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Revision of the staphylinoid and ground-dwelling genus *Carvalhoma* Slater & Gross (Insecta: Heteroptera: Miridae: Cylapinae) of Australia

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Abstract. The Australian endemic staphylinoid plant bug genus *Carvalhoma* Slater & Gross, 1977 is revised. The genus is redescribed and its systematic position within Cylapinae is discussed. *Carvalhoma malcolmae* Slater & Gross, 1977 and *C. taplini* Slater & Gross, 1977 are redescribed. Three species, *C. ovatum* sp. nov., *C. parvum* sp. nov., and *C. weiri* sp. nov., are described as new to science. A key to species, digital habitus images, SEM images, drawings of male and female genitalia and distribution map are provided.

Keywords. New species, key, description, taxonomy, diagnosis.

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Introduction

The Miridae (Insecta: Hemiptera: Heteroptera) is one of the largest insect families (Cassis & Schuh 2012). Until the mid-1990s the family received little taxonomic attention in Australia, with less than 200 species described (Cassis & Gross 1995). Recent surveys of the Plant Bug Inventory (Cassis *et al*. 2007) and Bush Blitz (www.bushblitz.org.au) projects (Preece *et al*. 2014) have reversed our notion that the family is depauperate in Australia, with many hundreds of new species discovered and remaining to be described (e.g., Cassis & Symonds 2014a, 2014b). Over the last decade many of these new Australian mirid taxa have been described, particularly those belonging to the subfamilies Orthotylinae (e.g., Cassis 2008; Tatarnic 2009; Namyatova *et al*. 2011; Cheng *et al*. 2012; Cassis *et al*. 2012; Cassis & Symonds 2014a, 2014b, 2016), Phylinae (e.g., Soto & Weirauch 2009; Schuh & Weirauch 2010; Schuh & Menard, 2011; Schuh & Pedraza 2011), and Bryocorinae (e.g., Namyatova & Cassis 2012, 2013, 2015).

In contrast, the subfamily Cylapinae has received relatively little attention. This subfamily has a worldwide distribution, but collecting of its representatives is hampered by their cryptic habits, as they usually live under the bark, in litter, or on fungi (Gorczyca 2001). Currently the cylapine fauna of Australia includes 17 genera and 35 species (Cassis & Gross 1995; Gorczyca 2001; Cassis *et al*. 2003; Moulds & Cassis 2006; Wolski & Gorczyca 2014), although we estimate that the number of cylapine species represented in the collections is close to 100. Among Australian cylapines only the genera *Peritropis* Uhler, 1891 and *Xenocylapidius* Gorczyca, 1997 from the tribe Fulviini and Australian species from the tribe Vanniini have been revised recently (Cassis *et al*. 2003; Moulds & Cassis 2006; Wolski & Gorczyca 2014).

Carvalhoma is noteworthy because of its highly specialised morphology, possessing staphylinoid wings, which are greatly reduced and are undoubtedly a function of their ground-dwelling habits (Wheeler 2001). Ground dwelling habits are known for other Cylapinae genera with shortened wings, including *Corcovadocola* Carvalho, 1948, *Mangalocoris* Murphy & Polhemus, 2012 (Murphy & Polhemus 2012), *Schizopteromiris* Schuh, 1986 (Schuh 1986) from the tribe Cylapini, and the genus *Austrovannius* Cassis, Schwartz & Moulds, 2003 (Cassis *et al*. 2003) from the tribe Vannini.

The systematic position of *Carvalhoma* has been debated; initially it was placed in the subfamily Phylinae (Slater & Gross 1977), and subsequently it was transferred to Cylapinae (Schuh & Schwartz 1984). The genus undoubtedly belongs to the Cylapinae, but has been placed in both the tribe Fulviini (Schuh 1995, 2002–2013; Gorczyca 2006) and Cylapini (Cassis & Gross 1995).

The aims of this work are to revise the Australian endemic genus *Carvalhoma* Slater & Gross, 1977, including a redescription and diagnosis of the genus, to discuss its systematic placement within Cylapinae, to redescribe the two previously described species, and to describe three new species.

Material and methods

Specimens

Twenty eight specimens were examined in this study. A unique specimen identifier with a UNSW_ENT prefix, unless otherwise stated, was attached to each specimen. Collection event data were digitised in the Plant Bug Planetary Biodiversity Inventory Database (http://research.amnh.org/pbi/databases/locality_database.html), which can also be accessed on the Discover Life website (http://www.discoverlife.org/) and the Heteroptera Species Page (http://research.amnh.org/pbi/heteropteraspeciespage/).

The specimens used for the descriptions of species are preserved in the following institutions:
AM = Australian Museum (Sydney, Australia)
ANIC = Australian National Insect Collection (Canberra, Australia)
QM = Queensland Museum (Brisbane, Australia)
NTM = Northern Territory Museum and Art Gallery (Australia)
CAS = California Academy of Science (San Francisco, USA)

Dissections and terminology

Terminology mostly follows Schuh & Slater (1995) and Cassis & Schuh (2012). Specimens were dissected following Kerzhner & Konstantinov (1999). The terminology for male genitalia follows Kerzhner & Konstantinov (1999) and Konstantinov (2003), and the notion of the aedeagal endosoma is also consistent with the definition of Cassis (2008). The terminology for female genitalia follows Davis (1955). A single male and female were dissected for each of *Carvalhoma malcolmae* and *C. weiri* sp. nov.; two males and three females were dissected for *C. parvum* sp. nov. We decided not to dissect *C. taplini* as it is known only from two females, representing holotype and paratype, and we found it is

impossible to remove the abdomen of either of them without damaging the specimen. All parameres and genital capsules are illustrated in the dorsal view.

Images

Scanning electron micrographs of uncoated specimens were taken using a Hitachi TM-3000 desktop scanning electron microscope. Dorsal habitus digital images were made using the Visionary Digital Imaging system (www.visionarydigital.com) with a Canon EOS 40D camera. Multiple images were taken of a male and a female for each species where possible and concatenated using Helicon Focus software (www.heliconsoft.com).

Measurements

Measurements were taken for core mirid characters and are given in Table 1. They were taken using a Leica graticule and 10× eye pieces, attached to a Leica MZ16 stereo microscope. All measurements are given in millimetres, unless otherwise stated.

Map

The map (Fig. 11) was composed using ArcGis 10.2 software (https://esriaustralia.com.au/products-arcgis-software-102), using ESRI World Physical Map as a background.

Results

Order Hemiptera Linnaeus, 1758
Suborder Heteroptera Latreille, 1810
Family Miridae Hahn, 1831
Subfamily Cylapinae Carvalho, 1957
Tribe Cylapini Kirkaldy, 1906

Carvalhoma Slater & Gross, 1977

Carvalhoma Slater & Gross, 1977: 135 (type species *Carvalhoma malcolmae* Slater & Gross, 1977, by original designation).

Carvalhoma – Schuh & Schwartz 1984: 48 (transferred to Cylapinae: Fulviini). — Schuh 1995: 20 (catalogue). — Cassis & Gross 1995: 145 (catalogue, transferred to Cylapinae: Cylapini).

Diagnosis

Distinguished by staphylinoid hemelytron, reaching abdominal segments V–VI, veins obsolete, with distinct punctation or rugopunctate; hypognathous head with shallow midline depression, eyes embedded into head, not pedunculate (Figs 1, 2B, 3B, 4B, 5B, 6B); pronotum ca 1.1–1.6× as wide as long as in males and ca 1.1–1.5× in females; metathoracic scent gland evaporative area elongate (Figs 2K, 3G, 4D, 5G, 6G); right paramere straight, left paramere longer than right one, c-shaped (Figs 7D–E, 8D–E, 9D–E, 10D–E); aedeagus longer than left paramere, theca often sclerotised at least apically; ductus seminis short, sclerotised around secondary gonopore; endosoma voluminous, not subdivided into conjunctiva and vesica, bearing sclerotisation (Figs 7A–B, 8A–B, 9A–B, 10A–B); sclerotised rings of dorsal labiate plate large and curved (Figs 7F, 9F, 10F).

Description

Male

Colouration. Body often mostly dark brown to black, rarely mostly pale brown (Fig. 1).

Table 1. Measurements. Abbreviations: Cunclyp = the length between apex of clavus and the base of clypeus; AntSeg = the antennal segment; InterOcDi = the vertex width.

Gender	Specimen	Length					Width		
		Body	Cun-Clyp	Pronotum	AntSeg 1	AntSeg2	Head	Pronotum	InterOcDi
Carvalhoma malcolmae Slater & Gross, 1977									
♂ (N=1)	M1	2.25	1.48	0.42	0.42	0.96	0.56	0.46	0.21
♀ (N=5)	F1	2.69	1.60	0.44	0.46	0.90	0.65	0.52	0.21
	F2	2.27	1.58	0.42	0.42	0.88	0.60	0.50	0.19
	F3	2.71	1.73	0.42	0.44	0.92	0.65	0.52	0.23
	F4	2.75	1.81	0.46	0.40	0.88	0.65	0.54	0.21
	F5	2.29	1.69	0.42	0.46	0.92	0.63	0.50	0.21
Carvalhoma parvum sp. nov.									
♂ (N=5)	M1	1.54	1.19	0.33	0.31	0.77	0.50	0.40	0.19
	M2	1.60	1.19	0.35	0.29	0.81	0.48	0.42	0.17
	M3	1.58	1.19	0.33	0.31	0.83	0.50	0.40	0.19
	M4	1.46	1.15	0.33	0.27	0.79	0.46	0.40	0.19
	M5	1.56	1.27	0.35	0.31	0.83	0.50	0.42	0.19
♀ (N=5)	F1	2.13	1.38	0.38	0.27	0.67	0.56	0.48	0.19
	F2	1.90	1.31	0.38	0.29	0.69	0.54	0.46	0.21
	F3	2.19	1.44	0.40	0.27	0.65	0.58	0.50	0.21
	F4	1.98	1.29	0.33	0.27	0.60	0.54	0.44	0.19
	F5	1.90	1.33	0.35	0.27	0.69	0.54	0.46	0.19
Carvalhoma taplini Slater & Gross, 1977									
♀ (N=2)	F1	2.08	1.65	0.42	0.35	0.79	0.67	0.58	0.25
	F2	2.27	1.67	0.40	0.33	0.77	0.67	0.60	0.27
Carvalhoma weiri sp. nov.									
♂ (N=2)	M1	2.29	1.48	0.46	0.40	0.92	0.56	0.46	0.19
	M2	2.27	1.44	0.42	0.35	0.83	0.54	0.46	0.19
♀ (N=1)	F1	2.65	1.75	0.46	0.40	0.92	0.63	0.52	0.19
Carvalhoma ovatum sp. nov.									
♂ (N=1)	M1	1.75	1.06	0.31	0.31	0.77	0.54	0.50	0.21

Surface and vestiture. Dorsum often more or less shiny, rarely entirely shagreened; head smooth or shagreened (Fig. 1), gula with finely rugulose area clothed with short setae (Figs 2C, 4C, 5A, 6B); pronotum dorsally shiny, with shagreened collar or entirely shagreened (Fig. 1), with round or longitudinal depression on midline, rugulose or smooth laterally (Figs 2C, 3A, 4C, 5A, 6B); hemelytron often shiny, with distinct punctation, scarcely and shallowly punctate (Figs 1, 4E, 5G, 6F). Dorsum often clothed with long erect setae (Figs 2C, 4B–C, 5A), denser on hemelytron and abdomen than on head and pronotum, rarely dorsum almost without setae (Figs 3A–B, 6B–C); pronotum with or without short dense setae laterally (Figs 2C, 3A, 4C, 5A, 6B); entire pleura or at least metepisternum anteriorly clothed with short setae (Figs 2K, 3G, 4D, 5G); abdomen and legs with short and long setae; antenna with adpressed setae, shorter than width of antennal segment II.

Head (Figs 2A–C, 3A–C, 4A–C, 5A–C, 6A–C). Hypognathous; distinctly wider than long in dorsal view, somewhat wider than high in anterior view, higher than long in lateral view; posterior margin straight and carinate posteriorly in dorsal view; vertex with shallow longitudinal depression; eye contiguous with pronotum, its diameter shorter or subequal to vertex width in dorsal view, eye removed from ventral side of head at distance subequal to eye height in lateral view; inferior margin of antennal fossa placed below inferior margin of eye in anterior view, antennal fossa removed from eye at distance subequal to antennal segment I width or slightly more and placed slightly above mandibular plate in lateral view; clypeus separated from frons by depression, its base placed below inferior margin of antennal fossa; mandibular and maxillary plates separated from remainder of head by weak suture posteriorly; buccula not reaching posterior margin of head, gula subequal in length to buccula.

Antenna (Figs 1, 2F, 3I, 4K, 5H, 6D). Shorter than body (Fig. 1); segment I almost straight, slightly widened medially, wider than other segments; segment II cylindrical, not incrassate; segments III and IV filiform; segment IV longer than others.

Labium (Figs 2H, 4H, 5D, 6E). Reaching abdominal segment II or III, four-segmented, its segments not subdivided.

Thorax (Figs 2B–C, 3A–B, 4B–C, 5A–B, 6B–C). Pronotum wider than long, often distinctly raised, sometimes flat in lateral view; collar delimited by shallow depression, pronotum not constricted medially; calli indistinct; lateral margins of pronotum rounded, not carinate; posterior margin rounded; scutellum small, acute apically; mesepimeral apodeme indistinct; mesepimeral spiracle elongate, slit-like, distinctly visible, without evaporative bodies; metepisternum with shallow ridge running from spiracle to evaporative area; metathoracic gland evaporative area oval, directed posteriorly, peritreme upraised, setose; metepimeron covered by abdomen.

Hemelytron (Figs 4F, 6F). Staphylinoid, shortened, without venation, apex truncate; clavus, cuneus and embolium not differentiated; costal margins parallel-sided, apical margin weakly upturned, reaching abdominal segment V–VI.

Legs (Figs 2D, G, 3D, 4G, M, 5F, 6H, K). Forefemur widened, wider than middle and hind femora, hind femur somewhat wider than middle femur; segment I of hind tarsus distinctly longer than segments II and III each; clavus narrow, with apical tooth, unguitractor with three rows of lamellae, placed close to each other and with the medial row of lamellae being characteristically acute; parempodia setiform, outer parempodium reduced (asymmetry described in dorsal view, pretarsus directed anteriorly).

Abdomen (Figs 2J, 3F, 4J, 5I, 6G). Genital segment not rotated.

Genitalia. Genital capsule (Figs 7C, 8C, 9C, 10C) trapeziform, almost symmetrical, without supragenital bridge. Right paramere small, C-shaped, its outer margin straight or concave (Figs 7D, 8D, 9D, 10D); left paramere somewhat longer than right one, C-shaped, with swelling in basal half (Figs 7E, 8E, 9E, 10E). Aedeagus (Figs 7A–B, 8A–B, 9A–B, 10A–B). Theca slightly curved apically, either mostly membranous, sclerotised apically or mostly sclerotised; ductus seminis short, its apical part, surrounding secondary gonopore, sclerotised; endosoma membranous with sclerotised areas.

Female

Similar to male, but longer and broader, sometimes also somewhat darker than male (Fig. 1), legs shorter than in male; hemelytra often gradually incrassate posteriorly (Figs 2E, 3E, 4F, 5G, 6I).

Genitalia. Dorsal labiate plate (Figs 7F, 9F, 10F) with large sclerotised rings, curved dorsoventrally, sometimes elongate posteriorly, outer margin of dorsal labiate plate sometimes with additional elongate

sclerite. Posterior wall (7G, 9G, 10G) membranous, with or without small tubercles. Vulva membranous, not surrounded by sclerites.

Distribution

Known from South Australia, Queensland, New South Wales, Victoria, Australian Capital Territory and Western Australia (Fig. 11).

Key to species

1. Hemelytron shiny with distinct punctures (Figs 1, 2E, 4E–F, 5G, 6F, I) ……2
– Hemelytron matte and shagreened, with shallow punctures (Figs 1, 3E) ……***C. ovatum*** sp. nov.

2. Head and pronotum shagreened (Figs 1, 5J), females ovate, ca 3.6–3.8× longer than pronotum width (Fig. 1) ……***C. taplini*** Slater & Gross, 1977
– Head and pronotum shiny (Fig. 1), females elongate, ca 4.1–5.2× longer than pronotum width (Fig. 1) ……3

3. Smaller, body length 1.5–1.6 in male and 1.9–2.2 in female (Fig. 1); lateral margin of pronotum distinctly rugulose and densely setose (Fig. 4C); thoracic pleura distinctly setose (Fig. 4D); antennal segment I short, ca 1.4–1.8× as long as vertex width in male and ca 1.3–1.4× in female ……***C. parvum*** sp. nov.
– Larger, body length 2.2–2.3 in male and 2.3–2.8 in female (Fig. 1); lateral margins of pronotum smooth, without rugosity and almost without setae; thoracic pleura mostly smooth, with short setae only on metepisternum (Fig. 2K), antennal segment I relatively long, ca 1.9–2.1× as long as vertex width in male and ca 1.8–2.2× in female ……4

4. Male dorsum and antennal segment I dark brown to black (Fig. 1); frons protruding anteriad at distance more than half of eye diameter in dorsal view, ca 2.1× as wide as long in male and ca 1.7–2.2× in female (Figs 1, 2B); upper part of sclerotised rings of dorsal labiate plate twice as long as wide (Fig. 7F) ……***C. malcolmae*** Slater & Gross, 1977
– Male dorsum pale brown, antennal segment I whitish yellow to pale brown (Fig. 1); frons protruding at distance less than half of eye diameter in dorsal view, ca 2.7–2.9× as wide as long in male and ca 2.3× in female (Fig. 6C); upper part of sclerotised rings of dorsal labiate plate ca 4× as long as wide (Fig. 10F) ……***C. weiri*** sp. nov.

Carvalhoma malcolmae Slater & Gross, 1977
Figs 1–2, 7, 11

Carvalhoma malcolmae Slater & Gross, 1977: 137.

Carvalhoma malcolmae – Schuh & Schwartz 1984: 48 (discussion, description). — Cassis & Gross 1995: 145 (catalogue). — Schuh 1995: 21 (catalogue).

Diagnosis

Recognised by the following characters: large size, 2.25 in male and 2.3–2.8 in female; elongate body; pronotum ca 1.1× as long as wide in male and ca 1.2–1.3× in female (Fig. 1); head, pronotum and hemelytra shiny, male mostly dark brown to black (Fig. 1); lateral margins of pronotum mostly smooth, with a few rugosities, without dense setae (Fig. 2C); frons produced anteriad of eyes for more than half of eye diameter in dorsal view (Figs 1B, 2B); head ca 2.1× as wide as long in male and 1.7–2.2× in female; antennal segment I relatively long, ca 2.0× as long as vertex width in male and ca 1.8–2.2× in female.

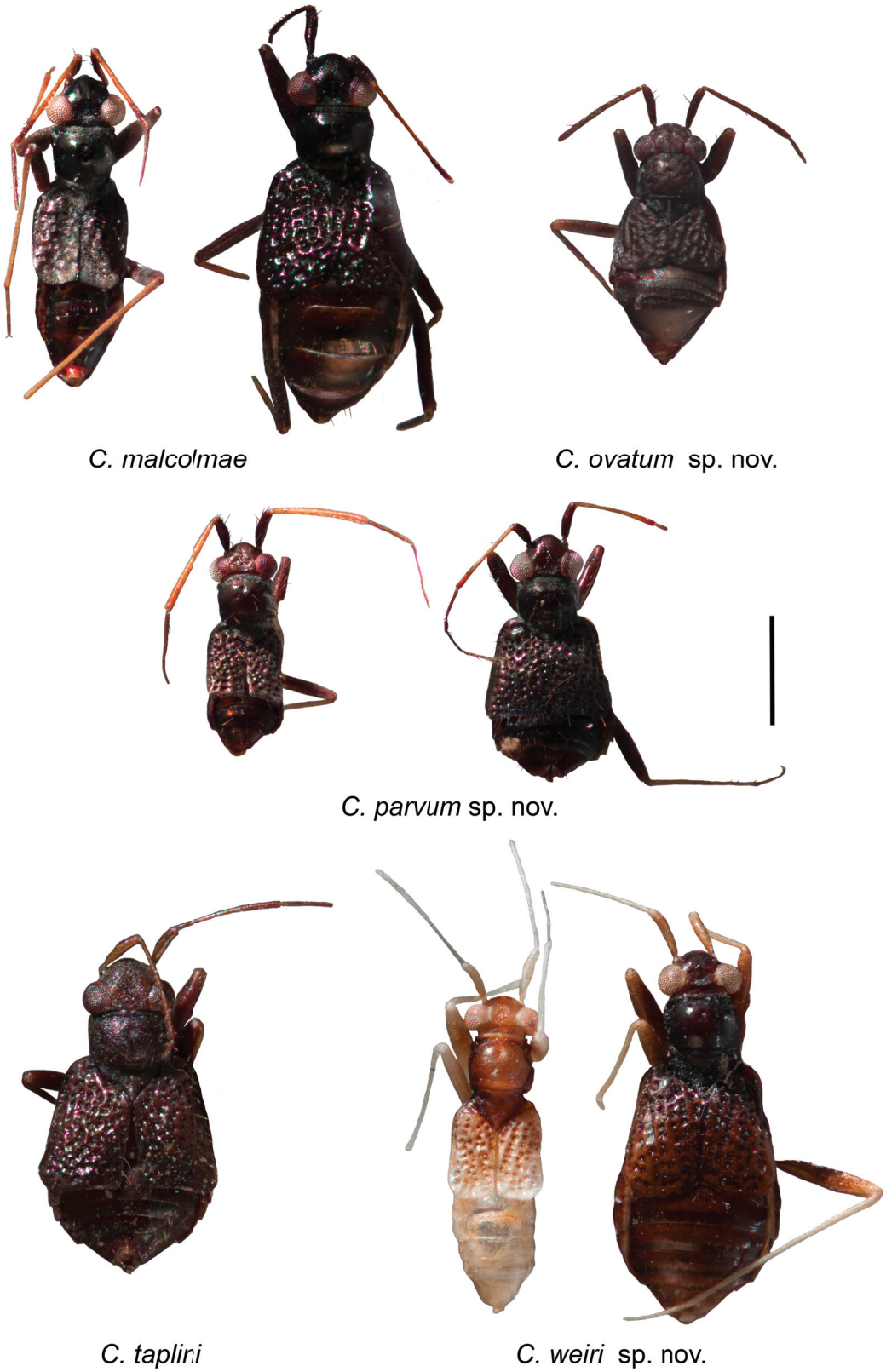

Fig. 1. Habitus of *Carvalhoma* species. Scale bar = 1 mm. When two specimens of the same species are shown, the male is on the left and the female on the right. *C. ovatum* sp. nov. shows the male holotype. *C. taplini* Slater & Gross, 1977 shows the female holotype.

Material examined

AUSTRALIA: New South Wales: 1 ♀, 0.4 km S along Barrington Trail from southern Green Gap turnoff, Stewarts Brook State Forest, 31.93333° S, 151.43333° E, 1460 m, 4 Feb. 1993–9 Apr. 1993, M. Gray and G. Cassis leg. (00043347) (AM); 1 ♀, Badja Fire Trail, Badja State Forest, Site 2, 36.125° S, 149.52694° E, 13 Mar. 1999, J. Tarnawski and S. Lassau (00043343) (AM); 1 ♀, Bumberry Creek Fire Trail, Wadbilliga National Park, Site 1, 36.54389° S, 149.54389° E, 13 Mar. 1999, R. Harris and H. Smith (UNSW_ENT 00043342) (AM); 1 sex unknown, Link Rd., Monga State Forest, 35.56778° S, 149.90389° E, 15 Mar. 1999, R. Harris and H. Smith (00043341) (AM); 1 ♂, South Forest Way, Tallaganda State Forest, Site 2, 35.70194° S, 149.54194° E, 15 Mar. 1999, J. Tarnawski and S. Lassau (00043338) (AM); 1 ♀, Taylor Rd, between Tapley and Oliver Rds, E of Narara, 33.40116° S, 151.38466° E, 1 Dec.

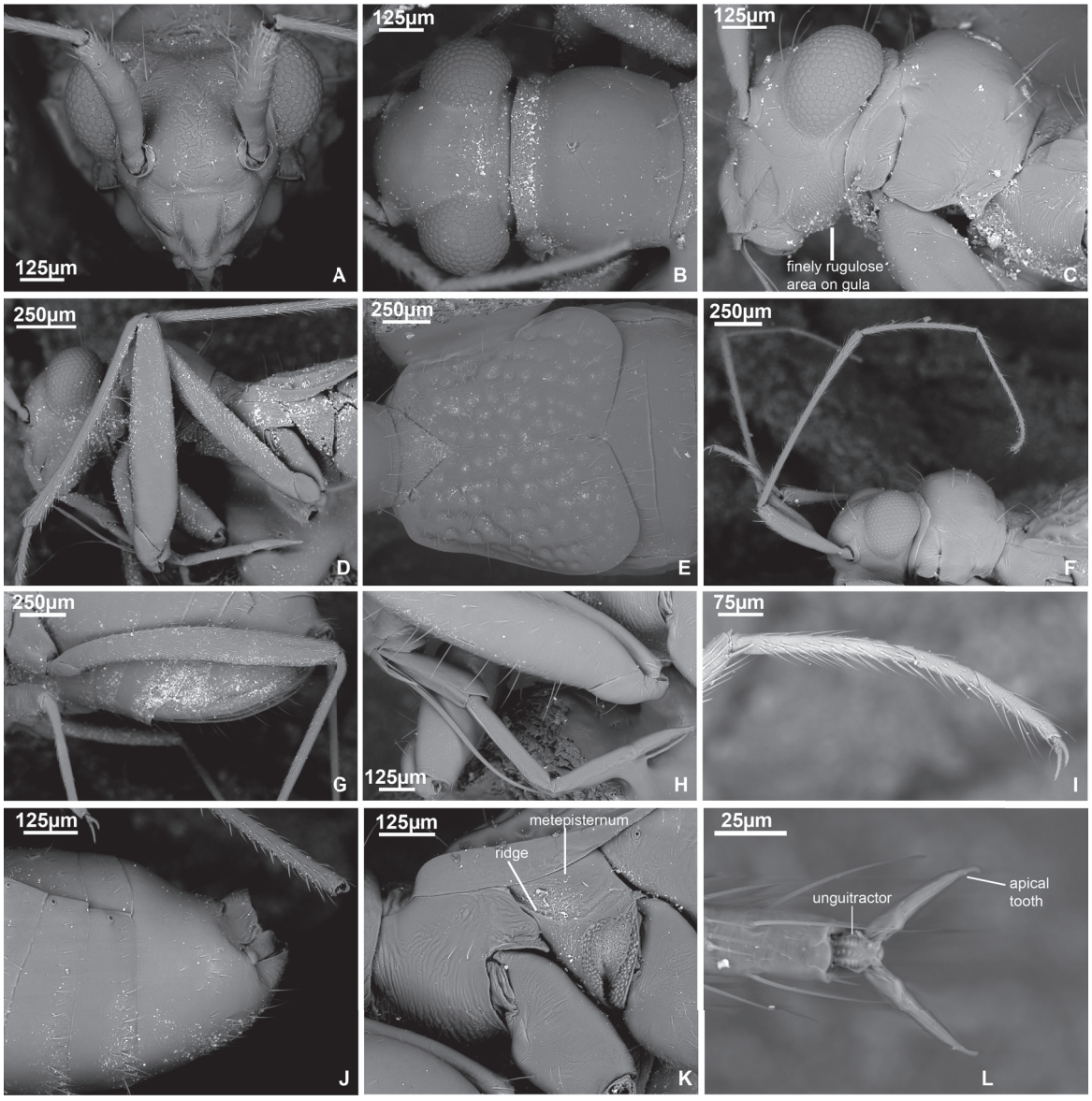

Fig. 2. SEM images of *C. malcolmae* Slater & Gross, 1977. **A**. Head, anterior view, ♀. **B**. Head and pronotum, dorsal view, ♂. **C**. Head and pronotum, lateral view, ♀. **D**. Fore- and middle femora, ♂. **E**. Scutellum and hemelytra, ♀. **F**. Antenna, ♀. **G**. Hind femur, ♀. **H**. Labium, ♀. **I**. Hind tarsus, ♀. **J**. Abdomen, lateral view, ♂. **K**. Pleura, ♀. **L**. Pretarsus, ventral view, ♂.

1999–15 Dec. 1999, Gray, Milledge and Smith (00043348) (AM). — Victoria: 1 ♀, [Bell's clearing Thomson River], 10 Feb. 1977, M. B. Malipatil (00043345) (NTM).

Type locality

AUSTRALIA: Victoria, Dartmouth Dam Survey, Eight Mile Creek track.

Description

Male

Body length. 2.25.

Colouration (Fig. 1). Mostly dark brown to black, eye whitish; antennal segment II yellow to pale brown, brown apically, segment III brown; labium mostly yellow, segment IV darkened apically; coxae yellow, brown basally; femur brown to dark brown; tibia and tarsi yellow to pale brown.

Surface and vestiture. Head and pronotum more or less smooth and shiny, except for shagreened collar; lateral margin of pronotum only with a few wrinkles, without dense setae; pleura with setae only in metepisternum anteriorly; hemelytron shiny, with distinct punctures. Dorsum and abdomen clothed with long erect pale simple setae.

Structure and measurements. Body ca 4.9× longer than pronotal width; head ca 2.1× wider than long, frons protruding anteriad at distance of more than half of eye diameter dorsally (Figs 1, 2B); vertex ca 1.2× wider than eye diameter; head ca 1.1× wider than high; antennal segment I twice length of vertex, antennal segment II longer than either segments I or III, ca 4.6× longer than vertex width, ca 2.3× longer than segment I; segment III slightly longer than segment I, segment IV slightly shorter than antennal segment III; labial segments I and II subequal in length, segment III slightly shorter than segment II, and segment IV slightly shorter than segment III (Fig. 2H); pronotum ca 1.1× wider than long, ca 0.8× width of head; metepimeron with distinct ridge (Fig. 2K); hind femur ca 3× longer than head height; tarsal segment I almost twice as long as segment II, segment II slightly shorter than segment III (Fig. 2).

Genitalia (Fig. 7A–E). Right paramere without ridge dorsally; outer margin of right paramere straight, apices of parameres straight, not hook-shaped; left paramere with ridge dorsally, its basal swelling rounded; theca mostly membranous, sclerotised apically; endosoma with single sclerite, placed ventrally on right side.

Female

Body length. 2.3–2.8.

Colouration (Fig. 1). Similar to male, but usually somewhat darker; antennal segment IV brown to dark brown; labial segment I reddish or reddish brown, sometimes segment II reddish brown, segments III and IV rarely pale brown; labium yellow to pale brown, darkened apically, segment I sometimes reddish or with reddish tinge; coxae dark brown to black, yellow apically.

Surface and vestiture. As in male.

Structure and measurements. Similar to male. Body ca 4.5–5.2× width of pronotum; head ca 1.7–2.2× wider than long, vertex ca 0.9–1.3× diameter of eye; in anterior view head ca 1.1–1.2× wider than high; antennal segment I ca 1.8–2.2× width of vertex, segment II ca 4.0–4.7× width of vertex, and ca 2.0–2.2× longer than segment I; pronotum ca 1.2–1.3× wider than long, ca 0.8× wider than head.

Genitalia. Dorsal labiate plate with elongate sclerite along outer margin; sclerotised ring not elongate posteriorly, its dorsal portion twice as long as wide (Fig. 7F); posterior wall with small tubercles (Fig. 7G).

Distribution

Eastern regions of NSW and Victoria (Fig. 11).

Remarks

Antennal segment IV is broken in males, and only partly present in examined females.

Differential diagnosis

Carvalhoma malcolmae was described from a single female specimen (Slater & Gross 1977) and the holotype is preserved in the Museum of Victoria. The specimen is damaged and photos of it are available at http://collections.museumvictoria.com.au/specimens/1018994. The non-type specimens we examined seem to be conspecific with the holotype and fit the original description. The only difference is a pair of strap-like sclerites on the dorsal labiate plate of the bursa copulatrix, as reported by Slater & Gross (1977), and we failed to find those structure in *C. malcolmae* and other congeners. However, the illustration of the bursa by Slater & Gross (1977) is not sufficiently detailed, and we refrain from drawing any further conclusions. The male genitalia of non-type material are very similar to those illustrated by Schuh & Schwartz (1984). Although they did not mention the sclerotised area in the description of the endosoma (= vesica in Schuh & Schwartz 1984), it was depicted on their fig. 7.

Carvalhoma malcolmae is most similar to *C. parvum* sp. nov. externally, with both species having an elongate body and a dark brown to black dorsum (Fig. 1). *Carvalhoma parvum* sp. nov. differs in being smaller in size, with the body length 1.5–1.6 in male and 1.9–2.2 in female, the distinctly rugulose and densely setose lateral margins of the pronotum (Fig. 4C), the densely setose pleura (Fig. 4D), and the short antennal segment I, ca 1.4–1.8× as long as vertex width in male and ca 1.3–1.4× in female.

Carvalhoma malcolmae also shares many characters in structure with *C. weiri* sp. nov., but the latter species differs in the colouration of the male, being mostly whitish yellow to pale brown (Fig. 1), the head is more transverse, ca 2.7–2.9× as wide as long in male and ca 2.3× in female (Fig. 6C).

Carvalhoma ovatum sp. nov.
urn:lsid:zoobank.org:act:3302BAE8-2B68-4CA8-8306-6608E4F897B3
Figs 1, 3, 8, 11

Diagnosis

Recognized by the following characters: pronotum and hemelytra matte and shagreened (Fig. 1); punctures on hemelytron shallow, mixed with wrinkles (Fig. 3E); small and ovate body in male (Fig. 1), 1.75 in length and 3.5× longer than pronotum width; pronotum laterally smooth, without wrinkles or dense setae; parameres with hook-shaped apices (Fig. 3A).

Etymology

The species is named for the oval body of males, whereas males of other species have an elongate body; from the Latin “ovatus”, meaning “oval”.

Material examined

Holotype

AUSTRALIA: ♂, Western Australia, Darlington, 31.92036° S, 116.07842° E, 137 m, 5 Sep. 1962, E.S. Ross and D.Q. Cavagnaro (00043323) (CAS).

Description

Male

Body length. 1.75.

Colouration (Fig. 1). Mostly dark brown to black, hind tibia apically and tarsi pale brown.

Surface and vestiture. Body mostly matte and shagreened; pronotum laterally not wrinkled (Fig. 3A); pronotum laterally and pleura almost entirely clothed with short setae (Fig. 3G); dorsum clothed with very short setae only, few dark suberect setae present on head and pronotum (Fig. 3B, E, H); appendages and abdomen clothed with suberect or adpressed dark setae shorter than width of antennal segment II (Fig. 3D, F, I).

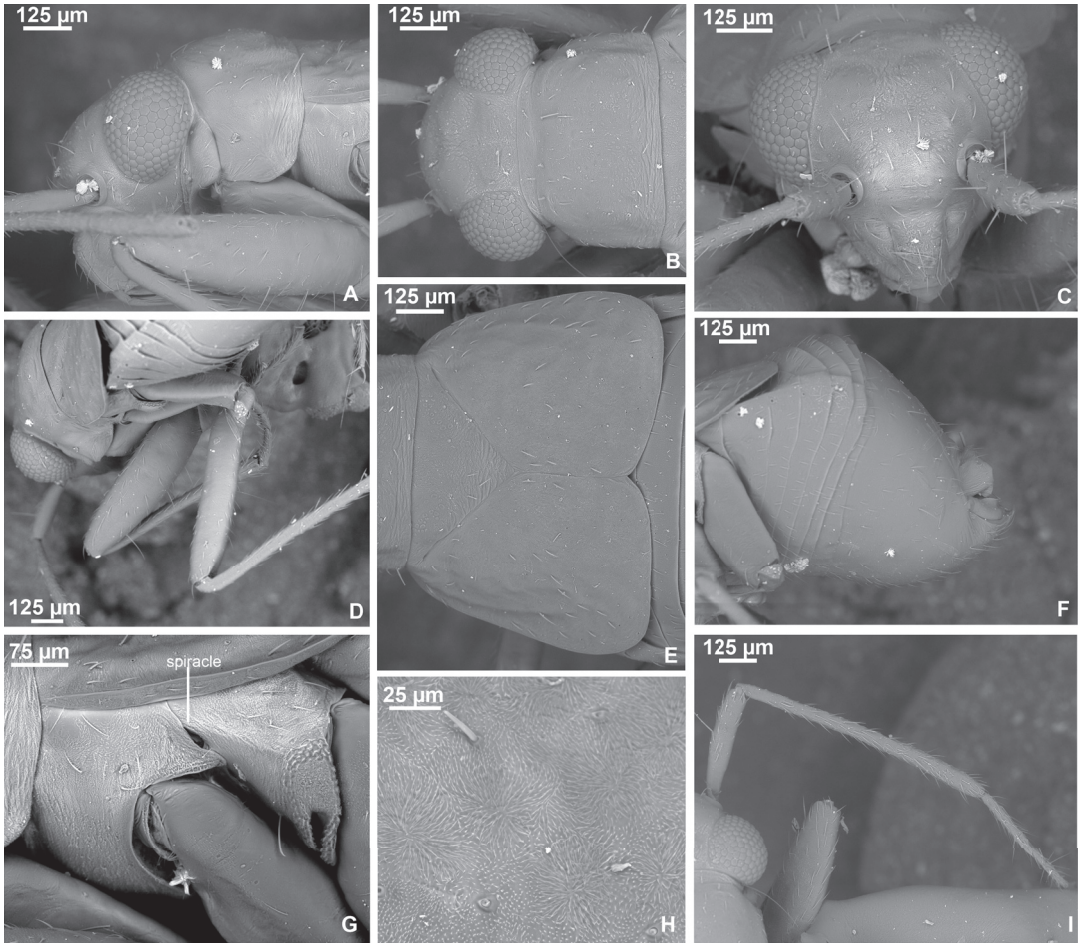

Fig. 3. SEM images of *C. ovatum* sp. nov., ♂. **A**. Head and pronotum, lateral view. **B**. Head and pronotum, dorsal view. **C**. Head, anterior view. **D**. Fore- and middle femora. **E**. Scutellum and hemelytra. **F**. Genital segment, lateral view. **G**. Pleura. **H**. Setae on hemelytron. **I**. Antenna.

Structure and measurements. Body ca 3.5× longer than pronotum width; frons only slightly protruding anteriad of eyes in dorsal view (Figs 1, 3B); head ca 2.4× wider than long, vertex ca 1.3× wider than eye diameter; in anterior view head ca 1.1× wider than high; antennal segment I ca 1.5× longer than vertex width, segment II ca 3.7× longer than vertex width, and ca 2.5× longer than segment I; labial segments I and II subequal in length, segments III and IV each shorter than segment II, subequal in length to each other; pronotum ca 1.6× wider than long, ca 0.9× wider than head, with single oval depression medially; metepimeron with shallow but distinct ridge (Fig. 3G).

Genitalia (Fig. 8). Right paramere with ridge dorsally, hook-shaped apically, its outer margin concave (Fig. 8D); left paramere with angulate basal swelling and hook-shaped apex, without dorsal ridge (Fig. 8E). Theca mostly sclerotised, endosoma with large sclerite, placed ventrally, smaller sclerite placed dorsally, and sclerotised area placed dorsally near base of endosoma in repose; membrane near base of endosoma thick, with small tubercles (Fig. 8A–B).

Female

Unknown.

Distribution

Known only from the type locality, Darlington, southwestern part of Western Australia (Fig. 11).

Remarks

Carvalhoma ovatum sp. nov. is distinguished by its oval male and shagreened hemelytron with shallow punctures, and it is not similar to congenerics.

Carvalhoma parvum sp. nov.

urn:lsid:zoobank.org:act:22E8AB43-51EB-4566-8B9C-278DC1A46314

Figs 1, 4, 9, 11

Diagnosis

Recognised by the following combination of characters: head, pronotum, hemelytron and antennal segment I shiny and dark brown to black (Fig. 1); body small, 1.5–1.6 in male and 1.9–2.2 in female; head elongate, ca 3.7–4.0× as long as pronotum width in male and 4.1–4.5× in female; pronotum laterally covered with dense wrinkles and setae at sides (Fig. 2C); antennal segment I short, ca 1.4–1.8× as long as vertex width in male and ca 1.3–1.4× in female.

Etymology

The specific epithet refers to the size of the males, which are smaller than its congeners; from the Latin "parvus", meaning "small, minute, short".

Distribution

Known from the southeastern part of Queensland and northeastern New South Wales (Fig. 11).

Material examined

Holotype

AUSTRALIA: ♂, Queensland, Gold Creek Reservoir, site 1, 27.45883° S, 152.872° E, 140 m, 31 Mar. 2004–30 Apr. 2004, QM party (AMNH_PBI 00404481) (QM).

Paratypes

AUSTRALIA: New South Wales: 2 ♀♀, NE slope of Little Mountain (just W of Karuah Rd), 32.6° S, 151.93333° E, 40 m, 4 Feb. 1993–9 Apr. 1993, M. Gray and G. Cassis (00043346, 00043324) (AM). — Queensland: 1 ♂ (00043506), 1 ♀ (00043507), Belmont Hills Bushlands, site 1, 27.51305° S, 153.11805° E, 80 m, 19 Feb. 2004, QM party (QM); 1 ♂, same data, 1 Mar. 2004–31 Mar. 2004, QM party (00043508) (QM); 1 ♀, Chelsea Road Bushlands Reserve, 27.47634° S, 153.1858° E, 15 m, 24 Feb. 2004, QM party (00043509) (QM); 1 ♂, same data, 31 Mar. 2004–29 Apr. 2004, QM party (AMNH_PBI 00400914) (QM); 1 ♂ (00043503), 1 ♀ (00043504), same locality as holotype, 30 Jan. 2004–1 Mar. 2004, QM party (QM); 1 ♀, same data, 1 Mar. 2004–29 Mar. 2004, QM party (00043505) (QM); 1 ♀, same data, 31 Mar. 2004–30 Apr. 2004, QM party (AMNH_PBI 00404482) (QM); 1 ♂, Illaweena Street, Drewvale, 27.63983° S, 153.0578° E, 40 m, 17 Apr. 2003, C.J. Burwell and S. Wright (AMNH_PBI 00400916)

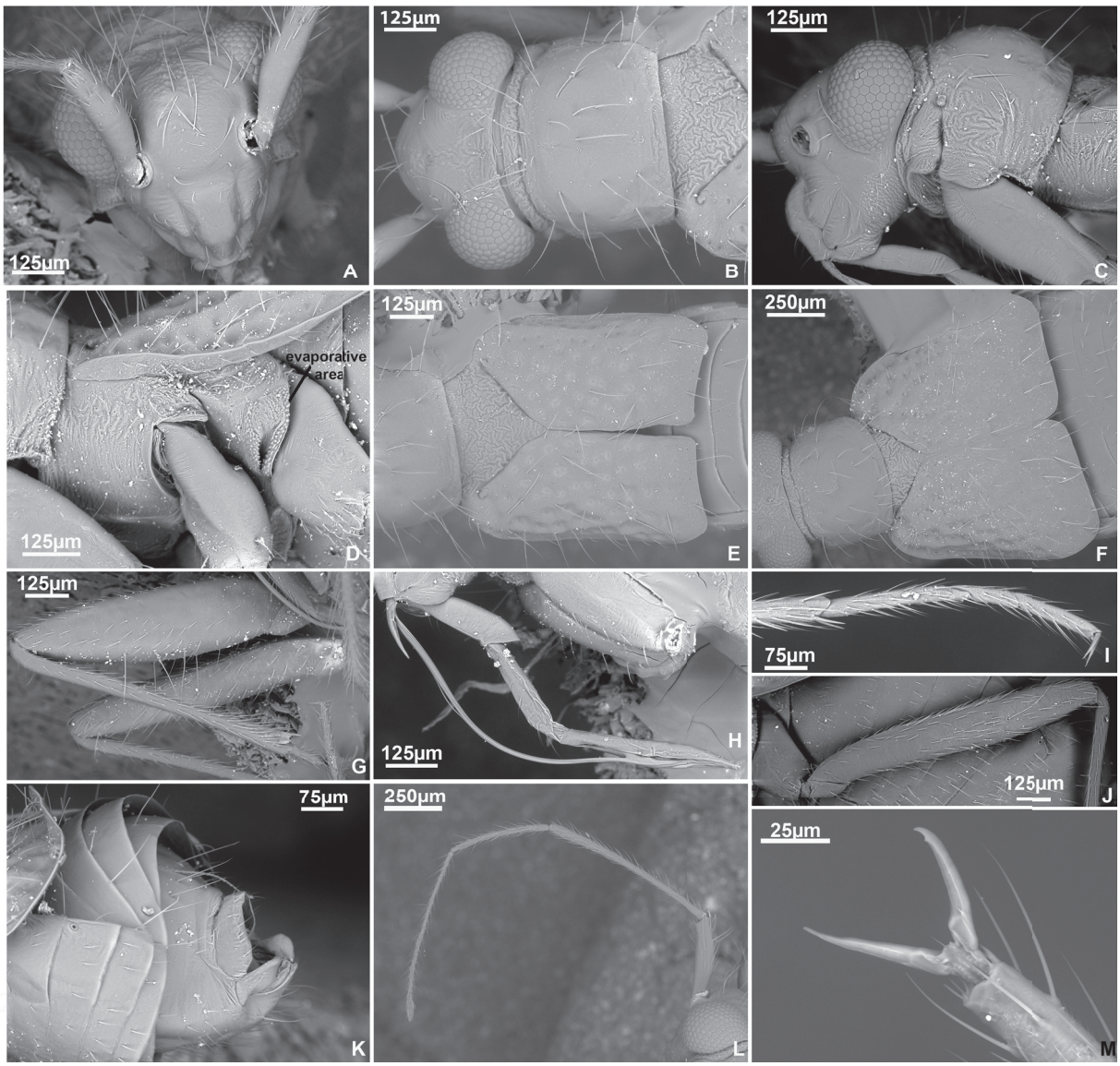

Fig. 4. SEM images of *C. parvum* sp. nov. **A**. Head, anterior view, ♀. **B**. Head and pronotum, dorsal view, ♂. **C**. Head and pronotum, lateral view, ♂. **D**. Pleura, ♀. **E**. Scutellum and hemelytra, ♂. **F**. Scutellum and hemelytra, ♀. **G**. Fore- and middle femora, ♀. **H**. Labium, ♂. **I**. Hind tarsus, ♀. **J**. Hind femur, ♀. **K**. Genital segment, lateral view, ♂. **L**. Antenna, ♀. **M**. Pretarsus, ♂.

(QM); 1 ♂, same data, 26 May 2003–1 Jul. 2003, QM party (AMNH_PBI 00400915) (QM); 1 ♀, same data, 31 Mar. 2004–29 Apr. 2004, QM party (00043510) (QM).

Description

Male

Body length. 1.5–1.6.

Colouration (Fig. 1). Mostly brown to dark brown, sometimes with reddish tinge, clypeus pale brown, labial segment I reddish brown to reddish, segments II–IV whitish yellow to yellow, segment IV brown apically; antennal segment II yellow, often reddish apically; fore- and middle coxae whitish yellow, often darkened basally; hind coxa the same colour as fore- and middle coxae or dark brown; femora reddish or dark brown, often whitish yellow basally, tibia whitish yellow, often darkened basally, tarsi whitish yellow to yellow.

Surface and vestiture. Head and pronotum smooth and shiny, except for shagreened collar (Fig. 1); pronotum laterally wrinkled (Fig. 1); hemelytron shiny, with distinct punctures (Figs 1, 4E), pleura entirely covered with short setae (Fig. 4D). Dorsum and abdomen clothed with long simple erect pale setae.

Structure and measurements. Body ca 3.7–4.0× as long as pronotum width; frons protruding anteriad of eyes at distance subequal to at least half of eye diameter (Fig. 1, 4B), head ca 1.8–2.4× as wide as long, vertex ca 1.1–1.4× as wide as eye diameter; head ca 1.0–1.1× as wide as high; antennal segment I ca 1.4–1.8× as long as vertex width; segment II ca 4.1–4.9× longer than vertex width, and ca 2.5–2.9× longer than segment I; segment III slightly longer than segment I, segment IV slightly shorter than segment III; labial segments subequal in length (Fig. 4H); pronotum ca 1.2–1.3× as wide as long, ca 0.8–0.9× as wide as head, with single oval depression medially; metepisternum with distinct ridge (Fig. 4D); tarsal segment I almost twice as long as segment II, segment II slightly shorter than segment III (Fig. 4L).

Genitalia (Fig. 9A–E). Right paramere without dorsal ridge, its outer margin concave, apex straight, not hooked; left paramere with ridge dorsally, its apex straight, not hooked, basal swelling rounded (Fig. 9D); theca mostly membranous, sclerotised only apically (Fig. 9A–B).

Female

Body length. 1.9–2.2.

Colouration (Fig. 1). Similar to male, but usually somewhat darker, colour of labial segments III–IV, coxae and tarsi varying from yellow to brown, tibiae whitish yellow to pale brown, often brown at extreme apex.

Surface and vestiture. As in male.

Structure and measurements. Body ca 4.1–4.5× longer than pronotum width; head ca 1.9–2.2 × wider than long, vertex ca 1.0–1.3× wider than eye diameter; head ca 1.1–1.3× wider than high; antennal segment I ca 1.3–1.4× longer than vertex width, segment II ca 3.1–3.7× longer than vertex width, and ca 2.2–2.5× longer than segment I, segment IV slightly longer than segment III; pronotum ca 1.2–1.3× wider than long, ca 0.8–0.9× wider than head; hind femur twice longer than head height.

Genitalia. Dorsal labiate plate with elongate sclerite along outer margin; sclerotised ring elongate posteriorly, its dorsal portion ca 2.5–3× as long as wide (Fig. 9F); posterior wall of bursa copulatrix without small tubercles (Fig. 9G).

Differential diagnosis

Carvalhoma parvum sp. nov. is similar to *C. malcolmae* externally and in the dark brown colouration (Figs 1–2, 4–5), but the latter species differs in the following characters: larger body (Figs 1–2), 2.25 in male and 2.3–2.8 in female, smooth lateral side of the pronotum, almost without wrinkles (Fig. 2C), lateral sides of the pronotum and pleura not densely setose (Fig. 2C, K), and relatively long antennal segment I, ca 2.0× as long as vertex width in male and ca 1.8–2.2× in female.

Carvalhoma taplini Slater & Gross, 1977
Figs 1, 5, 11

Carvalhoma taplini Slater & Gross, 1977: 137.

Diagnosis

Separated from all other species in the genus by the following characters: head and pronotum matte and shagreened, hemelytron shiny, with distinct punctures (Fig. 1G); body large and ovate, total length of female 2.1–2.3, ca 3.6–3.8× longer than pronotum; antennal segment I ca 1.2–1.4× as long as vertex width; pronotum laterally with dense wrinkles and setae (Fig. 5G).

Material examined

Holotype
AUSTRALIA: ♀, South Australia, 1 km NW of Monash, 34.26742° S, 140.57012° E, 17 May 1970, I.C. Taplin (00043321) (ANIC).

Paratype
AUSTRALIA: 1 ♀, same collection data as holotype (00043322) (ANIC).

Description

Male
Unknown

Female
Body length. 2.1–2.3.

Colouration (Fig. 1G). Dark brown, mostly with reddish tinge, head anteriorly pale brown to yellow, antenna, labial segments I–III, fore- and middle coxa, tibiae and tarsi yellow, hind coxa brown or yellow, ventral side of abdomen pale brown or brown.

Surface and vestiture. Body mostly matte and shagreened, hemelytron moderately shiny and distinctly punctate (Figs 1, 5J), pronotum laterally wrinkled (Fig. 5A), pronotum laterally and pleura clothed with short setae (Fig. 5A, G); dorsum and abdomen clothed with long suberect setae, usually longer than width of antennal segment II (Fig. 5A–B, I–J); appendages clothed with setae shorter than width of antennal segment II.

Structure and measurements. Body ca 3.6–3.8× longer than pronotum width; frons protruding anteriad at distance subequal to at least half of eye diameter in dorsal view (Figs 1, 5B), ca 2.0× as wide as long, vertex ca 1.1–1.4× as wide as eye diameter; head ca 1.2–1.4× as wide as high (Fig. 5C); antennal segment I ca 1.2–1.4× longer than vertex width, segment II ca 2.9–3.2× longer than vertex width, and ca 2.2–2.3× longer than segment I; segment III subequal to segment I, segment IV slightly shorter than segment III; labial segments I and II subequal in length, segments III and IV each shorter than segment II, subequal in length to each other (Fig. 5D); pronotum ca 1.4–1.5× wider than long, ca 0.9× wider

than head, with single oval depression medially; metepisternum with very shallow ridge (Fig. 5G); hind femur ca 1.5× longer than head height; tarsal segment I almost twice as long as segment II, segment II slightly shorter than segment III (Fig. 5E).

Genitalia. Not dissected.

Distribution

Known from a single locality in northeastern South Australia (Fig. 11).

Differential diagnosis

Due to its surface and oval body shape (see diagnosis) *Carvalhoma taplini* is not very similar to the congenerics.

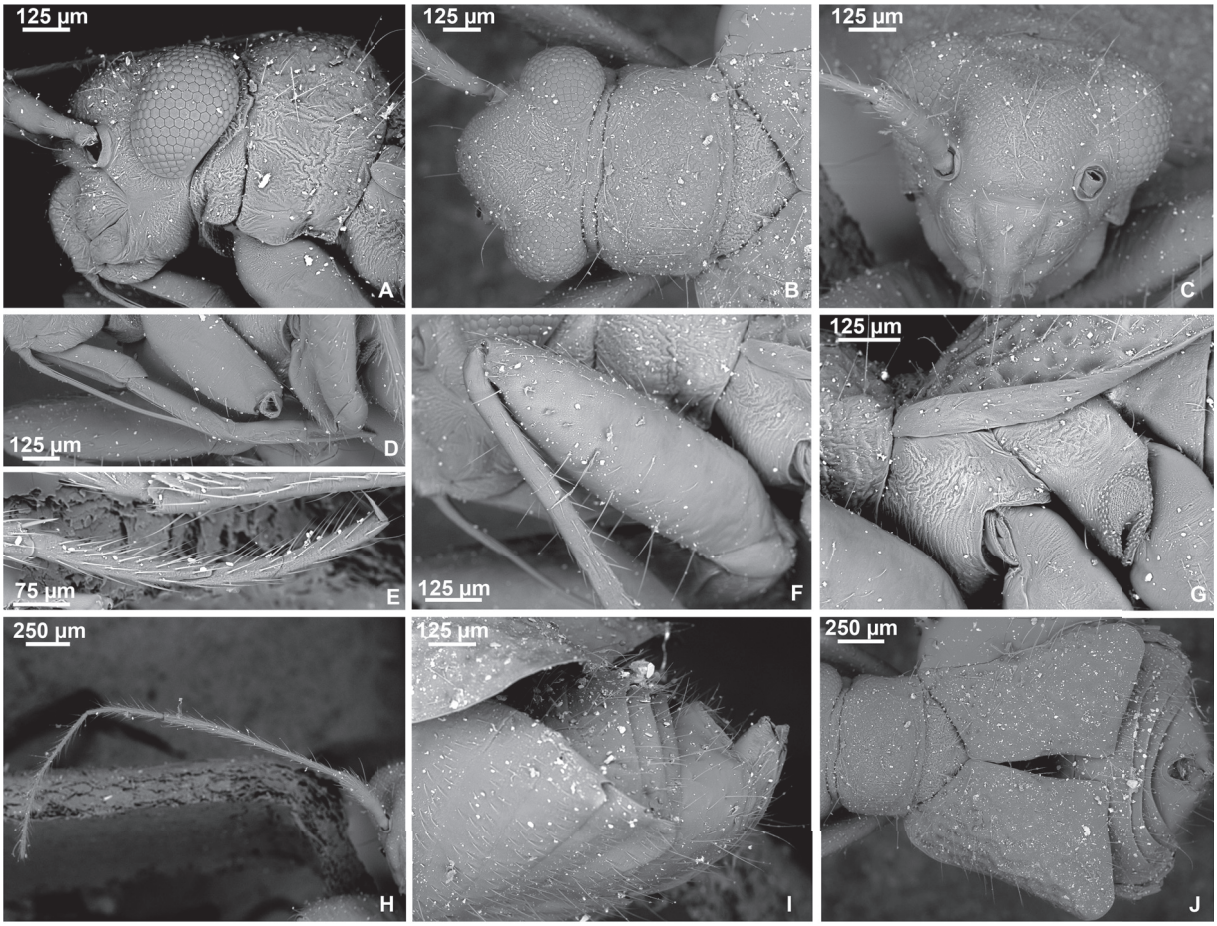

Fig. 5. SEM images of *C. taplini* Slater & Gross, 1977, ♀. **A**.Head and pronotum, lateral view. **B**. Head and pronotum, dorsal view. **C**. Head, anterior view. **D**. Labium. **E**. Hind tarsus. **F**. Forefemur. **G**. Pleura. **H**. Antenna. **I**. Abdomen, lateral view. **J**. Pronotum, scutellum, hemelytra and abdomen, dorsal view.

Carvalhoma weiri sp. nov.
urn:lsid:zoobank.org:act:B6582026-5F0A-495F-9586-01EDBE0BBDB6
Figs 1, 6, 10, 11

Diagnosis

Recognized by the following combination of characters: head, pronotum and hemelytron shiny, hemelytron with distinct punctures; body in male mostly pale brown, antennal segment I in both sexes whitish yellow to pale brown (Fig. 1); lateral side of pronotum smooth, almost without wrinkles and setae; antennal segment I long, ca 1.9–2.1× as long as width of vertex in male and ca 1.2× in female.

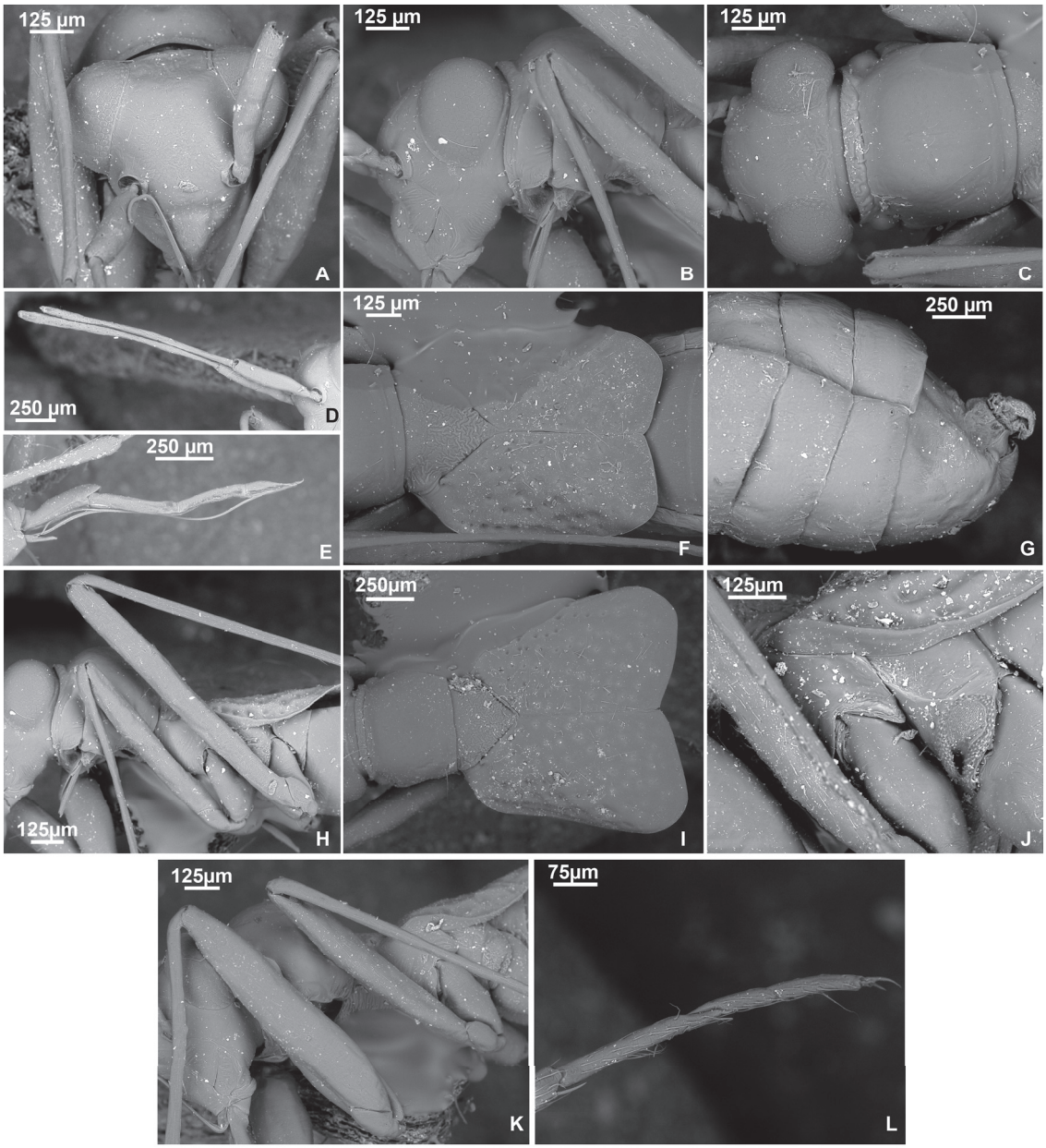

Fig. 6. SEM images of *C. weiri* sp. nov. **A**. Head, anterior view, ♂. **B**. Head and pronotum, lateral view, ♂. **C**. Head and pronotum, dorsal view, ♂. **D**. Antennal segments I and II, ♂. **E**. Labium, ♀. **F**. Hemelytron, ♂. **G**. Abdomen, lateral view, ♂. **H**. Middle and hind femora, ♂. **I**. Hemelytron, ♀. **J**. Pleura, ♀. **K**. Fore- and middle femora, ♂. **L**. Hind tarsus, ♀.

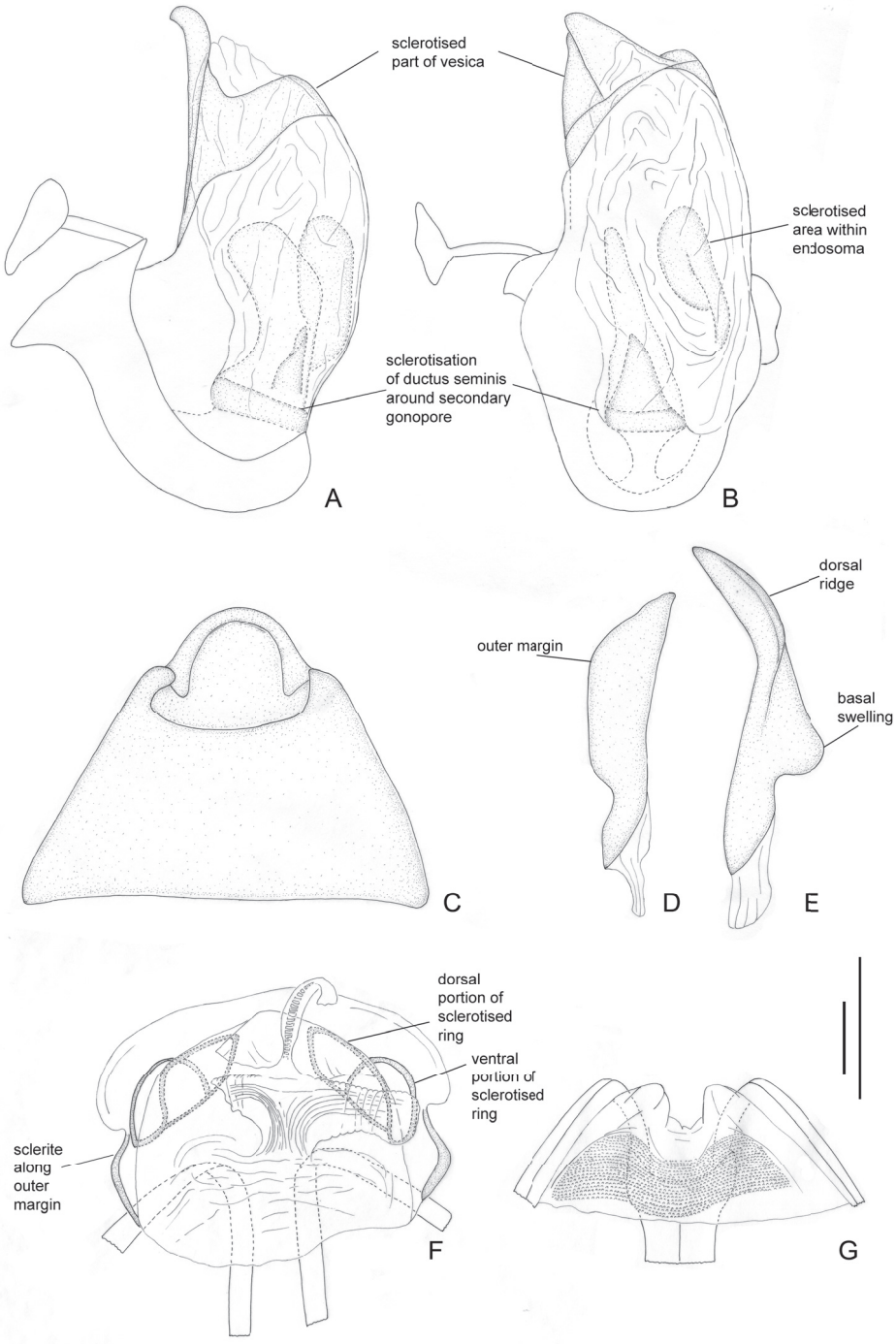

Fig. 7. Genitalia of *C. malcolmae* Slater & Gross, 1977. **A**. Aedeagus, left lateral view. **B**. Aedeagus, ventral view. **C**. Genital capsule. **D**. Right paramere. **E**. Left paramere. **F**. Dorsal labiate plate of bursa copulatrix. **G**. Posterior wall of bursa copulatrix. Scale bars = 0.1 mm (the large scale bar is for A–B and D–E, the small scale bar is for C and F–G).

Etymology

The species is named after T. Weir, one of the collectors of the specimens.

Material examined

Holotype

AUSTRALIA: ♂, Australian Capital Territory, Blundell's Creek, 3 km E of Piccadilly Circus, 35.55° S, 148.83333° E, 850 m, Feb. 1984, T. Weir, J.F. Lawrence and M.L. Johnson (00043340) (ANIC).

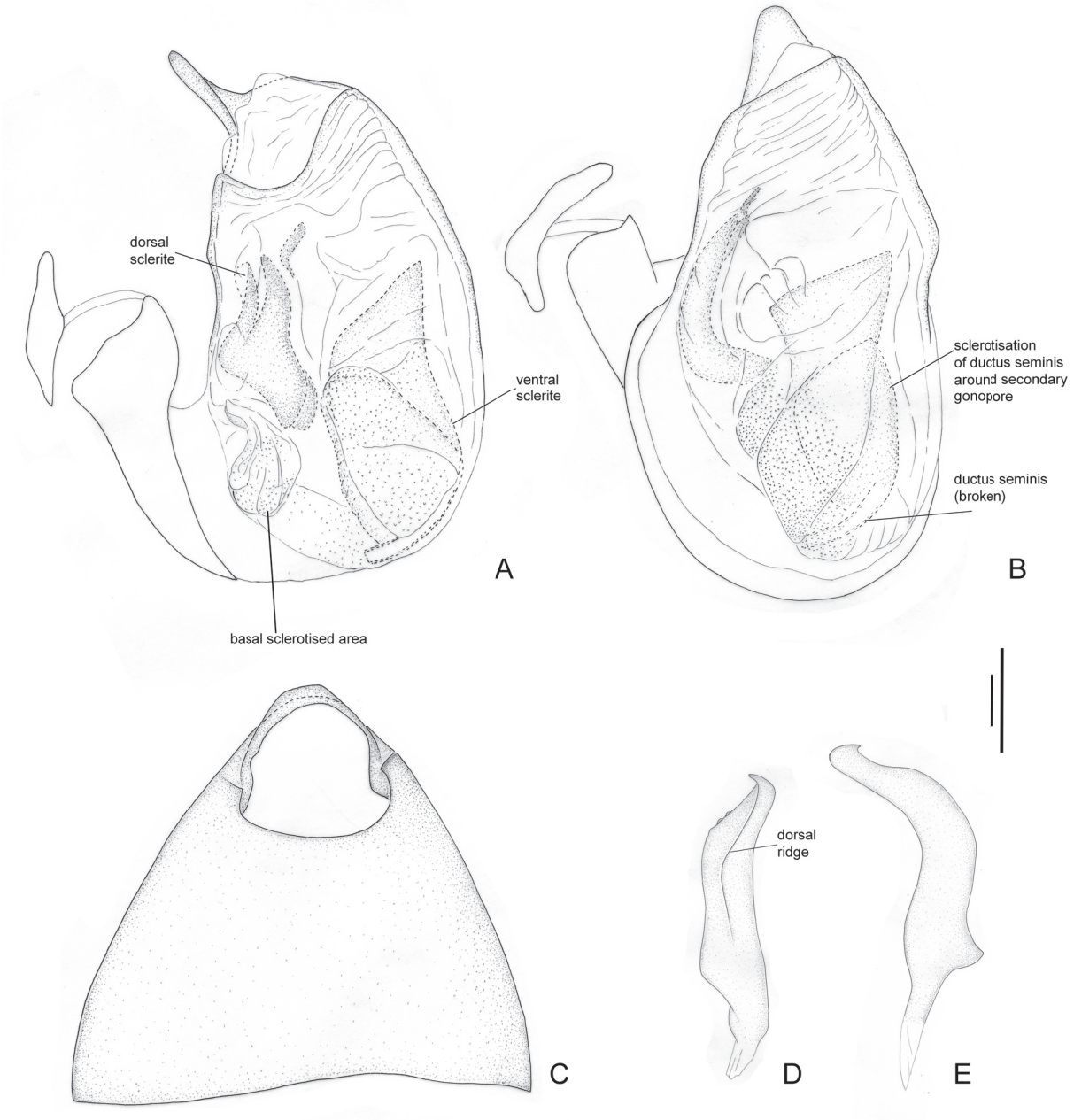

Fig. 8. Genitalia of *C. ovatum* sp. nov. **A**. Aedeagus, left lateral view. **B**. Aedeagus, ventral view. **C**. Genital capsule. **D**. Right paramere. **E**. Left paramere. Scale bars = 0.1 mm (the large scale bar is for A–B and D–E, the small scale bar is for C).

Paratypes

AUSTRALIA: Australian Capital Territory: 1 ♂, same collection data as holotype (00043339) (ANIC); 1 ♀, Wombat Creek, 6 km NE of Piccadilly Circus, 35.19° S, 148.51° E, 750 m, Jan. 1984, T. Weir, J.F. Lawrence and M.L. Johnson leg. (00043344) (ANIC).

Description

Male

Body length. 2.3.

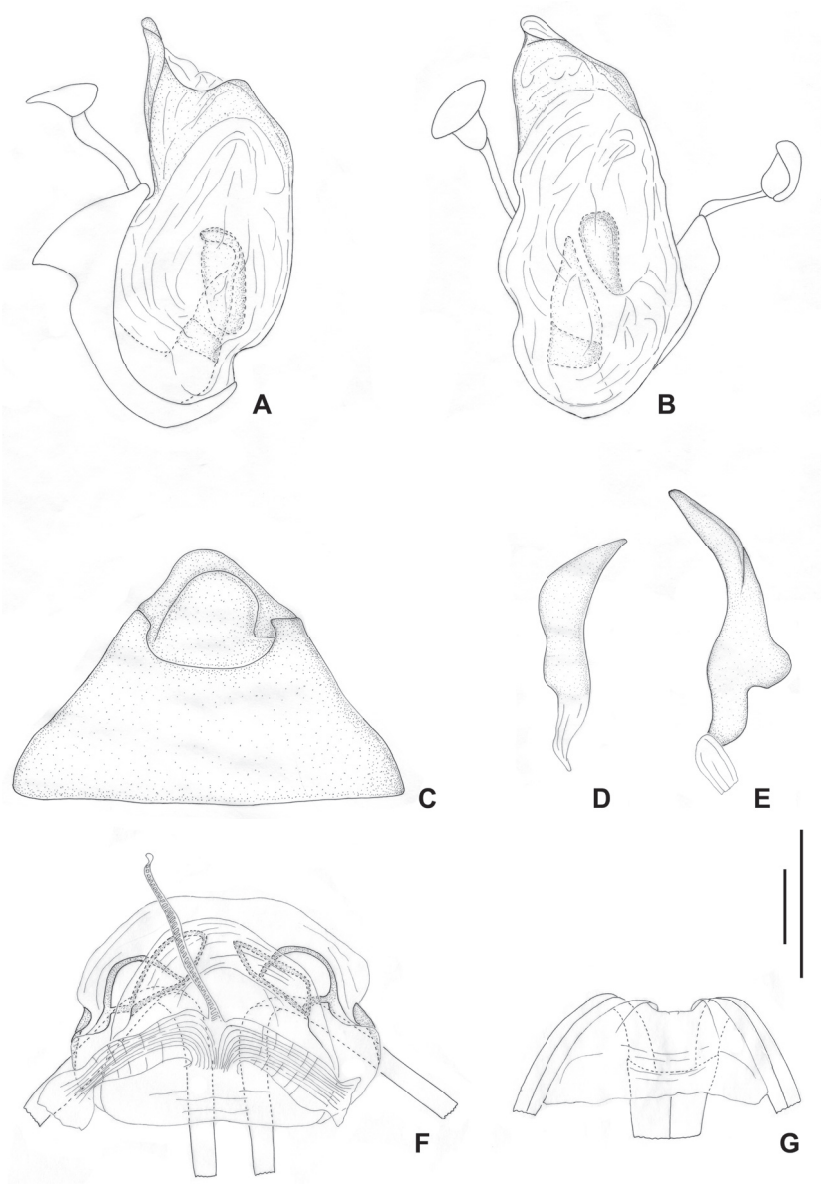

Fig. 9. Genitalia of *C. parvum* sp. nov. **A**. Aedeagus, left lateral view. **B**. Aedeagus, ventral view. **C**. Genital capsule. **D**. Right paramere. **E**. Left paramere. **F**. Dorsal labiate plate of bursa copulatrix. **G**. Posterior wall of bursa copulatrix. Scale bars = 0.1 mm (the large scale bar is for A–B and D–E, the small scale bar is for C and F–G).

Colouration (Fig. 1). Head brown or reddish brown, clypeus, maxillary and mandibular plates yellow, pronotum and scutellum brown or reddish brown; pleura brown, with yellow metathoracic scent gland evaporative area; hemelytron yellow, brown basally and with brown punctures; antenna, labium, legs and abdomen yellow, forefemur sometimes with reddish tinge, abdomen with pale brown or brown markings.

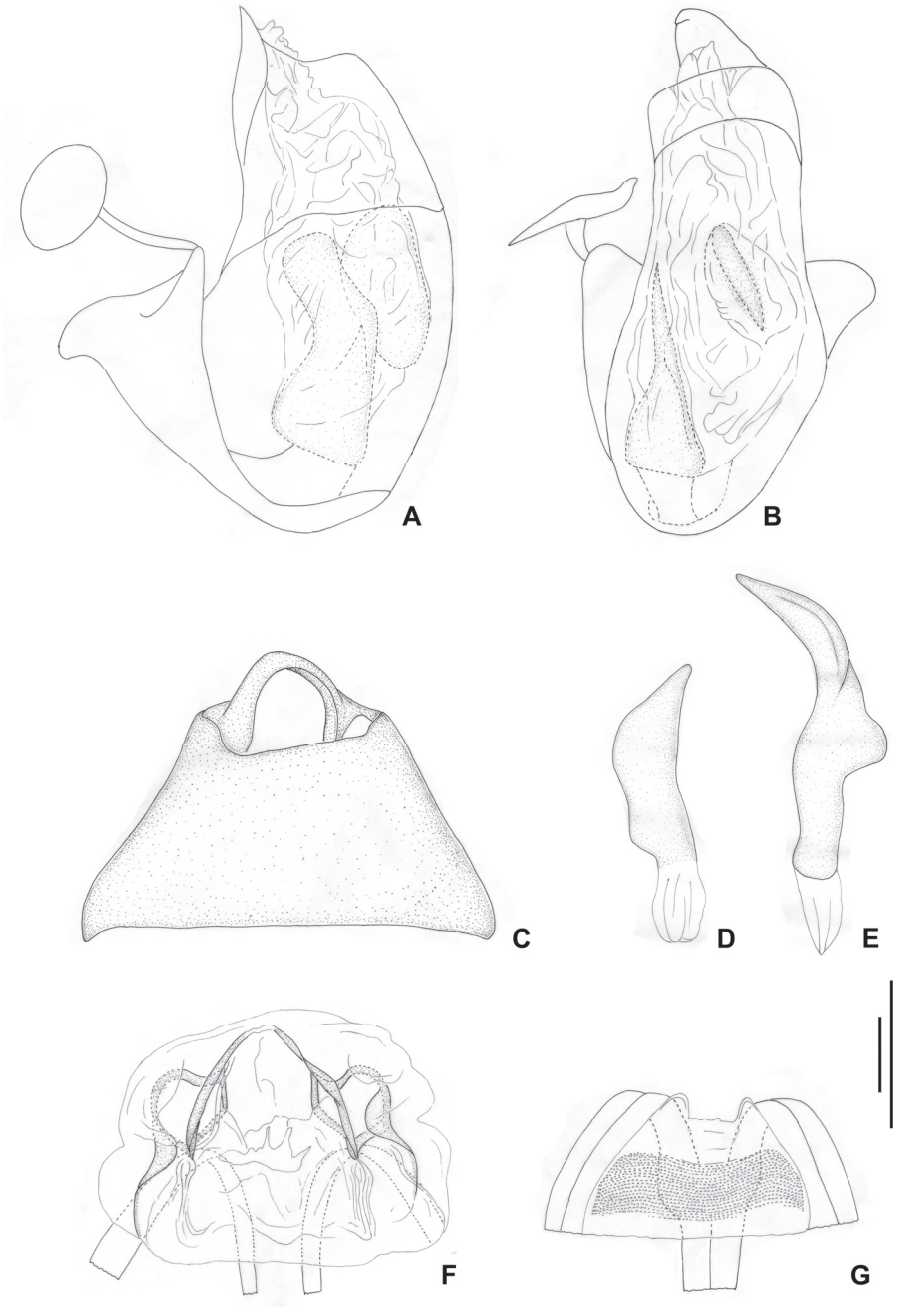

Fig. 10. Genitalia of *C. weiri* sp. nov. **A**. Aedeagus, left lateral view. **B**. Aedeagus, ventral view. **C**. Genital capsule. **D**. Right paramere. **E**. Left paramere. **F**. Dorsal labiate plate of bursa copulatrix. **G**. Posterior wall of bursa copulatrix. Scale bars = 0.1 mm (the large scale bar is for A–B and D–E, the small scale bar is for C and F–G).

Surface and vestiture. Head shiny, pronotum shiny with collar shagreened, scutellum shagreened (Fig. 1); pronotum smooth laterally, without wrinkles or short setae; pleura with short setae only on anterior part of metapleuron (Fig. 6J); setae on dorsum, appendages and abdomen almost absent.

Structure and measurements. Body ca 5.0× longer than pronotum width; frons only slightly protruding anteriad (Figs 1, 6C), head ca 2.0× wider than long, vertex ca 1.0–1.1× wider than eye diameter; head ca 1.0–1.1× wider than high; antennal segment I ca 1.9–2.1× longer than vertex width, segment II ca 4.5–4.9× longer than vertex width, and ca 2.3–2.4× longer than segment I; labial segments I and II subequal in length, segment III slightly shorter than segment II, and segment IV slightly shorter than segment III (Fig. 6E); pronotum ca 1.0–1.1× wider than long, ca 0.8–0.9× wider than head, with single oval depression medially; metepisternum with distinct ridge (Fig. 6J); hind femur ca 3× longer than head height; tarsal segment I almost twice as long as segment II, segments II and III subequal in length (Fig. 6L); pregenital segments not upraised above genital segment (Fig. 6G).

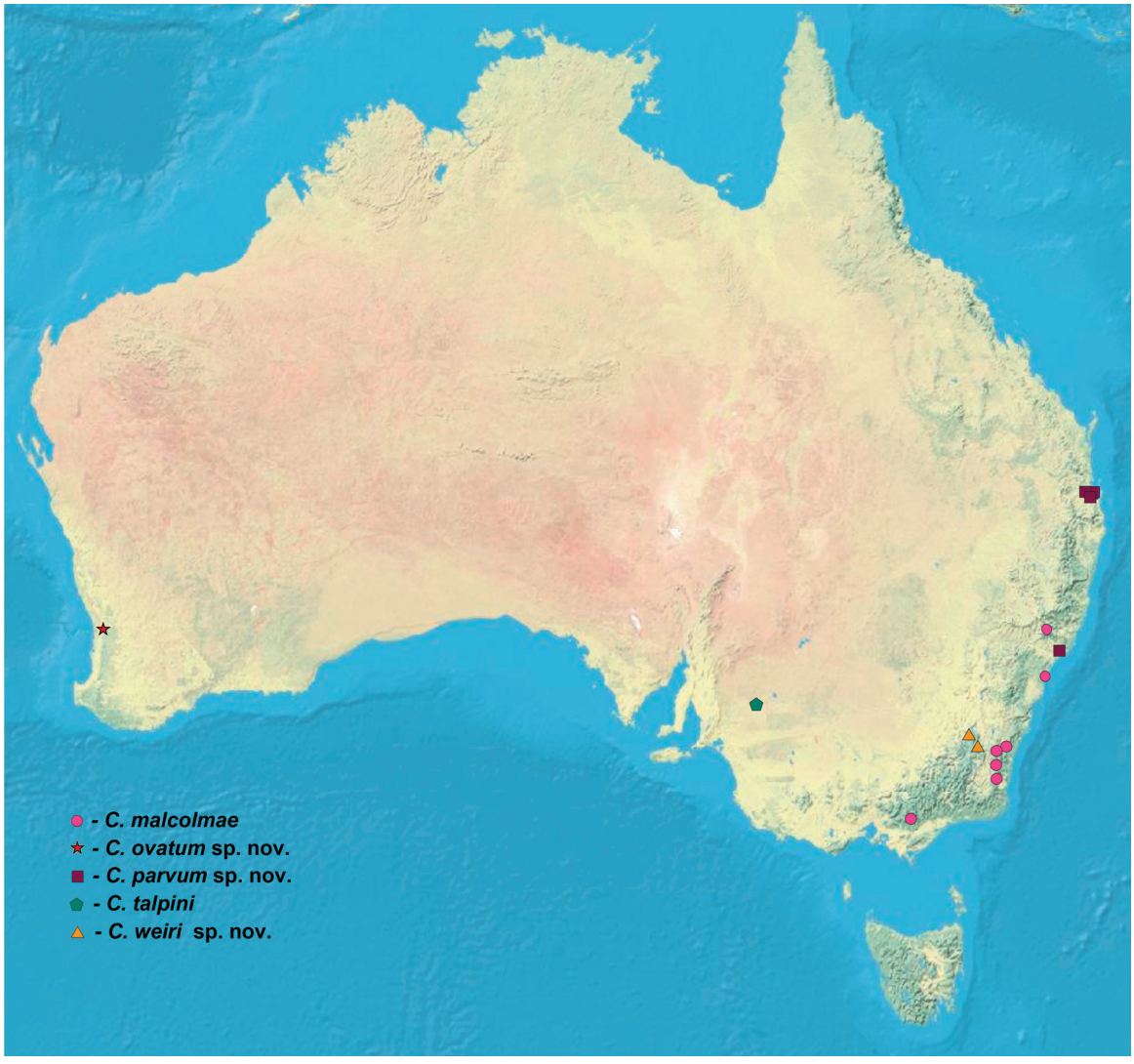

Fig. 11. Distribution of *Carvalhoma* species.

Genitalia (Fig. 10A–E). Right paramere without ridge dorsally, its outer margin concave; apices of parameres straight, not hook-shaped; left paramere with ridge dorsally, its basal swelling rounded. Theca mostly membranous; endosoma with single sclerite, placed ventrally on the right side.

Female

Body length. 2.7.

Colouration (Fig. 1). Darker than in male. Head dark brown, with clypeus and mandibular plate pale brown, antennal segment I and labium yellow; pronotum and scutellum dark brown; pleura dark brown; coxae pale brown to brown, paler apically; femora pale brown, tibia and tarsi yellow; abdomen brown.

Surface and vestiture. Similar to male, but setae on dorsum and legs distinct.

Structure and measurements. Body ca 5.0–5.1× longer than pronotum width; head ca 2.3× wider than long, vertex ca 0.9× wider than eye diameter; head ca 1.2× wider than high; antennal segment I ca 2.1× longer than vertex width, segment II ca 4.9× longer than vertex width, and ca 2.3× longer than segment I; pronotum ca 1.1× wider than long, ca 0.8× wider than head; hind femur ca 2.5× longer than head height.

Genitalia. Sclerotised ring of dorsal labiate plate elongate posteriorly, its dorsal portion very narrow, ca 4× longer than wide (Fig. 10F); posterior wall with small tubercules (Fig. 10G).

Distribution

Known only from the Australian Capital Territory (Fig. 11).

Remarks

Antennal segments III and IV are broken in the males of the type material, and segments II–IV are broken in the female. In contrast to other *Carvalhoma* species, specimens of *C. weiri* sp. nov. are relatively pale, and genitalia also very soft and pale, which can indicate that the specimens are teneral.

Differential diagnosis

Carvalhoma weiri sp. nov. is most similar to *C. malcolmae* in the relatively large size, elongate body, surface and vestiture (Fig. 1). However, *C. malcolmae* differs in the mostly dark brown to black male (Fig. 1), the frons distinctly protruding anteriad of the eyes (Figs 1, 2B), in dorsal view ca 2.1× as wide as long in male and 1.7–2.2× in female.

Discussion

Slater & Gross (1977) described *Carvalhoma*, placing it in the nominotypical tribe of the subfamily Phylinae. Schuh & Schwartz (1984) transferred the genus to the subfamily Cylapinae. We agree with the latter decision. The representatives of Cylapinae are very diverse morphologically, but all of them have a similar structure of the tarsus and pretarsus, with thin tarsi, no pulvilli, setiform parempodia and slender claws often toothed apically (Gorczyca 2000; Cassis & Schuh 2012). The structure of the unguitractor in *Carvalhoma* is very similar to that found in other Cylapinae, except for the Vanniini, as described in Namyatova *et al*. (2016) (compare Figs 2L and 4I with fig. 21E in Namyatova *et al*. 2016), with three rows of lamellae on the unguitractor placed close to each other and with the medial row of lamellae being characteristically acute. The position of the lamellate rows of the unguitractor in *Carvalhoma* is unique, with the three rows of lamellae separated in comparison to being contiguous as in other cylapines (fig. 21E in Namyatova *et al*. 2016). All examined species of Cylapinae, except for Vannini, in Namyatova *et al*. (2016) also have asymmetrical parempodia with the outer parempodia in

dorsal view strongly reduced. Although the SEM image is not particularly clear, *Carvalhoma* shares the same type of parempodia asymmetry (Fig. 4I).

The tribal placement of *Carvalhoma* within Cylapinae is uncertain. Among Cylapinae tribes, this genus is not similar to Bothriomirini, as its members are stout bugs with the head and pronotum punctate and the pronotum without a collar (Wolski & Gorczyca 2012). It also does not fit to the diagnosis of Rhinomirini, as this tribe has a horizontal head (Gorczyca 2000). Although there are brachypterous species within Vanniini, this tribe differs from *Carvalhoma* in having flattened spatulate parempodia and impunctate hemelytra (Cassis *et al*. 2003). Gorczyca (2000, 2006) and Schuh (2003–2013) treated the genus within the tribe Fulviini. In contrast, Cassis & Gross (1995) in their catalogue of the Australian heteropteran fauna placed *Carvalhoma* within Cylapini.

When using Gorczyca's taxonomic key (Gorczyca 2000), *Carvalhoma* cannot be assigned to Fulviini or Cylapini with any confidence. According to this key the main difference between those two tribes is the structure of antennae. They are either longer than the body, with antennal segment IV being the longest in Cylapini, or the antennae are shorter than the body, with antennal segment II being longest in Fulviini. In *Carvalhoma*, antennal segment IV is the longest segment, but the antennae are as long as or slightly longer than the body Although Fulviini is likely a convenience group, most of its genera are characterised by a more or less prognathous head, whereas *Carvalhoma* has a strongly hypognathous head, which is elongate and dorsoventrally oriented, and with a swollen frons; this is more similar to the head of Cylapini (Gorczyca 2000). *Carvalhoma* is not very similar to most of the New World genera of Cylapini, as they usually have the antennae longer than the body and prominent eyes. However, some New World and Old World genera placed in the Cylapini by Gorczyca (2000, 2006) have eyes which are not prominent and/or antennae shorter than the body; these include *Corcovadocola* Carvalho, 1948) *Cylapoides* Carvalho, 1952, *Phyllocylapus* Poppius, 1913, and *Cylapomoprha* Yasunaga, 2000. Murphy & Polhemus (2012) also placed *Mangalocoris* Murphy & Polhemus, 2012, known from Singapore and Thailand, in the Cylapini; this genus has antennae distinctly longer than the body and fits the diagnosis of the tribe provided by Gorczyca (2000), and it is externally similar to *Carvalhoma*. Based on this, we support the placement of *Carvalhoma* in the tribe Cylapini (Cassis & Gross 1995), but acknowledge that an explicit phylogenetic analysis is required to determine its relationships with other genera of Cylapinae.

With respect to the proximity of relationship of *Carvalhoma* to *Mangalocoris*, both taxa have shortened wings, enlarged forefemora and a similar ratio of labial segments. Although Murphy & Polhemus (2012) did not give a detailed description of the external efferent system of the metathoracic glands of *Mangalocoris*, their illustration indicates that it is elongate and similar to that of *Carvalhoma*. *Mangalocoris* is separated from *Carvalhoma* by having very short wings, covering only the anterior part of the second abdominal tergite, and two-segmented tarsi.

Other species of Cylapinae with a hypognathous head and shortened wings include the Brazilian genus *Corcovadocola* Carvalho, 1948 and the Australian genus *Schizopteromiris* Schuh, 1986. Based on Carvalho's (1948) original description, *Corcovadocola* is separated from *Carvalhoma* by the following characters: males macropterous, forewings in female reaching abdominal segment IX, and the pronotum 3× wider than long. *Schizopteromiris* and *Carvalhoma* possess the similar hypognathous head, with a protruding frons and a similar ratio of labial segments, but can be separated by the former having a distinctly convex hemelytron, covering almost the entire abdomen, and the broad external efferent system of the metathoracic glands (Schuh 1986).

In this paper, the genus *Carvalhoma* is revised and three new species, *C. ovatum* sp. nov., *C. parvum* sp. nov. and *C. weiri* sp. nov., are described. There might be more species of this genus inhabiting Australia, but not yet collected, due to the difficulties in finding representatives of this group.

As a result of this work the number of known species in Australia increased from five to eight for Cylapini and from 35 to 38 for Cylapinae, with some genera and many species awaiting description.

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References

Carvalho J.C.M. 1948. Mirideos neotropicais, 35: Generos *Corcovadocola* n. g., *Guanabarea* n. g. e *Caulotops* Bergroth (Hemiptera). *Revista Brasileira de Biologia* 8: 525–533.

Cassis G. 2008. The *Lattinova* complex of austromirine plant bugs (Hemiptera: Heteroptera: Miridae: Orthotylinae). *Proceedings of the Entomological Society of Washington* 110 (4): 845–939.

Cassis G. & Gross G.F. 1995. *Hemiptera: Heteroptera (Coleorrhyncha to Cimicomorpha). Zoological Catalogue of Australia*, Vol. 27.3A. CSIRO, Melbourne, Australia.

Cassis G. & Schuh R.T. 2012. Systematics, biodiversity, biogeography, and host associations of the Miridae (Insecta: Hemiptera: Heteroptera: Cimicomorpha). *Annual Review of Entomology* 57: 377–404. http://dx.doi.org/10.1146/annurev-ento-121510-133533

Cassis G. & Symonds C. 2014a. Systematics and host plant associations of a new genus of *Acacia*-inhabiting plant bugs from arid Australia (Insecta: Hemiptera: Heteroptera: Miridae: Orthotylinae). *Invertebrate Systematics* 28: 522–554. http://dx.doi.org/10.1071/IS13063

Cassis G. & Symonds C. 2014b. *Granitohyoidea calycopeplus* gen. nov. and sp. nov: a new plant bug taxon (Heteroptera: Miridae) affiliated with granite outcrops in south-west Western Australia, and its Palearctic affinity and host plant associations. *Austral Entomology* 53: 353–362. http://dx.doi.org/10.1111/aen.12082

Cassis G. & Symonds C. 2016. Plant bugs, plant interactions and the radiation of a species rich clade in south-western Australia: Naranjakotta, gen. nov. and eighteen new species (Insecta: Heteroptera: Miridae: Orthotylinae). *Invertebrate Systematics* 30 (2): 95–186. http://dx.doi.org/10.1071/IS15011

Cassis G., Schwartz M. & Moulds T. 2003. Systematics and New Taxa of the *Vannius*-complex (Hemiptera: Miridae: Cylapinae) from the Australian Region. *Memoirs of the Queensland Museum* 49: 125–143.

Cassis G., Wall M.A. & Schuh R.T. 2007. Insect biodiversity and industrializing the taxonomic process: A case study with the Miridae (Heteroptera). *In:* Hodkinson T. & Parnell J. (eds) *Towards the Tree of Life: Taxonomy and Systematics of Large and Species Rich Clades*: 193–212. CRC Press, Boca Raton.

Cassis G., Cheng. M. & Tatarnic N.J. 2012. Systematics of the plantbug genus *Irianocoris* Carvalho (Insecta: Heteroptera: Miridae: Orthotylinae: Austromirini). *Entomologica Americana* 118 (1): 157–176. http://dx.doi.org/10.1664/12-RA-039.1

Cheng M., Mututantri A. & Cassis G. 2012. *Myrtlemiris*, a new genus and new species of Australian plant bugs (Insecta: Heteroptera: Miridae): Systematics, phylogeny and host associations. *Systematic Entomology* 37 (2): 305–331. http://dx.doi.org/10.1111/j.1365-3113.2012.00621.x

Davis N.T. 1955 Morphology of the female organs of reproduction in the Miridae (Hemiptera). *Annals of the Entomological Society of America* 48: 132–150.

Gorczyca J. 2000. *A Systematic Study on Cylapinae with a Revision of the Afrotropical Region (Heteroptera, Miridae)*. Wydawnictqo Uniwersytetu Slaskiego, Katowice.

Gorczyca J. 2001. *Rhinomiriella tuberculata* n. gen. n. sp., the first report of Rhinomirini from Australia (Heteroptera: Miridae: Cylapinae). *Genus* 12 (4): 415–419.

Gorczyca J. 2006. The Catalogue of the Subfamily Cylapinae Kirkaldy, 1903 of the World (Hemiptera, Heteroptera, Miridae). *Monographs of the Upper Silesian Museum* 5: 1–100.

Kerzhner I.M. & Konstantinov F.V. 1999. Structure of the aedeagus in Miridae (Heteroptera) and its bearing to suprageneric classification. *Acta Societatis Zoologicae Bohemicae* 63: 117–137.

Konstantinov F.V. 2003. Male genitalia in Miridae (Heteroptera) and their significance for suprageneric classification of the family. Part I: general review, Isometopinae and Psallopinae. *Belgian Journal of Entomology* 5: 3–36.

Moulds T. & Cassis G. 2006. Review of Australian species of *Peritropis* (Insecta: Heteroptera: Miridae: Cylapinae). *Memoirs of Queensland Museum* 52 (1): 171–189.

Murphy D.H. & Polhemus D.A. 2012. A new genus of micropterous Miridae from Singapore mangroves (Insecta: Hemiptera: Heteroptera). *The Raffles Bulletin of Zoology* 60: 109–115.

Namyatova A.A. & Cassis G. 2012. *Schuhirandella fulva*, new genus and new species from Western Australia (Hemiptera: Heteroptera: Miridae: Bryocorinae: Monaloniina). *Entomologica Americana* 118 (1): 99–106. http://dx.doi.org/10.1664/12-RA-017.1

Namyatova A.A. & Cassis G. 2013. Systematics, phylogeny and host associations of the Australian endemic monaloniine genus *Rayieria* Odhiambo (Insecta: Heteroptera: Miridae: Bryocorinae). *Invertebrate Systematics* 27 (6): 689–726. http://dx.doi.org/10.1071/IS13034

Namyatova A.A. & Cassis G. 2015. Revision of the Australian endemic plant bug genus *Volkelius* Distant, 1904 (Insecta: Heteroptera: Miridae: Bryocorinae). *Austral Entomology* 54: 180–190. http://dx.doi.org/10.1111/aen.12106

Namyatova A.A., Elias M. & Cassis G. 2011. A new genus and two new species of Orthotylinae (Hemiptera: Heteroptera: Miridae) from central Australia. *Zootaxa* 2927: 38–48.

Namyatova A.A., Konstantinov F. & Cassis G. 2016. Phylogeny and systematics of the subfamily Bryocorinae based on morphology with emphasis on the tribe Dicyphini sensu Schuh, 1976. *Systematic Entomology* 41 (1): 3–40. http://dx.doi.org/10.1111/syen.12140

Preece M., Harding J. & West J.G. 2014. Bush Blitz: journeys of discovery in the Australian outback. *Australian Systematic Botany* 27: 325–332. http://dx.doi.org/10.1071/SB15009

Schuh R.T. 1986. *Schizopteromiris*, a new genus and four new species of coleopteroid cylapine Miridae from the Australian Region (Heteroptera). *Annales de la Société Entomologique de France* 22: 241–246.

Schuh R.T. 1995. *Plant Bugs of the World (Heteroptera: Miridae): Systematic Catalog, Distributions, Host List, and Bibliography*. New York Entomological Society, New York.

Schuh R.T. 2002–2013. On-line systematic catalog of plant bugs (Insecta: Heteroptera: Miridae) [online]. Available from http://research.amnh.org/pbi/catalog [accessed 17 Dec. 2015]

Schuh R.T. & Menard K. 2011. Santalalean-feeding plant bugs: Ten new species in the genus *Hypseloecus* Reuter from Australia and South Africa (Heteroptera: Miridae: Phylinae): Their hosts and placement in the Pilophorini. *Australian Journal of Entomology* 50 (4): 365–392. http://dx.doi.org/10.1111/j.1440-6055.2011.00829.x

Schuh R.T. & Pedraza P. 2011. *Wallabicoris*, new genus (Hemiptera: Miridae: Phylinae: Phylini) from Australia, with the description of 37 new species and an analysis of host associations. *Bulletin of the American Museum of Natural History* 338: 1–118. http://dx.doi.org/10.1206/689.1

Schuh R.T. & Schwartz M. 1984. *Carvalhoma* (Hemiptera: Miridae): revised subfamily placement. *Journal of the New York Entomological Society* 92 (1): 48–52.

Schuh R.T. & Slater J.A. 1995. *True Bugs of the World (Hemiptera: Heteroptera). Classification and Natural History*. Cornell University Press, Ithaca.

Schuh R.T. & Weirauch C. 2010. *Myrtaceae-feeding Phylinae (Hemiptera, Miridae) from Australia: description and analysis of phylogenetic and host relationships for a monophyletic assemblage of three new genera. Bulletin of the American Museum of Natural History* 344: 1–95.

Slater J.A. & Gross G.F. 1977. A remarkable new species of coleopteroid Miridae from southern Australia (Hemiptera: Heteroptera). *Journal of the Australian Entomological Society* 16: 135–140.

Soto D. & Weirauch C. 2009. Description of the Australian plant bug genus *Jiwarli*, n. gen. (Heteroptera: Miridae: Phylinae). *American Museum Novitates* 3653: 1–14. http://dx.doi.org/10.1206/617.1

Tatarnic N. 2009. *Dampierella* and *Goodeniaphila*: two new genera and three new species of Halticini from Australia, with a species key to the Halticini of Australia (Hemiptera: Heteroptera: Miridae: Orthotylinae). *Zootaxa* 2105: 43–60.

Wheeler A.G. 2001. *Biology of the Plant Bugs (Hemiptera: Miridae). Pests, Predators, Opportunists*. Cornell University Press, Ithaca.

Wolski A. & Gorczyca J. 2012. Plant bugs of the tribe Bothriomirini (Hemiptera: Heteroptera: Miridae: Cylapinae) from the Oriental Region: descriptions of eight new species and keys to Oriental genera and species of *Bothriomiris* Kirkaldy, *Dashymenia* Poppius, and *Dashymeniella* Poppius. *Zootaxa* 3412: 1–41.

Wolski A. & Gorczyca J. 2014. Revision of the plant bug genus *Xenocylapidius* (Hemipetra, Heteoptera, Miridae, Cylapinae), with descriptions of five new species from Australia and New Caledonia. *ZooKeys* 459: 73–94. http://dx.doi.org/10.3897/zookeys.459.8015

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