Revision of the wolf spider genus *Diahogna* Roewer, 1960 (Araneae, Lycosidae)

VOLKER W. FRAMENAU

Department of Terrestrial Invertebrates, Western Australian Museum, Welshpool DC, Western Australia, Australia

(Accepted 21 February 2006)

Abstract

The Australian/Pacific wolf spider genus *Diahogna* Roewer, 1960 is revised with *D. martensii* (Karsch, 1878) as type species. In addition to *D. martensii*, of which the male is illustrated for the first time, the genus includes a further three species, *D. exculta* (L. Koch 1876), n. comb., *D. hildegardae* n. sp., and *D. pisauroides* n. sp. The presence of a basoembolic apophysis on the male pedipalp places *Diahogna* in an unnamed Australasian/Pacific subfamily of wolf spiders that also includes *Anoteropsis* L. Koch, 1878, *Artoria* Thorell, 1877, *Notocosa* Vink, 2003, and *Tetracyclos* Roewer, 1960. *Diahogna* differs from these mainly in the presence of a distinct apical extension of the tegulum on the male pedipalp. Somatic characters of *Diahogna* that are peculiar within the Lycosidae include eye arrangement, carapace shape, and body coloration which superficially resemble that of fishing spiders (Pisauridae). *Lycosa neptunus* (Rainbow, 1896) and *Lycosa spinipes* (Rainbow, 1896), both only known from the holotypes collected near Sydney, Australia, have been previously associated with *D. martensii* and *D. exculta*. As these types are immature specimens in faded condition, accurate species identification is impossible and both species are considered *nomina dubia*. All species of *Diahogna* are known from wet habitats, such as the margins of rivers, creeks, dams, marshes and swamps.

Keywords: *Arachnida, Araneae, Australia, Diahogna, Lycosa, New Caledonia, new species, systematics, taxonomy, Trochosa*

Introduction

The knowledge of morphological characters of the genitalia, in particular the structure of the male pedipalp, is crucial for an interpretation of phylogenetic relationships in wolf spiders at all taxonomic levels (e.g. Zyzuin 1985, 1993; Dondale 1986). Early wolf spider taxonomists ignored the importance of differences in male genitalia resulting in a large number of paraphyletic and polyphyletic taxa (e.g. Roewer 1959, 1960; Guy 1966; McKay 1979). Recent studies focusing on genital morphology in combination with somatic characters have resulted in a re-evaluation of a large number of Australasian wolf spider genera in a variety of subfamilies, for example *Anoteropsis* L. Koch, 1878 and *Notocosa* Vink,
2002 (Vink 2002), Artoria Thorell, 1877 (Framenau 2002, 2005), Passiena Thorell, 1890 (Lehtinen 2005), Tetralycosa Roewer, 1960 (Framenau et al. forthcoming), and Venatrix Roewer, 1960 (Framenau and Vink 2001; Framenau 2006). The genus Diahogna Roewer, 1960, with Lycosa martensii Karsch, 1878 as type species, is also characterised by a peculiar pedipalp structure, a unique apical extension on the tegulum, that warrants the revalidation of this genus. Diahogna is currently considered a junior synonym of Trochosa C. L. Koch, 1847, however, the presence of a basoembolic apophysis places Diahogna in an undescribed Australasian/Pacific subfamily of wolf spiders with affinities to Artoria, Anoteropsis, Notocosa, and Tetralycosa (Framenau 2002, 2005; Framenau et al. forthcoming; Vink 2002; Murphy et al. 2006).

Diahogna was first listed as nomen nudum by Roewer (1955). It was later diagnosed as part of a world-wide generic revision of the Lycosidae (Roewer 1960) based on variable and ill-defined somatic characters, in particular the arrangement of the eyes, the number of retromarginal teeth on the chelicerae, and the relative length of legs and their segments. Guy (1966) employed similar characters but dismissed Roewer’s (1959, 1960) generic concepts by applying what he called a more reliable “statistical methodology”. He regarded Diahogna as junior synonym of Trochosa but due to his obscure reasoning and the lack of investigating type material, subsequent cataloguers did not accept this synonymy and other changes (Brignoli 1983). It is remarkable that both Roewer (1960) and Guy (1966) based their generic concepts of Diahogna solely on a single, immature specimen, the holotype of L. martensii, collected in Alexandra (Victoria, south-eastern Australia). When McKay (1979) revised the genus Trochosa in Australia, he provided the first illustrations of a mature specimen of D. martensii. He confirmed Guy’s (1966) synonymy of Diahogna with Trochosa but similar to Roewer (1960) based his decision on a somatic diagnosis of Trochosa.

In his original description of L. martensii, Karsch (1878) related his new species to L. Koch’s (1876) “Gruppe 1” (=group 1), which included Lycosa exculta L. Koch, 1876 and other species in which the anterior row of eyes is distinctly wider than the posterior median row of eyes. Simon (1898) confirmed close morphological affinities between D. martensii and D. exculta and suggested that Lycosa neptunus (Rainbow, 1896) and Lycosa spinipes (Rainbow, 1896) may also form part of this group. I have examined the type material of L. neptunus (Australian Museum, KS8694) and L. spinipes (Australian Museum, KS8698), both from Port Jackson, Sydney. These holotypes are early stage immatures with faded body coloration and it is impossible to identify them accurately to species level. Consequently, I consider L. spinipes and L. neptunus to be nomina dubia.

Here, I revalidate the genus Diahogna based on a combination of somatic and, in particular, genital characters of the male pedipalp to include four species from Australia and New Caledonia: D. martensii and D. exculta (in both of which the males are described for the first time) and two new species, D. hildegardae and D. pisauroides (the latter only known from the male).

**Methods**

This revision of the genus Diahogna is based on an exhaustive examination of all major Australian museum collections that resulted in a database of nearly 20 000 records (more than 60 000 specimens examined) of Australian wolf spiders. Berland (1924) reported Lycosa exculta from New Caledonia based on specimens in E. Simon’s collection (today
housed at the Museum national d'Histoire naturelle, Paris). The comparison of these specimens with the type material of *L. exculta* confirmed E. Simon’s identification and the presence of *Diahogna* in New Caledonia.

All descriptions are based on specimens preserved in 70% ethanol. Female epigynes were prepared for examination by submersion in lactic acid for 2h. For clarity, the illustrations of male pedipalps and female epigynes omit the setae. Photographs were taken with a digital camera (Canon G6) that was connected to the ocular tube of a stereo microscope (Leica MZ6) with an adapter set (Scopetronix MaxView Plus). Photographs were taken in different focal planes and combined with the software package Helicon Focus 3.10.3 (Khmelik et al. 2005).

The morphological nomenclature follows Framenau (2002, 2005), however, the term “tegular apophysis” is given preference over “median apophysis” for a structure of the male pedipalp as it more accurately describes its topology (see also Lehtinen 2005). The curvature of the anterior row of eyes was determined by the shape of an imaginary line through the centre of the eyes in frontal view. The anterior row of eyes is “procurved” if the ends of this line point downwards and “recurved” if they point upwards (see Roewer 1959 for a detailed discussion on lycosid eye patterns). Some confusion may arise in regard to naming the marginal bands on the carapace. In many lycosids, a light band of varying width is present along the carapace margin. This light band is referred to as a “marginal band” (e.g. Figure 1A). It becomes a “submarginal” band if there is a distinct dark band (usually of the same colour as the carapace) present between the light band and the carapace margin (Figure 1D). All measurements are given in millimetres.

The following abbreviations are used. Eyes: AE, anterior; AME, anterior median; ALE, anterior lateral; PE, posterior; PME, posterior median; PLE, posterior lateral. Measurements (adult spiders, if not otherwise stated): TL, total length; CL, carapace length; CW, carapace width; AL, abdomen length; AW, abdomen width. Collections: AM, Australian Museum, Sydney; BMNH, Natural History Museum, London; MHNP, Museum national d’Histoire naturelle, Paris; MV, Museum Victoria, Melbourne; NTMAG, Museum and Art Gallery of the Northern Territory, Darwin; QVMAG, Queen Victoria Museum and Art Gallery, Launceston; SAM, South Australian Museum, Adelaide; TMAG, Tasmanian Museum and Art Gallery, Hobart; WAM, Western Australian Museum, Perth; ZMB, Museum für Naturkunde, Zentralinstitut der Humboldt-Universität, Berlin; ZMH, Zoologisches Institut und Zoologisches Museum der Universität Hamburg.

**Taxonomy**

**Order ARANEAE** Clerck, 1757

**Family LYCOSIDAE** Sundevall, 1833

**Diahogna** Roewer, 1960

*Type species.* *Lycosa martensii* Karsch, 1878. By original designation.

**Diagnosis**

*Diahogna* differs from all other wolf spider genera by the following combination of somatic and genitalic characters. The dorsal carapace profile is straight in lateral view (Figure 2B),
Figure 1. Photographs (dorsal view) of species of *Diahogna*. (A) Female of *D. martensii* (Karsch) from Blackmans Lagoon, Tasmania, Australia (QVMAG 13:42205); (B) female of *D. exculta* (L. Koch) from O’Brians Gap, Wollongong, New South Wales, Australia (AM KS58056); (C) female of *D. hildegardae* n. sp. from Tambo River at Doctors Flat, Victoria, Australia (WAM T48116); (D) male holotype of *D. pisauroides* n. sp. from Adelaide River, Northern Territory, Australia (NTMAG A485). Scale bar: 1 mm.
Figure 2. Male of *Diahogna martensi* (Karsch) from Cape Naturaliste, Tasmania, Australia (QVMAG 13:42218). (A, B) Carapace profile, dorsal and lateral views, respectively; (C) eye pattern in frontal view; (D) left male pedipalp, apical part of bulbus; (E, F) left male pedipalp, ventral and lateral views, respectively. Scale bar: 3.93 mm (A); 4.17 mm (B); 1.16 mm (C); 1.04 mm (D); 0.77 mm (E, F).
Description

Medium-sized wolf spiders (TL ca 6.0–14.0 mm). Males smaller than females. Carapace longer than wide, dorsal profile straight in lateral view (Figure 2B). Head flanks in frontal view a gentle slope (Figure 2C). Carapace brown, medially lighter (sometimes in the form of a Y-shaped median band) and with marginal or submarginal light bands enhanced by white setae. Anterior median eyes generally larger than anterior lateral eyes (of equal size in male *D. pisauroides*), row of anterior eyes wider than row of posterior median eyes; row of anterior eyes straight or slightly procurved. Chelicerae with three promarginal and three (rarely two or four) retromarginal teeth. Labium generally longer than wide (except female *D. exculta* and male *D. pisauroides*). Abdomen olive-grey with light lanceolate heart mark formed by white setae. Leg formula VI>I>II>III (VI>III>I>II in male *D. exculta*). Spination of legs: femur: two or three dorsal, one apicoprolateral, zero or two retrolateral; patella: zero or one prolateral; tibia one to three ventral pairs (basal pairs sometimes reduced to one or no spine), zero or one prolateral; metatarsus: three ventral pairs, one apicoventral.

Tegulum longitudinally divided, retrolateral part narrow in ventral view. Tegular apophysis located retrolaterally at apical tip of tegulum, without basal lobe. Embolus originating prolaterally on palea and curving ventrally around it, long and slender. Basoembolic apophysis forms a white or transparent, membranous lobe. Terminal apophysis with bulging base. Epigyne with a heavily sclerotised plate, with two small (*D. exculta, D. hildegardae*) or a single, wide opening (*D. martensii*). Spermathecae round or ovoid, copulatory ducts distinctly narrower than spermathecae.

Remarks

A recent molecular phylogeny inferred from 12S rRNA and NADH1 including 70 world-wide lycosid species with the majority from the Australasian region, included *D. pisauroides* (as “New Genus 2 sp.”) as representative of *Diahogna* (Murphy et al. 2006). Independent of the phylogenetic analysis used (parsimony, Bayesian), *D. pisauroides* represented the sister taxon of *Tetralycosa oraria* (L. Koch, 1876) within a distinct Australasian/Pacific clade at the subfamily level. Morphologically, this clade is characterised by the presence of a unique basoembolic apophysis on the male pedipalp and had previously been argued to represent a new lycosid subfamily (Framenau 2002; Vink 2002; Framenau et al. forthcoming). A formal description of this subfamily is forthcoming as part of my revision of the Australian Lycosidae.
Distribution

Australia and New Caledonia.

_Diahogna martensii_ (Karsch, 1878)
(Figures 1A, 2E, F, 3A, B, 4)

_Lycosa martensii_ Karsch, 1878, p 812–813; Moritz 1992, p 319.
_Lycosa martensi_ Karsch: Bonnet 1957, p 2652.
_Diahogna martensii_ (Karsch): Roewer 1955, p 239; Roewer 1960, p 745.
_Trochosa martensii_ (Karsch): McKay 1973, p 381; McKay 1979, p 290–293, Figure 4a–c;
McKay 1985, p 83.
_Trochosa martensi_ (Karsch): Platnick 1989, p 391.

Material examined

Holotype: penultimate female, Alexandra (37°11′S, 145°42′E, Victoria, Australia), E. von Martens, found in a parcel with conchylid shells (ZMB 756).

Other material examined. Australia: New South Wales: one male, Wahronga Fraser Reserve, 33°43′S, 151°08′E, 22 November 1993, J. Noble, slides reference 9/10 (AM KS57289); one female, same data, slides reference 11/12 (AM KS57288); one female, same data,

Figure 3. Female of _Diahogna martensii_ (Karsch) from Blackmans Lagoon, Tasmania, Australia (QVMAG 13:42205). (A, B) Female epigyne, ventral and dorsal views, respectively. Scale bar: 0.59 mm.
slides reference 13/14 (AM KS57287). South Australia: one female, Beachport, 37°29′S, 140°00′E, January 1906, J. C. Verou (SAM NN13350); one female, Bool Lagoon Conservation Reserve, 37°07′S, 140°41′E, D. Lee, lagoon dry for 3 years (SAM NN16873); one male, two juveniles, Cortina Lakes, SE, 36°17′S, 139°55′E, August 1992, T. and J. White (SAM NN16891); one male, Wandilo, NE of, 37°44′S, 140°41′E, 23 September 1978, J. Aslin, under wood on floor of a swamp, J.E.A. 2:238 (SAM NN22392). Tasmania: one female, two juveniles, Tasmania (no exact location), 14 February 1986, L.C. (AM KS28281); one female, three juveniles, Blackmans Lagoon, 40°54′S, 147°35′E, 21 January 1992, T. J. Kingston, L. F. McGowan, plank bridge, EQ 498 703 (QVMAG 13:42205); four females, one juvenile, same data, except: 9 October 1991, Horwitz site, EQ 497 707 (QVMAG 13:42214); two females, five juveniles, Bowlers Lagoon, 40°51′S, 147°55′E, 23 September 1991, T. J. Kingston, L. F. McGowan, site 3, EQ 787 757 (QVMAG 13:42222); one female, six juveniles, same data, except: 6 November 1991, site 2, sample 1, EQ 787 758 (QVMAG 13:42215); Cape Naturaliste, 40°50′S, 148°13′E, 8 October 1991, T. J. Kingston, L. F. McGowan, 773 m, site 2b, FQ 21 (QVMAG 13:42218); one female with eggsac, Cascades, Hobart, 42°53′S, 147°17′E, 23 October 1937, D. Turner (TMAG J3497); one female, Georgetown, 41°06′S, 146°49′E, August 1993, L. Bebbington (SAM NN16874); one female, Lake Tiberias, 42°25′S, 147°21′E, December 1938, J. W. Evans (TMAG J3498); one male, Little Waterhouse Lake, 40°52′S, 147°36′E, 15 August 1991, T. J. Kingston, L. F. McGowan, EQ 516 751 (QVMAG 13:42204). Victoria: one female with eggsac, Alexandra, 37°11′S, 145°42′E, 7 December 1954, A. Neboiss (MV K7811); two females with eggsac, same location, 7 November 1927 (MV K7812); one female, Churchill, 38°19′S, 146°26′E, 23 May 1990, R. de Souza-Daw (SAM NN16875); one male, one female, three juveniles, same data, 16 October 1992, marsh (SAM NN16876–7); one male, four juveniles, same

Figure 4. Records of *Diahogna* in Australia and New Caledonia. *Diahogna martensii* (Karsch) (light circles); *D. hildegardae* n. sp. (full circles); *D. pisauroides* n. sp. (light squares); *D. exculta* (L. Koch) (full squares).
data, 14 February 1993, farm dam, at night, “apparently under water” (SAM NN16879); one male, nine juveniles, same data, 3 March 1993, dam (SAM NN16878); one male, 13 juveniles, same data, 30 July 1993, farm dam (SAM NN16890); one male, three females, three females with eggsac, same data, edge of dam (SAM NN16880–5); one male, Errinundra Plateau, Delegate River and Gunmark Road, 37°04’S, 148°40’E, 6 December 1994, pan, D. Bickel, 900 m, sphagnum bog (AM KS44427); one female, one juvenile, Lakes Entrance, beachside, 37°53’S, 148°00’E, 28 March 1972, D. Hoese, “in water on algae in brackish pool in shore dunes” (AM KS84117); one female, La Trobe River survey, St. 20, B. L. Outfall, 16 February 1973 (MV K9329); one male, Preston, 37°44’S, 145°00’E, July 1922, S. Butler (MV K8138); one male, Wilsons Promontory National Park, 38°57’S, 146°15’E, 18 August 1987, A. Neboiss, K. Walker (MV K9328).

Diagnosis

Males of *D. martensii* differ from *D. exculta* and *D. hildegardeae* in a variety of structures in the male pedipalp, in particular the shape of the tegular apophysis, which is much smaller. The sperm duct, which is visible through the tegulum, has an S-shaped curve but it is straight in *D. hildegardeae*. They can be easily distinguished from *D. pisauroides* by the carapace coloration as the latter is the only species with submarginal instead of marginal light bands (Figure 1A, D). The female epigyne of *D. martensii* with its single posterior opening is unique within the genus.

Description

Male. Based on QVMAG 13:42218.

Carapace: brown; indistinct dark radial pattern; light brown median band narrowing from behind PLE to just behind fovea; darker coloration centrally in median band results in a Y-shaped pattern of the median band; distinct light marginal bands through dense cover of white setae; otherwise brown setae; dark brown macrosetae in cephalic area and medially between PLE and fovea.

Eyes (Figure 2A, C): row of AE slightly procurved and wider than row of PME.

Sternum: orange-brown; brown setae which are denser and longer towards margins.

Labium: light brown, basally darker; front end truncated and white.

Chelicerae: dark orange-brown; covered with light grey setae and brown macrosetae; three promarginal teeth, the median largest; three retromarginal teeth of similar size.

Pedipalp (Figure 2D–F): sperm duct strongly S-curved in prolateral part of tegulum (Figure 2E); tegular apophysis widening apically; embolus long and slender, terminal apophysis bent slightly basally (Figure 2D).

Abdomen: dark olive-grey; dense white setae form a lanceolate heart mark in anterior half; lateral light stripes reach along the whole abdomen; four pairs of small, widely separated light spots in posterior half; otherwise brown setae and dark brown macrosetae. Venter orange-brown; covered with light brown setae. Spinnerets light brown.

Legs: leg formula VI>I>II>III; brown, with the distal segments darker. Spination of leg I: femur: three (right leg: two) dorsal, one apicoprolateral, one retrolateral (left leg only); tibia: three ventral pairs; metatarsus: three ventral pairs, one apicoventral.
Female. Based on QVMAG 13:42205.

Carapace, eye, and labium: as male.

Sternum: orange-brown. Setae as male.

Chelicerae: dark reddish brown; setae and dentition as male.

Abdomen: as male, but lanceolate heart mark very indistinct and no lateral stripes (Figure 1A). Venter brown, setae as male. Spinnerets: light brown.

Epigyne, ventral view (Figure 3A): simple sclerotised plate with a posterior opening that is much wider than long.

Epigyne, dorsal view (Figure 3B): spermathecae round-ovoid; copulatory ducts straight, connecting posteriorly to spermathecae.

Legs: leg formula IV>I>II>III; coloration as male. Spination of leg I: femur: three dorsal, one apicoprolateral; tibia: three ventral pairs; metatarsus: three ventral pairs, one apicoventral.

Measurements. Male QVMAG 13:42218 (female QVMAG 13:42205): TL 9.76 (11.73), CL 5.31 (6.55), CW 4.20 (5.06). Eyes: AME 0.20 (0.28), ALE 0.19 (0.24), PME 0.28 (0.32), PLE 0.24 (0.26). Row of eyes: AE 1.13 (1.33), PME 0.89 (0.97), PLE 1.48 (1.70). Sternum (length/width) 2.10/1.91 (2.47/2.35). Labium (length/width) 0.80/0.78 (1.11/0.87). AL 4.32 (6.18), AW 3.71 (4.32). Legs: lengths of segments (femur+patella/tibia+metatarsus+tarsus=total length): pedipalp 2.22+2.10+1.72=6.04, I 3.21+4.20+2.77+1.48=11.66, II 3.21+3.95+2.77+1.36=11.29, III 2.96+3.58+2.96+1.36=10.86, IV 3.95+5.06+4.08+1.73=14.82 (pedipalp 2.22+2.47+1.73=6.42, I 3.95+5.06+2.77+1.61=13.39, II 3.95+4.82+2.77+1.48=13.02, III 3.58+4.45+2.84+1.48=12.35, IV 4.82+6.05+4.82+2.10=17.79).

Variation. Males (females) (range, mean ± SD): TL 7.50–9.45, 8.45 ± 0.98; CL 4.35–5.25, 4.80 ± 0.45; CW 3.45–4.05, 3.75 ± 0.30; n=3 (TL 9.30–13.80, 11.63 ± 1.32; CL 4.80–6.45, 5.70 ± 0.53; CW 3.45–5.10, 4.52 ± 0.54; n=8).

Distribution

South-eastern Australia, including New South Wales, South Australia, Tasmania, and Victoria (Figure 4).

Life history and habitat preferences

Diahogna martensii is the most commonly encountered of the four species within the genus. Mature males and females have been found nearly all year round, with females peaking in October and November. The species appears to prefer moist conditions, such as swamps and marshes, and can also be found in the vicinity of rivers, lakes, and dams. References such as “in water” or “apparently under water” suggest that this species heavily utilises water sources, for example to hide from predators (such as collecting arachnologists).

Remarks

Although the holotype female of D. martensii is an immature specimen, somatic characters, in particular the distinct Y-shaped pattern on the carapace, allow an accurate identification of this species (see also McKay 1979).
The original specific epithet of this species was *martensii* (Karsch 1978). Bonnet (1957) amended this name to *martensi* (ending with only one -i), and as such this species is currently listed (Platnick 2006; personal communication). However, the International Code of Zoological Nomenclature undoubtedly clarifies the case of alternative genitive endings of species-group names and ruled to follow the original spelling of the specific epithet (International Commission on Zoological Nomenclature 1999, Article 33.4).

**Diahogna exculta** (L. Koch, 1876), n. comb.

(Figures 1B, 4, 5A–D)

*Lycosa exculta* L. Koch, 1876, p 881–883, Plate 76, Figures 1, 5a–c; Rainbow 1911, p 267; Berland 1924, p 163; Bonnet 1957, p 2640.

*Allohogna exculta* (L. Koch): Roewer 1955, p 212; Rack 1961, p 37.

*Trochosa exculta* (L. Koch): McKay 1973, p 381; McKay 1979, p 293, Figure 4d; McKay 1985, p 86; Platnick 1989, p 390.

**Material examined**

Lectotype (designated by McKay 1979): female, Sydney (33°53’ S, 151°13’ E, New South Wales, Australia), L. Koch collection (BMNH 1919.9.18.333). Paralectotypes: one female, most likely Sydney (33°53’S, 151°13’E, New South Wales, Australia), Rack (1961) catalogue 452 (ZMH); one penultimate male, most likely Gayndah (25°37’S, 151°36’E, Queensland), Rack (1961) catalogue 452 (ZMH).

Other material examined. Australia: New South Wales: one female, Gerringong, Mayflower Retirement Village, 34°44’ S, 150°50’ E, 21 March 1991, G. Wishart (AM KS91403); one female, O’Brians Gap, Wollongong, 34°26’ S, 150°53’ E, 9 July 1966 (AM KS85056); one female, Sydney, 33°52’ S, 151°12’ E (SMF 5293). New Caledonia: two males, one female with eggsac, seven juveniles, Noumea, 22°16’ S, 166°26’E (MHNP 3877).

**Diagnosis**

The distinctly two-lobed tegular apophysis that points apically in the male pedipalp of *D. exculta* is unique within the genus. Females of this species can easily be distinguished from *D. martensii* and *D. hildegardeae* by the shape of their epigyne that has distinct sclerotised edges medially from the copulatory openings.

**Description**

**Male.** Based on MHNP 3877.

Carapace: brown, indistinct light Y-shaped pattern medially; indistinct dark radial pattern; distinct light marginal bands; brown setae, white setae in marginal bands; dark brown macrosetae around eyes.

Eyes: row of AE slightly procurved and wider than row of PME.

Sternum: orange-brown; brown setae which are longer and denser towards margins.

Labium: brown, basally darker.
Chelicerae: brown, dense brown setae, longer anteromedially; three promarginal teeth, the median largest; three retromarginal teeth of similar size.

Pedipalp (Figure 5A–C): tegular apophysis two-lobed (Figure 5A); embolus straight apically, terminal apophysis with narrow, ventrally bent tip and a ventrally bulging base (Figure 5C).

Figure 5. *Diahogna exculta* (L. Koch), male from Noumea, New Caledonia (MHNP 3877) and from O’Brians Gap, Wollongong, New South Wales, Australia (AM KS58056). (A, B) Left pedipalp, ventral and lateral views, respectively; (C) left male pedipalp, apical part of bulb; (D, E) female epigyne, ventral and dorsal views, respectively. Scale bar: 0.81 mm (A, B); 0.63 mm (C); 0.67 mm (D, E).
Abdomen: brown; indistinct darker lanceolate heart-mark in anterior half; white lines laterally that end above spinnerets; brown setae, white setae in lateral bands. Venter orange-brown with brown setae. Spinnerets brown.

Legs: leg formula VI>I>III>II; brown, distal. Spination of leg I: femur: three dorsal, one apicoprolateral, one apicoretrolateral; tibia: two ventral pairs; metatarsus: three ventral pairs, one apicoventral.

**Female.** Based on AM KS85056.
Carapace (Figure 1B), sternum, labium and chelicerae: as male.
Eyes: row of AE straight and wider than row of PME.
Abdomen: uniformly olive-brown without a distinct pattern (Figure 1B); covered with brown setae. Venter orange-brown with brown setae. Spinnerets light brown.

Epigyne, ventral view (Figure 5D): heavily sclerotised plate with two lateral copulatory openings.

Epigyne, dorsal view (Figure 5E): spermathecae round, copulatory ducts narrow and connect postero-medially to spermathecae.

Legs: leg formula IV>I>II>III; uniformly orange-brown. Spination of leg I: femur: three dorsal, one apicoprolateral, one apicoretrolateral (only left leg); tibia: two ventral pairs (one pair on right leg, basal pair reduced to single prolateral); metatarsus: three ventral pairs, one apicoventral.

**Measurements.** Male, MHNP 3877 (female, AM KS85056): TL 10.25 (12.35), CL 5.56 (6.67), CW 4.32 (5.43). Eyes: AME 0.19 (0.20), ALE 0.15 (0.17), PME 0.24 (0.35), PLE 0.22 (0.33). Row of eyes: AE 1.06 (1.35), PME 0.72 (1.15), PLE 1.17 (1.76). Sternum (length/width) 2.22/2.10 (2.77/2.35). Labium (length/width) 0.85/0.74 (0.93/1.02). AL 4.57 (6.55), AW 3.71 (5.31). Legs: lengths of segments (femur+patella/tibia+metatarsus+tarsus=total length): pedipalp 2.22+2.10+1.63=5.95, I 3.46+4.32+2.96+1.48=12.22, II 3.46+4.20+2.84+1.48=11.98, III 3.58+4.20+3.21+1.48=12.47, IV 4.32+5.06+4.20+1.73=15.31 (pedipalp 2.47+2.35+1.73=6.55, I 4.08+5.31+3.09+1.61=14.09, II 3.95+5.06+3.09+1.61=13.71, III 3.95+4.69+3.46+1.61=13.71, IV 4.94+6.05+5.31+2.22=18.52).

**Variation.** Two other females (AM KS91403: TL 12.97, CL 6.67, CW 5.43; MHNP TL 12.60, CL 6.79, CW 5.56) and the second male (MHNP TL 9.63, CL 5.56, CW 4.32) are of very similar size and colouration in comparison to the specimens described above.

**Distribution**

*Diahogna exculta* has so far only been recorded reliably from the vicinity of Sydney, New South Wales (Australia) and Noumea (New Caledonia) (Figure 4). The record of the penultimate male paralectotype from Gayndah (Queensland) (Koch 1876; Rack 1961) must be treated cautiously since an accurate species identification of juveniles is not possible. Therefore, I omitted the record from Gayndah from the distribution map (Figure 4).

**Life history and habitat preferences**

Collection dates (March and July) are only available for two females from Sydney, suggesting that this species may be autumn and/or winter active.
The collector of the type material, Mr Daemel, called this species “water spider” as he only found it in the proximity of water and apparently able to walk on the water surface (Koch 1876).

**Remarks**

Ludwig Koch (1876) described *D. exculta* from females from Sydney (New South Wales) and a juvenile male from Gayndah (Queensland). The female lectotype in the BMNH is labelled “Sydney”, but the female and penultimate male specimens in the ZMH have no locality data. Taking L. Koch's (1876) original information into consideration, the specimens in the ZMH must be assumed from Sydney (female) and Gayndah (penultimate male).

Both male and female of *D. exculta* match closely the new generic diagnosis of *Diahogna* in somatic and genitalic characters. Consequently, this species is here transferred from the genus *Trochosa*.

Due to the fragile and bleached condition of the type material, the female of *D. exculta* is redescribed from a more recently collected specimen.

*Diahogna hildegardae* n. sp.

(Figures 1C, 4, 6A–E)

**Material examined**

Holotype: male, Smiths Lakes, UNSW Biological Station (32°23’S, 152°30’E, New South Wales, Australia), 25–28 September 2000, D. Bickel, yellow pans, marsh/heath (AM KS75568). Paratype: female, Tambo River at Doctors Flat (37°18’S, 147°45’E, Victoria, Australia), 9 December 1998, V. W. Framenau, riparian gravel bank (WAM T48116).

*Other material examined.* Australia: Australian Capital Territory: one female, Canberra, 10.2 miles S, 35°28’S, 149°08’E, 5–7 December 1967, H. Evans, prey of spider wasp (AM KS58055). South Australia: one male, three females, Snug Cove, 5.5 km SW, Kangaroo Island (35°44’29”S, 136°48’45”E, South Australia), 22–27 October 1999, NPWS Survey #96 (SAM NN16952–5).

**Etymology**

The specific epithet is a matronym in honour of my mother, the late Hildegard Framenau. She never knew that I became a scientist.

**Diagnosis**

Males of *D. hildegardae* are easily distinguished from *D. martensii* and *D. pisauroides* by much larger tegular apophysis of the male pedipalp. In contrast to that of *D. martensii* and *D. exculta* the female epigyne of *D. hildegardae* does not have distinct sclerotised edges near the lateral copulatory openings.
Description

Male. Based on holotype (AM KS75568).

Carapace: brown, indistinctly lighter medially around and anterior of fovea; indistinct dark radial pattern; indistinct light marginal bands; brown setae, mainly white setae in submarginal bands; dark brown macrosetae around eyes; six long bristles below AE; one long black bristle between AME.
Eyes: row of AE straight and wider than row of PME.

Sternum: light brown, medially somewhat lighter; brown setae which are longer and denser towards margins.

Labium: brown, basally darker.

Chelicerae: brown, few grey setae anteromedially; three promarginal teeth, the median largest; three (right chelicera: two) retromarginal teeth with the median (right: apical) largest.

Pedipalp (Figure 6A–C): tegulum apically drawn out to a tip, tegular apophysis massive with apical margin folded dorsally (Figure 6A); embolus abruptly narrowing at three-quarter lengths, terminal apophysis with a ventrally bulging base (Figure 6C).

Abdomen: uniformly dark olive-grey; light brown lanceolate heart mark in anterior half; brown setae. Venter light brown with light brown setae. Spinnerets light brown.

Legs: leg formula VI>I>II>III; brown, distal segments darker; two light annulations per segment caused by a ring of white setae. Spination of leg I: femur: three dorsal, one apicoprolateral; tibia: two ventral pairs, one basoventral, one prolar; metatarsus: three ventral pairs, one apicoventral.

Female. Based on paratype (WAM T48116).

Carapace (Figure 1C): brown, lighter medially between eyes and fovea; indistinct dark brown radial pattern; indistinct lighter marginal bands; brown setae, few white setae towards carapace margins; brown macrosetae around eyes in cephalic region; six macrosetae below AE; one long bristle between AME.

Eyes: row of AE straight and wider than row of PME.

Sternum: yellow-brown; brown setae and macrosetae which are denser and longer towards carapace margins.

Labium: as male.

Chelicerae: dark orange-brown; few white and grey setae mainly anteromedially.

Abdomen (Figure 1C): uniformly olive-grey with a very indistinct lighter heart mark in anterior half; covered with brown setae and fewer macrosetae. Venter light olive-grey with a few dark spots in posterior half; covered with light brown setae and dark macrosetae. Spinnerets light brown.

Epigyne, ventral view (Figure 6D): large sclerotised plate constricted in posterior half at the copulatory openings.

Epigyne, dorsal view (Figure 6E): spermathecae round-ovoid with anterior tubercle; copulatory ducts very short.

Legs: leg formula IV>I>II=III; coloration as male. Spination of leg I: femur: two dorsal, one apicoprolateral; tibia: two ventral pairs; one basoventral on prolar side; metatarsus: three ventral pairs, one apicoventral.

Measurements. Male holotype, AM KS75568 (female paratype, WAM T48116): TL 6.18 (7.90), CL 2.84 (3.46), CW 1.98 (2.78). Eyes: AME 0.14 (0.15), ALE 0.09 (0.11), PME 0.19 (0.24), PLE 0.17 (0.20). Row of eyes: AE 0.57 (0.81), PME 0.48 (0.59), PLE 0.70 (0.96). Sternum (length/width) 1.30/1.11 (1.61/1.36). Labium (length/width) 0.50/0.41 (0.56/0.52). AL 3.21 (4.45), AW 1.85 (2.78). Legs: lengths of segments (femur+patella/tibia+metatarsus+tarsus=total length): pedipalp 1.07+0.93+0.78=2.78, I 1.91+2.16+1.61+0.99=6.67, II 1.85+1.85+1.36+0.87=5.93, III 1.73+1.73+1.36+0.74=5.56, IV 2.16+2.47+2.22+1.11=7.96 (pedipalp 0.87+1.05+0.74=2.91, I 2.22+2.72+1.73+0.99=7.66, II 2.10+2.35+1.61+0.99=7.05, III 1.98+2.35+1.85+0.87=7.05, IV 2.59+3.34+2.84+1.24=9.57).
Distribution
Southeastern Australia, including Australian Capital Territory, New South Wales, South Australia, and Victoria (Figure 4).

Life history and habitat preferences
The few specimens of *D. hildegardeae* have been found in spring and summer (September to December) and the collection information suggests that this species prefers wet habitats such as river margins and marshland.

*Diahogna pisauroides* n. sp.
(Figures 4, 7A–C)

Material examined
Holotype: male, Adelaide River floodplain (12°13′S, 131°13′E, Northern Territory, Australia), 1 March 2002, G. Wallace (NTMAG A485).

*Other material examined.* Australia: Northern Territory: one male, Blackmore River, Letchford Road, 12°36′S, 130°56′E, 8 January 2001, A. Spiers (NTMAG A480); one male, same locality, 25 January 2001, J. K. Webber (NTMAG A481).

Figure 7. *Diahogna pisauroides* n. sp., male holotype from Adelaide River, Northern Territory, Australia (NTMAG A485). (A, B) Left pedipalp, ventral and lateral views, respectively; (C) left male pedipalp, apical part of bulb. Scale bar: 0.68 mm (A, B); 0.37 mm (C).
Etymology

The specific epithet is an adjective in apposition and refers to the pisaurid-like eye pattern and carapace coloration of this species.

Diagnosis

*Diahogna pisauroides* is easily distinguished from other species in the genus *Diahogna* by the carapace coloration, in particular the distinct submarginal light bands that are accompanied by dark marginal bands. All other *Diahogna* have light marginal bands.

Description

**Male.** Based on holotype (NTMAG A485).

Carapace (Figure 1D): brown, distinct light median band filled anteriorly with brown centre resulting in a Y-shaped pattern, the base of which reaches to posterior carapace margin; indistinct dark brown radial pattern; distinct light brown submarginal bands and dark marginal bands; dark brown setae, mainly white setae in submarginal bands; dark brown macrosetae around eyes of which those below and between the AE are longest. Eyes: row of AE straight and wider than row of PME. Sternum: brown; brown setae and dark brown macrosetae that are longer and denser towards margins. Labium: dark brown, front end truncated and white. Chelicerae: brown, silver-grey setae and dark brown macrosetae; three promarginal teeth, the median largest; three (right chelicera: four) retromarginal teeth of similar size. Pedipalp (Figure 7A–C): tegulum apically drawn out to a tip, tegular apophysis round with ventrally bent tip (Figure 7A); embolus narrowing slender, terminal apophysis heavily sclerotised with lateral incision and ventrally bulging base (Figure 7C). Abdomen (Figure 1D): uniformly light olive-grey; indistinct lanceolate heart mark in anterior half accompanied by two lighter longitudinal bands on either side; grey setae and macrosetae. Venter yellow olive-grey; setae as dorsally. Spinneret coloration as venter.

Legs: leg formula VI > I > II > III; light brown, distal segments darker. Spination of leg I: femur: two dorsal, one apicoprolateral, two retrolateral; tibia: three ventral pairs; metatarsus: three ventral pairs, one apicoventral.

**Female.** Unknown.

**Measurements.** Male holotype, AM KS75568: TL 7.41, CL 4.08, CW 3.15. Eyes: AME 0.18, ALE 0.18, PME 0.20, PLE 0.19. Row of eyes: AE 0.78, PME 0.58, PLE 1.24. Sternum (length/width) 1.67/1.42. Labium (length/width) 0.56/0.59. AL 3.21, AW 2.35. Legs: lengths of segments (femur + patella/tibia + metatarsus + tarsus = total length): pedipalp 1.48 + 1.36 + 1.24 + 4.08, I 2.71 + 3.58 + 2.22 + 1.11 = 9.62, II 2.59 + 3.33 + 2.22 + 1.11 = 9.25, III 2.59 + 3.21 + 2.22 + 1.11 = 9.13, IV 3.21 + 4.08 + 3.21 + 1.36 = 11.86.

**Variation.** The other two males are slightly smaller than the holotype (NTMAG A480: CW 2.72, CL 3.70, TL 6.79; A481: CW 2.59, CL 3.33, TL 6.80).
Distribution

Only known from the type locality, the Adelaide River floodplain, Northern Territory (Figure 4).

Remarks

*Diahogna pisauroides* was included in a recent molecular phylogeny of wolf spiders (as "New Genus 2 sp.") (Murphy et al. 2006) (see Remarks section in the generic description above).

Acknowledgements

I am indebted to a variety of curators, collection managers, and museum staff for assistance in accessing their collections either as loan or during visits to their respective institutions (in no particular order): Elise-Anne Leguin and Christine Rollard (MHNP); Liz Turner (TMAG), Mike Gray and Graham Milledge (AM), Peter Lillywhite (MV), Lisa Joy Boutin (QVMAG), David Hirst (SAM), Mark Harvey and Juliane Waldock (WAM), Gavin Dally (NTMAG), Hieronymus Dastych (ZMH), Jason Dunlop and Shahin Nawai (ZMB), and Peter Jäger and Julia Altmann (SMF). This study would have been impossible without the support of these institutions and their enthusiastic personnel. This study forms part of a revision of Australian wolf spiders funded by the Australian Biological Resource Study (ABRS) to Mark Harvey (WAM) and Andy Austin (University of Adelaide). Melissa Thomas, Mark Harvey, Torbjörn Kronestedt, and Jung-Sun Yoo provided helpful comments on earlier drafts of this paper.

References

Berland L. 1924. Araignées de la Nouvelle-Calédonie et des Îles Loyalty. Nova Caledonia, Zoologie 3:159–255.
Bonnet P. 1957. Bibliographia Araneorum, Tome II (3me partie: G–M). Toulouse: Douladoure. p 1926–3026.
Brignoli PM. 1983. A catalogue of the Araneae described between 1940 and 1981. Manchester: British Arachnological Society. 755 p.
Dondale CD. 1986. The subfamilies of wolf spiders (Araneae: Lycosidae). Actas X Congreso Internacional de Aracnología, Jaca, España 1:327–332.
Framenau VW. 2002. Review of the wolf spider genus *Artoria* Thorell (Araneae, Lycosidae). Invertebrate Systematics 16:209–235.
Framenau VW. 2005. The wolf spider genus *Artoria* Thorell in Australia: new synonymies and generic transfers (Araneae, Lycosidae). Records of the Western Australian Museum 22:265–292.
Framenau VW. 2006. The wolf spider genus *Venatrix* Roewer, 1960 in Australia: new species, synonymies and generic transfers (Araneae, Lycosidae). Records of the Western Australian Museum 23:145–166.
Framenau VW, Gotch TB, Austin AD. The wolf spiders of artesian springs in arid South Australia, with a revalidation of *Tetrallycosa* (Araneae, Lycosidae). Journal of Arachnology. Forthcoming.
Framenau VW, Vink CJ. 2001. Revision of the genus *Venatrix* Roewer (Araneae, Lycosidae). Invertebrate Taxonomy 15:927–970.
Guy Y. 1966. Contribution à l’étude des araignées de la famille des Lycosidae et de la sous-famille des Lycosinae avec étude spéciale des espèces du Maroc. Travaux de l’Institut Scientifique Cherifien, Série Zoologie 33:1–172.
International Commission on Zoological Nomenclature. 1999. International Code of Zoological Nomenclature. 4th ed. London: The International Trust for Zoological Nomenclature/Natural History Museum. 306 p.
Karsch F. 1878. Exotisch-araneologisches. Zeitschrift für die Gesamten Naturwissenschaften 51:332–333, 771–826.
Khmelik VV, Kozub D, Glazunov A. 2005. Helicon focus 3.10.3 [online]. Kharkov (Ukraine): Helicon Co. http://www.helicon.com.ua/.
Lehtinen PT. 2005. Review of the Oriental wolf spider genus Passiena (Lycosidae, Pardosinae). Journal of Arachnology 33:398–407.

McKay RJ. 1973. The wolf spiders of Australia (Araneae: Lycosidae): 1. The bicolor group. Memoirs of the Queensland Museum 16:375–398.

McKay RJ. 1979. The wolf spiders of Australia (Araneae: Lycosidae): 13. The genus Trochosa. Memoirs of the Queensland Museum 19:277–298.

McKay RJ. 1985. Lycosidae. In: Walton DW, editor. Zoological catalogue of Australia. Volume 3, Arachnida: Mygalomorphae, Araneomorphae in part, Pseudoscorpionida, Amblypygida, Palpigradi. Canberra: Australian Government Publishing Service. p 73–88.

Moritz M. 1992. Die Typen der Arachniden-Sammlung des Zoologischen Museums Berlin. X. Araneae: Lycosidae. Mitteilungen des Zoologischen Museums Berlin 68:309–329.

Murphy NP, Framenau VW, Donellan SC, Harvey MS, Park Y-C, Austin AD. 2006. Phylogenetic reconstruction of the wolf spiders (Araneae: Lycosidae) using sequences from the 12S rRNA, 28 rRNA and NADH1 genes: implications for classification, biogeography and the evolution of web building behavior. Molecular Phylogenetics and Evolution 38:583–602.

Platnick NI. 1989. Advances in spider taxonomy, 1981–1987. Manchester: Manchester University Press. 673 p.

Platnick NI. 2006. The world spider catalog, version 6.5 [online]. American Museum of Natural History. http://research.amnh.org/entomology/spiders/catalog/INTRO1.html.

Rack G. 1961. Die Entomologischen Sammlungen des Zoologischen Staatsinstituts und Zoologischen Museums Hamburg. II. Teil Chelicerata II: Araneae. Mitteilungen des Hamburgischen Zoologischen Museums und Instituts 59:1–60.

Rainbow WJ. 1911. A census of Australian Araneidae. Records of the Australian Museum 9:107–319.

Roewer CF. 1955. Katalog der Araneae von 1758 bis 1940. Volume 2a. Brussels: Institut Royal des Sciences Naturelles de Belgique. 923 p. (Imprint date 1954).

Roewer CF. 1959. Araneae Lycosiformae II (Lycosidae). Exploration du Parc National de l’Upemba—Mission GF de Witte 55:1–518. (Imprint date 1958).

Roewer CF. 1960. Araneae Lycosiformae II (Lycosidae) (Fortsetzung und Schluss). Exploration du Parc National de l’Upemba—Mission GF de Witte 55:519–1040. (Imprint date 1959).

Simon E. 1898. Histoire naturelle des Araignées. 2nd ed. Volume 2. Paris: Roret. p 193–380.

Sundevall CJ. 1833. Conspectus Arachnidum. Lund: C. F. Berling. 39 p.

Vink CJ. 2002. Lycosidae (Arachnida: Araneae). Lincoln (New Zealand): Manaaki Whenua Press. 94 p. (Fauna of New Zealand; 44).

Zyuzin AA. 1985. Generic and subfamilial criteria in the systematics of the spider family Lycosidae (Aranei), with the description of a new genus and two new subfamilies. Trudy Zoologicheskogo Instituta, Akademia Nauk SSSR 139:40–51.

Zyuzin AA. 1993. Studies on the wolf spiders (Araneae: Lycosidae). I. A new genus and new species from Kazakhstan, with comments on the Lycosinae. Memoirs of the Queensland Museum 33:693–700.