

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

Volker W. Framenau<sup>A,B,F</sup>, Nikolaj Scharff<sup>C,D</sup> and Mark S. Harvey<sup>A,B,E</sup>

<sup>A</sup>Department of Terrestrial Zoology, Western Australian Museum, Locked Bag 49, Welshpool DC, Western Australia 6986, Australia.

<sup>B</sup>School of Animal Biology, University of Western Australia, Crawley, Western Australia 6009, Australia.

<sup>C</sup>Natural History Museum of Denmark, Zoological Museum, University of Copenhagen, Universitetsparken 15, 2100 Copenhagen, Denmark.

<sup>D</sup>Center for Macroecology, Evolution and Climate, Department of Biology, University of Copenhagen, Universitetsparken 15, 2100 Copenhagen, Denmark.

<sup>E</sup>Division of Invertebrate Zoology, American Museum of Natural History, Central Park West at 49th Street, New York, NY 10024-5192, USA; and California Academy of Sciences, Golden Gate Park, San Francisco, CA 94103-3009, USA.

<sup>F</sup>Corresponding author. Email: volker.framenau@museum.wa.gov.au

**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 alticephala* 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 alticephala* Urquhart, 1891, and *Arkys nitidiceps* Simon, 1908 is proposed as a junior synonym of *Arkys walckenaeri* Simon, 1879.

**Additional keywords:** *Aerea*, *Archemorus*, *Arkys*, Australasia, *Neoarchemorus*, new species, phylogeny, taxonomy.

## 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 *Dema* 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 *Dema* with *Cyrtarachne* Thorell, 1868. Subsequently, Strand (1929, p. 18) doubted this placement ('...if, as I suppose, the type of *Dema* Karsch, *D. simplex* Karsch, is generically distinct from *Cyrtarachne*...'), translated from the original German) and, realising that *Dema* was preoccupied by a beetle genus, *Dema* Gistel, 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 *Dema simplex* and the syntypes of *Paraplectanoides cerulus* Simon, 1908 as part of a current

revision of the Australian Araneidae suggested both species to be congeneric and differing considerably from both *Cyrtarachne* and *Paraplectanoides* Keyserling, 1886 (type species *P. crassipes* 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 prolateral side of the tarsus of the first leg in males, presumed to be of chemosensory nature, suggested a placement in the subfamily Arkyinae L. Koch, 1872, as this structure is currently only known in *Arkys* (Heimer *et al.* 1982; Heimer 1984).

The systematic placement of *Arkys* 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 *Arkys 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 Arcyidae a tribe in the Argiopinae Simon, 1890 (more or less equivalent to present day Araneidae). Numerous other authors placed *Arkys* 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 *Arkys* 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 *Arkys*. This suggested that *Arkys* belonged in the Araneoidea, the only known group of spiders possessing such silk glands. Davies (1988) suggested a placement with 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 *Arkys* 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 *Arkys* and *Archemorus*. A recent study by Blackledge *et al.* (2009) tested the placement of *Arkys* 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 Haplogynae 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 *Arkys* 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 *Arkys* 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 *Arkys*) was sistergroup to *Arkys* and the Tetragnathidae combined. Analyses of the morphological data only, however, placed *Arkys* as sister to a clade of araneid genera (*Gasteracantha* Sundevall, 1833, *Cyrtophora* Simon, 1864, *Argiope* Audouin, 1826 and *Araneus* Clerck, 1758) (Blackledge *et al.* 2009), thereby supporting Scharff and Coddington's (1997) placement of *Arkys* within Araneidae. We here retain *Arkys* 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.

*Arkys* (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. alticephala* 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 *Arkys* 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 *Arkys*. 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 *Arkys*.

## Materials and methods

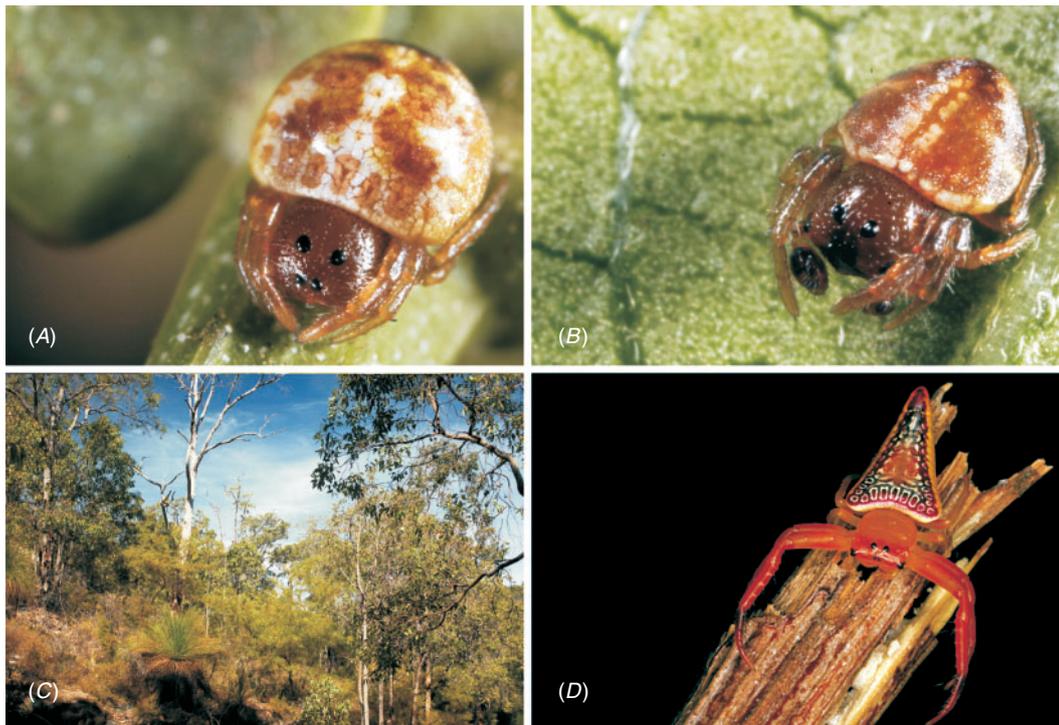
### Morphology and illustrations

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](http://www.lmscope.com/index_e.html)) to a Leica M16A stereomicroscope and combined with Auto Montage (version 5.02) software from Syncrosopy. 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 redescrptions 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.

*Character abbreviations: eyes*

ALE	anterior lateral eyes
AME	anterior median eyes
PLE	posterior lateral eyes
PME	posterior median eyes
MOQ	median ocular quadrangle

*Character abbreviations: spinnerets*

AC	aciniform gland spigot(s)
AG	aggregate gland spigot(s)
ALS	anterior lateral spinnerets
CY	cylindrical gland spigot(s)
MAP	major ampullate gland spigot(s)
mAP	minor ampullate gland spigot(s)
nu	nubbin(s)
PI	piriform gland spigot(s)
PMS	posterior median spinnerets
PLS	posterior lateral spinnerets

*Acronyms of institutes*

AM	Australian Museum, Sydney, Australia
BMNH	Natural History Museum, London, United Kingdom
MNHN	Museum National d'Histoire Naturelle, Paris, France
NMV	Museum Victoria, Melbourne, Australia
QM	Queensland Museum, Brisbane, Australia
SAM	South Australian Museum, Adelaide, Australia
WAM	Western Australian Museum, Perth, Australia
ZMB	Museum für Naturkunde, Humboldt Universität zu Berlin, Germany
ZMH	Zoologisches Institut und Zoologisches Museum der Universität Hamburg, Germany
ZMUC	Zoological Museum, University of Copenhagen, Denmark

*Phylogenetic analysis*

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 a within genus phylogeny (species-level phylogeny) with a further test of *Demadiana* monophyly.

*Genus-level phylogeny*

To test the generic placement of *Demadiana* and to carry out a preliminary test of the monophyly of the genus we used the published data matrix of Scharff and Coddington (1997), which included 57 araneid genera and 13 genera from 8 outgroup families, scored for 82 morphological and behavioural characters. To this matrix we added data for *Demadiana simplex* (Karsch, 1878), the type species of the genus *Demadiana* (0001110000000000-000-00000010000000001010200011000?2101206100000021002112-----), and *Demadiana cerula* (Simon, 1908) (0001110000000000-000-00000010000000001010200011000?210120610000002100212-----). Thus, the matrix we analysed had 72 taxa and 82

characters. 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* Thorell, 1895; Kuntner and Hormiga 2002 – *Singafrotypa* Benoit, 1962; Smith 2005 – *Cyphalonotus* Simon, 1895, *Ideocaira* Simon, 1903, *Micropoltys* Kulczyński, 1911 and *Poltys* 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*, male (AM KS65324); *D. cerula*, male (WAM 93/47), female (WAM 93/49). Material used as outgroup taxa: *Arkys alticephala*: male from Western Australia, Shannon National Park (WAM 93/2330) and female from Western Australia, Capel (WAM T76095); *A. walckenaeri*: male and female from Western Australia, Gidgegunnup (WAM 93/56–7); *Austracantha minax* (Thorell, 1859): male and female from Western Australia, 7–8 km

**Table 1. Morphological characters and character states for species-level phylogeny of *Demadiana****Cephalothorax*

(1) *Carapace, anterior margin, shape*: (0) straight, (1) rounded.

Some species of *Demadiana* have a clearly rounded (convex) anterior carapace margin (e.g. Figs 10C, 15A) in comparison to those with a straight margin (e.g. Figs 10A, 15C). This character appears to be partly related to whether the lateral eyes sit on a distinct tubercle or not, and is particularly pronounced in males. All outgroup taxa have a straight anterior carapace margin (e.g. Figs 19A, B, 20A–D).

(2) *Carapace, sternum, paturons, setal pits with spherical socket*: (0) absent, (1) present.

Setal pits with spherical sockets are clearly present in all *Demadiana* species (Fig. 3A–D). They cover carapace, sternum and chelicerae and are considered a synapomorphy for the genus. The setal sockets of the outgroups have a different morphology lacking the spherical socket (Fig. 21B).

(3) *Carapace, setae*: (0) glabrous, (1) hirsute.

This character conforms to character (41) of Scharff and Coddington (1997). The specialised setae that sit in the setal pits of *Demadiana* are not considered homologous to the setae present in *Arkys alticephala* and *Austracantha minax*.

(4) *Female cephalon* (Scharff and Coddington (1997), character 47): (0) normal, (1) enlarged.

See Scharff and Coddington (1997) for a definition of this character.

*Abdomen*

(5) *Female abdominal surface*: (0) soft, (1) sclerotised.

The female abdomens of *Austracantha*, *Arkys* and *Demadiana* are sclerotised whereas females of all other outgroup taxa have soft abdominal surfaces.

*Spinnerets*

(6) *Posterior lateral spinnerets, trumpet-shaped aggregate gland spigots extremely elongated*: (0) absent, (1) present.

Trumpet-like aggregate gland spigots with spindle-shaped cross-section at their bases are present in all Arkyinae and are here considered a synapomorphy for this subfamily (*Demadiana*, Figs 4D, 5D; *Arkys*, Figs 22D, 23D). In *Demadiana* these form long, apically widening tubes, much longer than in *Arkys*. As the aggregate gland spigots are not trumpet-shaped in *Austracantha*, this character is coded not applicable. The presence of trumpet-shaped aggregate gland spigots is not coded in this analysis, as it is not informative within the selection of taxa.

*Appendages*

(7) *Females, tibia I and II, prolateral row of strong spines*: (0) absent, (1) present.

Although strong spination of the first one or two pairs of legs is comparatively common in male araneids, this is not the case for females. However, *Arkys* females have a row of strong spines prolaterally on metatarsi and tibiae I and II (Figs 19A, 20A; see also Balogh 1978: figs 48–55). These rows of spines are absent in females of *Demadiana* (e.g. Figs 1A, 8B, 10D, 15B, D).

*Male sexual characters*

(8) *Males, tarsus I, elongated patch of dense setae*: (0) absent, (1) present.

Males in the subfamily Arkyinae have an elongated dense patch of setae on the prolateral face of their tarsi I (Fig. 2A–D; see also Heimer *et al.* 1982: figs 1a–e). This character is included here to illustrate the synapomorphy for the Arkyinae, although it is uninformative within our taxon sample of the species-level phylogeny.

(9) *Male, pedipalp, median apophysis, keel*: (0) absent, (1) present.

The median apophysis of *Demadiana* is either a flat, two dimensional structure (Figs 9A, 11A, 14A, 17A) or may be more complicated, three-dimensional with an apical keel (Figs 12A, 16A). *Arkys* and *Austracantha* have a flat median apophysis.

(10) *Male, pedipalp, median apophysis, prongs*: (0) absent, (1) present.

Two long prongs are characteristic for both species of *Arkys* included here (see Heimer 1984, Fig. 23: *A. walckenaeri*; Fig. 21: *A. alticephala* [sub *A. simsoni*]).

Neither *Demadiana* nor *Austracantha* have these prongs, which in our taxon sample represent a synapomorphy for *Arkys*.

(11) *Male, pedipalp, paracymbium, ridges*: (0) absent, (1) present.

In most species of *Demadiana* (and *Arkys* and *A. minax*), the paracymbium is a simple hook, sometimes with a broad base. However, *D. cerula* and *D. diabolus* have more complicated paracymbia with two distinct ridges (Figs 12A, 13B, 16A, B). Although the paracymbium in *A. simsoni* is a rather complex hook (Heimer, 1984, Fig. 21), it does not have ridges, which are coded absent (0) for this species.

(12) *Male, pedipalp, direction of embolus tip in relation to median apophysis*: (0) embolus tip curves against median apophysis, (1) embolus tip follows median apophysis.

This character distinguishes *Arkys* (and *A. minax*) from *Demadiana*. The embolus in *Demadiana* alters its basic curvature relatively early and turns into the tegulum following a somewhat anticlockwise direction along the median apophysis most of its way. Its tip is then accompanied by the conductor (Fig. 9C). In contrast, the embolus of *Arkys* does not curve into the tegulum but follows a clockwise direction into the median apophysis (e.g. Heimer 1984, figs 5, 8, 15). However, the basic embolus direction is considered to curve clockwise in both groups (character 24 in Scharff and Coddington 1997).

(13) *Male, pedipalp, conductor, sclerotisation*: (0) absent, (1) present.

The conductor of the male pedipalp is generally a soft, lamellar structure (e.g. Figs 11A, 14A), but in some species examined here, a clear sclerotisation is evident by thickness and darker colouration (Figs 9A, 12A).

(14) *Male, cymbium* (modified from Scharff and Coddington (1997), character 5): (0) dorsal, (1) mesal.

See Scharff and Coddington (1997) for a definition of this character.

(15) *Araneid radix* (modified from Scharff and Coddington (1997), character 16): (0) absent, (1) present.

See Scharff and Coddington (1997) for a definition of this character.

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 genitalic characters for the species-level phylogenetic analysis, since two species of *Demadiana* are only known from males.

**Table 2.** Phylogenetic matrix of *Demadiana* species-level phylogeny

Taxa	Characters	
	0000000001 1234567890	11111 12345
<i>Linyphia triangularis</i>	00100000--	0-000
<i>Argiope bruennichi</i>	0010000000	00010
<i>Austracantha minax</i>	0011100000	00110
<i>Arkys alticephala</i>	0011101101	00011
<i>Arkys walckenaeri</i>	0001101101	00011
<i>Demadiana simplex</i>	1101110100	01111
<i>Demadiana carrai</i>	010111-100	01011
<i>Demadiana cerula</i>	1101110110	11111
<i>Demadiana complicata</i>	010111-100	01011
<i>Demadiana diabolus</i>	1101110110	11111
<i>Demadiana milledgei</i>	0101110100	01111

### Phylogenetic analyses

The parsimony analyses were performed using the computer programs TNT version 1.1 (Goloboff *et al.* 2003) and PAUP\*4.0 (Swofford 2002). Mesquite version 2.0 (Maddison and Maddison 2007) was used to build and edit the character matrices and WinClada (Nixon 2002) was used to study character optimisations on the cladograms. Multistate characters (12 in the modified matrix of Scharff and Coddington and none in the current *Demadiana* matrix) were treated as non-additive (unordered). TNT was used to calculate branch support (Bremer 1994).

### 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 longitude, 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)

Species are listed in alphabetical order similar to the taxonomic part of this study, with the exception of the type species *D. simplex*, which is listed first. NSW, New South Wales; Qld, Queensland; SA, South Australia; Vic., Victoria; Tas., Tasmania; WA, Western Australia

	Distribution	Remarks
<i>Demadiana simplex</i> (Karsch, 1878)	NSW, SA, Vic., WA	Type species
<i>D. carrai</i> , sp. nov.	NSW	Known from male only
<i>D. cerula</i> (Simon, 1908)	WA	
<i>D. complicata</i> , sp. nov.	Qld	Known from male only
<i>D. diabolus</i> , sp. nov.	SA, Tas.	
<i>D. milledgei</i> , sp. nov.	NSW, Vic.	

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]

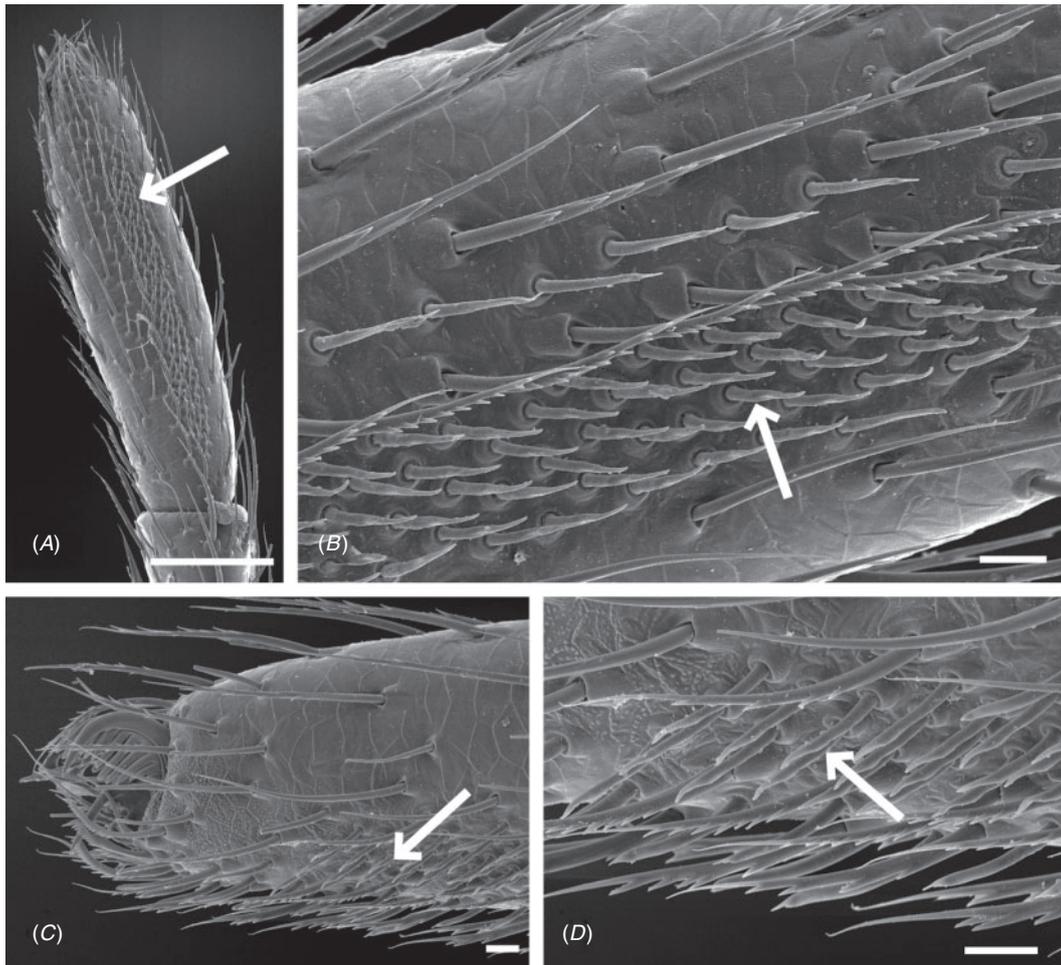
*Demadiana* do not have any of the peculiar leg appendages or structures considered in Scharff and Coddington's (1997) study, such as macrosetae on coxae and trochanter of leg IV [32], coxal hooks on male leg I [33], or male femoral II grooves [34] or trichobothria [35]. However, males of *Demadiana* 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.



**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.

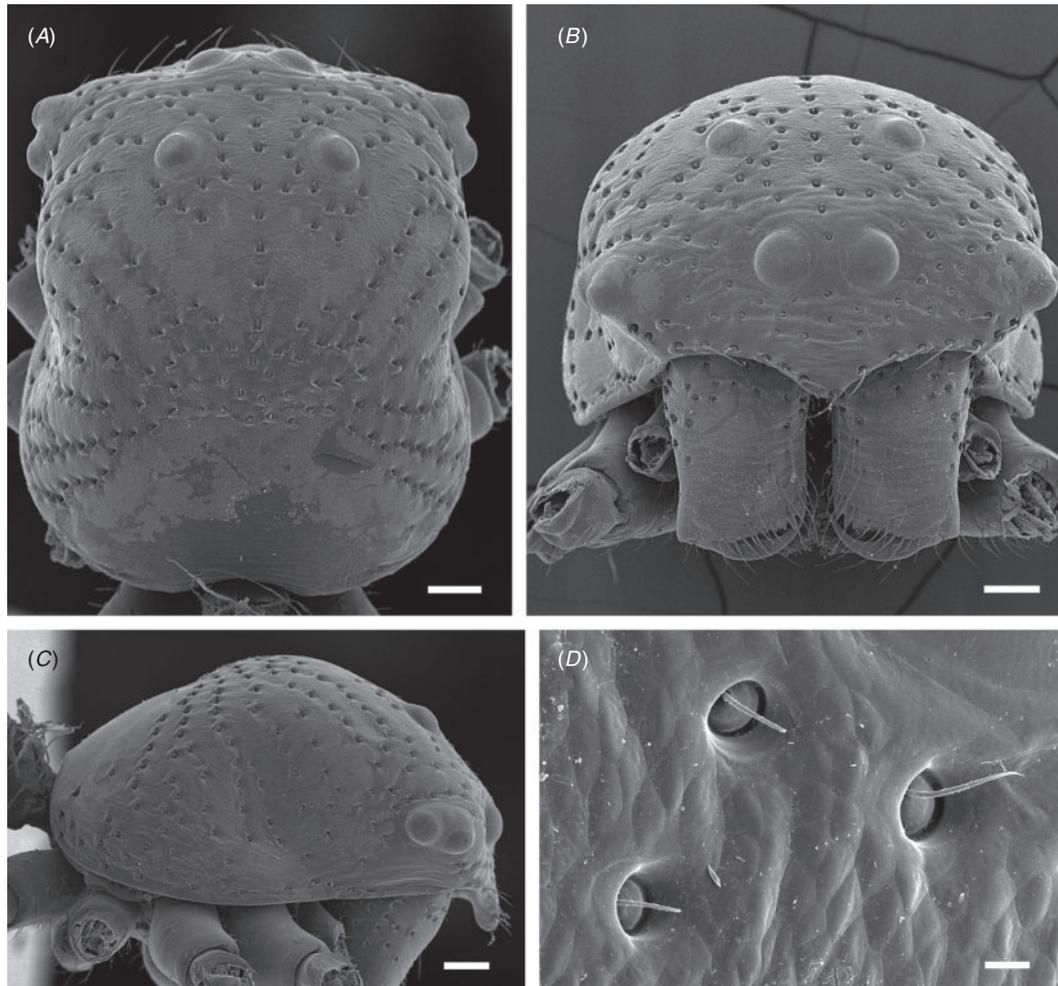
#### Abdomen [55–67]

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. 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.

but the posterior median spinnerets do not have aciniform brushes [73] (Figs 4C, 5C).

#### *Behaviour* [74–82]

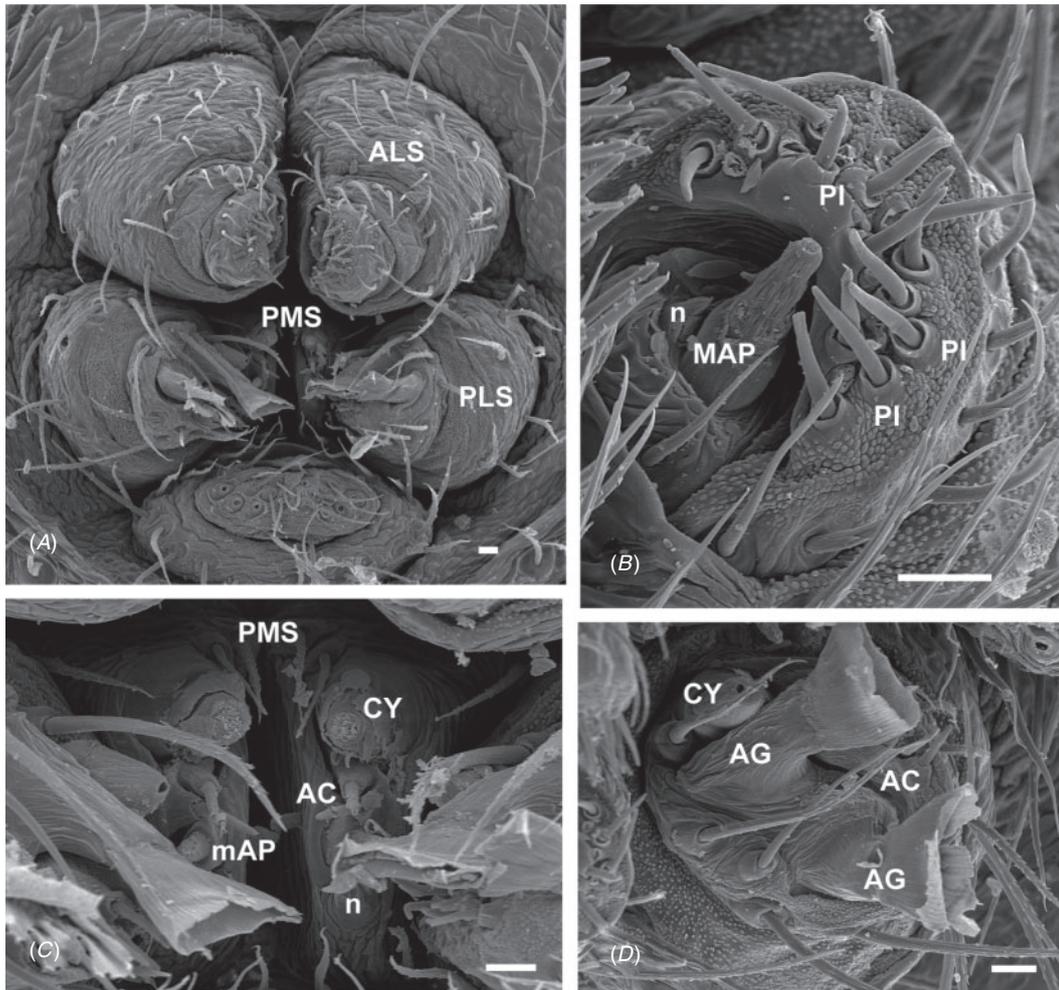
Most characters regarding web-building and prey capture were scored inapplicable. Not much is known about the behaviour of these comparatively rarely collected spiders; however it appears that they do not build an orb-web [74] (observed for *D. cerula*, M. S. Harvey and J. M. Waldoock, pers. obs.).

#### *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

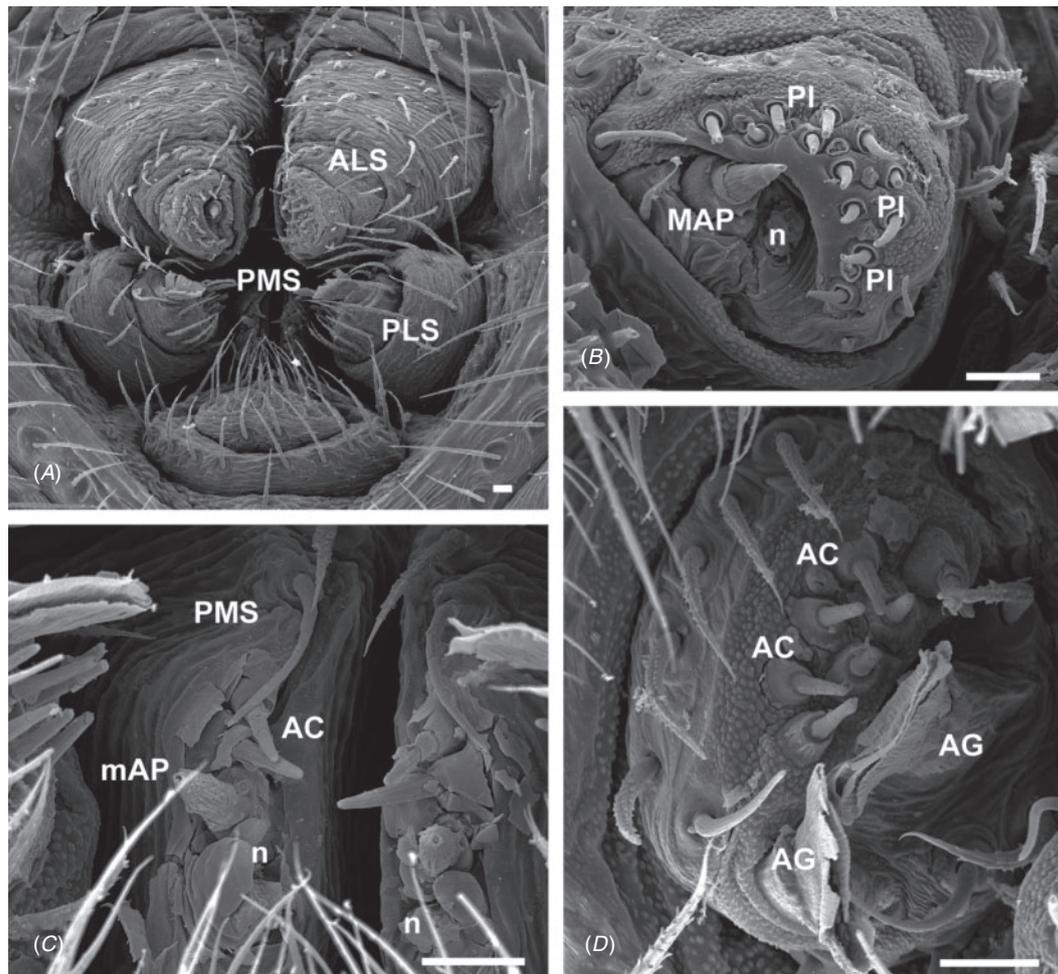


**Fig. 4.** *Demadiana cerula* female from Stirling Range National Park, Western Australia (ZMUC) (scanning electron micrographs, SEM). (A) Spinnerets, ventral view; (B) left anterior lateral spinneret (ALS), ventral view; (C) posterior median spinnerets (PMS), ventral view; (D) trumpet-like aggregate gland spigots (AG) on right posterior lateral spinnerets (PLS), ventral view. Additional abbreviations: AC, aciniform gland spigot; CY, cylindrical gland spigot; mAP, minor ampullate gland spigot; MAP, major ampullate gland spigot; nu, nubbin; PI, piriform gland spigot. Scale bars: 0.01 mm.

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 procurved (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)*).



**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 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; nu, nubbin; PI, piriform gland spigot. Scale bars: 0.01 mm.

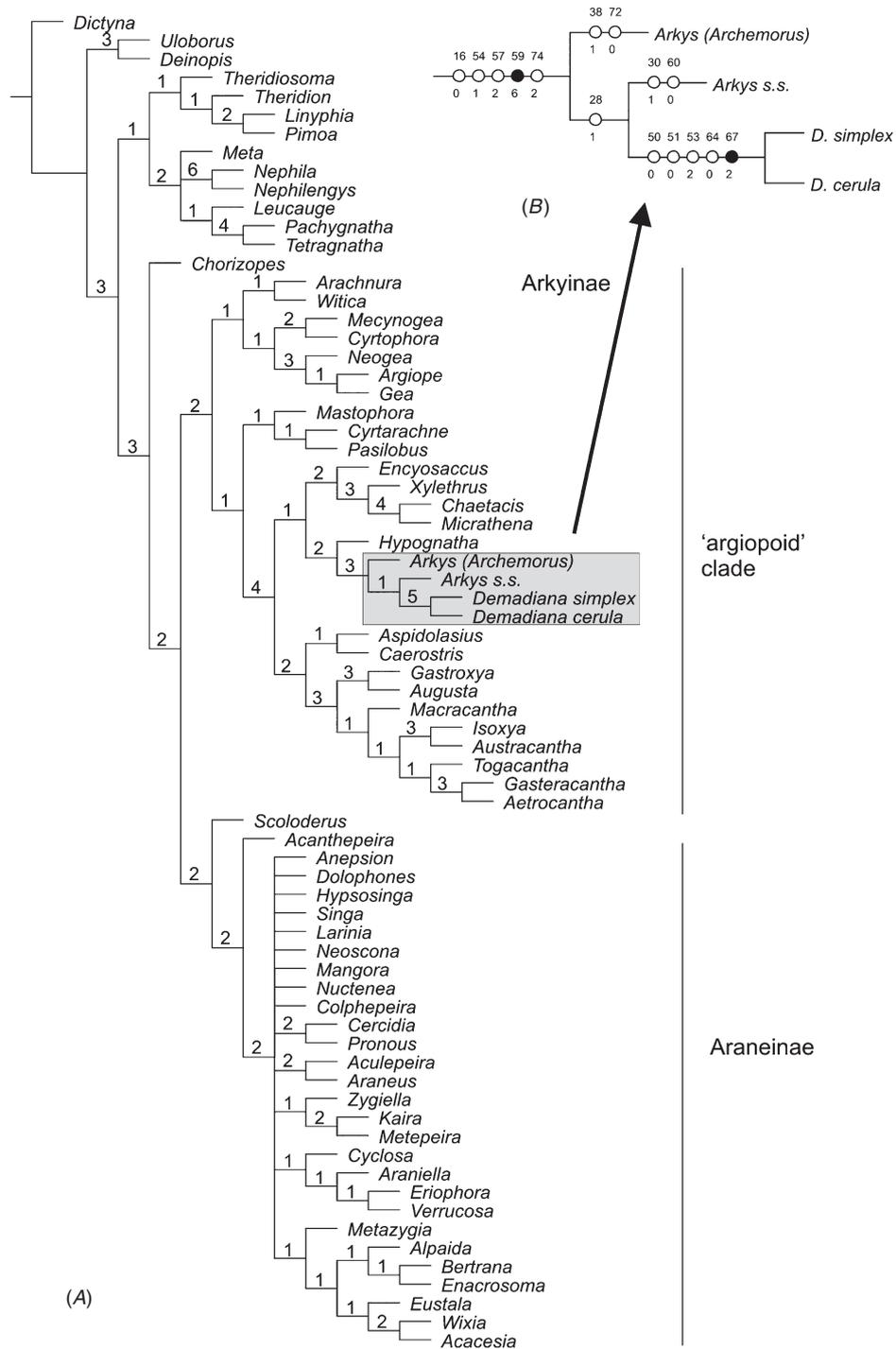
### Species-level analysis

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*

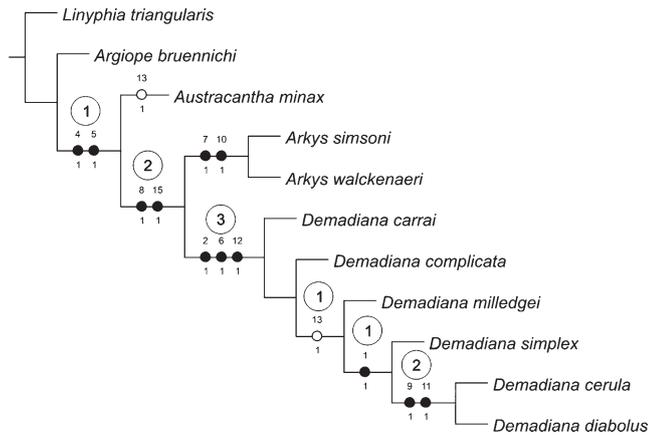
In a review of the genera *Arkys* and *Archemorus*, Heimer (1984) concluded that there was insufficient morphological differentiation to support separate genera, and synonymised *Archemorus* with *Arkys*. He was apparently unaware of the generic names *Aerea* and *Neoarchemorus*, which are clearly close 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. 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); homoplasious characters in open circles, non-homoplasious characters in full circles.

*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. 7.** Species-level phylogeny for *Demadiana*. For characters and character states see Table 1; homoplasious characters are in open circles, non-homoplasious characters are in full circles. Numbers in circles above clades denote Bremer support values.

*Archemorus* is ever removed from the synonymy of *Arkys*, then *Aerea* would become the valid generic name based on priority.

## Discussion

### Morphology

The tactile setae on carapace, sternum, chelicerae and abdomen of araneids normally insert in a narrow, pocketed socket (*sensu* Foelix 1982: p. 72, fig. 62), but some araneids have modified sockets that are broad, flat and hooded and the setae themselves may be of characteristic shape (Scharff and Coddington 1997: p. 385, fig. 47). However, no other known araneid genera have their tactile setae inserted in deep pits with spherical sockets as seen in *Demadiana* (Fig. 3D). Deep pits on the carapace and sternum are also seen in the genus *Carathea* Moran, 1986 (N. Scharff, pers. obs.) and *Perissopmeros* Butler, 1932 (both Malkaridae) (Platnick and Forster 1987), but these are not associated with tactile setae.

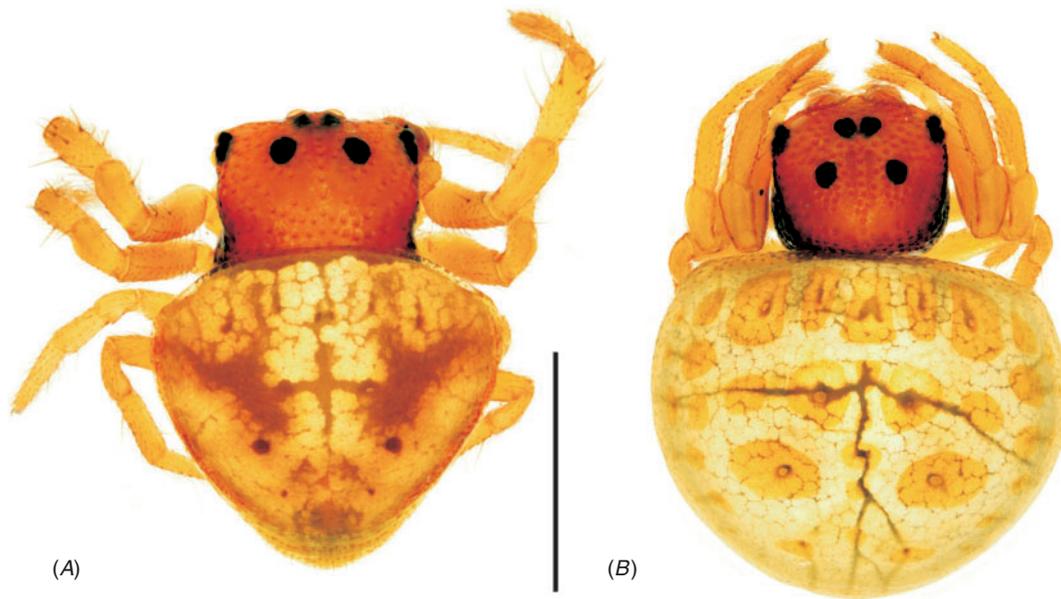
Aggregate gland spigots (AG) are only found in araneoids (Griswold *et al.* 2005). They are always paired and flank a single flagelliform gland spigot (FL) on the posterior lateral spinnerets (PLS). They are used to produce the viscid glue of the sticky line (the FL fibre). In araneoids they are normally 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 *Arkys* 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; Agnarsson 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.

### Genus-level phylogeny

*Demadiana* belongs to the subfamily Arkyinae, which was represented in Scharff and Coddington’s (1997) phylogenetic analysis by *Arkys s.s.* and *Arkys (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 homoplasious characters support the monophyly of the Arkyinae, such as absence of a radix [16], the procurved 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 *Arkys* (Blackledge *et al.* 2009), the absence of a radix can be considered true absence. The procurved 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*, *Arkys s.s.* and *Arkys (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 Cyrtarachninae Simon, 1892.

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



**Fig. 8.** *Demadiana simplex* (Karsch). (A) Male from Wyrabalong 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.

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.

#### Taxonomy

Family **ARANEIDAE** Clerck, 1758

Subfamily **ARKYINAE** L. Koch, 1872

Arcyinae Koch, 1872: 215. – Simon, 1879: 55.

Arciinae Simon, 1890: 81.

Arcyae Simon, 1895: 898.

Arkyae Roewer, 1942: 908.

Arciinae Scharff & Coddington, 1997: 492.

#### Diagnosis

Male Arkyinae 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 Arkyinae 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 individually 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 carapaceal ‘horns’ (well developed in the type species of *Arkys*, *A. lancearius*, Fig. 20C, 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 first 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 alticephala* and *Aerea magnifica* from Tasmania as conspecifics of *A. simsoni*. Urquhart’s (1891) portrayal of *A. alticephala* 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. alticephala* and *A. magnifica* we consider *Aerea* to be identical with *Archemorus*, as *A. alticephala* (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* Gistel, 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. carrai* and *D. milledgei*), nearly touching; posterior eye row strongly procurved 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. Altogether 14 PI, all with short bases and a few tartipores 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:** epigyne 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* (Karsch, 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.

- Median apophysis three dimensional structure with apical keel (Figs 12A, B, 13C, 16A, B); female epigyne with simple V-shaped scape (Fig. 12C) or with T-shaped atrium and without scape (Fig. 16C).....2  
Median apophysis of male pedipalp a two-dimensional plate, no apical keel (e.g. Figs 9A, 11A, 14A, 17A); female epigyne with narrow scape and separate V-shaped sclerotisation anteriorly (Fig. 9D) or without scape and with long, triangular anterior margin (Fig. 17C).....3
- 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. 16A, B); female without scape (Fig. 16C); currently known from Tasmania and South Australia only.....*D. diabolus*, sp. nov.
- Anterior margin of carapace convex (Figs 8A, B, 10B); median apophysis of male pedipalp apically truncated (Figs 9A, 14A); epigyne with narrow scape (Fig. 9D).....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
- 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 anteriorly (Fig. 9C); apparently widespread (New South Wales, South Australia, Victoria, Western Australia).....*D. simplex* (Karsch)
- 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.  
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* (Karsch, 1878)

(Figs 8A, B, 9A–E, 18)

*Dema simplex* Karsch, 1878: 801–802.

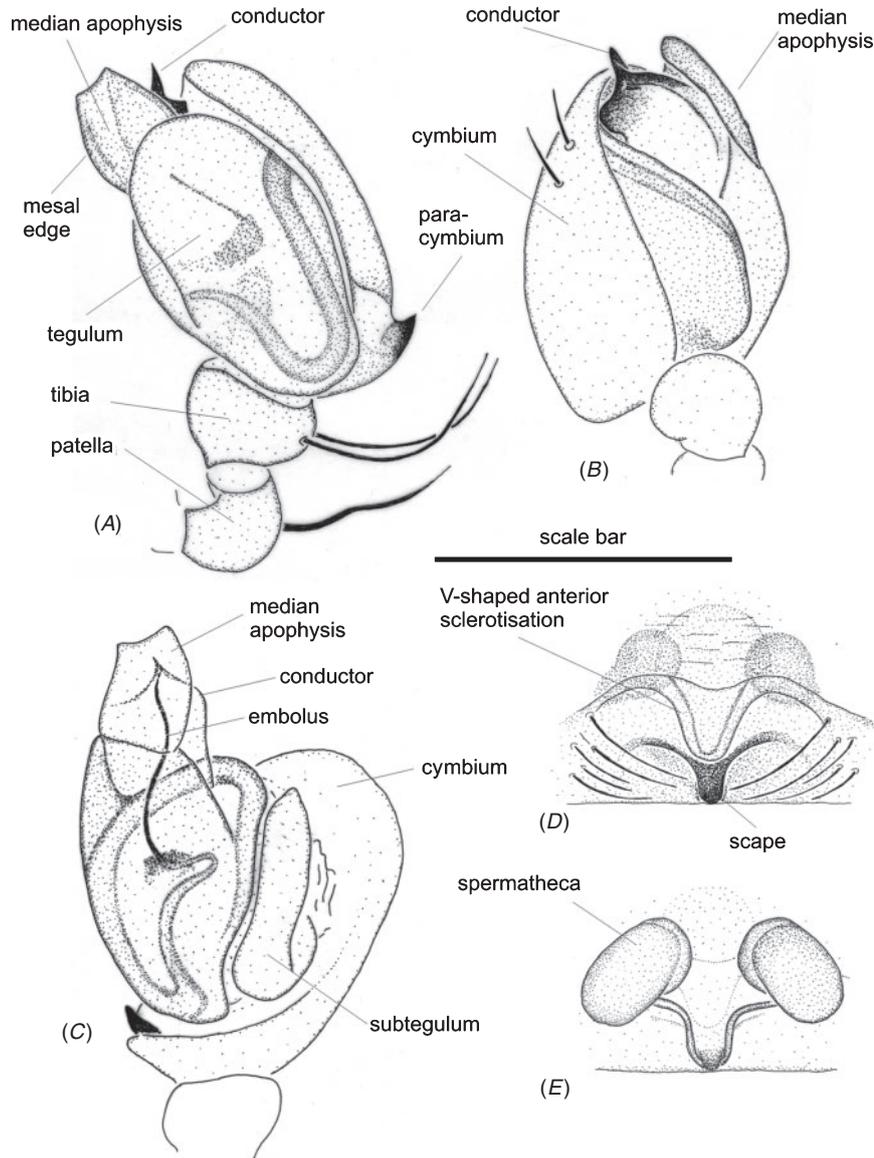
*Cyrtarachne simplex* (Karsch, 1878). – Roewer, 1942: 897; Bonnet, 1956: 1347.

*Demadiana simplex* (Karsch, 1878). – Strand, 1929: 18.

### Material examined

**Holotype.** Female, no exact locality (New South Wales, Australia), no date, E. Daemel (ZMB 1308).

**Other material examined.** **Australia: New South Wales:** 1 ♀, Booti Booti National Park (AM KS65325); 1 ♂, same locality (AM KS65323); 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 ♂, Wyrribalong



**Fig. 9.** *Demadiana simplex* (Karsch), male from Wyrabalong National Park, New South Wales, Australia (AM KS64324) and female from Six Mile Creek, Victoria Australia (NMV K9985). (A) Left male pedipalp, retrolateral view; (B) left male pedipalp, mesal view; (C) left male pedipalp, antero-retrolateral view, expanded; (D) female epigyne, ventral view; (E) female epigyne, dorsal view. Scale bar: 0.2 mm.

National Park (AM KS65322); 1 ♂, same data (AM KS65324). **South Australia:** 1 ♀, Arcoona Creek, near Sambot Waterhole, Gammon Ranges National Park (SAM NN24389); 1 ♀, same data (SAM NN24390); 1 ♀, Douglas Scrub, near McLaren Flat (SAM NN24385); 1 ♀, McLaren Vale (SAM NN24388); 1 ♀, Sellicks-Aldinga Scrub (SAM NN24386–7). **Victoria:** 1 ♀, Six Mile Creek (NMV K9985); 1 ♂, Cement Creek Reserve, 2.2 km ESE of Mt Donna Buang (NMV K6804). **Western Australia:** 1 ♂, Dwellingup (WAM 93/48).

#### 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 Wyrabalong 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. 8A). Venter marginally whitish, centrally dirty yellow. Spinnerets light brown.

*Pedipalps* (Fig. 9A–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  $\pm$  s.d.): TL 1.82–1.91, 1.87  $\pm$  0.05; CL 1.00–1.03, 1.01  $\pm$  0.02; CW 0.85–0.91, 0.89  $\pm$  0.03;  $n=3$ .

*Female* (from Six Mile Creek, NMV K9985)

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

*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. 8B). Venter light grey. Spinnerets light brown.

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

*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  $\pm$  s.d.): TL 2.64–3.24, 2.90  $\pm$  0.22; CL 1.12–1.27, 1.18  $\pm$  0.05; CW 0.97–1.09, 1.03  $\pm$  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 10A, 11A, 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. 10A), 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. 11A), but wider than long in *D. milledgei* and the tip is blunt (Fig. 17A, 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. 10A).

*Chelicerae*: orange-brown.

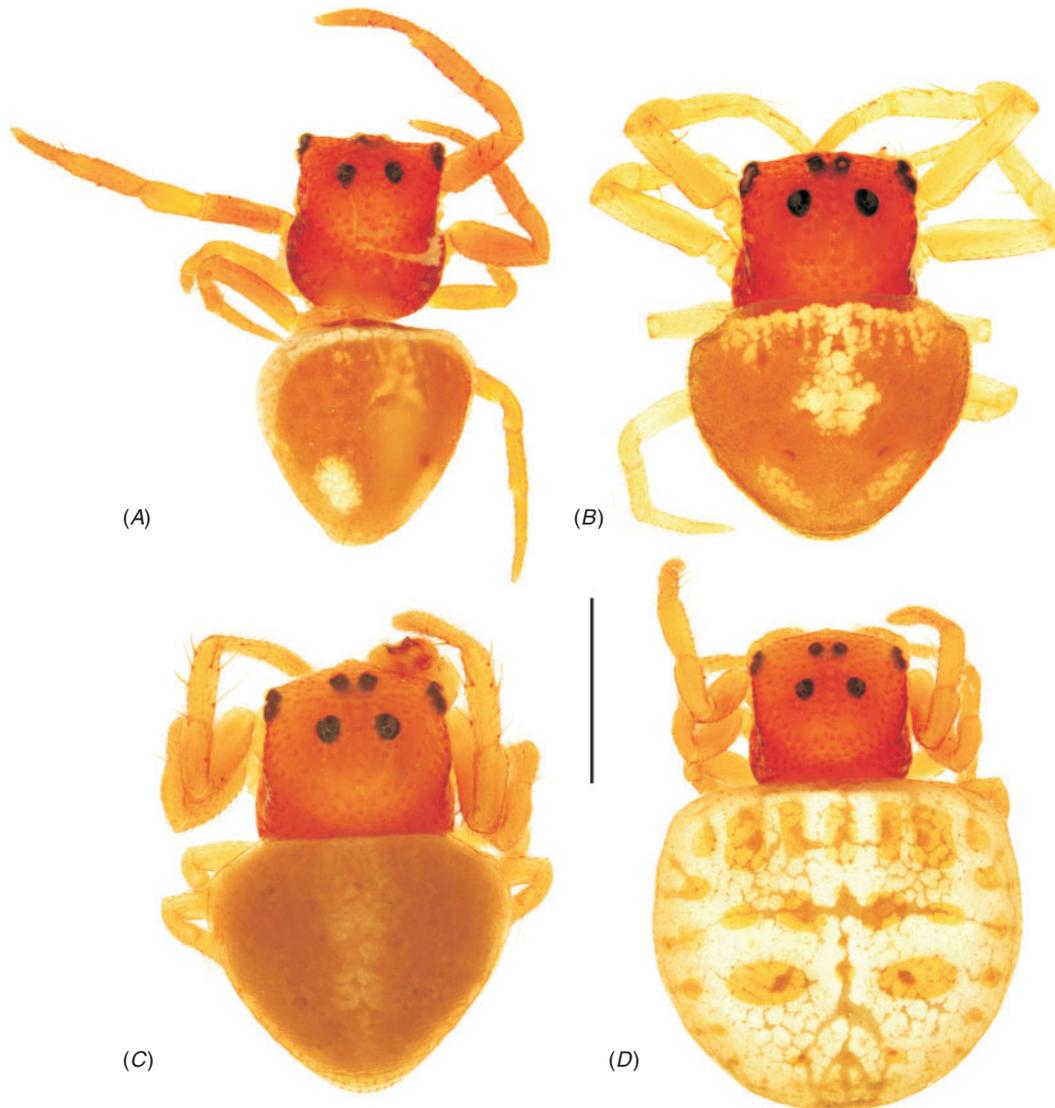
*Sternum*: light orange-brown, glabrous.

*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. 10A). Venter beige, covered in brown setae that are densest medially. Spinnerets light brown.

*Pedipalps* (Fig. 11A, 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



**Fig. 10.** *Demadiana* spp. (A) Holotype male of *D. carrai*, sp. nov. from Carrai State Forest, New South Wales (AMKS66693); (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.

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).

#### Etymology

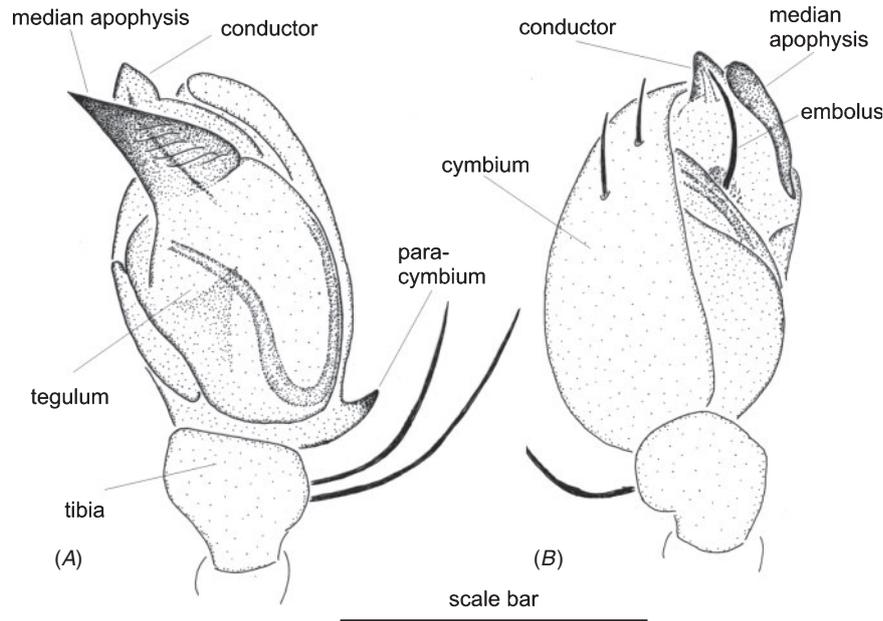
The specific epithet is a noun in apposition derived from the type locality of this species, the Carrai State Forest in New South Wales.

#### *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 cerula* Simon, 1908: 428. – Rainbow, 1911: 201; Roewer, 1942: 893.

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



**Fig. 11.** *Demadiana carrai*, sp. nov., male holotype from Carrai State Forest, New South Wales, Australia (AM KS66693). (A) Left male pedipalp, retrolateral view; (B) left male pedipalp, mesal view. Scale bar: 0.2 mm.

### Material examined

*Syntypes.* 1 ♂, 1 ♀, Brown Station, Dirk Hartog Island (25°44'S, 113°01'E, Western Australia, Australia), Hamburger Südwest-australische Forschungsreise, Station 67, 7 & 21.vi. & 14.ix.1905, W. Michaelsen, R. Hartmeyer (MNHN 23891); 1 ♀, same data, except 21.vi.1905 (ZMB 24042).

*Other material examined.* **Australia: Western Australia:** 7 ♂, 6 ♀, 12 juveniles, Dog Pool, Shannon National Park (WAM 97/1994–7, 97/2017–21, 97/2023–8); 1 ♂, Lake Pooginup (WAM 93/50); 1 ♀, Lucy Beach, Greenough (WAM 93/49); 1 ♀, 1 juvenile, Moingup Spring, Stirling Range National Park (WAM 97/2039–40); 1 ♂, Pemberton Youth Hostel (WAM 93/47); 2 ♂, 7 ♀, 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.

*Sternum:* light red-brown, medially glabrous.

*Abdomen:* 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.

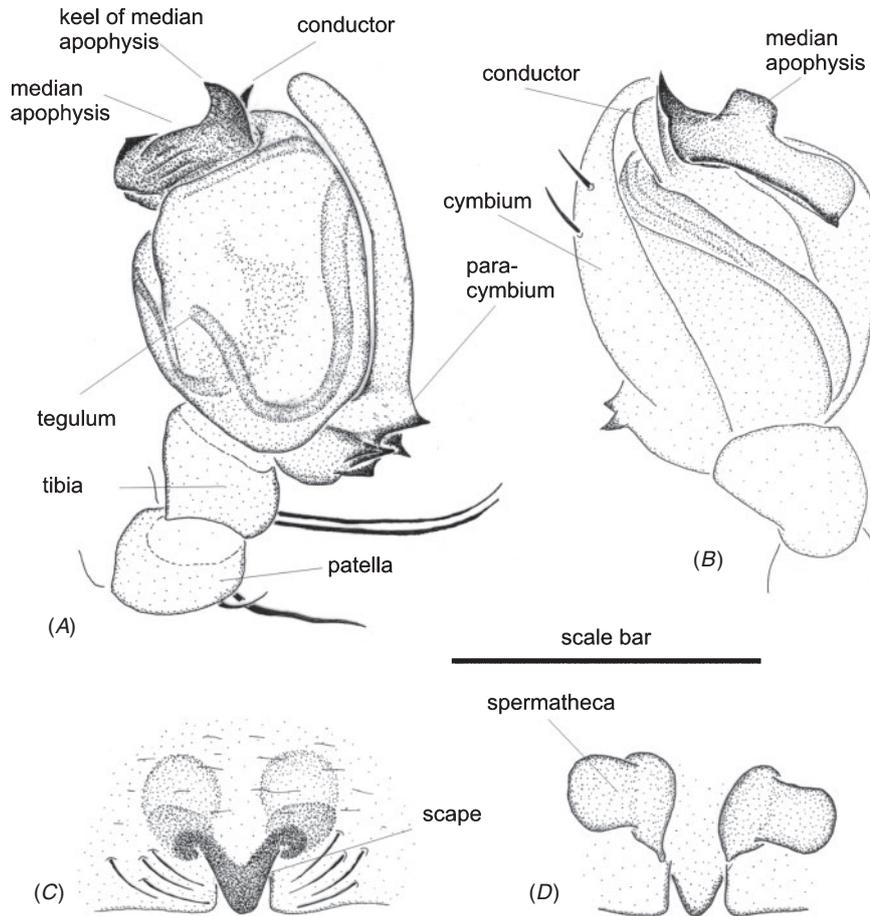
*Dimensions* (mm): total length (excluding chelicerae) 2.00. Carapace length 1.00, width 0.90, height 0.60. Eyes: AME 0.08, ALE 0.08, PME 0.06, PLE 0.08, AME–AME 0.06, AME–ALE 0.26, PME–PME 0.26, PME–PLE 0.20, PLE–ALE 0.00, MOQ width front 0.22, MOQ width back 0.38, MOQ length 0.30, eye group width 0.87. 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  $\pm$  s.d.): TL 1.73–2.15, 1.98  $\pm$  0.13; CL 0.97–1.09, 1.03  $\pm$  0.03; CW 0.88–0.94, 0.90  $\pm$  0.02;  $n = 10$ .

*Female* (from Greenough WAM 93/49)

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

*Chelicerae:* red-brown.



**Fig. 12.** *Demadiana cerula* (Simon), male from Pemberton, Western Australia (WAM 93/47) and female from Greenough, Western Australia (WAM 93/50). (A) Left male pedipalp, retrolateral view; (B) left male pedipalp, mesal view; (C) female epigyne, ventral view; (D) female epigyne, dorsal view. Scale bar: 0.2 mm.

*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.

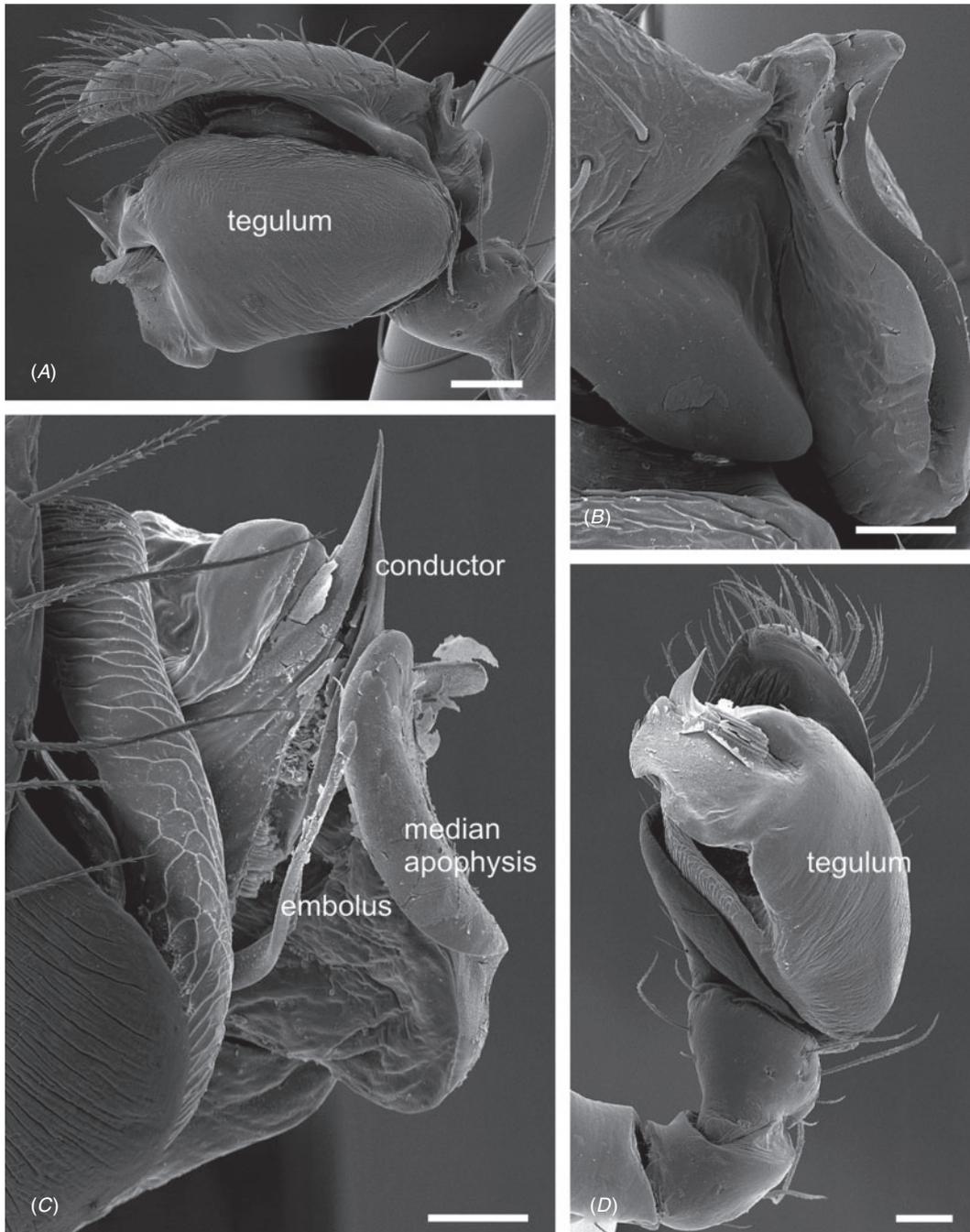
*Variation* (mm range, mean  $\pm$  s.d.): TL 1.79–2.58,  $2.21 \pm 0.25$ ; CL 1.03–1.18,  $1.07 \pm 0.05$ ; CW 0.88–0.97,  $0.93 \pm 0.03$ ;  $n = 11$ .

#### 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)



**Fig. 13.** *Demadiana cerula* (Simon), male from Stirling Range National Park, Western Australia (ZMUC), Western Australia (scanning electron micrographs (SEM)). (A) Left male pedipalp, retrolateral view; (B) paracymbium of left male pedipalp, apico-retrolateral view; (C) left male pedipalp, apical view; (D) left male pedipalp, ventral view. Scale bars: (A) 0.1 mm, (B, C) 0.01 mm, (D) 0.1 mm.

#### Etymology

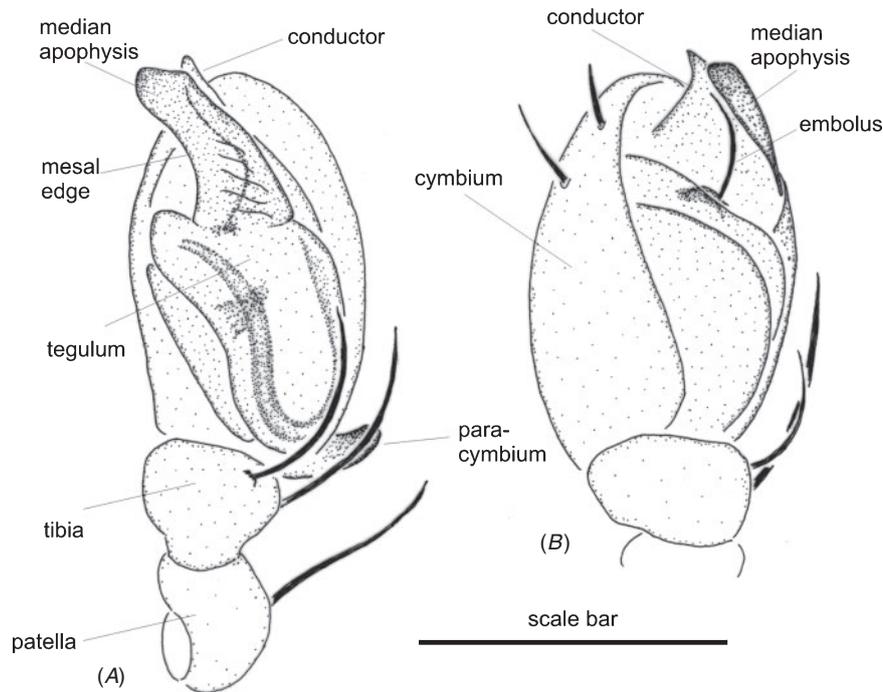
The specific name given to *D. cerula* by Simon (1908) apparently refers to the feminine Latin noun *cerula*, aptly meaning 'little piece of wax'. Bonnet (1958) misinterpreted it as the Latin adjective for the colour dark blue, *caeruleus*, which renders his emendation to the specific name (see above)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



**Fig. 14.** *Demadiana complicata*, sp. nov., male holotype from Beerwah State Forest, Queensland, Australia (QM S48966). (A) Left male pedipalp, retrolateral view; (B) left male pedipalp, prolateral view. Scale bar: 0.2 mm.

### 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. 14A).

### 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 antero-centrally, 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, PME 0.08, PLE 0.08, AME–AME 0.09, AME–ALE 0.25, PME–PME 0.33, PME–PLE 0.23, PLE–ALE 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.

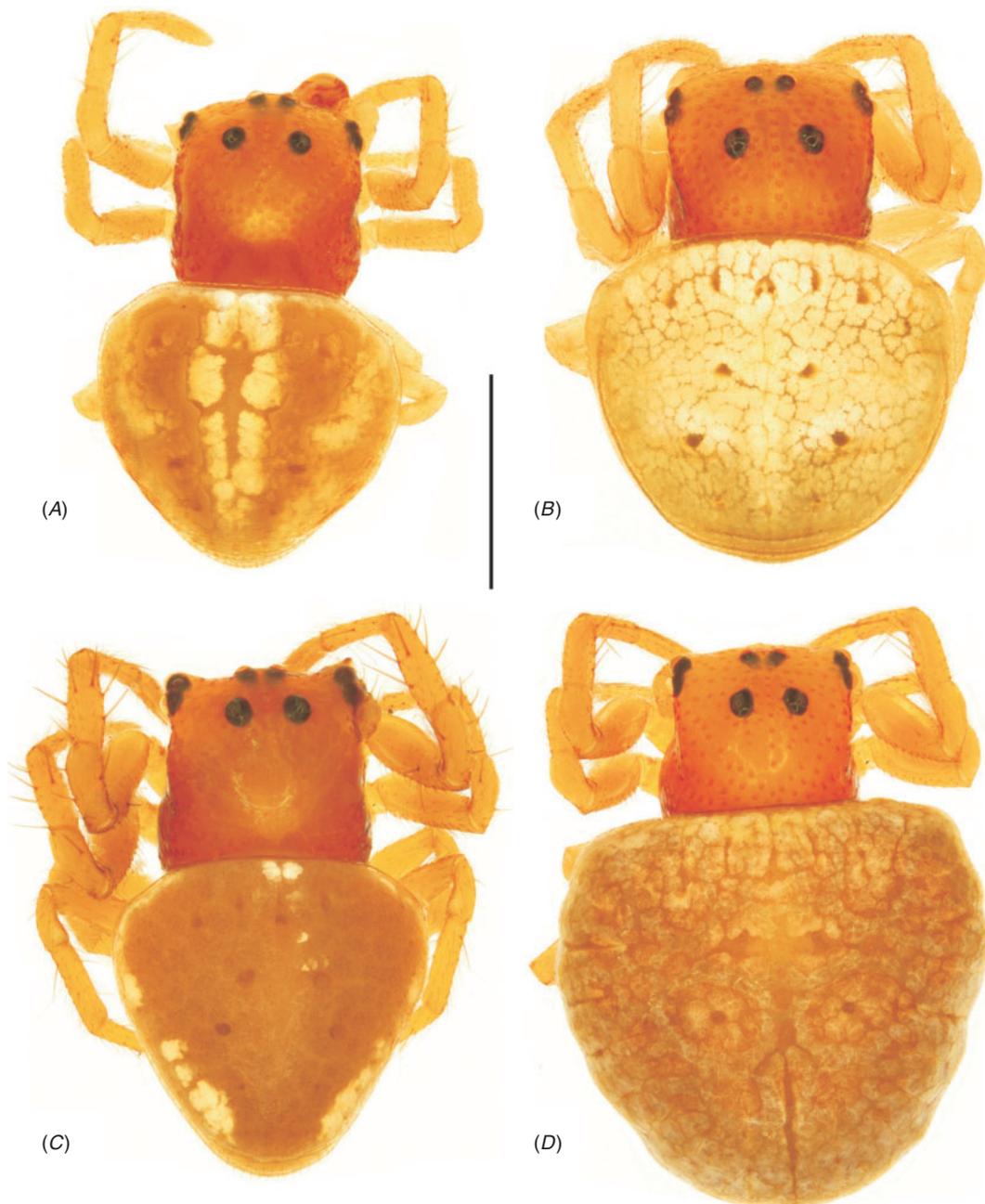
### *Demadiana diabolus*, sp. nov.

(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).



**Fig. 15.** *Demadiana* spp. (A) Holotype male of *D. diabolus*, sp. nov. from Trevallyn, Tasmania (AM KS28625); (B) female of *D. diabolus*, sp. nov. from Muston, Kangaroo Island, South Australia (SAM NN24383); (C) holotype male of *D. milledgei*, sp. nov. from Phillips Track, Victoria (NMV K9984); (D) paratype female of *D. milledgei*, sp. nov. from Phillips Track, Victoria (NMV 10406). Scale bar: (A, C, D) 1.0 mm, (B) 1.2 mm.

*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

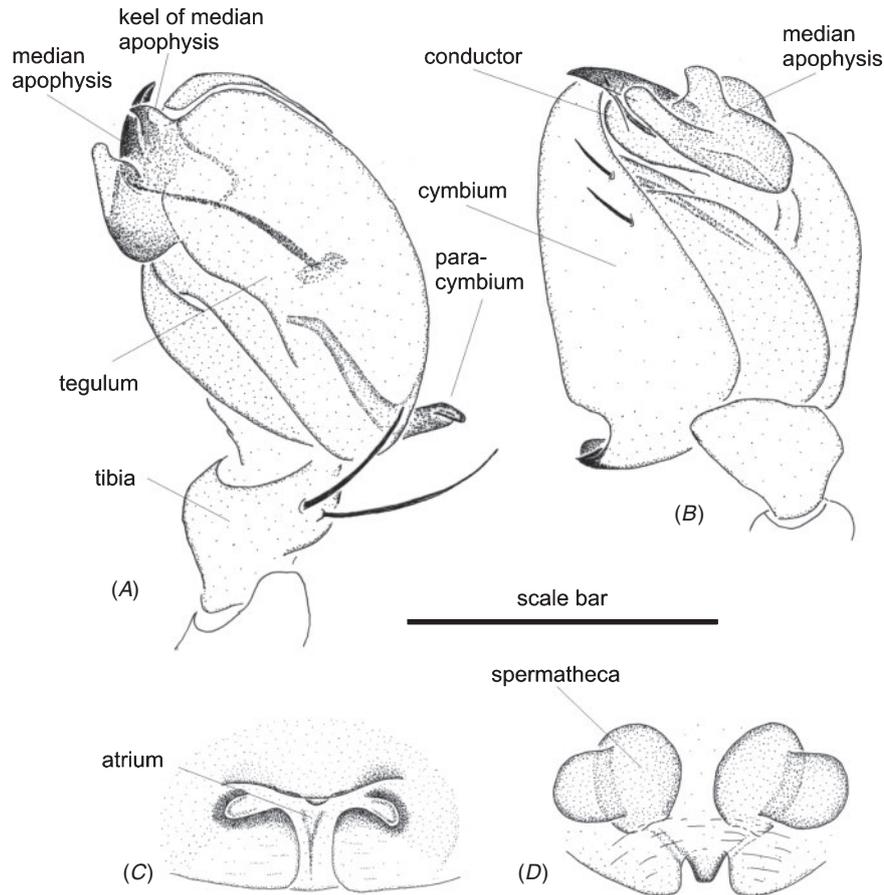
Median apophysis and paracymbium of *Demadiana diabolus* are somewhat similar to that of *D. cerula* (compare Fig. 12A, B with Fig. 16A, B), but *D. diabolus* can be easily distinguished by the much narrower paracymbium that only has a short

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).



**Fig. 16.** *Demadiana diabolus*, sp. nov., holotype male from Trevallyn, Tasmania, Australia (AM KS28625) and female from Muston, Kangaroo Island, South Australia (SAM NN24383). (A) Left male pedipalp, retrolateral; (B) left male pedipalp, prolateral view; (C) female epigyne, postero-ventral; (D) female epigyne dorsal view. Scale bar: 0.2 mm.

*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  $\pm$  s.d.): TL 2.03–2.85, 2.45  $\pm$  0.38; CL 1.00–1.06, 1.05  $\pm$  0.03; CW 0.85–0.94, 0.90  $\pm$  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.

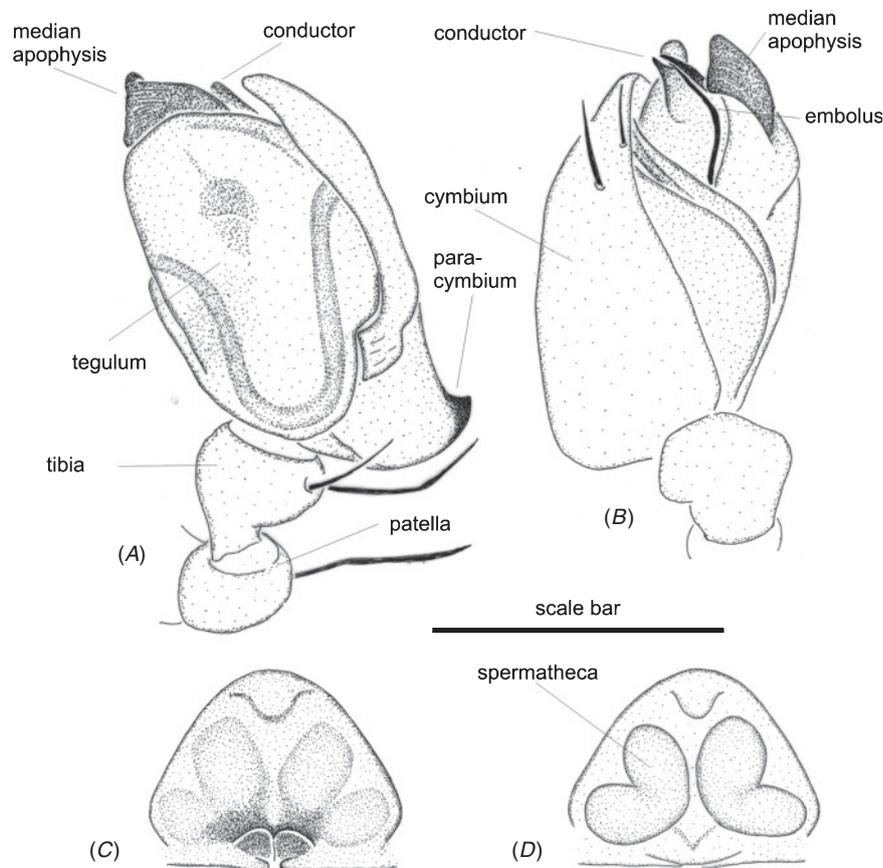
(Figs 15C, D, 17A–D, 18)

#### Material examined

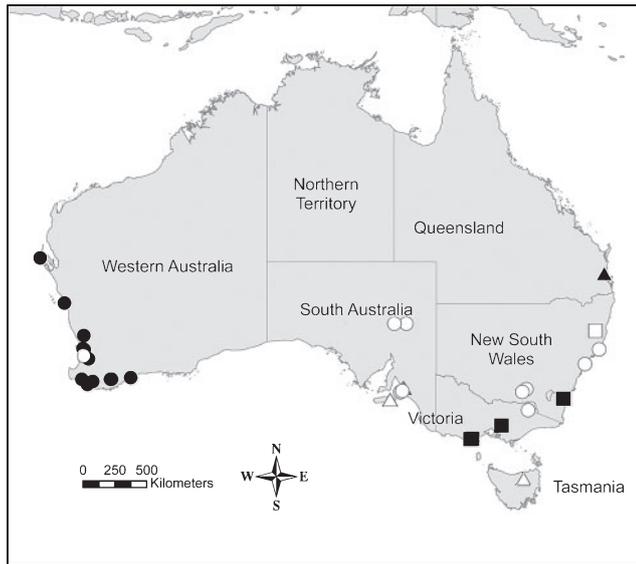
*Holotype*. Male, Phillips Track, Youngs Creek Crossing, 0.5 km N Triplet Falls (38°40'S, 143°29'E, Victoria, Australia), 20.ii.1992, G. Milledge, *Nothofagus cunninghamii* forest (NMV K9984).

*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 Cairn 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.



**Fig. 18.** Distribution records of *Demadiana* in Australia. *D. carrai*, sp. nov. (open square), *D. cerula* (Simon) (full circle), *D. complicata*, sp. nov. (full triangle), *D. diabolus*, sp. nov. (open triangle), *D. simplex* (Karsch) (open circle), *D. milledgei* (full square).

### 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.

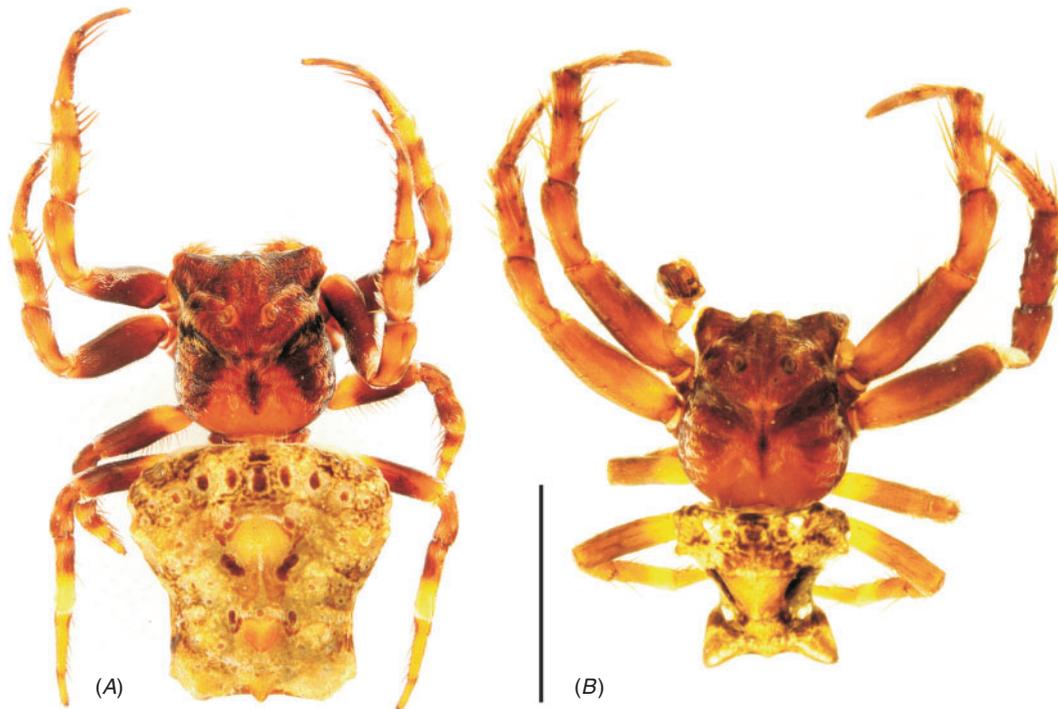
*Sternum*: yellow-brown, glabrous.

*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.



**Fig. 19.** *Arkys alticephala* (Urquhart). (A) Female and (B) male from Minnamurra Falls, New South Wales (AM KS7727). Scale bar: 3 mm.

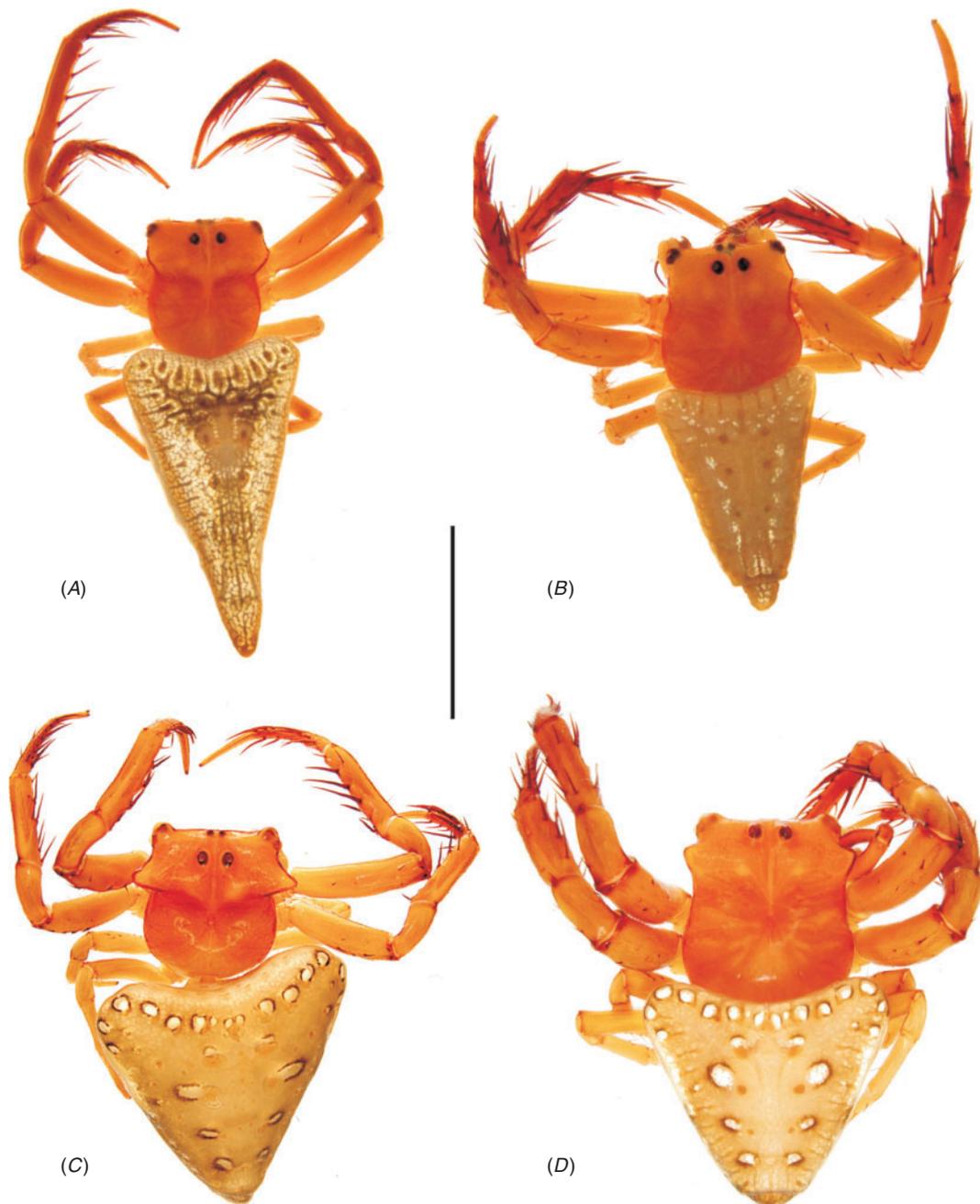
Leg III: femur 0.45, patella 0.18, tibia 0.27, metatarsus 0.24, tarsus 0.18, total 1.33. Leg IV: femur 0.68, patella 0.26, tibia 0.42, metatarsus 0.36, tarsus 0.26, total 1.98.

*Variation* (mm range, mean  $\pm$  s.d.): TL 2.12–2.21,  $2.17 \pm 0.04$ ; CL 1.03–1.12,  $1.06 \pm 0.03$ ; CW 0.91–0.97,  $0.94 \pm 0.02$ ;  $n=6$ . 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).



**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 brown.

*Epigyne*: ventral view: almost triangular with arched antero-lateral margin (Fig. 17C). Dorsal view: spermathecae form globular L-shapes.

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

*Dimensions* (mm): total length (excluding chelicerae) 2.58. Carapace length 1.15, width 1.00, height 0.58. Eyes: AME 0.08, ALE 0.10, PME 0.08, PLE 0.09, AME–AME 0.08, AME–ALE 0.27, PME–PME 0.25, PME–PLE 0.27, PLE–ALE 0.04, MOQ width front 0.23, MOQ width back 0.238 MOQ length 0.31, eye group width 0.99. Sternum length 0.52, width 0.48. Abdomen 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  $\pm$  s.d.): TL 2.12–2.73, 2.50  $\pm$  0.23; CL 1.12–1.18, 1.16  $\pm$  0.03; CW 0.97–1.03, 1.00  $\pm$  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* Walckenaer, 1837: 497. – Rainbow, 1911: 207 (as *Arcys*). Type species: *Arkys lancearius* Walckenaer, 1837, by monotypy.

*Aerea* Urquhart, 1891: 119 (as *Aerea*). – Rainbow, 1911: 196 (as *Aerea*); Roewer, 1942: 908 (as *Aera* [sic]). Type species: *Aerea alticephala* Urquhart, 1891, by monotypy. **New synonymy.**

*Archemorus* Simon, 1893: 328. Rainbow, 1911: 207. Type species: *Archemorus simsoni* Simon, 1893, by monotypy. Synonymy established by Heimer (1984).

*Neoarchemorus* Mascord, 1968: 10. Type species: *Neoarchemorus speechleyi* Mascord, 1968, by original designation. **New synonymy.**

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

(Figs 19A, B, 24)

*Aerea alticephala* Urquhart, 1891: 245–247. – Roewer, 1942: 908 (as *Aera* [sic] *alticephala*).

*Aerea magnifica* Urquhart, 1893 (June): 119–121. – Rainbow, 1911: 196; Roewer, 1942: 908 (as *Aera* [sic] *magnificia* [sic]); Bonnet, 1955: 177. **New synonymy.**

*Archemorus simsoni* Simon, 1893 (October): 328; Simon, 1895: fig. 967; Rainbow, 1911: 207 (as *Archemorus simoni* [sic]); Roewer, 1942: 909; Bonnet, 1955: 639; Balogh, 1978: 21, figs 13, 31, 52, 53; Heimer, 1984: 172–174, figs 21, 22. **New synonymy.**

#### Type material

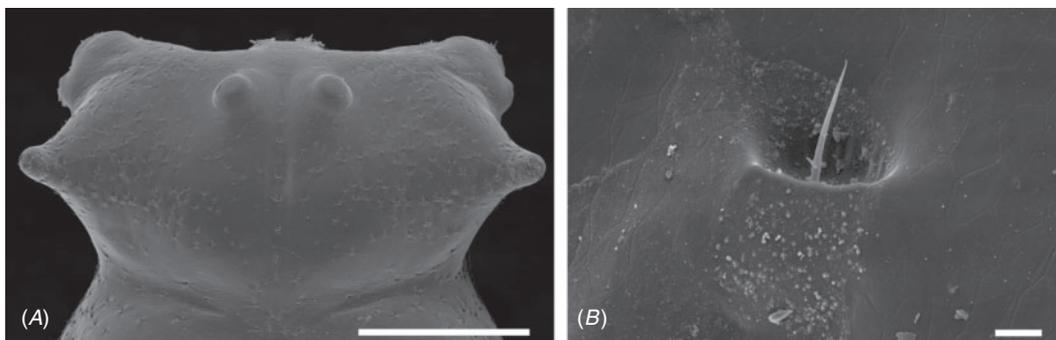
*Holotype* of *Aerea alticephala*. Female, Tasmania, Australia (without precise locality), A. Morton (not located, not examined).

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

*Holotype* of *Archemorus simsoni*. 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 ♀, Yancheep (WAM 93/1616).



**Fig. 21.** *Arkys brevivalpus* 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*

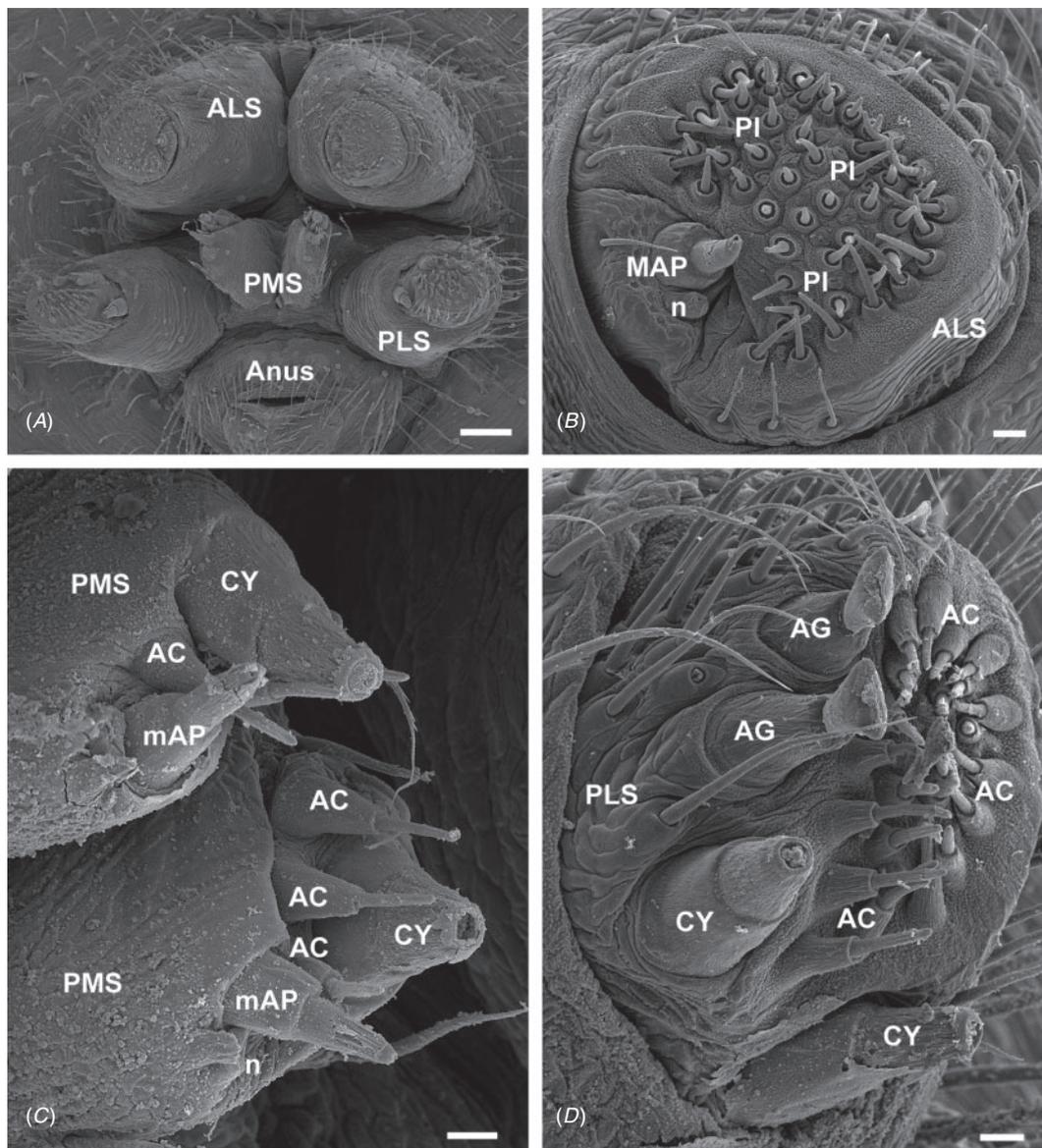
*Aerea alticephala* has been previously recorded from Tasmania (Urquhart 1891; Simon 1893; Urquhart 1893; Heimer 1984),

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)

*Arcys walckenaeri* Simon, 1879: 57–58. – Roewer, 1942: 909; Bonnet, 1955: 664; Heimer, 1984: 175, figs 23–25; Guerin, 1986: 178; Davies, 1988: fig. 9.

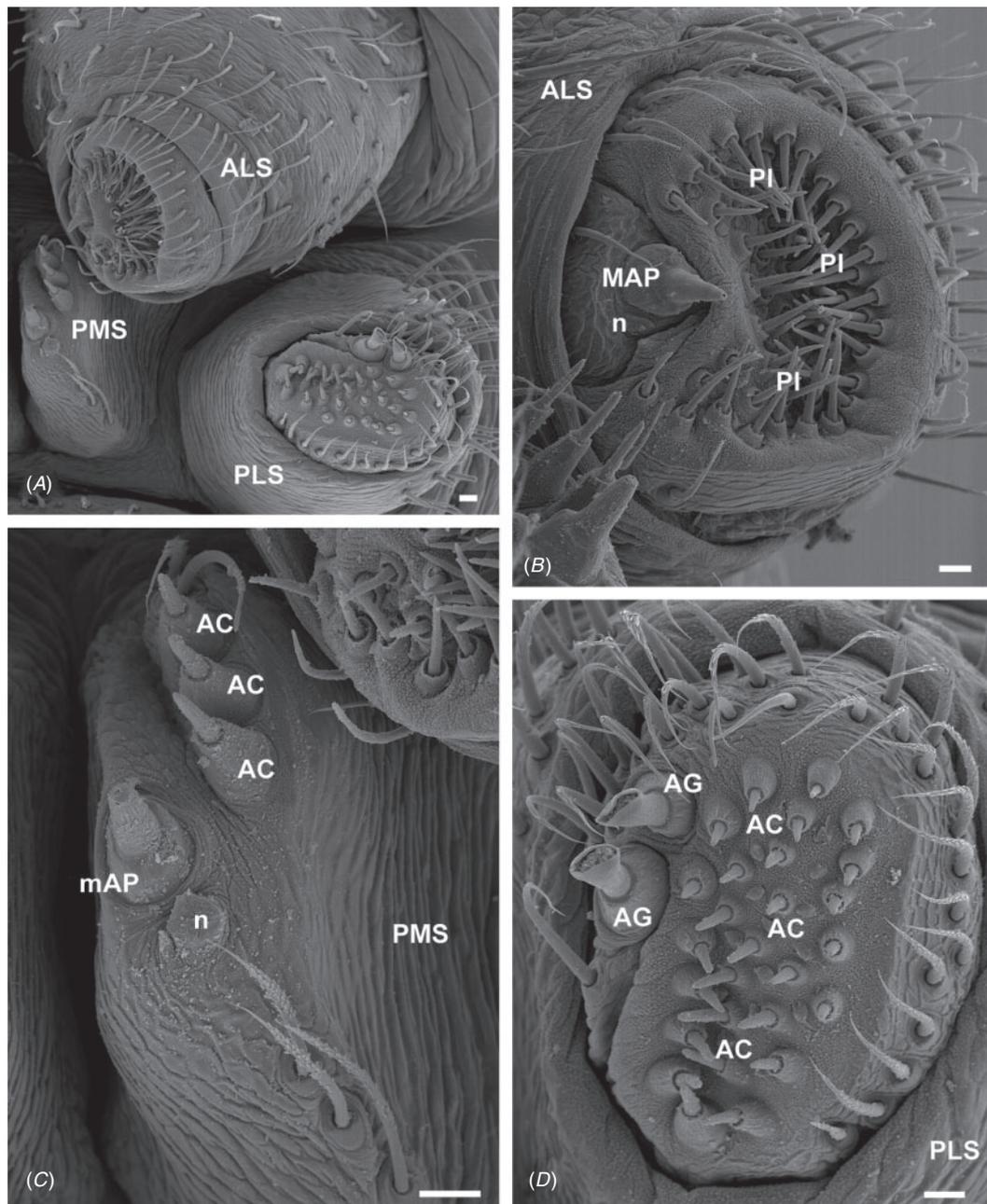


**Fig. 22.** *Arkys brevipalpus* Karsch. (A, C) female from Sarraméa, New Caledonia (ZMUC OW128) (scanning electron micrographs (SEM)); (B, C) female from Mt. Koghi, New Caledonia (OW130) (SEM). (A) Spinnerets, ventral view; (B) left anterior lateral spinneret (ALS), ventral view; (C) left posterior 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.

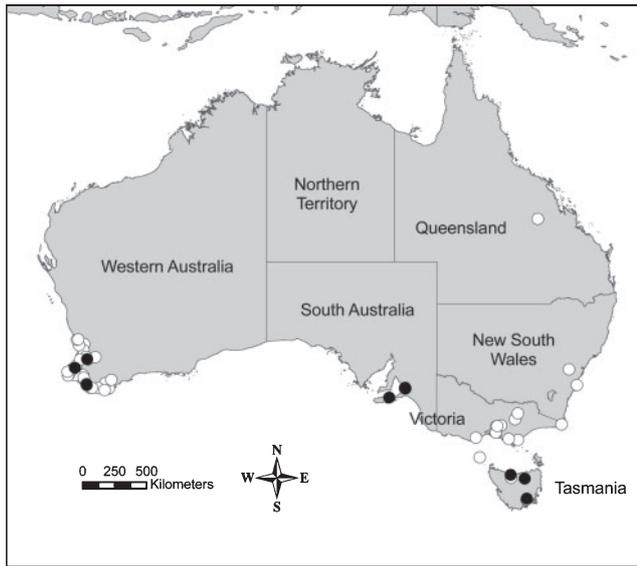
*Arcys clavatus* Keyserling, 1890: 259–261, plate xxiv, figs 1, 1a, 1b, 2, 2a.  
 – Rainbow, 1911: 207; Roewer, 1942: 909; Bonnet 1955: 663–664.  
 Synonymy established by Heimer (1984): 175.  
*Arcys nitidiceps* Simon, 1908: 429. – Rainbow, 1911: 207; Roewer, 1942:  
 909; Bonnet, 1955: 664; Main, 1982: 425–431, figs 1–13. **New  
 synonymy.**

#### Type material

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



**Fig. 23.** *Arcys 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.



**Fig. 24.** Records of *Arkys alticephala* (Urquhart) (full circle) and *A. walckenaeri* Simon (open circle) in Australia based on our own observations and Heimer (1984).

#### Material examined

*Syntypes of Arcys 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 Arcys 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 ♀, Darkes Forest (AM KS5797). **Queensland**: 1 ♂, 2 ♀, Queensland (no exact locality) (SAM). **South Australia**: 2 ♂, 1 ♀ (SAM); 1 ♂, 1 ♀, Bridgewater (SAM); 1 ♂, Uraidla (WAM T81159). **Tasmania**: 1 ♂, 1 ♀, Forth Falls (BMNH 1931.7.30.14–18); 2 ♀, 18 juveniles, King Island (NMV K10770); 1 ♂, Ridgeway (NMV K10769). **Victoria**: 1 ♀, Victoria, no exact locality, Prof. Spencer presented and collected (BMNH 1888.144); 1 ♂, 1 ♀, Coranderk Reserve, Healesville (WAM 93/67–68); 1 ♂, Croydon (NMV K10773); 1 ♂, Dondangadale (NMV K10771); 2 ♀, Eltham (NMV K10778); 1 ♂, Forrest (NMV K10777); 1 ♀, Frankston (NMV K10772); 1 ♀, Healesville (NMV K10774); 1 ♀, Kangaroo Ground (NMV K10775); 1 ♀, Mallacoota (NMV K10776); 1 ♂, 3 ♀, 1 juvenile, Port Albert (NMV K10781, det. *Arcys 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. *Arcys clavatus* by Hogg). **Western Australia**: 3 ♀, Albany (WAM 93/51, 97/1977–8); 1 ♀, Boddington Bauxite Mine (WAM T66197); 1 ♂, Bridgetown, 15 km 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 ♀, Gelorup 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 juvenile, 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 ♀, Yanchep Inn, Yanchep (WAM 93/66); 1 ♀, Yanchep National Park, Boomerang Gorge (WAM 97/1993); 1 ♀, Yarloop (WAM T42170).

#### Remarks

*Arkys 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. 20A, B), that are even more pronounced in the type species *A. lancearius* (Fig. 20C, D).

*Arkys 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.

## Acknowledgements

We are indebted to a variety of curators, collection managers and museum staff for assistance in accessing their collections either as loans or during visits to their respective institutions and by providing access to their databases: Owen Seeman, Robert Raven and Barbara Baehr (QM), David Hirst (SAM), Graham Milledge and Helen Smith (AM), Peter Lillywhite, Ken Walker and Richard Marchant (NMV), Janet Beccaloni (BMNH), Hieronymus Dastych (ZMH), and Jason Dunlop (ZMB). Helen Smith (AM) collected the living specimens of *D. cerula* that were photographed for Fig. 1A, B. This study would have been impossible without the support of these institutions and their enthusiastic personnel. We are grateful to Tamás Szűts (California Academy for Sciences) for productive comments on this manuscript. This study was initially supported by the Australian Biological Resources Study (ABRS) to VWF and NS (grant no. 205–24) and by the Danish Natural Science Foundation to NS (grant no. 21020502). VWF received funding through BHP Billiton Iron Ore in the final stages of this study. NS received funding through the Center for Macroecology, University of Copenhagen, when this study was completed.

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Manuscript received 12 February 2010, accepted 13 April 2010