Jewel Bugs of Australia (Insecta, Heteroptera, Scutelleridae)[1]

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Abstract: The Australian genera of the Scutelleridae are redescribed, with a species exemplar of the male genitalia of each genus illustrated. Scanning electron micrographs are also provided for key non-genitalic characters. The Australian jewel bug fauna comprises 13 genera and 25 species. *Heissiphara* is described as a new genus, for a single species, *H. minuta* nov.sp., from Western Australia. *Calliscyta* is restored as a valid genus, and removed from synonymy with *Choerocoris*. All the Australian species of Scutelleridae are described, and an identification key is given. Two new species of *Choerocoris* are described from eastern Australia: *C. grossi* nov.sp. and *C. lattini* nov.sp. *Lampromicra aerea* (Distant) is restored as a valid species, and removed from synonymy with *L. senator* (Fabricius). *Calliphara nobilis* (Linnaeus) is recorded from Australia for the first time. *Calliphara billardierii* (Fabricius) and *C. praslinia praslinia* Breddin are removed from the Australian biota. The identity of *Sphaerocoris subnotatus* Walker is unknown and is incertae sedis. A description is also given for the Neotropical species, *Agonosoma trilineatum* (Fabricius); a biological control agent recently introduced into Australia to control the pasture weed Bellyache Bush (*Jatropha gossypifolia*, Euphorbiaceae). *Coleotichus borealis* Distant and *C.* (*Epicoleotichus*) *schultzei* Taueber are synonymised with *C. excellens* (Walker). *Callidea erythrina* Walker is synonymized with *Lampromicra senator*. Lectotype designations are given for the following taxa: *Coleotichus testaceus* Walker, *Coleotichus excellens*, *Sphaerocoris circuliferus* (Walker), *Callidea aureocincta* Walker, *Callidea collaris* Walker and *Callidea curtula* Walker. A discussion of the higher classification of scutellerids is given, and diagnoses of the subfamilies natively present in Australia are provided. A new term, the ejaculatory apparatus is introduced for the subdistal elaboration of the ductus seminis, to include the ventral conducting canal, ejaculatory reservoir and dorsal conducting canal. A survey of male pheromonal glands found on the pregenital abdominal sterna was undertaken, recognising two types, androconial glands (present in Odontotarsinae and Tectocorinae) and setose sternal glands (Elvisurinae). The biology of the Australian species is summarised, with new host plant records given for *Austrotichus rugosus* Gross, all the Australia native species of *Coleotichus* (*C. artensis* (Montrouzier), *C. costatus* Fabricius and *C. excellens*), *Calliscyta stalii* (Volenhoven), *Scutiphora pedicellata* (Kirby) and *Tectocoris diophthalmus* (Hahn).

Key words: androconial glands, Australia, biogeography, classification, ejaculatory apparatus, Heteroptera, host plants, new genus, new species, Pentatomoidea, Scutelleridae, setose sternal glands.

Introduction

The Scutelleridae or jewel bugs are a family of landbugs belonging to the superfamily Pentatomoidea (Insecta, Heteroptera) (Slater 1982; Schaefer 1993; Schuh & Slater 1995; Cassis & Gross 2002). These often large insects are recognised in part by the greatly enlarged scutellum, which covers most if not all of the abdomen, with the exocorium of the forewings minimally exposed proximally, and the membrane tip sometimes visible caudally (e.g. Scutellerinae: *Calliphara*, *Lampromicra*). Scutellerids can be confused with other pentatomoids with an enlarged scutellum, including members of the cydnid complex (e.g. Corimelaeninae), Aphylidae, Canopidae, Lestoniidae, Plataspidae, and a number of genera of the nominotypical subfamily of the Pentatomidae (e.g.

[1] This work is dedicated to our friend and colleague Dr Ernst Heiss, in recognition of his efforts in documenting true bugs, particularly piesmatids and barkbugs from around the world. In celebrating his 70th birthday, we dedicate a new species, *Heissiphara minuta*, in his honour; the shortest described jewel bug for the tallest heteropterist!

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Australian genera: *Ippatha* DISTANT, *Kambutha* DISTANT). Most species of the nominotypical subfamily, the Scutellerinae, and some taxa of the Pachycorinae and Sphaerocorinae, are characterised by highly colourful bodies, presumably aposematic. In contrast, the adults of species of other scutellerid subfamilies are often dull in colouration, and apparently cryptozoic (e.g. Elvisurinae, Eurygastrinae and Odontotarsinae), although in some such cases the larvae are brilliantly coloured (e.g. Elvisurinae: *Coleotichus*).

Jewel bugs are moderately diverse in comparison to other pentatomoid families (e.g. Acanthosomatidae: 180 species; Cydnidae: 600; Pentatomidae: 6000; Plataspidae: 560; and, Tessaratomidae: 235; figures from CASSIS & GROSS 2002). LATTIN (1964) recognised 80 genera and 450 species of jewel bugs worldwide. In the interim, less than 50 new taxa have been described (JAVAHERY et al. 2000; CASSIS & GROSS 2002), countered by significant levels of synonymy (e.g. EGER & LATTIN 1995).

FABRICIUS (1775) described the first Australian scutellerid species, for the charismatic jewel bug species *Calliphara imperialis*, *Calliphara regalis* and *Choerocoris paganus*. STÅL (1873) produced the first comprehensive and systematic treatment of scutellerids, providing a suprageneric classification, including keys to the tribes and genera, as well as listing all described species, including those from Australia. SCHOUTEDEN (1904) provided a monograph of the jewel bugs, including detailed descriptions of the supraspecific taxa and a list of species. The Australian scutellerid fauna has received a number of modern treatments, including those of GROSS (1975) and MCDONALD & CASSIS (1984). CASSIS & GROSS (2002) catalogued the Australian scutellerids, recognizing 11 genera and 26 species. In this work we give an updated revision of the Australian scutellerids, providing generic and species treatments, including the description of new taxa and addition of new character information. An identification key is given for all genera and species. This work serves as an updated account of MCDONALD & CASSIS (1984) and CASSIS & GROSS (2002), and includes numerous additions and corrections. Illustrations are given for a species of each genus, and for each species a detailed description is given, and for those taxa without illustrations in this work, users are referred to those given in MCDONALD (1961, 1963a, 1963b) and MCDONALD & CASSIS (1984). The biological control agent, *Agonosoma trilineatum* (FABRICIUS) (Scutelleridae: Pachycorinae), introduced from South America to control a pasture weed (Bellyache Bush, *Jatropha gossypifolia*, Euphorbiaceae) (HEARD et al. 2002), is also treated in this work. In addition, we review the status of scutellerid systematics and character systems, place the Australian jewel bug fauna in a global context, and discuss their biology.

Material and Methods

Specimens

Most of the material examined includes new collections across temperate Australia by the senior author [GC] and Randall Schuh of the American Museum of Natural History (AMNH). Additional material was examined from the Queensland Museum (QM), the Australian National Insect Collection (ANIC), the South Australian Museum (SAMA), and the Western Australian Museum (WAM). Late in the project, one of us [GC] was able to re-examine type and other materials in the Natural History Museum (BMNH). We particularly focused on the Dallas, Distant and Walker types, doubting the validity of previous observations on their status. The type material that we examined is listed separately, and new lectotype and paralectotype designations are given. The Fabricius types in the Banks collection (BMNH) were not available for observation. We also found that some of the lectotype designations of LYAL (1979) for *Calliphara* are invalid. For types that we have not re-examined, we refer users to CASSIS & GROSS (2002), which lists all the types and associated information; most of which have been previously examined by one of us [GC].

The distribution maps are based on these new data as well as the collection localities given in GROSS (1975), MCDONALD & CASSIS (1984) and CASSIS & GROSS (2002).

Microscopy

Observations were made using Leica MZ 16A and MZ 12 stereomicroscopes, and a Leica DMB compound microscope. Illustrations of morphological features were made using a camera lucida. These were rendered in Adobe Illustrator software. Scanning electron micrographs were made using a Cambridge scanning microscope.

Morphometric measurements

The measurements taken in McDonald & Cassis (1984) are recorded for the new species (*Choerocoris grossi* nov.sp., *C. lattini* nov.sp. and *Heissiphara minuta* nov.sp.) or species of revised status (*Lampromicra aerea* Distant). Measurements are also given for *Austrotichus rugosus* Gross, which were not given in McDonald & Cassis (1984), and the introduced species *Agonosoma trilineatum*. All measurements are given in tables, except for *Heissiphara minuta* nov.sp., for which only the holotype was measured, and the new Australian record, *Calliphara nobilis* (Linnaeus); in both cases, measurements are given in the species description. Measurements were made using a graticule, and all measurements are maximum lengths and given in millimetres.

In McDonald & Cassis (1984), the antennae are referred to as five-segmented; in fact, they are four-segmented with AII subdivided (see below). The following synonymy is required to allow for comparison of measurements in the latter work, and those given in below: AII = AII(a); AIII = AII(b); AIV = AIII; and, AV = AIV.

Morphological Abbreviations

Throughout this manuscript abbreviations are used for antennal and labium segments, pregenital abdominal sterna, and the conjunctival appendages of the male aedeagus, as follows: AI-AIV = first to fourth antennal segments, with AII divided, and given as AII(a) and AII(b); LI-LIV = first to fourth labium segment; SII-SVIII = first to eighth abdominal sterna; CAI = first conjunctival appendages; CAI(D) = dorsal branch of first conjunctival appendages; CAI(V) = ventral branch of first conjunctival appendages; CAII = second conjunctival appendages; CAII(M) = medial branches of second conjunctival appendages; CAII(L) = lateral branch of first conjunctival appendages; CAIII = paired or fused third conjunctival appendage(s); CAIII(D) = dorsal branch of third conjunctival appendages; and, CAIII(V) = ventral branch of third conjunctival appendages. Further abbreviations are provided in the illustrations, where legends are provided for each plate. For *Heissiphara minuta* nov.sp. and *Calliphara nobilis*, the following abbreviations are also used for the morphometric characters: BL = body length; IOD = interocular distance; and, PW = pronotal width.

Biology

In Australia, the biology of only a few scutellerid species has been described in any detail. McDonald (1960, 1963b) studied the life cycle, larval morphology and feeding behaviour of five Australian species (*Lampromicra senator*, *Cantao parentum*, *Scutiphora pedicellata*, *Choerocoris paganus* and *Tectocoris diophthalmus*). The biology of *Tectocoris diophthalmus* has also been detailed, often in relation to its pest status (Ballard & Holdaway 1926; McKeown 1942; Staddon et al. 1987). Cassis & Gross (2002) gave a brief summary of the biology of Australian scutellerids and a list of their host plants. The following review focuses on the plant associations and feeding behaviour of these species.

Plant Associations

From a systematic heteropterist's point of view, the fundamental biological information source for phytophagous species is the documentation of plant associations. In this work we have increased the number of associations by almost 50 % from those given in Cassis & Gross (2002), with our own fieldwork resulting in 10 new plant association records (Table 1). Of the 25 species of Australian scutellerids (including *Agonosoma trilineatum*), 16 species have known plant associations. In Table 1 we list all the known plant associations, and report or speculate as to how they use these plants. Cassis et al. (in press) have shown in Australian Pentatomomorpha, that many family-groups have a broad range of plant associations, including scutellerids (Cassis & Gross 2002). As with other pentatomoids,

Table 1: Plant associations (species, order and clade) for Australian jewel bugs, and information source. Cassis & Gross (2002) includes other citations to host plant information. GC = G. Cassis fieldwork 1995-2005.

Jewel Bug Species	Plant Species Association	Plant Family	Plant Order	Clade	Plant Usage	Source
Austrotichus rugosus	*Allocasuarina humilis* (Otto & F.Dietr.) L.A.S.Johnson	Casuarinaceae	Fagales	Eurosids I	food plant	this work; GC fieldwork
	Allocasuarina pusilla (Macklin) L.A.S.Johnson	Casuarinaceae	Fagales	Eurosids I	food plant	this work; GC fieldwork
Coleotichus artensis	*Alphitonia excelsa* (Fenzl) Benth.	Rhamnaceae	Rosales	Eurosids I	unknown	this work; label data
Coleotichus costatus	*Acacia consanguinea* R.S.Cowan & Maslin	Mimosaceae	Fabales	Eurosids I	food plant	this work; GC fieldwork
	Acacia cyclops G.Don	Mimosaceae	Fabales	Eurosids I	food plant	Cassis & Gross 2002
	Acacia ligulata Benth.	Mimosaceae	Fabales	Eurosids I	food plant	Whitney & Stanton 2004
	Acacia pendula A.Cunn ex G.Don	Mimosaceae	Fabales	Eurosids I	food plant	Cassis & Gross 2002
	Acacia saligna (Labill.) H.L.Wendl.	Mimosaceae	Fabales	Eurosids I	food plant	Cassis & Gross 2002
	Acacia stowardii Maiden	Mimosaceae	Fabales	Eurosids I	food plant	this work; GC fieldwork
	Acacia victoriae Benth.	Mimosaceae	Fabales	Eurosids I	food plant	Cassis & Gross 2002
	Dodonaea viscosa Jacq.	Sapindaceae	Fabales	Eurosids I	food plant	Whitney pers. comm.
	Lambertia inermis R.Br.	Proteaceae	Proteales	Core Eudicot	?sitting record	this work; GC fieldwork
Coleotichus excellens	*Ficus* sp.	Moraceae	Rosales	Eurosids I	?food plant	this work; GC New Caledonia fieldwork
	Hibiscus rosasinensis L.	Malvaceae	Malvales	Eurosids II	unknown	this work; label data
Solenotichus circuliferus	*Eucalyptus gongylocarpa* Blakely	Myrtaceae	Myrtales	Rosids (unplaced)	?aggregation site	Cassis & Gross 2002
Agonosoma trilineatum	*Jatropha gossypifolia* L.	Euphorbiaceae	Malpighiales	Eurosids I	food plant	Heard pers. comm.
Calliphara nobilis	*Acer oblongum* Wall.	Sapindaceae	Sapindales	Eurosids II	food plant	Takara 1957
	Xanthium strumarium L.	Asteraceae	Asterales	Euasterids II	food plant	Baloch et al. 1968
	Macaranga tanarius (L.) Mull.Arg.	Euphorbiaceae	Malpighiales	Eurosids I	food plant	Hilgendorf & Gaden 1982
	Excoecaria agallocha L.	Euphorbiaceae	Malpighiales	Eurosids I	food plant	Lim et al. 2001
	Rhizophora sp.	Rhizophoraceae	Malpighiales	Eurosids I	food plant	Lim et al. 2001
Calliscyta stalii	*Pandanus* sp.	Pandanaceae	Pandanales	Monocots	?aggregation site	Monteith pers. comm.
Cantao parentum	*Mallotus claoxyloides* (F.Muell.) Mull.Arg.	Euphorbiaceae	Malpighiales	Eurosids I	food plant	Cassis & Gross 2002
	Mallotus philippensis (Lam.) Mull.Arg.	Euphorbiaceae	Malpighiales	Eurosids I	food plant	Cassis & Gross 2002
	Mallotus discolor Benth.	Euphorbiaceae	Malpighiales	Eurosids I	food plant	Monteith pers. comm.
	Araucaria cunninghamii Aiton ex A.Cunn.	Araucariaceae	Coniferales	Gymnosperms	aggregation site	Cassis & Gross 2002
Choerocoris grossi	*Beyeria viscosa* (Labill.)Miq.	Euphorbiaceae	Malpighiales	Eurosids I	?food plant	label data
Choerocoris paganus	*Dodonaea lanceolata* F.Muell.	Sapindaceae	Sapindales	Eurosids II	food plant	Cassis & Gross 2002
	Dodonaea triquetra J.C.Wendl.	Sapindaceae	Sapindales	Eurosids II	food plant	Cassis & Gross 2002
	Dodonaea viscosa	Sapindaceae	Sapindales	Eurosids II	food plant	Cassis & Gross 2002
	Dodonaea viscosa angustissima (DC.) J.G. West	Sapindaceae	Sapindales	Eurosids II	food plant	this work; GC fieldwork
	Dodonaea viscosa mucronata J.G.West	Sapindaceae	Sapindales	Eurosids II	food plant	this work; GC fieldwork
	Dodonaea viscosa spatulata (Sm.) J.G. West	Sapindaceae	Sapindales	Eurosids II	food plant	this work; GC fieldwork
	Medicago sativa L.	Fabaceae	Fabales	Eurosids I	?food plant	Cassis & Gross 2002
	Plantago sp.	Plantaginaceae	Lamiales	Euasterids I	?food plant	Cassis & Gross 2002
Choerocoris variegatus	*Beyeria lechenaultii* (DC.) Baill.	Euphorbiaceae	Malpighiale	Eurosids I	food plant	Cassis & Gross 2002
	Beyeria viscosa (Labill.) Miq.	Euphorbiaceae	Malpighiale	Eurosids I	food plant	Cassis & Gross 2002
	Spyridium globulosum (Labill.) Benth.	Rhamnaceaes	Rosales	Eurosids I	food plant	Cassis & Gross 2002
	Acacia cyclops G. Don.	Mimosaceae	Fabales	Eurosids I	?sitting record	label data; GC fieldwork
Heissiphara minuta	*Stenanthemum complicatum* (F. Muell.) Rye	Rhamnaceae	Rosales	Eurosids I	?food plant	label data; GC fieldwork
Lampromicra aerea	*Bursaria spinosa* Cav.	Pittosporaceae	Apiales	Euasterids II	unknown	this work; label data
	Kunzea ambigua (Sm.) Druce	Myrtaceae	Myrtales	Rosids (unplaced)	unknown	this work; label data
Lampromicra senator	*Adiantum aethiopicum* L.	Adiantaceae	Filicales	Ferns	?aggregation site	this work; GC fieldwork
	Bursaria sp.	Pittosporaceae	Apiales	Euasterids II	food plant	this work; label data
	Arachis hypogaea L.	Fabaceae	Fabales	Eurosids I	?aggregation site	Cassis & Gross 2002
	Breynia oblongifolia (Mull.Arg.) Mull. Arg.	Euphorbiaceae	Malpighiales	Eurosids I	food plant	Cassis & Gross 2002

Jewel Bug Species	Plant Species Association	Plant Family	Plant Order	Clade	Plant Usage	Source
Lampromicra senator	*Ficus carica* L.	Moraceae	Rosales	Eurosids I	food plant	Cassis & Gross 2002
	Ficus leucotricha (Miq.) Miq.	Moraceae	Rosales	Eurosids I	food plant	Cassis & Gross 2002
	Lantana camara L.	Verbenaceae	Lamiales	Euasterids I	unknown	Cassis & Gross 2002
	Mimosa pigra L.	Mimosaceae	Fabales	Eurosids I	unknown	Wilson et al. 1990
Scutiphora pedicellata	*Crataegus oxyacantha* L.	Rosaceae	Rosales	Eurosids I	food plant	Cassis & Gross 2002
	Dodonaea triquetra J.C.Wendl.	Sapindaceae	Sapindales	Eurosids I	food plant	Cassis & Gross 2002
	Prunus domestica L.	Rosaceae	Rosales	Eurosids I	food plant	Cassis & Gross 2002
	Sambucus guadichaudiana DC.	Caprifoliaceae	Dipsacales	Euasterids II	food plant	http://morwell np.pangean.net
	Ficus sp.	Moraceae	Rosales	Eurosids I	food plant	Froggatt 1907
	Leptospermum sp.	Myrtaceae	Myrtales	Rosids (unplaced)	?sitting record	label data
Tectocoris diophthalmus	*Gossypium hirsutum* L.	Malvaceae	Malvales	Eurosids II	food plant	Cassis & Gross 2002
	Hibiscus tiliaceus L.	Malvaceae	Malvales	Eurosids II	food plant	Cassis & Gross 2002
	Lagunaria patersonia (Andrews) G.Don	Malvaceae	Malvales	Eurosids II	food plant	this work; GC fieldwork
	Brachychiton acerifolius (A.Cunn ex G.Don) Macarthur & C.Moore	Malvaceae	Malvales	Eurosids II	food plant	Monteith pers. comm.
	Brachychiton australis (Schott & Endl.) Terracino	Malvaceae	Malvales	Eurosids II	food plant	Monteith pers. comm.
	Brachychiton rupestris (T.Mitch ex. Lindl.) K.Schum.	Malvaceae	Malvales	Eurosids II	food plant	Monteith pers. comm.

scutellerids generally prefer higher angiosperms (*sensu* Stevens 2006; Angiosperm Phylogeny Group cladogram and classification), belonging to the rosid and asterid subclasses, but particularly with species belonging to three groups of the rosids: i. Unplaced Rosids; ii. Eurosid I; and, iii. Eurosid II. More than half of all Australian scutellerids have been found on 'Eurosid I' plants, with highest frequency of association with the Euphorbiaceae, Sapindaceae and Mimosaceae. Australian scutellerids are known from a range of euphorbs, with three species (*Cantao parentum*, *Choerocoris paganus* and *Lampromicra senator*) found in Australia on three different euphorb genera, and *Calliphara nobilis* found on two euphorb species outside of Australia (Singapore). The sapind records are of particular interest, with a number of species found in association with species of *Dodonaea*, particularly *D. viscosa* and *D. triquetra*. *Choerocoris paganus*, which has a broad range of plant associations, is most commonly found on *Dodonaea viscosa* (including a number of its subspecies) (Fig. 1d). This plant is a secondary host plant for *Coleotichus costatus* (Whitney pers. comm.), which is most commonly found on a range of *Acacia* species. Curiously, this '*Acacia* and *Dodonaea*' pattern of association also occurs for the Hawaiian endemic *Coleotichus* species, *C. blackburniae* (Johnson et al. 2004). Three species of scutellerids (*Coleotichus excellens*, *Lampromicra senator* and *Scutiphora pedicellata*) are found on figs; an association known elsewhere in the Heteroptera (e.g., Slater 1971; Cassis & Gross 2002; Heterogastridae), including extralimital scutellerids (Cervantes 2004).

The association of Australian scutellerids with asterid angiosperms is far less common, with records known for Euasterid I and Euasterid II plants. The associations with more basal angiosperms are not of any great significance, with the association with 'Core Eudicot' plants most likely 'sitting records' rather than host plants. Likewise, the association of the above scutellerids with gymnosperms and ferns are considered either sitting or aggregation records.

Host Plant Specificity and Food Preferences

Unlike the Miridae, where host plant specificity is very high (Schuh & Slater 1995; Cassis et al. in press), the Australian scutellerid species are found on a broad range of plants. For example, only three jewel bug species are known from one plant species alone (Table 1: *Coleotichus artensis*, *Solenotichus circuliferus* and *Calliscyta stalii*), but in each of these cases, the species are not commonly encountered, and there is doubt as to whether any of the records represent food or breeding hosts. For scutellerids where more information exists, *Cantao parentum* is found on three species of the euphorb genus *Mallotus* (Fig. 1b). This is also the case for *Austrotichus rugosus*, which we have found on two species of *Allocasuar-*

ina (Casuarinaceae) in temperate Australia. *Tectocoris diophthalmus* also shows a degree of host plant restrictiveness, as it is found only on species of plants belonging to the Malvaceae.

Scutellerids are considered to be exclusively phytophagous although a few cases of omnivory and opportunistic carnivory are known (EUBANKS et al. 2003). Surprisingly little is known of the biology of jewel bugs, aside from the economic Sunn pests (JAVAHERY et al. 2000; *Eurygaster integriceps* and related species). In Australia, *Tectocoris diophthalmus* has been recorded as a minor pest of cotton, where it is known to facilitate staining of the bolls (BALLARD 1925, 1927; BALLARD & HOLDAWAY 1926). Three species (*Cantao parentum*, *Lampromicra senator* and *Scutiphora pedicellata)* have been reported as minor pests of cherries (FROGGATT 1901, 1902, 1907; MCDONALD 1963c), although there are no recent records of pest activity.

As with many pentatomomorphans, numerous scutellerids are known to feed on seeds. JAVAHERY et al. (2000) report that some species also feed on fruits, as well as vegetative parts. The Australian species feed on pre-dispersed seeds, upon their host plants. They are also commonly encountered on the ground, in the 'seed shadow' of their host plant, feeding also on post-dispersal seeds. The Australian species that have been encountered on the ground as well as on plants include, *Austrotichus rugosus*, *Coleotichus costatus*, *Choerocoris paganus*, *C. variegatus*, *Lampromicra senator* and *Scutiphora pedicellata*. MCDONALD (1963c) reported *Lampromicra senator* feeding on the fruits of *Breynia* shrubs. There is also strong evidence that a number of Odontotarsinae species are epigaeic; found on the ground, presumably being post-dispersal seed-predators. All the species of the Australian endemic genus *Morbora* have only been collected on the ground (see below). In contrast, *Tecotocoris diophthalmus* feeds on vegetative and reproductive parts of their host plants (BALLARD & HOLDAWAY 1926; MCDONALD 1963c).

Bellyache plant, *Jatropha gossypifolia*, is a native of the Neotropical region, and is becoming a significant pasture weed in northern Australia (HEARD et al. 2002; Heard pers. comm.). In 2003, the South American scutellerid species *Agonosoma trilineatum*, was introduced into southeast Queensland as a biological control agent. This species has not as yet been recovered in Australia.

Aggregation and Maternal Behaviour

Numerous species of scutellerids are known to exhibit aggregative behaviour. JAVAHERY et al. (2000) report that *Eurygaster integriceps* is found in mass aggregations in the Palearctic region; it both aestivates in the mid-summer and overwinters in the winter in such aggregations. MONTEITH (1982) found *Lampromicra senator* in dry season aggregations amongst vegetation and on the ground in tropical north Queensland. We have also recently found this species at the beginning of the dry season in large aggregations on fig leaves in open woodland on the Atherton Tableland. MCDONALD (1963c) reports that *Scutiphora pedicellata* hibernates under the bark of *Eucalyptus* trees, and *Cantao parentum* hibernates in clusters on the underside of leaves. Many of the small clusters of *Cantao parentum* merge as winter progresses leading to the formation of giant aggregations of sometimes tens of thousands of bugs in the tops of emergent trees (often Hoop pines, *Araucaria cunninghamii*) adjacent to the thickets of their *Mallotus* food plants (Monteith pers. comm.). Monteith (pers. comm.) has also found *Calliphara regalis* in aggregations on leaf surfaces (Fig. 1a).

Scutellerids are often found in large aggregations when feeding (e.g., *Choerocoris paganus*), and the larvae are commonly associated with the adults. Some species are also known to engage in maternal care, with females protecting the egg brood from predators and parasites. In Australia, this has been recorded for *Tectocoris diophthalmus*

Fig. 1: Examples of Australian Scutelleridae species and their host plant species (**a**) adult aggregation of *Calliphara regalis* (**b**) *Cantao parentum* on *Mallotus philippensis* (**c**) *Choerocoris paganus* on *Dodonaea viscoca* (**d**) *Lampromicra senator* on unidentified host plant (**e**) *Scutiphora pedicellata* on unidentified host plant (**f**) *Tectocoris diophthalmus* on *Brachychiton acerifolius*.

Table 2: Alternative Suprageneric Classifications of the Scutelleridae.

Dallas (1851)	Stål (1872, 1873)	Schouteden (1904)	Kirkaldy (1909)	Leston (1952d)	McDonald (1966)	Gross (1975)	McDonald & Cassis (1984)	Carayon (1984)	Cassis & Gross 2002
Superfamily? Scutelleroides	Subfamily Scutellerinae	Subfamily Scutellerinae	Subfamily Scutellerinae	Subfamily Scutellerinae	Family Scutellerinae	Family Scutelleridae	Family Scutelleridae	Family Scutelleridae	Family Scutelleridae
Pachycoridae	Elvisuraria	Elvisuraria	Elvisurini	Eurygastrini: Eurygastraria	Eurygastrinae	Elvisurinae	Elvisurinae	Eurygastrinae: Eurygastrini	Elvisurinae
Eurygastridae	Eurygastraria	Odonto-tarsaria	Odontotarsini	Eurygastrini: Odontoscelaria	Odonto-scelinae	Scutellerinae	Odonto-tarsinae	Eurygastrinae: Odontoscelini	Odonto-tarsinae
Odonto-scelidae	Odonto-scelaria	Scutelleraria	Scutellerini	Eurygastrini: Odontotarsaria	Pachycorinae	Odonto-tarsinae	Scutellerinae	Eurygastrinae: Odontotarsini	Pachy-corinae
	Odonto-tarsaria	Sphaero-coraria	Sphaerocorini	Pachycorini	Scutellerinae		Tectocorinae	Pachycorinae	Scutellerinae
	Scutelleraria	Tetyraria	Tetyrini	Scutellerini: Elvisuraria				Scutellerinae: Elvisurini	Tectocorinae
	Sphaero-coraria			Scutellerini: Scutelleraria				Scutellerinae: Scutellerini	
	Tetyraria			Scutellerini: Sphaerocoraria				Scutellerinae: Sphaerocorini	

where the eggs are laid on petioles and the females guard the eggs (Dodd 1904; Tallamy & Schaefer 1997; Tallamy 1998; Monteith 2006).

Higher classification

Monophyly and Supra-familial position of Scutelleridae within the Pentatomoidea

Leach (1815) first recognised the jewel bugs as a family-group. Subsequent workers proposed alternative classifications, with scutellerids as a family (e,g., Van Duzee 1917) allied to the Pentatomidae, or as a subfamily of the Pentatomidae, along with other pentatomoid taxa such as the Cydnidae, Plataspidae and Tessaratomidae (e.g. Kirkaldy 1909; Leston 1952c, 1952d). In the modern era, scutellerids are consistently maintained as a distinct family (Carver et al. 1991; Schaefer 1993; Schuh & Slater 1995; Cassis & Gross 2002). At present, the debate centres on the systematic placement of the Scutelleridae in the Pentatomoidea, for example: i. sister-taxon to the Canopidae, basal to the ((Lestoniidae + Plataspidae) + (Thyrecorinae + Cydnidae)) (Gapud 1991); ii. Scutelleridae + Tessaratomidae, basal to the Pentatomidae (Dai & Zheng 2004); iii. Scutelleridae + Penatomidae or (Pentatomidae + (Scutelleridae + (Tessaratomidae + Phloeidae) (Fischer 2001); and, iv. sister-taxon to the Thaumastellidae (Grazia et al. in prep.).

The Scutelleridae are not currently diagnosed by any single character that has been surveyed extensively across the family. As with other taxa in the Pentatomoidea the jewel bugs are polythetically defined. Kumar (1965) and Gaffour-Bensebbane (1990) gave features of the male genitalia ('six ectadene tubules') and spermatozoa ('plumed' motility structure) as scutellerid characters, but the sampling was limited. Gapud (1991), in the first phylogenetic analysis of pentatomoid relationships, proposed that scutellerids were diagnosable by the following characters: i. weak to moderately sulcate prosternum; ii. ten or more forewing membrane veins; iii. second gonocoxae fused; iv. first gonapophyses membraneous, with first rami reduced; and, v. second gonapophyses membraneous, with second rami weakly sclerotized; and, vi. spermatheca with sclerotized basal groove. Schuh & Slater (1995) and Cassis & Gross (2002) provided broader diagnoses of the family, which repeated the aforementioned characters, and also highlighted the following: i. absence or reduction of the frena; ii. sulcate prosternum; and, iii. carinate propleura. Grazia et al. (in prep.) have identified these latter characters as diagnostic, but not exclusive to the Scutelleridae. They report that the grooved spermathecal base, first identified by Gapud (1991), is exclusive for the Scutelleridae; curiously they do not include it in their phylogenetic analysis. Fischer (2001) proposed that the scutellerids are defined by the following characters: i. greatly enlarged scutellum; ii. first abdominal glands laterally positioned; iii. hindwing with a hamus; and, iv. the cori-

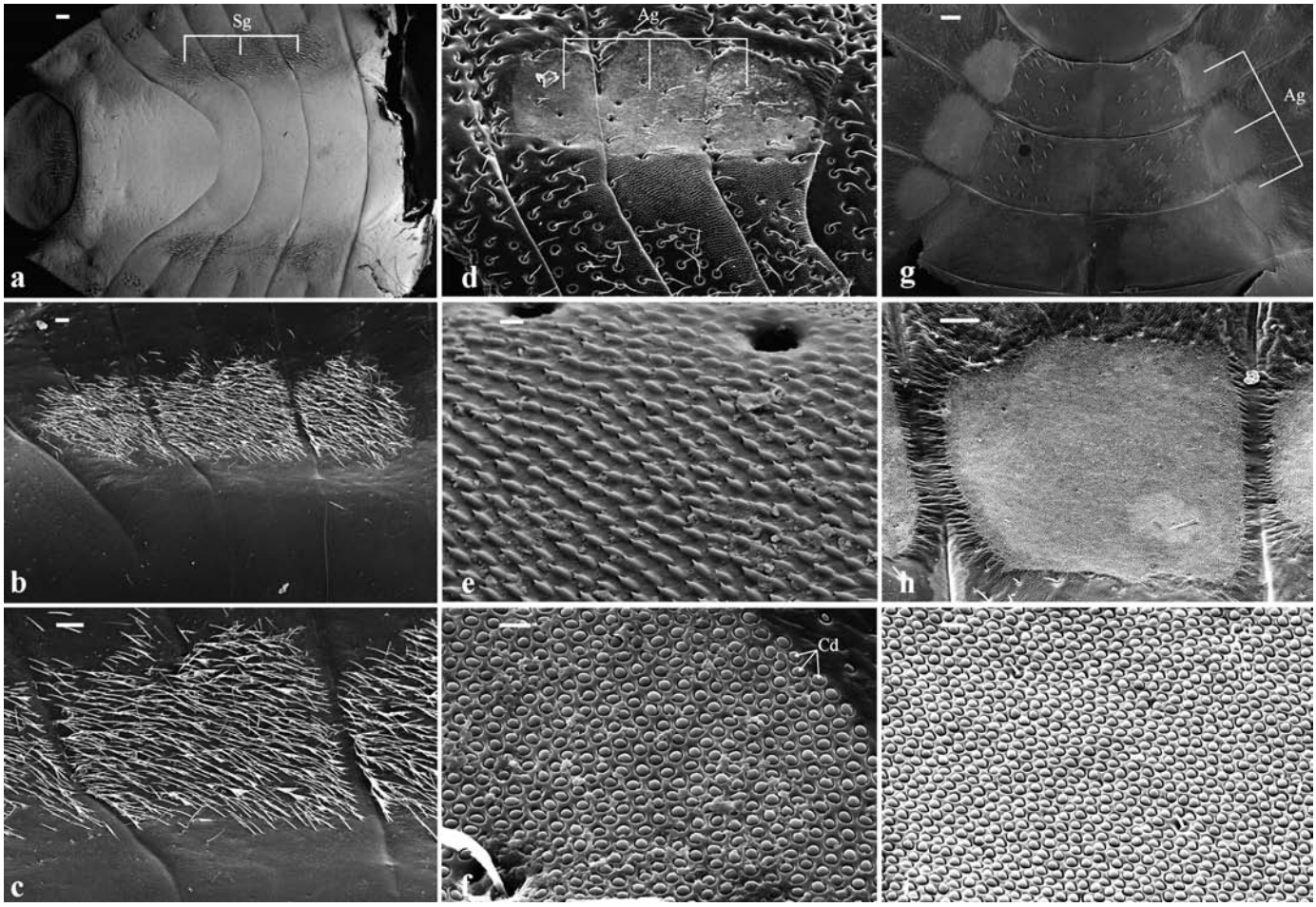


Fig. 2: Abdominal Sternal Glands of Scutelleridae (**a-c**) *Coleotichus costatus* (**a**) abdominal venter, sternal glands on SIV-SVI (**b-c**) higher magnification of sternal glands (**d-f**) *Morbora schoutedeni* (**d**) androconial glands on SIV-SVI (**e**) higher magnification of microsculpture medial to androconial glands (**f**) higher magnification of apex cuticular duct of glandular unit of androconial glands (**g-i**) *Tectocoris diophthalmus* (**g**) androconial glands on SIV-SVI (**h**) higher magnification of androconial glands on abdominal SVI (**i**) higher magnification of apex of cuticular ducts of glandular units of androconial glands. Abbreviations: Ag = Androconial glands; Cd = cuticular ducts; Sg = sternal glands. Scale bars = 0.1 mm.

um of the forewing desclerotized. He also found that aside from the last character, there was convergence in these character states with other pentatomoid groups.

Infra-familial classification of the Scutelleridae

There are alternative views on the suprageneric classification of the Scutelleridae (Table 2). As with many other family-group taxa of the Heteroptera, their classification derives from STÅL (1872, 1873), based on characters, such as, body contour, segment lengths of the labium, carination of thoracic sterna, metathoracic glands, and pregenital abdominal characters (e.g., stridulatory vittae, curvature of sternal sutures). He recognised seven suprageneric groups (suffix -aria), introducing three new groups (Elvisuraria, Eurygastraria and Odontotarsaria). SCHOUTEDEN (1904) monographed the scutellerids, recognising the latter two suprageneric groups, and the Odontoscelaria as synonyms. KIRKALDY (1909) in his world catalogue of the scutellerids, followed the classification of Schouteden, and largely was consistent with his generic placements within tribal groups. LESTON (1952d, 1953a, latter reference with less hierarchical arrangement) re-appraised the infrafamilial classification of the scutellerids, with particular emphasis on the male aedeagus, introducing terminology for the ejaculatory reservoir and conjunctival appendages. He maintained the suprageneric groups of Stål, but relegated a number of them as subtribes, within three scutellerid tribes (Eurygastrini, Pachycorini and Scutellerini). In his conception, the male aedeagus of the Eurygastrini and Pachycorini are more like those of the Pentatomidae, with the vesica bounded, sleeve-like, by the conjunctiva. He also recognised significant within-group variation for the Pachycorini, suggesting subgroups for *Deroplax* MAYR and *Hotea* AMYOT & SERVILLE genitalic types. He concluded that the Scutellerini *sensu* Leston possess a derived male genitalic type, characterised by: i. a cylindrical, sclerotized phallotheca; generalized phallobase; sclero-

tized vesica, with an apical positioned secondary gonopore; two pairs of dorsal conjunctival appendages (CAI mostly membraneous with apical lobal sclerites, and CAII various, but mostly sclerotized) and a ventral pair of conjunctival appendages (CAI-II). McDONALD (1961, 1963a, 1963b) in an investigation of the male and female genitalia of Australian jewel bugs, recognised the group as a family, and largely was in accord with LESTON. He suggested that a novel subtribal arrangement for *Tectocoris* HAHN might be required, on the basis of the genitalia of both sexes. KUMAR (1964, 1965) disputed the findings of LESTON (1952d), concluding that the Eurygastrinae and Pachycorinae do not have pentatomid male genitalia, instead possessing an eversible 'conducting canal'. Despite these re-interpretations and new observations, KUMAR retained the classification of LESTON (1952d), and in particular the subtribal arrangement of Leston's Scutellerini, but significantly, moved the Australian genus *Tectocoris*, to the largely Neotropical subfamily, the Pachycorinae. McDONALD (1966) in a broad survey of genitalia of North American Pentatomoidea, illustrated many species, in more detail than previous workers for any scutellerid taxon, and proposed equal ranking for four of the suprageneric groups; namely, the Eurygastrinae, Odontotarsinae, Pachycorinae and the Scutellerinae, with no reference to the extralimital Elvisuraria and Sphaerocoraria *sensu* Leston. GROSS (1975) subsequently recognised the elvisurines as a subfamily, thereby recognising all the Australian jewel bugs within three subfamilies, the Elvisurinae, Odontotarsinae and Scutellerinae. McDONALD & CASSIS (1984) in a revision of the Australian scutellerids, confirmed these arrangements, but erected a new subfamily for *Tectocoris* (Tectocorinae), on the aforementioned genitalic characters, as well as the presence of male abdominal sternal glands. CARAYON (1984) provided a detailed anatomical account of these latter glands, referring to them as androconial glands. He found that these glands were more widespread in scutellerids, with homologous structures also found in the Eurygastrinae sensu LESTON (*Irochrotus* AMYOT & SERVILLE, *Odontoscelis* LAPORTE and *Psacasta* SPINOLA), as well as other sternal glands that are putatively homologous in the elvisurine genus *Coleotichus* WHITE and *Solenosthedium* SPINOLA, and the type genus of the Sphaerocoraria. Despite these findings, CARAYON (1984) maintained the classification of LESTON (1952d), but elevating the jewel bugs to family (as Scutelleridae), with all subordinate suprageneric taxa raised accordingly. SCHUH & SLATER (1995) adopted a modification of LESTON's (1952d) classification, recognizing four subfamilies (Eurygastrinae, Odontotarsinae, Pachycorinae and Scutellerinae), but only recognising a tribal classification within the nominotypical tribe. They provided a key and short diagnosis for each subfamily, placing emphasis on the contour of the abdominal sterna and hind wing venation. CASSIS & GROSS (2002) adopted the system of McDONALD & CASSIS (1984), recognising four subfamilies for Australia, as well as outlining the Eurygastrinae, Pachycorinae and Sphaerocorinae as extralimital subfamilies, such that the Eurygastrinae are not divided into subordinate tribal groups (i.e. Eurygastrini, Odontoscelini and Odontotarsini).

The above-mentioned suprageneric groups of Scutelleridae have not been tested by phylogenetic analysis, with explicit character definition and optimization, in the primary literature. FISCHER (2001) in a published thesis gave character support for the monophyly of the Pachycorinae, Sphaerocorinae, Elvisurinae, and a sister-group relationship between *Tectocoris* and Odontotarsinae. He also found that the Scutellerinae and Odontotarsinae are not monophyletic. It is beyond the scope of this work to provide an analytical appraisal of these groups, and discussions given below are couched within a narrative of character systems, pending a cladistic analysis. Thus, we have maintained the classification used in McDONALD & CASSIS (1984) and CASSIS & GROSS (2002), and treatments below are arranged alphabetically, as follows: Elvisurinae, Odontotarsinae, Pachycorinae, Scutellerinae and Tectocorinae.

Taxonomic characters

In this work we re-examined existing homologies and terminology used in the Scutelleridae. The characters examined in

this work use, in part, the homologies and terminology established in McDonald & Cassis (1984) and references therein, unless otherwise stated in discussions below. We have focused particularly on the external efferent system of the metathoracic glands, male abdominal sternal glands, and the male genitalia. A survey of Australian and extralimital taxa was undertaken to provide a broader context for these decisions.

Colouration. The colouration of jewel bugs is generally diagnostic for species, although within some species there is extreme variation in colour and colour patterns. For example, in *Tectocoris diophthalmus* specimens can vary from mostly orange to mostly metallic blue-green, which is further confounded by partial sexual skewing, with males varying from mostly orange to mostly dark iridescent blue, whereas females are notably paler, although 'dominant-blue' morphs are not unknown (Figs 1f, 45a, b). The scutellerines are the most colourful of all the jewel bugs, and the dorsum of these species nearly always have a metallic-like colouration, with polished and iridescent orange, red, blue, green and purple hues, and most often with contrasting markings (Figs 19, 24, 28). Lyal (1979) commented on colour variation in *Calliphara*, proposing that light interference and pigmentation contribute to observed colouration. He reported that variation within a population of *Calliphara* species can be extreme, ranging from orange to blue/green individuals, and that there are also geographical subspecies of distinct colouration in species such as *C. caesar* (Vollenhoven) and *C. dimidiata* (Dallas). We have also observed considerable variation in scutellerine taxa, such as species of *Lampromicra* Stål (Figs 28c-e) and *Choerocoris* Dallas (Figs 24c-f). In particular, *Lampromicra senator* (Fabricius), varies from mostly iridescent green to purple or blue, and with or without an orange scutellar callus, and sometimes with darker patterning posteriorly. We urge caution in using colouration in this species, as the preserved colouration of museum specimens can be impacted by the 'killing agent' used.

Species of Elvisurines are mostly pale to dark brown (Fig. 3), with minor markings; e.g., minor black spotting in the Australian species of *Coleotichus*. The eastern Australian species, *C. artensis* Van Duzee ranges from pale to dark brown, with the latter colouration type being influenced by the embrownment of the punctures. Species of the extralimital species of *Solenosthedium* exhibit more elaborate colouration, with bright yellow patterned markings against a dark ground colour.

In the Pachycorinae, many of the species are dull in colouration, or can exhibit homogenous ground colour without markings, such as in the genus *Tetyra* Fabricius. There are also spectacularly coloured species, such as the introduced species *Agonosoma trilineatum* (Figs 16a, b), with striped and spotted morphs. The Odontotarsinae are mostly dull in colouration, including the Australian species of *Morbora*, which is consistent with their epigaeic and cryptozoic habits.

In this work, we have documented colour patterns of the pregenital abdominal venter, which are often reliable for diagnosing species (Figs 21, 32). Although there is some intraspecific variation in these patterns, we have found reliable discontinuities between related species. For example, species of *Choerocoris*, which can be continuous in the variation of the dorsum, have diagnostic colour patterns of the venter (Fig. 32). In *Choerocoris grossi* nov.sp., the venter has a band of sublateral fuscous markings (Figs 32a, b), which are absent in *C. variegatus* (Figs 32g, h), although southwest Western Australian populations of the latter species sometimes have the segmental boundaries weakly embrowned.

In this work we do not treat the larvae, but note that the Elvisurinae, which generally have dull coloured adults, have aposematically coloured larvae in the genus *Coleotichus*, as in the Scutellerinae.

Texture. The texture of scutellerids is highly variable; from smooth to highly punctate, and less commonly rugo-punctate. Many scutellerids are punctate, although in some cases this is deceptive as the punctures are often shallow. The dorsum can be more densely punctate on the underside of the body, and the distribution of punctures on the thoracic pleura can be irregularly dis-

tributed, In general, the Elvisurinae are punctate, but vary in the degree of the punctation. For example, *Austrotichus rugosus* is deeply punctate (Fig. 3a), with the punctures of the dorsum sometimes coalesced, and lateral regions of the pronotum and scutellum rugo-punctate. The other Australian species of elvisurines are all punctate, but often the punctures are shallower (Figs 3b-e). Most of the species of scutellerines are punctate, and deeply so in *Choerocoris* (Figs 24c-f) and *Heissiphara minuta* nov.sp. (Figs 24b, 37).

Vestiture. Few Australian scutellerids have vestiture of taxonomic importance. Extralimital exceptions include the species of the remarkable Afrotropical genus *Elvisura* SPINOLA where the underside of the body is completely encased in scale-like setae. The vestiture of the Australian genus *Morbora* DISTANT is diagnostic for the genus and the three known species (Fig. 13), and is comparable to the elaborate vestiture of the extralimital odontotarsine genus *Irochrotus*. *Morbora* have curly white sericeous setae (Figs 13a, e, h) on the head, pronotum, and thoracic pleura, which are intermixed on the dorsum with fan-like (Figs 13c, h, i) or clove-like (Figs 13a, b, f) setae.

Most Australian species of Scutellerinae have the dorsum almost glabrous. The notable exception is *Lampromicra*, which is in part defined by a setose dorsum, and particularly so in *L. senator* (Fig. 1d). In the Australian species, *Cantao parentum*, the head and pronotum are setose, and diagnostic for this taxon. In the scutellerines, dense vestiture is also found in a number of extralimital genera such as *Brachaulax* STÅL, *Procilia* STÅL, *Scutellera* LAMARCK, and *Tetratharia* DALLAS. *Heissiphara minuta* nov.sp. has setigerous punctures on both surfaces of the body.

The antennae of most species jewel bugs have simple, short setae, with the more proximal segments almost naked. The leg vestiture is also simple, with the femora having scattered setae, mostly on the ventral surface. In nearly all scutellerids, the ventral surface of the tibiae is more densely setose, particularly more distally, as are the tarsi. In general the vestiture of antennae and legs is not diagnostic or indicative of relationships, aside from *Calliscyta stalii*, where the ventral surface of the tibiae has dense and thick, yellow setae. The genital opening of the male pygophore is usually densely setose, particularly on the ventral surface, such as in *Tectocoris diophthalmus* (Fig. 46e, f). LYAL (1979) made significant use of the setose patches on the genital opening in discerning species-groups within *Calliphara*. We have not assessed the value of this character system across the Australian scutellerids, finding it in the first instance to be of limited value. Whether these setose patches have a glandular function has not been determined.

Head. The head of scutellerids has characters of taxonomic and possibly phylogenetic significance. In *Agonosoma trilineatum*, the head is enlarged, being subequal to the length of the pronotum (Figs 16a, b). Most scutellerines have a triangular to subtriangular head, with the apices of the jugae either just short or subequal to the anterior edge of the clypeus. In many taxa the lateral margins of the jugae are excavate; e.g., particularly in *Calliphara* (Fig. 20a), and less so in *Choerocoris* (Fig. 31a), *Lampromicra* (Fig. 39a) and *Scutiphora* (Fig. 42a). In contrast, *Cantao parentum* has the margins relatively straight (Fig. 29a), although in extralimital species, such as *C. ocellatus* (THUNBERG) the margins are a little excavate. The jugal margins may also be carinate in lateral view, such as in species of *Choerocoris* (Figs 31a, b). Odontotarsines often have a more rounded head, including *Morbora*, which also has the lateral margins highly denticulate (Figs 11, 12a), although it is not diagnostic at the species level.

Antennae. The antennae of scutellerids are relatively short, and articulated near or below the ventral margin of the eyes. ZRAZVÝ (1990) documented the evolution of antennal structure in the Heteroptera, recognizing the subdivision of the second antennal segment (= pedicel) into pedicellites in the Pentatomoidea. This is the case in the Scutelleridae and we have introduced the terminology of AII(a) and AII(b), for the proximal and distal pedicellites respectively. The shape of the antennae is often taxonomically diagnostic; e.g., AII(a) is arcuate in *Scutiphora pedicellata* (Fig. 28b), particu-

larly in males. In most scutellerids AIII-AIV (occasionally AII as well) are flattened. The relative lengths of the antennae can be diagnostic at both the generic and species levels. For example, AII(a) or AII(b) are the shortest segments in *Calliphara* (Figs 19a, b) and *Scutiphora* (Fig. 28b) respectively.

Labium. The labium is informative in terms of its absolute length, and relative proportions of the four segments. The labium usually terminates between the apices of the mesocoxae (Fig. 4c) and abdominal SIV. In those species with an elongate labium, the abdominal sterna are sometimes sulcate serving as a housing for the labium; e.g., Elvisurinae species (particularly species of the extralimital genus *Elvisura* SPINOLA) and *Tectocoris diophthalmus*. STÅL (1873) and SCHOUTEDEN (1904) afforded value to the relative lengths of the labial specimens, particularly LII in relation to subsequent segments, in discerning suprageneric groups. We find that there is significant variability in such characters, even within genera (e.g., *Coleotichus*).

Pronotum. The pronotum is relatively uniform in the scutellerines, and is mostly trapezoidal in shape (e.g., Figs 3, 16, 19, 24, 28, 37 and 45a, b). Some genera of the Odontotarsinae, including the Australian genus *Morbora*, and extralimital species of *Irochrotus*, are exceptional in the scutellerids, where the lateral margins are not clearly differentiated into anterior and posterior components, being more rounded across the entire length, with the anterior angles projected in front of the posterior margins of the eyes (e.g., *Morbora*: Figs 11, 12b, extralimital *Irochrotus*). The contour of the pronotum is usually strongly convex, and declivent towards the posterior margin. The pronotum is often divided into a weakly demarcated callosite region, with sublateral muscle attachment 'scars'. In a few taxa, such as *Lampromicra senator*, the callosite region is demarcated by a broad transverse furrow (Fig. 28e). The anterior margin varies between weakly (e.g., Figs 28a, 29a) to strongly concave (e.g., Fig. 9a) conditions. The anterolateral margins are sometimes diagnostic, and can be explanate, with the margin carinate (Figs 25c, 46b), and if so, the head is usually also carinate. Some scutellerids have the anterolateral margins rounded in profile. The anterolateral margins vary in terms of their divergence, and can be very strongly divergent, such as in *Tectocoris diophthalmus* (Figs 45a, b, 46a) to weakly divergent, as in *Calliscyta stalii* (Figs 24a, 25a). In addition, the anterolateral margins are sometimes weakly excavate (e.g., *Tectocoris diophthalmus*), to strongly excavate in extralimital genera of Odontotarsinae (e.g., *Odontotarsus* LAPORTE). The humeral angles are usually rounded, although they are spinose in a few extralimital species (e.g., *Cantao ocellatus*). The posterolateral margins are short and rounded. The posterior margin is usually rectilinear in scutellerines, excavate in *Tectocoris diophthalmus* (Figs 47a, b), to strongly rounded in the elvisurine genus, *Coleotichus* (Figs 3c-e).

Scutellum. All scutellerids have a greatly enlarged scutellum, which reaches near the lateral margins of the abdomen, with the areas proximal to the forewing articulation and abdominal connexiva exposed (e.g., Figs 3, 16, 19, 24, 28, 37 and 45a, b). The scutellum is strongly convex in profile, and in some species is very strongly declivent posteriorly, such as in *Tectocoris diophthalmus* (Fig. 47). The anterior margin often has sublateral foveae, however it is not regarded as having classificatory significance; occurring in unrelated taxa such as *Austrotichus rugosus* and *Cantao parentum* (cf. Figs 3a and 28a). The extent of scutellar coverage of the hemelytra and abdomen has taxonomic significance. In many scutellerines, the hemelytral membrane extends beyond the scutellum at rest (e.g., Figs 19a-d and 28a), with a few exceptions including the species of *Choerocoris*, *Calliscyta stalii* and *Heissiphara minuta* nov.sp. (Figs 24a-f). In the extralimital genus *Eurygaster* LAPORTE, the scutellum is diagnostically less extensive, with the forewing more exposed.

Thoracic Sterna. Characters of the thoracic sterna are most important in differentiating the Elvisurinae from the remainder of the Scutelleridae. Elvisurines have the thoracic sterna greatly modified into keel-like structures, which are relatively thin and elevated in species of *Coleotichus* (Fig. 7c) to thick and moderately high, as in *Austrotichus rugosus* (Fig. 4c) and *Solenotichus*

circuliferus (Fig. 9c). In *Coleotichus*, the mesosternal keel is anteriorly projected and overlaps the prosternal keel. In other scutellerids the thoracic sterna are flat to sulcate, and exhibit little variation. The most notable exceptions exist in the Eurygastrinae and Odontotarsinae, where the proepisternal anterior edge can be explanate and contiguous with the prosternum, but never of the height found in elvisurines. In some odontotarsines, the mesosternal margins can also be a little raised, housing the labium, but not prominently as in elvisurines.

Thoracic Pleura. The thoracic pleura are relatively uniform, aside from the anterior margin of the proepisternum, the coverage of the evaporative areas, and the condition of the external efferent system of the metathoracic glands. In scutellerids the anterior margin of the proepisternum is nearly always prominent and explanate, which in the elvisurines is contiguous with the prosternal keel (e.g., Fig. 7c). In most taxa, this margin is explanate, housing the eye, except in *Tectocoris diophthalmus*. The presence or absence of evaporative areas of the posterior margin of the mesepimeron (bounding the metathoracic spiracle) is also informative at a taxonomic level, such as in *Calliscyta stalii* where such areas are absent. The absence of evaporative areas on the mesepimeron appears to be correlated with reduction in the external efferent system of the metathoracic glands.

Metathoracic Scent Glands. The external efferent system of the metathoracic glands is informative at a diagnostic and phylogenetic level in the Heteroptera (e.g., CARAYON 1971: Heteroptera; KELTON 1978: Anthocoridae, SLATER 1979: Blissidae, CASSIS 1995: Miridae). The terminology used for the pterothoracic pleura, particularly for characters of the metathoracic gland efferent system follow those given for the Miridae (Heteroptera) in CASSIS (1995). In this work, the following definitions are applied: i. ostiole: opening of the metathoracic glands; ii. peritreme: the canal emanating from the ostiole; and, iii. evaporative areas: 'mushroom-like' bodies bounding the peritreme and ostiole on the metepisternum. The position, shape, size, and orientation of the ostiole, peritreme and evaporative areas can all be informative.

Within the Pentatomoidea, the external efferent system has been under-utilized in defining supraspecific groups. This character system was used in the suprageneric classification of scutellerids, as far back as STÅL (1873), who differentiated his notion's of the Eurygastraria and Odontotarsaria, on the basis of distinct and indistinct 'orifices' respectively. SCHOUTEDEN (1904) also recognised that the Pachycorinae (as Tetyraria) had weakly developed orifices. We have found that variation in the peritreme is taxonomically significant; poorly developed to almost absent in most species of Odontotarsinae and Pachycorinae (exceptions include *Morbora* and *Agonosoma* in each of these subfamilies, where the peritreme is prominent). Other examples include the extralimital Sphaerocorinae (both *Hyperoncus* STÅL and *Sphaerocoris* BURMEISTER), where the peritreme is greatly elongate and narrow, subparallel to the posterior margin of the mesepimeron.

The condition of the peritreme and extent of the evaporative areas are most informative at the genus level. For example in elvisurines, *Coleotichus* possesses a linear, elongate peritreme, which is sulcate medially (Fig. 7d). *Solenotichus* also has an elongate peritreme, but is strongly raised (almost auriculate) distally. In comparison, *Austrotichus* has a relatively short peritreme (Fig. 4d), which is also true of the extralimital genus *Solenosthedium*, and in *Elvisura*, the peritreme is near obsolete. Many of the scutellerines have a subreniform-shaped peritreme, which can be large (e.g., *Caliphara*, Figs 20c, d); *Lampromicra*, Fig. 39d) to small (e.g., *Scutiphora*, Fig. 42d). In contrast, other genera have an obovate peritreme, which is more expanded laterally, such as *Choerocoris* spp. (Fig. 31d) and *Heissiphara* (Fig. 38c). In *Calliscyta* STÅL (Fig. 25d) and *Cantao* AMYOT & SERVILLE (Fig. 29d), the peritreme is greatly enlarged, subtriangular and polished, occupying more than 1/2 of the metepisternum, and the evaporative areas are reduced in extent. In *Tectocoris*, the external efferent system is greatly reduced to a linear, sulcate strip, with few evaporative bodies (Fig. 46d).

Pregenital Abdomen. The morphology of the pregenital abdomen is most informative at the generic and species levels. The

pregenital abdomen has five important characters that we examined: sternal glands (Figs 2a-i) and stridulatory structures (Figs 17e-f), which are informative at the suprageneric level; the presence or absence of posterolateral processes, which are informative at both the generic and specific levels; the exposure of the eighth urite; and, the development of SVII, which can cover both the male and female terminalia in *Agonosoma trilineatum*.

In the Pachycorinae, both sexes have stridulatory structures found sublaterally on abdominal SV-VI (plectrum on metatibiae), as seen in *Agonosoma trilineatum* (Figs 17e-f). In the extralimital genus *Vanduzeenia* SCHOUTEDEN, originally placed in the Odontotarsinae, we found stridulatory areas, medially positioned on SIII-SVI, consolidating its place in the Pachycorinae. No other scutellerid of the other subfamilies known to us possess stridulatory areas on the abdominal sterna.

The lateral margins of the pregenital abdomen possess spines of nodules that are diagnostic. In the genus *Calliphara*, species vary in the possession of spines on the posterolateral angles of the pregenital abdominal sterna, varying in combination from SIV-SVII (Figs 21a, b), and are sometimes absent (e.g., Fig. 21c). The connexiva are also diagnostic for species of *Choerocoris*; *C. lattini* nov.sp., has the posterior angles nodulate (Fig. 32c, d), unlike the other *Choerocoris* species (Figs 32a, b, e, f).

In most cases the eight abdominal urite is recessed and not visible. In the unrelated species *Cantao parentum* and *Tectocoris diophthalmus*, SVIII is exposed, covering the posterior margin of the male pygophore (Figs 29e, 46e).

Abdominal Sternal and Androconial Glands. The presence of multicellular dorsal abdominal glands in larvae and most adults of the Heteroptera are defining for the suborder, and have significant classificatory value within the suborder (DUPUIS 1947; ALDRICH 1988; SCHUH & SLATER 1995). The multicellular metathoracic glands are diagnostic for the Neoheteroptera, but particularly in the Leptopodomorpha + Trichophora, which have the characteristic mushroom bodies (evaporative areas or evaporatoria) (CARAYON 1971; COBBEN 1978; STADDON 1979; ALDRICH 1988; SCHUH & SLATER 1995).

More recently the discovery of various unicellular abdominal sternal glands has yielded morphological and anatomical evidence that has taxonomic significance, in disparate groups such as the Reduviidae: Holoptilinae (WEIRAUCH & CASSIS in press), and numerous families and infrafamilial groups of the Pentatomoidea (CARAYON 1981; STADDON & EDMUNDS 1991; STADDON 1999; FISCHER 2000). In the Pentatomoidea, many of these glandular systems have been found in males, and have been determined to be concerned with the production of sex pheromones (STADDON et al. 1987; STADDON 1990; ALDRICH 1996). CARAYON (1984) described a novel sternal gland system, which he termed androconial glands, in the males of scutellerids; in detail for the Australian species, *Tectocoris diophthalmus*, and in some extralimital odontotarsine species of *Irochrotus*, *Odontoscelis* and *Psacasta*; all of which he regarded as homologous. He also reported androconial glands in the elvisurine taxa, *Solenosthedium bilunatum* (FABRICIUS) and *Coleotichus costatus* (FABRICIUS) (as *C. unicolor* (FABRICIUS)). These two types are putatively homologous, but we regard them as distinct enough, to warrant different terminology, which we propose as follows: i. androconial glands (with peg-like ducts; e.g., Figs 2d-f, g-i), which are found in the Odontotarsinae and Tectocorinae; and, ii. setose sternal glands (with elongate setae; Figs 2a-c), which are found in the Elvisurinae. We also found that all the species of the Australian odontotarsine genus *Morbora* have androconial glands (Figs 2d-f), that are remarkably alike in external structure and distribution to those found in *Tectocoris diophthalmus*.

STADDON (1999) reported the presence of male sternal glands in two British species of *Eurygaster*, with two types of unicellular glands, one of which he postulated as possibly being androconial glands. Under light microscopy, we were able to discern microtrichiae broadly distributed across the abdominal sterna of these two species, but no structures that appeared like androconial or setose sternal glands.

Table 3: Presence, extent and type of male androconial glands in Scutelleridae. ssg = setose sternal glands, ag = androconial glands. + = fused glandular patches; ++ = paired glandular patches.

Taxon	Gland type	SIII	SIV	SV	SVI	SVII
Elvisurinae						
Coleotichus biroi	ssg			++	++	++
Coleotichus costatus	ssg		++	++	++	
Coleotichus fuscus	ssg		++	++	++	
Solenosthedium chinense	ssg		++	++	++	++
Solenosthedium lederei	ssg	++	++	++	++	++
Solenosthedium liligerum	ssg	++	++	++	++	++
Solenosthedium lyriceum	ssg	++	++	++	++	++
Solenosthedium madagascarense	ssg		++	++	++	++
Solenosthedium rubropunctatum	ssg		++	++	++	
Solenosthedium schulzi	ssg	++	++	++	++	++
Solenotichus circuliferus	ssg		++	++	++	+
Odontotarsinae						
Irochrotus incisus	ag			++	++	
Irochrotus indicus	ag			++	++	
Irochrotus mongolicus	ag			++	++	
Morbora australis	ag		++	++	++	
Morbora hirtula	ag		++	++	++	
Morbora schoutedeni	ag		++	++	++	
Odontoscelis byrrhus	ag			++	++	
Odontoscelis dorsalis	ag			++	++	
Odontoscelis fuliginosa	ag			++	++	
Odontoscelis iberica	ag			++	++	
Odontoscelis litura	ag			++	++	
Odontoscelis lineola	ag			++	++	
Odontoscelis signatus	ag			++	++	
Periphima batesoni	ag	++	++	++	++	++
Psacasta cerinthe	ag	++	++	++	++	+
Psacasta exanthematica	ag	++	++	++	++	++
Psacasta pallida	ag	++	++	++	++	++
Tectocorinae						
Tectocoris diophthalmus	ag		++	++	++	

In Table 3, we list scutellerid taxa that we examined which possess sternal glands of the two types described, and their distribution on the abdominal sterna. The results of this survey indicate that the androconial glands, are widespread in the Odontotarsinae, but not universal; no cuticular evidence of such glands were found in *Alphocoris* GERMAR, *Ceatocranum* JAKOVLEV, *Ellipsocoris* MAYR, *Phimodera* GERMAR, *Polyphyma* JAKOVLEV, *Promecocoris* JAKOVLEV and *Xerobia* STÅL. Androconial glands were found in the species of *Irochrotus*, *Morbora*, *Odontoscelis*, *Periphima* JAKOVLEV and *Psacasta* that we observed. We found variation in the distribution of the androconial glands, from widespread in *Psacasta* and *Periphima* (SIII-SVII), to less widespread in *Morbora* (SIV-SVI), and *Irochrotus* and *Odontoscelis* (SV-SVI). In the Tectocorinae the androconial glands are found on abdominal SIV-SVI. The setose sternal glands of the Elvisurinae are found in all species of *Solenosthedium* examined, but vary in their distribution, from SIII-SVII to SIV-SVII, and in all cases are densely setose, more so than any other elvisurine examined. The setose sternal glands are found in some species of *Coleotichus*, but are missing in many species examined (*C. artensis*, *C. blackburniae* WHITE, *C. bulowi* SCHOUTEDEN and *C. excellens* WALKER); in most species where these glands are present, they are distributed on SIV-SVI, where the setae are moderately dense. Setose sternal glands are present in the monotypic genus *Solenotichus* MARTIN, where they are medially contiguous on SVII. We found no evidence of these glands in *Austrotichus* and *Elvisura*.

The phylogenetic value of setose sternal and androconial glands requires a broader sampling within the Scutelleridae. FISCHER (2001) found the androconial glands to be synapomorphic for *Tectocoris* + Odontotarsinae. The homology of the setose and androconial glands needs to be investigated further, so that the anatomical features of the glandular units are described. Our current hypothesis is limited by observation of only the external efferent system component of the elvisurine setose sternal glands. In addition, we need a broader understanding of the distribution of these gland types within the scutellerids.

Female Terminalia. The terminology of female genitalia follows that given by MCDONALD (1966), and the homologies and terminology therein have not been reassessed in this work. In the main, the external plate-like sclerites do not differ significantly from other pentatomoids, with elliptoid to triangular paratergites VIII and IX, and subtriangular gonocoxae I. In scutellerids there is variation in the orientation of these sclerites, which are either ventral in orientation, such as in elvisurines and scutellerines such as *Calliphara* and *Lampromicra*, to caudal in orientation, as in *Choerocoris* and *Morbora*. The orientation of these sclerites can also vary relative to each other; they can be co-planar and flat such as

in *Coleotichus* to bi-planar, where paratergites are obtusely oriented relative to gonocoxae I. In *Choerocoris* species the size and shape of the female terminalia sclerites are of great importance in separating species.

Spermatheca. We re-examined the spermatheca of the Australian species, and found no significant enhancement of morphological understanding beyond McDonald & Cassis (1984); therefore, no illustrations of the spermatheca are provided in this work and users are referred to the latter reference. In most scutellerids, the spermatheca has a membraneous to lightly sclerotized fecundation canal, a dilated reservoir, and a pump composed of flanges to which muscles attach, and a distal bulb. Fischer (2001) proposes an alternative nomenclature, rejecting the usage of 'spermathecal reservoir', on the basis that there is no evidence of a 'reservoir' function for this character state. He uses the terminology of the 'dilation of the spermathecal duct'. Similarly, he rejects the functional description of a 'spermathecal pump'. We did not examine these character systems in any great detail, and prefer to use the descriptive terms used in McDonald & Cassis (1984), recognising their limitation.

The base of the spermatheca has sclerites bounding the opening of the fecundation canal of the spermatheca. Gapud (1991) regards this as diagnostic for scutellerids, a view supported by Grazia (pers. comm.). There is variation in these sclerites, as reported in McDonald & Cassis (1984), but have not been further investigated in this work. The fecundation canal can be short (e.g., *Choerocoris* spp.) to elongate (e.g., *Coleotichus costatus*), although its length is not necessarily informative above the species level (e.g., *Coleotichus artensis*). The spermathecal reservoir is most often round in scutellerines, and relatively large, with a few exceptions where it is narrow (e.g., *Austrotichus rugosus* Gross, *Morbora* spp.). The spermathecal reservoir often has a ribbed substructure, as in most scutellerines, but can be simple and uniformly membraneous (e.g., *Austrotichus rugosus*). The bulb is also uniform in the Australian scutellerids, round and unmodified. However, in *Morbora* species the bulb is more elongate, with its margins sinuate. *Tectocoris diophthalmus* has a unique spermatheca, with the pump minute, and the bulb with an arcuate, acute apex.

Pygophore. The pygophore has a number of characters that have diagnostic significance. The pygophore varies in orientation, and can be ventral (e.g., elvisurines, *Calliphara* spp., *Tectocoris diophthalmus*; Figs 4e, 20e, 46e) or caudal in orientation (*Choerocoris* spp., Figs 32b, d, f, h). Leston (1952a, 1952b), regarded the presence of a row of peg-like bristles on a pygophoral process defining for the Sphaerocorinae. This structure has not been found in any of the Australian scutellerids. In addition, Lyal (1979) considered the distribution of setae on the genital opening of the male pygophore to be of importance in determining species-group boundaries. We found that the distribution of setae on the pygophore was not particularly noteworthy for the Australian taxa, and did not use it in our classification.

Parameres. The parameres, as with all other pentatomoids, are symmetrical, and small to relatively large. The stem of the parameres is nearly always columnar, and thin to thick. In some cases, such as in some elvisurines (e.g., *Austrotichus rugosus*, *Coleotichus* species; Figs 5b, 7b) and the scutellerine genus *Choerocoris* (Figs 35b, 36b) the apex of the stem has a lobe-like flange. Nearly all species have a hook-shaped crown, which can be greatly enlarged, as in *Tectocoris diophthalmus* (Fig. 47b). There appears to be no phylogenetic or suprageneric classificatory value in the condition of the parameres, although they are sometimes diagnostic at the species level.

Aedeagus. Terminology and homologies of the male aedeagus of pentatomoids are various (e.g., Singh-Pruthi 1925; Leston 1952d; Dupuis 1955; Kumar 1964, 1965; McDonald 1966; Agarwal & Baijal 1984; Tsai et al. 2004), and we use the following terminology, including some modifications of the above authors, as follows:

i. phallobase (= articulatory apparatus) which is a U-shaped process attached to the mesial surface of the ventral aspect of the pygophore, with generalised capitate processes, and housing the primary gonopore.

ii. ductus seminis proximalis, is usually a narrow, membraneous tubule, originating

from the primary gonopore. In a few taxa, the ductus seminis proximalis is broader, with light sclerotization, and bounded by a membraneous tubule, as in *Agonosoma trilineatum* (Figs 18c, d) and *Tectocoris diophthalmus* (Figs 47c, d). Tsai (pers. comm.) regards the outer tubule as derived from a ligament of the phallobase, and we introduce the term 'ligamentary tubule' for this structure.

iii. the term 'ejaculatory apparatus' is proposed for the medial modification of the ductus seminis, and begins at the apical opening of the ductus seminis proximalis, and basad of the distal margin of the phallotheca and vesica. This is synonymous with the ejaculatory reservoir of SINGH-PRUTHI (1925) and subsequent workers (e.g., MCDONALD 1966; TSAI et al. 2004), the 'seminal reservoir' of BAKER (1931), and the 'conducting chamber' of KUMAR (1964). The ejaculatory apparatus includes the dorsal and ventral conducting canals of Kumar, and the sac-like intermediary chamber, which is often labeled as the 'ejaculatory reservoir'. In Figures 5c & d these constituent parts are first labeled, and then throughout the publication. The ventral conducting canal is basally oriented, subparallel to the ventral margin of the phallotheca, and usually sclerotized. The canal is often convoluted, in an alternating pattern, giving the impression that the canal is paired, as interpreted by KUMAR (1964, 1965). MCDONALD (1966) has shown this canal to be undivided in cross-section. The number of convolutions in the ventral conducting canal is sometimes diagnostic for taxa, such as in *Cantao* (e.g., Figs 30c, d) where there are as many 12 convolutions, whereas in some species of *Calliphara* there are no apparent convolutions (e.g., *C. regalis* (FABRICIUS), Figs 22c, d). The convoluted ventral conducting canal is characteristic of species of the Elvisurinae (e.g., Figs 5c, d), Scutellerinae and Sphaerocorinae, but is not unknown in other subfamilies, aside from the Tectocorinae (Figs 47c, d). The ejaculatory reservoir varies in shape, from oval to elliptoid in shape, and in size, from large (subequal in length to the ventral conducting canal) to relatively small, as well as being lightly to heavily scerlotized (Fig. 47c). The ejaculatory reservoir terminates adjacent to the ventral conducting canal, and enters into a dorsal conducting canal (= 'lumen 'of TSAI et al. 2004), which is largely undifferentiated, continuous with the ductus seminis distalis, and without a discrete separation of the two. For utilitarian purposes and realising its limitations, we refer to the commencement of the ductus seminis distalis, as distal to the junction of the ventral conducting canal and the ductus seminis proximalis.

iv. the vesica is a distal tubule bounding the ductus seminis distalis, and is attached basally to the conjunctival appendages. There is serious doubt that the notion of the vesica, introduced by SINGH-PRUTHI (1925), is homolgous to that found in the Pentatomomorpha and the Cimicomorpha. KERZHNER & KONSTANTINOV (1999) have emphasised that in the Miridae, the vesica is a distal differentiation of the endosoma, and defined by its positional attachment to the secondary gonopore, and functionally by its method of eversion or inflation. In contrast, KUMAR (1965) hypothesised that the vesica was derived from the conjunctiva; this could be interpreted as being in contrast to endosomal differentiation. In the Scutelleridae, we retain the use of the vesica, largely as a descriptive term, and in the main is a sclerotized tubule which parallels the contour of the ductus seminis distalis, although it can have subdistal or apical processes, as in some species of *Choerocoris* (e.g., Fig. 36c) and *Calliphara* (e.g., Figs 22c, d) respectively. In the latter case, the secondary gonopore is subapical, but exhibits no further complexity. The condition of the vesica is very different in some pachycorinae species, including, *Agonosoma trilineatum*, where it is fully membraneous and broadly attached to the phallotheca (Figs 18c, d).

v. the conjunctival appendages are processes that are attached mesially to the vesica, and externally to the phallotheca, and are often fused basally to each other. LESTON (1952d) introduced a terminology for the conjunctival appendages, recognising three pairs in the Scutelleridae. He described two dorsal pairs of conjunctival appendages, which are basally contiguous, and termed them as the first and second pairs; and also, a ventral pair, the so-called third conjunctival appendages. We have modified this nomenclature, regarding the first and second

pairs as the second pair only (our CAII), which are most often subdistally bifurcate, with lateral (CAII(L)) and medial branches (CAII(M)). These are regarded as the second conjunctival appendages, because in some cases, there is a pair of conjunctival appendages which are more ventrad. We refer to these as the first conjunctival appendages (CAI), and they can also be branched, as in some *Calliphara* species, where there are dorsal (CAI(D)) and ventral (CAI(L)) branches (e.g., C. *regalis*, Figs 22 c, d), or they can be membraneous outgrowths of the phallotheca as in *Morbora schoutedeni* DISTANT (Figs 14c, d) and *Tectocoris diophthalmus* (Figs 47c, d). The shape, size, and degree of sclerotization of each of the conjunctival appendages are diagnostic at the species, and sometimes generic levels. The CAII are often useful in scutellerid classification, where the lobal sclerites may be short and conical (e.g., Figs 5c, d, 10c, d), arcuate (e.g., Figs 8c, d, 14c, d, 26c, d), or denticulate (e.g., Figs 40c, d). The CAIII are also various, and can be separated (e.g., Figs 36c, d), or partially to fully contiguous medially (cf. Figs 8c, d, 14c, d, 26c, d). On the basis of the Australian scutellerids, we have found no features of the conjunctival appendages that support existing suprageneric groups.

Taxonomy

Family Scutelleridae

Scutellerida LEACH 1815: 123 (suprageneric group)
Scutelleroides: DALLAS 1851: 3 (superfamily; infrafamilial classification)
Pentatomidae, Scutellerina: STÅL 1872: 32 (classification); STÅL 1873: 3 (classification)
Pentatomidae, Scutelleridae (sic): LETHIERRY & SEVERIN 1893: 15 (catalogue)
Pentatomidae, Scutellerinae: SCHOUTEDEN 1904: 1 (monograph); KIRKALDY 1909: 263 (catalogue); LESTON 1952d: 13 (subfamily)
Scutelleridae: MCDONALD 1966: 67, 68 (genitalia); MCDONALD & CASSIS 1984: 550 (revision); CASSIS & GROSS 2002: 580 (catalogue)

Diagnosis: Scutellerids are recognised by the following combination of characters: body moderately to strongly biconvex (e.g., Fig. 1); apices of jugae and anterior edge of clypeus subequal in length (e.g., Figs 4a, 7a, 20a, 46a); bucculae flattened, sub-parallel (e.g., Figs 7c, 25b, 46c); antennae four-segmented, AII divided, distal segments often flattened; labium four-segmented, most often reaching between metacoxae and abdominal SIV; pronotum trapeziform, with anterolateral and posterolateral margins (e.g., Figs 3, 16, 19, 45a, b), or rounded lateral margins (Figs 16a-c); callosite region weakly demarcated; scutellum enlarged, covering most of abdomen and wings, with exocorium and clavus minimally exposed proximally (e.g., Figs 3, 16, 19, 45a, b); forewing membrane sometimes exposed beyond tip of abdomen (e.g., Figs 19a-d); frena reduced or absent; hemelytral membrane with 10 or more longitudinal veins; external efferent system of metathoracic glands present (e.g., Figs 4d, 17c, 20d, 46d); ostiole placed anteriorly on metepisternum; evaporative areas present on metepisternum, and most often on mesepimeron (e.g., Figs 4d, 12d, 20d, 31d); parameres with a columnar stem, and usually with a hook-shaped crown (e.g., Figs 5b, 22b, 47b); aedeagus most often with an ejaculatory apparatus (e.g., Figs 5c, d, 26c, d, 30c, d); first and second gonapophyses membraneous; spermathecal reservoir without a sclerotized rod; and, spermathecal bulb round without processes.

Description: Body elongate to elongate-ovoid; moderately to strongly biconvex, sometimes dorsum more rounded than venter; mostly large species, between 8-20 mm, smallest species < 4 mm, largest species > 20 mm; body either dull brown to black in colouration (e.g., Figs 3a-e), or brightly coloured, with iridescent hue and often with contrasting markings (e.g., Figs 19a-d, 24a-f, 28a-e); body often punctate, with shallow (e.g., Figs 7a), to deep punctures (e.g., Figs 4a, 12a, 31a, 37), usually regularly distributed, sometimes punctures coalesced (e.g., Fig. 3a); body less commonly rugo-punctate on lateral aspects of pronotum and abdominal venter; body mostly with sparse distribution of simple setae, rarely with dense distribution of simple setae (e.g., Fig. 1d), rarely with setigerous (Figs 31a, 38a) or scale-like setae (e.g., Figs 13c, h, i). Head: usually triangular to subtriangular (e.g., Figs 4a, 7a, 17a) sometimes suboval (e.g., Fig. 9a); jugae large, not exceeding the anterior edge of clypeus (e.g., Figs, 4a, 20a, 42a, 46a); lateral margins of jugae most often excavate (e.g.,

Figs 20a, 25a), sometimes linear (e.g., Figs 29a, 46a), rounded (e.g., Figs 7b, 25c, 38b, 39b, 42b) or carinate (e.g., Figs 29b, 31a, b) in profile; clypeus well-developed, lateral margins reaching between frons (e.g., Figs 4a, 7a, 9a, 31a) and anterior aspect of vertex (e.g., Figs 25a, 38a, 42a); vertex weakly convex; lorae triangular, not visible from above, with strongly demarcated margins; bucculae large, narrow, subparallel, usually reaching near base of head (e.g., Figs 4c, 7c, 20c, 31c, 46c); gula short, convex. Eyes: contiguous with pronotum (e.g., Figs 3, 24, 45a, b); usually moderately sized, ≥ 1/3 of head length, sometimes large, about 1/2 head length (Fig. 19d); pair of ocelli, removed from posterior margin of head (e.g., Figs 3, 24, 45). Antennae: inserted anteriad of ventral margin of eyes (e.g., Figs 7b, 9b, 20b, 29b, 31b, 38b, 39b, 46b); four-segmented, AII divided, relatively short; segments linear, cylindrical, AII(b)-AIV often flattened; AII rarely arcuate; AI short, sometimes AII(a) and AII(b) shortest segment; AIV often longest segment. Labium: usually reaching between apices of mesocoxae to abdominal SIV, rarely longer; LI reaching posterior margin of head; LII usually longest segment; LII sometimes laterally bicompressed; LIII-LIV sometimes dorsoventrally flattened. Pronotum: large, trapeziform; anterior margin weakly (e.g., Figs 3a, 7a) to strongly concave (e.g., Fig. 9a); anterolateral margins elongate, weakly (e.g., Figs 16a, 25b) to strongly divergent (e.g., Figs 9a, 19a-d, 45a,b, 46a) posteriorly, anterolateral margins usually linear (e.g., Figs 3a-e, 19a-d), rarely weakly convex (e.g., Figs 24c, d, e) or concave (e.g., Figs 28b, 45a, b), carinate (e.g., Fig. 25d) or rounded in profile; posterolateral margins short, most often weakly convex; posterior margin usually rectilinear (e.g., Figs 3a, 16a, b, 19a-d, 24a-f), rarely rounded (e.g., Figs 3c-e), if so covering anterior margin of scutellum, rarely weakly excavate (e.g., Fig. 28a); callosite region with sublateral triangular markings, most often not strongly demarcated, co-planar with pronotal disc (e.g., Figs 3a-e), rarely with transverse furrow (e.g., Figs 28c-e). Scutellum: greatly enlarged, shield-like, U-shaped, covering most of hemelytra and abdomen (e.g., Figs 3a-e, 16a, b, 19a-d, 24a-f, 28a-e, 45a, b), exocorium always partly exposed, base of clavus sometimes exposed, tip of hemelytral membrane sometimes visible beyond scutellum at rest (e.g., Figs 19a-d, 28a); strongly convex, often strongly declivent posteriorly, beyond midpoint; anterior margin sometimes with sublateral foveae (e.g., Figs 24a, 28a); lateral margins weakly to strongly rounded, sometimes strongly divergent posteriorly; tip rounded, rarely truncate (Fig. 24a). Frena: greatly reduced to absent. Hemelytra: membrane with ten (e.g. Fig. 24c) or more longitudinal veins. Thoracic pleura: anterior margin of proepisternum weakly (e.g., Figs 4c, 7c, 20c, 31c) to strongly (e.g., Figs 7c) explanate, sometimes excavate at eye (e.g., Fig. 7c), sometimes entire and linear (Figs 17b, 39c, 46b-c); mesepimeron subrectangulate, most often with evaporative areas on posterior margin, bounding metathoracic spiracle (e.g., Figs 4d, 7d, 9d, 12d, 17c, 20d, 31d, 38c, 42d), sometimes extending to meso-supracoxal lobe, sometimes absent (e.g., Figs 25d, 46d), posterior margin sometimes swollen (e.g., Fig. 12d); metepisternum usually with well-developed external efferent system of metathoracic glands (e.g., Figs 4d, 7d, 9d, 17d,) usually covering at least 1/2 of segment, rarely reduced (e.g., Figs 12d, 42d, 46d); ostiole small (e.g., Fig. 4d, 46d) to moderately large, oriented near anterior margin of segment; peritreme very small (e.g., Fig. 4d) to greatly enlarged (e.g., Fig. 7d), either linear (e.g., Figs 7d), linear with apex anteriorly recurved (e.g., Figs 17c, 31d), subreniform (e.g., Figs 20d, 39d, 42d), obovate (Fig. 38c) or greatly enlarged and subtriangular (Figs 25d, 29d), peritreme often medially sulcate (e.g, Figs 7d); evaporative areas reduced (e.g., Figs 25d, 29d, 42d, 46d) to extensive (e.g, Figs 4d, 7d, 9d, 17c, 31d), often extending laterally beyond tip of peritreme. Thoracic sterna: usually flat (e.g., Figs 12c, 20c, 29c, 31c, 39c, 42c, 46c), sometimes lateral margins strongly raised, keel-like (e.g., Figs 4c, 7c, 9c), rarely with pro- and mesosternal keels overlapping (Fig. 7c). Legs: femora fusiform; tibiae terete, tarsi three-segmented. Pregenital Abdominal Venter: SII-SVII always visible (Figs. 21a-d, f-i), SVIII most often recessed, rarely exposed in males (Figs 21e, 45c), covering posterior margin of pygophore (Figs 29e, 46e); sometimes posterolateral angles with acuminate spine (e.g., Figs 21a, b); males with

sternal glands sublaterally, ranging between SIII-SVII (Figs 2a-i, 12e); sometimes males and females with stridulatory region on SV-SVI (Figs 17e-f). Male Genitalia: pygophore moderate size to large, ventral surface caudally (e.g., Figs 4e, 9e, 12e, 31e) or ventrally oriented (e.g., Figs 20e, 29e, 42e, 46e); ventral margin convex, emarginate or sublinear; genital opening moderately broad to broad, with setose regions usually on dorsal margin (e.g., Figs 22a, 43a), and often on ventral (e.g., Figs 22a, 46f) and lateral margins (e.g., Figs 4f, 7f, 8a, 31f, 43a, 46f); parameres moderate size (e.g., Figs 14b, 40b, 43b) to large (e.g., Figs 36b, 47b), symmetrical, with columnar stem, and weakly (e.g., Figs 14b, 26b, 35b, 40b, 43b) to strongly hooked (e.g., Figs 8b, 10b, 18b, 22b, 47b) crown, usually with apex of stem setose, and sometimes with flange (e.g., Figs 5b, 8b, 35b, 36b); aedeagus with mesial U-shaped phallobase, with round capitate processes; aedeagus box-like, often heavily sclerotized; phallotheca cylindrical (e.g., Figs 5c, 26c) to subconical (e.g., Figs 8c, 10c, 22c), thick, sometimes with pair of subdistal thorn-like processes (Fig. 40c), or areas of sclerotization (e.g., Figs 5c, d, 30c, 36c); ductus seminis proximalis narrow, membraneous, without ribbing (e.g., Figs 5c, 8c, 10c, d, 14c, 22c, d, 26c, 30c, 36c, 43c) sometimes thicker (Fig. 18c), rarely bounded by sclerotized process of vesica (Fig. 30c) or ligamentary tubule (e.g., Figs 18c, 47c, d); ejaculatory apparatus elaborate (e.g., Figs 5c, 8c, 10c, d, 14c, 22c, d, 26c, 30c, 36c, 43c), moderately to heavily sclerotized, most often with convoluted ventral conducting canal (e.g., Figs 5c, 8c, 10c, d, 22c, d, 26c, 30c, 36c, 43c), with 2-12 convolutions; ejaculatory reservoir small (e.g., Fig. 22c), moderate size (e.g., Figs 5c, 8c, 10c, 14c, 43c) to large (e.g., Figs 18c, 22c, d, 26c, 30c, 35c, 36c, 40c), elliptoid to oval, sometimes greatly reduced and heavily sclerotized (Fig. 47c); dorsal conducting canal simple, narrow to relatively broad (e.g., Figs 5c, 8c, 10c, d, 22c, d, 26c, 30c, 36c, 43c); ductus seminis distalis usually narrow, rarely expanded; vesica rarely membraneous (Fig. 18c, d), usually sclerotized, moderate size (e.g., Figs 5c, d, 22c, d, 36c, d, 47c, d), or elongate (e.g., Figs 8c, d, 10c, d, 26c, d, 30c, d, 35c, d, 40c, d, 43c, d), arcuate (e.g., Figs 10c, d, 14c, d, 43c, d, 47c, d), sinuate (e.g., Fig. 5c, d, 8c, d, 30c, d, 35c, d, 40c, d), rarely subdistally strongly incrassate (e.g., Figs 30c, 35c), sometimes with subdistal processes (Fig, 36c, d), or with distal process above secondary gonopore (Figs 22c, d); CAI most often absent (e.g., Figs 5c, d, 8c, d, 10c, d, 26c, d, 30c, d, 35, d, 36c, d, 40c, d, 43, d), if present medially fused at base (Fig. 14c, d, 47c, d), or bifurcate with ventral and dorsal branches (e.g., Figs 22c, d); CAII sometimes undivided (e.g., Figs 36c, d, 47c, d), usually bifurcate (e.g., Figs 5c, d, 8c, d, 10c, d, 26c, d, 30c, d, 35, d, 36c, d, 40c, d, 43c, d), CAII(L) often basally membraneous, rarely without lobal sclerites (e.g., Fig. 35c, d), usually with apical lobal sclerite, either short, subconical (e.g., Figs 10c, d, 26c, d), hooked with spicules (e.g., Fig. 40c, d), or digitiform (e.g., Figs 8c, d, 43c, d), sometimes entirely sclerotized (e.g., Figs 22c, d), sometimes spiculate, CAII(M) usually membraneous with apical lobal sclerite, either short (e.g., Figs 5c, d), triangular (e.g., Figs 36c, d), digitiform lobal sclerite (e.g., Figs 26c, d), hooked (e.g., Figs 40c, d), or with bifid sclerotized process (e.g., Figs 22c, d, 43c, d); CAIII either separated, heavily sclerotized, moderate size, arcuate (e.g. Figs 10c, d), elongate and sclerotized (e.g., Figs 22c, d), medially fused, small (e.g., Figs 8c, d) or large and U-shaped (e.g., Figs 26c, d, 30c, d, 40c, d, 43c, d), or antler-like (Figs 36c, d), or medially fused and membraneous (e.g., Figs 14c, d, 47c, d), sometimes bifurcate, with dorsal and ventral branches (e.g., Figs 5c, d), rarely absent (Fig. 18c). Female Terminalia: either co-planar or bi-planar (e.g., Figs 33d, f); either ventrally or caudally oriented, sometimes recessed; paratergites VIII moderate size to large, subtriangular to subelliptoid, usually strongly tapered towards midline; paratergites IX small (e.g., Fig. 33b) to large (e.g., Figs 33e, f), usually ovoid and broader in middle, rarely tapered medially; gonocoxae I most often entire, rarely subdivided, usually moderate size, greater than paratergites IX, subtriangular, posterior margin rectilinear to weakly excavate, sometimes depressed medially, and often with medial margins raised; first and second gonapophyses membraneous; first and second rami usually developed. Spermatheca: proximal fecundation canal short to

elongate, membraneous, sometimes strongly sclerotized basally; reservoir usually broad, oval, often ribbed, rarely weakly dilated, membraneous; distal fecundation canal usually short, rarely elongate, sometimes heavily sclerotized, usually with proximal and distal flanges, bulb small, oval, sometimes bilobed. Larvae: dull or iridescent colouration; dorsal abdominal gland openings between terga III-IV, IV-V and V-VI.

Diversity and distribution: The Scutelleridae are composed of about 80 genera and 500 species (LATTIN 1964; Zoological Record 1965-2005). Of the scutellerid subfamilies, the nominotypical Scutellerinae are the most diverse and are primarily found in the Old World tropics, with only one genus, *Augocoris* BURMEISTER, known from the Western Hemisphere. The Pachycorinae are also diverse, with over 100 described species, including numerous undescribed taxa, and are primarily found in the Western Hemisphere, mostly in the Neotropical zoogeographic region, with a few genera also represented in the Afrotropical (*Deroplax* MAYR) or Afrotropical and Oriental regions (*Hotea* AMYOT & SERVILLE). The Odontotarsinae are the next most diverse suprageneric group, and have putatively the broadest distribution of all the scutellerid subfamilies, with a near cosmopolitan distribution, although more than 80 of the species of this subfamily are found in the Palaearctic region. The Elvisurinae and the Sphaerocorinae are small subfamilies, with less than 25 species, which are found primarily in the Old World tropics. The Eurygastrinae and Tectocorinae are currently defined as monogeneric subfamilies, of the Eastern Hemisphere.

Key to Australian Scutelleridae

1 Lateral margins of thoracic sterna strongly sulcate with elevated keels (Figs 4c, 7c, 9c); adults dull in colouration (Figs 3a-e), jugal and pronotal margins entire (Figs 3a-e) (Elvisurinae) 2

– Lateral margins of thoracic sterna flat, without elevated keels (Figs 12c, 20c, 29c, 31c, 39c, 43c, 46c); adults brightly coloured (Figs 1a-f, 16a, b, 19a-d, 24a,c-f, 28a-e, 45a, b), or if dull in colouration (Figs 14a-c), jugal and pronotal margins denticulate (Figs 11c,d, 12a-c), or body very small, < 4 mm (Fig. 24b, 37b) . .(6)

2 Posterior margin of pronotum strongly rounded (Fig. 3c-e); pro- and mesosternal keels overlapping (Fig. 7c); peritreme of metathoracic glands elongate (Fig. 7d) (*Coleotichus*) 3

– Posterior margin of pronotum rectilinear (Fig. 3a), or weakly arcuate, rectilinear medially (Fig. 3b); pro- and mesosternal keels not overlapping (Figs 4c, 9c); peritreme of metathoracic glands short (Fig. 4d) to moderate size (Fig. 9d) 5

3 Moderately sized species, males < 16 mm, females < 17.2 mm; labium reaching at most to metasternum; sub-anterolateral angles of scutellum without polished orange callus (Figs 3a, b), at most with a black spot; scutellum without patterned small black spots (Figs 3c, d) 4

– Large species, males > 20 mm, females > 18 mm; labium reaching abdominal SIV, with medial regions of SII-SIV correspondingly sulcate; sub-anterolateral angles of scutellum with polished orange calli (Fig. 3e); scutellum with pair of black spots sublateral anterior to midpoint (Fig. 3e) . . . . . *Coleotichus excellens*

4 Callosite region of pronotum with two black spots submedially (Fig. 3d); lateral margins of posterior 1/2 of scutellum contrastingly fuscous (Fig. 3d); males with abdominal setose sternal glands on SIV-SVI (Figs 2a-c); CAII asymmetrical (Figs 8c, d); CAIII medially fused (Fig. 8d); female terminalia co-planar; paratergites VIII large, subelliptoid . . . *Coleotichus costatus*

– Callosite region of pronotum with four black spots, arranged transversely (Fig. 3c); lateral margins of scutellum concolorous with remainder of scutellum (Fig. 3c); males without abdominal setose sternal glands; CAII symmetrical; CAIII medially separated; female terminalia bi-planar, paratergites VIII angulate relative to gonocoxae I; paratergites moderately sized, subtriangular . . .*Coleotichus artensis*

5 Body elongate-oval (Fig. 3a); dark brown species with heavy punctation (Fig. 3a); ventral surface strongly setose; labium reaching posterior margin of abdominal SII abdominal; males without abdominal

sternal glands; connexival margins thickened, each segment bicoloured yellow then black (Fig. 3a); CAIII bifurcate, medially fused (Fig. 4d); spermathecal reservoir weakly dilated . . . . . *Austrotichus rugosus*

– Body ovoid (Fig. 3b); orange-brown species with shallow punctation (Fig. 3b); ventral surface mostly glabrous; labium reaching metasternum; males with abdominal sternal glands on SIV-SVII connexival margins greatly thickened, concolorous; CAIII not bifid, medially separated (Figs 10c, d); spermathecal reservoir broad, oval . . . . . *Solenotichus circuliferus*

6 Both sexes with stridulatory vittae on abdominal SV-SVI (Fig. 17e); head large (Figs 16a, b); SVII enlarged, covering male (Fig. 17d) and female terminalia (Pachycorinae) . . . . . *Agonosoma trilineatum*

– Both sexes without stridulatory vittae on abdominal SV-SVI; head moderately sized (e.g., Figs. 19a-d); SVII not greatly enlarged (e.g., Figs 21a-i), terminalia of both sexes exposed, sometimes male SVIII exposed partially covering pygophore (e.g., Figs 45c, 46f) 7

7 Males with androconial glands on abdominal SIV-VI (Figs 2d-f, g-i, 12e, 45c); external efferent system of metathoracic glands reduced (e.g., Figs 12d, 46d); aedeagal ejaculatory apparatus without convoluted ventral conducting canal (Figs 14c, d, 47c, d); CAI present (Figs 14c, d, 47c, d); CAIII well-developed, membraneous, basally fused (Figs 14c, d, 47c, d) 8

– Males without androconial glands, most often with abdominal sterna unadorned (e.g., Figs 21a-i); external efferent system of metathoracic glands usually well-developed (e.g., Figs 20d, 31d), if evaporative areas reduced, peritreme greatly enlarged, subtriangular (Figs 25d, 29d); aedeagal ejaculatory apparatus with convoluted ventral conducting canal (e.g., Figs 5c, 8c, 10c, d, 22c, d, 26c, 30c, 36c, 43c); CAIII usually large, membraneous and U-shaped (e.g., Figs 26c, d, 30c, d, 40c, d, 43c, d), rarely antler-like (Figs 36c, d) or digitiform (Fig. 22c, d) (Scutellerinae) 11

8 Body small, males and females < 6 mm; body dull colouration, densely punctate (Figs 11a-c); dorsum densely setose, with curly sericeous setae (Figs 13a, b, e, h) intermixed with fan-like (Figs 13c, h, i) or clove-like setae (Figs 13b, f); male abdominal SVIII recessed, not visible (Fig. 12e); female gonocoxae I tripartite (Odontotarsinae: *Morbora*) 9

– Body large, males and female > 13 mm; body mostly orange, most often with iridescent blue or green markings, rarely uniformly orange (Figs 1f, 45a, b; dorsum glabrous; male abdominal SVIII exposed, broadly covering ventral surface of pygophore (Figs 45c, 46e); female gonocoxae I undivided . . . *Tectocoris diophthalmus*

9 Anterolateral margins of pronotum and costal margins greatly expanded (Figs 11c); scutellum with broad fan-like setae (Figs 13h-i) . . . . . *Morbora schoutedeni*

– Anterolateral margins of pronotum and costal margins not expanded (Fig. 13a, b); scutellum with either clove-like setae (Figs 13b, 13f) or narrow fan-like setae (Fig. 13c) 10

10 Dorsum with short, narrow fan-like setae, strongly tapered proximally (Fig. 13c); AI longest antennal segment; CAI branched; CAIII absent . . . . . .*Morbora australis*

– Dorsum without fan-like setae, with clove-like setae only (Fig. 13f); AIV longest antennal segment; CAI branched; CAIII present . . . . . *Morbora hirtula*

11 Body very small, < 4 mm (Figs 24b, 37); body with setigerous punctures (Figs 38a-c); head short, strongly rounded in profile (Fig. 38b); jugal margins rounded (Fig. 38b); apex of peritreme of metathoracic glands distally raised, obovate (Fig. 38c) . . . . . *Heissiphara minuta*

– Body small to large species, > 8 mm; body without setigerous punctures, dorsum usually glabrous, at most with simple setae; head short to elongate; jugal margins carinate (e.g., Figs 29b, 31a, b) or rounded (e.g., Figs 25c); peritreme subreniform (e.g., Figs 20d, 39d, 42d), subtriangular (e.g., Figs 25d, 29d), rarely obovate, but if so anteriorly directed (Fig. 31d) 12

12 Jugal margins straight in dorsal view (Figs 28a, 29a); large orange species with seven black spots on pronotum and seven

spots on scutellum (Fig. 28a); abdominal SVIII exposed (Figs 21e, 29e), covering anterior margin of pygophore; CAII undivided (Figs 30c, d); female terminalia caudal in orientation . . . . . *Cantao parentum*

– Jugal margins sinuate in dorsal view (e.g., Figs 20a, 25a, 31a, 39a, 42a); various colouring, if orange never with abovementioned black markings; male abdominal SVIII recessed, not visible; CAII divided (e.g., Figs 22c, d, 26c, d, 35c, d, 40c, d, 43c, d); female terminalia caudal or ventral in orientation 13

13 Dorsum densely setose (Fig. 1d); body iridescent copper-dark brown (Fig. 28c), green (Fig. 1f), bicoloured dark-green/purple and yellow (Fig. 28d) or blue (Fig. 28e), often with contrasting colouration (e.g., Figs 1d, 28d); CAII(L) with perpendicular or hook-shaped apex, distally denticulate (Fig. 40c, d) (*Lampromicra*) 14

– Dorsum usually glabrous, at most with scattered setae; CAII(L) either with digitiform (Fig. 22c, d) or subconical lobal sclerite (Fig. 26c, d), or bag-like (Figs 35c, d, 36c, d), with or without basal denticulation 16

14 Posterior 1/2 of scutellum yellow, remainder iridescent dark-green/purple (Fig. 28d); abdominal venter mostly iridescent green, with yellow lateral margins, inner outline of latter linear (Fig. 21g); CAIII medially fused post-thecal margin . . . . . *Lampromicra regia*

– Posterior 1/2 of scutellum either copper-fuscous (Fig. 28c) or iridescent dark green or blue (Fig. 1f, 28e); abdominal venter with margins of lateral colour band linear (Fig. 21f) or notched (Fig. 21h); CAIII separated post-thecal margin (Fig. 40d) 15

15 Dorsum uniformly copper-fuscous, sometimes with iridescent green or purple sheen (Fig. 28c); abdominal venter mostly concolorous with dorsum, with red lateral margins, inner outline of latter linear (Fig. 21f); anterior callus of scutellum punctate, always fuscous (Fig. 28c); CAII(L) apex hook-like (Figs 40c, d) . . . . . *Lampromicra aerea*

– Dorsum mostly iridescent green (Fig. 28e) or blue, often with anterior orange callus on scutellum (Fig. 1d); abdominal venter mostly iridescent dark green or blue, with orange lateral margins, inner outline of latter notched (Fig. 21h); anterior callus of scutellum impunctate (Figs 1f, 28e); CAII(L) apex linear . . . . . *Lampromicra senator*

16 AII(b) minute, shortest antennal segment; AII(a) arcuate, more so in males; dorsum strongly iridescent green with orange and fuscous markings (Fig. 28b); lateral areas of mesosternum striate; crown of paramere weakly curved, apex truncate (Fig. 43b); CAII(L) with an elongate arcuate lobal sclerite (Figs 43c, d) . . . . . *Scutiphora pedicellata*

– AI or AII(a) shortest segment; AII(a) linear; body usually red or orange with contrasting markings, if iridescent green without orange markings; lateral areas of mesosternum smooth; crown of paramere strongly hooked (e.g., Fig. 36b); CAII either undivided, or with base membraneous post-thecal margin (e.g., Figs 35c, d, 36c, d), if entirely sclerotized, oval in shape 17

17 Body small to moderate size, males < 12.5 mm, females < 13 mm; dorsum densely punctate (Figs 24c-f); jugal margins carinate (Figs 31a, b); hemelytral membrane tip not exposed beyond scutellum (Figs 24c-f); peritreme of metathoracic glands obovate, elongate, laterally recurved towards head (Fig. 31d); ventral surface of male pygophore caudally oriented (Figs 31e, 32b, f, h) (*Choerocoris*) 18

– Body moderate size to large, males > 13 mm, females > 13.5 mm; dorsum punctate to impunctate; hemelytral membrane tip exposed beyond scutellum (Figs 19a-d); peritreme of metathoracic glands either subtriangular (Fig. 25e) or subreniform (Fig. 20d); ventral surface of male pygophore ventrally oriented (Figs 20 a-c) or caudally oriented 21

18 Callosite region of pronotum medially impunctate (Fig. 24d); callosite region demarcated posteriorly by transverse furrow (Fig. 24d); scutellum red with pair of submedial, iridescent blue, subtriangular

markings (Fig. 24d), anterior margin with iridescent blue marking; apex of scutellum without markings (Fig. 24d); abdominal venter mostly red with lateral and submedial dark blue markings (Figs 32e, f); CAII(M) and CAII(L) roughly symmetrical . . . . . *Choerocoris paganus*

– Pronotum densely and uniformly punctate (Figs 24c, e, f); callosite and disc regions of pronotum co-planar (Figs 24c, e, f); scutellum orange or red with three prominent iridescent blue regions, always with V-shaped distal markings (Figs 24c, e, f); abdominal venter mostly orange or red, with (Figs 32a, b) or without submedial darker markings (Figs 32c, d, g, h); CAII(M) and CAII(L) significantly differentiated (Figs 35c, d, 36c, d) 19

19 Jugae orange (Fig 24c); abdominal venter mostly orange with lateral blue or green markings (Figs 32c, d); apex of CAII(M) with weak sclerotization (Fig. 35c, d); CAIII contiguous medially, lightly sclerotized, lobe-like (Figs 35c, d); vesica without distal process beyond secondary gonopore (Fig. 35c, d) . . . . . *Choerocoris lattini* nov.sp.

– Head mostly iridescent dark green or blue (Figs 24e, f); abdominal venter either yellow or orange, with (Fig. 32a, b) or without submedial dark (Figs 32g, h) blue markings; apex of CAIII with prominent triangular lobal sclerite (Figs 36c, d); CAIII separated, as antler-like and heavily sclerotized processes (Figs 36c, d); vesica with subdistal paired process (Figs 36c, d) 20

20 Pregenital abdominal venter mostly yellow with submedial and lateral black bands (Figs 32a,b); posterior angles of abdominal connexiva V-VII nodulate, yellow (Figs 32a, b); female paratergites IX greatly expanded, much larger than gonocoxae I (Figs 33e, f); gonocoxae I greatly reduced, posterior margin deeply excavate (Figs 33e, f) . . . *Choerocoris grossi* nov.sp.

– Pregenital abdominal venter mostly yellow with lateral black band only (Figs 32g, h); posterior angles of abdominal connexiva V-VII weakly swollen at most, fuscous (Figs 32g, h); female paratergites IX not greatly enlarged, smaller than gonocoxae I (Figs 33c, d); gonocoxae I well-developed, posterior margin weakly excavate (Figs 33c, d) . . . . . *Choerocoris variegatus*

21 Hemelytral membrane barely surpassing tip of scutellum (Fig. 24a); dorsum mostly fuscous, with orange/red and iridescent dark green markings (Figs 24a); AII(a) moderately short, AII(b) at most 2.5x > AII(a); peritreme of metathoracic glands greatly expanded laterally, subtriangular, 1-1.5x longer than wide (Figs 25d); evaporative areas restricted, not extending to mesepimeron (Fig. 25d); CAI absent (Figs 26c); female terminalia caudal in orientation . . . . . *Calliscyta stalii*

– Hemelytral membrane clearly surpassing tip of scutellum (Figs. 19a-d); dorsum mostly iridescent green, orange, or orange and blue, with various markings (Figs 19a-d); AII(a) minute, AII(b) more than 6x > AII(a) length; peritreme of metathoracic glands subreniform, tapered distally, 3x or more longer than wide (Fig. 20d); evaporative areas extensive, extending to mesepimeron (Fig. 20d); CAI present (Figs 22c, d); female terminalia ventral in orientation (*Calliphara*) 22

22 Eye length 1/2 head length (Fig. 19d); head orange-red to copper with fuscous markings (Fig. 19d); pronotum iridescent copper, with calli most often fuscous (Fig. 19d); scutellum iridescent copper, with fuscous spot at tip (Fig. 19d); exocorium iridescent green (Fig. 19d); posterior angles of abdominal SVI-SVII spinose; CAI bifurcate, with CAI(D) elongate, digitiform (Fig. 22c, d); CAIII divided (Figs 22c, d); vesica with apical hood (Fig. 22c, d) . . . . . *Calliphara regalis*

– Eye length < 1/2 head length (Figs 19a-c); head concolorous, iridescent dark green or blue; pronotum orange or iridescent green, rarely with calli fuscous; scutellum broadly bicoloured (Fig. 19a), or orange with narrow distal iridescent green marking (Fig. 19b); posterior angles of abdominal sterna without spines (Fig. 21c), or SIV-SVI (Fig. 21b) or SIV-SVII spinose (Fig. 21a); CAI and CAIII divided or undivided; vesica with or without processes 23

23 Scutellum either red and iridescent dark blue (Fig. 19a) or mostly orange (Fig. 19b); legs concolorous, fuscous; abdominal venter impunctate (Figs 21a, b), sometimes rugose laterally; spinose posterolateral angles of abdominal sterna SIV-SVI (Fig. 21b) or SIV-SVII (Fig. 21a) 24

– Scutellum mostly iridescent green, each with seven black spots (Fig. 19c); femora mostly orange, apex narrowly fuscous; tibiae and tarsi fuscous; abdominal venter punctate (Fig. 21c); posterior angles of abdominal sterna not spinose (Fig. 19c) . . . . . *Calliphara nobilis*

24 Scutellum mostly orange, with extreme caudal tip iridescent green (Figs 1a, 19b); dorsum with moderately deep punctation; abdominal pregenital venter mostly iridescent green, laterally red to orange-red, rugose (Fig. 21b); posterolateral angles of abdominal SIV-SVI spinose (Fig. 21b) . . . . . *Calliphara imperialis*

– Scutellum broadly bicoloured, anterior 1/2 orange to orange-red, remainder iridescent dark blue, with w-shaped anterior outline (Fig. 19a); dorsum with shallow punctation; abdominal pregenital venter orange, laterally smooth (Fig. 21a); posterolateral angles of abdominal SIV-SVII spinose (Fig. 21a) . . . . . *Calliphara dimidiata cruenta*

Subfamily Elvisurinae

Pentatomidae, Scutellerina, Elvisuraria STÅL 1872: 32 (new suprageneric taxon)
Pentatomidae, Scutellerinae, Elvisuraria: SCHOUTEDEN 1904: 4 (diagnosis)
Pentatomidae, Scutellerinae, Elvisurini: KIRKALDY 1909: 311 (catalogue)
Pentatomidae, Scutellerinae, Scutellerini, Elvisuraria: LESTON 1952d: 13 (new suprageneric classification)
Scutelleridae, Elvisurinae: MCDONALD & CASSIS 1984: 538 (Australia)

Diagnosis: The Elvisurinae are recognised by the following combination characters: small (e.g., Fig. 3b) to very large species (e.g., Fig. 3e); ovoid to elongate-ovoid, sometimes strongly tapered towards terminalia; body moderately to heavily punctate; pale to dark brown species (e.g., Figs 3a-e), sometimes with red or fuscous highlighting (e.g., Fig. 3d), occasionally with patterning on scutellum (e.g., Fig. 3d), sometimes with green iridescence; larvae brilliantly and aposematically coloured; head subtriangular to triangular (e.g., Figs 4a, 7a, 9a); sulcate thoracic sterna with highly elevated keels (e.g., Figs 4c, 7c, 9c), contiguous with explanate anterior margin of proepisternum; efferent system of metathoracic glands well-developed (e.g., Figs 4d, 7d, 9d), with peritreme short (e.g., Fig. 4d) to elongate (e.g., Fig. 7d); sometimes males with abdominal sternal glands (e.g., Figs 2a-c); ventral surface of pygophore caudally (e.g., Fig. 4e) or ventrally oriented (e.g., Fig. 7e); posterior margin of male pygophore emarginate (e.g., Figs 4e, 7e) to entire (e.g., Fig. 9e); genital opening narrow to broad; parameres hook-shaped (e.g., Figs 5b, 8b, 10b); ejaculatory reservoir well-developed, with ventral conducting canal and ejaculatory apparatus (e.g., Figs 5c, d, 8c, d, 10c, d); CAI absent; CAII bifurcate, with lobal sclerites (e.g., Figs 5c, d, 8c, d, 10c, d), CAIII undivided (e.g., Figs 8c, d) or divided (e.g., Figs 5c, d, 10c, d); spermathecal fecundation canal short or long; and, spermathecal reservoir oval to weakly dilated.

Remarks: STÅL (1872) first described the elvisurines as a tribal group (Elvisuraria), providing a diagnosis (STÅL 1872, 1873) based primarily on the carinate thoracic sterna. SCHOUTEDEN (1904) followed this arrangement and provided a listing of species. KIRKALDY (1909) catalogued the species and the classification of SCHOUTEDEN (1904).

The Elvisurinae are retained as a subfamily in this work, on the basis of the keel-like thoracic sterna (Figs 4c, 7c, 10c), which is a putative apomorphy for this taxon. In some Odontotarsinae species, the pro- and mesosterna are raised, but not to any great height, and not keel-like as in the elvisurines.

Unlike, the Scutellerinae and some Pachycorinae, the adults of elvisurines are nearly all dull in colouration, aside from two species of *Coleotichus* (*C. blackburniae* and *C. bulowi*), which have a green iridescence, and some species of *Chiastosternum* and *Solenosthedium*, which have contrasting yellow markings on the dorsum. It is noteworthy that larval elvisurines have brilliant colouration, like the larvae in the Scutellerinae. In most other characters, the elvisurines are indistinguishable from the other jewel bug sub-

families, aside from the Tectocorinae. The male aedeagus of elvisurines is not diagnostic for the subfamily, and closely resembles the aedeagus in taxa of the other subfamilies, particularly the Scutellerinae (e.g., *Choerocoris* species, Figs 35c, d, 36c, d), Pachycorinae (e.g., *Camirus* DALLAS; MCDONALD 1966: Fig. 30) and Odontotarsinae (e.g., *Phimodera* GERMAR; MCDONALD 1966: Fig. 22); with a well-developed ejaculatory apparatus, including a convoluted ventral conducting canal and a prominent ejaculatory reservoir. In addition, the character states of the conjunctival appendages are difficult to interpret, with the CAI absent in elvisurines, but also in many taxa in all subfamilies except the Tectocorinae. Moreover, the female terminalia and spermatheca of elvisurines is consistent with most other scutellerids. At present, there is no conclusive evidence that suggests a sister-taxon relationship with any of the other scutellerid subfamilies.

The Elvisurinae are a small subfamily of scutellerids comprised of five genera (KIRKALDY 1909; LESTON 1952d). This subfamily is restricted to the Eastern Hemisphere, with the genera distributed as follows: the monotypic genera *Austrotichus* and *Solenotichus* are endemic to Australia; *Solenosthedium* has seven species in the Eastern Hemisphere (from Africa to Indonesia, including Madagascar), aside from the Australian zoogeographic region; *Coleotichus* is broadly distributed in the Australian region, including continental Australia and the Melanesian subregion, with spectacular species in Samoa (*C. bulowi*) and Hawaii (*C. blackburniae* WHITE); the nominotypical genus *Elvisura* is endemic to the southern regions of the Afrotropical region, including Madagascar, to India (KIRKALDY 1909).

The genus *Nesogenes*, a monotypic genus (*N. boscii* FABRICIUS), was described by HORVÁTH (1921), and is known from the Greater Antilles (Cuba, Haiti and St. Vincent). He placed this taxon in the Elvisurinae, based on the conformity of the keel-like thoracic sterna with all the other members of the subfamily. We examined a single specimen of this taxon at the BMNH (label data as 'St. Dom.'), and found that the species has elvisurine-type thoracic sterna, but possesses extensive stridulatory vittae

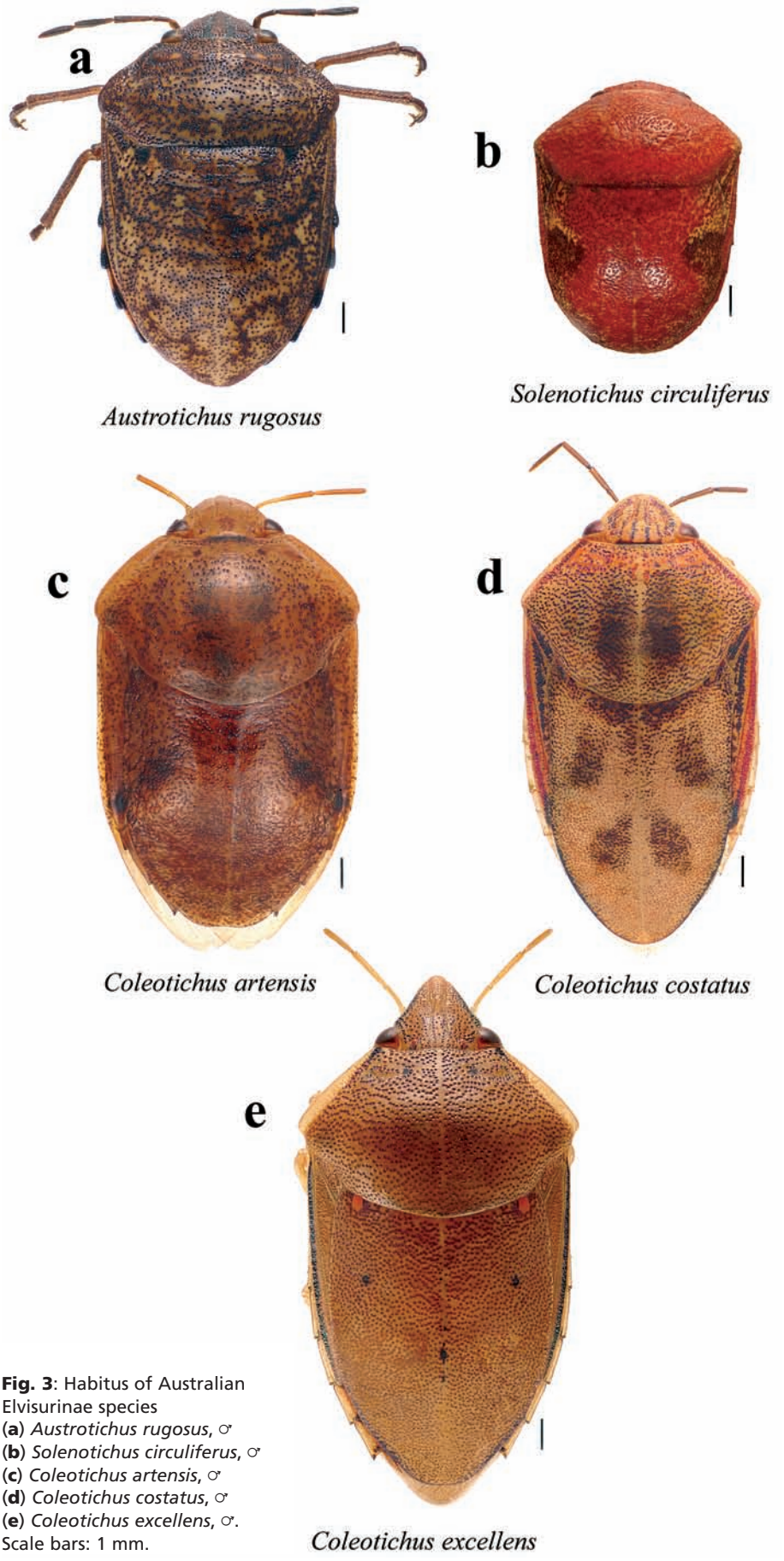


Fig. 3: Habitus of Australian Elvisurinae species
(**a**) *Austrotichus rugosus*, ♂
(**b**) *Solenotichus circuliferus*, ♂
(**c**) *Coleotichus artensis*, ♂
(**d**) *Coleotichus costatus*, ♂
(**e**) *Coleotichus excellens*, ♂.
Scale bars: 1 mm.

(sublaterally on abdominal SIII-SVII), the latter being diagnostic for the Pachycorinae. On these two character systems alone, this taxon is annectant between the Elvisurinae and the Pachycorinae. Externally, this species is reminiscent of species of *Coleotichus*, having a rounded posterior margin of the pronotum, and densely punctate dorsum, with green iridescence (as in *C. blackburniae* and *C. bulowi*). The external efferent system of metathoracic glands is extensive, with no peritreme evident, but with a prominent ostiole; a character state conforming to many Western Hemisphere pachycorine taxa. The external female genitalia are distinctive, with the mediposterior angles of the first gonocoxae narrowly excavate. There has been no examination of the male genitalia of this species. We regard this taxon as incertae sedis, pending examination of additional material, but exclude it from the Elvisurinae.

Austrotichus Gross 1975 (Figs 3a, 4, 5, 6)

Austrotichus Gross 1975: 83 (gen. nov.); McDonald & Cassis 1984: 538, 545 (key description, genitalia); Cassis & Gross 2002: 582 (catalogue)

Type species: *Austrotichus rugosus* Gross 1975, by original designation

Diagnosis: *Austrotichus* is recognised by the following characters: posterior margin of pronotum rectilinear (Fig. 3a); thoracic sterna carinate, not overlapping (Fig. 4c); anterior margin of proepisternum truncate (Fig. 4c); peritreme of metathoracic glands short, arcuate (Fig. 4d); posterior margin of male pygophore medially emarginate (Fig. 4e); CAI absent (Figs 5c, d); CAII(L) without lobal sclerite (Figs 5c, d); CAII(M) with short lobal sclerite (Figs 5c, d); CAIII bifid, medially fused, CAIII(V) with short lobal sclerite (Figs 5c, d); gonocoxae I not divided, medial margins raised; and, spermathecal reservoir membraneous, weakly dilated, elliptoid.

Description: Body elongate-ovoid (Fig. 3a); dorsum and venter strongly convex; wing tip not extending beyond scutellum (Fig. 3a). Head: mostly flattened, posterior aspect of vertex weakly convex (Fig. 4a); jugal margins thickened, subcarinate (Figs 4a, b); bucculae margins subparallel, weakly expanded anteriorly (Fig. 4c). Pronotum: strongly transverse, subtrapezoidal; anterior margin weakly concave (Fig. 3a); anterolateral margins subcarinate; posterior margin rectilinear (Fig. 3a); callosite region weakly demarcated; disc strongly convex, declivent posteriorly (Fig. 3a). Scutellum: broad, strongly depressed beyond anterior 1/2; elliptoid tumescence on anterior margin, marked sublaterally by dark foveae (Fig. 3a); lateral margins convex (Fig. 3a); base of corium and clavus, and connexiva III-VII exposed (Fig. 3a). Thoracic pleura: external efferent system of metathoracic glands well-developed (Fig. 4d); evaporative areas occupying most of metepisternum, extending to mesepimeron (Fig. 4d); ostiole small (Fig. 4d); peritreme short, raised, reniform, not medially sulcate (Fig. 4d). Thoracic sterna: lateral margins sulcate, prosternal and mesosternal keels not overlapping (Fig. 4c); anterior margin of proepisternum truncate, not elevated (Fig. 4c). Male Genitalia: pygophore (Figs 4e, f, 5a) caudally oriented, moderately large, transverse; genital opening dorsal, narrow, suboval, lateral margins setose (Figs 4f, 5a); parameres with columnar stem, moderately hook-shaped crown, flange at base of crown (Fig. 5b); aedeagus (Figs 5c, d): phallotheca short, without processes; ductus seminis proximalis narrow, singular, membraneous, tubelike; ejaculatory apparatus moderately developed; ventral conducting canal with about eight paired convolutions, heavily sclerotized; ejaculatory reservoir small, subelliptical; dorsal conducting canal narrow; ductus seminis distalis and vesica basally incrassate, sinuate, apically truncate; CAI absent; paired CAII greatly enlarged, membraneous, distally bifurcate, lateral branch without sclerotization, medial branch with small, acute lobal sclerite (Figs 5c, d); paired CAIII mostly membraneous, with lateral margins sclerotized, bifurcate, lateral branch membraneous, medial branch with small acute lobal sclerite, medial pair fused along midline (Figs 5c, d). Female Abdominal Venter: posterior margin of SVII weakly bisinuate, weakly thickened medially. Female Terminalia: caudally oriented, bi-planar; paratergites VIII subelliptoid, medially raised; paratergites IX small, narrowly elliptoid, medially rounded; gonocoxae I moderately

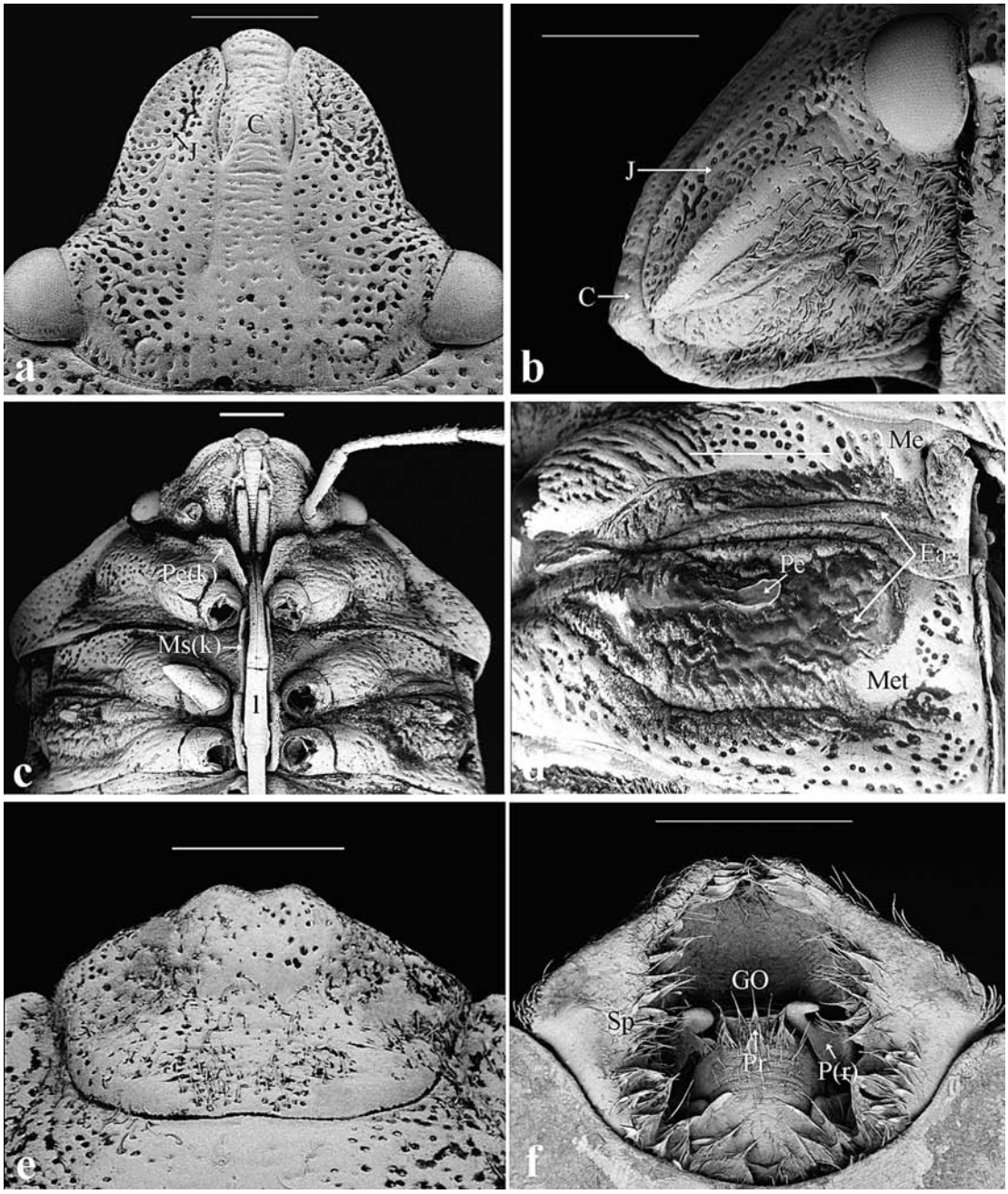


Fig. 4: Scanning electron micrographs of key characters of *Austrotichus rugosus* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Abbreviations: C = clypeus; Ea = evaporative area; Go = genital opening; J = juga; Me = mesepimeron; Met = metepisternum; Ms(k) = mesosternal keel; Pe = peritreme; Pe(k) = proepisternal keel, ventral view; P(r) = right paramere; Pr = proctiger. Scale bars = 1 mm.

large, medially depressed, posterior margin concave, medial margins elevated. Spermatheca: short proximal fecundation canal; spermathecal reservoir narrowly dilated, elliptoid, membraneous, without pronounced modifications; pump short, with dorsal and proximal flanges; bulb oval.

Diversity and distribution: *Austrotichus* is a monotypic genus, which is broadly distributed in temperate Australia, including Victoria, South Australia and Western Australia.

Included species:

A. rugosus GROSS 1975	Australia

Remarks: GROSS (1975) described *Austrotichus* as a monotypic genus, based on external characters alone. MCDONALD & CASSIS (1984) supported its generic status, and described the male and female genitalia. It is a distinctive genus of jewel bug, with a robust body, apomorphic male genitalia and metathoracic glands, and specialized host plant associations. Unlike species of *Coleotichus*, this genus has the posterior margin of the pronotum rectilinear (Fig. 3a) (also in *Solenotichus* and Afrotropical *Solenosthedium* SPINOLA) and the anterior margin of the scutellum is moderately tumose, with sublateral dark foveae (Fig. 3a). The male

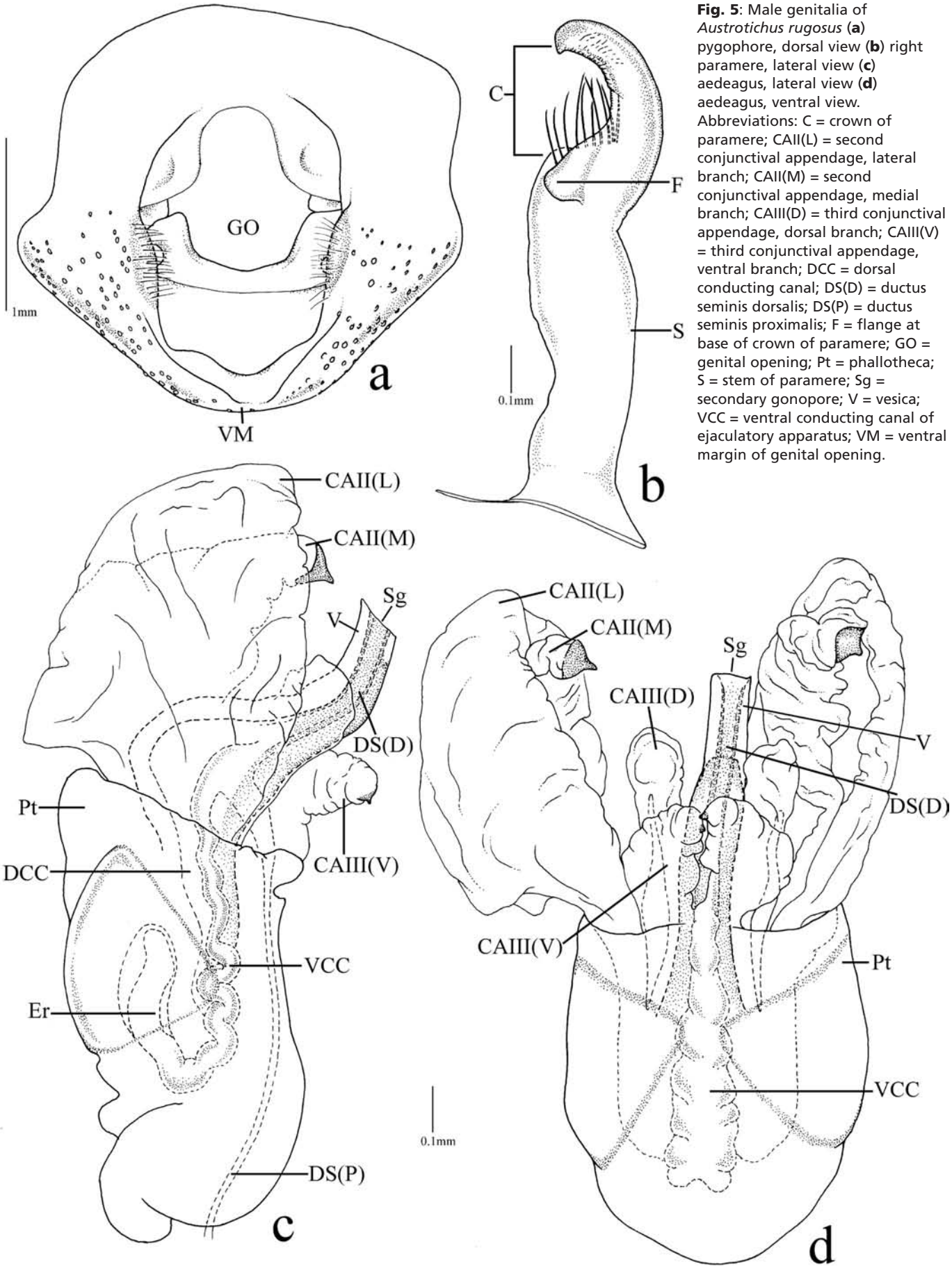


Fig. 5: Male genitalia of *Austrotichus rugosus* (**a**) pygophore, dorsal view (**b**) right paramere, lateral view (**c**) aedeagus, lateral view (**d**) aedeagus, ventral view. Abbreviations: C = crown of paramere; CAII(L) = second conjunctival appendage, lateral branch; CAII(M) = second conjunctival appendage, medial branch; CAIII(D) = third conjunctival appendage, dorsal branch; CAIII(V) = third conjunctival appendage, ventral branch; DCC = dorsal conducting canal; DS(D) = ductus seminis dorsalis; DS(P) = ductus seminis proximalis; F = flange at base of crown of paramere; GO = genital opening; Pt = phallotheca; S = stem of paramere; Sg = secondary gonopore; V = vesica; VCC = ventral conducting canal of ejaculatory apparatus; VM = ventral margin of genital opening.

genitalia of *Austrotichus rugosus*, with the paired CAIII mostly membraneous (Fig. 5c, d), differs from species of *Coleotichus*, *Solenotichus circuliferus*, and extralimital species of Elvisurinae, where the CAIII is sclerotized. In addition, the peritreme is short in *Austrotichus* (Fig. 4d), much shorter than in *Solenotichus* (Fig. 9d), still apparent in comparison to *Solenosthedium*, and much shorter than the consistently elongate peritreme of species of *Coleotichus* (Fig. 7d).

Austrotichus rugosus Gross 1975 (Figs 3a, 4, 5, 6, Table 4)

Austrotichus rugosus Gross 1975: 582 (n.sp.); McDonald & Cassis 1984: 544, Figs 17-22 (description, ♂ & ♀ genitalic illustrations); Cassis & Gross 2002: 582 (catalogue)

Diagnosis: *Austrotichus rugosus* is recognised by the following combination of characters: body strongly convex dorsally; dark grey-brown (Fig. 3a); heavily punctate (Fig. 3a); AII(a) short; AIV longest segment; labium extending to posterior margin of abdominal sterna IV; and, genitalia as in generic description (Fig. 5).

Description: Body moderately large, males 10.03-12.22 mm, females 11.10-12.66 mm.

Colouration. Body mottled yellow-brown to most often dark grey-brown (Fig. 3a), punctures black, with scattered polished yellow regions on callosite region of pronotum. Head: darker brown on clypeal margins extending to posterior margin of vertex; antennae dark-brown, sometimes AI proximally yellow; labium uniformly fuscous. Pronotum: calli with dark brown outline. Scutellum: anterolateral foveae black. Thoracic pleura: yellow-brown. Pregenital Abdomen: venter mostly mottled yellow-brown, spiracular-trichobothrial region polished yellow; posterior angles of SIV-VIII with anterior 1/2 yellow, posterior 1/2 fuscous (Fig. 3a).

Texture. Body densely punctate, punctures irregularly distributed often coalesced.

Vestiture. Dorsum almost glabrous; antennae: AI almost glabrous, sometimes AII(a,b) also glabrous or nearly so, AIII-AIV with moderate distribution of short semierect setae; genae pilose; abdominal venter moderately pilose, more so on lateral margins, sternal sutures and terminalia.

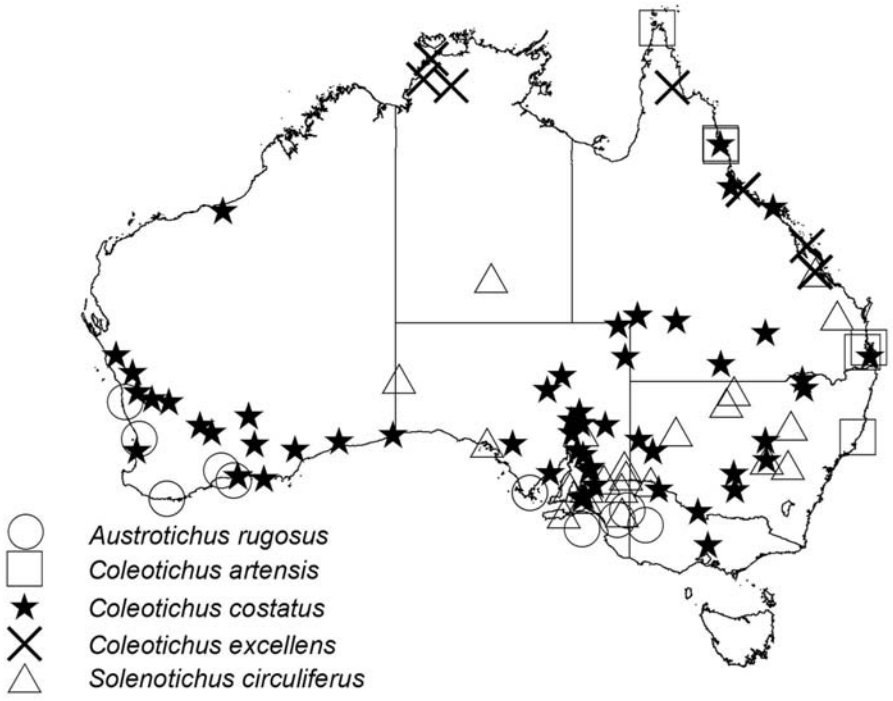


Fig. 6: Distribution of Australian Elvisurinae species.

Structure. Antennae: AI relatively elongate, just surpassing lateral margins of head; AII(a) short; AII(b) and AIV roughly subequal in length; AIII longest segment. Labium: reaching between posterior margin of abdominal sternite IV; LII longest segment; LIV shortest segment. Abdominal Venter: posterior angles of SIV-VII expanded (Fig. 3a). Male genitalia as in generic description (Fig. 5).

Measurements. Table 2. McDonald & Cassis (1984) did not provide measurements for this species.

Type material examined: Holotype: ♂, Port Lincoln, South Australia (SAMA I20,400). Paratypes: 1♀, same data as holotype (SAMA I20,402); 1♀, Keith, South Australia, ex leaf litter, June 1952, MG coll. (SAMA I20, 404; paratype seen); 1♀, 23 mi. E Ravensthorpe, Western Australia (SAMA I20,600); 1♂, Wembley Park, 8 mi. N Perth, Western Australia, 4-xi-1935, RE Turner, BM 1935-240 (BMNH); 1♀, Dedari, 40 mi. W Coolgardie, ii-21-i-1936, RE Turner BM 1936-28 (BMNH).
Other material examined: **Victoria**: 1♀, Little Desert National Park, Stans Camp Track, 36°35.211'S 138°33.732'E, 173 m, RT Schuh, G Cassis, MD Schwartz & R Silveira, 6 November 2002, ex *Allcasuarina pusilla* (AM); **Southern Australia**: 1♀, Scorpion Springs Conservation Park, 35.626S 140.867E 100m, G Cassis, RT Schuh and R Silveira, 10 November 1998, site

Table 4: *Austrotichus rugosus*: diagnostic measurements in millimetres. N = sample size.

	Male			Female		
	N	**Mean±SD**	**Range**	**N**	**Mean±SD**	**Range**
Length	9	11.08±0.59	10.03-12.22	4	12.03±0.66	11.10-12.66
Pronotal width	9	7.65±0.36	6.96-8.23	4	8.32±0.70	7.35-8.96
Width between eyes	9	2.39±0.19	2.14-2.78	4	2.51±0.15	2.34-2.63
Antennal segment length						
I	17	1.04±0.08	0.93-1.23	8	1.19±0.06	1.10-1.27
II(a)	17	0.59±0.05	0.51-0.69	8	0.66±0.04	0.59-0.71
II(b)	16	1.23±0.07	1.10-1.35	8	1.25±0.09	1.13-1.40
III	7	1.38±0.07	1.27-1.47	7	1.32±0.06	1.25-1.40
IV	3	1.25	1.18-1.35	4	1.26±0.01	1.25-1.27
Labial segment length						
I	9	1.92±0.06	1.84-2.01	4	1.90±0.02	1.86-1.91
II	9	2.08±0.13	1.96-2.25	4	2.06±0.07	1.96-2.13
III	9	1.38±0.11	1.23-1.52	4	1.43±0.06	1.35-1.47
IV	9	1.26±0.11	1.18-1.54	4	1.27±0.05	1.23-1.35

98-40, ex *Allocasuarina pusilla* (AM); **Western Australia**: 3♂♂ 5♀♀, 17 km W of Brand Highway on Green Head Road, 30.05S, 115.133E, 350m, G Cassis and RT Schuh, 1 November 1996, site 96-53, ex *Allocasuarina humilis* (AM); 1♀, Madfish Bay, William Bay National Park, 35.017S, 117.25E, 100 m, G Cassis, RT Schuh and R Silveira, 1 December 1999, site 99-54, ex *Allocasuarina humilis* (AM); 2♀♀, Eneabba, RP McMillan, 12-viii-1978 (WAM).

Distribution: *Austrotichus rugosus* is broadly distributed in temperate Australia, from Western Australia to Victoria, including South Australia (Fig. 6). This work includes new records from Victoria, South Australia and Western Australia. The species exhibits a significant distributional disjunction, between southwest Western Australia and the southern region of the Murray-Darling basin.

Host plants and biology: The Green Head Road specimens of *Austrotichus rugosus* were found on the sheoak species, *Allocasuarina humilis* (Casuarinaceae); a monoecious shrub commonly found in heath habitats in southwest Western Australia. Both sexes were collected on the female seed cones, in association with the true bug species *Laryngodus australis* HERRICH-SCHAEFFER (Rhyparochromidae: Udeocorini) and *Cermatulus nasalis* (WESTWOOD) (Pentatomidae). Despite their large size, these jewel bugs are surprisingly cryptozoic, with their mottled colouration blending closely with the dark brown colour of the female cones. Similarly, the South Australian specimen was collected on the female seed cones of another species of *Allocasuarina*, *A. pusilla*. We have not made direct observations of feeding behaviour, although their presence on seed cones is suggestive of seed-predation, as opposed to sap-feeding proposed by CASSIS & GROSS (2002). GROSS (1975) in describing this species, documented that one of the paratypes was found in leaf litter. This is consistent with other jewel bugs, such as *Choerocoris paganus*, which are known to be pre- and post-dispersal seed predators.

Remarks: GROSS (1975) described this species from a handful of specimens from South Australia and Western Australia. He also provided a habitus illustration and detailed description of non-genitalic characters. MCDONALD & CASSIS (1984) described the male and female genitalia and first recognised that the peritreme of the metathoracic glands is distinctively short. The male genitalia are largely invariant across its distributional range.

Coleotichus WHITE 1839 (Figs 3c-e, 6, 7, 8)

Coleotichus WHITE 1839: 541 (nov. gen.); DALLAS 1851: 5 (description); STÅL 1865: 35 (key); MAYR 1866: 13 (diagnosis); STÅL 1873: 4 (diagnosis); LETHIERRY & SEVERIN 1893: 15 (catalogue); SCHOUTEDEN 1904: 4, 5 (description); KIRKALDY 1902: 172 (Hawaii); SCHOUTEDEN 1905 (monograph); KIRKALDY 1909: 313 (catalogue); GROSS 1975: 80 (description); DISTANT 1920: 143 (catalogue); GROSS 1975: 80 (description); MCDONALD & CASSIS 1984: 538 (genitalia); CASSIS & GROSS 2002: 583 (catalogue)

Type species: *Cimex costatus* FABRICIUS 1787 by monotypy

Diagnosis: *Coleotichus* is recognised by the following combination of characters: elongate-ovoid (Figs 3c-e); lateral margins of jugae rounded (Fig. 7b); posterior margin of pronotum strongly convex (Figs 3c-e), covering anterior margin of scutellum; metathoracic peritreme mostly rectilinear, sulcate, with apex anteriorly arcuate (Fig. 7d); thoracic sterna strongly keel-like, pro- and mesosternal keels overlapping (Fig. 7c); CAI absent; CAII symmetrical or asymmetrical, bifid (Figs 8c, d), with rounded or digitiform lobal sclerites; CAIII separated or fused (Fig. 8d); and, spermathecal reservoir oval.

Description: Body elongate-ovoid (Figs 3c-e); moderately-sized to large species; moderately convex dorsally and ventrally;

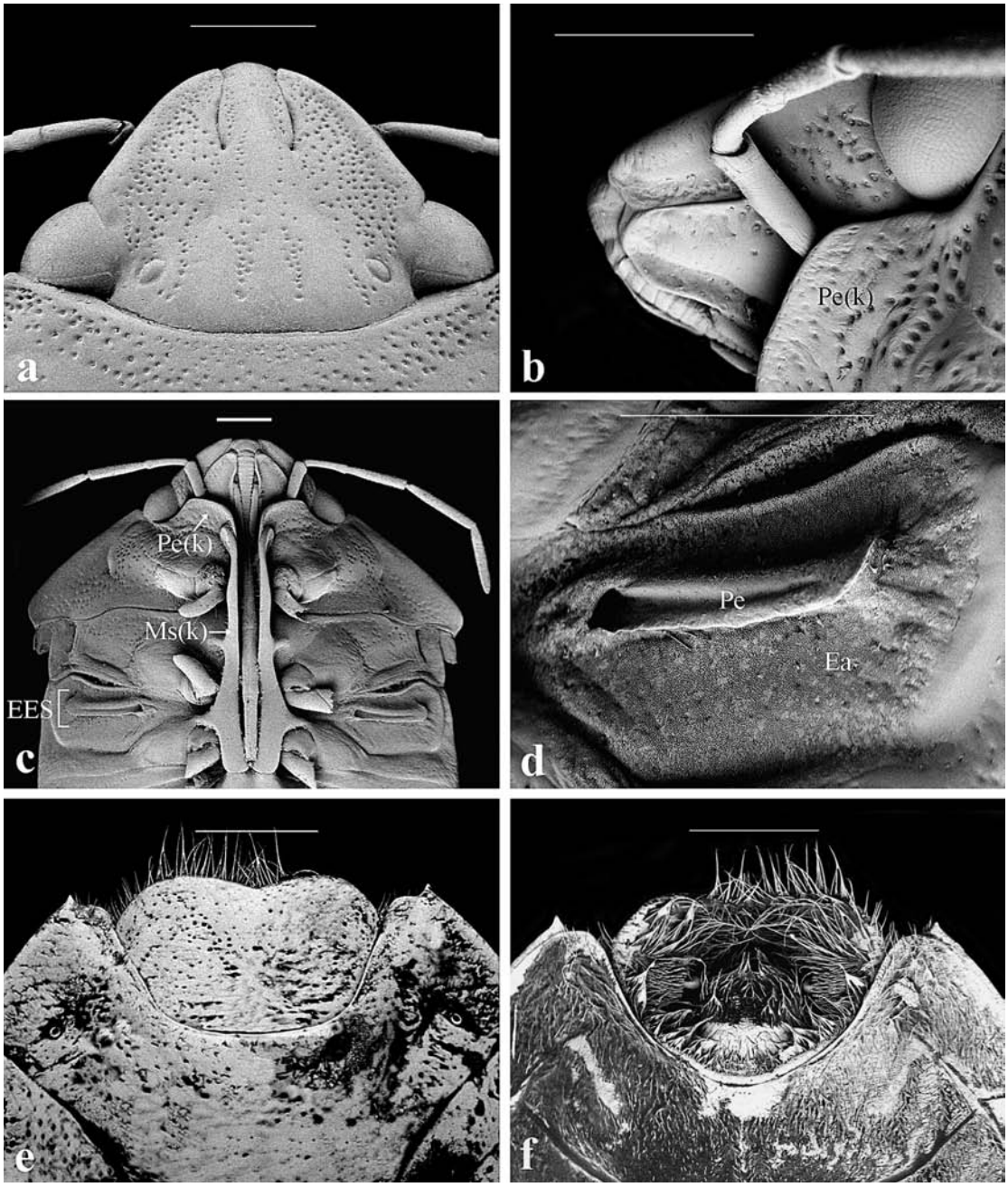


Fig. 7: Scanning electron micrographs of key characters of *Coleotichus costatus* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Abbreviations: Ea = evaporative area; Ms(k) = mesosternal keel; Pe = peritreme; Pe(k) = proepisternal keel, ventral view; EES = external efferent system. Scale bars = 1 mm.

wing tip extending beyond scutellum; moderately to densely punctate; pale to dark brown, sometimes with red or green iridescent highlighting (e.g. *Coleotichus blackburniae*; Hawaii), rarely with patterned darker brown markings. Head: triangular (Figs 3c-e, 7a), moderately convex; clypeus broadly rounded at apex and barely surpassing juga (Fig. 7a); jugal margins rounded (Fig 7b); lorae strongly demarcated, margins carinate (Fig. 7b); bucculae narrow, lateral margins weakly arcuate (Fig. 7c). Antennae: AI-AII(a) shortest segments, subequal; AIII-AIV longest segments, subequal or AIV slightly longer. Labium: reaching apex of metasternum (Fig. 7c) to abdominal SIV; LII usually longest segment. Pronotum: large, shield-like, strongly convex (Figs 3c-e); anterior margin concave; anterolateral margins rectilinear, carinate; humeral angles rounded to weakly angulate; posterior region of disc greatly expanded, posterior margin strongly convex, overlapping anterior margin of scutellum (Figs 3c-e). Scutellum: elongate, strongly convex, U-shaped, most often strongly tapered posteriorly (Figs 3c-e); basal aspects of corium and clavus, and connexiva III-VII exposed (Fig. 3c-e). Thoracic pleura: external efferent system of metathoracic glands well-developed, raised

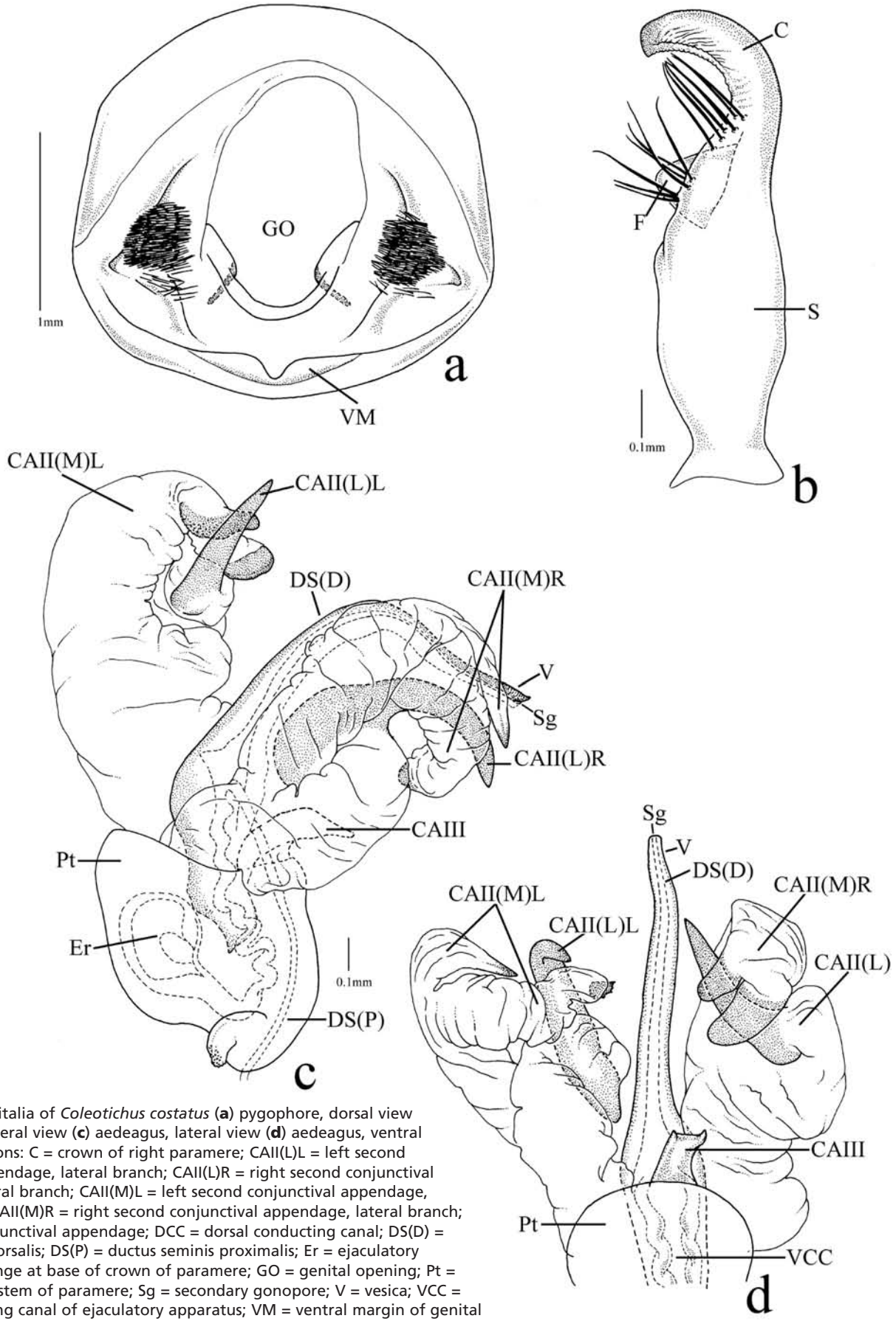


Fig. 8: Male genitalia of *Coleotichus costatus* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) aedeagus, ventral view. Abbreviations: C = crown of right paramere; CAII(L)L = left second conjunctival appendage, lateral branch; CAII(L)R = right second conjunctival appendage, lateral branch; CAII(M)L = left second conjunctival appendage, medial branch; CAII(M)R = right second conjunctival appendage, lateral branch; CAIII = third conjunctival appendage; DCC = dorsal conducting canal; DS(D) = ductus seminis dorsalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; F = flange at base of crown of paramere; GO = genital opening; Pt = phallotheca; S = stem of paramere; Sg = secondary gonopore; V = vesica; VCC = ventral conducting canal of ejaculatory apparatus; VM = ventral margin of genital opening.

(Fig. 7c); evaporative areas occupying most of metepisternum, and extending to mesepimeron (Figs 7c, d); ostiole moderately-sized (Fig. 7d); peritreme elongate, mostly rectilinear, with apex weakly curved at apex, gutter-like, medially sulcate (Fig. 7d). Thoracic sterna: lateral margins strongly sulcate, prosternal and mesosternal keels overlapping (Fig. 7c), with latter contiguous with explanate anterior margin of proepisternum, rounded (Fig. 7c); metasternal keels thickened (Fig. 7c). Male Genitalia: pygophore (Figs 7e, f, 8a) large, subquadrate to suboval, ventral margin convex; genital opening dorsal in orientation, broad, suboval, lateral margins densely setose; parameres (Fig. 8b), columnar stem, strongly hook-shaped crown, sometimes base of crown with flange; aedeagus (Figs 8c, d), asymmetrical (Fig. 8c, d) or symmetrical; phallotheca squat (Fig. 8c), sclerotized, without processes; ejaculatory apparatus moderately developed (Fig. 8c); ventral conducting canal with 8-10 paired convolutions (Fig. 8c); ejaculatory reservoir short, oval (Fig. 8c); vesica short to elongate, tapered towards apex, strongly arcuate; conjunctival appendages (Figs 8c, d): CAI absent; CAII asymmetrical (Figs 8c, d) or symmetrical, greatly enlarged, mostly membraneous, distally bifurcate, CAII(L) with short (acute) or large (sickle-shaped) lobal sclerite, CAII(M) with short acute lobal sclerite, or blunt bifid lobal sclerites; CAIII sclerotized (Fig. 8c, d) or membraneous, fused medially or separated, flange-shaped or S-shaped, sometimes bifid. Female Terminalia: ventrally oriented, co-planar; paratergites VIII large, broad, subelliptoid, posterior margin rounded; paratergites IX narrowly elliptoid, medial margins truncate; gonocoxae I transverse, undivided, posterior margin concave, medial margins elevated. Spermatheca: short to moderately-sized proximal fecundation canal; spermathecal reservoir narrowly dilated elliptoid, membraneous; pump with dorsal and proximal flanges; bulb oval.

Diversity and distribution: The highest area of species diversity in *Coleotichus* is in the Australian zoogeographic region, with seven of the thirteen described species. A number of the species are widespread, with all three Australian species, found also in New Guinea, or surrounding islands, with *C. excellens* now known from as far north as Taiwan (see below). The genus is also represented in the Oriental region, with two species known from Indonesia (Borneo and Sumatra). *Coleotichus* is also represented in Pacific islands and archipelagos, distant from Australia, including Samoa, Hawaii and the Marquesas. The most spectacular species of *Coleotichus*, *C. blackburniae*, is endemic to the Hawaiian Islands, where it breeds on koa, a native species of *Acacia*, where both plant and insect are threatened, the jewel bug by green vegetable bug biological control agents (JOHNSON et al. 2005).

Included species:

C. adamsoni VAN DUZEE 1932	Marquesas
C. artensis (MONTROUZIER 1858)	Australia, New Caledonia, Fiji, Vanuatu, Samoa, Aru Island
C. bakeri TAEUBER 1929	Philippines
C. biroi SCHOUTEDEN 1905	New Guinea
C. blackburniae WHITE 1881	Hawaii
C. breddini SCHOUTEDEN 1905	Micronesia
C. bulowi SCHOUTEDEN 1905	Samoa
C. costatus (FABRICIUS 1787)	Australia, New Caledonia, Tonga
C. excellens WALKER 1867	Australia, Fiji, New Guinea, New Caledonia, Samoa, Philippines, Taiwan, Indonesia (Irian Jaya)
C. fuscus VOLLENHOVEN 1863	Ambon, Ceram
C. marianensis USINGER 1946	Guam
C. ornamentifer BERGROTH 1915	Borneo
C. sumatranus BREDDIN 1900	Sumatra

Remarks: *Coleotichus* is a distinctive genus of Elvisurinae, having greatly enlarged thoracic sternal keels, with the pro- and mesothoracic keels overlapping (Fig. 7d). The genus shares some similarities with the nominotypical genus *Elvisura*, with the pronotum greatly expanded posteriorly, covering the anterior margin of the scutellum (Figs 3c-e). The male genitalia resemble those of *Elvisura*, in the following ways: the CAII have lateral and medial lobes with lobal sclerites, and the CAIII are sclerotized and fused medially (as in *C. costatus* and *C. artensis*) (e.g., Figs 8c, d). LESTON (1953b) described the male genitalia of *Elvisura irrorata* SPINOLA, which serve as a basis for this comparative hypothesis.

WHITE (1839) described *Coleotichus* on the basis of the Australian species, *C. costatus*. SCHOUTEDEN (1904), in redescribing the genus, established three subgenera (*Coleotichus*, *Epicoleotichus* and *Paracoleotichus*) on the basis of the prosternal shape, declivity of the male pygophore, and the shape of the female genital plates. GROSS (1975) redescribed *Coleotichus*, and used these subgeneric categories, giving credence to the shape of the prosternum in relation to the eyes. Our observations indicate that differences in these characters are more indicative of species relationships, and not diagnostic at the genus level.

MCDONALD & CASSIS (1984) added a description of the male genitalia for *Coleotichus*, and did not adhere to subgeneric categories, without any explicit explanation. Pending a more detailed comparative morphological investigation and phylogenetic analysis of *Coleotichus*, the sister-species relationships are uncertain, and we know of no new evidence that supports the use of subgeneric categories. Aside from the Australian species, the male and female genitalia of the extralimital species of *Coleotichus* have not been documented; a necessary prerequisite for any further classificatory hypotheses.

Coleotichus artensis (MONTROUZIER 1858) (Figs 3c, 6)

Scutellera artensis MONTROUZIER 1858: 259 (n.sp.)
Coleotichus artensis: STÅL 1873: 4 (new combination); LETHIERRY & SEVERIN 1893: 15 (catalogue); SCHOUTEDEN 1904: 6 (list; separate species); SCHOUTEDEN 1905: 336 (description); SCHOUTEDEN 1907: 107 (Montrouzier type); KIRKALDY 1909: 313 (catalogue); DISTANT 1920: 143 (New Caledonia); MCDONALD & CASSIS 1984: 542, fig. 16 (description; spermatheca); CASSIS & GROSS 2002: 583 (catalogue; synonymy); SMITH 1978: 821 (defensive secretion)
Coleotichus marginatus SIGNORET 1861: 59 (n.sp.); STÅL 1873: 4 (synonymy)
Coleotichus sordidus WALKER 1867: 1 (n.sp.); DISTANT 1899: 50 (as junior synonym of *Coleotichus fuscus*); CHINA 1930: 91 (Samoa); SMITH 1978: 821 (defense); MCDONALD & CASSIS 1984: 542 (synonymy)
Coleotichus discrepans WALKER 1867: 2 (n.sp.); MCDONALD 1961: 179, figs 24-28 (male genitalia); MCDONALD 1963a: 179, figs 24-28 (male genitalia); MCDONALD 1963b: 223, figs 15-16 (female genitalia); MCDONALD & CASSIS 1984: 542 (synonymy)
Coleotichus nigrovarius WALKER 1867: 2 (n.sp.); MCDONALD & CASSIS 1984: 542 (synonymy)
Coleotichus testaceus WALKER 1867: 2 (n.sp.); STÅL 1873: 4 (synonymy)

Diagnosis: *Coleotichus artensis* is recognised by the following combination of characters: AIV longest antennal segment; callosite region of pronotum with four prominent black spots; labium reaching apex of metasternum; female abdominal SVII narrow caudally, ventral margin deeply concave; males without abdominal sternal glands; posterior margin of male pygophore excavate; CAII symmetrical, tripartite; CAII fused post-thecal margin; vesica elongate; and, proximal sclerotization of spermathecal fecundation canal.

Description: Body elongate-ovoid (Fig. 3c); moderately sized, males 12.8-14.7 mm, females 12.6-14.7 mm.

Colouration. Body stramineous-brown to dark-brown, sometimes with mottled appearance, punctures dark-brown to black, sometimes with green iridescence (Fig. 3c). Head: stramineous-brown, sometimes darker with clypeal margins fuscous, reaching posterior margin of vertex, posterior margin of head rarely transversely fuscous; anterior margin of pronotum sometimes dark brown to fuscous; pronotal calli with prominent dark brown to fuscous spots; anterolateral angles of scutellum with black spot; scutellum often mottled, sometimes with medial darker brown oblique fasciae; thoracic pleura and abdominal sterna yellow-brown to dark-brown; deep punctures of proepisternal keel sometimes with green iridescence; abdominal spiracular-trichobothrial region contrastingly dark-brown; appendages concolorous, pale to dark brown.

Texture. Dorsum with dense distribution of deep punctures, less so on head, more so on scutellum and pronotal disc, irregularly distributed; thoracic pleura with deep punctures submarginally on propleuron and mesopleuron.

Vestiture. Dorsum near glabrous. Antennae: AI-AII(a) almost glabrous, AII(b)-AIV densely pilose, with short simple semi-erect setae. Legs: ventral margins of tibiae

densely pilose.Underside of body with scattered short simple setae; lateral margins of abdominal sterna more densely pilose.

Structure. Antennae: AI(a) little longer than AII(b), AIV longest segment. Labium: reaching apex of metasternum. Thoracic Pleura: external efferent system of metathoracic glands extensive, peritreme elongate, strongly recurved towards head. Abdominal Venter: SIII with medial anteriorly projecting processes; posterior angles of SIV-SVII acute, particularly SVII; female abdominal SVII narrow caudally, posterior margin deeply concave; males without abdominal sternal glands. Male Genitalia: posterior margin of male pygophore excavate, with medial setose patches; parameres with flange at base of crown; phallotheca with pair of subdistal thorn-like processes; ejaculatory reservoir heavily sclerotized; ductus seminis distalis basally incrassate; CAI absent; CAII symmetrical, tripartite mostly membraneous, CAII(L) with large, elongate sickle-shaped lobal sclerite, CAII(M) with small, bifid lobal sclerite, paired ventral CAII process with laterally oriented bill-shaped lobal sclerites; CAIII strongly sclerotised, medially fused, with apices arcuate, laterally directed, vesica elongate, extending beyond conjunctival appendages. Female Terminalia: paratergites VIII moderately sized, subtriangular, posterior margin arcuate, medially separated; paratergites moderately sized, subtriangular, medial margins truncate; gonocoxae I subtriangular. Spermatheca: proximal fecundation canal short, base sclerotized; bulb oval, heavily sclerotized.

Measurements. McDonald & Cassis 1984: Table 1.

Type material examined: *Coleotichus artensis* Montrouzier: Holotype, ♀, 'B.M. Hem. 365', 'New Caled', '59-63'; *Coleotichus discrepans* Walker: Holotype, ♀, 'B.M. Hem Type No. 366', 'Moreton Bay' (BMNH); *Coleotichus nigrovarius* Walker: Holotype, ♀, 'B.M. Hem Type No. 367', 'Fiji Isles, Ovalau', '56-69', '585' (BMNH); *Coleotichus sordidus* Walker: Holotype, 1♀, 'B.M. Hem Type No. 368', 'I of Pines' (BMNH); *Coleotichus testaceus* Walker: Lectotype, ♀, 'New Caled', 'B.M. Hem. Type No. 365', '*Coleotichus testaceus* Walker's catal.', '59-63' (BMNH; here designated); Paralectotype, ♀, 'Moreton Bay', 'artensis Montr.' (BMNH; here designated). Walker (1867) described *C. testaceus* from two specimens; the original description listing them as: 'a. New Caledonia. 'From Mr Macgillvray's collection' and 'b. Moreton Bay. From Mr Diggles' collection'. The lectotype and paralectotype specimens designated here, bear labels with these localities respectively.

Other material examined: **Queensland**: 1♀, Kuranda, 5 December 1988, R Bejsak (AM); 1♀, Cairns, Crystal Cascades, 1 February 1989, J & M Bugeja (AM); 1♀, Kuranda Range, State Forest, 10 January 1967, DK McAlpine & G Holloway (AM); 1♀, Bluewater Range, 16-v-1990, T Woodger (AM); 1♂, 14 km ENE Heathlands, 11.41S 142.42E, 21 October 1993, P Zborowski & DCF Rentz, at light, rainforest (ANIC); 2♀♀, Shiptons Flat, 15.47S 145.14E, 17 October 1980, T Weir (ANIC); 1♀, 9 km SSW Kuranda, 16.54S 145.37E, 25-26 November 1992, A Calder & P Zborowski, at light (ANIC); 1♀, 2 km N Kuranda, 16.48S 145.38E, 20 November 1981 (ANIC); 1♀, FP Dodd, 1907-54, 'det. as *Coleotichus discrepans*' (BMNH); 1♀, Redlynch, 21-30-viii-1938, RG Wind, 'det. as *Coleotichus discrepans*' (BMNH); **New South Wales**: 4♂♂ 1♀, 3 to 5 km NE of Harrington, G Williams, January 1989 & 1991, ex *Alphitonia excelsa*, littoral rainforest (AM); FIJI: 1♂, Cuvie, '1920-82', ii-1918, R Veitch, 'det. as *Coleotichus nigrovarius*' (BMNH); TONGA: 'Distant Coll. 1911-383', 'det. as *Coleotichus nigrovarius* Walk.' (BMNH); VANUATU: 6♂♂ 6♀♀, Aneityum, 3 mi. NE Anelgauhat, Red Crest, 200 ft, iii-1955, LE Cheesman, B.M. 1955217 (BMNH).

Distribution: *Coleotichus artensis* is broadly distributed in the tropical regions of the Australian zoogeographic region; known from Australia, Indonesia, Papua New Guinea, Fiji, New Caledonia, Samoa and Vanuatu (Cassis & Gross 2002). Within Australia, it was known previously from the tropical parts of the Northern Territory and Queensland. In this work, we greatly extend its range to the south, with new collections from the mid-north coast of New South Wales (near Harrington) (Fig. 6). There is also a significant distributional gap between the populations of the wet tropics and subtropical regions of Queensland.

Host plants and biology: *Coleotichus artensis* was collected from the flowers of the littoral rainforest tree, *Alphitonia excelsa* (Rhamnaceae), during two separate collection events. This represents the first recorded plant association for this jewel bug species, but doubt remains as to whether this is its food plant or breeding host.

Remarks: McDonald & Cassis (1984) redescribed *C. artensis* and gave a detailed synonymy. It exhibits variability in colour, ranging from matt light brown to polished dark brown, otherwise it is homogeneous, particularly in the male genitalia. We recently re-examined all the types, aside from *C. marginatus*, and found that a wider examination of extralimital specimens of this species is required to confirm the identity of this species and the above-mentioned synonymy. As the types are all females, doubts of the validity of the given species synonymy prevail, as the male genitalia remain the chief criterion for distinguishing species. The holotype of *C. sordidus*, which was described from a New Caledonian specimen (Isle of Pines), is possibly deserving of species resurrection, as it is pale brown without patterned spotting, the pronotal humeral angles are more rounded, and the posterolateral angles of the abdominal venter are not pronounced, as in the other types. However, we have refrained from removing the latter from synonymy pending a generic revision of *Coleotichus*, and found that its pale colouration is consistent with individuals found in Australian populations that we observed.

Coleotichus artensis most resembles *C. costatus* in colour and size, although the mean lengths of both sexes of *C. artensis* are smaller and the maximal width of males is a little larger. The male genitalia of *C. artensis* are discrete with the CAII tripartite; a character state which does not occur in all other species of *Coleotichus* investigated. Like other species of *Coleotichus*, the male genitalia of *C. artensis* exhibit little intraspecific variation. Its closest relationships may lie with extralimital species such as *C. biroi*, which it resembles on the basis of external characters and size. The female genitalia of *C. artensis* and *C. costatus* are alike, with the proximal sclerotization of the fecundation canal, a feature not found in *C. excellens*.

Coleotichus costatus (Fabricius 1787) (Figs 3d, 6, 7, 8)

Cimex costatus Fabricius 1787: 282 (n.sp.); Donovan 1805: pl. 3 fig. 5 (habitus); Germar 1839: 74 (list)
Tetyra costatus: Fabricius 1803: 135 (new combination)
Coleotichus costatus: White 1842: 88 (new combination); Walker 1867: 1 (list); Walker 1868: 505 (list); Stål 1873: 4 (list); Lethierry & Severin 1893: 15 (catalogue); Schouteden 1904: 6 (list); Kirkaldy 1909: 313 (catalogue; as junior synonym of *Coleotichus unicolor*) Distant 1920: 143 (New Caledonia); Kumar 1965: 46 (male genitalia); Gross 1975: 81 (description); van den Berg 1980: 223-225 (biology; host plant); McDonald & Cassis 1984: 9 (redescription; synonymy; male genitalia: Figs 3-7, 9; female genitalia: Figs 7 & 8); Cassis & Gross 2002: 584 (catalogue)
Eurygaster costatus: Vollenhoven 1863: 39 (new combination)
Coleotichus unicolor Dallas 1851: 5 (n.sp.); Schouteden 1904: 6 (synonymy)
Coleotichus pallidus Vollenhoven 1863: 4 (n.sp.); Schouteden 1904: 6 (synonymy)

Diagnosis: *Coleotichus costatus* is recognised by the following combination of characters: AIII and AIV subequal, longest antennal segments; callosite region of pronotum with pair of small submedial black spots (Fig. 3d); labium reaching anterior margin of metacoxae; female abdominal SVII broad caudally, ventral margin shallowly concave; males with abdominal sternal glands on SIV-VI (Figs 2a-c); posterior margin of pygophore arcuate; CAII asymmetrical (Figs 8c, d); CAII fused post-thecal margin (Figs 8c, d); vesica elongate (Figs 8c, d); and, basal sclerotisation of spermathecal fecundation canal.

Description: Body elongate-ovoid (Fig. 3d); moderately large, males 12.6-15.5 mm, females 13.4-17.2 mm.

Colouration. Body yellow-brown to orange-brown, sometimes with dusty appearance, often with darker brown patterning on scutellum (Fig. 3d), sometimes with red highlighting, jugal margins, anterolateral margins of pronotum and embolium most often contrastingly paler yellow. Head: uniformly yellow-brown, punctures either fuscous or with green iridescence; underside of head yellow; antennae, AI yellow, AII-AIV yellow-brown to orange-brown; labium yellow to yellow-brown distally, with stylets black. Pronotum: pale red fasciae submarginal to anterolateral margins; callosite region sometimes with pair of small submedial spots. Hemelytra: exocorium and base of clavus with dark punctures, often with green

iridescence, exocorium sometimes with pale red longitudinal fascia. Scutellum: posterolateral margins with fuscous punctures, often with green iridescence. Legs: uniformly yellow-brown to orange-brown. Thoracic pleura and abdominal sterna: uniformly yellow-brown, often with red spotting.

Texture. Body densely punctate, punctures shallow; mostly evenly distributed, linearly arranged on head, absent from callosite region and anterolateral margins of Pronotum.

Vestiture. Dorsum glabrous; underside of body almost glabrous, with scattered distribution of short, simple setae on abdominal venter, more so caudally. Antennae: AI-AII near glabrous; AIII-AIV with moderate distribution of short simple semierect setae. Legs: sparse distribution of simple short semierect setae.

Structure. Antennae: AIII and AIV subequal, longest antennal segments. Labium: reaching anterior margin of metacoxae. Abdominal Venter: males with sternal glands on abdominal SIV-VI (Figs 2a-c). Male Genitalia: pygophore lozenge shape (Figs 7e, f, 8a); ventral margin of pygophore arcuate (Fig. 7e); parameres with strongly hooked crown, with flange at base of crown (Fig. 8b); CAI absent (Fig. 8c); paired CAII asymmetrical (Fig. 8c, d), greatly enlarged, mostly membraneous, distally bifurcate, right CAII(L) with enlarged, sickle-shaped lobal sclerite, right CAII(M) with blunt bifid lobal sclerite, left CAII(L) with moderately-sized, arcuate lobal sclerite, left CAII(M) bifid with short subdistal acute lobal sclerite and small apical serrate lobal sclerite; CAIII small (Fig. 8c, d), flange-shaped, fused, heavily sclerotized, vesica extending beyond conjunctival appendages. Female Venter: posterior margin of SVII bisinuate, medially thickened. Female Terminalia: paratergites VIII large, medial margins broadly contiguous. Spermatheca: fecundation canal short, proximally incrassate and heavily sclerotized; and, spermathecal bulb oval, heavily sclerotized.

Measurements. McDonald & Cassis 1984: Table 1.

Type material examined: *Coleotichus unicolor* Dallas: Holotype, ♂, 'North Coast of New Holland' [label data as 'New Holl'], 'B.M. Hem. Type No. 364', '*unicolor* Dallas' (BMNH).

Other material examined: **Queensland**: 2♀♀, 146 km NW Quilpie. 25:858S 143.399E, 230m, G Cassis, RT Schuh & R Silveira, 3 November 1998, ex *Acacia stowardii* Maiden, Site 98-20 (AM); 3♂♂ 2♀♀, 73.7 km E Betoola, 25.591S 141.399E, 180m, G Cassis, RT Schuh & R Silveira, 3 November 1998, at light. (AM); **New South Wales**: 1♂, Kinchega National Park, G Cassis, 28 April 1995, ex grass (AM); 1♀, Kinchega National Park, Cawndilla Campground, 32°33'S 142°12'E, 100m, G Cassis & RT Schuh, 28 October 1995, Site 95-34, at light. (AM); 2♂♂ 4♀♀, Moppin-Aveymore Road, 28°53'26"S 149°51'30"E, 400 m S of junction at Dolgelly Bore, R Harris & T Moulds, ex *Acacia pendula* (AM); 15 km NE by N Moree, 29°20'S 149°56'E, 21 April 1981 (ANIC); **Australian Capital Territory**: 52 specimens, Griffith, 17 February 1969, TG Campbell & CJ Shepherd, (ANIC); **Southern Australia**: 1♀, Cadelga Homestead, 26.089S 140.410E, 150m, G Cassis, RT Schuh & Silveira, 4 November 1998, Site 98-24, at light (AM); 2♂♂ 2♀♀, Mt Serle district (near Gammon Ranges National Park), 30°33'15"S 138°50'13"E, 567 m, 8 November 2001, RT Schuh, G Cassis, & M Schwartz, ex *Acacia victoriae* (AM); **Western Australia**: 1♂, NW Coastal Highway, 36km N Kalbarri Road, 27.616°S 114.683°E, 500m, G Cassis & RT Schuh, 28 October 1996, Site 96-38, at light (AM); 1♀, 20 km S of Menzies, G Cassis & RT Schuh, 28 October 1996 (AM); 3♂♂ 6♀♀, Moorine Rocks, 11.7 km N Great Eastern Highway on Noongar Rd, 31.228°S 118.986°E, 345 m, RT Schuh, G Cassis, H Brailovsky & A Asquith, 4 December 1997, ex *Acacia saligna* (Labill.) H.L. Wendl, Site 97-01 (AM); 21♂♂ 33♀♀, 55.6 km SE Southern Cross, 31.589°S 119.592°E, 470m, RT Schuh, G Cassis, H Brailovsky & A Asquith, 4 December 1997, ex *Acacia consanguinea* R.S. Cowan & Maslin, Site 97-03 (AM); 1♀, Pilbara District, Shay Gap Rd, 15.1 km NE Muccan Homestead, 20.222S 120.149E, 130m, G Cassis & R Silveira, 27 May 1999, at light. (AM); 1♀, adjacent to N boundary of Lake Shaster Nature Reserve, 33.833°S 120.916°E, 40m, RT Schuh, G Cassis & R Silveira, 27 November 1999, ex *Lambertia inermis*, Site 99-42 (AM); 2 larvae, Rossiter Bay, Cape Le Grande National Park, 3 m, 33°58.0345'S 122°16.0457'E, 23 November 1999, RT Schuh, G Cassis & R Silveira, Site SWA99-29, ex *Acacia cyclops* (AM); 1♀, Walsh Point, 14.34 125.51E, 17 May 1983, I Naumann & JC Cardale (ANIC); 5 specimens, Red Bluff, 28 November 1971, N McFarland, ex green pods of *Acacia* sp. (ANIC); 3 specimens, Mt Magnet, 6 December 1978, K&E Carnaby

(ANIC); 2 specimens, 1 km W Jimberiana Hill, Norseman, 32°09'S 121°48'E, 11 January 1993, ED Edwards & ES Nielsen (ANIC).

Distribution: *Coleotichus costatus* occurs in arid and semi-arid regions of Australia, primarily in temperate Australia (Fig. 6). It is also known from tropical Australia, including the Pilbara district of Western Australia and the wet tropics of Queensland. McDonald & Cassis (1984) record it from the Northern Territory, although no precise localities are currently known. It has also been recorded from New Caledonia and Tonga (Cassis & Gross 2002).

Host plant records and biology: *Coleotichus costatus* is known to feed on seven species of *Acacia* (*consanguinea*, *cyclops*, *ligulata*, *pendula*, *saligna*, *stowardii* and *victoriae*; Table 1) in Australia, primarily in semi-arid and arid regions. It can be abundant when the seed set of *Acacia* species is high (e.g. Southern Cross locality). It appears to be opportunistic and probably feeds on additional *Acacia* species, depending on seed availability. Whitney & Stanton (2004) report that C. *costatus* primarily feeds on *Acacia ligulata* in the Kinchega National Park in western New South Wales, but occasionally feeds on the seeds or fruits of *Dodonaea viscosa* (Whitney pers. comm.). The *Lambertia inermis* plant association (Table 1) is probably a sitting record. As with other species of jewel bugs, Gross (1975) reports that C. *costatus* can be found on the ground, but only occasionally on vegetation. Our observations do not support this contention, with C. *costatus* commonly encountered feeding on pre-dispersed seeds, upon plants.

Remarks: Schouteden (1904) established the synonymy for *Coleotichus costatus*, which has been supported by all subsequent authors. Gross (1975) redescribed this species including a habitus illustration. McDonald & Cassis (1984), also redescribed C. *costatus*, documenting the male and female genitalia for the first time. Cassis & Gross (2002) gave a comprehensive synonymy for the species.

Coleotichus costatus is best defined by the distinctive aedeagus, with the CAII asymmetrical (Figs 8c, d). This condition appears to be unique in the Scutelleridae, and even more generally within the Heteroptera. None-the-less the affinities of C. *costatus* are more with C. *artensis*, which possess fused CAIII (cf. C. *excellens*; paired, segregated CAIII). In addition, the two former species are similar externally, with the body smaller, the ventral margin of the pygophore emarginate, and the base of the spermathecal fecundation canal heavily sclerotized.

Coleotichus excellens (Walker 1867) (Figs 3e, 6)

Coleotichus excellens Walker 1867: 3 (n. sp.); Lethierry & Severin 1893: 15 (catalogue); Distant 1899: 30 (Australia, Samoa); Hutton 1904: 332 (erroneous New Zealand record); Schouteden 1904: 6 (list); Schouteden 1905: 328 (description); Bergroth 1908: 139 (description); Kirkaldy 1909: 313 (catalogue); McDonald & Cassis 1984: 540, Figs 11-15 (description; female genitalia); Cassis & Gross 2002: 585 (catalogue)

Coleotichus borealis Distant 1899: 31 (n.sp.) **New Synonymy**

Coleotichus handlirschi Schouteden 1905: 332 (n. sp.); McDonald & Cassis 1984: 540 (synonymy)

Coleotichus (*Epicoloeotichus*) *schultzei* Taeuber 1929: 221 (n.sp.) **New Synonymy**

Diagnosis: *Coleotichus excellens* is recognised by the following characters: AIII and AIV subequal, longest antennal segments; labium reaching abdominal sterna IV, LII-IV subequal in length, longest segments; callosite region of pronotum with pair of small submedial black spots; scutellum with antero-sublateral orange calli; scutellum often with six small black spots; female abdominal SVII broad caudally, ventral margin shallowly concave; posterior margin of male pygophore convex; males without abdominal sternal glands; CAII symmetrical, bipartite; CAII separated; and, vesica short.

Description: Body elongate-ovoid, tapered towards terminalia; large species, males 17.67-21.50 mm, females 18.17-21.83 mm;

Colouration. Body uniformly yellow-brown (Fig. 3e), with yellow midline, often with green or purple iridescent punctures. Head: punctures of jugal margins strongly iridescent green. Pronotum: callosite region with pair of submedial black spots. Scutellum with pair of antero-sublateral black spots, and medial black spot.

Texture. Dorsum uniformly punctate; with moderately deep punctures; anterolateral margins of pronotum broadly impunctate; anterolateral calli of scutellum smooth; ventral aspect of jugae and antennifers deeply punctate; thoracic pleura moderately punctate.

Vestiture. Dorsum glabrous. Antennae: AI-AII(a,b) near glabrous, AIII-AIV with moderate distribution of short setae. Legs: femora with sparse distribution of short setae; tibiae with moderate distribution of short setae, more so on ventral surface. Abdominal Venter: scattered short simple semierect setae, more so on terminalia.

Structure. Antennae: AI and AII(a), and AIII and AIV subequal in length. Labium: elongate, reaching abdominal SIII, LII-IV roughly subequal in length. Pregenital Abdomen: SIII medially sulcate, contiguous with thoracic sternal keel. Male Genitalia: ventral margin of pygophore arcuate; genital opening broad; parameres with hooked crown, tip blunt, with flange at base of crown; CAI absent; CAII symmetrical, mostly membraneous, bifid, CAI(L) and CA(M) with acute lobal sclerites; CAIII, heavily sclerotized, S-shaped, segregated. Female Terminalia: ventrally oriented, coplanar; paratergites VIII large, posterior margin arcuate, medially contiguous; paratergites IX large, subelliptoid, medial margins arcuate; gonocoxae I large, subtriangular, posterior margin weakly convex. Spermatheca: fecundation canal elongate; spermathecal reservoir large, oval; bulb round, moderately sclerotized.

Measurements. McDonald & Cassis 1984: Table 1.

Type material examined: *Coleotichus excellens* Walker: Lectotype, ♀, '124', '56-69', 'B.M. Hem. No. 369', '*Coleotichus excellens* Walker (type)' (BMNH; here designated); Paralectotypes, 1♀: '56-69', '*Coleotichus excellens* Walker's catal.', '*Coleotichus excellens*: Det. J. Cassis' (BMNH; here designated); 1♀, '55-69', '127', '*Coleotichus excellens* Walker's catal.' (BMNH; here designated). Walker (1867) listed three specimens in his original description, as follows: 'a,b. ___ ? From Mr Macgillvray's collection' and c.___ ? Presented by Sir John Liddell'. Neither the original description, nor the label data indicate a type locality. All the specimens are females, and the specimen labeled as '*Coleotichus excellens* Walker (type)' and 'B.M. Hem. Type No. 369" is designated as the lectotype; the other two specimens as paralectotypes; *Coleotichus borealis* Distant: Holotype, ♀, 'Formosa', '*Coleotichus borealis* Dist. (type)', 'B.M. Hem. Type No. 370' (BMNH); Paratype: ♂, same data as holotype, '*Coleotichus borealis* Dist.' (BMNH); *Coleotichus schultzei* Taeuber: Holotype, ♂, 'Surigao', 'Minando', '13351', 'Taeuber Coll. 1949-474' 'Holotype *Coleotichus* (*Epicoleotichus*) *schultzei* Taeuber 1929', 'B.M. Hem. Type No. 602' (BMNH; genitalia dissected, in microvial).

Other material examined: **Queensland**: 1♂, Black River, 20 km N Townsville, 14-i-1990, T Woodger, at light (AM); 1♂, Gap Creek, 15°51'S 145°20'E, 29 May 1994, P Zborowski, ex light, rainforest (ANIC); 1♂, 1 km E Mt Cook, 13°30'S 145°16'E, 13 October 1980, T Weir (ANIC); 4♂♂, Warraber Island, 10°12'S 142°49'E, March 1978 (ANIC); 1♂, Mt Webb National Park, 15°04'S 145°07'E, 27-30 April 1981, A Calder (ANIC); 2♀♀, 12 km SE Daintree, 16°19'S 145°24'E, 22 November 1981, J Balderson (ANIC); 1♀, 32 km N by W of Isabella Creek, 15°18'S 145°00'E, 230 m, 22 May 1975, IFB Common & ED Edwards (ANIC); 1♀, Mackay, AJ Turner, 1905-125 (BMNH; identified as *Coleotichus borealis*; **Northern Territory**: 1♀, Smith Point, Cobourg Peninsula, 11°07'S 132°08'E, 3-21 February 1972, RC Lewis, ex watertrap (ANIC); 1♂ 1♀, 1 km N Cahills Crossing, E Alligator River, 12°25'S 132°58'E, 31 October 1972, M Upton & Barrett (ANIC); **New Caledonia**: Province Sud, 1 km S Poya, 21°21'19.4"S 165°10'8.1E, 61 m, 27 April 2005, G Cassis, MA Wall, N Tatarnic & GB Monteith, ex *Ficus* sp. (AM); **Papua New Guinea**: 1♂, Port Moresby, Broko, Cent[ral Dist[trict], 15-iii-1959, ex *Hibiscus rosasinesis*, JJH Szent-Ivany (BMNH); 1♂, Port Moresby, 26 February 1969, R Lossin (AM); 1♀, Amazon Bay area, Doveta, 2400 ft, 24.vii-11.ix, 1962, WW Brandt (ANIC); 1♂, Kokoda, 1,200 ft, ix-1933, LE Cheesman, B.M. 1934-321' (BMNH); 2♂♂, Madew, St Joseph's River, 2000-3000 ft, W Stalker, 1909-22 (BMNH); **Solomon Islands**: 1♀, Malaita, Auki Harbour, 24-xii-1965, Roy. Soc. Exped. Brit. Mus. 1966-1', '169', '*Coleotichus excellens* Walker's catal.' (BMNH; identified as *Coleotichus handlirschi*); 4♀♀, Guadalcanal, PJM Greenslade, xii-1964, 3-I-1965, 8-I-1965 (BMNH); **Fiji**: 3♀♀, Rotuma Is., 17-27-iv-1971, GS Robinson, B.M. 1972-46 (BMNH); 1♀, Suva, 20-I-1030, B.M. 1948-548 (BMNH); **Philippines**: 2♂♂ 2♀♀, Balabae, Dalwan Bay, Noona Dan Exp. 61-62, 18-30 to 23-30, [1962], ex mercury light (BMNH; identified as *Coleotichus borealis*); 1♀, C.S. Banks 1908-228, Acc. No. 6377, Bu. of Sci., P.I. (BMNH; identified as *Coleotichus borealis*);

Indonesia: 1♂, [Irian Jaya], Waigeu Camp Nok, N Dutch New Guinea, 2,500 ft, LE Cheesman, B.M. 1938-593 (BMNH).

Distribution: *Coleotichus excellens* is broadly distributed in the Australian zoogeographic region, extending to the northeast of Australia (Solomon Islands, New Caledonia, Fiji, and Samoa), and to the Oriental region, including the Philippines and Taiwan. We provide the first record of this species from Indonesia, Papua New Guinea and Fiji. Within Australia, its found primarily in the tropical regions of the Northern Territory and Queensland, extending in the latter as far south as Rockhampton (Fig. 6). CASSIS & GROSS (2002) reported this species from New Zealand, in an erroneous reference to HUTTON (1904). LARIVIÈRE & LAROCHELLE (2004) did not mention it in their New Zealand catalogue.

Host plants and biology: There are no host plants recorded in the literature for *Coleotichus excellens*. We recently collected a large series from an undetermined *Ficus* species in New Caledonia, at a roadside reststop, where there were few shrubs or trees. We also record specimen from New Guinea (see above) which was collected on an ornamental *Hibiscus*.

Remarks: New synonymy for this species is proposed, with *Coleotichus borealis* DISTANT and *Coleotichus schultzei*, established as junior synonyms. The external features of the holotypes are identical to those of the holotype of *C. excellens*. The male genitalia of the holotype of *C. schultzei*, and a paratype of *C. borealis* were examined, and are consistent with those found in *C. excellens*.

MCDONALD & CASSIS (1984) gave the most recent redescription of *Coleotichus excellens*, including the description and illustration of the male and female genitalia. It is distinct from the other Australian species of *Coleotichus*, and can be distinguished from them by the larger body, dorsal markings, elongate labium (with modified abdominal SIII housing), and the segregated CAIII. Its affinities are unknown, as it differs from other *Coleotichus* species in that the ventral conjunctival appendages are not fused. This species approaches the Hawaiian species, *Coleotichus blackburniae*, in size, however, the male genitalia of this species have not been examined. A dissected male specimen of *C. bulowi* in the BMNH, which is similar in colouration and size to *C. blackburniae*, and its aedeagus is very similar to that of *C. excellens* (CAII bifurcate, branches near symmetrical, with conical lobal sclerites).

Solenotichus MARTIN 1897 (Figs 3b, 6, 9, 10)

Solenotichus MARTIN 1897: 264 (nov. gen.); DISTANT 1899: 31 (description); KIRKALDY 1904: 280 (note); SCHOUTEDEN 1904: 7 (description); GROSS 1975: 86 (description); MCDONALD & CASSIS 1984: 545 (description); CASSIS & GROSS 2002: 585 (catalogue)

Damelia DISTANT 1899: 31 (gen. nov.; junior homonym of *Damelia* CLARK 1864 [Coleoptera]

Damellera KIRKALDY 1904: 280 (nom. nov. for *Damelia* DISTANT 1899); KIRKALDY 1909: 313 (synonymy)

Type species: *Solenotichus*: *Solenotichus brevipes* MARTIN 1897, monotypy; *Damelia*: *Sphaerocoris circuliferus* WALKER 1867, monotypy

Diagnosis: *Solenotichus* is recognised by the following combination of characters: body ovoid (Fig. 3b); dorsum strongly convex; posterior margin of pronotum arcuate (Fig. 3b); metathoracic peritreme narrow, moderately elongate, medially sulcate, strongly raised distally (Fig. 9d); male abdominal sternal glands submedially on SIV-SVII; ventral conducting canal of ejaculatory apparatus almost straight (Figs 10c, d); ejaculatory reservoir small, circular (Fig. 10c); CAI absent; CAII bifurcate, with triangular lobal sclerites; CAIII sclerotized, separate, apices laterally recurved (Figs 10c, d); vesica elongate, arcuate (Figs 10c, d); spermathecal fecundation canal short; and, spermathecal reservoir oval, wrinkled.

Description: Body small to moderately sized; ovoid (Fig. 3a); dorsum strongly convex; moderately convex ventrally; orange to orange-brown, with patterned markings; dorsum moderately to heavily punctate, less so ventrally. Head: subhemispherical, strongly transverse (Fig. 9a); moderately deflexed (Fig. 9b); lateral margins of jugae convex, subcarinate (Fig. 9b). Pronotum: transverse, subtrapezoidal, strongly convex (Fig. 3b); anterior margin concave; anterolateral margins strongly divergent, weakly convex, rounded in profile; posterolateral margins weakly convex; posterior margin

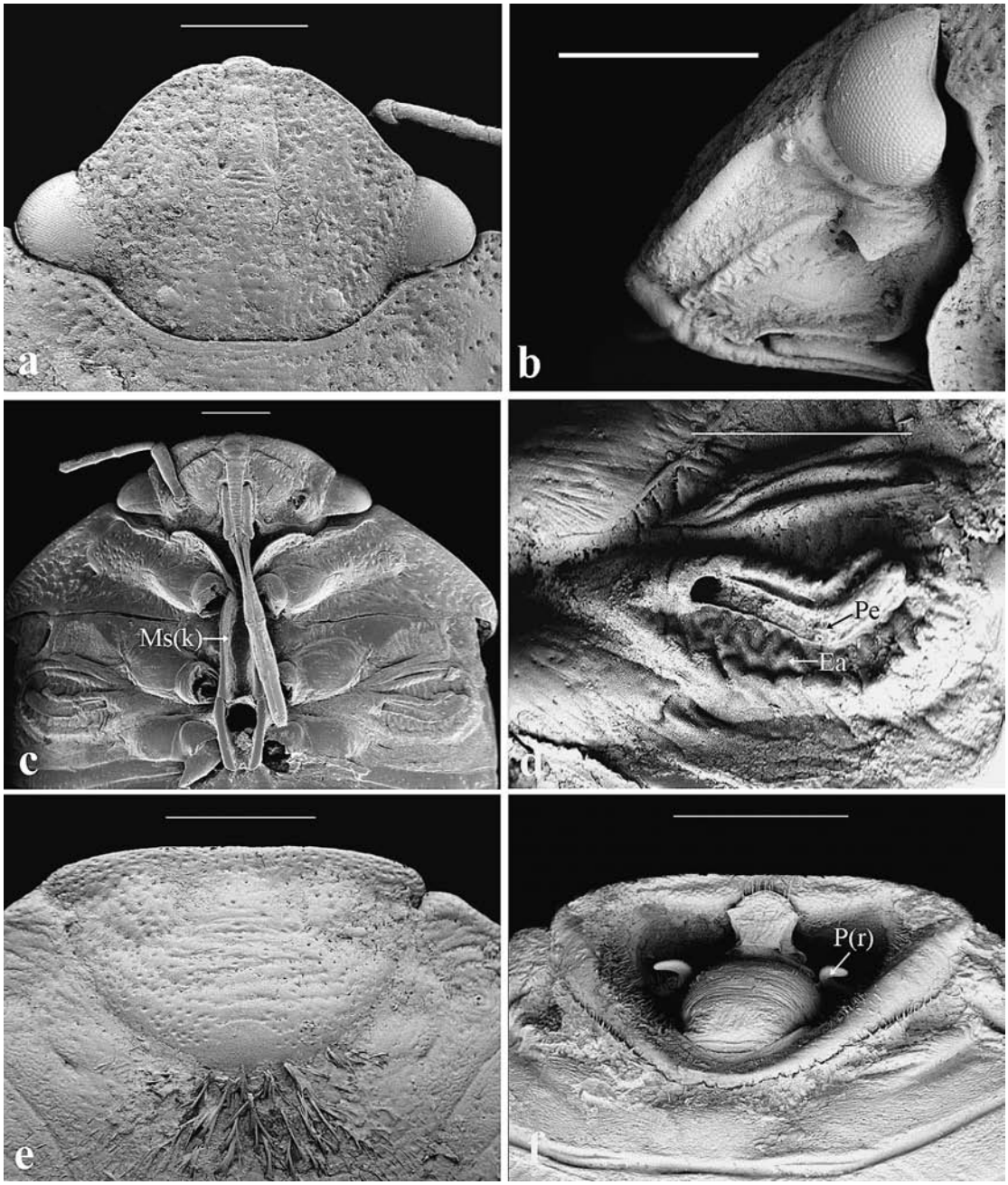


Fig. 9: Scanning electron micrographs of key characters of *Solenotichus circuliferus* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Abbreviations: Ea = evaporative area; Ms(k) = mesosternal keel; Pe = peritreme; P(r) = right paramere. Scale bars = 1 mm.

arcuate. Scutellum: broad, covering most of forewings and abdomen, U-shaped, strongly convex (Fig. 3b); heavily punctate; anterior region raised, posteriorly strongly declivent. Thoracic sterna: moderately elevated, thickened keels, not overlapping (Fig. 9c); anterior margin of proepisternum explanate (Fig. 9c). Thoracic pleura: external efferent system of metathoracic glands well-developed (Fig. 9c, d); ostiole large; peritreme moderately elongate, narrow, medially sulcate, strongly raised distally; evaporative areas extending beyond peritreme and reaching mesepimeron (Figs 9c,d). Pregenital Abdomen: abdominal sternal glands on SIV-SVII, unpaired on SVII. Male Genitalia: ventral margin of pygophore truncate (Fig. 9e); genital opening large, transverse, moderately pilose laterally (Figs 9f, 10a); parameres, large, stem broad, crown with large hook, apex blunt (Fig. 10b); aedeagus, ejaculatory apparatus relatively simple and moderately short; ventral conducting canal almost straight (Figs 10c, d); ejaculatory reservoir small, circular (Fig. 10c); ductus seminis distalis without basal tumescence; CAI absent; CAII symmetrical, mostly membraneous, distally bifid, CAII(L) and CAII(M) subequal in size and shape, both with large triangular, lobal sclerites (Figs

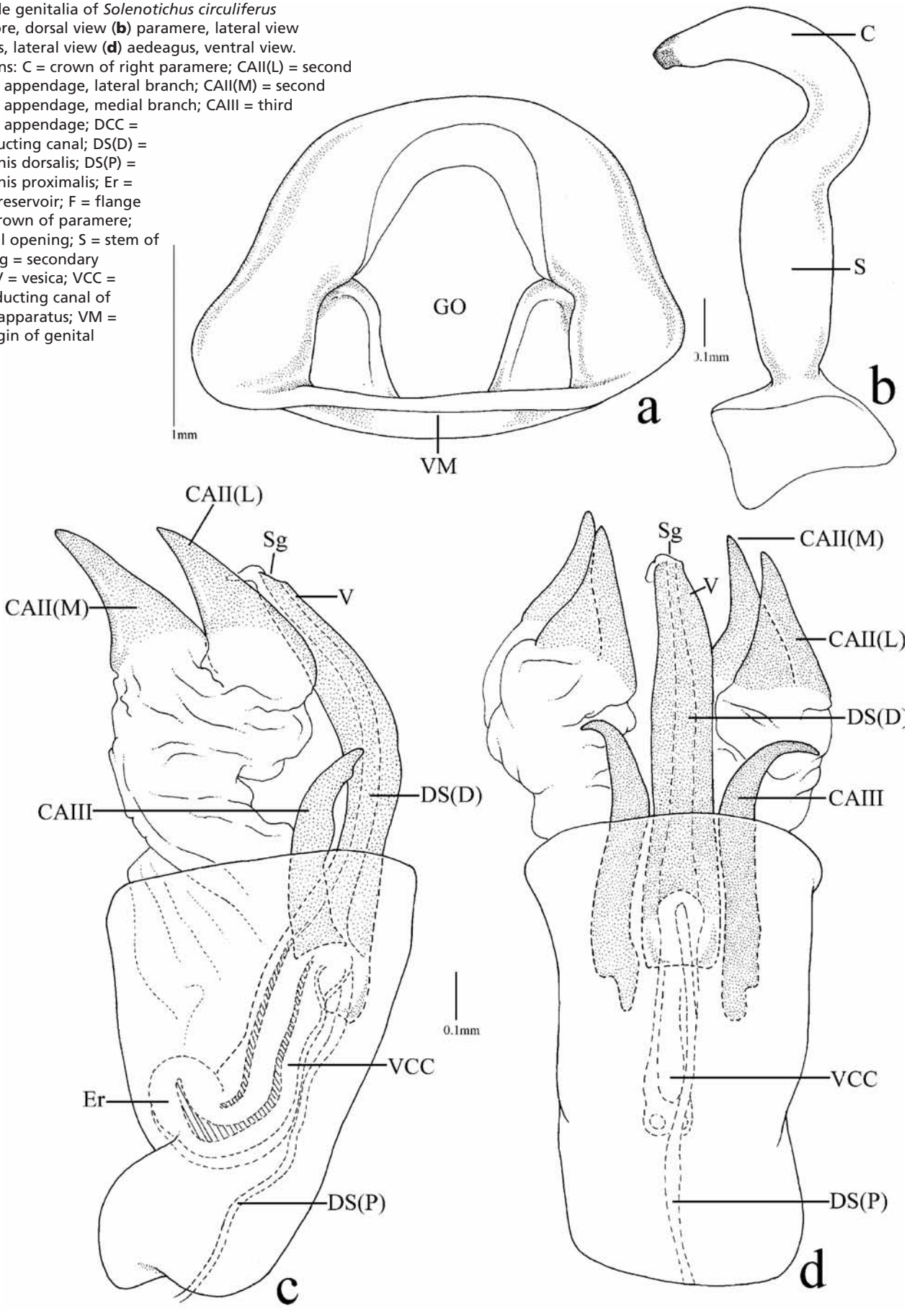


Fig. 10: Male genitalia of *Solenotichus circuliferus* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) aedeagus, ventral view. Abbreviations: C = crown of right paramere; CAII(L) = second conjunctival appendage, lateral branch; CAII(M) = second conjunctival appendage, medial branch; CAIII = third conjunctival appendage; DCC = dorsal conducting canal; DS(D) = ductus seminis dorsalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; F = flange at base of crown of paramere; GO = genital opening; S = stem of paramere; Sg = secondary gonopore; V = vesica; VCC = ventral conducting canal of ejaculatory apparatus; VM = ventral margin of genital opening.

10c, d); CAIII prominent, segregated, heavily sclerotized, arcuate, apices laterally recurved (Figs 10c, d); vesica elongate, recurved (Figs 10c, d). Female Terminalia: paratergites VIII subtriangular, medially tapered; paratergites IX large, subtriangular, medial margins rounded; gonocoxae I large, subrectangular, posterior margin concave. Spermatheca: proximal fecundation canal short; spermathecal reservoir oval, with wrinkled texture; distal fecundation canal, with proximal flange only; bulb oval, moderately sclerotised.

Diversity and distribution: *Solenotichus* is a monotypic genus, endemic to Australia.

Included species:

S. circuliferus (WALKER 1867) Australia

Remarks: *Solenotichus* is a distinctive genus of Elvisurinae, due to its oval and highly convex body, elongate and arcuate vesica, separated CAIII, simple ejaculatory apparatus (without convoluted ventral conducting canal) (Figs 10c, d), and moderately elongate, raised metathoracic peritreme (Figs 9c, d). The separate CAIII of *Solenotichus* also occur in *Coleotichus excellens*, but differ significantly in shape (arcuate versus S-shaped). On this character system alone, the monophyly of *Coleotichus* is brought into question, however the truncate posterior margin of the pronotum, and other aspects of the male aedeagus, indicate other possible affinities. In summary, the sister-taxon relationship of *Solenotichus* is not established on the basis of the characters examined.

GROSS (1975) and MCDONALD & CASSIS (1984) redescribed the type species, and confirmed its synonymy, but did not comment on its relationships. CASSIS & GROSS (2002) provided a comprehensive synonymy for the genus.

Solenotichus circuliferus (WALKER 1867) (Figs 3b, 6, 9, 10)

Sphaerocoris circuliferus WALKER 1867: 7 (n.sp.)
Solenotichus brevipes MARTIN 1897: 264 (n.sp.); MCDONALD & CASSIS 1984: 545, Figs 24-29 (synonymy; male and female genitalia)
Damelia circuliferus: DISTANT 1899: 32 (new combination)
Solenotichus circuliferus: SCHOUTEDEN 1904: 7 (new combination); BERGROTH 1908: 139 (description); KIRKALDY 1909: 313 (catalogue); GROSS 1975: 86 (description); CASSIS & GROSS 2002: 586 (catalogue)

Diagnosis: *Solenotichus circuliferus* is recognised by the following combination of characters: body mostly orange-brown, with brown markings mediolaterally on scutellum (Fig. 3b); endocorium dark; AI-AIII subequal in length; LI and LIV subequal, LII longest segment; male and female genitalia as in generic description (Figs 10a-d).

Description: Body ovoid; moderately-sized species, males 9.3-10.7 mm, females 8.7-11.8 mm.

Colouration. Body yellow-brown to red-brown, often with lateral pair of arcuate darker markings at half length of scutellum, sometimes with yellow tinge anterior to dark markings; punctures often red; appendages concolorous with body, sometimes with tibiae more red; exocorium sometimes darker at base, endocorium mostly fuscous.

Texture. Body with dense distribution of shallow punctures.

Vestiture. Body almost glabrous; appendages sparsely setose.

Structure. Antennae: segments roughly subequal in length, AIII and AIV a little longer than previous segments. Labium: reaching apices of metacoxae, LII longest segment; and, male (Figs 10a-d) and female genitalia as in generic description.

Measurements: MCDONALD & CASSIS 1984: Table 2.

Type material examined: Lectotype, ♂, Australia, '58-124', 'B.M. Hem. Type No. 372' (BMNH; here designated); Paralectotype, ♂, same data as lectotype (BMNH; here designated). WALKER (1867) described from two male specimens, presumably from the same locality (given as 'Australia' in original description and label data).
Other material examined: **Queensland**: 1♂, Bluff Range, via Biggenden, 1000 m, 16 August 1974, H Frauca (ANIC); 1♂, Bluff Range, via Biggenden, 16 December 1971, H Frauca (ANIC); 1 ♀, Coast Range, via Boompa, 18 April 1977, H Frauca (ANIC); **Southern Australia**: 1 ♀, 51 km NW of Morgan, 33.835S, 140.800E, 150m, G Cassis, RT Schuh & G Gross, 1 November, 1995, Site L95-44, at light (AM); **Northern Territory**: 2♂♂ 2 ♀ ♀, Alice Springs, 5 September 1992, R Patterson, at light (ANIC).

Distribution: *Solenotichus circuliferus* is broadly distributed across Australia, including Queensland, New South Wales, Victoria, South Australia and the Northern Territory (Fig. 6). It is known as far north as Rockhampton in Queensland and Alice Springs in central Australia.

Host plants and biology: This species is relatively rare in collections and its biology remains unknown. Based on specimen locality data, CASSIS & GROSS (2002) recorded it from the Desert Gum, *Eucalyptus gongylocarpa* (Myrtaceae). There is no evidence whether this record is a food-preference, overwintering site or sitting record.

Remarks: GROSS (1975) and MCDONALD & CASSIS (1984) redescribed *Solenotichus circuliferus*, with the latter authors documenting the male and female genitalia. A female from Western Australia has not been included in this work. This specimen is significantly larger than all other specimens of *S. circuliferus*, but the other morphological attributes are consistent with the definition of the species.

Subfamily Odontotarsinae

Scutelleroides, Odontoscelidae DALLAS 1851: 54 (new family)
Pentatomidae, Scutellerina, Odontotarsaria STÅL 1872: 32 (new suprageneric taxon)
Pentatomidae, Scutellerinae, Odontotarsaria: SCHOUTEDEN 1904: 32 (synonymy of Eurygastraria 1872 STÅL and Odontoscelaria STÅL 1872)
Pentatomidae, Scutellerinae, Odontotarsini: KIRKALDY 1909: 263 (catalogue)
Pentatomidae, Scutellerinae, Eurygastrini, Odontotarsaria + Odontoscelaria: LESTON 1952d: 13 (new suprageneric classification)
Pentatomidae, Odontoscelinae: MCDONALD 1966: 67, 68 (new suprageneric classification)
Scutellerinae, Odontotarsinae: MCDONALD & CASSIS 1984: 547 (Australia)

Diagnosis: The Odontotarsinae are recognised by the following combination characters: small (e.g., Figs 11a-c) to moderately-sized species; ovoid (e.g., Figs 11a-c), elongate-ovoid or elongate, rarely strongly tapered at terminalia; body strongly punctate; often with setigerous punctures, and sometimes with sericeous setae (Figs 13a-i), rarely with body extremely setose with elongate setae; mostly grey-brown to dark brown species (e.g., Figs 11a-c), sometimes stramineous, and at times with paler stripes or spots, sometimes mottled, rarely black, occasionally with patterning on scutellum (e.g., Fig. 11a-c); larvae dull in colouration; pro- and mesothoracic sterna flat to weakly elevated, never keel-like, metasternum mostly flat, rarely a little raised; anterior margin of proepisternum weakly to moderately explanate; pronotum often subtrapezoidal, with anterolateral margins explanate, and anterior angles spinose, sometimes more rounded, with lateral margins evenly arcuate, rarely, with a medial notch, with anterior angles anteriorly projected, in front of posterior margin of eyes; external efferent system of metathoracic glands often greatly reduced, without peritreme, with prominent rounded ostiole, laterally oriented, evaporative areas often greatly reduced to absent, sometimes external efferent system more well developed, with short oval peritreme, elevated, bounded by moderate distribution of evaporative areas, also occurring on mesepimeron; sometimes males abdominal androconial glands present (e.g., Figs 2a-c, 12e); pregenital abdomen without stridulatory vittae; ventral surface of pygophore caudally (e.g., Fig. 12e) or ventrally oriented; parameres hook-shaped, often weakly (e.g., Fig. 14b); ejaculatory apparatus weakly to moderately-developed, usually without prominent ventral conducting canal (not convoluted), ejaculatory reservoir usually small and oval (e.g., Fig. 14c); CAI present or absent (e.g., Fig. 14c); CAII unbranched or bifurcate (e.g., Figs 14c, d), either sclerotized or membraneous with lobal sclerites; CAIII medially contiguous (Fig. 11d); spermathecal fecundation canal short; and, spermathecal reservoir oval to weakly dilated.

Remarks: STÅL (1872) described the Odontotarsinae (as Odontotarsaria) a tribe of the scutellerids, and redefined another tribe, as the Odontoscelaria, for a group of genera mostly from the Eastern Hemisphere. He separated these taxa primarily on the shape of the head (elongate versus semi-oval), the lateral margins of the pronotum, and degree of carination of the metathoracic sterna. SCHOUTEDEN (1904) synonymised these two taxa and the Eurygastraria sensu STÅL, and recognised the Odontotarsaria as the valid name, even though the Eurygastri-

dae DALLAS and Odontoscelidae DALLAS have priority. He recognised the tribe on the basis of absence characters, such as the absence of stridulatory vittae on the pregenital abdomen, the lack of a keel-like carination on the thoracic sterna, as well as characters of general application, such as the biconvex body. KIRKALDY (1909) followed SCHOUTEDEN (1904), and grouped the three abovementioned suprageneric taxa within the single tribe, and included the same taxa within it. LESTON (1952d) reverted to the Stålian classification in part, by distinguishing these three groups as subtribes, within the tribe Eurygastrini. He hypothesised that these taxa were clearly differentiated from both his Scutellerini and Pachycorini on the basis of the male genitalia, suggesting that the Scutellerini-type was distinctive, and more derived from the pentatomid-type, the latter being more characteristic of pachycorines and eurygastrines.

Modern Australian workers (e.g., GROSS 1975; MCDONALD & CASSIS 1984) have rejected this approach, mainly based on MCDONALD's (1966) work on North American taxa, who regarded the eurygastrines as distinct from odontotarsines. SCHUH & SLATER (1995) also separated these two taxa, on the basis of the less broad scutellum (and more exposed abdominal connexiva) and reduced hindwing intervannal vein in eurygastrines. We have not evaluated either of these characters, and uncritically support the separation of the taxa. It is noteworthy that many odontotarsines and pachycorines have a reduced metathoracic peritreme, or it is absent entirely, with a distinct, laterally oriented ostiole, however these taxa are separated on the absence of stridulatory vittae in odontotarsines.

The monophyly of the Odontotarsinae, however, is contentious, and we know of no character that defines them exclusively. The above diagnosis is polythetic in format and the group is retained largely as a 'convenience' group. There are putative infra-subfamilial clades which are worthy of examination. A group of genera related to *Odontoscelis*, including those taxa with male setose sternal glands (Table 3), and sometimes have rounded lateral margins of the Pronotum. This is largely a Palearctic group, but potentially includes the Australian genus *Morbora* (see below for discussion). Another putative clade, is represented by a group including and potentially related to *Odontotarsus* (e.g, *Phimodera*, *Xerobia*), which lack the male sternal glands, and sometimes have excavate anterolateral margins of the Pronotum. These ideas are reminiscent of STÅL'S Odontotarsaria and Odontoscelaria, and require explicit character testing. We retain the use of the Odontotarsinae in the broad sense in this work, acknowledging the above limitations.

Morbora DISTANT 1899 (Figs 2d, e, 11, 12, 13, 14, Table 5)

Morbora DISTANT 1899: 47 (gen. nov.); DISTANT 1899: 47 (description); BERGROTH 1904: 355 (note); SCHOUTEDEN 1904: 86 (description); KIRKALDY 1909: 265 (catalogue); GROSS 1975: 88 (description); MCDONALD & CASSIS 1984: 538, 547 (key; revision); CASSIS & GROSS 2002: 586 (catalogue)

Type species: *Morbora australis* DISTANT 1899 monotypy

Diagnosis: *Morbora* is recognised by the following characters: body oval; head semicircular, with dentate margins (Figs 11a-c, 12a); body with fanlike (Figs 13c, h, i) or clove-like (Figs 13a, b, f) setae intermixed with curly sericeous setae; pronotal, corial and connexival margins dentate (Fig. 11); male androconial glands present on abdominal sterna IV-VI (Figs 2d, e); ejaculatory reservoir small, oval (Figs 14c, d); ventral conducting canal straight; CAI membraneous, medially fused (Figs 14c, d); CAII strongly sclerotized, U-shaped (Figs 14c, d); CAIII present or absent (Figs 14c, d); vesica, elongate, arcuate or S-shaped (Figs 14c, d); female gonocoxae I tripartite; interlocking rami absent; spermathecal fecundation canal short; spermathecal reservoir elliptoid; and spermathecal bulb bilobed.

Description: Body oval; small species, males 4.51-5.37 mm, females 4.41-5.88 mm; dorsum moderately convex; cryptozoic colouring, yellow-brown to dark brown, with patterned darker markings; dorsum with elongate clove-shaped (Figs 13a, b, f) to fanlike setae (Figs 13c, h, i), intermixed with curly sericeous setae (Figs 13a, e, h); densely punctate. Head: semicircular, strongly deflexed (Figs 12a, b); lateral mar-

Table 5: *Morbora australis*, *M. hirtula*, and *M. schoutedeni*: diagnostic measurements in millimetres. N = sample size.

	Male			Female		
	N	**Mean±SD**	**Range**	**N**	**Mean±SD**	**Range**
M. australis						
Length	1	5.37	-	4	5.40±0.22	5.27-5.73
Pronotal width	1	4.41	-	4	4.17±0.21	3.85-4.29
Width between eyes	1	1.59	-	4	1.66±0.13	1.54-1.84
Antennal segment length						
I	2	0.64	0.61-0.67	7	0.60±0.03	0.54-0.63
II	2	0.30	0.29-0.30	8	0.33±0.02	0.30-0.36
III	2	0.22	-	8	0.23±0.02	0.22-0.26
IV	2	0.35	-	7	0.32±0.02	0.28-0.35
V	2	0.62	0.62-0.63	7	0.56±0.03	0.50-0.59
Rostral segment length						
I	1	0.62	-	2	0.59	0.57-0.61
II	1	0.51	-	3	0.45	0.39-0.54
III	1	0.45	-	2	0.45	0.42-0.48
IV	1	0.34	-	2	0.33	-
Morbora hirtula						
Length	3	5.06	4.97-5.12	2	4.90	4.41-5.39
Pronotal width	3	3.64	3.58-3.72	2	3.55	3.31-3.80
Width between eyes	3	1.53	1.47-1.57	2	1.58	1.54-1.62
Antennal segment length						
I	5	0.58±0.04	0.53-0.63	3	0.61	0.61-0.62
II(a)	5	0.33±0.03	0.30-0.36	2	0.36	0.35-0.36
II(b)	4	0.23±0.02	0.21-0.25	2	0.22	0.22-0.23
III	3	0.40	0.35-0.42	2	0.42	0.41-0.42
IV	5	0.65±0.03	0.62-0.70	2	0.64	0.63-0.65
Labial segment length						
I	1	0.82	-	1	0.85	-
II	1	0.97	-	1	0.91	-
III	1	0.36	-	1	0.42	-
IV	2	0.37	0.36-0.38	1	0.45	-
Morbora schoutedeni						
Length	2	4.74	4.51-4.97	5	5.47±0.34	5.00-5.88
Pronotal width	2	3.79	3.65-3.92	5	4.41±0.28	4.17-4.85
Width between eyes	2	1.40	1.35-1.45	5	1.70±0.09	1.59-1.84
Antennal segment length						
I	4	0.54±0.02	0.51-0.57	9	0.68±0.06	0.61-0.76
II(a)	4	0.25±0.03	0.22-0.28	9	0.28±0.03	0.23-0.33
II(b)	4	0.23±0.01	0.23-0.24	10	0.22±0.01	0.21-0.24
III	4	0.29±0.02	0.27-0.31	10	0.32±0.04	0.24-0.39
IV	4	0.49±0.03	0.46-0.52	9	0.55±0.04	0.46-0.61
Labial segment length						
I	2	0.77	0.75-0.79	3	0.75	0.73-0.79
II	2	0.77	0.76-0.79	2	0.79	0.73-0.85
III	2	0.36	-	2	0.41	0.36-0.46
IV	2	0.38	0.36-0.39	1	0.43	-

gins of jugae explanate, strongly denticulate, surpassing apex of clypeus (Figs 12a, b); bucculae moderately tumescent, medial margins subparallel (Fig. 12c); eyes small (Figs 12a-c); antennae: AI elongate, either longest subequal or subequal to AIV; labium: reaching metasternum; either LI or LII longest segment, LIII & LIV small, either subequal or LIII longest. Pronotum: subtrapezoidal, moderately convex in profile (Figs 11a-c); anterior margin excavate; with broad, explanate paranotal lobes, lateral margins convex, explanate, denticulate, anterolateral angles anteriorly produced, extending beyond posterior margins of eyes (Figs 11a-c, 12a-c); posterior margins rounded to truncate (Figs 11a-c). Scutellum: broad, U-shaped to subhemispherical (Figs 11a-c), strongly convex in profile; dentate corial and abdominal connexival margins visible (Figs 11a-c). Thoracic sterna: prosternal margins and anterior margin of proepisternum jointly raised, moderately explanate (Fig. 12c). Thoracic pleura: external efferent system of metathoracic glands moderately developed (Fig. 12c, d); ostiole small; evaporative area of metathoracic gland extending onto posterior portion of mesopleuron and beyond peritreme; peritreme short, tongue-like, raised, and wrinkled (Figs 12c, d). Pregenital abdomen: broad, strongly convex; lateral margins spinose; male abdominal SIV-VI with paired, suboval regions of androconial glands (Figs 2d-f). Male Genitalia: ventral surface of pygophore terminal in orientation (Fig. 12e), ventral margin entire (Fig. 14a); genital opening small to moderately sized (Figs 12f, 14a); parameres short, crown small, hook-like, tip blunt (Fig. 14b); aedeagus broad; phallotheca conical, without processes, weakly sclerotized (Figs 14c, d); ductus seminis proximalis thin, membraneous (Figs 14c, d); ejaculatory apparatus simple (Figs 14c, d), with single, straight, ventral conducting canal, without convolutions; ejaculatory reservoir short, suboval; dorsal conducting canal simple, not expanded; vesica broad, elongate, weakly S-shaped (Figs 14c, d); CAI large, membraneous, medially fused, distally divided, without sclerotization (Figs 14c, d); CAII large, strongly sclerotized, U-shaped, with subdistal spur (Figs 14c, d); CAIII membraneous, medially fused, distally free, without sclerotization (Figs 14c, d). Female Terminalia: female paratergites IX S-shaped; female gonocoxae I divided, tripartite; interlocking rami absent. Spermatheca: fecundation canal short; spermathecal reservoir weakly dilated, simple; and spermathecal bulb bilobed, with proximal and distal flanges.

Diversity and distribution: *Morbora* is endemic to continental Australia, comprised presently of three species.

Included species:	
M. *australis* DISTANT 1899	Australia
M. *hirtula* BERGROTH 1904	Australia
M. *schoutedeni* BERGROTH 1904	Australia

Remarks: DISTANT (1899) first described *Morbora*, with SCHOUTEDEN (1904) and GROSS (1975) providing subsequent redescriptions. MCDONALD & CASSIS (1984) redescribed the species, without providing any additional observations for the genus or comments on its relationships.

GROSS (1975) placed *Morbora* in the Odontotarsinae, on the basis of observations by Fred McDonald of the male genitalia, the latter worker suggesting that they resembled members of the Odontotarsinae. Our observations confirm these findings, and have found further evidence that *Morbora* is nested within the odontotarsines. As stated above, *Morbora* has male abdominal androconial glands, in common with some Palearctic odontotarsinae taxa (Table 3). Moreover, we have found that some species of *Psacasta* (e.g., *P. exanthematica* SCOPOLI) have the first gonocoxae divided (bipartite), which is a putative homology to the tripartite GXI condition found in all the species of *Morbora*.

Morbora australis DISTANT 1899 (Figs 11a, 13a-c, 15, Table 5)

Morbora australis DISTANT 1899: 47 (n.sp.); SCHOUTEDEN 1904a: 87, pl. 5 fig. 10 (list; habitus); GROSS 1975: 90, fig. 21 (description; habitus); MCDONALD & CASSIS 1984: 548 (description; genitalia); CASSIS & GROSS 2002: 586 (catalogue; localities); MOIR et al. 2003: 353 (Western Australian record)

Diagnosis: *Morbora australis* is recognised by the following combination of characters: scutellum with clove-shaped and short fan-shaped setae (Figs 13a-c); AI longest segment; exocorium not expanded (Fig. 11a); CAI branched, lobe-like; CAII elongate, sickle-shaped; and, CAIII absent.

Description: Body small, males 5.37 mm, females 5.27-5.73.

Colouration. Dorsum yellowish-brown to dark brown, with contrasting markings, broad W-shaped yellow marking on posterior 1/2 of scutellum (Fig. 11a).

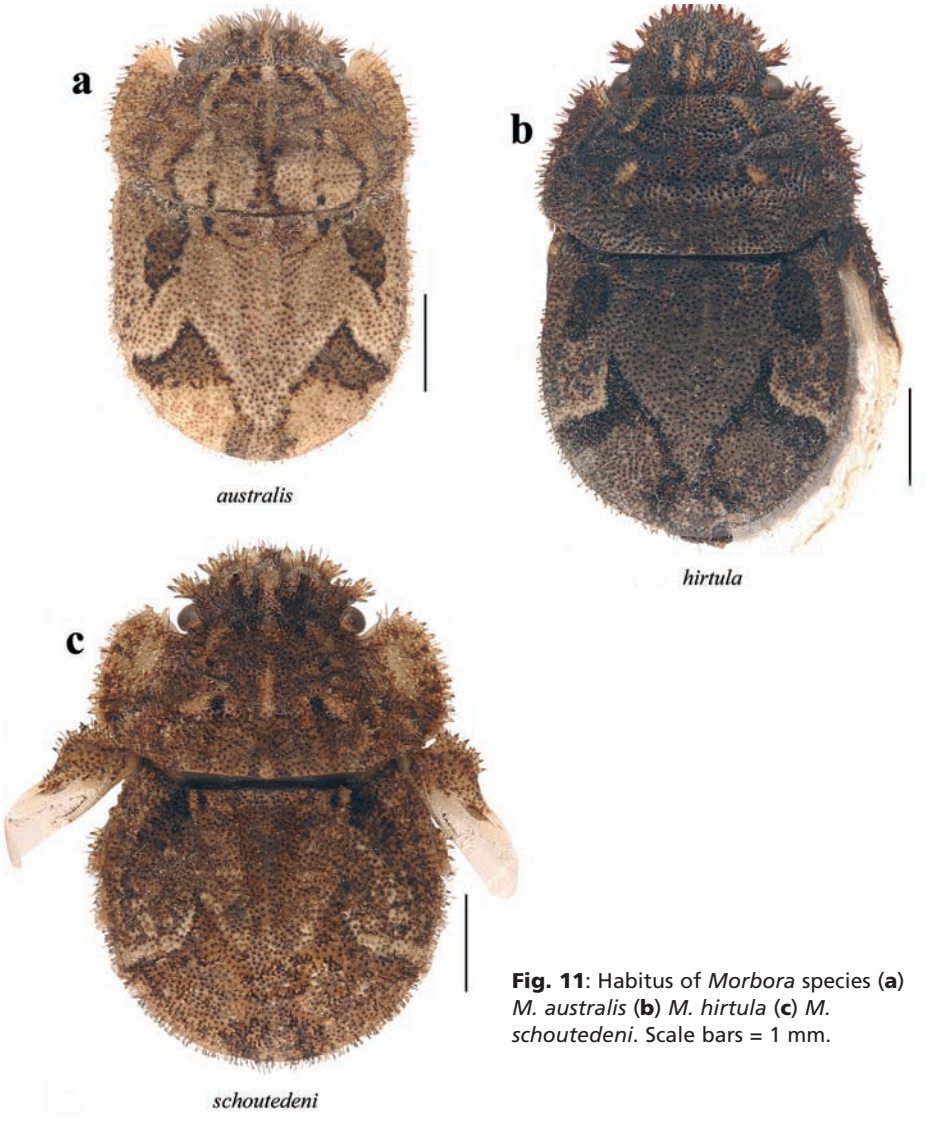


Fig. 11: Habitus of *Morbora* species (**a**) *M. australis* (**b**) *M. hirtula* (**c**) *M. schoutedeni*. Scale bars = 1 mm.

Vestiture. Head and pronotum with dense distribution of erect, elongate, clove-shaped setigerous punctures, intermixed with curly sericeous setae (Figs 13a-c); scutellum with dense distribution of short, fan-shaped setae, relatively narrow distally.

Structure. Antennae: AI longest segment, little longer than AIV. Labium: LI longest segment, LII & LIII roughly subequal, LIV shortest segment. Pronotum: lateral margins moderately expanded; anterolateral angles not surpassing anterior margin of eyes. Hemelytra: costal margins not greatly expanded laterally. Male Genitalia: CAI branched, membraneous, lobe-like, without sclerotization; CAII elongate, sickle-shaped, heavily sclerotized; CAIII absent; vesica heavily sclerotized, distally tapered.

Measurements. Table 5.

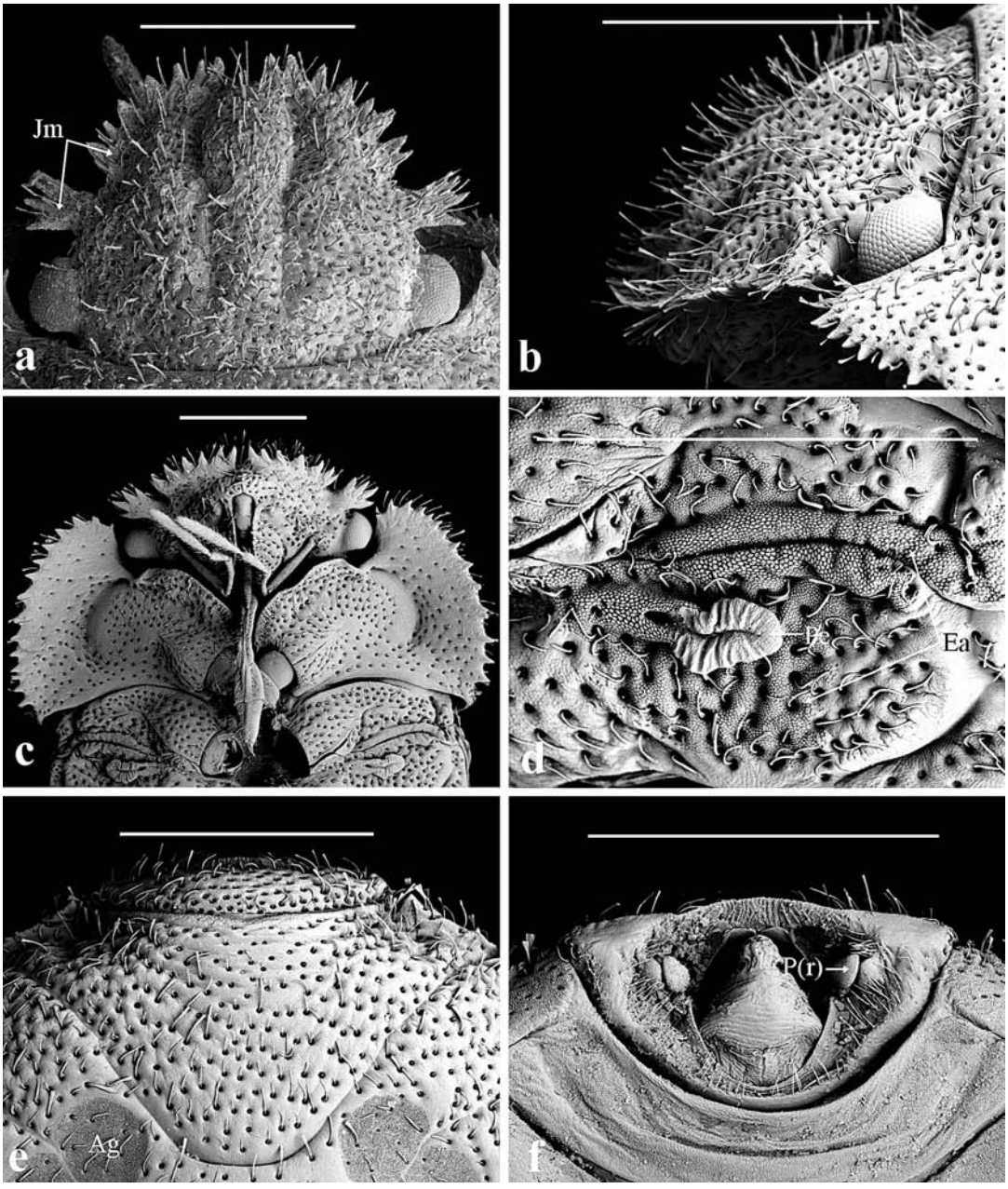


Fig. 12: Scanning electron micrographs of key characters of *Morbora australis* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Abbreviations: Ag = androconial glands; Ea = evaporative areas; Pe = peritreme; P(r) = right paramere. Scale bars = 1 mm.

Type material examined: Holotype, 1♂, Peak Downs, B.M. Hem. Type No. 613, '*Morbora australis* DIST type', 'Dist. Coll. 1911-383' (BMNH). Material examined: **Queensland**: 3♀♀, Walkers Creek campsite, 17°28'S 141°10'E, 28 July 1995, J Thompson, FN 997 (AM); 1♀, Carnarvon Range, March 1944, N Geary (AM); 1♂ 1♀, Clermont, viii-1929 KK Spence (AM); 1♀, Bluff Range, near Biggenden, 21-iii-1975, H Frauca (ANIC); 1♀, Luster Creek, 8 km W by N Mt Molloy, 21-22 May 1980, ID Naumann (ANIC); **New South Wales**: 1♂ 1♀, Bundjalong National Park, 32°24'S 152°32'E, G Cassis, 15 November 1993, ex beach wash (AM); 2♀♀, 30°04'41"S 148°56'53"E, I Oliver, February 2001, DLWC WALCOL00286 and WALCOL00498 (AM); 1♀, Road Reserve, 30°11'42"S 148°54'54"E, I Oliver, February 2001, DLWC WALCOL00149 (AM); 2♀♀, Yelta, 30°27'14"S 148°41'42"E, I Oliver, February 2001, DLWC WALCOL00025 and WALCOL00065, ex pitfall trap (AM); 1♀, Wentworth, May 1965, MJ Coulson (ANIC); **Australian Capital Territory**: 1♀, Black Mountain, 35°16'S 149°06'E, 600 m, March 1987, TA Weir, JF Lawrence & W Dressler, ex flight intercept trap (ANIC); **Southern Australia**: 1♀, Maree-Lyndhurst Road, J Upton, 15-ix-1972 (ANIC); **Western Australia**: 1♀, Kimberley District, Emma Gorge Resort, 4.5 km N Gibb River Road, 15°54'40"S 128°07'29"E, 4-13 June 1999, MR Gray, G Milledge & H Smith, pitfall trap, ex savanah woodland FN 14481 (AM).

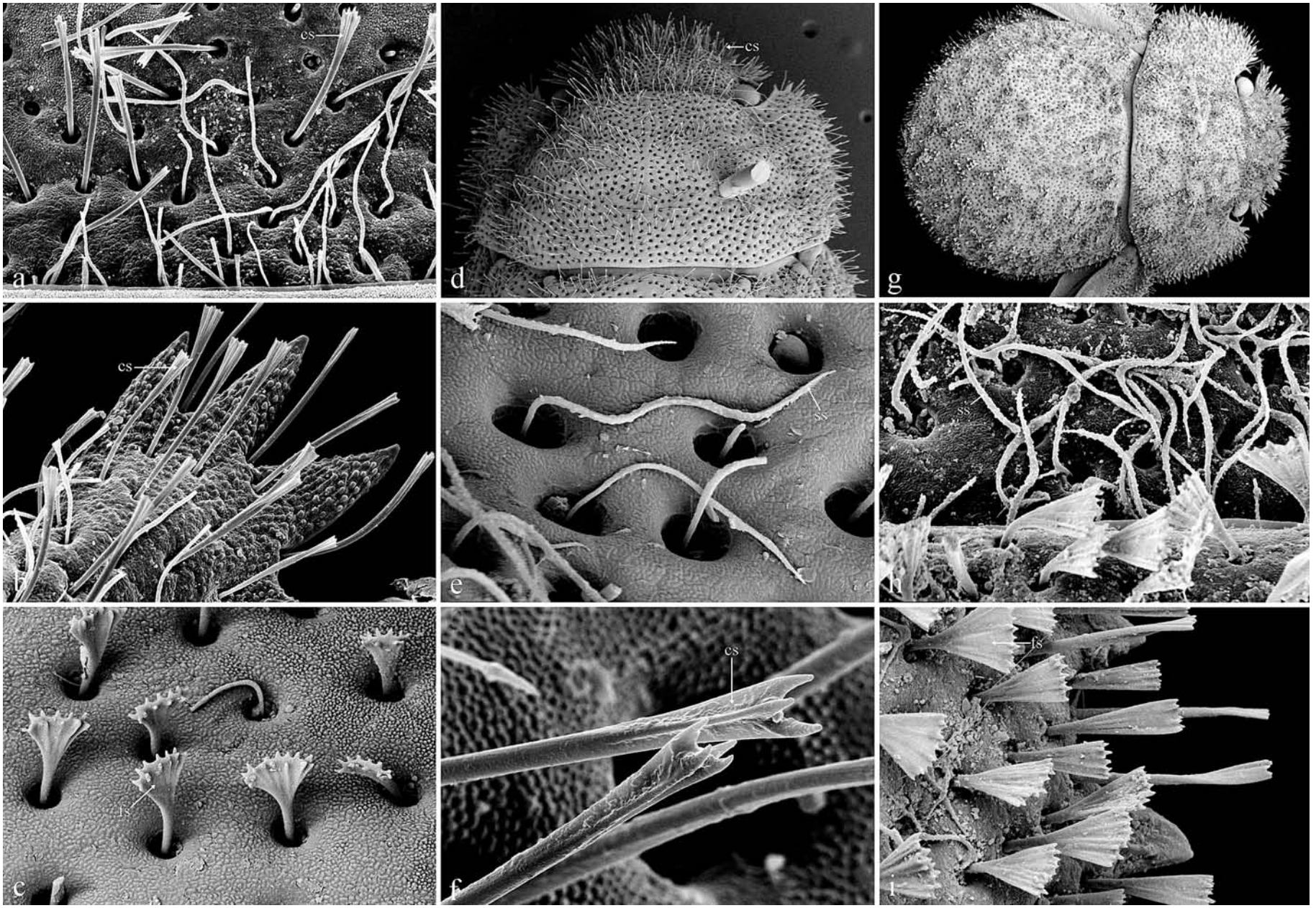


Fig. 13: Scanning electron micrographs of vestiture of *Morbora* species (**a-c**) *Morbora australis* (**a**) sericeous and clove-shaped setae on pronotum (**b**) clove-shaped setae on lateral projections of pronotum (**c**) short fan-like setae on scutellum (**d-f**) *Morbora hirtula* (**d**) head and pronotum with sericeous and clove-shaped setae (**e**) sericeous setae on pronotum (**f**) clove-shaped setae on scutellum (**g-i**) *Morbora schoutedeni* (**g**) dorsum with sericeous and fan-like setae (**h**) fan-like and sericeous setae on head and pronotum (**i**) broad fan-like setae on scutellum**.** Abbreviations: cs = clove-shaped setae; fs = fan-shaped setae.

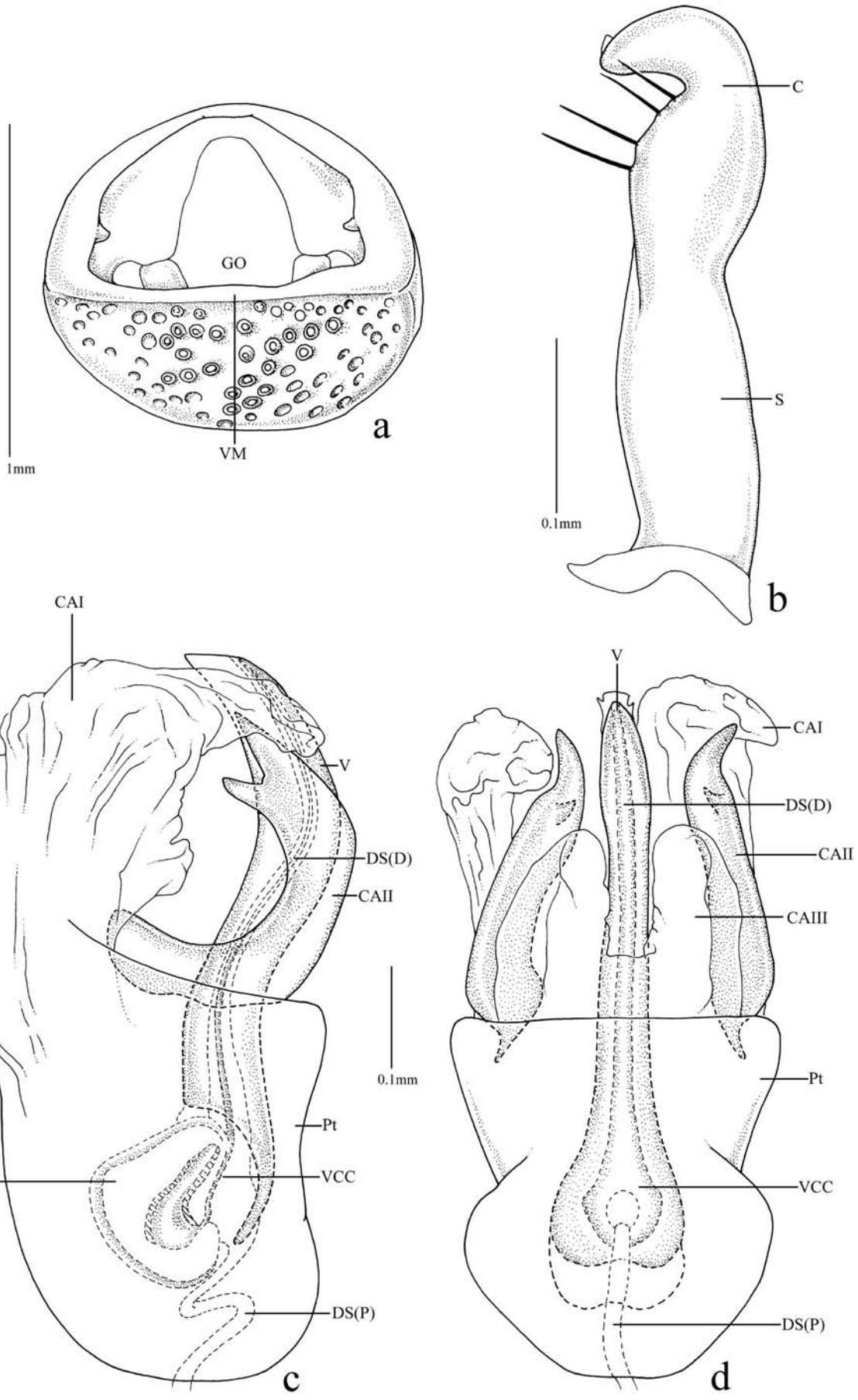


Fig. 14: Male genitalia of *Morbora schoutedeni* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) aedeagus, ventral view. Abbreviations: C = crown of right paramere; CAI = first conjunctival appendage; CAII = second conjunctival appendage; CAIII = third conjunctival appendage; DS(D) = ductus seminis dorsalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; GO = genital opening; Pt = phallotheca; S = stem of paramere; V = vesica; VCC = ventral conducting canal of ejaculatory apparatus; VM = ventral margin of genital opening.

Distribution: *Morbora australis* is widely distributed in Australia, mostly from arid or semi-arid habitats. It is presently recorded from Queensland, New South Wales, Australian Capital Territory, South Australia, Victoria, Western Australia and the Northern Territory (Fig. 15). MOIR et al. (2003) reported this species from Western Australia. The Kimberley district record reported in this work confirms the western distribution of M. *australis*.

Host plant records and habitats: *Morbora australis* has been collected primarily in pitfall traps or flight intercept traps, suggesting it is epigaeic in its habits. The specimens collected at Bundjalong National Park (NSW) were collected on beach wash, after a violent thunderstorm at sea. Nothing is known of its food-preferences.

Remarks: DISTANT (1899) first described this species from Peak Downs in southeast Queensland. GROSS (1975) redescribed it from a range of collections across eastern Australia, and South Australian and the Northern Territory. He distinguished it from M. *hirtula*, on the basis of its paler colouration (and contrasting dorsal colour patterning) and different vestiture (cf. Figs 13a-i). MCDONALD & CASSIS (1984) redescribed this species, and provided the first description (and illustration) of the male and female genitalia. They found that the aedeagus has only two conjunctival appendages (CAIII absent), which conclusively differentiates it from M. *hirtula*. CASSIS & GROSS (2002), in cataloguing this species, provided additional distributional information. Our observations do not support the colour distinction as mentioned above; we found that M. *australis* varies from yellow-brown to dark brown, even within the same population. It is best determined by the distribution of short fan-like setae (Fig. 13c) particularly on the lateral margins of the pronotum and across the scutellum. Some specimens also possess clove-shaped setae, as in M. *hirtula*, but the latter species always lacks the fan-shaped setae.

Morbora hirtula BERGROTH 1904 (Figs 11b, 13d-f, 15, Table 5)

Morbora hirtula BERGROTH 1904: 356 (n.sp.); SCHOUTEDEN 1904: 87, pl. 5 fig. 10 (description; habitus); KIRKALDY 1909: 265 (catalogue); GROSS 1975: 91 fig. 22 (description; habitus); MCDONALD & CASSIS 2002: 548 (description; genitalia); CASSIS & GROSS 2002: 587 (catalogue)

Diagnosis: *Morbora hirtula* is recognised by the following combination of characters: dorsum with clove-shaped setae, intermixed with curly sericeous setae (Figs 13d-f); AIV longest segment; exocorium not expanded (Fig. 11b); CAI membraneous, lobe-like; CAII elongate, sickle-shaped, distally bifurcate; and, CAIII lyre-shaped and heavily sclerotized.

Description: Body small, males 4.97-5.12, females 4.41-5.39.

Colouration. Dorsum dark brown, with contrasting markings, most notably with broad W-shaped marking on posterior 1/2 of scutellum (Fig. 11b).

Vestiture. Dorsum with dense distribution of erect, elongate, clove-shaped setae, intermixed with curly sericeous setae, mostly on head and pronotum; without fan-shaped setae (Figs 13d-f).

Structure. Antennae: AIV longest segment, little longer than AI. Labium: LII longest segment, LIII & LIV subequal in length. Pronotum: lateral margins moderately expanded (Fig. 11b); anterolateral angles not surpassing anterior margin of eyes (Fig. 11b). Hemelytra: costal margins not greatly expanded laterally. Male Genitalia: CAI membraneous, lobe-like, without sclerotization; CAII elongate, sickle-shaped, heavily sclerotized, distally bifurcate, antler-like; CAIII short, lyre-shaped, heavily sclerotized; vesica heavily sclerotized, distally tapered.

Measurements. Table 5.

Material examined: **Queensland**: 3♀♀, 3 km NE of Mt Webb, 15°03'S 145°09'E, A Calder & J Feehan, 30 April-3 May, 1981, ANIC Berlesate 723, ex rainforest litter (AM, ANIC); **New South Wales**: 4 km NE Mt Wog Wog, 17 km SE Bombala, 37°04'S 149°28'E, CR Margules, October 1991, ex pitfall (ANIC).

Distribution: *Morbora hirtula* is widely distributed in eastern Australia, and reaches the Northern Territory to the west. It is known from locations in Queensland, New South Wales, Tasmania and South Australia (Fig. 15). It has been recorded from Victoria and the Northern Territory, but without precise locations.

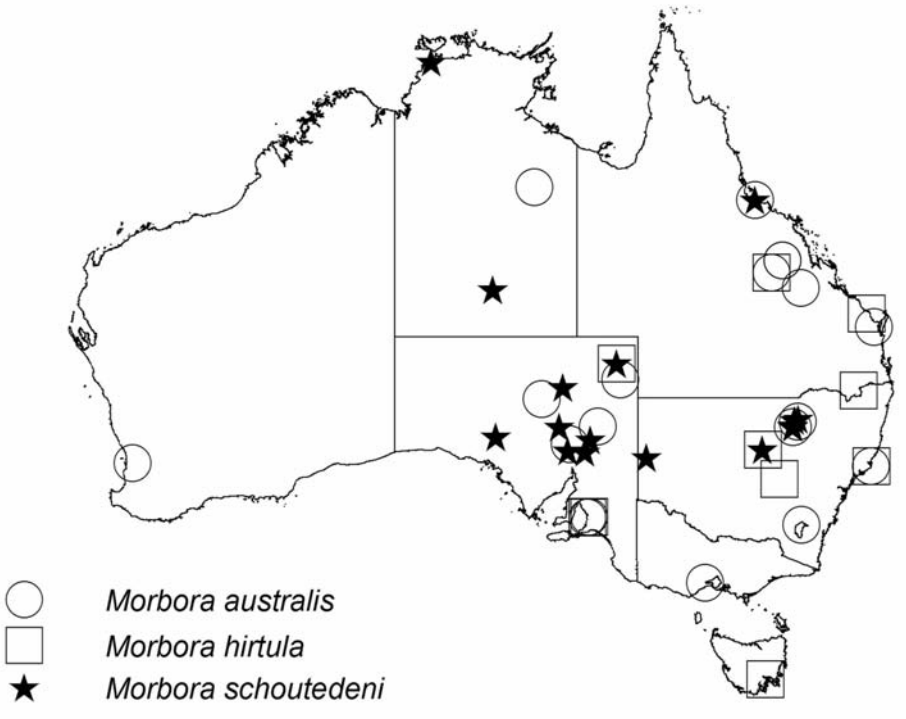


Fig. 15: Distribution of *Morbora* species.

Host plants and habitats: *Morbora hirtula* is also likely to be an epigaeic species; collected in pitfall traps or through litter extraction. It is broadly distributed across ecosystems, from open woodland to rainforest habitats.

Remarks: *Morbora hirtula* is best identified by the uniform distribution of elongate, clove-shaped setae on the dorsum, and lacks the fan-like setae that occur in its two congeners (cf. Figs 13a-i). Externally it is very similar to M. *australis*, but the male genitalia differs significantly in having three conjunctival appendages. This is also the case in M. *schoutedeni*, but in M. *australis* the bifurcation of CAII is more pronounced.

Morbora schoutedeni Bergroth 1904 (Figs 11c, 13g-i, 14, 15, Table 5)

Morbora schoutedeni Bergroth 1904: 356 (n.sp.); Schouteden 1904: 87 (list, habitus); Kirkaldy 1909: 265 (catalogue); Gross 1975: 92 (description, habitus); McDonald & Cassis 1984: 548 (description); Cassis & Gross 2002: 586 (catalogue)

Diagnosis: *Morbora schoutedeni* is recognised by the following combination of characters: dorsum with broad fan-shaped setae, intermixed with curly sericeous setae (Figs 13g-i); AI longest antennal segment; pronotal lateral margins expanded (Fig. 11c); exocorium expanded (Fig. 11c); pygophore (Fig. 14a); parameres with short apical hook (Fig. 14b); CAI membraneous, lobe-like, bifid (Figs 14c, d); CAII elongate, sickle-shaped, distally bifurcate (Figs 14c, d); and, CAIII lobe-like, fused basally, membraneous (Figs 14c, d).

Description: Small species, males 4.51-4.97 mm, females 5.00-5.88 mm.

Colouration. Dorsum dark brown, with contrasting markings, most notably with broad W-shaped marking on posterior 1/2 of scutellum (Fig. 11c).

Vestiture. Dorsum with dense distribution of erect, elongate setae, intermixed with curly sericeous setae, mostly on head and pronotum (Figs 13g-i); pronotum and particularly scutellum with dense distribution of broad fan-shaped setae (Figs 13g-i).

Structure. Antennae: AI longest segment, little longer than AIV. Labium: LI & LII, and LIII & LIV subequal in length. Pronotum: lateral margins greatly expanded (Fig. 11c); anterolateral angles surpassing anterior margin of eyes (Fig. 11c). Hemelytra: costal margins greatly expanded laterally (Fig. 11c). Male Genitalia: pygophore with narrow genital opening (Fig. 14a); parameres with a short apical hook (Fig. 14b); CAI large, membraneous, lobe-like, bifurcate, without sclerotization (Figs 14c, d); CAII elongate, sickle-shaped, heavily sclerotized, with short distal bifurcation, antler-like (Figs 14c, d); CAIII broad, membraneous, medially fused; vesica broad, heavily sclerotized, weakly S-shaped (Figs 14c, d).

Measurements. Table 5.

Material examined: **New South Wales**: 1♀, Baraba, 30.115S 148.790 E, I Oliver, February 2001, Site WALCOL00162, ex pitfall trap, (AM); 1♀, Nerrub, 30°04'41"S 148°56'53"E, I Oliver, February 2001, Site WALCOL00285, ex pitfall trap (AM); 1♀, Yetta, 30°27'04"S 148°41'35"E, I Oliver, February 2001, Site WALCOL00068, ex pitfall trap (AM); 1♀, Womba, 30°23'60"S 148°41'53"E, I Oliver, February 2001, Site WALCOL00568, ex pitfall trap (AM); 2♂♂, Bogan River, J Armstrong (AM; **Queensland**: 1♂, Clermont, November 1929, KK Spence (AM); **Western Australia**: 2♀♀, Pilbara District, Hammersley Station, Kaengaenarina well, 500 m from well, 22°15'44"S 159°48'38"E, 14-22 April 2005, S Lassau, M Elliott, L Kampen & M Bulbert, PILB126/05P (AM).

Distribution: This species is broadly distributed in Australia (New South Wales, Northern Territory, Queensland, South Australia) in semi-arid and arid areas (Fig. 15). In this work we record it from Western Australia (Pilbara District). It is sympatric with M. *australis* at a number of sites in eastern Australia (NSW: Yelta, Nerrub; QLD: Clermont).

Host plants and habitats. *Morbora schoutedeni* is a ground-dwelling species, which has been mostly collected in pitfall traps. As with the other *Morbora* species, nothing is known of its food preferences.

Remarks: BERGROTH (1904) first described this species from Townsville (Queensland). GROSS (1975) redescribed it, and diagnosed it in part by the reportedly subequal AII(a) (as third segment) and AII(c) (as fourth segment). In our work, we have measured specimens of all three species, and found this character to not have diagnostic value, with continuous variation existing, such that AII(b) can be longer than AII(a), and overlaps in the ranges of these characters were found with the other *Morbora* species. This species is distinctive having the broad fan-like setae that are very densely distributed on the pronotal disc and scutellum (Figs 13g-i). The conjunctival appendages are also distinctive, with medially fused CAIII, and CAII with a short distal bifurcation.

Subfamily Pachycorinae

Remarks: It is beyond the scope of this work to review the Pachycorinae, which are not native to Australia; we only reviewed the introduced species, *Agonosoma trilineatum* in any detail. This subfamily is largely found in the Western Hemisphere, with only *Deroplax* MAYR and *Hotea* occurring in the Old World (KIRKALDY 1909; SCHUH & SLATER 1995). KUMAR (1964) placed the Australian species, *Tectocoris diophthalmus*, in the Pachycorinae, on the basis of the ejaculatory apparatus; an action not followed by subsequent authors. Pachycorines are primarily diagnosed by the presence of stridulatory vittae and tibial plectra; characters that are thought to be exclusive to the Pachycorinae (e.g., SCHUH & SLATER 1995).

Agonosoma LAPORTE 1832 (Figs 16, 17, 18, Table 6)

Eurygaster (*Agonosoma*) LAPORTE 1832: 62
Agonosoma: SCHOUTEDEN 1904: 67 (generic status; description); AMYOT & SERVILLE 1843: 44 (description); STÅL 1867: 494 (description); KIRKALDY 1909: 278 (catalogue); EGER 1987: 339 (diagnosis); PALEARI 1992: 505 (description; revision)
Agonocoris BERGROTH 1891: 235 (unnecessary nom. nov.)
Type species: *Agonosoma flavolineata* LAPORTE 1832, monotypy

Diagnosis: *Agonosoma* is recognised by the following combination of characters: body elongate-ovoid (Figs 16a, b), moderately convex dorsum; body mostly glabrous (Figs 16a, b); densely punctate with small punctures (Figs 16a, b, 17a); head large, jugal margins weakly sinuate (Fig. 17a), thickened and rounded in profile; bucculae lateral margin anteriorly compressed (Fig. 17b); eyes small, contiguous with pronotum, overlapping anterolateral angles of pronotum (Fig. 17a); anterior margin of proepisternum moderately explanate (Fig. 17b); pronotum trapezoidal, anterior margin weakly excavate, anterolateral margins elongate, strongly divergent, posterior margin truncate (Figs 16a, b); scutellum strongly declivent posteriorly, rounded distally; mesepimeron with evaporative areas (Fig. 17c); external efferent system well-developed, peritreme sickle-shaped, medially sulcate, anteriorly recurved, evaporative area extending beyond peritreme (Figs 17c, d); abdominal SV-VI with stridulatory vittae (Figs 17e, f); and, SVII enlarged in both males and females covering terminalia. (Fig. 17d).

Diversity and distribution: *Agonosoma* has four species, which are endemic to the tropics of the Neotropical zoogeographic region (KIRKALDY 1909; PALEARI 1992).

Included species:

A. dohrni SCHOUTEDEN 1903	Mexico
A. bicolor WESTWOOD 183	Brazil
A. flavolineatum LAPORTE 1832	Brazil, Guyana, Venezuela
A. trilineatum (FABRICIUS 1781)	Colombia, Brazil, Guyana, Panama, Suriname, Venezuela, West Indies, Australia (introduced)

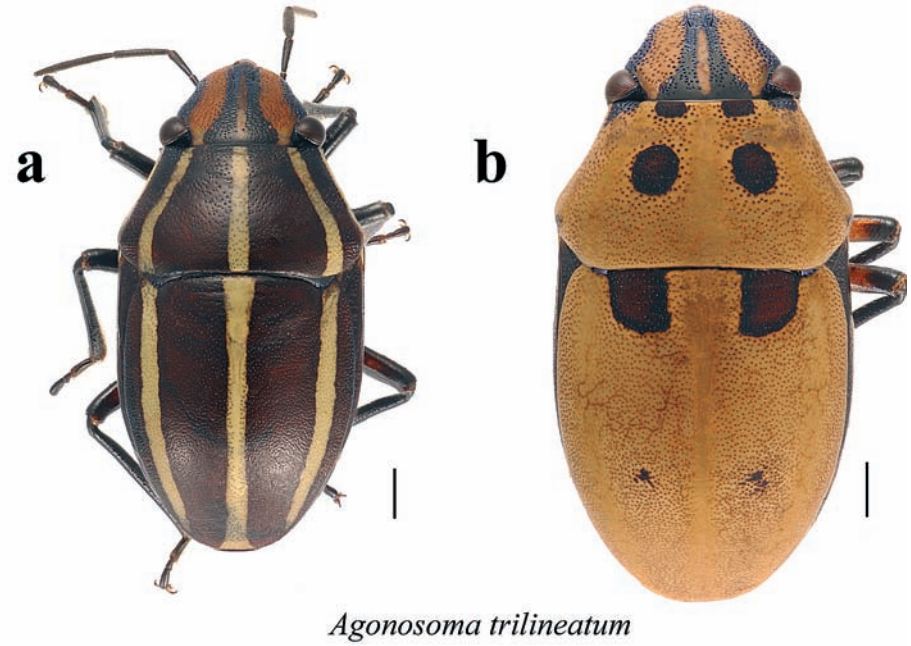


Fig. 16: Habitus of introduced Pachycorinae species (**a-b**) *Agonosoma trilineatum* (**a**) ♂ (**b**) ♀. Scale bar = 1 mm.

Remarks: *Agonosoma* was described as a subgenus of *Eurygaster* by LAPORTE (1832). SCHOUTEDEN (1904) redescribed the genus and provided a comprehensive synonymy for the species. EGER (1987) in revising *Tiridates* STÅL, recognised a group of genera (*Agonosoma*, *Crathis* STÅL, *Diolcus* MAYR, *Lobothyreus* MAYR, *Symphylus* DALLAS and *Tiridates*) with enlarged abdominal SVII (in both sexes), concealing the genitalia. Further, EGER (1987) provided differential diagnoses for *Agonosoma* and *Tiridates*, placing most importance on the external efferent system of the metathoracic glands, and secondary diagnostic value to the body and head shape. PALEARI (1992) redescribed *Agonosoma* and the constituent species, but did not detail the genitalia.

Agonosoma trilineatum (FABRICIUS 1781) (Figs 16, 17, 18, Table 6)

Cimex trilineatus FABRICIUS 1781: 341 (n. sp.)
Cimex sexpunctatus FABRICIUS 1781: 339 (n.sp.); PALEARI 1992: 513 (synonymy)
Cimex trivittatus PANZER 1798: 111 (n.sp.); PALEARI 1992: 513 (synonymy)
Pachycoris virgatus GERMAR 1839: 102 (n.sp.); PALEARI 1992: 513 (synonymy)
Agonosoma quadiguttatum SIGNORET 1851: 330 (n.sp.); WALKER 1867: 59 (list); PALEARI 1992: 513 (synonymy)
Agonosoma trivittatum: SIGNORET 1851: 330 (new combination); DALLAS 1851: 42 (list)
Agonosoma trilineatum: STÅL 1870: 13 (new combination); SCHOUTEDEN 1904: 68 (synonymy); PALEARI 1992: 505 (redescription)
Agonosoma trivittata fabricii KIRKALDY 1909: 278 (unnecessary nom. nov.)

Diagnosis: *Agonosoma trilineatum* is recognised by the following combination of characters: males chocolate brown, with three longitudinal yellow stripes (Fig. 16a); females dimorphic, as in male, or mostly yellow-brown, with pair of submedial spots on pronotum and scutellum (Fig. 16b).

Colouration. Males monomorphic, dorsum dark chocolate brown with three longitudinal yellow stripes (Fig. 16a); females dimorphic, either as in male, or pale brown with black spots (Fig. 16b). Head: jugal margins black, subjugal regions of frons orange, large fuscous triangular marking from posterior margin of head to near anteclypeus, with medial yellow stripe; underside of head mostly iridescent green, with posterior region orange; AI orange, sometimes tip embrowned, remainder of segment fuscous; LI-II mostly dusty stramineous, LIII-LIV fuscous; Pronotum: spotted morph with 6 spots, pairs on anterolateral angles, submedially on anterior margin, and submedially below callosite region. Thoracic pleura: anterior edge of proepisternum yellow, remainder of pleura fuscous, with green iridescent tinge, intermixed with yellow posterior margin of mesepimeron and peritreme and part of supracoxal lobes. Legs: coxae yellow; femora orange; tibiae fuscous in stripped morph, or mostly orange with anterior surface fuscous; tarsi fuscous. Abdominal Venter: ground colour yellow-orange, with lateral margins dark brown and green iridescence, SV-SVI stridulatory vittae dark brown, SII mostly dark brown, anterior margins of SIII-VII dark brown.

Texture. Dorsum, underside of head and thoracic pleura punctate (Figs 16a, b, 17b).

Vestiture. Body glabrous. Antennae: AI-AII(a) almost glabrous, AII(b)-AIV with dense distribution of short, simple, semi-erect setae; femora with sparse distribution of short setae; ventral surface of tibiae with dense distribution of short, semi-erect setae.

Structure. Antennae: AII(a) smallest segment, AIV longest segment, > AIII, AII(b) little longer than AII(a), AII(b) subequal to AI; AIII and AIV flattened.

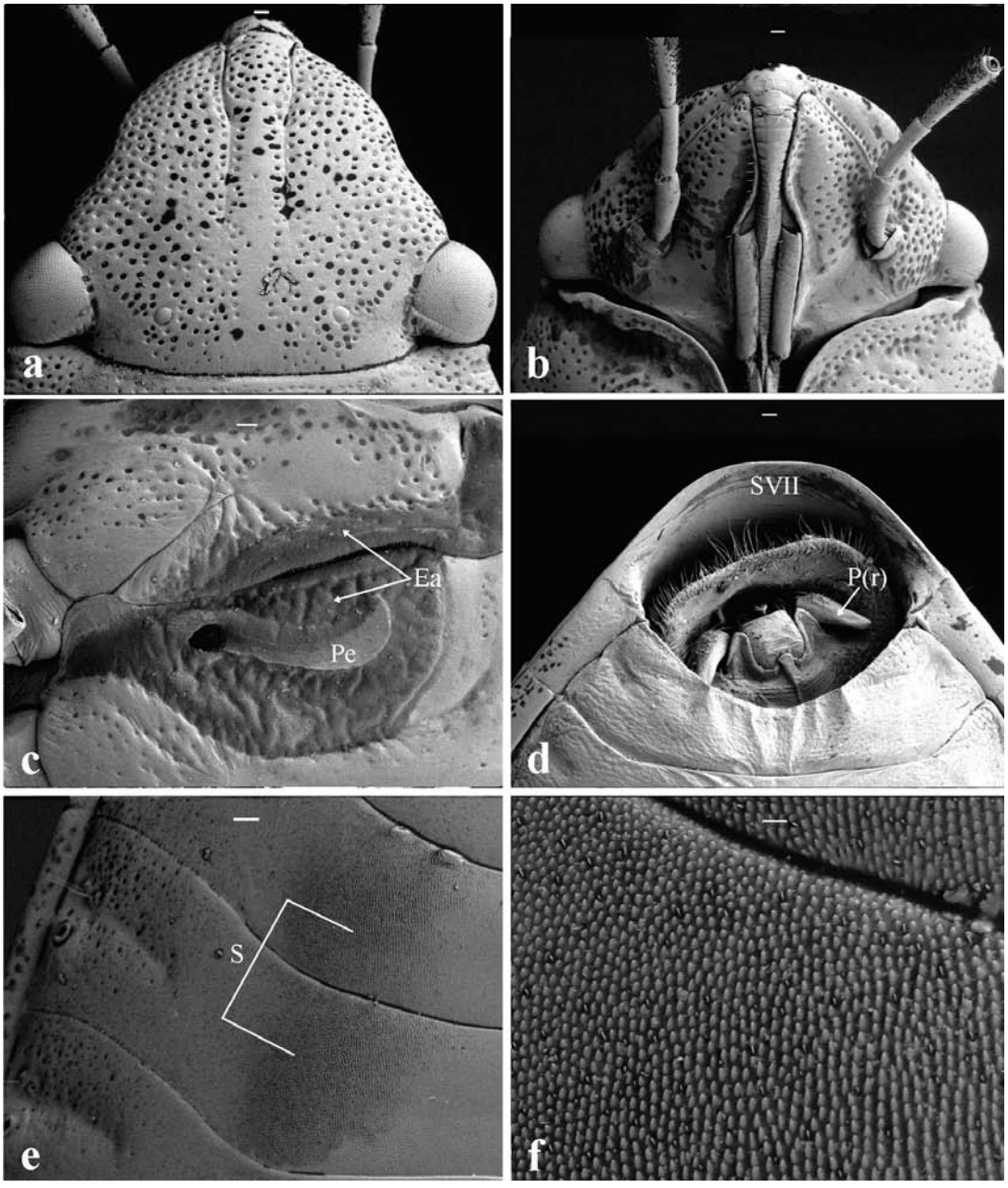


Fig. 17: Scanning electron micrographs of key characters of *Agonosoma trilineatum* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) External efferent system of metathoracic glands, ventral view (**d**) male pygophore, dorsal view (**e**) Stridulatory areas, pregenital abdominal SV-SVI (**f**) Substructure of stridulatory area. Abbreviations: Ea = evaporative area; Pe = peritreme; P(r) = right paramere; S = stridulatory area; SVII = seventh abdominal sternite, dorsal view. Scale bars = 0.1 mm.

Labium: reaching abdominal SIII, LII longest segment. Male Genitalia: pygophore with narrow genital opening, laterally setose (Fig. 17d, 18a); parameres with short, broad stem and angulate, elongate crown (Fig. 18b); aedeagus with sclerotized, broad ductus seminis proximalis, bounded by ligamentory tubule (Fig. 18c); ejaculatory apparatus with ventral conducting canal broad, not convoluted (Fig. 18c); ejaculatory reservoir elongate, subreniform (Fig. 18c); ductus seminis distalis broad, scerlotized (Fig. 18c, d); vesica membraneous, denticulate (Fig. 18c, d); CAI and CAIII absent (Fig. 18c); CAII broad, antler-like, distally denticulate (Fig. 18c). Female Terminalia: paratergites VIII small, subtriangular, tapered medially; paratergites IX large, subelliptoid, medial margins rounded; gonocoxae I bipartite, posterior, digitiform branch, anteriorly subtriangular, moderately-sized. Spermatheca: fecundation canal short; reservoir very weakly dilated, thickened; pump elongate, with proximal and distal flanges present; bulb small, round.

Measurements. Table 6.

Material examined: **Venezuela**: 5♂♂ 11♀♀, Falcon State, Paraguana Peninsula, 15 December 1999, R Segura & TA Heard, ex *Jatropha gossypifolia*, quarantine colony (AM).

Table 6: *Agonosoma trilineatum*: diagnostic measurements in millimetres. N = sample size.

	Male			Female		
	N	Mean±SD	Range	N	Mean±SD	Range
Length	9	8.70±1.05	7.36-10.42	9	9.72±0.67	9.14-11.07
Pronotal width	9	5.40±0.43	4.84-5.93	9	6.01±0.34	5.53-6.62
Width between eyes	9	2.42±0.14	2.22-2.62	9	2.59±0.14	2.27-2.77
Antennal segment length						
I	18	0.75±0.05	0.70-0.85	17	0.82±0.07	0.75-1.00
II(a)	18	0.59±0.06	0.50-0.68	16	0.62±0.08	0.48-0.75
II(b)	18	0.77±0.06	0.65-0.85	16	0.86±0.07	0.78-0.95
III	18	1.37±0.07	1.25-1.48	12	1.50±0.07	1.35-1.58
IV	14	1.84±0.11	1.65-2.00	10	1.85±0.05	1.78-1.90
Labial segment length						
I	9	2.15±0.05	2.05-2.20	9	2.22±0.11	2.05-2.40
II	9	2.22±0.06	2.15-2.33	9	2.42±0.11	2.25-2.55
III	8	0.85±0.11	0.73-1.00	8	0.90±0.07	0.85-1.03
IV	8	0.97±0.05	0.90-1.05	8	1.09±0.04	1.03-1.15

Distribution: This species was introduced to southeast Queensland, and naturalised populations are as yet to be recovered (Heard pers. comm.). It is naturally known from Panama, Colombia, Venezuela, Surinam, Grenada and Trinidad (PALEARI 1992).

Host plants and biology: *Agonosoma trilineatum* was introduced as a biocontrol agent of *Jatropha gossypifolia* (see above).

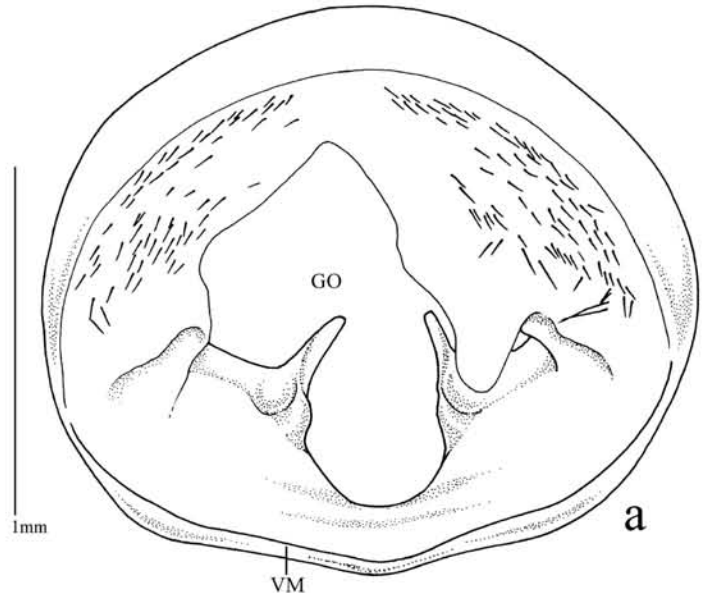
Remarks: PALEARI (1992) redescribed this species, highlighting the colour dimorphism, external morphology and distribution. It is distinguished from all the native jewel bugs of Australia, on colour and colour patterning alone. It is easily diagnosed by the enlarged abdominal SVII of both sexes (covering the terminalia) (Fig. 17d, male), the membraneous vesica (Figs 18c, d), and thickened and narrow spermathecal reservoir.

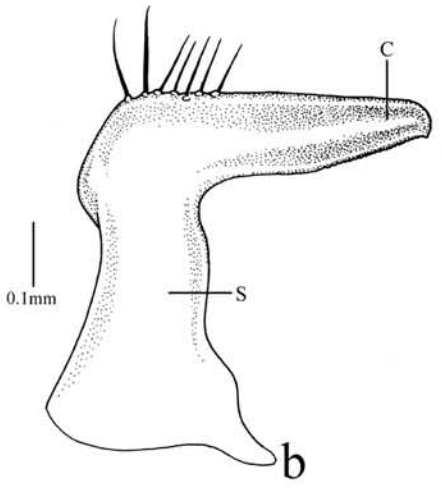
Subfamily Scutellerinae

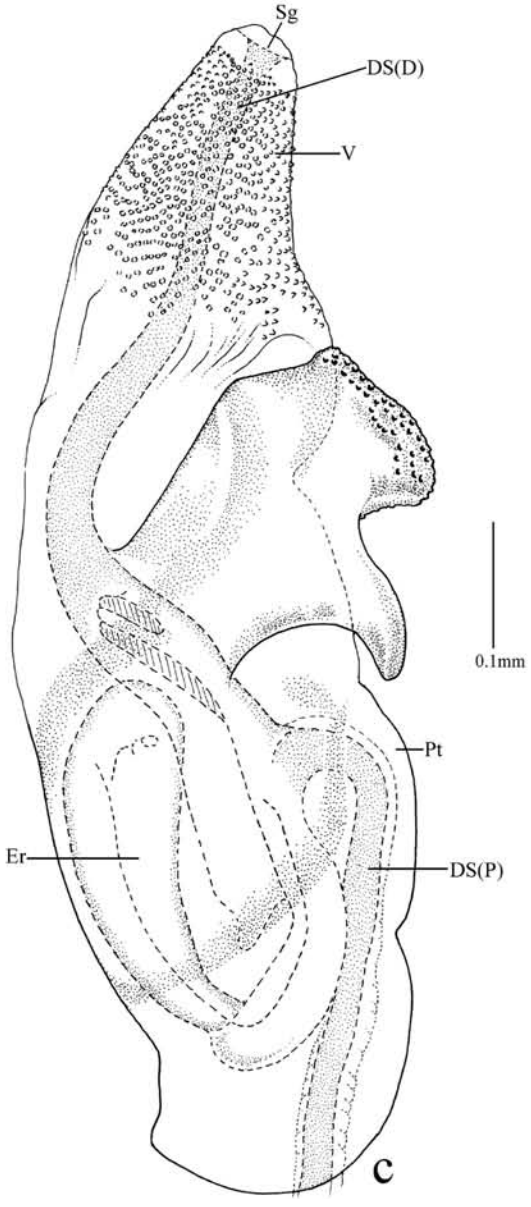
Pentatomidae, Scutellerina, Scutelleraria STÅL 1872: 32 (new suprageneric taxon)
Pentatomidae, Scutellerinae, Scutelleraria: SCHOUTEDEN 1904: 13 (description)
Pentatomidae, Scutellerinae, Scutellerini: KIRKALDY 1909: 289 (catalogue)
Pentatomidae, Scutellerinae, Scutellerini: LESTON 1952d: 13 (new suprageneric classification)
Scutelleridae, Scutellerinae: MCDONALD 1966: 67, 68 (new suprageneric classification)
Scutelleridae, Scutellerinae: MCDONALD & CASSIS 1984: 550 (Australia)

Diagnosis: The Scutellerinae are recognised by the following combination characters: small (e.g., Figs 24b, 37) to very large body (e.g., Figs 19a-d, 28a); ovoid (e.g., Figs 24b, 37) to elongate-ovoid (Figs 28a, b), sometimes strongly tapered towards terminalia; body weakly (e.g., Fig. 28a) to heavily punctate (Figs 24a, c-f); body brilliant, aposematically coloured, often with iridescent blue, green, orange colouration, often with contrasting markings (e.g., Figs 19a-d, 24a, c-f, 28a-e); head subtriangular to suboval (e.g., Fig. 31a); thoracic sterna flat (e.g., Figs 20c, 29c, 31c); anterior margin of proepisternum weakly explanate (e.g., Figs 20c, 31c); efferent system of metathoracic glands well-developed (e.g., Figs 20d, 25d, 31d); peritreme mostly subreniform (e.g., Figs 20d, 39d, 42d), sometimes large, subtriangular (e.g., Figs 25d, 29d), or obovate (e.g., Figs 31d, 38c); males without abdominal androconial or setose sternal glands; pregenital abdomen in both sexes without stridulatory vittae; ventral surface of pygophore caudally (e.g., Figs 32a-h) or ventrally oriented (e.g., Figs 29e, 30e); parameres hook-shaped (e.g., Figs 22b, 40b); ejaculatory apparatus usually well-developed, with convoluted ventral conducting canal and oval to subelliptoid ejaculatory reservoir (e.g., Figs 30c, d, 36c, d, 40c, d); CAI usually absent, rarely present (e.g., Figs 22c, d); CAII usually bifurcate, with lobal sclerites (e.g., Figs 22c, d, 36c, d, 40c, d), CAIII undivided, often U-shaped (e.g., Figs 26d, 30d, 43d) or divided (e.g., Figs 22c, d); spermathecal fecundation canal short or long; and, spermathecal reservoir oval.

Remarks: There is no unique character state defining the Scutellerinae, and most of the above-mentioned features are also true for the family. They are the most brilliantly coloured of all the scutellerids, but numerous Pachycorinae also exhibit colouration consistent with models of warning colouration. The male and female genitalia are also similar to taxa in other scutellerid subfamilies, such as the Elvisurinae and Sphaerocorinae, although the development of the ventral conducting canal of the ejaculatory apparatus is putatively greatest in the scutellerines, such as in *Cantao parentum* (Figs 30c, d). Many species have a U-shaped, and basally fused CAIII (e.g., Figs 26d, 30d, 43d), but there are significant variations, particularly in *Calliphara* (Fig. 22d). Scutellerines can be separated from the Pachycorinae, and Odon-







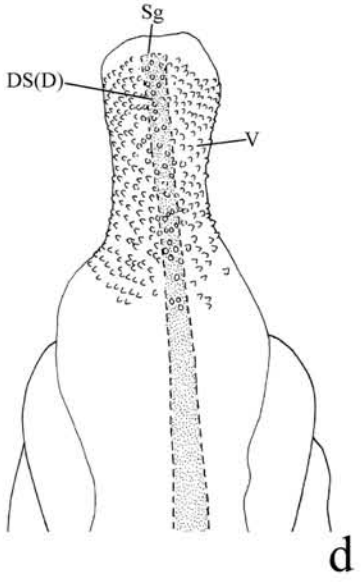


Fig. 18: Male genitalia of *Agonosoma trilineatum* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) apex of aedeagus, ventral view. Abbreviations: C = crown of right paramere; DS(D) = ductus seminis distalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; F = flange at base of crown of paramere; GO = genital opening; Pt = phallotheca; S = stem of paramere; Sg = secondary gonopore; V = vesica; VM = ventral margin of genital opening.

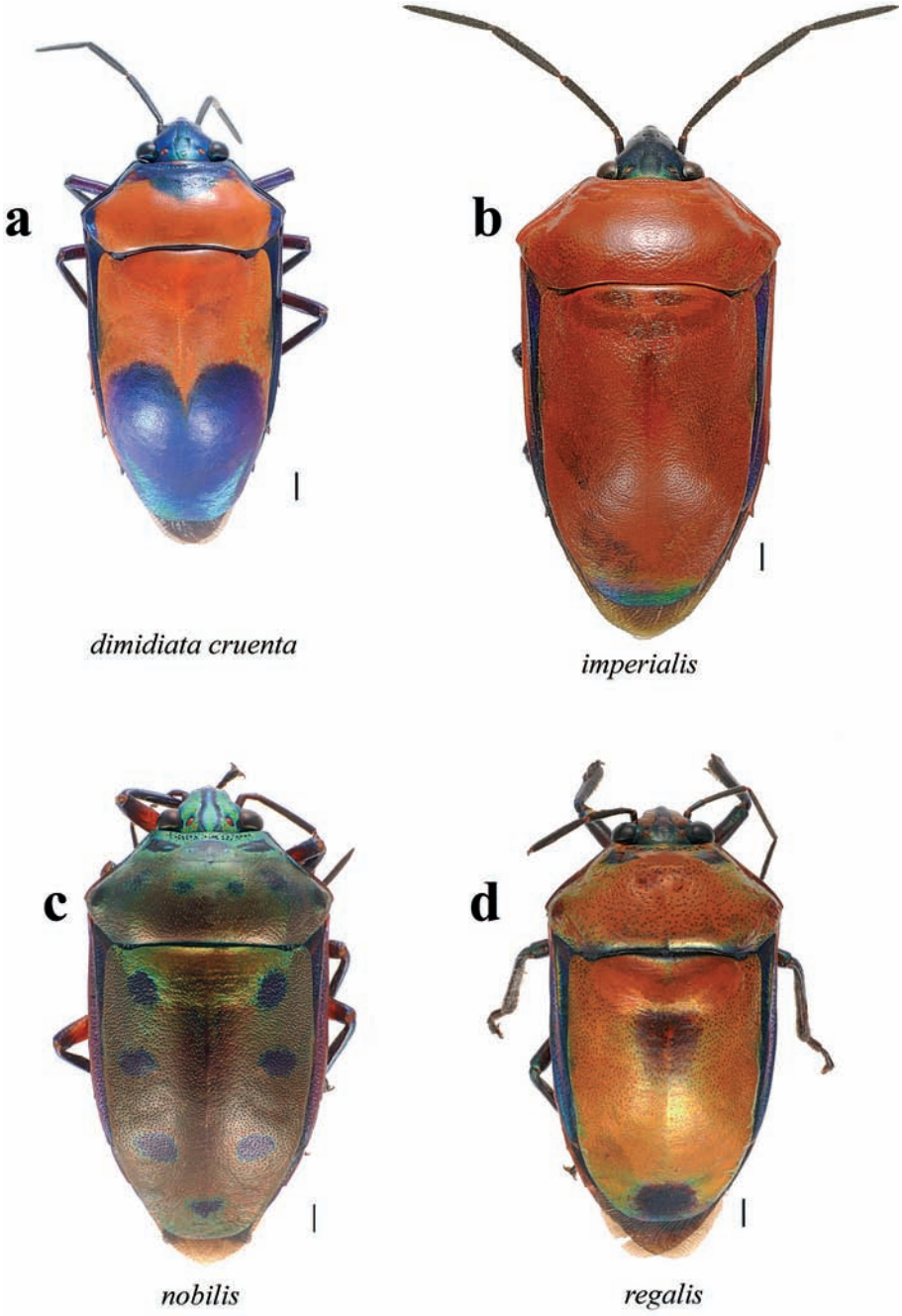


Fig. 19: Habitus of Australian *Calliphara* species (**a**) *Calliphara dimidiata cruenta*, ♂ (**b**) *Calliphara imperialis*, ♂ (**c**) *Calliphara nobilis*, ♂ (**d**) *Calliphara regalis*, ♂. Scale bar = 1 mm.

totarsinae + Tectocorinae, in lacking stridulatory vittae and androconial/setose sternal glands respectively. They can be separated from the Elvisurinae, Odontotarsinae and Sphaerocorinae superficially by their aposematic colouration (cf. dull colouration), although even in the latter subfamily some taxa exhibit moderately striking colouration, as in *Sphaerocoris* BURMEISTER.

SCHUH & SLATER (1995) adopted LESTON's (1952d) definition of the Scutellerinae (including the Elvisurinae and Sphaerocorinae), but on the basis of the emarginate abdominal sterna (recurved anteriorly) and the presence of two intervannal veins in the hindwing. Neither of these characters is considered exclusive to this conception of the taxon. We have retained the scutellerines in the narrow sense, despite it being a 'convenience' group, as it helps in distinguishing the colourful Australian scutellerid species, pending a more in-depth review of the issue.

Calliphara GERMAR 1839 (Figs 19, 20, 21a-c, 22, 23)

Calliphara GERMAR 1939: 122 (gen. nov.); HERRICH-SCHAEFFER 1839: 19, 20, 22, 58 (description); STÅL 1865: 33 (key); STÅL 1873: 16 (description); LETHIERRY & SEVERIN 1893: 23 (catalogue); SCHOUTEDEN 1904: 24, 31 (description); KIRKALDY 1909: 297 (catalogue); MCDONALD 1961: 183 (transferred to Sphaerocoraria); LYAL 1979 (revision); MCDONALD & CASSIS 1984: 561 (description); CASSIS & GROSS 2002: 587 (catalogue)

Lamprophara STÅL 1865: 34 (gen. nov.); LYAL 1979: 154 (synonymy)

Calliphara (*Chrysophara*) STÅL 1873: 17 (subgen. nov.); LYAL 1979: 154 (synonymy)

Type species: *Calliphara*: *Cimex imperialis* FABRICIUS 1775, subsequent designation, KIRKALDY 1909: xxxv; *Lamprophara*: *Calliphara* (*Scutellera*) *bifasciata* WHITE 1839, monotypy; *Calliphara* (*Chrysophara*): *Tetyra excellens* BURMEISTER 1834, subsequent designation KIRKALDY 1909: xxxv.

Diagnosis: *Calliphara* is recognised by the following combination of characters: glabrous; lateral margins of jugae deeply excavate (Fig. 20a), rounded in profile (Fig. 20b); AII(a) shortest segment; forewing tip extending beyond scutellum (Figs 19a-d); proepisternum with short anterior keel (Fig. 20c); broad subreniform, raised peritreme; CAI divided (Figs 22c, d); CAII(L) prominent digitiform lobal sclerite, CAII(M) membraneous with bifid lobal sclerites (Figs 22c, d); vesica often with apical process distal to secondary gonopore (Figs 22c, d); and, spermatheca with short proximal fecundation canal; and, spermathecal reservoir large, oval.

Description: Body elongate to elongate-ovoid (Figs 19a-d); Large species, males 13.00-19.00 mm, females 14.00-20.00 mm.

Colouration. Body iridescent colouration, either orange-brown, blue, green or

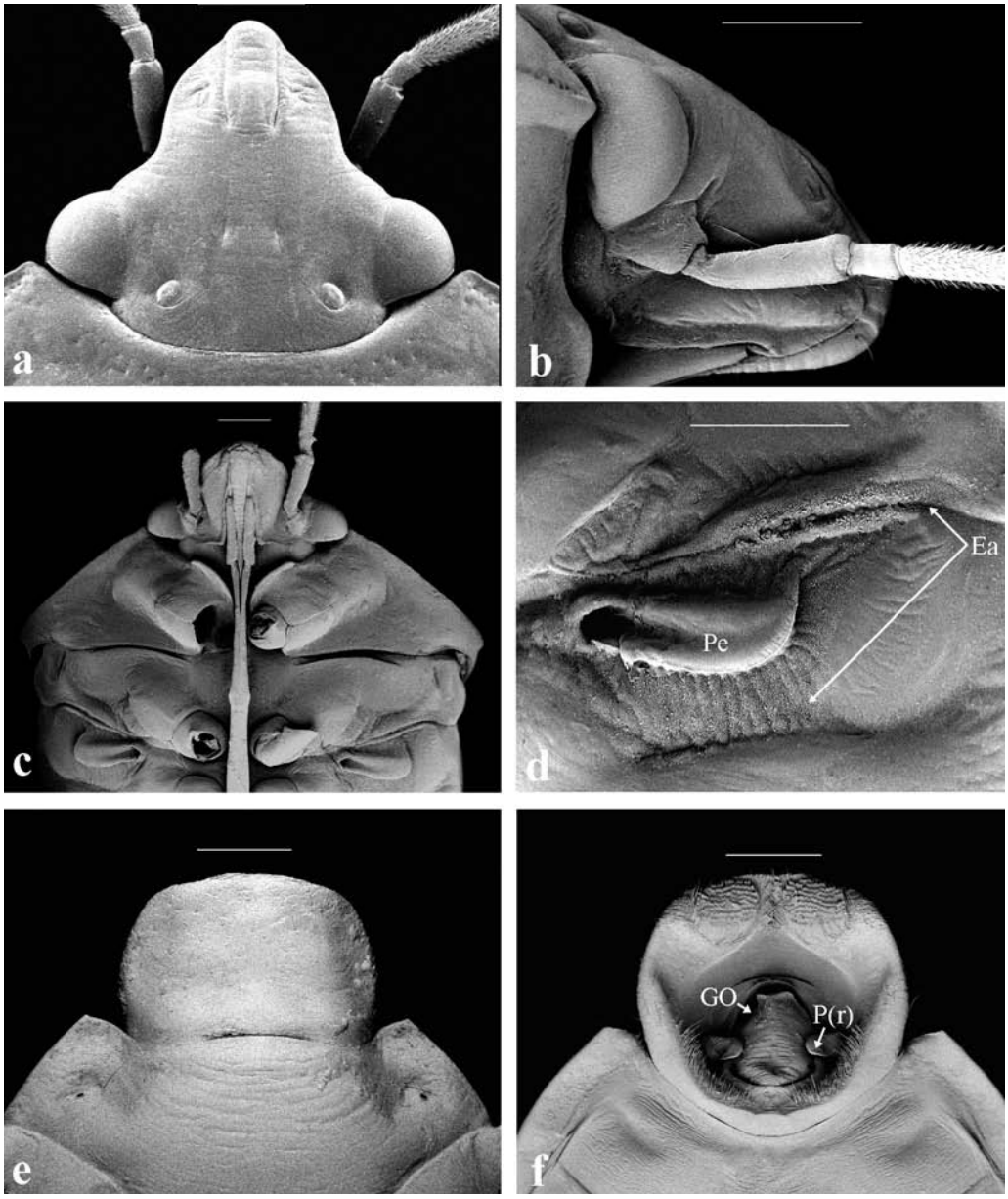


Fig. 20: Scanning electron micrographs of key characters of *Calliphara imperialis* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Abbreviations: Ea = evaporative area; Go = genital opening; Pe = peritreme; P(r) = right paramere.
Scale bars = 1 mm.

black, often with patterned, contrasting markings (Figs 19a-d).

Texture. Body impunctate to moderately punctate, with shallow punctures (Figs 19a-d).

Vestiture. Body mostly glabrous.

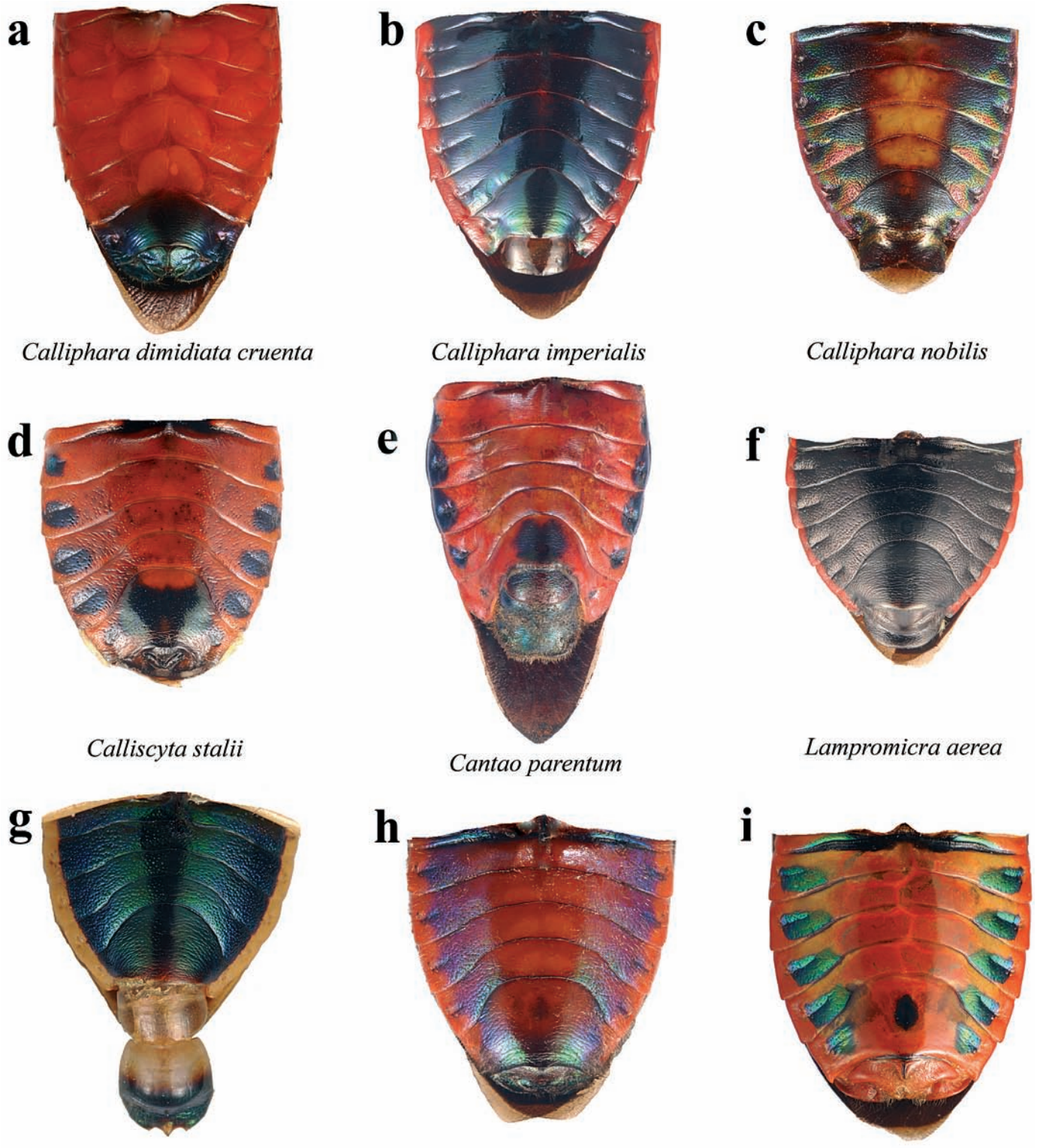
Structure. Head: large, subtriangular, moderately declivent; strongly produced in front of eyes (Fig. 20a); lateral margins of jugae strongly excavate (Fig. 20a), rounded in profile (Fig. 20b); bucculae parallel-sided (Fig. 20c). Antennae: not greatly elongate; AII(a) often very short (Figs 20a, b); AII(b)-AIV flattened, roughly subequal in length, with AIV longest, and AIII a little longer than AII(b). Labium: reaching posterior margin of metasternum, LII longest segment, LIII and LIV roughly subequal. Pronotum: broadly trapezoidal (Figs 19a-d); anterior margin weakly excavate; anterolateral margins rectilinear, strongly divergent, carinate in profile (Figs 19a-d); posterolateral margins weakly convex (Figs 19a-d); posterior margin weakly excavate to rectilinear (Figs 19a-d). Scutellum: broadly U-shaped, strongly convex (Figs 19a-d), base of exocorium, membrane tip and abdominal connexiva visible. Thoracic pleura: anterior margin of proepisternum moderately explanate (Fig. 20c); mesepimeron with evaporative areas; external efferent system of metathoracic glands well-developed; peritreme broad, sickle-shaped, shallowly sulcate medially,

apex anteriorly directed (Figs 20c, d); evaporative areas extending beyond peritreme (Fig. 20d). Pregenital Abdomen: mostly posterolateral angles of connexiva acuminate. Male Genitalia: pygophore large, suboval, dorsal in orientation (Figs 20e, f, 22a), most often with dorsal and ventral patches of setae (Figs 20f, 22a); parameres with crown hooked, apex blunt (Fig. 22b); aedeagus: ductus seminis proximalis narrow, membraneous, tubelike (Figs 22c, d); ejaculatory apparatus with short, paired ventral conducting canal, weakly convoluted (Figs 22c, d); ejaculatory reservoir small, suboval; dorsal conducting canal not expanded (Figs 22c, d); vesica short, often with distal sclerotized process (Figs 22c, d); CAI divided post-thecal margin, either basally membraneous, CAI(V) with short conical lobal sclerite (Figs 22c, d) or uniformly sclerotised, and CAI(D) greatly enlarged, subrectilinear to arcuate, sclerotised process (Figs 22c, d); CAIII bifid, with outer arcuate, sclerotised process, and medial membraneous lobe, often with bifid lobal sclerite (Figs 22c, d). Female Terminalia: paratergites IX small, suboval; gonocoxae I subtriangular, outer surface flat, posterior margin weakly excavate; interlocking rami present. Spermatheca: proximal fecundation canal short; reservoir oval to barrel-shaped, with ribbed texture; distal fecundation canal with proximal and distal flanges; and, bulb oval.

Diversity and distribution: *Calliphara* comprises 15 species, five (*dimidiata*, *excellens*, *placida*, *praslinia* and *regia*) of which are divided into subspecies. The genus occurs primarily east of Wallace's Line in southeast Asia, with most species occurring in Indonesia, New Guinea and Australia. The genus occurs as far north as China (*C. munda* and *C. nobilis*) and extends through the east Melanesian Islands, and reaches most eastward to Samoa, with inclusions in Vanuatu, New Caledonia and Fiji. The genus is represented in Australia by six species, with only *C. imperialis* and the subspecies *C. dimidiata cruenta*, endemic. *Calliphara nobilis* is re-established as an Australian species, based on a collection from the Northern Territory. The remaining Australian species are widespread in the Australian zoogeographic region, known in both Indonesia and New Guinea, and in some instances also in the east Melanesian Islands and New Caledonia. Within Australia, most species of *Calliphara* are found in northern Queensland, with a few species extending as far south as northern New South Wales, and west to the Northern Territory. LIS & SKÓRKA (1996) transferred *C. bipunctata* to *Notocalliphara* LYAL.

Included species:

C. bifasciata WHITE 1839 Fiji, Samoa
C. billardierii (FABRICIUS 1803) Australia, Indonesia, New Guinea, Solomon Islands
C. caesar (VOLLENHOVEN 1863) Indonesia, New Guinea
C. dimidiata dimidiata (DALLAS 1851 New Guinea
C. dimidiata cruenta STÅL 1873 Australia
C. dimidiata fasciata (WALKER 1867) New Guinea
C. excellens excellens (BURMEISTER 1834) Philippines, Indonesia
C. excellens coelestis TAEUBER 1929 Philippines
C. excellens speciosa (WHITE 1842) Philippines
C. imperialis (FABRICIUS 1775) Australia
C. lanceolata DISTANT 1903 Indonesia (Timor)
C. munda STÅL 1866 China
C. nobilis (LINNAEUS 1763) Australia, Burma, China, Indonesia, Malaysia, Philippines, Taiwan
C. placida placida BREDDIN 1905 New Guinea
C. placida scintillans BREDDIN 1905 New Guinea
C. praslinia praslinia (GUÉRIN-MÉNEVILLE 1838) Australia, Indonesia, New Ireland, Solomon Islands, Vanuatu
C. praslinia admiraltyensis KIRKALDY 1909 Admiralty Islands
C. regalis (FABRICIUS 1775) Australia, Indonesia, New Caledonia, New Guinea, Solomon Islands
C. regia regia (WESTWOOD 1837) Indonesia (Timor)
C. regia allorensis LEHMANN 1920 Indonesia (Timor)
C. regia timorensis LEHMANN 1920 Indonesia (Timor)
C. solomonensis LYAL 1979 Solomon Islands
C. vollenhoveni LYAL 1979 Bismarck Archipelago



Species excluded from the Australian fauna: CASSIS & GROSS (2002) included two species of *Calliphara*, *C. billardierii* and *C. praslinia*, in the Australian fauna. These are now considered to be erroneous records. The Australian records of *Calliphara praslinia* were based on misidentification of museum collections. In CASSIS & GROSS (2002) this species was recorded from the Northern Territory, Queensland and New South Wales. On re-examination of these collections, we have not found any specimens that belong to this species. A specimen identified as *C. praslinia* from the South Australian Museum has 'N.T.' as the label data; this however cannot confidently

Fig. 21: Colouration of Abdominal Venter in Australian Scutellerinae (**a**) *Calliphara dimidiata cruenta* (**b**) *Calliphara imperialis* (**c**) *Calliphara nobilis* (**d**) *Calliscyta stalii* (**e**) *Cantao parentum* (**f**) *Lampromicra aerea* (**g**) *Lampromicra regia* (**h**) *Lampromicra senator* (**i**) *Scutiphora pedicellata*.

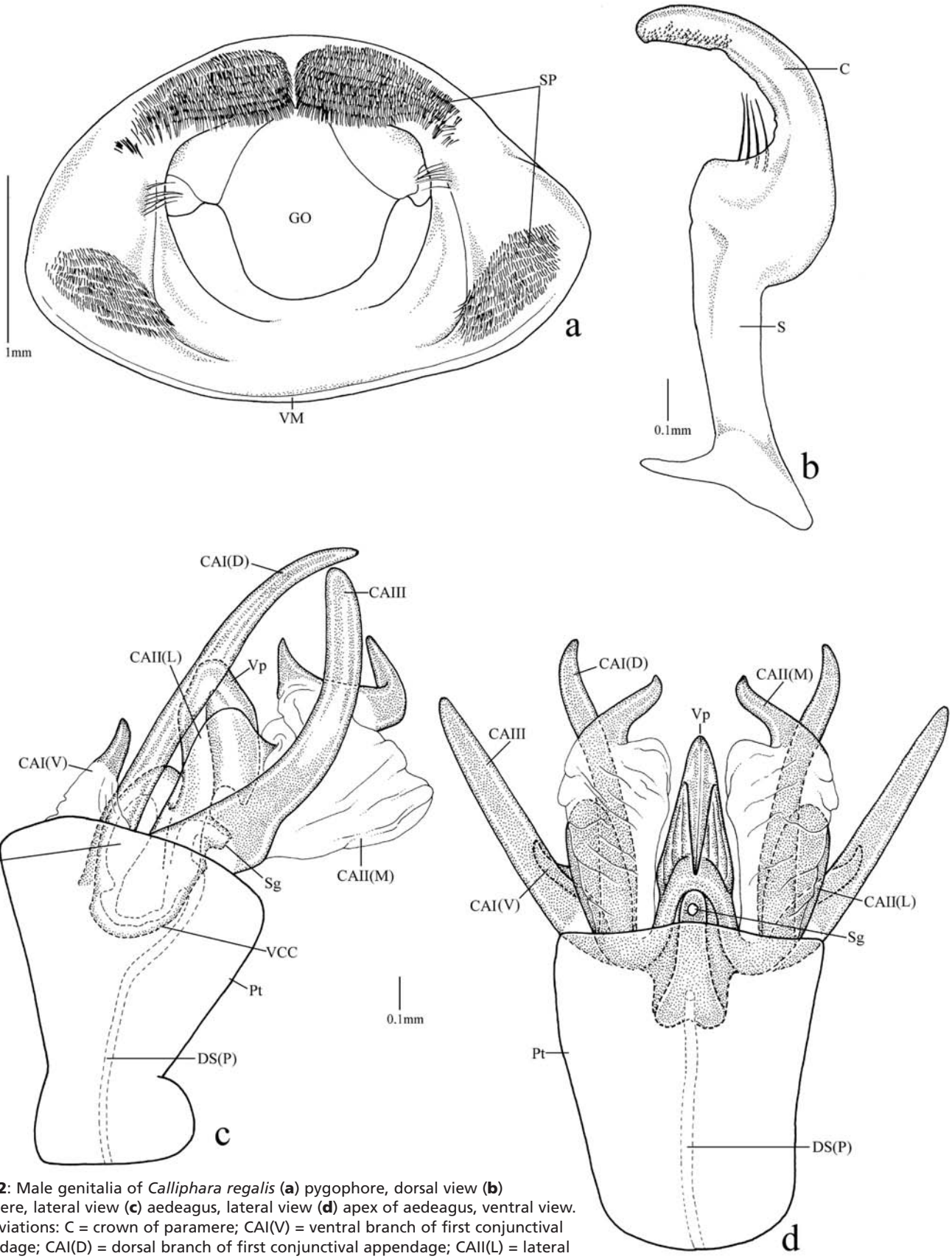


Fig. 22: Male genitalia of *Calliphara regalis* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) apex of aedeagus, ventral view. Abbreviations: C = crown of paramere; CAI(V) = ventral branch of first conjunctival appendage; CAI(D) = dorsal branch of first conjunctival appendage; CAII(L) = lateral branch of second conjunctival appendage; CAII(M) = medial branch of second conjunctival appendage; CAIII = third conjunctival appendage; DS(D) = ductus seminis distalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; GO = genital opening; Pt = phallotheca; S = stem of paramere; Sg = secondary gonopore; SP = setose patches of male genital opening; VCC = ventral conducting canal; Vp = distal process of vesica; VM = ventral margin of genital opening.

be regarded as a contraction for the 'Northern Territory'. In addition, this specimen is more likely to be C. *excellens*. In addition, there are various collections of *Calliphara* from the Melanesian zoogeographic subregion, which have been identified as C. *praslinia*. These specimens superficially resemble C. *praslinia* in terms of the colouration patterns. However, an examination of the male genitalia, indicate that they are very similar to C. *regalis*.

CASSIS & GROSS (2002) recorded *Calliphara billardierii* as an Australian species, based on KIRKALDY's (1909) distributional descriptor of 'Tropical Queensland' for this species, but without reference to a precise locality. We have investigated all known collections of this species, and not found any specimens of C. *billardierri*, and therefore exclude it from the Australian biota.

Remarks: LYAL (1979) reviewed *Calliphara*, describing new taxa, establishing new synonymies, and detailing the male genitalia. He subdivided the genus into four informal species groups (C. *excellens*, C. *praslinia*, C. *caesar* and C. *dimidiata*) based on characters of the male genitalia, particularly the development of the conjunctival appendages, and length and shape of the vesica.

LYAL (1979) proposed that *Calliphara* was most closely related to *Chrysocoris* HAHN and *Lampromicra*, but without explicit morphological hypotheses. On external characters, *Calliphara* and *Lampromicra* closely resemble each other on the basis of the following characters: sinuate lateral margins of the jugae (cf. Figs 20a & 39a), explanate anterior margin of the proepisternum (cf. Figs 20c & 39c), mesepimeron with evaporative bodies (cf. Figs 20d & 39d), large metathoracic gland ostiole (cf. Figs 20d & 39d), subreniform peritreme (cf. Figs 20d & 39d), suboval male pygophore (cf. Figs 20f & 39f), dorsal margin of genital opening of male pygophore with broad setose patch (cf. Figs 20f & 39f), small suboval female paratergites IX, and angulate posterior margin of gonocoxae I.

Calliphara differs externally from *Lampromicra* by the larger body and very short second antennal segment (Figs 20a, b). The most significant differences between the two genera exist in the morphology of the ejaculatory apparatus and conjunctival appendages. *Calliphara* has the following attributes: simple male ejaculatory apparatus with simple and short ventral conducting canal (Fig. 22d), vesica with distal process (Fig. 22d), CAI with enlarged digitiform lobal sclerites (Figs 22c, d), CAII distally with bifid lobal sclerite, lateral branch of CAIII with long sclerotized, digitiform process (Figs 22c, d), and medial branch of CAIII with bifid lobal sclerite (Fig. 22c). We have not examined any specimens of *Chrysocoris*, but published descriptions of the male aedeagus (TSAI et al. 2004), indicate a closer relationship of this genus with *Lampromicra* than *Calliphara*, in that the ejaculatory apparatus has an elongate and highly convoluted ventral conducting canal.

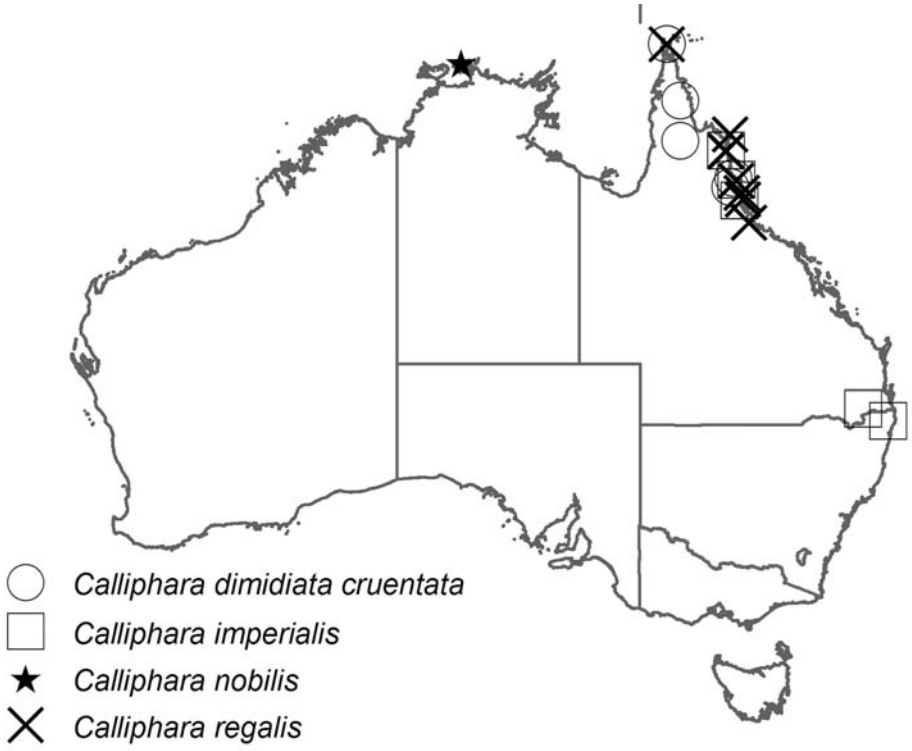


Fig. 23: Distribution of Australian *Calliphara* species.

Calliphara dimidiata cruenta STÅL 1873 (Figs 19a, 21a, 23)

Calliphara cruenta STÅL 1873: 17 (n.sp.); LETHIERRY & SEVERIN 1893: 23 (catalogue); SCHOUTEDEN 1904: 32 (list); KIRKALDY 1909: 297 (catalogue); MCDONALD 1963a: 28 (male genitalia)
Calliphara dimidiata cruenta: LYAL 1979: 170 (as subspecies); MCDONALD & CASSIS 1984: 563, Fig. 75 (description; spermatheca)
Calliphara dimidiata cruentata: CASSIS & GROSS 2002: 589 (incorrect subsequent spelling; catalogue)

Diagnosis: *Calliphara dimidiata cruenta* is recognised by the following characters: head, pronotal callosite region and posterior 1/2 of scutellum iridescent green; remainder of pronotum and scutellum orange (Fig. 19a); posterior angles of abdominal SIV-VII spinose (Fig. 21a); sternites of pregenital abdomen orange (Fig. 21a); terminalia iridescent green (Fig. 21a); legs uniformly iridescent dark blue; labium reaching posterior margin of abdominal SIII; CAI claw-shaped; CAII(M) with bulb-shaped apical process; CAIII bifid; and, vesica short.

Description: Body elongate-ovoid; large, males 13-16 mm, females 14-17 mm.

Colouration. Body bicoloured (Fig. 19a), head, anterior and lateral margins of pronotum, posterior 1/2 of scutellum, thoracic pleura and sterna, and abdominal terminalia bluish-fuscous, often with purplish hue and green iridescence, posterior 1/2 of pronotum, anterior 1/2 of scutellum, and pregenital abdominal venter orange (Fig. 21a); antennae, labium and legs uniformly fuscous.

Texture. Body mostly smooth, with scattered shallow punctures on dorsum.

Vestiture. Dorsum glabrous; abdominal venter with sparse distribution of pale, simple setae.

Structure. Eyes: small, about 1/3 length of head; Antennae: AII(a) little longer than AI. Labium: reaching abdominal sterna IV. Pregenital Abdomen: posterior angles of abdominal SVI-VII with acuminate spines (Fig. 21a). Male Genitalia: ventral margin of male pygophore deeply emarginate; genital opening of pygophore with dorsal and ventral patches of setae; ejaculatory apparatus small; ventral conducting canal, with two pairs of convolutions; ductus seminis distalis dorsally tumescent, proximal to apex of vesica, without an apical process; ejaculatory reservoir absent; CAI elongate, claw-shaped, with basally broad, plate-like, with apex narrow, strongly arcuate inwardly; CAII prominent, bifurcate, CAII(M) basally membraneous, with apex outwardly arcuate, heavily sclerotized, with subdistal sclerotised spine, and moderately sclerotised apical bulb-shaped process, CAII(L) thorn-like in lateral view, basally membraneous, distally moderately sclerotised, tapered distally; CAIII(D) broad sickle-shaped, with tapered apex, sclerotized; CAIII(V) absent; vesica short. Female Terminalia: paratergites VIII large, subtriangular, medially separated; paratergites IX smaller, subelliptoid; gonocoxae I large, subtriangular, flap-like.

Measurements. McDonald & Cassis 1984: Table 6.

Material examined: **Queensland**: 1♂ 1♀, Leo C[ree]k track, approx. 300 m, McIlwraith Range, 11 January 1990, MS & BJ Moulds (AM); 2♂♂ 2♀♀, Kelsal Collection (BMNH); 1♀, Cape York, Dämel, Australia Coll. 92-6 (BMNH); **Torres Strait Islands**: 3♀♀, 77-29 (BMNH); 2♀♀, Murray Is., 78-66 (BMNH).

Distribution: Cassis & Gross (2002) reported the known records of this species, from northern Queensland, the Torres Strait Island and Papua New Guinea (Fig. 23).

Host plant and biology: No host plant has been recorded for this species.

Remarks: Lyal (1979) established *Calliphara dimidiata* in its own species-group, and also erected *C. cruenta* as a subspecies of *C. dimidiata*. He also delineated three subspecies on external colour characteristics, with the abdominal sterna orange to red basally in the New Guinea subspecies (nominotypical subspecies and *C. dimidiata fasciata*) compared to *C. dimidiata cruenta*, with darker sternites. In the Australian subspecies, the CAIII(V) is absent and the CAII(M) has only one subdistal spine. The subspecific status of these taxa was not evaluated in this work, although it is noteworthy that the bulb-like process of CAIII(M) is unique to all the subspecies of *C. dimidiata*. McDonald & Cassis (1984) redescribed the species, including the first description of the female genitalia.

Calliphara imperialis (Fabricius 1775) (Figs 19b, 20, 21c, 23)

Cimex imperialis Fabricius 1775: 697 (n.sp.); Fabricius 1781: 339 (description); Fabricius 1787: 280 (description); Fabricius 1794: 81 (description); Donovan 1805: pl. 3 fig. 2 (habitus)
Tetyra imperialis: Fabricius 1803: 128 (new combination)
Calliphara imperialis: Germar 1839: 126 (new combination); Herrich-Schaeffer 1840: 83, fig. 529 (description); Stål 1866: 153 (description); Lethierry & Severin 1893: 24 (catalogue); Schouteden 1904: 32 (list); Van Duzee 1905:

189 (description); KIRKALDY 1909: 297 (catalogue); TILLYARD 1926: 149 (diagnosis); MCDONALD 1961: 182, figs 29-32 (male genitalia); MCDONALD 1963a: 30 (male genitalia); MCDONALD 1963b: 235, figs 17, 18 (female genitalia); KUMAR 1964: 62 (male genitalia); KUMAR 1965: 53, fig. 87 (female genitalia); MCDONALD & CASSIS 1984: 566 (description); CASSIS & GROSS 2002: 589 (catalogue)

Callidea imperialis: DALLAS 1851: 24 (new combination)

Diagnosis: *Calliphara imperialis* is recognised by the following characters: dorsum dark orange (Fig. 19b); head and tip of scutellum iridescent dark-green (Fig. 19b); pronotal callosite region with black medial spot (Fig. 19b); ventral surface of body mostly dark black with iridescent green tinge, lateral margins of sternites of pregenital abdomen orange (Fig. 21b); dorsum densely punctate (Fig. 19a); abdominal SIV-VII strongly spinose (Fig. 21b); lateral margins of abdominal venter impunctate (Fig. 21b); CAI elongate, S-shaped; CAII with bifid lobal sclerite; CAIII(D) elongate, narrow, S-shaped, sclerotized process; and, CAIII(V) absent.

Description: Body elongate-ovoid; large, males 17-19 mm, females 18-20 mm;

Colouration. Body bicoloured (Fig. 19b), dorsum mostly burnt-orange with head fuscous iridescent green and tip of scutellum iridescent green, sometimes callosite region of pronotum with large dark medial spot; antennae and labium black; legs black, with iridescent green or blue tinge; thoracic pleura mostly fuscous, laterally with iridescent green hue, metepisternum orange; most of abdominal venter black, with lateral margins orange; terminalia black with iridescent green hue.

Texture. Dorsum with moderate distribution of very shallow punctures; abdominal venter weakly rugulose.

Vestiture. Dorsum glabrous; abdominal venter with sparse distribution of decumbent, simple, pale setae.

Structure. Antennae: AII(a) very short, ca. 1/3 of AI. Labium: reaching posterior margin of abdominal sterna IV. Eyes: not large, about 1/2 length of Head. Pregenital Abdomen: posterior angles of abdominal connexiva VI-VII with acuminate spines (Fig. 21b). Male Genitalia: genital opening of pygophore with dorsal and ventral patches of setae; vesica short, with a small subdistal tumescence, ejaculatory apparatus small, paired ventral conducting canals, with three pairs of convolutions; ejaculatory reservoir absent; CAI elongate, S-shaped, apex acute, strongly sclerotised; CAII basally membraneous medially, apex with bifid lobal sclerite; CAIII(D) elongate, narrow, S-shaped, sclerotized process; CAIII(V) absent. Female Terminalia: paratergites VIII large, subtriangular; paratergites IX small, subelliptoid; gonocoxae I large, subtriangular, flap-like.

Measurements. MCDONALD & CASSIS 1984: Table 6.

Material examined: **Queensland**: 1♂ 1♀, Bluewater Range, N of Townsville, T Woodger & L Ring, 29-xii 1990 (AM); 1♀, 'K3613' (AM); 3♂♂ 2♀♀, Brisbane (AMNH); 1♂, Palm Island, W Taylor (AMNH); 2♂♂ 2♀♀, '318' (AMNH).

Distribution: *Calliphara imperialis* is endemic to Australia (Fig. 23), found primarily in the wet tropics of northeast Queensland. CASSIS & GROSS (2002) also listed it from the Northern Rivers of New South Wales and southeast Queensland, but there is some doubt as to whether this species occurs this far south. We have seen a single specimen from the Northern Territory, without a specified location. This species was erroneously recorded from New Zealand (CASSIS & GROSS 2002, references therein).

Host plant and biology: No host plant has been recorded.

Remarks: LYAL (1979) designated a lectotype, and we have accepted this as the original description does not indicate the number of specimens in the type series.

LYAL (1979) assigned C. *imperialis* to the *Calliphara excellens* species-group, on the basis of the male pygophore and aedeagus. The lobal sclerite of CAII is significantly different to all other of the Australian species of *Calliphara*, bifid, but not U-shaped as in the other species. In addition, this species has S-shaped CAI and CAIII(D). Our observations differ significantly from those of MC-

DONALD's (1961) description of the conjunctival appendages. In addition, MCDONALD (1961) does not report a setal patch on the dorsal margin of the pygophore, which is in contradistinction to LYAL (1979) and our observations a character state present in all species of *Calliphara*.

Calliphara nobilis (LINNAEUS 1763) (Figs 19c, 21c) Revised Australian Record

Cimex nobilis LINNAEUS 1763: 17 (n.sp.); STÅL 1866: 153 (description)
Cimex pustulatus PANZER 1798: 111 (n.sp.; junior homonym); LYAL 1979: 172 (synonymy)
Scutellera buquetti GUÉRIN-MÉNEVILLE 1838: 159, 162 (n.sp.); LYAL 1979: 172 (synonymy)
Callidea nobilis: GERMAR 1839: 117 (new combination); DALLAS 1851: 25 (list); WALKER 1867: 32 (list); STÅL 1873: 17 (list); ATKINSON 1887: 165 (list); TRYON 1892: 14 (New Guinea); LETHIERRY & SEVERIN 1893: 24 (catalogue); DISTANT 1902: 53, fig. 23 (description); SCHOUTEDEN 1904: 32 (list); KIRKALDY 1909: 298 (catalogue); TAKARA 1957 (host plant); BALOCH, MOHYUDDIN & GHANI 1968 (host plant); HILGENDORF & GOEDEN 1982 (host plant); TOMOKUNI et al. 1993: 218, pl. 89 (description; colour photos); KOHNO 2006: 67 (biology; host plants)
Calliphara buquetti: STÅL 1866: 153 (new combination)

Diagnosis: *Calliphara nobilis* is recognised by the following characters: dorsum iridescent green; callosite region mostly black (Fig. 19c); pronotal black with 8 black spots (Fig. 19c); scutellum with six spots (Fig. 19c); femora orange; abdominal venter mostly orange, with broad sublateral green iridescent band (Fig. 21c); eyes large (Fig. 19c); lateral margins of abdominal sterna densely punctate (Fig. 21c); posterolateral angles of abdominal sterna without spines (Fig. 21c); CAII(M) with U-shaped lobal sclerite CAIII divided; and, vesica short.

Description: Body moderately large, male 13 mm.

Colouration. Body mostly green to copper-green, with patterned black spots on pronotum (4 spots medially, plus subtriangular burnt-orange calli) and scutellum (7 spots) (Fig. 19c). Antennae: uniformly fuscous. Pronotum black, tip of scutellum, hemelytral margins, appendages, connexiva, and male and female terminalia black to bluish-black, sometimes with a green tinge. Scutellum: mostly burnt orange; thoracic pleura bicoloured, ventrally orange, laterally with greenish iridescence; Legs: coxae, trochanters and proximal 4/5 of femora burnt-orange to red; remainder of legs fuscous to bluish-fuscous. Abdominal Venter: mostly orange, with broad sublateral green iridescence, with embrowned margins (Fig. 21c); terminalia embrowned; ventral surface of pygophore iridescent copper-brown, basally iridescent green (Fig. 21c).

Texture. Body densely punctate, with shallow punctures.

Vestiture. Abdominal venter with moderate distribution of pale, simple setae.

Structure. Eyes: large, about 1/2 length of Head. Antennae: AII(a) a little longer than AI. Labium: reaching between middle and apex of metacoxae. Male Genitalia: ventral margin of male pygophore deeply emarginate; genital opening of pygophore with dorsal and ventral patches of setae; vesica short, with arcuate dorsal process; CAII bifurcate, CAII(M) mostly membraneous with U-shaped lobal sclerite, CAII(L) elongate, digitiform, sclerotized, distally recurved; CAIII bifurcate, CAIII(D) branch elongate, digitiform, sclerotized; CAIII(V) short, mostly membraneous, lobate. Abdominal Venter: posterior angles of female abdominal SVI-VII with minute acuminate spines; male posterior angles of abdominal sterna bare (Fig. 21c). Female Terminalia: paratergites VIII large, concave and triangular; paratergites IX smaller, convex and club-shaped, fused medially to the tenth sternum; and gonocoxae I large, subtriangular, flap-like.

Measurements. BL: 12.89, PW: 8.25, IOD: 1.98, AI: 0.64, AII(a): 1.04, AII(b) 4.54, AIII: 5.24, AIV: 5.46, LI: 3.61, LII: 3.95, LIII: 3.46, LIV: 2.77.

Specimens examined: **Australia**: 1♂, **Northern Territory**, 7 km ESE Smith Point, 11°09'S132°11'E, Cobourg Peninsula, 23 January 1977, ED Edwards (ANIC); **Indonesia**: 5♂♂ 1♀, Sumatra, Dolok Merangir, EW Diehl (AMNH); 2♀♀, East Borneo, Saminedia, Sternitzky coll. (AMNH); 1♂, Sumatra, Stabat, 60 km NW of Medan, 30 m, 23-vi-1974, EW Diehl (AMNH); **Philippines**: 4♂♂ 3♀♀, Mindanao, Calapan, P de Mesa (AMNH).

Distribution: This species is broadly distributed in southeast Asia from China (in-

cluding Taiwan) and Burma in the north, and through the Indo-Malaysian peninsula, as well as the Philippines and New Guinea. KIRKALDY (1909) tentatively recorded *C. nobilis* from Australia (Tropical Queensland?), LYAL (1979) explicitly excluded it. The specimen from the Northern Territory (Fig. 23) is the first precise Australia record.

Host plants and biology: There was no host plant record for the Northern Territory specimen listed above. There are five host plants recorded for this species from outside of Australia (Table 1).

Remarks: In LYAL's (1979) classification, *C. nobilis* belongs to the *Calliphara excellens* species group, the latter established primarily on the condition of the conjunctival appendages. This species group comprises seven species, including two Australian species (*C. imperialis* and *C. regalis*) additional to *C. nobilis*, as well as three species from Indonesia, *C. lanceolata*, *C. regia* and *C. excellens*, with the last also occurring in the Philippines. The relationships of these taxa have not been analysed, although, *C. nobilis* shares numerous similarities in the male genitalia with *C. regalis*, including a short vesica, simple ejaculatory apparatus, and very similar conjunctival appendages. They are easily separated externally by colouration patterns alone (cf. Figs 19a-d).

Calliphara regalis (FABRICIUS 1775) (Figs 1a, 19d, 20, 22, 23)

Cimex regalis FABRICIUS 1775: 697 (n.sp.); FABRICIUS 1781: 339 (description); FABRICIUS 1794: 80 (description); DONOVAN 1805: pl. 3 fig. 3 (habitus)
Tetyra regalis: FABRICIUS 1803: 28 (new combination); GERMAR 1839: 127 (description)
Calliphara regalis: GERMAR 1839: 127 (new combination); STÅL 1866: 153 (description); LETHIERRY & SEVERIN 1893: 24 (catalogue); DISTANT 1899: 38 (list; synonymy); VAN DUZEE 1905: 189 (diagnosis); SCHOUTEDEN 1904: 32 (list); KIRKALDY 1909: 297 (catalogue); SCHOUTEDEN 1933: 46 (Indonesia); MCDONALD 1961: 182, figs 33-38 (male genitalia); MCDONALD 1963a: 30 (male genitalia); BLACK 1968: 573 (Melanesia); MCDONALD & CASSIS 1984: 563 (description); CASSIS & GROSS 2002: 589 (catalogue)
Caliphara (*Chrysocoris*) *imperialis*: STÅL 1873: 18 (subgeneric arrangement)
Callidea eximia VOLLENHOVEN 1863: 20 (n.sp.); LETHIERRY & SEVERIN 1893: 24 (catalogue); DISTANT 1899: 38 (synonymy); KIRKALDY 1909: 298 (catalogue); LYAL 1979: 173 (synonymy)
Tetrarthria sobria WALKER 1867: 21 (n.sp.); LETHIERRY & SEVERIN 1893: 25 (catalogue); KIRKALDY 1909: 297 (synonym of *Calliphara praslinia*); LYAL 1979: 173 (synonymy)
Callidea erythrospila WALKER 1867: 33 (n.sp.); LETHIERRY & SEVERIN 1893: 23 (as *Calliphara billardierii* ?ssp.); DISTANT 1899: 38 (synonymy); KIRKALDY 1909: 298 (catalogue; synonymy); SCHOUTEDEN 1904: 32 (synonymy)
Callidea semirufa WALKER 1867: 34 (n.sp.); LETHIERRY & SEVERIN 1893: 23 (as *Calliphara billardierii* ?ssp.); DISTANT 1899: 38 (synonymy); KIRKALDY 1909: 297 (catalogue; synonymy); DISTANT 1899: 38 (synonymy); SCHOUTEDEN 1904: 32 (synonymy)
Callidea biplaga WALKER 1867: 35 (n.sp.); LETHIERRY & SEVERIN 1893: 23 (as *Calliphara billardierii* ?ssp.); DISTANT 1899: 38 (synonymy); KIRKALDY 1909: 297 (catalogue; synonymy); SCHOUTEDEN 1904: 32 (synonymy)

Diagnosis: *Calliphara regalis* is recognised by the following characters: dorsum orange, with head and tip of scutellum iridescent dark-green (Figs 1a, 19d); base of femora orange, remainder orange-fuscous; pregenital abdominal venter mostly orange, sometimes with trichobothrial area dusty; abdominal SIV-VII minutely spinose; CAI(D) lobate (Figs 22c, d); CAI(V) elongate, outwardly arcuate (Figs 22c, d); CAII(M) with distal bifid lobal sclerite (Figs 22c, d); CAIII elongate, digitiform (Figs 22c, d); and, vesica short, with apical hood (Figs 21c, d).

Description: Body large, males 16-17 mm, females 17-19 mm.

Colouration. (Australian morph) Body bicoloured (Figs 1a, 19d); dorsum mostly golden-orange with head fuscous iridescent green and tip of scutellum with a round fuscous subdistal spot; antennae black; labium mostly orange-black, LIV fuscous. Legs: coxae, trochanters and proximal 4/5 of femora orange-red, apex of femora, tibiae and tarsi orange-fuscous. Thoracic pleura mostly golden-orange, with irregular fuscous markings. Pregenital Abdomen: venter mostly orange, with SII/III boundary and areas bounding trichobothria fuscous. Female Terminalia: with fuscous highlighting. Male Genitalia: pygophore fuscous-iridiscent green; with lateral margins orange; terminalia black with iridescent green hue.

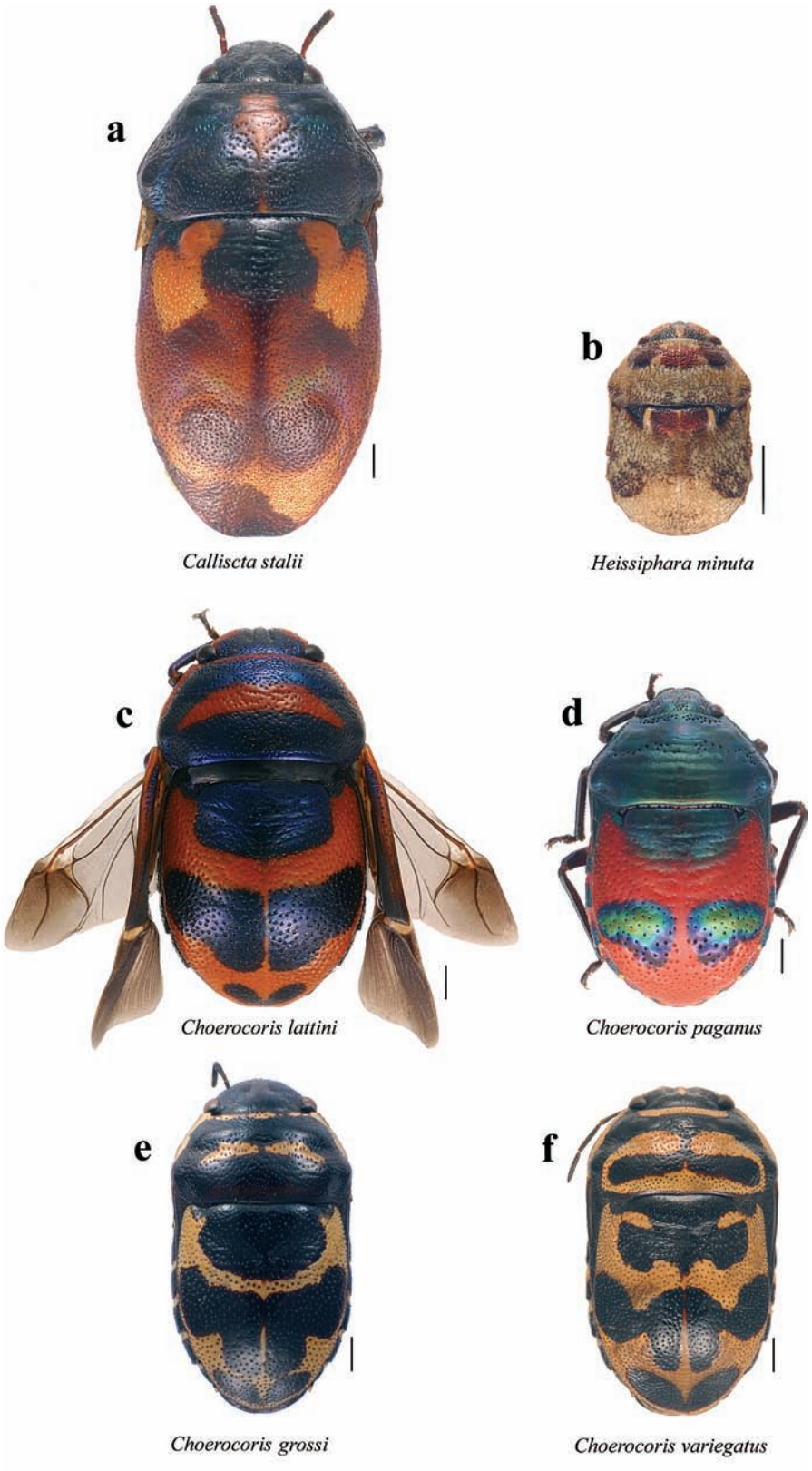


Fig. 24: Habitus of Australian Scutellerinae species (**a**) *Calliscyta stalii*, ♀ (**b**) *Heissiphara minuta* nov.sp., ♀ (**c**) *Choerocoris lattini* nov.sp., ♀ (**d**) *Choerocoris paganus*, ♂ (**e**) *Choerocoris grossi* nov.sp., ♂ (**f**) *Choerocoris variegatus*, ♂. Scale bar = 1 mm.

Texture. Pronotum and scutellum with moderate distribution of fine punctures, less densely distributed on callosite region and anterior callus of scutellum; propleuron and metepimeron with sparse distribution of deep punctures; abdominal venter weakly rugulose, more rugopunctate laterally.

Vestiture. Dorsum glabrous; abdominal venter with sparse distribution of pale, semi-erect, pale setae.

Structure. Head: eyes large, greater than 1/3 length of Head. Antennae: AII(a) short, little more than 1/2 of AI; Labium: reaching posterior margin of metacoxae to abdominal sterna II. Pregenital Abdomen: posterior angles of SIV-VII minutely spinose. Male Genitalia: ventral margin of male pygophore rounded, genital opening of pygophore with dorsal and ventral patches of setae (Figs 20f, 22a); parameres with small medial tumescence, setose (Fig. 22b); ejaculatory apparatus small, ventral conducting canal short, with two pairs of convolutions (Figs 22c, d); ejaculatory reservoir short, heavily sclerotized (Figs 22c, d); CAI(D) lobate, weakly sclerotized medially, CAI(V) elongate, outwardly arcuate, heavily sclerotized (Figs 22c, d); CAII(L) with large, membraneous lobe; CAII(M) with distal bifid lobal sclerite (Figs 22c, d); CAIII greatly elongate, digitiform lobal sclerite (Figs 22c, d); vesica short, secondary gonopore positioned just post-thecal margin, with a greatly enlarged, hooded apical process (Fig. 22d). Female Terminalia: paratergites VIII large, subtriangular, medially separated; paratergites IX smaller, subelliptoid; gonocoxae I large, subtriangular, flap-like. Spermatheca: reservoir elliptoid.

Measurements. McDonald & Cassis 1984: Table 6.

Type material examined: *Callidea biplaga* Walker: Holotype, ♂, 'Aru Isl.', 58-48', '42 *Callidea biplagia*' 'B.M. Hem. Type No. 471' (BMNH; dermestid damage; without lectotype label); *Callidea semirufa* Walker: Holotype, ♀, 'Waigou', 'Saunders 65-13', '*Callidea semirufa* Walk. (type) ', 'B.M. Hem. Type No. 472' (BMNH; dermestid damage; without lectotype label); *Callidea erythrospila* Walker: Lectotype, ♂, 'Cer.', 'Saunders 65-13', '*Callidea erythrospila*', 'B.M. Hem. Type No. 473' (BMNH; damaged; without lectotype label); *Tetrarthria sobria* Walker: Holotype, ♀,

'New Heb', '66-12', '*Tetrarthria sobria* WALK', 'B.M. Hem. Type No. 468' (BMNH; damaged; without lectotype label).

Other material examined: **Queensland**: 1♂, Cairns, July 1954, A Homes (AM); 1 ♀, Etty Bay, 8 km SE Innisfail, 13-viii-1983, NW Rodd (AM); 1♂, Clump Point, 6 March 1964, IFB Common & MS Upton (ANIC); 1 ♀, Lloyd Bay, 3 miles N Claudie River, 14-i-1972, DK McAlpine & GA Holloway (AM); 1♂, Palm Island (AMNH); 2♂♂ 1 ♀, '318' (AMNH).

Distribution: *Calliphara regalis* is widespread outside Australia from Indonesia (as far west as Sumatra) to New Caledonia and Vanuatu in the east. In Australia, it is known from the Torres Strait Islands to the wet tropics of Queensland (Fig. 23).

Host plant and biology: No host plant has been recorded for this species. This species has been found in aggregations on leaves (Fig. 1a).

Remarks: LYAL (1979) designated all of the Walker types of the junior synonyms as lectotypes. The lectotype designations were unnecessary as the original descriptions refer to a single specimen, and only a single specimen of each available name was found in the BMNH. In addition, we found that he did not add lectotype labels to the specimens. We formally reject these lectotype designations and regard them as holotypes.

LYAL (1979) placed *C. regalis* in the *Calliphara excellens* species-group on the basis of the male pygophoral and aedeagal characters. MCDONALD (1961) described its male genitalia in detail, showing the elongate, digitiform CAI(V) and CAIII. Our dissections from across the range of this species confirm McDonald's observations. It exhibits remarkable colour variation; in Australia, all the specimens we observed have the dorsum mostly orange, with the head iridescent green and the subapex of the scutellum with a subdistal iridescent fuscous-green; sometimes the pronotum is darker. In Melanesia, this species is extremely variable, but rarely as in the Australian colour morph, and can be mostly iridescent blue or green, or copper-green, with up to eight black spots on the scutellum. The male aedeagi of all the colour morphs are identical, and the colour variation is extreme if not continuous.

Calliscyta STÅL 1873 (Figs 21d, 24a, 25, 26, 27) Revised Status

Calliscyta STÅL 1873: 9 (gen.n.); LETHIERRY & SEVERIN 1893: 31 (catalogue); SCHOUTEDEN 1904: 26 (description); KIRKALDY 1909: 301 (catalogue); MCDONALD & CASSIS 1984: 538 (junior synonym of *Choerocoris*); CASSIS & GROSS 2002: 592 (junior synonym of *Choerocoris*)

Diagnosis: *Calliscyta* is recognised by the following combination of characters: elongate-ovoid (Fig. 24a); head strongly deflexed (Fig. 24c); jugal margins rounded (Fig. 24c); anterolateral margins of pronotum strongly divergent, rectilinear (Figs 24a, 25a), carinate in profile (Figs 25c, d); anterolateral margins of scutellum foveate (Fig. 25a); peritreme broad, subtriangular (Fig. 25d); evaporative areas reduced (Fig. 24d); posterior margin of pygophore emarginate (Fig. 25e, f); ejaculatory apparatus prominent, convoluted ventral conducting canal present (Figs 26c, d); CAI absent (Fig. 26c); CAII symmetrically bifurcate (Figs 26c, d); CAIII fused medially (Figs 26c, d); and, vesica elongate (Figs 26c, d).

Type species: *Calidea stalii* VOLLENHOVEN 1863, monotypy

Description: Moderately sized; elongate-ovoid (Fig. 24a); dorsum mostly dark with orange to red markings (Fig. 24a); dorsally and ventrally strongly convex (Fig. 25c); body mostly punctulate (Fig. 24a); tip of wing visible beyond emarginate apex of Scutellum. Head: transverse; subtriangular (Fig. 25a), moderately deflexed; lateral margins of jugae rounded, punctulate (Fig. 25a); bucculae narrow. Antennae: AI, AII(a) and AII(b) short, AIV longest segment; AII(b)-AIV compressed. Labium: reaching base of metacoxae. Pronotum: broadly trapezoidal (Fig. 24a), strongly convex; anterolateral margins elongate, rectilinear, carinate; humeral angles rounded; posterolateral margins short, rounded; posterior margin rectilinear. Scutellum: elongate (Fig. 24a), strongly convex in profile, anterolateral angles depressed; apex truncate (Fig. 24a); forewings weakly exposed basally and caudally. Thoracic sterna: without prominent carination (Fig. 25b). Thoracic pleura: anterior margin of proepisternum lobate, moderately explanate (Fig. 25b). Thoracic Pleura: external efferent system of metathoracic glands moderately developed (Fig. 25d), os-

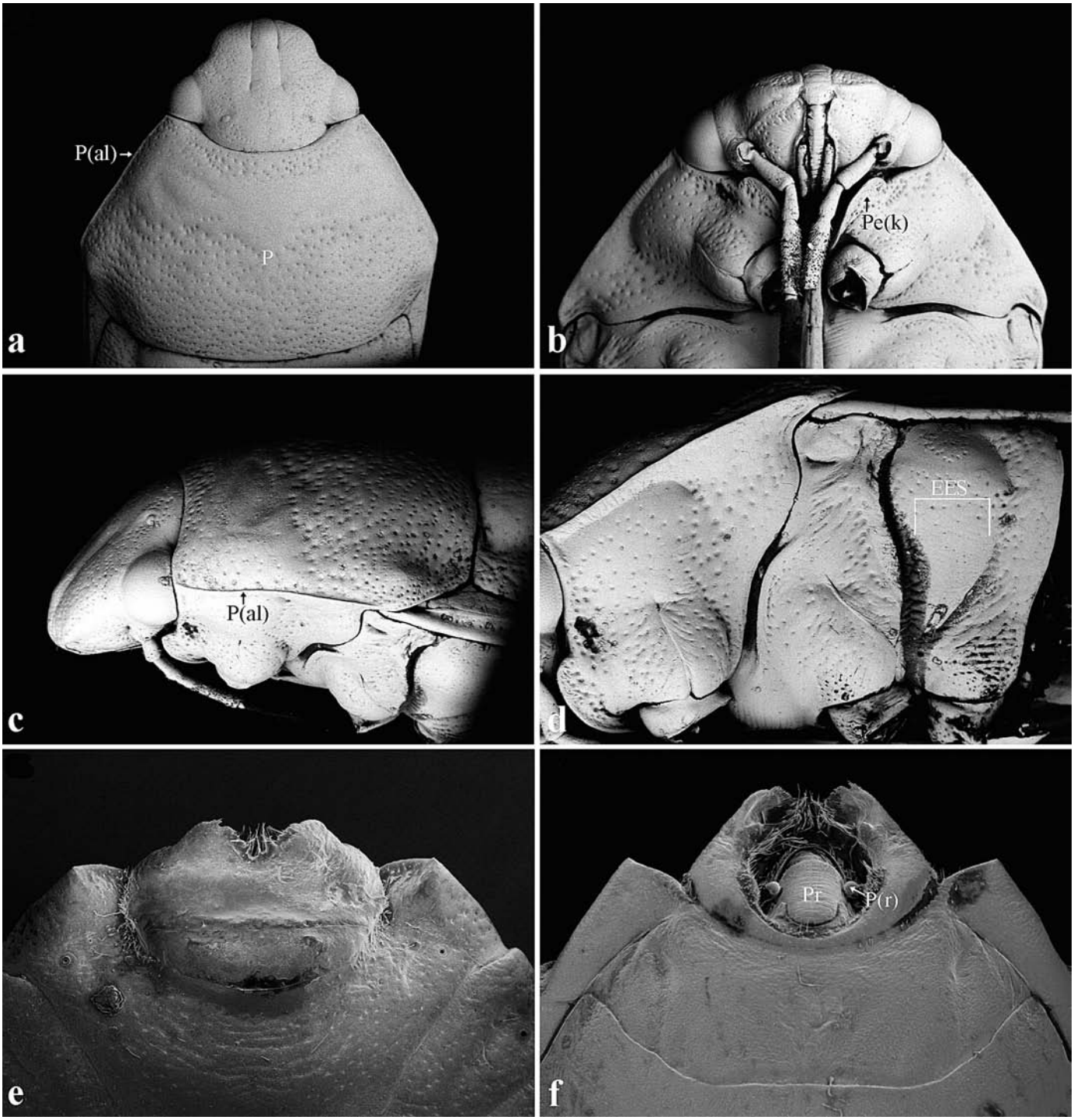


Fig. 25: Scanning electron micrographs of key characters of *Calliscyta stalii* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Abbreviations: Ea = evaporative area; Go = genital opening; P = pronotum; P(al) = anterolateral margin of pronotum; Pe = peritreme; Pe(k) = keel of anterior margin of proepisternum; P(r) = right paramere; Pr = proctiger; EES = external efferent system.

tiole small; peritremal plate large, strongly convex (Fig 25b), without prominent medial sulcation; evaporative areas restricted to either side of anterior and posterior margins of the peritremal plate, not extending to mesepimeron (Fig. 25d). Male abdomen: strongly convex, broad; abdominal trichobothria in recessed area; urite VIII hidden. Male Genitalia: pygophore moderately sized, lozenge-shaped, ventral surface sinuate in profile, medially excavate, posterior margin with deep v-shaped notch (Figs 25e, f, 26a), with moderate distribution of setae (Fig. 25f); parameres basally columnar with shallow, hook-shaped apex, tip rounded (Fig. 26b); aedeagus with heavily-sclerotized box-shaped phallotheca, without processes (Figs 26c, d); two conjunctival appendages, CAII pair symmetrical membraneous, bifid, CAII(M) and CAII(L) with apical conical sclerites (Figs 26c, d); CAIII bifid, large, heavily-sclerotized, U-shaped, medially

Fig. 26: Male genitalia of *Calliscyta stalii* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) apex of aedeagus, ventral view. Abbreviations: C = crown of paramere; CAI(V) = ventral branch of first conjunctival appendage; CAI(D) = dorsal branch of first conjunctival appendage; CAII(L) = lateral branch of second conjunctival appendage; CAII(M) = medial branch of second conjunctival appendage; CAIII = third conjunctival appendage; DCC = dorsal conducting canal; DS(D) = ductus seminis distalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; GO = genital opening; Pt = phallotheca; S = stem of paramere; Sg = secondary gonopore; SP = setose patches of male genital opening; VCC = ventral conducting canal; V = vesica; VM = ventral margin of genital opening.

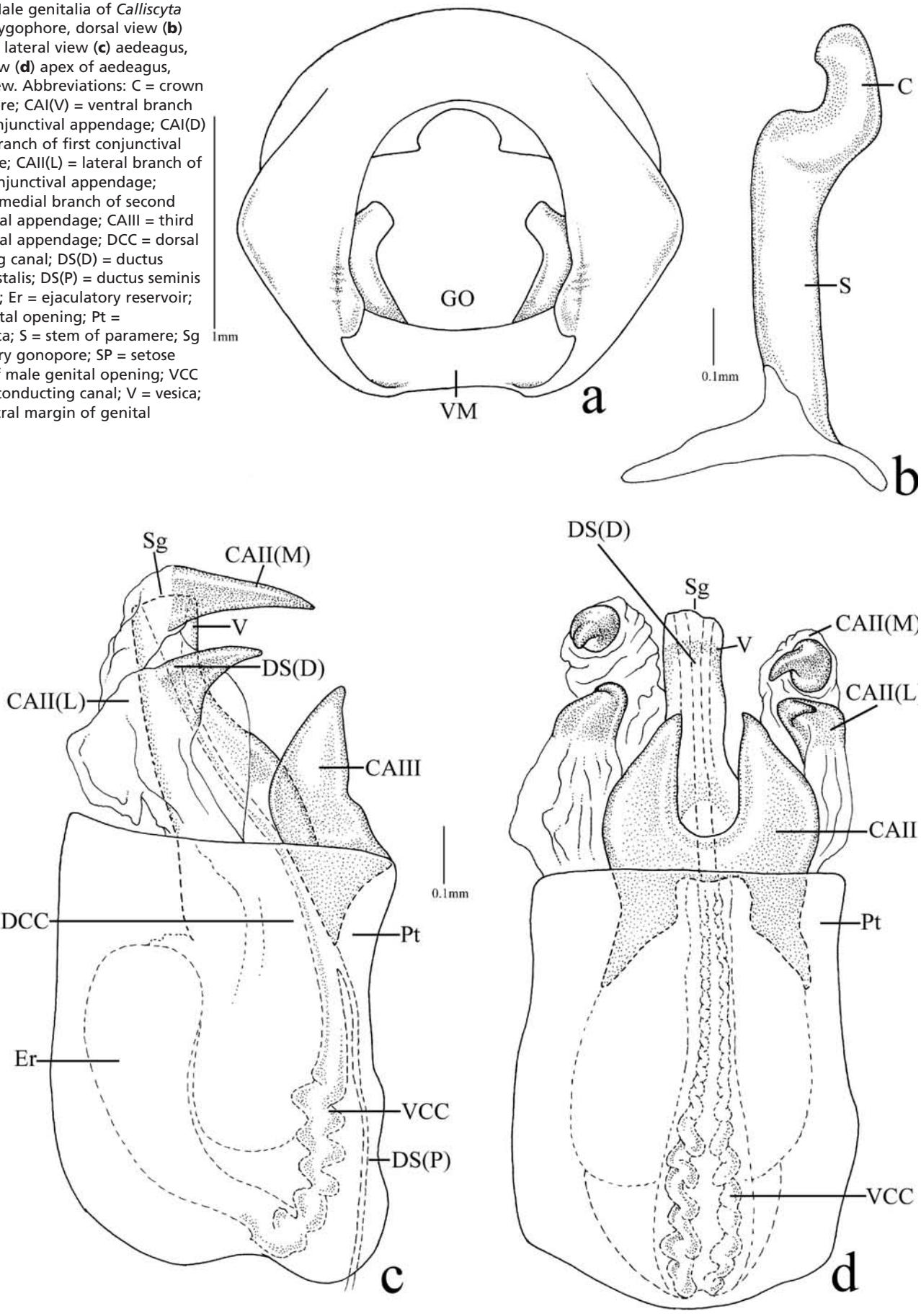


Fig. 27: Distribution of Scutellerinae species (**a**) *Calliscyta stalii* (**b**) *Cantao parentum* (**c**) *Heissiphara minuta* nov.sp.

fused at base (Figs 26c,d); ductus seminis proximalis narrow; ejaculatory apparatus with heavily-sclerotized ventral convoluted conducting canals (Figs 26c, d); ejaculatory reservoir heavily-sclerotized, elongate-ovoid (Figs 26c, d): dorsal conducting canal broad, strongly sclerotized (Figs 26c, d); ductus seminis distalis strongly sclerotized (Figs 26c, d); vesica broad (Figs 26c, d). Female Terminalia: paratergites VIII broad, large, medially emarginate; paratergites IX small, subelliptoid; gonocoxae I subtriangular, with posterior margins concave; fecundation canal short; spermathecal reservoir circular, large, strongly thickened; fecundation canal short, narrow spermathecal bulb heavily sclerotized, with proximal and distal flanges.

Diversity and distribution: *Calliscyta* is a monotypic genus, restricted to tropical eastern Queensland.

Included species:
C. *stalii* (VOLLENHOVEN 1863) Australia

Remarks: MCDONALD & CASSIS (1984) synonymized *Calliscyta* with *Choerocoris* based on similarities of the male and female genitalia. Males of *Calliscyta stalii* differ significantly from *Choerocoris paganus* and C. *variegatus*, by having the ductus seminis distalis tapered as opposed to greatly incrassate. In contrast, the conjunctival appendages of C. *stalii* and C. *paganus* are more alike, than the latter is with its congener C. *variegatus*. MCDONALD (1963a) reported on the significance of the bifid condition of the CAII and CAIII conjunctival appendages in these taxa. However, our observation reveal that these character states are broadly held in scutellerids. We consider the shape of the conjunctiva as of importance in separating species, but are doubtful indicators of phylogenetic significance. MCDONALD & CASSIS (1984) also indicated that the female genitalia of *Calliscyta* and *Choerocoris* are closely aligned, but our observations indicate no special similarities in the external female genitalia and spermatheca. The conditions described in MCDONALD (1963b) are more descriptive of the Scutellerinae, rather than at any subordinate taxonomic level.

In contrast, *Calliscyta stalii*, differs from *Choerocoris*, by the following characters: lateral margins of jugae rounded (cf. carinate), forewings extending beyond apex of scutellum (cf. covered), peritreme and evaporative areas of the metathoracic glands greatly reduced (cf. extensive), ventral margin of the male pygophore emarginate (cf. entire), and tapered ductus seminis distalis. These character differences are not only sufficient in recognising *Calliscyta*, but also provide significant differentiation from *Choerocoris*, such that the closeness of the relationship of these two genera is in question.

Calliscyta stalii (VOLLENHOVEN 1863) (Figs 21d, 24a, 25, 26, 27)
Revised Status

Calidea stalii VOLLENHOVEN 1863: 24 (n.sp.)
Calliscyta stalii: STÅL 1873: 24 (new combination); LETHIERRY & SEVERIN 1893: 31 (catalogue); SCHOUTEDEN 1904: 25 (list, habitus); VAN DUZEE 1905: 190 (distribution); BERGROTH 1908: 296 (list); KIRKALDY 1909: 301 (list); WU 1933: 229 (China, incorrect record)
Choerocoris stalii: MCDONALD & CASSIS 1984: 561 (new combination); CASSIS & GROSS 2002: 594 (catalogue)
Calliscyta australis DISTANT 1899: 40 (n.sp.); LETHIERRY & SEVERIN 1893: 31 (catalogue); SCHOUTEDEN 1904: 25 (list); BERGROTH 1908: 296 (list); KIRKALDY 1909: 301 (list); MCDONALD 1963a: 26 (male genitalia); MCDONALD & CASSIS 1984: 561 (synonymy); CASSIS & GROSS 2002: 594 (catalogue; synonymy)

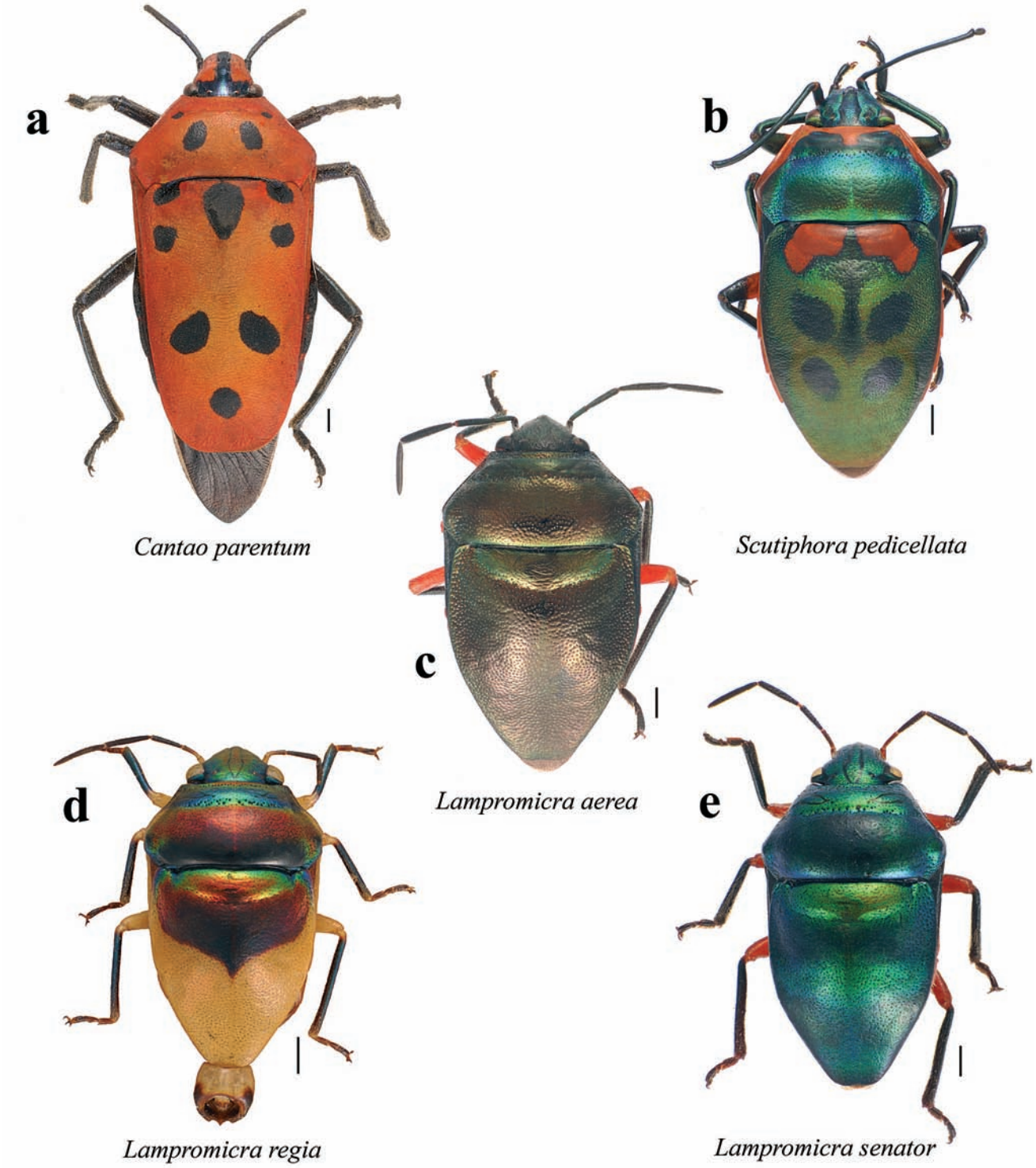


Fig. 28: Habitus of Australian Scutellerinae (**a**) *Cantao parentum*, ♂ (**b**) *Scutiphora pedicellata*, ♀ (**c**) *Lampromicra aerea*, ♂ (**d**) *Lampromicra regia*, ♂ (**e**) *Lampromicra senator*, ♂. Scale bars = 1mm.

Diagnosis: *Calliscyta stalii* is recognised by the following combination of characters: dorsum mostly red-fuscous, with orange markings on pronotum and scutellum (Fig. 24a); AIV longest segment; labium reaching midpoint of metacoxae; anterolateral margins of pronotum elongate; ventral surface of legs with thick orange setae; abdominal venter mostly red with sublateral fuscous spots (Fig. 21d); and, genitalia as in generic diagnosis (Figs 26a-d).

Description: Body moderately large, males 13-14.7 mm, females 13.6-14.7 mm; dorsum strongly convex.

Colouration. Dorsum mostly red-fuscous and green iridescence, with orange markings on pronotum and scutellum (Fig.

24a). Head: mostly fuscous, sometimes with green iridescence, jugae orange-red. Antennae: uniformly fuscous. Labium: fuscous. Pronotum: mostly red-fuscous, callosite region and pronotal midline most often with yellow-red to orange-red marking. Scutellum: mostly red-fuscous, anterolateral regions with yellow-red to orange-red markings. Thoracic Pleura: mostly yellow to orange with fuscous punctations. Legs: uniformly fuscous, often with green iridescence. Pregenital Abdomen: mostly red, with fuscous patches bounding spiracular + trichobothria region (Fig. 21d).

Texture. Dorsum densely punctate, with moderately deep punctures; callosite region of pronotum partly impunctate; underside of head and thoracic pleura densely punctate; abdominal venter weakly rugopunctate.

Vestiture. Dorsum glabrous; ventral surfaces of legs setose, with thick yellow setae; abdominal venter with a few scattered setae.

Structure. Antennae: relatively short; AIV longest segment, little longer than AI-II; AII(a) shortest segment; AI & AII(b) subequal in length; AIII and AIV weakly flattened. Labium: flattened, reaching midpoint of metacoxae; LII longest segment; LI shortest segment; LIII-LIV subequal in length. Pronotum: anterolateral margins greatly elongate, more than 2x length of posterolateral margins. Pregenital Abdomen: connexival margins entire, without posterolateral spines or nodules (Fig. 21d). Genitalia: as in generic description.

Measurements. McDonald & Cassis 1984: Table 5 (as *Choerocoris stalii*)

Other material examined: **Queensland**: 2♂♂ 2♀♀, South Percy Island, NW Bay, 23-29 November 1992, GB Monteith, G Thompson, D Cook & H Janetzki (QM).

Distribution: *Calliscyta stalii* is known from North Queensland (Fig. 27).

Host records and biology: Monteith (pers. comm.) found large numbers of *Calliscyta stalii* in the leaf axils of a species of the monocot genus *Pandanus* (Pandancaceae). It is uncertain whether this is a food plant or a diapause site.

Remarks: Vollenhoven (1863) originally described *Calliscyta stalii* from an unspecified locality in Timor. Distant (1899) subsequently described an additional species, *C. australis*, from Queensland. McDonald & Cassis (1984) synonymized the latter on the basis of similarities of the male genitalia.

Calliscyta stalii is not common in collections and often has a greasy appearance. It is much larger than species of *Choerocoris*, and more elongate-ovoid, than ovoid. Re-examination of the type material of *C. stalii* and *C. australis* confirm the synonymy given by McDonald & Cassis (1984). This species shows less variation in size and colouration than in most other scutellerine species. There is some intraspecific variation in the colour patterning of the pronotum and scutellum, particularly in the extent of the lighter markings.

Cantao Amyot & Serville 1843 (Figs 1b, 21e, 27, 28a, 29, 30)

Cantao Amyot & Serville 1843: 29 (gen.n.); Dallas 1851: 3, 17 (key, list); Stål 1865: 33 (key); Mayr 1866: 14 (description); Stål 1873: 10 (list); Lethierry & Severin 1893: 18 (catalogue); Distant 1902: 42 (description); Schouteden 1904: 18 (description); Kirkaldy 1909: 307 (catalogue); McDonald & Cassis 1984: 550, 552 (key, description); Cassis & Gross 2002: 591 (catalogue)

Cantao (*Iostethus*) Stål 1873: 10 (gen.n.); Kirkaldy 1909: 307 (catalogue)

Type species: *Cantao*: *Cimex ocellatus* Thunberg 1789, subsequent designation, Kirkaldy 1909: 307; *Cantao* (*Iostethus*): *Calidea parentum* White 1839: 85, subsequent designation, Kirkaldy 1909: 307

Diagnosis: *Cantao* is recognised by the following characters: elongate-ovoid (Figs 1b, 28a); large size; bicoloured, orange or red with fuscous to dark blue markings (Figs 1b, 28a), sometimes with green iridescence ventrally; body smooth, punctulate to rugopunctulate (Figs 1b, 28a); hemelytra extending beyond tip of abdomen; lateral margins of jugae almost straight (Fig. 29a), carinate in profile (Fig. 29b); anterolateral margins of pronotum carinate; anterolateral angles of scutellum foveate (Figs 1b, 28a); apex of scutellum truncate (Fig. 28a); peritreme greatly enlarged, subtriangular, raised, sulcate at base (Fig. 29d); abdominal SVIII visible (Fig. 29e); male pygophore large, ventrally oriented (Fig. 29e); ejaculatory apparatus with convoluted ventral conducting canals (Figs 30c, d); CAII undivid-

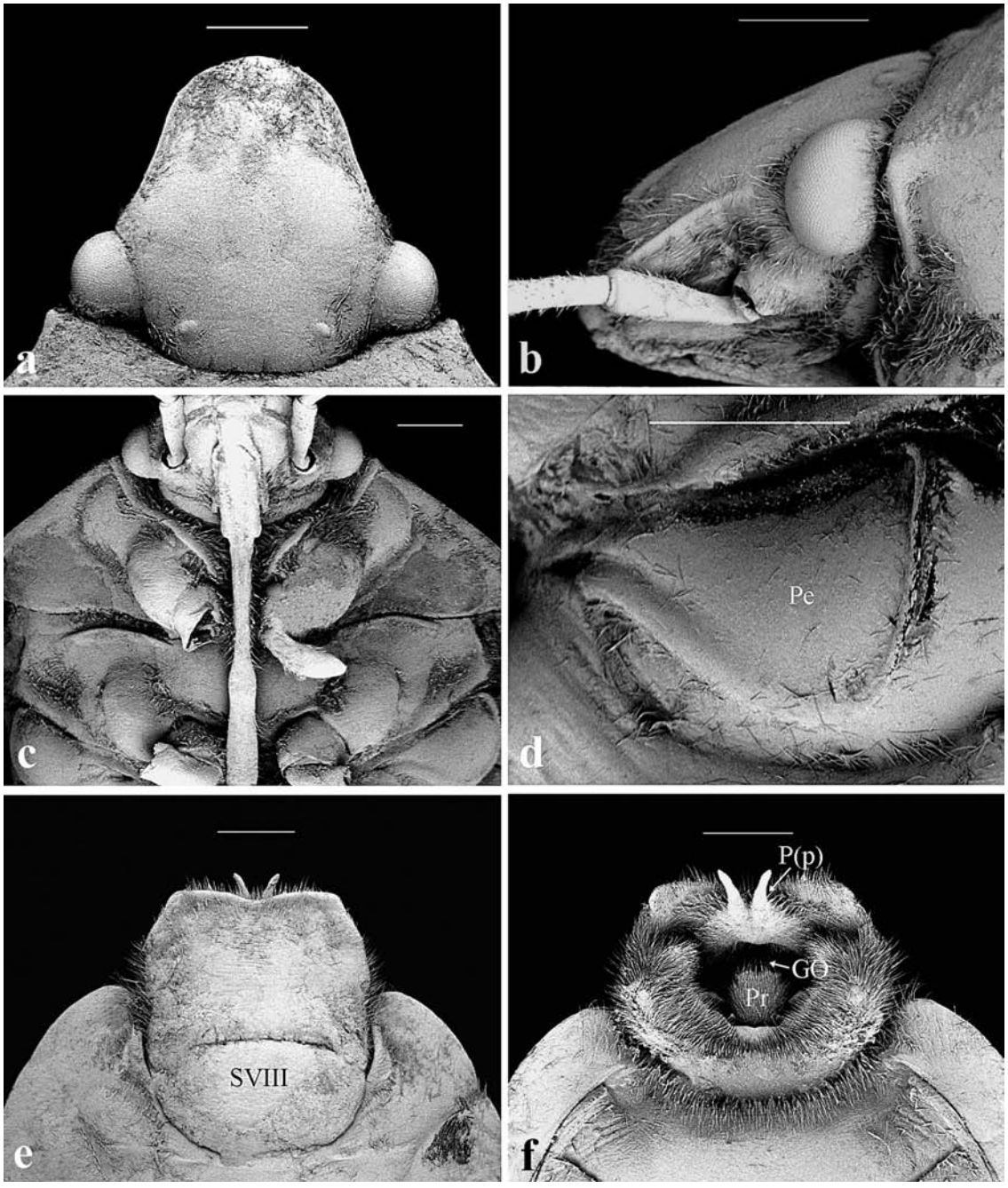


Fig. 29: Scanning electron micrographs of key characters of *Cantao parentum* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Abbreviations: Ea = evaporative area; Go = genital opening; P = pronotum; P(al) = anterolateral margin of pronotum; Pe = peritreme; Pe(k) = keel of anterior margin of proepisternum; P(r) = right paramere; Pr = proctiger; EES = external efferent system.
Scale bars = 1 mm.

ed, with blunt lobal sclerite (Figs 30c, d); spermathecal reservoir large, oval; spermathecal pump with proximal and distal flanges.

Description: Body elongate-ovoid, hemelytra extending beyond truncate tip of scutellum (Figs 1b, 28a); dorsum ground colour yellow, orange or red-brown with patterned fuscous to black markings (Figs 1b, 28a), venter with green-fuscous iridescent patterned markings; body smooth, punctulate to rugo-punctulate; ventral surface densely setate with rows of setae on anterior margin of proepisternum and evaporative areas posteriad to peritreme. Head: transverse, convex in dorsal view; jugal margins carinate; jugae rugulose; bucculae narrow, sometimes margins weakly excavate. Antennae: AI and AII(a) short, AII(b)-AIV subequal in length. Labium: reaching between apices of metacoxae and basal abdominal sterna. Pronotum: broadly trapezoidal, wider than long (Figs 1b, 28a), evenly convex in profile, without a transverse furrow, posteriad to callosite region; anterior margin deeply excavate (Figs 1b, 28a), sometimes weakly depressed; anterolateral margins strongly carinate, weakly to strong-

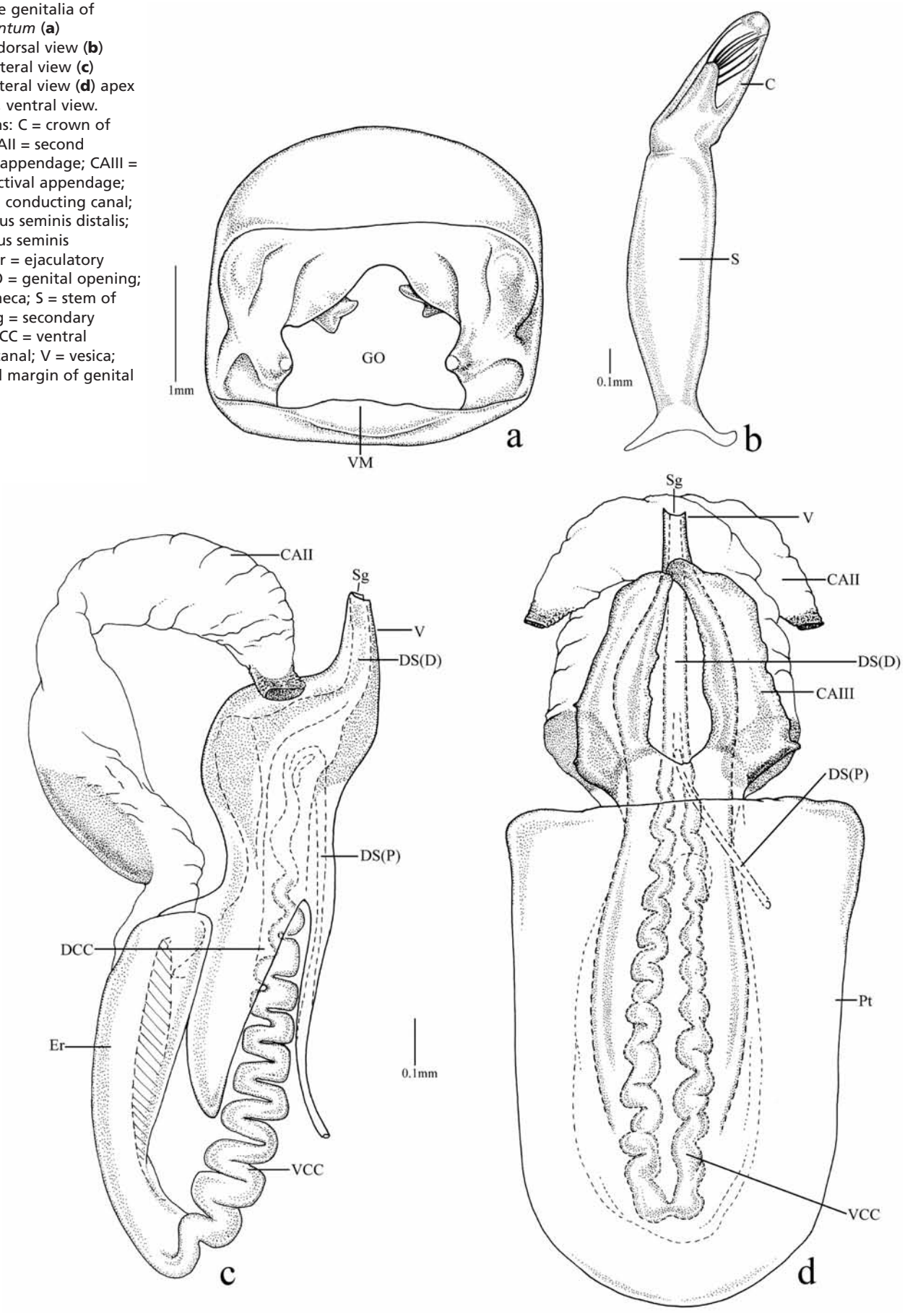


Fig. 30: Male genitalia of *Cantao parentum* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) apex of aedeagus, ventral view. Abbreviations: C = crown of paramere; CAII = second conjunctival appendage; CAIII = third conjunctival appendage; DCC = dorsal conducting canal; DS(D) = ductus seminis distalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; GO = genital opening; Pt = phallotheca; S = stem of paramere; Sg = secondary gonopore; VCC = ventral conducting canal; V = vesica; VM = ventral margin of genital opening.

ly concave (Figs 1b, 28a); posterior margin weakly excavate (Fig. 28a); humeral angles rounded (Figs 1b, 28a) to prominently spinose; posterior angles, with posteriorly projecting thorn-like process. Scutellum: elongate (Fig. 28a), strongly convex in profile; anterolateral region deeply foveate (Figs 1b, 28a), forewings minimally exposed basally; truncate apically, wings visible (Figs 1b, 28a). Thoracic sterna: without carination (Fig. 29c). Thoracic pleura: anterior margin of proepisternum thickened (Fig. 29c). Thoracic Pleura: ostiole small, with greatly enlarged subtriangular peritreme, with shallow basal sulcation (Fig. 29d); evaporative areas restricted to anterior and posterior margins of peritreme, not extending laterally beyond peritreme (Fig. 29d); mesepimeron without evaporative areas. Male Pregenital Abdomen: moderately convex, broad; abdominal trichobothria in recessed area; SVIII visible, caudally extending well beyond base of pygophore (Fig. 29e). Male Genitalia: pygophore large, barrel-shaped, ventral surface sometimes with excavation, ventral margin sometimes with a U- or V-shaped projection medially (Figs 29e, f); genital opening broad (Fig. 30a), suboval, sometimes with ventral bifid pygophoral process; parameres hook-shaped, with apices rounded (Fig. 30b) to acute; aedeagus with moderately sclerotized phallotheca, subconical, without processes (Figs 30a, b); CAII membraneous, with blunt lobal sclerite, basally with area of sclerotisation (Figs 30c, d); CAIII U-shaped, heavily sclerotized (Fig. 30d); ductus seminis proximalis narrow, within a phallothecal extension (Fig. 30c); ejaculatory apparatus with highly convoluted ventral conducting canal, with up to 12 convolutions (Figs 30c, d); ejaculatory reservoir sclerotised (Fig. 30c); ductus seminis dorsalis and vesica with subapical tumescence (Fig. 30c). Female Terminalia: caudally oriented, sometimes recessed; paratergites VIII large, subtriangular; paratergites IX small to absent. Spermatheca: base of spermatheca strongly sclerotized; fecundation canal elongate, moderately sclerotized; spermathecal reservoir oval, robust; sclerotized proximal and distal flanges present; and, usually, with heavily sclerotized oval bulb.

Diversity and distribution: *Cantao* has an Indo-Pacific distribution (sensu SCHUH & STONEDAHL 1986). The Australian species *C. parentum* is found through coastal Queensland, as far south as the Northern Rivers district of New South Wales. There is some doubt as to the native distribution and identity of *C. africanus*. HORVÁTH'S (1892) original description gives the Congo as the type locality. SCHOUTEDEN (1904) suggested that the species could be either from the Congo or Queensland. MCDONALD (1988) queried if *C. africanus* is a synonym of *C. ocellatus*, based on identified material of the latter from Zaire. *Cantao ocellatus* is the most broadly distributed species in the genus, and is found from the Afrotropical region to Papua New Guinea, as well as many countries in the Oriental region, and extending westward as far as Pakistan. The other three species of *Cantao* exhibit more restricted distributions in the eastern Oriental region and the Australian region.

Included species:

C. africanus HORVÁTH 1892	Afrotropical region
C. ocellatus (THUNBERG 1784)	Afrotropical (Zaire), Oriental (broadly) and Palearctic (Regions) regions, Papua New Guinea
C. variabilis (MONTROUZIER 1855)	Indonesia, Philippines, Papua New Guinea
C. parentum (WHITE 1839)	Australia
C. purpuratus (WESTWOOD 1837)	Indonesia (Banda, Timor)

Remarks: SCHOUTEDEN (1904) divided *Cantao* into two subgenera; *Cantao* (*Cantao*) and *Cantao* (*Iostethus*), based on the presence or absence of punctures, respectively. MCDONALD (1988) synonymized these two subgenera, implicitly dismissing the importance of punctation. We endorse this view, particularly as the supposedly smooth body of *C. parentum* and *C. purpuratus* has minor punctulation. The male and female genitalia of all *Cantao* species are alike. In males, the aedeagus has two pairs of conjunctival appendages (CAII and CAIII), an ejaculatory apparatus with a ventral convoluted conducting canal; typical of scutellerines. In addition, the male abdominal SVIII is visible, overlapping the basal margin of the Py-

gophore. The females have terminally oriented external genitalia, and the spermathecal reservoir is oval and large. In *Cantao* there is surprising variation in the development of paratergites IX, which can be present (*parentum*) or reduced/absent (*africanus*, *ocellatus* and *variabilis*).

The sister-genus of *Cantao* is not apparent, as it shares a number of features with numerous Old World genera. McDONALD (1988) suggested that *Cantao* is closely related to *Calliphara*, *Callidea* LAPORTE and *Chrysocoris*, but gave no morphological basis for such an hypothesis. *Cantao*, like other scutellerine genera such as *Chrysophara*, *Lampromicra* and *Scutiphora*, has the forewings extending beyond the tip of the scutellum and the female external genitalia terminal in orientation. However, the external efferent system of the metathoracic glands of *Cantao* is distinctive, with the evaporative areas reduced and the peritreme greatly enlarged. This is unlike that found in genera such as *Calliphara*, *Chrysocoris*, *Lampromicra* and *Scutiphora*, and similar to the condition found in *Calliscyta*.

Cantao parentum (WHITE 1839) (Figs 1b, 21e, 27, 28a, 29, 30)

Calidea parentum WHITE 1839: 542 (n.sp.); WALKER 1867: 14 (list); LETHIERRY & SEVERIN 1893: 18 (catalogue); SCHOUTEDEN 1904: 19 (list); KIRKALDY 1909: 308 (catalogue); TILLYARD 1926: 149 (description); McDONALD 1961: 174, 185, figs 1-4 (male genitalia); McDONALD 1963a: 30 (male genitalia); McDONALD 1963b: 233, figs 10-12 (female genitalia); McDONALD 1963c 285 (biology); KUMAR 1964: 58 (morphology); KUMAR 1965: 41 (male genitalia); McDONALD & CASSIS 1984: 552 (description); McDONALD 1988: 293 (key, synonymy); CASSIS & GROSS 2002: 592 (catalogue); MILLAR 2005: 78 (glandular chemistry)

Cantao pulcher SCHOUTEDEN 1906: 137 (n.sp.); McDONALD & CASSIS 1984: 522 (synonymy)

Diagnosis: *Cantao parentum* is recognised by the following combination of characters: dorsum orange, pronotum with pair of black spots, and scutellum with eight black spots (Figs 1b, 28a); humeral angles rounded (Figs 1b, 28a); male pygophore with ventral forked process (Figs 29e, f); CAII with basal sclerotisation and apical, blunt lobal sclerite (Fig. 30c, d); CAIII fused basally, U-shaped, with lateral margins weakly serrate (Fig. 30d); female terminalia strongly recessed; and, paratergites IX present;

Description: Body elongate-ovoid; large, males9.2-22.5 mm, females 15.5-24.6 mm.

Colouration. Dorsum mostly orange, with patterened black spots (Figs 1b, 28a); body mostly iridescent green-black ventrally. Head: medial regions of clypeus and frons, and vertex green-black, often with iridescent green tinge; jugae and frons orange; antennae and labium fuscous, often with reddish tinge; underside of head red-fuscous; antennae and labium uniformly fuscous. Pronotum: mostly orange, with a pair of small black spots, sublaterally at base of callosite region (Figs 1b, 28a). Scutellum: mostly orange, with eight black spots, three pair sublaterally from anterior margin to just beyond midlength, and single spot along midline at anterior margin and single spot submedially (Figs 1b, 28a). Thoracic pleura: mostly fuscous with purple to green iridescence, with posterior region of proepimeron orange. Legs: mostly fuscous, often with purple to green iridescence, coxae with orange shading. Pregenital Abdomen: venter mostly orange, SII uniformly orange, SIII-SVI with lateral, suboval fuscous markings (Fig. 21e); SVII medially with large iridescent green-fuscous markings, trichobothrial region with short black spot (Fig. 21e); male SVIII mostly orange with iridescent green tinge (Fig. 21e). Female Terminalia: orange. Male Pygophore: iridscent dark green.

Texture. Dorsum smooth to weakly punctulate.

Vestiture. Body with moderate distribution of simple, short pale setae; more densely distributed on head, thoracic pleura and abdominal venter.

Structure. Antennae: AI shortest segment; AII(b)- AIV roughly subequal, AIV longest segment. Labium: reaching between apex of metacoxae and posterior margin of abdominal SII; LI shortest segment; LI longest segment; LIII & LIV subequal. Pronotum: humeral angles rounded (Figs 1b, 28a). Pregenital Abdomen: male abdominal SVIII visible, overlapping posterior margin of Pygophore. Male Genitalia: genital opening of male pygophore with ventral forked process, branches divergent, dorsolaterally

strongly tumose (Figs 29e, f, 30a); parameres large, crown weakly hooked, weakly flattened, with prominent basal flange (Fig. 30b); ejaculatory apparatus well-developed, heavily sclerotized; ventral conducting canal elongate, with 10-12 convolutions (Figs 30c, d); CAII singular, membraneous lobe, outer margin at base sclerotized, apex with truncate lobal sclerite (Figs 30c, d); CAIII U-shaped, convergent apically, fused post-thecal margin, heavily sclerotized, margins weakly serrate (Figs 30c, d); vesica elongate, subdistally swollen (Figs 30c, d). Female Terminalia: caudal in orientation, recessed; paratergites VIII subtriangular, depressed medially; paratergites IX small, suboval, gonocoxae I large, subelliptoid, tapered medially. Spermatheca: proximal fecundation canal elongate, heavily sclerotized; reservoir relatively small, oval, heavily sclerotized; distal fecundation canal moderately elongate; proximal and distal flanges present; bulb oval, heavily sclerotized.

Measurements. McDonald & Cassis 1984: Table 3.

Material examined: **Queensland**: 2♂♂ 1♀, Lockerbie Scrub, Cape York, 11 April 1975, MS Moulds (AM); 2♀♀, North Pine River, A Musgrave, 30 December 1926 (AM; 58634); 1♀, Surfers Paradise, 10 August 1953 (AM); **New South Wales**: 2♂♂, Lismore, A Musgrave, 1 January 1929 (AM; K47241); 1♀, Tweed Rivers, C Gibbons (AM; K49069).

Distribution: This species is distributed in tropical areas of Queensland and the subtropical areas of eastern Queensland and the Northern Rivers of New South Wales (Fig. 27).

Host plants and biology: McDonald (1963c) described the biology of this species, including life history attributes and host plant associations. *Cantao parentum* is known to breed on three species of the euphorb genus *Mallotus*; *M. claoxyloides*, *M. discolor* and *M. philippensis*. A single specimen was collected on *Araucaria cunninghamii*, but is treated here as a sitting record, as this species is known to regularly cluster on tall on-host trees during winter aestivation (Monteith, pers. comm.).

Remarks: White (1839) originally described *C. parentum* from an unspecified location. Schouteden (1906) described a second Australian species of *Cantao*, *C. pulcher*, from a male specimen from Queensland. McDonald & Cassis (1984) synonymized the latter with *C. parentum*, regarding it, at most, as a colour variation. Our observation indicate that there are variations in the colour patterning of this species, yet there is almost no variation in the male genitalia and we thus endorse this synonymy.

Cantao parentum is a distinctive component of the Australia jewel bug fauna. Some individuals of both sexes are over 20 mm in length. The body is also relatively less convex than all the other species of jewel bugs, and has a bright orange dorsum, with black spots (Fig. 28a). The male genitalia is also distinctive in that CAII is not subdivided (Figs 30c, d). It is easily differentiated from the other species of *Cantao* (all of which are found outside of Australia), by the arrangement of black spots on the dorsum. In this character, it resembles *C. ocellatus*, but is distinguished from the latter by having rounded humeral angles (cf. spinose angles) and differences in the male and female genitalia. McDonald (1988) provides a key to species of *Cantao*.

Choerocoris Dallas 1851 (Figs 24c-f, 31, 32, 33, 34, 35, 36, Table 7)

Choerocoris Dallas 1851: 29 (gen. nov.); Mayr 1866: 22 (description); Stål 1865: 33 (key); Stål 1873: 13 (description); Lethierry & Severin 1893: 21 (catalogue); Schouteden 1904: 38 (description); Kirkaldy 1909: 291 (catalogue); Gross 1975: 93 (description); McDonald & Cassis 1984: 558 (description); Cassis & Gross 2002: 592 (catalogue)

Type species: *Cimex paganus* Fabricius 1775, subsequent designation: Schouteden 1904: 28

Diagnosis: *Choerocoris* is recognised by the following characters: elongate-ovoid (Figs 24c-f); bicoloured, orange or red with fuscous to dark blue markings, sometimes with green iridescence (Figs 24c-f); body punctate (Figs 24c-f); jugal margins of head carinate (Fig. 31b); metathoracic gland ostiole not hooded (Fig. 31d); peritreme narrow, elongate, arcuate, anteriorly-projected distally, medially sulcate (Fig. 31d); male pygophore caudally oriented (Fig. 31e); spermathecal reservoir large, oval; and, spermathecal bulb with proximal and distal flanges.

Table 7: *Choerocoris grossi* nov.sp. and *C. lattini* nov.sp. diagnostic measurements in millimetres. N = sample size.

	Male			Female		
	N	**Mean±SD**	**Range**	**N**	**Mean±SD**	**Range**
Choerocoris grossi nov.sp.						
Length	5	10.60±0.64	10.15-11.05	5	10.72±0.61	9.70-11.22
Pronotal width	5	5.45±0.61	5.03-5.88	5	5.76±0.40	5.07-6.05
Width between eyes	5	2.33±0.23	2.17-2.50	5	2.47±0.16	2.21-2.60
Antennal segment length						
I	-			5	0.59±0.08	0.53-0.64
II	-			5	0.44±0.12	0.36-0.53
III	-			5	0.56±0.09	0.52-0.59
IV	-			5	1.08±0.03	1.06-1.10
V	-			5	1.15±0.09	1.08-1.21
Labial segment length						
I	5	1.22±0.24	1.05-1.38	5	1.05±0.30	1.11-1.36
II	5	1.33±0.10	1.26-1.40	5	1.33±0.15	1.11-1.50
III	5	1.28±0.31	1.06-1.50	5	1.21±0.17	0.94-1.33
IV	5	1.14±0.15	1.03-1.25	5	1.08±0.29	0.76-1.33
Choerocoris lattini nov.sp.						
Length	5	11.57±0.62	10.49-12.08	5	11.81±0.56	11.14-12.41
Pronotal width	5	5.99±0.21	5.77-6.24	5	6.13±0.22	5.90-6.38
Width between eyes	5	2.74±0.16	2.50-2.89	5	2.74±0.09	2.67-2.85
Antennal segment length						
I	5	0.79±0.10	0.71-0.95	5	0.70±0.16	0.43-0.82
II(a)	5	0.44±0.06	0.35-0.50	2	0.43±0.33	0.38-0.48
II(b)	5	0.74±0.06	0.68-0.83	5	0.74±0.06	0.65-0.81
III	5	0.63±0.20	0.46-0.92	5	1.01±0.15	0.82-1.16
IV	1	0.72	-	5	1.09±0.14	0.95-1.24
Labial segment length						
I	5	1.21±0.21	0.91-1.45	5	1.42±0.32	0.94-1.83
II	5	1.39±0.19	1.22-1.66	5	1.41±0.18	1.25-1.62
III	5	1.51±0.28	1.20-1.87	5	1.43±0.38	1.00-1.71
IV	5	1.37±0.10	1.28-1.51	5	1.40±0.31	1.22-1.52

Description: Elongate-ovoid (Figs 24c-f); strongly convex (Figs 32b, d, f, h); body moderately sized, males 8-14.7 mm, females 10-14.5 mm; dorsum densely punctate (Figs 24c-f), sometimes less so on pronotum (Fig. 24d); body glabrous (Figs 24c-f); appendages weakly setose; ground colour orange or red, with fuscous to blue-fuscous markings, often with iridescence (Figs 24c-f); forewing not surpassing tip of scutellum (Figs 24c-f). Head: moderately sized, suboval, transverse (Fig. 31a); lateral margins of postclypeus sulcate; jugal margins sinuate, in profile carinate (Fig. 31b). Antennae: AI-AII(b), AIV cylindrical, AIII flattened; AII(a) shortest segment, a little shorter than AI, AIV longest segment. Labium: reaching between apices of metacoxae to abdominal sterna III; LII longest segment, little longer than LIII & LIV (latter two subequal). Pronotum: broad, trapezoidal, strongly convex (Figs 24c-f); anterior margin weakly excavate; anterolateral margins rectilinear to weakly convex, strongly to moderately divergent (Figs 24c-f), carinate in profile (Fig. 31b); posterolateral margins rounded, carinate; posterior margin rectilinear. Scutellum: broadly U-shaped (Figs 24c-f), strongly convex; forewing visible at base; connexiva visible. Thoracic Pleura: anterior margin of proepisternum truncate to weakly explanate (Fig. 31c); mesepimeron with evaporative areas (Fig. 31d); external efferent system of metathoracic glands well-developed, covering most of metepisternum, raised (Fig. 31d); peritreme broad, sickle-shaped, anteriorly directed distally, medially carinate (Fig. 31d); evaporative areas barely surpassing peritreme distally, rugose (Fig. 31d). Pregenital Abdomen: posterior angles of SIV-VII or III-VII weakly to strongly nodulate (Figs 32a-h); males without sternal glands. Male Genitalia: pygophore moderately sized, lozenge-shaped, ventral margin rectilinear to weakly excavate (Figs 31e, f, 32a, b, e-h, 35a, 36a); genital opening narrowly oval, dorsal in orientation, entire opening with setose patches; parameres with short to elongate stem, small to moderately hooked apex, sometimes with subdistal flange (Figs 35b, 36b); ductus seminis proximalis narrow, (Figs 35c, 36c); ejaculatory apparatus moderately developed, with convoluted ventral conducting canal, 4-5 convolutions (Figs 35c, 36c); ejaculatory reservoir subelliptoid, bag-like (Figs 35c, 36c); ductus seminis distalis and vesica greatly incrassate subapically, vesica sometimes with subapical, antler-like projections (Figs 36c, d). Female Terminalia: small, in terminal plane; paratergites VIII small and triangular; paratergites IX large, subelliptoid; gonocoxae large, subtriangular, undivided, weakly concave, medial margins weakly elevated. Spermatheca: short fecundation canal; reservoir oval, internally ribbed; proximal and distal flanges; bulb sclerotized, oval.

Diversity and distribution: *Choerocoris* is an endemic Australian genus, which is composed of four species, including two new species, and are found commonly in continental Australia (Fig. 34).

Included species:

Ch. grossi nov.sp.	Australia
Ch. lattini nov.sp.	Australia
Ch. paganus (FABRICIUS 1775)	Australia
Ch. variegatus (DALLAS 1851)	Australia

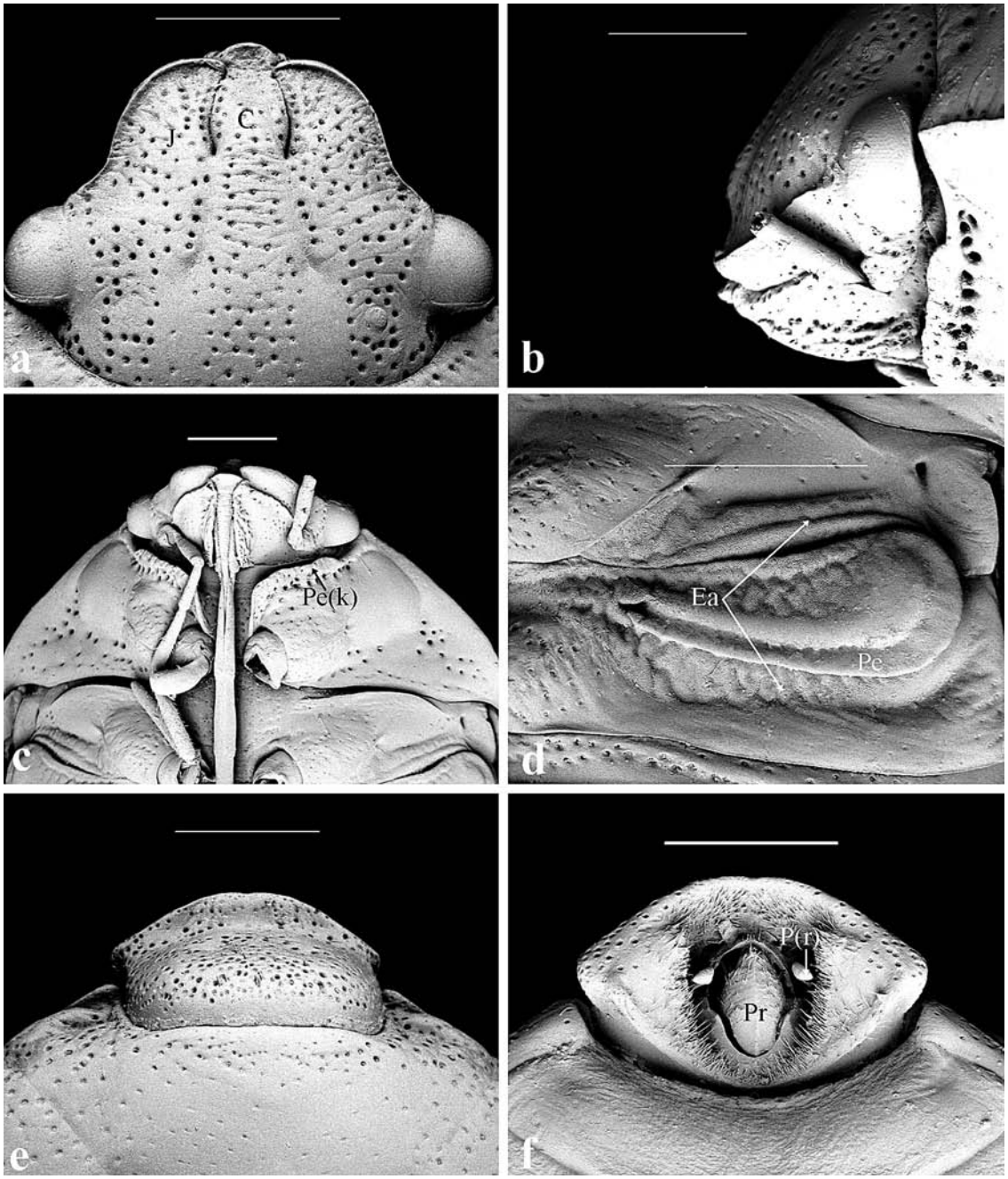


Fig. 31: Scanning electron micrographs of key characters of *Choerocoris paganus* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Abbreviations: C = clypeus; Ea = evaporative area; Pe = peritreme; Pe(k) = keel of anterior margin of proepisternum; P(r) = right paramere; Pr = proctiger.
Scale bars = 1 mm.

Remarks: *Choerocoris* is a distinctive genus in the Scutellerinae, whose affinities are uncertain. The ejaculatory apparatus is typical of many scutellerines; with the ejaculatory apparatus possessing a convoluted ventral conducting canal and an enlarged ejaculatory reservoir. It shares some similarities with *Cantao*, in that the ductus seminis distalis is incrassate subapically. It is similar to many Australian scutellerines, with the first conjunctival appendages (CAI) absent. McDonald (1961) first proposed that the male aedaegus of *Calliscyta* and *Choerocoris* were unlike, and McDonald & Cassis (1984) latter synonymized the genera, adding that the female genitalia were also alike. On closer inspection, the aedeagus of *Calliscyta stalii* shows close resemblance to *Choerocoris paganus*, in that the second conjunctival appendages are divided, with a conical lobal sclerite. However, this arrangement occurs in other scutellerines, and also the elvisurine *Solenotichus circuliferus*. The two genera differ externally in that *Choerocoris* has carinate jugal margins and a strongly arcuate (and medially sulcate) peritreme of the metathoracic glands.

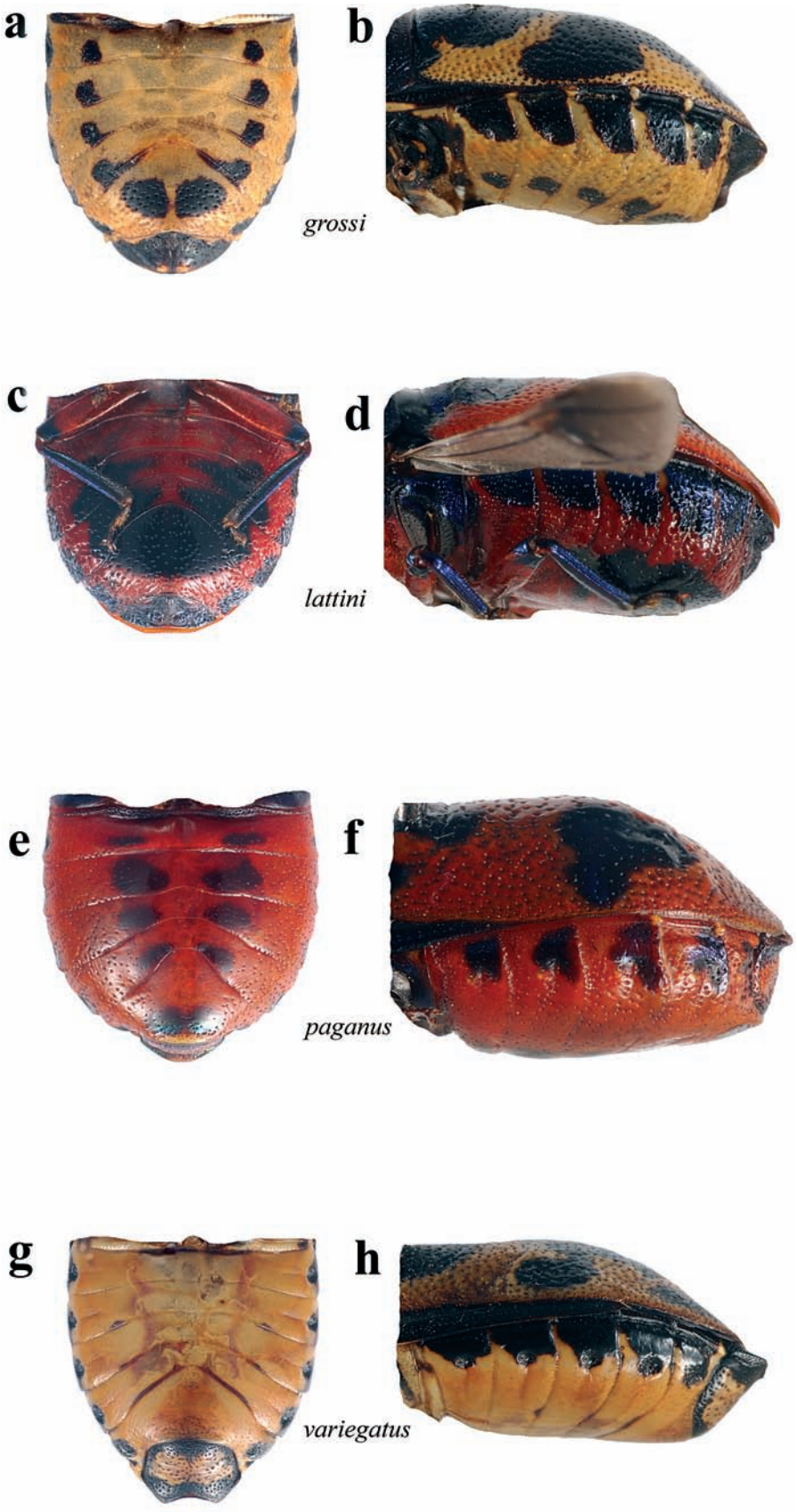


Fig. 32: Colouration of Abdominal Venter of *Choerocoris* species (**a-b**) *Choerocoris grossi* nov.sp. (**a**) ventral view (**b**) lateral view (**c-d**) *Choerocoris lattini* nov.sp. (**c**) ventral view (**d**) lateral view (**e-f**) *Choerocoris paganus* (**e**) ventral view (**f**) lateral view (**g-h**) *Choerocoris variegatus* (**g**) ventral view (**h**) lateral view.

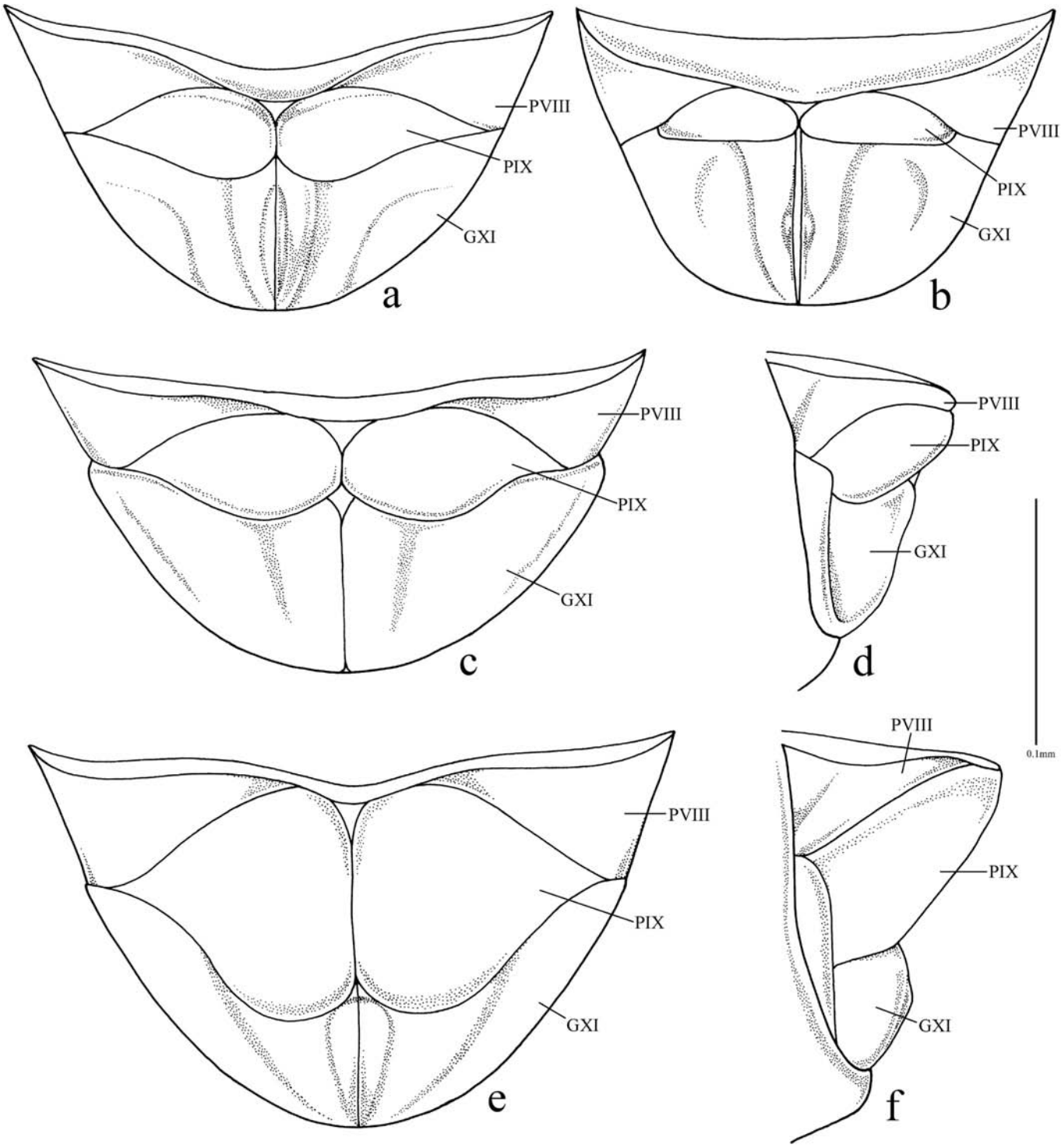
Choerocoris grossi nov.sp. (Figs 24e, 32a, b, 33e, f, 34, Table 7)

Holotype: **Queensland**: ♂ Bunya Mountains, N Geary, 12 February 1940 (AM); Paratypes: 1♀, same data as holotype (AM); 1♂ 3♀♀, Rockhampton, P1876-1877 (SAMA); **New South Wales**: 1♂ 1♀, Mullaley, 20 miles from Coonabarabran, HJ Carter, November 1930 (AM; K63008); 1♂ 2♀♀, Mullaley, November 1957, FE Wilson (SAMA); 4♀♀ 1 larva, Curlewis, A Musgrave, 29 October 1933, ex *Beyeria viscosa* (AM); 1♀, Mt Grattai, Nandewar Range, H Paul, November 1933 (AM).

Diagnosis: *Choerocoris grossi* nov.sp. is recognised by the following characters: yellow, nodulate posterior angles of connexiva V-VII (Figs 32a, b); abdominal venter yellow with lateral and submedial black markings (Figs 32a, b); paratergites IX greatly enlarged, suboval (Fig. 33e), oblique in profile (Fig. 33f); gonocoxae I reduced, scythe-like, strongly incrassate medially (Figs 33e, f); and, male genitalia as in C. *variegatus*.

Description: Body moderately sized, males 10.15-11.05 mm, females 9.70-11.22 mm.

Colouration. Body bicoloured, dusty yellow, with extensive black markings (Fig. 24c). Head: mostly black, clypeus with a longitudinal yellow stripe (variable in length), lateral margins of jugae broadly yellow, rarely head mostly black, sometimes with green iridescence; lorae black; genae mostly yellow, sometimes with dusty embrownment. Antennae: black, sometimes with green iridescence, rarely AI proximally orange-brown. Labium: mostly yellow, LIV fuscous. Pronotum: mostly black, anterior and anterolateral margins yellow, sometimes transverse yellow stripe, submarginal to posterior margin (Fig. 24c). Scutellum: yellow anterior margin with subhemispherical black marking, medially with W-shaped marking, sometimes contiguous with anterior marking, posterior margin with V-shaped black marking (Fig. 24c). Thoracic pleura and sterna: mostly yellow, proepimeron and mesepimeron with black sublateral stripe, evaporative areas partially black. Legs: femora mostly black, with yellow markings, more so ventral surface; tibiae mostly black, sometimes with green iridescence, lateral surfaces yellow. Pregenital Abdomen: posterior angles of connexiva V-VII yellow, nodulate (Figs 32c, d); abdominal venter mostly yellow, lateral margins of SIV-SVII with large, subtriangular black



markings, submedial regions of SIV-SVII with black suboval markings (Figs 32a, b); . Male Genitalia: pygophore mostly yellow, with margins black (Figs 32a, b). Female Terminalia: mostly black, paratergites IX with prominent yellow spots.

Texture. Dorsum densely punctate.

Structure. Antennae: females, AIV longest segment, little longer than AIII; AII(a) smallest segment; AI & AII(b) subequal in length. Labium: reaching posterior margin of abdominal SIII; segments roughly subequal in length, SII longest segment. Pregenital Abdomen: connexiva V-VIII with posterior angles strongly incrassate, nodulate (Figs 32a, b). Male Genitalia: ventral margin of pygophore deeply excavate; CAII(L) baglike with outer margins spiculate; heavily-sclerotized, antler-like CAIII; vesica with

Fig. 33: Female Terminalia of *Choerocoris* species (**a**) *Choerocoris lattini* nov.sp., ventral view (**b**) *Choerocoris paganus*, ventral view (**c-d**) *Choerocoris variegatus* (**c**) ventral view (**d**) lateral view (**e-f**) *Choerocoris grossi* nov.sp. (**e**) ventral view (**f**) lateral view. Abbreviations: PVIII = eighth paratergites; PIX = ninth paratergites; GXI = gonocoxae I.

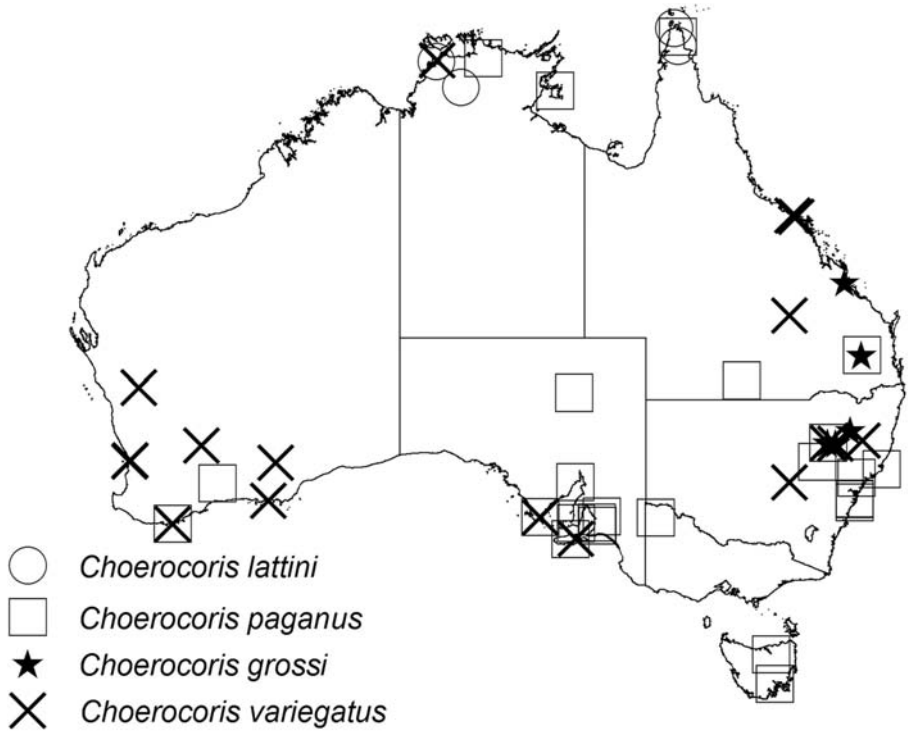


Fig. 34: Distribution of *Choerocoris* species.

paired, subdistal, sclerotized processes. Female Terminalia: paratergites VIII small, subtriangular (Figs 33e, f); paratergites IX greatly enlarged, suboval, oblique in profile (Figs 33e, f); gonocoxae I reduced, scythe-like, medially incrassate (Figs 33e, f).

Measurements. Table 7.

Etymology: This species is named after Gordon Gross, in recognition of his major contribution to Australian Heteropterology.

Distribution: This species is distributed in semi-arid regions of eastern Australia, from Rockhampton (Queensland) to locations west of the Great Dividing Range in New South Wales (Fig. 34).

Host plants and biology: This species has been collected on *Beyeria viscosa*.

Remarks: GROSS (1975) reported *Choerocoris variegatus* to be composed of five subspecies; the nominotypical subspecies, *C. variegatus similis*, and three undescribed subspecies. We have borrowed the material on which Gross made these conclusions, and found a collection of specimens labeled as '*Choerocoris variegatus* subsp.nov.' These are conspecific with a series of specimens of the Australian Museum, from New South Wales and Queensland. These specimens can be distinguished externally from *C. variegatus* by the colouration of the abdominal venter, in possessing lateral and submedial bands of black colouration (cf. lateral band alone). The most conclusive diagnostic feature of *C. grossi*, is the female terminalia, which are unlike any species of *Choerocoris*, and indeed any Australian species of jewel bug. In this species, paratergites IX are greatly enlarged, and much larger than gonocoxae I (cf. relatively small paratergites IX and large gonocoxae I), with the latter greatly reduced, with the posterior margin deeply excavate (Fig. 33e). Although the male genitalia of *C. grossi* and *C. variegatus* are indistinguishable, the female terminalia serve as a strong basis for species separation.

Choerocoris lattini nov.sp. (Figs 24c, 32c, d, 33a, 34, 35a-d, Table 7)

Holotype: **Queensland**: ♂, Bamaga, N Cape York, January 1958, PF Darlington, ex gum forest (AMNH). Paratypes: 1 larva, same data as holotype (AMNH). 1♀, Heathlands, 11°45'S 142°35'E, 1-6 April 1993, P Zborowski (ANIC); **Northern Territory**: 3♂♂ 3♀♀, Daly River, H Wesselman (SAMA); 1♀, Pine Creek, December 1908, B Hooper (SAMA); 1♀, Port Darwin (SAMA); 1♂ 1♀, Cape York (SAMA); 1♂, Cape York Penin[sula], C French, November 8 1892 (SAMA).

Diagnosis: *Choerocoris lattini* nov.sp. is recognised by the following combination of characters: head orange with subtriangular iridescent dark blue marking (Fig. 24c); jugae and lorae orange; pronotum with orange transverse crescent-shaped fascia (Fig. 24c); scutellum orange with broad anterior, paired subtriangular, and caudal V-shaped iridescent dark blue markings (Fig. 24c); AI orange; labium reaching abdominal sternum IV; abdominal venter mostly orange with lateral subquadrate, blue markings (Figs 32c, d); connexiva without yellow nodules (Figs 32c, d); CAII(L) membraneous (Figs 35c, d); CAII(M) mostly membraneous with apical sclerotization (Figs 35c, d); CAIII mostly membraneous, without pronounced processes (Figs 35c, d); vesica simple, moderately elongate, with subdistal tumescence (Fig. 35c); paratergites VIII small (Figs 32c, d, 33a), triangular; paratergites IX small, suboval (Figs 32c, d, 33a); and, gonocoxae I moderately sized, larger than paratergites IX (Figs 32c, d, 33a).

Description: Body moderately large, males 10.49-12.08, females 11.14-12.41 mm.

Colouration. Body bicoloured, orange to orange-red, with iridescent dark blue markings, sometimes with greenish tinge (Fig. 24c). Head mostly orange-red with a subtriangular iridescent dark blue marking, widest at posterior margin of head; lateral and ventral aspects of head orange-red; eyes brown, ocelli red. Antennae: AI orange-red; AII(a)-AIV dark brown. Labium: LI-III orange, stylets mostly fuscous; LIV dark brown to fuscous. Pronotum: anterior and anterolateral margins orange, remainder mostly iridescent blue, with a medial, transverse orange crescent-shaped orange fascia, male with posterior margin a little orange (Fig. 24c). Scutellum: mostly orange, with broad subrectangulate iridescent dark blue marking on anterior margin, pair of subtriangular iridescent dark blue markings, and caudal, small V-shaped, dark blue iridescent marking (Fig. 24c). Thoracic pleura and sterna mostly orange, with iridescent dark blue or green markings on lateral margins of pleura; evaporative areas grey. Legs: coxae and trochanters orange; femora mostly orange with small apical iridescent dark blue annulation; tibiae and tarsi iridescent dark blue. Pregenital Abdomen: venter mostly orange, with lateral margins of sterna with discontinuous, subquadrate, iridescent dark blue markings, SV-SVII with broad, V-shaped iridescent dark blue marking; posterior angles of connexiva not swollen, fuscous (Figs 32c, d).

Vestiture. Body mostly glabrous, with a few scattered setae on abdominal sterna, more so on terminalia.

Texture. Dorsum uniformly punctate, with moderately deep, broad punctures (Fig. 24c); thoracic pleura and abdominal venter densely punctate, with margins laterad of spiracular-trichobothrial region rugo-punctate.

Structure. Body oval, strongly convex. Antennae: AII(a) about 1/2 length of AI, shortest segment; AIII-AIV longest segment in females. Labium: reaching junction of abdominal sterna III/IV. Male Genitalia: dorsal margin of pygophore arcuate, ventral margin emarginate (Fig. 35a); genital opening surface sub-pentagonal (Fig. 35a); parameres with elongate stem, subdistal flange, and short hook-shaped crown (Fig. 35b). phallotheca conical, with dorsal sclerotized areas (Figs 35c, d); ejaculatory apparatus with convoluted ventral conducting canal (Figs 35c, d); elongate ejaculatory reservoir (Figs 35c, d); ductus seminis distalis moderately incrassate (Figs 35c, d), without projections, tapered distally; vesica with out processes, moderately elongate, with subdistal tumescence (Fig. 35c); CAII(L) membraneous (Figs 35c, d); CAII(M) mostly membraneous, with apical sclerotization (Figs 35c, d); CAII mostly membraneous, lobe-like, medially fused post-thecal margin (Figs 35c, d). Female Genitalia: paratergites VIII small (Figs 32c, d, 33a), triangular; paratergites IX small, suboval (Figs 32c, d, 33a); gonocoxae I subtriangular, weakly concave (Figs 32c, d, 33a).

Measurements. Table 7.

Etymology: This species is named after Professor John D. Lattin of Oregon State University, PhD supervisor of the senior author [GC], in recognition of his knowledge of the jewel bugs of the world.

Distribution: This species is known from Cape York Peninsula and the Northern Territory (Fig. 34).

Host plants and biology: No host plant is known for this species.

Remarks: *Choerocoris lattini* nov.sp. is most closely related to *C. variegatus*, on the basis of similarities of the male genitalia, particularly in the shape of the parameres and the conjunctival appendages (cf. Figs 35 and 36), with the former species lacking antler-like CAIII. These species are however clearly differentiated by colour patterning of the dorsum (cf. Figs 24c-f), the orange AI in *C. lattini* nov.sp. (dark brown in *C. variegatus*), and the colour patterning of the abdominal venter (cf. Figs 32c, d and g, h).

Choerocoris paganus (Fabricius 1775) (Figs 1c, 24d, 31, 32e, f, 33b, 34) Ground Jewel Bug

Cimex paganus Fabricius 1775: 698 (n.sp.); Fabricius 1781: 340 (description); Fabricius 1787: 281 (description); Fabricius 1794: 84 (description); Donovan 1805: pl. 3 fig. 4 (description)

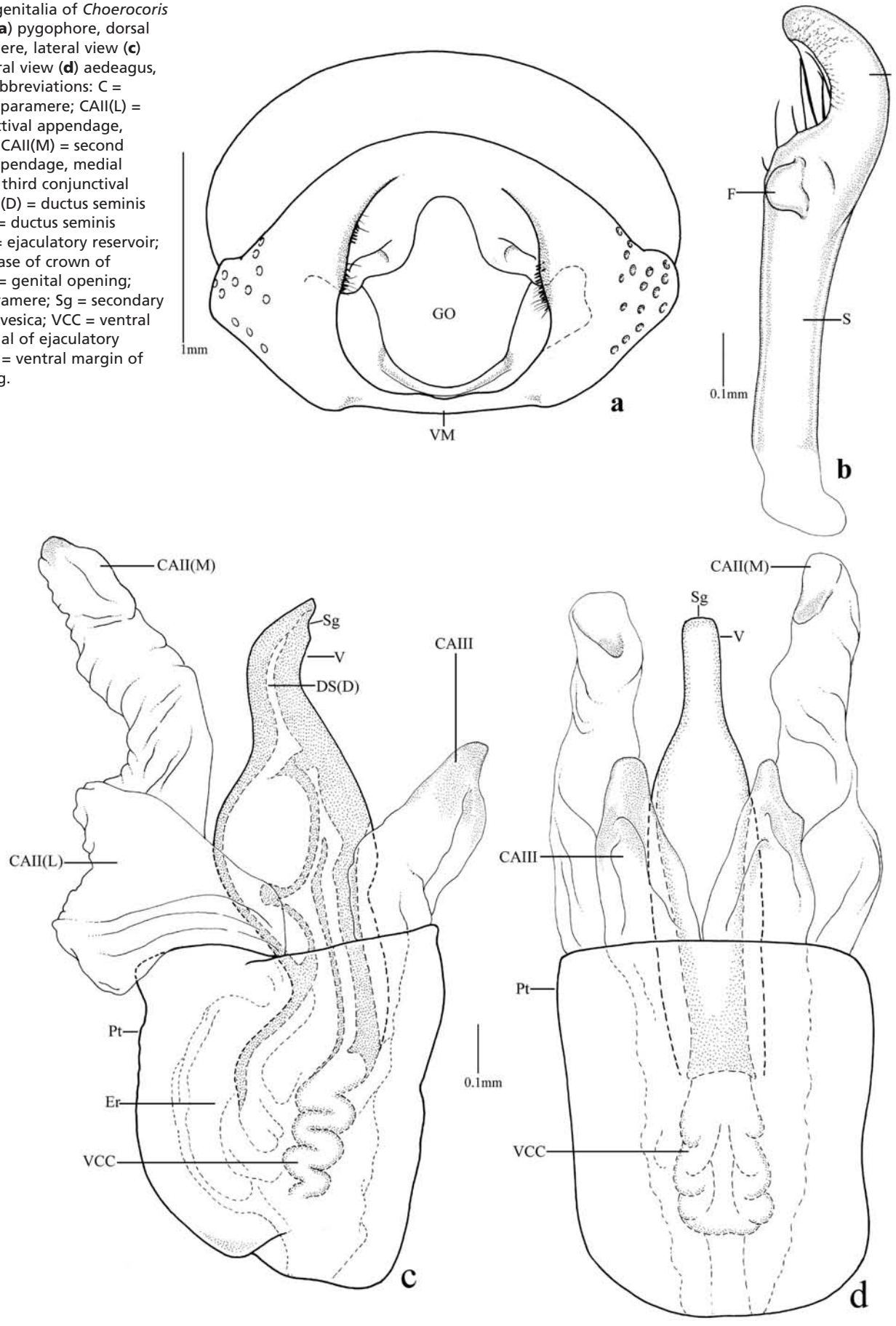


Fig. 35: Male genitalia of *Choerocoris lattini* nov.sp. (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) aedeagus, ventral view. Abbreviations: C = crown of right paramere; CAII(L) = second conjunctival appendage, lateral branch; CAII(M) = second conjunctival appendage, medial branch; CAIII = third conjunctival appendage; DS(D) = ductus seminis dorsalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; F = flange at base of crown of paramere; GO = genital opening; S = stem of paramere; Sg = secondary gonopore; V = vesica; VCC = ventral conducting canal of ejaculatory apparatus; VM = ventral margin of genital opening.

Tetyra pagana: FABRICIUS 1803: 134 (new combination); AMYOT & SERVILLE 1843: 47, pl. 1 fig. 6 (description; habitus)
Scutellera paganus: GUÉRIN 1831: pl. 11 fig. 5 (new combination); BOISDUVAL 1835: 625, pl. 11 fig. 4 (description); GUÉRIN-MÉNEVILLE 1838: 156 (description)
Callidea pagana: GERMAR 1839: 122 (new combination)
Choerocoris paganus: DALLAS 1851: 29 (new combination); VOLLENHOVEN 1863: 36 (description, distribution); MAYR 1866: 22 (description); STÅL 1873: 13 (list); LETHIERRY & SEVERIN 1893: 21 (catalogue); Distant 1899: 34 (biology); FROGGATT 1901: 1595 (description); FROGGATT 1902: 322 (description); SCHOUTEDEN 1904: 39 (list); KIRKALDY 1909: 291 (catalogue); TILLYARD 1926: 149 (diagnosis); MCDONALD 1963a: 230, figs 1,2 (female genitalia); MCDONALD 1963c: 290 (biology); KUMAR 1964: 60 (male genitalia); GROSS 1975: 94, pl. C (description; colour habitus); MCDONALD & CASSIS 1984: 558, figs 61,62 (description); CASSIS & GROSS 2002: 593 (catalogue)

Diagnosis: *Choerocoris paganus* is recognised by the following combination of characters: scutellum mostly red, with pair of submedial triangular blue markings (Fig. 24d); callosite region of pronotum medially impunctate (Fig. 24d); callosite region posteriorly demarcated by transverse furrow (Fig. 24); abdominal venter orange with lateral and submedial dark blue markings (Fig. 32e, f); CAII(M) and CAII(L) symmetrical, with conical lobal sclerites; vesica with subdistal tumescence; paratergites IX small, suboval (Fig. 33b); and gonocoxae I relatively large (Fig. 33b).

Description: Body moderately sized, males 8-11 mm, females 9-12 mm.

Colouration. Body mostly red with iridescent green-black to blue-black markings (Fig. 24d). Head: uniformly iridescent green-black; underside of head iridescent green to blue-black. Antennae: uniformly fuscous. Labium: fuscous. Pronotum: mostly green to blue black, sometimes medially red (Fig. 24d). Scutellum: mostly red, with submedial pair of subtriangular green to blue-black iridescent markings, usually with anterior margin with large subrectangulate green to blue-black iridescent marking, sometimes absent and red (Fig. 24d). Thoracic Pleura: nearly all iridescent green to blue-black, with anterior edge of proepisternum orange to red. Pregenital Abdomen: venter mostly red to orange-red, with lateral margins of SIV-SVII with triangular iridescent green to blue-black markings (Figs 32e, f); SIII-SVII with paired submedial oval dark markings (Figs 32e, f); SVII with large, broad medial black marking (Figs 32e, f). Male Genitalia: pygophore uniformly black or red medially and remainder black. Female Terminalia: most often red to orange-red, with minor black markings, to paratergites VIII and IX and medial margins of gonocoxae I mostly black.

Texture. Dorsum mostly densely punctate; pronotum with scattered punctures (Fig. 24d).

Structure. Antennae: AII(a) shortest segment, a little longer than AI; AIV longest segment. Labium: reaching metasternum; LII longest segment, a little longer than LIII and LIV. Male Genitalia: ventral margin of pygophore with broad, shallow notch; parameres with short hook-like crown, without sub-apical flange; phallotheca heavily sclerotized; ductus seminis proximalis narrow, single membraneous tube; ejaculatory apparatus with convoluted ventral conducting canal, 5-6 convolutions; ejaculatory reservoir large, subelliptoid; base of ductus seminis distalis greatly incrassate; CAII mostly membraneous, bifid, with small lobal sclerites; CAIII heavily sclerotized, sinuate, distally acute, basally fused (pre-thecal margin); vesica tapered distally without adornments. Female Terminalia: paratergites VIII moderate, size, subtriangular (Fig. 33b); paratergites IX small, suboval (Fig. 33b); gonoxocae I relatively large, depressed (Fig. 33b); spermatheca as in generic description.

Measurements. MCDONALD & CASSIS 1984: Table 5.

Material examined: **Queensland**: 1 ♀, Lizard Island, 29 September-1 October 1967, H Heatwole (AM); **New South Wales**: 17♂♂ 9 ♀ ♀, Bundjalong National Park, Black Rocks, 32.24S 152.32E, 15 November 1993, G Cassis, ex beach wash (AM); 1♂1 ♀, Mt Kaputar, Bullawa Creek, 28 April 1985, G Hangay (AM); 3♂♂ 1 ♀, Goonoo State Forest, south side, 9 November 1987, DK McAlpine & R de Keyzer (AM); Myall Lakes National Park, 10.3 km S Seal Rocks Road on Hawks Nest Road, 32°30'S 152°21'E, October

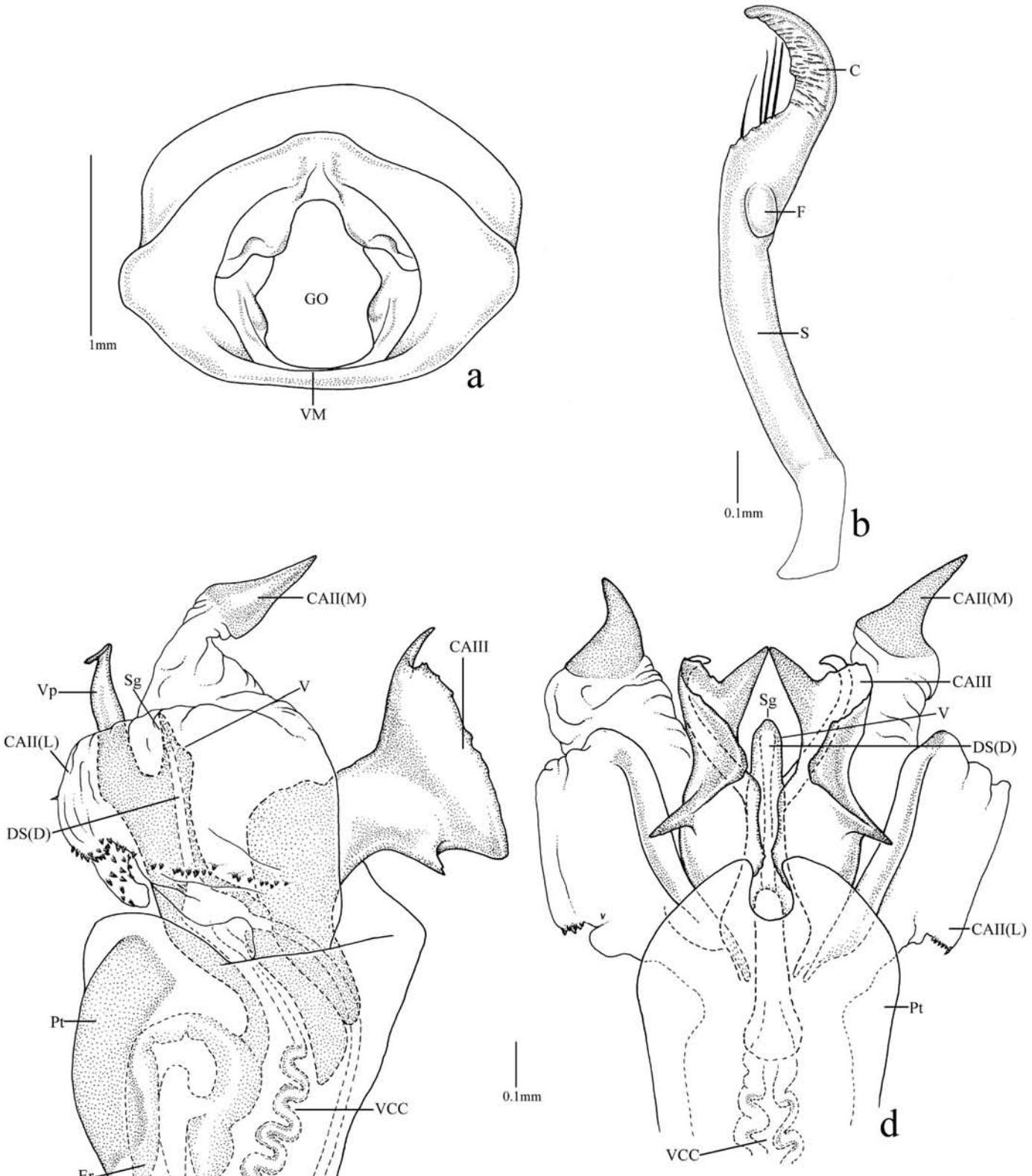


Fig. 36: Male genitalia of *Choerocoris variegatus* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) aedeagus, ventral view. Abbreviations: C = crown of right paramere; CAII(L) = second conjunctival appendage, lateral branch; CAII(M) = second conjunctival appendage, medial branch; CAIII = third conjunctival appendage; DS(D) = ductus seminis dorsalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; F = flange at base of crown of paramere; GO = genital opening; S = stem of paramere; Sg = secondary gonopore; V = vesica; Vp = process of vesica; VCC = ventral conducting canal of ejaculatory apparatus; VM = ventral margin of genital opening.

20 1995, RT Schuh & G Cassis, ex *Dodonaea viscosa* angustissima (AM); 3♂♂, 2.9 km W Nyngan, 31°33'56"S 147°09'19"E, 202 m, October 18.2001. RT Schuh, G Cassis, R Silveira & MA Wall, ex *Dodonaea viscosa spatulata* (AM); 1♂, Munmorah State Recreation Area, 33°12.26'S 131°34.37'E, 11 October 1997, L Wilkie, K145365 (AM); 1♀, Booti Booti National Park, 32°11.15'S 152°31.42'E, 25 November 1997, L Wilkie (AM); 5♂♂ 9♀♀, Yara, 32°51'54"S 146°11'21"E, December 2000, G Swan, semiarid grassland, pitfall trap (AM); 2♂♂ 4♀♀, Yara, 32°56'48"S 146°11'32"E, December 2000, G Swan, spinifex grassland, pitfall trap (AM); 4♂♂ 11♀♀, Yara, 32°56'39"S 146°11'32"E, November-December 1997, G Swan & E Wapstra, mallee woodland, pitfall trap (AM); **Southern Australia**: 1♂, 7 km E of Para Wirra National Park, nr. Williamstown, 34.42S 138.51E, 31 October 1995, RT Schuh, G Cassis, & GF Gross, Site 95-39. (AM); **Western Australia**: 9♂♂ 7♀♀, Frank Hann National Park, Lillian Stoke Rock, 33.066S, 120.083E, 400 m, 5 November 1996, G Cassis & RT Schuh, Site 96-66, ex *Dodonaea viscosa angustissima* (AM); **Northern Territory**: 4♂♂ 3♀♀, 13.5 km E Stuart Highway, on Horseshoe Bend Road, 464 m, 28°08'53"S 133°17'59"E, 28 October 2001, G Cassis, RT Schuh, MD Schwartz, R Silveira & MA Wall, ex *Dodonaea viscosa* (AM); Trephina Gorge National Park, John Hayes Rockpool Campground, 580 m, 23°23'30"S 134°21'15"E, 25 October 2001, G Cassis, RT Schuh, MD Schwartz & R Silveira & MA Wall, ex *Dodonaea viscosa mucronata*, Site CA01L21H79 (AM).

Distribution: This species is broadly distributed in Australia, and is known from all states and territories, aside from the Australian Capital Territory (Fig. 34).

Host plants and biology: This species is known primarily from a number of subspecies of *Dodonaea viscosa* (Table 1). It has also been collected on a variety of plants, and appears to be polyphagous, although these plants are likely to be secondary food-preferences. McDONALD (1960, 1963c) described its biology, and found that they are both pre- and post-dispersal seed predators. He also reported it often found amongst rocks, within the 'seed shadow' of their host plants. The adults are known to overwinter in dry places, and the larvae are sometimes found in grass tussocks.

Remarks: *Choerocoris paganus* is one of the most distinctive and commonly encountered jewel bugs in Australia. It can be readily identified on colour patterning alone; with the dorsum mostly red with iridescent blue-black markings. It can also be separated from its congeners by texture, with the pronotum less densely punctate; the callosite region is medially impunctate (cf. uniformly and densely punctate in others). The male genitalia of *C. paganus* are also distinct, with the CAII bifid, each branch possessing a conical lobal sclerite.

Choerocoris variegatus DALLAS 1851 (Figs 24f, 32g, h, 33c, d, 34, 35)

Choerocoris variegatus DALLAS 1851: 29 (n.sp.); STÅL 1873: 13 (list); LETHIERRY & SEVERIN 1893: 21 (catalogue); SCHOUTEDEN 1904: 39 (list); KIRKALDY 1909: 292 (catalogue); TILLYARD 1926: 149 (note); McDONALD 1963a: 30 (male genitalia); McDONALD 1963b: 230, figs 3-5 (female genitalia); McDONALD 1963c 285 (larvae); KUMAR 1964: 60-61, 63 (morphology); KUMAR 1965: 44, 52-53 (male genitalia); McDONALD & CASSIS 1984: 559 (description); McDONALD CASSIS & GROSS 2002: 594 (catalogue)
Choerocoris similis DISTANT 1899: 34 (n.sp.); FROGGATT 1907: 327 (note); McDONALD & CASSIS 1984: 559 (synonymy)
Choerocoris variegatus similis: GROSS 1975: 95 (subspecies)

Diagnosis: *Choerocoris variegatus* is recognised by the following characters: pronotum uniformly punctate (Fig. 24f); body yellow to red, with black markings (Fig. 24d); posterior angles of connexiva V-VIII not expanded (Figs 32g, h); abdominal venter yellow with lateral black markings (submedial markings lacking) (Figs 32g, h); stem of parameres elongate (Fig. 36b); CAII(L) with basal denticulation (Figs 36c, d); CAIII large, sclerotized, antler-like (Figs 36c, d); vesica with pair of subapical processes (Fig. 36c); and, gonocoxae I moderately developed, larger than paratergites IX (Figs 33c, d).

Description: Body moderate size, males 8-12 mm, females 10.2-12.9 mm.

Colouration. Body bicoloured, dusty yellow to red, with extensive black markings, not iridescent (Fig. 24f). Head: mostly black, clypeus with a longitudinal yellow stripe (variable in length), lateral margins of jugae yellow, sometimes jugae with small medial yellow spot to yellow longitudinal

stripe; lorae black (sometimes with yellow spot); jugae yellow. Antennae: mostly black, with AI partially to mostly yellow; remainder fuscous. Labium: mostly yellow, LIV fuscous. Pronotum: mostly black, anterior, anterolateral and posterior margins mostly yellow (punctures black), with medial pair of yellow or red elliptoid markings, sometimes almost contiguous medially (Fig. 24f). Scutellum: yellow to red, anterior margin with subrectangulate black margin, medially with W-shaped marking, sometimes contiguous with anterior marking, posterior margin with V-shaped black marking (Fig. 24f). Thoracic Pleura: mostly yellow, proepimeron with black sublateral stripe, evaporative areas partially black. Legs: forefemora bicoloured, yellow, with distal regions blackened (sometimes with black spotting), dorsal surface of meso- and metafemora black, remainder mostly yellow, tibiae mostly black, laterally with yellow stripes; tarsi black. Pregenital Abdomen: venter mostly yellow, lateral margins of SIV-SVII with large, subtriangular black markings (Figs 32g, h). Male Genitalia: pygophore mostly yellow, with margins black. Female Terminalia: mostly black, with medial regions of gonocoxae I and paratergites with yellow markings.

Structure. Antennae: AI and AII(b) subequal in length; AII(a) shortest segment; AIII and AIV longest segment. Labium: reaching apex of metacoxae; LI shortest segment; LII-LIV subequal in length, sometimes LII a little longer than LIII and LIV. Male Genitalia: pygophore lozenge-shaped, with narrow genital opening, ventral margin deeply excavate (Fig. 36a); parameres with stem greatly elongate, with lateral flange, and weakly hooked crown (Fig. 36b); phallotheca conical, with ventral areas of sclerotisation (Fig. 36c); ductus seminis proximalis narrow; ejaculatory apparatus well developed, with convoluted ventral conducting canal, 6-8 convolutions (Fig. 36c); ejaculatory reservoir suboval, moderately sclerotised (Fig. 36c); CAII mostly membraneous, bifid, CAII(L) with basal denticulation, CAII(M) with conical lobal sclerite (Figs 36c, d); ductus seminis distalis not greatly incrassate (Fig. 36c); vesica with arcuate subapical processes, secondary gonopore apical (Figs 36c, d); CAIII heavily sclerotized, large, antler-like (Figs 36c, d). Female Terminalia: paratergites VIII subtriangular (Figs 33c, d); paratergites IX suboval, moderately sized, weakly incrassate medially (Figs 33c, d); gonocoxae I large, depressed medially, medial margins recurved (Figs 33c, d); spermatheca as in generic description.

Measurements. McDonald & Cassis 1984: Table 5.

Type material examined: *Choerocoris variegatus* Dallas: Holotype, ♀, 'Swan River', 'B.M. Hem. Type No. 426' (BMNH); *Choerocoris similis* Distant: Holotype, ♀, 'Adelaide' 'B.M. Hem. Type No. 427' (BMNH). There are two other specimens in the BMNH of *Choerocoris variegatus*, which are labeled as paratypes, and have the same locality as the holotype. Dallas (1851) only referred to a single specimens (as 'a. Swan River'), and we interpret this is the holotype, and have no evidence for designating a lectotype.
Other material examined: **New South Wales**: 1♂, Round Hill Fauna Reserve, 9 April 1977, G Daniels (AM); 1♂, Round Hill Reserve, near Euabalong, 28 December 1992, MS & BJ Moulds (AM); 1♂, 30 km E Southern Cross, 30 September 1985, J Bugeja (AM); **Western Australia**: 1♀, 115.4 km E of Norseman, 32.05S 122.966E, 600 m, RT Schuh & G Cassis, 23 October 1996, Site 96-10, ex *Beyeria lechenaultii*; 9♂♂ 2♀♀, Duke of Orleans Bay, Table Island Picnic Area, 33.899S 122.594E, 50 m, 24 November 1999, RT Schuh, G Cassis & R Silveira, Site 99-32, ex *Spyridium globulosum* (AM); 2♂♂ 7♀♀, Duke of Orleans Bay, E Esperance, 14 November 1993, J & A Leask (AM); 1♂ 2♀♀, 5 km W Wuarga, 2 September 1981, GA Holloway (AM); 5♂♂, Rossiter Bay, Cape Le Grande National Park, 33°58.0345'S 122°16.0457'E, 3 m, 23 November 1999, RT Schuh, G Cassis & R Silveira, Site 19-29, ex *Acacia cyclops* (AM).

Distribution: This species is broadly distributed in Australia, and is known from New South Wales, Northern Territory, Queensland, South Australia, Victoria, and Western Australia. It is primarily known from temperate Australia, although a few specimens have been taken in tropical Queensland and the Northern Territory (Fig. 34).

Host plants and biology: The biology of *Choerocoris variegatus* is not well-known. It has been collected on numerous occasions in association with seeds, mostly on plants. It has been collected on a number of plants (Table 1), but its primary hosts are thought to be species of the euphorb genus *Beyeria*.

Remarks: *Choerocoris variegatus* is widespread, but is less commonly encountered than its congener, *C. paganus*. It has male genitalia varying only in shape and size of the CAIII; the aedeagus cannot be separated from those of the new species, *C. grossi* nov.sp. Differences in colour patterns and female terminalia are sufficient to separate species.

Heissiphara **nov.gen.** (Figs 24b, 27, 37, 38)

Type species: *Heissiphara minuta* nov.sp., original designation

Diagnosis: *Heissiphara* nov.gen. is recognised by the following combination of characters: small species (Figs 24b, 37); dorsum strongly convex; dorsum heavily punctate with setigerous punctures (Figs 24b, 37); head strongly declivent and rounded (Fig. 38b); jugae rounded (Fig. 38b); bucculae small, arcuate (Fig. 31c); anterior margin of scutellum with submedial subreniform polished calli (Fig. 24b, 37); lateral margins of pronotum subcarinate; external efferent system of metathoracic glands moderately developed, with raised obovate peritreme (Fig. 38c); evaporative areas extending to mesepimeron (Fig. 38c); spermathecal fecundation canal very short (Fig. 38d); reservoir oval, not heavily sclerotized; and, spermathecal pump large (Fig. 38d).

Description: Small species (Figs 24b, 37); ovoid; dorsum strongly convex (Figs 24b, 37); body evenly punctate, with setigerous punctures (Figs 24b, 37). Head: transverse (Figs 38a), strongly rounded and declivent (Fig. 38b); lateral margins of jugae rounded (Fig. 38b). Antennae: AIII and AIV bicompressed. Pronotum: subtrapezoidal, strongly convex (Figs 24b, 37); anterolateral margins elongate, rectilinear, subcarinate; posterolateral margins short, rounded; posterior margin truncate (Figs 24b, 37). Scutellum: broad, U-shaped, base of forewings and abdominal connexiva III-VII visible (Figs 24b, 37); anterior margin with submedial, subreniform, polished calli (Figs 24b, 37); tip of forewings not exposed; propleuron large, platelike, with anterior margins of proepisternum arcuate; external efferent system of metathoracic glands moderately developed (Fig. 38c), evaporative areas extensive, rugose, extending beyond peritreme and on to mesepimeron (Fig. 38c); ostiole small; peritreme raised, obovate (Fig. 38c). Abdominal Venter: SIII carinate along midline. Female Terminalia: paratergites IX small, subelliptoid; gonocoxae I large, subtriangular, posterior margin weakly excavate. Spermatheca: basal sclerites present; fecundation canal very short (Fig. 38d); reservoir oval (Fig. 38d); prominent pump (Fig. 38d).

Male unknown.

Etymology: This genus is named after our colleague Dr. Ernst Heiss in recognition of his significant contribution to Heteropterology.

Included species:	
H. minuta nov.sp.	Australia

Diversity and distribution: *Heissiphara* is a monotypic genus, known from a single locality in temperate Western Australia.

Remarks: *Heissiphara* superficially resembles a number of Australian pentatomid species, with an enlarged scutellum, such as *Kapunda*. However, *Heissiphara* is a member of the Scutelleridae based on the following characters: greatly enlarged scutellum, spermatheca with basal sclerites, and the spermathecal reservoir without a sclerotized rod.

The position of *Heissiphara* within the scutellerid hierarchy is difficult to determine, as males are unknown. It is conclusively excluded from the Elvisurinae in that it does not possess keel-like thoracic sterna. It is unlikely to be a member of the Tectocorinae as its female terminalia and spermatheca are consistent with those of the scutellerines. *Heissiphara* shares some similarites with *Morbora*, in that both the body has setigerous punctures and the metathoracic peritreme is obovate. However, *Heissiphara* also shares these characters with *Choerocoris*, and on the basis of the similar spermathecae, the former genus is putatively assigned to the Scutellerinae, despite its dull colouration.

Heissiphara differs from *Choerocoris* in the shape of the head, which is more rounded and the lateral jugal margins are not explanate. In addition, *Heissiphara* has a more densely punctate body, and is significantly smaller, the anterior margin of the scutellum

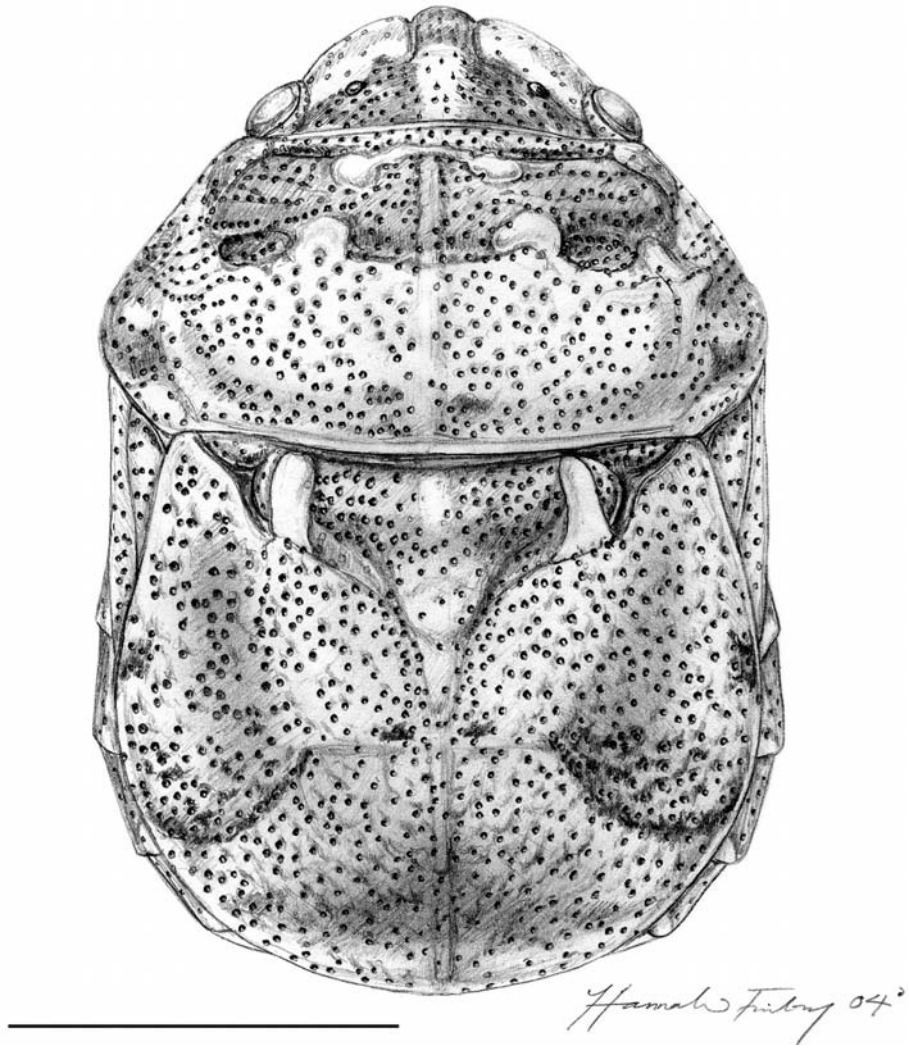


Fig. 37: Habitus of holotype of *Heissiphara minuta* nov.sp., ♀.

has submedial calli, and the spermathecal reservoir is not heavily sclerotised.

Heissiphara minuta nov.sp. (Figs 24b, 27, 37, 38)

Holotype: ♀, **Western Australia**: Coastal Highway, 57 km N of Kalbarri Road, -27.26.853S, 114.41.204E, altitude 500m, G. Cassis and R.T. Schuh ex *Stenanthemum complicatum* (AM); Paratype: ♀, same data as holotype (AM).

Diagnosis: This species is recognised by the following combination of characters: small size, < 3.5 mm; body strongly convex (Fig. 24d); body uniformly distributed with setigerous punctures (Fig. 24d); AII(b) shortest antennal segment; pronotum and scutellum with medial red markings (Fig. 24d); and, female terminalia and spermatheca as in generic description.

Description: **Colouration.** Head: mostly yellow; posterior margin of vertex with triangular fuscous markings; clypeus mostly yellow with brown apex and fuscous midline; eyes reddish brown; ocelli yellow. Antennae: AI-AII(a&b) yellow, AIII and AIV dark brown. Labium: LI and II yellow, LIII and LIV brown. Pronotum mostly light yellow-brown to medium brown, with darker punctations; callosite region anteriorly with yellow fascia and calli yellow; disc with medial rectangular red mark and two adjacent submedial fuscous spots. Scutellum: ground colour mostly concolorous with pronotum, anterior margin with central red marking and two yellow submedial calli; anterolateral areas with dark brown foveae; posterolaterally with dense patches of dark punctations forming obscure semi-circular marking. Thoracic pleura and abdominal venter uniformly yellow with brown punctations. Legs uniformly yellow-brown with darker brown punctations.

Vestiture. Body glabrous. Antennae: AI-AII(a&b) with sparse distribution of short setae; AIII-AIV with denser distribution of setae.

Texture. Body densely punctate, with setiferous punctures.

Structure. Head: interocellar space twice distance between ocelli and eye. Antennae: AII(a) and AII(b) short, subequal in length; AIV longest segment. Labium: reaching metasternum; LI and LII cylindrical; LIII and IV flattened. Abdominal segment III with a medial groove to accommodate rostrum; apical margins of segments III to VI tumescent. Female genitalia: see generic description.

Male unknown.

Measurements. Holotype: BL: 3.35, PW: 2.39, IOD: 1.12, AI: 0.26, AII(a): 0.16, AII(b): 0.18, AIII: 0.30, AIV: 0.40, LI: 0.49, LII:0.63, LIII: 0.39, (LIV not observable).

Etymology: This species is named for its small size.

Distribution: *Heissiphara minuta* nov.sp. is known from the type locality only, north of Kalbarri National Park, on the central-west coast of Western Australia (Fig. 27).

Host plants and biology: This species was collected from *Stenanthemum complicatum* (Rhamnaceae).

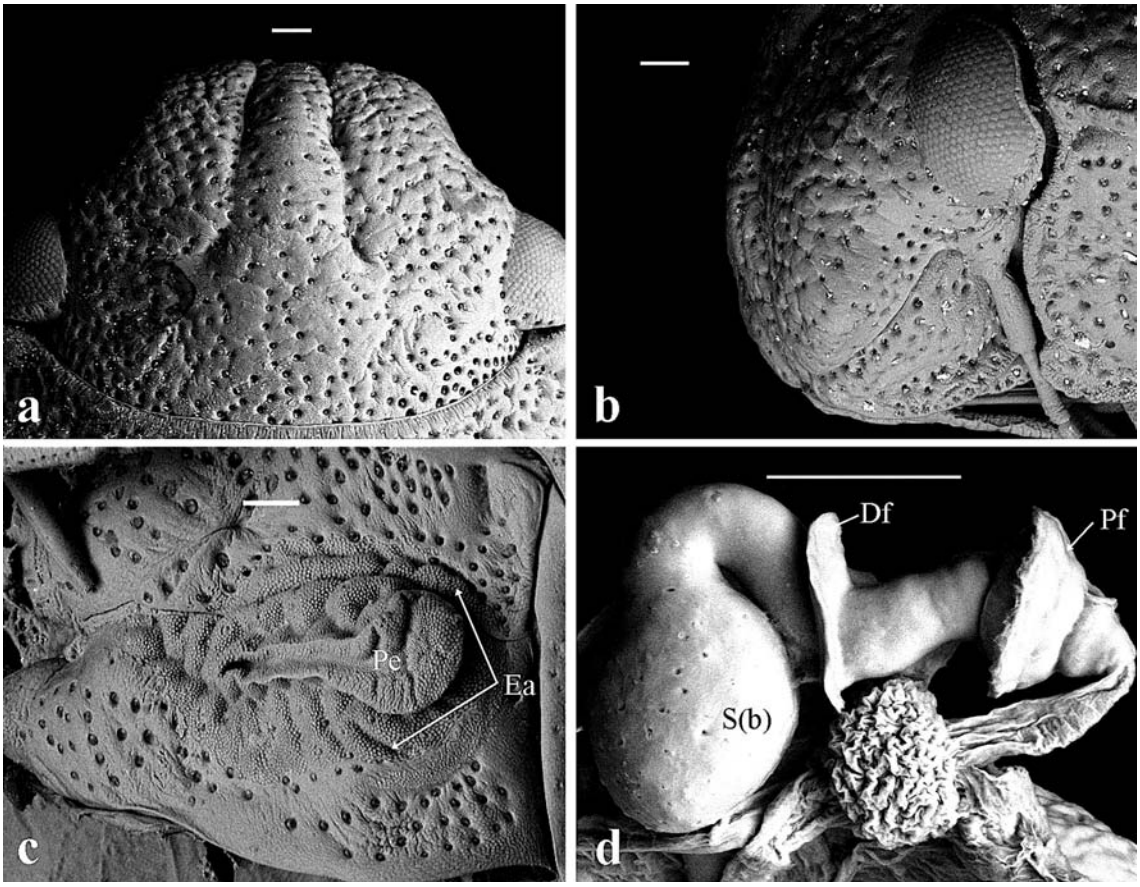


Fig. 38: Scanning electron micrographs of key characters of *Heissiphara minuta* nov.sp. (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) **Spermatheca.** Abbreviations: Df = dorsal flange; Ea = evaporative area; Pe = peritreme; Pf = proximal flange; P(r) = right paramere; S(b) = spermathecal bulb. Scale bars = 1 mm.

Remarks: *Heissiphara minuta* nov.sp. is one of the smallest species of scutellerid known to us, rivalling odontotarsine species like *Odontoscelis signatus* FIEBER, *O. tomentosa* (GERMAR) and *Psacasta lethierryi* PUTON. Unlike most other scutellerines, *H minuta* nov.sp. is relatively dull in colouration; mostly pale brown, with yellow markings. It is known only from females.

Lampromicra **STÅL 1873** (Figs 1d, 21f-h, 28c-e, 39, 40, 41, Table 8)

Philia SCHIÖDTE 1842: 279 (gen. nov.) (junior homonym of *Philia* MEIGEN 1800 [Diptera]); STÅL 1868: 9 (description); LETHIERRY & SEVERIN 1893: 22 (catalogue); SCHOUTEDEN 1904: 28 (description);

Philya STÅL 1865: 33 (incorrect subsequent spelling; key); STÅL 1866: 151 (incorrect subsequent spelling)

Lampromicra STÅL 1873: 16 (gen. nov.); KIRKALDY 1909: 299 (synonymy); MCDONALD & CASSIS 1984: 555 (description); CASSIS & GROSS 2002: 595 (catalogue)

Schioedtia KIRKALDY 1905: 79 (nom. nov. for *Philia* SCHIÖDTE 1842)

Type species: *Tetyra senator* FABRICIUS 1803, subsequent designation, SCHOUTEDEN 1904: 29

Diagnosis: *Lampromicra* is recognised by the following combination of characters: moderately sized-body; iridescent colouration Figs 1d, 28c-e); dorsum and abdominal venter setose (Figs 1d, 28c-e); lateral margins of jugae weakly sinuate (Fig. 39a); antennae short; AII(a) a little shorter than AI; AI-AII(a&b) rounded; AIII-AIV flattened; AIV longest segment; scutellum with tumescent anterior callus, impunctate, rarely punctate; forewing extending beyond scutellum (Figs 28c-e); proepisternum weakly explanate (Fig. 39c); external efferent system with a large ostiole; broad, subreniform peritreme, without a medial, longitudinal groove (Fig. 39d); evaporative areas extending to mesepimeron (Fig. 39d); ventral border of pygophore rounded (Fig. 39e) to emarginate; dorsal margin of male genital opening with setal patches (Fig. 40a); parameres with moderately sized hook-shaped apex (Fig 40b); phallotheca with pair of subdistal, thornlike processes (Fig. 40c); ductus seminis distalis S-shaped (Figs 40c, d); ventral conducting canals of ejaculatory apparatus, with ≤ 10 convolutions (Figs 40c, d); CAI absent; CAII bifurcate, CAII(M)

Table 8: *Lampromicra aerea*: diagnostic measurements in millimetres. N = 8 males and 8 females.

	Male		Female	
	Mean±SD	**Range**	**Mean±SD**	**Range**
Length	11.58±0.52	11.00-12.17	11.46±0.34	11.00-11.50
Pronotal Width	6.33±0.76	5.12-7.08	6.15±0.54	5.67-6.92
Width between the eyes	2.21±0.05	2.17-2.28	2.22±0.07	2.08-2.32
Antennal segment length				
I	0.63±0.14	0.60-0.68	0.87±0.04	0.80-0.92
II(a)	0.64±0.04	0.60-0.68	0.65±0.03	0.60-0.68
II(b)	1.32±0.07	1.24-1.40	1.28±0.05	1.20-1.32
III	1.80±0.06	1.72-1.84	1.69±0.21	1.60-1.72
IV	1.96±0.04	1.92-2.00	1.90±0.08	1.80-2.00
Labial segment length				
I	0.96±0.03	0.92-1.16	0.93±0.04	0.88-1.16
II	1.83±0.22	1.60-2.04	1.63±0.07	1.56-1.84
III	1.34±0.04	1.24-1.40	1.29±0.04	1.24-1.32
IV	1.34±0.80	1.32-1.40	1.28±0.05	1.20-1.32

basally membraneous, with hook-shaped lobal sclerite (Fig. 40c); CAII(L) membraneous, with denticulate apex, perpendicular to hook-shaped (Figs 40c, d); vesica S-shaped (Fig. 40c, d); spermathecal fecundation canal elongate; and, spermathecal reservoir broad, oval.

Description: Body elongate-ovoid, strongly tapered caudally (Figs 28c-e); moderately-sized body, males 9-12 mm, females 8.8-13 mm; iridescent colouration, most often dark blue or green (Figs 1d, 28c-e), sometimes orange, often with contrasting markings on pronotum and scutellum, either black, orange, bronze or green; body strongly setose (Figs 1d, 28c-e); dorsum with dense distribution of shallow to moderately deep punctures (Figs 28c-e), sometimes more scattered on pronotum; ventral surface of body and appendages densely setate, less so on thoracic pleura. Head: subtriangular (Fig. 39a), transverse, weakly declivent; lateral margins of jugae weakly excavate (Fig. 39a), subcarinate in profile (Fig. 39b). Antennae: AII(a) a little shorter than AI; AI-AI(a&b) rounded; AIIII-AIV flattened; AIV longest segment. Labium: reaching between the apices of the metacoxae to the mid-point of abdominal sternite IV; LII longest segment; LIII and LIV roughly subequal in length. Pronotum: moderately convex; anterior margin weakly excavate; anterolateral margins rectilinear, strongly divergent, carinate in profile (Fig. 39b); callosite region demarcated posteriorly by transverse trough-like depression, sometimes punctate; posterolateral margins weakly convex; posterior margin rectilinear to weakly convex (Figs 28c-e). Scutellum: V-shaped, strongly tapered posteriorly, strongly declivent beyond connexiva V, posterior margin subtruncate (Figs 28c-e). Thoracic pleura: anterior margin of proepisternum weakly explanate (Fig. 39c); mesepimeron with evaporative areas (Fig. 39d); external efferent system of metathoracic glands well-developed (Fig. 39d); ostiole large, hooded; peritreme raised, broadly subreniform (Fig. 39d); evaporative areas of metepisternum extending little beyond peritreme (Fig. 39d). Pregenital Abdomen: posterolateral angles without tubercles (Figs 21f-h). Male Genitalia: pygophore with ventral surface concave, ventral margin rounded (Figs 39e, f, 40a) to excavate; genital opening with dorsal setal patches (Fig. 40a); parameres with columnar base, and relatively short, hook-shaped apex (Fig. 40b); phallotheca box-like, with pair of small, subdistal, thorn-like processes (Fig. 40c); ejaculatory apparatus with elongate ventral conducting canals, ≤ 10 convolutions (Fig. 40c, d); ejaculatory chamber elongate (Fig. 40c); dorsal conducting canal broad; ductus seminis and vesica distalis S-shaped (Fig. 40c); CAII bifurcate, CAII(M) basally membraneous, with hook-shaped lobal sclerite (Fig. 40c); CAII(L) membraneous, with denticulate apex, perpendicular to hook-shaped (Figs 40c, d). Female Terminalia: paratergites VIII moderately-sized, subtriangular; paratergites IX moderately-sized, subelliptoid; gonocoxae I large, subtriangular, outer surface concave. Spermatheca: fecundation canal elongate; spermathecal reservoir broad, oval; pump well-developed, with proximal and distal flanges.

Diversity and distribution: *Lampromicra* comprises 17 species, three of which occur in Australia (*aerea*, *regia* and *senator*). It also occurs in Indonesia (6 species), New Guinea (7), Philippines (2), New Caledonia (4), and the Solomon Islands (2), with a number of these species occurs in at least two of these countries. Two of the Australian species have restricted distributions, whereas *L. senator* is in tropical north Australia, extending on the eastern coast as far south as the Northern Rivers of New South Wales (Fig. 41).

Included species:

L. aerea (DISTANT 1892)	Australia
L. balteata (WALKER 1867)	New Guinea
L. cuprina (STÅL 1873)	New Guinea
L. caledonica (DISTANT)	New Caledonia
L. distinguenda (WALKER 1868)	Indonesia
L. ditissima (VOLLENHOVEN 1863)	Indonesia, New Guinea
L. elegans (MONTROUZIER 1861)	New Caledonia
L. fastuosa (VOLLENHOVEN 1863)	Indonesia, New Guinea
L. festiva (GERMAR 1839)	Philippines
L. geminata (DISTANT)	New Caledonia
L. geniculata (STÅL 1871)	Philippines
L. jactator (STÅL 1854)	Indonesia, New Guinea
L. leucocyanea (MONTROUZIER 1855)	New Caledonia, New Guinea, Solomon Islands
L. regia (BERGROTH 1895)	Australia
L. senator (FABRICIUS 1803)	Australia, New Guinea, Indonesia
L. vulcanica (LE GUILLOU 1841)	Indonesia
L. woodfordi (DISTANT 1899)	Solomon Islands

Remarks: There has been no modern comprehensive systematic treatment of *Lampromicra*. MCDONALD & CASSIS (1984) redescribed the genus on the basis of the Australia species, highlighting the importance of the male genitalia. LYAL (1979) mentioned the diagnostic proximity of *Lampromicra* with *Calliphara* and *Chrysophara*. *Lampromicra* differs from *Calliphara* in having a strongly setose dorsum (Fig. 1d), trough-like posterior margin of the callosite region of the pronotum (Figs 28c-e), rounded connexival angles (Figs 21f-h), the CAI absent (Figs 40a, d), CAII(L) perpendicular to hook-shaped with denticulations (Figs 40a, d), and the vesica is S-shaped (Figs 40a, d). The setose dorsum is not useful for generic boundaries, as it occurs in other scutellerine taxa, such as species of *Brachaulax*, *Procilia*, *Scutellera* and *Tetratharia*, as well as the Australian species, *Cantao parentum*.

The species taxonomy of *Lampromicra* is exceedingly complex, with high intra-population variation in body colour and shape of the male conjunctival appendages. The lobal sclerite of CAII(L) exhibits continuous variation; particularly in the ubiquitous species, *L. senator*.

Lampromicra aerea DISTANT 1892 (Figs 21f, 28c, 40, 41, Table 8) Revised Status

Philia aerea DISTANT 1892: 96 (n.sp.); SCHOUTEDEN 1904: 29 (list)

Philia compacta BREDDIN 1903: 57 (n.sp.); SCHOUTEDEN 1904: 29 (synonymy)

Lampromicra aerea: KIRKALDY 1909: 299 (new combination); MCDONALD 1963: 26 (male genitalia); MCDONALD & CASSIS 1984: 556 (as junior synonym of *Lampromicra senator*); CASSIS & GROSS 2002: 597 (catalogue; as junior synonym of *Lampromicra senator*)

Diagnosis: *Lampromicra aerea* is recognised by the following combination of characters: dorsum iridescent copper-fuscous (Fig. 28c); femora red; abdominal venter fuscous, with lateral regions red (inner margin of stripe linear) (Fig. 21f); dorsum setose (Fig. 28c); anterior callosite region of scutellum punctate (Fig. 28c); and, CAII dorsal branch with hooked, denticulate lobal sclerite (Figs 40c, d).

Description: Moderate size species, males 11.0-12.17 mm, females 11.0-11.5 mm.

Colouration. Dorsum uniformly copper-fuscous, often with purple iridescence (Fig. 28c); eyes and ocelli red; antennae fuscous; labium mostly fuscous, with LI burnt-orange highlighting. Thoracic pleura and sterna uniformly black. Legs: coxae and trochanters burnt-orange with dusty black highlighting; femora red; tibiae mostly fuscous with narrow basal red annulation; tarsi black. Pregenital Abdomen: venter mostly fuscous, with region lateral to spiracular-trichobothrial region red, sometimes orange-red, inner margin of stripe linear (Fig. 21f).

Vestiture. Body with dense distribution of elongate, fine, erect setae (Fig. 28c).

Texture. Body with dense distribution of shallow punctures. Pronotum: indistinct rows of deeper punctures on anterior and posterior margins of callosite region (Fig. 28c). Scutellum: anterior callosite region punctate; lateral margins weakly rugopunctate. Abdominal Venter: region lateral of spiracular-trichobothrial region rugopunctate (Fig. 21f).

Structure. Antennae: AI and AII(a) subequal in length, AI little longer in females; AIV longest segment. Labium: ex-

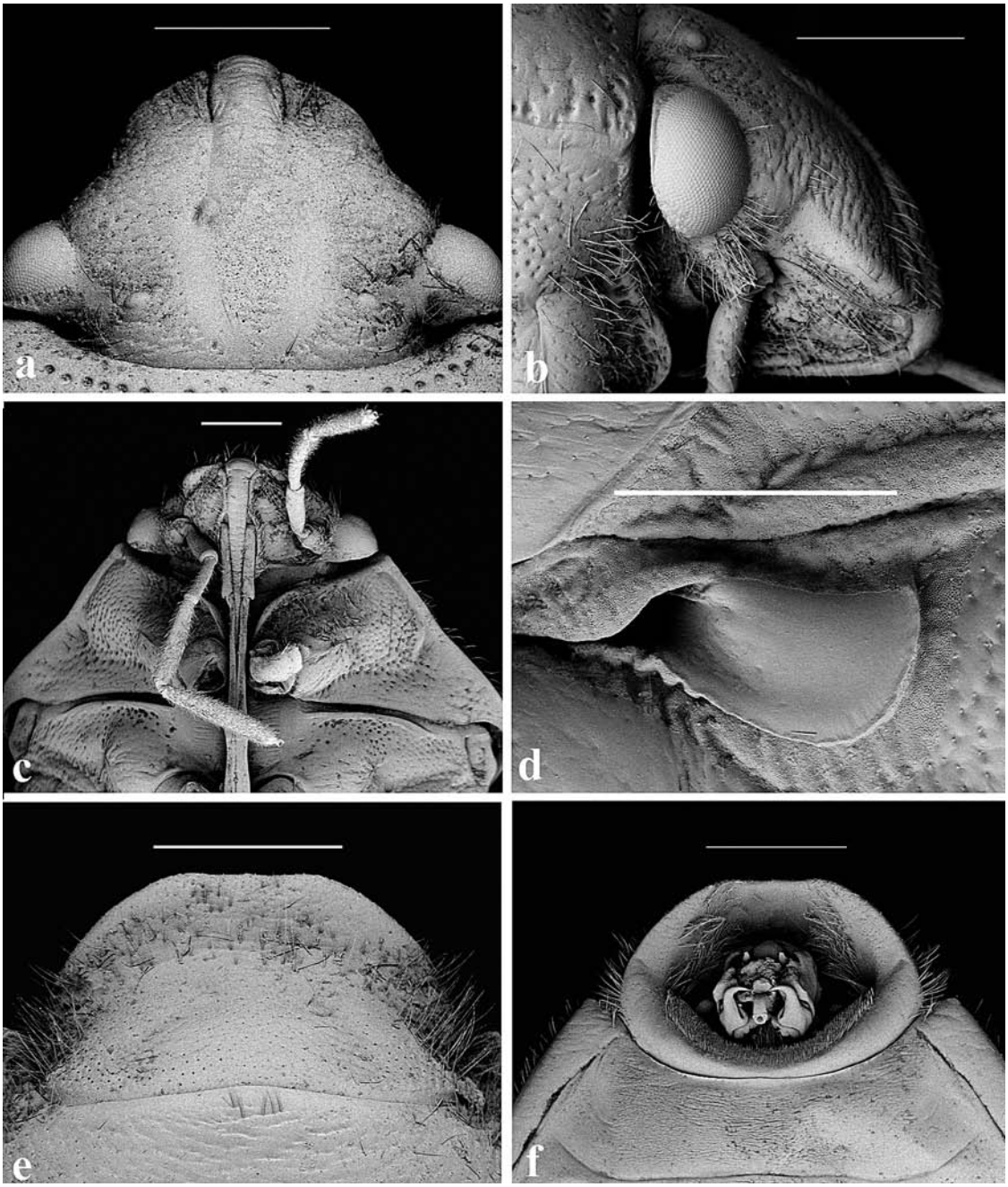


Fig. 39: Scanning electron micrographs of key characters of *Lampromicra senator* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Scale bars = 1 mm.

tending to junction of abdominal sterna III/IV. Pronotal width broader than 1/2 body length. Head: weakly convex; broad. Male Genitalia: pygophore with broad setal patch on dorsal margin of genital opening (Fig. 40a); parameres with short hook-shaped apex (Fig. 40b); phallotheca with moderately large subapical thornlike processes (Fig. 40b); ejaculatory apparatus with prominent ventral conducting canals, up to 10 convolutions (Figs 40c, d); ejaculatory reservoir elongate (Fig. 40c); dorsal conducting canal broad; ductus seminis distalis and vesica S-shaped, extending to apex of conjunctival appendages in resting position (Figs 40c, d); CAI absent (Figs 40c, d); CAII(M) with conical lobal sclerite (Figs 40c, d); CAII(L) membraneous, with large hook-shaped, denticulate lobal sclerite (Figs 40c, d); CAIII arcuate, heavily sclerotised, separated posthecal margin (Fig. 40d). Female Genitalia: paratergites VIII small, subtriangular; paratergites IX small, subelliptical; outer surface of gonocoxae I weakly concave. Spermatheca: fecundation canal elongate; reservoir, large, oval; pump well-developed.

Measurements. See Table 1.

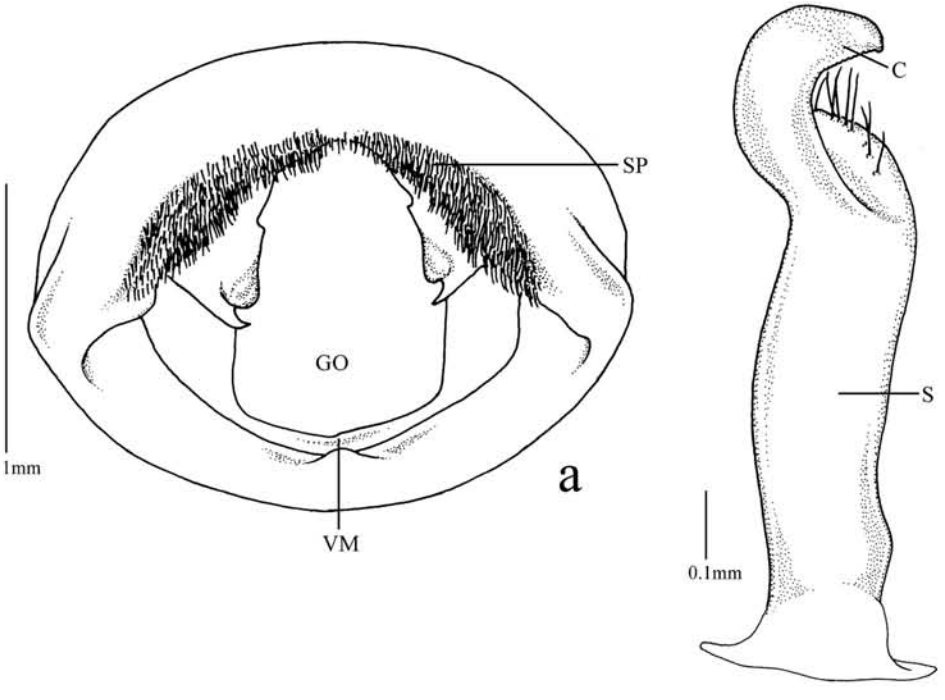
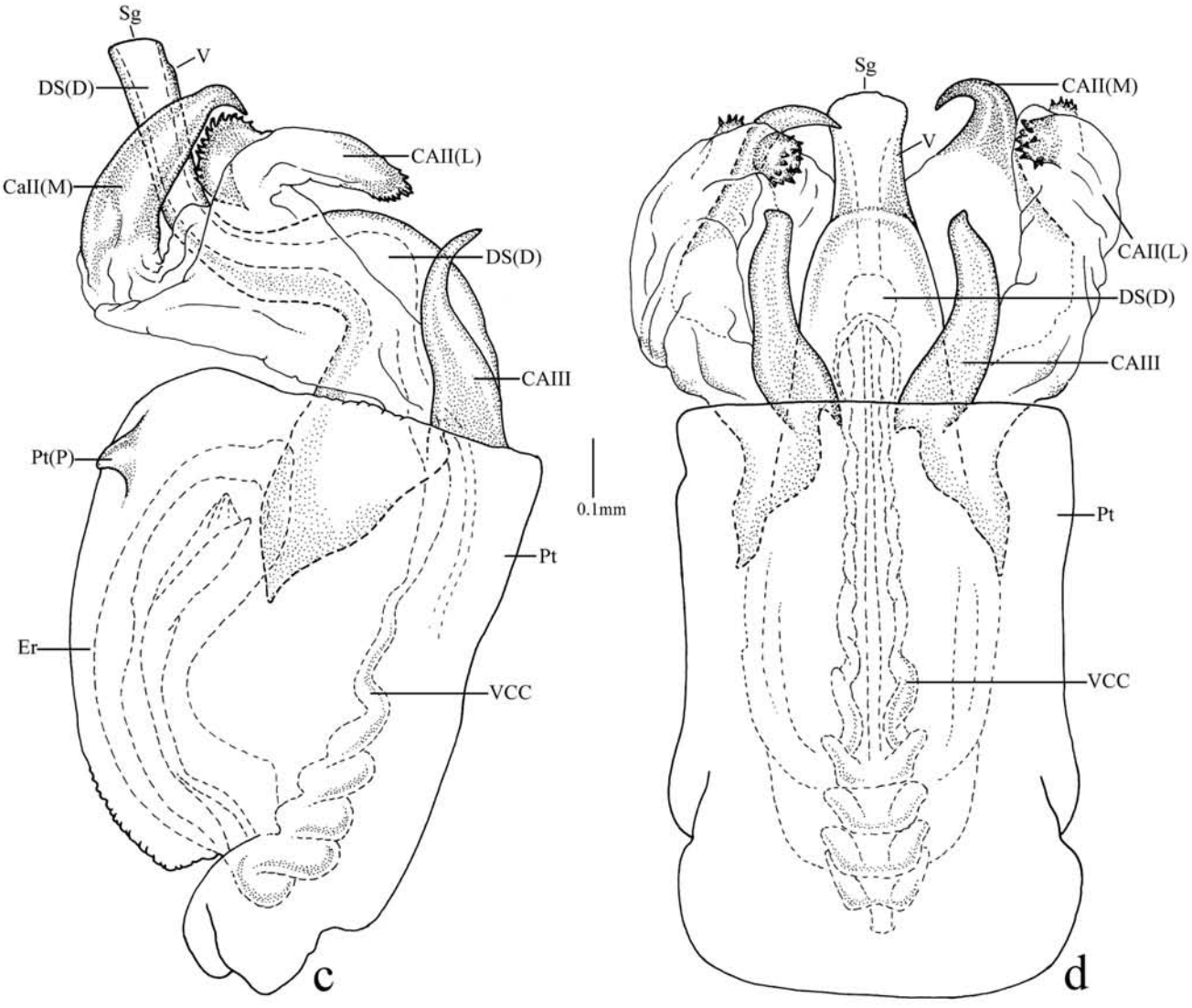


Fig. 40: Male genitalia of *Lampromicra aerea* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) aedeagus, ventral view. Abbreviations: C = crown of right paramere; CAII(L) = second conjunctival appendage, lateral branch; CAII(M) = second conjunctival appendage, medial branch; CAIII = third conjunctival appendage; DS(D) = ductus seminis dorsalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; GO = genital opening; Pt = phallotheca; Pt(P) = process of phallotheca; S = stem of paramere; Sg = secondary gonopore; SP = setose patch; V = vesica; VCC = ventral conducting canal of ejaculatory apparatus; VM = ventral margin of genital opening.



Type material examined: *Philia aerea* DISTANT: Holotype, ♀, 'Sidney', 'B.M. Hem. Type No. 456', 'Dist. Coll. 1911-383' (BMNH).

Other material examined: **New South Wales**: 1♂, Woody Head, near Iluka, 31 December 1978, BJ Day, ex rainforest (AM); 1♀, 3 km NE Harrington, 30 November 1987, G Williams, ex littoral rainforest (AM); 1♀, Coory, P Cantwell, 7 January 1983 (AM); 1♂, Mooney Mooney Creek, near Gosford, 10-11 November 1982, B Day & K Khoo (AM); 1♀, 17 km N Macksville, 4-xii-1948 (BMNH); 1♀, Cabramatta, George's River Valley, 5-30-I-1963, M Nikitin, B.M. 1963-283, on flowers of *Bursaria spinosa* (BMNH); 1♂, Sydney, x-1904, AP Dodd, 'H65', B.M. 1923-124 (BMNH); 1♀, Nowra, FA Rockway, B.M. 1929-45 (BMNH); 1♀, Hornsby, 19-xi-1969, MI Nikitin (BMNH); 1♀, Lane Cove, 23-x-1958, B.M. 1964-57 (BMNH); 1♂, Cabramatta, George's River Valley, MI Nikitin, B.M. 1962-347, ex *Kunzea ambigua* (BMNH).

Distribution: *Lampromicra aerea* is known primarily from the Sydney Basin, with its most northern limit near Iluka on the Northern Rivers of New South Wales, and extends as far south as Narooma (Fig. 41).

Host plants and biology: *Lampromicra aerea* is not common in collections, and nothing is known of its biology. Single specimens have been collected on two shrub-like plants (Table 1).

Remarks: MCDONALD & CASSIS (1984) in erecting a new synonymy, regarded *L. aerea* as a geographically isolated colour morph of the ubiquitous *L. senator*. Our examination of the same material, re-establishes the species status of *L. aerea*, on the basis of its ground colour (Fig. 28c), red femora, and colouration of the abdominal venter (Fig. 21f), as well as the shape of the lobal sclerite of CAII(L) (Figs 40c, d).

Lampromicra regia BERGROTH 1895 (Figs 21g, 28d, 41)

Lampromicra regia BERGROTH 1895: 287 (n.sp.); DISTANT 1904: 276 (description); SCHOUTEDEN 1904: 30 (list); BERGROTH 1906: 1 (note); FROGGATT 1907: 328 (biology); MCDONALD 1963: 24, 29 (male genitalia); GAEDIKE 1971: 90 (type); MCDONALD & CASSIS 1984: 557 (description); CASSIS & GROSS 2002: 596 (catalogue)

Philia leucochalcea BREDDIN 1903: 58 (n.sp.); KIRKALDY 1909: 300 (synonymy)

Diagnosis: *Lampromicra regia* is recognised by the following combination of characters: head, most of pronotum, and anterior 1/3 of scutellum purple-fuscous, with iridescent green tinge (Fig. 28d); posterior 2/3 of scutellum yellow (Fig. 28d); femora yellow; tibiae iridescent green; abdominal venter mostly dark iridescent green, lateral margins green (Fig. 21g); CAII(M) apex serrate and hooked; CAIII medially fused; and, vesica moderately sized, weakly arcuate.

Description: Body moderate-sized, males 9.3-12.0 mm, females 8.8-12.0 mm.

Colouration. Body bicoloured (Fig. 28d), with head, pronotum and anterior 1/2 of scutellum (latter (pentagonal marking) purple-fuscous with green iridescence, remainder of scutellum yellow; coxae, trochanters and femora yellow, tibiae mostly iridescent green with bases narrowly yellow; tarsi iridescent green; abdominal venter mostly iridescent green, lateral margins yellow (Fig. 21g).

Texture. Head sparsely punctate, with shallow punctures (Fig. 28d); vertex weakly rugopunctate. Pronotum: moderately dense punctate; posterior margin of callosite region with irregular row of dense punctures. Scutellum: densely punctate, less so on anterior callus. Thoracic pleura: mostly with dense punctures. Pregenital Abdomen: sterna densely punctate, lateral regions (laterad of trichobothria) impunctate.

Vestiture. Body moderately setose. Legs: ventral surface of femora, and tibiae densely setose.

Structure. Labium: reaching posterior margin of abdominal SIII. Male Genitalia: pygophore with ventral margin deeply bisinuate, with a short medial process; crown of parameres with short hook; ejaculatory apparatus well-developed, ventral conducting canal with up to 12 convolutions; CAI absent; CAII bifid; CAII(L) with large, digitiform lobal sclerite, weakly arcute, apex acute; CAII(M) with serrate, hook-shaped lobal sclerite. CAIII fused medially, bifid post-thecal margin. Female Terminalia: bi-planar, caudal in orientation; paratergites VIII moderately-sized, subtriangular; paratergites IX small, suboval; gonocoxae I large, medially depressed, posterior margin weakly concave.

New specimens examined: Queensland: 1♂, Wongabal S[tate] F[orest] 10 km S Atherton,12 June 1992, C Reid, ex beating rainforest bush-

es/vines (AM); 1♂, Upper Nesbit Riv[er], Claudie Creek, Lake Lands, 1500 feet, 16-21 August 1948, Archibold Expedition, LJ Brass (AMNH).

Distribution: *Lampromicra regia* is restricted to tropical north Queensland (Fig. 41).

Host plants and biology: *Lampromicra regia* is known from a few specimens, and there is no recorded host plant. A single species was found in rainforest understorey.

Remarks: Body colouration in species of *Lampromicra* is usually of no diagnostic value, except in species such as *L. regia* and *L. leucocyanea*. No other species approximates the colour pattern of the former species, with its yellow and fuscous-iridescent green dorsum. In contrast, its relationships are uncertain, as the genitalia do not provide a basis for sister-group relationships, although they bear a strong resemblance to *L. aerea*.

Lampromicra senator (Fabricius 1803) (Figs 1d, 21h, 28e, 40, 41)

Teytra senator Fabricius 1803: 131 (n.sp.)
Scutellera dux Kirby 1818: 474 (n.sp.); Stål 1873: 15 (synonymy)
Scutellera corallifera Macleay 1827: 466 (n.sp.); Stål 1873: 15 (synonymy)
Scutellera basalis Gray 1832: 223 (n.sp.); Stål 1873: 15 (synonymy)
Tectocoris binotata Westwood 1837: 15 (n.sp.); Stål 1873: 15 (synonymy)
Calliphara binotata: Germar 1839: 129 (new combination)
Callidea senator: Germar 1839: 121 (new combination); Dallas 1851: 22 (list); Vollenhoven 1863: 25 (list)
Philia senator: Schiödte 1842: 284 (new combination); Mayr 1866: 23 (as *Philya senator*); Stål 1868: 10 (list); Lethierry & Severin 1893: 23 (catalogue; synonymy); Breddin 1900: 140 (description); Kirkaldy 1901: 52 (distribution); Schouteden 1904: 30 (list); Schouteden 1907: 108 (list)
Scutellera aurantiacomaculata Blanchard 1849: pl. 4 fig. 1 (n.sp.); Stål 1873: 15 (synonymy); McDonald & Cassis 1984: 555 (synonymy)
Scutellera metallica Montrouzier 1855: 94 (n.sp.); Stål 1873: 15 (synonymy); McDonald & Cassis 1984: 555 (synonymy)
Callidea femorata Walker 1867: 38 (n.sp.); Lethierry & Severin 1893: 23 (incertae sedis); McDonald & Cassis 1984: 555 (synonymy)
Callidea curtula Walker 1867: 39 (n.sp.); Distant 1899: 51 (synonymy with *Callidea femorata*); Lethierry & Severin 1893: 48 (incertae sedis); McDonald & Cassis 1984: 555 (synonymy)
Callidea collaris Walker 1867: 40 (n.sp.) Distant 1899: 51 (synonymy with *Callidea femorata*); Lethierry & Severin 1893: 48 (incertae sedis); McDonald & Cassis 1984: 555 (synonymy)
Callidea aureocincta Walker 1867: 40 (n.sp.); Distant 1899: 51 (synonymy with *Callidea femorata*); McDonald & Cassis 1984: 555 (synonymy)
Callidea erythrina Walker 1867: 44 (n.sp.). **New Synonymy**
Tectocoris croesus Vollenhoven 1868: 176 (n.sp.); Stål 1873: 15 (synonymy)
Philia fulgurans Stål 1873: 15 (n.sp.); Distant 1888: 476 (note); Lethierry & Severin 1893: 22 (catalogue); Schouteden 1904: 30 (list); McDonald & Cassis 1984: 555 (synonymy)
Philia senator croesus: Tryon 1982: 14 (New Guinea; Queensland)
Philia femorata: Distant 1899: 35 (new combination); Schouteden 1904: 30 (list)
Lampromicra senator: Froggatt 1902: 318 (new combination); Distant 1904: 276 (note); Froggatt 1907: 327 (biology); Kirkaldy 1909: 300 (catalogue); Horváth 1919: 307 (description); Szent-Ivany & Catley 1960: 256 (distribution); McDonald 1961: 175-176, 184, figs 5-8 (male genitalia); McDonald & Cassis 1963b: 232, figs 8,9 (female genitalia); McDonald 1963c: 277 (larval morphology); Kumar 1964: 41 (male genitalia); Kumar 1965: 41 (morphology); Black 1968: 573 (distribution); Monteith 1982: 534

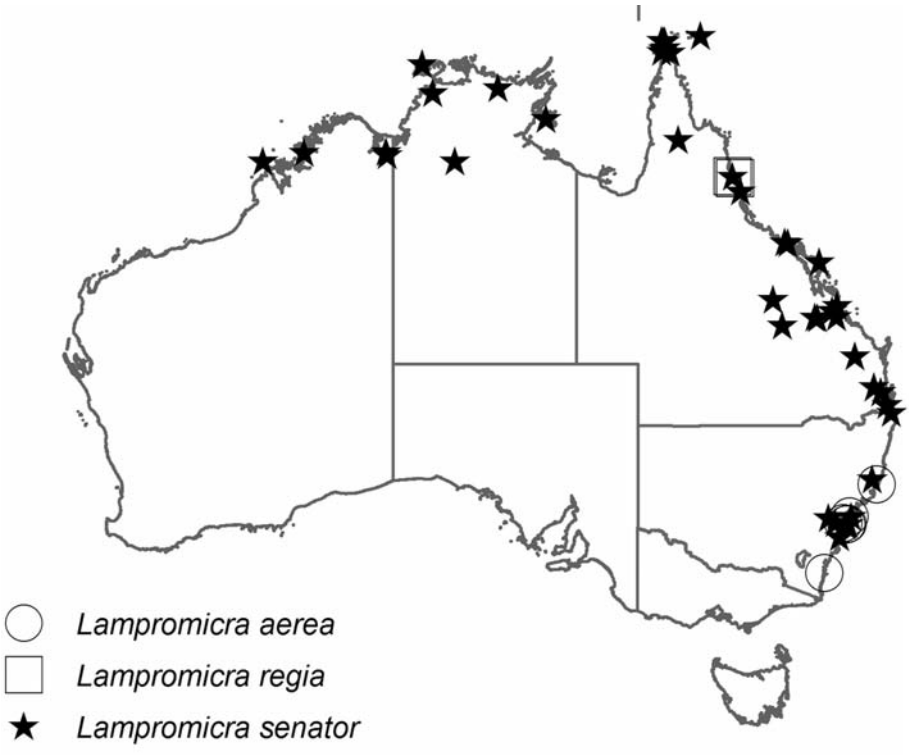


Fig. 41: Distribution of *Lampromicra* species.

(aggregation); JAVAHERY et al. 2000: 492 (biology); CASSIS & GROSS 2002: 596 (catalogue)
Philia insignis SCHOUTEDEN 1904: 297 (n.sp.); BERGROTH 1908: 140 (list); MCDONALD & CASSIS 1984: 555 (synonymy)
Lampromcira senator metallica: SCHOUTEDEN 1907a: 108 (type)
Philia croesus: SCHOUTEDEN 1907b: 45 (list)
Lampromicra fulgurans: KIRKALDY 1909: 300 (new combination; catalogue)
Lampromicra insignis: KIRKALDY 1909: 300 (new combination; catalogue)

Diagnosis: *Lampromicra senator* is recognised by the following combination of characters: dorsum densely setose (Figs 1d, 28e); body mostly iridescent green (Fig. 28e); AI orange, AII(a)-AIV fuscous; anterior margin of scutellum most often with broad elliptoid callus (usually orange) (Fig. 1d); femora orange; lateral margins of abdominal venter impunctate (Fig. 21h); lateral margins of abdominal venter orange, remainder iridescent green (Fig. 21h); apex of CAII(M) perpendicular and elongate; and, CAIII heavily sclerotized, arcuate.

Description: Body moderate size, males 10-12 mm, females 10-13 mm.

Colouration. Body mostly iridescent green to purplish-blue, with orange markings, sometimes with copper-iridescence (Figs 1d, 28e). Head: uniformly iridescent green; lorum sometimes with copper tinge; gula yellow to orange; antennae, AI orange, AII-AIV fuscous. Labium: ventral surface fuscous, dorsal surface mostly orange-brown. Pronotum: mostly iridescent green, sometimes with purple tinge; callosite region often with copper iridescence (Figs 1d, 28e). Thoracic pleura: iridescent green, often with copper-iridescence; peritreme iridescent green, evaporative areas matt black. Thoracic sterna: uniformly fuscous. Scutellum: mostly iridescent green, sometimes with purple tinge; anterior callus mostly orange, sometimes concolorous with remainder of scutellum (Figs 1d, 28e). Hemelytra: endocorium iridescent green; membrane black. Legs: coxae, trochanters and femora orange; tibiae, tarsi and pretarsi black. Pregenital Abdomen: venter mostly iridescent green, with lateral margins orange, with V-shaped inner outline; sometimes venter more orange medially, with iridescent green, sublateral band (Fig. 21h). Terminalia: mostly iridescent green, sometimes with copper tinge.

Texture. Dorsum with dense distribution of moderately deep punctures; medial regions of pronotal callosite region and anterior callus of scutellum impunctate (Fig. 28e). Thoracic pleura: moderate distribution of deep punctures. Pregenital Abdomen: venter mostly with moderate distribution of shallow punctures, laterally impunctate (Fig. 28e).

Vestiture. Dorsum and abdominal venter with dense distribution of elongate, semi-erect pale setae; thoracic pleura with scattered setae (Figs 1d, 28e). Antennae: AI-AII(a) sparsely setose; AII(b)-AIV with dense distribution of short, semi-erect setae. Legs: ventral surface of femora densely setose, with elongate setae; tibiae and tarsi densely setose.

Structure. Antennae: AI & AII(a) subequal in length; AIV longest segments, a little longer than AIV; AIIII-AIV flattened. Labium: reaching posterior margin of abdominal SIV; LI shortest segment, LII longest segment. Male Genitalia: pygophore with broad setal patch on dorsal margin of genital opening; parameres with short hook-shaped apex; phallotheca with moderately large subapical thornlike processes; aedeagus: ejaculatory apparatus with convoluted ventral conducting canal, 8-10 convolutions, ejaculatory reservoir elliptoid, dorsal conducting canal broad; ductus vesica S-shaped, extending beyond conjunctival appendages in resting position; CA I absent; CAII(L) with large hook-shaped lobal sclerite; CAII(M) distally perpendicular, with large sub-elliptoid lobal sclerite with basal and apical serrations, variable in shape, tapered to rounded apically; CAIII arcuate, heavily sclerotised, separated. Female Terminalia: large, biplanar; paratergites VIII small, subtriangular, medially tapered; paratergites IX small, subelliptical; gonocoxae I large, medially swollen; weakly concave laterally. Spermatheca: fecundation canal elongate; reservoir large, oval; distal fecundation canal elongate; proximal and distal flanges present; bulb small, elliptoid.

Measurements. MCDONALD & CASSIS 1984: Table 4.

Type material examined: *Callidea femorata* WALKER: Holotype, 'Ceram', 'B.M. Hem. Type No. 445' (BMNH); *Callidea curtula* WALKER: Lectotype, ♀, 'Ké', 'Wallace', 'Saunders 65-13', 'B.M. Hem. Type No. 444' (BMNH; here designated); *Callidea collaris* WALKER: Lectotype, ♂, 'Dor', 'Wallace', 'B.M. Hem. Type No. 446', 'Saunders 65-13' (BMNH; here designated); *Callidea collaris* WALKER: Paralectotypes, ♀, same data as lectotype (BMNH; here designated), ♂, 'Ké', '*Callidea collaris* WALK. Cat.' (BMNH; here designated), ♂, 'Cer' '*Callidea collaris* WALK. Cat.', 'Saunders 65-13' (BMNH; here designated), 1♂ 1♀, 'Ter' '*Callidea collaris* WALK. Cat.', 'Saunders 65-13' (BMNH; here designated; male pygophore missing); *Callidea aureocincta* WALKER: Lectotype, ♀, 'Salwatty', 'B.M. Hem. Type No. 443' (BMNH; here designated); *Callidea erythrina* WALKER: Holotype, ♀, 'North Austr.', 'Vict. R. Depart.', 'B.M. Hem. Type No. 458' (BMNH). *Callidea curtula* was described from two specimens; from the following locations, 'a. Aru' and 'b. Ké'. Only the former specimen was found and has been designated as the lectotype. *Callidea aureocincta* was described from two specimens, as follows: 'a. New Guinea. Presented by W.W. Saunders Esq.' and 'b. Salwatty. From Mr Wallace's collection'. The latter specimen has been designated as the lectotype. A specimen was found that had the following label data: '59-58, Dory, New Guinea', '*Callidea collaris* WALK. Cat.' and 'Paratype'. In the syntypical series of *Callidea collaris*, there is no mention of a specimen from New Guinea. We have refrained from designating this specimen as a paralectotype of either *Callidea collaris* or *C. aureocincta*.

Other material examined: **Queensland**: 1♂, Rockhampton, 12 January 1973, MS Moulds (AM); 1♂ 2♀♀, Flinders Island, 2 June 1923, C Hedley (AM); 3♂♂ 1♀ Almaden, WD Campbell (AM); 1♂, Clermont, July 1928, KK Spence (AM); 1♀ 1 larva, Carnarvon Gorge National Park, Track 7-8, 1 December 1993, G Cassis, ex *Breynia* (AM); 1♂, Heathlands, 11°14'S 142°35'E, 9 December 1992, P Zborowski & K Halfpapp, ex *Leptospermum* (ANIC); 16♂♂ 18♀♀, Louis Creek, SW Adels Grove, 8 October 1963, R Lossin (AM); 1♂, 15 km W Paluma, A Sundholm & J Bugeja, 16 January 1989; 3♂♂ 2♀♀, Boolburra, 12 January 1968, G Hangay (AM); 7♂♂ 12♀♀, Foleyvale Arboretum Reserve, 20-25 January 1968, G Hangay (AM); 5♂♂, Expedition Range, 1 January 1968, G Hangay (AM); 3♂♂ 4♀♀, Expedition Range, 5 May 1945, TW Gamble (AM); 2♂♂ 2♀♀, Wild Horse Creek, 30 January 1968, G Hangay (AM); 1♂, Mt Surprise, 23 February 1988, G O'Reilly (AM); **New South Wales**: 1♀, Mt Ousley, Wollongong, 27 December 1967, RB Lachlan (AM); 1♂ 2♀♀, 30 km W Fairview, NW Laura, 7 November 1979, MS & BJ Moulds, ex sandstone outcrop (AM); **Western Australia**; 16♂♂ 17♀♀, Kimberley district, Black Rock Pool, 18km N of Victoria Hwy, G Cassis and R Silveira, 24 May 1999, ex *Adiantum aethiopicum* (AM); 5♂♂ 7♀♀, Kimberley district, Middle Springs, 16.6 km N Victoria Hwy, 24 May 1999, G Cassis and R Silveira, ex *Ficus leucotricha* (AM); 1♂ 2♀♀, Beagle Bay, M Granney (AM); 2♀♀, Jeremiah Hills, on Carlton Hill Station, near KJ-8, 14 July 1989, N Poulter (AM); **Northern Territory**: 6♂♂ 5♀♀, Armstrong River, near Top Springs, 16°41'09"S 132°03'25"E, 9 January 2001, MS & BJ Moulds (AM); 3♂♂ 1♀, Mann River, Central Arnhem Land, 12°28'24"S 134°8'58"E, 20 July 1993, P Taçon (AM).

Distribution: *Lampromicra senator* is broadly distributed in northern Australia, and is commonly encountered in tropical regions of Queensland, Western Australia and the Northern Territory. It is also more broadly distributed on the eastern seaboard, extending as far south as Wollongong in New South Wales (Fig. 41).

Host plants and biology: *Lampromicra senator* is found on many plants (Table 1). MCDONALD (1963c) described aspects of its biology, reporting its primary host as *Breynia oblongifolia*. We have found it on a number of species of *Ficus* (Table 1), as well as additional fig species from a recent field trip to north Queensland, that are not recorded here. In The Kimberley district of Western Australia, we found this species in aggregations on a fern (Table 1), at the beginning of the dry season, indicating a possible aestivating site.

Remarks: MCDONALD & CASSIS (1984) established an extensive synonymy for *Lampromicra senator*, recognising significant polymorphism in colour and male genitalia. We confirm in this work, that the condition of CAII(M) exhibits significant and continuous variation within and between populations. The apex of CAII(M) is elongate and strongly perpendicular to its base, with various sclerotizations. The shape of the apex but is not indicative of species limits, as it varies from a subtriangular process to being rounded apically, and sometimes with subapical projections. MCDONALD & CASSIS (1984: Figs 54-58) illustrated these variations of CAII(M). In the main, other components of the aedeagus are uniform within

the species. The colour of *L. senator* also varies considerably, although the predominant colour morph is iridescent green, with the anterior callus of the scutellum orange. Within some populations, the orange scutellar callus is absent, and the scutellum is uniformly iridescent green. There is also variation in the colour of the callosite region (iridescent green to iridescent copper) and the pregenital abdominal venter (mostly iridescent green with orange lateral margins to mostly orange, with sublateral band of iridescent green). Extralimital populations have colour patterning not seen in Australian populations. However, the male genitalia do not show any discontinuities between these populations.

None-the-less, in considering the extent of the morphological polymorphism and widespread geographic distribution of *L. senator*, it would be desirous to reinvestigate the synonymy of the extralimital junior synonyms (*Scutellera iridescenta*, *Callidea femorata*, *Callidea curtula*, *Callidea collaris*, *Callidea aureocincta*, *Tectocoris croesus* and *Philia fulgurans*) using molecular data. In keeping with this broad conception of the species, we have synonymised another of WALKER's names, *Callidea erythrina*, which has the orange scutellar callus, and a mostly purple dorsum, the latter a recurrent artefact of preservation.

Scutiphora GUÉRIN 1831 (Figs 1e, 21i, 28b, 42, 43, 44)

Scutiphora GUÉRIN 1831: pl. XI fig. 7 (gen. nov.); LAPORTE 1832: 11 (list); GERMAR 1839: 110 (description); AMYOT & SERVILLE 1843: 35 (description); STÅL 1865: 33 (key); MAYR 1866: 16, 23 (key, list); STÅL 1873: 8,10 (key, list); LETTHIERRY & SEVERIN 1893: 18 (catalogue); SCHOUTEDEN 1904: 28 (description); KIRKALDY 1909: 308 (catalogue); DUPUIS 1952: 452 (taxonomy); MCDONALD & CASSIS 1984: 555 (description); CASSIS & GROSS 2002: 598 (catalogue)

Peltophora BURMEISTER 1835: 393 (gen. nov.); DALLAS 1851: 19 (synonymy); STÅL 1865: 33 (key)

Type species: *Scutiphora*: *Scutiphora rubromaculata* GUÉRIN 1831 (= *Scutellera pedicellata* KIRBY 1826), monotypy; *Peltophora*: *Peltophora cruenta* BURMEISTER 1835 (= *Scutiphora rubromaculata* GUÉRIN 1831), monotypy

Diagnosis: *Scutiphora* is recognised by the following combination of characters: mesosternum sulcate, laterally striate (Fig. 42c); AII(a) arcuate; AII(b) short; anterolateral margin of pronotum concave (Fig. 28b); metathoracic external efferent system reduced (Figs 42c, d); peritreme short, subreniform (Fig. 42c, d); pygophore enlarged, medially excavate (Figs 42e, f, 43a); crown of parameres short (Fig. 43b); CAI absent (Fig. 43c); CAII tripartite, three elongate lobal sclerites (Figs 43c, d); CAIII fused medially, apically bifid (Fig. 43d); female terminalia caudally oriented; and, gonocoxae I greatly enlarged.

Description: Large species; elongate-ovoid (Figs 1e, 28b); dorsally and ventrally convex; dorsum densely punctate (Figs 1e, 28b); body almost glabrous (Figs 1e, 28b); body iridescent green with orange and black markings (Figs 1e, 28b). Head: triangular (Fig. 42a); weakly convex; jugal margins subcarinate (Fig. 42b); lorae strongly demarcated, margins carinate; bucculae narrow, lateral margins parallel. Antennae: AII(a) strongly arcuate, more so in males; AII(b) very short; AIV flattened. Labium: reaching abdominal SIV; LII bicompressed. Pronotum: subtrapeziform, shield-like, moderately convex (Figs 1e, 28b); post-callosite region depressed (Figs 1e, 28b); anterior margin strongly concave (Figs 1e, 28b); anterolateral margins weakly concave, carinate (Figs 1e, 28b); posterior margin rectilinear (Figs 1e, 28b); post-humeral angles depressed. Scutellum: elongate, large, covering most of forewings, base of exocorium and tip of abdomen visible (Figs 1e, 28b); moderately convex, strongly declivent posteriorly; anterior region raised, with two prominent calli (Figs 1e, 28b); anterolateral angles upturned. Thoracic pleura: anterior margin of proepisternum truncate (Fig. 42c); external efferent system of metathoracic glands reduced, peritreme short, subreniform, evaporative areas confined minimally beyond margins of peritreme, including mesepimeron (Figs 42c, d). Thoracic sterna: prosternum depressed; mesosternum medially sulcate, laterally striate; metasternum depressed. Pregenital Abdomen: posterolateral angles of abdominal venter rounded; connexiva smooth, without processes; male SIII medially rounded, without medial sulcation or processes; female SII with very weak medial depression; male SVII visible, weakly overlapping pygophore;

female SVII recessed, not visible. Male Genitalia: pygophore greatly enlarged; posterior margin of pygophore with medial notch (Figs 42e, f, 43a); dorsal margin with setal patches (Fig. 42f, 43a); parameres with thick stem, crown small, weakly notched Fig. 43b); ductus seminis proximalis narrow, membraneous, singular (Figs 43c, d); ventral conducting canal, with up to 12 convolutions (Figs 43c, d); ejaculatory reservoir subelliptoid, moderately-sized (Figs 43c, d); vesica S-shaped; elongate, extending beyond conjunctival appendages (Figs 43c, d); CAI absent; CAII tripartite, CAII(L) elongate, sickle-shaped, strongly sclerotized, CAII(M) basally membraneous, apically with two digitiform lobal sclerites (Figs 43c, d); CAIII strongly sclerotized, fused medially, apically bifid (Figs 43c, d). Female Terminalia: caudally oriented; paratergites VIII moderately large, subelliptoid, medially incrassate; paratergites IX small, suboval, medial margins rounded; gonocoxae I greatly large, subtriangular, dorsal margin excavate; Spermatheca: fecundation canal short; reservoir round; proximal and distal flanges present; bulb oval.

Diversity and distribution: *Scutiphora* is a monotypic genus endemic to Australia.

Included species:

S. pedicellata (KIRBY 1826)	Australia

Remarks: The affinities of *Scutiphora* are difficult to deduce, with distinctive character states of the antennae, mesosternum, external efferent system of the metathoracic glands, and male aedeagus. The metathoracic peritreme resembles those found in *Calliphara* and *Lampromica*, with all three genera having the peritreme subreniform in shape, although it is much smaller in *Scutiphora*. The male genitalia are autapomorphic, with the CAII tripartite and enlarged digitiform lobal sclerites. *Scutiphora* also has fused, U-shaped CAIII, which is not found in the former two genera, but in genera such as *Calliscyta* and *Cantao*.

Scutiphora pedicellata (KIRBY 1826)
(Figs 1e, 21i, 28b, 42, 43, 44)
Iridescent Jewel Bug

Scutellera pedicellata KIRBY 1826: 517 (n.sp.);
Scutiphora rubromaculata GUÉRIN 1831: pl. XI Fig. 7 (n.sp.); LAPORTE 1832: pl. 55 fig. 3 (habitus); GUÉRIN-MÉNEVILLE 1838: 165 (description); STÅL 1873: 10 (synonymy)
Peltophora cruenta BURMEISTER 1835: 393 (n.sp.); STÅL 1873: 10 (synonymy)
Peltophora rubromaculata: HERRICH-SCHAEFFER 1836: 100, pl. 10, fig. 326 (new combination); BURMEISTER 1835: 393 (list); GERMAR 1839: 110 (list)
Scutiphora picta GUÉRIN-MÉNEVILLE 1838: 165 (n.sp.); CASSIS & GROSS 2002: 599 (catalogue)
Peltophora picta: AMYOT & SERVILLE 1843: 35 (new combination); DALLAS 1851: 19 (description)
Peltophora pedicellata: STÅL 1873: 13 (list); LETHIERRY & SEVERIN 1893: 21 (catalogue); FROGGATT 1897: 104 (description; biology); FROGGATT 1901: 1594 (description; cherry pest); VAN DUZEE 1905: 188 (list); FROGGATT 1907: 327 (description; cherry pest)
Scutiphora pedicellata: SCHOUTEDEN 1904: 28 (new combination); KIRKALDY 1909: 291 (catalogue); TILLYARD 1926: 149 (diagnosis); MCKEOWN 1942: 86 (biology); MCDONALD 1961: 176-177, 185 figs 9-13 (male genitalia); MCDONALD 1963a: 30 (male genitalia); MCDONALD 1963b: 231-232, figs 6,7 (female genitalia); MCDONALD 1963c: 293, figs 11-16 (life cycle); KUMAR 1964: 60 (male genitalia); KUMAR 1965: 41 (male genitalia); HELY et al. 1982: 124, 145, 165 (biology; pest status); MCDONALD & CASSIS 1984: 522, figs 49,50 (description); CASSIS & GROSS 2002: 593 (catalogue)

Diagnosis: *Scutiphora pedicellata* is recognised by the following combination of characters: iridescent green with orange and fuscous markings (Figs 1e, 28b); AII(a) arcuate; AII(b) very short; labium reaching abdominal SIII; pronotum with deep transverse furrow (Figs 1e, 28b); scutellum with pair of submedial calli (Figs 1e, 28b); mesosternum striate; abdominal venter mostly orange, with SII/III fuscous, and SIV-SVII with sublateral iridescent green band of markings (Fig. 21i); and, male (Figs 43a-d) and female genitalia as in generic diagnosis.

Description: Large species, males 13-15 mm, 12-15 mm.

Colouration. Dorsum iridescent green with orange and fuscous markings (Figs 1e, 28b). Head: mostly iridescent green, with anteclypeus and ocular regions fuscous; antennae mostly fuscous, AI sometimes with green iridescent tinge, AII(a) greatly elon-

gate, AII(b) short. Pronotum: anterior and anterolateral margins orange, callosite region mostly fuscous, medially orange, disc uniformly iridescent green. Scutellum: iridescent green with four to six elliptical fuscous spots. Legs: coxae, trochanters and proximal 2/3 of femora orange, remainder of femora and tibiae iridescent green, tarsi fuscous. Pregenital Abdomen: venter mostly orange, with submarginal iridescent green markings (Fig. 21i). Terminalia: uniformly orange.

Texture. Iridescent green regions of body densely punctate; orange regions mostly impunctate (Figs 1e, 28b).

Vestiture. Body mostly glabrous (Figs 1e, 28b). Antennae: AI & AII(a) glabrous, AII(b)-AIV setose. Legs: ventral surface of femora weakly spinose; ventral surface of tibiae densely setose, with short thick setae.

Structure. Antennae: AII(a) arcuate, strongly in male; AII(b) longest segment; AII(b) very short; AIV little longer than AIII. Labium: reaching abdominal SIII. Pronotum: anterolateral margins very weakly excavate; post-callosite region with deep transverse furrow. Scutellum: with pronounced, submedial calli on anterior margin. Male (Figs 43a-d) and female genitalia as in generic description.

Measurements. McDonald & Cassis 1984: Table 3.

Material examined: **New South Wales**: 1♀, Deua River National Park, near Woolli Homestead, G Cassis, 9 October 1988 (AM); 1♂, Collaroy, 28 December 1981, BJ Day (AM); 1♀, Frenchs Forest, La Sorlie Road, December 1987, T Ralph (AM); 1♀, Cowan Field Station, 25-v-1981, M McDonald (AM); 2♀♀, Ingleburn, 8 September 1985, R Bejsak (AM); 15♀♀, Avoca Beach, 15 November 1985, S Hunter & AL Johnson (AM); 5♂♂, NSW: Pearl Beach, 1-i-1986, C Urquhart, ex ground (AM); 2♂♂ 1♀, Woodford, Blue Mountains, 30 November 1985, M Dingley (AM); 1♂ 5♀♀, Mt Kaputar, 6-xii-1979, DJ Scambler (AM); 1♂ 2♀♀, Mt Kaputar, Bullawa Creek, 27 November 1984, G Hangay (AM); 5♂♂ 28♀♀, Mt Kaputar, 1500 m, 29 November 1984, G Hangay (AM); Whiskers, 7 km WNW Hoskinstown, 23.241S 149.23E, 18 February 1990, MS Upton, ex privet bush (ANIC); MT Goonoo State Forest, southside, 9 November 1987, DK McAlpine & R de Keyzer (AM); 1♀, Mann River, near Grafton, 30 December 1978, BJ Day (AM); 1♀, Clarence, 21 January 1990, R de Keyzer & GA Clark, 21 January 1990, ex *Leptospermum*; **Australian Capital Territory**: Canberra (Farrer), 35.22S 149.05E, DCF Rentz, 3-cii-1986 (ANIC); **Tasmania**: Aspley Gorge, 23 February 1994, J & A Leask (AM).

Distribution: *Scutiphora pedicellata* is broadly distributed in New South Wales, extending as far north as southeast Queensland and as far south as Tasmania (Fig. 44). This species was erroneously recorded from New Zealand (Cassis & Gross 2002, also references therein).

Host plants and biology: *Scutiphora pedicellata* is known from five host plants (Table 1). McDonald (1963c) described its biology and found it feeding primarily on *Dodonaea triquetra*.

Remarks: This species is remarkably homogenous, with colour patterning and male genitalia exhibiting little intraspecific variation. It is easily distinguished by the iridescent green body with orange markings (Figs 1e, 28b) and the male genitalia.

Subfamily Tectocorinae

Tectocorinae McDonald & Cassis 1984: 566 (new subfamily); Cassis & Gross 2002: 600 (catalogue)

Diagnosis: The Tectocorinae are recognised by the following combination of characters: usually large species (Figs 45a, b); aposematic colouration; elongate-ovoid (Figs 1f, 45a, b), shallowly punctate; elongate head (Fig. 46a); thoracic sterna flat (Fig. 46c); anterior margin of proepisternum linear (Fig. 46c); efferent system of metathoracic glands vestigial, with rectilinear peritreme (Fig. 46d); males with abdominal androconial glands on SIV-SVI (Figs 2g-i, 45c); pregenital abdomen in both sexes without stridulatory vittae; ventral surface of pygophore ventrally oriented (e.g., Figs 46c); parameres large, strongly hook-shaped (Fig. 47b); ductus seminis proximalis broad, bounded by ligamentary tubule (Figs 47c, d); ejaculatory apparatus box-like, heavily sclerotised; without convoluted ventral conducting canal (Figs 47c, d); three conjunctival appendages present, mostly membraneous (Figs 47c, d); CAII undivided with conical lobal sclerite (Figs 47c, d); females lacking interlocking rami; spermathe-

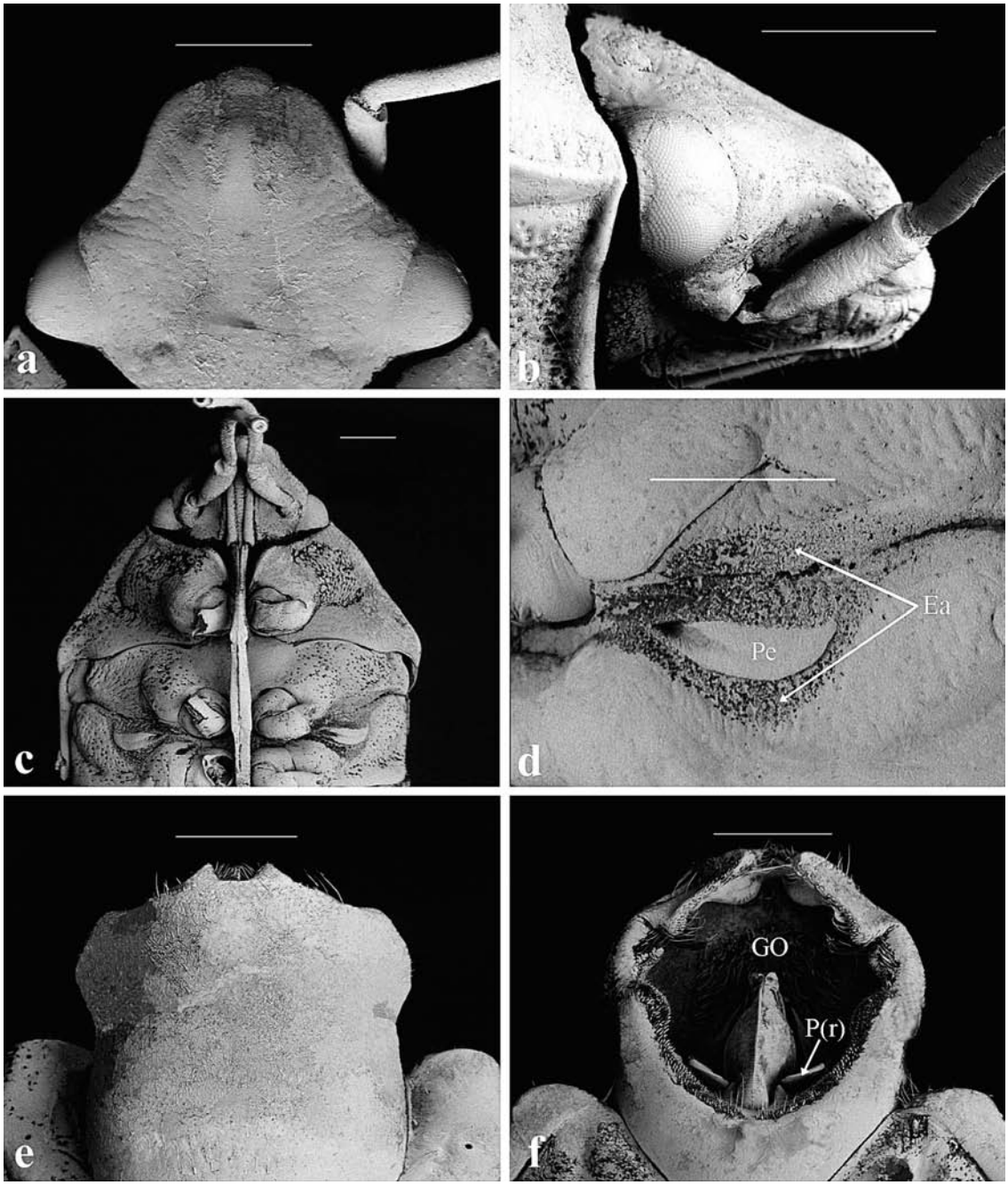


Fig. 42: Scanning electron micrographs of key characters of *Scutiphora pedicelllata* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Ea = evaporative areas; GO = genital opening; Pe = peritreme; P(r) = right paramere. Scale bars = 1 mm.

cal fecundation canal short; spermathecal reservoir membraneous, oval; spermathecal pump minute, without flanges.

Remarks: *Tectocoris diophthalmus* is a distinctive taxon based on the male and female genitalia alone. The aedeagus has a ligamentary tubule (Figs 47c, d), which is also found in some species of Pachycorinae, including *Agonosoma trilineatum* (Fig. 18c). In contrast, *Tectocoris* has androconial glands which are only found in the Odontotarsinae. SCHUH & SLATER (1995) amongst others have ignored the use of this subfamily, placing *Tectocoris* in the Scutellerinae, following previous workers (SCHOUTEDEN 1904; KIRKALDY 1909; MCDONALD 1961, 1963b). In our view, this is not supported as *Tectocoris* lacks the scutellerine-type ejaculatory apparatus. In our view there is sufficient evidence to retain the use of the Tectocorinae as a subfamily, pending a more detailed cladistic analysis of the family.

Tectocoris HAHN 1834 (Figs 1f, 2g-i, 45, 46, 47, 48)

Tectocoris HAHN 1834: 33 (gen. nov.); DALLAS 1851: 3 (description); STÅL 1865: 33 (key); MAYR 1866: 17 (list); STÅL 1873: 11 (list); LETHIERRY &

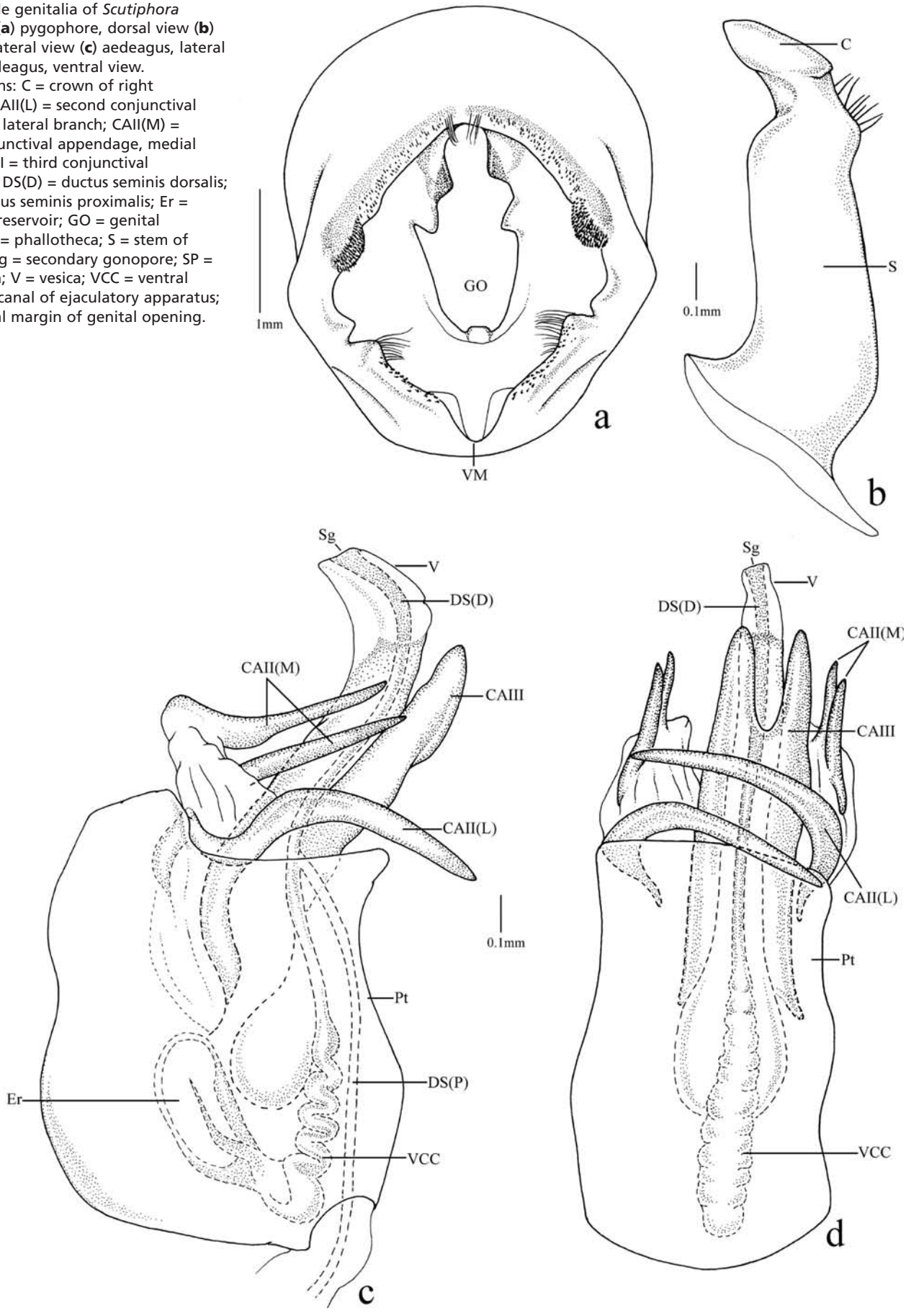


Fig. 43: Male genitalia of *Scutiphora pedicellata* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) aedeagus, ventral view. Abbreviations: C = crown of right paramere; CAII(L) = second conjunctival appendage, lateral branch; CAII(M) = second conjunctival appendage, medial branch; CAIII = third conjunctival appendage; DS(D) = ductus seminis dorsalis; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; GO = genital opening; Pt = phallotheca; S = stem of paramere; Sg = secondary gonopore; SP = setose patch; V = vesica; VCC = ventral conducting canal of ejaculatory apparatus; VM = ventral margin of genital opening.

SEVERIN 1893: 19 (catalogue); SCHOUTEDEN 1904: 19 (description); KIRKALDY 1909: 306 (catalogue); MCDONALD & CASSIS 1984: 568 (list); CASSIS & GROSS 2002: 600 (catalogue)
Type species: *Tetyra cyanipes* FABRICIUS 1803 (= *Cimex diophthalmus* THUNBERG 1783), monotypy

Diagnosis: *Tectocoris* is recognised by the following combination of characters: large, elongate-ovoid body (Figs 1f, 45a,b); head elongate (Fig. 46a); anterolateral margins of pronotum strongly divergent posteriorly (Figs 1f, 45a,b); posterior margin of pronotum excavate (Figs 1f, 45a,b); anterior margin of proepisternum entire (Fig. 46b); external efferent system of metathoracic glands reduced, linear (Fig. 46d); mesepimeron without evaporative areas (Fig. 46d); abdominal SIII-SIV sulcate; males with androconial glands on abdominal SIV-VI (Figs 2g-I, 45c); male SVIII visible (Fig. 46e); parameres strongly hooked (Fig. 47b); aedeagus with three conjunctival appendages (Figs 47c,d); CAI medially fused (Figs 47c,d); ductus seminis proximalis bounded by ligamentary tubule (Figs 47c,d); ejaculatory apparatus box-like (Fig. 47c), heavily sclerotized; spermathecal reservoir greatly enlarged, oval; and, spermathecal pump minute.

Description: Body elongate-ovoid (Figs 1f, 45a,b); aposematic colouration, often sexually dimorphic (Figs 1f, 45a,b), females mostly oranges, dorsum often with iridescent green or blue markings (Figs 1f, 45a,b), males ranging from uniformly orange to mostly iridescent green or blue, with orange markings (Figs 1f, 45a,b); dorsum densely punctulate (Figs 1f, 45a,b); body nearly glabrous (Figs 1f, 45a,b). Head: elongate, little longer than wide, porrect, weakly convex (Fig. 46a); lateral margins of jugae rectilinear, carinate in profile (Fig. 46a); clypeus extending beyond jugae (Fig. 46a); bucculae elongate, margins low (Fig. 46a); eyes small. Pronotum: callosite region and disc co-planar, without transverse furrow (Figs 1f, 45a,b); anterolateral margins strongly divergent, weakly sinuate, explanate (Figs 1f, 45a,b), carinate in profile (Fig. 46b); humeral angles angulate (Figs 1f, 45a,b); posterior margin excavate (Figs 1f, 45a,b). Scutellum: strongly convex; strongly declivent beyond midpoint (Figs 1f, 45a,b); lateral margins convex (Figs 1f, 45a,b); base of corium and clavus visible (Figs 1f, 45a,b); tip of membrane wing visible (Figs 1f, 45a,b). Hemelytra: exocorium expanded (Figs 1f, 45a,b). Thoracic Pleura: anterior edge of proepisternum linear, explanate (Fig. 46c); external efferent system of metathoracic glands greatly reduced, ostiole minute, peritreme as linear sulcation (Fig. 46d); evaporative areas reduced, not extending to mesepimeron (Fig. 46d). Thoracic Sterna: prosternum depressed (Fig. 46c); mesosternum weakly impressed, laterally striate; metasternum flat. Pregenital Abdomen: laterally rounded, posterior angles weakly acuminate (Fig. 45c); abdominal SIII-SIV medially sulcate, housing labium; males with androconial glands present sublaterally on SIV-VI (Figs 2g-i, 45c); male SVIII visible, strongly overlapping posterior margin of pygophore (Fig. 46e). Male Genitalia: posterior region of pygophore visible, margin notched medially (Figs 46e,f, 47a); genital opening broad, densely setose (Figs 46e,f, 47a); parameres with arcuate, broad stem, densely setose, crown strongly hooked (Fig. 47b); aedeagus large; phallotheca sub-cylindrical, without processes (Figs 47c,d); ductus seminis proximalis narrow, bounded by ligamentary-derived membraneous tubule (Figs 47c,d); CAI large, lobe-like, without sclerotization (Figs 47c,d); CAII membraneous lobe, with short,

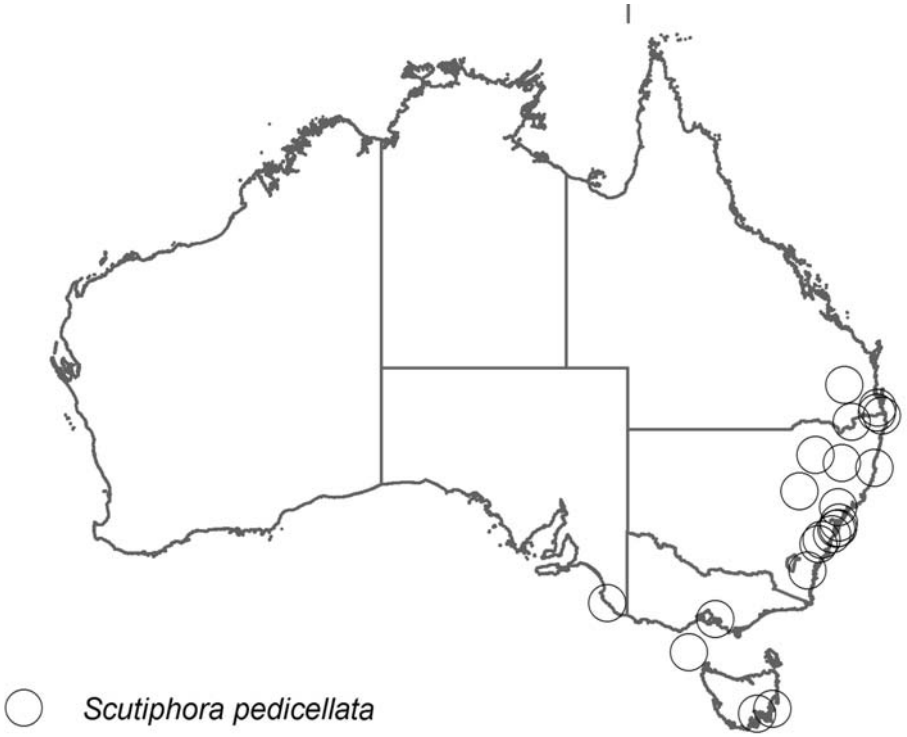


Fig. 44: Distribution of *Scutiphora pedicellata*.

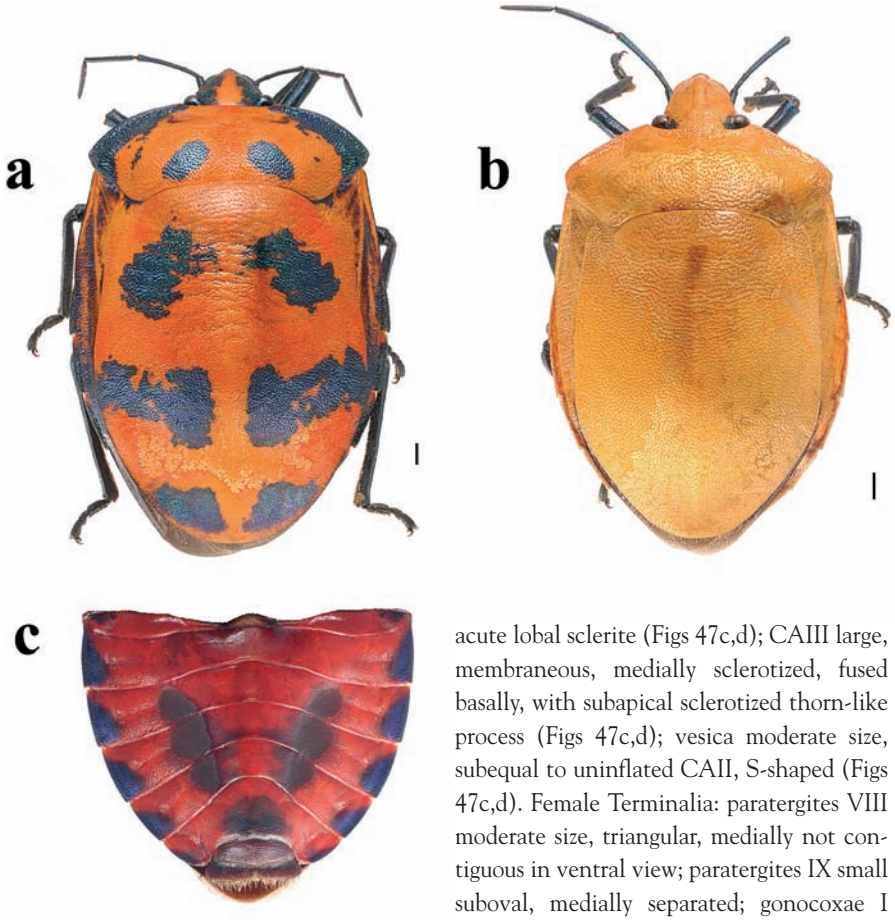


Fig. 45: Habitus and abdominal venter of *Tectocoris diophthalmus* (**a**) ♂ (**b**) ♀ (**c**) abdominal venter.

acute lobal sclerite (Figs 47c,d); CAIII large, membraneous, medially sclerotized, fused basally, with subapical sclerotized thorn-like process (Figs 47c,d); vesica moderate size, subequal to uninflated CAII, S-shaped (Figs 47c,d). Female Terminalia: paratergites VIII moderate size, triangular, medially not contiguous in ventral view; paratergites IX small suboval, medially separated; gonocoxae I moderate size, subelliptoid, medially contiguous. Spermatheca: fecundation canal moderate size; reservoir large, oval, membraneous; spermathecal pump minute, with flanges vestigial, pump oval with acute apex.

Diversity and distribution: *Tectocoris* is a monotypic genus which is known primarily from the Melanesian and Australian subregions of the Australian zoogeographic region, as well as Indonesia.

Included species:
T. diophthalmus (THUNBERG 1783)
Australia, Indonesia, New Caledonia, Papua New Guinea, Samoa, Tonga, Vanuatu

Remarks: The taxonomic history of this genus and species is convoluted, owing in part to the extreme colour variability found. This species has been placed in a number of genera with varying specific epithets and subspecies. A list of these synonyms can be found in CASSIS & GROSS (2002) and above. SCHOUTEDEN (1904) and KIRKALDY (1909) placed the insect in the tribe Scutellerini with other members of the current subfamily Scutellerinae. MCDONALD (1961, 1963b) also placed it within the tribe Scutellerini, but proposed that it occupies a taxonomic position of its own. KUMAR (1965) placed the species in the tribe Pachycorinae, a group otherwise absent from the Australian continent.

Tectocoris diophthalmus (THUNBERG 1783) (Figs 1f, 2g-i, 45, 46, 47, 48)
Cotton Harlequin Bug

Cimex lineola FABRICIUS 1781: 340 (n.sp.; junior homonym of *Cimex lineola* LINNAEUS 1758); FABRICIUS 1787: 281 (description); FABRICIUS 1794: 84 (description); VOLLENHOVEN 1863: 8 (synonymy); STÅL 1873: 19 (synonymy); LETHIERRY & SEVERIN 1893: 19 (synonymy)
Cimex diophthalmus THUNBERG 1783: 30, pl. 2 fig. 45 (n.sp.)
Tetyra lineola: FABRICIUS 1803: 135 (new combination)
Tetyra cyanipes FABRICIUS 1803: 133 (n.sp.); WOLFF 1811: 171, fig. 165; BLANCHARD 1840: 159 (synonymy); LETHIERRY & SEVERIN 1893: 19 (synonymy)
Cimex banksii DONOVAN 1805: 29 (n.sp.); DALLAS 1851: 16 (synonymy); VOLLENHOVEN 1863: 8 (synonymy); STÅL 1873: 19 (synonymy); LETHIERRY & SEVERIN 1893: 19 (synonymy)
Scutellera schoenherri ESCHSCHOLTZ 1822: 99 (n.sp.); BURMEISTER 1835: 396 (list); GERMAR 1839: 133 (synonymy); VOLLENHOVEN 1863: 8 (synonymy); STÅL 1873: 19 (synonymy); LETHIERRY & SEVERIN 1893: 19 (synonymy)
Scutellera banksii: GUÉRIN-MÉNEVILLE 1838: 1555 (new combination; description); GERMAR 1839: 133 (synonymy); HERRICH-SCHAEFFER 1839: 1 (description); AMYOT & SERVILLE 1843: 28, pl. 1 fig. 5 (description; synonymy); MONTROUZIER 1855: 91 (parental care); WESTRING 1858: 50 (stridulation); MONTROUZIER 1858: 243 (New Caledonia)
Tectocoris cyanipes: HAHN 1834: 34 (new combination); DALLAS 1851: 16 (synonymy); VOLLENHOVEN 1863: 8 (description; synonymy; varieties)
Tectocoris diophthalmus: HAHN 1834: 33 (new combination); DALLAS 1851: 16 (synonymy); MAYR 1866: 22 (synonymy); STÅL 1871: 617 (synonymy); DISTANT 1920: 144 (New Caledonia); SIMMONDS 1922: 36-38 (cotton pest; omnivory); BALLARD 1925: 542 (pest status); BALLARD & HOLDAWAY 1926: 329 (biology); TILLYARD 1926: 149, pl. 12 fig. 13 (diagnosis; habitus); BALLARD 1927: 604 (cotton pest); SIMMONDS 1928: 10-12 (cotton pest; Fiji); DAMMERMAN 1929: 2020 (biology); SCHOUTEDEN 1933: 47 (distribution); MCKEOWN 1933: 24 (maternal

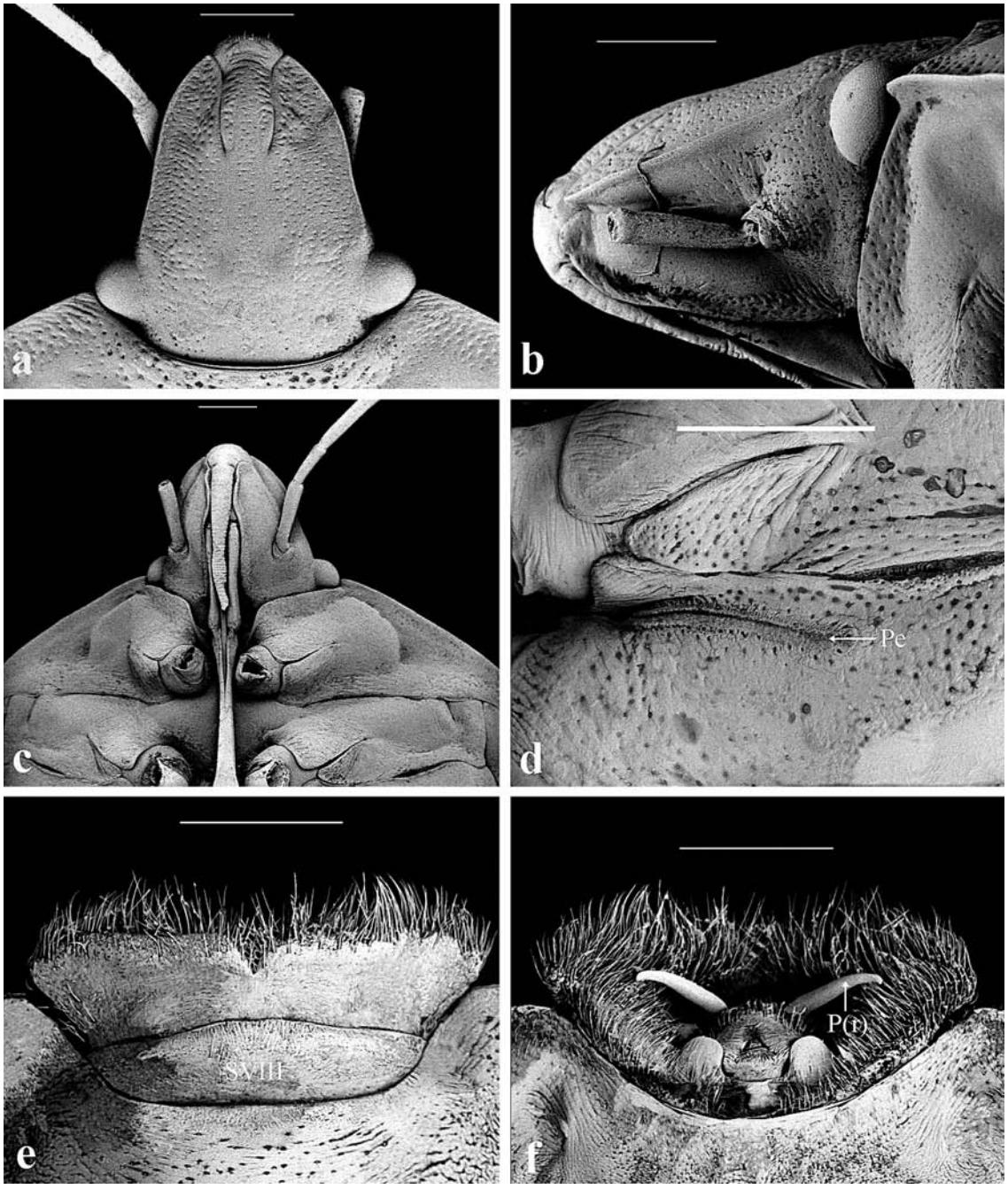


Fig. 46: Scanning electron micrographs of key characters of *Tectocoris diophthalmus* (**a**) Head, dorsal view (**b**) Head, lateral view (**c**) Head and thorax, ventral view (**d**) External efferent system of metathoracic glands, ventral view (**e**) male pygophore, ventral view (**f**) male pygophore, dorsal view. Abbreviations: Ea = evaporative areas; Pe = peritreme; P(r) = right paramere; SVIII = eighth abdominal sternite. Scale bars = 1 mm.

care); PENDERGRAST 1957: 22 (spermatheca); SZENT-IVANY & CATLEY 1960: 256 (host plant; New Guinea); MCDONALD 1961: 177 (male genitalia); MCDONALD 1963a: 30 (male genitalia); MCDONALD 1963b: 233, 236 (female genitalia); MCDONALD 1963c: 289-290, figs 29-31 (life cycle); KUMAR 1964: 43, 49 (male genitalia); BLACK 1968: 574 (distribution); SMITH 1978: 821-822 (gland chemistry); WILSON et al. 1983: 311-317 (biology); CARAYON 1984: 113-134 (androconial glands); MCDONALD & CASSIS 1984: 568, figs 78-80 (synonymy; morphology); STADDON et al. 1987: 227-234 (gland chemistry; morphology); JAVAHERY et al. 2000: 491 (biology); CASSIS & GROSS 2002: 603 (catalogue); NAUMANN & STEINBAUER (2001): 12 (parasitoids); MILLAR 2005: 78 (glandular chemistry); MONTEITH 2006: 1135-1152 (maternal care)

Scutellera cyanipes: BURMEISTER 1835: 396 (new combination); AMYOT & SERVILLE 1843: 40, 94, pl. 9 fig 58, pl. 24 fig. 167 (description; synonymy)

Scutellera cyanipoda BOISDUVAL 1835: 624 (n.sp.); VOLLENHOVEN 1863: 8 (synonymy); STÅL 1873: 19 (synonymy); STÅL 1873: 19 (synonymy); LETHIERRY & SEVERIN 1893: 19 (synonymy)

Scutellera tongae BOISDUVAL 1835: 624 (n.sp.); BLANCHARD 1840: 159 (synonymy); VOLLENHOVEN 1863: 8 (synonymy); STÅL 1873: 19 (synonymy); LETHIERRY & SEVERIN 1893: 19 (synonymy)

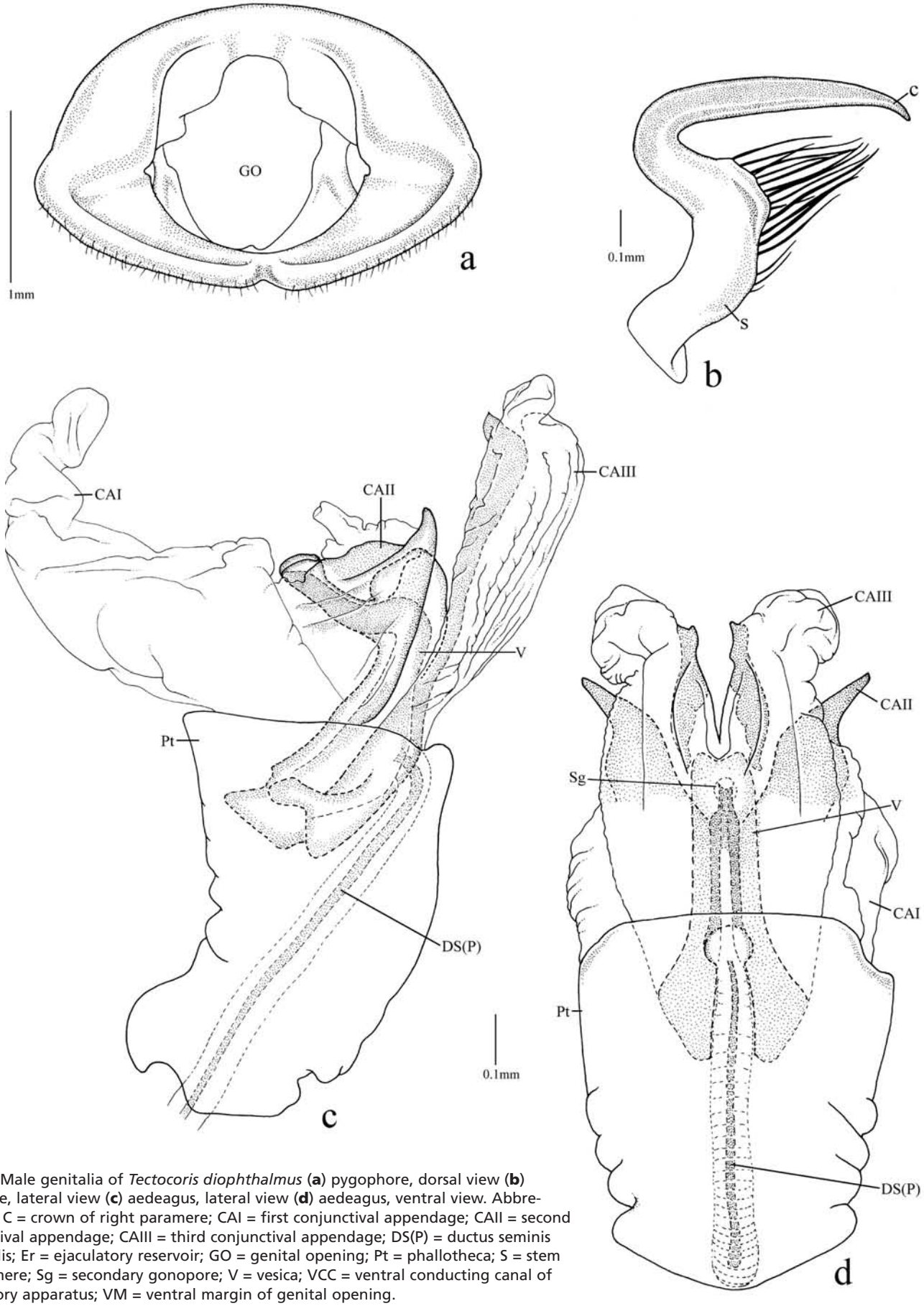


Fig. 47: Male genitalia of *Tectocoris diophthalmus* (**a**) pygophore, dorsal view (**b**) paramere, lateral view (**c**) aedeagus, lateral view (**d**) aedeagus, ventral view. Abbreviations: C = crown of right paramere; CAI = first conjunctival appendage; CAII = second conjunctival appendage; CAIII = third conjunctival appendage; DS(P) = ductus seminis proximalis; Er = ejaculatory reservoir; GO = genital opening; Pt = phallotheca; S = stem of paramere; Sg = secondary gonopore; V = vesica; VCC = ventral conducting canal of ejaculatory apparatus; VM = ventral margin of genital opening.

Tectocoris gambiae WESTWOOD 1837: 14 (n.sp.); STÅL 1873: 19 (synonymy); LETHIERRY & SEVERIN 1893: 19 (synonymy)
Pachycoris lineola: GERMAR 1839: 133 (new combination)
Scutellera cyanipes: AMYOT & SERVILLE 1843: 28 (new combination)
Tectocoris lineola: DALLAS 1851: 16 (new combination); STÅL 1873: 19 (synonymy); LETHIERRY & SEVERIN 1893: 19 (synonymy); DISTANT 1899: 33 (synonymy); TILLYARD 1926: 149 (diagnosis); MCKEOWN 1942: 83 (biology); HORI 2000: 17 (biology)
Tectocoris banksii: DALLAS 1851: 16 (new combination); WALKER 1867: 12 (synonymy)
Tectocoris cyanipes: DALLAS 1851: 16 (new combination); VOLLENHOVEN 1863: 8 (description; varieties); WALKER 1867: 12 (distribution)
Tectocoris bancksii: MONTROUZIER 1861: 60 (incorrect subsequent spelling)
Tectocoris obliquus WALKER 1867: 13 (n.sp.); LETHIERRY & SEVERIN 1893: 19 (synonymy)
Tectocoris pusillus WALKER 1867: 13 (n.sp.); LETHIERRY & SEVERIN 1893: 19 (synonymy)
Tectocoris amboinensis WALKER 1867: 14 (n.sp.); LETHIERRY & SEVERIN 1893: 19 (synonymy)
Tectocoris diophthalmus rufus STÅL 1871: 617 (n.ssp.)
Tectocoris diophthalmus tagalicus STÅL 1871: 617 (n.ssp.)
Tectocoris diophthalmus schoenherri: STÅL 1871: 617 (subsp. arrangement)
Tectocoris lineola banksi: DODD 1904: 483 (maternal care)
Tectocoris diophthalmus cookiana KIRKALDY 1909: 306 (unnecessary nom. nov. for *Tetyra cyanipes*: BLANCHARD 1841)
Tectocoris diophthalmus venusta KIRKALDY 1909: 307 (unnecessary nom. nov. for *Scutellera cyanipoda* var.)
Tectocoris purpureus: KNIGHT et al. 1985: 851-853 (incorrect subsequent spelling; glandular chemistry)

Diagnosis: *Tectocoris diophthalmus* is recognised by the following combination of characters: male dorsum mostly iridescent blue-green, with orange markings (Figs 1f, 45a,b); females mostly orange, with iridescent blue-green markings (Figs 1f, 45a,b); AIV longest segment; labium reaching abdominal SIV; male (Figs 47a-d)and female genitalia as in generic diagnosis.

Description: Large species, males 13-18 mm, females 16-22 mm.

Colouration. Dorsum of males mostly iridescent blue-green, with orange markings, sometimes orange, or mostly orange, with iridescent blue-green markings (Figs 1f, 45a,b); dorsum of females mostly orange, with iridescent blue-green markings, sometimes uniformly orange (Figs 1f, 45a,b). Head: males orange to mostly iridescent blue-green, sometimes with purplish hue; females either uniformly orange; bicoloured morphs with clypeus orange, remainder iridescent blue-green; underside of head uniformly orange, sometimes with iridescent blue-green markings, or uniformly iridescent blue-green. Antennae: mostly fuscous, sometimes with iridescent green tinge. Labium: either uniformly fuscous, or in pale morphs with LI-LII orange, remainder fuscous. Pronotum: males orange to mostly iridescent blue-green, sometimes in darker morphs with orange spot at midline of callosite region; females either orange, or bicoloured, mostly orange, with anterolateral margins iridescent blue-green, with pair of large submedial iridescent blue-green, sometimes also with smaller sublateral blue-green markings. Scutellum: males orange to mostly iridescent blue-green, with purplish hue, intermixed with orange markings anterolaterally, mediolaterally, and subdistally, sometimes markings coallesced. Hemelytra: exocorium orange to iridescent blue, with purple hue. Thoracic Sterna: orange to orange with red-fuscous, sometimes with green iri-

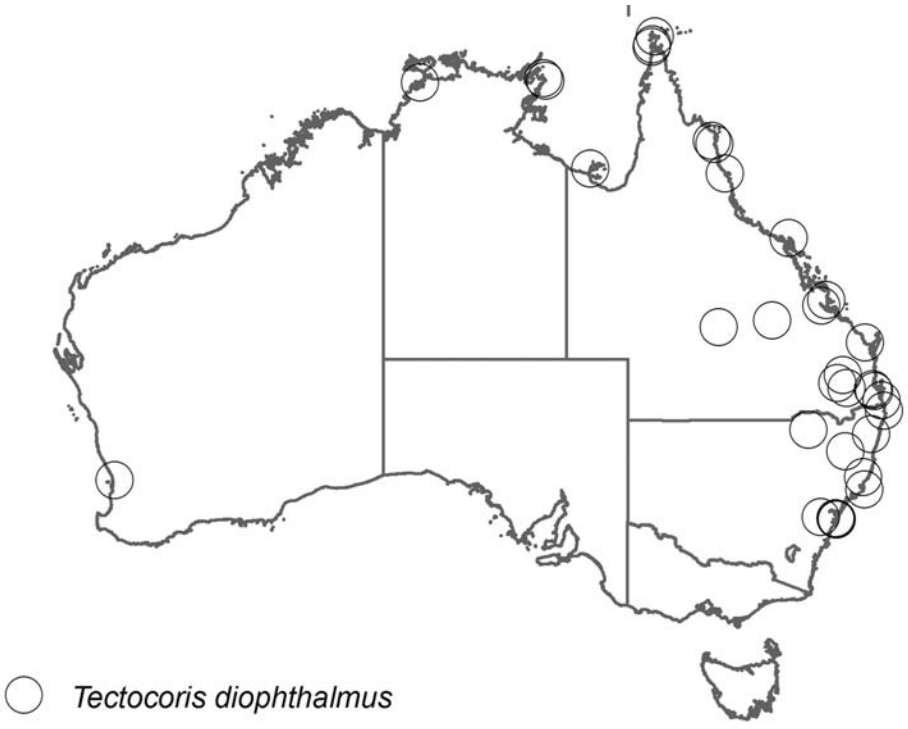


Fig. 48: Distribution of *Tectocoris diophthalmus*.

descence. Thoracic Pleura: orange to iridescent blue-green, always with anterior margin of proepisternum orange; supracoxal lobes most often orange. Legs: femora often orange, sometimes fuscous-iridescent blue distally; tibiae and tarsi fuscous-iridescent blue with purplish hue. Pregenital Abdomen: either uniformly orange (Fig. 45c) to red-orange, or orange to red-orange with posterior 3/5 of lateral regions of SIII to SIV or SVI iridescent blue-green; male SVIII orange, sometimes with iridescent blue hue. Female Terminalia: uniformly orange to mostly iridescent blue-green.

Texture. Dorsum densely punctate with shallow punctures, ventral surface impunctate (Figs 1f, 45a,b).

Vestiture. Antennae: AI-AII weakly setose, AIII-AIV more densely setose with very short setae. Legs: femora with scattered short setae, ventral surface of tibiae with more dense short setae. Pygophore: genital opening with dense distribution of yellow setae.

Structure. Antennae: AII(a) just shorter than AI; AII(b) and AIV subequal in length; AIII longest segment. Labium: reaching between abdominal SIV to SV; LII longest segment; LI, LIII and LIV roughly subequal in length; male and female genitalia as in generic description.

Type material examined: *Tectocoris pusillus* WALKER: Holotype, ♂, 'New Caled', 'B.M. Hem Type No. 411' (BMNH); *Tectocoris obliquus* WALKER: Holotype, ♂, '56-85' 'B.M. Hem Type No. 412' (BMNH). The type of *Tectocoris ambionensis* WALKER is destroyed.

Other material examined: **Queensland**: 1♀, Newell Beach, 16°25'25"S 145°24'22"E, 29 April 1998, G Cassis, Site Q98-22 (AM); 1♀, Macgregor, 30 August 1988, CE Chadwick (AM); 2♀♀, Burrum Heads, 14-viii-1982, NW Rodd (AM); 1♀, Black Rock, N Townsville, 18 June 1991, T Woodger (AM); 2♂♂ 2♀♀, Torres Strait Islands, Moa Island, 20 February 1975, E Cameron, (AM): 1♀ Torres Strait Islands, Prince of Wales Island, 16 February 1975, E Cameron (AM); 11♂♂ 11♀♀, Sydney, 11 March 1992, G Hangay (AM); 1♂, Alstonville, April-May 1991, B Turner (AM); 2♀♀, Double Bay, Sydney, 4 February 1999, C Lemann (AM); 2♀♀, Avoca Beach, 24 February 1985, S Hunter (AM); 8♀♀, Hazelbrook, 1984, M Dingley (AM); 1♂, Bundjalong National Park, 32.24S 152.32E, 15 November 1993, G Cassis, ex beach wash (AM); 1♀, Ingleburn, 8 September 1985, R Bejsak (AM); 1♀, Mosman, Sydney, 5 August 1989, McBride (AM); **Northern Territory**: 1♂, East Point Reserve Lookout, 10 March 1997, M Hoskins, ex *Hibiscus tiliaceus* (AM); 2♀♀, Darwin, 14 December 1994, A Keast (AM); **New Caledonia**: 1♂, Noumea, 2-iii-1982, DJ Scambler (AM); **Philippines**: 3♂♂ 8♀♀, Marindupue Island, February-March 1991, L Layron (AM).

Distribution: This species is broadly distributed in Australia from tropical north Queensland (including the Torres Strait Islands) to southeast New South Wales (including Lord Howe Island). It is also found to the west in the Northern Territory (Fig 48). A single specimen was collected in metropolitan Perth. This species is found extralimitally in the southwest Pacific, and is also known from the Oriental region (Indonesia).

Host plants and biology: The biology of *Tectocoris diophthalmus* has been described by various authors (DODD 1904; MCDONALD 1963c; SMITH 1978); WILSON et al. 1983; STADDON et al. 1987; MONTEITH 2006). It occurs on a wide range of malvaceous plants, including *Hibiscus* and *Malva* species, *Lagunaria patersonia*, and cotton, on which it is known as a pest. We have found this species on *L. patersonia* on Lord Howe Island, where it is endemic (also on Norfolk Island). This plant has also been introduced to eastern Australia as a parkland tree, and in Sydney, *T. diophthalmus* is prolific on it in late spring and summer. Its primary host in the northern half of eastern coastal Australia is beach hibiscus, *Hibiscus tiliaceus*, as well as on island of Indonesia and southwest Pacific. It is also found in suburban gardens on *Hibiscus* cultivars along the eastern seaboard of Australia. The native distribution of *Tectocoris diophthalmus* is unknown, but distribution records, indicate it has spread further south in Australia over the past 50 years, possibly tracking plantings of malvaceous plants. Monteith (pers. comm.) has found this species commonly on *Brachychiton acerifolius* (Malvaceae [formerly Sterculiaceae]) in the Brisbane region, and on the inland "bottle trees", *B. australis* and *B. rupestris* in the Roma district.

Remarks: *Tectocoris diophthalmus* is the most emblematic of all the Australian jewel bugs, particularly in eastern Australia where

it is commonly encountered. Its colour variation is one of the most extreme of any true bug known to us; ranging from orange to metallic blue. It has a complex synonymy that has not been re-examined in modern times. The intrapopulation variation in colour (e.g., Fig. 1f) is an indication that the current synonymy is legitimate, and we have found that the male genitalia are invariant across the distributional range of this species; inside and outside of Australia.

Incertae Sedis

Sphaerocoris subnotatus WALKER 1868: 505 (n.sp.); DISTANT 1899: 52 (type location); CASSIS & GROSS 2002: 603 (catalogue; incertae sedis)

Remarks: The identity of this species is unknown. MCDONALD & CASSIS (1984) did not refer to it. CASSIS & GROSS (2002) referred to it as incertae sedis, and indicated that the type was in Museum Victoria. Ken Walker (pers. comm.) has indicated that the type does not occur in that collection. The type locality is given in the original description as 'N Australia'. We also examined the BMNH collection, where most of the Francis Walker types are deposited, and did not find the type specimen. We have not been able to provide any additional clarification as to its identity or whether it is a synonym of an existing species. Consequently, we retain its status as incertae sedis.

Discussion

The Scutelleridae of Australia are depauperate, with only 5 % of the world's fauna. The family is much more diverse in the tropical regions of southeast Asia and South America, where genera with high species diversity are known (KIRKALDY 1909), with many species remaining to be described, particularly in the Neotropical region (Grazia pers. comm.). There is little doubt that we have now reached a levelling off of the species description accumulation curve for the jewel bugs of Australia, with only three new species described in this work. As with other places in the world (EGER & LATTIN 1995), there is also significant new synonymy in this work. However, a caveat needs to be added in this respect, as the conspecificity of all the populations of *Lampromicra senator* requires closer scrutiny, with molecular data required to test its current polymorphic definition presented in this work.

The major taxonomic issue in the scutellerids worldwide is the classification impediment (sensu CASSIS et al. in press), at both the generic and suprageneric levels. In this work we have attempted to establish new character definitions of the genera found in Australia, but with reference to the variation found in genera with extralimital species. None-the-less, the definition of many genera, particularly in the aposematic Scutellerinae has serious shortcomings. For example, the generic boundaries of *Brachyaulax*, *Calliphara*, *Chrysocoris*, *Lampromicra* and *Lamprocoris* are in need of serious revision. LYAL (1979) provided some clarity as to the generic boundaries for *Calliphara*, and we have attempted in this work to differentiate it from *Lampromicra*. Moreover, the relationships of the suprageneric groups of scutellerids have received little attention. FISCHER (2001) has made an important step in this direction, with the first phylogenetic analysis of genera. This work is hampered however by the lack of generic definition for many scutellerids. The suprageneric classification of scutellerids is similarly impeded, with the landmark works of STÅL (1872, 1873) and LESTON (1952d), being without serious re-assessment. FISCHER (2001) has also addressed this issue but found, as we have, that the Scutellerinae and Odontotarsinae are 'convenience groups' and can only be defined polythetically at this time. CASSIS et al. (in press), amongst others, have stated the importance of globally scoped taxonomic studies for establishing the framework for correct species assignment. This is true for the Scutelleridae and the shortfalls in the present classification is a consequence of its piecemeal and regional development.

The generic and species endemicity of Australian scutellerids is 58 % and 68 % respectively, which is commensurate for all of the Pentatomomorpha of Australia (CASSIS & GROSS 2002: 53 % and 83 %), although it is a little lower for scutellerid species endemicity. Of the genera represented in Australia and extralimitally, there are four major patterns observed, as follows: i. Oriental

+ Australia (including Melanesia) + Pacific (*Coleotichus*); ii. Oriental + Australia (*Calliphara* and *Lampromicra*); iii. Indo-Pacific + Australia (*Cantao*); and, iv. Australia + Melanesia + Indonesia (west of Wallace's line) (*Tectocoris*). These area relationships are consistent with those found for other pentatomomorphans (CASSIS & GROSS 2002), although there are no Gondwanan area relationships exhibited. The Afrotropical connection shown by *Cantao* is reminiscent of the Indo-Pacific pattern described by SCHUH & STONEDAHL (1986), but with an Australian extension; a pattern seen in other true bugs, e.g., the mirid genus *Hypsoleocus* (Schuh pers. comm.). The relationships of *Morbora* are of great interest, as they are not related to any other Australian scutellerid, and our observations indicate a closer relationship with the Palearctic genus *Psacasta*. This hypothesis is however confounded by the likely non-monophyly of the Odontotarsinae.

Within Australia, scutellerids are broadly distributed in Australia (Figs 6, 15, 23, 27, 34, 41, 44 and 48), and we give significant range extensions for many of the species (e.g., *Coleotichus artensis*). We have also found distribution patterns that are also found in unrelated taxa of true bugs, as follows: i. restricted to the tropics: e.g., *Calliphara regalis*, *Calliscyta stalii*, *Choerocoris lattini* and *Lampromicra regia* (CASSIS et al. 2003; *Vannius* complex [Miridae]); ii. eastern Australia: *Coleotichus artensis*, *C. excellens* and *Calliphara imperialis* (CASSIS & SILVEIRA 2002; *Nerthra alaticollis* species-group [Gelastocoridae]); and, iii. temperate Australia: *Choerocoris grossi*, *Lampromicra aerea* and *Scutiphora pedicellata* (CASSIS & SILVEIRA 2001; *Nerthra elongata* species-group [Gelastocoridae]). We have also found that a number of species are ubiquitous across continental Australia (e.g., *Coleotichus costatus*, *Choerocoris paganus* and *Morbora australis*).

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Zusammenfassung

Alle australischen Gattungen und Arten der Scutelleridae werden beschrieben und mit je einem Beispiel der männlichen Genitalien jeder Gattung illustriert. Rasterelektronenmikroskopische Aufnahmen werden für einige Merkmale präsentiert. Die australische Schildwanzenfauna enthält 13 Gattungen und 25 Arten. *Heissiphara* wird als neue Gattung beschrieben, mit der einzigen Art, *H. minuta* nov.sp. aus dem westlichen Australien. *Calliscyta* wird als Gattung aus der Synonymie mit *Choerocoris* erhoben. Ein Bestimmungsschlüssel für die australischen Scutelleridae wird präsentiert. Zwei neue Arten der Gattung *Choerocoris* werden aus dem östlichen Australien beschrieben: *C. grossi* nov.sp. und *C. lattini* nov.sp. *Lampromicra aerea* (DISTANT) wird aus der Synonymie mit *L. senator* (FABRICIUS) erhoben. *Calliphara nobilis* (LINNAEUS) wird erstmals aus Australien gemeldet. *Calliphara billardierii* (FABRICIUS) und *C. praslinia praslinia* BREDDIN sind nicht Teil der australischen Fauna. Die Identität von *Sphaerocoris subnotatus* WALKER ist unbekannt und als incertae sedis gewertet. Auch die neotropische Art *Agonosoma trilineatum* (FABRICIUS), die zur biologischen Schädlingsbekämpfung gegen das Unkraut *Jatropha gossypifolia* (Euphorbiaceae) eingeführt wurde, wird beschrieben. *Coleotichus borealis* DISTANT und *C.* (*Epicoleotichus*) *schultzei* TAEUBER werden mit *C. excellens* (WALKER) synonymisiert. *Callidea erythrina* WALKER wird mit *Lampromicra senator* synonymisiert. Lectotypen werden für *Coleotichus testaceus* WALKER, *C. excellens*, *Sphaerocoris circuliferus* (WALKER), *Callidea aureocincta* WALKER, *Callidea collaris* WALKER und *Callidea curtula* WALKER festgelegt. Die Klassifikation der Scutelleridae wird diskutiert und Beschreibungen der in Australien heimischen Unterfamilien präsentiert. Für the subdistale Erweiterung des Ductus seminis, inklusive des ventralen Verbindungskanals, des Spermienreservoirs, und des dorsalen Verbindungskanals wird ein neuer Begriff, Ejakulationsapparat, eingeführt. Ein Überblick der männlichen Pheromondrüsen der pregenitalen Abdominalsternite zeigt zwei Typen: Androconien (in den Odontotarsinae und Tectocorinae) und behaarte Sternaldrüsen (in den Elvisurinae). Die Biologie der australischen Arten wird zusammengefasst und neue Wirtspflanzenbindungen für *Austrotichus rugosus* GROSS, die heimischen Arten von *Coleotichus* (*C. artensis* (MONTROUZIER), *C. costatus* FABRICIUS und *C. excellens*), *Calliscyta stalii* (VOLLENHOVEN), *Scutiphora pedicellata* (KIRBY) und *Tectocoris diophthalmus* (HAHN) mitgeteilt.

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