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Taxonomy of *Paraplatyarthrus* Javidkar and King (Isopoda: Oniscidea: Paraplatyarthridae) with description of five new species from Western Australia, and comments on Australian *Trichorhina* Budde-Lunde, 1908 (Platyarthridae)

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Abstract

The oniscidean fauna of Australia is generally poorly known but recent sampling has revealed a new family, Paraplatyarthridae, found in both terrestrial and groundwater calcretes of central Western Australia. The family was initially described based on a new genus and species, *Paraplatyarthrus subterraneus* Javidkar and King, 2015. Here we describe an additional five *Paraplatyarthrus* species from the Yilgarn region of Western Australia, based on both morphological and molecular evidence (*COI* divergences). Four species are subterranean: *P. crebesconiscus* Javidkar and King **sp. nov.**, *P. cunyuensis* Javidkar and King **sp. nov.**, *P. occidentoniscus* Javidkar and King **sp. nov.**, and *P. pallidus* Javidkar and King **sp. nov.**, and one is a surface species, *P. nahidae* Javidkar and King **sp. nov.** A key to their identification is provided along with information on their distribution. In addition, type material of the two described Australian species of Platyarthridae, *Trichorhina australiensis* Wahrberg, 1922 from Western Australia and *T. tropicalis* Lewis, 1998 from Queensland, are examined. Morphological reassessment of type material shows *T. australiensis* belongs to *Paraplatyarthrus* (comb. nov.) and that *T. tropicalis* is correctly placed in *Trichorhina*, confirming that the genus and family Platyarthridae occur in Australia.

Key words: Oniscidea, Paraplatyarthridae, *Paraplatyarthrus*, Platyarthridae, *Trichorhina*, Western Australia

Introduction

A significant and diverse subterranean invertebrate fauna, including both stygofauna (subterranean aquatic) and troglofauna (subterranean terrestrial), is known to exist in the groundwater calcrete aquifers of central Western Australia (Taiti & Humphreys 2001; Cooper *et al*. 2002; Karanovic 2004; Cho 2005; Cooper *et al.* 2007, Cooper *et al.* 2008; Taiti and Humphreys 2008; Guzik *et al.* 2008; Karanovic & Cooper 2012; King *et al.* 2012), with many species showing patterns of isolation and short-range endemism (Harvey 2002). Recently, a diverse oniscidean isopod troglofauna was recognised in the Yilgarn region of Western Australia, with a multi-gene phylogeny and comparative morphological study leading to the recognition of a new family, Paraplatyarthridae (Javidkar *et al*. 2015). The family was described based on a new genus and species, *Paraplatyarthrus subterraneus* Javidkar and King, and an undescribed taxon from South America, united on the presence of a unique antennal water conducting system (Javidkar *et al*. 2015). A number of additional congeneric species were recognised from both subterranean and surface habitats in Western Australia and included in the phylogenetic analysis of Javidkar *et al*. (2015), but were not described.

Although phylogenetically distinct and in a different family, members of *Trichorhina* Budde-Lunde, 1908 (Platyarthridae), share some characters with *Paraplatyarthrus*, with undescribed species in the latter genus previously being tentatively assigned to *Trichorhina* prior to Javidkar *et al.* (2015). *Trichorhina* comprises some 64

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described species world-wide, and can be recognised by having the dorsal body not granulated, with large ridged scale setae, having a supra-antennal line, the absence of a frontal line, a two-jointed antennal flagellum with first joint shorter than the second, pleon normally not interrupted from pereon, and the telson usually triangular (round in *T. simony* Dollfuss, 1983 and *T. caeca* Vandel, 1952) (Schmalfuss & Ferrara 1978). Currently, there are two described species of *Trichorhina* from Australia, *T. australiensis* Wahrburg, 1922 (Western Australia) and *T. tropicalis* Lewis, 1998 (Queensland). Given the resemblance of this genus to *Paraplatyarthrus* the generic placement of these two species needed to be assessed.

The aims of this study were to describe a number of new species of *Paraplatyarthrus* for which *COI* sequences and both sexes were available, to provide a key for their identification, to document their distribution, and to determine the generic status of the two described species of *Trichorhina.*

Material and methods

Specimens were collected widely from across the Yilgarn region of Western Australia, from numerous calcrete aquifers (Table 1, Figs 1, 3). Various methods were used for collecting calcrete-associated subterranean and surface specimens as described in Javidkar *et al.* (2015). Most specimens were preserved in 100% ethanol (for DNA extraction) and subsequently became brittle, making dissections difficult. To avoid too much damage to the specimens during dissection for morphological examination they were mounted in a drop of water-based lubricant (equate) in a Petri dish and then 100% ethanol was added to the Petri dish, causing the lubricant drop to stabilize the mounted samples during dissection.

TABLE 1. Lineage codes (B = subterranean; S = surface) and abbreviations for calcrete and non-calcrete sampling sites for undescribed *Paraplatyarthrus* spp., *P. subterraneus* and outgroup taxa, with sampling locations and associated geographic coordinates, and BES/JA numbers.

Lineage codes/species	Locality	Coordinates	BES /JA codes
B3/LV	Lake Violet Calcrete	S26.7091, E120.2357; S26.709, E120.2346	15080;15097
B6/LDW	Laverton Downs Calcrete-Windarra	S28.4989, E122.1798	3U.1, 3; 14632.3
B7/NAM	Nambi Calcrete	S28.2351, E121.8306	17221.1
B8/LDQ	Laverton Downs Calcrete-Quandong	S28.35515, E122.22551	16567.1
B9/URA	Uramurdah Calcrete	S26.6876, E120.313; S26.6876, E120.3078	15088.1; 15087.1
B10/URA-BUB	Uramurdah/Bubble Well Calcretes	S26.6876, E120.313; S26.5607, E120.0409; S26.5607, E120.0409	15067.1; 15095.3; 15065.1
B11/LV	Lake Violet Calcrete	S26.70923, E120.26404	16476.1, 2
B18/BAR	Barwidgee Calcrete	S27.1375, E120.9495	15062
S1/JP-GOO	Jorgensen Park, Kalamunda; Gooseberry Hills	-	Ja126; Ja144
S2/WOO	Wooroloo	-	Ja148
S3/MOO	Moorapulling Rd. Marradong	-	Ja152; Ja155
P. subterraneus/LDW	Laverton Downs Calcrete-Windarra	S28.50282, E122.17726	15525.15, 25
P. subterraneus /LDQ	Laverton Downs Calcrete-Quandong	S28.35515, E122.22551	16567
P. subterraneus /LDW	Laverton Downs Calcrete-Windarra	S28.49937, E122.17838	15524.6
P. subterraneus /LDS	Laverton Downs Calcrete-Shady	S28.4074, E122.1997	14605.1
Outgroups			
Armadillidae: *Troglarmadillo* sp.	Sturt Meadows Calcrete	S28.70118, E120.89849	15550.1
Philosciidae: *Haloniscus* sp.	Laverton Downs Calcrete-Windarra	S28.5002,E122.1785	15094.1
Stenoniscidae (Genus indet)	Laverton Downs Calcrete-Windarra	S28.44388, E122.18681	16022

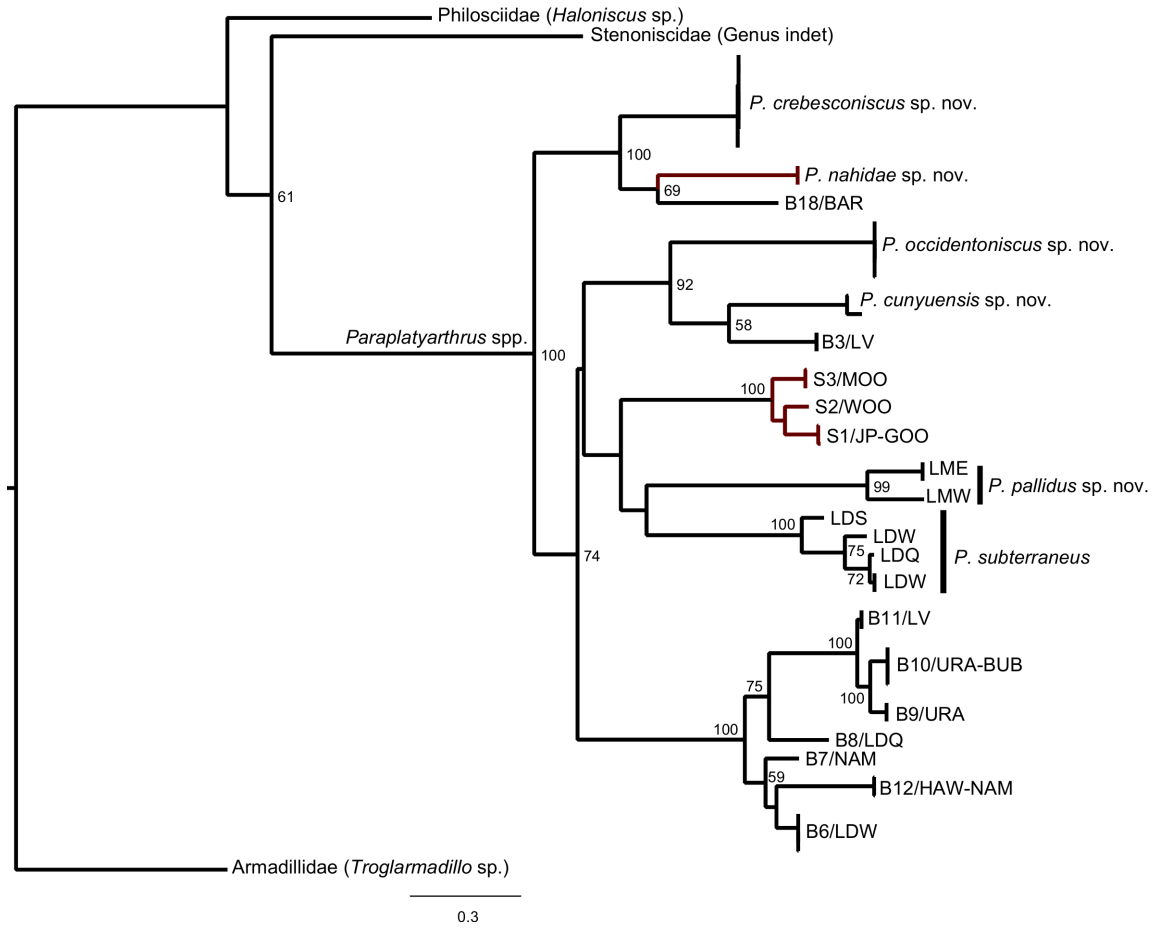

FIGURE 1. Maximum Likelihood (ML) tree for the mtDNA *COI* gene. The numbers next to the nodes are ML bootstrap values (only those greater than 50 are shown). The clade labels comprise either described new species or lineage specific codes (B or S letters) followed by the calcrete codes for undescribed species. Black and red branches (online version only) denote subterranean and surface species respectively. Abbreviations for the calcrete aquifers and some localities from Western Australia include: Calcrete areas: Laverton Downs-Windarra (LDW); Laverton Downs-Quandong (LDQ); Laverton-Shady Well (LDS); Sturt Meadows (SM); Cunyu (CUN); Lake Violet (LV); Lake Miranda East (LME); Lake Miranda West (LMW); Nambi (NAM); Uramurdah (URA); Bubble Well (BUB); Halfpenny Well (HAW); Barwidgee (BAR); Mt Morgans (MOR); Non-calcrete areas: Jorgensen Park, Kalamunda, WA (JP); Gooseberry Hills, WA (GOO); Wooroloo, WA (WOO); Moorapulling Rd., Marradong, WA (MOO).

Illustrations were undertaken using an Olympus compound microscope BX53 equipped with a camera lucida. Digital images were taken using a Visionary Digital BK+ inImaging System, with either a 65 mm Varifocal lens (5D, 1.4X extension, 5X) or a long distance microscope lens K2 (7D, P1, 10X). Source images were stacked using Zerene Stacker version 1.04 and enhanced using Adobe Photoshop CS5. All type material is deposited in the Western Australian Museum (WAM). New species were only described if *COI* sequences and both sexes were available. Those for which males were unavailable remain undescribed until additional material is forthcoming. However, they have been included in the *COI* phylogeny and are shown with lineage specific letters (B) or (S) followed by the calcrete or area codes (Table 1, Fig. 1).

Species were delineated on apparent fixed morphological differences and the results of a phylogenetic analysis (Javidkar 2014; Javidkar *et al.* 2015), based on sequences from the mitochondrial cytochrome c oxidase subunit I (*COI*) gene. The protocols for DNA extraction and amplification are outlined in detail in Javidkar *et al.* (2015). Sequences of *Paraplatyarthrus* species were aligned using the Geneious Alignment function in Geneious version 9.1.4 (Biomatters Pty Ltd; www.geneious.com) with application of default settings. To conduct the phylogenetic analysis, the dataset was partitioned by three codon positions and separate General Time Reversible (GTR) models of nucleotide evolution (Rodríguez *et al*. 1990), and Gamma (G) models (Yang 1996) of rate heterogeneity with estimation of proportion of invariable sites were applied to each partition. A rapid bootstrap Maximum Likelihood

phylogenetic analysis was carried out using the RAxML BlackBox with a 100 bootstrap pseudo-replicates (Stamatakis *et al.* 2008). Three oniscidean species belonging to Armadillidae (*Troglarmadillo* sp.), Philosciidae (*Haloniscus* sp.) and Stenoniscidae (genus indeterminate) were selected as outgroups from the Javidkar *et al*. (2015) study. *COI* sequences have been submitted to GenBank (accession numbers KX656285 to KX656315; KR424561 to KR424581).

Species delineation and phylogeny

Species were delimited using the criteria outlined by Guzik *et al*. (2011) for crustacean species: genetically monophyletic, geographically isolated and *COI* divergences of >11%. Using these criteria 12 *Paraplatyarthrus* species are recognised across the phylogeny (Fig. 1, Appendix 1). As stated above, apart from the type species *P. subterraneus* (Javidkar *et al.* 2015), five of these species (with multiple *COI* sequences per species) for which males are available showed fixed morphological differences and have been formally described below. Of the species for which only females were available and multiple specimens were sequenced, *COI* divergences were below 11%, so they were considered conspecific (e.g.S1-S3 = 9.6%; B9-B11 = 4.6%). Additional specimens and sequence data are also required for the lineages B6 to B12 to delimit the species within this group and enable their formal description (This complex is here regarded as the same putative species until more material becomes available). Given the preliminary nature of the phylogeny, that it is based only on a single marker, and we suspect there are additional species still to be collected from the region, we refrain from discussing phylogenetic relationships in any detail, but point to likely sister-groups in the 'Remarks' sections under the species described below. The species delimitation in this study has been also confirmed by a multiple gene approach, and using different species delimitation methods on a broader range of oniscidean species, including those described in this study (Javidkar *et al*. 2016).

Systematics

Order Isopoda Latrielle, 1817

Suborder Oniscidea Latrielle, 1802

Section Crinocheta Legrand, 1946

Family Paraplatyarthridae Javidkar and King, 2015

Genus *Paraplatyarthrus* Javidkar and King, 2015

Type species: *Paraplatyarthrus subterraneus* Javidkar and King, 2015; in Javidkar *et al*. 2015: 566.

Diagnosis. Smooth, fan-like scale setae covering body. Maxilliped endite with 2 small arrow-like setae on distal margin. Pereonal tergite 7 with 2 noduli laterales on each side (4 on whole pereonite), pereonal tergites 1–6 with 1 nodulus lateralis on each side (2 on whole pereonite).

Species level characters. The relative position of the noduli laterales to the lateral margins of the pereonites was found to be useful for distinguishing *P. pallidus* from other paraplatyarthrid species. In this species, D/C ratios (Appendix 2) are relatively constant in tergites 1–7 (except for the one next to the lateral margin in tergite 7), whilst there is a significant variation in the other paraplatyartrid species described here for this character. For this reason D/C ratios were not used in the key.

The morphology of the posterior corners of tergites 1 to 4 in dorsal view, used in the species' descriptions, showed some variability within *P. pallidus* and *P. crebesconiscus* so this character was not used to diagnose these species. For example, in some individuals of both species the posterior corners of tergite 4 were directed posteriorly. It is possible that the direction of the posterior corner can be influenced by muscle movements when the animal flexes upwards or inwards or alternatively, it may be an artefact caused by fixing specimens in absolute

ethanol. This character has been used previously in determination of some Australian *Trichorhina* species (Lewis 1998a, 1998b), however, in future, it should be treated with some caution and its variability assessed for a large number of individuals.

FIGURE 2. A: *P. crebesconiscus* **sp. nov.**; B & C: *P. cunyuensis* **sp. nov.**, the arrow shows the cephalic lateral lobe; D: *P. nahidae* **sp. nov.**; E & F: *P. occidentoniscus* **sp. nov.**, the arrow shows the cephalic lateral lobe; G: *P. pallidus* **sp. nov.**; H: *P. subterraneus*; scale bar of the image c: 0.5 mm, scale bar in other images: 1 mm. All images are of paratype specimens.

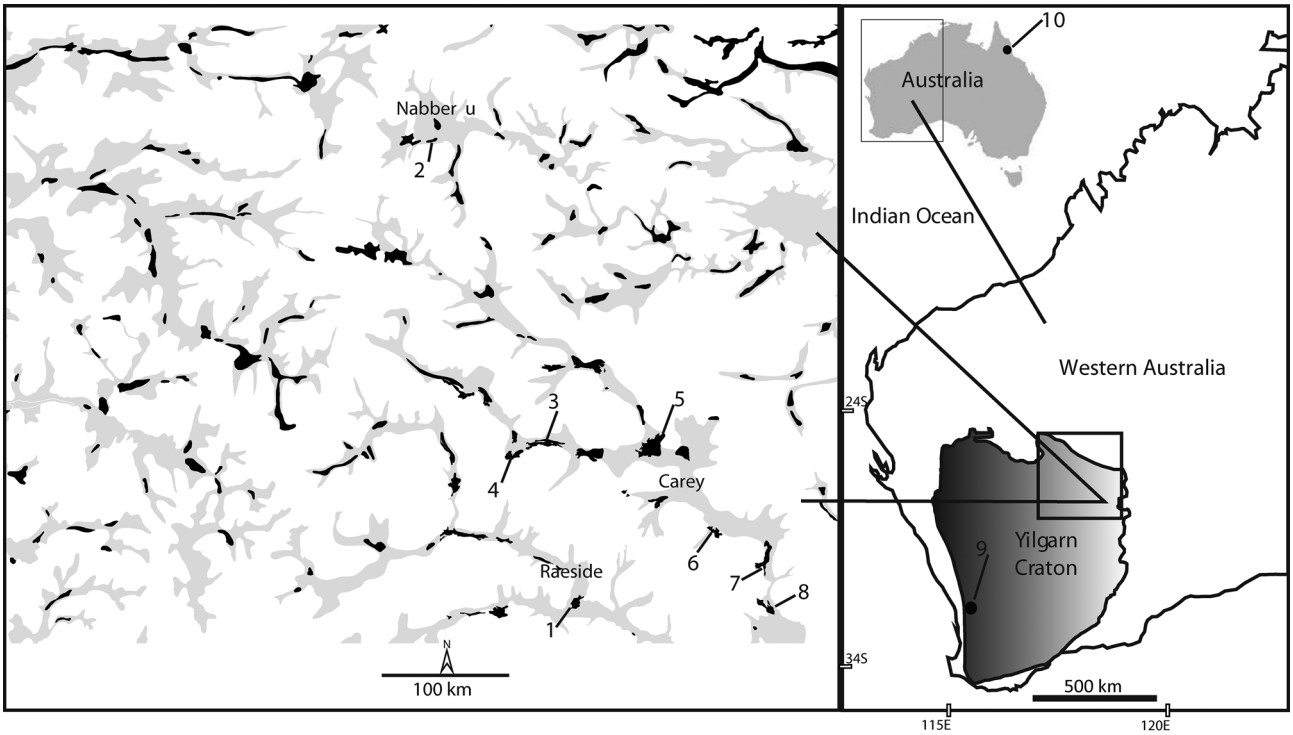

FIGURE 3. A map of the Yilgarn region of Western Australia and the sampled calcrete aquifers (black) with their position in the palaeodrainages (grey shading) including Carey, Nabberu and Raeside. Numbers for calcretes and non-calcrete areas include: 1, Sturt Meadows (SM); 2, Cunyu (CUN); 3, Lake Miranda East (LME); 4, Lake Miranda West (LMW); 5, Halfpenny Well (HAW); 6, Nambi (NAM); 7, Laverton Downs Windarra (LDW); 8, Mt Morgans (MOR); 9, Goosberry Hill, Wooroloo (WOO); 10, Wongalinga Beach, Qld.

Diversity and distribution of species. With the species treated here there are now seven described species of *Paraplatyarthrus*, however, there are 12 potential species in the phylogenetic analysis using a *COI* divergence threshold of >11%.

Distributional patterns (Fig. 3) of subterranean Paraplatyarthridae include both restricted and relatively widespread taxa. For instance, *P. pallidus* **sp. nov**. (Lake Miranda East/West), *P. cunyuensis* **sp. nov**. (Cunyu) and *P. occidentoniscus* **sp. nov**. (Sturt Meadows) are only recorded from single calcrete aquifer bodies, are likely to have distributions that match the area of the calcrete (i.e. only a few hundred square kilometres) and, therefore, should be considered as short range endemic taxa (Harvey 2002). However, *P. crebesconiscus* **sp. nov**. has been recorded from multiple distinct calcretes including Nambi, Halfpenny and Laverton Downs. To date, the surface species, *P. nahidae* **sp. nov**., has only been recorded from a single site at Mt Morgans, but this general area has not been well collected and the species may well have a broader distribution than this.

Key to species of *Paraplatyarthrus* from Western Australia*

1. Maxilla 2 with no delimiting line between lobes (see Fig. 17E). . . . . *P. pallidus* **sp. nov.**
- Maxilla 2 with delimiting line between lobes (see Fig. 5F) 2
2. Eyes absent (no ommatidia present) (see Fig. 2H) . . . . . *P. subterraneus*
- Eyes present or significantly reduced (1–5 ommatidia present) 3
3. Male genital papilla apically truncated (Fig. 9C); eyes with 1 very reduced orange ommatidium-like component (Fig. 2C) . . . . . *P. cunyuensis* **sp. nov.**
- Male genital papilla apically rounded (Fig. 19A); eyes with 3–5 black ommatidia 4
4. Cephalic lateral lobes enlarged (Fig. 11H); male pleopod 1 exopodite with posterior point developed (Fig. 13B). . . . . *P. nahidae* **sp. nov.**
- Cephalic lateral lobes small (Figs. 2E–F); male pleopod 1 exopodite with no or a weak posterior point (Fig. 16B) 5
5. Eyes with 3 ommatidia . . . . . *P. occidentoniscus* **sp. nov.**
- Eyes with 5 ommatidia . . . . . *P. crebesconiscus* **sp. nov.**

(**P. australiensis* could not be included in the key due to a lack of material)

***Paraplatyarthrus australiensis* Wahrberg, 1922 comb. nov.**
Fig 4A–C

Trichorhina australiensis Wahrberg, 1922: 189–195, fig 59.—Poore 2002: 325–326.

Holotype. Wooroloo, Goosberry Hill, Western Australia, Zoology Museum, University of Hamburg [N.B. Loan of the holotype was denied to be dispatched]

Material examined. Paratypes: K-18517, K-18521, K-18522 (gender unknown), Wooroloo, Goosberry Hill, Western Australia (Zoology Museum, University of Hamburg)

Diagnosis. Body pale. Eyes with 4–6 developed black ommatidia.

Remarks. This species has not been recollected in more than 90 years. Unfortunately, the paratypes examined were in poor condition which precluded a full redescription. However, the following characters match those for *Paraplatyerthrus* as follows: dorsal body covered with scale setae; cephalothorax with postfrons and profrons fused; outer endite of first maxilla with four outer teeth (including one stout smaller tooth; Fig. 4A); maxilla 2 with inner lobe smaller than outer one, a fine suture delimiting lobes (Fig. 4B); maxilliped endite with two small arrow-like setae on distal margin (Fig. 4C). As the antennae were missing from the paratypes, the presence of a capillary furrow on the antennal peduncle could not be observed. However, the characters above provide enough evidence to confirm its generic placement. Additional sampling from the type locality and a further morphological examination should be undertaken for this species as a matter of priority.

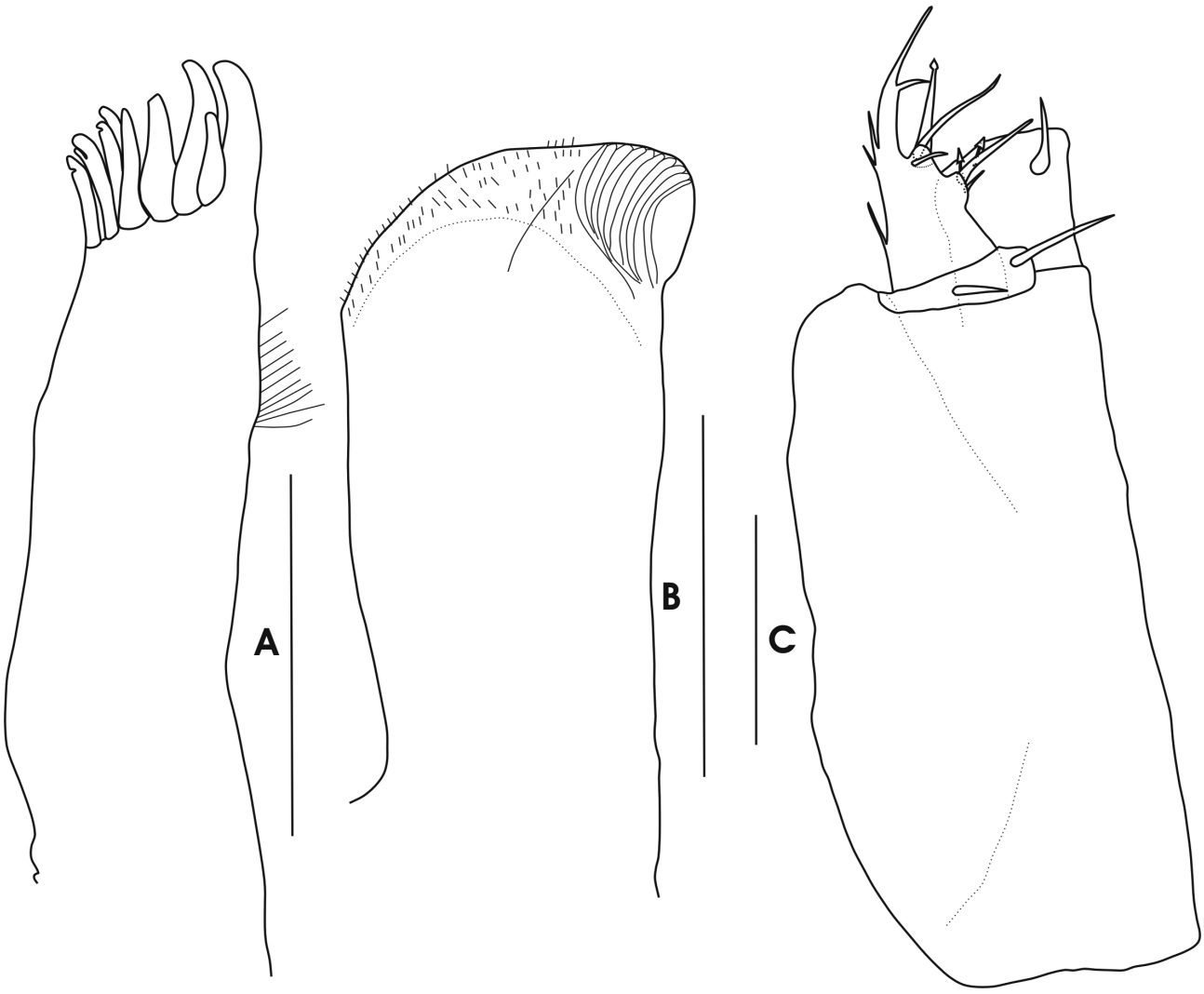

FIGURE 4. *Paraplatyarthrus australiensis* (Paratype), A, maxilla 1 outer endite; B, maxilla 2; C, maxilliped. Scale bars: 0.1 mm.

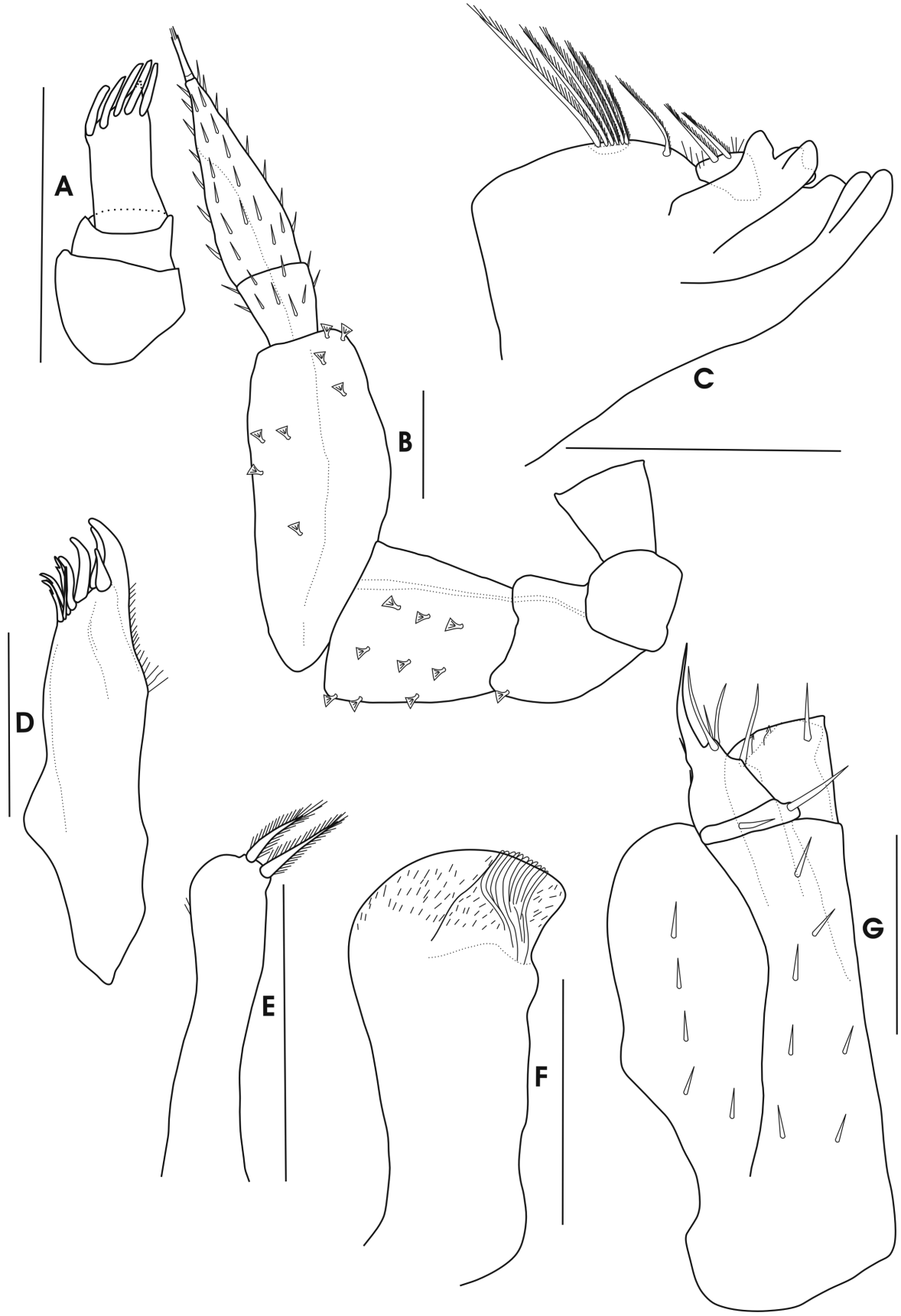

FIGURE 5. *Paraplatyarthrus crebesconiscus* **sp. nov.**, (Holotype, ♂), A, antenna 1; B, antenna 2; C, left mandible; D, maxilla 1 outer endite; E, maxilla 1 inner endite; F, maxilla 2; G, maxilliped. Scale bars: 0.1 mm.

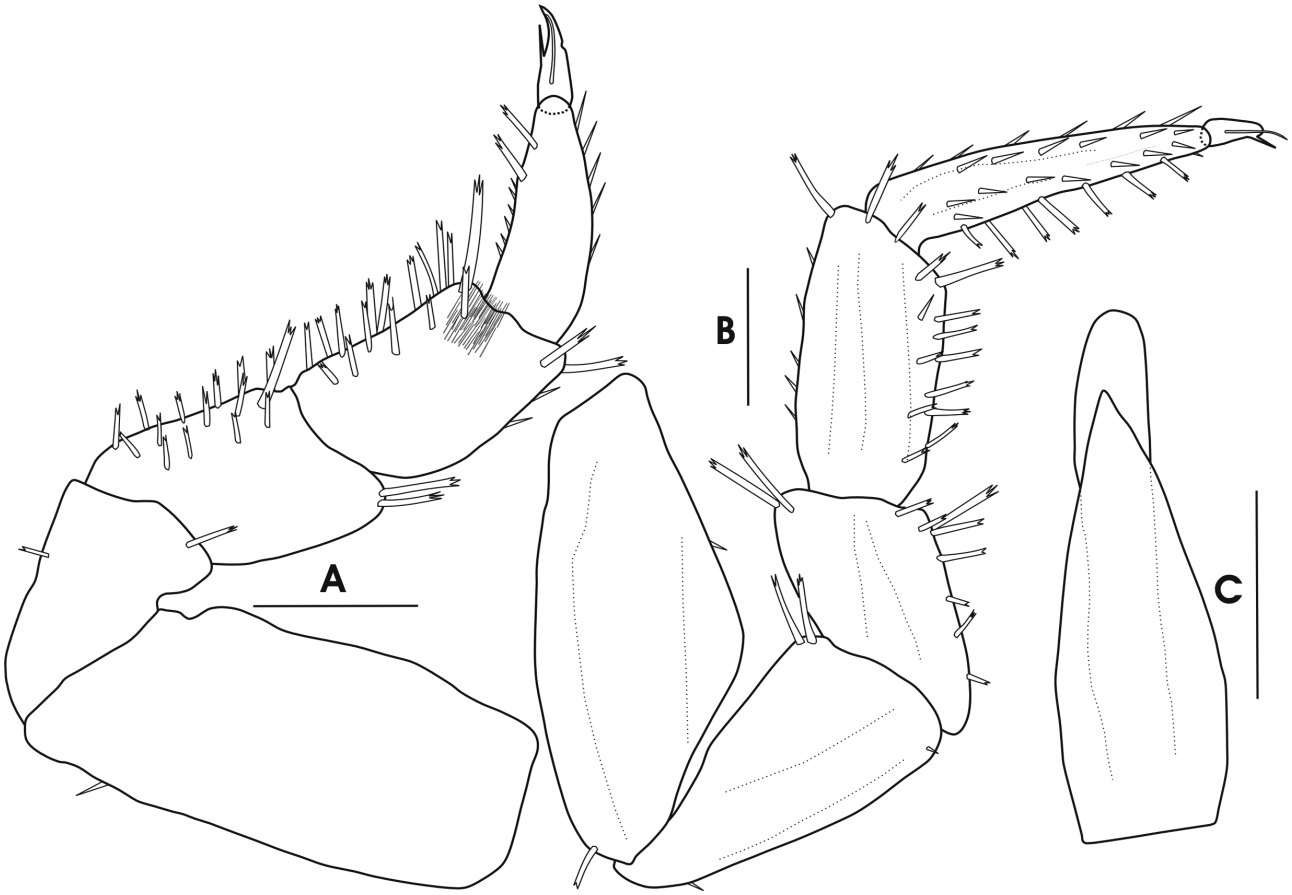

FIGURE 6. *Paraplatyarthrus crebesconiscus* **sp. nov.**, (Holotype, ♂), A, pereopod 1; B, pereopod 7; C, genital papilla. Scale bars: 0.1 mm.

***Paraplatyarthrus crebesconiscus* Javidkar and King, sp. nov.**

Figs 5–7, 2A, 20B

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Type material. *Holotype***:** Male, WAM C 54789 (BES16478.3), Halfpenny Well calcrete, Millbillillie pastoral station, Eastern Murchison region, Western Australia, Australia, 27.69661°S, 121.33953°E, Oct 2011, coll. W. F. Humphreys & S. J. B. Cooper.

Paratypes: 3 females (WAM C 54790, BES16478.2; WAM C 54791, BES16478.4; WAM C 54792, BES16478.5), 1 male (WAM C 54793, BES16478.1) (same locality and collection data as holotype); 1 female (WAM C 66918, BES15072.1) (same calcrete as holotype), 27.69661°S, 121.33953°E, Mar 2009, coll. W. F. Humphreys & S.J.B. Cooper; 1 female (WAM C 66919, BES15073), Nambi calcrete, Eastern Murchison region, Western Australia, Australia, 28.22232°S, 121.82014°E, Mar 2009, coll. W.F. Humphreys & S.J.B. Cooper; 1 female (WAM C 66920, BES17224.1), Laverton Downs Calcrete-Windarra, Eastern Murchison region, Western Australia, Australia, 28.50517°S, 122.18038°E, May 2012, coll. W.F. Humphreys & S.J.B. Cooper; 1 specimen, Gender indeterminate (WAM C 66917, BES15072) (same calcrete as holotype), 27.69661°S, 121.33953°E, Mar 2009, coll. W.F. Humphreys & S.J.B. Cooper; 1 specimen, Gender indeterminate (WAM C 66921, BES17224.2), Laverton Downs Calcrete-Windarra, Eastern Murchison region, Western Australia, Australia, 28.50517°S, 122.18038°E, May 2012, coll. W.F. Humphreys & S.J.B. Cooper.

Diagnosis. Eyes with 5 ommatidia. Cephalic lateral lobes not developed. Male pleopod 1 exopodite with weak posterior point.

Description. Male (WAM C 54789). *Body* length 2.7 mm, cephalon and posterior body weakly pigmented. Cephalic lateral lobes small. Eyes with 5 black ommatidia.

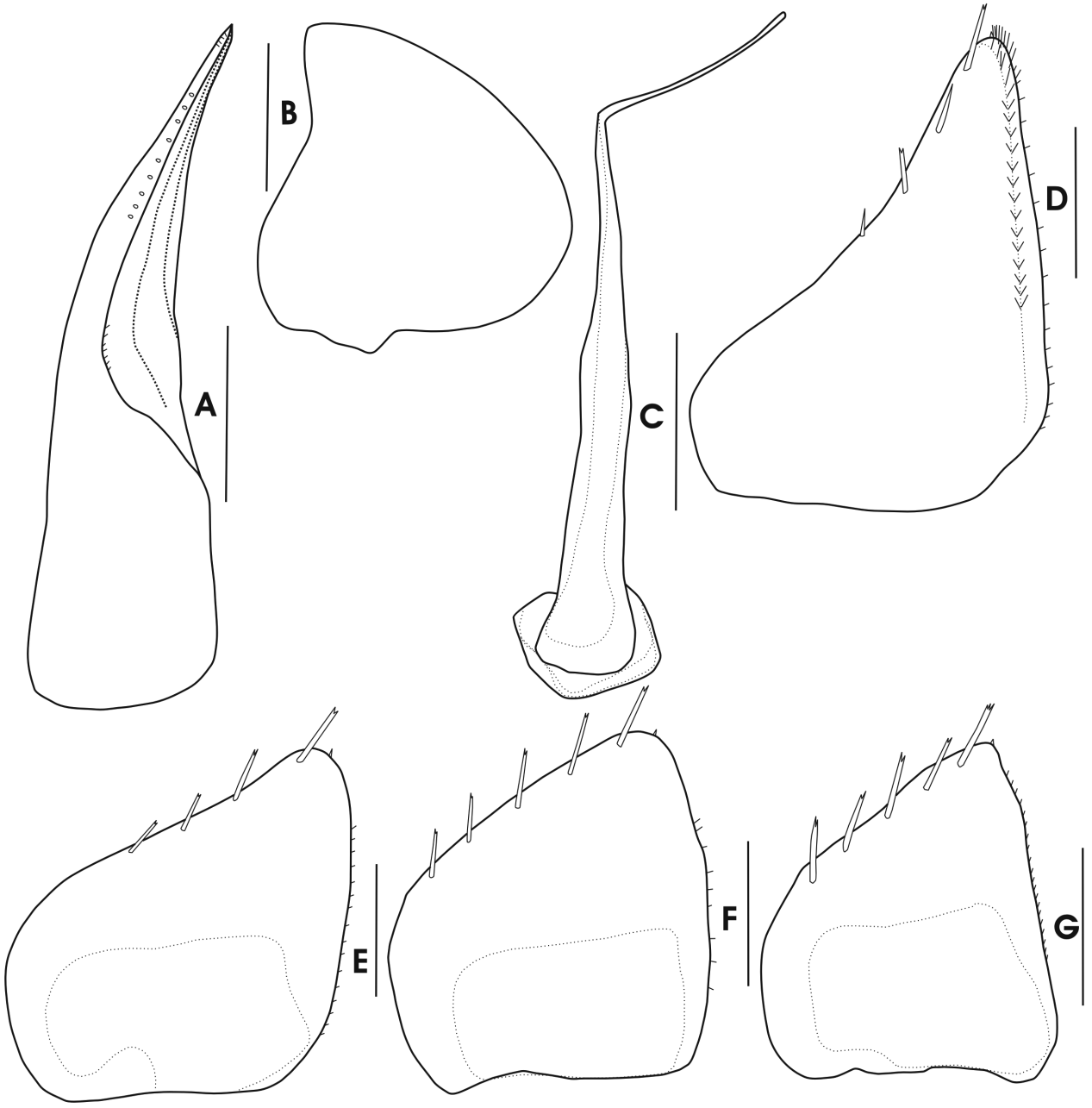

FIGURE 7. *Paraplatyarthrus crebesconiscus* **sp. nov.**, (Holotype, ♂), A, pleopod 1 endopodite; B, pleopod 1 exopodite; C, pleopod 2 endopodite; D, pleopod 2 exopodite; E, pleopod 3 exopodite; F, pleopod 4 exopodite; G, pleopod 5 exopodite. Scale bars: 0.1 mm.

Antenna 1 with medial article shortest, distal article longest (Fig. 5A). *Antenna 2* flagellum with basal article shorter, about 1/3 length of distal article (Fig. 5B).

Left mandible pars molaris (Fig. 5C) with 6 to 7 plumose setae; hairy lobe bearing 2 plumose setae. *Right mandible* pars molaris with about 6 plumose setae; 1 plumose seta on hairy lobe. *Maxilla 1* outer endite (Fig. 5D) with outer group of 4 teeth covering about 65% of marginal area, inner group of 3 cleft teeth, 1 simple and 1 stalk-like tooth; inner endite (Fig. 5E) with 2 very fine setae on subapical outer marginal corner. *Maxilla 2* (Fig. 5F) apically bilobate; inner lobe comparatively smaller than outer one; inner and outer lobes delimited by fine suture. *Maxillipedal* endite with 1 large seta close to subapical inner corner; distal articles of palp with 1 large proximal seta, medial tuft of 2 large and 1 small setae and apical tuft of probably 2 long setae (Fig. 5G).

Epimeron 1 rounded anteriorly. In dorsal view, posterolateral corner of *pereonites 1–4* rounded. Posterolateral corner of *pereonites 5–7* posteriorly directed (Fig. 20B). *Pleonal epimeron 5* reaching (but not surpassing) uropodal sympodite. *Noduli laterales* with D/C ratios not constant in tergites 1–7.

Pereopod 1 (Fig. 6A) carpus inner margin densely covered with long serrate setae, tuft of fine setae present medially near distal margin; propodus with both small simple and large serrate setae; dactylus with long seta not exceeding claws, outer claw relatively straight, with small depression on medial part. *Pereopod 7* (Fig. 6B) carpus not showing any sexual dimorphism.

Pleon outline continuous with pereon. *Pleopod 1* endopodite (Fig. 7A) slender, with simple apex, medial margin with group of fine setae, very fine setae also close to tip of endopodite; exopodite (Fig. 7B) heart-shaped with posterior point not developed. Genital papilla (Fig. 6C) ventral sheath apically pointed, surpassed by long rounded lobe. *Pleopod 2* endopodite (Fig. 7C) with distal half slender, not reaching to posterior apex of pleopod 4 exopodite. *Pleopod 2–5* exopodites (Fig. 7D–G) with 4 to 5 cleft and simple long setae. *Pleotelson* triangular and pointed. *Uropodal* exopodites surpassing pleotelson; endopodites slightly exceeding pleotelson; uropodal sympodite with elongated circumflex-shaped incision.

Etymology. The species name is composed of the Latin word 'crebesco' (meaning widespread) and 'oniscus', referring to its comparatively widespread distribution in the calcrete aquifers.

Remarks. *Paraplatyarthrus crebesconiscus* **sp. nov.** appears in the same clade with *P. nahidae* **sp. nov.** (Fig. 1) from which it has a 12.3% *COI* divergence (Appendix 1). Unlike *P. nahidae*, the body is semi-pigmented to pale, cephalic lobes are not developed on the head, and male pleopod 1 exopodite has a weak posterior point. The body length varies between 2.7 mm and 3.5 mm. Some individuals have slightly stronger pigmentation on the dorsal body (Fig. 2A). It has been recorded from calcrete aquifers at Halfpenny Well (Millbillillie pastoral station), Nambi pastoral station and Laverton Downs pastoral station (Mt Windarra), and the Eastern Murchison region of Western Australia.

Paraplatyarthrus cunyuensis **Javidkar and King, sp. nov.**

Figs 8–10, 2B–C, 20A

urn:lsid:zoobank.org:act:BEAB73B4-325A-42EE-B647-7F6A0F96EA03

Type material. *Holotype*: Male, WAM C 54809 (BES17212.2), State Barrier Fence calcrete, Cunyu pastoral station, Eastern Murchison region, Western Australia, Australia; 25.7642°S, 120.1143°E, May 2012, coll. W.F. Humphreys & S.J.B. Cooper.

*Paratypes***:** 1 female (WAM C 54813, BES17212.1) (Same locality and collection data as holoptype); 3 females (WAM C 54810, BES17217; WAM C 54811, BES17217.1; WAM C 54812, BES17217.2), 25.7726°S, 120.1108°E, May 2012, coll. W.F. Humphreys & S.J.B. Cooper; 4 females (WAM C 54814, BES15090.2; WAM C 66911, BES15090.1; WAM C 66912, BES15090.3; WAM C 54815, BES15081.1), 25.78064°S, 120.10745°E, March 2009, coll. W.F. Humphreys & S.J.B. Cooper; 1 male (WAM C 54816, BES15081.2), 25.78064°S, 120.10745°E, March 2009, coll. W.F. Humphreys & S.J.B. Cooper. All paratypes from State Barrier Fence calcrete, Cunyu pastoral station, Eastern Murchison region, Western Australia, Australia.

Diagnosis. Eyes with 1 reduced orange ommatidium-like component (vestigial) without external eye structure. Male genital lobe apically truncated, subapically protruded.

Description. Male (WAM C 54809), *Body* completely pale (Fig. 2B). Cephalon lateral lobes present but not enlarged. Eyes with 1 reduced orange ommatidium-like component (vestigial) with no external eye structure (Fig. 2C). *Antenna 1* medial article shortest, distal and basal articles same size but longer than medial one (Fig. 8A). *Antenna 2* flagellum with basal article short about 1/3 of distal article (Fig. 8B). *Left mandible* (Fig. 8C) pars molaris with about 5 plumose setae; hairy lobe bearing 2 plumose setae. *Right mandible* pars molaris with few long plumose setae; 1 relatively long plumose seta on hairy lobe, 1 smaller set a bit lower. *Maxilla 1* outer endite (Fig. 8D) with outer group of 4 teeth covering about 65% of marginal area, inner group of 2 cleft, 2 truncated and 1 simple tooth; inner endite (Fig. 8E) with no fine setae on subapical outer marginal corner. *Maxilla 2* (Fig. 8F) apically bilobate, inner lobe smaller than outer one, fine suture delimiting lobes. *Maxillipedal* endite (Fig. 8G) with 1 large seta close to subapical inner corner; distal articles of palp with 1 long proximal seta, 2 medial smaller setae and apical tuft of few long setae, 2 small setae on medial outer margin of palp.

Epimeron 1 rounded anteriorly. In dorsal view, posterolateral corner of *pereonites 1–3* rounded. Posterolateral corner of *pereonites 4–7* posteriorly directed (Fig. 20A). *Pleonal epimeron 5* posterior corner not surpassing uropodal sympodite. *Tergite 7* with noduli laterales relatively at same distance to posterior margin. *Noduli Laterales* with D/C ratios not constant in tergites 1–7.

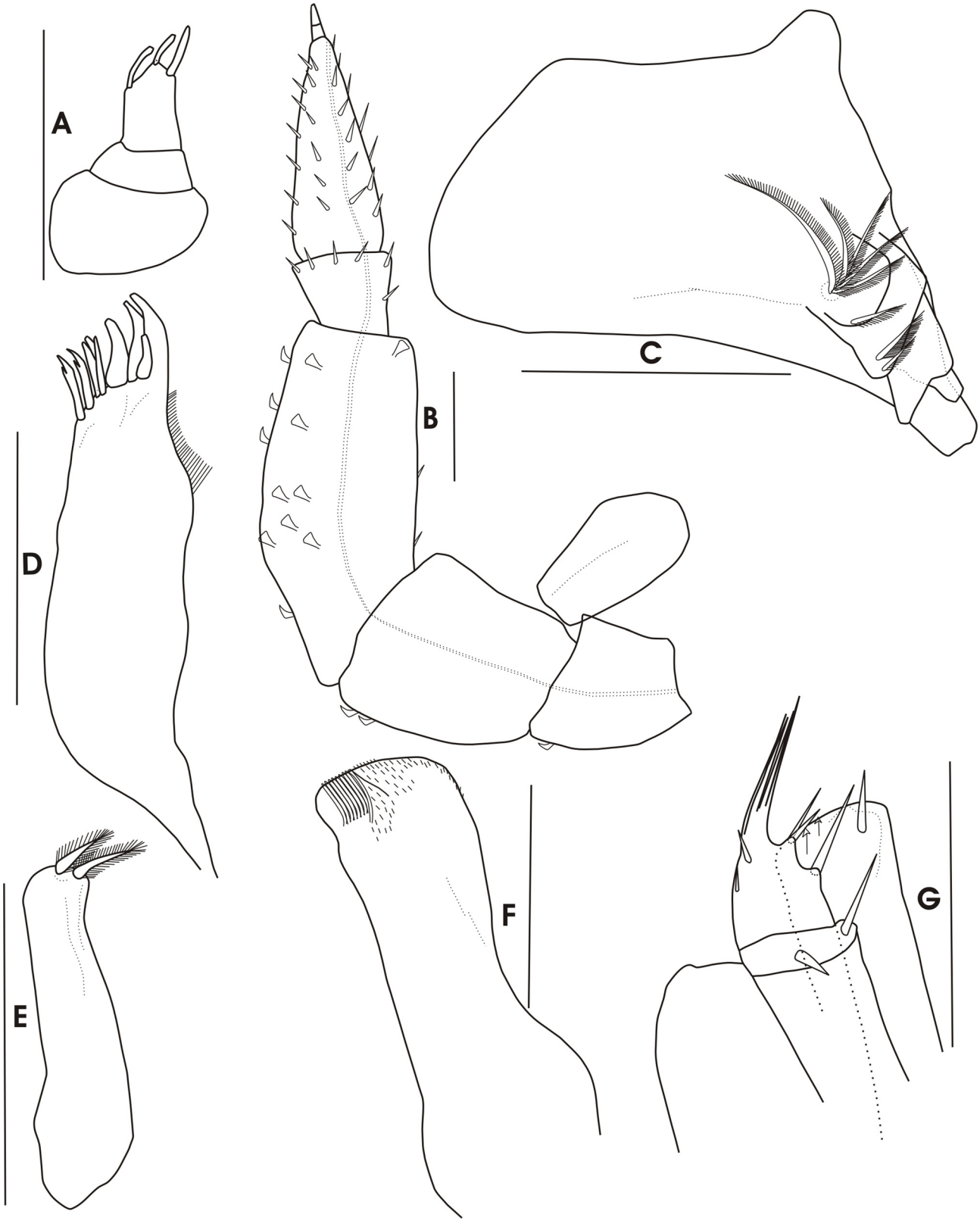

FIGURE 8. *Paraplatyarthrus cunyuensis* **sp. nov.**, (Holotype, ♂), A, antenna 1; B, antenna 2 (Paratype); C, left mandible; D, maxilla 1 outer endite; E, maxilla 1 inner endite; F, maxilla 2; G, maxilliped. Scale bars: 0.1 mm.

Pereopod 1 carpus inner margin not dense, with few long and short serrate setae, tuft of fine setae present (Fig. 9A); propodus with both small simple and large serrate setae; dactylus with long fine seta not surpassing claws, outer claw relatively straight, with small depression on medial part. *Pereopod 7* not showing any sexual

dimorphism (Fig. 9B). *Pleon* outline continuous with pereon. *Pleopod 1* endopodite (Fig. 10A) with simple apex, distal part with very fine small setae; exopodite heart-shaped, posterior point not developed (Fig. 10B). *Genital papilla* ventral sheath apically pointed and surpassed by long lobe which is apically truncated and subapically protruded (Fig. 9C). *Pleopod 2, 3 and 5* exopodites with 1 marginal simple seta (Fig. 10C, D, F). *Pleopod 4* exopodite with 2 marginal setae (Fig. 10E). *Pleotelson* triangular, with rounded tip. *Uropodal* exopodites well-developed and surpassing pleotelson; endopodites slightly exceeding pleotelson, insertion point at almost same level as exopodite; sympodite with extended circumflex-shaped incision, with rounded apex (not reaching proximal sympodite) on outer side (Fig. 9D).

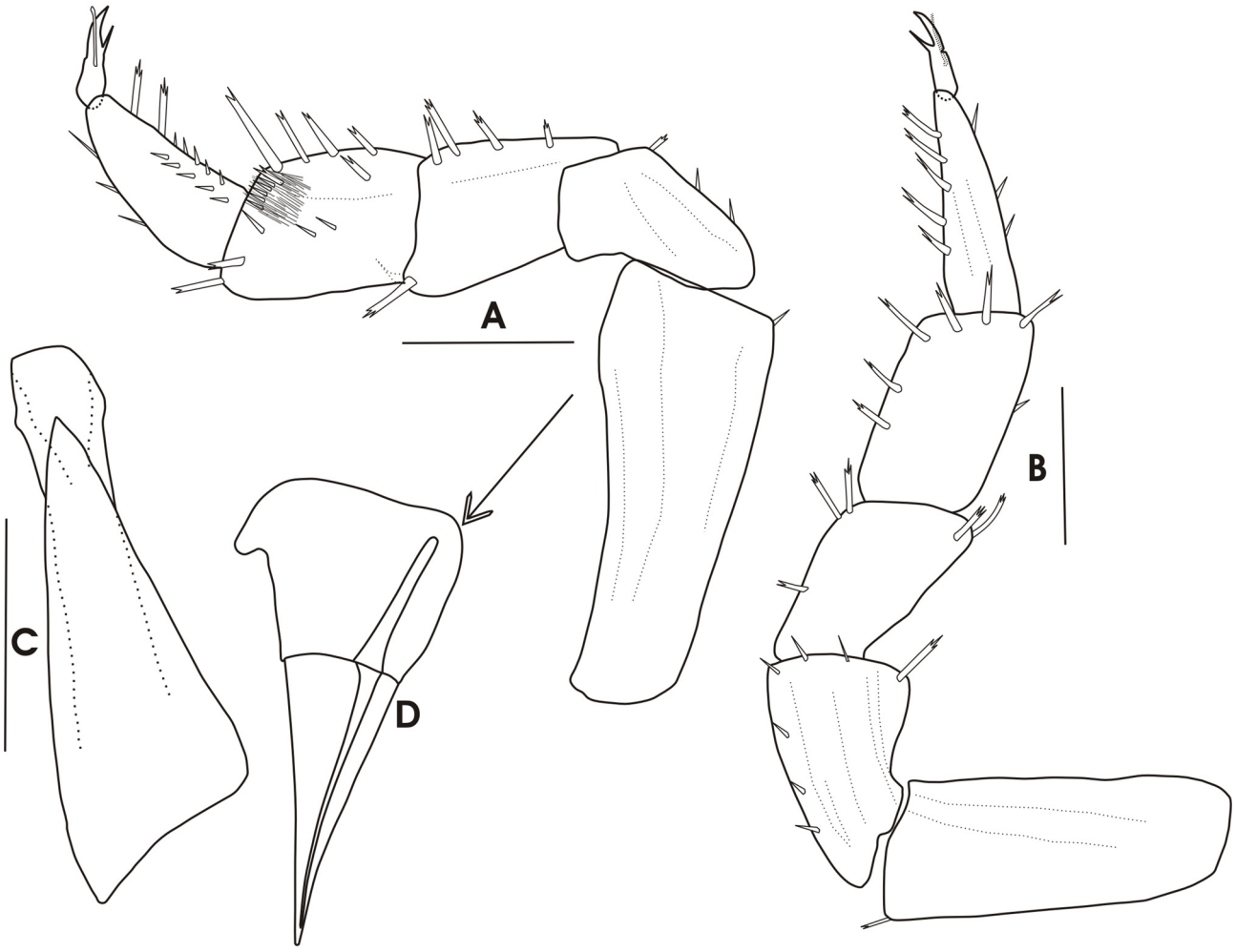

FIGURE 9. *Paraplatyarthrus cunyuensis* **sp. nov.**, (Holotype, ♂), A, pereopod 1; B, pereopod 7; C, genital papilla (Paratype); D, uropod (Paratype), the arrow shows uropodal sympodite incision with rounded-apex. Scale bars: 0.1 mm.

Etymology. The species name refers to its confined distribution in the Cunyu calcrete aquifer.

Remarks. *Paraplatyarthrus cunyuensis* **sp. nov.** appears in the same clade with *P. occidentoniscus* **sp. nov.** (Fig. 1) from which it has a *COI* divergence of 15.9% (Appendix 1). The new species is easily distinguishable based on its pale body and the occurrence of 1 reduced orange ommatidium-like component (vestigial) with no external eye structure. The body length of *P. cunyuensis* varies between 3.0 mm and 4.5 mm, and the pleotelson is somewhat pointed in a few individuals. This species was referred to as Taxon 7 in Javidkar *et al.* (2015). It is restricted to a single calcrete aquifer, Cunyu State Barrier Fence calcrete, Eastern Murchison region, Western Australia.

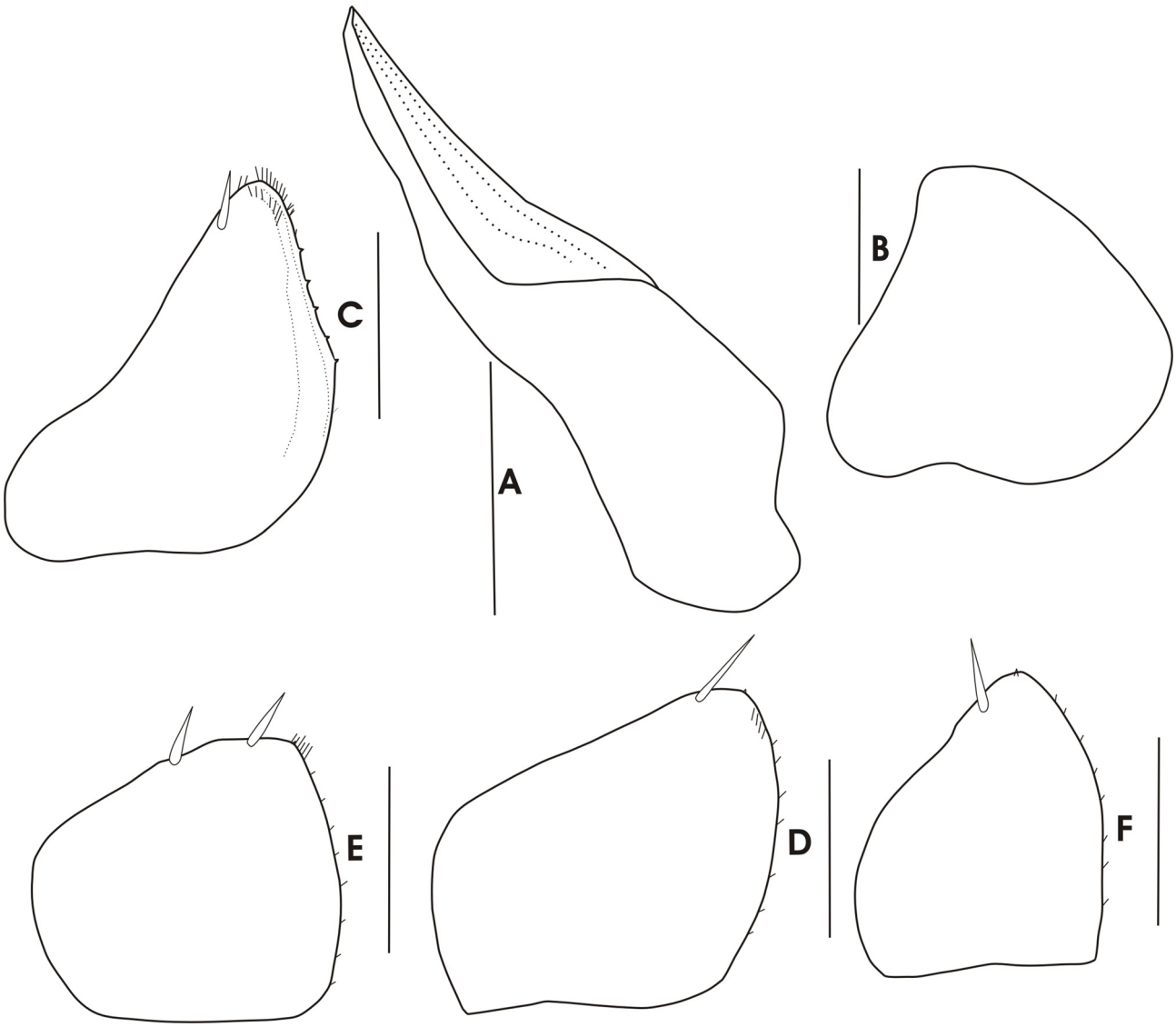

FIGURE 10. *Paraplatyarthrus cunyuensis* **sp. nov.**, (Holotype, ♂), A, pleopod 1 endopodite; B, pleopod 1 exopodite (Paratype); C, pleopod 2 exopodite; D, pleopod 3 exopodite; E, pleopod 4 exopodite; F, pleopod 5 exopodite. Scale bars: 0.1 mm.

Paraplatyarthrus nahidae **Javidkar and King, sp. nov.**
Figs 11–13, 2D, 20A
urn:lsid:zoobank.org:act:09F086DD-1E71-4CCE-92C1-1E1E1B7A2D0F

Type material. *Holotype*: Male (WAM C 54785, JA100), Mt Morgans calcrete, Eastern Murchison region, Western Australia, Australia; 28.73272°S, 122.15430°E, 8 Aug 2011, coll. M. Javidkar & W.F. Humphreys.

Paratypes: 2 males (WAM C 54786, JA103; WAM C 54787, JA105); 1 female (WAM C 54788, JA104); 2 additional paratype specimens (WAM C 54817, JA101; WAM C 54818, JA102) are kept on SEM stubs (WAM). Same locality and collection data as holotype.

Diagnosis. Body fully pigmented (surface species). Posterior point of male pleopod 1 exopodite developed. Single nodulus lateralis on profrons of cephalon. Cephalic lateral lobes enlarged.

Description. Male (WAM C 54785), *Body* length 5.0 mm, fully pigmented from head to pleotelson (Fig. 2D). Cephalon lateral lobes enlarged, with straight sides and apex (Fig. 11H). Single *nodulus lateralis* occurring on profrons. Eyes with 5 ommatidia. *Antenna 1* with medial article shortest, distal article longest (Fig. 11A). *Antenna 2* flagellum with basal article short, less than half length of distal article (about 0.35 of distal) (Fig. 11B). *Left mandible* (Fig. 11C) pars molaris with tuft of 6 plumose setae; hairy lobe bearing 2 plumose setae, top covered with

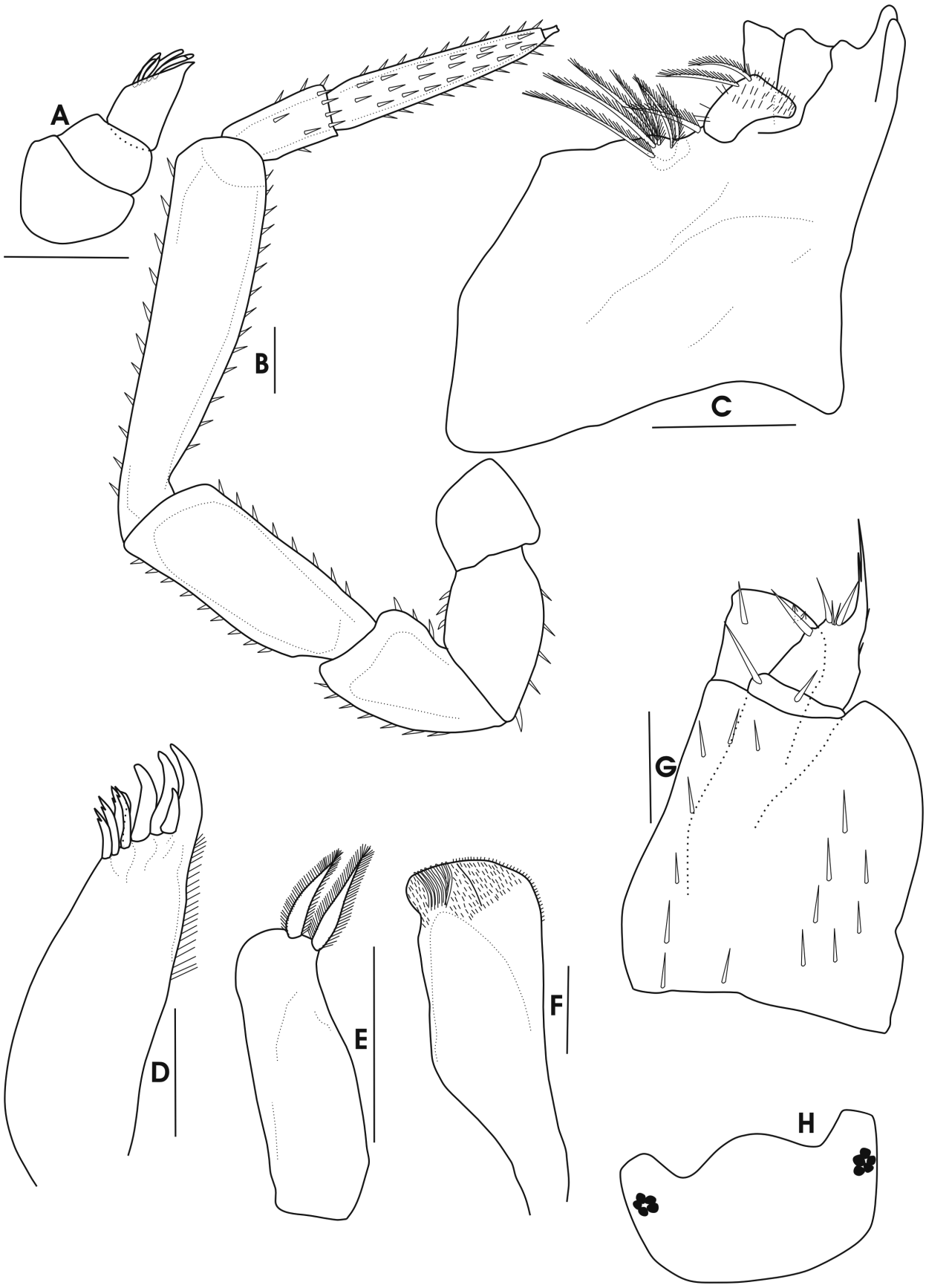

FIGURE 11. *Paraplatyarthrus nahidae* **sp. nov.**, (Holotype, ♂), A, antenna 1; B, antenna 2; C, left mandible; D, maxilla 1 outer endite; E, maxilla 1 inner endite; F, maxilla 2; G, maxilliped; H, cephalon. Scale bars: 0.1 mm.

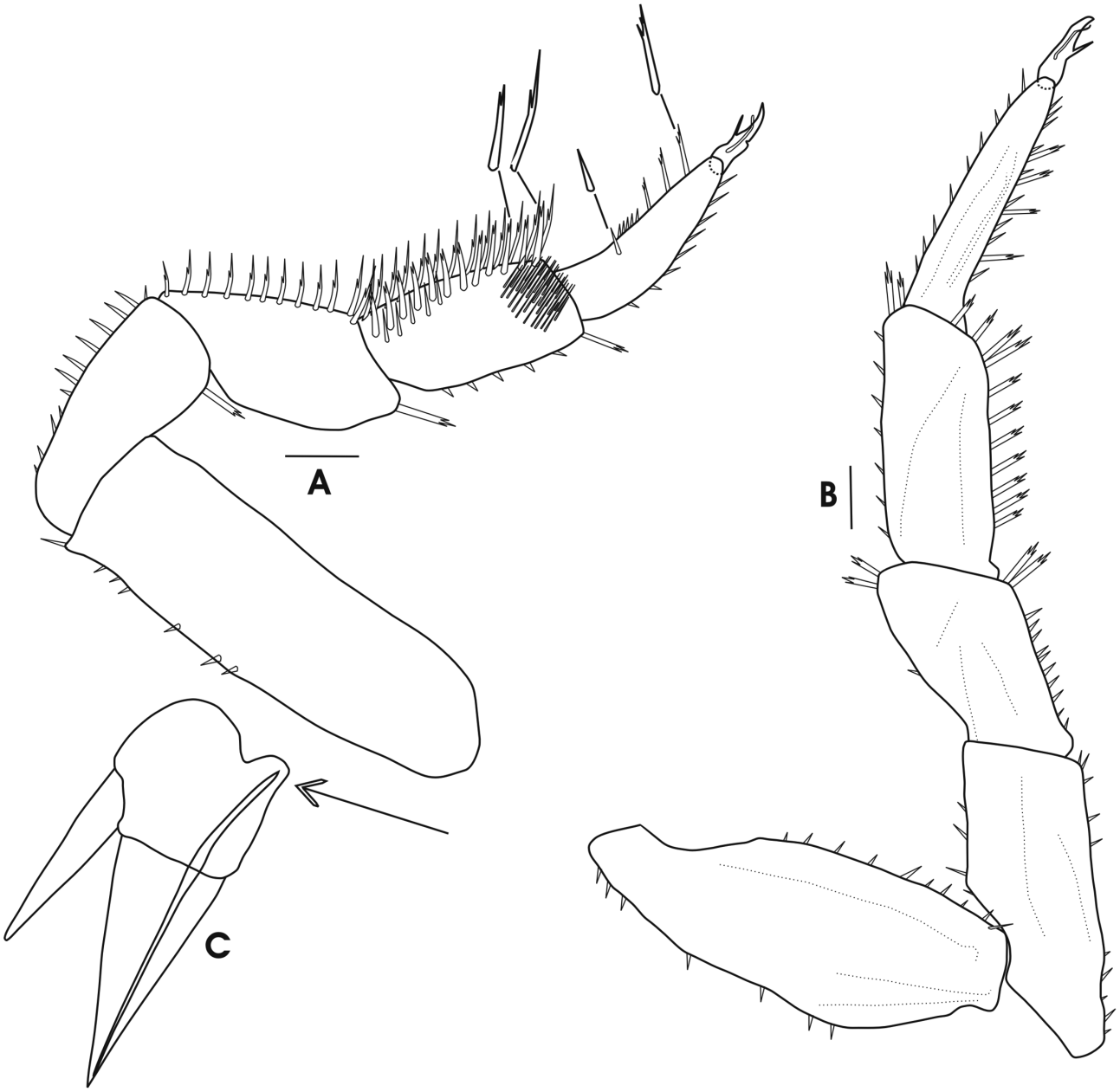

FIGURE 12. *Paraplatyarthrus nahidae* **sp. nov.**, (Holotype, ♂), A, pereopod 1, the arrows show different types of setae on the carpus and propodus; B, pereopod 7; C, uropod. Scale bars: 0.1 mm.

small fine setae, with few fine setae down the lobe. *Right mandible* pars molaris with several long to short plumose setae (about 8); 1 plumose seta on hairy lobe; several very fine setae between hairy lobe and pars molaris. *Maxilla 1* outer endite (Fig. 11D) with outer group of 4 teeth covering about 67% of marginal area, inner group of 4 cleft teeth and 1 simple tooth; inner endite (Fig. 11E) with no fine setae on subapical outer marginal corner. *Maxilla 2* (Fig. 11F) apically bilobate; inner lobe relatively large, inner and outer lobes delimited by fine suture. *Maxillipedal* endite (Fig. 11G) with 1 large seta close to subapical inner corner; distal articles of palp with 1 large proximal seta, medial tuft of 2 large and 2 smaller setae and apical tuft of few long setae; outer margin of palp with 1–2 fine setae.

Epimeron 1 bluntly projected anteriorly. In dorsal view, posterolateral corner of *pereonites 1–3* rounded. Posterolateral corner of *pereonites 4–7* posteriorly directed (Fig. 20A*). Noduli Laterales* with B/C ratio (Appendix 2) on tergite 1 less than 0.2 (0.18); tergite 4 with noduli laterales most distant from lateral margin (D/C ratio more than 0.8); tergite 5 with noduli laterales closest to posterior margin; D/C ratios not constant in tergites 1–7 (Appendix 2).

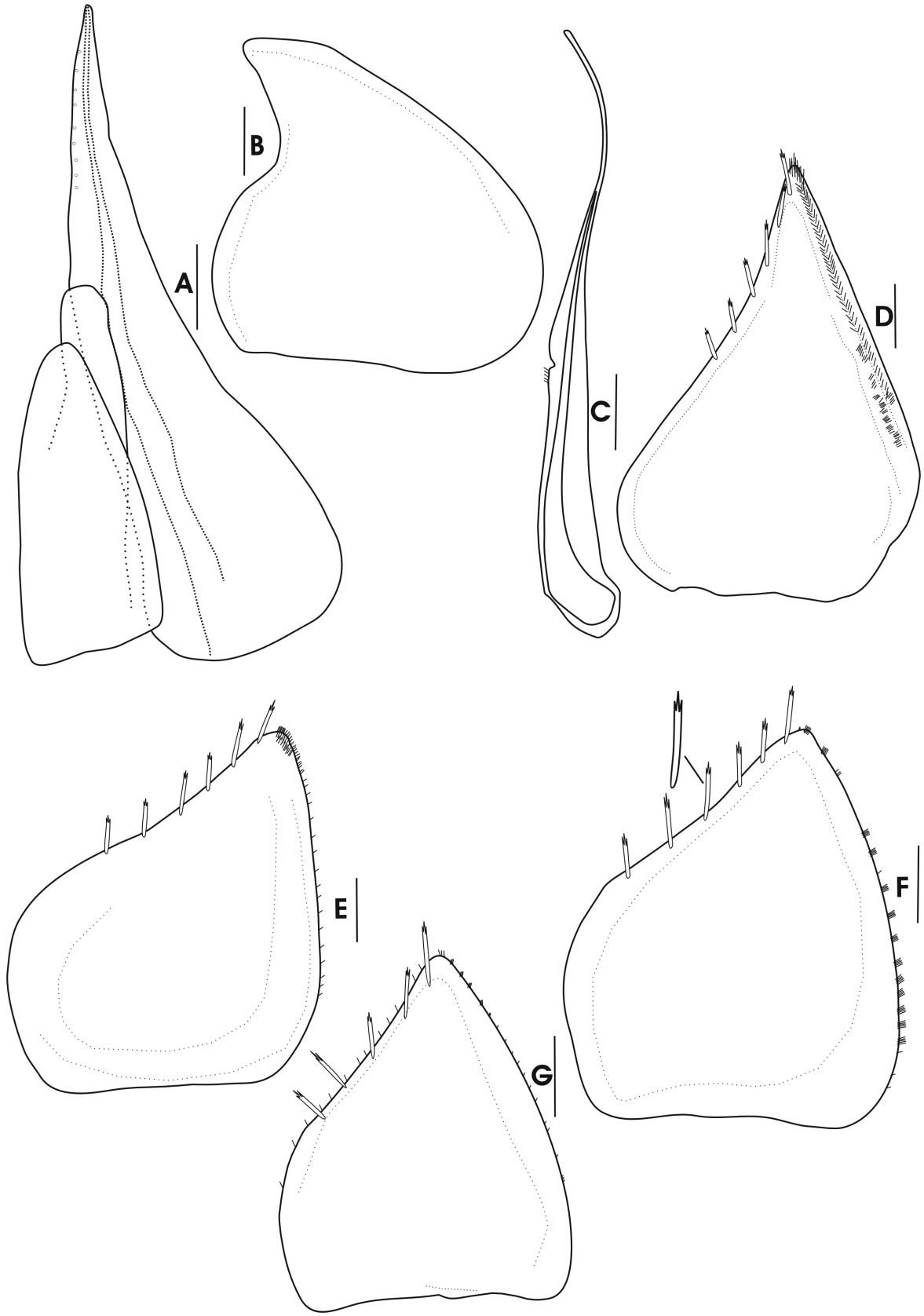

FIGURE 13. *Paraplatyarthrus nahidae* **sp. nov.**, (Holotype, ♂), A, pleopod 1 endopodite and genital papilla; B, pleopod 1 exopodite; C, pleopod 2 endopodite; D, pleopod 2 exopodite; E, pleopod 3 exopodite; F, pleopod 4 exopodite, the arrow shows the serrate setae; G, pleopod 5 exopodite. Scale bars: 0.1 mm.

Pereopod 1 (Fig. 12A) carpus inner margin densely covered with long serrate setae, two types of long cleft setae and one simple and short recognisable, dense tuft of fine setae present medially near distal margin; propodus with both small simple and large serrate setae; dactylus with long narrow seta not exceeding claws, outer claw relatively straight. *Pereopod 7* (Fig. 12B) carpus not showing any sexual dimorphism.

Pleon outline continuous with pereon (Fig. 2D). *Pleopod 1* endopodite (Fig. 13A) moderately apically acute, with narrow spermatic furrow and row of very small spine-like setae along medial margin; exopodite (Fig. 13B) with prominent posterior point and no marginal setae. Genital papilla (Fig. 13A) ventral sheath apically rounded and surpassed by long rounded-tip lobe. *Pleopod 2* endopodite (Fig. 13C) long, reaching to base of pleopod 5, with small depression on medial endopodite, with tuft of very fine setae posteriorly. *Pleopods 2–5* (Fig. 13D–G) exopodites with 5–6 marginal long serrate setae. *Pleotelson* pointed (Fig. 2D). *Uropodal* exopodites well developed, longer than pleotelson; endopodites slightly exceeding pleotelson; sympodite (Fig. 12C) with elongated suture.

Etymology. This species is named for Nahid Shokri (wife of M. Javidkar), for her significant support during this research.

Remarks. *Paraplatyarthrus nahidae* **sp. nov.** is a surface species, and is similar to *P. crebesconiscus* in having 5 ommatidia, however, the size of each ommatidium is larger and fully developed in *P. nahidae*. This species is easily distinguished from the rest of described *Paraplatyarthrus* species based on its fully pigmented body, the male pleopod 1 exopodite having a posterior point developed, and the cephalic lateral lobes being enlarged. The body length varies between 4.5 mm and 5.5 mm. This species was referred to as Taxon 1 in Javidkar *et al.* (2015). It has been recorded from Mt Morgans borefield, Eastern Murchison region, Western Australia.

***Paraplatyarthrus occidentoniscus* Javidkar and King, sp. nov.**

Figs 14–16, 2E–F, 20A

urn:lsid:zoobank.org:act:FDBD3D8A-A787-46F4-8056-7E136B072D8A

Type material. *Holotype***:** Male, WAM C 54794 (BES15551.10), Sturt Meadows pastoral station calcrete, Eastern Murchison region, Western Australia, Australia; 28.70124°S, 120.90361°E, Jul 2010, coll. W.F. Humphreys & S.J.B. Cooper.

*Paratypes***:** 5 females (WAM C 54795, BES15551.12; WAM C 54796, BES15551.23; WAM C 54797, BES15551.4; WAM C 54798, BES15551.22; WAM C 66914, BES15551.9), 5 males (WAM C 54799, BES15551.14; WAM C 54800, BES15551.3; WAM C 54801, BES15551.1; WAM C 54802, BES15551.17; WAM C 66913, BES15551.8) (same locality and collection data as holoptype). 2 females (WAM C 66915, BES17225.1; WAM C 66916, BES17225.2) (same calcrete as holotype), 28.70034°S, 120.90260°E, May 2012, coll. W.F. Humphreys & S.J.B. Cooper.

Diagnosis. Cephalic lateral lobes small. Eyes with 3 black ommatidia. Male pleopod 1 exopodite with no posterior point.

Description. Male (WAM C 54794), *Body* pale. Cephalic lateral lobes small and rounded. Eyes with 3 black ommatidia. *Antenna 1* medial article shortest, distal and basal articles approximately same size (Fig. 14A). *Antennal 2* flagellum (Fig. 14B) with basal article shorter, about 1/3 length of distal one. *Left mandible* pars molaris with 5–6 plumose setae; 2 plumose setae on hairy lobe. *Right mandible* pars molaris (Fig. 14C) with about 6 plumose setae; hairy lobe bearing 2 plumose setae on top and down lobe, with few single fine setae between 2 plumose setae. *Maxilla 1* outer endite (Fig. 14D) with outer group of 4 teeth covering about half of marginal area, also with inner group of 3 cleft teeth, 1 simple and 1 stalk-like tooth; inner endite (Fig. 14E) with plumose setae very close to each other so they can appear as single stout plumose seta, 1 single very fine seta on subapical outer marginal corner. *Maxilla 2* (Fig. 14F) apically bilobate; inner lobe slightly smaller than outer one; inner and outer lobes delimited by fine suture. *Maxillipedal* endite (Fig. 14G) with 1 large seta close to subapical inner corner; distal articles of palp with 1 large proximal seta, 2 medial large setae and apical tuft of few long setae.

Epimeron 1 rounded anteriorly. In dorsal view, posterolateral corner of *pereonites 1–3* rounded. Posterolateral corner of *pereonites 4–7* posteriorly directed (Fig. 20A). *Pleonal epimeron 5* not reaching uropodal sympodite. *Tergites 6 and 7* (one distant to lateral margin) with noduli laterales closest to posterior margin.

Pereopod 1 (Fig. 15A) carpus inner margin with both small simple setae and long and short serrate setae but

not dense, tuft of fine setae present; propodus with both small simple and large serrate setae; dactylus with long narrow seta not exceeding claws, outer claw sickle-shaped with small depression on medial part. *Pereopod 7* (Fig. 15B) not showing any sexual dimorphism.

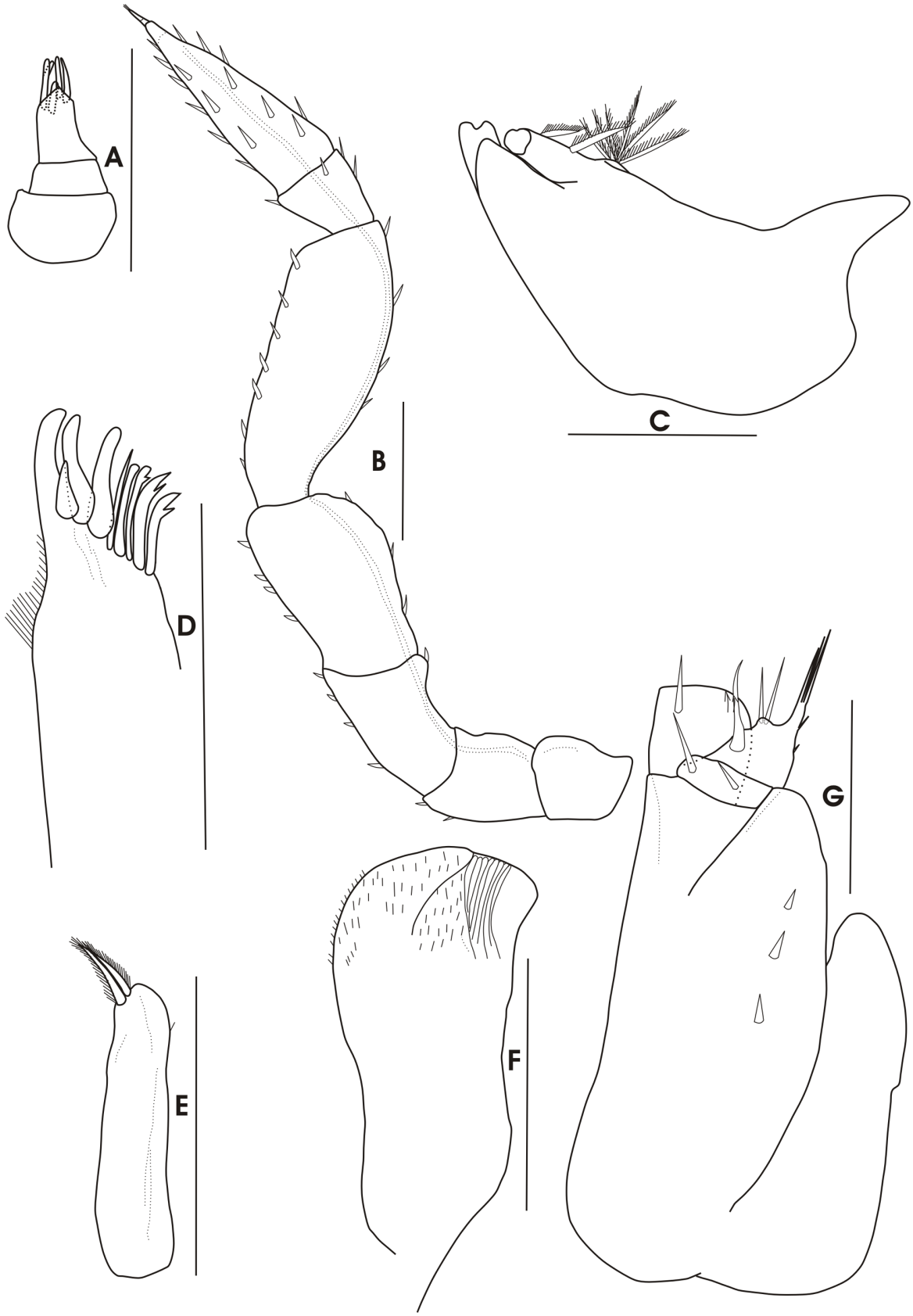

FIGURE 14. *Paraplatyarthrus occidentoniscus* **sp. nov.**, (Holotype, ♂), A, antenna 1; B, antenna 2; C, right mandible (Paratype); D, maxilla 1 outer endite; E, maxilla 1 inner endite; F, maxilla 2; G, maxilliped. Scale bars: 0.1 mm.

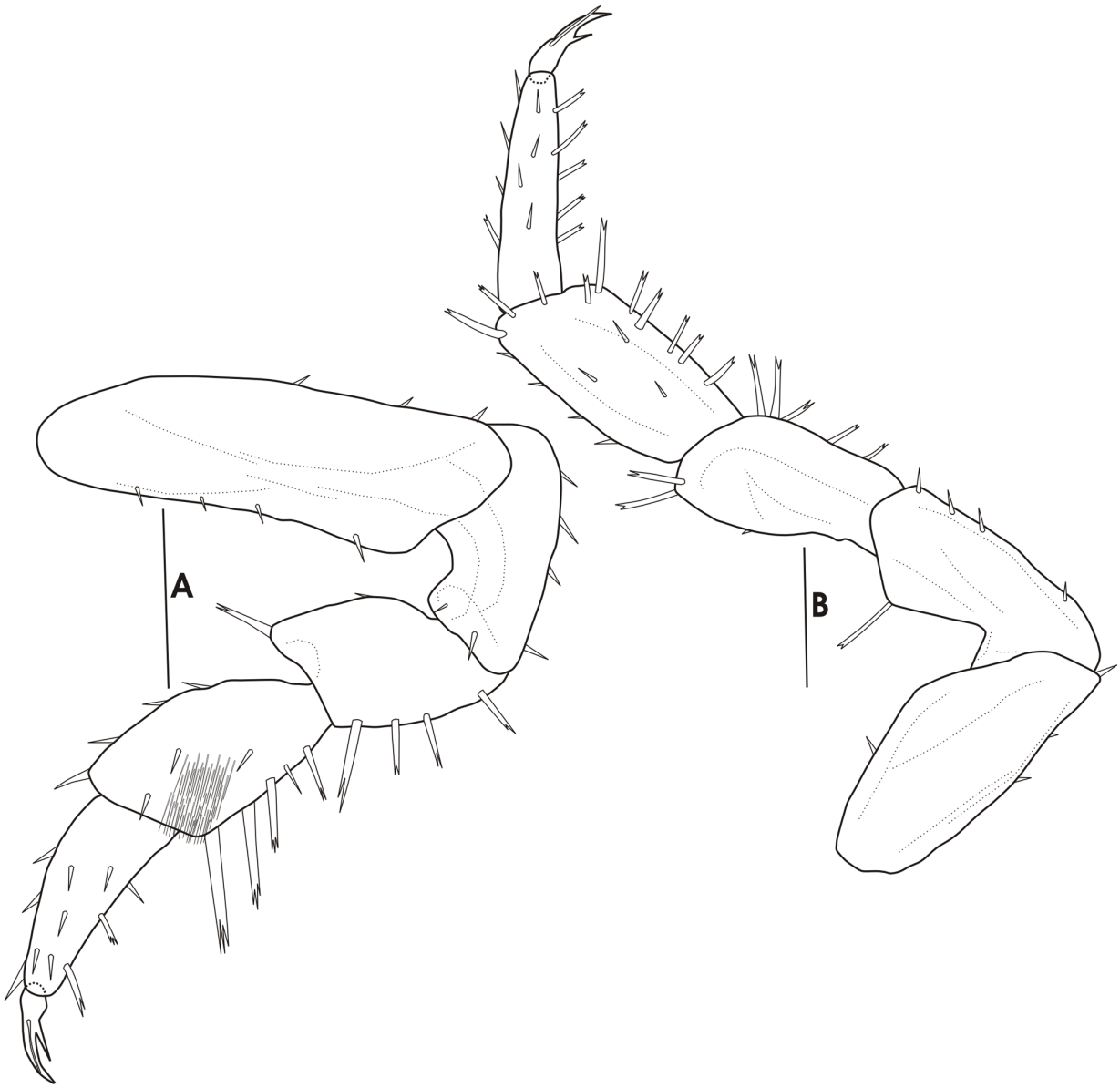

FIGURE 15. *Paraplatyarthrus occidentoniscus* **sp. nov**., (Holotype, ♂), A, pereopod 1; B, pereopod 7. Scale bars: 0.1 mm.

Pleon outline continuous with pereon. *Pleopod 1* endopodite (Fig. 16A) slender, with simple apex including very fine setae, very fine setae in medial part; exopodite (Fig. 16B) heart-shaped, with no posterior point or setae on margins. *Genital papilla* (Fig. 16A) ventral sheath apically pointed and surpassed by long distally rounded lobe. *Pleopod 2* endopodite (Fig. 16C) very slender; exopodite with 2 long marginal setae and very fine setae on other side (Fig. 16D). *Pleopod 3–5* exopodites (Fig. 16E–G) with 3 simple and serrate marginal long setae.

Pleotelson triangular and pointed. *Uropodal* exopodites surpassing pleotelson; endopodites, inserted at approximately same level (a bit upper) as exopodites; sympodite with extended circumflex-shaped incision on outer side.

Etymology. The species name is composed of the Latin 'occidente' meaning west, referring to its Western Australian distribution, plus oniscus.

Remarks. *Paraplatyarthrus occidentoniscus* **sp. nov.** is distinguished from the described *Paraplatyarthrus* species by a combination of characters, including eyes with 3 black ommatidia, the cephalic lateral lobes being small, and the male pleopod 1 exopodite with no or a very weak developed posterior point. The body length varies between 2.0 mm and 4.5 mm, and the body pigmentation varies from semi- to weakly-pigmented to pale (Figs. 2E, F). This species was referred to as Taxon 3 in Javidkar *et al.* (2015). It is confined to a single calcrete aquifer, Sturt Meadows pastoral station, Eastern Murchison region, Western Australia.

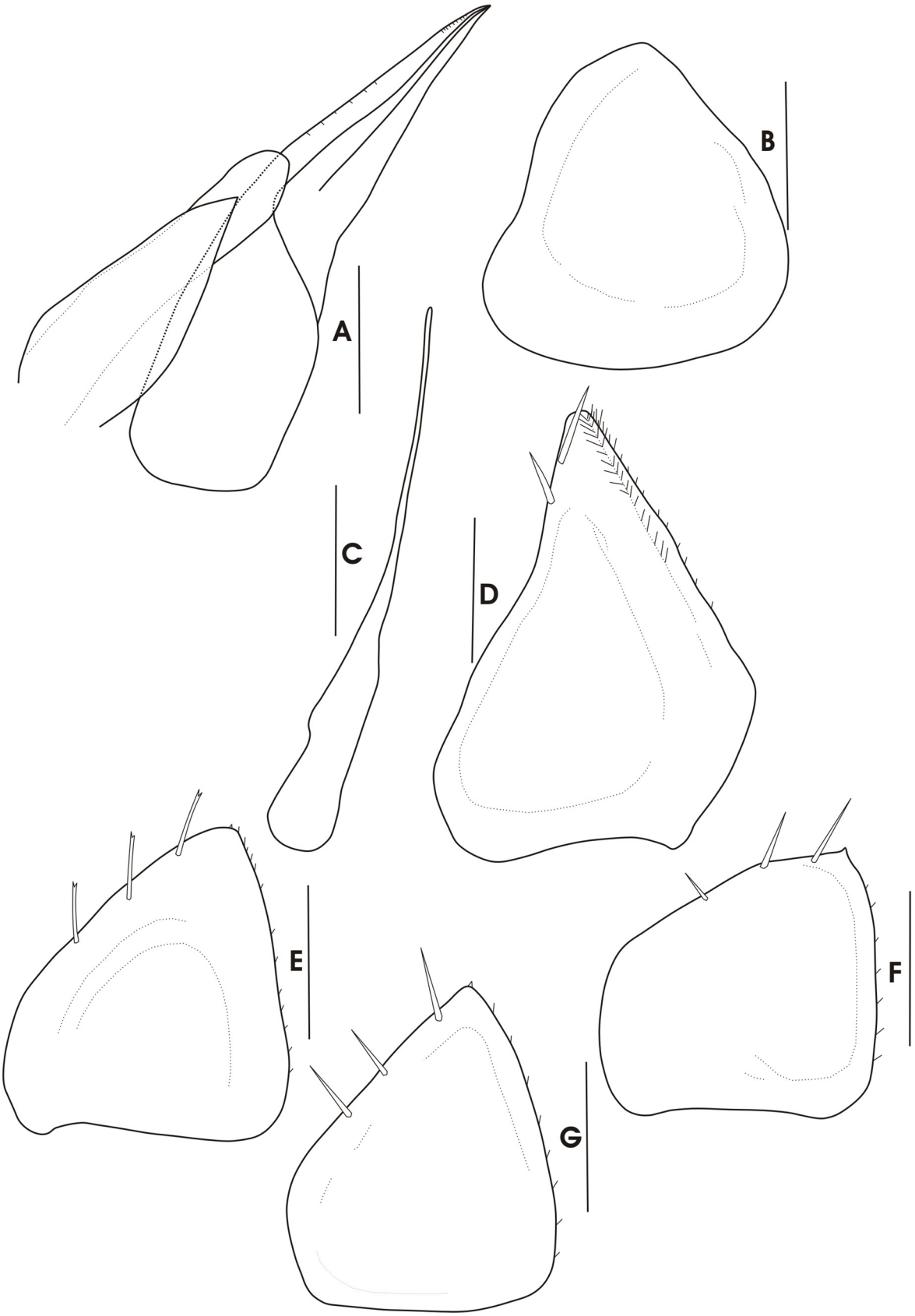

FIGURE 16. *Paraplatyarthrus occidentoniscus* **sp. nov.**, (♂), A, pleopod 1 endopodite and genital papilla (Paratype); B, pleopod 1 exopodite (Paratype); C, pleopod 2 endopodite (Paratype); D, pleopod 2 exopodite (Paratype); E, pleopod 3 exopodite (Paratype); F, pleopod 4 exopodite (Holotype); G, pleopod 5 exopodite (Paratype). Scale bars: 0.1 mm.

***Paraplatyarthrus pallidus* Javidkar and King, sp. nov.**
Figs 17–19, 2G, 20B
urn:lsid:zoobank.org:act:149ADE06-BD8E-4517-A3D4-F3A2182CEEF8

Type material. *Holotype***:** Male, WAM C 54803 (BES15545.2), Lake Miranda East calcrete aquifer, Yakabindie pastoral station, Eastern Murchison region, Western Australia, Australia; 27.66405°S, 120.61015°E, Jul 2010, coll. S.J.B. Cooper & W.F. Humphreys.

Paratypes: Lake Miranda East: 2 females (WAM C 54804, BES15545.8; WAM C 54805, BES15545.3), 3 males (WAM C 54806, BES15545.11; WAM C 54807, BES15545.10; WAM C 54808, BES15545.6) (same locality and collection data as holotype), 1 female (WAM C 66909, BES15543.3), 1 male (WAM C 66910, BES17215.2), 27.66384°S, 120.61076°E, May 2012, coll. S.J.B. Cooper & W.F. Humphreys. Lake Miranda West (same calcrete as holotype): 2 males (WAM C 66897, BEST15538.2; WAM C 66898, BES15538.3), 2 females (WAM C 66899, BES15538.14; WAM C 66908, BES15538.10), 27.74667°S, 120.5266°E, Jul 2010, coll. S.J.B. Cooper & W.F. Humphreys.

Diagnosis. Single significantly reduced black ommatidium-like component (vestigial) with no eye structure. Body pale. Maxilla 2 with no delimiting line between lobes, inner lobe contracted into small area in distal inner apical corner. Uropodal sympodite with incision on outer margin, apically truncated and merging with proximal sympodite. D/C ratio is relatively constant in tergites 1–7, except for one next to lateral margin in tergite 7.

Description. Male (WAM C 54803), *Body* length 2.7 mm, completely pale (Fig. 2G). Cephalon lateral lobes small, with straight sides. Eyes significantly reduced, with only 1 dark ommatidium-like component (vestigial) with no external eye structure. *Antenna 1* medial article shortest, distal article longest, seemingly bearing 6 aesthetascs on top (Fig. 17A). *Antenna 2* flagellum with basal article short, about 1/3 of distal one. *Left mandible* (Fig. 17B) pars molaris with about 8 plumose setae; hairy lobe bearing 2 plumose setae, with no small fine setae. *Right mandible* pars molaris with probably more than 4 plumose setae; 1 plumose seta on hairy lobe. *Maxilla 1* outer endite (Fig. 17C) with outer group of 4 teeth covering about 65% of marginal area, inner group of 2 cleft, 2 simple and 1 truncated tooth; inner endite (Fig. 17D) with 3 fine setae on subapical outer marginal corner. *Maxilla 2* (Fig. 17E) not apically bilobate (delimiting line hardly recognisable); inner lobe contracted into small area on distal inner corner. *Maxillipedal* endite (Fig. 17F) with 1 large seta close to subapical inner corner; distal articles of palp with 1 large proximal seta, medial tuft of 2 or 3 simple setae and apical tuft of few long setae.

Epimeron 1 bluntly projected anteriorly. In dorsal view, posterolateral corner of *pereonites 1–4* rounded. Posterolateral corner of *pereonites 5–7* posteriorly directed (Fig. 20B). *Pleonite 5* posterior corner reaching uropod sympodite but not surpassing it. with *Noduli laterales* at approximately same distance from posterior margin in tergites 2–7; D/C ratio is relatively constant in tergites 1–7, except for one next to lateral margin in tergite 7 (Appendix 2).

Pereopod 1 carpus inner side with long simple and serrate setae, tuft of fine setae present medially near distal margin (Fig. 18A); propodus with both small simple and large serrate setae; dactylus with long seta exceeding claws, outer claw relatively straight. *Pereopod 7* carpus not showing sexual dimorphism (Fig. 18B). *Pleon* outline continuous with pereon. *Pleopod 1* endopodite (Fig. 19A) moderately acute, with narrow spermatic furrow and few very fine setae close to distal part; exopodite (Fig. 19B) with no marginal setae, posterior point not developed. Genital papilla ventral sheath apically pointed and surpassed by long rounded-tip lobe (Fig. 19A). *Pleopod 2* endopodite (Fig. 19C) long and very slender closer to distal end. *Pleopod 2–5* exopodites with 3 to 4 medium to large simple and serrate setae (Fig. 19D–G). *Pleotelson* pointed. *Uropodal* exopodites surpassing pleotelson; endopodites slightly exceeding pleotelson; sympodite with extended incision and truncated apex linking proximal and distal sympodite (Fig. 18C).

Etymology. The new species name is taken from the Latin ‘pallidus’ alluding to its pale body.

Remarks. *Paraplatyarthrus pallidus* **sp. nov**. has a minimum *COI* divergence of 16.5% from the described *Paraplatyarthrus* species (Appendix 1). *Paraplatyarthrus pallidus* is easily distinguished based on having only 1, significantly reduced, pale dark ommatidium-like component (vestigial) with no external eye structure, a pale body, Maxilla 2 not apically bilobate (delimiting line hardly recognisable), and the incision on the uropod sympodite merging with the proximal sympodite. The body length varies between 2.7 mm and 4.0 mm. This species was referred to as Taxon 4 in Javidkar *et al.* (2015). It is restricted to the Lake Miranda East/West calcrete, Yakabindie pastoral station, Eastern Murchison region, Western Australia.

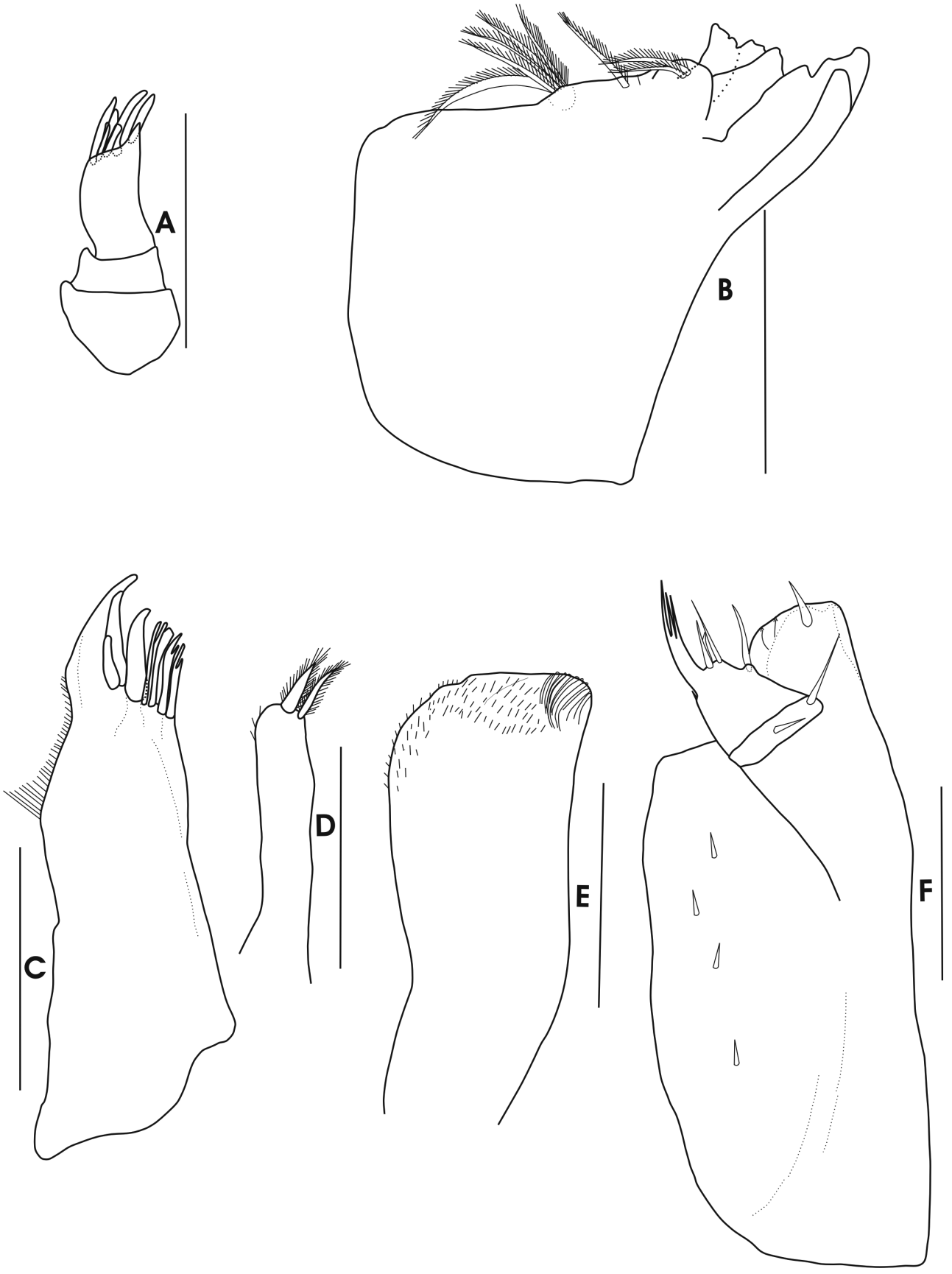

FIGURE 17. *Paraplatyarthrus pallidus* **sp. nov.**, (Holotype, ♂), A, antenna 1; B, left mandible; C, maxilla 1 outer endite; D, maxilla 1 inner endite; E, maxilla 2; F, maxilliped. Scale bars: 0.1 mm.

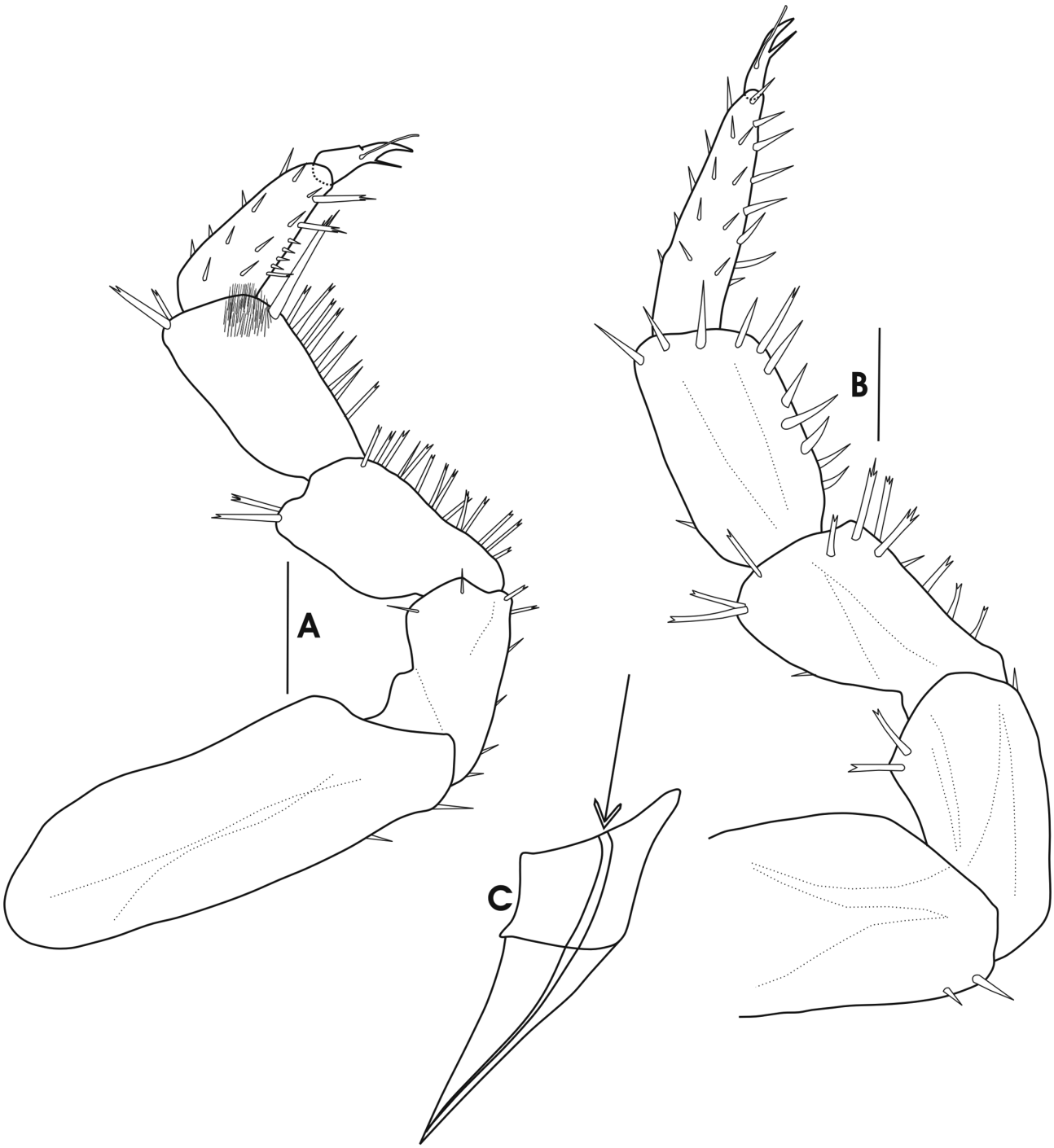

FIGURE 18. *Paraplatyarthrus pallidus* **sp. nov.**, (Holotype, ♂), A, pereopod 1; B, pereopod 7; C, uropod (Paratype). Scale bars: 0.1 mm.

Paraplatyarthrus subterraneus Javidkar and King, 2015

Fig. 2H.

Paraplatyarthrus subterraneus Javidkar and King, in Javidkar *et al*. 2015: 567.

Type material. *Holotype***:** Male, WAM C53623 (BES15525.19), Laverton Downs Windarra calcrete, Eastern Murchison region, Western Australia, Australia; 28.50282°S, 122.17726°E, 13 July 2010, coll. W.F. Humphreys & S.J.B. Cooper, deposited in the Western Australian Museum.

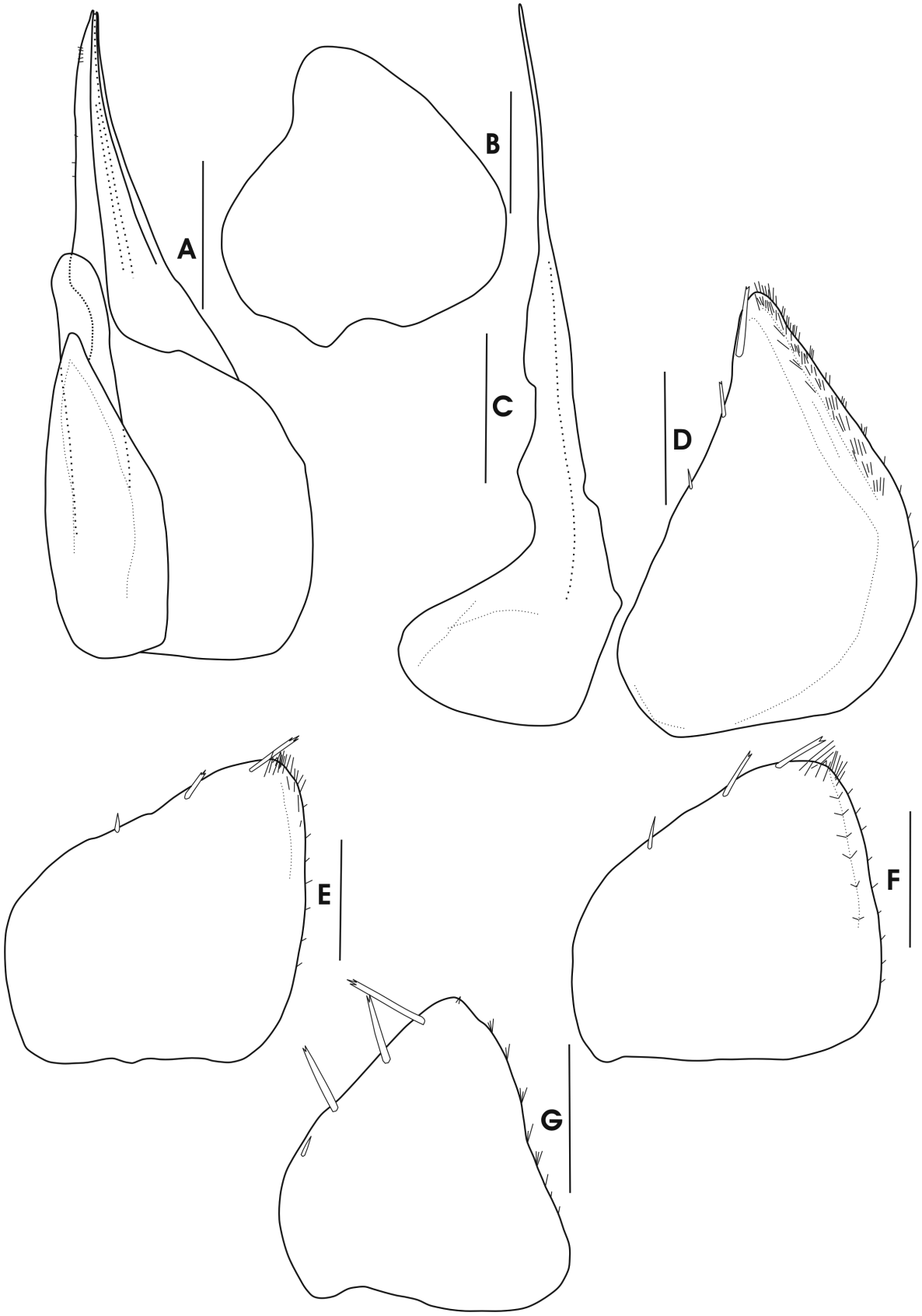

FIGURE 19. *Paraplatyarthrus pallidus* **sp. nov.**, (Holotype, ♂), A, pleopod 1 endopodite and genital papilla; B, pleopod 1 exopodite; C, pleopod 2 endopodite; D, pleopod 2 exopodite; E, pleopod 3 exopodite; F, pleopod 4 exopodite; G, pleopod 5 exopodite. Scale bars: 0.1 mm.

Paratypes: 5 males (WAM C53624, BES15525.24; WAM C53625, BES15525.16; WAM C53626, BES15525.12; WAM C53627, BES15525.2; WAM C53628, BES15525.3), 1 female (WAM C53629, BES15525.4), BES15525.20 held on SEM stubs (sex unknown); same locality and collectors' as holotype, all deposited in the Western Australian Museum.

Diagnosis. Body pale without pigmentation. Eyeless (no ommatidia) (Fig. 2H).

Remarks. *Paraplatyarthrus subterraneus* is distinguished from other described *Paraplatyarthrus* species with a combination of characters including a pale body with no pigmentation, no ommatidia in cephalothorax and a delimiting line in maxilla 2. The body length varies between 3.0 and 3.8 mm. It is restricted to a single calcrete aquifer, Laverton Downs, Eastern Murchison region, Western Australia.

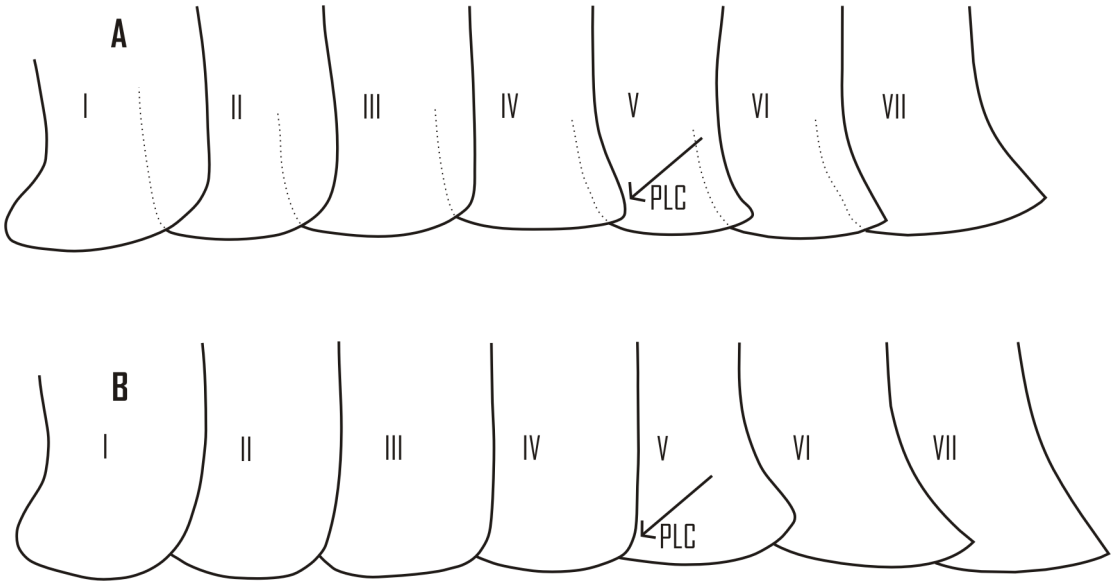

FIGURE 20. The position of posterolateral corner (PLC) of epimera 1 to 7 in dorsal view; Type A, PLC in pereonal epimera 1–3 rounded, in 4–7 posteriorly directed; Type B, PLC in pereonal epimera 1–4 rounded, in 5–7 posteriorly directed.

Genus *Trichorhina* Budde-Lund, 1908

Trichorhina Budde-Lund 1908: 293.
Type species: *Bathytropa thermophila* Dollfuss, 1896 by subsequent designation (see Schmalfuss & Ferrara (1978)).

Diagnosis: Small in size, not exceeding 6 mm. Most of species white or greyish owing to more or less reduced pigmentation. Dorsal body covered with large scale-spines supported with skeleton. Frontal line absent. Supra-antennal line present. Small eyes with less than 10 ommatidia, often reduced or absent. Pleon normally not interrupted from pereon. Telson triangular (rounded in *Trichorhina simoni* (Dollfus, 1893) and *T. caeca* (Vandel, 1952)). Second antenna short, flagellum with first joint much shorter than second one.

Trichorhina tropicalis Lewis, 1998

Trichorhina tropicalis Lewis 1998a: 710, figs 40–43.—Poore 2002: 325–326.

Type material (examined). Holotype: P.50646.001 (mounted on an SEM stub, gender unknown), Wongalinga Beach, Queensland (Australian Museum, Sydney).

Remarks. Examination of the holotype using light microscopy revealed that this species lacks capillary furrows on the second antenna, and that the postfrons and profrons of the cephalothorax are clearly delimited (not fused). These characters validate its taxonomic position as a true member of the genus *Trichorhina*, thus confirming the presence of the genus and family Platyarthridae (albeit that it is polyphyletic; Javidkar *et al.* 2015) in Australia.

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APPENDIX 1. Matrix of *COI* p-distances for described and undescribed *Paraplatyarthrus* species from the Yigarn region of Western Australia. Species delineated by >11% p-distances are indicated along the top row by shading. Lineage specific numbers are indicated by (B) and (S) followed by the calcrete or area codes (e.g. B6/LDW) (given in full in Table 1 and Fig. 1).

	P. occidentoniscus sp.nov.	*P. cunyuensis* sp.nov.	B3/LV	*P. crebesconiscus* sp. nov.	*P. nahidae* sp. nov.	B18/BAR	S1/JP-GOO	S2/WOO	S3/MOO	B6/LDW
P. cunyuensis sp. nov.	0.159									
B3/LV	0.153	0.13								
P. crebesconiscus sp. nov.	0.18	0.187	0.161							
P. nahidae sp. nov.	0.177	0.183	0.158	0.123						
B18/BAR	0.185	0.174	0.152	0.128	0.129					
S1/JP-GOO	0.2	0.191	0.17	0.192	0.178	0.177				
S2/WOO	0.187	0.18	0.161	0.176	0.164	0.159	0.067			
S3/MOO	0.196	0.183	0.171	0.188	0.187	0.165	0.096	0.082		
B6/LDW	0.181	0.194	0.174	0.158	0.183	0.167	0.179	0.18	0.186	
B7/NAM	0.177	0.179	0.159	0.161	0.184	0.178	0.189	0.175	0.195	0.072
B12/HAW-NAM	0.189	0.193	0.16	0.163	0.179	0.174	0.185	0.17	0.181	0.112
B8/LDQ	0.175	0.185	0.167	0.15	0.166	0.167	0.182	0.162	0.179	0.098
B9/URA	0.188	0.194	0.172	0.179	0.197	0.183	0.206	0.184	0.192	0.128
B10/URA-BUB	0.183	0.197	0.172	0.19	0.193	0.193	0.201	0.172	0.194	0.139
B11/LV	0.182	0.189	0.172	0.177	0.193	0.184	0.189	0.172	0.192	0.125
P. pallidus sp. nov./LME	0.179	0.189	0.177	0.175	0.196	0.187	0.188	0.181	0.189	0.203
P. pallidus sp.nov./LMW	0.187	0.201	0.187	0.19	0.196	0.197	0.189	0.178	0.198	0.194
P. subterraneus/LDW	0.178	0.175	0.163	0.159	0.156	0.158	0.175	0.151	0.17	0.202
P. subterraneus/LDQ	0.17	0.17	0.152	0.155	0.158	0.158	0.176	0.149	0.171	0.204
P. subterraneus/LDW	0.176	0.182	0.154	0.161	0.164	0.159	0.174	0.156	0.169	0.199
P. subterraneus/LDS	0.179	0.178	0.166	0.161	0.169	0.17	0.187	0.161	0.179	0.193

……continued on the next page

APPENDIX 1. (Continued)

	B7/NAM	B12/HAW-NAM	B8/LDQ	B9/URA	B10/URA-BUB	B11/LV	*P. pallidus* sp. nov./LME	*P. pallidus* sp. nov./LMW	*P. subterraneus* /LDW	*P. subterraneus* /LDQ	*P. subterraneus* /LDW
P. cunyuensis sp. nov.											
B3/LV											
P. crebesconiscus sp. nov.											
P. nahidae sp. nov.											
B18/BAR											
S1/JP-GOO											
S2/WOO											
S3/MOO											
B6/LDW											
B7/NAM											
B12/HAW-NAM	0.104										
B8/LDQ	0.091	0.104									
B9/URA	0.119	0.136	0.108								
B10/URA-BUB	0.122	0.136	0.115	0.049							
B11/LV	0.112	0.137	0.097	0.046	0.049						
P. pallidus sp. nov./LME	0.195	0.198	0.175	0.194	0.177	0.187					
P. pallidus sp.nov./LMW	0.185	0.184	0.175	0.198	0.177	0.183	0.09				
P. subterraneus/LDW	0.188	0.195	0.172	0.193	0.198	0.189	0.185	0.186			
P. subterraneus/LDQ	0.187	0.185	0.168	0.182	0.183	0.181	0.178	0.188	0.018		
P. subterraneus/LDW	0.181	0.185	0.162	0.172	0.178	0.18	0.18	0.18	0.061	0.059	
P. subterraneus/LDS	0.191	0.187	0.17	0.187	0.182	0.184	0.165	0.181	0.086	0.09	0.086

APPENDIX 2. Relative position of the noduli laterales on pereonites 1 to 7 defined by the ratios B/C and D/C for the new described species and *P. subterraneus*. B = distance from the nodulus lateralis to the posterior margin of the pereonite, C = maximum length of the pereonal tergite (antero-posterior); D = distance from the nodulus lateralis to the lateral margin of the pereonite. Noduli laterales on tegite 7 defined as "a" and "b" are proximally and distally positioned to the lateral margin respectively. All measurements are for paratype specimens.

Species	Ratio	Pereonite No.							
		1	2	3	4	5	6	7a	7b
P. crebesconiscus sp. nov. (♀)	B/C	0.21	0.18	0.16	0.14	0.15	0.14	0.18	0.12
	D/C	0.53	0.56	0.59	0.67	0.7	0.65	0.11	0.69
P. cunyuensis sp. nov. (♀)	B/C	0.2	0.18	0.18	0.15	0.15	0.13	0.13	0.12
	D/C	0.6	0.66	0.66	0.68	0.69	0.66	0.12	0.69
P. nahidae sp. nov. (♂)	B/C	0.18	0.15	0.14	0.13	0.11	0.13	0.15	0.11
	D/C	0.62	0.65	0.7	0.81	0.76	0.72	0.24	0.73
P. occidentoniscus sp. nov. (♀)	B/C	0.2	0.17	0.17	0.18	0.14	0.13	0.17	0.13
	D/C	0.54	0.61	0.64	0.7	0.63	0.67	0.17	0.77
P. pallidus sp. nov. (♀)	B/C	0.2	0.17	0.18	0.17	0.17	0.17	0.13	0.12
	D/C	0.65	0.65	0.67	0.68	0.68	0.69	0.11	0.68
P. subterraneus sp. nov. (♀)	B/C	0.2	0.18	0.17	0.18	0.17	0.18	0.14	0.17
	D/C	0.59	0.59	0.61	0.66	0.64	0.63	0.1	0.62