

FOURTEEN NEW DYTISCIDAE (COLEOPTERA) OF THE GENERA *LIMBODESSUS* GUIGNOT, *PAROSTER* SHARP, AND *EXOCELINA* BROUN FROM UNDERGROUND WATERS IN AUSTRALIA

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Abstract

Fourteen new species of stygobitic Dytiscidae from inland Western Australia and Central Australia are described: *Limbodessus micromelitaensis*, *L. microbubba*, *L. lornaensi*, *L. macrolornaensis*, *L. yarrabubbaensis*, *L. trispinosus*, *L. murrumensis*, *L. ordinarius*, *L. nyungduo*, *L. insolitus*, *Paroster elongatus*, *P. novem*, *P. readi* and *Exocelina rasjadi*. The males of *P. tetrameres* Watts and Humphreys and *P. kurutjutu* (Watts & Humphreys) (*Kintingka*) are described for the first time.

This brings the total of stygobitic Dytiscidae described from Australia to 99 species in four genera. One of the new species, *Limbodessus insolitus*, has single-lobed parameres, the first undoubted member of the tribe Bidessini not to have bilobed parameres. A key to the known species of Australian stygobitic Dytiscidae is given as well as a checklist of the species discovered prior to December 2008. The geographic distribution of this fauna (Fig. 192) and the physico/chemical properties of selected collecting sites (Fig 193, Table 2) and associated fauna (Table 3) are summarised.

Geographically, stygal Dytiscidae are now known within Australia from three discrete areas; the Ngalia Basin northwest of Alice Springs in central Australia, the Yilgarn Craton in central Western Australia and the north-east region of New South Wales. In the first two regions the beetles are found in groundwater calcrete formations; in New South Wales the seemingly much sparser fauna is found in coarse alluvial gravels in the upper reaches of rivers.

Kintingka Watts & Humphrey is synonymised with *Limbodessus* Guignot.

KEY Words: Dytiscidae, stygobites, underground water, taxonomy, biogeography, water chemistry.

Introduction

This is the seventh paper in our series describing the stygobitic Dytiscidae of Australia (Watts & Humphreys 1999, 2000, 2001, 2003, 2004b, 2006; Balke *et al.* 2004). In it we describe the new species found during fieldwork in Western Australia in the winters of 2005 and 2006 and summarize the work so far.

This fieldwork had the primary aim of mapping the distribution of stygobitic Dytiscidae in arid Australia. This task has largely been completed and the broad scale survey work that underpinned it and was mainly funded by the Australian Biological Resource Survey, finished in 2006. Work on the other stygobitic faunal elements, mainly crustaceans, discovered during our study is continuing, as well as some associated fieldwork. This continuing work and also sampling activity associated with environmental impact studies, will inevitably lead to the discovery of additional stygobitic Dytiscidae, but our expectations are that this will be at a slower rate than in past years. This then seems an appropriate time to summarise our results over the past seven years in a little more detail than in previous papers in the series, in particular an illustrated key to the stygobitic Dytiscidae of Australia is provided. A striking feature of the Australian stygobitic Dytiscidae fauna is that species are, with only the odd possible exception, confined to one calcrete body or alluvial system. Furthermore in Western Australia, but not in the Northern Territory, the sizes of species found in each calcrete do not overlap. In Table 1 we list the species found in each calcrete together with their length. At least in Western Australia this information is all that is needed to identify currently known species without recourse to the rather

lengthy key. But be aware that calcrete areas which have been quite well collected continue to yield additional species and so there is still a need to measure absolute not relative sizes of the specimens in a collection.

Specifically, this paper describes 10 new species of *Limbodessus* Guignot, three new species of *Paroster* Sharp (*Nirripiriti* Watts & Humphreys has been shown to be a junior synonym of *Paroster* Sharp (Watts & Leys 2008)), and one new species of *Exocelina* Broun (*Papuadytes* Balke has recently been shown to be a junior synonym of *Exocelina* Broun (Nilsson 2007)). Most of these were collected during the winters of 2005 and 2006 but we have included some incompletely known species, e.g. only females, from previous years that have defied our attempts to recollect them. We also describe the males of *P. tetramers* (Watts & Humphreys) and *Kintingka kurutjutu* Watts and Humphreys. This later species and genus was based on a single female specimen which made even tribal allocation difficult. The collection of additional specimens in 2005 from the type locality allowed us to examine the male genitalia and also for the mitochondrial CO1 gene to be sequenced. The results place the species (and genus) unambiguously in the Bidessini and, based on morphology and sequence data, within *Limbodessus* (see later under *Kintingka*).

A key synapomorphy for the tribe Bidessini is two-segmented parameres (Bistrom 1988, Miller 2001). A species discovered at a number of localities near Wiluna in 2006 has single segmented parameres despite other characters indicating that it belongs in the Bidessine genus *Limbodessus* (see Balke & Ribera 2004a). This would appear to be the first species, clearly in the tribe, that has monosegmented parameres (see later under *L. insolitus* sp nov. for further discussion).

Another interesting discovery was a second species in the Copelatine genus *Exocelina*. Two specimens were collected from a bore near Lake Hopkins in Western Australia. At only 3.6 mm long it is the smallest known species in the genus. Although geographically in Western Australia, Lake Hopkins is close to the western edge of the Amadeus basin in the Northern Territory and not far from the Ngalia basin in which the only other stygobitic *Exocelina*, *E. abdita* (Watts & Humphreys), is found.

The collections that have formed the basis of this series of descriptive papers have also provided material for a number of associated studies which address questions of phylogeny and evolution, the taxonomic composition of the Dytiscidae and the associated fauna and more general issues. The following papers are pertinent: Bathynellacea (Cho 2005; Cho *et al.* 2006a, 2006b; Guxie *et al.* 2008), Amphipoda (Cooper *et al.* 2007), Dytiscidae (Cooper *et al.* 2002; Leys *et al.* 2003), Copepoda (Pesce *et al.* 1996; De Laurentiis *et al.* 2001; T. Karanovic 2004a, 2004b, 2005), Ostracoda (Karanovic & Marmonier 2002), oniscidean Isopoda (Taiti & Humphreys 2001; Cooper *et al.* 2008) and general background papers (Humphreys 2001, 2006, 2008).

Materials and Methods

For some older material measurements of physico-chemical parameters in the water largely follow those used previously (Watts & Humphreys 2000), whereas for most of the recent material water quality was determined using a Quanta-G (Hydrolab Corporation, Austin, Texas) water quality monitoring system attached to a 50 m cable that which permitted the measurement of various physico-chemical water quality parameters (temperature, specific conductance (or TDS), pH, dissolved oxygen (% saturation or mg L⁻¹), oxidation reduction potential (redox), and depth, the latter facilitating the determination of any vertical stratification present in the water column in some boreholes, as used by Watts and Humphreys (2004). The instrument was calibrated against the standards recommended for the instrument.

Abbreviations used:

BES = Prefix for field numbers, WAM Biospeleology. BF = Borefield; SAMA = South Australian Museum, Adelaide. WAM = Western Australian Museum, Perth; MB = Groundwater monitoring bore. RN = Prefix for bore numbers in the Northern Territory. MEB = Mineral exploration bore.

Other prefixes are those for bores for particular drilling projects.

Table 1. The distribution of stygal species of dytiscids amongst discrete calcrete bodies in Australia. The separate palaeodrainage systems (Figure 156) and the Indian Ocean and interior drainages are indicated. Species shown in **bold** are those treated in this paper. Species underlined occur in more than one calcrete. Numbers after species give size range in mm.

Calcrete	Palaeovalley	1 Species	2 Species	3 Species	4/5 Species
WESTERN DRAINAGES					
1	Cue	<i>Limbodessus magnificus</i> 4.2-4.8	<i>Limbodessus cueensis</i> 2.1-2.4		
2	Austin Downs	<i>Limbodessus cueensis</i> 2.1-2.4	<i>Limbodessus bigbellensis</i> 3.0-3.2		
3	Challa North	<i>Limbodessus challaensis</i> 2.3-2.5	<i>Limbodessus surreptitius</i> 3.2		<i>Limbodessus nyungduo</i> 1.6
4	Killara	<i>Paroster killaraensis</i> 1.5-1.9			
5	Windimurra	<i>Limbodessus trispinosus</i> 2.2-2.5			
6	Moorarie Bin Bin	<i>Limbodessus occidentalis</i> 1.9-2.3	<i>Paroster bulbosus</i> 2.1-2.5		
7	Killara North	<i>Limbodessus occidentalis</i> 1.9-2.3			
8	Hillview	<i>Limbodessus hillviewensis</i> 2.3			
9	Mt Padbury	<i>Limbodessus padburyensis</i> 2.5-2.7			
10	Moorarie	<i>Limbodessus wogarthaensis</i> 1.4-1.5			
11	Innoudy	<i>Paroster copidotibiae</i> 3.2	<i>Paroster eurypleuron</i> 2.3	<i>Paroster verrucosus</i> 3.2	
12	Byro West	<i>Paroster arachnoides</i> 2.2-2.3	<i>Paroster innouendyensis</i> 1.8-2.1		
13	Karalundi	<i>Limbodessus karalundiensis</i> 1.3-1.4	<i>Paroster byroensis</i> 3.9-4.1	<i>Paroster dingbatensis</i> 2.0-2.2	
14	Narrey	<i>Limbodessus narreyensis</i> 2.7-3.1	<i>Paroster skaphites</i> 2.1-2.3	<i>Paroster stegastus</i> 3.6-3.8	
15	Yarrabubba North	<i>Limbodessus microbubba</i> 1.8-2.2			
16	Yarrabubba South	<i>Limbodessus yarrabubbaensis</i> 4.0			
17	Three Rivers Station	<i>Bidessodes guttifer</i> 1.3-1.5	<i>Bidessodes limestonensis</i> 4.2	<i>Paroster plutonicensis</i> 3.0-3.5	
18	Milgum Station	<i>Paroster hamoni</i> 1.7	<i>Paroster milgumensis</i> 1.2-1.3		
19	Bunnawarra	<i>Limbodessus microocular</i> 2.2-2.3	<i>Limbodessus micrommaton</i> 1.7-1.8		
20	Maranalgo	<i>Limbodessus exilis</i> 2.4-2.5			
21	Murrum	<i>Limbodessus murrumensis</i> 2.1-2.3			
22	Mt Augustus	<i>Paroster tetrameres</i> 1.4-1.5			
INLAND DRAINAGES					
23	Paroo	<i>Limbodessus eberhardi</i> 3.2-3.5	<i>Limbodessus pulpa</i> 2.0-2.2	<i>Limbodessus kurujutu</i> 1.0-1.1	
24	Lake Violet	<i>Limbodessus wilunaensis</i> 1.4	<i>Limbodessus millbilliensis</i> 2.1	<i>Limbodessus insolitus</i> 3.1-3.9	
25	Uramurdah Lake	<i>Limbodessus halmi</i> 4.8	<i>Limbodessus morgani</i> 2.1-2.1	<i>Limbodessus insolitus</i> 3.1-3.9	
26	Hinkler Well	<i>Limbodessus hinkleri</i> 1.4-1.8	<i>Limbodessus macrohinkleri</i> 3.9-4.0	<i>Limbodessus raeae</i> 2.0-2.1	
27	Mount Windarra	<i>Limbodessus windarraensis</i> 2.2-2.3	<i>Limbodessus lapostaae</i> 1.3-1.5	<i>Limbodessus palmituloides</i> 4.2	
28	Melrose Station (Lake Darlot)	<i>Paroster darlotensis</i> 3.5-4.1			
29	Barwidgee	<i>Limbodessus barwidgeensis</i> 4.4	<i>Paroster melroseensis</i> 1.8-2.0	<i>Limbodessus usitatus</i> 2.1-2.3	
30	Mt Morgan	<i>Limbodessus cooperi</i> 3.2-3.6	<i>Limbodessus leysi</i> 1.5-1.9		

Continues on next page

Table 1. Continued from previous page

Calcrete	Palaeovalley	1 Species	2 Species	3 Species	4/5 Species
INLAND DRAINAGES (CONTINUED)					
31	Bubble	Carey	<i>Limbodessus millbilliensis</i> 2.1		
32	Miranda West	Carey	<i>Limbodessus mirandaae</i> 2.7-3.1		
33	Nambi	Carey	<i>Limbodessus nambiensis</i> 2.3		
34	Miranda East	Carey	<i>Limbodessus phoebeae</i> 2.6-2.8		
35	Yandal	Carey	<i>Limbodessus yandalensis</i> 3.8-4.0		
36	Depot Springs	Raeside	<i>Limbodessus fridaywellensis</i> 1.7-1.8	<i>Paroster hinzeae</i> 2.8-3.0	
37	Pinnacles Stn	Raeside	<i>Limbodessus pinnaclesensis</i> 1.5	<i>Paroster fortissipina</i> 2.5-3.0	<i>Paroster elongatus</i> 2.3
38	Lake Mason	Raeside	<i>Limbodessus raesidensis</i> 3.5-4.0	<i>Limbodessus masonensis</i> 1.6-1.9	
39	Black Range North	Raeside	<i>Limbodessus ordinarius</i> 2.4-2.7		
40	Yuinmery	Raeside	<i>Limbodessus yuinmeryensis</i> 1.6-2.0		
41	Perrinvale	Raeside	<i>Limbodessus gumwellensis</i> 1.8-2.2		
42	Melita	Raeside	<i>Limbodessus melitaensis</i> 2.2-2.3	<i>Limbodessus micromelitaensis</i> 1.4	
43	Sturt Meadows	Raeside	<i>Paroster macrosturtensis</i> 3.6-4.1	<i>Paroster mesosturtensis</i> 2.0-2.3	<i>Paroster microsturtensis</i> 1.7-1.8
	Jundee	Camegie	<i>Limbodessus jundeeensis</i> 2.3-2.6		
44	Camegie	Camegie	<i>Limbodessus harleyi</i> 2.1-2.6		
45	Lorna Glen	Camegie	<i>Limbodessus lornaensis</i> 1.4-1.6	<i>Limbodessus macrolornaensis</i> 3.0-3.4	
46	Cunyu: Sweetwaters	Nabberu	<i>Limbodessus cunyuensis</i> 1.3	<i>Limbodessus silus</i> 1.7-2.1	<i>Limbodessus sweetwatersensis</i> 3.2-3.6
47	Cunyu: SBF	Nabberu	<i>Limbodessus bialveus</i> 1.4-1.9	<i>Limbodessus macrotarsus</i> 4.2-4.4	
48	Tjukurla	Lake Hopkins	<i>Exocelina rasjadi</i> 3.4-3.6		
49	Napperby	Ngalia Basin: N.T.	<i>Paroster macrocephalus</i> 1.9-2.0	<i>Paroster napperbyensis</i> 1.7-1.8	<i>Paroster septum</i> 1.8
50	Newhaven Homestead	Ngalia Basin: N.T.	<i>Paroster newhavenensis</i> 1.5-1.7	<i>Limbodessus atypicalis</i> 0.9	
51	Newhaven Camel Well	Ngalia Basin: N.T.	<i>Paroster pentameres</i> 2.2	<i>Exocelina abdita</i> 4.6	<i>Paroster megamacrocephalus</i> 2.4 <i>Paroster novem</i> 1.0 <i>Paroster readi</i> 3.6-3.9
52	Central Mount Wedge	Ngalia Basin: N.T.	<i>Paroster wedgeensis</i> 1.2-1.4	<i>Limbodessus sp.</i> >3.0	

52 calcretes 10 palaeodrainages

Table 2. Water quality values of sites inhabited by 11 of the stygal beetles described in this paper. The statistics refer to the surface sample only and an example of the change in water quality through the water column are given in Fig. 193) Temperature, pH, specific conductivity (mS cm⁻¹), Dissolved oxygen (% saturation), Redox (ORP mV), Depth below water surface (m).

Species	Temp C	pH	Sp. C mS cm ⁻¹	DO % sat.	ORP mV	Depth m
<i>Paroster elongatus</i>	23.60	7.43	12.37	36	209	-0.1
<i>P. tetrameres</i>	25.18	7.40	1.6	32	179	-0.1
<i>P. readi</i>	27.74	7.52	7.34	67	84	-0.1
<i>Limbodessus nyungduo</i>	21.40	7.92	3.39	86	139	-0.3
<i>L. insolitus</i>	25.55	7.58	8.38	87	84	-0.8
<i>L. murrumensis</i>	23.71	7.71	9.29	88	88	-0.1
<i>L. microbubba</i>	21.74	8.29	15.3	83	76	-0.1
<i>L. insolitus</i>	25.26	6.95	26.8	61	151	-0.1
<i>L. lornaensis</i>	26.78	7.36	25	58.9	74	-0.1
<i>L. lornaensis</i>	26.55	7.28	27	67.7	86	0
<i>L. ordinarius</i>	25.33	7.56	7.31	70.1	49	-0.2
<i>L. ordinarius</i>	24.95	7.31	8.77	72.5	72	-0.1
<i>L. kurutjutu</i>	27.08	7.43	18	59.6	79	-0.1
Mean	24.83	7.55	12.43	67.05	111.27	
Min	21.4	6.95	1.6	32.3	49	
Max	27.74	8.29	27	88	209	
Range	6.34	1.34	25.4	55.7	160	
S.d.	2.04	0.35	8.58	19.29	50.32	
N	11	11	11	11	11	

Systematics

The taxonomy used in this paper follows the changes proposed in Nilsson 2007 and Leys and Watts 2008. Nilsson 2004 pointed out that the genus *Papuadytes* Balke, 1998, into which a number of Australian species of *Copelatus* were transferred by Nilsson and Fery (2006), was a junior synonym of *Exocelina* Broun, 1886. In Leys and Watts, the genus *Nirripiriti* Watts and Humphreys, 2001, which previously encompassed all the Australian stygobitic Hydroporinae, was synonymised with the epigean genus *Paroster* Sharp, 1882 and most species of *Nirripiriti* transferred into it.

In the checklist in this paper, we transfer *Nirripiriti septum* Watts and Humphreys 2006, into *Paroster* and *Nirridessus lapostaae* Watts and Humphreys 1999 into *Limbodessus* Guignot, 1939, which had missed being transferred in Leys and Watts, 2008, and Watts and Humphreys, 2006 respectively.

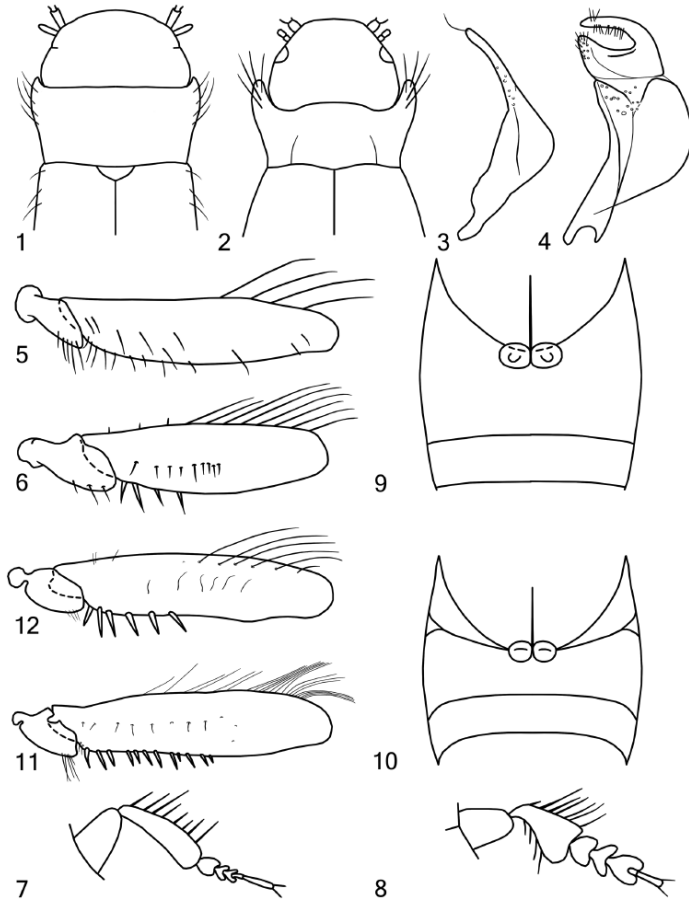
Table 3. Stygofauna sampled from the same calcretes as each of the new stygal diving beetles.

Species	Associated stygofauna
<i>Limbodessus micromelitaensis</i>	<i>Limbodessus melitaensis</i> (Dytiscidae), Chiltonidae (Amphipoda), <i>Haloniscus</i> n. sp. 13 (Oniscidea: Scyphacidae).
<i>L. microbubba</i>	<i>Limbodessus yarrabubbaensis</i> (Dytiscidae), <i>Mesocyclops brooksi</i> , <i>Metacyclops superincidentis</i> , <i>Metacyclops pilanus</i> (Copepoda), <i>Brevisomabathynella cunyuensis</i> (Parabathynellidae), <i>Haloniscus</i> n. sp. 13 (Oniscidea: Scyphacidae).
<i>L. lornaensis</i>	<i>Limbodessus macrolornaensis</i> (Dytiscidae), <i>Nitocrella absentia</i> (Hapacticoida: Ameiridae), <i>Schizopera uramurdahi</i> , <i>S. jundeei</i> (Hapacticoida: Diosaccidae), Bathynellidae, “ <i>Australobathynella magna</i> “ (Bathynellacea: Parabathynellidae).
<i>L. macrolornaensis</i>	<i>Limbodessus lornaensis</i> (Dytiscidae), <i>Nitocrella absentia</i> (Hapacticoida: Ameiridae), <i>Schizopera uramurdahi</i> , <i>S. jundeei</i> (Hapacticoida: Diosaccidae), Bathynellidae, “ <i>Australobathynella magna</i> “ (Bathynellacea: Parabathynellidae).
<i>L. yarrabubbaensis</i>	<i>Limbodessus microbubba</i> (Dytiscidae), <i>Mesocyclops brooksi</i> , <i>Metacyclops superincidentis</i> , <i>Metacyclops pilanus</i> (Copepoda), <i>Brevisomabathynella cunyuensis</i> (Parabathynellidae), <i>Haloniscus</i> n. sp. 13 (Oniscidea: Scyphacidae).
<i>L. trispinosus</i>	Ostracoda, Chiltonidae (Amphipoda), <i>Halicyclops eberhardi</i> , <i>Mesocyclops brooksi</i> , <i>Apocyclops dengizicus</i> , <i>Halicyclops kieferi</i> , <i>Metacyclops laurentiisae</i> (Cyclopoidea: Cyclopidae), <i>Schizopera depotspringsi</i> (Harpacticoida: Diosaccidae), <i>Haloniscus</i> n. sp. 5 (Isopoda: Oniscidea: Scyphacidae).
<i>L. murrumensis</i>	<i>Atopobathynella watsi</i> (Bathynellacea: Parabathynellidae) Cyclopoidea (Copepoda), Chiltonidae (Amphipoda).
<i>L. ordinarius</i>	Chiltonidae (Amphipoda), <i>Haloniscus</i> sp. (Isopoda: Oniscidea: Scyphacidae).
<i>L. nyungduo</i>	<i>Limbodessus challaensis</i> , <i>L. surreptitius</i> (Dytiscidae), <i>Mesocyclops brooksi</i> , <i>M. laurentiisae</i> (Cyclopidae: Cyclopinae), Chiltonidae (Amphipoda).
<i>L. insolitus</i>	<i>Limbodessus wilunaensis</i> , <i>L. millbilliensis</i> , <i>L. insolitus</i> , <i>L. hahni</i> , <i>L. morgani</i> (Dytiscidae); <i>Haifameira pori</i> , <i>Nitocrella trajan</i> , <i>Parapseudoleptomesochra karamani</i> (Hapacticoida: Ameiridae); <i>Halicyclops kieferi</i> , <i>Metacyclops laurentiisae</i> , <i>Fierscyclops fiersi</i> , <i>Mesocyclops brooksi</i> (Cyclopoidea: Cyclopidae); <i>Schizopera uramurdahi</i> (Hapacticoida: Diosaccidae); <i>Candonopsis dani</i> (Ostracoda: Podocopida: Candonidae: Candoninae); <i>Gomphodella glomerosa</i> (Podocopida: Limnocytheridae); Gen. nov., <i>Brevisomabathynella cooperi</i> , Gen. nov. 1, Gen. nov. 2 (Bathynellacea: Parabathynellidae); Crangonyctoid and Chiltonidae (Amphipoda); <i>Andricophiloscia pedisetosa</i> (Isopoda: Oniscidea: Philosciidae), <i>Haloniscus longiantennatus</i> , <i>H. stilifer</i> (Isopoda: Oniscidea: Scyphacidae).
<i>Paroster elongatus</i>	<i>Limbodessus pinnalesensis</i> , <i>Paroster fortisspina</i> (Dytiscidae); Parabathynellidae, Bathynellidae (Bathynellacea); <i>Halicyclops eberhardi</i> , <i>Mesocyclops brooksi</i> (Cyclopoidea: Cyclopidae); Chiltonidae (Amphipoda).
<i>P. novem</i>	<i>Exocelina abdita</i> , <i>Paroster pentameres</i> , <i>Paroster megamacrocephalus</i> . <i>P. novem</i> , <i>P. readi</i> (Dytiscidae), Hydrobiidae aff <i>Trochidrobia</i> n.sp. 1 (Gastropoda) <i>Atopobathynella readi</i> , <i>A. watsi</i> (Bathynellacea: Parabathynellidae), <i>Haloniscus</i> n.sp. 1 (Oniscidea: Scyphacidae), Unionicolidae <i>Koenikea?</i> sp. (Acarina).
<i>P. readi</i>	<i>Exocelina abdita</i> , <i>Paroster pentameres</i> , <i>Paroster megamacrocephalus</i> . <i>P. novem</i> , (Dytiscidae), Hydrobiidae aff <i>Trochidrobia</i> n.sp. 1 (Gastropoda) <i>Atopobathynella readi</i> , <i>A. watsi</i> (Bathynellacea: Parabathynellidae), <i>Haloniscus</i> n.sp. 1 (Oniscidea: Scyphacidae), <i>Koenikea?</i> sp. (Acarina: Unionicolidae).
<i>Exocelina rasjadi</i>	-

KEY TO AUSTRALIAN SPECIES OF STYGOBITIC DYTISCIDAE.

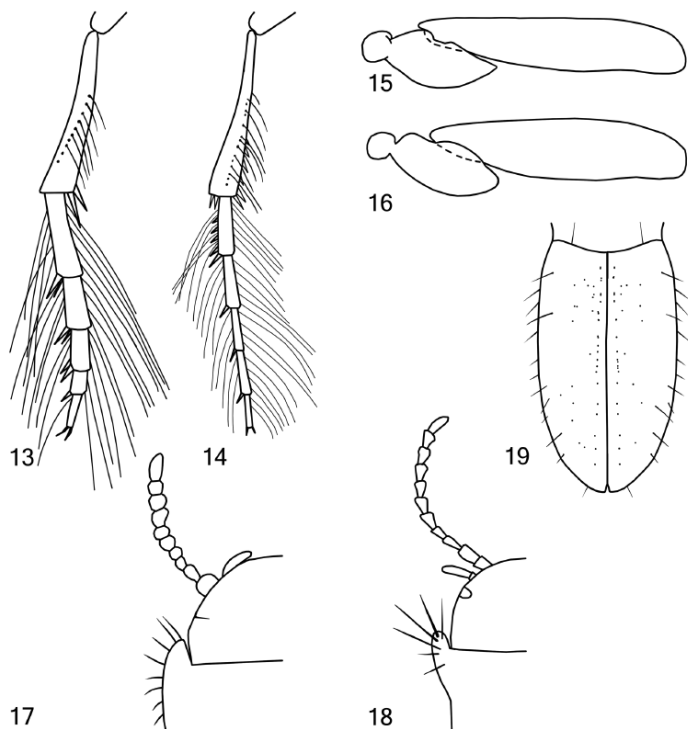
- 1 – Scutellum visible (Fig.1) (Small in *C. stephanieae* Watts *et al* from northeastern NSW) 2
 – Scutellum absent (Fig. 2) 4
- 2 (1) – Length <3.0 mm; elytron with distinct longitudinal groove towards side; northeastern NSW
 *Carabhydrus stephanieae* Watts *et al.*
 – Length >3.0 mm; elytra smooth; central Australia and adjacent WA 3
- 3 (2) – Length 4.3 – 5.0 mm; elytra lacking fine stria *Exocelina abdita* (Balke *et al.*)
 – Length 3.2 – 3.6 mm; elytra with fine transverse stria *Exocelina rasjadi* sp. nov.
- 4 (1) – Paramere one-segmented (eg. Fig. 3); metatibia approximately the same width throughout; without pronotal plicae — (Hydroporini) 66
 – Paramere two-segmented (e.g. Fig. 4) (except in *L. insolitus* which has pronotal plicae); metatibia narrow at base then strongly expanding towards apex; usually with pronotal plicae (Bidessini) 5
- 5 (4) – With eyes at least half normal size (Fig. 2) with some dark pigment 6
 – Without eyes, may have a small, chitinized, triangular or oval plate without dark pigment, or suture lines where eyes normally are (Fig. 1) (called eye remnant in rest of key) 7
- 6 (5) – Western Australia, eyes of normal size *Limbodessus occidentalis* (Watts & Humphreys)
 – Eastern Australia; eyes about two thirds normal size *Limbodessus rivulus* (Larson)
- 7 (5) – Mesofemur with spines on hind edge approximately the same strength as those on mesotrochanter (Fig. 5); length > 3.0 mm 57
 – Mesofemur with spines on hind edge much more robust than those on mesotrochanter (Fig. 6); length 1.4 – 4.2 mm 8
- 8 (7) – Mesotibia thin, strongly curved (Fig. 7); pro and mesofemora broad, robust, mesofemur with approximately 14 stout spines on hind edge; parameres one-segmented (Fig. 3) *Limbodessus insolitus* sp. nov.
 – Mesotibia usually triangular, not curved (Fig. 8); parameres two-segmented (Fig. 4); other characters variable 9
- 9 (8) – Normal ventrites 1 and 2 lacking or virtually lacking suture between them (i.e. number of visible abdominal segments reduced to four) (Fig. 9) 10
 – Ventrites 1 and 2 with suture between them at least in inner portion (Fig. 10) 14
- 10 (9) – Length 0.90 – 0.95 mm *Limbodessus atypicalis* Watts & Humphreys
 – Length 1.6 – 3.6 mm 11
- 11 (10) – Mesofemur with 12–15 spines on hind edge (Fig.11) *Limbodessus macrolornaensis* sp. nov
 – Mesofemur with 4–9 spines on hind edge 12
- 12 (11) – Length 1.6 – 2.2 mm; pronotal plicae very weak 13
 – Length 3.2 – 3.6 mm; pronotal plicae moderately strong *Limbodessus sweetwatersensis* (Watts & Humphreys)
- 13 (12) – Eye remnant a small triangular area (Fig. 18); mesofemur with 4 spines on hind edge
 *Limbodessus gumwellensis* Watts & Humphreys
 – Eye remnant a single suture (Fig. 17); mesofemur with 5–6 spines on hind edge (Fig. 12)
 *Limbodessus leysi* Watts & Humphreys
- 14 (9) – Pronotal plicae strong, well marked, excavated on inside 15
 – Pronotal plicae weak, difficult to trace, may be absent, not, or only very weakly, excavated on inside 20
- 15 (14) – Head broad, deflexed; metatrochanter round; spines on hind edge of mesofemur long
 *Limbodessus silus* (Watts & Humphreys)
 – With none of above characters 16

Plate 1



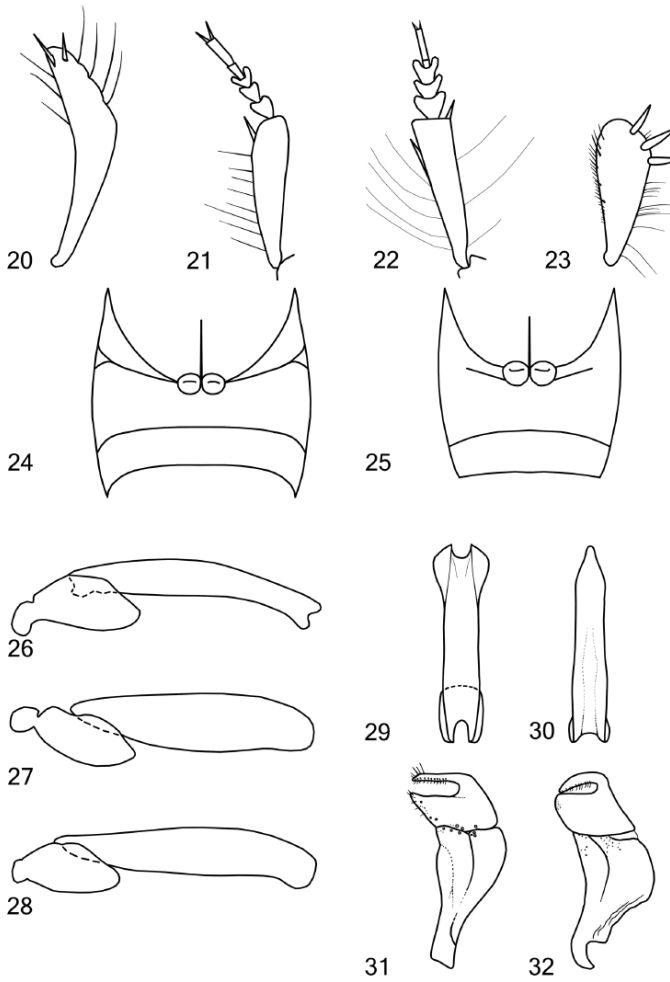
- 16** (15) – Combined length of first two segments of metatarsus > rest (Fig.13); eye remnant present as small oval or triangular structure *Limbodessus pulpa* (Watts & Humphreys)
 – Combined length of first two segments of metatarsus approximately equal to rest (Fig.14); eye remnant reduced to a single short suture **17**
- 17** (16) – Length >2.0 mm; metatrochanters strongly pointed (Fig.15); mesofemur with 2 long spines close together near base on rear edge *Limbodessus morgani* (Watts & Humphreys)
 – Length <2.0 mm; metatrochanters oval, bluntly pointed (Fig.16); mesofemur with 3–6 spines on rear edge **18**
- 18** (17) – Antenna (and legs) stout (Fig.17), segments 4 and 5 as wide as long; mesofemur with 2 long spines on hind edge close to base *Limbodessus cunyuensis* (Watts & Humphreys)
 – Antenna (and legs) more normally elongate (Fig.18), segments 4 and 5 clearly longer than wide; mesofemur with 3–6 long spines on hind edge **19**
- 19** (18) – Mesofemur with 3 spines on hind edge, 2 near base, 1 more distant
 *Limbodessus bialveus* (Watts & Humphreys)
 – Mesofemur with 5–6 spines relatively evenly placed along hind edge *Limbodessus lornaensis* sp. nov.
- 20** (14) – Elytron with row of large punctures adjacent to suture (hard to see if wet) (Fig. 19) **44**
 – Elytron without sutural punctures, other than a few weak ones near base **21**
- 21** (20) – Eye remnant present as a small oval or triangular structure (Fig. 18) **40**
 – Eye remnant reduced to one or several single short sutures (Fig. 17) **22**
- 22** (21) – Mesofemur with 5–7 spines on hind edge in basal half **23**
 – Mesofemur with 2–4 spines on hind edge in basal half **30**

Plate 2



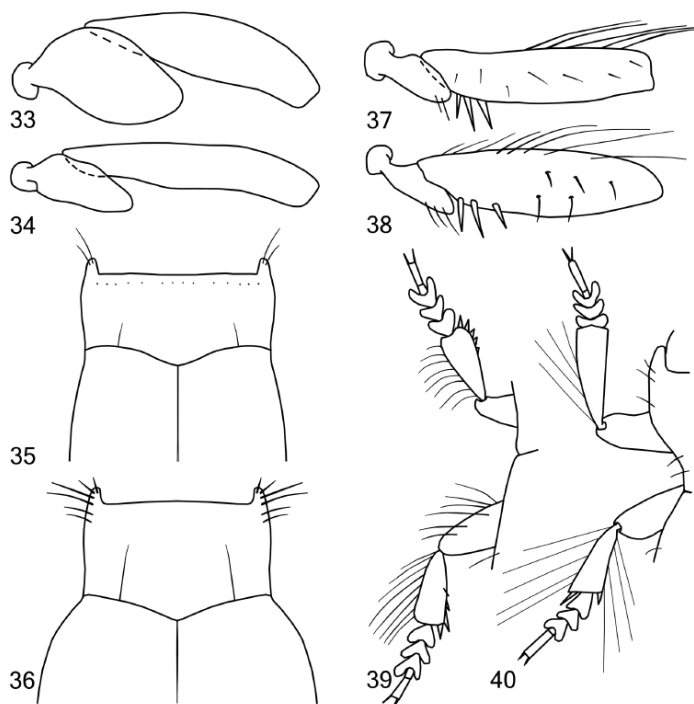
- 23(22) – Length >3.0 mm; pro (Fig. 21) and mesotarsi not expanded *Limbodessus cooperi* Watts & Humphreys
 – Length < 2.8 mm; pro (Fig. 22) and mesotarsi moderately expanded 24
- 24 (23) – Protibia thick (Fig. 23); protarsus moderately expanded, mesotarsus less so; mesotibia slightly angular
 *Bidessodes gutteridgei* Watts & Humphreys
 – Protibia thin (Fig. 21); protarsus and mesotarsus approximately the same size; mesotibia not angular 25
- 25 (24) – Length 2.5 – 2.7 mm; suture between ventrites 1 and 2 complete (Fig. 24)
 *Limbodessus padburyensis* Watts & Humphreys
 – Length 1.6 – 2.4 mm; suture between ventrites 1 and 2 obliterated laterally (Fig. 25) 26
- 26 (25) – Metatrochanter greatly extended at base (Fig. 26); elytra quite densely covered with small setae
 *Limbodessus murrumensis* sp. nov.
 – Metatrochanter normal (Fig. 27); elytra sparsely and unevenly covered with setae 27
- 27 (26) – Metafemur relatively stout (Fig. 27); pronotal process weakly bulbous
 *Limbodessus nambiensis* Watts & Humphreys
 – Metafemur relatively thin (Fig. 28); pronotal process narrowing towards rounded tip 28
- 28 (27) – Aedeagus broadening towards tip (Fig. 29) *Limbodessus melitaensis* Watts & Humphreys
 – Aedeagus narrowing towards tip (Fig. 30) 29
- 29 (28) – Paramere with lobe as wide as rest of apical segment, flat on top, expanded slightly at tip (Fig. 31)
 *Limbodessus masonensis* (Watts & Humphreys)
 – Paramere with lobe narrower than rest of apical segment, rounded on top, tip pointed (Fig. 32)
 *Limbodessus yuinmeryensis* (Watts & Humphreys)
- 30 (22) – Suture between ventrites 1 & 2 complete except close to side 32
 – Suture between ventrites 1 & 2 incomplete, only present in inner portion (Fig. 25) 31

Plate 3



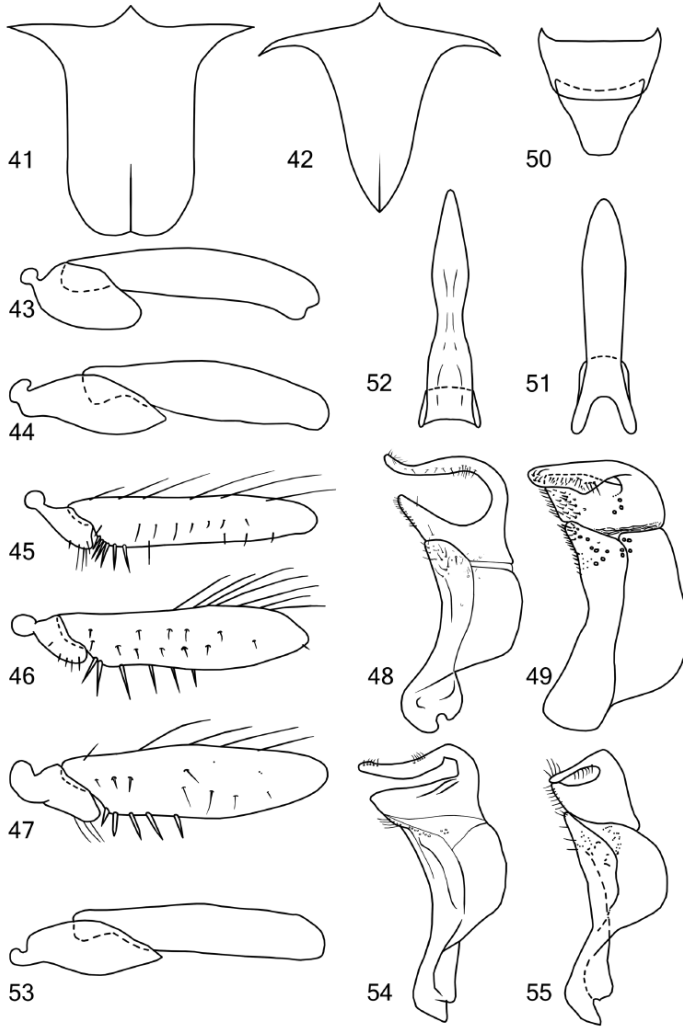
- 31 (30)** – Length > 1.6 mm: mesofemur with 2–3 strong spines grouped together on hind edge near base *Limbodessus trispinosus* sp. nov.
 – Length < 1.6 mm: mesofemur with 3 strong spines grouped together on hind edge near base and 2 more distant *Limbodessus micromelitaensis* sp. nov.
- 32 (30)** – Length 1.0 mm; metafemur <2x length of metatrochanter (Fig. 33) *Limbodessus kurutjutu* (Watts & Humphreys)
 – Length >1.3mm; metafemur >2x length of metatrochanter (Fig. 34) **33**
- 33 (32)** – Mesofemur with 3–4 spines on hind edge in basal half **36**
 – Mesofemur with 2 spines on hind edge in basal half **34**
- 34 (33)** – Metatrochanter with basal pedicle-like piece *Limbodessus pinnaclesensis* (Watts & Humphreys)
 – Metatrochanter without pedicle-like base **35**
- 35 (34)** – Length 1.4 – 1.5 mm; pronotum nearly as wide as elytra (Fig. 35) *Limbodessus wilunaensis* (Watts & Humphreys)
 – Length 2.0 – 2.2 mm; pronotum noticeably narrower than elytra (Fig. 36) *Limbodessus millbilliensis* Watts & Humphreys
- 36 (33)** – Elytra densely punctate *Limbodessus cueensis* Watts & Humphreys
 – Elytra sparsely punctuate **37**

Plate 4



- 37 (36) – Mesofemur with 3 spines grouped closely together on hind edge near base (Fig. 37)
 *Limbodessus fridaywellensis* (Watts & Humphreys)
 – Mesofemur with 2 spines grouped together near base and one more distant on hind edge (Fig. 38) 38
- 38 (37) – Pro and mesotibia club-shaped (Fig. 39); antenna with middle segments enlarged a little on inside
 *Limbodessus hinkleri* (Watts & Humphreys)
 – Pro and mesotibia elongate/triangular in shape (Fig. 40); antenna with middle segments virtually symmetrical 39
- 39 (38) – Mesosternum with posterior portion ‘U’-shaped in midline (Fig. 41); metatrochanter tip round (Fig. 43)
 *Limbodessus nyungduo* sp. nov.
 – Mesosternum with posterior portion ‘V’-shaped in midline (Fig. 42); metatrochanter tip pointed (Fig. 44)
 *Limbodessus karalundiensis* (Watts & Humphreys)
- 40 (21) – Mesofemur with 5–6 spines close to base on hind edge (Fig. 45)
 *Limbodessus bigbellensis* (Watts & Humphreys)
 – Mesofemur with 3–7 spines, most spread out along basal half of hind edge (Fig. 46) 41
- 41 (40) – Suture line between ventrites 1 and 2 well marked (Fig. 24) 42
 – Suture line between ventrites 1 and 2 weak, obsolete in lateral half (Fig. 25) 43
- 42 (41) – Mesofemur with spines short and stout (Fig. 47); pro and mesotarsi weakly expanded; apical lobe of paramere thin, well separated from rest of segment (Fig. 48) *Limbodessus harleyi* Watts & Humphreys
 – Mesofemur with spines moderately long (Fig. 46); pro and mesotarsi strongly expanded; apical lobe of paramere broad, overlying rest of segment (Fig. 49) *Limbodessus challaensis* (Watts & Humphreys)
- 43 (41) – Ventrite 5 constricted towards apex (Fig. 50), aedeagus with medial lobe distinctly narrower in middle (Fig. 52), apex upturned *Limbodessus jundeeensis* (Watts & Humphreys)
 – Ventrite 5 not constricted towards apex; aedeagus with medial lobe subparallel, apex not upturned (Fig. 51)
 *Limbodessus narryerensis* Watts & Humphreys

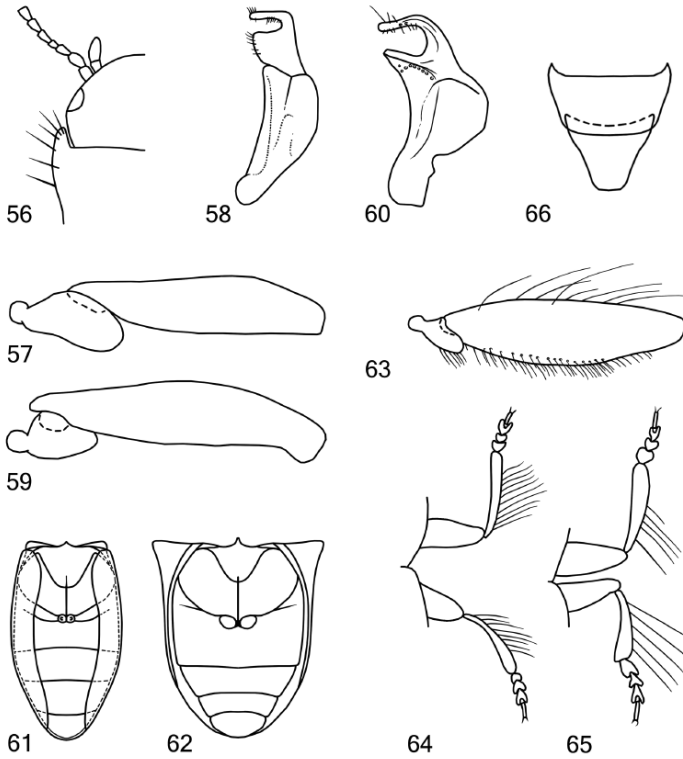
Plate 5



- 44 (20) – Suture line between ventrites 1 and 2 well marked (e.g. Fig. 24) 45
 – Suture line between ventrites 1 and 2 weak obsolete in lateral half (e.g. Fig. 25) 51
- 45 (44) – Mesofemur with 2–3 spines spread out along basal half of hind edge; basal piece of metatrochanter elongate (Fig. 53) *Limbodessus wogarthaensis* (Watts & Humphreys)
 – Mesofemur with 4–7 spines in basal half of hind edge; metatrochanter normal (eg. Fig. 47) 46
- 46 (45) – With small oval or triangular eye remnant (Fig. 18) 47
 – Eye remnant reduced to one or two short sutures (e.g. Fig. 17) 48
- 47 (46) – Apical lobe of paramere shorter and wider (Fig. 54) *Limbodessus microbubba* sp. nov.
 – Apical lobe of paramere longer and narrower (Fig. 55) *Limbodessus hillviewensis* Watts & Humphreys
- 48 (46) – Length >4 mm; pronotal plicae (striae) virtually absent
 *Limbodessus palmulaoides* Watts & Humphreys
 – Length <3.0 mm; pronotal plicae (striae) weak to moderately impressed 49
- 49 (48) – Metafemur with 4–5 spines spread out along basal half of hind edge 50
 – Metafemur with 6–7 spines spread out along basal half of hind edge
 *Limbodessus phoebeae* Watts & Humphreys

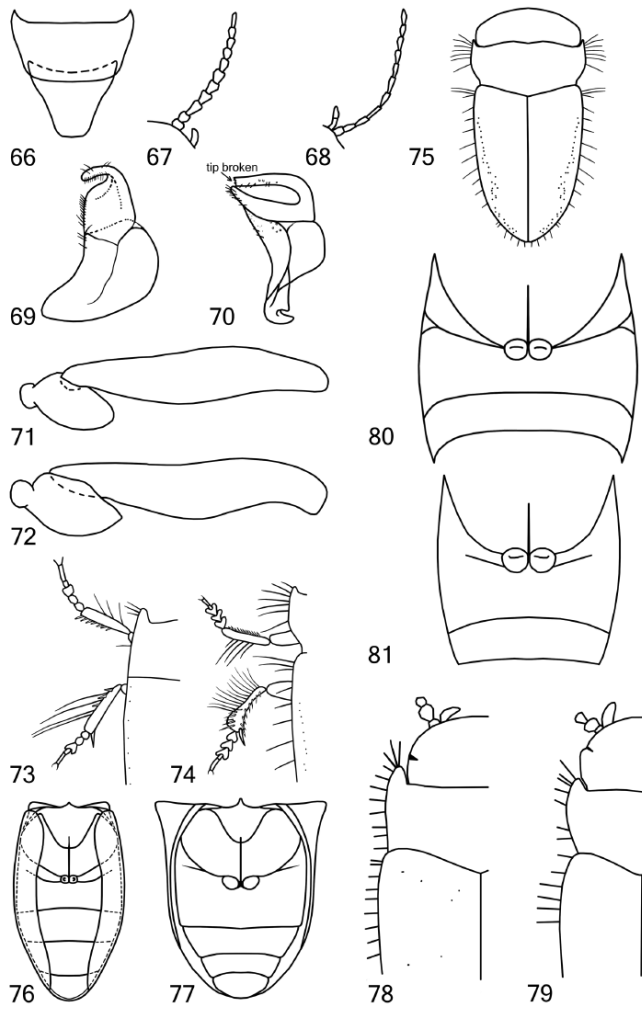
- 50 (49) – Length 1.2 – 1.5 mm; basal segments of pro and mesotarsi wider than long *Limbodessus lapostae* (Watts & Humphreys)
 – Length 2.0 – 2.3 mm; basal segments of pro and mesotarsi shorter than long *Limbodessus usitatus* Watts & Humphreys
- 51 (44) – Mesofemur with 4–6 spines in basal half of hind edge 52
 – Mesofemur with 1–3 spines in basal half of hind edge 54
- 52 (51) – Eye remnant relatively large (Fig. 56) *Limbodessus micrommatoion* Watts & Humphreys
 – Eye remnant small, reduced to a single suture or small triangular plate (Fig. 17) 53
- 53 (52) – Metatrochanters oval (Fig. 57), apical portion of parameres long (Fig. 58) *Limbodessus windarraensis* (Watts & Humphreys)
 – Metatrochanters bluntly pointed (Fig. 59), apical portion of parameres short (Fig. 60) *Limbodessus ordinarius* sp. nov.
- 54 (51) – Length <2.2 mm; mesofemur with 1 spine on hind edge at base *Limbodessus raeae* (Watts & Humphreys)
 – Length >2.2 mm; mesofemur with 2–3 spines on hind edge in basal half 55
- 55 (54) – Length >3.4 mm; epipleura wide (Fig. 61); eye remnant small, triangular (eg. Fig. 78) *Limbodessus yarrabubbaensis* sp. nov.
 – Length <3.3 mm; epipleura narrow to moderately wide (Fig. 62); eye remnant relatively large, oval (Fig. 56) 56
- 56 (55) – Length 2.7 – 3.1 mm *Limbodessus mirandae* (Watts & Humphreys)
 – Length 2.4 – 2.5 mm *Limbodessus exilis* (Watts & Humphreys)
- 57 (7) – Mesofemur with spines arranged in two comb-like rows along hind edge from base to apex (Fig. 63) 58
 – Mesofemur with spines on hind edge spaced out, not dense and comb-like (eg. Fig. 47) 59
- 58 (57) – Pro and mesotarsi with basal segment not larger than other segments (eg. Fig. 64) *Bidessodes limestoneensis* Watts & Humphreys
 – Pro and mesotarsi with basal segment much larger than others (eg. Fig. 65) *Limbodessus barwidgееnsis* Watts & Humphreys
- 59 (57) – Ventrite 6 clearly visible, extended behind, vase-like (Fig. 66) *Limbodessus yandalensis* Watts & Humphreys
 – Ventrite 6 normal, usually not visible, if so, smoothly rounded behind (eg. Fig. 61) 60
- 60 (59) – Pro and mesotarsus with basal segment much more expanded than other segments (eg. Fig. 65) 61
 – Pro and mesotarsus with basal segment not, or only moderately, more expanded compared with other segments (e.g. Fig. 64) 63
- 61 (60) – Antenna with segments 8–11 noticeably thinner than others, segment 3 longer than segment 2 (Fig. 67) *Limbodessus magnificus* (Watts & Humphreys)
 – Antenna with segments 8–10 not noticeably thinner than others, segment 3 same length as segment 2 (Fig. 68) 62
- 62 (61) – Head as wide as elytra; eye remnant small, triangular *Limbodessus macrotarsus* (Watts & Humphreys)
 – Head much narrower than elytra; eye remnant virtually absent *Limbodessus macrohinkleri* Watts & Humphreys
- 63 (60) – Pronotum a little narrower than elytra; length 3.5 – 5.0 mm 65
 – Pronotum as wide or wider than elytra; length 3.0 – 3.5 mm 64

Plate 6



- 64 (63)** – Basal portion of apical segment of paramere almost as broad as long (Fig. 69) *Limbodessus eberhardi* (Watts & Humphreys)
 – Basal portion of apical segment of paramere very short, about 4x as broad as long (Fig. 70) *Limbodessus surreptitius* Watts & Humphreys
- 65 (63)** – Metatrochanter rounded at tip (Fig. 71); aedeagus with median lobe straight, tip pointed *Limbodessus raesidensis* (Watts & Humphreys)
 – Metatrochanter bluntly pointed at tip (Fig. 72); aedeagus with median lobe twisted, tip knobbed *Limbodessus hahni* (Watts & Humphreys)
- 66 (4)** – From north-eastern New South Wales *Paroster peelensis* Watts *et al*
 – From the Northern Territory **67**
 – From Western Australia **74**
- 67 (66)** – Protarsus with segment 3 not bilobed, segment 4 clearly visible (Fig. 73); pronotum not constricted at base (Fig. 73) *Paroster pentamerus* (Watts & Humphreys)
 – Protarsus with segment 3 bilobed, segment 4 mostly hidden within lobes of segment 3 (Fig. 74); pronotum weakly to moderately constricted at base (Fig. 74) **68**
- 68 (67)** – Head short, very broad, strongly deflexed (Fig. 75); pronotum strongly narrowed at base; prosternal process anvil-shaped *Paroster macrocephalus* (Watts & Humphreys)
 – Head variably shaped, not deflexed, base of pronotum variable; prosternal process ‘normally’ shaped **69**
- 69 (68)** – Length >2.0 mm **70**
 – Length <2.0 mm **71**
- 70 (69)** – Length 2.4 mm; head very large, as wide as elytra *Paroster megamacrocephalus* (Watts & Humphreys)
 – Length 3.5 – 3.9 mm; head narrower than elytra *Paroster readi* sp. nov.

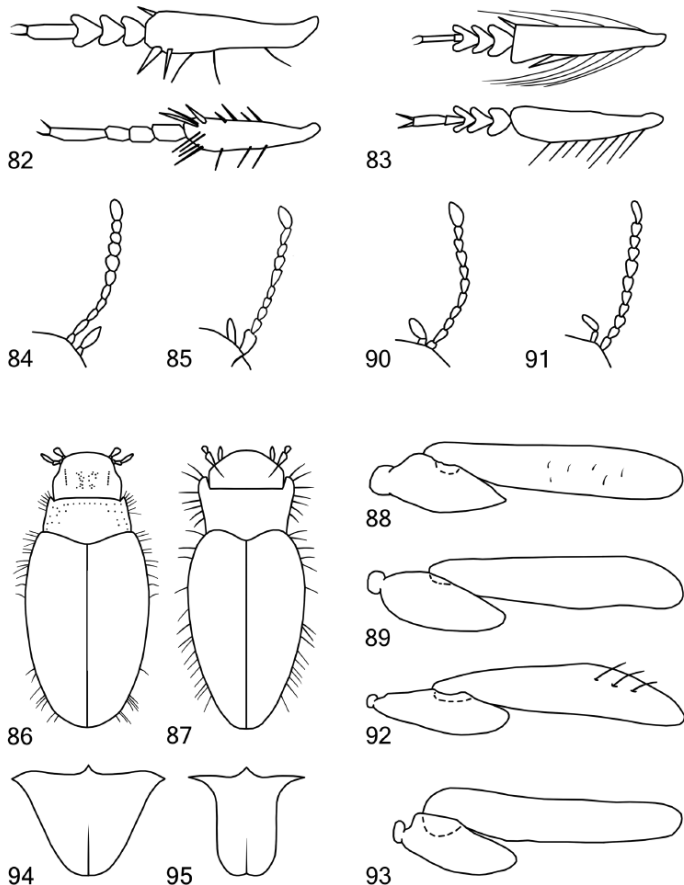
Plate 7



- 71 (69) – Length 1.8 mm; body well chitinized; elytral epipleura narrow except close to base (Fig. 77) *Paroster napperbyensis* (Watts & Humphreys)
 – Length 1.2 – 1.6 mm; body weakly chitinized; elytral epipleura moderately broad for most of its length (Fig. 76) 72
- 72 (71) – Body only slightly constricted at junction of pronotum and elytra (Fig. 78) *Paroster wedgeensis* (Watts & Humphreys)
 – Body quite strongly constricted at junction of pronotum and elytra (Fig. 79) 73
- 73 (72) – Length 1.5 mm; suture between ventrites 1 & 3 complete (eg. Fig. 80) *Paroster newhavenensis* (Watts & Humphreys)
 – Length 1.0 mm; suture between ventrites 1 & 2 absent in lateral third (eg. Fig. 81) *Paroster novem* sp. nov.
- 74 (66) – Pronotum (and head) about half width of elytra *Paroster arachnoides* (Watts & Humphreys)
 – Pronotum > three quarters width of elytra 75
- 75 (74) – Pro and mesotarsi 4-segmented (Fig. 82) *Paroster tetrameres* (Watts & Humphreys)
 – Pro and mesotarsi 5-segmented (Fig. 83) 76
- 76 (75) – Elytron with visible ventral portion extensive except close to apex (Fig. 76) 77
 – Elytron with visible ventral portion narrow except in basal quarter (Fig. 77) 81
- 77 (76) – Length 3.6 – 3.8 mm *Paroster stegastos* (Watts & Humphreys)
 – Length 1.5 – 2.5 mm 78

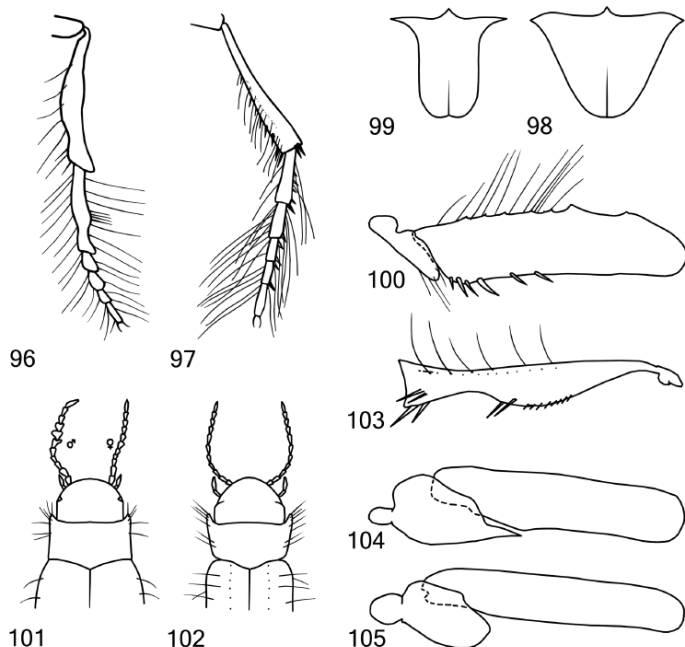
- 78 (77) – Antenna with segments 6–8 greatly expanded, much broader than segments 9 and 10 (Fig. 84)
 *Paroster bulbus* (Watts & Humphreys)
 – Antenna with segments 6–10 of approximately equal size (Fig. 85) 79
- 79 (78) – Body strongly boat-shaped, pronotum much narrower in front (Fig. 86) 80
 – Front and rear of pronotum about same width (Fig. 87) *Paroster euryleuron* (Watts & Humphreys)
- 80 (79) – Length 2.1–2.3 mm; metatrochanter with tip sharply pointed (Fig. 88) *Paroster skaphites* (Watts & Humphreys)
 – Length 1.5–1.9 mm; metatrochanter with tip rounded (Fig. 89) *Paroster killaraensis* (Watts & Humphreys)
- 81 (76) – Antenna with segment 2 larger and more oval than segment 1 (Fig. 90); 1.2–2.1 mm long 91
 – Antenna with segment 2 more or less the same shape as segment 1 or smaller (Fig. 91); 2.5–3.9 mm long 82
- 82 (81) – Mesofemur with row of about 20 closely placed small spines along hind edge
 *Paroster byroensis* (Watts & Humphreys)
 – Mesofemur with 10 or fewer, weak to very strong spines along hind edge 83
- 83 (82) – Metatrochanter long and thin, about 4x as long as wide (Fig. 92) 84
 – Metatrochanter moderately elongate 2.0–2.5 x as long as wide (Fig. 93) 85
- 84 (83) – Metasternal plate parallel sided (eg. Fig. 95); mesofemur with 8–10, closely placed, very strong spines
 *Paroster fortisspina* (Watts & Humphreys)
 – Metasternal plate narrowing towards rear (eg. Fig. 94); mesofemur with 4–8 weak to moderately strong spines
 *Paroster elongatus* sp. nov.
- 85 (83) – Metatarsus with segment 1 as long as others combined, with confluent group of 5 strong spines in middle on outside (Fig. 96) *Paroster copidotibiae* (Watts & Humphreys)
 – Metatarsus with segment 1 much shorter than others combined, without confluent group of spines on outside (Fig. 97) 86

Plate 8



- 86 (85) – Metasternal plate without wings (Fig. 98) *Paroster plutonicensis* (Watts & Humphreys)
 – Metasternal wings obvious but short (Fig. 99) 87
- 87 (86) – Mesofemur with 2–4 small lumps on top edge (Fig. 100) *Paroster verrucosus* (Watts & Humphreys)
 – Mesofemur with smooth top edge 88
- 88 (87) – Mesofemur with moderately strong spines; metacoxal plate nearly reaching mesocoxae 89
 – Mesofemur with thin spines; metacoxal plate at least the width of metafemur from mesocoxae
 *Paroster darlotensis* (Watts & Humphreys)
- 89 (88) – Length 3.6 – 4.1 mm; mesofemur with 7–9 spines on hind margin
 *Paroster macrosturtensis* (Watts & Humphreys)
 – Length < 3.3 mm; mesofemur with 4–5 spines on hind margin 90
- 90 (89) – Length 2.8 – 3.0 mm; pronotum with constricted base (Fig 102); antennae not expanded (Fig. 102)
 *Paroster hinzeae* (Watts & Humphreys)
 – Length 1.8– 2.4 mm; pronotum with sides sinuate (Fig.101); antennae in males with greatly expanded middle
 segments (Fig. 101) *Paroster mesosturtensis* (Watts & Humphreys)
- 91 (81) – Elytron with shoulder flared outwards (Fig. 77) *Paroster hamoni* (Watts & Humphreys)
 – Elytron with shoulder not flared 92
- 92 (91) – Protibia distinctly scalloped on inner edge near apex (Fig.103); mesotibia scalloped along most of inner edge
 *Paroster microsturtensis* (Watts & Humphreys)
 – Protibia and mesotibia not scalloped 93
- 93 (92) – Suture between ventrites 1 and 2 complete (eg. Fig. 80) 94
 – Suture between ventrites 1 and 2 lacking in lateral quarter (eg. Fig. 81)
 *Paroster milgunensis* (Watts & Humphreys)
- 94 (93) – Metatrochanter produced into long strong point (Fig. 104) *Paroster innouendyensis* (Watts & Humphreys)
 – Metatrochanter rounded at most bluntly pointed (Fig. 105) *Paroster melroseensis* (Watts & Humphreys)

Plate 9



The following species descriptions are grouped in alphabetical order under genus which are placed in the order *Exocelina*, *Limbodessus*, *Paroster*.

***Exocelina* Broun, 1886 (Copelatinae, Copelatini)**

***Exocelina rasjadi* sp. nov.**

FIGS 106–111

Holotype: Australia; Western Australia. m. 'WA app 10 km E Tjukurla 24 21 42.85 128 45 59.9E 24/9/06 CHS Watts', card mounted, WAM70496.

Paratype: f. as for holotype, slide, SAMA.

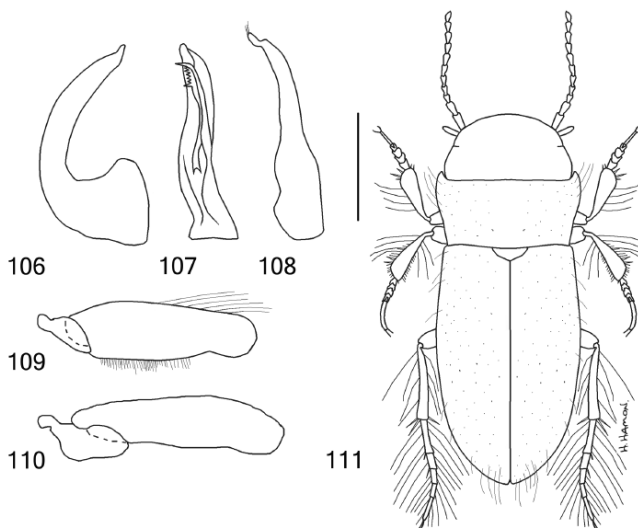
Description (number examined, 2)

Habitus: Length 3.4 – 3.6 mm; elongate, relatively flat, moderately constricted at junction of pronotum/elytra; uniformly testaceous; eyes absent; hindwing vestigial, reduced to small vestigial bud.

Head: Relatively large, wider than elytra; smooth, reticulation moderately strong, a few scattered small punctures; sides parallel in posterior half; eye remnant reduced to short suture. Antenna thin, segment 1 long, thin, cylindrical, segment 2 shorter, as wide, slightly vase-shaped, segment 3 about 1.5x as long as segment 2, narrow, vase-shaped, segments 3–10 subequal, segment 11 1.5x length of segment 10, apex pointed. Maxillary palpus moderately stout, segment 4 about as long as segments 2 and 3 combined. Mentum and gula fused, no visible suture.

Pronotum: A little wider than elytra; anteriolateral angles projecting forward; sides curved, quite strongly constricted at base, posterolateral angles acute; a few scattered minute punctures and some larger ones along front margin; long setae concentrated on anteriolateral angles; strongly reticulate, a few fine striae.

Scutellum: Small, widely triangular.



Figures 106–111. *Exocelina rasjadi* sp. nov.; **106**, lateral view of median lobe of aedeagus; **107**, ditto dorsal view; **108**, paramere; **109**, mesotrochanter and mesofemur; **110**, metatrochanter and metafemur; **111**, dorsal view. Scale bar represents 1 mm (habitus only).

Elytra: Not fused, lacking inner ridges; elongate, sides parallel; smooth; reticulation moderately strong; evenly but sparsely covered with small punctures, a few moderately large punctures with long setae, more frequent towards apex and sides. Epipleuron moderately differentiated, present only at shoulder of elytron.

Ventral surface: Prosternal process narrowed between coxae, not reaching mesothorax, apical portion rounded, slightly pointed behind, arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact in midline. Metathorax sharply projecting forward in midline; wings well marked nearly reaching sides; triangular in midline behind. Metacoxal plates large, metacoxal lines sub obsolete, close in hind quarter, moderately diverging towards front and becoming obsolete; sparsely covered with small punctures, virtually nonreticulate, moderately densely covered with short fine striae; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3–5, strongly reticulate with scattered small punctures and a few long central setae or bunch of long setae, all ventrites with numerous fine striae, transverse on ventrites 3–5, variable on ventrites 1 and 2, ventrite 5 rounded behind.

Legs: (female) Protibia moderately broad, widest near apex where it is about 4x its basal width 3–4 strong spines at apex, a few long setae on outer edge; protarsus not expanded, a few long setae on outer edge, segments 1–4 subequal, segment 5 thin, cylindrical, combined, claws relative long, simple. Mesotrochanter elongate with a few very fine setae at apex; mesotarsus a little longer than protarsus, not expanded. Metatrochanter relatively small, elongate oval, apex rounded (Fig. 147); metafemur relatively narrow; metatibia narrow, weakly curved; metatarsus elongate, segments cylindrical, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 about as long as others, all segments without spines other than at apex; claws weak.

Male: Prolegs missing. Mesotarsi moderately expanded, segment 4 a little longer than segment 3, much narrower, segment 5 elongate, curved, about as long as other segments in combination; segments 1–3 each with 2–4 weak adhesive setae. Medial lobe of aedeagus distinctly sinuate, with thin pointed accessory piece on ventral surface (Fig. 107). Parameres symmetrical; rather narrow, internal margin without setae, stylus distally with a few relatively long setae (Fig. 108).

Etymology

Named after Rasjad Butler, Tjukurla, who captured the first specimen.

Remarks

This second species of stygobitic *Exocelina* comes from an area just to the west of the Ngalia basin in which *E. abdita* (Watts & Humphreys) is found. It agrees with *E. abdita* in its range of stygobitic character states—cordiform body shape, pronotal process not reaching mesosternum, lack of eyes and obsolete forewings. From *E. abdita*, *E. rasjadi* is considerably smaller (by far the smallest known *Exocelina*), has fine striae on the dorsal as well as the ventral surface, has more expanded male mesotarsi but with fewer adhesive setae. Unlike the simple median lobe of the aedeagus in *E. abdita* that of *E. rasjadi* is strongly sinuate and has an additional piece on the ventral side.

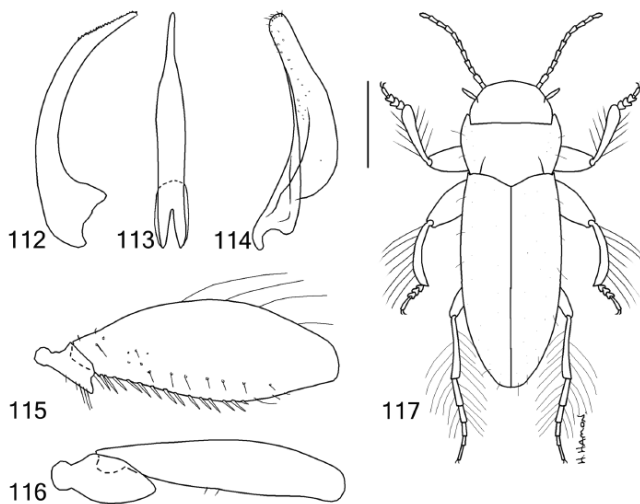
***Limbodessus* Guignot, 1939 (Hydroporinae, Bidessini)**

***Limbodessus insolitus* sp. nov**

FIGS 112–117

Holotype: Australia, Western Australia. m; ‘BES 14296 Millbillillie Station MEB site 29 –26.6876 120.3078 W.F. Humphreys & T. Moulds 16/9/06’, slide, WAM70497.

Paratypes: 5; 1, as for holotype, card mounted, SAMA; 1, ‘BES14326 Millbillillie Station MRB north site 58 26.6828S 120.2152E 18/9/06 W.F. Humphreys & T. Moulds 18/9/06’ damaged, slide mounted, SAMA; 1, ‘BES 14326 Millbillillie Station MRB north site 58 –26.6845 120.2152 W.F. Humphreys & T. Moulds 18/9/06’, slide, WAM70498; 1, ‘BES 10526 4/6/04 Uraturia MEB site 262 26.68762 120.35282 W.F. Humphreys CHS Watts C Clay,’ card, SAMA; 1, ‘Magellan Station AQH B 001-2, 22/3/06’, SAMA.



Figures 112–117. *Limbodessus insolitus* sp. nov.; **112**, lateral view of median lobe of aedeagus; **113**, ditto dorsal view; **114**, paramere; **115**, mesotrochanter and mesofemur; **116**, metatrochanter and metafemur; **117**, dorsal view. Scale bar represents 1 mm (habitus only).

Description (number examined, 6)

Habitus: Length 3.1 – 3.9 mm; relatively flat, strongly constricted at junction of pronotum/elytra; elongate, elytra almost parallel-sided; uniformly light testaceous; hindwing reduced, about a third length of elytron.

Head: Narrower than elytra; smooth, reticulation weak or absent, punctures sparse, very small; subparallel in posterior half, widest in middle; eye remnant a single well- marked suture. Antenna thin, segments 1 and 2 slightly vase-shaped, segment 3 shorter than segment 2, a little narrower, narrowing towards base, segments 3 to 10 approximately equal in shape, segment 11 thinner, 1.4x length of segment 10, segments 5–8 slightly expanded on inner apical edge. Maxillary palpus, elongate, segment 4 as long as segments 1 to 3 combined.

Pronotum: A little wider than elytra; anteriolateral angles projecting strongly forward; base strongly constricted, posterolateral angles almost square, overlying elytra somewhat; smooth, reticulation very weak, punctures very weak, very sparse, a few larger ones along front edge; basal plicae moderately impressed, pronotum slightly depressed between plicae, slightly curved, reaching to about 1/3 way along pronotum; with some long setae laterally in anterior half.

Elytra: Not fused, lacking inner ridges; sides subparallel, moderately reticulate, meshes small giving elytra mat surface, punctures masked by reticulation; some long setae, more frequent towards sides; with 1–2 weak longitudinal ridges. Epipleuron weakly differentiated from rest of elytron, that portion of elytron visible ventrally, relatively broad in anterior third, gradually thinning towards apex of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, sides narrowing towards rear, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metathorax triangular in front in midline; wings narrow; rounded in midline behind. Metacoxal plates large, shiny, virtually nonreticulate, metacoxal lines weak, relatively close, diverging slightly towards front, reaching nearly to mesosternum; closely adpressed to ventrite 1. Sutural lines between ventrites 1 and 2 weak, absent towards sides, ventrites 3–5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Profemur very broad; protibia narrow, bow-shaped, widest a little beyond centre where it is about three times its basal width; protarsus quite strongly expanded, segment 1 about 2x as broad as long, segment 2 broader, segment 3 not quite as broad as segment 2, very deeply bilobed, segment 4 very small, hidden within lobes of segment 3, segment 5 thin, elongate, about same length as segment 3, segments 1–3 with covering of adhesive setae; claws relatively long and stout. Mesotrochanter elongate/rectangular with a few thin setae

on inner edge near tip; mesofemur very broad with row of about 14 relatively strong spines along basal half, evenly spaced (Fig. 115); mesotarsus narrower and more elongate than protarsi, segments 1 and 2 slightly asymmetrical. Metatrochanter relatively small, tip slightly pointed (Fig. 116); metafemur thin, lacking spines; metatibia narrow, quite strongly curved, widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak, subequal in length.

Male: Little external difference between the sexes. Median lobe of aedeagus relatively thin, narrowing towards tip, tip quite sharp; paramere relatively narrow, seemingly one – segmented, a few short spines near rounded tip (Figs 112 –114).

Etymology

Latin. '*Insolitus*' – unusual. A reference to the unusual, for Bidessini, one segmented parameres.

Additional specimen

1, partial, 'BES6458' 'Uramurdah Lake (NE lake Way) No4 (Site 286) 26 41 16S 120 17 52N coll WF Humphreys CHS Watts S.Cooper 9/5/01', slide, SAMA.

Remarks

Readily recognized by the strong fore and mid legs, particularly the strongly curved mesotibiae. Smaller than *Limbodessus hahni* which occurs in the same calcrete but has more normal fore and mid legs. Some other large stygobitic *Limbodessus*, such as *L. macrolornaensis*, have robust fore and mid legs but none have the strongly curved mesotibia.

We have placed *L. insolitus* in the Bidessini, genus *Limbodessus*, despite the males having one-segmented parameres (Fig. 114), for the following reasons. a) Sequence data (Remko Leys pers com) places the species within *Limbodessus* but not close to any species. b) The form of the base of the paramere is curved and hooked as in other *Limbodessus* unlike the more simple structure found in *Paroster* (eg Fig. 171). c) The presence of a small but distinct spermathecal spine in the female similar to those of some other *Limbodessus*, which Miller (2001) identified as only being found in the Bidessini. d) The presence of pronotal plicae and curved and apically expanded metatibia more typically found in the Bidessini than in the Hydroporini. On this interpretation the form of the parameres would represent a convergence on the Hydroporini form and represent an extreme example of the unusually large degree of variation found in the form of the parameres of stygobitic *Limbodessus*.

Limbodessus lornaensis sp. nov

FIGS 118–123

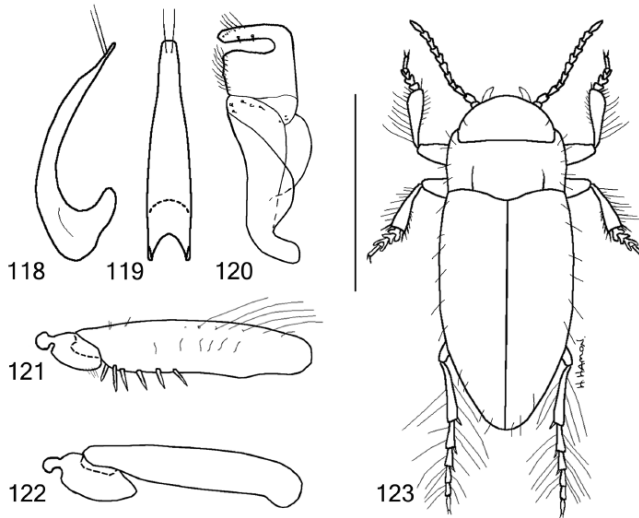
Holotype: Australia, Western Australia. m, 'Lorna Glen Stn Bore @ No 9 Well 26.29826S 121.40341E 7/4/05 WF Humphreys & R. Leys', slide mounted, WAM70499.

Paratypes: 11; 7, as for holotype, 3 SAM 4 WAM70500 – 70503; 4, ditto except 'BES12874' 'Bore site 42, 26.25863S 121.40429E', 3 WAM70504 – 70506 2 SAM.

Description (number examined, 12)

Habitus: Length 1.4 – 1.6 mm; relatively flat, not constricted at junction of pronotum/elytra; elongate oval; uniformly light testaceous; hindwing reduced, about a third length of elytron, apex folded.

Head: Considerably narrower than elytra; smooth, reticulation relatively strong, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to single suture line. Antenna relatively stout, segment 1 cylindrical, segment 2 barrel-shaped, segment 3 as long as segment 2,



Figures 118–123. *Limbodessus lornaensis* sp. nov.; **118**, lateral view of median lobe of aedeagus; **119**, ditto dorsal view; **120**, paramere; **121**, mesotrochanter and mesofemur; **122**, metatrochanter and metafemur; **123**, dorsal view. Scale bar represents 1 mm (habitus only).

narrower, narrowing towards base, segment 4 shorter, segments 5–10 approximately equal in shape, segments 6–10 a little stouter than segment 5, inner apical angles slightly expanded, segment 11 elongate, 1.2x length of segment 10, each segment, except segment 1, with some very small setae on inside apically. Maxillary palpus, elongate, segment 4 as long as segments 1–3 combined.

Pronotum: Narrower than elytra; anteriolateral angles projecting strongly forward; sides subparallel, base not constricted, posterolateral angles square; smooth, reticulation relatively strong, punctures very weak, sparse, masked by reticulation; basal plicae strong, strongly excavated on inward sides, slightly curved inwards, reaching to about half way along pronotum; with row of long setae laterally in anterior half.

Elytra: Not fused, lacking inner ridges; elongate/oval, widest in middle, smooth, quite strongly reticulate, most punctures masked by reticulation; a few large punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated from rest of elytron, that portion of elytron visible ventrally, relatively broad in anterior quarter, thin along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, sides subparallel, narrowing rapidly near apex to a point, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metathorax triangular in front in midline; wings narrow; rounded in midline behind. Metacoxal plates large, shiny, reticulate, metacoxal lines weak, well separated, diverging towards front, reaching nearly to mesosternum; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3–5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs: Protibia weakly club-shaped, relatively narrow, widest near apex where it is about four times its basal width; protarsus quite strongly expanded, segment 1 about as long as broad, segment 2 as wide as segment 1 and about a half its length, segment 3 about as long as segment 1, a little narrower, bifid, segment 4 very small, hidden within lobes of segment 3, segment 5 narrow, cylindrical, a little longer than segment 3, segments 1 to 3 with covering of adhesive setae; claws relatively long, thin. Mesotrochanter elongate/oval with a few thin setae on inner edge near tip; mesofemur with 5–6 spines on inner edge near base (Fig. 121); mesotarsus less expanded than protarsus, a little more elongate. Metatrochanter tip bluntly pointed (Fig. 122); metafemur relatively thin, lacking spines; metatibia very narrow, moderately curved, widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male: Little external differences between the sexes. Median lobe of aedeagus relatively broad, narrowing near tip, tip rounded, two long setae on dorsal surface close to tip; basal segment of paramere broad; apical segment broad, square, apical lobe narrow, well separated from rest of segment (Figs 118–120).

Etymology

Named after the pastoral station on which it was found.

Remarks

A small species with almost no constriction at the base of the pronotum, relatively strong pronotal plica, complete suture between ventrites 1 and 2, relatively small and pointed metatrochanters and 5–6 spines on the mesofemur. The aedeagus is unusual for *Limbodessus* in having two thin setae near the tip. Easily separated from *L. macrolornaensis*, which occurs in the same calcrete, by its smaller size and nearly straight sided pronotum.

Limbodessus macrolornaensis sp. nov

FIGS 124–129

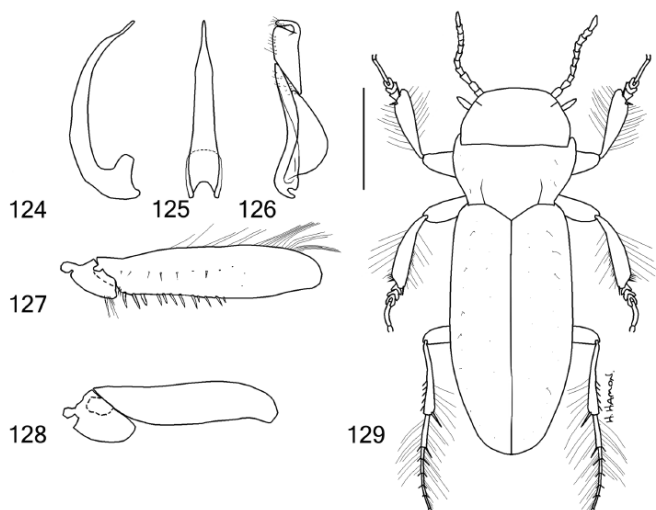
Holotype: Australia, Western Australia. m., ‘Lorna Glen Stn 26.2926 121.40301 Bore @ no 9 well 7/4/05 WF Humphreys & R. Leys’, slide mounted, WAM70507.

Paratypes: 6; 2 as for holotype, 1 WAM70508 1 SAMA; 4, ‘Lorna Glen Stn ‘26.25863S 121.40429E Bore site 42 7/4/05 WF Humphreys & R. Leys’ 2 SAMA (card) 2 WAM70509 – 70510 (alcohol).

Description (number examined, 7)

Habitus: Length 3.0 – 3.4 mm; relatively flat, strongly constricted at junction of pronotum/elytra; elongate, elytra almost parallel-sided; uniformly light testaceous; hindwing reduced, about a third length of elytron.

Head: Narrower than elytra; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, widest in middle; eye remnant small, oval. Antenna relatively thin, segments 1 and 2 cylindrical, segment 3 as long as segment 2, a little narrower, narrowing towards base, segment 4 a bit shorter, segments 5–10 approximately equal in shape, progressively slightly smaller; segment 11 thinner, 1.4x length of segment 10,



Figures 124–129. *Limbodessus macrolornaensis* sp. nov.; **124**, lateral view of median lobe of aedeagus; **125**, ditto dorsal view; **126**, paramere; **127**, mesotrochanter and mesofemur; **128**, metatrochanter and metafemur; **129**, dorsal view. Scale bar represents 1 mm (habitus only).

each segment, except segment 1, with some very small setae on inside apically. Maxillary palpus, elongate, segment 4 as long as segments 1–3 combined.

Pronotum: About as wide as elytra; anteriolateral angles projecting strongly forward; base strongly constricted, posterolateral angles square, overlying elytra somewhat; smooth, reticulation weak, punctures very weak, sparse; basal plicae moderately impressed, slightly depressed on insides, straight, reaching to about half way along pronotum; with row of long setae laterally in anterior half.

Elytra: Not fused, lacking inner ridges; sides subparallel, smooth, very weakly reticulate, sparsely covered with small punctures; a few additional larger punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated from rest of elytron, that portion of elytron visible ventrally, relatively broad in anterior quarter, thin along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, sides subparallel, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metathorax triangular in front in midline; wings narrow; rounded in midline behind. Metacoxal plates large, shiny, virtually nonreticulate, metacoxal lines weak, well separated, diverging towards front, reaching nearly to mesosternum; closely adpressed to ventrite 1. Sutural lines between normal ventrites 1 and 2 absent, normal ventrites 3–5 mobile, sparsely covered with small seta-bearing punctures, normal ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs: Protibia bow-shaped, relatively narrow, widest a little beyond centre where it is about four times its basal width; protarsus weakly expanded, segment 1 about 2x as long as broad, segment 2 as wide as segment 1 and about a half its length, segment 3 about as long as segment 1, about as wide, bifid, segment 4 very small, hidden within lobes of segment 3, segment 5 narrow, cylindrical, about 2x length of segment 3, segments 1–3 with covering of adhesive setae; claws relatively long and stout. Mesotrochanter elongate/rectangular with a few thin setae on inner edge near tip; mesofemur relatively thin with two rows each of about 12 relatively weak spines along basal half, evenly spaced except at base where they are closer. (Fig. 127); mesotarsus similar to protarsus, a little more elongate. Metatrochanter relatively small, tip rounded (Fig. 128); metafemur relatively thin, lacking spines; metatibia narrow, quite strongly curved, widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male: Little external differences between the sexes. Median lobe of aedeagus relatively thin, narrowing near tip, tip blunt; basal segment of paramere long, narrow, apical segment narrow, apical lobe long, thin, separated from rest of segment, tip bent inwards (Figs 124–126).

Etymology

Named after the type locality and its large size.

Remarks

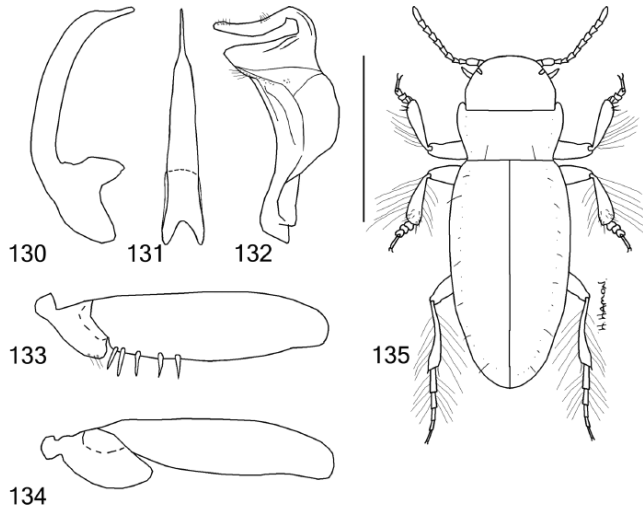
A relatively large species with strongly constricted pronotal base, strong forelegs, no sutural line between what would have been ventrites 1 and 2, and 10–12 relatively small spines along the edge of the mesofemur. These characters will easily separate it from the much smaller *L. lornaensis* from the same calcrete.

Limbodessus microbubba sp. nov

FIGS 130–135

Holotype: Australia; Western Australia. m., ‘BES 13098’ ‘Yarrabubba MEB site 70 27.06684S 118.6784E 21/10/05 WF Humphreys & R Leys’, slide mounted, WAM70511.

Paratypes: 16; 4 (1 partial), ‘BES13094’ ‘site 73 27.0668 118.6799 21/10/05 WF Humphreys & R Leys’, 2 WAM70543 – 70544 (alcohol), 2 SAMA (1 slide, 1 alcohol); 12, ditto except ‘BES13098’ ‘site 70 27.066845S 118.67844E’, 8 WAM70512 – 70519 (6 alcohol, 2 slide) 4 SAMA (card).



Figures 130–135. *Limbodessus microbubba* sp. nov.; **130**, lateral view of median lobe of aedeagus; **131**, ditto dorsal view; **132**, paramere; **133**, mesotrochanter and mesofemur; **134**, metatrochanter and metafemur; **135**, dorsal view. Scale bar represents 1 mm (habitus only).

Description (number examined, 18)

Habitus: Length 1.8–2.2mm, relatively flat, moderately constricted at junction of pronotum/elytra; elongate oval; uniformly light testaceous; hindwing reduced, about a third length of elytron.

Head: Narrower than elytra; smooth, reticulation relatively strong, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to a small triangle. Antenna relatively stout, segment 1 cylindrical, segment 2 barrel-shaped, slightly curved backwards, segment 3 about 2/3 as long as segment 2, narrower, narrowing towards base, segment 4 shorter, segments 5–10 approximately equal in shape, segments 6–10 a little stouter than segment 5, inner apical angles slightly expanded, segment 11 elongate, 2x length of segment 10, each segment, except segment 1, with some very small setae on inside apically. Maxillary palpus, elongate, segment 4 a little shorter than segments 1–3 combined.

Pronotum: Narrower than elytra; anteriolateral angles projecting strongly forward; sides moderately constricted towards base, posterolateral angles square; smooth, reticulation relatively strong, punctures very weak, sparse, masked by reticulation; basal plicae short, weak; with row of long setae laterally in anterior half.

Elytra: Not fused, lacking inner ridges; elongate/oval, widest in middle, smooth, weakly reticulate; a few large punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated from rest of elytron, that portion of elytron visible ventrally, relatively broad in anterior 1/5, thin along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, sides subparallel, narrowing rapidly near apex to a blunt point, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metathorax triangular in front in midline; wings narrow; rounded in midline behind. Metacoxal plates large, shiny, moderately reticulate, metacoxal lines weak, well separated, weakly diverging 2/3 of way to mesosternum; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3–5 mobile, sparsely covered with small setae-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs: Protibia weakly club-shaped, moderately broad, widest near apex where it is about five times its basal width; protarsus weakly expanded, segment 1 longer than broad, segment 2 as wide as segment 1 and about half its length, segment 3 about as long as segment 1, a little narrower, bifid, segment 4 very small, hidden within lobes of segment 3, segment 5 narrow, cylindrical, a little longer than segment 3, segments 1 to 3 covered with a few adhesive setae; claws relatively short, thin. Mesotrochanter elongate/oval with a few thin setae on inner edge near tip; mesofemur with 5 spines along inner edge in basal half (Fig. 133); mesotarsus

a little more elongate than protarsus. Metatrochanter tip bluntly pointed (Fig. 134); metafemur relatively thin, lacking spines; metatibia very narrow, moderately curved, quite strongly widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male: Little external differences between the sexes. Median lobe of aedeagus moderately broad, narrowing near tip, tip rounded; basal segment of paramere moderately broad; apical segment very broad, rectangular, apical lobe long, narrow, convex on front margin, well separated from rest of segment (Figs 130–132).

Etymology

Greek. ‘*Micros*’ – small. The smaller of the two species known from Yarrabubba station calcrete.

Remarks

Very close morphologically to *L. hillviewensis* from which it can only be separated by the slightly broader apical segment of the paramere and the slightly longer and thinner and slightly convex apical lobe of the paramere. *Limbodessus usitatus* is also morphologically close but lacks the small eye remnant of *L. microbubba* as well as small differences in the mesofemoral spines and male genitalia.

Limbodessus micromelitaensis sp. nov

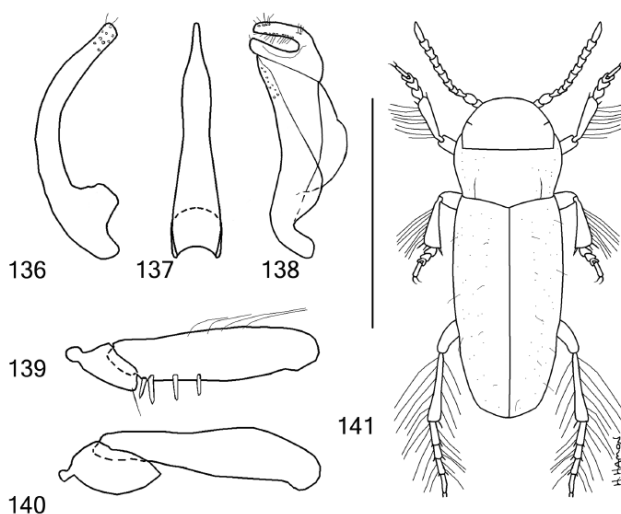
FIGS 136–141

Holotype: Australia; Western Australia. m., ‘BES12951’ ‘Melita Station RL #94 28.932911S 121.302640E SJB Cooper & R. Leys, 3/4/05’, slide mounted, WAM70520.

Paratypes: 7; 4 (1 partial), as for holotype, 2 SAMA (card) 2 WAM70521 – 70522 (alcohol); 3, as for holotype except ‘BES 12596’ ‘RL #97’, 1 WAM70545 (alcohol) 2 SAMA(alcohol).

Description (number examined, 8)

Habitus: Length 1.4 mm; relatively flat, moderately constricted at junction of pronotum/elytra; elongate oval; uniformly pale testaceous; hindwing reduced, about half length of elytron.



Figures 136–141. *Limbodessus micromelitaensis* sp. nov.; **136**, lateral view of median lobe of aedeagus; **137**, ditto dorsal view; **138**, paramere; **139**, mesotrochanter and mesofemur; **140**, metatrochanter and metafemur; **141**, dorsal view. Scale bar represents 1 mm (habitus only).

Head: Narrower than elytra; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant small, slit-like. Antenna stout, segment 1 cylindrical, segment 2 broader, barrel-like, segment 3 a bit shorter than segment 2, much narrower, narrowing towards base, segment 4 a bit smaller, segments 5–10 approximately equal in shape, stout, inner apical angles slightly expanded, segment 11 elongate, 1.2x length of segment 10, each segment, except segment 1, with some very small setae on inside apically. Maxillary palpus, elongate, segment 4 relatively broad, as long as segments 1–3 combined.

Pronotum: A little narrower than elytra; anteriolateral angles projecting strongly forward; base moderately constricted, posterolateral angles squarish, overlying elytra somewhat; smooth, reticulation weak, punctures very weak, sparse; basal plicae relatively strong, quite deeply excavated on insides, inwardly curved, reaching to about half way along pronotum; with row of long setae laterally in anterior half.

Elytra: Not fused, lacking inner ridges; elongate, widest behind middle; smooth, very weakly reticulate, sparsely covered with small punctures, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated from rest of elytron, that portion of elytron visible ventrally, relatively broad in anterior third, less so along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, sides subparallel, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metathorax triangular in front in midline; wings narrow; rounded or weakly triangular in midline behind. Metacoxal plates large, shiny, virtually nonreticulate, metacoxal lines weak, well separated, short, straight; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct only in inner half, ventrites 3–5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs: Protibia triangular, relatively broad, widest near apex where it is about five times its basal width; protarsus moderately expanded, segment 1 about 1.5x as long as broad, segment 2 as wide as segment 1 and about a half its length, segment 3 about as long as segment 1, about as wide, bifid, segment 4 very small, hidden within lobes of segment 3, segment 5 narrow, cylindrical, about 2x length of segment 3, segments 1–3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate/rectangular with a few thin setae on inner edge near tip; mesofemur with 4 spines on inner edge near base (Fig. 139); mesotarsus similar to protarsus, a little more elongate. Metatrochanter relatively large, tip bluntly pointed (Fig. 140); metafemur relatively thin, broadening in apical half (Fig. 140), lacking spines; metatibia very narrow, moderately curved, widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination a little shorter than others; claws weak.

Male: Little external differences between the sexes. Median lobe of aedeagus relatively broad, narrowing towards tip, tip truncated; paramere relatively broad, apical segment short, apical lobe thin (Figs 136–138).

Etymology

Named after the type locality.

Remarks

A small species with four spines on the mesofemur, only a trace of the suture between ventrites 1 and 2, stout antennae and slightly asymmetric mesotarsal segments. Separated from *L. melitaensis*, which occurs in the same calcrete by its smaller size (1.4 mm vs. 2.2–2.5 mm) and four as against six mesofemoral spines.

Limbodessus murrumensis sp. nov

FIGS 142–147

Holotype: Australia; Western Australia. m., 'BES 13037' 'Murrum stn MRB2 28.2769S 117.325E 15/10/05 WF Humphreys & R Leys', slide mounted, WAM70523.

Paratypes: 3, as for holotype 2 SAMA (1 card 1 slide) 1 WAM70524 (alcohol).

Description (number examined, 4)

Habitus: Length 2.1 – 2.3 mm; relatively flat, moderately constricted at junction of pronotum/elytra; elongate oval; uniformly pale testaceous; hindwing reduced, about half length of elytron.

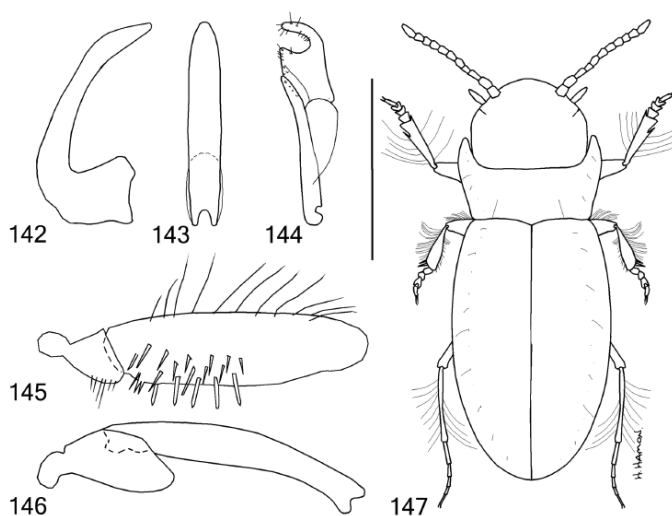
Head: Narrower than elytra; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, widest in middle; eye remnant reduced to short suture line. Antenna moderately stout, segment 1 cylindrical, segment 2 about as wide, barrel-like, segment 3 about as long as segment 2, narrower, narrowing towards base, segment 4 a bit smaller, segments 5–10 approximately equal in shape, progressively slightly shorter, segment 11 elongate, 2x length of segment 10, each segment, except segment 1, with some very small setae on inside apically. Maxillary palpus, elongate, segment 4 relatively broad, a little longer than segments 1–3 combined.

Pronotum: A little narrower than elytra; anteriolateral angles projecting strongly forward; base quite strongly constricted, posterolateral angles acute, overlying elytra somewhat; smooth, reticulation obsolete, punctures small, moderately dense, setiferous; basal plicae very weak, straight, short; with row of long setae laterally in anterior half.

Elytra: Not fused, lacking inner ridges; elongate, widest behind middle, smooth, very weakly reticulate, moderately densely and evenly covered with small setiferous punctures; a few additional larger punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated from rest of elytron, virtually lacking except for short distance near base of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, bullet-shaped, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metathorax weakly triangular in front in midline; wings narrow; rounded in midline behind. Metacoxal plates large, finely rugose, virtually impunctate, metacoxal lines not traceable, closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct only in inner half, ventrites 3–5 mobile, sparsely covered with very small seta-bearing punctures, finely rugose, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs: Protibia bow-shaped, relatively narrow, widest near apex where it is about 3x its basal width; protarsus weakly expanded, segment 1 about 1.2x as long as broad, segment 2 as wide as segment 1 and about 2/3 its length, segment 3 about as long and wide as segment 1, strongly bilobed, segment 4 very small, hidden



Figures 142–147. *Limbodessus murrumensis* sp. nov.; **142**, lateral view of median lobe of aedeagus; **143**, ditto dorsal view; **144**, paramere; **145**, mesotrochanter and mesofemur; **146**, metatrochanter and metafemur; **147**, dorsal view. Scale bar represents 1 mm (habitus only).

within lobes of segment 3, segment 5 narrow, cylindrical, a little longer than segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate/triangular with a few thin setae on inner edge near tip; mesofemur with 5–6 spines on inner edge near base (Fig. 145); mesotarsus similar to protarsus, a little more elongate. Metatrochanter relatively large, basal portion elongate, tip bluntly pointed (Fig. 146); metafemur relatively thin (Fig. 146), lacking spines; metatibia very narrow, weakly curved, widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination a little shorter than others; claws weak.

Male: Little external differences between the sexes. Median lobe of aedeagus relatively broad, tip rounded, paramere relatively narrow, apical segment relatively short with thin apical lobe well separated from rest of segment (Figs 142–144).

Etymology

Named after the type locality.

Remarks

The dense covering of short setae on the elytra separates it from similar sized species of *Limbodessus*. In this respect it resembles *Bidessodes gutteridge* Watts and Humphreys. However the parameres are typical of *Limbodessus* and DNA sequence data place it clearly within *Limbodessus* (R Leys *pers com.*)

Limbodessus nyungduo sp. nov

FIGS 148 – 150

Holotype: Australia; Western Australia. F., ‘BES7251 DNA v (oucher) Challa Station, Nyung Well 27 59 18S 118 31 03E WFHumphreys CHS Watts & S Cooper 3/5/01’ (slide), WAM70525.

Paratypes: 2; 1, ‘BES 10438 27/5/04 Challa Station North Nyung Well 27.98842 118.51750 WFHumphreys CHS Watts C Clay’ (card), SAMA; 1, ‘BES7251 DNA voucher 27 59 18S 118 31 03E WFHumphreys CHS Watts & S Cooper 3/5/01’ (slide), SAMA

Description (number examined, 3)

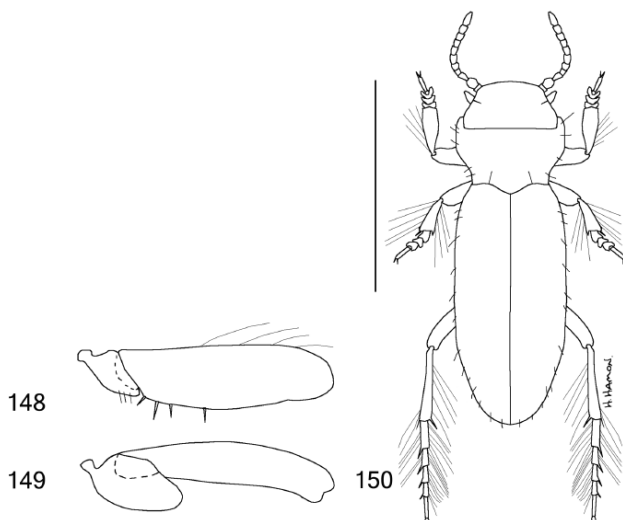
Habitus: Length 1.6 mm; relatively flat, quite strongly constricted at junction of pronotum/elytra; elongate oval; uniformly pale testaceous; hindwing reduced, about 1/3 length of elytron.

Head: Narrower than elytra; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, widest in middle; eye remnant reduced to suture line. Antenna stout, segment 1 cylindrical, segment 2 broader, barrel-shaped, segment 3 a bit shorter than segment 2, narrower, narrowing towards base, segment 4 about ½ as long, segments 5–10 approximately equal in shape, stout, inner apical angles slightly expanded, segment 11 elongate, about 2x length of segment 10, each segment, except segment 1, with some very small setae on inside apically. Maxillary palpus, stout, segment 4 relatively broad, as long as segments 1–3 combined.

Pronotum: A little narrower than elytra; anteriolateral angles projecting strongly forward; base quite strongly constricted, posterolateral angles squarish, overlying elytra somewhat; smooth, reticulation weak, punctures very weak, sparse; basal plicae obsolete; with row of long setae laterally in anterior half.

Elytra: Not fused, lacking inner ridges; elongate, widest behind middle, smooth, very weakly reticulate, moderately covered with small setiferous punctures, a few larger punctures near suture, particularly in apical half; a few additional larger punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated from rest of elytron, that portion of elytron visible ventrally, moderately broad in anterior 1/5, virtually absent along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, sides subparallel, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae.



Figures 148–150. *Limbodessus nyungduo* sp. nov.; **148**, mesotrochanter and mesofemur; **149**, metatrochanter and metafemur; **150**, dorsal view. Scale bar represents 1 mm (habitus only).

Mesocoxae in contact at midline. Metathorax triangular in front in midline; wings narrow; rounded in midline behind. Metacoxal plates large, shiny, virtually nonreticulate, metacoxal lines weak, well separated, short, straight; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct.

Legs: Protibia triangular, relatively broad, widest near apex where it is about five times its basal width; protarsus moderately expanded, segment 1 about 1.5x as long as broad, segment 2 as wide as segment 1 and about a half its length, segment 3 about as long as segment 1, about as wide, bifid, segment 4 very small, hidden within lobes of segment 3, segment 5 narrow, cylindrical, about 2x length of segment 3, segments 1–3 with covering of adhesive setae; claws short, simple. Mesotrochanter elongate/triangular with a few thin setae on inner edge near tip; mesofemur with 3 spines on inner edge, 2 near base, 1 more distant (Fig. 148); mesotarsus similar to protarsus, a little more elongate. Metatrochanter relatively large, tip rounded (Fig. 149); metafemur relatively thin (Fig. 149), lacking spines; metatibia very narrow, moderately curved, widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination a little shorter than others; claws weak.

Male: Not known

Etymology

Latin. ‘*Duo*’ – two. A reference to the working rubric ‘Nyung Well sp 2’.

Remarks

The smallest of the three known species from the Nyung Well calcrete, recognized by its small size, stout appendages and strongly constricted pronotal base. In general it resembles *L. micromelitaensis* but can be distinguished by the complete suture line between ventrites 1 and 2.

Limbodessus ordinarius sp. nov.

FIGS151–156

Holotype: Australia, Western Australia; m, ‘BES 13116 Black Range north MEB 111 23/10/2005 27.71371S 119.39969E WF Humphreys & R Leys’ slide mounted, WAM70526.

Paratypes: 6; 2, ‘BES14367’ ‘Black Range north MEB site 88 –27.54 119.6243 20/9/06 WF Humphreys & S Cooper’, 1 SAMA (slide) 1 WAM70527 (alcohol); 1 ‘BES 13222’ Black Range south MEB 160. –27.8286S

119.3213E. 2/4/06 WF Humphreys & S Cooper', WAM70530 (alcohol); 3, 'BES 13231' 'Lake Mason Stn, Black Range north MEB 164 -27.7137S 119.3997E, 3/4/06, WF Humphreys & T.Moulds', WAM70528 - 70529 (alcohol).

Description (number examined, 7)

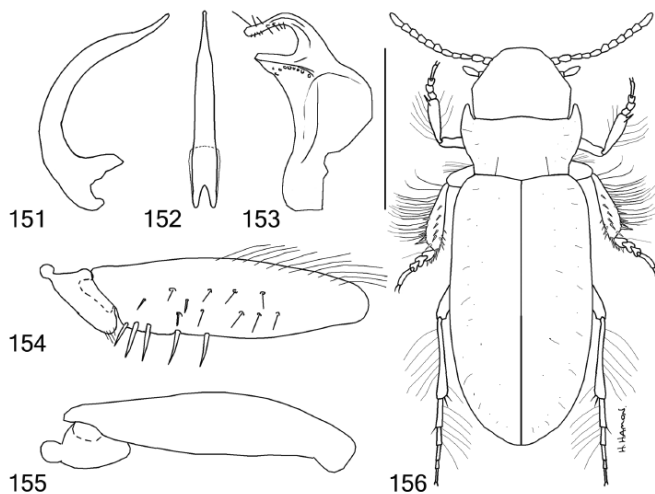
Habitus: Length 2.4–2.7 mm; relatively flat, moderately constricted at junction of pronotum/elytra; elongate oval; uniformly pale testaceous; hindwing reduced, about half length of elytron.

Head: Narrower than elytra; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to small oval/triangular area. Antenna moderately stout, segment 1 cylindrical, segment 2 about as broad, barrel-like, segment 3 a bit shorter than segment 2, much narrower, narrowing towards base, segment 4 a bit smaller, segments 5–10 approximately equal in shape, stout, inner apical angles slightly expanded, segment 11 elongate, almost 2x length of segment 10, each segment, except segment 1, with some very small setae on inside apically. Maxillary palpus, elongate, segment 4 relatively broad, as long as segments 1–3 combined.

Pronotum: As wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly constricted, posterolateral angles acute, overlying elytra somewhat; smooth, reticulation weak, punctures very weak, sparse; basal plicae weak, straight, reaching to about 1/3 way along pronotum; with row of long setae laterally in anterior half.

Elytra: Not fused, lacking inner ridges; elongate, widest behind middle, smooth, very weakly reticulate, sparsely covered with small punctures; a few additional larger punctures with long setae, more frequent towards sides, row of quite strong punctures near suture. Epipleuron weakly differentiated from rest of elytron, that portion of elytron visible ventrally, relatively broad in anterior third, less so along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, sides subparallel, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metathorax broadly triangular in front in midline; wings narrow; rounded in midline behind. Metacoxal plates large, shiny, virtually nonreticulate, metacoxal lines obsolete; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct only in inner half, ventrites 3–5 mobile, very sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.



Figures 151–156. *Limbodessus ordinarius* sp. nov.; **151**, lateral view of median lobe of aedeagus; **152**, ditto dorsal view; **153**, paramere; **154**, mesotrochanter and mesofemur; **155**, metatrochanter and metafemur; **156**, dorsal view. Scale bar represents 1 mm (habitus only).

Legs: Protibia club-shaped, moderately broad, widest near apex where it is about 4x its basal width; protarsus moderately expanded, segment 1 about 1.2x as long as broad, segment 2 as wide as segment 1 and about a half its length, segment 3 about as long as segment 1, about as wide, deeply bilobed, segment 4 very small, hidden within lobes of segment 3, segment 5 narrow, cylindrical, about as long as segment 3, segments 1 – 3 with covering of adhesive setae; claws moderately long, simple. Mesotrochanter elongate/triangular, base elongate, a few thin setae on inner edge near tip; mesofemur with 5 spines on inner edge near base (Fig. 154); mesotarsus similar to protarsus, a little more elongate. Metatrochanter relatively large, tip bluntly pointed, base narrow and elongated a bit (Fig. 155); metafemur relatively thin, broadening in apical half (Fig. 155), lacking spines; metatibia very narrow, moderately curved, widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination a little shorter than others; claws weak.

Male: Little external differences between the sexes. Median lobe of aedeagus relatively narrow, narrowing towards tip, tip rounded; paramere broad, apical segment moderately long, apical lobe thin, well separated from rest of segment (Figs 151–153).

Etymology

Latin. ‘*Ordinarius*’ – ordinary. A reference to its ordinary morphology.

Remarks

A moderate sized, elongate species with a small eye remnant, elongate trochanter bases and relatively wide elytral epipleura. Resembles *L. windarraensis* but differs from that species in being a bit larger, by the more elongate antennae, bluntly tipped pronotal process, somewhat pointed rather than rounded metatrochanters and short apical piece to the parameres.

***Limbodessus trispinosus* sp. nov.**

FIGS 157–162

Holotype: Australia; Western Australia; m., ‘WA Windimurra Stn Coffeys Well 24/10/05 28.2861 118.5743 WFHumphreys & R Leys’, slide mounted, WAM70531.

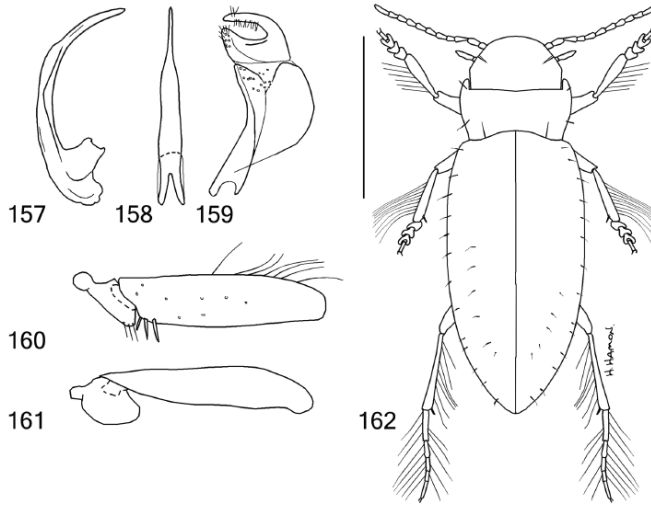
Paratypes: 5, as for holotype, 4 SAMA (3 slide, 1 card) 2 WAM70532 – 70533 (alcohol); 1, ‘BES 5520 Windamurra Station Coffeys Well 28 17 10S 118 34 27E WFHumphreys CHS Watts S Cooper 2/5/01’, WAM70534 (slide).

Description (number examined, 6)

Habitus: Length 2.2 – 2.5 mm; relatively flat, moderately constricted at junction of pronotum/elytra; elongate; uniformly pale testaceous; hindwing reduced, about half length of elytron.

Head. Narrower than elytra; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to single suture line. Antenna relatively elongate, segment 1 cylindrical, segment 2 as long and a bit broader, barrel-like, segment 3 about as long as segment 2, much narrower, narrowing towards base, segment 4 shorter, segments 5–10 approximately equal in shape, stout, inner apical angles slightly expanded, segment 11 elongate, about 2x length of segment 10, each segment, except segment 1, with some very small setae on inside apically. Maxillary palpus, elongate, segment 4 relatively broad, as long as segments 1–3 combined.

Pronotum: A little narrower than elytra; anteriolateral angles projecting strongly forward; base moderately constricted, posterolateral angles acute, overlying elytra somewhat; smooth, reticulation weak, punctures very weak, sparse; basal plicae relatively strong, straight, sloping inwards, reaching to about one third way along pronotum; with row of long setae laterally in anterior half.



Figures 157–162. *Limbodessus trispinosus* sp. nov.; **157**, lateral view of median lobe of aedeagus; **158**, ditto dorsal view; **159**, paramere; **160**, mesotrochanter and mesofemur; **161**, metatrochanter and metafemur; **162**, dorsal view. Scale bar represents 1 mm (habitus only).

Elytra: Not fused, lacking inner ridges; elongate, widest behind middle, smooth, very weakly reticulate, sparsely covered with small punctures; a few additional larger punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated from rest of elytron, that portion of elytron visible ventrally, relatively broad in anterior third, less so along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, sides subparallel, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metathorax triangular in front in midline; wings relatively broad; rounded in midline behind. Metacoxal plates large, shiny, a few small punctures virtually nonreticulate, metacoxal lines not traceable; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct only in inner half, ventrites 3–5 mobile, very sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs: Protibia triangular, moderately broad, widest near apex where it is about five times its basal width; protarsus moderately expanded, segment 1 about 1.2x as long as broad, segment 2 a little wider than segment 1 and about 2/3 its length, segment 3 about as long as segment 1, narrower, deeply bilobed, segment 4 very small, hidden within lobes of segment 3, segment 5 narrow, cylindrical, about as long as segment 3, segments 1–3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate/triangular, base somewhat narrower and elongated, a few thin setae on inner edge near tip; mesofemur with 3 strong spines on inner edge close to base (Fig. 160); mesotarsus similar to protarsus, a little more elongate. Metatrochanter relatively large, base slightly narrowed, tip bluntly pointed (Fig. 161); metafemur thin (Fig. 161), lacking spines; metatibia very narrow, moderately curved, widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination a little shorter than others; claws weak.

Male: Little external differences between the sexes. Median lobe of aedeagus rather narrow, apical quarter thin, tip rounded; paramere relatively broad, apical segment relatively short with thin apical lobe well separated from rest of segment (Figs 157–159).

Etymology

Latin. 'Tri' – three. A reference to the three closely placed spines on the mesofemur.

Remarks

An 'average' species recognized by having only a short remnant of the sutural line between ventrites 1 and 2, a group of 3 spines close to the base of the mesofemur and with both meso- and metatrochanters constricted and elongate at their bases.

Limbodessus yarrabubbaensis sp. nov

FIGS163–168

Holotype: Australia; Western Australia; m., 'BES13097 Yarrabubba Stn MEB site 70 21/10/05 27.0668 118.6784 WFHumphreys & R Leys', slide mounted, WAM70535.

Paratype: As for holotype except 'BES13095', SAMA (slide).

Description (number examined, 2)

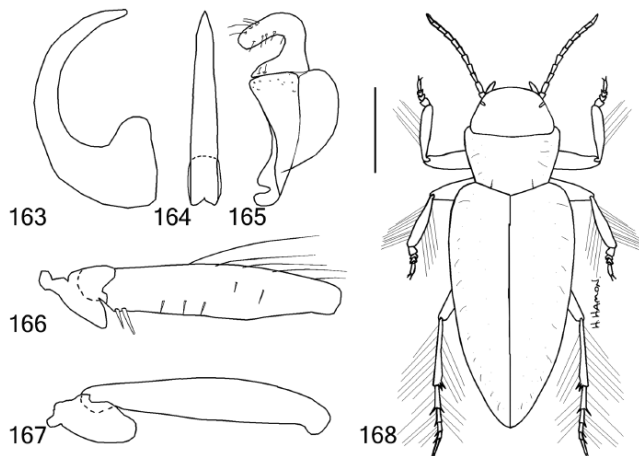
Habitus: Length 4.0 mm; relatively flat, quite strongly constricted at junction of pronotum/elytra; elongate oval; uniformly pale testaceous; hindwing reduced, about half length of elytron.

Head: Narrower than elytra; smooth, punctures sparse, very small except for a few above antennal bases; subparallel in posterior half, widest just behind eye remnant; eye remnant small, elongate-oval. Antenna thin, segment 1 cylindrical, segment 2 similar but slightly curved, barrel-like, segment 3 a bit shorter than segment 2, much narrower, narrowing towards base, segment 4 a bit smaller, segments 5–10 approximately equal in shape, stout, inner apical angles slightly expanded, segment 11 elongate, about 1.2x length of segment 10, each segment, except segment 1, with some very small setae on inside apically. Maxillary palpus, elongate, segment 4 as long as segments 1–3 combined.

Pronotum: A little narrower than elytra; anteriolateral angles projecting strongly forward; base moderately constricted, posterolateral angles obtuse, overlying elytra somewhat; smooth, basal half depressed slightly, reticulation weak, punctures very weak, sparse; basal plicae obsolete; row of long setae laterally in anterior half.

Elytra: Not fused, lacking inner ridges, elongate, widest in middle, smooth, very weakly reticulate, sparsely covered with small punctures, a row of irregularly placed larger punctures near suture, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated from rest of elytron, that portion of elytron visible ventrally, very broad in anterior third, broad along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, sides subparallel, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metathorax weakly triangular in front in midline; wings relatively broad; rounded in midline behind. Metacoxal plates large, shiny, virtually impunctate, weakly reticulate, metacoxal lines obsolete; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct only in inner half, ventrites 3–5 mobile, very sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.



Figures 163–168. *Limbodessus yarrabubbaensis* sp. nov.; **163**, lateral view of median lobe of aedeagus; **164**, ditto dorsal view; **165**, paramere; **166**, mesotrochanter and mesofemur; **167**, metatrochanter and metafemur; **168**, dorsal view. Scale bar represents 1 mm (habitus only).

Legs: Protibia thin, cylindrical in apical half, narrowing towards base in basal half; protarsus weakly expanded, segment 1 about 1.5x as long as broad, segment 2 as wide as segment 1 and about a half its length, segment 3 shorter and narrower than segment 1, deeply bilobed, segment 4 very small, hidden within lobes of segment 3, segment 5 narrow, cylindrical, about as long as 3, segments 1–3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate/triangular with a few thin setae on inner edge near tip; mesofemur with 2 spines on inner edge close to base (Fig. 166); mesotarsus similar to protarsus, a little more elongate. Metatrochanter relatively small, tip rounded (Fig. 167); metafemur thin, (Fig. 167), lacking spines; metatibia very narrow, moderately curved, widening towards apex; metatarsus elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination, about as long as others; claws weak.

Male: Little external differences between the sexes. Median lobe of aedeagus narrow, narrowing towards tip, tip pointed; paramere relatively broad, apical segment short with thick apical lobe well separated from rest of segment (Figs 163–165).

Etymology

Named after the pastoral station on which it was found.

Remarks

A large species recognized by its small head, wide wrap-around elytral epipleura reminiscent of some *Paroster*, and, despite its large size, only 2 spines on the mesofemur.

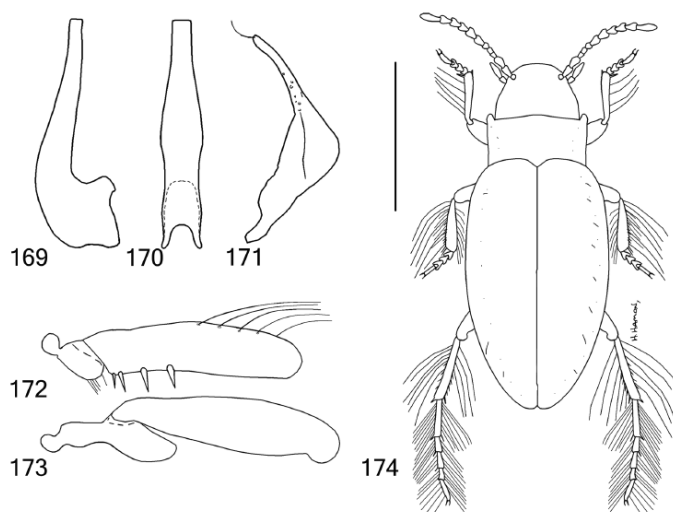
Paroster Sharp 1882

Paroster elongatus sp. nov.

FIGS 169–174

Holotype: Australia; Western Australia; f., ‘BES 6645 Pinnacles Station Site 432 28 15’ 27S 120 07’ 37E 14/5/01 WF Humphreys & CHS Watts S Cooper’, slide mounted, WAM70536.

Paratype: m. 1 partial. ‘BES14349 Pinnacles Station, large bore adj site 79 28.2574 120.1269 19/9/06’, SAMA (slide).



Figures 169–174. *Paroster elongatus* sp. nov.; **169**, lateral view of median lobe of aedeagus; **170**, ditto dorsal view; **171**, paramere; **172**, mesotrochanter and mesofemur; **173**, metatrochanter and metafemur; **174**, dorsal view. Scale bar represents 1 mm (habitus only).

Description (number examined, 2, 1 partial)

Habitus: Length 2.3 mm; elongate, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

Head. Relatively small, much narrower than elytra; smooth, weak reticulation, a few small punctures; sides parallel in posterior half; eye remnant almost completely absent. Antenna moderately stout, segment 1 cylindrical, segment 2 barrel-shaped, segment 3 shorter than segment 2, half as wide, narrower in basal half, segment 4 cylindrical, half length of segment 2, segment 5 as long as segment 3, narrowing in basal half, slightly bulbous on inside apically, segments 6–10 longer, thin, subequal, slightly bulbous on inner apical angle, segment 11 1.2x length of segment 10, thinner, tip conical, each segment with some very small setae on inside apically. Maxillary palpus thin, elongate, segment 4 about as long as segments 2 and 3 combined.

Pronotum: Much narrower than elytra; anteriolateral angles projecting forward; sides subparallel, posterolateral angles right angles; a few scattered punctures; a few long setae at sides particularly towards front; weakly reticulate.

Elytra: Not fused, lacking inner ridges; elongate, widest in middle; smooth, sparsely covered with moderately strong fine reticulation; evenly but sparsely covered with small punctures, a few slightly larger punctures with long setae, larger and denser towards sides and apex. Epipleuron moderately differentiated, broad in anterior fifth, virtually absent along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half with sides subparallel, tip weakly pointed, arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact in midline. Metathorax projecting forward in midline; wings thin; narrowly rounded in midline behind. Metacoxal plates large, metacoxal lines weak, well separated, weakly diverging in front quarter, reaching nearly to mesosternum; sparsely covered with very small punctures, moderately reticulate; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct.

Legs: Protibia very narrow, almost cylindrical; protarsus weakly expanded, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 stout, cylindrical, longer than segment 3, segments 1 to 3 with adhesive setae; claws short and simple. Mesotrochanter rather small with a few very fine setae at apex; mesofemur with row of 4 stout spines along hind edge in basal half (Fig. 172); mesotibia with inner apical spine slightly enlarged, mesotarsus about as long as protarsus. Metatrochanter thin, basal half constricted, greatly elongate, apex weakly pointed, tip close to metafemur (Fig. 173); metafemur relatively thin; metatibia stout, weakly curved; metatarsus greatly elongate, segments cylindrical, segments 1 and 5 longest, segment 4 shortest, in combination segments 1 and 2 shorter than others, all segments without spines other than at apex; claws very weak.

Male: Median lobe of aedeagus relatively narrow, sides sinuate, apex truncated; paramere thin in apical half, with a single long setae at tip (Figs 169–171).

Etymology

A reference to the greatly elongated metatrochanter bases.

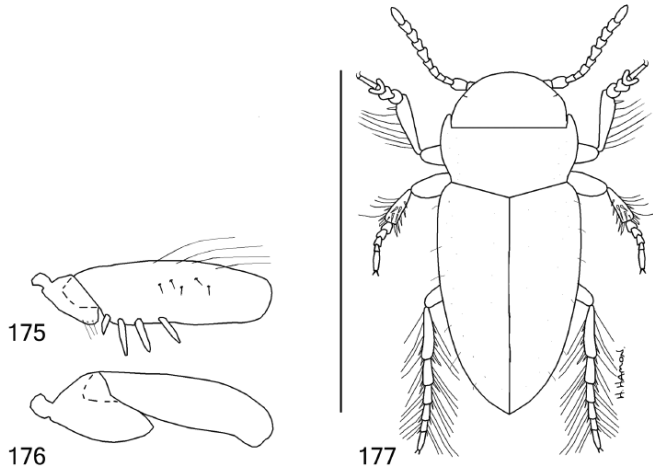
Remarks

A small-headed species with straight sides to the pronotum, most easily recognized by the narrow protibia, unusually lengthened metatrochanter bases and long metatarsi. It occurs together with two other species in the small Pinnacles Station calcrete (Table 1), one of which, *Limbodessus pinnaclesensis*, also has elongated metatrochanter bases but to nowhere near the same extent.

Paroster novem sp. nov.

FIGS 175–177

Holotype: Australia; Northern Territory; f., 'BES 7295 Newhaven Stn. Camel Bore. RN 10150 15/6/01 22.93439S 131.23972E WF Humphreys & A.Russ', slide mounted, NTM.



Figures 175–177. *Paroster novem* sp. nov.; **175**, mesotrochanter and mesofemur; **176**, metatrochanter and metafemur; **177**, dorsal view. Scale bar represents 1 mm (habitus only).

Description (number examined, 1)

Habitus: Length 1.0 mm; moderately elongate, relatively flat, moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to about 1/3 length of elytra.

Head: Relatively large, narrower than elytra; smooth, reticulation moderately strong, a few scattered small punctures; sides parallel in posterior half; eye remnant reduced to short suture. Antenna stout, segment 1 cylindrical, segment 2 much broader, barrel-shaped, segment 3 about 1/3 as long as segment 2, 1/3 width, slightly narrower in basal half, segment 4 cylindrical, a little shorter than segment 2, segments 5 and 6 bit longer and wider than segment 4, segments 7–10 subequal, broader than segment 6, narrowing in basal half, bulbous apically on outside, segment 11 1.5x length of segment 10, each segment with some very small setae on inside apically. Maxillary palpus stout, segment 4 a little longer than segments 2 and 3 combined.

Pronotum. About as wide as elytra; anteriolateral angles projecting forward; sides curved, quite strongly constricted at base, posterolateral angles acute; a few scattered minute punctures and some larger ones along front margin; long setae at sides particularly towards front; strongly reticulate.

Elytra: Not fused, lacking inner ridges; elongate, widest just behind shoulders; smooth; reticulation moderately strong; evenly but sparsely covered with small punctures, a few slightly larger punctures with long setae, more frequent towards apex and sides. Epipleuron moderately differentiated, relatively broad along most of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half oval, sharply pointed behind, arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact in midline. Metathorax projecting forward in midline; wings short; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines obsolete; sparsely covered with small punctures, strongly reticulate; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct only in inner 2/3, ventrites 3–5, strongly reticulate with scattered small punctures and a few long central setae or bunch of long setae.

Legs: Protibia moderately broad, widest near apex where it is about 3x its basal width; protarsus moderately expanded, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 stout, cylindrical, longer than segment 3, segments 1–3 with adhesive setae; claws short and simple. Mesotrochanter elongate with a few very fine setae at apex; mesofemur with row of 4 very stout spines along hind edge in basal half (Fig. 175); mesotarsus longer than protarsus, segments only weakly expanded, segment 3 not bifid, segment 4 relatively large. Metatrochanter very large, elongate, apex weakly pointed (Fig. 176); metafemur stout; metatibia stout, weakly curved, weakly expanded towards apex;

metatarsus elongate, segments cylindrical, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 shorter than others, all segments without spines other than at apex; claws weak.

Male: Not known.

Etymology

Latin. 'Novem' – nine. A reference to the working rubric 'NT 9'.

Remarks

The smallest of the five stygobitic Dytiscidae now known from Camel Bore, recognized, apart from its small size, by its stout hind legs and blunt mesofemoral spines.

Paroster readi sp. nov.

FIGS 178–183

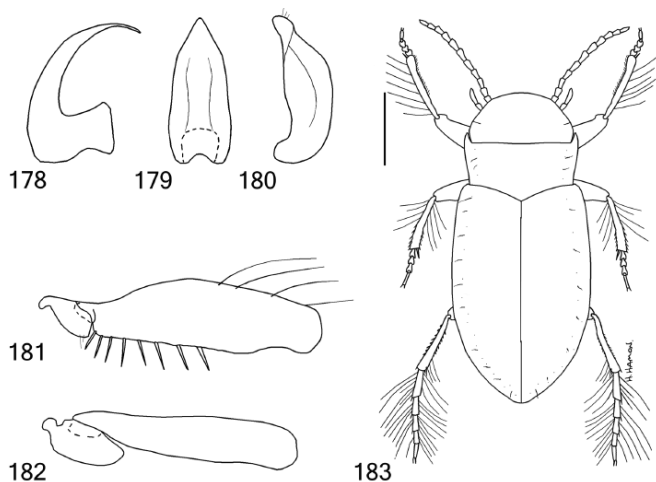
Holotype: Australia; Northern Territory; m., 'BES 10078' 'Yelabra Well 22.89801S 131.5746E, 5/05, WF Humphreys & CHS Watts', (card), NTM.

Paratypes: 3 (cards), 'Newhaven Stn bore RN15494 22.9344S 131.2397E WF Humphreys & R.Read 19/8/02', 2 SAMA 1 WAM70537.

Description (number examined, 4)

Habitus: Length 3.6 – 3.9 mm; elongate, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

Head: Relatively large, narrower than elytra; smooth, small punctures in region above antennal bases; sides weakly converging in anterior half; eye remnant reduced to short suture. Antenna thin, segments 1 and 2 cylindrical, segments 3 and 4 as long as segment 2, half width, narrower in basal half, segments 5–10 about same length as segment 4, narrowing in basal half, weakly bulbous on inside apically, segment 11 1.5x length of segment 10, thinner, tip conical, each segment with some very small setae on inside apically. Maxillary palpus thin, elongate, segment 4 a little longer than segments 2 and 3 combined.



Figures 178–183. *Paroster readi* sp. nov.; **178**, lateral view of median lobe of aedeagus; **179**, ditto dorsal view; **180**, paramere; **181**, mesotrochanter and mesofemur; **182**, metatrochanter and metafemur; **183**, dorsal view. Scale bar represents 1 mm (habitus only).

Pronotum. Narrower than elytra; anteriolateral angles projecting forward; sides converging slightly towards rear, posterolateral angles right angles; impunctate except for a row of punctures along front margin; a few long setae at sides particularly towards front; not reticulate.

Elytra: Not fused, lacking inner ridges; elongate, widest just behind middle; shiny, sparsely covered with small punctures, larger and denser towards sides and apex. Epipleuron moderately differentiated, broad in anterior fifth, virtually absent along rest of elytron.

Ventral surface: Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half diamond-shaped, arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact in midline. Metathorax projecting forward in midline; wings relatively short; widely rounded in midline behind. Metacoxal plates large, metacoxal lines very weak, moderately separated, parallel, reaching about $\frac{1}{2}$ way to mesosternum; without punctures, virtually without reticulation; closely adpressed to ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3–5 not fused, shiny, without punctures or reticulation, a few long central setae or bunch of long setae.

Legs: Protibia narrow, widest near apex where it is about 2x its basal width; protarsus weakly expanded, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 stout, cylindrical, longer than segment 3, segments 1–3 with adhesive setae; claws short and simple. Mesotrochanter elongate with a few very fine setae at apex; mesofemur with row of 8–10 long stout spines along hind edge in basal half (Fig. 181); metafemur relatively thin; metatibia moderately, weakly curved, weakly expanded towards apex; metatarsus elongate, segments 1–4 progressively shorter, segment 5 a little longer than segment 4, in combination segments 1 and 2 about as long as others, all segments without spines other than at apex; claws very weak.

Male: Median lobe of aedeagus broad, sides subparallel, narrowing to rounded apex; paramere relatively elongate (Figs 178–180).

Etymology

Named after John Read of Alice Springs for his great support of stygobiological surveys of the southern Northern Territory.

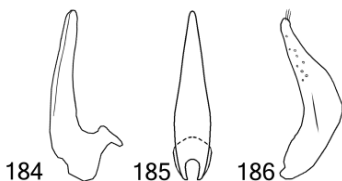
Remarks

The largest of the four *Paroster* species now known from the Newhaven Station Camel Well calcrete (Table 1). Initially confused with the slightly larger and more elongate *Exocelina abdita*, which occurs in the same calcrete and from which it can be separated by the lack of a visible scutellum.

Paroster tetrameres Watts & Humphreys

FIGS 184–186

This unusual species with only four segments to the pro- and mesotarsi was described from two female specimens. On 14/9/2006 several more specimens were collected two of which were male enabling the male of the species to be described. As expected the tarsi of the male do not differ from those of the female and are similarly lacking the fourth tarsal segment. Like the female the protarsi are quite strongly expanded but the mesotarsi are not. The male genitalia are typical of *Paroster* and are described below.



Figs 184–186. *Paroster tetrameres* (Watts and Humphreys); **184**, lateral view of median lobe of aedeagus; **185** ditto dorsal view; **186**, paramere.

Male: No external difference between the sexes. Aedeagus with medium lobe relatively narrow, evenly narrowing to blunt point. Paramere narrowly triangular, tip rounded with 2–3 moderately long setae (Fig. 186).

Specimens examined: 9, ‘BES 14258 Mt Augustus Station Isabel Well 24.386S 117.0193E 14/9/06’, 5 WAM70538 – 70542, 4 SAMA.

Limbodessus kurutjutu (Watts & Humphreys, 1999), comb. nov.

Kintingka kurutjutu Watts & Humphreys, 1999.

FIGS 187–191

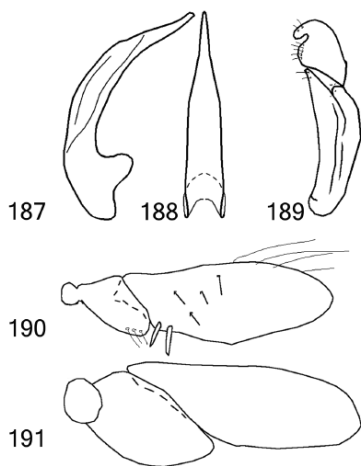
Supplementary description (number examined, 3).

Elytra: Without row of punctures close to the suture.

Legs: Mesofemur with 2 short spines on hind edge near base (Fig 190).

Male: No external difference between the sexes. Median lobe of aedeagus relatively short and broad, narrowing towards tip, tip bluntly pointed; paramere relatively narrow, apical segment with short, stubby, apical lobe separated from rest of segment (Figs 187–189).

Specimens examined: 1, ‘BES6032’ ‘Paroo Station GSWA5 26.44028S 119.77194E 25/6/1998 S.MN.Eberhard’, WAM9975; 1, ‘BES 12920 Paroo Station GSWA16 26.43389 119.77722 9/4/05 WFHumphreys, R Leys’, SAMA; 1, ‘BES 12906 Paroo GSWA 5 26.44028 119.77194 8/4/05 WFHumphreys R Leys’, SAMA.



Figures 187–191. *Paroster kurutjutu* (Watts and Humphreys); **187**, lateral view of median lobe of aedeagus; **188**, ditto dorsal view; **189**, paramere. **190**, mesotrochanter and mesofemur; **191**, metatrochanter and metafemur.

Remarks

Initially only known from a single female specimen (Watts & Humphreys 1999) two specimens including a male were recently collected from the type locality. The parameres are two segmented placing the species in the Bidessini. The apical segment of the paramere has an apical lobe typical of *Limbodessus*. Other morphological characters also fit within the definition of *Limbodessus* given in Balke and Ribera, 2004. DNA sequence analysis places the species clearly within *Limbodessus* (Remko Leys pers com). From these observations it is clear that the genus *Kintingka* is a junior synonym of *Limbodessus*. Accordingly we herein synonymise *Kintingka* Watts and Humphreys 1999 with *Limbodessus* Guignot 1939.

The species can be easily recognized by its small size, stout legs and very large mesotrochanters (Fig. 191).

CHECKLIST OF AUSTRALIAN STYGOBITIC DYTISCIDAE AS OF DECEMBER 2008

Limbodessus Guignot, 1939*Tjirtudessus* Watts & Humphreys, 1999. Balke & Ribera, 2004.*Nirridessus* Watts & Humphreys, 1999. Balke & Ribera, 2004.*Boongurrus* Larson, 1994. Balke & Ribera, 2004.*Kintingka* Watts & Humphreys, 1999, syn. nov.

<i>L. atypicalis</i> Watts & Humphreys, 2006	NT
<i>L. barwidgeeensis</i> Watts & Humphreys, 2006	WA
<i>L. bialveus</i> (Watts & Humphreys, 2003) (<i>Tjirtudessus</i>)	WA
<i>L. bigbellensis</i> (Watts & Humphreys, 2000) (<i>Nirridessus</i>)	WA
<i>L. challaensis</i> (Watts & Humphreys, 2001) (<i>Nirridessus</i>)	WA
<i>L. cooperi</i> Watts & Humphreys, 2006	WA
<i>L. cueensis</i> (Watts & Humphreys, 2000) (<i>Nirridessus</i>)	WA
<i>L. cunyuensis</i> (Watts & Humphreys, 2003) (<i>Tjirtudessus</i>)	WA
<i>L. eberhardi</i> (Watts & Humphreys, 1999) (<i>Tjirtudessus</i>)	WA
<i>L. exilis</i> Watts & Humphreys, 2006	WA
<i>L. fridaywellensis</i> (Watts & Humphreys, 2001) (<i>Nirridessus</i>)	WA
<i>L. jundeeensis</i> (Watts & Humphreys, 2003) (<i>Tjirtudessus</i>)	WA
<i>L. hinkleri</i> (Watts & Humphreys, 2000) (<i>Nirridessus</i>)	WA
<i>L. karalundiensis</i> (Watts & Humphreys, 2003) (<i>Tjirtudessus</i>)	WA
<i>L. kurutjutu</i> (Watts & Humphreys, 1999). Syn. nov. (<i>Kintingka</i>)	WA
<i>L. lapostaae</i> (Watts & Humphreys, 1999) (<i>Nirridessus</i>)	WA
<i>L. leysi</i> , Watts & Humphreys, 2006	WA
<i>L. lornaensis</i> sp. nov.	WA
<i>L. gumwellensis</i> Watts & Humphreys, 2006	WA
<i>L. hahni</i> (Watts & Humphreys, 2000) (<i>Tjirtudessus</i>)	WA
<i>L. harleyi</i> Watts & Humphreys, 2006	WA
<i>L. hillviewensis</i> (Watts & Humphreys, 2004) (<i>Tjirtudessus</i>)	WA
<i>L. insolitus</i> sp. nov.	WA
<i>L. macrolornaensis</i> sp. nov.	WA
<i>L. macrohinkleri</i> Watts & Humphreys, 2006	WA
<i>L. macrotarsus</i> (Watts & Humphreys, 2003) (<i>Tjirtudessus</i>)	WA
<i>L. magnificus</i> (Watts & Humphreys, 2000) (<i>Tjirtudessus</i>)	WA
<i>L. masonensis</i> (Watts & Humphreys, 2001) (<i>Nirridessus</i>)	WA
<i>L. melitaensis</i> Watts & Humphreys, 2006	WA
<i>L. millbilliensis</i> Watts & Humphreys, 2006	WA
<i>L. microbubba</i> sp. nov.	WA
<i>L. micromelitaensis</i> sp. nov.	WA
<i>L. micrommatoion</i> Watts & Humphreys, 2006	WA
<i>L. microocula</i> (Watts & Humphreys, 2004) (<i>Tjirtudessus</i>)	WA
<i>L. mirandaae</i> Watts & Humphreys, 2006	WA
<i>L. morgani</i> (Watts & Humphreys, 2000) (<i>Nirridessus</i>)	WA
<i>L. murrumensis</i> sp. nov.	WA
<i>L. narryerensis</i> Watts & Humphreys, 2006	WA
<i>L. nambiensis</i> Watts & Humphreys, 2006	WA
<i>L. nyungduo</i> sp. nov.	WA
<i>L. pulpa</i> (Watts & Humphreys, 1999) (<i>Nirridessus</i>)	WA
<i>L. occidentalis</i> (Watts & Humphreys, 2004) (<i>Boongurrus</i>)	WA
<i>L. ordinarius</i> sp. nov.	WA
<i>L. padburyensis</i> (Watts & Humphreys, 2004) (<i>Tjirtudessus</i>)	WA
<i>L. palmulaoides</i> Watts & Humphreys, 2006	WA

<i>L. phoebeae</i> Watts & Humphreys, 2006	WA
<i>L. pinnaclesensis</i> (Watts & Humphreys, 2001) (<i>Nirridessus</i>)	WA
<i>L. raeae</i> Watts & Humphreys, 2006	WA
<i>L. raesidensis</i> (Watts & Humphreys, 2001) (<i>Tjirtudessus</i>)	WA
<i>L. silus</i> (Watts & Humphreys, 2003) (<i>Tjirtudessus</i>)	WA
<i>L. sweetwatersensis</i> (Watts & Humphreys, 2003) (<i>Tjirtudessus</i>)	WA
<i>L. surreptitius</i> Watts & Humphreys, 2006	WA
<i>L. trispinosus</i> sp. nov.	WA
<i>L. usitatus</i> Watts & Humphreys, 2006	WA
<i>L. wogarthaensis</i> (Watts & Humphreys, 2004) (<i>Tjirtudessus</i>)	WA
<i>L. wilunaensis</i> (Watts & Humphreys, 2003) (<i>Tjirtudessus</i>)	WA
<i>L. windarraensis</i> (Watts & Humphreys, 1999) (<i>Nirridessus</i>)	WA
<i>L. yandalensis</i> Watts & Humphreys, 2006	WA
<i>L. yarrabubbaensis</i> sp. nov.	WA
<i>L. yuinmeryensis</i> (Watts & Humphreys, 2003) (<i>Tjirtudessus</i>)	WA

***Paroster* Sharp, 1882**

Nirridessus Watts & Humphreys, 2001. Leys & Watts 2008.

<i>P. arachnoides</i> Watts & Humphreys, 2004) (<i>Nirripirti</i>)	WA
<i>P. bulbus</i> (Watts & Humphreys, 2004) (<i>Nirripirti</i>)	WA
<i>P. byroensis</i> (Watts & Humphreys, 2004) (<i>Nirripirti</i>)	WA
<i>P. copidotibiae</i> (Watts & Humphreys, 2004) (<i>Nirripirti</i>)	WA
<i>P. darlotensis</i> (Watts & Humphreys 2003) (<i>Nirripirti</i>)	WA
<i>P. dingbatensis</i> (Watts & Humphreys, 2004) (<i>Nirripirti</i>)	WA
<i>P. elongatus</i> sp. nov.	WA
<i>P. eurypleuron</i> (Watts & Humphreys, 2004) (<i>Nirripirti</i>)	WA
<i>P. innouendyensis</i> (Watts & Humphreys, 2004) (<i>Nirripirti</i>)	WA
<i>P. fortisspina</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	WA
<i>P. hinzeae</i> (Watts & Humphreys, 2001) (<i>Nirripirti</i>)	WA
<i>P. hamoni</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	WA
<i>P. killaraensis</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	WA
<i>P. macrocephalus</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	NT
<i>P. macrosturtensis</i> (Watts & Humphreys, 2006) (<i>Nirripirti</i>)	WA
<i>P. melroseensis</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	WA
<i>P. megamacrocephalus</i> (Watts & Humphreys, 2006) (<i>Nirripirti</i>)	NT
<i>P. mesosturtensis</i> (Watts & Humphreys, 2006) (<i>Nirripirti</i>)	WA
<i>P. microsturtensis</i> (Watts & Humphreys, 2006) (<i>Nirripirti</i>)	WA
<i>P. milgunensis</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	WA
<i>P. napperbyensis</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	NT
<i>P. newhavenensis</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	NT
<i>P. novem</i> sp. nov.	NT
<i>P. peelensis</i> Watts, Hancock & Leys, 2008	NSW
<i>P. readi</i> sp. nov.	NT
<i>P. septum</i> (Watts & Humphreys, 2006) (<i>Nirripirti</i>)	NT
<i>P. stegastos</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	WA
<i>P. skaphites</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	WA
<i>P. tetrameres</i> (Watts & Humphreys, 2006) (<i>Nirripirti</i>)	WA
<i>P. pentameres</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	NT
<i>P. plutonicensis</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	WA
<i>P. verrucosus</i> (Watts & Humphreys, 2004) (<i>Nirripirti</i>)	WA
<i>P. wedgeensis</i> (Watts & Humphreys, 2003) (<i>Nirripirti</i>)	NT

Carabhydrus Watts, 1978*C. stephanieae* Watts, Hancock & Leys, 2007

NSW

Bidessodes Regimbart, 1900*B. limestoneensis* Watts & Humphreys, 2003

WA

B. gutteridgei Watts & Humphreys, 2003

WA

Exocelina Broun, 1886*Copelatus* Erichson, 1832, subgenus *Papuadytes* Balke, 1998*Papuadytes* Balke, 1998. Balke et al 2004b, Nilsson 2007*E. abdita* (Balke, Watts, Cooper, Humphreys & Vogler, 2004),
Nilsson 2007 (*Copelatus*)

NT

E. rasjadi sp. nov

WA

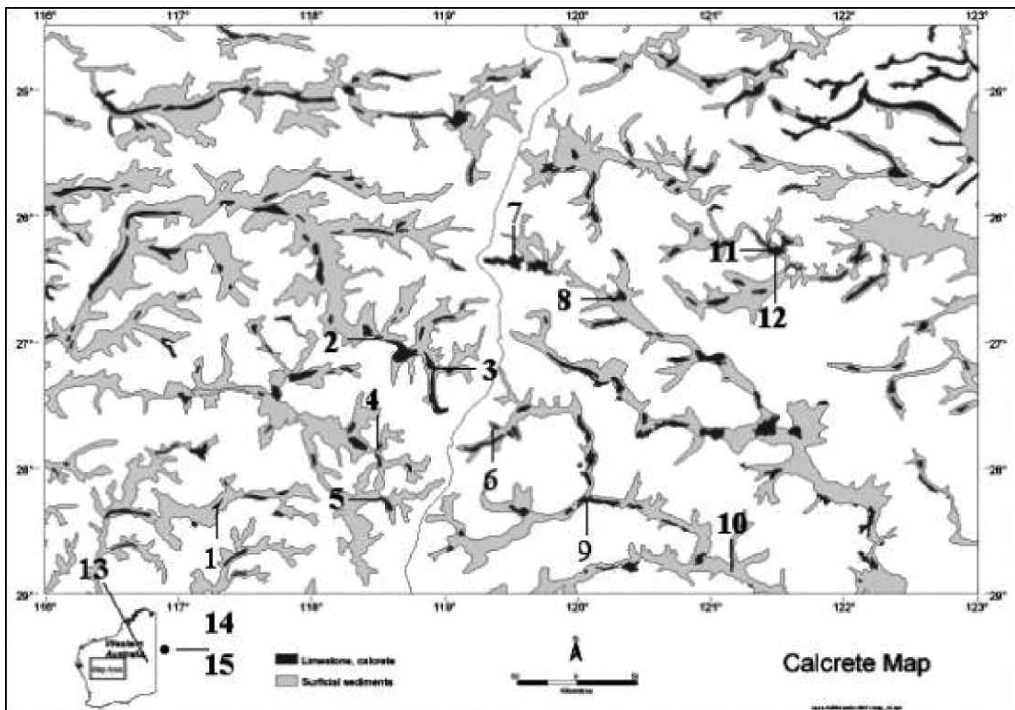


Figure 192. The distribution of the species described in this paper in the groundwater calcrete aquifers of the Yilgarn area of Western Australia. The dark shading denotes groundwater calcrete bodies and the lighter shading the surficial sediments associated with the palaeodrainages incised into the Archaean basement. The calcrete bodies (and associated species) are termed: 1, Murrum (*Limbodessus murrumensis*); 2, Yarrabubba North (*L. microbubba*); 3, Yarrabubba South (*L. yarrabubbaensis*); 4, Challa North (*L. nyungduo*); 5, Windimurra (*L. trispinosus*); 6, Black Range North (*L. ordinarius*); 7, Paroo (*L. kurutjutu*); 8, Lake Uramurdah and Lake Violet (*L. insolitus*); 9, Pinnacles (*Paroster elongatus*); 10, Melita (*L. micromelitaensis*); 11, Lorna Glen (*L. lornaensis*); 12, Lorna Glen (*L. macrolornaensis*); 13, Tjukurla (*Exocelina rasjadi*); 14, Camel Well, Newhaven (*P. novem*); 15, Camel Well, Newhaven (*P. readi*). The sites are in the following palaeodrainage systems and regional drainages — Coastal drainages: Moore (1), Murchison (2–5). Inland Drainages: Carey (6–8), Raeside (9–10), Carnegie (11–12), Lake Hopkins (13), Ngalia Basin (14–15). Map based on 1: 2,500,000 *Hydrogeological Map of Western Australia* 1989 compiled by D.P. Commander.

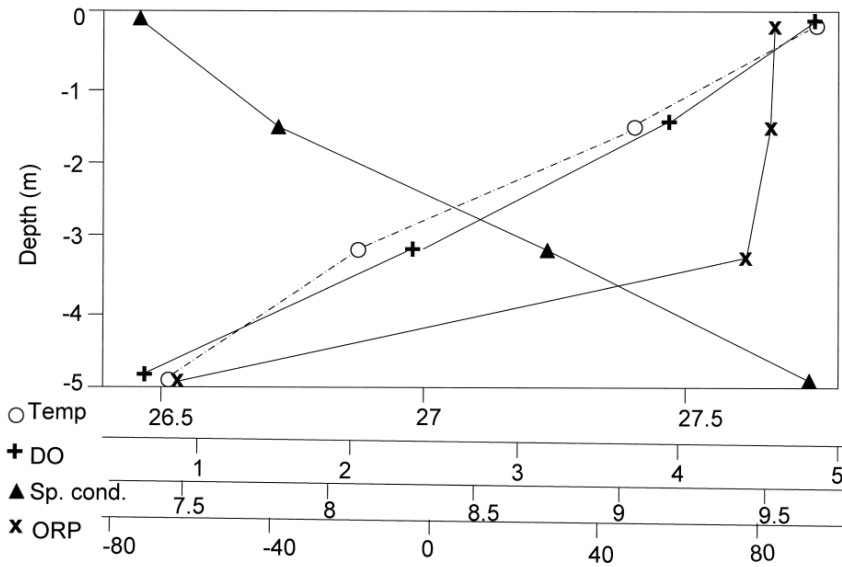


Figure 193. Water quality profile in Yelabra Well, Newhaven Station NT, one location of *Paroster readi*. Depth (m), temperature (°C), specific conductance (mS cm⁻¹), DO (mg L⁻¹), ORP (mV).

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