Systematics of the Australian orb-weaving spider genus *Demadiana* with comments on the generic classification of the Arkyinae (Araneae: Araneidae)

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**Abstract.** The orb-weaving spider subfamily Arkyinae L. Koch, 1872 is exclusively found in the Australasian region and its taxonomy and the systematic relationships within and between genera of this subfamily are poorly understood. We here revise the arkyine genus *Demadiana* Strand, 1929 to include six Australian species, four of which are described as new: *Demadiana simplex* (Karsch, 1878) (type species), *D. carrai*, sp. nov., *D. cerula* (Simon, 1908), comb. nov., *D. complicata*, sp. nov., *D. diabolus*, sp. nov., and *D. milledgei*, sp. nov. A phylogenetic analysis based on an updated araneid morphological data matrix including 57 genera of orb-weaving spiders identified *Demadiana* as a member of the araneid subfamily Arkyinae. A separate phylogenetic analysis for the genus at the species level showed little resolution within *Demadiana*, but did identify a monophyletic *Demadiana* supported by three putative synapomorphies: small unique setal pits with spherical sockets covering the carapace, sternum and the bases of the paturon (chelicerae), an extreme elongation of the trumpet-like aggregate spigots of the posterior lateral spinnerets and a distinct curvature of the embolus. We detail several new generic and species synonymies within Arkyinae. *Aerea* Urquhart, 1891 (type species *Aerea aliticephala* Urquhart, 1891) and *Neoarchemorus* Mascord, 1968 (type species *N. speechleyi* Mascord, 1968) are regarded as junior synonyms of *Arkys* Walckenaer, 1837 (type species *A. lancearius* Walckenaer, 1837), resulting in *Arkys* *speechleyi* (Mascord, 1968), comb. nov. *Aerea* *magnifica* Urquhart, 1893 and *Archemorus simsoni* Simon, 1893 are regarded as junior synonyms of *Aerea* *aliticephala* Urquhart, 1891, and *Arkys nitidiceps* Simon, 1908 is proposed as a junior synonym of *Arkys* *walkenaeri* Simon, 1879.


**Introduction**

The Arkyinae L. Koch, 1872 is one of the smallest subfamilies of spiders within the orb-weaving family Araneidae Clerck, 1758. Three genera, *Aerea* Urquhart, 1891, *Arkys* Walckenaer, 1837 and *Neoarchemorus* Mascord, 1968 are currently recognised in this group with a total of 34 species (Platnick 2010). Arkyinae are solely found in the Australasian region, i.e. Indonesia, Papua New Guinea, Australia and New Caledonia (e.g. Mascord 1968; Chrysanthus 1971; Balogh 1978; Heimer 1984). Systematic relationships of and within the Arkyinae are poorly understood and the taxonomy of many species requires revision.

The orb-weaving spider genus *Demata* was described by Karsch (1878), with *D. simplex* Karsch, 1878 as type species, based on a small araneid female collected from an unspecified location in New South Wales. Without providing any justification, Simon (1892) synonymised *Demata* with *Cyrtarachne* Thorell, 1868. Subsequently, Strand (1929, p. 18) doubted this placement (‘...if, as I suppose, the type of *Demata* Karsch, *D. simplex* Karsch, is generically distinct from *Cyrtarachne*...’, translated from the original German) and, realising that *Demata* was preoccupied by a beetle genus, *Demata* Gistl, 1848, provided the replacement name *Demadiana* Strand, 1929. Strand’s (1929) replacement name was not accepted by later cataloguers (Roewer 1942; Bonnet 1956; Platnick 2010). An examination of the holotype of *Demata simplex* and the syntypes of *Paraplectanoides cerulus* Simon, 1908 as part of a current
revised the Australian Araneidae suggested both species to be congeneric and differing considerably from both Cyrtauchenidae and Parasemideinae. Keyserling, 1886 (type species P. catus Keyserling, 1886), thereby confirming Strand’s (1929) conclusion on Dema. Genital and somatic morphology, in particular the presence of a patch of short dense setae on the proteral side of the tarsus of the first leg in males, presumed to be of chemoosensory nature, suggested a placement in the subfamily Arkyinae L. Koch, 1872, as this structure is currently only known in Arky (Heimer et al. 1982; Heimer 1984).

The systematic placement of Arky has always been controversial. Walckenaer (1837) placed it with thomisids and philodromids and this placement was followed by Simon (1864) and Keyserling (1890). Ludwig Koch (1872) placed Arky lancearius Walckenaer, 1837 and his new species A. cornutus L. Koch, 1872 in a new subfamily, Arcyinae, within his Epeiridae (current day Araneidae) and was followed by Simon (1894, p. 594). Later, Simon (1895, p. 763) considered Arcyae a tribe in the Argiopinae Simon, 1890 (more or less equivalent to present day Araneidae). Numerous other authors placed Arky into Epeiriformes/Araneoidea/Araneidae (Pickard-Cambridge 1870; Simon 1879; Roewer 1942; Bonnet 1955; Chrysanthus 1971; Balogh 1978, 1982; Brignoli 1983). Subsequent to his initial placements, Simon (1895, p. 898) revealed that he originally intended to place Arky in Mimetidae, a placement that was later supported by Heimer (1984). Heimer based his suggestion on the complex paracymbium of the male pedipalp, a supposed functional relationship between the paracymbium and median apophysis, and the lack of a conductor. Platnick and Shadab (1993) placed mimetids within Palpimanoidea, and reported the presence of aggregate gland spigots on the posterior lateral spinnerets of Arky. This suggested that Arky belonged in the Araneoidea, the only known group of spiders processing such silk glands. Davies (1988) placed Arky into the tetragnathid subfamily Metainae Simon, 1894.

In general, there have been few arkyine specimens available in museum collections, as evidenced by the small series available to revisers of Arky and Archemorus (Balogh 1978, 1982; Heimer 1984). Scharff and Coddington (1997) tested the monophyly and phylogenetic placement of both genera within Araneoidea based on a morphological character matrix and found the two genera to be sister-groups and firmly nested within an argiopoid clade. However, Scharff and Coddington (1997) did not include representatives of non-araneoid genera (except Dictyna Sundevall, 1833) and they could therefore not test alternative non-araneoid placements of Arky and Archemorus. A recent study by Blackledge et al. (2009) tested the placement of Arky in a dataset including both morphological and molecular data and representatives of both araneoid (27 genera in 11 families) and non-araneoid spiders (17 genera in 13 families), including representatives from the diverse RTA (=retrolateral tibial apophysis) clade, Oecobiidae Blackwall, 1862, Austrochilidae Zapfe, 1955 and the more distantly related Haplogyne and Mygalomorphae. Compared to Scharff and Coddington (1997), Blackledge et al. (2009) included much fewer representatives of Araneidae (only 8 of the 57 araneid genera included in Scharff and Coddington, 1997), the family where Arky is currently placed. However, they added many more outgroup taxa, more morphological characters and molecular data for six genes. Combined analyses of molecular and morphological data as well as a variety of analyses performed on various alignments of the molecular data found strong support for a placement of Arky outside the Araneidae as sister to the spider family Tetragnathidae (represented by Leucauge White, 1841, Tetragnatha Latreille, 1804, Meta C.L. Koch, 1836 and Metellina Chamberlin & Ivie, 1941). In this analysis, Mimetus Hentz, 1832 (representing the Mimetidae, in which Heimer (1984) placed Arky) was sistergroup to Arky and the Tetragnathidae combined. Analyses of the morphological data only, however, placed Arky as sister to a clade of araneid genera (Gasteracantha Sundeval, 1833, Cyrtophora Simon, 1864, Argyope Audoun, 1826 and Araneus Clerck, 1758) (Blackledge et al. 2009), thereby supporting Scharff and Coddington’s (1997) placement of Arky within Araneidae. We here retain Arky and its close relative Demadiana in the Araneidae pending further investigations (i.e. expanded molecular and morphological analyses) into the phylogenetic relationships of these genera.

Arky (and Archemorus) and Demadiana are not the only arkyine genera known today but generic boundaries between any of these genera are not well established. Although long recognised as a member of this subfamily (e.g. Roewer 1942), Aerea Urquhart, 1891 and its two Tasmanian species, A. alliceps Urquhart, 1891 (type species) and A. magnifica Urquhart, 1893 have not been mentioned in the primary literature since Urquhart’s descriptions. Ignorance of these taxa was evidently maintained by the fact that all of Urquhart’s (1891, 1893) Tasmanian types are lost (e.g. Court and Forster 1988) and are not available for critical study. However, the late V.V. Hickman (quoted in Heimer 1984) also noted that Urquhart’s (1893) description of A. magnifica from Tasmania was very reminiscent of Archemorus simsoni Simon, 1893. Mascord (1968) erected another genus of arkyine spiders, Neoarchemorus, based on a single species, N. speechleyi Mascord, 1968 from New South Wales, but the characters he used to distinguish this genus from Archemorus such as carapace and abdomen shape and position of eyes do not seem to be of taxonomic value at the genus level. Heimer’s (1984) justification to synonymise Arky and Archemorus was based on significant variation of somatic characters and at the same time similar genitalia, and Neoarchemorus falls well within this variation in Arky. Heimer (1984) did not treat Neoarchemorus, of which he was evidently unaware.

The main aim of this study is to revise the arkyine spider genus Demadiana and provide descriptions of the six species recognised in museum collections, four of which are described as new. We incorporated Demadiana in an updated Scharff and Coddington (1997) araneid phylogenetic matrix to test the monophyly and phylogenetic placement of Demadiana. In addition, we provide a phylogenetic hypothesis for all species within Demadiana to further test the monophyly of the genus and to test whether the geographic distribution of the species reflects their phylogenetic relationships. Pending a comprehensive systematic revision of all arkyine genera we critically review the validity of the genera Aerea and Neoarchemorus within the currently recognised generic boundaries of Arky.
Materials and methods

Morphology and illustrations

This study forms part of a comprehensive revision of Australian orb-weaving spiders. All major museums in Australia were searched for Demadiana specimens. We also checked some collections, in particular the Western Australian, South Australian and Victorian Museums, for Arkys. We were particularly interested in records of A. walckenaeri (a suspected senior synonym of A. nitidiceps Simon, 1908) and A. simsoni (a suspected junior synonym of Aerea alticephala). Descriptions are based on specimens stored in 70% ethanol. The male pedipalp of the type species D. simplex was expanded to explore topology and morphology of sclerites. Expansions of male pedipalps were done by immersion in a potassium hydroxide (KOH) solution for five to ten minutes at room temperature, and subsequent transfer to distilled water. If expansion did not occur, or the pedipalps only expanded partly, the treatment was repeated until the pedipalp was fully expanded. Expanded pedipalps were observed in distilled water and transferred back to 70% ethanol for storage. Specimens of D. cerula were prepared for scanning electron micrograph (SEM) imaging by passing them through a graded ethanol series of 70% to 100%, and by subsequent critical point drying in a Baltec CPC-030 Critical Point Dryer (Bal-Tec, Liechtenstein). Specimens were then coated with Platinum-Palladium in a JEOL JFC-2300HR high resolution coater before scanning at 7kV in a JEOL JSM-6335F Field Emission Electron Microscope at Zoological Museum, University Copenhagen. As suitable material for SEM imaging of setal pits and spinnerets of two of our target taxa within Arkys, A. alticephala and A. walckenaeri, was not available, we illustrated carapace setal pits of a female (Fig. 21A, B) and the spinnerets of a female (Fig. 22A–D) and a male (Fig. 23A–D) A. brevipalpus Karsch, 1878. All measurements are in millimetres if not otherwise indicated.

Images of live spiders (Fig. 1A–B, D) were taken with a Canon setup (Rebel 300D digital SLR camera, MP-E 65 mm 1:5x f/2.8 Macro lens and Macro Twin Lite MT-24EX). Images of preserved Demadiana and A. walckenaeri were taken at Western Australian Museum, Perth (WAM) with a Leica DFC500 digital camera that was attached to a Leica MZ16A stereomicroscope. Photographs were taken in different focal planes (approximately 30 images) and combined with the Leica Application Suite version 2.5.0R1 to increase depth of field. All other images of preserved Arkys (including its type species A. lancearius Walckenaer, 1837), were taken at ZMUC with a Nikon D300 digital SLR camera attached via a C-mount adaptor from LM-Scope (http://www.lmscope.com/index_e.html) to a Leica M16A stereomicroscope and combined with Auto Montage (version 5.02) software from Syncroscopy. We used 2–3 Nikon R1C1 wireless speedlights to provide light instead of fibre lights. The latter was just used as guide-light for focusing.

The taxonomic part of this study lists the type species of Demadiana, D. simplex, first and then all other species of the genus in alphabetical order, followed by taxonomic changes and redescriptions in relation to Arkys.

Fig. 1. Demadiana cerula (Simon) and Arkys walckenaeri Simon. (A) Female and (B) male of D. cerula from Wungong Dam, Western Australia (WAM T91865); (C) habitat of D. cerula at Wungong Dam, Western Australia; (D) immature specimen of A. walckenaeri from Mt Barker, Western Australia. Body length (A) ~2.3 mm, male (B) ~1.8 mm, (D) ~4.5 mm. Photographs: V.W. Framenau.
We conducted two phylogenetic analyses. One tested the generic placement of Demadiana within Araneoidea/Araneidae (genus-level phylogeny) and the monophyly of Demadiana using two exemplars of the genus; the second analysis was designed to infer the monophyly of the genus Demadiana. We decided to use the original, but updated (see below) data matrix of Scharff and Coddington (1997) instead of more recent versions of the dataset generated by authors who tested the placement of other araneid genera (Tanikawa 2000 – Zilla C. L. Koch, 1834; Kuntner 2002 – Perilla Thomell, 1895; Kuntner and Hormiga 2002 – Singafrotypa Benoit, 1962; Smith 2005 – Cyphalonotus Simon, 1895, Ideoecia Simon, 1903, Micropoltys Kulczyński, 1911 and Polys C. L. Koch, 1843). Scharff and Coddington (1997) had already shown that adding taxa to this particular dataset without additional characters was doomed and would result in large numbers of trees with little or no resolution. The result of this analysis helped us choose proper outgroups for a more detailed phylogenetic analysis on the species level, in which we further test the monophyly of Demadiana. Some scoring within the Nephilidae were amended following Kuntner (2006, 2007) and Kuntner et al. (2008): character 41 (carapace: (0) hirsute instead of (1) glabrous for Nephila) and character 50 (LE–ME separation: (1) wide instead of (0) narrow for both Nephila and Nephilengys). Finally, we changed the character states definition of character 67 (carapace and abdomen setal bases: (0) normal (1) gasteracanthine-shaped) of Scharff and Coddington (1997) by adding an extra character state: (2) ‘in deep pits with spherical sockets’. Demadiana was scored as having setal bases in deep pits with spherical pockets (character state 2). We could also have used the more recent morphological matrix of Blackledge et al. (2009), but since this matrix also points to a placement of Arkys within Araneidae, we decided to use the matrix of Scharff and Coddington (1997), which has many more araneid representatives and thereby represents a stronger test of placement within Araneidae. Unfortunately, molecular data for Demadiana are currently not available and we therefore could not test its phylogenetic placement in the molecular data matrix of Blackledge et al. (2009).

Both Arkys and Archemorus were included as separate genera in the original analysis of Scharff and Coddington (1997), even though Heimer (1984) had suggested Archemorus to be a junior synonym of Arkys. To comply with the synonymy established by Heimer (1984) but at the same time allow distinguishing both taxa in our study we list these as Arkys s.s. and Arkys (Archemorus).

Species-level phylogeny

For the species-level phylogeny, we constructed a new matrix including 15 characters (Tables 1, 2) of which 11 are newly developed for the six species of Demadiana. Outgroup selection was guided by the result of the first analysis, where Demadiana was added to a modified data matrix of Scharff and Coddington (1997). If possible, we used type material for investigation of characters, with the exception of the following specimens (for collection data see ‘Taxonomy’ below): Demadiana simplex (Karsch, 1878), the type species of the genus Demadiana (000111000000000000000001000000000010200011000021002112--.--), and Demadiana cerula (Simon, 1908) (00011100000000000000000100000000010200011000021002112--.--). Thus, the matrix we analysed had 72 taxa and 82 characters. We used the original, but updated (see below) data matrix of Scharff and Coddington (1997) instead of more recent versions of the dataset generated by authors who tested the placement of other araneid genera (Tanikawa 2000 – Zilla C. L. Koch, 1834; Kuntner 2002 – Perilla Thomell, 1895; Kuntner and Hormiga 2002 – Singafrotypa Benoit, 1962; Smith 2005 – Cyphalonotus Simon, 1895, Ideoecia Simon, 1903, Micropoltys Kulczyński, 1911 and Polys C. L. Koch, 1843). Scharff and Coddington (1997) had already shown that adding taxa to this particular dataset without additional characters was doomed and would result in large numbers of trees with little or no resolution. The result of this analysis helped us choose proper outgroups for a more detailed phylogenetic analysis on the species level, in which we further test the monophyly of Demadiana. Some scoring within the Nephilidae were amended following Kuntner (2006, 2007) and Kuntner et al. (2008): character 41 (carapace: (0) hirsute instead of (1) glabrous for Nephila) and character 50 (LE–ME separation: (1) wide instead of (0) narrow for both Nephila and Nephilengys). Finally, we changed the character states definition of character 67 (carapace and abdomen setal bases: (0) normal (1) gasteracanthine-shaped) of Scharff and Coddington (1997) by adding an extra character state: (2) ‘in deep pits with spherical sockets’. Demadiana was scored as having setal bases in deep pits with spherical pockets (character state 2). We could also have used the more recent morphological matrix of Blackledge et al. (2009), but since this matrix also points to a placement of Arkys within Araneidae, we decided to use the matrix of Scharff and Coddington (1997), which has many more araneid representatives and thereby represents a stronger test of placement within Araneidae. Unfortunately, molecular data for Demadiana are currently not available and we therefore could not test its phylogenetic placement in the molecular data matrix of Blackledge et al. (2009).
Table 1. Morphological characters and character states for species-level phylogeny of Demadiana

<table>
<thead>
<tr>
<th>Character</th>
<th>State</th>
<th>State Code</th>
<th>State Code Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carapace, anterior margin, shape</td>
<td>(0) straight</td>
<td>12726</td>
<td>Homologous to setae</td>
</tr>
<tr>
<td>Carapace, sternum, setal pits with spherical socket</td>
<td>(0) absent</td>
<td>5523</td>
<td>Homologous to setae</td>
</tr>
<tr>
<td>Carapace, setae</td>
<td>(0) glabrous</td>
<td>00012726</td>
<td>Homologous to setae</td>
</tr>
<tr>
<td>Abdomen</td>
<td>(0) dorsal, (1) mesal</td>
<td>00005923</td>
<td>Homologous to setae</td>
</tr>
<tr>
<td>Appendages</td>
<td>(0) embolus tip curves against median apophysis, (1) embolus tip follows median apophysis</td>
<td>00008601</td>
<td>Homologous to setae</td>
</tr>
</tbody>
</table>

WNW of Point Salvation (WAM T41734); Argiope bruennichi Scopoli, 1772: male from Frejlev Skov, Denmark (ZMUC 00005923) and female from Bornholm, Denmark (ZMUC 00012726); Linyphia triangularis (Clerck, 1758): male and female from Frejlev Skov, Denmark (ZMUC00008601). We did not use female genitalia characters for the species-level phylogenetic analysis, since two species of Demadiana are only known from males.
morphological characters are listed here as they relate to Scharff and Coddington’s (1997) character matrix to illustrate our character coding for the genus-level analysis; reference to the original character numbering is given in square parentheses ([ ]).

Male sexual characters [1–24]

Male leg II tibiae [1, 2] and pedipalp femora [3] of Demadiana are without modifications, the pedipalp patella has one strong macroseta [4] (e.g. Figs 9A, 12A, 13D, 14A, 17A). The cymbium of the male pedipalp is situated mesally [5] and a paracymbium is present [6] (e.g. Figs 9A, 11A, 12A, 13B). The conductor is entire [8] (e.g. Figs 9C, 13C) and does not wrap the embolus in a tetragnathid fashion [9]. A median apophysis is present [10], but does not carry any prongs, spurs or other particular structures [11–15] (e.g. Figs 9A, 11A, 12A, 13B). Radix [16], distal haematodocha [17, scored inapplicable], paramedian apophysis [18], stipes [19] and subterminal [20, 21] and terminal [22] apophyses are absent. The embolus is not capped [23]. Its curvature [24] is difficult to score; its base in the left pedipalp is curved clock-wise (and as such scored here), but the embolus then follows the inside of the median apophysis and thereby changing into a moderately anti-clock-wise direction (e.g. Figs 9C, 11B).

Female sexual characters [25, 26, 28–31]

Demadiana have epigynes [25, 26] of highly variable shape. A genital tubercle is absent [27]. Short scapes are present in some species (e.g. Figs 9D, 12C) [28–31].

Appendages [32–40]

Demadiana do not have any of the peculiar leg appendages or structures considered in Scharff and Coddington’s (1997) study, such as macrosetae on coxae and trochanter of leg IV [32], coxal hooks on male leg I [33], or male femoral II grooves [34] or trichobothria [35]. However, males of Demadiana have a dense patch of short setae on the prolateral surface of tarsus I (Fig. 2A–D), similar to Arkys (= Archemorus) (Heimer et al. 1982: figs 1a–e), a character that was not included in the analysis of Scharff and Coddington (1997).

Cephalothorax [41–48, 67]

The coding of cephalothorax characters (e.g. shape [42, 43]) is trivial for Demadiana, i.e. the female carapace is longer than wide and the male carapace is wide anteriorly. The carapace (and paturon and sternum) is covered by setae that arise from distinct setal pits [67] with spherical sockets and is here coded hirsute [41] (Fig. 3A–D). The endite tooth in males [45] and a female clypeal tooth [46] are absent, although the clypeus of females bulges somewhat medially (Fig. 3B).

Eyes [49–54]

The median ocular quadrangle is distinctly narrower in front than behind [49] and the lateral to median eye separation is wide [50] (e.g. Figs 1A, 3A, B, 8A, B). The shape of the tapeta of the eyes [51–54] could not be ascertained and tapeta are here coded as absent.

Table 2. Phylogenetic matrix of Demadiana species-level phylogeny

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linyphia triangularis</td>
<td>0100000000</td>
</tr>
<tr>
<td>Argiope bruennichi</td>
<td>0010000000</td>
</tr>
<tr>
<td>Austracantha minax</td>
<td>0011100000</td>
</tr>
<tr>
<td>Arkys alticuphalus</td>
<td>0011101100</td>
</tr>
<tr>
<td>Arkys walkekneri</td>
<td>0011101100</td>
</tr>
<tr>
<td>Demadiana simplex</td>
<td>1101110100</td>
</tr>
<tr>
<td>Demadiana carrai</td>
<td>0101111000</td>
</tr>
<tr>
<td>Demadiana cerula</td>
<td>1101110110</td>
</tr>
<tr>
<td>Demadiana complicata</td>
<td>0101111000</td>
</tr>
<tr>
<td>Demadiana diabolus</td>
<td>1101110110</td>
</tr>
<tr>
<td>Demadiana milledgei</td>
<td>0101110100</td>
</tr>
</tbody>
</table>

Results

We recognise six species of Demadiana, four of which are described as new (Table 3). Demadiana is restricted to the southern half of Australia south of 25°S latitude, with the greatest diversity in the eastern region of the country (Fig. 18).

Morphology

Members of Demadiana are small and very peculiar arkyine orb-web spiders with a highly domed carapace (Fig. 1A, B) that is covered by diagnostic setal pits (Fig. 3A–D). Key

Table 3. Distribution of Demadiana in Australia (see also Fig. 18)

<table>
<thead>
<tr>
<th>Species</th>
<th>Distribution</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demadiana simplex</td>
<td>NSW, SA, Vic., WA</td>
<td>Type species</td>
</tr>
<tr>
<td>(Karsch, 1878)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. carrai, sp. nov.</td>
<td>NSW</td>
<td>Known from male only</td>
</tr>
<tr>
<td>D. cerula (Simon, 1908)</td>
<td>WA</td>
<td>Known from male only</td>
</tr>
<tr>
<td>D. complicata, sp. nov.</td>
<td>Qld</td>
<td></td>
</tr>
<tr>
<td>D. diabolus, sp. nov.</td>
<td>SA, Tas.</td>
<td></td>
</tr>
<tr>
<td>D. milledgei, sp. nov.</td>
<td>NSW, Vic.</td>
<td></td>
</tr>
</tbody>
</table>
Abdomen [55–67]

Feathery abdominal setae are absent [55]. Abdominal sigillae are present [56] in two rows [57] and can be seen most prominently in females (e.g. Figs 8B, 10D). Female ventral condyles [58] are absent. The shape of the male abdomen [59] is scored triangular (Figs 8A, 10A–C, 15A, C) and that of the female [60] marginally wider than long. There is a slight sexual size dimorphism [61] with females somewhat larger. Abdominal spines are absent [62]. Booklung covers do not have stridulating files [63] or grooves [64]. Demadiana does not display any of the gasteracanthine-like characters of the abdomen, such as sclerotised rings around the spinnerets or a sclerotised tracheal spiracle in females [65, 66] but they have setal bases in deep pits [67]. The spherical sockets in these pits are a putative synapomorphy for Demadiana.

Spinnerets [68–73]

Demadiana have very peculiar elongated trumpet-like aggregate gland spigots on the posterior lateral spinnerets (PLS) of both males and females (Figs 4D, 5D). These trumpet-like aggregate gland spigots, although somewhat smaller, are also present in Arkys (Figs 22D, 23D) and are considered a synapomorphy for the two genera and therefore the subfamily Arkyinae. In Demadiana, the shaft of the aggregate gland spigots is very long (Figs 4D, 5D) and this elongation is here considered a synapomorphy for Demadiana. Elongated aggregate gland spigots are also present in other araneids, and somewhat similar trumpet-like aggregate gland spigots are also present in Zygiella, but their spigot bases are quite different in comparison to Demadiana. In Zygiella the spigot base is short and gradually turns into a spigot shaft, whereas in arkyines the spigot base is long and the point where the spigot shaft begins is well marked by an invagination (Figs 5D, 22D). A flagelliform gland spigot on the PLS is absent in females of Demadiana and Arkys and could be considered another synapomorphy for Arkyinae. A cribellum [68] is absent, the anterior spinneret piriform gland spigot bases are normal [69], and the piriform field is not reduced as in cyrtophorine spiders [70] (Figs 4B, 5B). Posterior median spinneret ampullate nubbins [72] are present (Figs 4C, 5C).

**Fig. 2.** Demadiana cerula (Simon), male from Stirling Range National Park, Western Australia (ZMUC), Western Australia (scanning electron micrographs, SEM). (A) Tarsus I, prolateral view with dense patch of presumed sensory setae (arrow); (B) detail of presumed sensory setae (arrow); (C) tarsal claw, lateral view (arrow points to presumed sensory setae); (D) detail of presumed sensory setae (arrow) in lateral view. Scale bars: (A) 0.1 mm, (B–D) 0.01 mm.
but the posterior median spinnerets do not have aciniform brushes [73] (Figs 4C, 5C).

**Behaviour [74–82]**

Most characters regarding web-building and prey capture were scored inapplicable. Not much is known about the behaviour of these comparatively rarely collected spiders; however, it appears that they do not build an orb-web [74] (observed for *D. cerula*, M. S. Harvey and J. M. Waldock, pers. obs.).

**Phylogeny**

**Genus-level analysis**

Heuristic searches (‘traditional search’) in TNT under equal weights, using collapsing ‘rule 1’ (tree collapsing = min. length 0; collapsing branches if supported ambiguously; default collapsing rule in TNT), 100 replications and holding 1000 trees during each replication (using tree-bisection-reconnection (TBR) swapping algorithm), resulted in eight minimal length trees of 288 steps for the large matrix with 72 taxa and 82 characters. TNT under ‘rule1’ reports 12 trees, but four of these trees are longer than 288, and should therefore be removed from the solution set (Coddington and Scharff, 1994). This is easily done in TNT using the tree menu, then ‘tree buffer’, ‘filter’, and finally ‘discard duplicate trees which are suboptimal’. Shortest-length trees were only found in 40 times out of 100 replications, so we broadened the search by including more replication and by holding more trees per replications. Various combinations from 20 replications holding 25,000 trees to 25,000 replications holding 20 trees found the same eight trees of length 288. The analysis with PAUP*4.0 (under its default collapsing rule that allows ambiguous character support) produced 16 trees of length 288. TNT produces the same 16 trees if the collapsing rule is changed to include ambiguous character support. The strict consensus tree, independent of the collapsing rule, is fully resolved for the

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**Fig. 3. Demadiana cerula** male from Stirling Range National Park, Western Australia (ZMUC) (scanning electron micrographs, SEM). *(A)* carapace, dorsal view; *(B)* carapace and paturons, frontal view; *(C)* carapace, lateral view; *(D)* setal pits with globular socket on carapace. Scale bars: *(A–C)* 0.1 mm, *(D)* 0.01.
argiopoid clade and rather unresolved for the araneine clade (Fig. 6A). Demadiana is nested within the arkyines, as sister to Arkys s.s. This clade is united by the presence of a scape, character 28. The arkyine clade (Arkys (Archemorus), Arkys s.s., and Demadiana) is supported by five synapomorphies (Fig. 6B). Homoplasious characters include: radix lost (Scharff and Coddington 1997, character 16, with parallel loss in Neogea Levi, 1983 and in the clade including Aspidolasius Simon, 1887 and Caerostris Thorell, 1868), posterior row of eyes procurred (Scharff and Coddington 1997, character 54, parallel origin in Argiopinae), abdominal sigillae of female in two rows (Scharff and Coddington 1997, character 57, parallel origin in the clade including Gastroxya Benoit, 1962 and Augusta O. Pickard-Cambridge, 1877), and orb-web lost (Scharff and Coddington 1997, character 74, parallel loss in Mastophora Holmberg, 1876, Chorizopes O. Pickard-Cambridge, 1870 and in the outgroup taxa Theridion Walckenaer, 1805, Linyphia Latreille, 1804 and Pimoa Chamberlin & Ivie, 1943). The triangular abdomen of males, character 59, represents the only non-homoplasious synapomorphy of the Arkyinae within the taxon sample and character set (Fig. 6B).

The Bremer support value for the clade including Arkys (Archemorus), Arkys s.s. and Demadiana is 3 (Fig. 6). Implied weighting in TNT, which weights the characters according to a concave function of homoplasy (Goloboff 1993), using ‘k’ values of 1, 3, 6, and 10 and the same search parameters as given above for the TNT analysis with equal weights, resulted in 1, 1, 66 and 15 trees respectively, all supporting the monophyly of Demadiana and Arkyinae (i.e. Demadiana, Arkys s.s. and Arkys (Archemorus)).
Species-level analysis

The species-level phylogeny matrix included six species of *Demadiana* in the ingroup. The outgroup consisted of *Arkys s.s.*, *Arkys* (*Archemorus*), and the genus *Austracantha* Dahl, 1914, which forms part of the ‘setal base clade’ to which also the Arkyinae belong (Scharff and Coddington 1997), and more distant outgroups such as *Argiope* and *Linyphia*. The species phylogeny matrix was small enough to allow exact solutions via ‘implicit enumeration’ in TNT, but other than that, search parameters were the same as for the larger dataset mentioned above. Analyses with equal weights resulted in a single tree of length 17 (consistency index (CI) = 88, retention index (RI) = 92) with a monophyletic *Demadiana* (Fig. 7), supported by a Bremer value of 3. Analyses with implied weights, using ‘k’ values of 1, 3, 6 and 10, resulted in the same tree as found with equal weights. The monophyly of *Demadiana* is supported by three putative synapomorphies: presence of setal pits with spherical sockets on the carapace, sternum and paturon of males and females (character 2, Fig. 3A–D), trumpet-like aggregate gland spigots of males and females heavily elongated (character 6, Figs 4D, 5D), and embolus curves into median apophysis and then to conductor (character 12).

Synonymies of *Arkys*

In a review of the genera *Arkys* and *Archemorus*, Heimer (1984) concluded that there was insufficient morphological differentiation to support separate genera, and synonymised *Archemorus* with *Arkys*. He was apparently unaware of the generic names *Aerea* and *Neoarchemorus*, which are clearly close relatives of *Archemorus* (Roewer 1942; Mascord 1968). Although Heimer’s conclusions have yet to be tested empirically, we hereby propose that *Aerea* and *Neoarchemorus* be regarded as synonyms of *Arkys*. This decision is also supported by our critical review of the original descriptions of *Aerea alticephalica* and

![Fig. 5. *Demadiana cerula* male from Stirling Range National Park, Western Australia (ZMUC) (scanning electron micrographs (SEM)). (A) Spinnerets, ventral view; (B) left anterior lateral spinneret (ALS), ventral view; (C) posterior median spinnerets (PMS), ventral view; (D) trumpet-like aggregate gland spigots (AG) on right posterior lateral spinnerets (PLS), ventral view. Additional abbreviations: AC, aciniform gland spigot; mAP, minor ampullate gland spigot; MAP, major ampullate gland spigot; nu, nubbin; PI, piriform gland spigot. Scale bars: 0.01 mm.]
A. magnifica (Urquhart 1891, 1893). Comparison of those descriptions with material of the type species of Archemorus, A. simsoni, unequivocally suggests that both are synonyms of A. simsoni, thus rendering Aerea as a synonym of Arkys (see detailed justification of these synonymies in Arkyinae in the Remarks section in the taxonomic part of this study below). If

Fig. 6. Phylogenetic hypothesis for Demadiana based on a modified morphological matrix of Scharff and Coddington (1997). (A) Complete topology. Numbers above branches denote Bremer support values; (B) Arkyinae only, including characters and character states according to Scharff and Coddington (1997); homoplastic characters in open circles, non-homoplastic characters in full circles.
Carathea sternum are also seen in the genus seen in their tactile setae inserted in deep pits with spherical sockets as p. 385, is ever removed from the synonymy of Archemorus Species-level phylogeny for Fig. 7.

Invertebrate Systematics may be of characteristic shape (Scharff and Coddington1997: sockets that are broad, Foelix 1982: p. 72, araneids normally insert in a narrow, pocketed socket (Argiopinae) and the clade Perissopmeros Butler, 1932 (both Malkaridae) (Platnick and Forster 1987), but these are not (N. Scharff, pers. obs.) and another exception is Demadiana (Griswold et al). However, no other known araneid genera have the FL are absent in both females (Fig.4) and males (Fig.5). Deep pits on the carapace and sternum are also seen in the genus Caratha Moron, 1986 (N. Scharff, pers. obs.) and Perissopmeros Butler, 1932 (both Malkaridae) (Platnick and Forster 1987), but these are not associated with tactile setae.

Aggregate gland spigots (AG) are only found in araneoids (Griswold et al. 2005). They are always paired and flank a single flagelliform gland spigot (FL) on the posterior lateral spinnerets (PLS). They are used to produce the viscid glue of the sticky line (Griswold et al. 1998). In araneoids they are normally found in females (adults and juveniles), but are absent in males (with exceptions) (Coddington 1989). The two AG and the FL are often referred to as the ‘araneoid triplet’. The triplet is a functional unit, and both types of gland spigots always occur together, or are absent. Demadiana and Arkyks represent an exception to this rule, since the FL are absent in both females (Fig.4D) and males (Fig.5D). Another known exception is Mecynogea (Araneidae; Coddington 1989) where females have AG but no FL on the PLS. The AG are well developed in both males and females of Demadiana, and much larger than in any other known genera within Araneidae. Such large AG with wide flat openings are otherwise only known from the spider family Theridiidae (Griswold et al. 1998; Aagnarsson 2004). In theridiids, the large AG are used in connection with sticky silk attacks, where large globules of viscid silk from the AG is thrown over the prey with the theridiid tarsus IV silk-throwing comb (Griswold et al. 1998). The function of the huge AG in Demadiana is unknown. They probably do not make regular webs, although individuals have been seen on single lines (M. S. Harvey and J. Waldock, pers. obs.). They also do not have a tarsus IV silk-throwing comb, but perhaps the huge AG spigots are involved in some kind of sticky silk attack.

Germs-level phylogeny
Demadiana belongs to the subfamily Arkyinae, which was represented in Scharff and Coddington’s (1997) phylogenetic analysis by Arkyks s.s. and Arkyks (Archemorus) (Fig. 6A, B). This placement is unambiguously supported even without scoring the presence of the tarsal patch of setae on leg I of males (thought to serve a chemosensory function during the courtship or copulation of males; Heimer et al. 1982: fig.1a–e) (Fig.2A–D), the enlarged aggregate gland spigots on the PLS and the absence of a flagelliform gland spigot on PLS (Figs 4D, 5D, 22D, 23D), all characters that we here consider as synapomorphies for the Arkyinae. Several homoplastic characters support the monophyly of the Arkyinae, such as absence of a radix [16], the procured posterior row of eyes [54], the pattern of abdominal sigillae in two rows [57], the triangular abdomen of males [59], and the lack of building an orb-web [74] (Fig. 6B). In an araneid context, the absence of the radix in the male pedipalp appears to be a secondary loss, and has also occurred within Neogea Levi, 1983 (Argiopinae) and the clade Aspidolasius Simon, 1887/Caerostris Thorell, 1868 (Scharff and Coddington 1997). However, if the Arkyinae, including Demadiana, are indeed a sister taxon to all other Tetragnathidae, as suggested by molecular data for Arkyks (Blackledge et al. 2009), the absence of a radix can be considered true absence. The procured posterior eye row (e.g. Fig. 8B) was previously only known from the Argiopinae, but was more recently also reported from a new genus of Australian orb-web spiders with elongated webs, Telaprocera Harmer & Framenau, 2008, of which the phylogenetic position within Scharff and Coddington’s (1997) phylogeny is ambiguous (Harmer and Framenau 2008). The pattern of abdominal sigillae on Demadiana, Arkyks s.s. and Arkyks (Archemorus) is otherwise only present in the African Gastroxya Benoit, 1962 and the monotypic Augusta O. Pickard-Cambridge, 1877 from Madagascar, sister genera within the subfamily Gasteracanthinae (Scharff and Coddington 1997). In Australia, abdominal sigillae, albeit of different arrangement, can be found in the araneine Dolophones Walckenaer, 1837. Finally, the loss of the orb-web has, within the Araneidae, only been reported for Chorizopes O. Pickard-Cambridge, 1870, a genus that is the sister taxon to all other Araneidae in Scharff and Coddington’s (1997) preferred phylogeny (see Fig. 6), and in some Cyrtarachnininae Simon, 1892.

The current placement of Demadiana in the morphology-based phylogeny of Scharff and Coddington (1997) jeopardises the monophyly of Arkyks (Fig. 6A, B), and could be used to argue that Demadiana is a junior synonym of Arkyks. This issue cannot be resolved until more Arkyks species and possibly further morphological characters can be added to the genus-level phylogeny. The small species-level phylogeny discussed
below suggests that Arkys and Demadiana are indeed separate, monophyletic taxa (Fig. 7).

Species-level phylogeny and distribution

Within our species-level phylogeny, characters supporting monophyly of Arkys s.s. and Arkys (Archemorus) are the presence of strong tibial setae in females (character 7) and the presence of two strong prongs on the median apophysis in males (character 10), whereas synapomorphies of Demadiana include the deep open setal pits with a spherical socket (character 2) and the long tubular-shaped aggregate gland spigots of the posterior lateral spinnerets (character 6). However, our dataset was primarily assembled to solve relationships within Demadiana putatively ignoring other characters supporting the genus itself and clades outside (e.g. species of Demadiana are significantly smaller in size than most Arkys). Clearly, the limited clade support outside Demadiana should be interpreted cautiously within our taxon sample but must be addressed when revising Arkys.

Although phylogenetic resolution within Demadiana is low, a clade of three species is supported by the character ‘convex shape of the frontal carapace margin’ (character 1). Although any biogeographical conclusion based on such a small dataset and a small number of specimens must be considered carefully, it seems interesting to note that the species of this clade are the only species of Demadiana that are not exclusively found along the east coast of Australia (see Fig. 18). Here, D. simplex has the widest distribution ranging from New South Wales to Western Australia, whereas D. cerula (Western Australia) and D. diabolus (Tasmania into South Australia) have smaller ranges. Dispersal may have played a role in the speciation of these species, with putative origin of the genus along the east coast of Australia supported by highest species diversity of basal taxa there.

Fig. 8. Demadiana simplex (Karsch). (A) Male from Wyrrabalong National Park, New South Wales, AM KS65324; (B) female (from Six Mile Creek, Victoria, NMV K9985). Scale bar: (A) 1.0 mm, (B) 1.5 mm.

Taxonomy

Family ARANEIDAE Clerck, 1758
Subfamily ARKYINAE L. Koch, 1872

Arkynae Simon, 1890: 81.
Arkynae Simon, 1895: 898.
Arkynae Roewer, 1942: 908.

Diagnosis

Male Arkynae can be segregated from all other araneid spiders by the following combination of characters: tarsus I with prolateral field of short dense setae (see Heimer et al. 1982; Fig. 2A–D), lack of radix in the male pedipalp and procurved posterior eye row. Females have two rows of sigillae dorsally on the abdomen.

Phylogenetics

The monophyly of Arkynae is supported by the presence of a prolateral field of short dense setae on the male tarsus I (Fig. 2A–D), a putative synapomorphy being present in all male specimens examined, the enlarged characteristic trumpet-shaped aggregate gland spigots (AG) on the PLS of both males and females, and the absence of a flagelliform gland spigot on the PLS of both males and females (Figs 4D, 5D).

Composition

Two Australasian/Pacific genera, Arkys Walckenaer, 1837 and Demadiana Strand, 1929.
Remarks

Four Australasian/Pacific genera have been included in the subfamily Arkyinae (*Arkys*, *Aerea*, *Archemorus* and *Neoarchemorus*) as well as two South American genera (*Gnolus* Simon, 1879 and *Oarces* Simon, 1879). The latter were transferred to Mimetidae Simon, 1881 by Platnick and Shadab (1993).

Whereas the monophyly of the Arkyinae is well supported by the characters mentioned above (Heimer *et al.* 1982; Scharff and Coddington 1997) and each of the genera included, *Demadiana* and *Arkys*, seems to be independently supported by putative synapomorphies (see taxonomic section), there is still the issue of morphological variation within *Arkys* which led previous authors to recognise a least two different genera, *Arkys* and *Archemorus*. Although Heimer (1984) presented a revision of *Arkys* in which he synonymised *Archemorus* with *Arkys*, there seem to be distinct features which distinguish each of these genera. For example, species of *Arkys* *s.s.* possess lateral carapacial ‘horns’ (well developed in the type species of *Arkys*, *A. lancearius*, Fig. 20A, C; D; somewhat reduced in *A. walckenaeri*, although traces are still apparent, Fig. 20A, B), and a triangular abdomen (Figs 1D, 20A–D). In contrast, species formerly placed in *Archemorus* possess white, lanceolate carapace setae, irregular abdominal protuberances (Fig. 19A, B), granulations on the sternum, and a vaulted carapace. A putative behavioural difference between the genera is the resting position of the two pairs of legs; in *Archemorus* these are folded tightly to the body, whereas they are diagonally stretched out in *Arkys* (Mascord 1970). The phylogenetic significance of these characters, however, is difficult to judge and will require a phylogenetic analysis involving all species previously included in *Arkys* and *Archemorus*. We here accept Heimer’s (1984) synonymy of *Arkys* and *Archemorus* as the currently most pragmatic solution pending a comprehensive systematic revision of the entire group.

In contrast, we are able to provide some taxonomic solutions for other arkyine genera. Although the type material of Urquhart’s (1891, 1893) studies are apparently lost, it is indeed possible to recognise both *Aerea alticaphala* and *Aerea magnifica* from Tasmania as conspecifics of *A. simsoni*. Urquhart’s (1891) portrayal of *A. alticaphala* includes a good description of the epigyne which, among other features, has ‘two short, black, clavate processes, directed towards apex of septum’ (Urquhart 1891: p. 247). These ‘processes’ correspond to the lateral margins of the epigynal pockets found in *A. simsoni*, as revised by Heimer (1984: fig. 22) and not found in any other known species of *Arkys*. Urquhart’s (1893) description of the male of *A. magnifica* specifically describes the bifurcate median apophysis as ‘two, strong, black close-lying, curved, spine-like apophyses, projecting from outer margin of concavity transversely across bulb’ (Urquhart 1893: p. 121), as found in *A. simsoni* (Heimer 1984: fig. 21). Therefore, despite the lack of type specimens for *A. alticaphala* and *A. magnifica* we consider *Aerea* to be identical with *Archemorus*, as *A. alticaphala* (the type species of *Aerea*) and *A. magnifica* are identical with *A. simsoni* (the type species of *Archemorus*).

When Mascord (1968) established *Neoarchemorus* with *N. speechleyi* as the only included species (holotype male AM KS6624, VWF examined), he distinguished the genus from *Archemorus* based exclusively on somatic characters such as shape of the carapace and abdomen, eye pattern, and setae and spine arrangement on the legs. These characters seem insufficient to separate this genus from *Arkys* (or its synonym *Archemorus*) in particular taking the more recent studies by Balogh (1978, 1982) and Heimer’s (1984) synonymy of *Arkys* and *Archemorus* into account. *Neoarchemorus* falls well within the morphological variation of *Arkys* as revised by these authors, in particular in relation to the shape of carapace and abdomen, and at the same time has very similar male and female genitalia. Therefore, we consider *Neoarchemorus* to be a junior synonym of *Arkys*, and transfer *N. speechleyi* to *Arkys*, resulting in *A. speechleyi* (Mascord, 1968), comb. nov.

Genus *Demadiana* Strand, 1929

*Dema* Karsch, 1878: 801. Type species: *Dema simplex* Karsch, 1878, by monotypy.

*Demadiana* Strand, 1929: 18 (replacement name for *Dema*, preoccupied by *Dema* Gistl, 1848, Coleoptera).

Diagnosis

Members of *Demadiana* differ from *Arkys* in the presence of deep setal pits with spherical sockets on the carapace, sternum and paturon (Fig. 3A–D), the presence of elongated trumpet-shaped aggregate gland spigots on the PLS of both males and females (Figs 4D, 5D), and by their small size (body length less than approximately 3.5 mm).

Description

Small araneid spiders, males (TL approximately 1.7–2.8) generally smaller than females (TL approximately 1.7–3.5).

*Carapace*: orange- to reddish-brown, slightly longer than wide, rectangular in dorsal view, anterior margin either slightly convex or straight; cephalic area distinguished from thoracic area by shallow grooves laterally; steeply arched in lateral profile, covered with numerous deep setal pockets (Fig. 3A, C); clypeus with clypeal tooth (Fig. 3B, C), which is most pronounced in males.

*Eyes*: median ocular quadrangle trapezoidal, wider posteriorly than anteriorly; lateral eyes on small elevation (more pronounced in *D. carrui* and *D. milledgei*), nearly touching; posterior eye row strongly procurred in both males and females.

*Chelicerae*: orange- to reddish-brown; basally with 10–12 deep setal pockets (Fig. 3B); few whitish setae basally, few darker setae medially in apical half; 4–5 promarginal teeth, up to 5 retromarginal teeth.

*Sternum*: yellow- to light red-brown; ~40 setal pockets situated in several longitudinal rows laterally, setae directed medially.

*Labium*: triangular, with bulging rim on anterior edges; basally brown, somewhat lighter apically.

Legs*: leg formula 1243 (males) or 1423 (females); uniformly yellow-brown; tarsi I slightly inflated (less pronounced in females) and with prolateral patch of dense, short setae in males (Fig. 2A–D); leg spination variable and more...
pronounced in females, but tibiae I with approximately 4 long prolateral spines (generally reduced to 2 or 3 in males). Males without coxal tooth or femur groove.

Abdomen: males: rounded triangular and flat, about as long as wide; brown with variable white colouration. Females: somewhat rounded with straighter anterior margin, generally wider than long; with 25–50 dorsal light brown sigillae of various size (central and anterior ones generally largest); white pigment present in variable density under integument.

Spinnerets (based on Demadiana cerula Figs 4A–D, 5A–D): female ALS with single major ampulate gland spigot (MAP), accompanied by a small nubbin. MAP field separated from piriform gland spigot (PI) field by a deep furrow. Alltogether 14 PI, all with short bases and a few tertiopores between PI (Fig. 4B). Female PMS with a median row of 2 aciniform gland spigots (AC), a posterior minor ampulate gland spigot (mAP) with a low thick base and tapering shaft accompanied by a posterior nubbin, and a rather large, thick anterior cylindrical gland spigot (CY) (Fig. 4C). Female PLS dominated by the two huge median aggregate gland spigots (AG) with broad base, flat tip and narrow shafts. Anterior to those, one CY and a few (~3–5) AC hidden behind the huge AG. No flagelliform gland spigot present (Fig. 4D). Male ALS as female ALS, but with 12 PI (Fig. 5B). Male PMS as female PMS, but without the CY (Fig. 5C). Male PLS with similar huge AG as in female, 7 AC and no FL or CY (Fig. 5D).

Male genitalia: cymbium with two mesal macrosetae; median apophysis either roughly triangular (sometimes apically truncated) or of three-dimensional structure with apical keel (D. cerula, D. diabolus); conductor of variable shape, sometimes with sclerotised tip; embolus long and thin.

Female genitalia: epigynie of variable shape; spermathecae large and globulous (e.g. Figs 9E, 12D, 16D).

Phylogenetics
The monophyly of Demadiana is supported by the following unambiguous putative synapomorphies (Fig. 7): males and females with deep setal pits on the carapace and sternum that accommodate a spherical socket; elongated trumpet-shaped aggregate gland spigots with wide base and tip and narrow shaft; tip is clearly flattened, a condition otherwise only found in Theridiidae. In general, the spinning field of Demadiana seems to be much reduced, something otherwise seen in linyphioids, symphytognathoids and theridioids (Griswold et al. 1998). As far as we know, Demadiana does not make capture webs, and the reduced spinning field supports this assumption.

Composition
Six species, D. simplex (Karch, 1878) (type species), D. carrai, sp. nov., D. cerula (Simon, 1908), D. complicata, sp. nov., D. diabolus, sp. nov., and D. milledgei, sp. nov.

Distribution
Australia south of 25°S Latitude (Fig. 18).

Remarks
Somatic characters do not vary substantially between species and as only a limited number of specimens are available to be examined for most species, intraspecific variation is difficult to judge. Differences between species relate mainly to genital morphology.

Key to the species of Demadiana
The females of D. carrai and D. complicata are unknown.

1. Median apophysis three dimensional structure with apical keel (Figs 12A, 13C, 16A, B); female epigyne with simple V-shaped scape (Fig. 12C) or with T-shaped atrium and without scape (Fig. 16C)........................................2

2. Paracymbium consists of two long and sharp ridges (Figs 12A, 13B); female epigyne with simple V-shaped scape (Fig. 12D); currently known from Western Australia only.............................D. cerula (Simon) Paracymbium with double tip (but not long ridges) (Fig. 16D, B); female without scape (Fig. 16C); currently known from Tasmania and South Australia only ..............................................D. diabolus, sp. nov.

3. Anterior margin of carapace convex (Figs 8A, 10B); median apophysis of male pedipalp apically truncated (Figs 9A, 14A); epigyne with narrow scape (Fig. 9D).................................................................4

4. Anterior margin of carapace straight (Figs 10A, 15C, D); median apophysis of male pedipalp with distinct, pointed tip (Figs 11A, 17A); epigyne without scape and with arched antero-lateral margin (Fig. 17C) ..................................................5

5. Mesal edge of median apophysis concave (Fig. 14A); female unknown; currently known from Queensland only ......D. complicata, sp. nov. Mesal edge of median apophysis convex (Fig. 9A); female epigyne with narrow scape and separate V-shaped sclerotisation anteriorily (Fig. 9C); apparently widespread (New South Wales, South Australia, Victoria, Western Australia) ..............................................D. simplex (Karch)

6. Median apophysis of male pedipalp longer than wide and with very sharp tip (Fig. 11A); female unknown; known from New South Wales only ..............................................................................D. carrai, sp. nov.

7. Median apophysis of male pedipalp wider than long with blunt tip (Fig. 17A); female epigyne with arched antero-lateral margin (Fig. 17C); known from Victoria only.D. milledgei, sp. nov.

Demadiana simplex (Karch, 1878) (Figs 8A, 9A–E, 18)

Dena simplex Karsch, 1878: 801–802.

Cyrarachne simplex (Karsch, 1878). – Roewer, 1942: 897; Bonnet, 1956: 1347.


Material examined
Holotype. Female, no exact locality (New South Wales, Australia), no date, E. Daemel (ZMB 1380).

Other material examined. Australia: New South Wales: 1 ♂, Booti Booti National Park (AM KS653525); 1 ♀, same locality (AM KS653523); 1 ♀, Pomingalarna Park, 8 km W Wagga Wagga (AM KS93839); 1 ♀, same data (AM KS93837); 2 ♀, same data (AM KS93856); 1 ♀, The Rock Nature Reserve, 30 km SW Wagga Wagga (AM KS93942); 1 ♀, Wyrrabalong.
Diagnosis

Males of *Demadiana simplex* differ from all other species of *Demadiana* by the convex lateral margins and truncated tip of the median apophysis of the pedipalp (Fig. 9A). The female epigyne of this species has a unique anterior V-shaped weak sclerotisation (Fig. 9D) that is absent in all other *Demadiana* species.

Description

**Male** (from Wyrrabalong National Park, AM KS65324)

- **Carapace**: orange-brown, anterior margin slightly convex (Fig. 8A).
- **Chelicerae**: orange-brown.
- **Sternum**: light orange-brown, glabrous.
Abdomen: dorsally covered in white pigmentation, with the exception of two brown spots latero-medially (Fig. 8 A). Venter marginally whitish, centrally dirty yellow. Spinnerets light brown.

Pedipalps (Fig. 9 A–C): median apophysis with convex lateral margin and truncated tip; paracymbium a simple sclerotised tip, conductor apically sclerotised.

Legs: uniformly yellow-brown. Leg spination leg I: femur: 1 prolateral; patella: 1 prolateral; tibia: 3 (left: 4) dorsal; 3 prolateral, 3 retrolateral; metatarsus: 1 dorsal, 3 prolateral (apical 2 small).

Dimensions (mm): total length (excluding chelicerae) 1.82. Carapace length 1.03, width 0.97, height 0.52. Eyes: AME 0.11, ALE 0.08, PME 0.11, PLE 0.08, AME–AME 0.10, AME–ALE 0.29, PME–PME 0.31, PME–PLE 0.23, PLE–ALE 0.03, MOQ width front 0.27, MOQ width back 0.46, MOQ length 0.28, eye group width 0.92. Sternum length 0.42, width 0.41. Abdomen length 1.27, width 1.52. Pedipalp: femur 0.27, patella 0.12, tibia 0.06, tarsus 0.36, total 0.82. Leg I: femur 0.73, patella 0.42, tibia 0.41, metatarsus 0.35, tarsus 0.39, total 2.30. Leg II: femur 0.64, patella 0.35, tibia 0.35, metatarsus 0.32, tarsus 0.27, total 1.92. Leg III: femur 0.42, patella 0.17, tibia 0.23, metatarsus 0.17, tarsus 0.18, total 1.17. Leg IV: femur 0.64, patella 0.26, tibia 0.35, metatarsus 0.30, tarsus 0.23, total 1.77.

Variation (mm range, mean ± s.d.): TL 1.82–1.91, 1.87 ± 0.05; CL 1.00–1.03, 1.01 ± 0.02; CW 0.85–0.91, 0.89 ± 0.03; n = 3.

Female (from Six Mile Creek, NMV K9985)

Carapace: as male, slightly darker (Fig. 8 B).

Chelicerae: orange-brown; four promarginal teeth and five very small retromarginal teeth.

Sternum: as male.

Abdomen: dense whitish-cream pigmentation and approximately 25 orange sigillae (Fig. 8 B). Venter light grey. Spinnerets light brown.

Epigyne: ventral view: narrow and short sclerotised scape and weak anterior V-shaped sclerotisation (Fig. 9 D). Dorsal view: large oval spermathecae and narrow spermducts with single, nearly 90 degree bend (Fig. 9 E).

Legs: uniformly light brown; tarsus I slightly inflated. Leg spination leg I: tibia: 3 (right leg 4) prolateral, 2 retrolateral; metatarsus: 3 prolateral, 2 retrolateral.

Dimensions (mm): total length (excluding chelicerae) 2.94. Carapace length 1.15, width 1.00, height 0.75. Eyes: AME 0.08, ALE 0.06, PME 0.08, PLE 0.06, AME–AME 0.10, AME–ALE 0.33, PME–PME 0.39, PME–PLE 0.26, PLE–ALE 0.03, MOQ width front 0.27, MOQ width back 0.54, MOQ length 0.31, eye group width 1.02. Sternum length 0.52, width 0.48. Abdomen length 2.06, width 2.36. Pedipalp: femur 0.30, patella 0.12, tibia 0.15, tarsus 0.27, total 0.85. Leg I: femur 0.79, patella 0.42, tibia 0.42, metatarsus 0.33, tarsus 0.33, total 2.30. Leg II: femur 0.70, patella 0.33, tibia 0.36, metatarsus 0.32, tarsus 0.24, total 1.95. Leg III: femur 0.48, patella 0.21, tibia 0.27, metatarsus 0.23, tarsus 0.18, total 1.38. Leg IV: femur 0.79, patella 0.33, tibia 0.45, metatarsus 0.42, tarsus 0.27, total 2.27.

Variation (mm range, mean ± s.d.): TL 2.64–3.24, 2.90 ± 0.22; CL 1.12–1.27, 1.18 ± 0.05; CW 0.97–1.09, 1.03 ± 0.04; n = 6.

Remarks

The holotype female of D. simplex is in poor condition as it was pinned as part of the dry collection in the ZMB. Therefore, we redescribe this species based on a more recently collected and better-preserved specimen.

Rainbow (1911: p. 201) in his ‘A census of Australian Araneidae’ lists Dema as a junior synonym of Cyrtarachne, but does not list Dema simplex itself which may explain why this species was ignored in subsequent catalogues (Roewer 1942; Bonnet 1956; Platnick 2010).

Distribution

Demadiana simplex is found in New South Wales, South Australia, Victoria, and Western Australia (Fig. 18).

Demadiana carrai, sp. nov.

(Figs 10 A, 11 A, B, 18)

Material examined

Holotype. Male. Carrai State Forest (30°54’35”S, 152°16’26”E, Australia, New South Wales), 11–16.i.1996, sticky trap, E. Tasker, CC-FK-018–1, altitude 1090 m, Eucalyptus campanulata (AM KS66693).

Diagnosis

Demadiana carrai shares with D. milledgei the straight anterior carapace margin (Fig. 10 A), however males differ distinctly by the shape of the median apophysis that is longer than wide and has a sharp tip in D. carrai (Fig. 11 A), but wider than long in D. milledgei and the tip is blunt (Fig. 17 A, B). The female of D. carrai is not known.

Description

Male (holotype from Carrai State Forest, AM KS66693)

Carapace: orange-brown, anterior margin straight and lateral eyes on small tubercles (Fig. 10 A).

Chelicerae: orange-brown.

Sternum: light orange-brown, glabrous.

Abdomen: dorsally covered by a brown scutum, white pigmentation at anterior and lateral margins and some white pigmentation antero-centrally, two white spots in posterior half (Fig. 10 A). Venter beige, covered in brown setae that are densest medially. Spinnerets light brown.

Pedipalps (Fig. 11 A, B): median apophysis longer than wide and with a sharp tip, paracymbium with narrow tip, conductor only weakly sclerotised.

Legs: uniformly orange-brown. Leg spination leg I: femur: 2 apicoprolateral; tibia: 6 prolateral, 1 retrolateral; metatarsus: 1 prolateral.

Dimensions (mm): total length (excluding chelicerae) 2.61. Carapace length 1.21, width 1.06, height 0.61. Eyes: AME 0.08, ALE 0.08, PME 0.08, PLE 0.09, AME–AME 0.12, AME–ALE 0.33, PME–PME 0.33, PME–PLE 0.29, PLE–ALE 0.03, MOQ width front 0.27, MOQ width back 0.45, MOQ length 0.27, eye group width 0.94. Sternum length 0.52, width 0.48. Abdomen length 1.58, width 1.73. Pedipalp: femur 0.33, patella 0.12, tibia 0.08, tarsus 0.39, total 0.92. Leg I: femur 0.94, patella 0.48, tibia...
0.59, metatarsus 0.39, tarsus 0.45, total 2.86. Leg II: femur 0.88, patella 0.45, tibia 0.50, metatarsus 0.39, tarsus 0.33, total 2.56. Leg III: femur 0.55, patella 0.18, tibia 0.29, metatarsus 0.21, tarsus 0.18, total 1.41. Leg IV: femur 0.79, patella 0.30, tibia 0.47, metatarsus 0.42, tarsus 0.27, total 2.26.

Variation: only known from holotype.

Female
Unknown.

Distribution
Demadiana carrai is only known from its type locality, the Carrai State Forest in north-eastern New South Wales (Fig. 18).

Fig. 10. Demadiana spp. (A) Holotype male of D. carrai, sp. nov. from Carrai State Forest, New South Wales (AM KS66693); (B) holotype male of D. complicata, sp. nov. from Beerwah State Forest, Queensland (QM S48966); (C) male of D. cerula (Simon) from Pemberton, Western Australia (WAM 93/47); (D) female of D. cerula (Simon) from Greenough, Western Australia (WAM 93/49). Scale bar: (A) 1.3 mm, (B, D) 1.0 mm, (C) 1.2 mm.

Etymology
The specific epithet is a noun in apposition derived from the type locality of this species, the Carrai State Forest in New South Wales.

Demadiana cerula (Simon, 1908), comb. nov.
(Figs 1A, B, 2A–D, 3A–D, 4A–D, 5A–D, 10C, D, 12A–D, 13A–D, 18)

Paraplectanoides caerulea Simon, 1908. – Bonnet, 1958: 3333 (invalid emendation; see Etymology below).
Material examined


Other material examined. Australia: Western Australia: 7 ♂, 6 ♀, 12 juveniles, Dog Pool, Shannon National Park (WAM 97/1994–7, 97/2023–8); 1 ♂, Lake Poorginup (WAM 93/50); 1 ♂, Lucy Beach, Greenough (WAM 93/49); 1 ♂, 1 juvenile, Moingup Spring, Stirling Range National Park (WAM 97/2017–21, 97/2023–21, 97/2039–8); 1 ♂, Pemberton Youth Hostel (WAM 93/47); 1 ♂, 1 ♂, Quaalup Homestead (WAM 97/2064–72); 3 ♂, 3 ♀, Toolbrunup Peak Track, Stirling Range National Park (QM S25408); 4 ♂, 3 ♀, same data (WAM 97/2050–5); 1 ♂, 1 ♀, Wungong Dam (WAM T91865).

Diagnosis

Based on the morphology of the male pedipalp, in particular the median apophysis with apical keel and the two-edged paracymbium, *D. cerula* is most similar to *D. diabolus* from Tasmania. However, males of *D. cerula* differ distinctly by the shape of the paracymbium, which has two long sharp ridges (Fig. 13B) in contrast to the short ridges in *D. diabolus* (Fig. 16A, B). Females of both species are easily separated by the presence of a sclerotised lip on the epigyne in *D. cerula* (Fig. 12C) which is absent in *D. diabolus* (Fig. 16C).

Description

**Male (from Pemberton, WAM 93/47)**

Carapace: uniformly red-brown; anterior margin slightly convex (Fig. 10C).

Chelicerae: orange-brown.

**Female (from Greenough WAM 93/49)**

Carapace: as male, slightly darker (reddish-brown) (Fig. 10D).

Chelicerae: red-brown.

Sternum: light brown with pale medial, longitudinal stripe; covered by thin dorsal scutum (Fig. 10C). Venter dirty yellow. Spinnerets light brown.

Pedipalps (Figs 12A, B, 13A–D): paracymbium with four small pointed projections, two of which are connected by a sharp concave edge; median apophysis with apical keel, conductor sclerotised with sharp tip.

Legs: uniformly light brown; Leg spination leg I: femur: 1 prolateral; patella: 1 prolateral; tibia: 3 dorsal; 3 prolateral, 4 retrolateral, 2 ventral; metatarsus: 1 prolateral.

Dimensions (mm): total length (excluding chelicerae) 2.00. Carapace length 1.00, width 0.90, height 0.60. Eyes: AME 0.08, ALE 0.08, PLE 0.08, PME 0.06, AME–AME 0.26, PLE–PME 0.26, PME–PLE 0.20, PLE–ALE 0.00, MOQ width front 0.22, MOQ width back 0.38, MOQ length 0.30, eye group width 0.87. Sternum length 0.46, width 0.44. Abdomen length 1.34, width 1.40. Pedipalp: femur 0.32, patella 0.14, tibia 0.12, tarsus 0.44, total 1.02. Leg I: femur 0.72, patella 0.41, tibia 0.53, metatarsus 0.35, tarsus 0.38, total 2.39. Leg II: femur 0.66, patella 0.33, tibia 0.39, metatarsus 0.30, tarsus 0.26, total 1.94. Leg III: femur 0.43, patella 0.20, tibia 0.24, metatarsus 0.20, tarsus 0.19, total 1.26. Leg IV: femur 0.64, patella 0.26, tibia 0.38, metatarsus 0.29, tarsus 0.26, total 1.83.

Variation (mm range, mean ± s.d.): TL 1.73–2.15, 1.98 ± 0.13; CL 0.97–1.09, 1.03 ± 0.03; CW 0.88–0.94, 0.90 ± 0.02; n = 10.
Sternum: as male.

Abdomen: somewhat rounded with straight anterior margin; with 28 small dorsal sigillae, each light brown; white pigment present under integument (Fig. 10D). Venter light olive-grey. Spinnerets light brown.

Epigyne (Fig. 12C, D): ventral view: V-shaped sclerotised scape. Dorsal view: ovoid spermathecae with a rectangular chambers in dorsal view.

Legs: uniform light brown; tarsus I only slightly inflated. Leg spination leg I: tibia: 4 prolateral, 2 retrolateral; metatarsus: 4 prolateral, 4 retrolateral.

Dimensions (mm): total length (excluding chelicerae) 2.81. Carapace length 1.06, width 0.96, height 0.55. Eyes: AME 0.08, ALE 0.08, PME 0.08, PLE 0.08, AME–AME 0.10, AME–ALE 0.30, PME–PME 0.31, PME–PLE 0.28, PLE–ALE 0.01, MOQ width front 0.21, MOQ width back 0.44, MOQ length 0.32, eye group width 0.96. Sternum length 0.50, width 0.49. Abdomen length 2.02, width 2.18. Pedipalp: femur 0.24, patella 0.16, tibia 0.15, tarsus 0.26, total 0.81. Leg I: femur 0.73, patella 0.40, tibia 0.48, metatarsus 0.32, tarsus 0.35, total 2.28. Leg II: femur 0.65, patella 0.35, tibia 0.41, metatarsus 0.29, tarsus 0.26, total 1.96.

Leg III: femur 0.46, patella 0.23, tibia 0.24, metatarsus 0.20, tarsus 0.19, total 1.32. Leg IV: femur 0.73, patella 0.32, tibia 0.44, metatarsus 0.35, tarsus 0.23, total 2.07.

Variation (mm range, mean ± s.d.): TL 1.79–2.58, 2.21 ± 0.25; CL 1.03–1.18, 1.07 ± 0.05; CW 0.88–0.97, 0.93 ± 0.03; n = 11.

Remarks
Specimens of *D. cerula* have been collected most commonly by sweeping vegetation or by hand collecting at night. They can be found suspended on a single thread on trees and shrubs (e.g. *Hakea, Acacia*) in open forests or bushland (Fig. 1C). Similar behaviour is described for *Arkys walckenaeri* (sub *A. nitidiceps*) (Main 1982).

Distribution
*Demadiana cerula* occurs in south-western Western Australia, including coastal areas south of 25°S longitude (Fig. 18).
Etymology

The specific name given to *D. cerula* by Simon (1908) apparently refers to the feminine Latin noun *cerula*, aptly meaning ‘little piece of wax’. Bonnet (1958) misinterpreted it as the Latin adjective for the colour dark blue, *caeruleus*, which renders his emendation to the specific name (see above) invalid.

**Demadiana complicata**, sp. nov.

(Figs 10B, 14A, B, 18)

*Material examined*

*Holotype.* Male, Beerwah State Forest (26°50'S, 153°00'E, Queensland, Australia, 5.iv.1991, M. Glover, vegetation (QM S48966).
Diagnosis

*Demadiana complicata* can be distinguished from all other *Demadiana* species by the shape of the median apophysis which is longer than wide and, unique within the males of the genus, has one convex and one concave lateral margin (Fig. 14).

Description

**Male** (holotype from Beerwah State Forest, QM S48966)

**Carapace**: orange-brown, anterior margin slightly convex (Fig. 10B).

**Chelicerae**: orange-brown.

**Sternum**: light orange-brown, glabrous.

**Abdomen**: dorsally dirty yellow-brown, whitish-cream pigmentation at anterior margin and a large white spot anterocentrally, two longitudinal white spots in posterior half (Fig. 10B). Venter and spinnerets dirty-yellow.

**Pedipalps** (Fig. 14A, B): median apophysis longer than wide and with one convex and one concave lateral margin; paracymbium comparatively long and wide with blunt tip, conductor triangular and not sclerotised.

**Legs**: Uniformly orange-brown. Leg spination leg I: femur: 1 apicoprolateral; tibia: 3 prolateral, 1 retrolateral; metatarsus: 1 prolateral.

**Dimensions** (mm): total length (excluding chelicerae) 2.00. Carapace length 1.06, width 0.91, height 0.50. Eyes: AME 0.09, ALE 0.08, PLE 0.08, PLE–AME 0.09, AME–ALE 0.25, PME–PME 0.33, PME–PLE 0.23, PLE–AME 0.03, MOQ width front 0.25, MOQ width back 0.45, MOQ length 0.28, eye group width 0.94. Sternum length 0.52, width 0.48. Abdomen length 1.36, width 1.39.

Pedipalp: femur 0.29, patella 0.09, tibia 0.06, tarsus 0.32, total 0.76. Leg I: femur 0.79, patella 0.41, tibia 0.45, metatarsus 0.35, tarsus 0.36, total 2.36. Leg II: femur 0.70, patella 0.36, tibia 0.42, metatarsus 0.33, tarsus 0.29, total 2.11. Leg III: femur 0.45, patella 0.17, tibia 0.23, metatarsus 0.20, tarsus 0.17, total 1.21. Leg IV: femur 0.64, patella 0.23, tibia 0.36, metatarsus 0.32, tarsus 0.23, total 1.77.

**Variation**: only known from holotype.

**Female**

Unknown.

Distribution

*Demadiana complicata* is only known from its type locality, the Beerwah State Forest in south-eastern Queensland (Fig. 18).

Etymology

The specific epithet is an adjective in apposition derived from *complicatus* (Latin – complicated). It is an antonym of *simplex* (Latin – simple) which Karsch (1878) used as the specific epithet for the type species of the genus.

*Demadiana diabolus*, sp. nov.

(Figs 15A, B, 16A–D, 18)

**Material examined**

**Holotype**: Male, Trevallyn (41°26'S, 147°07'E, Tasmania, Australia), 22.iv.1930, V.V. Hickman collection, from Blackwood tree (AM KS28625).

**Paratype**: 1 female, data as holotype (AM KS98074).
Other material examined. **Australia: South Australia**: 2 ♀, Muston, Kangaroo Island (SAM NN24383–4); 1 ♀, Belair, Government Farm (SAM NN24381); 1 ♀, Mt Lofty (SAM NN24382).

**Diagnosis**
Median apophysis and paracymbium of *Demadiana diabolus* are somewhat similar to that of *D. cerula* (compare Fig. 12A, B with Fig. 16A, B), but *D. diabolus* can be easily distinguished by the much narrower paracymbium that only has a short ridge (Fig. 16A) in contrast to the broad sharp ridges in *D. cerula* (Figs 12A, 13B). Females of *D. diabolus* lack a scape (Fig. 16C, D) which is present in *D. cerula* (Fig. 12C, D).

**Description**

Male (holotype from Trevallyn, AM KS28625)

*Carapace*: light brown, somewhat lighter centrally; anterior margin slightly convex (Fig. 15A).
**Chelicerae**: light brown.

**Sternum**: yellow-brown, glabrous.

**Abdomen**: dorsally light brown, white pigmentation form two central longitudinal bands, that are wider anteriorly, and less distinct lateral bands (Fig. 15A). Venter uniformly light yellow-grey covered with similarly coloured short setae. Spinnerets light yellow-brown.

**Pedipalp** (Fig. 16A, B): median apophysis three-dimensional with apical keel; paracymbium narrow with a short ridge; conductor not sclerotised, forms a wide lobe.

**Legs**: uniformly yellow-brown. Leg spination leg I: femur: 1 apicoprolateral; tibia: 3 dorsal; 3 prolateral, 5 retrolateral; metatarsus: 1 prolateral, 1 retrolateral.

**Dimensions** (mm): total length (excluding chelicerae) 2.04. Carapace length 1.04, width 0.92, height 0.54. Eyes: AME 0.08, ALE 0.06, PME 0.06, PLE 0.06, AME–AME 0.10, AME–ALE 0.28, PME–PME 0.32, PME–PLE 0.23, PLE–ALE 0.02, MOQ width front 0.23, MOQ width back 0.41, MOQ length 0.29, eye group width 0.90. Sternum length 0.46, width 0.42. Abdomen length 1.04, width 1.46. Pedipalp: femur 0.36, patella 0.15, tibia 0.10, tarsus 0.44, total 1.06. Leg I: femur 0.73, patella 0.38, tibia 0.46, metatarsus 0.33, tarsus 0.37, total 2.28. Leg II: femur 0.67, patella 0.36, tibia 0.37, metatarsus 0.31, tarsus 0.27, total 1.98. Leg III: femur 0.42, patella 0.16, tibia 0.21, metatarsus 0.21, tarsus 0.15, total 1.16. Leg IV: femur 0.65, patella 0.24, tibia 0.33, metatarsus 0.32, tarsus 0.23, total 1.77.

**Variation**: males only known from holotype.

**Female (from Muston, Kangaroo Island, SAM NN24383)**

**Carapace**: as male (Fig. 15B).

**Chelicerae orange-brown**; four promarginal teeth and five very small retromarginal teeth.

**Sternum**: as male.

**Abdomen**: dense whitish-cream pigmentation (Fig. 15B). Venter and spinnerets light grey.

**Epigyne**: ventral view: lightly waved anterior margin, no scape (Fig. 16C). Dorsal view: ovoid spermathecae with dorsal chamber (Fig. 16D).

**Legs**: uniformly yellow; tarsus I slightly inflated. Leg spination leg I: tibia: 4 prolateral, 1 retrolateral; metatarsus: 4 prolateral, 2 retrolateral.

**Dimensions** (mm): total length (excluding chelicerae) 2.85. Carapace length 1.06, width 0.94, height 0.44. Eyes: AME 0.08,
ALE 0.06, PME 0.08, PLE 0.06, AME–AME 0.10, AME–ALE 0.31, PME–PME 0.35, PME–PLE 0.24, PLE–ALE 0.03, MOQ width front 0.24, MOQ width back 0.47, MOQ length 0.32, eye group width 0.94. Sternum length 0.48, width 0.45. Abdomen length 1.85 width 1.91. Pedipalp: femur 0.33, patella 0.15, tibia 0.14, tarsus 0.20, total 0.82. Leg I: femur 0.73, patella 0.39, tibia 0.39, metatarsus 0.29, tarsus 0.33, total 2.14. Leg II: femur 0.64, patella 0.39, tibia 0.33, metatarsus 0.29, tarsus 0.23, total 1.88. Leg III: femur 0.41, patella 0.17, tibia 0.24, metatarsus 0.20, tarsus 0.15, total 1.17. Leg IV: femur 0.67, patella 0.29, tibia 0.42, metatarsus 0.33, tarsus 0.23, total 1.94.

Variation (mm range, mean ± s.d.): TL 2.03–2.85, 2.45 ± 0.38; CL 1.00–1.06, 1.05 ± 0.03; CW 0.85–0.94, 0.90 ± 0.04; n = 5. The abdominal sigillae are distinct in the paratype female, but absent in all specimens from South Australia, except the female from Mt Lofty which has sigillae only on the anterior half of the abdomen.

Distribution

Demadiana diabolus has been found in South Australia and Tasmania (Fig. 18).

Etymology

The specific epithet is a noun in apposition derived from diabolus (Latin – devil) recognising the current threat to the Tasmanian Devil, Sarcophilus harrisii (Boitard, 1841), by Devil Facial Tumor Disease (e.g. McCallum 2008). The holotype and paratype of D. diabolus are from Tasmania.

Demadiana milledgei sp. nov.

(Figs 15C, D, 17A–D, 18)

Material examined

Holotype. Male, Phillips Track, Youngs Creek Crossing, 0.5 km N Triplet Falls (38°40’S, 143°29’E, Victoria, Australia), 20.ii.1992, G. Milledge, Nothofagus cunninghamii forest (NMV K9984).

Paratypes. 2 females, same data as holotype, except 18–20.ii.1992, K. Walker (NMV K9983, K10406).

Other material examined. Australia: New South Wales: 1♀, Monga National Park, Lind Road (WAM T102432). Victoria: 1♂, Cement Creek Reserve, 2.2 km ESE of Mt Donna Buang (NMV K6804); 1♀, Beauchamp Falls, 3.6 km ESE of Beech Forest, Otway Ranges (NMV K9982); 4♂, 2♀, Mt Ben Caim and Mt Donna Buang (QM S74406).

Fig. 17. Demadiana milledgei, sp. nov., holotype male from Phillips Track, Victoria, Australia (NMV K9984) and paratype female from the Otway Ranges, Victoria, Australia (NMV K10406). (A) Left male pedipalp, retrolateral view; (B) left male pedipalp, prolateral view; (C) female epigyne, ventral view; (D) female epigyne, dorsal view. Scale bar: 0.2 mm.
Diagnosis

Demadiana milledgei shares with D. carrai the straight anterior margin of the carapace and the pronounced tubercles that accommodate the lateral eyes (Fig. 15C). However, D. milledgei and D. carrai differ in the shape of the median apophysis in males which is much shorter and less pointed in D. milledgei (Fig. 17A, B). The female of D. carrai is not known.

Description

Male (holotype from Otway Ranges, NMV K9984)

Carapace: light brown, lighter centrally; setal pits reduced centrally; anterior margin straight, lateral eyes on distinct tubercles (Fig. 15C).

Chelicerae: light brown.

Sternum: yellow-brown, glabrous.

Abdomen: dorsally light brown scute, white pigmentation anteriorly and laterally, few white pigments antero-medially (Fig. 15C). Venter uniformly beige covered with similarly coloured short setae. Spinnerets beige.

Pedipalp (Fig. 17A, B): median apophysis triangular, with some indistinct ridges; conductor with two tips, the basal one sclerotised; paracymbium a very broad hook.

Legs: uniformly yellow-brown. Leg spination leg I: femur: 1 dorsal, 1 apicoprolateral; patella: 1 prolateral, 1 retrolateral; tibia: 3 dorsal; 3 prolateral, 4 retrolateral; metatarsus: 1 prolateral.

Dimensions (mm): total length (excluding chelicerae) 2.18. Carapace length 1.06, width 0.91, height 0.69. Eyes: AME 0.07, ALE 0.10, PME 0.08, PLE 0.07, AME–AME 0.08, AME–ALE 0.25, PME–PME 0.23 PME–PLE 0.23, PLE–ALE 0.02, MOQ width front 0.23, MOQ width back 0.37, MOQ length 0.23, eye group width 0.88. Sternum length 0.47, width 0.44. Abdomen length 1.30, width 1.36. Pedipalp: femur 0.30, patella 0.11, tibia 0.08, tarsus 0.41, total 0.89. Leg I: femur 0.80, patella 0.41, tibia 0.50, metatarsus 0.39, tarsus 0.41, total 2.51. Leg II: femur 0.73, patella 0.36, tibia 0.44, metatarsus 0.36, tarsus 0.32, total 2.21.
Leg III: femur 0.45, patella 0.18, tibia 0.27, metatarsus 0.24, tarsus 0.18, total 1.33. Leg IV: femur 0.68, patella 0.26, tibia 0.42, metatarsus 0.36, tarsus 0.26, total 1.98.

Variation (mm range, mean ± s.d.): TL 2.12–2.21, 2.17 ± 0.04; CL 1.03–1.12, 1.06 ± 0.03; CW 0.91–0.97, 0.94 ± 0.02; n = 6. There is some variation in the setal pits on the carapace of males. They can be reduced centrally as in the holotype described above, but may be more prominent in other specimens.

Female (paratype from Otway Ranges, NMV K10406)

Carapace: as male, but with more setal pits centrally (Fig. 15E).

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**Fig. 20.** Arkys spp. (A) Female *A. walckenaeri* Simon from Torbay Head, Western Australia (WAM 82/112); (B) male of *A. walckenaeri* Simon from NE of Jarrahdale, Western Australia (WAM T44691); (C) female of *A. lancearius* Walckenaer from Brisbane, Queensland (ZMUC); (D) male of *A. lancearius* Walckenaer from Brisbane, Queensland (ZMUC). Scale bar: (A) 2.0 mm, (B) 2.5 mm, (C,D) 3 mm.
Chelicerae: orange-brown; four promarginal teeth and five very small retromarginal teeth.

Sternum: as male.

Abdomen: light olive-green with white pigmentation marginally; approximately 25 brown sigillae (Fig. 15E). Venter dirty yellow with light brown setae. Spinnerets light globular L-shapes.

Carapace length 1.15, width 1.00, height 0.58. Eyes: AME 0.08, prolateral, 2 retrolateral.

Spination leg I: tibia: 4 prolateral, 2 retrolateral; metatarsus: 3 marginally; approximately 25 brown sigillae (Fig. 15F).

Leg III: femur 0.48, patella 0.17, tibia 0.29, metatarsus 0.26, tarsus 0.14, tarsus I slightly in flared. Leg

Leg IV: femur 0.85, patella 0.44, tibia length 1.61 width 2.06. Pedipalp: femur 0.30, patella 0.14, tibia 0.14, tarsus 0.27, total 0.85. Leg I: femur 0.85, patella 0.44, tibia 0.52, metatarsus 0.36, tarsus 0.38, total 2.55. Leg II: femur 0.76, patella 0.38, tibia 0.39, metatarsus 0.36, tarsus 0.30, total 2.20. Leg III: femur 0.48, patella 0.17, tibia 0.29, metatarsus 0.26, tarsus 0.18, total 1.38. Leg IV: femur 0.85, patella 0.32, tibia 0.52, metatarsus 0.42, tarsus 0.29, total 2.39.

Variation (mm range, mean ± s.d.): TL 2.12–2.73, 2.50 ± 0.23; CL 1.12–1.18, 1.16 ± 0.03; CW 0.97–1.03, 1.00 ± 0.02; n = 5.

Distribution

Demadiana milledgei is only known from high rainfall areas in Victoria (Fig. 18).

Etymology

The specific epithet is a patronym in honour of Graham Milledge (Australian Museum), collector of the type material of this species and in recognition of his support of arachnological studies in Australia.

Genus Arkys Walckenaer, 1837


Arkys alticephala (Urquhart, 1891), comb. nov.

(Figs 19A, B, 24)


Type material

Holotype of Aerea alticephala. Female, Tasmania, Australia (without precise locality), A. Morton (not located, not examined).

Syntypes of Aerea magnifica. 2 males, Tasmania, Australia (without precise locality) (not located, not examined).

Holotype of Archemorus simoni. Juvenile female, Launceston (41°26′S, 147°08′E, Tasmania, Australia) (MNHN, not examined).

Material examined

Australia: South Australia: 1 ♂, 3 ♀, Aldgate, 35°00′S, 138°44′E, iii.1985 (SAM); 1 ♂, Kingscote, Kangaroo Island (SAM); 1 ♂, Mylor, Bridgewater (SAM); 1 ♂, Sterling (SAM). Western Australia: 1 ♂, Boddington Bauxite Mine (WAM T66193); 1 ♂, Capel (WAM T76095); 1 ♂, Dog Pool, Shannon National Park (WAM 93/2330); 1 juvenile ♂, Jarrahdale (WAM 94/515); 1 juvenile ♀, Yanchep (WAM 93/1616).

Fig. 21. Arkys brevipalpus Karsch, female from Sarraméa, New Caledonia (ZMUC OW128) (scanning electron micrographs (SEM)). (A) Carapace, thoracic part, dorsal view; (B) detail of setal pit. Scale bars: (A) 1 mm, (B) 0.01 mm.
Remarks
Arkys alticephala has been re-described by Balogh (1978) (juvenile female holotype) and subsequently fully revised by Heimer (1984) (as Archemorus simsoni). We here depict specimens from Western Australia to illustrate some somatic features of this species (Fig. 20A, B).

Distribution
Aerea alticephala has been previously recorded from Tasmania (Urquhart 1891; Simon 1893; Urquhart 1893; Heimer 1984), South Australia (Guerin 1986), Victoria and the Australian Capital Territory (Balogh 1978). The specimens reported here represent the first records for Western Australia (Fig. 24).

Arkys walckenaeri Simon, 1879
(Figs 1C, 20A, B)

Fig. 22. Arkys brevipalpus Karsch. (A, C) female from Sarraméa, New Caledonia (ZMUC OW128) (scanning electron micrographs (SEM)); (B, C) female from Mt. Koghi, New Caledonia (OW130) (SEM). (A) Spinnerets, ventral view; (B) left anterior lateral spinneret (ALS), ventral view; (C) left posterior median spinneret (PMS), ventral view; (D) trumpet-like aggregate gland spigots (AG) on left posterior lateral spinnerets (PLS), ventral view. Additional abbreviations: AC, aciniform gland spigot; CY, cylindrical gland spigot; mAP, minor ampullate gland spigot; MAP, major ampullate gland spigot; PI, piriform gland spigot. Scale bars: (A) 0.1 mm, (B–D) 0.01 mm.
Arcys clavatus Keyserling, 1890: 259–261, plate xxiv, figs 1, 1a, 1b, 2, 2a.
- Rainbow, 1911: 207; Roewer, 1942: 909; Bonnet 1955: 663–664.
  Synonymy established by Heimer (1984): 175.

Type material

Syntypes of Arcys walcenaeri: 2 females, 1 juvenile, Victoria, Australia (without precise locality data) (MNHN, not examined).

Fig. 23. Arkys brevipalpus Karsch, male from Maré, New Caledonia (ZMUC OW001) (scanning electron micrographs (SEM)).
(A) Left spinnerets, ventral view; (B) left anterior lateral spinneret (ALS), ventral view; (C) left posterior median spinneret (PMS), ventral view; (D) trumpet-like aggregate gland spigots (AG) on right posterior lateral spinnerets (PLS), ventral view. Additional abbreviations: AC, aciniform gland spigot; mAP, minor ampullate gland spigot; MAP, major ampullate gland spigot; PI, piriform gland spigot. Scale bars: 0.01 mm.
**Material examined**

_Syntypes of Arkys clavatus_: female, Peak Downs (22°56’S, 148°05’E, Queensland, Australia) (ZMH, Rack (1961) – catalogue 35); 1 male, 1 female (no precise locality data), Keyserling Collection (BMNH1890.7.1.8472).

_Holotype of Arkys nitidiceps_: juvenile, Torbay (35°01’S, 117°38’E, Western Australia, Australia) or Subiaco (31°56’S, 115°49’E, Western Australia, Australia) (see Remarks below in relation to the type locality), 1905, W. Michaelsen, R. Hartmeyer (ZMB 23250).

_Other material examined. New South Wales_: 1 ♀, Blue Mountains, Megalong Valley (ZMUC); 1 ♀, 1 ♂, Darke’s Forest (AM KS5797).

_Queensland_: 1 ♀, 2 ♂, Queensland (no exact locality) (SAM).

_South Australia_: 2 ♀, 1 ♂ (SAM); 1 ♀, 1 ♂, Bridgewater (SAM); 1 ♂, Urailda (WAMT81159). _Tasmania_: 1 ♀, 1 ♂, Forth Falls (BMNH 1931.7.30.14–18); 2 ♀, 18 juveniles, King Island (NMV K10770); 1 ♀, Ridgeway (NMV K10769). _Victoria_: 1 ♀, 1 ♂, Victoria, no exact locality, Prof. Spencer presented and collected (BMNH 1888.144); 1 ♀, 1 ♂, Coranderrk Reserve, Healesville (WAM 93/67–68); 1 ♀, Croydon (NMV K10773); 1 ♂, Dondangadale (NMV K10771); 2 ♀, Etham (NMV K10778); 1 ♂, Forrest (NMV K10777); 1 ♀, Frankston (NMV K10772); 1 ♂, Healesville (NMV K10774); 1 ♀, Kangaroo Ground (NMV K10775); 1 ♀, Mallacoota (NMV K10776); 1 ♀, 1 ♂, 1 juvenile, Port Albert (NMV K10781, det. _Arkys clavatus_ by Hogg); 1 ♀, Stoney Creek, South Gippsland (NMV K10779); 1 ♀, Stockyard Flat, Howqua River (WAM 93/69). _No locality data_: 5 ♀, 6 ♂, 1 juvenile (NMV K10780, det. _Arkys clavatus_ by Hogg).

_Western Australia_: 3 ♀, 1 ♂, Albany (WAM 93/51, 97/1977–9); 1 ♀, Boddington Bauxite Mine (WAM T66197); 1 ♀, Bridgetown, 15km SW, Mockerdillup Road (WAM T42169); 1 ♀, Busselton, Marine Terrace (WAM 97/1979); 1 ♀, 1 juvenile, Capel (WAM 93/52, T71673); 1 ♀, Darradup, 3 km W (WAM 90/822); 1 ♀, Dog Pool, Shannon National Park (WAM 93/2332); 1 ♀, 1 juvenile, Dryandra (WAM T81161); 1 ♀, Dwellingup (WAM 93/53); 1 ♀, Emu Point (WAM 94/1511); 1 ♀, Geroup Rise, Lot 101 (WAM 93/55); 1 ♀, 1 ♂, Gidgegannup, Waterford Road (WAM 93/56–57); 2 ♀, Jarrahdale, NE, Alcoa Mine (WAM T44691); 1 ♀, Lane-Poole Reserve (WAM 93/54); 1 ♀, Manjimup (WAM 97/1983); 2 ♀, Moingup Spring, Stirling Ranges (WAM 93/58–59); 1 ♀, Mt Barker (WAM 93/1615); 1 ♀, 2 ♀, Murdoch (WAM 93/60–62); 1 ♀, Parryville, W of Denmark (WAM T73534); 1 ♀, Pemberton (WAM 28/73); 1 ♀, Sabina River (WAM 93/63); 1 ♀, Shannon River at Nelson Road (WAM 93/64); 1 ♀, Shannon National Park, Nelson Road at Shannon River (WAM T81379); 1 juvenile, Stirling Range National Park, near ranger station (WAM T85291); 1 ♀, Stokes Inlet (WAM 93/65); 4 ♀, 2 ♀, Torbay Head (Trig point hill) (WAM 82/112–117); 1 ♀, Torbay Head, Lot 40 Trig Point Hill (WAM 93/2875); 1 ♀, 1 ♂, same data (WAM 93/2873–4); 1 ♀, Two Road, Walpole-Nornalup N.P., 11.1 km 282’ W Walpole (ZMUC); 1 ♀, Witchcliffe (WAM 37/1176); 2 ♀, same data (WAM 39/1–2); 1 ♀, Yancheep Inq, Yancheep (WAM 93/66); 1 ♀, Yancheep National Park, Boomerang Gorge (WAM 97/1993); 1 ♀, Yearloop (WAM T42170).

**Remarks**

_Arkyx walckenaeri_ was illustrated in detail in Heimer (1984) and Davies (1988). We depict a male and female here to illustrate the characteristic cephalic protuberances of the genus _Arkys_ (Fig. 204, _B_), that are even more pronounced in the type species _A. lancearius_ (Fig. 20C, _D_).

_Arkyx nitidiceps_ was described based upon a juvenile female from ‘Stat. 163, Torbay’ (Michaelsen and Hartmeyer 1908: p. 116 (translated from German): ‘19 August 1905, freshwater pond, lowland South of the Stirling Range’) in Western Australia (Simon 1908). The holotype female lodged in ZMB, however, is clearly labelled ‘Station 109’, which, according to Michaelsen and Hartmeyer (1908) is Subiaco (Michaelsen and Hartmeyer 1908: p. 114 (translated from German): ‘9/12/16 May, 26 June, 21 July, 6 August, 3/27 September, 10 October, forest, coastal area.’). Although it is impossible to solve the type locality of _A. nitidiceps_, only one species of _Arkys_ is currently known from Western Australia and known locality data includes both Torbay and Subiaco (Fig. 24).

Adult spiders from Torbay examined by Main (1982), and re-examined as part of this study, exhibit very little variation from the adults of _A. walckenaeri_ described by Heimer (1984). In addition, we have been able to compare the Western Australian specimens with many collected in south-eastern Australia (see _Other material examined_ above) and we cannot detect any appreciable differences, especially in the morphology of the male pedipalp and female epigyne. Therefore, _A. nitidiceps_ must be considered a junior synonym of _A. walckenaeri._

Collection records indicate extreme seasonality for adult specimens of _A. walckenaeri_ from Western Australia, which, except for a single female collected in May, are from December to February. These observations are in accordance with seasonal data presented by Main (1982).

**Distribution**

Although _Arkys walckenaeri_ and its junior synonyms have been recorded from a vast area, including eastern Australia, south-western Australia and Java (Main 1982; Heimer 1984; Guerin 1986), it has not been collected on a consistent basis. Indeed, the three papers listed above cite only six definite Australian localities (two from New South Wales, two from Western Australia, and two from South Australia) along with unspecified records from Victoria, Tasmania and Queensland. The records presented here for Western Australia (Fig. 24) indicate a less ‘patchy’ distribution, which will probably be augmented by further collecting in suitable habitats.
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