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New genera and species of cicadas from arid Australia (Hemiptera: Cicadoidea: Cicadidae)

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Abstract

All described species of cicadas (Cicadidae) from the Northern Territory and South Australia are listed (Tables 1 and 2) and the composition of these faunas is briefly compared and discussed.

Five new genera and 12 new species are described from arid regions of Western Australia, Northern Territory, South Australia and New South Wales, viz. *Amica glauca* **gen. et sp. nov.**, *Amica sitis* **gen. et sp. nov.**, *Arenopsaltria exmouthensis* **sp. nov.**, *Arenopsaltria dryas* **sp. nov.**, *Austropunia cheloides* **gen. et sp. nov.**, *Brevia bullula* **gen. et sp. nov.**, *Paraclinata chlorotes* **gen. et sp. nov.**, *Paraclinata nullarboris* **gen. et sp. nov.**, *Cognadanga capricornica* **gen. et sp. nov.**, *Cognadanga isos* **gen. et sp. nov.**, *Gudanga kolos* **sp. nov.** and *Xeropsalta eremica* **sp. nov.** Notes on the attributes of *Heremusina* Ewart, 2018 are reviewed and discussed. Correction is provided for a misidentification of *Paradina leichardti* (Distant, 1882) in the molecular study of Marshall *et al*. (2018).

Key words: bioacoustics, biogeography, cicada songs, Auchenorrhyncha, taxonomy

Introduction

In an earlier publication (Moulds & Marshall 2022) we documented new species and genera of cicadas (Hemiptera: Cicadidae) from Western Australia, together with a list of all species from that state. Here we describe new genera and species mostly from arid regions of the Northern Territory and South Australia together with additional species from Western Australia and two whose distributions reach arid New South Wales. We also provide a list of species currently known from the Northern Territory and South Australia (Tables 1 and 2) and briefly compare the faunas of these States.

Family and subfamily classification follows that proposed by Marshall *et al.* (2018) with amendment to the authorship of family group names based on *Cicada*

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following the recent Official Correction 138, *Bulletin of Zoological Nomenclature*, pages 107–108.

Materials and methods

The following abbreviations are used for collections housing specimens: AMS Australian Museum, Sydney; ANIC Australian National Insect Collection, Canberra; AS collection of A. Sundholm; DE collection of David Emery; LP collection of Lindsay Popple; MSM author's collection; NHMUK Natural History Museum, London, United Kingdom; NTM Northern Territory Museum of Arts and Science, Darwin; PH collection of Paul Hutchinson; QM Queensland Museum, Brisbane; UCONN University of Connecticut, Storrs, USA; WAM Western Australian Museum, Perth.

GPS values of localities were obtained using a handheld GPS unit (Garmin GPS V). Maps were generated by hand in Adobe Photoshop with assistance from plots generated in QGIS v3.22 (http://www.qgis.org).

Male calling songs were digitally recorded in the field at a sampling rate of 44.1 kHz or 48.0 kHz using a Sony (Sony Electronics Inc., Fort Myers, FL) TCD-D8 DAT recorder (2002–2004 field work), or one of several models of Marantz (Mahwah, NJ, USA) audio recorders (e.g., PMD-670) (2005–2010 field work), or a Zoom (Zoom Corporation, Tokyo, Japan) H4n audio recorder (late 2011 field work), the latter using a 96 kHz sampling frequency. The digital recorder was combined with a Sennheiser (Old Lyme, CT, USA) ME62 omnidirectional microphone with a windscreen and, in most cases, a Sony PBR-330 parabolic reflector (otherwise a ME66 short shot gun microphone plus windscreen was used). The microphones were powered by Sennheiser K6 power modules, and they have a frequency response that is approximately flat from 40 Hz–20 kHz (+/-2.5 dB).

Terminology for morphological features follows that of Moulds (2005, 2012). Acoustic terminology is as follows: A *pulse* is a burst of sound energy containing multiple sound *waves* (the primary pressure-amplitude waveform); pulses often appear in pairs as *doublets*. This definition does not assume a specific mechanical basis, so a pulse could be created by one timbal collapsing or rebounding, both timbals collapsing/rebounding in synchrony or asynchrony (Puissant & Gurcel 2018), or one or more ribs of one or both timbals collapsing/rebounding (e.g., Fleming 1975). Further, in many recordings a single main pulse is accompanied by one or more much quieter secondary pulses that vary in intensity and degree of coalescence across instances. We emphasize here only the primary pulses. A *syllable* or *buzz* is a group of pulses or doublets repeated at an approximately uniform rate. For some species the term *echeme* is used to denote a characteristic combination of different kinds of syllables. A *phrase* is the highest order combination of stereotypically produced syllables and/or echemes.

Measurements of acoustic features were made using Raven version 1.5 Pro (Cornell Lab of Ornithology, Ithaca, NY, USA). Repetition rates of sound components were measured from oscillograms (waveforms) to the nearest 0.001 s. Recordings were sometimes filtered to remove background sound energy below a threshold frequency, which was adjusted as needed. Spectrograms were made using a Hann window, with size varying from 256–512 samples depending on species, and with Raven allowed to adjust the remaining parameters automatically. Spectrogram illustrations show only the frequencies above the filter threshold in each case. Air temperatures, if taken, were recorded in shade with an Omega HH-25KF temperature meter and type K thermocouple (OMEGA Engineering, Stamford, CT, USA) or in some cases with an ordinary household digital thermometer. Some males were recorded while kept in 1.5 litre mesh fabric 'Port-a-Bug' cages obtained from Insect Lore, 132 South Beech Avenue, Shafter, CA, USA.

The Northern Territory and South Australian faunas

The Northern Territory and South Australia together span continental Australia from north to south and together incorporate almost all climatic zones found in Australia, from the tropical monsoonal north in the NT to the cool temperate of SA. These climatic differences are reflected in the composition of their cicada faunas. They do, however, share a very large central arid environment.

The NT cicadas (Table 1) comprise 67 species distributed through 9 tribes and 30 genera. Most of the species (72%) fall within just two tribes, the Cicadettini and Lamotialnini. The SA cicadas (Table 2) comprise 64 species most of which (86%) fall within just one tribe, the Cicadettini. Four tribes out of the combined total of 12, and 16 genera of 50, are not shared between the NT and SA.

Amazingly, only 17 species of the 115 are shared between the two States. As the NT and SA share a large arid environment one would anticipate a larger number of shared species, especially as the arid regions of Australia are reasonably rich in cicada species, many of which have wide distributions. This low number of shared species may be explained by the nature of the arid environments when average annual rainfall is considered. Only the extreme south of the NT is exceptionally arid, receiving less than 300 mm average rainfall, whereas much of SA, in fact some 80% of it, receives less than 300 mm, much of it less than 200 mm (Fig. 1).

These statistics may be a little biased against SA as its fauna is likely the least well documented. Twenty three of the 64 species have been named only since 2015. Five of the 10 new species described in this paper are found in SA, four having been discovered since 2002 and collected on only one or two occasions. There are likely others awaiting discovery.

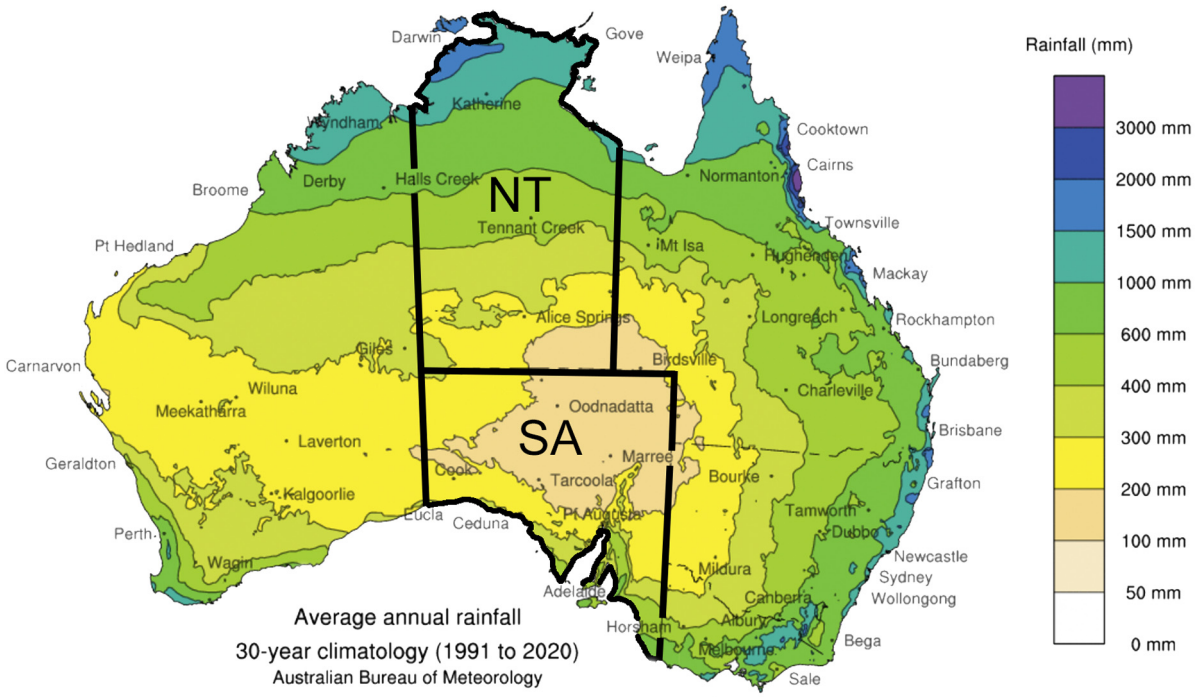

FIGURE 1. Australian average annual rainfall (adapted from Australian Bureau of Meteorology, with permission).

TABLE 1. Summary of cicada species recorded from the Northern Territory (including the species added in this paper). Total number of species equals 67 in 30 genera and 9 tribes.

Family CICADIDAE Batsch, 1789*
Subfamily CICADINAE Batsch, 1789*

Tribe ARENOPSALTRIINI Moulds in Marshall *et al.*, 2018
Arenopsaltria Ashton, 1921
nubivena (Walker, 1858)

Tribe BURBUNGINI Moulds, 2005
Burbunga Distant, 1905a
albofasciata Distant 1907
gilmorei (Distant, 1882)
hillieri (Distant, 1907) (nec *hillieri* Distant, 1906)
parva Moulds, 1994

Tribe JASSOPSALTRIINI Moulds, 2005
Jassopsaltria Ashton, 1914
danielsorum Moulds & Marshall, 2021

Tribe MACROTRISTRIINI Moulds in Marshall *et al.*, 2018
Illyria Moulds, 1985
australensis (Kirkaldy, 1909)
burkei (Distant, 1882)
hilli (Ashton, 1914)
major Moulds, 1985
viridis Moulds & Marshall, 2022
Macrotristria Stål, 1870
doddi Ashton, 1912
douglasi Burns, 1964
frenchi Ashton, 1914b
intersecta (Walker, 1850)

Tribe TAMASINI Moulds, 2005
Parnquila Moulds, 2012
venosa (Distant, 1907)

Tribe THOPHINI Distant, 1904
Thopha Amyot & Serville, 1843
colorata Distant, 1907
sessiliba sessiliba Distant, 1892

Subfamily CICADETTINAE Buckton, 1890
Tribe CHLOROCYSTINI Distant, 1905b
Thaumastopsaltria Kirkaldy, 1900
globosa (Distant, 1897)

Tribe CICADETTINI Buckton, 1890
Austropunia **gen. nov.**
cheloides **sp. nov.**

.....*continued on the next page*

TABLE 1. (Continued)

Brevia **gen. nov.**
bullula **sp. nov.**
Calipsalta Moulds & Marshall, 2022
brunnea Moulds & Marshall, 2022
fumosa Moulds & Marshall, 2022
Cognadanga **gen. nov.**
capricornica **sp. nov.**
Drymopsalta Ewart, 2005
acrotela Ewart & Popple, 2013
Erempsalta Moulds, 2012
hermannsburgensis (Distant, 1907)
Ewartia Moulds, 2012
adusta Moulds & Marshall, 2022
etesia Popple, 2017b
thamna Popple, 2017b
Graminitigrina Ewart & Marques, 2008
uluruensis Ewart, Popple & Hill, 2017
Heremusina Ewart, 2018
udeoecetes Ewart, 2018
Kobonga Distant, 1906
apicans Moulds & Kopestonsky, 2001
Myopsalta Moulds, 2012
xerograsidia Popple, 2017a
Neopunia Moulds, 2012
graminis (Goding & Froggatt, 1904)
Palapsalta Moulds, 2012
ligneocauda Emery, Emery & Hutchinson, 2018
palaga Owen & Moulds, 2016
serpens Owen & Moulds, 2016
Paraclinata **gen. nov.**
chlorotes **sp. nov.**
Parnquila Moulds, 2012
venosa (Distant, 1907)
Pauropsalta Goding & Froggatt, 1904
adelphe Owen & Moulds, 2016
agasta Owen & Moulds, 2016
borealis Goding & Froggatt, 1904
katherina Owen & Moulds, 2016
kriki Owen & Moulds, 2016
melanopygia (Germar, 1834)
similis Owen & Moulds, 2016
walkeri Moulds & Owen, 2011
Popplepsalta Owen & Moulds, 2016
granitica (Popple, 2013)
corymbiae (Popple, 2013)
Punia Moulds, 2012
hyas Moulds, 2020
kolos Moulds, 2020
minima (Goding & Froggatt, 1904)
limpida Moulds, 2020
Simona Moulds, 2012
erema Ewart, Popple & Marshall, 2015
Uradolichos Moulds, 2012
longipennis (Ashton, 1914)
Yoyetta Moulds, 2012
fluviatilis Emery, Emery & Popple, 2015

Tribe LAMOTIALNINI Boulard, 1976
Tryella Moulds, 2003
adela Moulds, 2003
burnsi Moulds, 2003
castanea (Distant, 1905a)
crassa Moulds, 2003
graminea Moulds, 2003
infuscata Moulds, 2003
noctua (Distant, 1913)
ochra Moulds, 2003
rubra (Goding & Froggatt, 1904)
willsi (Distant, 1882)
wuggubun Emery, Emery, Hutchinson & Ong, 2022

* There has been broad agreement among cicada systematists that the authorship of family-group names based on *Cicada* was Latreille, 1802. However, in a ruling by the ICZN (Opinion 2475, *Bulletin of Zoological Nomenclature*) the authorship was erroneously attributed to Berthold, 1827. This led to Official Correction 138, *Bulletin of Zoological Nomenclature*: 107–108 that now recognises the authority for family group names based on *Cicada* as Batsch, 1789.

TABLE 2. Summary of cicada species recorded from South Australia (including the species added in this paper). Note that some old species originally recorded from South Australia were actually from the Northern Territory as South Australia was considered part of the Northern Territory until its recognition as a separate entity in 1911. Unnamed species are not included. Total number of described species equals 64 in 34 genera and 9 tribes.

Family CICADIDAE Batsch, 1789
Subfamily CICADINAE Batsch, 1789
Tribe ARENOPSALTRIINI Moulds in Marshall *et al.*, 2018
Arenopsaltria Ashton, 1921
nubivena (Walker, 1858)

Tribe BURBUNGINI Moulds, 2005
Burbunga Distant, 1905a
gilmorei (Distant, 1882)
hillieri (Distant, 1907) (nec *hillieri* Distant, 1906)

Tribe CYCLOCHILINI Distant, 1904
Cyclochila Amyot & Serville, 1843
australasiae (Donovan, 1805)

Tribe MACROTRISTRIINI Moulds in Marshall *et al.*, 2018
Macrotristria Stål, 1870
angularis (Germar, 1834)

Tribe PSALTODINI Moulds, 2018 in Marshall *et al.*, 2018
Psaltoda Stål, 1861
moerens (Germar, 1834)

Tribe THOPHINI Distant, 1904
Thopha Amyot & Serville, 1843
colorata Distant, 1907

Subfamily CICADETTINAE Buckton, 1890
Tribe CICADETTINI Buckton, 1890
Atrapsalta Owen & Moulds, 2016
audax Popple & Stolarski, 2024b
emmotti Owen & Moulds, 2016
furcilla Owen & Moulds, 2016
vinea Owen & Moulds, 2016
Auscala Moulds, 2012
flammea Emery, Emery & Hutchinson, 2020
spinosa (Goding & Froggatt, 1904)
Brevia **gen. nov.**
bullula **sp. nov.**
Calipsalta Moulds & Marshall, 2022
brunnea Moulds & Marshall, 2022
fumosa Moulds & Marshall, 2022
viridans Moulds & Marshall, 2022
Chelapsalta Moulds, 2012
myoporae Ewart, Popple & Marshall, 2015
puer (Walker, 1850)
Cognadanga **gen. nov.**
isos **sp. nov.**
Clinopsalta Moulds, 2012
adelaida (Ashton, 1914)
tigris (Ashton, 1914)
Diemeniana Distant, 1905b
euronotiana (Kirkaldy, 1909)
Erempsalta Moulds, 2012
hermannsburgensis (Distant, 1907)
Ewartia Moulds, 2012
adusta Moulds & Marshall, 2022
Kobonga Distant, 1906
apicans Moulds & Kopestonsky, 2001
froggatti Distant, 1906
godingi (Distant, 1905c)
oxleyi (Distant, 1882)
umbrimargo (Walker, 1858)
Marteena Moulds, 1986
rubricincta (Goding & Froggatt, 1904)
Myopsalta Moulds, 2012
binotata (Goding & Froggatt, 1904)
bisonabilis Popple & Stolarski, 2024a
waterhousei (Distant, 1905c)
Paraclinata **gen. nov.**
nullarboris **sp. nov.**
Parnquila Moulds, 2012
hillieri (Distant, 1906)
Pauropsalta Goding & Froggatt, 1904
conflua Owen & Moulds, 2016
contigua Owen & Moulds, 2016
castanea Goding & Froggatt, 1904
extensa Goding & Froggatt, 1904
infuscata (Goding & Froggatt, 1904)
mneme (Walker, 1850)
stigmatica Distant, 1905c*
Pedana Moulds & Marshall, 2022
hesperia Moulds & Marshall, 2022
Physeema Moulds, 2012
labyrinthica (Walker, 1850)
Pipilopsalta Ewart, 2005
ceuthoviridis Ewart 2005
Platypsalta Moulds, 2012

.....continued on the next page

TABLE 2. (Continued)

dubia (Goding & Froggatt, 1904)	*abdominalis* (Distant, 1892)
Plerapsalta Moulds, 2012	*australicta* Popple & Emery 2022
incipiens (Walker, 1850)**	*incepta* (Walker, 1850)
multifascia (Walker, 1850)***	*fluviatilis* Emery, Emery & Popple, 2015†
Popplepsalta Owen & Moulds, 2016	*loftyensis* Popple & Emery, 2020
rubristrigata (Goding & Froggatt, 1904)	
Samaecicada Popple & Emery, 2010	Tribe LAMOTIALNINI Boulard, 1976
mallee Popple, 2023	*Tryella* Moulds, 2003
Terepsalta Moulds, 2012	*graminea* Moulds, 2003
infans (Walker, 1850)	*noctua* (Distant, 1913)
Xeropsalta Ewart, 2018	
thomsoni Ewart, 2018	Tribe PICTILINI Moulds & Hill in Marshall *et al.*, 2018
festiva (Distant, 1907)	*Amica* **gen. nov.**
Yoyetta Moulds, 2012	*glauca* **sp. nov.**
aaede (Walker, 1850)	*sitis* **sp. nov.**

* Described by Distant (1905c) from Adelaide. Treated as a *nomen dubium* by Owen & Moulds (2016).
** Originally recorded from Adelaide by Walker (1850) and repeated by Goding & Froggatt (1904) but there are no confirmed records from South Australia (Moulds 2012) and the locality is considered doubtful.
*** Originally recorded from Adelaide by Walker (1850) but there are no confirmed records from South Australia and the locality is considered doubtful.
† Two similar species, *Y. landsboroughi* (Distant, 1882), and *Y. tristrigata* (Goding & Froggatt,−1904) were previously recorded from South Australia but were shown to be restricted to the eastern States by N.J. Emery *et al*. (2015).

Subfamily Cicadinae Batsch, 1789

Tribe Arenopsaltriini Moulds in Marshall *et al.*, 2018

Arenopsaltria Ashton, 1921

Ashton (1921) erected *Arenopsaltria* to accommodate *fullo* (Walker, 1850), *nubivena* (Walker, 1858), *pygmaea* (Distant, 1904), and his new species *unicolor* Ashton, 1921. These taxa had remained largely forgotten apart from listings in the catalogues of Burns (1957) and Duffels and van der Laan (1985). It was not until Gwynne *et al*. (1988) published on the biology, behaviour and song of the common Perth species, *A. fullo*, and Moulds (1990) provided an overview of the species, that they began to receive attention, but no additional species have yet been published. In a phylogenetic study by Moulds (2005), *Arenopsaltria* was found to be allied to *Henicopsaltria,* and later Marshall *et al*. (2018) found a similar relationship and *Arenopsaltria* was transferred from the Cryptotympanini to the new tribe Arenopsaltriini. *Arenopsaltria unicolor* was transferred to the genus *Parnquila* (in the tribe Tamasini) leaving just three species in *Arenopsaltria* (Moulds 2012). Ewart *et al*. (2015) reviewed the status of *A. nubivena* and analysed the songs of all three species.

Here we described two additional species of *Arenopsaltria* from Western Australia, both of which are common at times.

Arenopsaltria exmouthensis sp. nov.

(Figs 2a, 2b, 22, 23a, 23b)
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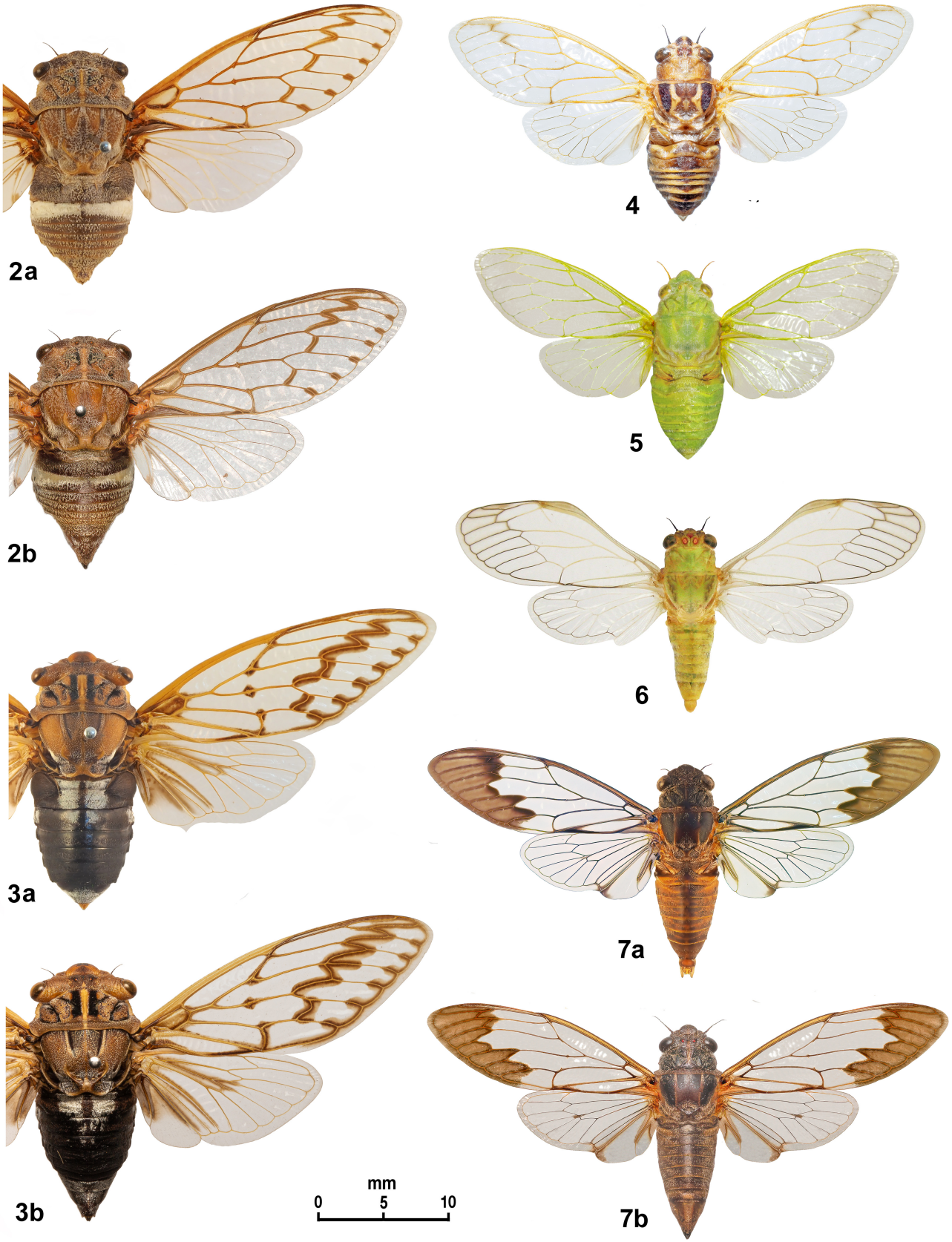
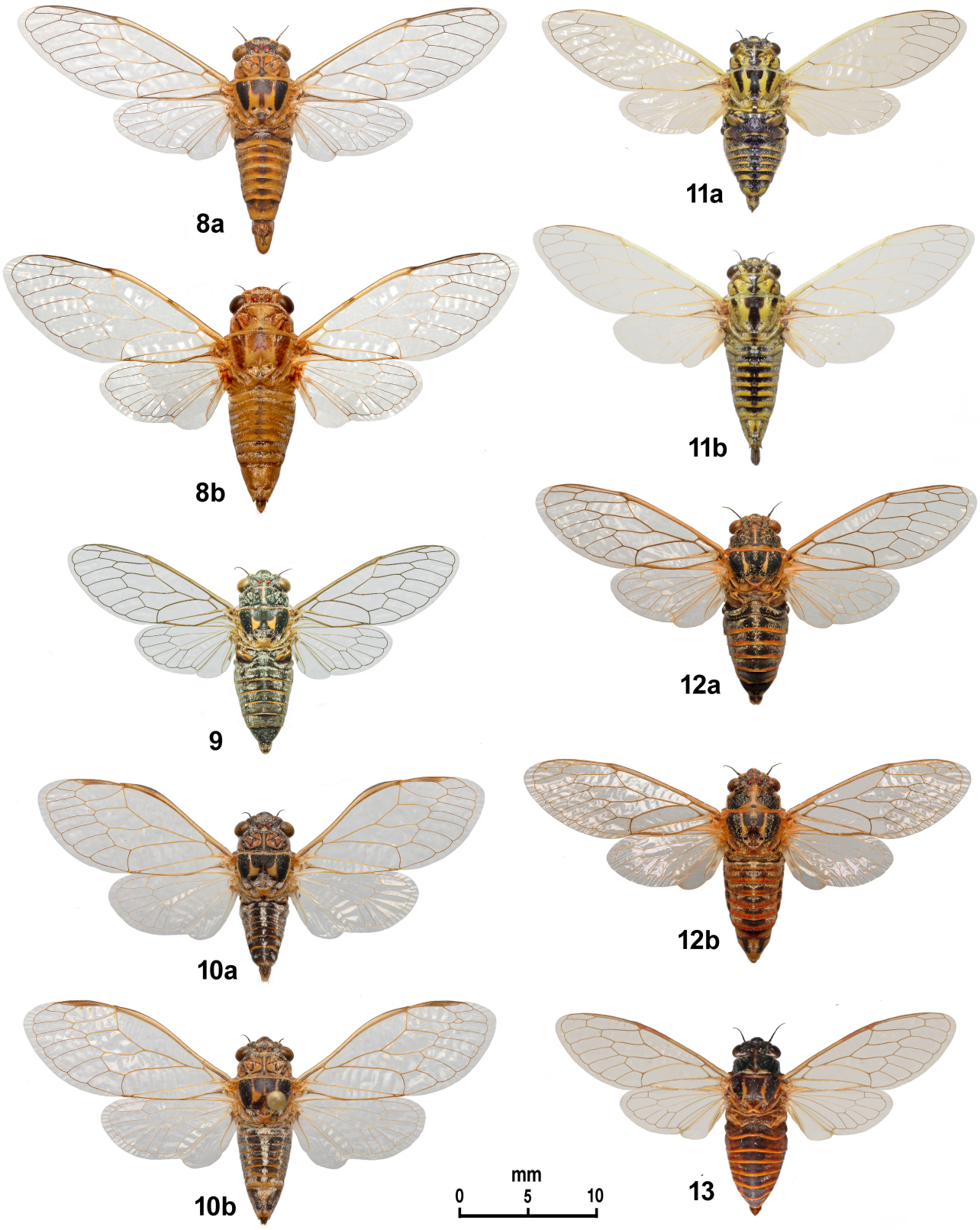
Etymology. Named for the town of Exmouth around which the species is found.

Types. *Holotype* male, near Exmouth, Tantabiddy Ck, W coast of North West Cape Pen., Western Australia, 14.x.1978, M.S. & B.J. Moulds (WAM). *Paratypes* as follows: **WESTERN AUSTRALIA**: 2 males, 1 female, near Exmouth, Tantabiddy Ck, W coast of North West Cape Pen., 14.x.1978, M.S. & B.J. Moulds; 2 males, 1 female, North West Cape, 13.iii.2008, P. Hutchinson; 1 female, Cape Holiday Park, Exmouth, 21°56'33"S 114° 08'01"E, 10.x.2008, W. Bell (DE). 2 males, 1 female, near Exmouth, Tantabiddy Ck, W coast of North West Cape Pen., 14.x.1978, M.S. & B.J. Moulds (LP). 5 males, North West Cape, N of Exmouth, in sand dune grass, 14.x.1978, M.S. & B.J. Moulds; 13 males (two genitalia preps AR1, AR13), 5 females, 8 km N of Exmouth, 14.x.1878, M.S. & B.J. Moulds; 14 males, 12 females, near Exmouth, Tantabiddy Ck, W coast of North West Cape Pen., 14.x.1978, M.S. & B.J. Moulds; 2 females, Cape Range Nat. Park, near Exmouth, on beach sandhills at T Bone Bay, 4.vii.1977, D. & N. McFarland; 1 male, 1 female, North West Cape, 13.iii.2008, P. Hutchinson; 1 male, Wobiri Bch, Cape Range, 8.iii.2004, P. Hutchinson; 1 male, blowholes, Exmouth, 13.iv.1985, A. Hay (MSM). 4 males, 2 females, Osprey Bay, Cape Range N.P., 11.iii.2008, P. Hutchinson; 1 female, Coral Bay, 20.iii.2021, P. Kay; 1 male, Miaboolya



FIGURES 2–7. (2a) *Arenopsaltria exmouthensis* **sp. nov.**, male; (2b) *Arenopsaltria exmouthensis* **sp. nov.**, female; (3a) *Arenopsaltria dryas* **sp. nov.**, male; (3b) *Arenopsaltria dryas* **sp. nov.**, female; (4) *Amica glauca* **gen. et sp. nov.**, male; (5) *Amica sitis* **gen. et sp. nov.**, male; (6) *Paraclinata chlorotes* **gen. et sp. nov.**, male; (7a) *Gudanga kolos* **sp. nov.**, male; (7b) *Gudanga kolos* **sp. nov.**, female.



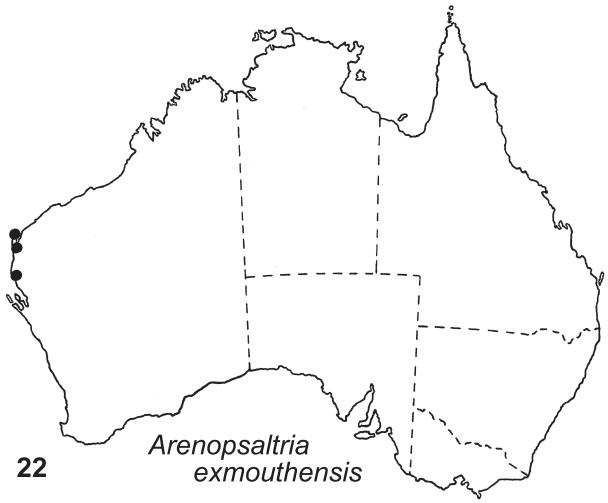
FIGURES 8–13. (8a) *Austropunia cheloides* **gen. et sp. nov.**, male; (8b) *Austropunia cheloides* **gen. et sp. nov.**, female; (9) *Brevia bullula* **gen. et sp. nov.**, male; (10a) *Paraclinata nullarboris* **gen. et sp. nov.**, male; (10b) *Paraclinata nullarboris* **gen. et sp. nov.**, female; (11a) *Xeropsalta eremica* **sp. nov.**, male; (11b) *Xeropsalta eremica* **sp. nov.**, female; (12a) *Cognadanga capricornica* **gen. et sp. nov.**, male; (12b) *Cognadanga capricornica* **gen. et sp. nov.**, female; (13) *Cognadanga isos* **gen. et sp. nov.**, male.

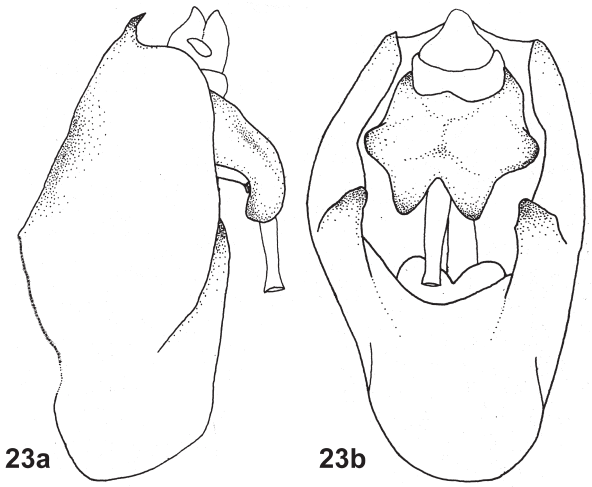
FIGURES 14–21. Live adults and habitats. (14a) *Paraclinata chlorotes* **gen. et sp. nov.**, male; (14b) same species, type locality; (15) *Paraclinata nullarboris* **gen. et sp. nov.**, type locality; (16) *Arenopsaltria dryas* **sp. nov.**, type locality; (17a) *Cognadanga capricornica* **gen. et sp. nov.**, male; (17b) same species, type locality; (18a) *Amica glauca* **gen. et sp. nov.**, male singing; (18b) same species, habitat, Paradise Creek, S.A.; (19) *Amica sitis* **gen. et sp. nov.**, type locality; (20) *Xeropsalta eremica* **sp. nov.**, type locality; (21) *Austropunia cheloides* **gen. et sp. nov.**, type locality.

Beach, [22 km] N of Carnarvon, 11.iii.2004, on dunal vegetation, P. Hutchinson (PH). 2 males, 1 female, near Exmouth, Tantabiddy Ck, W coast of North West Cape Pen., 14.x.1978, M.S. & B.J. Moulds (WAM).

Distribution and habitat (Fig. 22). From the northern extremity of North West Cape Peninsula in the vicinity of Exmouth on both the east and west coasts, south to Coral Bay and Miaboolya Beach (22 km N of Carnarvon). Most records are from the eastern side of North West Cape Peninsula north of Exmouth, but on the western side the species is found as far south as T-bone Bay. There are records for March, April, July and October, suggesting that adults may be present for much of the year. The species inhabits dune grasses.

Adult description. *Male* (Figs 2a, 23). *Head* black with a broad yellow anterior edge and often a little irregular yellow at posterior margin; extensively covered with a dusting of silver white pubescence. Postclypeus brown tending partly black dorsally variable between individuals. Rostrum brown with black apex; reaching apices of hind coxae. Thorax a mixture of black, brown and yellow, extensively covered with a dusting of silver white pubescence. Pronotum yellow overlaid with irregular black mottling except for yellow midline; pronotal collar black with a yellow distal margin; paranotum bearing distinct small rounded teeth. Mesonotum brown, the sigilla a little lighter in colour than remainder; cruciform elevation yellow tending blackish between arms, especially between anterior arms. Forewings with zig-zag





FIGURES 22–23. *Arenopsaltria exmouthensis* **sp. nov.** (22) distribution; (23a) male genitalia in lateral view; (23b) same in ventral view.

infuscation at distal ends of ulnar cells 1 and 2, on crossveins m and m-cu, and as six marginal spots one each on distal end of veins forming apical cells; basal cell opaque amber with a partly formed narrow black margin; basal membrane dark grey to blackish. *Hindwings* very weakly infuscated along length of vein 2A and at distal end of white plaga on 3A. *Legs* yellowish brown partly overlaid black on coxae; distal edge of femora partly dull yellow. *Opercula* black becoming yellow on distal third or so; tightly closing tympanal cavity and slightly overlapping. *Timbal covers* black becoming brown anteriorly and yellowish laterally, variable between individuals. *Abdomen* above dark brown (never black) with a distinct silver white pubescent band covering much of tergite 3 (sometimes ill-defined in old specimens); sternites yellowish, variably diffused brown except for distal portion of sternites VII and VIII yellowish. *Genitalia* (Figs 23a, 23b). Pygofer black; basal lobes well developed, in ventral view broad and tapering to a blunt point; uncus in lateral view sharply downturned distally; apically bifurcate, the lobes spread apart; theca curved in a sweeping arc close to a U-shape.

Female (Fig. 2b). Similar to male. Abdominal segment 9 pale yellow with a black dorsal area extending variably along anterior lateral margin. Ovipositor sheath barely protruding beyond abdominal segment 9.

Measurements. Range and mean (in mm) for 10 males and 10 females (includes smallest and largest specimens). *Length of body* (including head): male 24.9–27.3 (26.2); female (including ovipositor) 24.0–27.7 (26.5). *Length of forewing*: male 30.5–33.6 (32.2); female 28.8–34.3 (32.4). *Width of head* (including eyes): male 10.3–11.2 (10.8); female 9.7–11.3 (10.8). *Width of pronotum* (across lateral angles): male 11.4–12.7 (12.1); female 10.6–12.9 (12.1).

Distinguishing features. Differs from *A. fullo* (Walker, 1850) in having a much shorter rostrum that reaches only to the apices of the hind coxae rather than reaching far beyond, in male *fullo* to about the distal margin of the opercula. Differs from *A. dryas* **sp. nov.**, the only other large *Arenopsaltria*, in having a brown abdomen that is black in *A. dryas*, and in the male abdomen having a white transverse pubescent band covering much of tergite 3 that is absent in *A. dryas*.

Distinguished from all *Arenopsaltria* species in having, in combination, a rostrum that reaches no further than the apices of the hind coxae, a brown abdomen rather than black and a forewing length more than 28 mm. The male genitalia are similar only to those of *fullo* in having a sharply downturned distal uncus.

Song. Unknown.

***Arenopsaltria dryas* sp. nov.**
(Figs 3a, 3b, 16, 24, 25a, 25b, 26)
urn:lsid:zoobank.org:act:18BA8981-406E-45D3-9844-23452F23226C

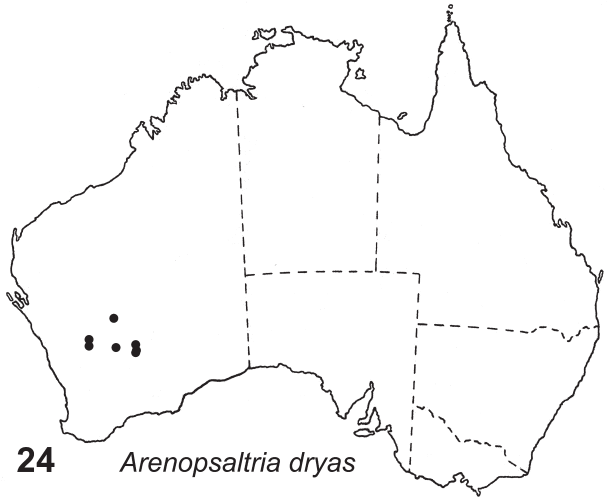
Etymology. Named from the Greek wood-nymphs known as Dryads who inhabited trees, each nymph living only as long as the tree she inhabited.

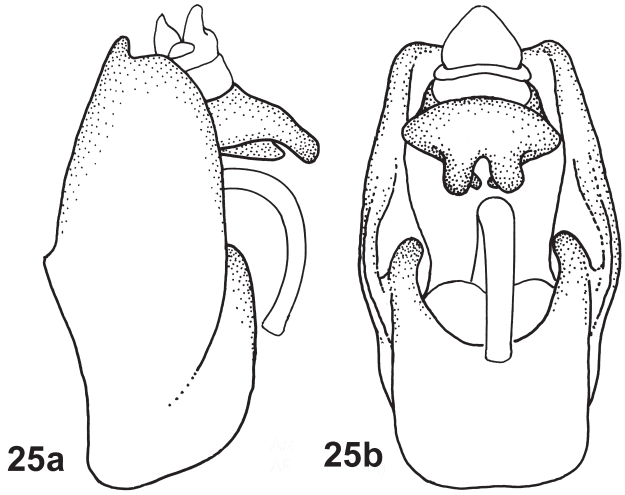
Types. *Holotype* male (molecular voucher 06.AU.WA.WSS.09), 30.5 km W of Sandstone, 28º00.692'S 118º59.922'E, 57 m, 17.ii.2006, Hill, Marshall, Moulds (WAM). *Paratypes* as follows : **WESTERN AUSTRALIA**: 2 males, 2 females, 110 km S of Mount Magnet, 10.i.1989, M.S. & B.J. Moulds (DE). 2 males, 2 females, 110 km S of Mount Magnet, 10.i.1989, M.S. & B.J. Moulds; 3 males, 27.1 km SSE of Menzies, 29.91904°S 121.12127°E, 3.iii.2016, D. Marshall & L. Popple, 013-0001 to 013-0003 (LP). 36 males, 23 females, AU.WA.WSS, 30.5 km W of Sandstone, 28º00.692'S 118º59.922'E, 57 m, 17.ii.2006, Hill, Marshall, Moulds; 48 males (3 genitalia preps AR4, AR19, AR20), 21 females, 110 km S of Mount Magnet, 10.i.1989, M.S. & B.J. Moulds; 10 males, 9 females, Paynes Find, 140 km S of Mount Magnet, 20.i.1989, M.S. & B. J. Moulds; 2 males, 2 females, L. Giles, 46 km E Diemals H.S., 15.ii.2000, on Acacia, P. Hutchinson; 1 male, Menzies, 16.i.1978, M. Powell; 6 males, 3 females, 26 km S of Menzies, 10.ii.2006, M. Hanlon, M. Powell. 2 males (molecular vouchers 09.AU.WA.YAZ.02 and 03), 50 km W of Yalgoo, 28º25.144'S 116º10.393'E, 358 m, 11.ii.2009, K. Hill & D. Marshall; 1 male (molecular voucher 06.AU.WA.EMG.05 and song recorded), 23 km E of Mt Magnet, 28º09.227'S 118º04.241'E, 450 m, 16.ii.2006, Hill, Marshall, Moulds. (MSM). 2 males, 2 females, 110 km S of Mount Magnet, 10.i.1989, M.S. & B.J. Moulds (PH). 2 males, 2 females, 110 km S of Mount Magnet, 10.i.1989, M.S. & B.J. Moulds (WAM).

Distribution and habitat (Figs 16, 24). The Mid West of Western Australia where it is found in an area bordered by 30.5 km west of Sandstone (type locality) in the north, to Paynes Find in the south-west and 26 km south of Menzies (M. Hanlon, M. Powell) in the south-east. There are records for January and February only. Adults inhabit *Eucalyptus, Grevillea* and *Acacia* trees.

Adult description. *Male* (Figs 3a, 25). *Head* mid brown often tending slightly darker brown around ocelli, and with a yellow anterior edge to supra-antennal plates extending almost to eye. Postclypeus mid brown with much of anterior part often slightly darker. Rostrum black; reaching a little beyond the bases of the hind coxae but not to their apices. Thorax mid brown. Pronotum always with a bold black fascia either side of a pale brown midline; fascia black to varying degrees. Mesonotum usually with parapsidal sutures highlighted black; lateral sigilla variously marked and submedian sigilla indistinct; cruciform elevation brown with area between arms black or mostly so. Forewings with bold infuscation continuous at distal ends of ulnar cells 1–3 and medial cell, but often broken at medial cell and restricted to crossvein m-cu; six bold infuscated marginal spots, one each on distal end of veins forming apical cells, and usually weak infuscation along ambient vein joining the spots; infuscation also partly along veins forming nodal line and on nodal intersection; costal margin to node and venation yellow or pale orange; basal cell variably black with small yellowish areas; basal membrane pale orange to greyish. *Hindwings* lightly infuscated along length of radial cell, along length of veins CuP, 2A, and either side of light brown plaga on 3A. *Legs* brown diffused with black especially on coxae; distal edge of femora partly yellow. *Opercula* black; tightly closing tympanal cavity and meeting. *Timbal covers* black. *Abdomen* above black with white pubescence between timbal covers but broken on midline, on tergite 3 partly dorsally and laterally adjacent to timbal covers, and over much of tergite 8; sternites black or blackish except for distal portion of sternites VII and VIII yellowish. *Genitalia* (Figs 25a, 25b). Pygofer black; basal lobes well developed, in ventral view tending parallel-sided; uncus in lateral view almost straight (not sharply downturned distally); in dorsal view apically bifurcate, the lobes almost parallel-sided and close together; theca curved in a sweeping arc that is not quite U-shaped.

Female (Fig. 3b). Similar to male. Abdominal segment 9 black with a pale yellow lateral margin of variable width.





FIGURES 24–25. *Arenopsaltria dryas* **sp. nov.** (24) distribution; (25a) male genitalia in lateral view; (25b) same in ventral view.

Ovipositor sheath barely protruding beyond abdominal segment 9.

Measurements. Range and mean (in mm) for 10 males, 10 females (includes smallest and largest specimens). *Length of body* (including head): male 24.5–31.0 (28.0); female (including ovipositor) 25.9–32.7 (29.5). *Length of forewing*: male 31.8–38.3 (34.8); female 33.0–38.9 (35.5). *Width of head* (including eyes): male 9.9–12.9 (11.4); female 10.4–13.0 (11.7). *Width of pronotum* (across lateral angles): male 10.6–13.5 (12.0); female 11.3–14.6 (12.4).

Distinguishing features. Closely similar to *A. nubivena* (Walker, 1858) but usually larger (forewing usually above 30 mm, *nubivena* never reaching 30 mm). Usually distinguishable by the yellow or pale orange costal margin of *dryas* that in *nubivena* is black or dark brown, rarely yellow. Further, the rostrum only reaches a little beyond the bases of the hind coxae in *dryas* but reaches at least to the apices in *nubivena*. These two species clearly differ in the shape of the male uncus that has the apical bifurcations almost parallel-sided and close together in *dryas* but triangular and widely spaced in *nubivena*.

Differs from the other large *Arenopsaltria* species, *A. fullo* (Walker, 1850) and *A. exmouthensis* **sp. nov.**, in having the rostrum reaching only to a little beyond the bases of the hind coxae (not reaching their apices or beyond), and a male uncus that is *not* sharply turned downwards distally. Males also differ in lacking a white pubescent transverse band on the abdomen, that is usually distinct in *fullo* and *exmouthensis*.

Song (Fig. 26). A coarse, whining buzz with a rapid but variable underlying pulse rate of ca. 450–850 pulses per second (sometimes in discernible doublets) and a peak sound frequency around 8 kHz. Males sing continuously for indefinite periods.

Subfamily Cicadettinae Buckton, 1890

Tribe Pictilini Moulds & Hill in Marshall *et al.*, 2018

Amica gen. nov.

(Figs 4, 5, 18, 19, 27–32)
urn:lsid:zoobank.org:act:F32A9034-D419-4E76-AD67-566261927886

Type species. *Amica glauca* **sp. nov.**, here designated.

Included species. *Amica glauca* **sp. nov.**, *Amica sitis* **sp. nov.**

Etymology. Based on the Latin word *amicus* meaning friend or friendly, and referring to the docile nature of the adults; feminine.

Distribution. Arid regions of South Australia and north-western New South Wales.

Diagnosis. Small to medium sized cicadas. *Head* including eyes a little narrower than mesonotum; supra-antennal plate nearly meeting eye; postclypeus broadly rounded transversely across ventral midline, in lateral profile rounded between 'top' and 'sides'. *Thorax*: pronotal collar width at dorsal midline much less than diameter of eyes; paranota confluent with adjoining pronotal sclerites, no mid lateral tooth; cruciform elevation with its dome wider than long; epimeral lobe not reaching operculum. *Forewings* hyaline, with 8 apical cells; subapical cells absent; ulnar cell 3 angled to radial cell; basal cell long and narrow; costal vein (C) clearly higher than R+Sc; costa parallel-sided to node; pterostigma present; vein CuA only weakly bowed so that cubital cell no larger than medial cell; veins M and CuA widely spaced at basal cell; vein RA_1 aligned closely with Sc for its length and not diverging in subapical region; vein CuA_1 divided by crossvein m-cu so that proximal portion longest or about equal to distal portion; veins CuP and 1A fused in part; infuscation absent; wing outer margin developed for its total length, never reduced to be contiguous with ambient vein. *Hindwings* with 6 apical cells; no infuscation on ambient vein; width of 1st cubital cell at distal end narrower than that of 2nd cubital cell; anal lobe narrow with vein 3A barely curved, long, separated from wing margin; veins RP and M fused basally. *Foreleg* femoral primary spine erect but tending towards prostrate

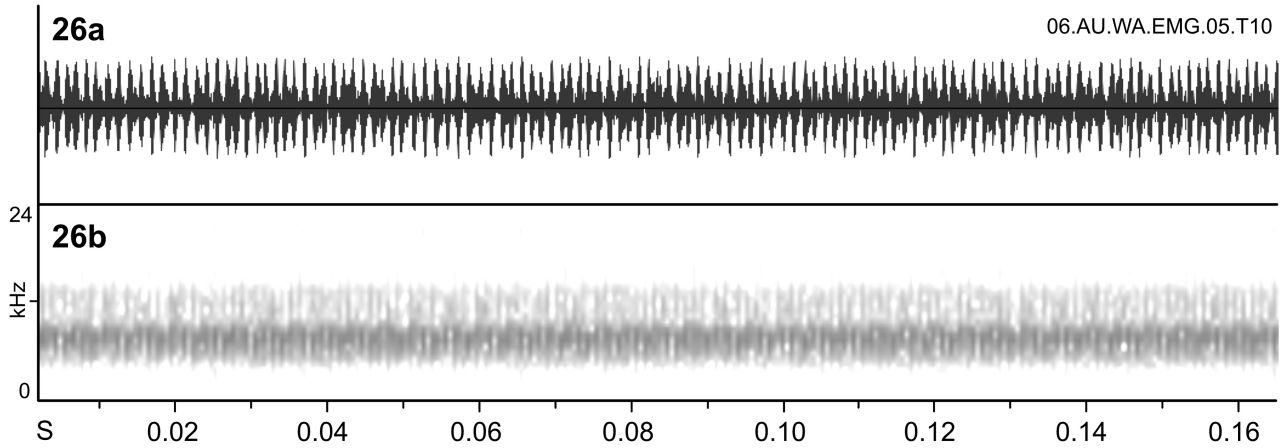


FIGURE 26. *Arenopsaltria dryas* **sp. nov.**, male calling song. (26a–b) oscillogram and spectrogram of a short song section, recorded in a cage in late afternoon sun (30.2ºC).

in *A. sitis*. *Male opercula* tending to be parallel-sided but curved in an arc almost through 90°; distal margin broadly rounded, reaching distal margin of tympanal cavity; clearly not meeting. *Male abdomen* in cross-section with sides of tergites weakly convex, epipleurites reflexed ventrally from junction with tergites; tergites 2–7 all similar in size (2 and 3 not considerably larger); sternites III–VII convex in cross-section. *Timbal* covers absent; timbals with 6 long ribs, regular in size and closely spaced filling entire timbal area apart from basal dome; in lateral view timbals extended below wing bases.

Male genitalia (Figs 28, 31). Pygofer with distal shoulders not developed; upper lobes flat, small, set well away from dorsal beak, rounded; basal lobes undivided, moderately developed, tending to be broadly rounded in lateral view; dorsal beak absent. Uncus absent. Claspers large, dominant, closely aligned, restraining aedeagus. Aedeagus with basal plate in lateral view undulated, depressed on dorsal midline, in dorsal view basally divided into two discs with apical arms lobe-like; basal portion of basal plate directed forwards away from thecal shaft; ventral rib rod-like with attachment only at ends; junction between theca and basal plate rigid, without a 'hinge'; thecal shaft recurved basally through some 180º; pseudoparameres absent; thecal apex entirely chitinized, thecal subapical cerci absent; flabellum absent; conjunctival claws absent; vesica retractable, vesica opening apical on theca.

Female sternite VIII deeply incised in a narrow U shape; abdominal segment 9 shorter than wide; dorsal beak barely formed, short and blunt.

Distinguishing features and relationships. A molecular phylogeny by Marshall *et al*. (2016, fig. 2) found *Amica glauca* **sp. nov.** (the type species of the genus) and *Amica sitis* **sp. nov.** (these species represented in their tree as 'bluebush cicada' and 'Woomera green friendly' respectively) to be sister species in a clade sister to *Chrysocicada trophis* (represented by '*Chrysocicada* nr. *franceaustralae*'). Together with *Pictila* these genera comprise the tribe Pictilini as implied by the Marshall *et al*. (2016) phylogeny. The long branches in the Marshall *et al*. (2016) tree separating *Amica glauca* **sp. nov.** + *Amica sitis* **sp. nov.** from *Chrysocicada trophis* suggest *Amica* is justified as a genus distinct from *Chrysocicada* and this is supported by morphology. Further, morphology also confirms the close affinity of *Amica* **gen. nov.** with *Chrysocicada* Boulard, 1989, a genus that comprises three species, *trophis* Moulds & Marshall, 2022, *franceaustralae* Boulard, 1989 (its type species) and *inflata* Emery & Emery, 2023. *Amica* **gen. nov.** shares with *Chrysocicada* a head with supra-antennal plates that reach beyond half way to the eyes, forewings with short apical cells, and a narrow hindwing anal lobe. The male genitalia are closely similar and share a pygofer that lacks a dorsal beak, basal lobes positioned in the distal half of the pygofer, and a rod-like ventral rib on the basal plate with attachment only at its ends.

Amica **gen n.** differs from *Chrysocicada* in having, in combination, male opercula that are turned near 90º around mid-length and surround the meracanthus rather than tending straight and not extending around the meracanthus, and a theca that has a simple unmodified apex rather than an apex bilobed and otherwise modified.

Amica **gen n.** can be distinguished from all other genera in having, in combination, a head narrower than the mesonotum with the supra-antennal plates almost reaching the eye, forewing veins M and CuA that meet the basal cell independently and are widely spaced, forewing apical cells that are short (compared to ulnar cells), and male genitalia that lack a dorsal beak, an uncus and pseudoparameres, have the basal lobes positioned in the distal half of the pygofer and have a theca in which the ventral rib of the basal plate is rod-like with attachment only at its ends.

Amica glauca sp. nov.

(Figs 4, 18a, 18b, 27–29)
urn:lsid:zoobank.org:act:59539766-0EF4-4DE7-81F2-181D8DAC84D8

Synonymy. "bluebush cicada" Marshall *et al*. 2016: 24.

Etymology. From the Greek glaukos and pertaining to the bluish green colour of the plant the species frequents.

Types. *Holotype* male (genitalia prep. CHR 7; molecular voucher 02.AU.NSW.KAY.01), Kayrunnera Ck, NW of White Cliffs, New South Wales, 30º36.677'S 142º30.420'E, 19.i.2002, Cooley, Hill, Cowan, Marshall, Moulds (**AMS**).

Paratypes as follows: **SOUTH AUSTRALIA**: 1 male, AU.SA.MED, 38 km S of Marree at Paradise Creek, 56 m, 29º56.336'S 138º15.818'E, 30.i.2015, D. Marshall (**DE**). 3 males, 43 km N of Roxby Downs, 30°11'45"S 136°59'47"E, 25.xii.2023, A. Stolarski, 1545 hrs, recordings 833-835, 793-0001 to 79300003; 1 male, 40 km S of Parachilna, 31°29'59"S 138°25'46"E, 27.xii.2023, A. Stolarski, 1520 hrs, sunny, 793-0004; 1 male, 40 km S of Parachilna, 31°29'59"S 138°25'45"E, 27.xii.2023, A. Stolarski, 1445 hrs, recording 859, 793-0005; 5 males, Puttapa Gap nr Leigh Creek, 30°42'42"S 138°24'35"E, 30.xii.2024, 32°C, A. Stolarski, 32°C, 793-0049 to 793-0053 (1male recording 2215); 2 males, 25 km N of Parachilna, 30°54'59"S 138°19'21"E, 30.xii.2024, 0955 hrs, 31°, 793-0054, 793-0055; 1 male, 1 female, 40 km S of Parachilna, 31°29'46"S 138°25'45"E, 30.xii.2024, A. Stolarski, 793-0056, 793-0057; 1 male, 14.5 km S of Parachilna, 31°16'01"S 138°24'34"E, 27.xii.2023, A. Stolarski, 30°C, recording 853, 793-0006; 1 male, 14.5 km S of Parachilna, 31°16'01"S 138°24'34"E, 27.xii.2023, A. Stolarski, 1520 hrs, sunny, 793-0007; 1 male, 14.5 km S of Parachilna, 31°16'01"S 138°24'34"E, 27.xii.2023, A. Stolarski, 30°C, recording 854, 793-0008; 1 male, 14.5 km S of Parachilna, 31°16'01"S 138°24'34"E, 27.xii.2023, A. Stolarski, 1305 hrs, sunny, 793-0009; 1 male, 22 km S of Marree, 29°49'32"S 138°10'02"E, 26.xii.2023, A. Stolarski, 1615 hrs, sunny, 30°C, 793-0010; 7 males, 17 km SE of Marree, 29°37'10"S 138°08'51"E, 20.i.2024, A. Stolarski, 1025 hrs, 37°C, 793-0011 to 793-0017; 17 males, 21 km SE of Marree, 29°49'03"S 138°09'46"E, 20.i.2024, A. Stolarski, sunny, 37°C, 793-0018 to 793-0034; 2 males,

23 km SE of Marree, 29°50'04"S 138°10'49"E, 20.i.2024, A. Stolarski, 1210 hrs, sunny, 38°C, 793-0035, 793-0036; 5 males, 13 km NW of Hawker, 31°47'17"S 138°21'16"E, 19.i.2024, A. Stolarski, 1200-1240 hrs, sunny, 37°C, 793-0037 to 793-0041; 2 males, 43 km S of Parachilna, 31°30'59"S 138°25'38"E, 19.i.2024, A. Stolarski, sunny, 32°C, 793-0042, 793-0043; 5 males, 13 km NW of Hawker, 31°47'17"S 138°21'16"E, 19.i.2024, A. Stolarski, 1035 hrs, sunny, 28°C, 793-0044 to 793-0048 (LP). 11 males, AU.SA.MED, 38 km S of Marree at Paradise Creek, 56 m, 29º56.336'S 138º15.818'E, 30.i.2015, D. Marshall; 2 males, 1 female, AU.SA.PAR, 38 km S of Parachilna, 183 m, 31º28.958'S 138º25.825'E, 2.ii.2015, D. Marshall; 1 male, AU.SA.OOM, 45 km W of Marree on Oodnadatta Track, 54 m, 29º38.74'S 137º38.253'E, 29.i.2015, D. Marshall; 3 males, AU.SA.STL, 48 km NE of Lyndhurst on Strzelecki Track, 186 m, 30º5.314'S 138º46.465'E, 31.i.2015, D. Marshall (MSM). 2 males, AU.SA.MED, 38 km S of Marree at Paradise Creek, 56 m, 29º56.336'S 138º15.818'E, 30.i.2015, D. Marshall (SAM).

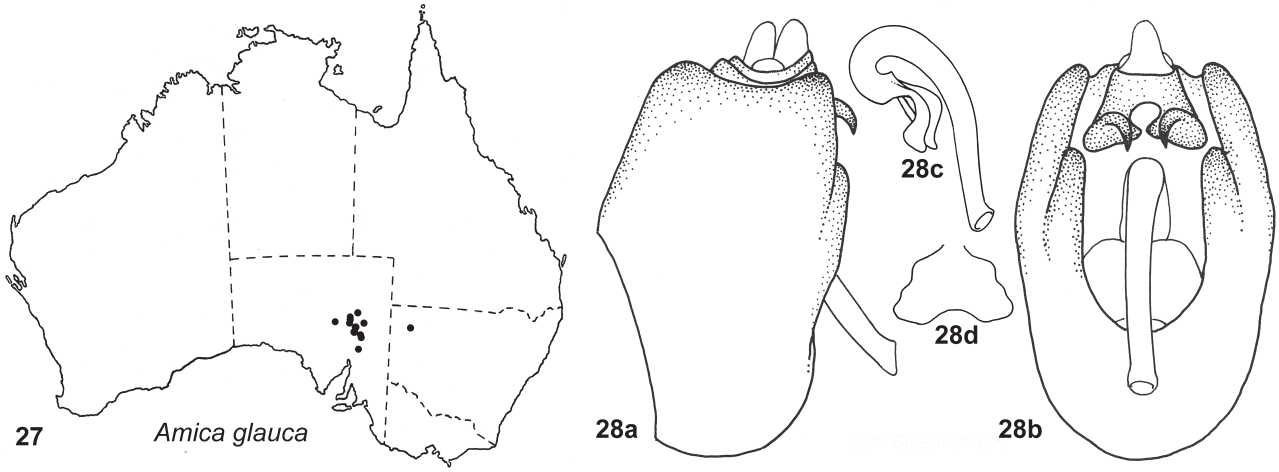
Distribution and habitat (Figs 18b, 27). South Australia in a small area from Maree south to Hawker, and near White Cliffs in north-western New South Wales. The most western record is 43 km N of Roxby Downs (A. Stolarski) and the most eastern is 48 km NE of Lyndhurst on Strzelecki Track, but most records are from areas north and south of Parachilna and south of Marree. Adults have been taken in late December, January and early February but emergence is likely dependent on the occurrence of heavy summer rains. Adults frequent Saltbush, *Atriplex* sp. (A. Stolarski) and Bluebush, *Maireana* species (family Amaranthaceae) in arid environments.

Adult description. *Male* (Figs 4, 28). *Head* light yellowish brown with a darker brown patch surrounding ocelli. Eyes in life light yellowish brown. Postclypeus light yellowish brown with a broad darker brown band down each side. Anteclypeus brown, tending black. Rostrum light yellowish brown, becoming black at apex; reaching to about bases of hind coxae. *Thorax* light yellowish brown. Pronotum sometimes with a faint darkened midline and fissures. Mesonotum with lateral sigilla dark brown, submedian sigilla variably light to dark brown; scutal depressions black, with a dark brown mark between anterior arms of cruciform elevation that sometimes projects forwards to submedian sigilla; cruciform elevation light yellowish brown. *Forewings* hyaline with faint infuscation at bases of ulnar cells 1 and 2; venation light yellowish brown; apical cells tending similar in length to ulnar cells; basal membrane weakly tinted yellowish brown. *Hindwing* venation pale yellowish brown with a white plaga bordered by a weak blackish infuscation. *Legs* light yellowish brown with irregular dark brown tints; fore femora with spines short, the primary spine almost prostrate; meracantha pale yellow with variable bluish suffusion. *Opercula* pale yellow with hints of blackish suffusion on distal half or more, variable between individuals. *Abdomen* with tergites light yellowish brown with a broad, irregular, black dorsal midline extending laterally along anterior margins, but dorsally not covering tergite distal margins; sternites I, II and VIII pale yellowish brown, sternites III–VII pale greenish yellow. *Timbals* with cavity broadly rounded along posterior margin; with six long ribs spanning the timbal membrane; timbal plate narrow. *Genitalia* (Figs 28a, 28b). Pygofer pale to light yellow with blackish anterior margin variable in extent between individuals; basal lobes clearly formed; upper lobes broad and broadly rounded; dorsal beak ill-defined, confluent with pygofer margin. Claspers distally fang-like, in lateral view curved and sharply pointed, in ventral view almost parallel distally. Aedeagus with theca curved slightly upwards distally, its opening simple and sloping backwards towards dorsal surface.

Female. Similar to male. Abdominal segment 9 light yellowish brown with a blackish subdorsal band either side not reaching distal margin, in dorsal view almost an equilateral triangle. Ovipositor sheath not protruding beyond abdominal segment 9.

Amica glauca **sp. nov.** is unusual in that vein CuA_1 is divided by crossvein m-cu so that the proximal section is longest, an uncommon feature in the subfamily Cicadettinae where the proximal section is usually equal to or shorter than the distal section.

Measurements. Range and mean (in mm) for 10 males, 1 female (includes smallest and largest specimens).



FIGURES 27–28. *Amica glauca* **sp. nov.** (27) distribution; (28a) male genitalia in lateral view; (28b) same in ventral view; (28c) aedeagus in lateral view; (28d) basal plate in dorsal view.

Length of body (including head): male 12.4–14.0 (13.08); female (including ovipositor) 13.2. *Length of forewing*: male 13.9–16.1 (15.14); female 15.5. *Width of head* (including eyes): male 3.8–4.5 (4.19); female 4.6. *Width of pronotum* (across lateral angles): male 5.0–5.3 (5.15); female 5.5.

Distinguishing features. The short body and wings, together with the distinctive colouring of the adults make this species unlikely to be confused with any other Australian species.

Song (Figs 18a, 29). A steady, high-pitched, whining buzz produced for indefinite periods. Syllables containing four or five pulses, sometimes partly coalesced, are produced at 145–165 syllables per second. The song has a dominant frequency of approximately 11.5–13.0 kHz. Similar to *Amica sitis* **sp. nov.**

Behaviour. If approached carefully, males cease calling but may produce very short ca 0.1 s chirps composed of a few syllables while they walk through the vegetation toward the investigator.

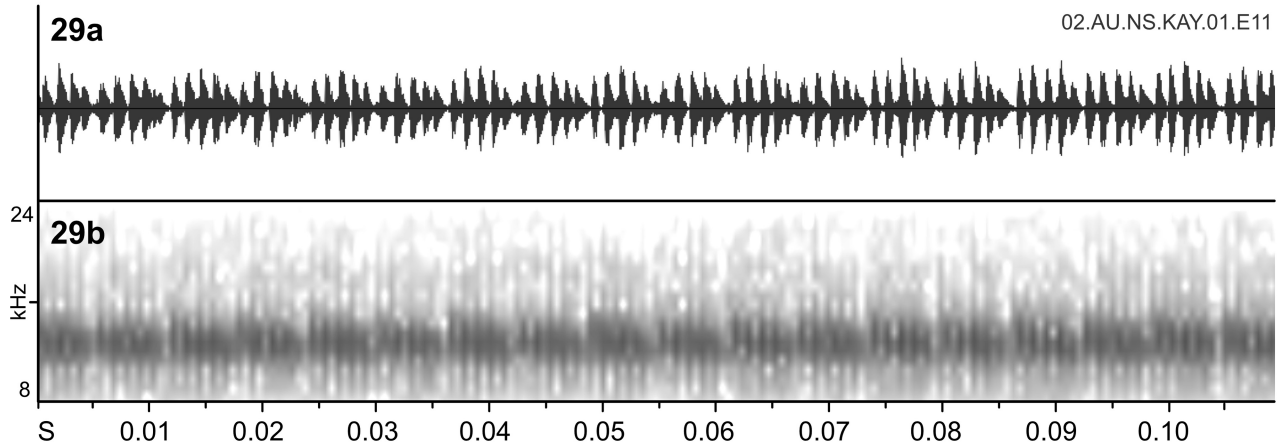


FIGURE 29. *Amica glauca* **sp. nov.**, male calling song. (29a–b) oscillogram and spectrogram of a short calling song section of the holotype, recorded in the field in afternoon sun.

***Amica sitis* sp. nov.**
(Figs 5, 19, 30–32)
urn:lsid:zoobank.org:act:FDC54634-DFC6-4640-A71C-8FF3FC5CD126

Synonymy. "Woomera green friendly" Marshall *et al*. 2016: 24.

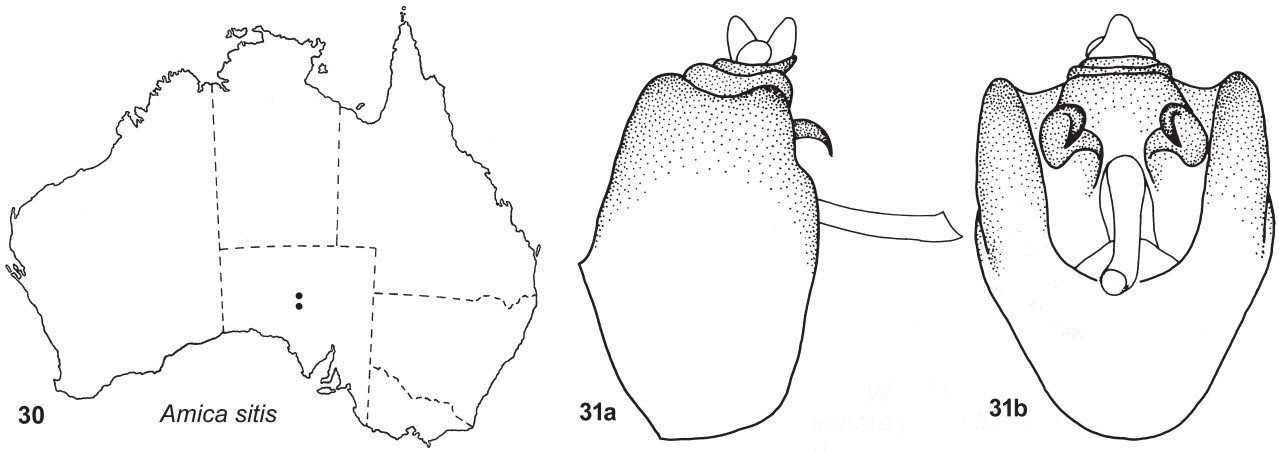
Etymology. From the Latin word *sitis* meaning thirst or dryness and pertaining to the arid habitat of the species.

Types. *Holotype* male (molecular voucher 07.AU.SA.WOB.02), 25 km S of Coober Pedy on Stuart Hwy, South Australia, 29º10.378'S 134º56.135'E, 2.ii.2007, K. Hill, D. Marshall (SAM). *Paratypes* as follows: **SOUTH AUSTRALIA**: 1 male, same data as holotype (LP). 13 males (2 genitalia prep. CHR 6, WOM 1; 1 molecular voucher 07.AU.SA.WOB.01), 2 females, same data as holotype; 1 male, 07.AU.SA.WOD, 92 km S of Coober Pedy on Stuart Hwy, 29º42.844'S 135º07.538'E, 2.ii.2007, K. Hill, D. Marshall (MSM). 1 male, same data as holotype (DE). 1 male, same data as holotype (LP). 2 males, same data as holotype (SAM).

Distribution and habitat (Figs 19, 30). Arid South Australia where it is known only from 25 km and 92 km south of Coober Pedy. Adults inhabit low shrubland where they favour saltbush and other low shrubs.

Adult description. *Male* (Figs 5, 31a, 31b). Predominantly green dorsally and dull pale yellow ventrally, but tending partly or entirely yellow or light brownish in discoloured dried specimens. *Head*, including postclypeus and anteclypeus, green; antennae brown except for partly green scape; rostrum pale brown to yellowish with black apex, reaching to about bases of hind coxae. *Thorax* almost uniformly green, the mesonotum with submedian sigilla and basal portion of lateral sigilla very slightly darker. *Forewing* venation green, without infuscations; apical cells tending shorter than ulnar cells; basal membrane pale grey to colourless. *Hindwing* venation green; without infuscations; plaga white to colourless. *Legs* with coxae green, otherwise tending pale yellow with tarsi a little blackish distally; meracanthus short, pale yellowish. *Opercula* pale yellowish, almost colourless. *Abdomen* with tergites and sternites green except sometimes pale orange dorsally on basal tergite segments tapering distally and variable in extent between individuals. *Timbals* with cavity broadly rounded along posterior margin, with six long ribs spanning the timbal membrane; timbal plate narrow. *Genitalia* (Figs 31a, 31b) with pygofer pale yellow; basal lobes ill-defined; upper lobes broad and broadly rounded; dorsal beak ill-defined, confluent with pygofer margin. Claspers distally fang-like, in lateral view curved and sharply pointed, in ventral view curved outwards. Aedeagus with theca curved slightly upwards distally, its opening simple and sloping backwards towards dorsal surface.

Female. Similar to male. Abdominal segment 9 green, in dorsal view almost an equilateral triangle. Ovipositor sheath not protruding beyond abdominal segment 9.



FIGURES 30–31. *Amica sitis* **sp. nov.** (30) distribution; (31a) male genitalia in lateral view; (31b) same in ventral view.

Measurements. Range and mean (in mm) for 10 males, 2 females (includes smallest and largest specimens). *Length of body* (including head): male 12.9–14.6 (13.53); female (including ovipositor) 13.1–14.0 (13.55). *Length of forewing*: male 12.9–14.4 (13.76); female 13.7–14.1 (13.9). *Width of head* (including eyes): male 3.3–4.0 (3.79); female 3.8–3.9 (3.85). *Width of pronotum* (across lateral angles): male 4.5–5.2 (4.96); female 4.7–4.8 (4.75).

Distinguishing features. Superficially similar to *Erempsalta hermannsburgensis* (Distant, 1907) in size and colour but clearly different in its forewing venation in which (among other things) veins M and CuA are widely spaced at basal cell instead of fused as one.

Song (Fig. 32). A steady, high-pitched, whining buzz produced for indefinite periods, very similar to *Amica glauca* **sp. nov.** Syllables containing four or five pulses are produced at about 150 per second, sometimes paired and sometimes partly coalesced. Individual pulses are produced at about 650–800 per second. The song has a dominant frequency of approximately 11.5–12.5 kHz.

Subfamily Cicadettinae Buckton, 1890

Tribe Cicadettini Buckton, 1890

Austropunia gen. nov.

(Figs 8, 21, 33–35)
urn:lsid:zoobank.org:act:4DD1CB80-6C20-487A-80CE-68BE91F52A62

Type species. *Austropunia cheloides* **sp. nov.**, here designated.

Included species. *Austropunia cheloides* **sp. nov.**

Etymology. Based on 'Australia' and the generic name *Punia* to which it is closely allied. Feminine.

Distribution. North-western Western Australia between the Fortescue and De Grey Rivers, and central Northern Territory.

Diagnosis. Head including eyes as wide as mesonotum; supra-antennal plate meeting or nearly meeting eye; postclypeus broadly rounded transversely across ventral midline, in lateral profile angulate between 'top' and 'sides'. Thorax: pronotal collar width at dorsal midline much less than diameter of eyes; paranota confluent with adjoining pronotal sclerites, no mid lateral tooth; cruciform elevation with its dome wider than long; epimeral lobe not reaching operculum. Forewings hyaline; with 8 apical cells; subapical cells absent; ulnar cell 3 angled to radial cell; basal cell long and narrow; costal vein (C) clearly higher than R+Sc; costa swollen a little before node; node clearly beyond mid length of wing; pterostigma present; vein CuA only weakly bowed with cubital cell no wider than medial cell; veins M and CuA meeting basal cell with their stems completely fused as one; vein RA_1 aligned closely with Sc for its length and not diverging in subapical region; vein CuA_1 divided by crossvein m-cu so that proximal portion shortest; veins CuP and 1A fused in part; infuscation absent; wing outer margin developed for its total length, never reduced to be contiguous with ambient vein. Hindwings with 6 apical cells; no infuscation on ambient vein; width of 1st cubital cell at distal end at least twice that of 2nd cubital cell; anal lobe broad with vein 3A curved, long, separated from wing margin; veins RP and M fused basally. Fore leg femoral primary spine erect. Male opercula more or less reaching margin of tympanal cavity, directed towards distomedial margin of tympanal cavity, apically broadly rounded, clearly not meeting, clearly raised above level of tympanal cavity on its outer half or so. Male abdomen in cross-section with sides of tergites straight or weakly convex, epipleurites reflexed ventrally from junction with tergites; tergites 2–7 all similar in size (2 and 3 not considerably larger); sternites III–VII in cross-section convex. Timbal ribs regular in size and spaced with prominent intermediate short ribs; basal dome very large; timbals not extended below wing bases; timbal covers absent.

Male genitalia (Figs 34a, 34b). Pygofer with distal shoulders not developed; upper lobes very long, narrow and claw-like; basal lobes undivided, large, in lateral view projecting outwards, basically triangular; dorsal beak present and a part of chitinized pygofer. Uncus small,

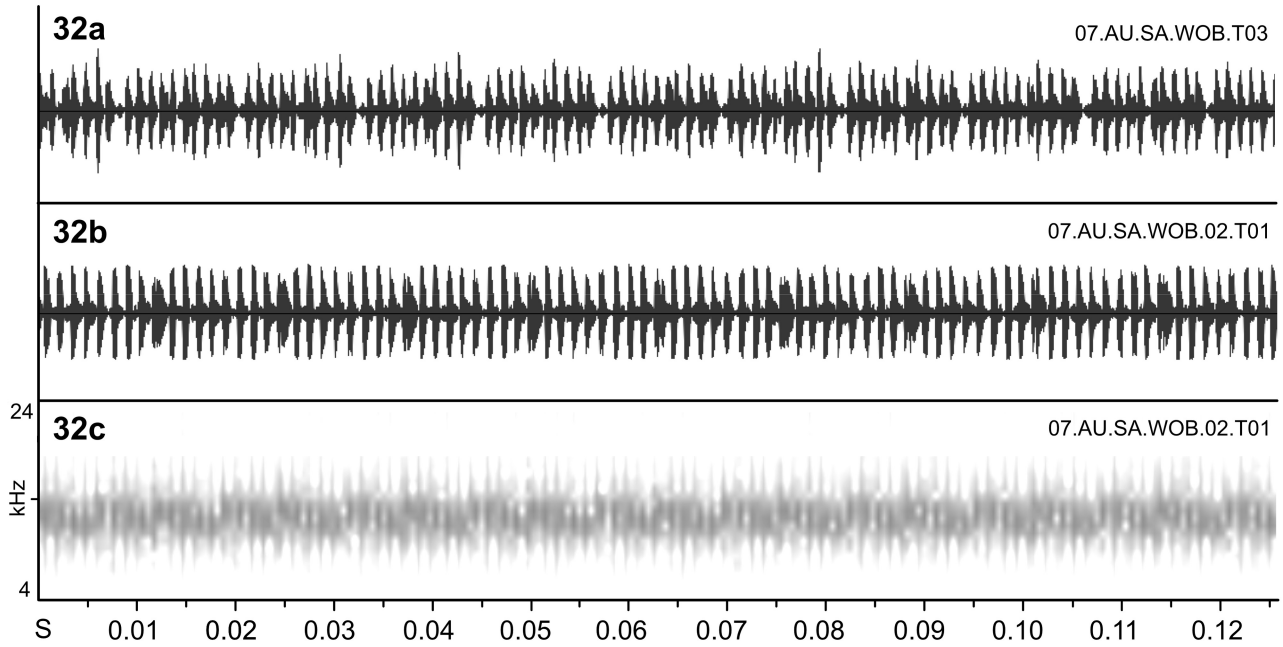


FIGURE 32. *Amica sitis* **sp. nov.**, male calling song. (32a–b) oscillograms showing slightly different patterns of syllable coalescence (32b is the holotype); (32c) spectrogram, holotype, recorded in the field in afternoon sun (38.0ºC).

short, flattened, more or less duck-bill shaped. Claspers well developed, large, dominant, unfused, claw-like but excavated ventrally, restraining aedeagus. Aedeagus with basal plate in lateral view undulated, weakly depressed on dorsal midline, in dorsal view Y-shaped; basal portion of basal plate directed forwards away from thecal shaft; ventral rib completely fused with basal plate; junction between theca and basal plate with a functional 'hinge'; pseudoparameres present, lying beside exposed endotheca and originating near thecal base; endotheca exposed, ridged and partly chitinous; endothecal ventral support absent; thecal subapical cerci absent; flabellum absent; conjunctival claws absent; vesica retractable, vesica opening apical.

Female. Sternite VIII deeply incised in a V shape; abdominal segment 9 a little longer than wide; dorsal beak with a developed apical spine (visible in dorsal view).

Distinguishing features and relationships. The single species in *Austropunia* **gen. nov.**, *A. cheloides* **sp. nov.**, is closely similar to *Neopunia graminis* (Goding & Froggatt, 1904) in body shape, size, colour and markings, but differs significantly in having the supra-antennal plates meeting or nearly meeting the eyes, the forewing costa swollen a little before the node and the node clearly beyond mid length of the wing, although not so much in the male genitalia that lacks the unusually long, slender and large claw-like upper pygofer lobes of *A. cheloides* **sp. nov.** However, the close relationship with *Neopunia* is corroborated by molecular data that places *A. cheloides* **sp. nov.** (as "Munjina peeper") in a tree sister to *Neopunia* (Marshall *et al*. 2016; Owen *et al*. 2015, 2017). On the other hand, the male genitalia of *A. cheloides* **sp. nov.** show similarities with those of *Falcatpsalta* Owen & Moulds, 2016, notably in the long, slender and large claw-like upper pygofer lobes. In the molecular phylogenies by Owen *et al*. (2015, 2017) *Falcatpsalta* and *Neopunia* (and *Punia*) are closely allied.

It is difficult to know the homology of the large claw-like upper structure on the pygofer but we conclude it is the upper pygofer lobe as previously stated by Ewart (1989) and Owen & Moulds (2016). In the molecular phylogenies by Owen *et al*. (2015, 2017), *Falcatpsalta* is sister to *Nanopsalta*, these in turn sister to *Neopunia* + *Punia*. The upper pygofer lobes of *Nanopsalta, Neopunia* and *Punia* are bilobed, with a broadly rounded upper part and a spine-like lower part. It would seem that in *Falcatpsalta* the broad rounded part has receded into the pygofer margin and the spike-like part has developed into a much larger claw-like structure. The broad rounded section may be a development of the distal shoulder as in *Diceropyga* and some other genera in the subfamily Cicadinae.

Austropunia **gen. nov.** differs from *Neopunia* (and *Punia*) in having 6 apical hindwing cells instead of 5, and significantly in the upper pygofer lobes of the male genitalia that are very long and claw-like in *Austropunia,* but short and bilobed in *Punia* and *Neopunia* with one lobe broadly round and the other short and spine-like.

Austropunia differs from *Falcatpsalta,* which also has a long claw-like upper pygofer lobe, in having the costa swollen a little before the node, and an aedeagus that has the pseudoparameres lying against an exposed endotheca that has its surface lightly sclerotized, rather than having the pseudoparameres positioned high above it as in *Falcatpsalta*.

Austropunia differs from all genera in having, in combination, forewing veins M and CuA with their stems meeting the basal cell completely fused as one, the costa swollen a little before the node, a large male upper

pygofer lobe that is long, narrow, and claw-like, and pseudoparameres that lie beside an exposed endotheca that has its surface lightly sclerotized.

Austropunia cheloides sp. nov.

(Figs 8, 21, 33–35)
urn:lsid:zoobank.org:act:4F8F68D9-1C5B-4933-8206-C0EE0C1761F1

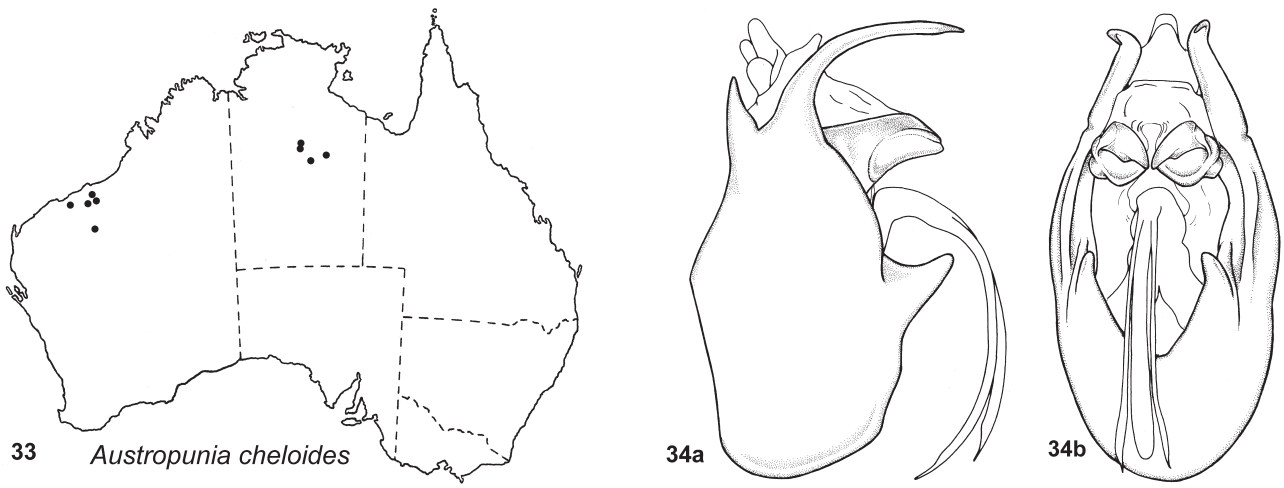
Synonymy. "Munjina peeper" Marshall *et al*. 2016: 24; Owen *et al*. 2015: 262.

Etymology. From the Greek *chele* meaning claw and pertaining to the long, curved, claw-like upper pygofer lobes of the male pygofer, together with the suffix *oides* implying likeness.

Types. *Holotype* male, molecular voucher 10.AU.WA.YUW.01, 20º48.032'S 118º08.679'E, 19 km SW of Yule R, NW Coastal Hwy, Western Australia, 17.i.2010, K. Hill, D. Marshall, M. Moulds (WAM). *Paratypes* as follows: **WESTERN AUSTRALIA**: 1 male, same data as holotype (DE). 1 male, same data as holotype (LP). 6 males, same data as holotype; 2 males (molecular voucher 10.AU.WA.CON.02), 11 km NE of De Grey R. xing, Shay Gap Rd, 96 km NE of Marble Bar, 20º31.995'S 120º06.856'E, 18.i.2010, K. Hill, D. Marshall, M. Moulds; 6 males, 5 females, AU.WA.WWG, Muccan Shay Gap Rd, ~60 km NE of Marble Bar, 20º50.906'S 120º02.635'E, 17.i.2010, K. Hill, D. Marshall, M. Moulds; 1 male, AU.WA.MBA, 30 km SE of NE Coastal Hwy on road to Marble Bar, 20º36.789'S 119º08.499'E, 17.i.2010, K. Hill, D. Marshall, M. Moulds; 1 male (molecular voucher 06.AU.WA.MUN.02, genitalia prep. PAU404), 261 km S of Port Hedland, 22º22.849'S 118º41.484'E, 475 m, 11.ii.2006, K. Hill, D. Marshall, M. Moulds (MSM). **NORTHERN TERRITORY**: 9 males (1 genitalia prep REN 1), 10 km N of Renner Springs, S of Elliott, 22.xii.1986, M.S. & B.J. Moulds; 1 male (molecular voucher 11.AU.NT.MAD.01), rd to Lake Mary Anne Dam, NE of Tennant Creek, 388 m, 19º36.510'S 134º12.531'E, 6.xii.2011, K. Hill, D. Marshall; 1 male (molecular voucher 04.AU.NT.MES.13), approx. 5 km S of Renner Springs, 18º21.1'S 133º49.0'E, 26.i.2004, K. Hill, D. Marshall, M. Moulds (MSM). 1 male, same data as holotype (PH). 1 male (molecular voucher 06.AU.NT.BHW.03), 66 km W of Barkly Homestead on Barkly Hwy, 19.39772ºS 135.312ºE, 30.i.2006, K. Hill, D. Marshall, M. Moulds; 1 male (molecular voucher 04.AU.NT.MES.10), Lubra's Lookout, Stuart Hwy (Hwy 87), mesa, ~5 km S Renner Springs (UCONN). 5 males, same data as holotype (WAM).

Distribution and habitat (Figs 21, 33). North-western Western Australia between the Fortescue and De Grey Rivers, and in central Northern Territory between Renner Springs and Tennant Creek and east to 66 km west of Barkly Homestead on the Barkly Highway. Records from WA are mostly within 100 km of the coast but it extends inland to the upper Fortescue River near the Hamersley Range close to Wittenoom Gorge. In the NT there are also records from 10 km north and 5 km south of Renner Springs. Adults have been recorded from late December to mid February but appearance is probably dependent upon summer monsoonal rains. Adults tend to be wary and inhabit spinifex and low shrubs.

Adult description. *Male* (Figs 8a, 34a, 34b). *Head* black with supra-antennal plates edged light yellowish and sometimes with a little brown around ocelli. Eyes in life pale brown to almost yellow. Postclypeus black with a yellowish brown margin and usually as small yellowish brown spot on most anterior part. Anteclypeus black, sometimes yellowish brown laterally. Rostrum predominantly black, partly brown basally; reaching to about apices of mid coxae. *Thorax* light yellowish brown, sometimes tending light reddish brown. Pronotum with narrow black markings highlighting fissures and midline, variable in extent. Mesonotum with submedian and lateral sigilla black, a black midline and black between anterior arms of cruciform elevation; scutal depressions black. *Forewings* hyaline; venation light brown to black except for partly light yellowish brown on basal half, variable between individuals; basal membrane weakly tinted



FIGURES 33–34. *Austropunia cheloides* **sp. nov.** (33) distribution; (34a) male genitalia in lateral view; (34b) same in ventral view.

grey. *Hindwings* with venation brown to black but partly yellowish on basal half; plaga white. *Legs* light yellowish brown with dark brown tints on fore femora fore tibia and tarsi of all legs; fore femora and mid and hind tibia often with a pair of very narrow longitudinal blackish fasciae. *Opercula* whitish or pale yellowish. *Abdomen* with tergites light yellowish brown with a broad, black anterior margin of variable extent, often dominating but sometimes much reduced except along dorsal midline; sternites I and II often black or blackish; sternites III–VIII yellowish with diffused black to varying degrees, sometimes completely so except for posterior margin. *Timbals* with cavity broadly rounded along posterior margin, with 5 long ribs spanning timbal membrane and one shorter anterior rib. *Genitalia* (Figs 34a, 34b) as in generic description above.

Female (Fig. 8b). Similar to male but much paler, pale brown with light brown markings. Abdominal segment 9 pale yellowish with an indistinct, pale brown, subdorsal fascia on either side not reaching distal margin, in dorsal view almost an equilateral triangle, with a well-formed dorsal beak that does not project distally beyond the level of the segment lateral margins. Ovipositor sheath protruding just a little beyond abdominal segment 9.

Measurements. Range and mean (in mm) for 10 males and 5 females (includes largest and smallest males). *Length of body*: male 12.5–15.1 (13.6); female (including ovipositor) 13.0–15.4 (14.8). *Length of forewing*: male 13.7–16.2 (14.9); female 13.2–18.2 (16.6). *Width of head*: male 3.7–4.1 (3.9); female 3.6–4.5 (4.2). *Width of pronotum*: male 4.0–4.6 (4.3); female 4.0–5.4 (4.9).

Distinguishing features. As for Genus *Austropunia* above.

Song (Fig. 35). Simple high-pitched phrases produced about one every four seconds, each pairing a short (*ca* 0.05 s) buzz followed by a much longer 1–10 s buzz, with about 0.15 s delay between the two components. Both buzzes consist of pulses arranged in alternating 2 and 3-pulse sets, with the pulses produced overall at about 750/s. The frequency band is broad with a shallow peak around 16 kHz. If disturbed may produce attenuated long pulses. Produces a strong protest call when handled.

Biology. Unpublished field observations by DM and Kathy Hill of male *Austropunia cheloides* responding to clicking *Chlorobalius* katydids (shown to be able to attract Cicadettini cicadas with tegmina-clicks) (Marshall and Hill 2009), suggest that the initial short pulse of the phrase is the song cue for the female, but additional observations are needed for confirmation.

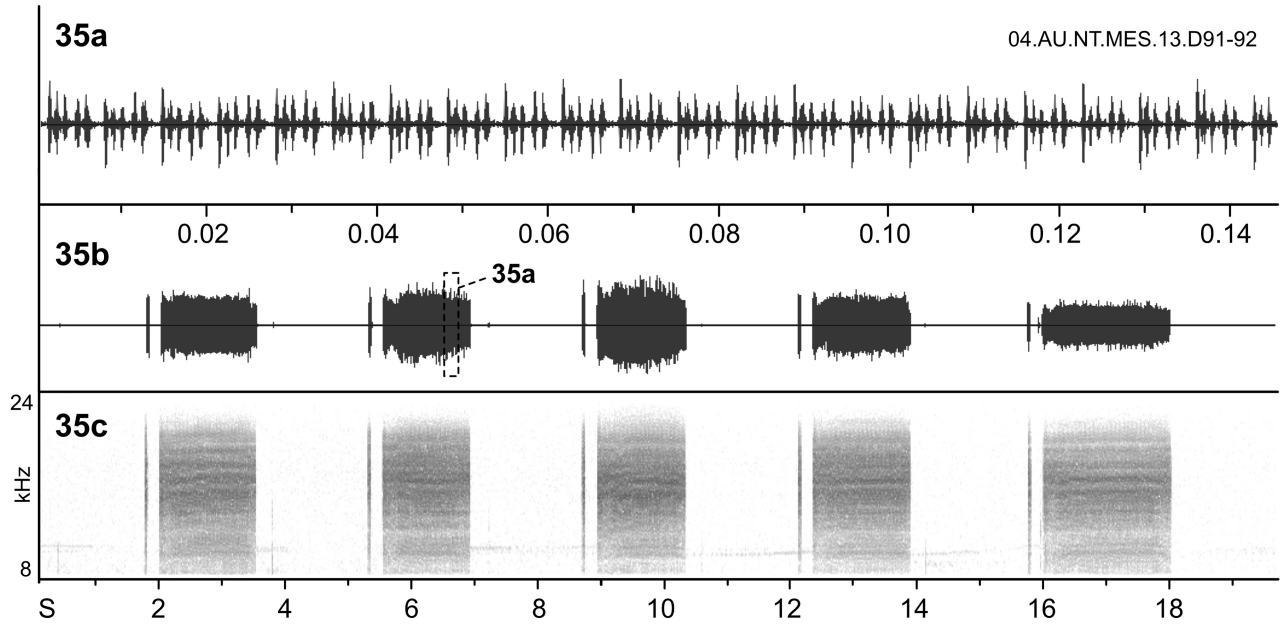


FIGURE 35. *Austropunia cheloides* **sp. nov.**, male calling song. (35a–c) zoom oscillogram, main oscillogram, and main spectrogram, recorded in the field in morning sun (*ca*. 30ºC).

Brevia gen. nov.

(Figs 9, 36–38)

urn:lsid:zoobank.org:act:C3614753-D89E-4006-ABBC-32ABB356EA01

Type species. *Brevia bullula* **sp. nov.**, here designated.

Included species. *Brevia bullula* **sp. nov.**

Etymology. From the Latin *brevis*, meaning short, and referring to the remarkably short pseudoparameres on the aedeagus, similar in length to a short ventral support. Feminine.

Distribution. Southern quarter of the Northern Territory, in South Australia at 102 km S of Coober Pedy, and in New South Wales from 31 km south of Broken Hill.

Diagnosis. Small sized cicadas. *Head* including eyes about as wide as mesonotum; supra-antennal plate meeting or almost meeting eye; postclypeus broadly rounded transversely across ventral midline, in lateral profile

rounded between 'top' and 'sides'. *Thorax*: pronotal collar width at dorsal midline much less than diameter of eyes; paranota confluent with adjoining pronotal sclerites, no mid lateral tooth; cruciform elevation with its dome wider than long; epimeral lobe not reaching operculum. *Forewings* hyaline; with 8 apical cells; subapical cells absent; ulnar cell 3 angled to radial cell; radial cell very long so that wing node is clearly beyond mid length of the wing; apical cell very short rather than long (as long as apical cell 2); cubital cell larger than medial cell; basal cell long and narrow; costal vein (C) clearly higher than R+Sc; costa parallel-sided to node and gently and evenly curved; pterostigma present; veins M and CuA widely spaced at basal cell; vein RA_1 aligned closely with Sc for its length and not diverging in subapical region; vein CuA_1 divided by crossvein m-cu so that proximal portion shortest; veins CuP and 1A fused in part; infuscation absent; wing outer margin developed for its total length, never reduced to be contiguous with ambient vein. *Hindwings* with 5 apical cells; no infuscation on ambient vein; width of 1st cubital cell at distal end wider than that of 2nd cubital cell; anal lobe narrow with vein 3A barely curved, long, separated from wing margin; veins RP and M fused basally. *Foreleg* femoral primary spine erect. *Male opercula* overall shape rounded with outer margin broadly rounded with rounded apex directed towards abdominal midline; not abnormally swollen at base; clearly not meeting. *Male abdomen* in cross-section with sides of tergites tending straight; epipleurites reflexed ventrally from junction with tergites; tergites 2–7 measured along dorsal midline all similar in size (2 and 3 not considerably larger); sternites III–VII convex in cross-section but not greatly swollen. *Timbal* covers absent; timbals with 6 long ribs spanning timbal membrane except for shorter anterior rib, regular in size and closely spaced filling entire timbal area apart from basal dome; in lateral view timbals extended below level of wing bases.

Male genitalia (Figs 37a-d). Pygofer with distal shoulders undeveloped; upper lobes flat, large, set well away from dorsal beak, broad and broadly rounded; basal lobes undivided, moderately developed, largely abutted against pygofer and partly tucked within; dorsal beak present, broad and largely confluent with pygofer margin. Uncus clearly protruding, broad with distal margin broadly straight. Claspers large, dominant, closely aligned, broad in lateral view and essentially flat with the outer face carrying an overhanging lip along its upper margin; restraining aedeagus. Aedeagus with basal plate in lateral view downturned at distal end, in dorsal view apically broadened with "ears"; basal portion of basal plate directed forwards away from thecal shaft; ventral rib completely fused with basal plate; junction between theca and basal plate with a functional membranous "hinge" that possesses a chitinous back; theca trifid, the straight pseudoparameres and ventral support all very short; thecal shaft nearly straight; thecal subapical cerci absent; flabellum absent; conjunctival claws absent; vesica retractable, vesica opening apical on theca.

Female unknown.-

Distinguishing features and relationships. A molecular phylogeny by Marshall *et al*. (2016, fig. 2) found *Brevia* **gen. nov.** (in their tree as "grey bubbler") to be sister to *Adelia borealis* (the type species of *Adelia*), these in turn together sister to *Terepsalta infans* (the type species of *Terepsalta*). These relationships are somewhat unexpected as *Brevia* **gen. nov.** looks rather different from both *Adelia* and *Terepsalta* in its morphology.

Brevia **gen. nov.** differs notably from *Adelia* in having a forewing of usual shape rather than exceptionally wide, forewing veins M and CuA meeting the basal cell fused as one instead of independently, the forewing apical cell very short rather than long (as long as apical cell 2), and the hindwing with 5 apical cells instead of 6. The male genitalia differ in the structure of the trifid aedeagus in which the pseudoparameres and ventral support are all very short and in the development of the dorsal beak that is short in *Brevia* **gen. nov.** but long and much narrower in *Adelia*.

Brevia **gen. nov.** differs from *Terepsalta* in having forewing veins M and CuA meeting the basal cell fused as one instead of independently, the forewing cubital cell large (much larger than medial cell), forewing apical cell very short rather than long (as long as apical cell 2), and the hindwing with 5 apical cells instead of 6. The male genitalia differ in the structure of the trifid aedeagus in which the pseudoparameres and ventral support are all very short and in the development of the dorsal beak that is short in *Brevia* **gen. nov.** but long and much narrower in *Adelia*.

Brevia **gen. nov.** differs from all other genera in having, in combination, the supra-antennal plates meeting or nearly meeting the eyes, forewing veins M and CuA meeting the basal cell fused as one, the forewing node clearly beyond mid length of the wing, forewing cubital cell large, much larger than medial cell, a hindwing with 5 apical cells, and male genitalia with a well-developed uncus and an aedeagus that is trifid with the pseudoparameres and ventral support all very short and near equal in length.

***Brevia bullula* sp. nov.**

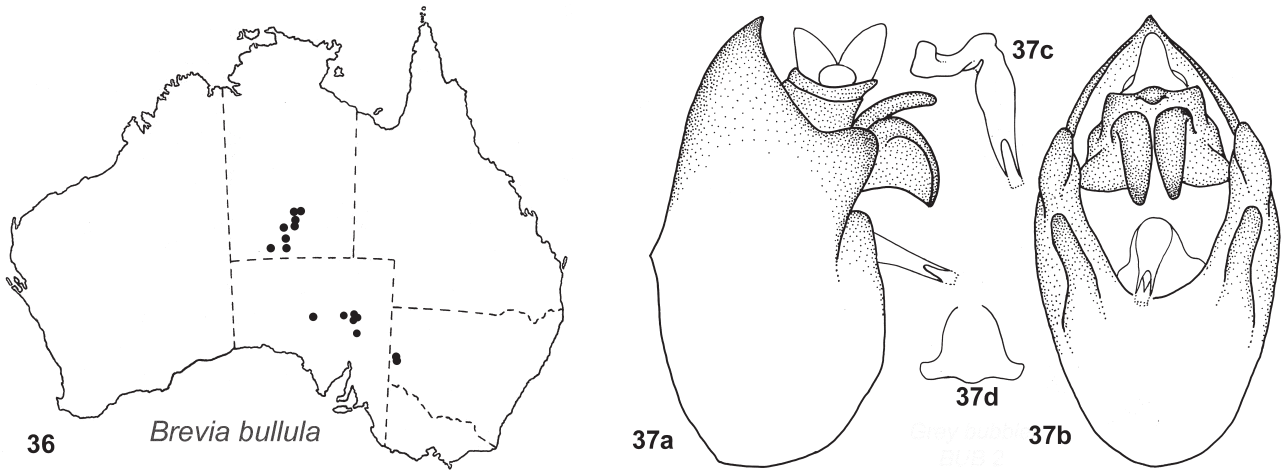
(Figs 9, 36–38)

urn:lsid:zoobank.org:act:7D42200C-FB44-4EBD-B383-2F5AB7897012

Synonymy. "grey bubbler" Marshall *et al*., 2016: 24.

Etymology. From the Latin *bulla*, meaning bubble, and referring to the bubbly lilt of the male's song.

Types. *Holotype* male (molecular voucher 07.AU.NT.KUN.01), 25º17.217'S 133º12.463'E, 66 km N of Kulgera, Northern Territory, 29.i.2007, 6 m, K. Hill, D. Marshall (NTM). *Paratypes* as follows: **NORTHERN TERRITORY**: 1 male, same data as holotype (DE). 1 male, same data as holotype (LP). 4 males, AU.NT.ERN, 24º44.313'S 133º10.884'E, 53 km N of Erldunda, nr the Palmer River, on Stuart Hwy, 409 m, 29.i.2007, K. Hill, D. Marshall; 5 males (2 molecular vouchers 07.AU.NT.KUN.03 and 05), same data as holotype; 1 male (molecular voucher 10.AU.NT.LSC.01), 25º13.144'S



FIGURES 36–37. *Brevia bullula* **sp. nov.** (36) distribution; (37a) male genitalia in lateral view; (37b) same in ventral view; (37c) dissected aedeagus in lateral view; (37d) basal plate in dorsal view.

132º03.705'E, W of Erldunda, ~122 km W of Stuart Hwy, 2.ii.2010, Hill, Marshall, Moulds; 3 males (one molecular voucher 07.AU.NT.TAA.01), 23º33.143'S 133º49.403'E, 4.6 km NW of Stuart Hwy on Tanami Rd, NNW of Alice Springs, 736 m, 31.i.2007, K. Hill, D. Marshall (MSM). 1 male, same data as holotype (NTM). 1 male, AU.NT. HMG, 23.9689ºS 133.0678ºE, 32 km E of Hermannsburg on Larapinta Drive, 29.i.2010, K. Hill, D. Marshall, M. Moulds; 1 male, AU.NT.AAS, 23.8465ºS 133.817ºE, 9 km S of turnoff to Alice Springs airport on Stuart Hwy, ~20 km S of Alice Springs, 546 m, 1.ii.2007, K. Hill, D. Marshall; 1 male. AU.NT.PLB, 22.9716ºS 133.7921ºE, 23.2 km E of Stuart Hwy on Plenty Hwy, NE of Alice Springs, 680 m. 31.i.2007, K. Hill, D. Marshall (UCONN). **SOUTH AUSTRALIA**: 2 males, 87 km N of Roxby Downs, 29°49'53"S 137°12'55"E, 25.xii.2023, 1745 hrs, A. Stolarski, 842-0001 (recording 838), 842-0002; 1 male, Parachilna, 31°08'02"S 138°23'49"E, 27.xii.2023, 1127 hrs, A. Stolarski, recording 849, 842-0003; 2 males, 8.5 km S of Marree, 29°42'58"S 138°07'06"E, 26.xii.2023, 31°C, A. Stolarski, 842-0004 (recording 840), 842-0005; 4 males, 1 female, 30 km N of Lyndhurst, 30°01'34"S 138°16'55"E, 20.i.2024, 1430–1600 hrs, 41°C, A. Stolarski, 842-0006 to 842-0010; 7 males, 9.25 km SE of Marree, 29°42'59"S 138°07'09"E, 19.i.2024, 37°C, A. Stolarski, 842-0011 to 842-0017 & 842-0025; 3 males, 39 km N of Lyndhurst, 29°55'57"S 138°15'46"E, 20.i.2024, 1405 hrs, 41°C, A. Stolarski, 842-0018 to 842-0020; 1 male, 3 km N of Lyndhurst, 30°15'42"S 138°20'49"E, 20.i.2024, 1630 hrs, 41°C, A. Stolarski, 842-0021; 1 male, 28 km SE of Marree, 29°52'19"S 138°12'51"E, 20.i.2024, 39°C, A. Stolarski, 842-0022; 1 male, 9.25 km SE of Marree, 29°42'59"S 138°07'09"E, 19.i.2024, 2130 hrs, night sweeping, A. Stolarski, 842-0023; 1 male,17 km SE of Marree, 29°47'10"S 138°08'51"E, 20.i.2024, 1025 hrs, 37°C, A. Stolarski, 842-0024; 1 male, 30 km N of Lyndhurst, 30°01'34"S 138°16'55"E, 30.xii.2024, A. Stolarski, 842-0026; 1 male, 3.25 km NE of Leigh Creek, 30°34'14"S 138°25'17"E, 30.xii.2024, 34°C, A. Stolarski, recording 2218, 842-0027 (LP). 1 male, Coober Pedy, 26.i.1966, N.S. Le Souef; 12 males, 56 km S of Coober Pedy, 6.ii.1984, M.S. & B.J. Moulds; 8 males, 20 km S of Moolawatana Hstd, 23.i.1978, M.S. & B.J. Moulds; 1 male, AU.SA.WOE, 29º48.353'S 135º07.227'E, 102 km S of Coober Pedy on Stuart Hwy, 193 m, 2.ii.2007, K. Hill, D. Marshall. 15.AU.SA.MED.01, 38 km S of Marree at Paradise Creek, 56 m, 29º56.336'S 138º15.818'E, 30.i.2015, D. Marshall. 15.AU.SA.BLE.01, ca. 30 km S of Balcaloona (S of Arkaroola) (MSM). **NEW SOUTH WALES**: 1 male (molecular voucher AU.NS.BHS.04), 32º14.429'S 141º25.580'E, 4.ii.2007, ~31 km S of Broken Hill, 181 m, K. Hill, D. Marshall (MSM).

Aural records

NORTHERN TERRITORY: 07.AU.NT.PLE, 22.9672ºE 134.2389ºS, Gillen Ck, nr turnoff to Gem Tree on Plenty Hwy. NE of Alice Springs, 643 m, 31.i.2007, K. Hill, D. Marshall. **NEW SOUTH WALES**: AU.NS.BHY, 32.5378ºS 141.6033ºE, 70 km S of Broken Hill, 4.ii.2007, K. Hill, D. Marshall.

Distribution and habitat (Fig. 36). The southern quarter of the Northern Territory where it is known from several locations south from 23.2 km E of Stuart Hwy on Plenty Hwy and nearby at Gillen Ck (north-east of Alice Springs) to near Erldunda and 66 km north of Kulgera, and in South Australia at 102 km S of Coober Pedy east to Leigh Creek (A. Stolarski) and south to Parachilna (A. Stolarski), and in New South Wales from 31 km south of Broken Hill. Most records are from the Northern Territory. Notable localities in South Australia include Roxby Downs, Parachilna, Maree and Leigh Creek (A. Stolarski). There are records for late December to early February only but emergence is likely dependent on heavy summer rains. Adults sing in grasses.

Adult description. *Male* (Figs 9, 37). *Head* black with yellow to pale orange supra-antennal plates, and a yellow to pale orange spot on midline against hind margin. Eyes in life dark reddish brown. Postclypeus black with yellow to pale orange blotch on most anterior part and an irregular yellow to pale orange band along lateral margins. Anteclypeus black. Rostrum light yellowish brown to

black, always with black at apex; reaching to about bases of hind coxae. *Thorax* black dorsally; largely pale yellow ventrally. Pronotum with a yellow to pale orange midline not quite reaching hind margin, a narrow yellow to pale orange anterior margin and a dark orange (sometimes reddish) pronotal collar overlaid with black suffusion between lateral angles variable between individuals. Mesonotum with a prominent pair of paramedian angular yellow to pale orange markings, sometimes a narrow yellow to pale orange edge to wing grooves and a yellow to pale orange cruciform elevation. *Forewing* hyaline; without infuscations; costal margin light brown, venation otherwise dark brown to black; basal membrane weakly tinted yellowish brown to pale grey. *Hindwing* venation dark brown to black.

Legs light yellowish with blackish linear markings except on tarsi and hind tibiae, variable between individuals. *Opercula* pale yellow. *Abdomen* black with a distinct yellow to pale orange distal margin on segments 2–6; sternites 1, 2 and 8 pale yellowish brown, sternite I black, sternites II–VIII pale yellow with a broad diffused black midline most pronounced on segment II. *Timbals* as in generic description; timbal membrane partly pale orange around dorsal margin. *Genitalia* (Figs 37a-d), see generic description above.

Female. Unknown.

Measurements. Range and mean (in mm) for 10 males (includes smallest and largest specimens). *Length of body* (including head): 11.8–13.5 (12.7). *Length of forewing*: 11.4–14.2 (12.7). *Width of head* (including eyes): 3.4–3.7 (3.5). *Width of pronotum* (across lateral angles): 3.8–4.4 (4.0).

Distinguishing features. Differs from all other species by the distinguishing features listed in the generic description above.

Song (Fig. 38). Repeated bubbly rattle phrases produced at about four per second. Each phrase contains generally 4–8 short syllables each with 2–3 pulses, with the syllables occurring at about 30/s and the pulses at about 220/s. Up to nine pulses per syllable were observed at the SA.MED location. Most sound energy appears in a low frequency range from 4–11 kHz, with the peak frequency around 9 kHz, making the song easy to hear. There is some frequency modulation, with each first pulse producing lower frequency sound. Males produce a small protest sound when captured.

Paraclinata **gen. nov.**

(Figs 6, 10, 14, 15, 39–44)
urn:lsid:zoobank.org:act:D284DC6E-3771-4DDE-80DF-85B51C9F3751

Type species. *Paraclinata chlorotes* **sp. nov.**, here designated.

Included species. *Paraclinata chlorotes* **sp. nov.**; *P. nullarboris* **sp. nov.**

Etymology. Based on the Greek *para* meaning beside, nearby, and the generic name *Clinata* to which it is related. Feminine.

Distribution. Widely scattered records through arid regions of Western Australia, Northern Territory, South Australia and Queensland.

Diagnosis. Small to medium sized cicadas. *Head* including eyes about as wide as mesonotum; supra-antennal plate nearly meeting eye; postclypeus broadly rounded transversely across ventral midline, in lateral profile rounded between 'top' and 'sides'. *Thorax*: pronotal collar width at dorsal midline much less than diameter of eyes; paranota confluent with adjoining pronotal sclerites, no mid lateral tooth; cruciform elevation with its dome wider than long; epimeral lobe not reaching operculum. *Forewings* hyaline; with 8 apical cells; apical cells 3–6 similar in length or a little longer than ulnar cells 1–3;

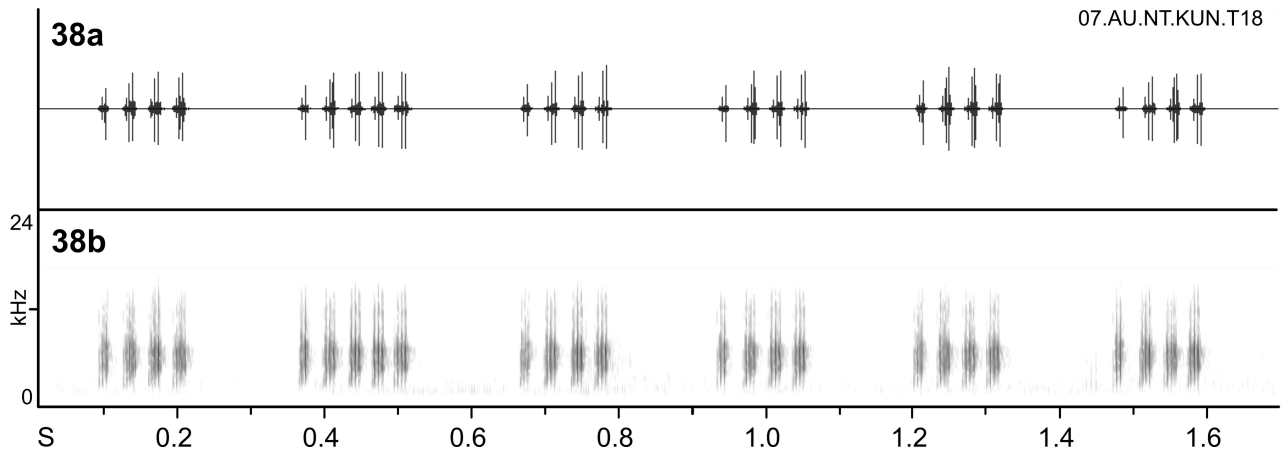


FIGURE 38. *Brevia bullula* **sp. nov.**, male calling song. (38a–b) oscillogram and spectrogram of a short calling song segment from the holotype location in sunny conditions (31.8ºC).

subapical cells absent; ulnar cell 3 angled to radial cell; basal cell long and narrow; costal vein (C) clearly higher than R+Sc; costa distinctly swollen preceding node so that the wing margin appears angulate; pterostigma present; vein CuA only weakly bowed so that cubital cell no larger than medial cell; veins M and CuA completely fused as one at basal cell; vein RA_1 aligned closely with Sc for its length and not diverging in subapical region; vein CuA_1 divided by crossvein m-cu so that proximal portion shorter than distal portion; infuscation absent; wing outer margin developed for its total length, never reduced to be contiguous with ambient vein. *Hindwings* with 5 or 6 apical cells; without infuscation; width of 1st cubital cell at distal end much wider than that of 2nd cubital cell; anal lobe narrow with vein 3A a little barely curved distally, long, separated from wing margin. *Foreleg* femoral primary spine erect. *Male opercula* broadly rounded, broadly angular and with inner margin broadly rounded; mostly reaching distal margin of tympanal cavity; clearly not meeting. *Male abdomen* in cross-section with sides of tergites weakly convex, epipleurites reflexed ventrally from junction with tergites; tergites 2–7 all similar in size (2 and 3 not considerably larger); sternites III–VII convex in cross-section. *Timbal* covers absent; timbals with 3 long ribs, regular in size and closely spaced; timbal plate large, about half to three-quarters timbal membrane; in lateral view timbals no not extend below the level of the wing bases.

Male genitalia (Figs 40, 43). Pygofer with distal shoulders not developed; upper lobes flat, small, set well away from dorsal beak, directed distally; basal lobes undivided, similar in size to upper lobes, adjacent to upper lobes; dorsal beak present but ill-defined, broad and confluent with pygofer margin, a part of chitinized pygofer. Uncus small, short, flattened, more or less duck-bill shaped. Claspers large, restraining aedeagus; essentially flat, wide in lateral view, outer face with an overhanging lip along upper margin; unfused; distally converging; their apices not widely separated. Aedeagus trifid; with basal plate in lateral view undulated, weakly depressed on dorsal midline; in dorsal view as long as or longer than broad, apically broadened with 'ears'; basal portion of basal plate directed forwards away from thecal shaft; ventral rib completely fused with basal plate; junction between theca and basal plate with a functional 'hinge'; pseudoparameres present, long, slender, gradually tapering to a point; originating near thecal base, unfused throughout their length, in dorsal view parallel for much of their length then diverging, in lateral view aligned with thecal shaft (not lateral or raised higher); endotheca exposed, soft, entirely fleshy; endothecal ventral support present, long, about half the length of the long pseudoparameres and supporting a very long fleshy endotheca; thecal subapical cerci absent; flabellum absent; conjunctival claws absent; vesicle opening apical on theca.

Female sternite VIII deeply incised in a V shape; abdominal segment 9 in dorsal view almost an equilateral triangle; dorsal beak absent.

Distinguishing features and relationships. A molecular phylogeny by Marshall *et al*. (2016, fig. 2) found that *Paraclinata chlorotes* **sp. nov.** (the type species of the genus) falls in the vicinity of other genera that have unusually modified wings used by males for incorporating wing-generated sound into their songs. *Paraclinata chlorotes* **sp. nov.**, together with some other unnamed species, is sister to *Clinata* Moulds, 2012, *Toxala* Moulds, 2012. We describe here only the distinctive green species *Paraclinata chlorotes* **sp. nov.** and another relatively common species not treated by Marshall *et al*., the others undescribed all being obscure and known from just one or very few individuals.

Paraclinata **gen. nov.** differs from *Clinata* in having forewing apical cells 3–6 similar in length to ulnar cells 1–3, instead of being almost twice as long as in *Clinata*; male timbals that are functional and with 3 long ribs, whereas in *Clinata* they are likely non-functional with the ribs effectively absent leaving only the basal plate; and in having an aedeagus in which the long ventral support is around half the length of the long pseudoparameres, whereas in *Clinata* the ventral support is nearly the same length as the pseudoparameres.

It differs from *Toxala* in having 5 or 6 hindwing apical cells instead of 3 or 4; and in having an aedeagus in which the long ventral support is around half the length of the long pseudoparameres whereas in *Toxala* the ventral support is nearly the same length as the pseudoparameres.

Paraclinata **gen. nov.** can be distinguished from all other genera in having, in combination, veins M and CuA meeting the basal cell with their stems completely fused as one; a strongly bowed forewing costa that is characteristically swollen proximal to the node; and male genitalia with a trifid aedeagus in which the ventral support is long, about half the length of the long pseudoparameres and supporting a very long fleshy endotheca. The timbal cavities do not extend below the level of the wings and the male opercula are also greatly reduced.

***Paraclinata chlorotes* sp. nov.**

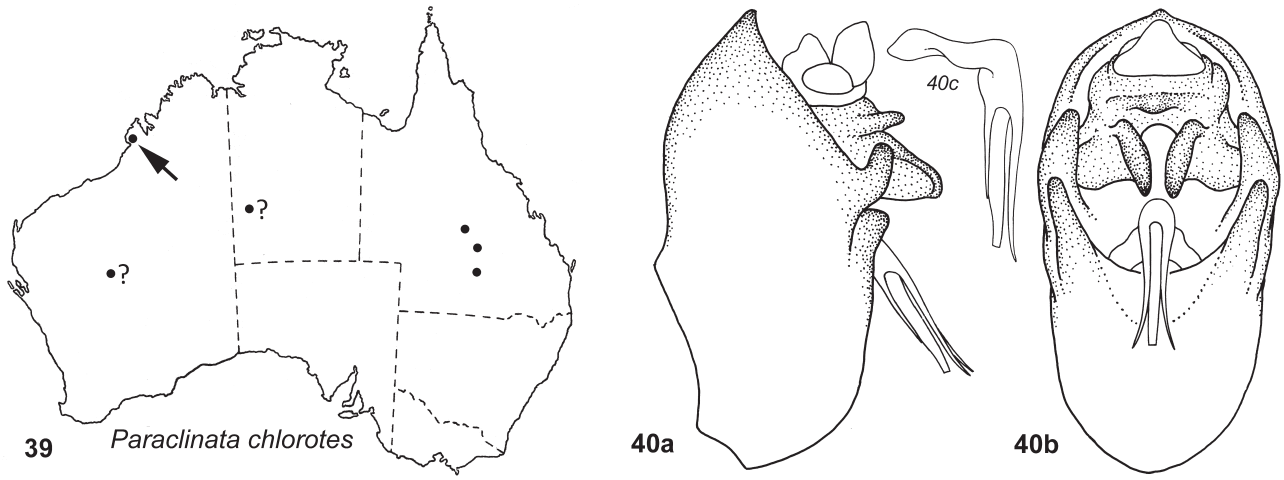
(Figs 6, 14, 39−41)

urn:lsid:zoobank.org:act:CBC3B8DE-6131-44B1-9021-F5A5A9DAD0AD

Synonymy. "green wingbanger", Marshall *et al*. 2016: 24.

Etymology. From the Greek *chlorotes* meaning greenness, and pertaining to the green colour of this species that is so different from the brownish or blackish appearance of all other known bent-winged species apart from the allied *Froggattoides* species.

Types. *Holotype* male (molecular voucher 10.AU.WA.LVQ.01; genitalia prep. WB1), near Broome, 13 km up Cape Leveque road, 17º46.210'S 122º16.868'E, Western Australia, 18.i.2010, Hill, Marshall, Moulds (WAM). *Paratypes* as follows: **WESTERN AUSTRALIA**: 2 males, 1 female, same data as holotype (MSM). 10 males (one genitalia prep. WIN 1, 6 females Meekatharra, Billiluna Pool, Canning Stock Rte Exp., Apr. 1930-Aug. 1931 (SAM). **NORTHERN TERRITORY**: 1 male, 213 km W of Yuendumu, 10.x.1975, G. Gow & P. Horner



FIGURES 39–40. *Paraclinata chlorotes* **sp. nov.** (39) distribution with type locality arrowed; (40a) male genitalia in lateral view; (40b) same in ventral view; (40c) dissected aedeagus in lateral view.

(MSM). 1 male, same data as holotype (UCONN). *Other material examined*: **QUEENSLAND**: 3 males, Barcaldine, 10.ii.1981, M.S. & B.J. Moulds; 4 males (one genitalia prep. PLA20; one molecular voucher 05.AU.QLD.CWB.01), AU.QLD.CWB, Little Windeyer Ck x-ing, 28 km N of Tambo, 24º40.187'S 146º22.190'E, 22.i.2005, Hill, Marshall, Moulds (MSM).

Distribution and habitat (Figs 14b, 39). Records are widely scattered across the northern half of Western Australia, the Tanami Desert of Northern Territory, and the central south of Queensland. There are confirmed records for October, January and February.

Adult description. *Male* (Figs 6, 14a, 40). In shades of pale green sometimes with hints of yellow or pink. *Head* pale green usually with a light suffusion of black mainly around supra-antennal plates. Ocelli pinkish. Postclypeus pale green with a large central black or blackish marking considerably variable from intense black to barely discernible. Rostrum pale brown becoming black distally; reaching to about apices of mid coxae. *Thorax* pale green; pronotum usually with a little black suffusion on lower lateral angles; mesonotum sometimes with submedian and lateral sigilla marked a little darker. *Forewings* hyaline, infuscation absent; discal cell very narrow; apical cells 3–6 all similar in size; costal margin gently incurved before a large pre-nodal swelling; node distal of mid length, about two thirds distance from base; venation pale green becoming black at apical cells and along vein 2A+3A; basal cell colourless and semi-opaque; basal membrane pale green to colourless. *Hindwings* with six apical cells; veins RP and M with a very long fused stem; venation pale green becoming black on distal half of apical cells; anal lobe very narrow with a white plaga. *Legs* pale green with pale brown tarsi. *Opercula* pale green; covering tympanal cavity but far from meeting. *Abdomen* pale green, sometimes with hints of black laterally on tergites. *Timbals* with cavity broadly rounded along posterior margin; with three long ribs spanning the timbal membrane. *Genitalia* (Figs 40a, 40b). Pygofer upper lobe similar in size to basal lobe, short, tending parallel-sided and apically rounded, upturned; dorsal beak ill-defined, broad and confluent with pygofer margin. Median lobe of uncus short and rounded. Claspers broad, flat with an overhanging upper margin, meeting apically. Aedeagus with long, slender pseudoparameres that gradually taper to a point and distally gently curve outwards; ventral support long, about half the length of the long pseudoparameres and supporting a very long fleshy endotheca.

Female. Similar to male. Abdominal segment 9 pale green in life; in dorsal view about an equilateral triangle. Ovipositor sheath not protruding beyond abdominal segment 9.

Measurements. Range and mean (in mm) for 10 males and 6 females (includes largest and smallest males). *Length of body*: male 12.6–13.7 (13.3); female (including ovipositor) 12.3–14.7 (13.6). *Length of forewing*: male 15.3–17.9 (16.7); female 16.7–17.6 (17.2). *Width of head*: male 3.4–3.9 (3.6); female 3.5–4.0 (3.8). *Width of pronotum*: male 3.9–4.5 (4.2); female 3.9–4.6 (4.3).

Distinguishing features. A distinctive species unlikely to be confused with any other. Superficially similar to *Froggattoides* in its pale green colour and modified forewings but distinctly different in having a large costal swelling proximal to node.

Song (Fig. 41). Two short cage recordings were made, one from the type locality near Broome, Western Australia, and one from near Tambo, Queensland. Both contain buzzes comprised mainly of strong pulses produced by visually confirmed wing movements, overlapped by softer, higher pitched doublets consistent with timbal song (paired pulses with the first pulse slightly louder). In the recording from near Broome (holotype), a longer buzz of 0.64 s duration is followed by three short 0.63 s buzzes. The long buzz begins with about 0.2 s of putative timbal doublets produced at 112/s and continues with 0.44 s of wing movement pulses at 68/s that overlap the continuing doublets. In the short buzzes, wing movement and putative timbal doublets overlap in the same manner. The peak frequency is 19 kHz for the putative timbal-only section of the Broome recording.

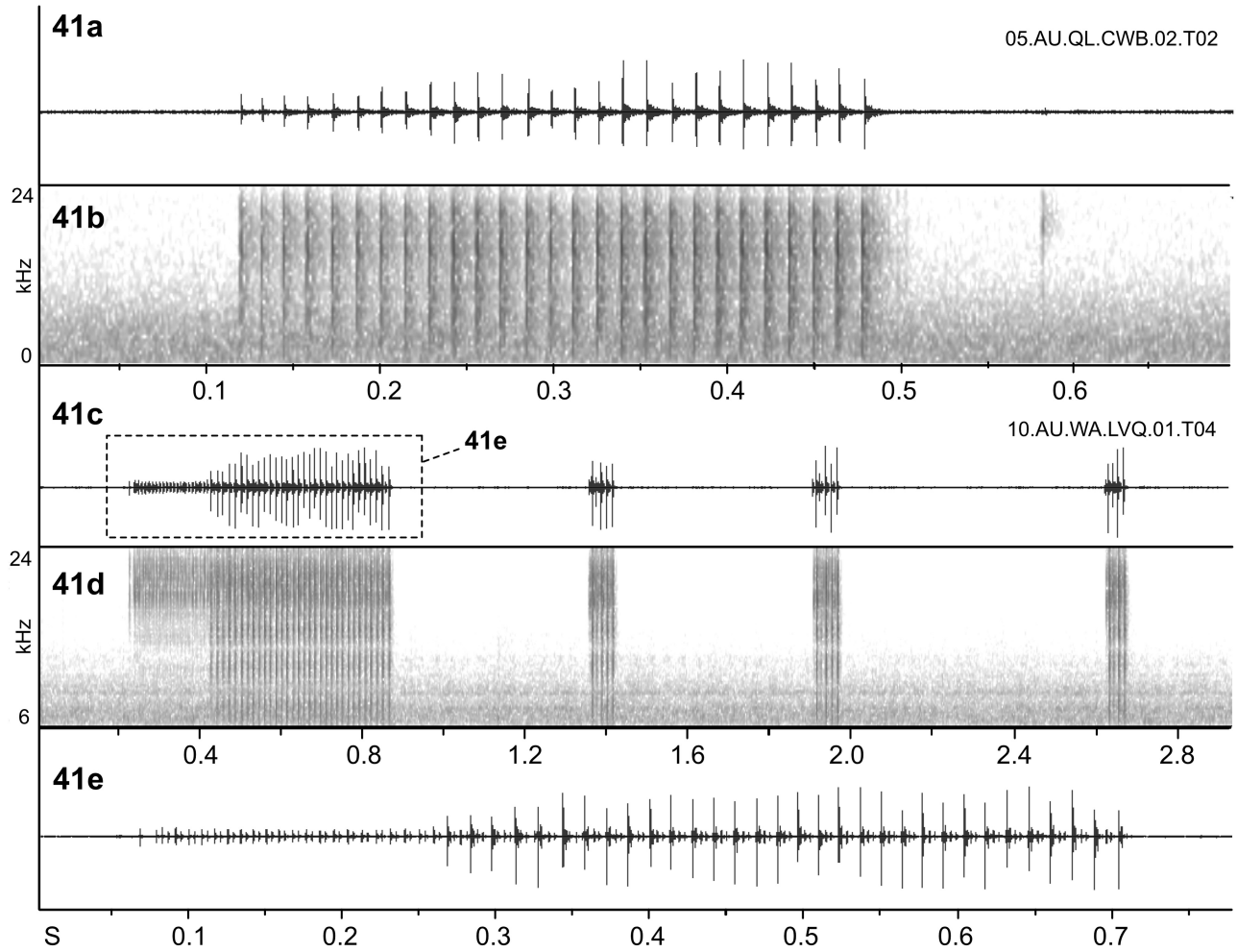


FIGURE 41. *Paraclinata chlorotes* **sp. nov.**, male calling song. (41a–b) oscillogram and spectrogram of a short calling song segment from a Queensland location. (41c–e) oscillogram, spectrogram, and zoom oscillogram of the male holotype. Both recordings made by K. Hill in a cage under dim MV light during collecting after dark. Both appear to combine sounds produced by wing movement with timbal sound, the former apparent as higher-frequency preceding and then overlapping doublets in the longer phrase in 41e and possibly as a few faint trailing doublets in 41a.

Where the wing movement overlaps the putative timbal song, the combined frequency profile is a broad plateau with a flat peak ranging from 14.5 kHz to well above 20 kHz. For the Queensland recording, the loud pulses produced by the wings occur at 72/s in a syllable 0.35 s long. The signature of the possible timbal component is much weaker but may be similar in rate to that of the Broome recording.

Paraclinata nullarboris sp. nov.

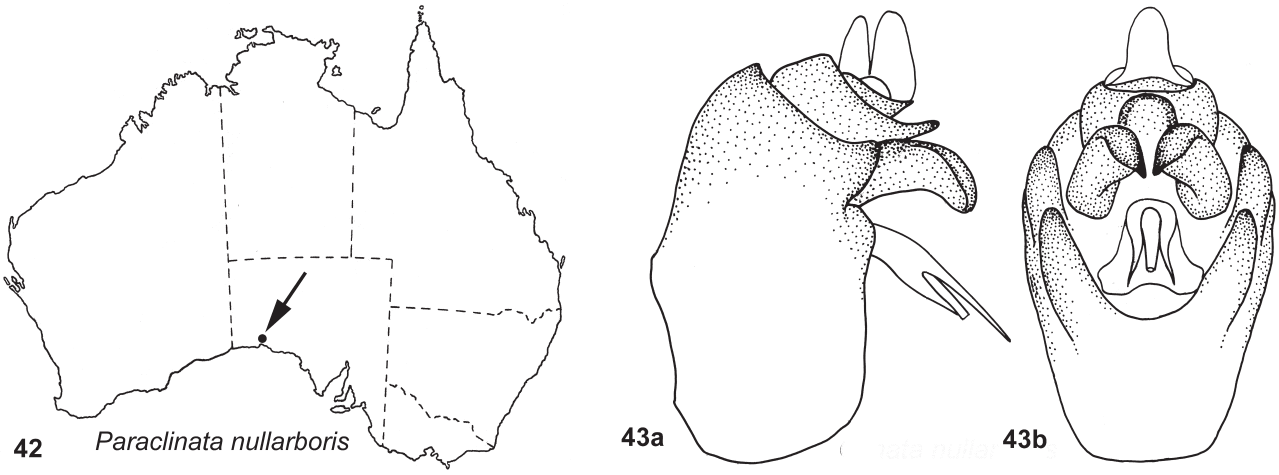
(Figs 10, 15, 42–44)
urn:lsid:zoobank.org:act:7D801496-B6D4-4C3D-86AA-51CE2DDD4502

Synonymy. "Nullarbor wingbanger" Marshall & Hill, 2009: Table 2, Fig. 6B.

Etymology. Of the treeless Nullarbor Plain, the habitat of the species; *nullarboris* the genitive singular of the feminine noun *nullarbor*.

Types. *Holotype* male (molecular voucher 06.AU.SA.NSE.02), 5.4 km NE of Nullarbor Motel, 31º26.300'S 130º57.235'E, South Australia, 58 m, 22.ii.2006, Hill, Marshall, Moulds (SAM). *Paratypes* as follows: **SOUTH AUSTRALIA**: 1 male, 1 female, Nullarbor Stn, 25.i.1989, M.S. & B.J. Moulds (DE). 1 male, 1 female, Nullarbor Stn, 25.i.1989, M.S. & B.J. Moulds (LP). 12 males (one molecular voucher 06.AU.SA.NSE.03), same data as holotype; 11 males, 12 females, Nullarbor Stn, 25.i.1989, M.S. & B.J. Moulds (MSM). 1 male, 1 female, Nullarbor Stn, 25.i.1989, M.S. & B.J. Moulds (PH). 2 males, same data as holotype; 1 female, Nullarbor Stn, 25.i.1989, M.S. & B.J. Moulds (SAM).

Distribution and habitat (Figs 15, 42). South Australia where it is known only from the vicinity of the Nullarbor Motel on the Eyre Highway (near the Head of the Gulf of Carpentaria some 180 km east of the Western Australian border). Adults frequent low saltbush and other small shrubs where they have a preference for sitting on the woody stems or dead branches. The habitat is exceptionally arid and the Nullarbor Plain is renowned for being treeless. As this habitat is extensive it



FIGURES 42–43. *Paraclinata nullarboris* **sp. nov.** (42) distribution; (43a) male genitalia in lateral view; (43b) same in ventral view.

is probable that the distribution of this species is far wider than records suggest.

Adult description. *Male* (Figs 10a, 43). *Head* black with supra-antennal plates edged light brown and usually with a small light brown spot on midline against posterior margin. Postclypeus black with a light brown margin and a light brown midline on most anterior portion. Anteclypeus black. Rostrum dark brown becoming black distally; reaching to about apices of mid coxae. *Thorax* light brown with extensive black markings. Pronotum with fissures marked black, a black fascia either side of midline, and a black edge adjacent to pronotal collar; pronotal collar light brown usually with black suffusion on lateral angles that sometimes extends along lateral margins. Mesonotum with lateral and submedian sigilla black, black below anterior arms of cruciform elevation reaching to scutal depressions and projecting anteriorly to between submedian sigilla, black also between anterior and posterior arms of cruciform elevation. *Forewings* hyaline, without infuscations; broad, about 2.1x longer than wide; node distal of mid length, about two thirds distance from base; costal margin strongly curved, bowed inwards on basal half, markedly swollen outwards proximal to node, the swelling narrowly edged black on its outer face; venation light brown tending black in vicinity of apical cells; basal membrane weakly tinted grey. *Hindwings* hyaline, without infuscation; with six apical cells; venation pale yellow with a white plaga. *Legs* light yellowish brown, all femora and tibia with narrow longitudinal black fascia not always distinct; meracantha pale yellow, approaching to near distal margin of opercula. *Opercula* pale yellow; straight along distal margin. *Abdomen* with tergites black except for narrow, light brown distal margins, t8 with the light brown extending along ventral margin; sternites light brown to greyish black. *Timbals* with cavity narrow; broadly rounded along posterior margin; with three long ribs spanning the timbal membrane and sometimes one shorter anterior rib. *Genitalia* (Figs 43a, 43b). Pygofer upper lobe similar in size to basal lobe, short, tending parallel-sided and apically rounded, straight and not distally upturned; dorsal beak ill-defined, broad and confluent with pygofer margin. Median lobe of uncus short and rounded. Claspers in lateral view broad, flat with a wide overhanging upper margin, adjacent apically. Aedeagus with long, slender pseudoparameres that gradually taper to a point and distally gently curve outwards; ventral support long, about half the length of the long pseudoparameres and supporting a very long fleshy endotheca.

Female (Fig. 10b). Similar to male. Abdominal segment 9 light yellowish brown with black dorsally extending laterally along anterior margin and sometimes as a black spot laterally; in dorsal view longer than an equilateral triangle. Ovipositor sheath not protruding beyond abdominal segment 9.

Measurements. Range and mean (in mm) for 10 males, 10 females (includes smallest and largest specimens). *Length of body* (including head): male 10.6–13.2 (12.0); female (including ovipositor) 11.3–14.3 (13.6). *Length of forewing*: male 12.7–15.1 (13.8); female 13.1–16.8 (15.3). *Width of head* (including eyes): male 3.6–4.3 (4.0); female 3.9–4.4 (4.2). *Width of pronotum* (across lateral angles): male 3.9–4.6 (4.3); female 4.1–4.7 (4.5).

Distinguishing features. Closely similar to *Clinata nodicosta* in overall appearance from which it differs in having 6 hindwing apical cells instead of 5, in its shorter forewing apical cells that are shorter than ulnar cells 1–3 but are longer in *C. nodicosta*, in its larger forewing costal swelling, and in the males having well developed and functional timbals rather than timbals that lack distinct ribs and are likely non-functional.

The male genitalia differ in the aedeagus that has shorter pseudoparameres and ventral support (they originate more distally on the theca), and in the ventral support being comparatively shorter than the pseudoparameres (just a little over half their length instead of just slightly shorter).

Song (Fig. 44). Males produce repeated wing snaps of <1 ms duration in short and then longer phrases of *ca.* 1

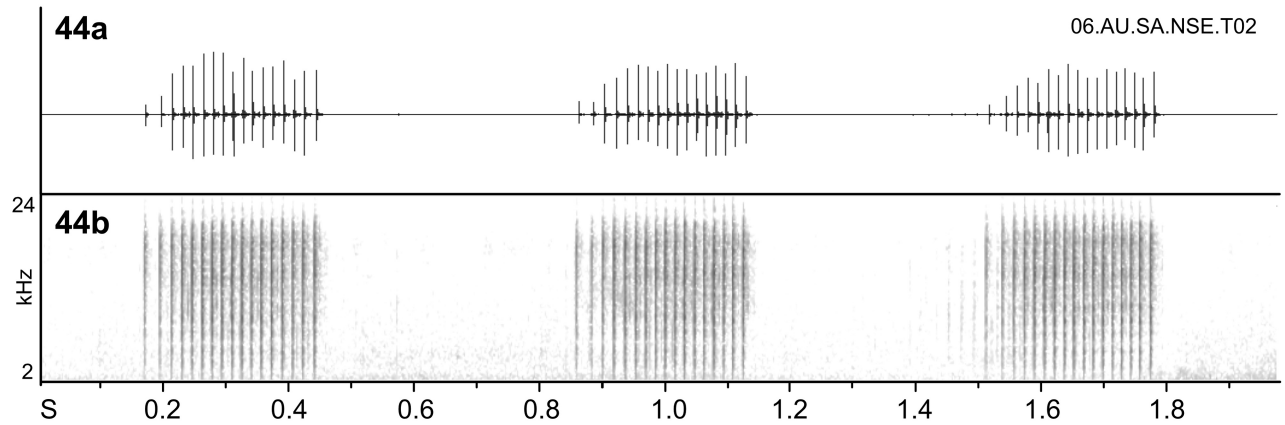


FIGURE 44. *Paraclinata nullarboris* **sp. nov.**, male calling song. (44a–b) oscillogram and spectrogram of a short calling song segment from the holotype location in sunny and windy conditions (21.2ºC).

s duration, occurring at 1–2 phrases per second. The wing snaps are produced at about 12/s and exhibit a broad, flat frequency profile reaching from 3 kHz to over 22 kHz. No apparent timbal sounds were noted in the field during the one episode in which this species was recorded. Some field recordings suggest that single timbal contractions are synchronised with the wing sounds, but isolated recordings with timbal-mutilated individuals are needed to exclude the possibility of echoes.

K. Hill observed caged males raising their abdomen while singing and possibly banging the wing costa together under the abdomen to make this sound. Adjacent males tend to synchronise their song phrases.

Biology. Singing males are preyed upon by the Australian Spotted Predatory Katydid, *Chlorobalius leucoviridis*, that can imitate the sound of wing-flicking by receptive female cicadas to attract males, and when the males mistakenly fly to the katydids they were captured and eaten alive. This remarkable behaviour was first discovered by Marshall & Hill (2009) who found these katydids could imitate the species-specific female wing-flicks of many species of cicadas, something that required precision timing and different for every cicada species. In fact they found they could even respond correctly to some New Zealand cicada species that the katydids would never encounter in the wild. Marshall and Hill note that the song element to which female cicadas reply is similar in structure across songs of many Cicadettini with duetting pair-formation systems.

Cognadanga gen. nov.

(Figs 12, 13, 17, 45–50)
urn:lsid:zoobank.org:act:636EFD28-9274-4C25-9D4A-47AC5AA4871E

Type species. *Cognadanga capricornica* **sp. nov.**, here designated.

Included species. *C. capricornica* **sp. nov.**, *C. isos* **sp. nov.**

Etymology. Based on the Lartin *cognatus* meaning kindred, related, and the generic name *Gudanga* to which it is related. Feminine.

Distribution. Northern Territory near Alice Springs and South Australia between 50 km north and 100 km south of Coober Pedy.

Diagnosis. *Head* including eyes about as wide as mesonotum; supra-antennal plate meeting or nearly meeting eye; postclypeus broadly rounded transversely across ventral midline, in lateral profile rounded between 'top' and 'sides'. *Thorax*: pronotal collar width at dorsal midline much less than diameter of eyes; paranota confluent with adjoining pronotal sclerites, no mid lateral tooth; cruciform elevation with its dome wider than long; epimeral lobe not reaching operculum. *Forewings* hyaline, without infuscations; with 8 apical cells; subapical cells absent; ulnar cell 3 angled to radial cell; basal cell narrow and elongate; costal vein (C) clearly higher than R+Sc; costa parallel-sided to node; costa of male gently and evenly curved; node clearly beyond mid length of wing; vein CuA weakly bowed so that cubital cell no larger than medial cell; veins M and CuA fused as one at basal cell; vein RA_1 aligned closely with Sc for its length and not diverging in subapical region; vein CuA_1 divided by crossvein m-cu so that proximal portion shortest; veins CuP and 1A fused in part; distance between crossveins r and r-m about equal to or a little shorter than between r-m and m; wing outer margin developed for its total length, never reduced to be contiguous with ambient vein. *Hindwings* with basal portion pigmented orange or red; 5 apical cells; no infuscation on ambient vein; width of 1st cubital cell at distal end at least twice that of 2nd cubital cell; anal lobe broad with vein 3A curved, long, separated from wing margin; veins RP and M fused basally. *Foreleg* femoral primary spine erect. *Male opercula* more or less reaching margin of tympanal cavity, directed towards distomedial margin of tympanal cavity, apically broadly rounded, clearly not meeting. *Male abdomen* slightly wider than thorax; in cross-section with sides of tergites straight or weakly convex, epipleurites reflexed ventrally from junction with tergites; tergites 2–7 all similar in size (2 and 3 not considerably larger); sternites IV–VII

convex in cross-section. *Timbals* lacking timbal covers, the posterior margin of the timbal cavity ridged along much of its length; basal dome very large; with four long ribs and one anterior short; timbals not extended below wing bases.

Male genitalia (Figs 46, 49). Pygofer with distal shoulders not developed; upper lobes flat, well developed but reaching distally anywhere near level of dorsal beak; basal lobes undivided, moderately developed, tending to be broadly rounded in lateral view, adjacent to upper pygofer lobe; dorsal beak present and a part of chitinized pygofer, broad and confluent with pygofer margin. Uncus small, short, flattened, more or less duck-bill shaped. Claspers well developed, large, dominant, lobe-like, restraining aedeagus broad in lateral view and essentially flat with the outer face carrying a broad overhanging lip along its upper margin. Aedeagus trifid; with basal plate very short, in lateral view undulated, weakly depressed on dorsal midline; in dorsal view apically broadened with 'ears'; basal portion of basal plate directed forwards away from thecal shaft; ventral rib completely fused with basal plate; junction between theca and basal plate with a functional 'hinge'; pseudoparameres as long or longer than thecal shaft, slender, unfused throughout their length, originating distal of thecal base, gradually diverging in dorsal view, in lateral view aligned with or slightly angled upwards from thecal shaft; ventral support short but well developed; thecal subapical cerci absent; flabellum absent; conjunctival claws absent; vesica retractable, vesica opening apical on theca.

Female sternite VIII deeply incised in a broad V shape with a raised rounded margin; abdominal segment 9 in dorsal view almost an equilateral triangle; dorsal beak small and not well formed.

Distinguishing features and relationships. In a molecular study by Marshall *et al*. (2016, fig. 2), *Cognadanga* **gen. nov.** (represented by "asphalt cicada", "Woomera urchip" and "allpurpose urchip") was found to be sister to *Gudanga* in a well-supported tree. While the two species described here in this new genus, "asphalt cicada" and "Woomera urchip" ("allpurpose urchip" is not described due to a lack of specimens), lack heavily infuscated black wings as found in *Gudanga* they do have other close morphological attributes, in particular the general form of the body including a ridged posterior margin to the male timbal cavity and general form of the male genitalia.

Differs from *Gudanga* notably in its hyaline forewings instead of partly or entirely pigmented black, and in having forewing veins M and CuA completely fused at the basal cell rather than meeting the basal cell independently. Also differs in the male aedeagus in which the pseudoparameres arise clearly distal of the thecal base whereas in *Gudanga* they arise close to the thecal base.

Differs from all genera in having, in combination, forewing veins M and CuA completely fused at the basal cell rather than meeting the basal cell independently, 5 hindwing apical cells, males with the posterior margin of the timbal cavity finely ridged rather than rounded, and male genitalia in which the aedeagus is trifid with a well-developed ventral support and long pseudoparameres.

Cognadanga capricornica sp. nov.

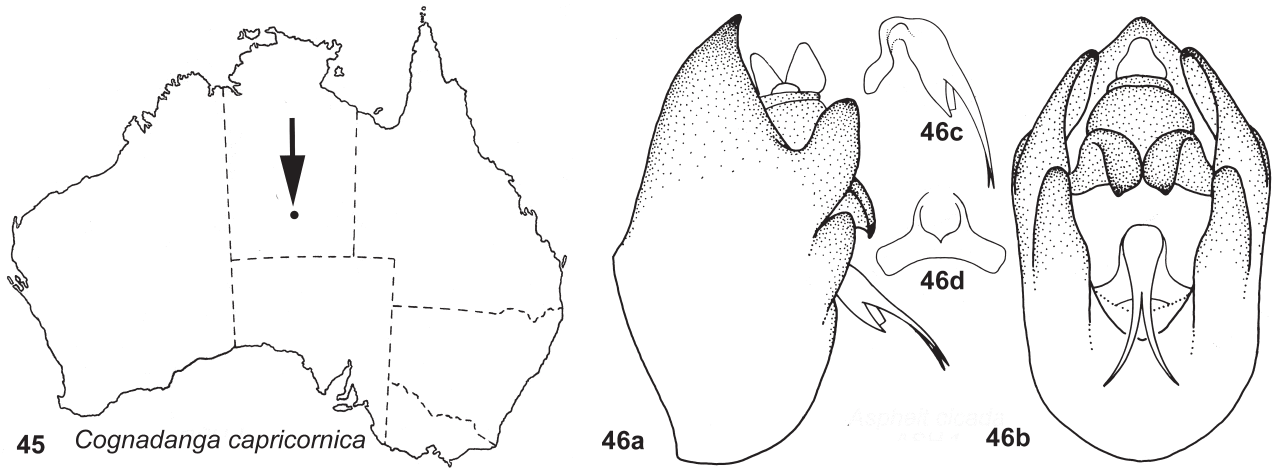
(Figs 12, 17, 45–47)
urn:lsid:zoobank.org:act:97F4EADF-C64D-413C-82F8-5215E3B1D354

Synonymy. "asphalt cicada" Marshall *et al*. 2016: 24.

Etymology. From the Tropic of Capricorn, where the only known locality of the species is situated exactly on this Tropic.

Types. *Holotype* male, 10.AU.NT.CAP, Stuart Hwy at Tropic of Capricorn, 23º26.600'S 133º49.887'E, Northern Territory, 713 m, 3.ii.2010, Hill, Marshall, Moulds (NTM). *Paratypes* as follows: **NORTHERN TERRITORY**: 1 male, same data as holotype (DE). 1 male, same data as holotype (LP). 17 males (2 genitalia preps PAU525, ASH1), 5 females, same data as holotype (MSM). 5 males, 1 female, same data as holotype (NTM). 1 male (molecular vouchers 04.AU.NTR.CAP.01), 29.i.2004, same locality as holotype; 1 male (molecular voucher 10.AU.NT.CAP.01) same data as holotype (UCONN).

Distribution and habitat (Figs 17b, 45). Northern



FIGURES 45–46. *Cognadanga capricornica* **sp. nov.** (45) distribution; (46a) male genitalia in lateral view; (46b) same in ventral view; (46c) dissected aedeagus in lateral view; (46d) basal plate in dorsal view.

Territory where it is known only from the type locality, on the Stuart Hwy at the Tropic of Capricorn about 20 km north of Alice Springs. Its natural habitat is unclear; all males encountered were singing from very short grass and weeds growing around the monument, and sometimes on pavement. Many individuals were present including many dead ones lying on the ground, many recently dead and still soft and undamaged.

Adult description. *Male* (Figs 12a, 17a, 46). *Head* black, occasionally with supra-antennal plates narrowly edged pale orange. Postclypeus black, sometimes with a pale orange to pale yellow spot at most anterior part and around ventral margins. Anteclypeus black. Rostrum light brown, becoming black distally; reaching to about apices of mid coxae. *Thorax* black with small pale orange to pale yellow markings. Pronotum black with a narrow pale yellowish midline of variable length, and often a narrow pale yellow crescent either side of midline against posterior margin; pronotal collar pale orange to pale yellow, sometimes with areas of brown or black mainly on anterior edge. Mesonotum black with a narrow pale orange to pale yellow fascia each side between submedian and lateral sigilla reaching to anterior arm of cruciform elevation and with an angular inward expansion at about mid length; cruciform elevation pale orange to pale yellow. Metanotum pale orange to pale yellow. *Forewings* hyaline; venation yellowish brown becoming black distally proximal of apical cells; apical cells tending similar in length to ulnar cells; basal membrane weakly pale orange. *Hindwings* hyaline; venation pale yellowish brown with hints of orange; plaga white with a weak blackish infuscation in jugum. *Legs* light yellowish with dominant black markings. coxae black; fore femora with broad linear black fascia; mid and hind femora black with yellow distal apices. *Opercula* black basally including slightly domed epimeron 3 becoming whitish on about distal half. *Abdomen* with tergites black, edged orange along distal margin of tergites 2–7 and broadening into a diffused orange midlateral band on tergites 3–7; tergite 8 black with a pale yellow spot at each basal lateral corner often hidden by t7, and a similar spot either side of dorsal midline usually expanded partway along distal margin; sternites uniformly black or blackish with pale yellow distal margins on sternites III–VI, yellow sometimes partly diffused across lateral margins; sternite VII black with a pale yellow apex; sternite VIII pale yellow with a diffed black base. *Timbals* with posterior margin of timbal cavity barely ridged on its upper fifth, otherwise broadly rounded; with four long ribs spanning the timbal membrane. *Genitalia* (Figs 46a, 46b). Pygofer black edged pale yellow around its outer margin; basal lobes longer than wide; upper lobes broad, tending parallel-sided and distally broadly rounded. Claspers with their inner margins curved; bluntly pointed at their apical outer corner. Aedeagus with pseudoparameres long and gradually curving outwards throughout their length; ventral support very short.

Female (Fig. 12b). Similar to male but with orange and yellow markings a little more expansive. Abdominal segment 9 light yellow with a black subdorsal band either side not reaching distal margin and a small black spot laterally. Ovipositor sheath not protruding distally beyond abdominal segment 9.

Measurements. Range and mean (in mm) for 10 males, 6 females (includes smallest and largest specimens). *Length of body* (including head): male 13.2–14.4 (13.8); female (including ovipositor) 13.0–15.2 (14.0). *Length of forewing*: male 13.6–14.8 (14.2); female 13.8–15.3 (14.8). *Width of head* (including eyes): male 3.4–3.8 (3.6); female 3.6–4.0 (3.8). *Width of pronotum* (across lateral angles): male 4.1–4.6 (4.3); female 4.4–4.8 (4.5).

Distinguishing features. Closely similar to *C. isos*

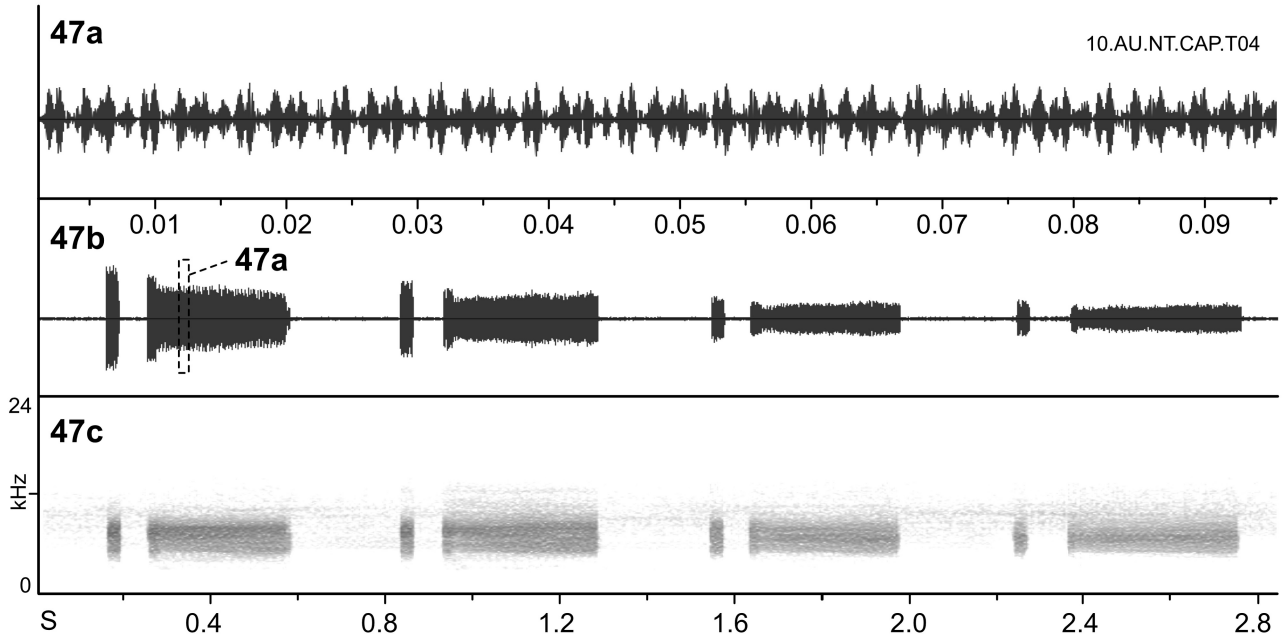


FIGURE 47. *Cognadanga capricornica* **sp. nov.**, male calling song. (47a–c) zoom oscillogram, main oscillogram, and spectrogram of a short calling song segment from the holotype location in hot, sunny conditions.

sp. nov., the males best distinguished by the male opercula that are predominantly white with the black almost entirely confined to the domed basal part whereas in *C. isos* **sp. nov.** the black is more extensive usually covering about half the opercula. The rostrum does not pass beyond the apices of the mid coxae but in *C. isos* **sp. nov.** they extend beyond the apices of the mid coxae. The male genitalia are clearly different in the length of the aedeagal ventral support that is very short in *C. capricornia* **sp. nov.** but in *C. isos* **sp. nov.** it is very long, almost as long as the pseudoparameres.

Song (Fig. 47). Consists of repeated "de-deee" phrases. Each phrase contains a short buzz of *ca.* 30 ms duration, a silent gap of 70 ms, and a longer buzz ranging from 0.3 sec to as many as 3.0 sec duration. Amplitude is consistently higher for the introductory buzz and the initial section of the longer buzz. In some individuals the louder initial section of the long buzz almost emerges as a second short buzz. Pulse structure within the sound is somewhat erratic but approximates an alternating 2-1-2 pattern. Sound intensity is highest from ca. 3.5–9.5 kHz with no strong peak frequency.

Cognadanga isos sp. nov.

(Figs 13, 48–50)
urn:lsid:zoobank.org:act:76FD563D-B3FC-4AA7-857E-C9E20AE6F39B

Synonymy. "Woomera urchip" Marshall *et al*. 2016: 24.

Etymology. From the Greek, *isos* meaning like or equal, and pertaining to the close likeness of this species to the type species *C. capricornica* **sp. nov.**

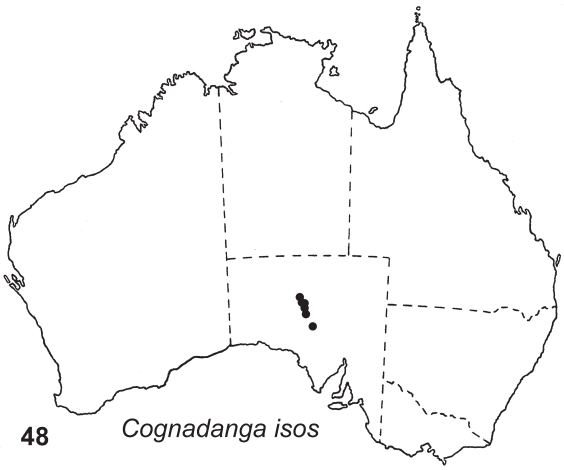
Types. *Holotype* male, AU.SA.WPB (molecular voucher 07.AU.SA.WPB.01), 29º45.485'S 135º07.037'E, ~97 km S of Coober Pedy on Stuart Hwy, South Australia, 214 m, 28.i.2007, K. Hill, D. Marshall (SAM). *Paratypes* as follows: **SOUTH AUSTRALIA**: 1 male, AU.SA.CPN, ~50 km N of Coober Pedy on Stuart Hwy, 28º41.906'S 134º26.971E, 2.ii.2007, K. Hill, D. Marshall (DE). 1 male, AU.SA.CPN, ~50 km N of Coober Pedy on Stuart Hwy, 28º41.906'S 134º26.971E, 2.ii.2007, K. Hill, D. Marshall (LP). 3 males (one genitalia prep WUR 1), AU.SA.CPN, ~50 km N of Coober Pedy on Stuart Hwy, 28º41.906'S 134º26.971E, 2.ii.2007, K. Hill, D. Marshall; 1 male, Coober Pedy, 8.ii.1984, M.S. & B.J. Moulds; 1 male, AU.SA.WOA, 29º04,576'S 134º51.142'E, ~11 km S of Coober Pedy on Stuart Hwy [at monument to William Hutcheson], 2.ii.2007, K. Hill, D. Marshall; 1 male, AU.SA.WOC, 29º28.767'S 135º01.022'E, 61 km S of Coober Pedy on Stuart Hwy, 2.ii.2007, K. Hill, D. Marshall; 3 males, AU.SA.WOH, 30º03.950'S 135º22.227'E, 60 km NW of Glandambo on Stuart Hwy, 2.ii.2007, K. Hill, D. Marshall (MSM). 1 male (molecular voucher 07.AU.SA.CPN.01), ~50 km N of Coober Pedy on Stuart Hwy, 28º41.906'S 134º26.971'E, 2.ii.2007, K. Hill, D. Marshall (UCONN).

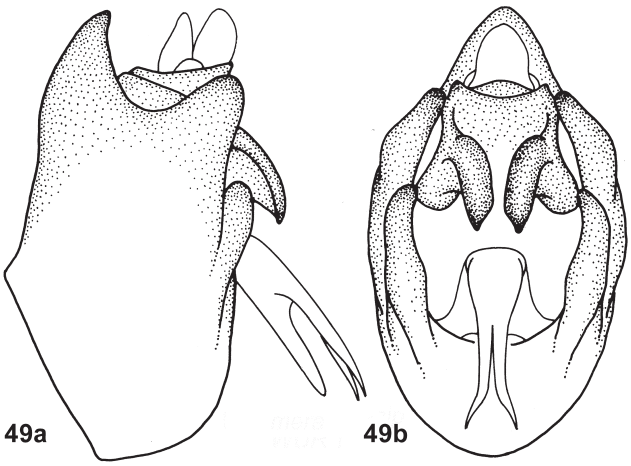
Aural record

SOUTH AUSTRALIA: 07.AU.SA.WOD, 29.71407ºS 135.125633ºE, 92 km S of Coober Pedy on Stuart Hwy, 229 m, 2.ii.2007, K. Hill, D. Marshall;

Distribution and habitat (Fig. 48). South Australia where it is only known from along the Stuart Highway between 50 km north and 100 km south of Coober Pedy. Adults are found in arid shrubland where they inhabit saltbush or bluebush. There are records for late January and early February only but emergence is likely dependent on heavy summer rains. They are usually wary cicadas and difficult to catch.

Adult description. *Male* (Figs 13, 49). As for *C. capricornica* with the following exceptions. *Rostrum* reaching a little beyond apices of mid coxae. Pronotum always with a narrow pale yellow crescent either side of midline against posterior margin; pronotal collar pale yellowish to light reddish brown with a black anterior margin. *Abdomen* with sternites predominantly yellowish brown with a diffused black band along midline; sternite VII variable in colour, either brown or blackish, the apex either pale yellow, brown or black. *Genitalia* (Figs 49a, 49b). Pygofer black edged pale yellow around its lower outer margin from basal lobes onwards; basal lobes longer than wide; upper lobes and gradually tapering to a broad rounded apex. Claspers with their inner margins tending straight; bluntly pointed at their apical outer corner.





FIGURES 48–49. *Cognadanga isos* **sp. nov.** (48) distribution; (49a) male genitalia in lateral view; (49b) same in ventral view.

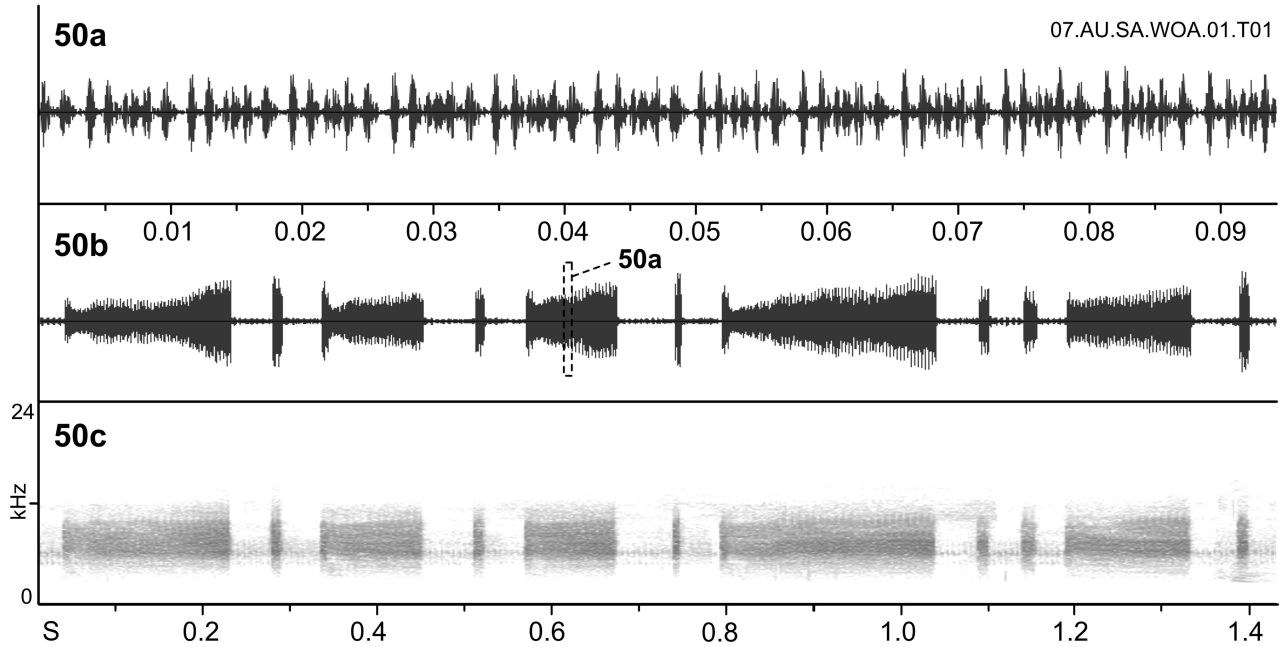


FIGURE 50. *Cognadanga isos* **sp. nov.**, male calling song. (50a–c) zoom oscillogram, main oscillogram, and spectrogram of a short calling song segment recorded in hot, sunny conditions.

Aedeagus with pseudoparameres long and diverging beyond mid length; ventral support long, more than three quarters length of pseudoparameres.

Female Unknown.

Measurements. Range and mean (in mm) for 10 males (includes smallest and largest specimens). *Length of body* (including head): 12.5–14.0 (13.1). *Length of forewing*: 12.2–14.2 (13.3). *Width of head* (including eyes): 3.3–4.0 (3.6). *Width of pronotum* (across lateral angles): 3.7–4.4 (4.1).

Distinguishing features. Closely similar to *C. capricornica* **sp. nov.**, the males best distinguished by the opercula that are about half black whereas in *C. capricornica* **sp. nov.** they are predominantly white with the black almost entirely confined to the domed basal part. The rostrum passes beyond the apices of the mid coxae but in *C. capricornica* **sp. nov.** not beyond their apices. The male genitalia are clearly different in the length of the aedeagal ventral support that is very long, almost as long as the pseudoparameres in *C. isos* **sp. nov.** but in *C. capricornica* **sp. nov.** it is very short.

Song (Fig. 50). Much like *Cognadanga capricornica* **sp. nov.**, the song of *C. isos* **sp. nov.** consists of repeated "de-deee" phrases, but the phrases are produced much more rapidly (about ten per second, versus around 1 per second in *C. capricornica*). In addition, the gaps preceding and following the short echeme are equal or nearly so, while in *C. capricornica* the short echeme closely precedes the long echeme. The short echeme duration is about 0.02 sec and the long echeme duration about 0.2 sec. Males nearly always call immediately upon landing from a flight. Most sound energy is found from 5–11 kHz with no clear peak frequency.

Gudanga Distant, 1905b

Gudanga includes ten species, all of which have heavily infuscated black forewings (Moulds 2012, Ewart and Popple 2013). Despite this unusual appearance of the adults the genus was found to be among the early branching taxa within the Cicadettini (Moulds 2005, Marshall *et al*. 2016). Here we describe another species of *Gudanga* that has only partly infuscated forewings and falls sister to all other *Gudanga* species.

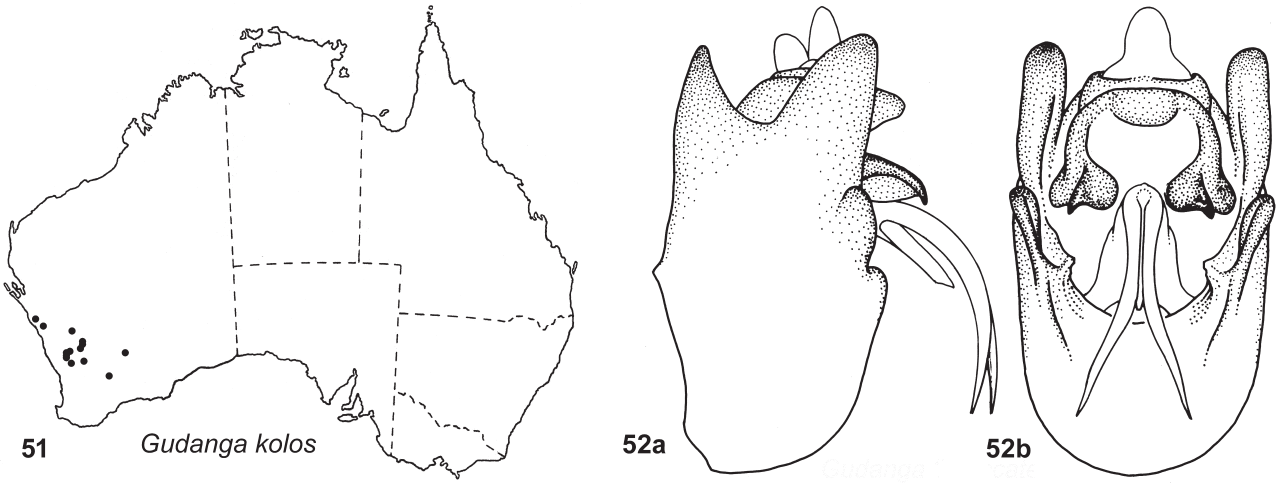
Gudanga kolos sp. nov.

(Figs 7, 51–53)
urn:lsid:zoobank.org:act:3384009E-B572-47BA-901A-57FBB3DE6269

Synonymy. "wingpatch" Owen *et al*. 2016: Fig. 2; 2017: Fig. 2.

Etymology. From the Greek *kolos*, meaning curtailed, shortened, incomplete, and referring to the reduced black pigmentation on the forewings that in all other species of *Gudanga* extends over the whole wing.

Types. *Holotype* male, 24 km S of Bindi Bindi, 30°49.511'S 116°23.081'E, 266 m, 13.i.2010, molecular vouchers 10.AU.WA.BBS.01, song recorded, Hill, Marshall, Moulds (WAM). *Paratypes* as follows: **WESTERN AUSTRALIA**: 1 female, 8 km S of Wubin. 30º10'45.15"S 116º39'20.2"E (±500 m), 22.i.1994, ~321 m, R. Mayo, M. Powell, T.M.S. Hanlon; 1 male, Tammin Railway Dam Nature Reserve, 31º39'52.90"S 117º31'40.87"E (±1000 m), 8.i.1982, ~287 m, on foliage of Allocasuarina, M. Powell (AS). 1 male, 1 female, Lake Hurlstone, 66 km N of Lake King [32º35'38.75"S



FIGURES 51–52. *Gudanga kolos* **sp. nov.** (51) distribution; (52a) male genitalia in lateral view; (52b) same in ventral view.

119º23'10.29" E] 29.xii.2012, on *Alloc*[*asuarina*] *campestris,* T.M.S. Hanlon (DE). 1 male, 22 km W of Coolgardie, 21°02'S 120°50'E, 18.i.1986, G. & A. Daniels; 1 female, South Tam[m]in, 8.i.[19]82, M. Powell; 1 male, Miling, 18.xii,[19]77, M. Powell; 1 male (genitalia pep. GU19), B3 HW, Howatharra Hill Reserve, 30 km NNE of Geraldton, N. McFarland (MSM). 2 males, 2 females, Wattening (S of Bolgart), 19.xii.2021, 2.i.2003, on Cas[uarina] campestris, P. Hutchinson; 1 female, 50.3 km S of Paynes Find [Great Northern Hwy], 9.i.2002, on *Casuarina dielsiana*, P. Hutchinson; 1 female, 52.5 km N of Wubin [Great Northern Hwy], 26.i.2006, on *Melaleuca*; P. Hutchinson; 1 male, 25 km NNE of Wubin, 2.i.2009, on *Acacia* branch, T.M.S. Hanlon (PH). 4 males, 1 female, 24 km S of Bindi Bindi, 30°49.511'S 116°23.081'E, 266 m, 13.i.2010, Hill, Marshall, Moulds (UCONN). 4 males (2 molecular vouchers 10.AU.WA.BBS.02, 03), 1 female, 24 km S of Bindi Bindi, 30°49.511'S 116°23.081'E, 266 m, 13.i.2010, Hill, Marshall, Moulds (WAM).

Audio only

WESTERN AUSTRALIA: AU.WA.KBT, ~16 km NW of Northampton on Port Gregory Rd (road to Kalbarri), 28.29875ºS 114.492766ºE, 141 m, 14.i.2010, Hill, Marshall, Moulds; AU.WA.MOA, Mt O'Brien Lookout Road, ~12 km NW of Wongan Hills, 30.84165ºS, 116.639116ºE, 353 m, 13.i.2010, Hill, Marshall, Moulds.

Distribution and habitat (Fig. 51). Inland southern Western Australia west of the Great Victoria Desert in an area south-east from Northampton to Coolgardie (G&A Daniels) and Lake Hurlstone (ESE of Hyden) (TMS Hanlon). Most records are from the vicinity of Wubin and the Tammin/Wattening/Bindi Bindi district some 150 km NE of Perth. The closest locality to Perth is Wattening (P. Hutchinson). Adults favour she-oaks, including *Allocasuarina dielsiana* and *A. campestris* (P. Hutchinson), but are also recorded from *Melaleuca.*

Adult description. *Male* (Figs 7a, 52). *Head* black; sometimes with a small, inconspicuous, dull yellow spot on midline at hind margin; supra-antennal plates narrowly edged yellow on some specimens; eyes in life dark pinkish brown tending black; postclypeus black, usually with a dull yellow or light brown midline variable in extent but never dominating; anteclypeus black; rostrum reaching to distal margin of mid coxae. *Thorax* black; the pronotum with a narrow dull yellow midline not always complete; mesonotum usually with a pair of narrow, dull yellow, submedian lines and a variably dull yellow cruciform elevation. *Forewings* hyaline with apical cells 1−7 opaque smoky black with veins highlighted jet black widest along cell inner margins but a little variable between specimens; apical cells shorter than ulnar cells; basal membrane orange basally becoming grey distally to varying degrees. *Hindwings* hyaline; with a small infuscation on margin at distal end of vein 2A; plage pale grey. *Legs* light brown with darker brown patchers mainly on fore coxae and femora. *Opercula* dull pale yellowish; projecting beyond distal margin of cavity but not meeting. *Abdomen* with tergites brown to blackish tending slightly paler laterally mainly on tergites 2 and 3, all narrowly edged dull yellow; sternites pale brown narrowly edged dull yellow, except sternite VIII entirely yellowish. *Timbals* with timbal covers very short, rudimentary, but projecting forward; with four long ribs spanning the tymbal membrane and one shorter anterior rib in the upper half of the timbal. *Genitalia* (Figs 52a, 52b) with pygofer brown; basal lobes small and rounded; upper lobes very large, broad and slightly tapering to a broadly rounded apex, projecting distally beyond level of dorsal beak; dorsal beak ill-defined, confluent with pygofer margin. Claspers small and beak-like; diverging. Aedeagus with pseudoparameres long, flat, distally tapering to a sharp point, curved in a broad arc but diverging from about mid length.

Female (Fig. 7b). Similar to male. Abdominal segment 9 brown with an ill-defined, slightly darker brown, subdorsal band not reaching distal margin. Ovipositor sheath barely protruding.

Measurements. Range and mean (in mm) for 10 males, 4 females (includes smallest and largest specimens). *Length of body* (including head): male 15.5–20.0 (18.8); female (including ovipositor) 17.2–19.2 (17.9). *Length of*

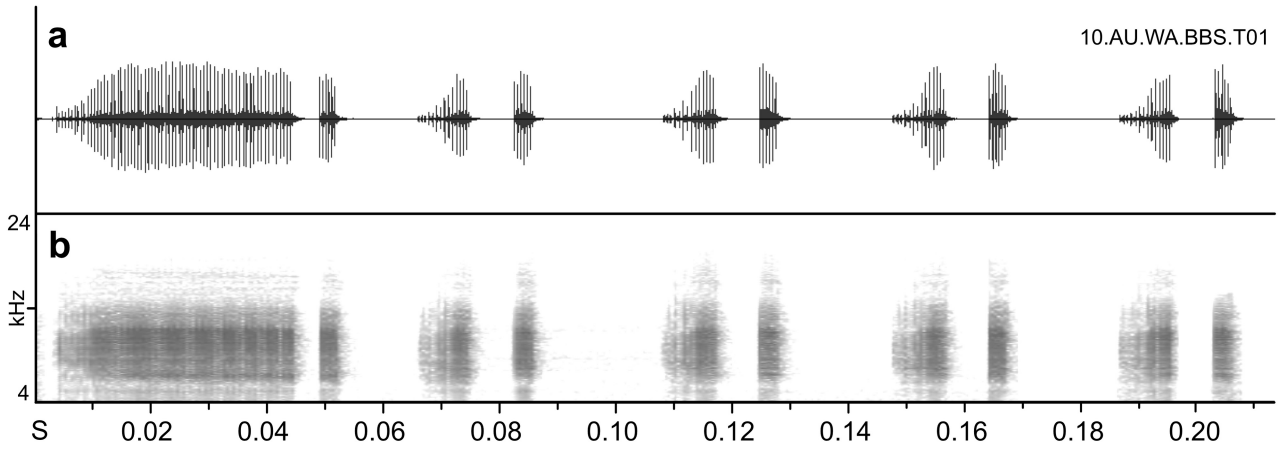


FIGURE 53. *Gudanga kolos* **sp. nov.**, male calling song. (53a–b) oscillogram and spectrogram of a short calling song segment from the holotype location in hot, sunny conditions (37.5ºC).

forewing: male 15.6–21.4 (19.8); female 17.6–21.0 (19.4). *Width of head* (including eyes): male 4.2–5.3 (5.0); female 4.7–5.1 (4.6). *Width of pronotum* (across lateral angles): male 4.8–6.2 (5.8); female 5.4–5.9 (5.7).

Distinguishing features and relationships. A distinctive species clearly unlike any other Australian species. Although the forewings are pigmented very differently from other *Gudanga* species, the morphology, including the male genitalia, is typical of the genus. However, *G. kolos* **sp. nov.** is the only *Gudanga* species with a true timbal cover that projects forwards, despite its small size. This, and its mostly unpigmented forewings, suggest it is less derived than other *Gudanga* species that have lost their timbal covers and have fully pigmented opaque forewings. Unpublished molecular data (R. Krauss, K. Hill & C. Simon, pers. comm.) supports this conclusion finding *G. kolos* **sp. nov.** as the earliest branching species sister to all others.

Song (Fig. 53). A series of *ca.* 0.6 s buzzes followed by paired "chick-it" phrases repeated at about three per second. All song elements are formed from pulse doublets produced at around 90/s. The first of the paired "chick-it" syllables increases in amplitude (modulation that is also observed near the beginning of the longer introductory buzzes), while the second somewhat shorter syllable maintains a louder amplitude. Most sound energy is found within the range 6–13 kHz, with no clear peak frequency.

Xeropsalta Ewart, 2018

Xeropsalta includes four species, *X. festiva* (Distant, 1907), *X. aridula* Ewart, 2018, *X. rattrayi* Ewart, 2018 and *X. thomsoni* Ewart, 2018, that are found in arid to semi-arid regions of inland Queensland, north-eastern South Australia and the far north-west corner of New South Wales.

The genus is closely similar to *Mugadina* Moulds, 2012 and *Heremusina* Ewart, 2018, and is distinguished by subtle differences in male body shape, the male genitalia, opercula shape and timbal structure, and differences in song structure (Ewart, 2018). It is best distinguished in having most males with a more uniformly expanded abdomen (particularly between segments 2 and 6), the upper pygofer lobes turned distally rather than being broadly rounded to broadly obtuse, and the slightly more linear male opercula that do not turn upward along their outer lateral margin or do so only slightly.

The songs of *Xeropsalta* species clearly differ from those of *Mugadina* species, the latter all with distinctly ticking calls that somewhat resemble a Geiger counter.

In a molecular phylogeny by Marshall *et al*. (2016) *Xeropsalta* is represented by a clade of four species, *X. festiva,* an undescribed species allied to *X. festiva, X. thomsoni* (as 'Noonbah tan'), and *X. eremica* **sp. nov.** (as 'Nullarbor green') and described here. This clade is sister to one containing *Paradina leichardti, Mugadina superba* Ewart & Moulds, 2021 (as 'superb grass cicada'), an undescribed species coded as 'machine gun ticker', and two undescribed species of *Dipsopsalta* Moulds, 2012.

Xeropsalta eremica sp. nov.

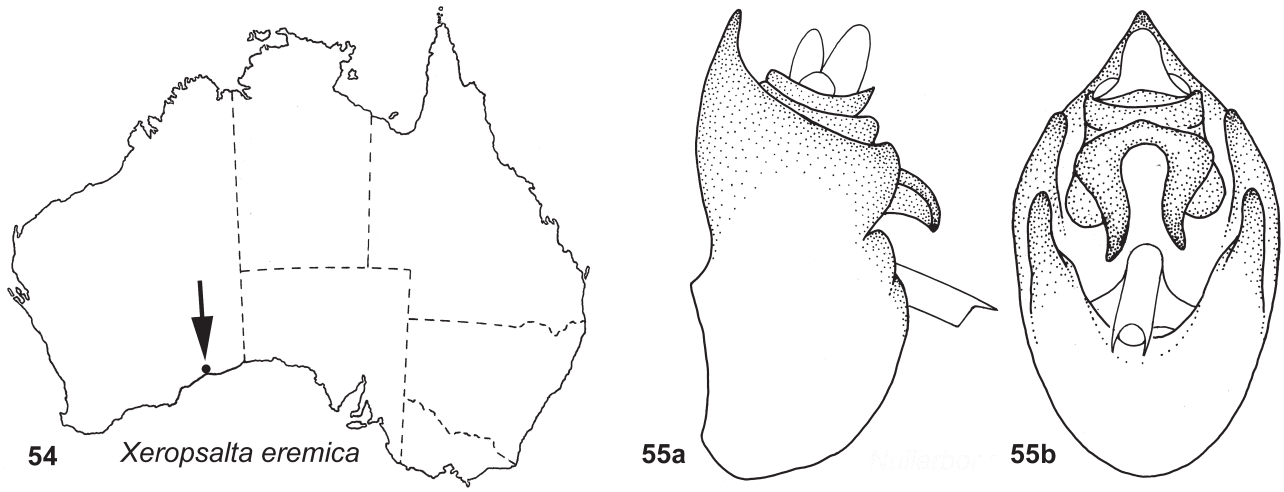
(Figs 11, 20, 54−56)
urn:lsid:zoobank.org:act:398A84B2-08E0-4DB6-B139-9923833B96F6

Synonymy. "Nullarbor green" Marshall *et al*. 2016: 24.

Etymology. From the Greek *eremia*, meaning desert, solitude wilderness, and pertaining to desert habitat of this species.

Types. *Holotype* male, AU.WA.NUL, 12.4 km E of Cocklebiddy, 32º00.834'S 126º13.743'E, 85 m,

21.ii.2006, Hill, Marshall, Moulds (WAM). *Paratypes* as follows: **WESTERN AUSTRALIA**: 1 male, same data as holotype (DE). 2 males, Eyre Bird Observatory turnoff, Eyre Highway, 32°00'19"S 126°15'57"E, 7.ix.2010, L. W. Popple, 623-001, 623-0002 (LP). 6 males (one genitalia prep NUL2), 2 females, same data as holotype (MSM). 5 males, 2 females, same data as holotype (WAM).



FIGURES 54–55. *Xeropsalta eremica* **sp. nov.** (54) distribution; (55a) male genitalia in lateral view; (55b) same in ventral view.

Distribution and habitat (Figs 20, 54). Far south-east of Western Australia where it is known only from two closely situated localities, 12.4 km and 17 km east of Cocklebiddy on the edge of the Nullarbor Plain. Adults were found on short grass clumps following good rains.

Adult description. *Male* (Figs 11a, 55). *Head* black with hints of green on supra-antennal plates and adjacent to eyes; gena pale green with a black upper marking; lorum pale green with black on inner margin. Postclypeus black with a broad yellow lateral margin. Anteclypeus black. Rostrum brown, becoming black at apex; reaching to about apices of mid coxae. *Thorax* pale yellow tinged green to yellowish brown with black markings dorsally, tending pale green ventrally. Pronotum dominated by a black angular marking either side of a narrow pale green midline and small patches of irregular black mottling elsewhere variable between individuals; pronotal collar black in vicinity of midline and variably along its anterior margin to partly black lateral angles. Mesonotum with prominent black sigilla and a broad black midline that usually incorporates the scutal depressions; cruciform elevation with dome black expanding anteriorly to be part of the black mesonotal midline and a little green between anterior and posterior arms merging to yellow. Metanotum yellowish with a broad black dorsal midline and usually a little black in wing grooves. *Forewings* hyaline; costa very pale green to whitish; venation pale green to pale yellow becoming black in vicinity of apical cells; apical cells tending a little shorter than ulnar cells; basal membrane pale grey. *Hindwings* with four apical cells (3 or 5 in variants but only in one wing); venation pale yellow with a white plaga merging with a weak blackish infuscation in jugum. *Legs* yellow with some black markings confined to the coxae and fore trochanters and fore femora, and as weak impressions on fore and mid tibiae, all variable between individuals; meracantha pale green to pale yellow; very short and rudimentary. *Opercula* pale green to pale yellow weakly suffused black on basal three-quarters or so; broadly rounded, extending distally a little beyond tympanal cavity, but not meeting. *Abdomen* with tergites black, tergite 1 with a little yellow at lateral anterior margins; tergites 3–8 edged yellow on their posterior margins and tending green sublaterally especially on tergite3; tergite 8 pale green laterally; sternites uniformly pale green. *Timbals* with cavity broadly rounded along posterior margin; with three long ribs spanning the timbal membrane and two anterior ones usually with small missing section. *Genitalia* (Figs 55a, 55b). Pygofer pale green to pale yellow with a black dorsal area confined to anterior half; basal lobes small, rounded, tight against inner pygofer margin; upper lobes small, very broad in lateral view; dorsal beak long and tapering to a bluntly pointed apex in lateral view, very broad and tapering to a bluntly pointed apex in dorsal view. Claspers distally fang-like, ventrally excavated with a wide overhanging outer rim, in lateral view gently curved and bluntly pointed, in ventral view gently turned outwards distally. Aedeagus with theca simple, straight, tubular, its opening simple and square cut, with short, pointed, dorso-lateral pseudoparameres projecting forwards beyond thecal opening.

Female (Fig. 11b). Similar to male. Mesonotum with lateral sigilla with black mostly confined to anterior half or less. Abdomen with black much reduced compared to male, confined to dorsal region of tergites 2–8 and mostly to anterior half of tergites except at midline, and tapering towards lateral extremities; abdominal segment 9 pale green to pale yellow with a narrow blackish subdorsal band either side not reaching distal margin and an irregular black mark subapically incorporating a black dorsal beak; in dorsal view much longer than width of its base. Ovipositor sheath clearly protruding beyond abdominal segment 9, projecting almost 2 mm.

Measurements. Range and mean (in mm) for 10 males, 5 females (includes smallest and largest specimens). *Length of body* (including head): male 12.3–13.9 (13.2); female (including ovipositor) 15.0–16.4 (15.6). *Length of forewing*: male 13.2–14.8 (14.1); female 14.7–15.7 (15.3). *Width of head* (including eyes): male 3.3–3.9 (3.6); female 3.7–3.9 (3.8). *Width of pronotum* (across lateral angles): male 3.9–4.5 (4.3); female 4.4–4.7 (4.5).

Distinguishing features and relationships. Males

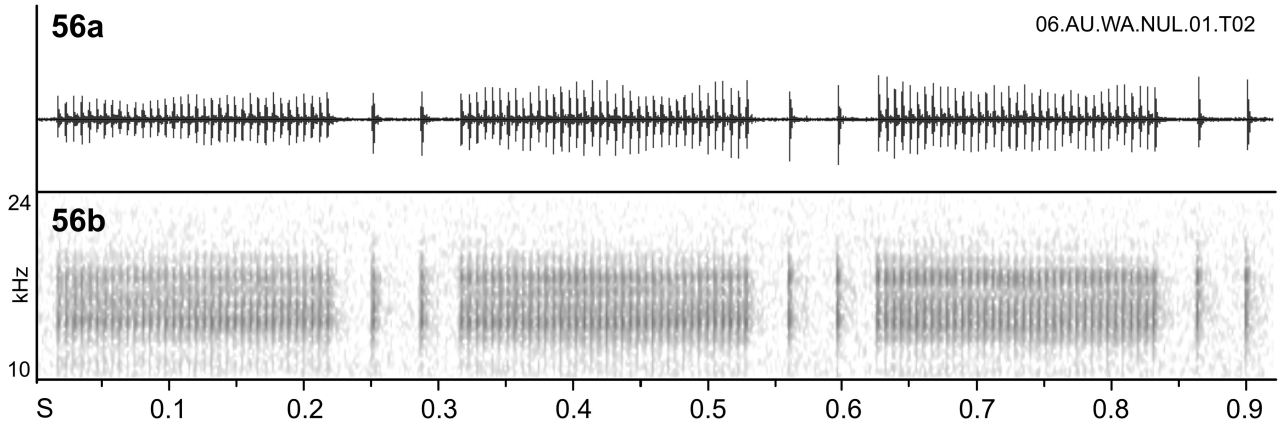


FIGURE 56. *Xeropsalta eremica* **sp. nov.**, male calling song. (56a–b) oscillogram and spectrogram of a short calling song segment from the holotype location in hot, sunny conditions (27.2ºC).

are similar to those of *Xeropsalta rattrayi* Ewart, 2018, but clearly differ in having their abdomen predominantly black dorsally. *Xeropsalta eremica* **sp. nov.** differs from other species of *Xeropsalta* in having, in combination, males with an abdomen that evenly tapers from abdominal segment 3 and is predominantly black dorsally, and in having females with prominent black sigilla.

Xeropsalta is closely allied to *Mugadina* and *Heremusina* from which it differs in having forewing apical cell 1 clearly shorter than apical cell 2 (usually about half its length), the upper pygofer lobes turned distally in *Xeropsalta* rather than broadly rounded to broadly obtuse, the metanotum more clearly visible dorsally in *Xeropsalta*, and the slightly narrower and more linear male opercula that do not, or barely, turn upwards along their outer margin. The male genitalia are similar to those of *Mugadina*, *Dipsopsalta* and *Heremusina* (Moulds 2012; Ewart 2018; Ewart & Moulds 2021; Ewart 2022), in having the pseudoparameres reduced to short, pointed, subapical projections that protrude a little beyond the thecal apex, small upper and basal pygofer lobes and a dorsal beak confluent with the pygofer margin.

Xeropsalta differs from all other genera in having, in combination, forewing veins M and CuA meeting the basal cell with their stems fused as one, forewing costa largely straight to node, forewing apical cell 1 similar in length to apical cell 2, four or five apical cells in the hindwings, and a male abdomen that is clearly wider than the thorax.

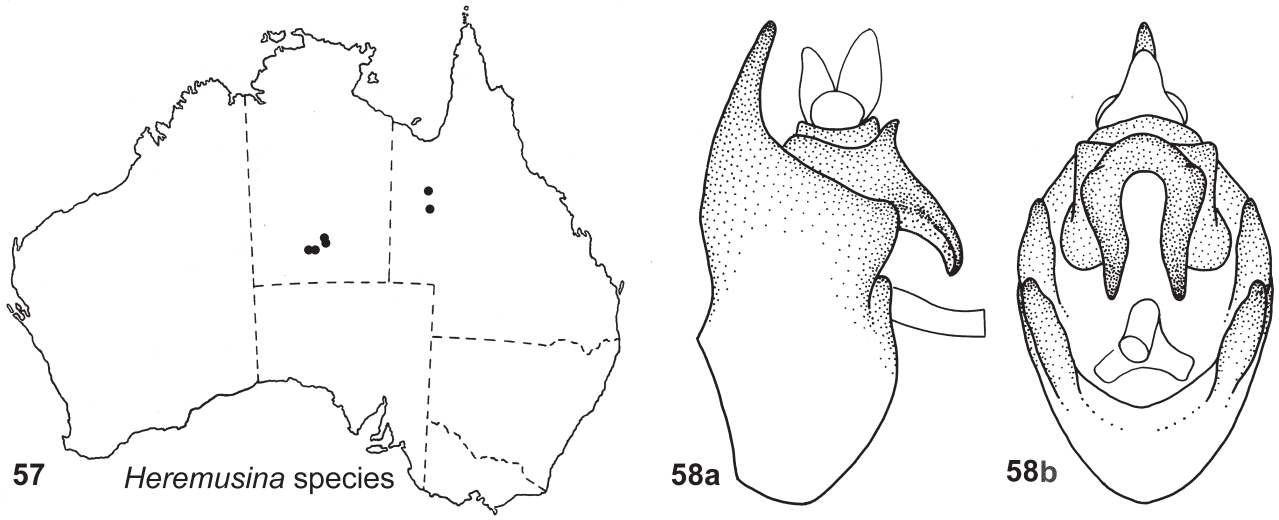
Song (Fig. 56). Repeated single buzzes of 0.13 to 0.26 s duration, composed of sharp ticks produced at 140–185/s, each buzz followed by two or three isolated ticks separated from the main buzzes by gaps of about 0.03 s duration (often with the last gap shorter). Each tick has a loud primary pulse and one or more much weaker following pulses, the complete structure lasting ca. 0.002 s. No amplitude or frequency modulation occurs. Most sound energy is found within a range spanning 13 to 19 kHz.

Biology. Observations by Kathy Hill (pers. comm.) found that females respond to the male call by wing flicking after each buzz. She also noted that males are wary and flighty and often sing while flying.

Notes on the attributes of *Heremusina* Ewart, 2018

Heremusina currently includes two species, *H. udeoecetes* Ewart, 2018 and *Heremusina pipatio* Ewart, 2018 found through arid regions of Australia (Fig. 57). The genus is closely allied to *Mugadina* Moulds, 2012 and is distinguished by small differences in the male genitalia, opercula shape and timbal structure, and differences in song structure. The more discernible of these features include the difference in the male opercula that are strongly upturned on their outer margin and have a straight or partially straight distal margin in *Heremusina*, whereas in *Mugadina* they are gently upturned and more broadly rounded; in the shape of the male pygofer that is more elongated in lateral and ventral views in *Heremusina*, and in the shape of the claspers that in ventral view have sharply diverging distal terminations in *Mugadina* but not in *Heremusina*. Other differences noted by Ewart (2018) include the dorsal beak being more elongate and gently curved in *Heremusina*, the timbal intercalary ribs of *Heremusina* unusually thin, and the ventral terminations of long ribs 1 to 4 clearly separated in *Heremusina* as compared to *Mugadina*. Ewart also noted differences in song structure between *Mugadina* and *Heremusina*; the species of the former produce simple, rapidly repeated ticking songs, whereas the latter produce repeated soft rattling or rapid purring phrases that do not resemble ticking.

There is another difference of consequence not recognised by Ewart (2018) that concerns the pseudoparameres of the male genitalia. The pseudoparameres of the allied genera *Mugadina, Dipsopsalta* and *Xeropsalta* are short, subapical, dorso-lateral appendages that protrude a little anterior of the thecal opening (see *Xeropsalta* Figs 55a, 55b). Ewart records similar pseudoparameres as present in *Heremusina*, and his ventral images of the male genitalia



FIGURES 57–58. *Heremusina* species. (57) distribution; (58a) male genitalia *Heremusina udeoecetes* Ewart, 2018, paratype from type locality, lateral view; (58b) same in ventral view.

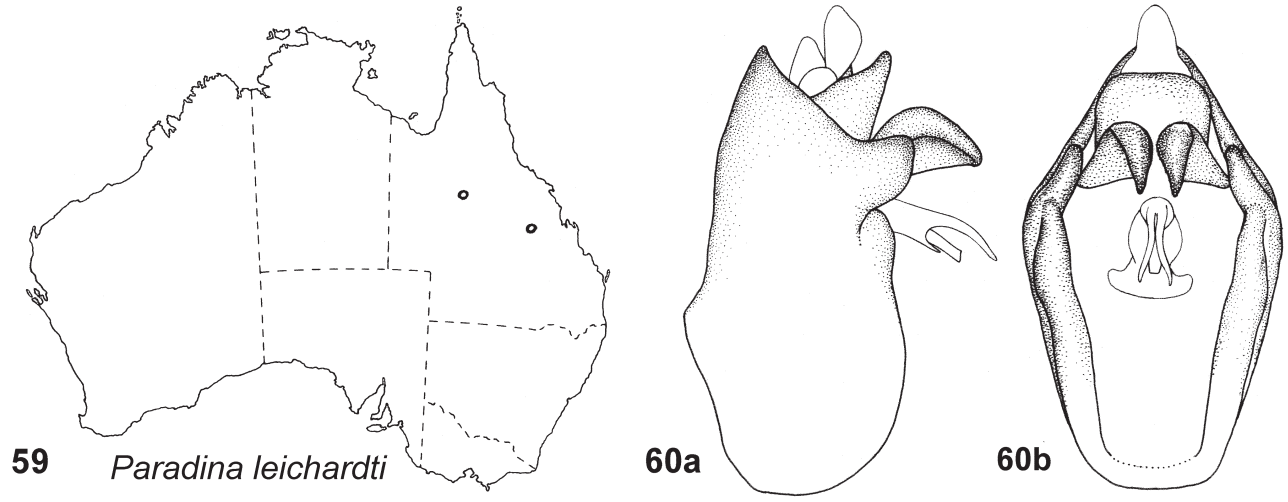
show short pointed apical structures presumably intended as pseudoparameres although his lateral images show no indication of pseudoparameres. We have examined two paratypes of *H. udeoecetes* from the type locality (one corroborated by L. Popple) and could find no evidence of these structures, even at 100x magnification. Nor could we find evidence of pseudoparameres in two other non-paratypes of *H. udeoecetes*. Further, we could find no pseudoparameres in a paratype of *H. pipatio*. We conclude that pseudoparameres are lost in *Heremusina*, at least in the two species currently described (Figs 58a, 58b). This is not surprising as the pseudoparameres of the allied *Mugadina* and *Xeropsalta* species are small and rudimentary. Pseudoparameres are found only in the Cicadettini and are present in all genera except the Australian monotypic genera *Samaecicada* and *Pegapsaltria,* and in the Palaearctic genus *Melampsalta,* including *M. musiva* and its close allies (Moulds & Marshall 2022; Popple & Emery 2010; Dugdale 1972; Stéphane Puissant pers. comm.). Tony Ewart donated his collection to the Queensland Museum in 2023 but it seems the genitalia dissections were lost during the transfer. Because the dissections were lost it has not been possible to determine how the confusion regarding the pseudoparameres occurred.

Heremusina most closely resembles *Dipsopsalta* and *Xeropsalta,* differing in having males with a distinctly bulbous abdomen (more uniformly expanded in *Dipsopsalta* and *Xeropsalta*, specifically between tergites 2 and 6); the dorsal beak more linear in *Heremusina*; the metanotum more clearly visible dorsally in *Dipsopsalta* and *Xeropsalta*, and the broader male opercula of *Heremusina*.

A note on the phylogenetic relationships of *Paradina leichardti* (Distant, 1882)

The genus *Paradina* was erected by Moulds (2012) to accommodate the single species *Paradina leichardti*, a genus that remains monotypic. Characters that define *Paradina* include the width of head (including eyes) narrower than lateral angles of pronotal collar, forewing veins M and CuA meeting the basal cell completely fused as one, the forewing apical cells similar in length to the ulnar cells, the hindwings with 5 apical cells (sometimes 4 or 6 if aberrant but usually so only in one wing), and a male abdomen that is swollen and bulbous with its widest point anterior of mid length and much wider than the thorax. Significantly, the male genitalia have a theca that is typically trifid with two robust pseudoparameres that in lateral view are shorter than, or about equal to, half the length of the theca, and a short but robust ventral support (Figs 60a, 60b).

In the molecular phylogeny of Marshall *et al*. (2016) *Paradina leichardti* is sister to *Mugadina superba* (as 'superb grass cicada'), these in turn sister to species of *Dipsopsalta* and *Xeropsalta*, including *Xeropsalta festiva* and several unnamed species. *Paradina leichardti* is an anomaly among these species in that it has a trifid aedeagus typical of many Cicadettini, whereas the species in the other aforementioned genera all have pseudoparameres reduced to very small subapical spikes and no ventral support (compare Figs 55a, 55b with 60a, 60b). This is unexpected and a matter of past contention (Ewart & Moulds 2021) and our recent studies of *Xeropsalta* and *Heremusina* above have brought the matter to the fore again. We re-examined the identity of the specimen used in the Marshall *et al*. study, a female, specimen 05.AU.QL.NCO.02. Females are often difficult to identify and we found this specimen to be misidentified, resulting from an incorrect comparison with the female type of *P. leichardti* in NHMUK. This molecular voucher female was collected in association with other conspecific females and males and dissection of one of those males confirmed the species was not *Paradina leichardti* but an undescribed species of *Mugadina*. Thus, *Paradina* was mistakenly represented in the Marshall *et al*. tree and its molecular associations remain unknown.



FIGURES 59–60. *Paradina leichardti*. (59) distribution after Moulds (2012); (60a) male genitalia lateral view, from Moulds (2012); (60b) same in ventral view.

An earlier morphological phylogenetic study by Moulds (2012) includes a true representative of *Paradina leichardti*. There *P. leichardti* falls between *Dipsopsalta* and *Mugadina* reflecting the erroneous associations in the Marshall *et al*. tree, and these in turn are sister to *Pipilopsalta*. This association with *Dipsopsalta* and *Mugadina* is not strongly supported in the Moulds tree, nor are the aedeagal differences appropriately scored (the absence/presence of a ventral support and different development of the pseudoparameres). We believe *Paradina* is likely more closely allied to *Pipilopsalta*, with which it shares a trifid aedeagus, than to *Dipsopsalta* and *Mugadina*.

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