all similar, and the characters used to separate them are presumptive based on the material available (Blahnik 1997).

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Supplementary material 1

Matrix data table used in the cladistic analyses of *Chimarra* (*Chimarrita*).

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Data type: matrix data

Explanation note: Matrix with 27 taxa and 41 characters used in the cladistic analyses of *Chimarra* (*Chimarrita*). Missing data are coded as "?", characters 32, 33, 36 are ordered, and all other characters were unordered.