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Systematic revision of *Hoggicosa* Roewer, 1960, the Australian '*bicolor*' group of wolf spiders (Araneae: Lycosidae)

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The Australian wolf spider genus *Hoggicosa* Roewer, 1960 with the type species *Hoggicosa errans* (Hogg, 1905) is revised to include ten species: ***Hoggicosa alfi* sp. nov.**; *Hoggicosa castanea* (Hogg, 1905) **comb. nov.** (= *Lycosa errans* Hogg, 1905 **syn. nov.**; = *Lycosa perinflata* Pulleine, 1922 **syn. nov.**; = *Lycosa skeeti* Pulleine, 1922 **syn. nov.**); *Hoggicosa bicolor* (McKay, 1973) **comb. nov.**; ***Hoggicosa brennani* sp. nov.**; *Hoggicosa duracki* (McKay, 1975) **comb. nov.**; *Hoggicosa forresti* (McKay, 1973) **comb. nov.**; ***Hoggicosa natashae* sp. nov.**; *Hoggicosa snelli* (McKay, 1975) **comb. nov.**; *Hoggicosa storri* (McKay, 1973) **comb. nov.**; and ***Hoggicosa wolodymyri* sp. nov.** The Namibian *Hoggicosa exigua* Roewer, 1960 is transferred to *Hogna*, *Hogna exigua* (Roewer, 1960) **comb. nov.** A phylogenetic analysis including nine *Hoggicosa* species, 11 lycosine species from Australia and four from overseas, with *Arctosa cinerea* Fabricius, 1777 as outgroup, supported the monophyly of *Hoggicosa*, with a larger distance between the epigynum anterior pockets compared to the width of the posterior transverse part. The analysis found that an unusual sexual dimorphism for wolf spiders (females more colourful than males), evident in four species of *Hoggicosa*, has evolved multiple times. *Hoggicosa* are burrowing lycosids, several constructing doors from sand or debris, and are predominantly found in semi-arid to arid regions of Australia.

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INTRODUCTION

Australia possesses a rich fauna of wolf spiders with 156 currently described species in 24 genera and four subfamilies: Artoriinae Framenau, 2007; Venoniinae Lehtinen & Hippa, 1979; Zoicinae Lehtinen & Hippa, 1979; and Lycosinae Sundevall, 1833 (Framenau, 2007). The latter is the most diverse subfamily in Australia with 109 described species in 17 genera, although the current count represents possibly fewer than half of the species present in collections (V. W. Framenau, unpubl. data). The Lycosinae are defined by two synapomorphies of the tegular apophysis of the male pedipalp, i.e. its transverse orientation, with ventrally directed spur and a sinuous channel on its dorsal surface (Dondale, 1986). Knowledge of Australian Lycosinae is poor, although there have been several recent generic revisions, including *Dingosa* Roewer, 1955, *Knoelle* Framenau, 2006, *Mainosa* Framenau, 2006 and *Tuberculosa* Framenau & Yoo, 2006 and Venatrix Roewer, 1960 (Framenau & Vink, 2001; Framenau, 2006a, b; Framenau & Yoo, 2006; Framenau & Baehr, 2007). Molecular studies have suggested two distinct clades of Australian Lycosinae; one has an oriental origin (*Venatrix* and *Tuberculosa*) and the remaining genera represent a Gondwanan clade with the closest relative in the taxon sampled, *Pavocosa gallopavo* (Mello-Leitão, 1941), from South America (see Murphy *et al*., 2006; Gotch *et al*., 2008).

Hoggicosa Roewer, 1960 clearly conforms to the subfamily diagnosis of the Lycosinae (Dondale, 1986).

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The genus was initially proposed as *nomen nudum* by Roewer (1955). Later it was formally described with the Australian *Lycosa errans* Hogg, 1905 as type species (Roewer, 1960) along with a second species from Namibia, *Hoggicosa exigua* Roewer, 1960. Roewer distinguished *Hoggicosa* by the shape of the labium (as long as wide) in combination with the curvature of the anterior eye row (straight). The somatic characters that Roewer (1959, 1960) used to diagnose many of his genera have since been found to be of limited value for wolf spider classification compared with more recently employed genitalic characters (see Vink, 2001; Stratton, 2005). *Hoggicosa* was later considered a junior synonym of *Arkalosula* Roewer, 1960, which is itself a junior synonym of *Arctosa* C. L. Koch, 1847 (Guy, 1966: 64). Guy's (1966) taxonomic changes, however, were not accepted by later cataloguers (e.g. Brignoli, 1983; Platnick, 2009).

In a review of a well-defined Australian group of wolf spiders that he called the '*bicolor* group' based on the striking colour combination of some females (see Fig. 1), McKay (1973) transferred *Hoggicosa errans* back to *Lycosa* without providing a taxonomic justification. However, McKay (1973) suggested close affinities of his '*bicolor* group' with *Geolycosa* Montgomery, 1904. Later McKay (1975) added two more species to the '*bicolor* group' and described males, apparently less conspicuously coloured than females, for the first time.

Sexual dimorphism in wolf spiders is evident in a multitude of forms, with most differences between males and females being attributed to reproductive roles (sexual selection). Females of ground dwelling spiders, including lycosids, are generally larger than their male counterparts, explained by a fecundity advantage of larger females (Prenter, Montgomery & Elwood, 1997; Prenter, Elwood & Montgomery, 1998, 1999). Sexual dimorphism in wolf spiders also exists in relative size of chelicerae and venom glands (Walker & Rypstra, 2001, 2002) and relative length of legs (Framenau, 2005). Some dimorphic colour patterns augment body size and condition and have been argued to play an important role in the mating behaviour of wolf spiders (Moya-Laraño, Taylor & Fernandez-Montraveta, 2003). Male wolf spiders generally have more conspicuous colour patterns than females, although the patterns are not pronounced in many species. This may play an important role in mate choice by females; for example, fore leg ornamentation of male lycosids was reviewed by Framenau & Hebets (2007). More cryptic colours of females may also have evolved through natural selection; wolf spider females exhibit prolonged brood care and cryptic colouration may protect the females and their clutch from predators such as birds, reptiles, and predatory insects. Some *Hoggicosa* species, however, show a remarkable reversed colour dimorphism. Females of *Hoggicosa bicolor* (similarly coloured as penultimate males, Fig. 1A), *Hoggicosa storri* (similarly coloured as penultimate males, Fig. 1D), *Hoggicosa castanea*, and *Hoggicosa forresti* (McKay, 1973, fig. 1F) are much more colourful than their male counterparts (Fig. 1B, E), but the evolution of these striking patterns has not been studied.

This paper revises the taxonomy and systematics of *Hoggicosa* which is here re-established as a valid genus. We test the monophyly of this genus with a phylogenetic analysis including 11 Australian representatives of the subfamily Lycosinae and representatives of the northern hemisphere genera *Lycosa* and *Geolycosa*, with which *Hoggicosa* was previously associated. This phylogenetic analysis also allowed us to test the origin of the striking colour dimorphism of males and females, evident in four species of *Hoggicosa*.

MATERIAL AND METHODS

This study is based on an examination of more than 20 000 records of wolf spiders in all Australian museums as part of an extensive revision of the Australian Lycosidae. Descriptions are based on spiders stored in 70% ethanol which were studied under a Leica MZ6 stereo microscope. For examination of female internal genitalia, epigynes were placed in lactic acid overnight. Digital images were taken using a Leica DFC 500 digital camera attached to a Leica MZ16A stereo microscope. To increase depth of field, multiple images were merged using the software program AutoMontage Pro Version 5.02 (p). These images were then placed into Adobe Illustrator CS3 and electronic drawings compiled by manually tracing over the structures in the image. For clarity, setae without diagnostic value have been omitted from all drawings. Male pedipalps mainly differ by details of the median apophysis and palea, but these details are not discernable in retrolateral view; therefore, although generally illustrated in taxonomic papers of Lycosidae, these views are omitted here. All measurements are in mm.

Scanning electron micrographs (SEMs) were taken using a Philips XL30 ESEM at the Centre for Microscopy and Microanalysis, University of Western Australia. In preparation for SEMs, specimens were placed in 100% ethanol overnight. They were then cleaned ultrasonically for 2 min and critically point dried. Specimens were then mounted on stubs using carbon tabs and coated with 10–15 nm of gold.

Morphological nomenclature follows Framenau & Baehr (2007), but some terms are introduced here for the first time. We identify three parts of the tegular apophysis: a 'ventral spur', an 'apical point', and a

'ridge' joining these (see Fig. 5A). The pars pendula is a membranous flap accompanying the embolus on its apical edge (in relation to the pedipalp) (see Dondale & Redner, 1983), which often joins the palea basally. We found a secondary structure basal to the terminal apophysis in all *Hoggicosa*, which we call the 'subterminal apophysis' (see Figs 7A–D, 13B). This structure was erroneously labelled pars pendula in the recent description of the genus *Knoelle* (Framenau, 2006b, fig. 8).

Abbreviations

Anatomy

AE, anterior eyes; ALE, anterior lateral eyes; AME, anterior median eyes; OL, opisthosoma length; OW, opisthosoma width; PL, prosoma length; PW, prosoma width; PE, posterior eyes; PLE, posterior lateral eyes; PME, posterior median eyes; TL, total length.

Institutions

AM, Australian Museum, Sydney; ANIC, Australian National Insect Collection, Canberra; NMV, Museum Victoria, Melbourne; NTMAG, Northern Territory Museum and Art Gallery, Darwin; SAM, South Australian Museum, Adelaide; QM, Queensland Museum, Brisbane; WAM, Western Australian Museum, Perth; Distribution; NSW, New South Wales; NT, Northern Territory; Qld, Queensland; SA, South Australia; Vic, Victoria; WA, Western Australia.

Phylogenetic analysis

Taxa

A number of factors determined which taxa in addition to nine *Hoggicosa* species were included in the analysis (*Hoggicosa natashae* sp. nov. was excluded as only females are known).

1. We included most Australian genera that were part of a Gondwanan clade, to which *Hoggicosa* belonged, in a molecular phylogeny of the Lycosidae (Murphy *et al*., 2006): *Hogna crispipes* L. Koch, 1877, *Lycosa godeffroyi* L. Koch, 1865, *Lycosa leuckartii* (Thorell, 1870), *Knoelle clara* (L. Koch, 1877), and the 'Grey Wolf Spider' ('New Genus 6' in Murphy *et al*., 2006; see also Framenau & Baehr, 2007). This allowed testing of the relationships found by Murphy *et al*. (2006) with our morphological character set.
2. Based on morphological and behavioural characters, two putative Australian sister genera were included in the analysis. Males of the monotypic genus *Knoelle* also possess backwards bent macrosetae on the cymbium tip, but in a larger patch than *Hoggicosa* (Framenau, 2006b). The undescribed 'Grey Wolf Spider' has similar somatic morphology and burrowing behaviour as *Hoggicosa* species.
3. Two Australian lycosine genera were recently reviewed, which allowed an appropriate consideration within our phylogenetic analysis: *Mainosa* Framenau, 2006 and *Dingosa* Roewer, 1955 (Appendix 1).
4. We included the type species of the Australian lycosine genus *Venator* Hogg, 1900, *V. spenceri* Hogg, 1900, and a putative conspecific with very similar somatic and genitalic morphology, *Hogna immansueta* (Simon, 1909).
5. Species of *Hoggicosa* were previously associated with two genera, *Lycosa* (Mediterranean; Zyuzin & Logunov, 2000) and *Geolycosa* (Holarctic; Wallace, 1942; Zyuzin & Logunov, 2000) and we included representatives of both to test their association with *Hoggicosa*. Male specimens of *Lycosa tarantula* (Linnaeus, 1758) and *Lycosa praegrandis* (C. L. Koch, 1836) were unavailable for study, so male characters were scored from secondary sources (Zyuzin & Logunov, 2000; Álvares, 2006).

The limits of the Lycosinae are unclear and this subfamily may include the traditional Pardosinae and Hippasinae (see Murphy *et al.*, 2006). Therefore, we chose the Holarctic species *Arctosa cinerea* (Fabricius, 1777) (type species of *Arctosa* C. L. Koch, 1847) as outgroup, as this genus is basal to a wider concept of the Lycosinae (Murphy *et al.*, 2006).

Characters

There are only a limited number of phylogenetic, cladistic, or phenetic studies exploring characters in the morphologically conservative family Lycosidae: Vink, 2002; Vink & Paterson, 2003; Stratton, 2005; Framenau & Yoo, 2006; Yoo & Framenau, 2006 (see also Roewer, 1959; Casanueva, 1980). We tested these characters and explored many new ones as part of our phylogenetic analysis. A total of 27 characters remained parsimoniously informative for the 25 species included in our analysis (Table 1; Appendix 2). Eight characters were based on somatic morphology, 16 on genitalic morphology (13 male and three female), and three on burrowing behaviour. We could not score characters relating to the subterminal apophysis of the male pedipalp when relying on secondary sources, therefore these were scored '?' for *L. tarantula* and *L. praegrandis*.

Analyses

The character matrix was edited using Nexus data editor (Page, 2001) and exported for phylogenetic analysis to TNT version 1.1 (Goloboff, Farris & Nixon, 2003, Willi Hennig Society version). We used the 'traditional search' option with the following settings:

Table 1. Morphological character matrix

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Arctosa cinerea	0	1	0	0	2	1	0	0	1	0	0	0	1	1	1	1	0	0	–	0	1	0	1	–	1	0	0
Dingosa serrata	1	2	1	0	2	2	0	0	0	–	–	–	–	–	0	0	1	0	–	0	0	1	0	0	1	0	1
Dingosa simsoni	1	2	1	0	2	2	0	0	0	–	–	–	–	–	0	0	1	0	–	0	0	1	1	0	1	0	1
Geolycosa hubbelli	1	0	1	0	1	2	1	3	0	–	–	0	1	1	1	0	0	0	–	0	0	1	0	0	1	0	1
Geolycosa missouriensis	1	0	1	0	0	0	1	3	0	–	–	0	1	1	1	0	0	0	–	0	0	1	0	0	1	0	1
'Grey Wolf Spider'	1	0	1	0	2	2	0	0	1	1	0	0	0	1	1	0	1	1	1	0	0	1	1	0	1	1	0
Hoggicosa alfi	1	1	2	0	2	1	0	3	1	1	1	0	1	0	1	1	0	1	0	1	1	1	1	1	1	0	0
Hoggicosa bicolor	1	0	2	1	1	1	1	3	1	1	1	1	0	1	1	0	0	1	1	0	0	1	1	1	1	1	0
Hoggicosa brennani	1	0	2	0	2	1	0	1	1	1	1	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	0
Hoggicosa castanea	1	1	2	1	2	1	0	3	1	1	1	0	0	0	1	0	0	1	0	1	2	1	1	1	1	1	0
Hoggicosa duracki	1	0	2	0	1	0	0	0	1	1	1	0	1	0	1	1	1	1	0	1	2	1	1	1	1	1	0
Hoggicosa forresti	1	1	2	1	2	2	0	3	1	1	1	0	1	0	1	0	0	1	0	0	1	1	1	1	1	1	0
Hoggicosa snelli	1	0	2	0	0	0	0	1	1	1	1	1	1	1	1	0	0	1	1	0	0	1	1	1	1	1	0
Hoggicosa storri	1	0	2	1	0	0	0	3	1	1	1	1	1	0	1	0	0	1	1	0	1	1	1	1	1	0	0
Hoggicosa wolodymyri	1	1	2	0	2	2	0	0	1	1	1	0	0	1	1	0	0	1	0	0	2	1	1	1	1	0	0
Hogna crispipes	0	1	2	0	2	1	0	0	1	0	2	0	1	1	1	0	0	1	1	0	0	1	0	0	0	–	–
Hogna immansueta	0	1	1	0	2	2	0	1	1	0	0	1	0	0	2	0	1	1	1	0	0	1	0	0	0	–	–
Hogna kuyani	0	1	2	0	2	2	0	0	1	0	2	0	1	1	1	0	0	1	1	0	0	1	0	0	0	–	–
Knoelle clara	0	1	2	0	2	2	0	1	1	2	1	0	1	–	2	1	1	1	1	0	0	1	1	0	0	–	–
Lycosa godeffroyi	0	2	2	0	2	2	0	3	1	0	0	1	1	0	1	0	1	1	0	0	0	1	1	0	1	0	0
Lycosa leuckartii	0	2	2	0	2	2	0	2	1	0	0	0	1	1	1	0	1	1	0	0	1	1	1	0	1	0	0
Lycosa praegrandis	1	1	2	0	2	2	0	1	1	0	0	0	1	?	1	0	0	?	?	0	1	0	0	0	1	0	0
Lycosa tarantula	1	1	2	0	2	2	0	1	1	0	0	0	1	?	1	0	0	?	?	0	1	0	0	0	1	0	0
Mainosa longipes	1	1	1	0	2	1	1	3	0	–	–	1	0	1	1	0	0	1	1	0	0	1	0	0	1	0	1
Venator spenceri	0	1	1	0	2	2	0	1	1	0	0	1	0	0	2	0	1	1	1	0	0	1	0	0	0	–	–

–, not applicable; ?, missing data.

Character and character state descriptions in Appendix 2.

number of replicates ('repls') 1000, 'trees to save per replication' at 10, 'collapse trees after search' with default collapsing rule (min. length = 0), 'replace existing trees', and maximum trees in memory set to 100 000. A strict consensus tree was exported to WinClada vers. 1.00.08 (Nixon, 2002) for character exploration. Bremer support (Bremer, 1994) and relative Bremer support (Goloboff & Farris, 2001) values were calculated using TNT.

RESULTS

Hoggicosa now includes ten species of which four are described as new (Table 2). The type species *Lycosa errans*, but also *Lycosa perinflata* Pulleine, 1922 and *Lycosa skeeti* Pulleine, 1922 are synonymized with *Hoggicosa castanea* comb. nov. The males of *Hoggicosa bicolor* comb. nov., *Hoggicosa castanea*, *Hoggicosa storri* comb. nov., and *Hoggicosa forresti* comb. nov. are described for the first time. All *Hoggicosa* species construct burrows, some with trap doors, and are predominantly found in the more arid parts of Australia (Table 2).

PHYLOGENY

The phylogenetic analysis generated 26 equally parsimonious trees [length (L) = 96, consistency index (CI) = 38, retention index (RI) = 64]. The resulting strict consensus tree (L = 113, CI = 32, RI = 53) had little resolution in resolving relationships amongst genera; however, *Hoggicosa* was monophyletic (Fig. 2). Although Bremer support values for *Hoggicosa* are low, it is supported by one unambiguous

Table 2. Current known distribution of *Hoggicosa* in Australia with biogeographical regions within states (after Thackway & Cresswell, 1997)

Species	Australian distribution
***Hoggicosa alfi* sp. nov.**	New South Wales, Queensland (ML), South Australia (CHC, EYB, GAW, MDD, SSD, STP), Western Australia (AW, CAR, COO, CR, GAS, GS, GSD, GVD, LSD, MUR, NUL, PIL, TAN, YAL)
Hoggicosa bicolor (Hogg, 1905)	New South Wales, Northern Territory (DMR, MAC), Queensland (MGD, MII, ML), South Australia (EYB, MDD, SSD, STP), Western Australia (AW, CAR, COO, CR, FIN, GAS, GAW, GD, GS, GVD, LSD, MAL, MUR, PIL, TAN, YAL)
***Hoggicosa brennani* sp. nov.**	New South Wales (CP, DRP, MDD, NSS), Queensland (BBS, NAN), South Australia (EYB, KAN, NCP, STP)
Hoggicosa castanea (Hogg, 1905)	New South Wales (BHC, CP), Northern Territory (MAC), Queensland (ML), South Australia (CHC, CR, EYB, FLB, GAW, MDD, SSD, STP), Victoria (VVP), Western Australia (AW, CAR, COO, ESP, GAS, GS, GSD, GVD, MAL, MUR, NSS, NUL, PIL, SWA, WAR, YAL)
Hoggicosa duracki (McKay, 1975)	Western Australia (PIL, VB)
Hoggicosa forresti (McKay, 1973)	Western Australia (AW, COO, GAS, GVD, HAM, MAL, MUR, NUL, SWA), South Australia (EYB, FLB, MDD)
Hoggicosa natashae* sp. nov.	New South Wales (BHC), Queensland (CHC), South Australia (GAW, SSD)
Hoggicosa storri (McKay, 1973)	Western Australia (AW, COO, CR, ESP, GAS, GS, JF, LSD, MAL, MUR, NUL, SWA, YAL)
Hoggicosa snelli (McKay, 1975)	Northern Western Australia (CAR, GAS, GSD, NK, PIL, TAN)
***Hoggicosa wolodymyri* sp. nov.**	New South Wales (CP), Northern Territory (GSD), South Australia (CR, EYB, FIN, FLB, GAW, MDD, NUL, RIV, STP), Western Australia (GVD, MUR)

Abbreviations of biogeographical regions: AW, Avon Wheatbelt; BBS, Brigalow Belt South; BHC, Broken Hill Complex; CAR, Carnarvon; CHC, Channel Country; COO, Coolgardie; CP, Cobar Peneplain; CR, Central Ranges; DMR, Davenport Murchison Ranges; DRP, Darling Riverine Plains; ESP, Esperance Plains; EYB, Eyre Yorke Block; FIN, Finke; FLB, Flinders Lofty Block; GAS, Gascoyne; GAW, Gawler; GD, Gibson Desert; GS, Geraldton Sandplains; GSD, Great Sandy Desert; GVD, Great Victoria Desert; HAM, Hampton; JF, Jarrah Forest; KAN, Kanmantoo; LSD, Little Sandy Desert; MAC, MacDonnell Ranges; MAL, Mallee; MDD, Murray Darling Depression; MGD, Mitchell Grass Downs; MII, Mount Isa Inlier; ML, Mulga Lands; MUR, Murchison; NAN, Nandewar; NCP, Naracoorte Coastal Plain; NK, Northern Kimberley; NSS, New South Wales South Western Slopes; NUL, Nullarbor; PIL, Pilbara; RIV, Riverina; SSD, Simpson Strzelecki Dunefields; STP, Stony Plains; SWA, Swan Coastal Plain; TAN, Tanami; VB, Victoria Bonaparte; VVC, Victorian Volcanic Plains; WAR, Warren; YAL, Yalgoo. (Interim Biogeographic Regionalization for Australia, version 6.1, after Thackway & Cresswell (1997).

*, only females known.

synapomorphy: the distance between the anterior pockets of the female epigynum is greater than the width of the posterior transverse part (character 24). The genus is also unified by five homoplasious characters: the cephalic region of the carapace is elevated, strongly sloping away from the eyes in lateral view (1), the cymbium tip has ten to 30 macrosetae (10), the cymbium tip macrosetae are curved dorsally (11), the tip of terminal apophysis comes to a sharp point (17), and the subterminal apophysis is beneath the terminal apophysis and difficult to see in ventral view (19).

Hoggicosa wolodymyri sp. nov. was found to be sister to all other *Hoggicosa*, which were defined by three homoplasious characters: the colour of the ventral abdomen of females is uniformly dark (8), the ridge connecting the ventral spur and apical tip on the tegular apophysis is curved (14), and trapdoors are present on burrows (26). Likewise, *H. forresti* was found to be sister to the remaining *Hoggicosa* species, which were defined by the presence of a light coloured cardiac or chevron mark on the dorsal abdomen of females (6) (Fig. 2).

The remaining *Hoggicosa* species formed two groups. One containing *Hoggicosa alfi* sp. nov., *H. castanea*, and *Hoggicosa duracki* comb. nov. is defined by the nonhomoplasious character of a thick and opaque pars pendula (20). The group containing *H. bicolor*, *Hoggicosa brennani* sp. nov., *Hoggicosa snelli* comb. nov., and *H. storri* is defined by two homoplasious characters: the absence of a radial pattern on the carapace (2) and the subterminal apophysis is easily visible next to the terminal apophysis in ventral view (19).

Hoggicosa species with a distinct colour dimorphism between adult males and females (*H. bicolor*, *H. castanea*, *H. forresti*, and *H. storri*, character 4) did not form a monophyletic group, suggesting this colour pattern has evolved multiple times. Under fast (ACCTRAN) character optimization this trait appears independently three times and is lost once (Fig. 2), whereas under slow (DELTRAN) optimization the character appears four times independently (Fig. 2). When the analysis was repeated without this character included there was no difference in the resulting topology.

Lycosa was found to be paraphyletic, with the Australian representatives (*Lycosa godeffroyi* and *Lycosa leuckartii*) not grouping with the type species *L. tarantula* (Fig. 2). *Lycosa tarantula* and *L. praegrandis* formed a monophyletic group based on six homoplasious characters.

The two species of *Dingosa* and *Geolycosa*, along with *Mainosa longipes* (L. Koch, 1878) formed a monophyletic group supported by two nonhomoplasious characters, the absence of macrosetae on the cymbium tip (9) and the presence of a burrow palisade (27). Two of the *Hogna* species (*Hogna crispipes* and *Hogna kuyani* Framenau, Gotch & Austin, 2006) were monophyletic based on the nonhomoplasious character of the ventrally curved cymbium macrosetae. The third *Hogna* species (*Hogna immansueta*) was found to group with the type species of *Venator* based on eight homoplasious characters (Fig. 2). The representative of an undescribed Australian genus 'Grey Wolf Spider' and the monotypic *Knoelle clara* (L. Koch, 1877) were both placed in the unresolved base of the tree.

DISCUSSION

The Australian wolf spider genus *Hoggicosa* Roewer, 1960 with the type species *H. errans* (Hogg, 1905) is revalidated and revised to include ten species. The revision of *Hoggicosa* is significant in relation to the taxonomy of the Australian wolf spider fauna. Prior to this revision, 33 Australian species were misplaced in the putative Mediterranean genus *Lycosa*. Nine of these species are treated in this revision and removed from *Lycosa*, reducing the species of this genus in Australia by nearly a third. Still, the Australian Lycosinae remain poorly known with many undescribed species and genera, particularly from the arid interior, present in Australian collections (V. W. Framenau, unpubl. data).

Monophyly of the genus *Hoggicosa*

The results of the phylogenetic analysis show clearly that *Hoggicosa* is a monophyletic genus unambiguously supported by the shape of the female epigyne (distance between anterior pockets greater than the width of the posterior transverse part, character 24). The monophyly of *Hoggicosa* confirms the results of a recent molecular phylogeny that included two *Hoggicosa* species (*H. bicolor* and *H. forresti*), the grouping of which was found to be strongly supported (*L. bicolor* and *L. castanea* in Murphy *et al*., 2006). Our morphological examination suggests a second synapomorphy for *Hoggicosa*, which is not evident in our phylogenetic analysis as it combines two characters. This second synapomorphy consists of ten to 30 cymbium macrosetae (character 10) which are bent dorsally (character 11).

Relationships of *Hoggicosa* to other lycosine genera

The systematic analysis resulted in an overall poor resolution of relationships amongst genera, which appears to reflect the conservative nature of wolf spider morphology (e.g. Vink, 2001; Stratton, 2005). Indeed, resolving relationships within the Lycosinae

poses a number of problems. A recent molecular attempt found that Lycosinae contain paralogous copies of the *28S* rRNA gene, making this gene unsuitable for analysis (Murphy *et al.*, 2006). A combined effort employing morphological character sets and molecular markers may solve relationships in this morphologically conservative group, as exemplified for the New Zealand Artoriinae (Vink & Paterson, 2003). Additional phylogenetic signal may also be provided by morphological characters that we were not able to explore as part of the current study. For example, spinneret morphology has been used in phylogenetic analyses of other entelegyne spiders (e.g. Scharff & Coddington, 1997; Griswold *et al*., 2005) and shows promising intergeneric differences within wolf spiders (Townley & Tillinghast, 2003).

We did not find an unambiguous sister group to *Hoggicosa* based on our character and taxon sample. Based on similarities in morphology and burrowing behaviour we included *Knoelle clara* and a representative of an undescribed Australian genus 'Grey Wolf Spider' as potential sister taxa. But neither of these nor McKay's (1973) previous suggestion of *Geolycosa* were supported as sister group by our phylogeny (Fig. 2). Molecular studies suggest that Australian *Hogna* may be closely related to *Hoggicosa*. The maximum parsimony analysis of molecular data by Murphy *et al*. (2006) found *Hogna crispipes* as sister to two *Hoggicosa* representatives. Adding to these results, Gotch *et al*. (2008) found that *Hogna kuyani* was sister to *Hoggicosa*, although the posterior probability of this relationship was low (54%), and *Hogna crispipes* was basal to both. These two *Hogna* species (*Hogna crispipes* and *Hogna kuyani*) were included in our phylogeny and found to form a monophyletic group, but a sister group relationship with *Hoggicosa* was not supported. In addition, a third species currently listed in *Hogna* (*Hogna immansueta*) was found to group with the type species of *Venator*, suggesting additional taxonomic problems within the six Australian species currently placed in *Hogna*.

Our analysis clearly shows that some Australian species currently listed in *Lycosa* do not form a monophyletic group with the type species of the genus, *L. tarantula* and a congeneric *L. praegrandis*. *Lycosa godeffroyi* and *L. leuckartii* were placed separately in the unresolved base of the tree, contrary to the molecular results of Murphy *et al*. (2006) who found very strong support for the monophyly of these two species. They represent a very diverse clade of common Australian Lycosinae characterized by a typical 'Union-Jack-colour pattern' on the cephalothorax with alternating dark and light radial lines (character 2). *Tasmanicosa tasmanica* (Hogg, 1905), the type species of *Tasmanicosa*, is part of this group and the genus *Tasmanicosa* is currently under revision by the junior author.

The grouping of the North American representatives of *Geolycosa* with the Australian genera *Dingosa* and *Mainosa* was surprising and may indicate a case of convergence. This group was defined by the lack of cymbium macrosetae and the presence of burrow palisades, which is an uncommon burrow modification in lycosids. All these species live in sandy habitats and this shared burrowing behaviour and putative associated morphology may be a result of adaptations to live in this substrate. Neither *Dingosa* nor *Mainosa* were represented in Murphy *et al*. (2006), but *Geolycosa missouriensis* which was included, was found to be the basal most lycosine (parsimony analysis) or sister to *Rabidosa* (Bayesian analysis).

The revalidation of *Hoggicosa* places *L. exigua* (Roewer, 1960) from Namibia back into *Hoggicosa*. A critical review of Roewer's (1960: 773–774, fig. 432A, B) original description of *Hoggicosa exigua* clearly shows that the epigyne is not like that of *Hoggicosa* or *Lycosa* (e.g. Zyuzin & Logunov, 2000), but much more reminiscent of *Hogna* (e.g. Fuhn & Niculescu-Burlacu, 1971 for the type species of *Hogna*, *Hogna radiata* Latreille, 1817 and Framenau *et al*., 2006 for Australian *Hogna*). We therefore transfer *Hoggicosa exigua* to *Hogna*, *Hogna exigua* (Roewer, 1960) pending a revision of the African Lycosidae related to *Hogna*. Unfortunately, we were not able to include *Hogna exigua* in our phylogenetic analysis to confirm this transfer.

Evolution of sexual dimorphism in colour pattern

Originally distinguished by McKay (1973) as the '*bicolor* group' because of the striking leg and body colouration of females in several species, the phylogenetic analysis under both fast and slow optimization suggests this trait to have evolved multiple times. The four species which display marked difference in colouration between adult males and females (*H. bicolor*, *H. castanea*, *H. forresti* and *H. storri*, Fig. 1A, B, D, E) did not form a distinct group. It is proposed that this trait has originated multiple times within *Hoggicosa* suggesting high evolutionary pressure on conspicuous female colour patterns or reduction in colouration of males. Whether this dimorphism is a result of sexual or natural selection (or both) remains unresolved and requires detailed studies into the mating behaviour and natural history of these species. If the striking colour pattern is a result of sexual selection and subject to male mate choice, this would be a remarkable example in sexual role reversal in spiders. For example, alternating light and dark bands on the ventral side of the male

wolf spider *L. tarantula* have been found to correlate highly with body size and condition (Moya-Laraño *et al*., 2003). However, it is also perceivable that a lack of colouration in males provides camouflage in their active search for a female mate, although *Hoggicosa* appear to be predominantly active at night (V. W. Framenau, pers. observ.).

Biogeography of *Hoggicosa*

All *Hoggicosa* species display broad geographical distributions, with some found over all of inland Australia (*H. castanea*, *H. alfi*, and *H. bicolor*, Figs 10, 12, 14). This is not surprising as wolf spiders are capable of ballooning (Greenstone, 1982) and are highly mobile. With a distribution typical of Eyrean fauna (Heatwole, 1987) it is possible that speciation in *Hoggicosa* occurred following the aridification of Australia, as seen in many other Australian groups of fauna and flora (see review by Byrne *et al.*, 2008).

SYSTEMATICS

Family Lycosidae Sundevall, 1833

Subfamily Lycosinae Sundevall, 1833

Genus *Hoggicosa* Roewer, 1960

Hoggicosa Roewer, 1955: 247 (*nomen nudum*) – Roewer, 1960: 772.

Type species: Lycosa errans Hogg, 1905 (by original designation). Gender feminine.

Diagnosis: Hoggicosa differs from other Lycosinae by a combination of genitalic and somatic characters. A putative synapomorphy is proposed based on the female epigyne, with the distance between the anterior pockets greater than the width of the posterior transverse part (Figs 8C, 11C). An undescribed genus from Brazil shares this trait; however, the anterior pockets extend along the anterior margin of the epigyne and join in a groove, forming somewhat of an 'm' shape (see Álvares, 2006: figs 127–150). A second synapomorphy is a patch of ten to 30 dorsally curved macrosetae on the tip of the cymbium in males (Fig. 1I). In lateral view, the shield of the prosoma is highest in the cephalic region sloping gently towards posterior end (Fig. 3A). The prosoma is uniform in colour or with indistinct radial pattern; median or lateral bands are absent. Females of several species show striking contrast in the colouration of the legs and opisthosoma (similarly coloured as penultimate males, Fig. 1A, D, F).

Most similar to *Hoggicosa* are the monotypic genus *Knoelle* and an undescribed Australian genus represented by the 'Grey Wolf Spider' (see Framenau & Baehr, 2007). *Knoelle* also possess backwards bent macrosetae on the cymbium tip, but in a much larger patch than in *Hoggicosa* (see Framenau, 2006b, fig. 2). Specimens of the currently undescribed genus including the 'Grey Wolf Spider' [Hickman, 1967: misidentified as *Dingosa simsoni* (Simon, 1898)] are of similar size and shape as *Hoggicosa* species and build burrows with trapdoors, but they differ by the synapomorphies of *Hoggicosa*.

Description: Large and robust wolf spiders, TL 11.6–21.6 in males and 14.4–25.6 in females. Prosoma longer than wide, length 6.4–11.4 in males and 6.9–10.7 in females. Dorsal shield of prosoma highest in cephalic region, sloping gently towards posterior end (Fig. 3A). Dorsal shield of prosoma uniform in colour or with faint radial pattern (sometimes artificially pronounced when preserved in ethanol), without median or marginal bands. AE row strongly procurved. PME greater than PLE and PME narrower than PLE row. Labium as long as wide or slightly longer than wide. Chelicerae with three promarginal teeth, the middle largest, and three retromarginal teeth of equal size. Male leg colouration uniform, females of some species with alternating light and dark pattern on legs. Leg lengths IV > I > II > III. Legs I and II with scopulae on tarsus and metatarsus, also part of tibia in females. Legs III and IV with scopulae on tarsus and half of metatarsus, all of the metatarsus in females.

Natural history: Hoggicosa are predominately found through semi-arid and arid regions of Australia. All species build burrows and many construct doors from sand, with *H. snelli* using pebbles or debris as a door (McKay, 1975). As the patch of macrosetae on the male cymbium is found only in adults, it is possible that these are used for courtship behaviour. We have made one observation of an attempted mating between a male and female of *H. alfi*. When approaching the female, the male used his palps to stroke the ground rapidly towards his body. This was carried out in repeated short bursts of less than a second, and created small 'dugouts' in the soft sand.

Hoggicosa are easily kept in the laboratory but can be difficult to rear past the penultimate stage. Our observations suggest that moulting can be triggered by hot and humid weather conditions.

Distribution: Australia.

KEY TO MALES OF *HOGGICOSA*

(Males of *H. natashae* are currently unknown)

1. Terminal apophysis curved apically, with tip of terminal apophysis located apically of its connection to the palea (Figs 8B, 13A)……2
Terminal apophysis not curved apically, pointing retrolaterally, with tip of terminal apophysis level with connection to palea (Figs 11A, 16A)……8
2. Subterminal apophysis large and easily visible next to terminal apophysis in ventral view (Fig. 13B)……3
Subterminal apophysis small and hard to see beneath terminal apophysis in ventral view (Figs 7A–D, 8B)……6
3. Tegular apophysis with straight ridge between ventral process and apical point (Fig. 6A–D)……4
Tegular apophysis with curved ridge between ventral process and apical point (Fig. 5A–C)……5
4. Ventral abdomen cream with black epigastric stripe (Fig. 4F)……*H. snelli*
Ventral abdomen black……*H. bicolor*
5. Ventral abdomen all black, tegular apophysis with rounded ventral process (Fig. 5G–H)……*H. storri*
Ventral abdomen pale, although may have faint 'V' pattern or spots in black (Fig. 4E), tegular apophysis with large flange on ventral process (Fig. 5C–D)……*H. brennani*
6. Tegular apophysis with curved ridge between ventral process and apical point (Fig. 5A–E), ventral abdomen with black patch……7
Tegular apophysis with straight ridge between ventral process and apical point (Fig. 5F), ventral abdomen cream or with a few black dots……*H. wolodymyri*
7. Prominent black stripe (cardiac or chevron mark) on dorsal abdomen (Fig. 1C), pars pendula transparent and joined to embolus below embolus tip (Fig. 7C)……*H. forresti*
Tan or brown stripe on dorsal abdomen, pars pendula opaque and joined to embolus at tip (Fig. 7A)……*H. castanea*
8. Ventral process of tegular apophysis with bifurcate tip (Fig. 6G, H), terminal apophysis very short and robust (Fig. 16A)……*H. duracki*
Ventral process of tegular apophysis with rounded end (Fig. 6E), terminal apophysis elongate and pointed, pars pendula with oval dark patch (Fig. 11B)……*H. alfi*

HOGGICOSA CASTANEA (HOGG, 1905) **COMB. NOV.** (FIGS 1I, 3A, B, 4A–C, 5A, B, 7A, 8A–D, 9A, B, 10)

Lycosa castanea Hogg, 1905: 577–579, fig. 83A–B; Rainbow, 1911: 266; Bonnet, 1957: 2637; McKay, 1973: 396, fig. 3J; McKay, 1985: 75; Platnick, 1993: 487.

Lycosa errans Hogg, 1905: 579, fig. 84; Rainbow, 1911: 267; Roewer, 1955: 247; Bonnet, 1957: 2640; McKay, 1973: 379, 394–395, fig. 3I. syn. nov.

Lycosa skeeti Pulleine, 1922: 83, pl. 5, fig. 1; Bonnet, 1957: 2664; McKay, 1973: 397–398, fig. 3K–L. syn. nov.

Lycosa perinflata Pulleine, 1922: 84, pl. 5, fig. 2; Bonnet, 1957: 2657; McKay, 1973: 395, fig. 3F–H. syn. nov.

Allocosa castanea Roewer, 1955: 206.

Types: Holotypes. *Hoggicosa castanea*, ♀ from Australia: no locality given, no date (SAM NN015). *L. errans*, ♀ from Australia: no locality given [Hogg, 1905: '(without locality) sent from Adelaide'], no date (SAM NN016). *L. skeeti*, ♀ from South Australia: Wilson, Flinders Ranges, 31°60′S, 138°21′E, iv.1908 (SAM NN019); *L. perinflata*, ♀ from South Australia: Whyte Yarcowie, 33°13′S, 138°53′E, i.1908 (SAM NN017).

Other material examined: 179 males, 134 females, and five juveniles from 232 records (Appendix S1).

Diagnosis: Hoggicosa castanea is most similar to *H. brennani* and *H. forresti*. The subterminal apophysis of *H. castanea* is very small and reduced (Fig. 7A), whereas it is much longer in *H. brennani* and *H. forresti* (Figs 7C, 15B). The pars pendula in *H. castanea* is opaque and joins at the embolus tip (Fig. 7A), whereas in *H. brennani* and *H. forresti* it is transparent and joins below the embolus tip (Figs 7C, 15B). *Hoggicosa forresti* may be distinguished by the presence of a black stripe on the dorsal abdomen, which is absent in both *H. castanea* and *H. brennani*. The venter of *H. castanea*, which is black (Fig. 4B), may also be used to distinguish it from *H. brennani*, in which it is pale with dark patches (Fig. 4E).

Description: Male: Based on SAM NN19314, Gluepot Station, Gluepot Homestead, 33°44′51′S, 140°01′07′E, South Australia (SA). Dorsal shield of prosoma brown, with faint radial pattern, covered with black setae. Sternum and labium brown with scattered black setae. Chelicerae dark brown with white setae. Legs brown, but ventral side of femur paler. Opisthosoma dorsally greyish-black, with mottled pale and brown patches. Grey median longitudinal band in anterior

KEY TO FEMALES OF *HOGGICOSA*

Body and leg colouration can be important for distinguishing females, which have very similar epigyne morphology amongst species and are somewhat variable within species.

1. Ventral abdomen all black or with large patch of black extending to spinnerets on ventral surface (Fig. 4B).....2
Ventral abdomen all pale (cream, yellow, or light orange) or with some black lines or dots only (Fig. 4E–F).....7
2. Abdomen entirely black except for a pale (yellowish or cream) anterior median stripe on the dorsal surface, femur, and part of patella black, with remainder of leg pale (Fig. 1A).....*H. bicolor*
Dorsal abdomen pale with black transverse stripes, mottled brown or grey with transverse lines, or black with pale stripes down lateral sides; leg colouration grey, brown, or if alternating dark and pale segments the patella and tibia are of the same colour.....3
3. Abdomen entirely black except for pale stripes along either side extending from spinnerets, patella and tibia black with rest of leg pale.....*H. storri*
Dorsal abdomen pale with black transverse stripes, mottled brown or grey with transverse lines, or with black anterior median stripe; leg colouration grey, brown or if alternating dark and pale segments with pale tibia and patella....4
4. Dorsal abdomen with prominent black stripe (cardiac or chevron mark) (Fig. 1C).....*H. forresti*
Dorsal abdomen without black stripe.....5
5. Dorsal abdomen pale with black transverse lines, epigynum with long anterior pockets (Figs 1F, 19A–B).....*H. natashae*
Dorsal abdomen mottled brown or grey with transverse lines or black dots.....6
6. Anterior pockets of epigynum much wider than posterior transverse part (Fig. 8C).....*H. castanea*
Anterior pockets of epigynum only slightly wider than posterior transverse part (Fig. 11C).....*H. alfi*
7. Dorsal abdomen cream or with faint black dots only.....8
Dorsal abdomen with median anterior stripe and transverse markings (Fig. 4D, H, I).....9
8. Ventral abdomen with black line posterior to epigastric furrow (Fig. 4F).....*H. snelli*
Ventral abdomen without black epigastric line.....*H. duracki*
9. Legs pale orange or yellow, epigynum small with anterior pockets only slightly wider than posterior transverse part (Fig. 24C).....*H. wolodymyri*
Legs brown or grey, epigynum large with anterior pockets much wider than posterior transverse part (Fig. 15C).....*H. brennani*

half with partial border of black. Remainder of opisthosoma with faint transverse lines angled to posterior (Fig. 4A). Opisthosoma laterally cream with black setae. Venter cream with darker central area, which does not reach spinnerets, all covered in white setae. Terminal apophysis of pedipalps curved slightly apically, commonly with slight twist in tip (Figs 7A, 8B). Pars pendula obvious, opaque, and connected to embolus at embolus tip (Fig. 7A). Subterminal apophysis present, but reduced and difficult to see under the terminal apophysis. Tegular apophysis with rounded ventral process located centrally and projecting perpendicular. Prominent ridge curving from ventral process to apical point (Fig. 5A).

Female: Based on SAM NN15185, Fisherman Point, Lincoln National Park, 34°45′S, 135°59′E, SA. Dorsal shield of prosoma as male but with black and white setae. Sternum, labium, chelicerae, and legs as male. Opisthosoma dorsally as male. Opisthosoma laterally cream with white setae and occasional black dots. Venter cream with a black patch covered in black setae. Epigyne with small anterior pockets, often located anterior to and far from posterior transverse part (Fig. 8C). Internal epigyne with wide spermathecal heads (Fig. 8D).

Variation: Hoggicosa castanea displays a large range of body colouration, particularly between specimens from Western and South Australia. Specimens from Western Australia can display a much paler dorsal abdomen colouration (Fig. 4C) compared with that typical of *H. castanea* (Fig. 4A). Some specimens from the Pilbara region of Western Australia were found to have a reduced black pattern on the ventral abdomen. In addition, female specimens from southern Western Australia can also display leg markings similar to that of *H. forresti*. The tegular apophysis of *H. castanea* also differs slightly in the west of its range with a broader ventral process and longer apical point (Fig. 5A vs. 5B). Although displaying these differences amongst locations, the palea region and attachment of the pars pendula, which is the most powerful character in distinguishing species, was identical amongst all male specimens and we currently consider these conspecific.

Remarks: Examination of the holotypes of *L. errans*, *L. perinflata*, and *L. skeeti* showed that they conform to the variation in epigynes and colouration found in all currently available material of *H. castanea*. This confirms McKay's (1973) suggestion that *L. errans*

and *L. perinflata* are junior synonyms of *H. castanea*. McKay (1973) also suggested that *L. skeeti* may be a subspecies of *L. bicolor*, but we cannot confirm this assumption. We give *L. castanea* precedence over *L. errans* as it was established in preceding pages of the same publication.

Measurements: ♂ NN19324 (♀ holotype): TL, 17.8 (18.6); PL, 9.3 (9.3); PW, 7.6 (7.8). Eyes: AME, 0.50 (0.50); ALE, 0.27 (0.36); PME, 1.04 (1.00); PLE, 0.86 (0.91). Sternum (length/width): 4.1/3.6 (4.1/3.7). Labium (length/width): 1.4/1.4 (1.6/1.6). OL, 8.6 (9.3); OW, 5.0 (6.4). Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 4.6 + 4.4 + – + 3.6 = 12.6; I, 9.3 + 11.1 + 8.7 + 4.7 = 33.8; II, 8.8 + 10.6 + 8.6 + 4.6 = 32.6; III, 8.1 + 9.3 + 8.7 + 4.4 = 30.5; IV, 10.1 + 11.4 + 11.7 + 4.8 = 38.0 (pedipalp, 4.3 + 4.6 + – + 3.1 = 12.0; I, 8.6 + 10.3 + 6.8 + 4.0 = 29.7; II, 8.4 + 9.7 + 7.0 + 3.8 = 28.9; III, 7.7 + 8.7 + 7.3 + 3.8 = 27.5; IV, 9.7 + 11.0 + 10.1 + 4.3 = 35.1).

♂ (♀) (range, mean ± SD): TL, 14.3–20.7, 18.0 ± 1.8; PL, 8.0–10.7, 9.6 ± 0.8; PW, 6.3–8.6, 7.7 ± 0.7; *N* = 10 (TL, 17.9–25.3, 20.7 ± 2.0; PL, 10.0–11.3, 10.6 ± 0.4; PW, 8.4–9.4, 8.9 ± 0.4; *N* = 11).

Natural history: Hoggicosa castanea has been collected from areas with white sand and limestone, red sandy loam, clay, or coastal dunes and rocky hills. This species has been found in association with *Acacia*, *Melaleuca*, and Black Box (*Eucalyptus largiflorens*) woodlands, as well as *Callitris*, Mulga (*Acacia anuera*), Mallee (*Eucalyptus*), and Spinifex (*Triodia*) habitats. Adult females have been collected all year round with adult males present from November to May. They build burrows with trapdoors, which can be very well camouflaged (Fig. 9A, B).

Distribution: New South Wales, Northern Territory, South Australia, Victoria, Queensland, and Western Australia (Fig. 10).

HOGGICOSA ALFI SP. NOV. (FIGS 1G, H, 6E, F, 11A–E, 12)

Types: Holotype. ♂ from Western Australia: Lorna Glen Station, 26°12′04′S, 121°18′14′E, 31.x.–7.xi.2002, M.A. Cowan *et al*. (WAM T77405).

Paratypes. 1 ♀ (WAM T77406) and 4 ♂s (WAM T53919), same data as holotype.

Other material examined: 397 males, 53 females, and 20 juveniles from 191 records (Appendix S1).

Etymology: The specific epithet is a patronym in honour of the senior author's recently deceased grandfather, Alf Cain, in appreciation for teaching me how to fish and the importance of a firm handshake.

Diagnosis: Males of *H. alfi* can be distinguished from all other *Hoggicosa* by the presence of a dark oval patch on the pars pendula and an elongated terminal apophysis which points retrolaterally with only a slight apical bend (Fig. 11A, B). Females can be distinguished from all other *Hoggicosa* by the unique shape of the epigynum, which has broad anterior pockets and a comparatively wide posterior transverse part (Fig. 11C).

Description: Male: Based on holotype. Dorsal shield of prosoma orange-brown, darker in eye quadrangle, with a faint radial pattern; covered with short black setae. Sternum and labium dark brown with scattered black setae. Chelicerae dark brown with white setae. Legs orange-brown. Opisthosoma dorsally mottled grey. Brown median longitudinal band at anterior end with faint transverse lines covering rest of opisthosoma (Fig. 1G). Cover of grey setae with longer black bristles scattered throughout. Opisthosoma laterally cream, venter black. Terminal apophysis of pedipalp pointing retrolaterally (Fig. 11A). Pars pendula connected to embolus near embolus tip, with unique dark oval patch (Fig. 11B). Subterminal apophysis small and only partly visible under terminal apophysis (Fig. 11B). Tegular apophysis with large rounded ventral process located towards apical point, with continuous ridge curving to the apical point (Fig. 6E).

Female: Based on paratype. Dorsal shield of prosoma similar to male but with darker radial pattern and cover of fine white setae. Sternum, labium, and chelicerae as male. Legs orange-brown, with the prolateral surface of the femur (especially leg I) darker. Ventral surface of patella darker than femur, less so for leg I. Opisthosoma dorsally pale (yellowish-cream) with scattered black dots and a faint anterior median band (Fig. 1H). Covered with grey setae, black setae forming dots from which a black bristle extends. Opisthosoma laterally cream with some black patches, venter black. Epigyne with broad anterior pockets, the base of which the median septum enters almost at right angles (Fig. 11C). Posterior transverse part large and long. Internal epigyne with spermathecae wider than anterior pockets (Fig. 11D).

Variation: The tegular apophysis and terminal apophysis of males are somewhat variable within this species. The terminal apophysis of some males points more retrolaterally (little curve apically). The ridge

between the ventral process of the tegular apophysis and apical point can also point retrolaterally with little curve (see Fig. 6E, F). The size of the female epigynum can vary (Fig. 11C, E). The opisthosoma of some females may be mottled and darker than described above.

Measurements: ♂ holotype (♀ paratype): TL, 16.8 (21.3); PL, 9.7 (10.1); PW, 7.1 (7.3). Eyes: AME, 0.5 (0.54); ALE, 0.27 (0.36); PME, 0.95 (1.23); PLE, 0.82 (1.14). Sternum (length/width): 4.3/3.4 (4.1/3.4). Labium (length/width): 1.2/1.1 (1.6/1.4). OL, 7.1 (11.1); OW, 4.3 (8.3). Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 4.4 + 3.8 + – + 3.1 = 11.3; I, 8.6 + 9.7 + 8.0 + 4.4 = 30.7; II, 8.0 + 9.7 + 7.8 + 4.4 = 29.9; III, 7.8 + 8.6 +7.8 + 4.3 = 28.5; IV, 9.3 + 10.7 + 10.0 + 4.4 = 34.4 (pedipalp, 4.6 + 4.3 + – + 3.0 = 11.9; I, 7.8 + 9.3 + 6.0 + 3.1 = 26.2; II, 7.6 + 9.0 + 6.0 + 3.3 = 25.9; III, 7.1 + 8.6 + 6.4 + 3.6 = 25.7; IV, 8.4 + 10.3 + 8.6 + 3.6 = 30.9).

♂ (♀) (range, mean ± SD): TL, 14.3–20.0, 17.4 ± 1.4; PL, 7.9–10.1, 9.2 ± 0.7; PW, 6.0–7.9, 7.0 ± 0.5; $N = 25$ (TL, 15.7–22.4, 18.1 ± 1.9; PL, 7.6–11.0, 9.2 ± 1.0; PW, 5.7–7.9, 6.9 ± 0.7; $N = 13$).

Natural history: Hoggicosa alfi has been collected from yellow sand plains, red dunes, interdunes, claypan edges, and stony tablelands. Specimens have been recorded in association with *Callitris* woodland, Mallee (*Eucalyptus*), *Grevillea*, and *Banksia* with *Verticordia*, Mulga (*Acacia aneura*), and Spinifex (*Triodia*) vegetation. Adult males have been collected from September to December with adult females caught through August to May. This species excavates burrows, but does not seal them with doors.

Distribution: New South Wales, Queensland, South Australia, and Western Australia (Fig. 12).

HOGGICOSA BICOLOR (HOGG, 1905) **COMB. NOV.**
(FIGS 1A, B, 2A, 13A–D, 14)

Lycosa bicolor Hogg, 1905: 580–582, fig. 85A–B; Rainbow, 1911: 266; Strand, 1913: 618; Bonnet, 1957: 2636; McKay, 1973: 378, 381–385, figs 1A–E, 2A–C; Main, 1976: 149, 231; McKay, 1985: 75; Platnick, 1993: 486.

Allocosa bicolor Roewer, 1955: 205.

Types: Lectotype (designated by McKay, 1973). ♀ from South Australia: no locality given, no date (SAM NN012).

Paralectotypes. South Australia: 1 ♀, no locality given, no date (SAM NN011); 1 juvenile, no locality given, no date (SAM NN013).

Other material examined: 335 males, 95 females, and 35 juveniles from 283 records (Appendix S1).

Diagnosis: The male palp of *H. bicolor* is most similar to *H. snelli*, but these two species can be easy distinguished by abdomen colouration. Male *H. bicolor* have a grey opisthosoma and black venter, whereas male *H. snelli* have a cream opisthosoma and venter with a black epigastric stripe (Fig. 4F). Females and juveniles can be readily distinguished from all other *Hoggicosa* species by the striking colouration of the legs and abdomen (Fig. 1A).

Description: Male: Based on WAM T62336, Mt Vernon Station, 24°30′S, 118°30′E, Western Australia (WA). Dorsal shield of prosoma brown, covered in short black and white setae. Sternum and labium brown with scattered black setae. Chelicerae dark brown with white setae. Legs brown. Opisthosoma grey with cover of grey and black setae (Fig. 1B). Opisthosoma laterally with faint longitudinal lines and black and white setae. Venter black with black setae. Terminal apophysis of pedipalp large and strongly curved apically (Fig. 13A). Pars pendula thin, transparent, and connected to embolus near embolus base (Fig. 13B). Subterminal apophysis large and easily visible next to terminal apophysis. Tegular apophysis with small, pointed ventral process, located close to apical point. Straight ridge between ventral process and apical point (Fig. 6A).

Female: Based on WAM T62336, data as above. Dorsal shield of prosoma reddish-brown, darker in eye quadrangle, cover of fine white setae. Sternum, labium, and chelicerae as male. Femur and first part of patella of all legs black–dark brown, with remainder of leg cream (can have almost yellow tinge when alive) (Fig. 1A). Opisthosoma dorsally black covered in fine black setae, with prominent cream anterior median lanceolate stripe (Fig. 1A). Opisthosoma laterally and ventrally black with black setae. Epigynum simple, with small anterior pockets located close to median septum (Fig. 13C). Internal epigyne with large spermathecal heads, which are very close to the anterior pockets (Fig. 13D).

Variation: The size and shape of the pale lanceolate stripe on the opisthosoma of females can vary amongst individuals from a small streak at the anterior end to a large band nearly reaching the spinnerets and covering most of the dorsal surface (see McKay, 1973, fig. 1B–E). Females and juveniles may sometimes have cream markings on the black dorsal femur (Fig. 1A).

Remarks: As the lectotype female is in poor condition, a representative male and female have been used for the redescription of *H. bicolor*.

Measurements: ♂ (♀): TL, 18.6 (25.4); PL, 10.0 (11.8); PW, 7.6 (8.6). Eyes: AME, 0.54 (0.59); ALE, 0.27 (0.36); PME, 1.36 (1.41); PLE, 1.09 (1.27). Sternum (length/width): 4.6/3.3 (4.8/3.6). Labium (length/width): 1.4/1.3 (1.8 /1.8). OL, 8.6 (13.6); OW, 5.0 (8.8). Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 5.1 + 5.3 + – + 3.6 = 14.0; I, 8.6 + 10.7 + 8.6 + 4.6 = 32.5; II, 8.6 + 10.6 + 8.1 + 4.6 = 31.9; III, 7.8 + 9.3 + 7.8 + 4.6 = 29.5; IV, 10.0 + 11.4 + 10.3 + 5.0 = 36.7 (pedipalp, 5.4 + 5.7 + – + 3.6 = 14.7; I, 9.6 + 11.6 + 7.4 + 4.3 = 32.9; II, 9.3 + 11.4 + 7.6 + 4.3 = 32.6; III, 8.6 + 9.8 + 7.8 + 4.1 = 30.3; IV, 10.4 + 12.8 + 10.7 + 4.8 = 38.7).

♂ (♀) (range, mean ± SD): TL, 13.6–18.6, 16.2 ± 1.4; PL, 7.4–10.0, 8.8 ± 0.7; PW, 5.4–7.1, 6.5 ± 0.5; $N = 23$ (TL, 15.0–25.0, 20.2 ± 3.0; PL, 7.9–12.0, 10.0 ± 1.4; PW, 5.9–9.1, 7.6 ± 1.0; $N = 13$).

Natural history: Hoggicosa bicolor has been collected from areas with sandy plains, red sand, claypans, and stony soil. Found in locations with Mulga (*A. aneura*) and *A. estrophiolata*, Ironwood (*A. estrophiolata*) woodland, *Eucalyptus socialis*, chenopod scrubland (*Atriplex* and *Mairean*), and Spinifex (*Triodia irritans*). Adult females have been collected all year round with adult males recorded from August to April. This species has been dug up from burrows with and without doors.

Distribution: New South Wales, Northern Territory, Queensland, South Australia, and Western Australia (Fig. 14).

HOGGICOSA BRENNANI SP. NOV. (FIGS 4D, E, 5C, D, 15A–D, 18)

Types: Holotype. ♂ from South Australia: 1.5 km south-west Middle dam, Taylorville Station, 33°53′10′S, 140°18′32′E, 8–13.xii.2000, Royal Geographic Society of South Australia (RGS)/Bookmark Survey, TV04 (SAM NN17017).

Paratype. ♀ from South Australia: Casuarina Dam, Taylorville Station, 33°53′10′S, 140°18′32′E, 10.x.2000, RGS/Bookmark Survey, TV-camp, burrow with trapdoor (SAM NN17029).

Other material examined: 53 males, 27 females, and four juveniles from 64 records (Appendix S1).

Etymology: The specific epithet is a patronym in honour of Karl E. C. Brennan in recognition of his work on the ecology of Australian spiders. The senior author also thanks him for his support and friendship.

Diagnosis: The pedipalps of *H. brennani* most closely resemble those of *H. castanea* and *H. forresti*. The pars pendula, which is transparent in *H. brennani* and joins below the embolus tip (Fig. 15B), may be used to distinguish it from *H. castanea*, in which it is opaque and joins at the embolus tip. In addition the subterminal apophysis of *H. brennani* is much longer than that of *H. castanea* (Figs 7A, 8B). The ventral process on the tegular apophysis of *H. brennani* has a flange on the prolateral side which is absent in *H. forresti* (Fig. 5C, D vs. 5E). Male and female *H. brennani* have a pale venter with dark patterning, whereas *H. castanea* and *H. forresti* have a black venter (Fig. 4B vs. 4D).

Description: Male: Based on holotype. Dorsal shield of prosoma orange-brown in colour, darker in eye quadrangle, with black and white setae. Sternum pale orange, labium brown, both with scattered black setae. Chelicerae dark brown with white setae. Legs brown. Opisthosoma dorsally mottled. Brown median longitudinal stripe at anterior end with partial edging of black. Faint transverse lines (grey/black) over rest of opisthosoma (Fig. 4D). Cover of black, grey, and white setae. Opisthosoma laterally cream with scattered black patches. Venter cream with faint V-shape made of black patches of black setae (Fig. 4E). Terminal apophysis of pedipalp curved apically (Fig. 15A). Pars pendula transparent and connected to embolus just below embolus tip (Fig. 15B). Subterminal apophysis next to terminal apophysis (Fig. 15B). Tegular apophysis with a large ventral process located centrally and pointing away from tip of tegular apophysis. Ventral process with flange on prolateral side, which has a characteristic notch when viewed from anterior of pedipalp (Fig. 5C, D). Ridge from ventral process to apical point present and curved (Fig. 5C).

Female: Based on paratype. Dorsal shield of prosoma as male. Sternum, labium, chelicerae, and legs as male. Opisthosoma dorsally and laterally as male (Fig. 4D, F). Venter cream with some scattered black dots that have a long black setae extending. Epigyne with small anterior pockets greater in width than posterior transverse part (Fig. 15C). Internal epigyne with clearly defined channel from anterior pockets to spermatheca (Fig. 15D).

Variation: The abdomen colouration of *H. brennani* can vary. In some specimens the dorsal markings may be much paler and the ventral abdomen nearly completely cream. Likewise, some specimens display a more pronounced ventral marking with a greater number of black dots and enhanced black lines.

Measurements: ♂ holotype (♀ paratype): TL, 19.8 (18.4); PL, 9.8 (9.6); PW, 7.9 (7.6). Eyes: AME, 0.46 (0.50); ALE, 0.31 (0.42); PME, 0.96 (1.15); PLE, 0.77 (1.00). Sternum (length/width): 4.5/3.9 (4.1/3.6). Labium (length/width): 1.6/1.4 (1.6/1.5). OL, 10.0 (8.8); OW, 6.2 (6.1). Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 5.1 + 5.2 + – + 4.0 = 14.3; I, 9.9 + 12.0 + 9.2 + 5.2 = 36.3; II, 9.6 + 11.6 + 9.0 + 5.1 = 35.3; III, 8.4 + 10.0 + 9.2 + 4.7 = 32.3; IV, 10.0 + 12.1 + 11.2 + 5.4 = 38.7 (pedipalp, 4.9 + 5.0 + – + 3.6 = 13.5; I, 8.8 + 9.9 + 6.2 + 3.8 = 28.7; II, 8.1 + 9.4 + 6.4 + 3.8 = 27.7; III, 7.2 + 8.5 + 7.4 + 3.6 = 26.7; IV, 9.0 + 10.6 + 9.4 + 4.4 = 33.4).

♂ (♀) (range, mean ± SD): TL, 14.3–20.0, 17.1 ± 2.3; PL, 7.5–11.4, 9.0 ± 1.3; PW, 6.1–9.0, 7.1 ± 1.0; $N = 8$ (TL, 18.1–25.6, 20.4 ± 3.0; PL, 8.8–11.9, 9.8 ± 1.3; PW, 6.9–9.4, 7.8 ± 1.0; $N = 5$).

Natural history: Hoggicosa brennani has been recorded from sand and dune locations with records of Mallee (*Eucalyptus*) vegetation with mixed understorey and Spinifex (*Triodia*). Adult females have been collected all year round with adult males found from October to March. This species builds burrows with trapdoors.

Distribution: New South Wales, Queensland, and South Australia (Fig. 18).

HOGGICOSA DURACKI (MCKAY, 1975) **COMB. NOV.**
(FIGS 6G, H, 7B, 16A–E, 18)

Lycosa duracki McKay, 1975: 313–316, fig. 2A–E; Brignoli, 1983: 450; McKay, 1985: 76.

Types: Holotype. ♀ from Western Australia: Old Argyle Downs Station (today submerged under Argyle Dam), Ord River, 16°12′S, 128°48′E, 23.x.1971, R. J. McKay, W. H. Butler, with young spiderlings (WAM 74/494).

Paratypes. 1 ♂ and 2 ♀s from same location as holotype: 5.x.1971 (WAM 74/495-7).

Other material examined: Six males and three females from five records (Appendix S1).

Diagnosis: Males can be distinguished from the similarly coloured *H. snelli* by a very short terminal apophysis (Fig. 16A) and a large tegular apophysis, which has a ventral process with a bifurcate tip (Fig. 6G, H). Both sexes can be distinguished from *H. snelli* by the plain cream venter which lacks the black stripe of *H. snelli* (Fig. 4F).

Description: Male: Based on paratype. Dorsal shield of prosoma pale orange, covered in fine black and white setae. Sternum pale orange, labium orange-brown, both with scattered black setae. Chelicerae dark brown with white setae. Legs pale orange-yellow. Opisthosoma dorsally cream, cover of fine black setae with longer black bristles scattered throughout. Opisthosoma laterally cream, venter cream with white setae. Terminal apophysis of pedipalp very short, robust, and pointing retrolaterally (Fig. 16A, B). Pars pendula thick and opaque, connected to embolus at embolus tip (Fig. 7B). Large tegular apophysis with a long ventral process located basally and pointing strongly away from tip of tegular apophysis. Ventral process with a bifurcate tip and no continuous ridge to the apical point (Fig. 6G, H).

Female: Based on holotype. Dorsal shield of prosoma pale orange-yellow with fine white setae. Sternum, labium, and chelicerae as male. Legs pale yellow. Opisthosoma dorsally cream, covered with white setae and scattered longer black bristles. Opisthosoma laterally cream, venter cream with two faint dark spots at anterior end. Epigyne with small anterior pockets, close to the median septum (Fig. 16E).

Remarks: The epigyne of one of the female paratypes (WAM 74/496, Fig. 16C, D) is vastly different to that of the holotype (Fig. 16E). Unfortunately, the epigyne of the second female paratype (WAM 74/497) is missing, but from McKay's (1975: fig. 2E) figure of the ventral view it appears to match that of the holotype. This difference may indicate that the epigynes of *H. duracki* are highly variable. However, the elongated structure of the ventral process on the tegular apophysis of the male specimens appears unlikely to 'match' the holotype epigyne (see Zyuzin, 1993). The dimensions of the tegular apophysis fit better with that of the paratype epigyne figured here (Fig. 16C). Therefore, the females of *H. duracki* may represent two species, but given the current lack of material, in particular a morphologically different male, we currently consider them as conspecific.

Measurements: ♂ paratype (♀ holotype): TL, 18.8 (19.4); PL, 9.4 (10.6); PW, 8.0 (8.0). Eyes: AME, 0.50 (0.62); ALE, 0.35 (0.38); PME, 1.15 (1.35); PLE, 0.81 (1.23). Sternum (length/width): 4.4/4.0 (4.9/3.8). Labium (length/width): 1.5/1.3 (1.5/1.5). OL, 9.4 (8.8); OW, 5.7 (6.2). Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 4.4 + 4.3 + – + 3.8 = 12.5; I, 9.4 + 11.4 + 9.4 + 4.7 = 34.9; II, 9.1 + 10.8 + 9.4 + 4.7 = 34.0; III, 8.6 + 9.8 + 9.3 + 4.4 = 32.1; IV, 10.1 + 11.8 + 11.4 + 4.8 = 38.1 (pedipalp, 5.0 + 5.0 + – + 3.6 = 13.6; I, 8.2 +

10.2 + 6.2 + 3.4 = 28.0; II, 7.9 + 9.6 + 6.2 + 3.6 = 27.3; III, 7.5 + 8.8 + 6.2 + 3.8 = 26.3; IV, 8.8 + 10.6 + 8.1 + 4.4 = 31.9).

♂ (♀) (range, mean ± SD): TL, 15.7–18.8, 16.8 ± 1.3; PL, 7.9–9.4, 8.7 ± 0.7; PW, 6.1–8.0, 7.2 ± 0.8; $N = 4$ (TL, 19.4–19.8, 19.5 ± 0.2; PL, 9.5–10.6, 10.0 ± 0.6; PW, 7.4–8.1, 7.8 ± 0.4; $N = 3$).

Natural history: Hoggicosa duracki have been collected from bare gravel slopes and ridges without vegetation in heavy clay-gravel. Burrows were 15–20 cm deep and up to 14 mm diameter with or without hinged doors (McKay, 1973). Mature males and females have been collected in October and November. The holotype female was collected with young in October.

Distribution: Northern Western Australia (Fig. 18).

HOGGICOSA FORRESTI (MCKAY, 1973) **COMB. NOV.** (FIGS 1C, 5E, 17A–D, 18)

Lycosa forresti McKay, 1973: 385–389, figs 1F–G, 2D–G; Main, 1976: 138–141, 149, 231, fig. 37B, plate B7; Brignoli, 1983: 450; McKay, 1985: 77.

Types: Holotype. ♀ from Western Australia: 8 miles west of Moorine Rock, 8.i.1970, W. H. Butler (WAM 70/44).

Paratypes. Western Australia: 1 ♀, Buntine Reserve, *c.* 3 miles east of Buntine Railway Station, 29°59′S, 116°42′E (WAM 72/635); 2 ♀, 1 juvenile (juv.), Buntine Reserve, *c*. 3 miles east of Buntine Railway Station, 29°59′S, 116°42′E (WAM 72/639-41); 1 ♂, Hyden, 32°27′S, 118°52′E (WAM 69/801); 1 juv., Lake Moore, near south end, 30°20′S, 117°58′E (WAM 71/198); 1 ♀, Nevoria mine, 10 miles east-south-east Marvel Loch, 31°30′S, 119°34′E (WAM 70/30); 1 ♀, Mt Magnet, 323 mile peg, 28°03′S, 117°50′E (WAM 69/467); 1 ♀, Rudall River, 22°28′S, 122°29′E (WAM 71/1151); 1 ♀, Southern Cross, 31°14′S, 119°19′E (WAM 72/634); 1 ♀, Southern Cross, 6 miles east, 31°16′S, 119°25′E (WAM 69/40); 1 juv., Tammin, 31°38′S, 117°29′E (WAM 69/38); 1 juv., Wongan Hills, 106.6 miles north-east, (WAM 69/792); 1 ♀, Wongan Hills, Ballidu Road, 135 mile peg, 30°54′S, 116°43′E (WAM 69/827); 1 juv., Wongan Hills - Ballidu Road, 135 mile peg, 30°54′S, 116°43′E (WAM 69/828); 1 juv., Wubin, 30°07′S, 116°38′E (WAM 69/41); 1 juv., Wubin, 20 miles north-east, 29°54′S, 116°52′E (WAM 69/43); 1 ♀, Wubin, 10 miles north-east, 30°00′S, 116°31′E (WAM 69/456); 1 ♀, Yandil Station, 26°22′S, 119°49′E (WAM 38/916); 1 ♀, 6 juv., Yellowdine, 38 miles south, 31°51′S, 119°39′E (WAM 71/69-75).

Misidentification, these are *H. alfi*: 1 ♀, Mt Magnet, 323 mile peg, 28°03′S, 117°50′E (WAM 69/791); 1 ♀, Paynes Find area, 323 mile peg, 29°15′S, 117°41′E (WAM 70/186).

Misidentification, these are *H. castanea*: 1 ♀, Morawa, 29°13′S, 116°00′E (WAM 70/172); 1 ♀, Mt Magnet, 323 mile peg, 28°03′S, 117°50′E (WAM 69/46); 1 ♀, Kulin, 32°40′S, 118°9′E (WAM T53819; 33/1607); 1 ♀, Coonana, 12 miles north-west, 30°54′S, 123°01′E (WAM 69/35); 1 ♀, Laverton, Police Station, 28°38′S, 122°24′E (WAM 26/716, published as WAM 26/717 in McKay, 1973); 1 ♀, Marloo Station, 28°19′S, 116°11′E (WAM 69/42).

Currently missing: 1 ♀, Carrabin (WAM 69/37); 1 juv., no locality (WAM 71/76); 1 ♂, no locality (WAM 69/465).

Other material examined: 64 males, 48 females, and 19 juveniles from 105 records (Appendix S1).

Diagnosis: Most similar to *H. forresti* are *H. brennani* and *H. castanea*. Males and females of *H. forresti* may be distinguished from both by the presence of a prominent black lanceolate stripe on the anterior of the dorsal abdomen (Fig. 1C). In addition, *H. brennani* has a pale venter with dark patterning compared with the black venter of *H. forresti* and *H. castanea*. McKay (1973) indicated the leg colouration of *forresti*, with a pale diamond on the femur, as a diagnostic feature, but females of *H. castanea* can also display this leg coloration, but lack a dark lanceolate stripe. Males of *H. forresti* may be distinguished from *H. castanea* by the pars pendula, which is thin and transparent and joins below the embolus tip (Fig. 7C), whereas in *H. castanea* it is thick and opaque and joins at the tip of the embolus (Fig. 7A). The tegular apophysis may be used to distinguish *H. brennani* males, which have a flange on the ventral process (Fig. 5C, D) that is lacking in *H. forresti* (Fig. 5E).

Description: Male: Based on WAM T47762, North Baandee Nature Reserve, 31°38′S, 117°43′E, WA. Dorsal shield of prosoma brown, faint radial pattern, covered with black and white setae. Sternum light brown, labium brown, with scattered black setae. Chelicerae dark brown with white setae. Legs brown with black setae, pale diamond shape at base of femurs. Also pale with white setae on retrolateral side of ventral surface of legs I and II. Opisthosoma dorsally mottled grey. Black median lanceolate stripe at anterior end with black setae (Fig. 1C). Cover of black and white setae. Opisthosoma laterally cream with white setae. Venter with black triangular patch extending to spinnerets. Terminal apophysis of pedipalp strongly curved apically (Fig. 17A, B). Pars

pendula transparent and connected to embolus just below embolus tip (Fig. 7C). Subterminal apophysis present, but small and difficult to see beneath terminal apophysis (Fig. 7C). Tegular apophysis with rounded ventral process projecting perpendicular. Prominent curved ridge between ventral process and apical point (Fig. 5E).

Female: Based on WAM T47762, data as above. Dorsal shield of prosoma pale orange with white setae covering. Sternum, labium, and chelicerae as male. Legs dark brown with black setae, same pale diamond shape on femur as male. Ventral side of legs on femur and patella brown, remainder pale. Opisthosoma dorsally as male with faint transverse rows from end of black stripe to spinnerets. Opisthosoma laterally cream with some black patches. Venter as male. Epigyne with broad anterior pockets (Fig. 17C). Internal epigyne with large ovoid anterior pockets and 's' shaped sclerotized median septum channels (Fig. 17D).

Variation: The carapace of males can be darker with a more obvious radial pattern; some display a less obvious leg pattern or lack it altogether with grey/brown legs. The dorsal opisthosoma can vary but always has a dark lanceolate stripe. The dark lanceolate stripe is sometimes surrounded by cream or with black extensions in the middle (bulges). The length between the process and the tip of the tegular apophysis can vary, but the pars pendula and subterminal apophysis are always the same.

Remarks: McKay (1973) noted atypical specimens from Forrest, Rawlinna, and Fitzgerald River in his description. Our examination of these specimens identified them as *H. castanea*.

Measurements: ♂ (♀) both T47762: TL, 18.1 (20.3); PL, 9.6 (11.0); PW, 8.0 (8.6). Eyes: AME, 0.54 (0.54); ALE, 0.32 (0.36); PME, 0.95 (1.32); PLE, 0.91 (1.14). Sternum (length/width): 4.1/3.6 (4.8/4.0). Labium (length/width): 1.45/1.36 (1.59/1.59). OL, 8.6 (9.3); OW, 4.3 (6.0). Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 4.6 + 4.3 + – + 3.6 = 12.5; I, 9.7 + 11.4 + 9.3 + 5.0 = 35.4; II, 9.3 + 10.8 + 9.3 + 4.8 = 34.2; III, 8.6 + 10.0 + 9.6 + 4.8 = 33.0; IV, 10.7 + 12.1 + 12.1 + 5.6 = 40.5 (pedipalp, 5.0 + 5.0 + – + 3.6 = 13.6; I, 9.3 + 11.4 + 7.1 + 4.3 = 32.1; II, 8.8 + 10.7 + 7.1 + 4.3 = 30.9; III, 7.8 + 9.7 + 8.3 + 4.3 = 30.1; IV, 10.0 + 12.1 + 11.4 + 5.0 = 38.5).

♂ (♀) (range, mean ± SD): TL, 13.6–20.0, 16.8 ± 1.7; PL, 7.9–10.3, 9.0 ± 0.7; PW, 6.3–8.3, 7.3 ± 0.6; $N = 31$ (TL, 17.1–22.4, 20.4 ± 1.3; PL, 9.3–11.4, 10.5 ± 0.6; PW, 7.1–9.4, 8.6 ± 0.6; $N = 18$).

Natural history: Hoggicosa forresti has been collected from gritty, stony, and fine clayey loams as well as sandplains. Found in woodlands of Gimlet (*Eucalyptus salubris*), Salmon Gum (*E. salmonophloia*), and *E. dundasii* as well as Mallee (*Eucalyptus*) and Spinifex (*Triodia*). Adult females were collected all year round and adult males from November to May. This species excavates burrows armed with a trapdoor (see Main, 1976, fig. 37B).

Distribution: Southern Western Australia and South Australia (Fig. 18). The record of a specimen from Cottesloe, Perth (WAM 22/5) is considered dubious and may be mislabelled.

HOGGICOSA NASTASHAE SP. NOV. (Figs 1F, 19A–D, 20, 22)

Types: Holotype. ♀ from South Australia: Lake Gilles, 32°41′20′S, 136°55′20′E, 9.xii.1994, P. Hudson (SAM NN14785).

Paratypes. South Australia: 1 ♀ from Lake Gilles, 32°41′20′S, 136°55′20′E, 15.v.1993, P. Hudson (SAM NN14786); 1 ♀ from Lake Gilles, 32°43′S, 136°47′E, i.1996, P. Hudson (SAM NN13801).

Other material examined: Seven females and one juvenile from six records (Appendix S1).

Etymology: The specific epithet is a matronym in honour of the senior author's mother, Natasha Langlands, in appreciation for all her love and support.

Diagnosis: This species can be distinguished from all other *Hoggicosa* by its striking dorsal abdominal pattern, which consists of black transverse markings on a pale cream abdomen (Fig. 1F). In addition, the anterior pockets of the epigynum are much larger than in any other species (Fig. 19A).

Description: Male: Currently unknown.

Female: Based on holotype. Dorsal shield of prosoma orange-brown, darker in eye quadrangle, faint radial pattern and cover of white setae. Sternum and labium brown with scattered black setae. Chelicerae dark brown with white setae. Legs grey. Opisthosoma dorsally cream with black transverse lines (Fig. 1F). Opisthosoma laterally and ventrally cream. Epigynum with broad and very elongate anterior pockets (Fig. 19A). Internal epigyne with spermatheca slightly wider than anterior pockets (Fig. 19B).

Remarks: A juvenile female displays the same dorsal abdominal pattern.

Measurements: ♀ holotype: TL, 19.0; PL, 9.0; PW, 6.8. Eyes: AME, 0.50; ALE, 0.36; PME, 1.04; PLE, 1.00. Sternum (length/width): 3.8/3.1. Labium (length/width): 1.4/1.1. OL, 10.0; OW, 7.1. Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 4.3 + 4.0 + – + 2.7 = 11.0; I, 7.3 + 8.6 + 5.7 + 2.8 = 24.4; II, 7.0 + 8.3 + 5.4 + 2.8 = 23.5; III, 6.3 + 7.4 + 6.0 + 2.8 = 22.5; IV, 7.7 + 9.1 + 8.1 + 3.3 = 28.2.

♀ (range, mean ± SD): TL, 16.7–23.6, 20.4 ± 3.3; PL, 8.9–11.4, 10.1 ± 1.2; PW, 6.4–8.6, 7.4 ± 0.9; $N = 5$.

Natural history: Several specimens have been collected in low depressions covered with vegetation of Chenopods and Samphire. Mature females collected from December to May. The holotype was dug from a burrow with a thick bathtub plug-like door (Fig. 20).

Distribution: New South Wales, Queensland, and South Australia (Fig. 22).

HOGGICOSA SNELLI (MCKAY, 1975) **COMB. NOV.**
(FIGS 4F, G, 6B–D, 21A–E, 22)

Lycosa snelli McKay, 1975: 313–316, fig. 1A–G; Main, 1976: 141, fig. 32D; Brignoli, 1983: 450; McKay, 1985: 83.

Types: Holotype. ♀ from Western Australia: Towera Station, north of Lyndon River, 23°11′S, 115°07′E, i.1952, A. Snell (WAM 69/797);

Paratypes. Western Australia: 2 juv., Barradale, 18 km south, 22°50′S, 114°57′E (QM W4021); 2 ♂, 1 ♀, Barrow Island, 20°48′S, 115°24′E (WAM 74/498-9, 71/1716); 1 ♀, Carnarvon, 14.5 km north, on NW Highway, 24°50′S, 113°47′E (WAM 69/1035); 2 juv., Lyndon Station, 23°38′S, 115°15′E (WAM 69/798-9); 1 ♀, 2 juv., Lyndon Station, via Carnarvon, 23°38′S, 115°15′E (WAM 69/803-5); 12 juv., Manberry, 7 miles from, towards Wandagee, 23°56′S, 114°10′E (WAM 37/117-28, published as 72/117-28 in McKay (1973); 1 juv., Mardie Station, 21°13′S, 115°58′E (WAM 71/1718); 1 juv., Marilla Station, 22°58′S, 114°28′E (QM W4022); 1 ♀, 1 juv., North Western Highway, 760 mile peg, near Marrilla Station Turnoff, 23°05′S, 114°32′E (WAM 70/163, 70/164); 1 ♀, Yannarie River, 23°15′S, 115°12′E (WAM 71/1717); 1 ♀, 3 juv., Yannarie River, near Barradale, 22°50′S, 114°57′E (QM W4023).

Other material examined: Forty-five males, ten females, and six juveniles from 25 records (Appendix S1).

Diagnosis: Males and females can be easily distinguished from all other *Hoggicosa* by the presence of a black line posterior to the epigastric furrow on the ventral opisthosoma (Fig. 4F). The male palp is most similar to that of *H. bicolor* but can be distinguished by the ventral process of the tegular apophysis, which is much larger and connected to the anterior edge (Fig. 6B vs. 6A).

Description: Male: Based on WAM T65133, Woodleigh Station, 26°11′45′S, 114°25′24′E, WA. Dorsal shield of prosoma orange-brown, darker in eye quadrangle, with a faint radial pattern; covered with black and white setae. Sternum pale orange and labium brown with scattered white setae. Chelicerae dark brown with white setae. Legs orange-brown, with tibia, metatarsus, and tarsus somewhat darker, especially legs I and II. Opisthosoma dorsally cream with two small black patches on anterior half. Cover of white setae with longer black setae scattered. Opisthosoma laterally cream. Venter cream with characteristic black stripe below epigastric furrow, covered in white setae (Fig. 4F). Terminal apophysis of pedipalp large, strongly curved apically (Fig. 21A). Pars pendula transparent and connected to embolus near embolus base (Fig. 21B). Subterminal apophysis large, easily visible next to the terminal apophysis. Tegular apophysis with angular ventral process located apically with straight ridge to the apical point (Fig. 6B).

Female: Based on WAM T47612, Shothole Canyon, Cape Range National Park, 22°02′41′S, 114°20′14′E, WA. Dorsal shield of prosoma orange, black around eye quadrangle, no radial pattern with cover of white-grey setae. Sternum, labium, and chelicerae as male. Legs yellowish-orange, with patella, tibia, metatarsus, and tarsus somewhat more orange. Opisthosoma entirely cream with white setae, except for characteristic bar of black setae to posterior of epigastric furrow (Fig. 4F). Epigyne with anterior pockets not much greater in width than posterior transverse part (Fig. 21C). Internal epigyne with spermatheca base as long as wide and nearly as wide as anterior pockets (Fig. 21D).

Variation: McKay (1975) described the males of *H. snelli* from Barrow Island, off the north-west coast of Western Australia. As there appear to be slight differences between the tegular apophysis of mainland and island specimens (Fig. 6B vs. 6C), both variations are figured here. In addition, the palp of a male found in the Kimberley region of Western Australia also shows variation in the tegular apophysis (Fig. 6D) and palea (Fig. 21E). These specimens are similar in all other morphological aspects, including the characteristic epigastric stripe, and we consider them conspecific. A female from Munda Station was found to have an enlarged epigastric stripe (Fig. 4G).

Measurements: ♂ WAM T65133 (♀ WAM T47612): TL, 19.9 (17.8); PL, 10.5 (10.0); PW, 7.5 (6.6). Eyes: AME, 0.54 (0.50); ALE, 0.31 (0.27); PME, 1.35 (1.18);

PLE, 1.23 (1.09). Sternum (length/width): 5.1/3.8 (4.3/3.1). Labium (length/width): 1.6/1.3 (1.6/1.4). OL, 9.4 (7.8); OW, 5.4 (5.0). Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 5.2 + 5.6 + – + 3.8 = 14.6; I, 9.4 + 11.0 + 8.2 + 4.4 = 33.0; II, 8.8 + 10.4 + 8.1 + 4.1 = 31.4; III, 7.6 + 9.0 + 7.9 + 4.2 = 28.7; IV, 10.0 + 11.9 + 10.1 + 4.4 = 36.4 (pedipalp, 4.3 + 4.3 + – + 2.8 = 11.4; I, 7.3 + 8.8 + 5.3 + 3.1 = 24.5; II, 6.6 + 8.6 + 5.4 + 2.8 = 23.4; III, 6.0 + 7.4 + 5.7 + 2.8 = 21.9; IV, 7.4 + 10.0 + 7.7 + 3.4 = 28.5).

♂ (♀) (range, mean ± SD): TL, 12.5–21.6, 18.0 ± 1.8; PL, 7.5–11.3, 9.9 ± 0.8; PW, 5.5–8.1, 7.0 ± 0.7; *N* = 25 (TL, 18.6–24.1, 20.7 ± 1.7; PL, 10.0–11.6, 10.8 ± 0.6; PW, 6.7–8.5, 7.6 ± 0.6; *N* = 9).

Natural history: Hoggicosa snelli have been found on bare gravel slopes or red clayey loams with one record from a red dune. Specimens have been recorded in association with Mulga (*Acacia aneura*), Snakewood (*A. xiphophylla*), and Spinifex (*Triodia*) vegetation or bare areas. Mature females were found all year round, but are particularly common from January to April. Males have been collected from August to February. *Hoggicosa snelli* differs in its burrowing behaviour in that it uses a pebble or debris to block its burrow entrance. McKay (1975) described that each morning the pebble is replaced in the same position, which leads to the build up of a visible circular ring of silk on the pebble.

Distribution: Northern Western Australia (Fig. 22).

HOGGICOSA STORRI (MCKAY, 1973) **COMB. NOV.**
(FIGS 1D, E, 5G, H, 23A–D, 25)

Lycosa storri McKay, 1973: 389–394, figs 1H–J, 3A–E; Main, 1976: 48, 141, 149, 231, pl. B8; Brignoli, 1983: 450; McKay, 1985: 83.

Types: Holotype: ♀ from Western Australia: Yellowdine, 38 miles south, 31°51′S, 119°39′E, 6.xi.1970, W. H. Butler (WAM 70/240). Epigynum missing.

Paratypes: Western Australia: 1 juv., Albion Downs, 24 miles south-west, 27°17′S, 120°01′E (WAM 71/875); 1 juv., Billeranga, 29°19′S, 115°52′E (WAM 68/501); 1 juv., Grants Patch, Broad Arrow near Kalgoorlie, 30°27′S, 121°20′E (WAM 70/22); 2 juv., Burnabinmah Station, 28°47′S, 117°22′E (WAM 68/823, 68/828); 1 ♀, Clinker Hill, 30°53′S, 121°46′E (WAM 68/504); 1 ♀, Corrigin, 32°20′S, 118°52′E (WAM 71/874); 1 juv., Dulbelling, 32°02′S, 117°15′E (WAM 68/825); 2 juv., Hyden, The Humps, 32°19′S, 118°58′E (WAM 69/884, 71/456); 1 ♀, Karonie, 4 miles north-east, 30°56′S, 122°35′E (WAM 68/505); 1 juv., Kellerberrin, 31°38′S, 117°43′E (WAM 38/1298); 1 ♀, 1 juv., Koorda, 30°50′S, 117°29′E (WAM 70/245, 39/2169); 2 ♀, 2 juv., Lake Moore, near south end, 30°12′S, 117°25′E (WAM 71/174, 71/175-6, 71/197); 1 juv., Leonara, 15 miles east, 28°53′S, 121°35′E (WAM 70/206); 1 ♀, Marloo Station, 28°19′S, 116°11′E (WAM 69/835); 1 ♀, 1 juv., Merredin, 31°29′S, 118°16′E (WAM 69/888, 68/502); 1 juv., Moorine Rock, 31°18′S, 119°08′E (WAM 68/500); 1 ♀, 2 juv., Mt Gibson, 29°36′S, 117°24′E (WAM 71/877, 71/876); 1 juv., Mullewa, 1.5 miles east, 28°32′S, 115°31′E (WAM 68/829); 1 ♂, 2 ♀ Muralgarra, 28°32′S, 117°03′E (WAM 39/2564, 39/2565, 39/2566); 1 ♀, 31 juv., Narembeen Camp Site, 32°04′S, 118°23′E (WAM 69/962-94); 1 ♀, Noongar, 31°20′S, 118°58′E (WAM 39/2472); 1 juv., Nukarni, 31°18′S, 118°12′E (WAM 47/963); 5 juv., Paynes Find, 29°15′S, 117°41′E (WAM 70/53, 70/202-3, 70/54, 69/454); 1 juv., Quairading, 32°01′S, 117°24′E (WAM 69/885); 1 juv., Randells, 13 miles west on railway, 31°00′S, 121°59′E (WAM 68/827); 1 juv., Walebing, 3 miles north, 30°39′S, 116°13′E (WAM 68/498); 1 juv., Walyahmoning Rock, 1 mile south-west, 30°38′S, 118°45′E (WAM 70/57, published as WAM 70/51 in McKay (1973); 1 ♀, Warburton Ranges, 26°06′S, 126°39′E (WAM 71/878); 1 juv., Wialki at Arnolds Water Reserve, 30°25′S, 118°03′E (WAM 68/826); 1 ♀, Williams, 33°02′S, 116°53′E (WAM 68/824); 1 juv., Ravensthorpe, 33°35′S, 120°03′E (WAM 69/886); 1 ♀, Cocklebiddy, 70 miles north, 32°03′S, 124°54′E (WAM 69/890).

Other material examined: Ninety-four males, 23 females, and 29 juveniles from 152 records (Appendix S1).

Diagnosis: Females and immature males can be readily distinguished from all other *Hoggicosa* species by the distinct leg coloration and abdominal pattern (Fig. 1D). This pattern consists of light femora, tarsi, and metatarsi, with black patellae and tibiae, with a pale stripe along either side of the abdomen from the spinnerets. The male palp is most similar to that of *H. brennani*, but can be distinguished by the shape of the ventral process on the tegular apophysis. In *H. storri* the ventral process lacks the flange found in *H. brennani* (Fig. 5C, D vs. 5G) and is located closer to the apical tip.

Description: Male: Based on male from type locality, WAM T53406, Yellowdine, 31°51′S, 119°39′E, WA. Dorsal shield of prosoma orange-brown, darker in eye quadrangle, covered with white setae. Sternum and labium brown with scattered black setae. Chelicerae dark brown with white setae. Legs all greyish-brown, except for paler ventral femur. Projections on apical end of coxae I (see remarks). Opisthosoma all grey-black with black setae except for creamish-yellow

streak running from spinnerets two-thirds along either side. Terminal apophysis of pedipalp large, strongly curved apically (Fig. 23A). Pars pendula transparent and connected just below embolus tip (Fig. 23B). Subterminal apophysis large and easily visible next to terminal apophysis. Tegular apophysis with angular ventral process located centrally or near apex. Curved ridge connecting ventral process and apical point (Fig. 5G).

Female: Based on WAM 68/503, Wubin, 30°07′S, 116°38′E, WA. Dorsal shield of prosoma orange-brown with cover of white setae. Sternum, labium, and chelicerae as male. Legs; femur, metatarsus, and tarsus yellowish-cream with tibia and patella black (Fig. 1D). Small projections on apical end of coxae I (see remarks). Opisthosoma black, with pale side streak as male. Epigyne with small anterior pockets, much greater in width than posterior transverse part (Fig. 23C). Internal epigyne with strongly sclerotized anterior pockets and head of spermatheca elongate (Fig. 23D).

Variation: In some males a small black longitudinal stripe is present at the anterior end of the dorsal abdomen. The length of the ridge between the ventral process and apical point of the tegular apophysis can vary (Fig. 5G vs. 5H). Some females have a faint pale longitudinal stripe at the anterior end of the dorsal abdomen.

Remarks: The epigynum of the holotype is missing and so a representative female is used here for redescription. Several of the male specimens, including those from the type locality, were found to have prominent protuberances extending from the tip of coxae I and II near the sternum. Following further examination, some females were found to have similar, but reduced, bulges. No other morphological differences were found between those with and without coxal points and as the distributions overlap we currently consider them conspecific.

Measurements: ♂ WAM T53406 (♀ WAM 68/503): TL, 17.6 (17.0); PL, 9.7 (9.1); PW, 7.3 (7.3). Eyes: AME, 0.45 (0.50); ALE, 0.23 (0.32); PME, 1.09 (1.18); PLE, 0.73 (1.04). Sternum (length/width): 3.6/3.4 (4.0/3.3). Labium (length/width): 1.0/1.0 (1.4/1.4). OL, 7.8 (7.8); OW, 5.7 (5.8). Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 4.3 + 4.0 + – + 3.4 = 11.7; I, 8.6 + 9.8 + 8.6 + 5.0 = 32.0; II, 8.3 + 9.6 + 8.8 + 4.4 = 31.1; III, 7.1 + 7.8 + 7.8 + 4.3 = 27.0; IV, 9.3 + 10.4 + 10.0 + 4.7 = 34.4 (pedipalp, 4.0 + 4.3 + – + 2.8 = 11.1; I, 7.4 + 9.0 + 6.0 + 3.1 = 25.5; II, 7.1 + 8.6 + 6.0 + 3.1 = 24.8; III, 6.4 + 7.4 + 6.4 + 3.3 = 23.5; IV, 7.8 + 9.3 + 8.6 + 3.6 = 29.3).

♂ (♀) (range, mean ± SD): TL, 12.9–20.1, 17.2 ± 1.6; PL, 7.1–10.3, 9.4 ± 0.6; PW, 6.4–8.1, 7.2 ± 0.4; $N = 35$ (TL, 17.9–23.0, 19.9 ± 1.7; PL, 8.7–10.3, 9.6 ± 0.5; PW, 6.6–8.1, 7.3 ± 0.5; $N = 14$).

Natural history: Hoggicosa storri have been collected from clay, gritty loam, rocky, red, and yellow soils. Specimens have been recorded in association with vegetation of Mallee (*Eucalyptus*) and Mulga (*Acacia aneura*) and woodlands of Wandoo (*Eucalyptus wandoo*), Salmon Gum (*E. salmonophloia*), York Gum (*E. loxophleba*), Gimlet (*E. salubris*), and *E. striaticalyx*, as well as open shrubland. Adult females have been collected all year round, whereas adult males have been predominately collected from October to March. *Hoggicosa storri* excavates burrows without doors.

Distribution: Western Australia (Fig. 25).

HOGGICOSA WOLODYMYRI SP. NOV. (FIGS 4H, I, 5F, 7D, 24A–D, 25)

Types: Holotype. ♂ from South Australia: Taylorville Station, 34°06′S, 139°58′E, 2–4.x.1999, Strathalbyn Field Nats. (SAM NN16408).

Paratype. ♀ with same data as holotype. (SAM NN16409).

Other material examined: One-hundred and twenty-three males, 27 females, and four juveniles from 87 records (Appendix S1).

Etymology: The specific epithet is a patronym in honour of the senior author's late grandfather Wolodymyr Kowal, who after immigrating to Australia fell in love with the outback landscapes where this species is found.

Diagnosis: Hoggicosa wolodymyri can be distinguished from all other *Hoggicosa* by its small body size and orange-yellow colour. The male palp is most similar to that of *H. bicolor*, but can be distinguished by the tegular apophysis, which has a ridge between the ventral process and the tip much longer than that of *H. bicolor* (compare Fig. 5F vs. 6A). The female epigyne is similar in shape to *H. bicolor* but is smaller in size and females can be easily distinguished on body colour.

Description: Male: Based on holotype. Dorsal shield of prosoma orange-brown, darker in eye quadrangle, with faint radial pattern; covered with black setae. Sternum orange-yellow, labium dark orange-brown, both with scattered black setae. Chelicerae dark brown with white setae. Legs orange-yellow. Opisthosoma dorsally

orange-yellow with mottled black and grey patches; grey-black setae. Dark orange median longitudinal band at anterior end (Fig. 4H). Opisthosoma laterally and ventrally pale orange-yellow, some black dots on venter. Terminal apophysis of pedipalp large and strongly curved apically (Fig. 24A, B). Pars pendula transparent and joins embolus at embolus tip (Figs 7D, 24B). Subterminal apophysis present, but located under terminal apophysis and difficult to see (Fig. 7D). Tegular apophysis with small process, pointed ventrally and located away from apical point. Straight ridge between ventral process and apical point (Fig. 5F).

Female: Based on paratype. Dorsal shield of prosoma pale orange, darker in eye quadrangle, with faint radial pattern; covered with black setae. Sternum, labium, chelicerae, and legs as male. Opisthosoma dorsally and laterally as male (Fig. 4I). Venter without black patches. Epigyne with small and simple anterior pockets, only slightly greater in width than posterior transverse part (Fig. 24C). Internal epigyne with thin sclerotized channels of median septum clearly visible as well as thin and elongate spermatheca stalks (Fig. 24D).

Variation: Male specimens from WA are slightly smaller and pale yellow in colour, with less colouration (dark patches) on the abdomen. Some males lack black patches on the ventral opisthosoma.

Measurements: ♂ holotype (♀ paratype): TL, 15.5 (14.2); PL, 8.0 (6.8); PW, 6.0 (5.4). Eyes: AME, 0.38 (0.38); ALE, 0.23 (0.27); PME, 0.81 (0.88); PLE, 0.77 (0.73). Sternum (length/width): 3.4/2.7 (2.9/2.5). Labium (length/width): 0.9/1.1 (1.0/1.1). OL, 7.5 (7.4); OW, 4.6 (5.0). Legs, lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp, 4.1 + 3.8 + – + – = 7.9; I, 9.4 + 10.0 + 8.5 + 5.0 = 32.9; II, 8.8 + 10.0 + 8.2 + 4.6 = 31.6; III, 8.2 + 9.4 + 8.8 + 4.6 = 31.0; IV, 10.2 + 11.2 + 11.5 + 5.4 = 38.3 (pedipalp, 3.1 + 3.4 + – + 2.6 = 9.1; I, 6.6 + 7.5 + 4.8 + 3.0 = 21.9; II, 6.7 + 7.1 + 4.8 + 2.8 = 21.4; III, 5.9 + 6.5 + 5.0 + 2.8 = 20.2; IV, 7.4 + 8.4 + 6.9 + 3.1 = 25.8).

♂ (♀) (range, mean ± SD): TL, 11.6–14.8, 13.3 ± 1.0; PL, 6.4–7.8, 6.9 ± 0.4; PW, 5.0–6.0, 5.5 ± 0.3; $N = 14$ (TL, 14.4–16.9, 15.5 ± 1.0; PL, 6.9–8.5, 7.4 ± 0.7; PW, 5.3–6.4, 5.8 ± 0.5; $N = 6$).

Natural history: Specimens have been collected from sand dunes, sand plains, interdune swales, and clayey soils associated with open Mallee (*Eucalyptus*) with mixed understorey or Mulga (*Acacia aneura*) and Spinifex (*Triodia*) vegetation. Males and females have been collected predominately from September to December, although a couple of males have been found in March and June. Records indicate *H. wolodymyri* constructs a doorless burrow.

Distribution: New South Wales, Northern Territory, South Australia, and Western Australia (Fig. 25).

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APPENDIX 1

Species used for phylogenetic analysis with specimen location, place deposited, and registration number. *characters scored from secondary sources.

Species		Location	Deposition	Registration
Arctosa cinerea (Fabricius, 1777)	♂	Isar River near Wallgau, Germany	WAM	T56247
	♀	Lech River near Forchach, Austria	WAM	T56246
Dingosa serrata (L. Koch, 1877)	♂	Yanchep, Western Australia	WAM	T58321
	♀	Inglewood, Perth, Western Australia	WAM	T68496
Dingosa simsoni (Simon, 1898)	♂	Yokrakine Rock, Western Australia	WAM	71.1422
	♀	Boorabin, Western Australia	WAM	T51253
Geolycosa hubbelli Wallace, 1942	♂	Archbold Biological Station, Florida, USA	WAM	T56572
	♀	* (Wallace, 1942)		
Geolycosa missouriensis (Banks, 1895)	♂	Holmes County State Park, Mississippi, USA	WAM	T56118
	♀	Holmes County State Park, Mississippi, USA	WAM	T56117
'Grey Wolf Spider'	♂	Broken Hill, New South Wales	WAM	T62654
	♀	Runnymede Flora Reserve, Victoria	WAM	T56072
***Hoggicosa alfi* sp. nov.**	♂	Lorna Glen Station, Western Australia	WAM	T53919
	♀	Lorna Glen Station, Western Australia	WAM	T77406
Hoggicosa bicolor (Hogg, 1905)	♂ ♀	Mt Vernon Station, Western Australia	WAM	T62336
***Hoggicosa brennani* sp. nov.**	♂	Taylorville Station, South Australia	SAM	NN17017
	♀	Taylorville Station, South Australia	SAM	NN17029
Hoggicosa castanea (Hogg, 1905)	♂	Gluepot Station, South Australia	SAM	NN19314
	♀	Fisherman Point, Lincoln National Park, South Australia	SAM	NN15185
Hoggicosa duracki (McKay, 1975)	♂ ♀	Argyle Downs Homestead, Western Australia	WAM	74/495-7
Hoggicosa forresti (McKay, 1973)	♂ ♀	North Baandee Nature Reserve, Western Australia	WAM	T47762
Hoggicosa snelli (McKay, 1975)	♂	Woodleigh Station, Western Australia	WAM	T65133
	♀	Shothole Canyon, Cape Range National Park, Western Australia	WAM	T47612
Hoggicosa storri (McKay, 1973)	♂	Stoneville, Western Australia	WAM	T47794
	♀	Wubin, Western Australia	WAM	68/503
***Hoggicosa wolodymyri* sp. nov.**	♂	Taylorville Station, South Australia	SAM	NN16408
	♀	Taylorville Station, South Australia	SAM	NN16409
Hogna crispipes L. Koch, 1877	♂	Deepdale, Western Australia	WAM	T65662
	♀	South Lake, Western Australia	WAM	T75884
Hogna immansueta (Simon, 1909)	♂ ♀	Red Bluff, Red Bluff Caravan Park, Western Australia	WAM	T58331
Hogna kuyani Framenau, Gotch & Austin, 2007	♂	'Sieda', East of Grass Patch, Western Australia	WAM	T53586
	♀	Laverton, Western Australia	WAM	T55296
Knoelle clara (L. Koch, 1877)	♂	Drysdale River Station, Western Australia	WAM	T56241
	♀	Kapalga, Northern Territory	WAM	T58372
Lycosa godeffroyi L. Koch, 1865	♂	Maylands, Perth, Western Australia	WAM	T65006
	♀	Eneabba, Western Australia	WAM	T65005
Lycosa leuckartii (Thorell, 1870)	♂	Burekup, Western Australia	WAM	T53852
	♀	Gardner Reserve Road, Western Australia	WAM	T53675
Lycosa praegrandis C. L. Koch, 1836	♂	* (Zyuzin & Logunov, 2000)		
	♀	Amissa, Greece	WAM	90/566
Lycosa tarantula (Linnaeus, 1758)	♂	* (Álvares, 2006)		
		San Rossore, Pisa, Italy	WAM	T56055
Mainosa longipes (L. Koch, 1878)	♂	Francois Peron National Park, Western Australia	WAM	T48038
	♀	Nerren Nerren Station, Western Australia	WAM	94/1940
Venator spenceri Hogg, 1900	♂	Kanyaka Creek, Wilson, South Australia	WAM	T51488
	♀	Adelaide, South Australia	WAM	T64071

APPENDIX 2

Character descriptions

1. **Carapace, profile in lateral view:** cephalic region not elevated, profile horizontal (0) (Framenau *et al*., 2006: fig. 23); cephalic region elevated, profile strongly sloping away from eyes (1) (Fig. 3A).
2. **Carapace, radial colour pattern, female:** absent (0) (Fig. 1A); weak or indistinct (1) (Fig. 1H); strong pattern of black and white lines 'Union-Jack-colour pattern' (2). The 'Union-Jack-colour pattern' is seen in *Lycosa leuckartii* (Main, 1976: figs 26, 27).
3. **Anterior eye row, curvature in frontal view:** straight (0); slightly procurved (1) (Framenau, 2006a: fig. 4); strongly procurved (2) (Fig. 3B). Eye row curvature is determined by drawing a line through the middle of the anterior median eyes. If the line passed through the middle of the anterior lateral eyes it was scored as straight. If the line passed through the upper half of the anterior lateral eyes it was considered slightly procurved and strongly procurved if the line did not pass through the anterior lateral eyes.
4. **Leg colouration, alternating dark and light segments, in females but not adult males:** absent (0) (Fig. 1G, H); present (1) (Fig. 1A, B).
5. **Abdomen, dorsal colour, female:** unicoloured (0) (Fig. 1D); dual coloured (1) (Fig. 1F); multicoloured (2) (Fig. 4A).
6. **Abdomen, cardiac (heart) or chevron mark, female:** absent (0) (Fig. 1D); present, light colour compared to surrounding (1) (Fig. 1A); present, dark colour compared to surrounding (2) (Fig. 1C). If multiple colours surrounded the cardiac mark, the predominate colour was used.
7. **Abdomen, lateral colour pattern, female:** pale (0) (fig. 4F); black (1) (Framenau, 2006a, fig. 1).
8. **Abdomen, ventral colour pattern, female:** uniform light (0); light with dark pattern (1) (Fig. 1E, F); dark with light pattern (2); uniform dark (3) (Fig. 4B). If the black pattern reached all the way to the spinnerets and covered most of the ventral abdomen it was considered uniform dark.
9. **Cymbium tip, macrosetae:** absent (0) (Framenau, 2006a: fig. 6); present (1) (Fig. 1I).
10. **Cymbium tip, number of macrosetae:** One to ten macrosetae (0) (Framenau *et al*., 2006: fig. 20); 10–30 macrosetae (1) (Fig. 1I); > 30 macrosetae (2) (Framenau, 2006b: fig. 2).
11. **Cymbium tip, macrosetae direction:** straight (0) (Álvares, 2006: fig. 13); curved dorsally (1) (Framenau *et al*., 2006: fig. 21); curved ventrally (2) (Fig. 1I).
12. **Tegular apophysis, position of ventral process:** distance between ventral process tip and tegular apophysis tip greater than half distance of tegular apophysis (0) (Fig. 5A); distance between ventral process tip and tegular apophysis tip less than half distance of tegular apophysis (1) (Fig. 6A). The distance of the tegular apophysis was taken as the length of the line from the apical point through the ventral process to the edge of the strongly sclerotized tegular apophysis (Fig. 5A).
13. **Tegular apophysis, connection of ventral process to apical edge:** absent (0) (Fig. 5A); present (1) (Fig. 6B). The apical edge of the tegular apophysis is defined in relation to the palp.
14. **Tegular apophysis, connection of ventral process to apical point, ridge shape:** curved (0) (Fig. 5A); straight (1) (Fig. 6A).
15. **Tegular apophysis, number of ventral processes:** none (0) (Framenau & Baehr, 2007: fig. 2C); one (1) (Fig. 1A); two (2) (Framenau, 2006b: fig. 6).
16. **Terminal apophysis, direction:** curved apically (0) (Fig. 8B); straight, pointing retrolaterally (1) (Fig. 11B).
17. **Terminal apophysis, shape of tip:** pointed, sharp tip (0) (Fig. 8B); truncated, broad tip (1) (Fig. 16B).
18. **Subterminal apophysis:** absent (0) (Framenau & Baehr, 2007: fig. 6A); present (1) (Fig. 11B).
19. **Subterminal apophysis, visibility in ventral view:** Beneath terminal apophysis and difficult to see (0) (Figs 7A, 8B); Next to terminal apophysis and easily visible (1) (Fig. 13B).
20. **Pars pendula, thickness:** thin, transparent (0) (Fig. 13B); thick and obvious, opaque (1) (Fig. 8B).
21. **Pars pendula, connection to embolus:** Joins well below embolus tip (0) (Fig. 13B); Joins just below embolus tip (1) (Fig. 11B); along whole embolus (2) (Fig. 7A, B). If the pars pendula was only found at the base of the embolus (Fig. 21B) or the length of embolus without the pars pendula was close to the length of the terminal apophysis (Fig. 13B), it was scored as 0. If the pars pendula joined at the embolus tip it was scored as 2 and those that had a pars pendula intermediate to these cases were scored as 1.
22. **Epigyne, inverted T-shaped median septum:** absent (0) (Zyuzin & Logunov, 2000: fig. 2); present (1) (Fig. 8C).
23. **Epigyne, median septum, widening anteriorly:** absent (0) (Zyuzin & Logunov, 2000: fig. 2); present (1) (Fig. 8C).

24. **Epigyne, distance between anterior pockets:** equal or shorter than width of posterior transverse part (0) (Framenau, 2006b: fig. 9); greater than width of posterior transverse part (1) (Fig. 8C).
25. **Burrow, female and immatures:** absent (0); present (1).
26. **Burrow, trapdoor:** absent (0) (Framenau, 2006a: fig. 2); present (door or rock) (1) (Fig. 9A, B).
27. **Burrow, palisade:** absent (0) (Fig. 9B); present (1) (Framenau, 2006a: fig. 2).

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Appendix S1. List of material examined by species then state.

Please note: Wiley-Blackwell are not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

Figure 1. *Hoggicosa* species, habitus photos (A–H) and male diagnostic character (I). A, *Hoggicosa bicolor* (Hogg) penultimate ♂ from Western Australia (WA), not registered. B, *H. bicolor* (Hogg) adult ♂ from Lorna Glen Station, WA, WAM T70329. C, *Hoggicosa forresti* (McKay, 1973) adult male from Lorna Glen Station, WA, WAM T65610. D, *Hoggicosa storri* (McKay) penultimate ♂ from WA, not registered. E, *H. storri* (McKay) adult ♂ from Lorna Glen Station, WA, WAM T70277. F, ***Hoggicosa natashae* sp. nov.** holotype ♀ from Lake Gilles, SA, SAM NN14785, Photo courtesy of D. Hirst. G, ***Hoggicosa alfi* sp. nov.** ♂ from type locality, Lorna Glen Station, WA, not registered. H, ***H. alfi* sp. nov.** ♀ from type locality, WAM T70334. I, *Hoggicosa castanea* (Hogg) lateral view of male cymbium tip with diagnostic macrosetae bent dorsally, from Gluepot Station, SA, SAM NN19314. Scale bars = 5 mm.

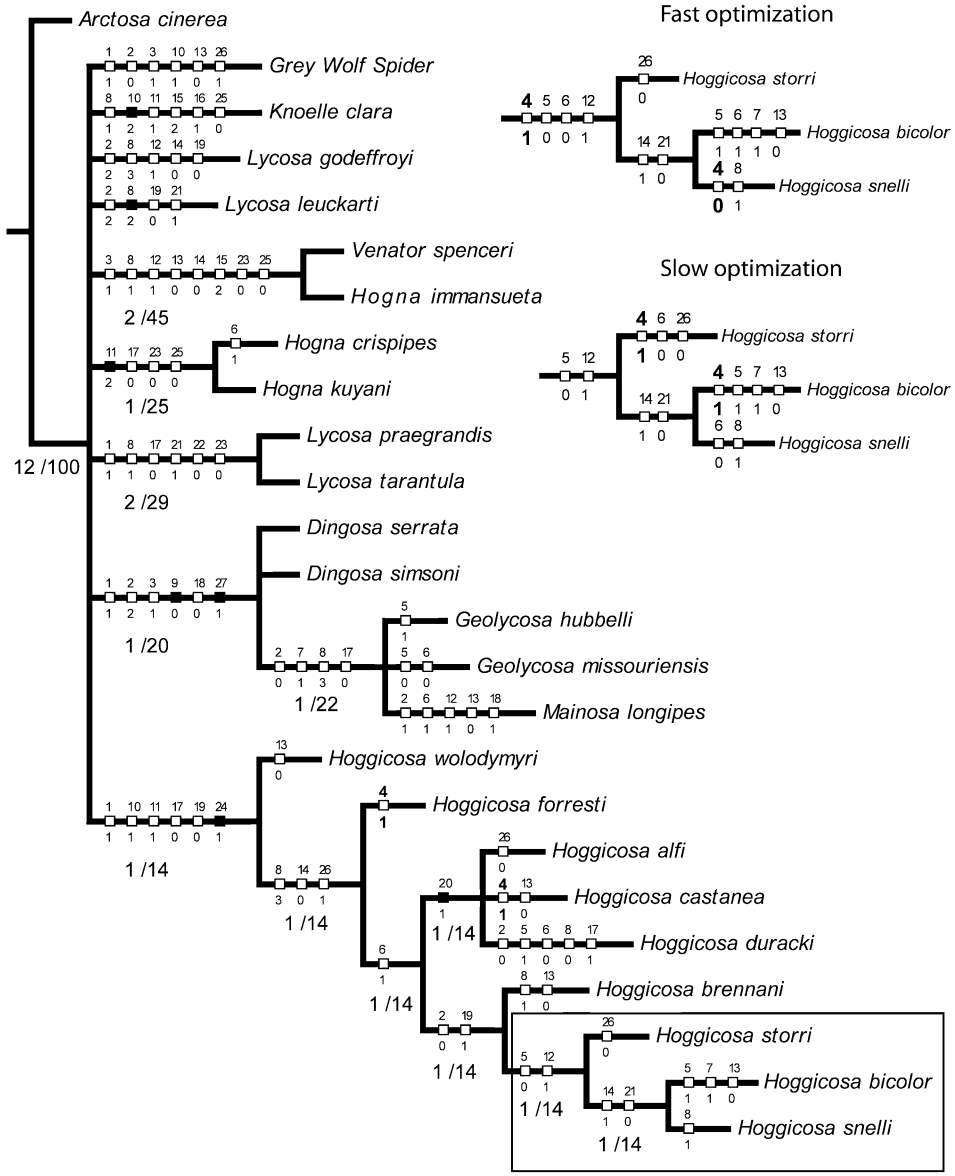

Figure 2. Strict consensus tree showing the relationships amongst *Hoggicosa* species and other Lycosinae (length = 104, consistency index = 35, retention index = 53). Characters are indicated by squares: character number above and character state below square with shaded squares for nonhomoplasious characters. Bremer support and relative Bremer support (0–100) values for each branch are indicated. Inset of colour dimorphism (character 4, bold) under fast optimization (ACCTRAN) and slow optimization (DELTRAN).

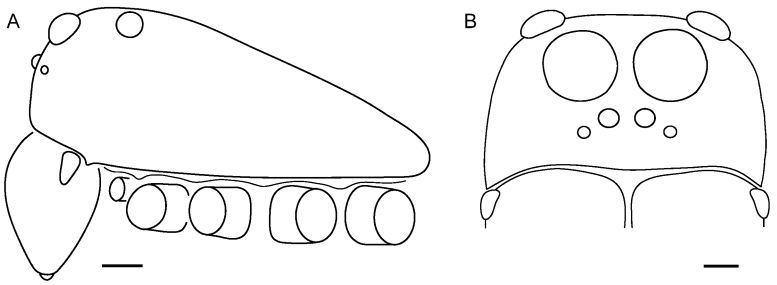

Figure 3. *Hoggicosa castanea* (Hogg) carapace. A, lateral view. B, frontal view. Scale bars = 1 mm.

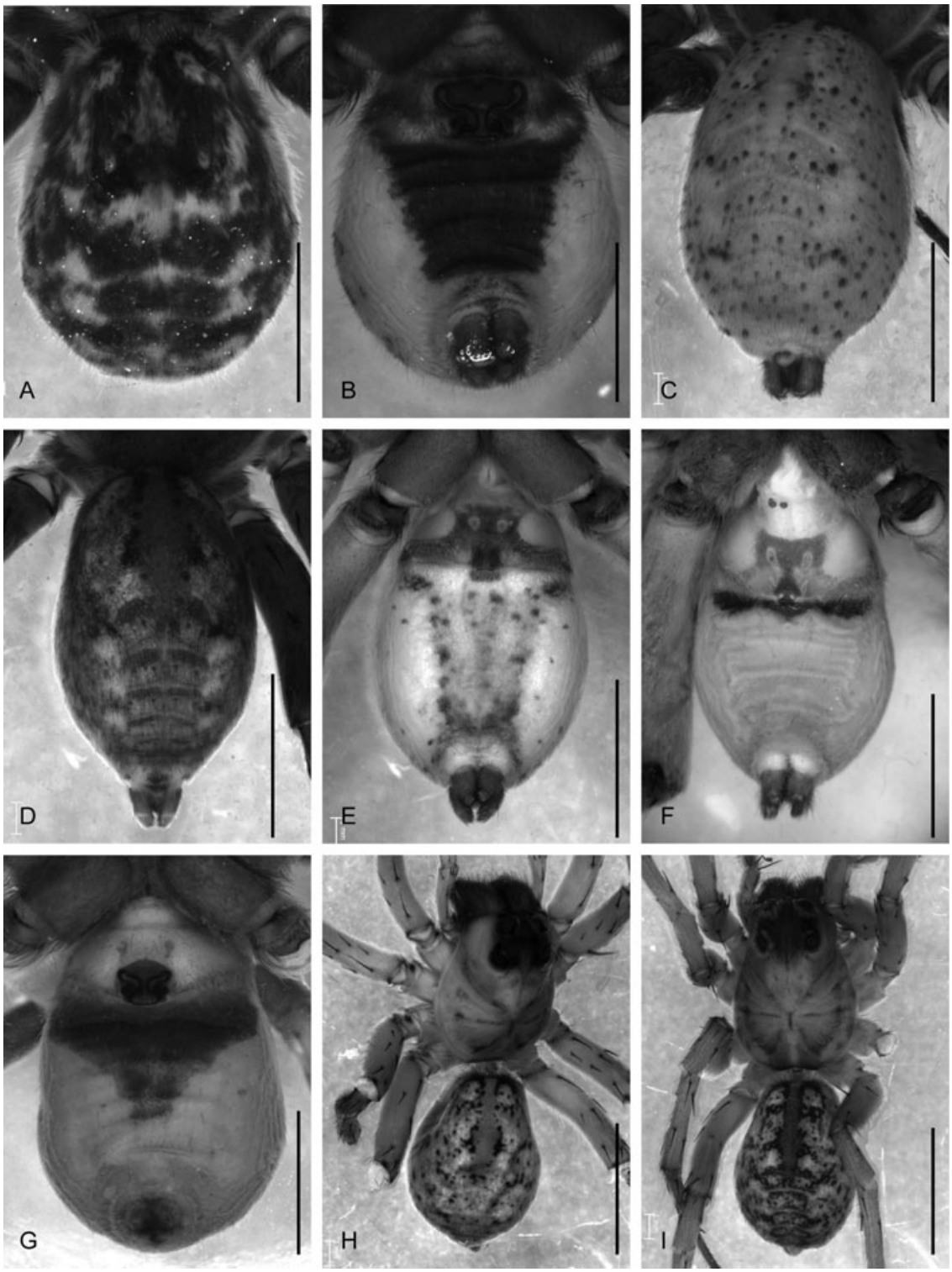

Figure 4. *Hoggicosa* species, abdomen (A–G) and habitus (H–I). A–C, ♀ *Hoggicosa castanea* (Hogg). A, dorsal; B, ventral, from Fisherman Point, Lincoln National Park, South Australia (SA), SAM NN15185; C, dorsal, from north of Lake Goorly, Western Australia (WA), WAM T47784. D–E, ***Hoggicosa brennani*** **sp. nov.** ♂ holotype from Taylorville Station, SA, SAM NN17017. D, dorsal; E, ventral. F–G, *Hoggicosa snelli* (McKay), ventral. ♂ from Kennedy Range National Park, WA, WAM T65149. G, ♀ from Munda Station, WA, WAM T53870. H–I, ***Hoggicosa wolodymyri*** **sp. nov.** from Taylorville Station, SA. H, ♂ holotype, SAM NN16408. I, ♀ paratype, SAM NN16409. Scale bars = 5 mm.

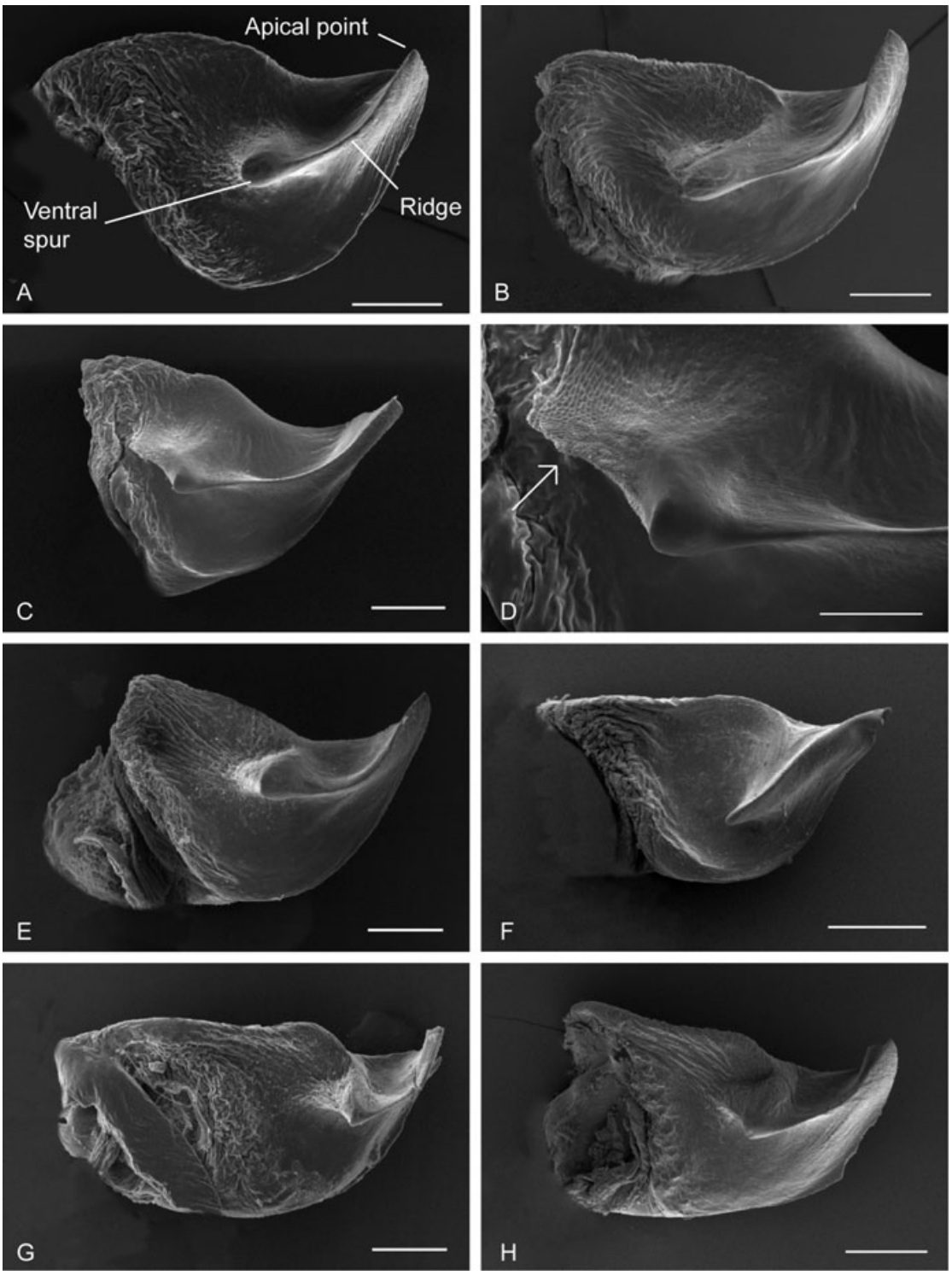

Figure 5. ♂ *Hoggicosa* species, male palp, tegular apophyses. A–B, *Hoggicosa castanea* (Hogg). A, north of Bower, South Australia (SA), WAM T64050; B, palpal variation from east of Mount Barren, Western Australia (WA), WAM T53507. C–D, ***Hoggicosa brennani* sp. nov.** holotype from Taylorville Station, SA, SAM NN17017; D, tegular apophysis ventral spur enlarged. E, *Hoggicosa forresti* (McKay) from North Baandee Nature Reserve, WA, WAM T47762. F, ***Hoggicosa wolodymyri* sp. nov.** from Queen Victoria Springs Nature Reserve, WA, WAM T52527. G–H, *Hoggicosa storri* (McKay). G, south of the type locality Yellowdine, WA, WAM T53406; H, palpal variation from Yuinmery, WA, WAM T62781. All scale bars = 0.2 mm except for D = 0.1 mm.

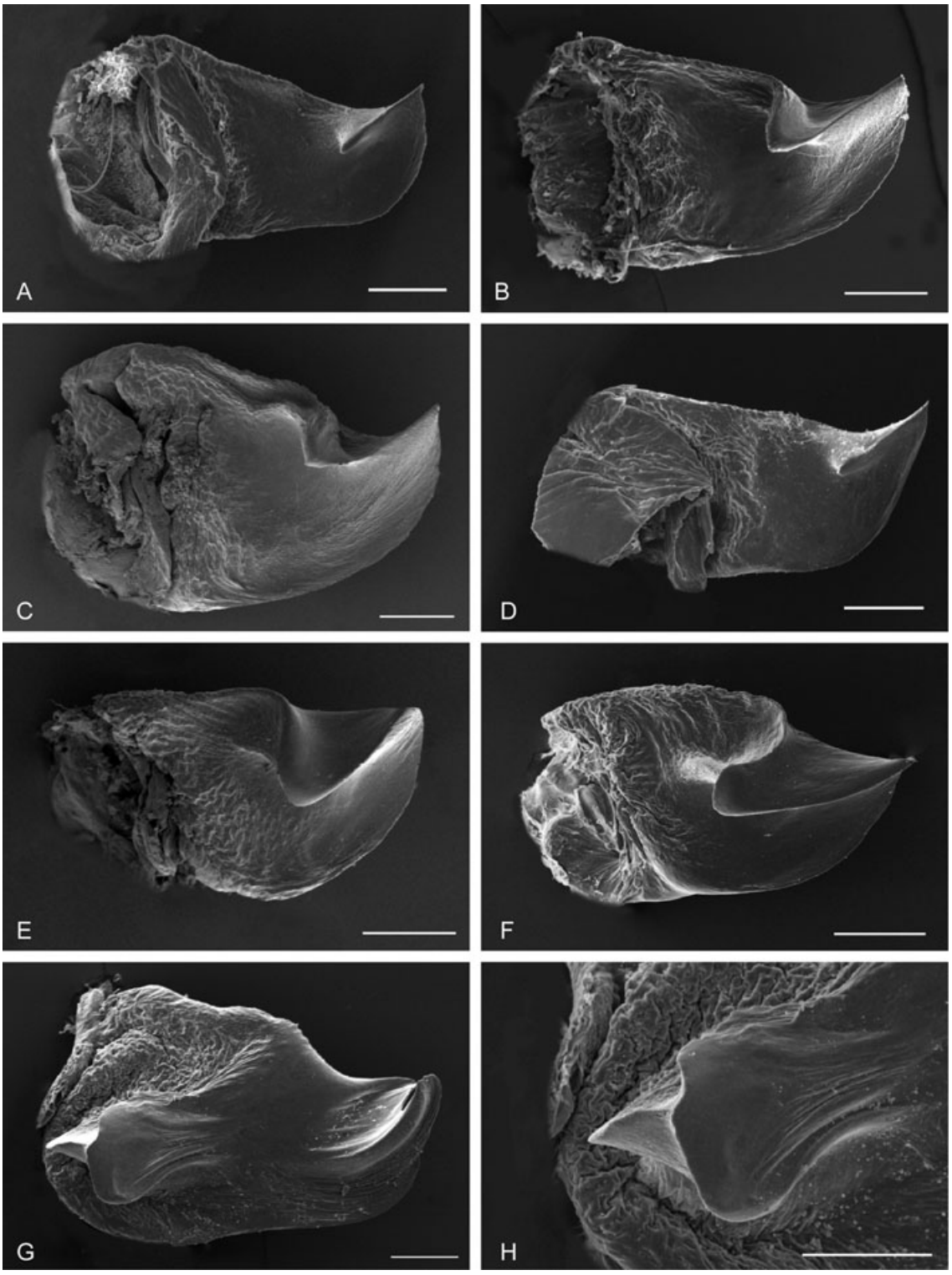

Figure 6. ♂ *Hoggicosa* species, male palp, tegular apophyses. A, *Hoggicosa bicolor* (Hogg) from Mt Vernon Station, Western Australia (WA), WAM T62336. B–D, *Hoggicosa snelli* (McKay). B, mainland male from Woodleigh Station, WA, WAM T65133; C, palpal variation from Barrow Island, WA, WAM T57697; D, palpal variation from Drysdale River Station, Kimberley, WA, WAM T56397. E–F, ***Hoggicosa alfi* sp. nov.** E, paratype from Lorna Glen Station, WA, WAM T53919; F, palpal variation from Nanga Station, WA, WAM T65565. G–H, *Hoggicosa duracki* (McKay) from Hope Downs Station, WA, WAM T65119. H, tegular apophysis ventral spur enlarged. Scale bars = 0.2 mm.

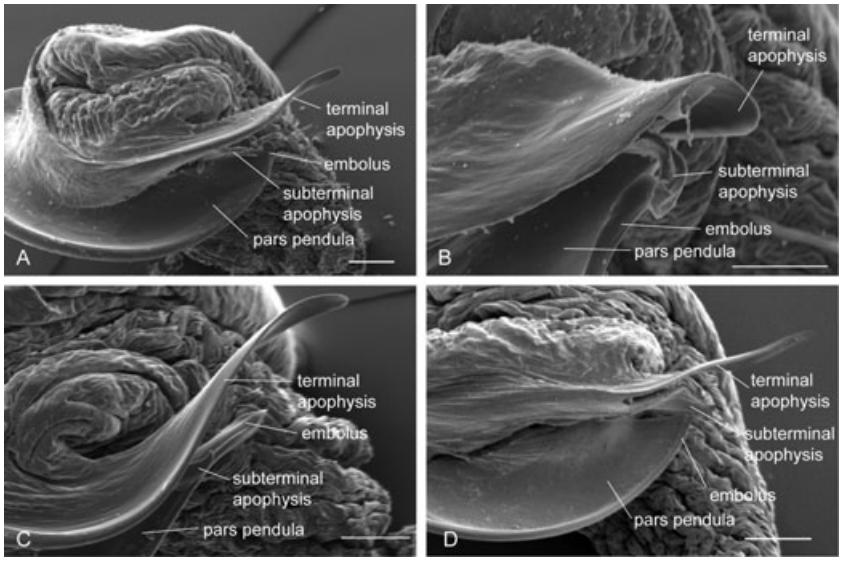

Figure 7. ♂ *Hoggicosa* species, male palp, palea region. A, *Hoggicosa castanea* (Hogg) from East Mt Barren, Western Australia (WA), WAM T53507. B, *Hoggicosa duracki* (McKay) from Hope Downs Station, WA, WAM T65119. C, *Hoggicosa forresti* (McKay) from Helena-Aurora Ranges, WA, WAM T47763. D, ***Hoggicosa wolodymyri* sp. nov.** from Queen Victoria Springs Nature Reserve, WA, WAM T52527. Scale bars = 0.1 mm. Note: twisting of terminal and subterminal apophysis is a result of scanning electron microscopy drying process.

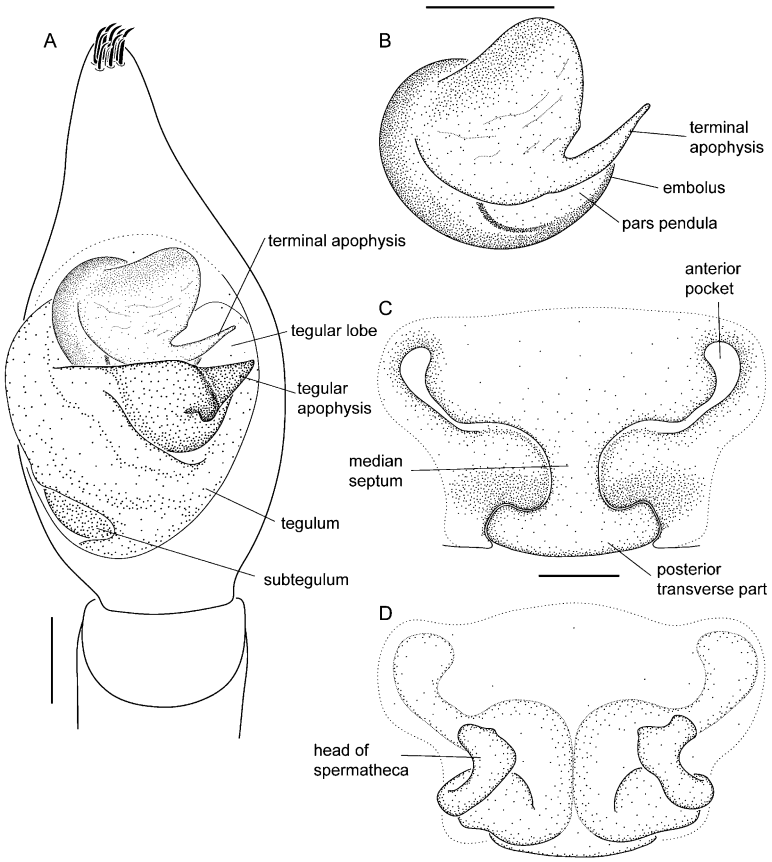

Figure 8. *Hoggicosa castanea* (Hogg). A–B, palp, ♂ from Gluepot Station, South Australia (SA), SAM NN19314. A, ventral; B, palea. C–D, epigynum, ♀ from Fisherman Point, Lincoln National Park, SA, SAM NN15185. C, ventral; D, dorsal. Scale bars = 0.5 mm.

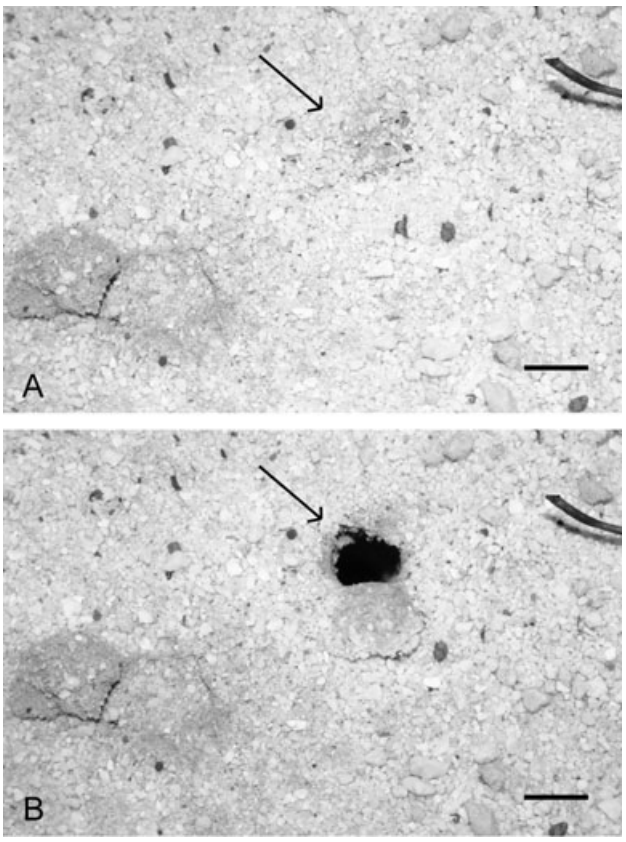

Figure 9. *Hoggicosa castanea* burrow from Stirling Range caravan park, Western Australia, WAM T58378. A, door closed. B, door open. Photos courtesy of M. Harvey. Scale bars = 10 mm.

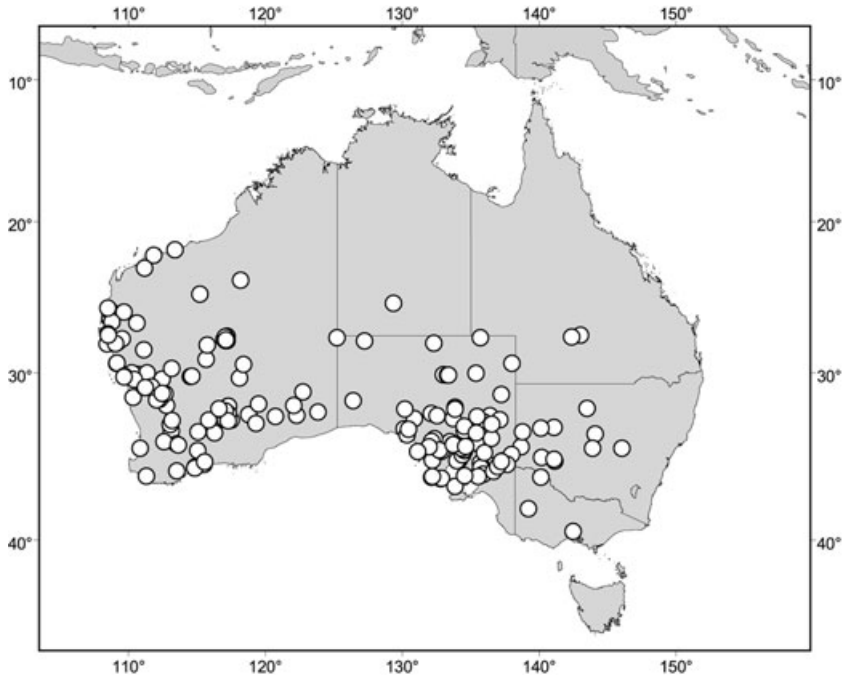

Figure 10. Distribution records of *Hoggicosa castanea* (Hogg).

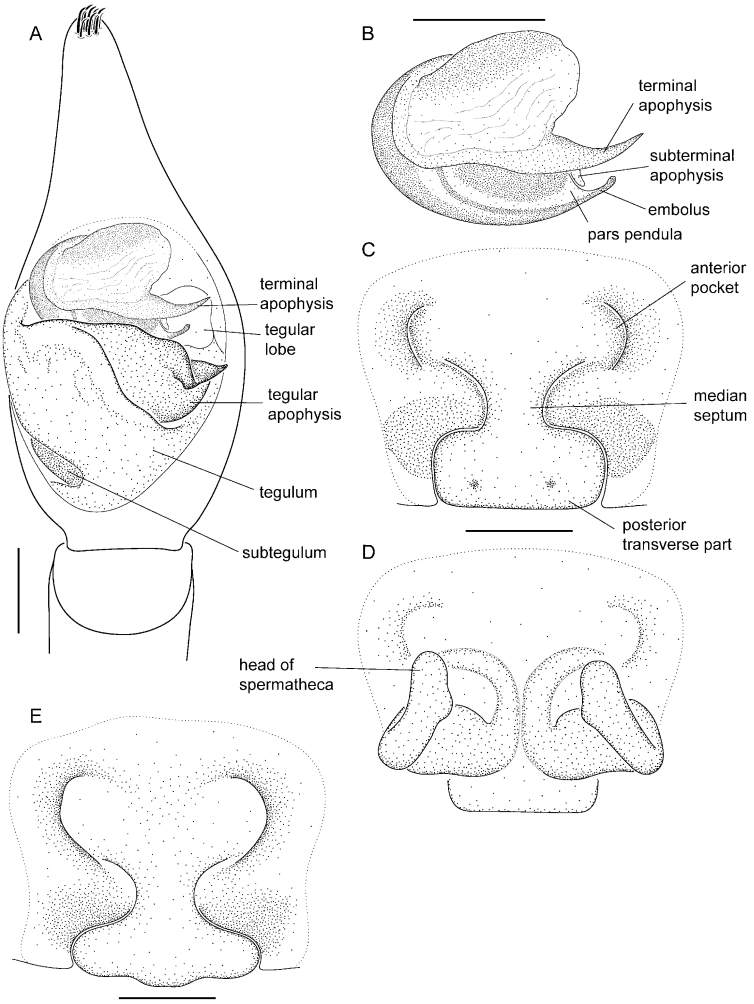

Figure 11. ***Hoggicosa alfi*** **sp. nov.** A–B, palp, ♂ paratype from Lorna Glen Station, Western Australia (WA), WAM T53919. A, ventral; B, palea. C–D, epigynum, ♀ paratype, from Lorna Glen Station, WA, WAM T77406. C, ventral; D, dorsal. E, epigynum, dorsal, ♀ variation from Nanga Station, WA, WAM T62772. Scale bars = 0.5 mm.

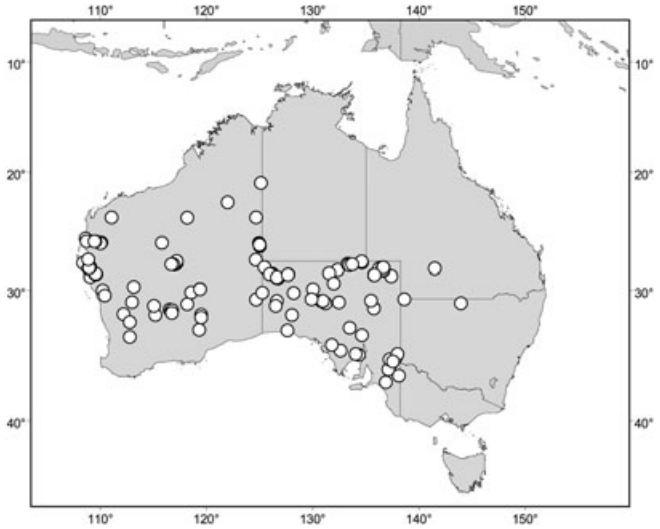

Figure 12. Distribution records of ***Hoggicosa alfi*** **sp. nov.**

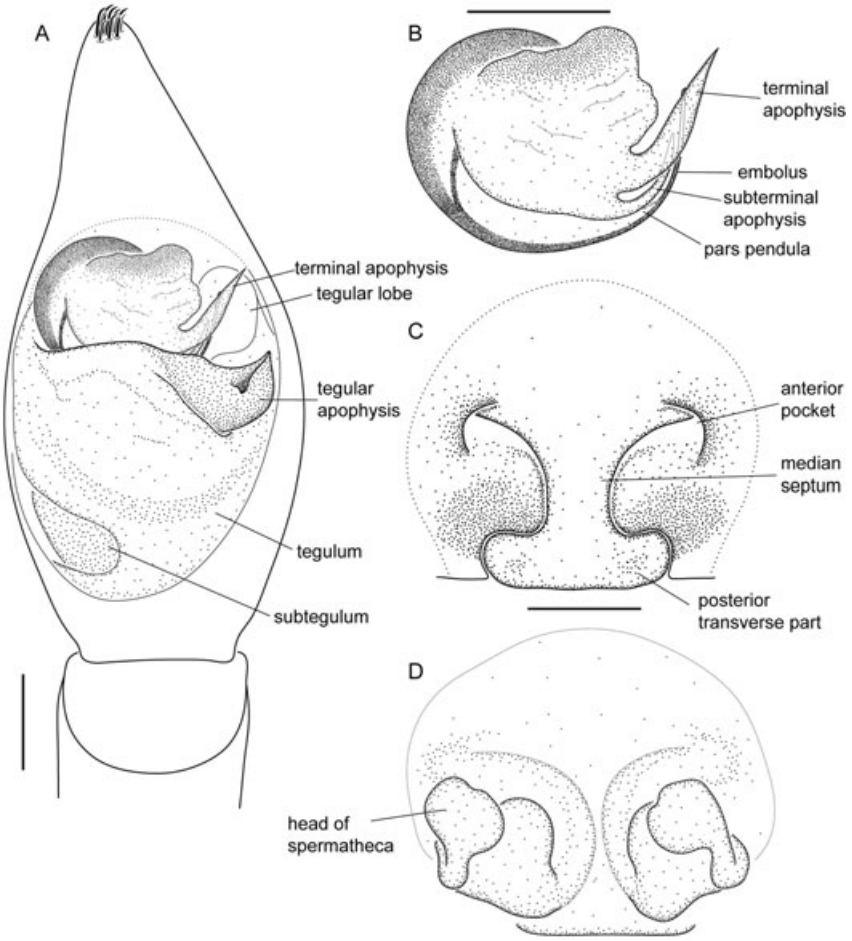

Figure 13. *Hoggicosa bicolor* (Hogg) from Mt Vernon Station, Western Australia, WAM T62336. A–B, ♂, palp. A, ventral; B, palea. C–D, ♀, epigynum. C, ventral; D, dorsal. Scale bars = 0.5 mm.

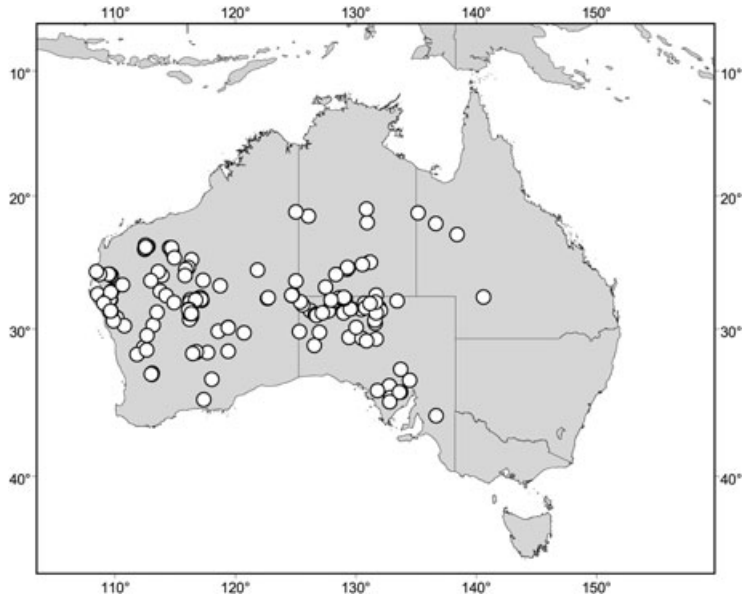

Figure 14. Distribution records of *Hoggicosa bicolor* (Hogg).

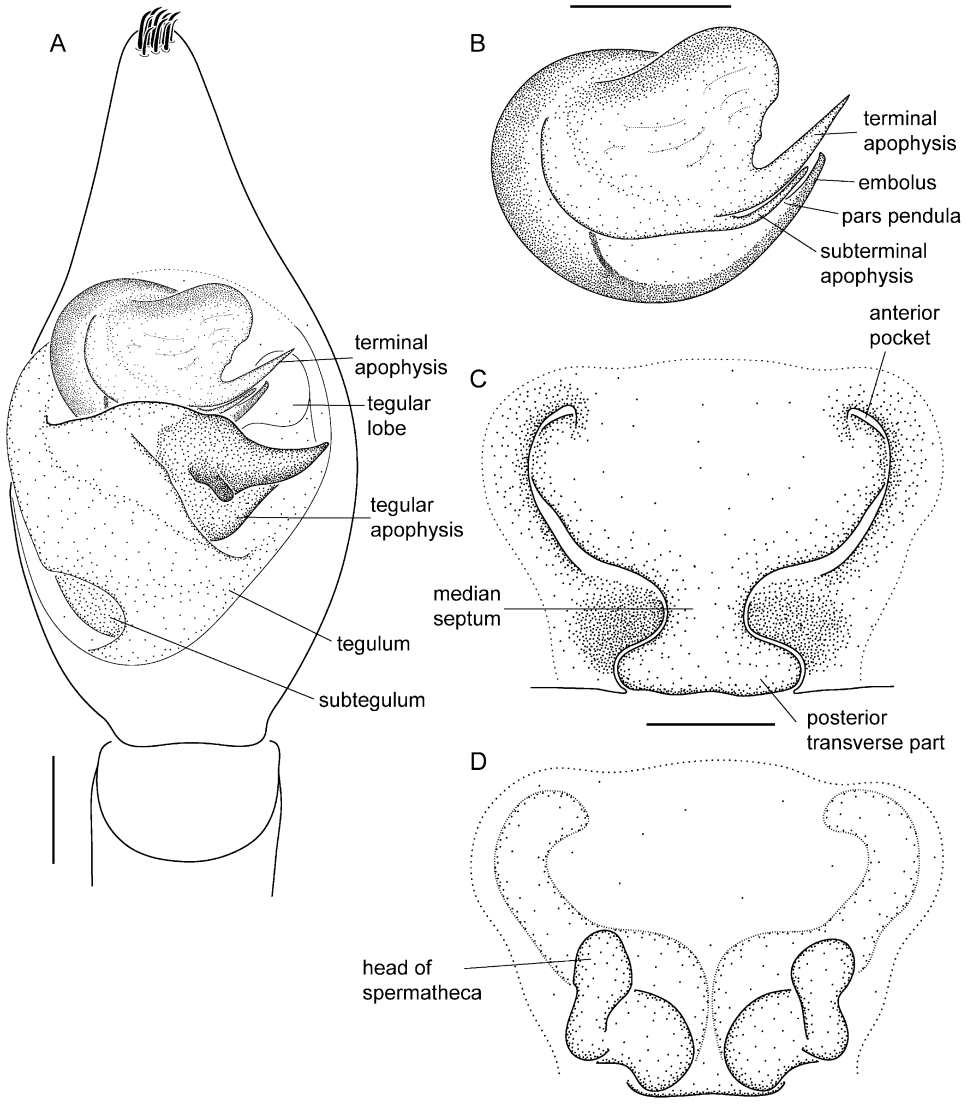

Figure 15. ***Hoggicosa brennani*** **sp. nov.** from Taylorville Station, South Australia. A–B, ♂ holotype, palp, SAM NN17017. A, ventral; B, palea. C–D, ♀ paratype, epigynum, SAM NN17029. C, ventral; D, dorsal. Scale bars = 0.5 mm.

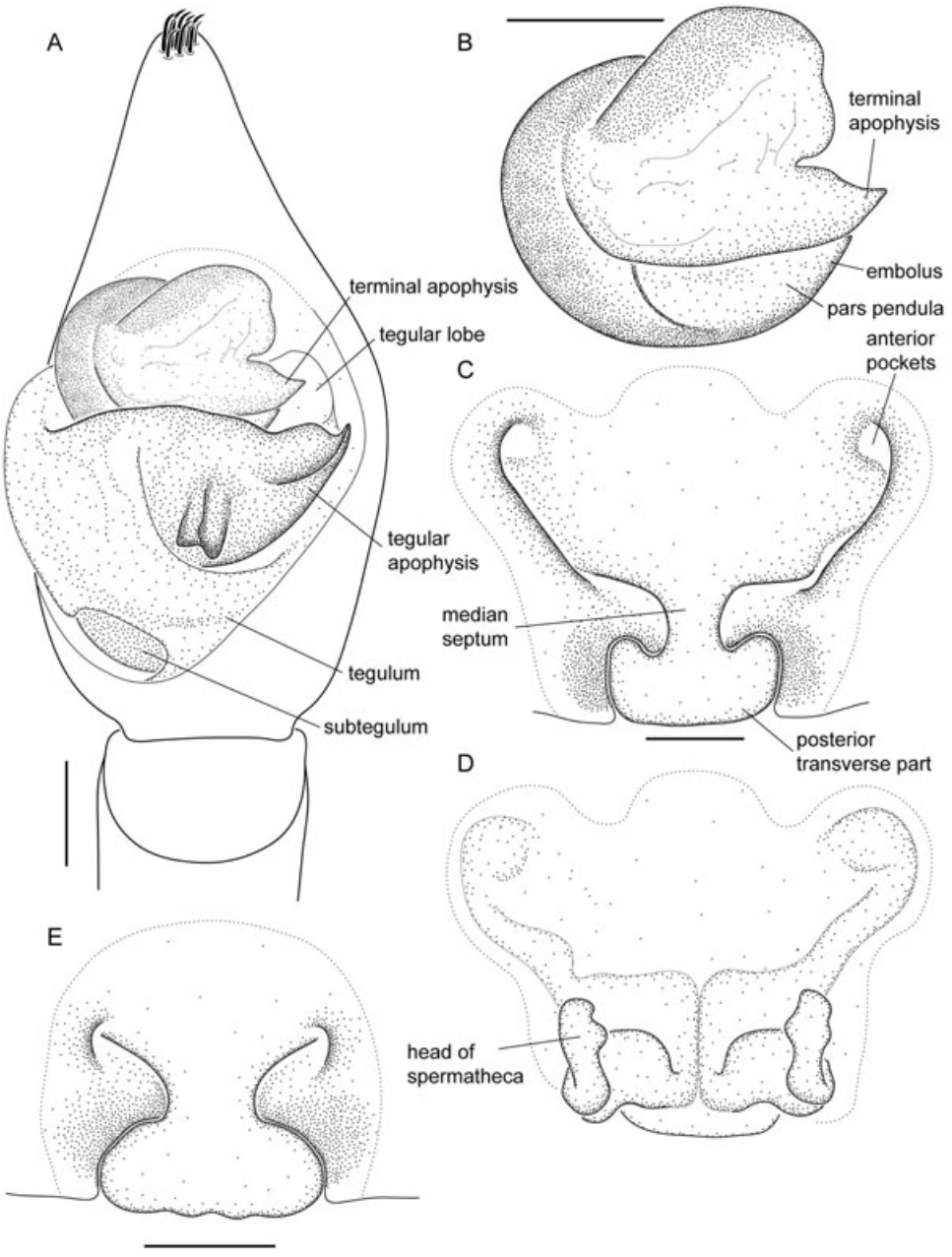

Figure 16. *Hoggicosa duracki* (McKay). A–D, paratypes from Argyle Downs Homestead, Western Australia (WA), WAM 74/495-6. A–B, ♂ palp. A, ventral; B, palea. C–D, ♀, epigynum. C, ventral; D, dorsal. E, epigynum, ventral, ♀ holotype from Argyle Downs, WA, WAM 74/494. Scale bars = 0.5 mm.

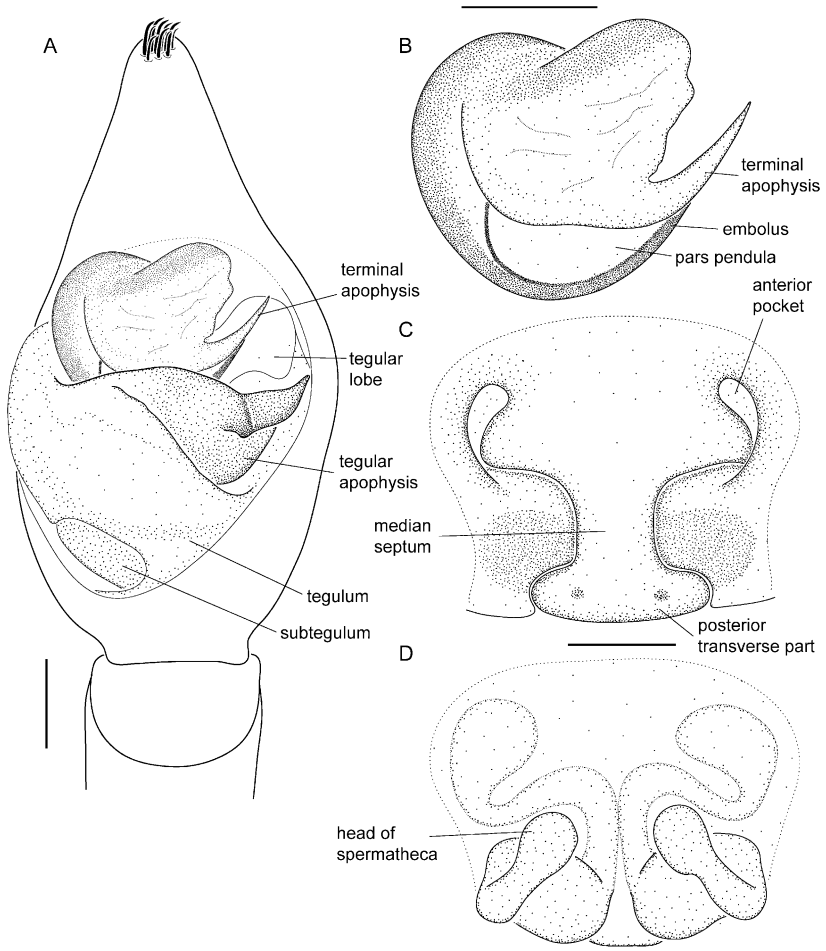

Figure 17. *Hoggicosa forresti* (McKay) from North Baandee Nature Reserve, Western Australia, WAM T47762. A–B, ♂, palp. A, ventral; B, palea; C–D, ♀, epigynum. C, ventral; D, dorsal. Scale bars = 0.5 mm.

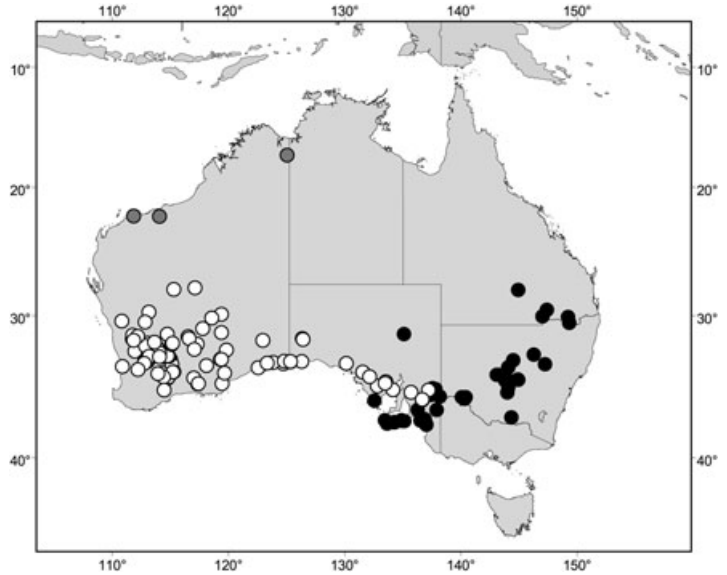

Figure 18. Distribution records of ***Hoggicosa brennani* sp. nov.** (black circles), *Hoggicosa duracki* (McKay) (grey circles), and *Hoggicosa forresti* (McKay) (white circles).

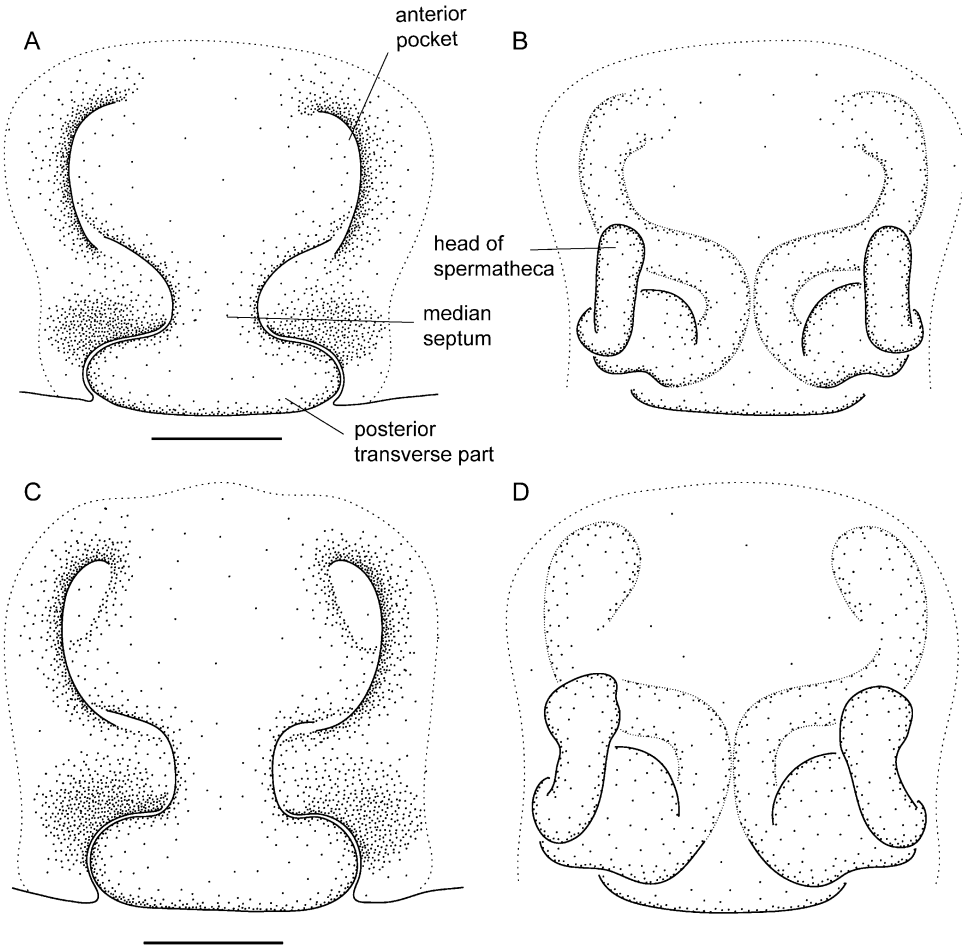

Figure 19. ***Hoggicosa natashae*** **sp. nov.** A–B, epigynum, ♀ holotype from Lake Gilles, South Australia (SA), SAM NN14785. A, ventral; B, dorsal. C–D, epigynum variation, ♀ from Cooper Creek, SA, SAM NN020. C, ventral; D, dorsal.

Figure 20. ***Hoggicosa natashae*** **sp. nov.** burrow entrance of holotype from Lake Gilles, South Australia, SAM NN14785. Photo courtesy of P. Hudson. Diameter of coin = 28 mm.

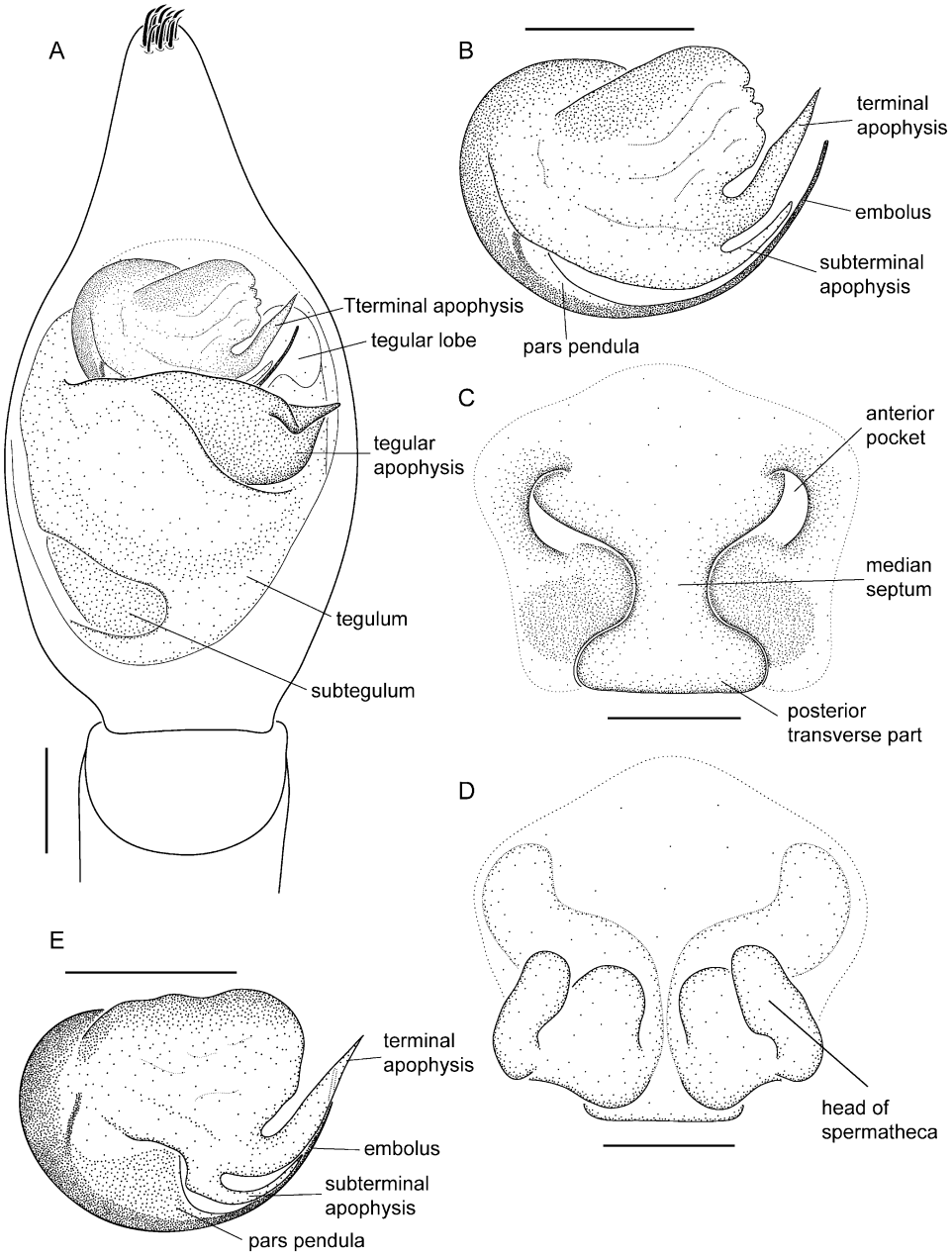

Figure 21. *Hoggicosa snelli* (McKay). A–B, palp, ♂ from Woodleigh Station, Western Australia (WA), WAM T65133. A, ventral; B, palea. C–D, epigynum, ♀ from Shothole Canyon, Cape Range National Park, WA, WAM T47612. C, ventral; D, dorsal. E, palp, ♂ palea variation from Drysdale River Station, Kimberley, WA, WAM T56397. Scale bars = 0.5 mm.

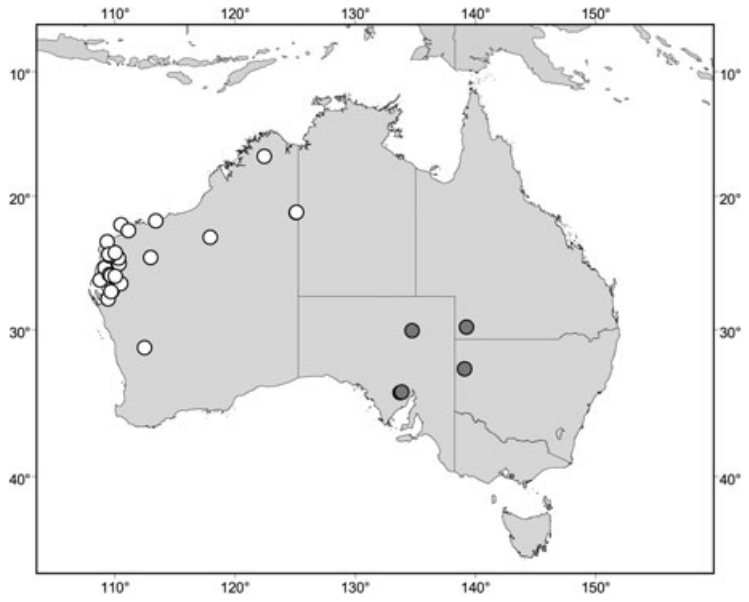

Figure 22. Distribution records of ***Hoggicosa natashae*** **sp. nov.** (grey circles) and *Hoggicosa snelli* (McKay) (white circles).

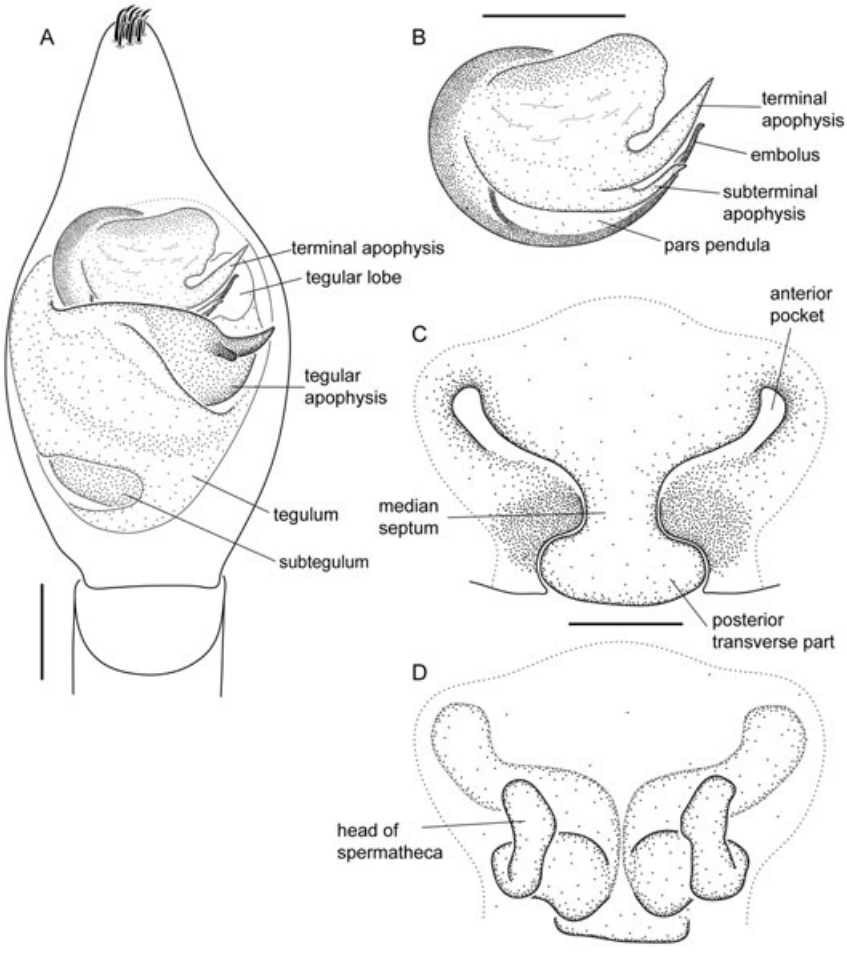

Figure 23. *Hoggicosa storri* (McKay). A–B, palp, ♂ from Stoneville, Western Australia (WA), WAM T47794. A, ventral; B, palea. C–D, epigynum, ♀ from Wubin, WA, WAM 68/503. C, ventral; D, dorsal. Scale bars = 0.5 mm.

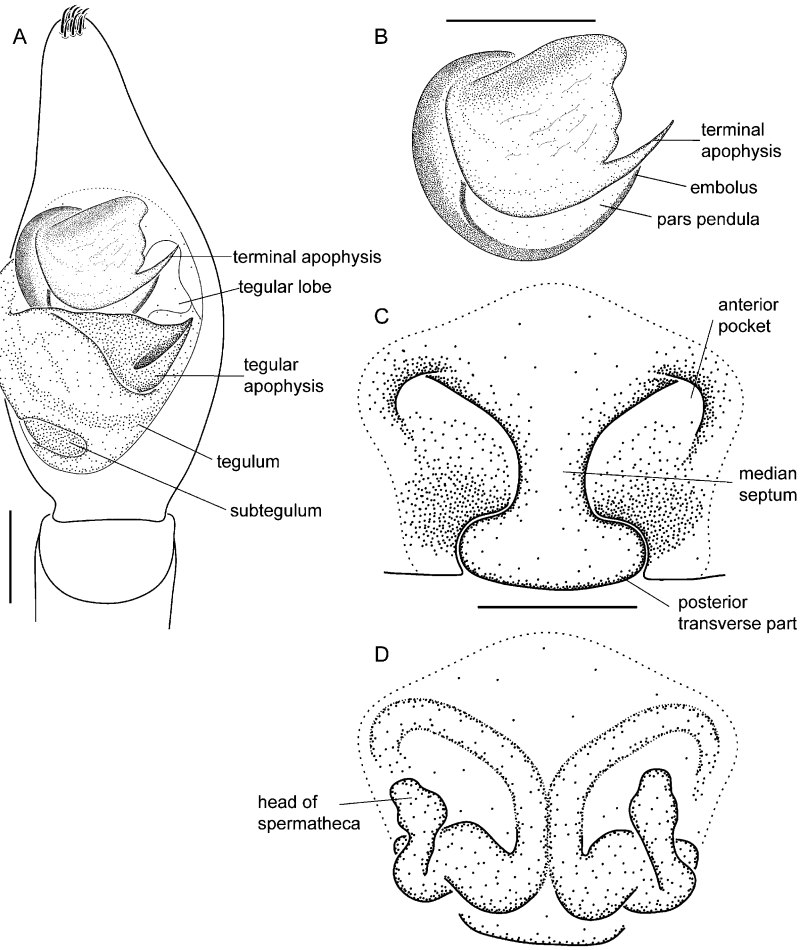

Figure 24. ***Hoggicosa wolodymyri*** **sp. nov.** from Taylorville Station, South Australia. A–B, ♂ holotype, palp, SAM NN16408. A, ventral; B, palea. C–D, ♀ paratype, epigynum, SAM NN16409. C, ventral; D, dorsal. Scale bars = 0.5 mm.

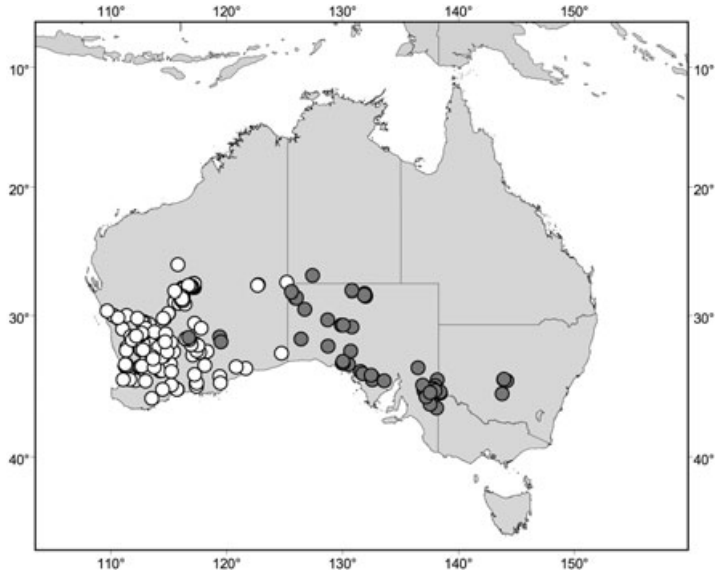

Figure 25. Distribution records of *Hoggicosa storri* (McKay) (white circles) and ***Hoggicosa wolodymyri*** **sp. nov.** (grey circles).