

**TWENTY-FIVE NEW DYTISCIDAE (COLEOPTERA) OF THE GENERA *TJIRTUDESSUS* WATTS & HUMPHREYS, *NIRRIPIRTI* WATTS & HUMPHREYS AND *BIDESSODES* REGIMBART FROM UNDERGROUND WATERS IN AUSTRALIA**

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Twenty-five new species of stygobitic Dytiscidae from inland Western Australia and Central Australia are described: *Tjirtudessus bialveus* sp. nov., *T. cunyuensis* sp. nov., *T. jundeensis* sp. nov., *T. karalundiensis* sp. nov., *T. macrotarsus* sp. nov., *T. silus* sp. nov., *T. sweetwatersensis* sp. nov., *T. wilunaensis* sp. nov., *T. yuinmeryensis* sp. nov., *Bidessodes limestoneensis* sp. nov., *B. gutteridgei* sp. nov., *Nirripiriti darlotensis* sp. nov., *N. fortisspina* sp. nov., *N. hamoni* sp. nov., *N. killaraensis* sp. nov., *N. macrocephalus* sp. nov., *N. melroseensis* sp. nov., *N. milgunensis* sp. nov., *N. napperbyensis* sp. nov., *N. newhavenensis* sp. nov., *N. pentameres* sp. nov., *N. plutonicensis* sp. nov., *N. stegastos* sp. nov., *N. skaphites* sp. nov. and *N. wedgeensis* sp. nov. The genus *Nirridessus* Watts & Humphreys 1999 is synonymised with *Tjirtudessus* Watts & Humphreys 1999.

This brings the total of stygobitic Dytiscidae described from Australia to 42 species in three genera. Two of the new species are placed in the genus *Bidessodes* Regimbart, representing the first stygobitic members of the genus. Geographically the new species greatly extend the range of stygobitic Dytiscidae in Australia to include Central Australia. As before (see Watts & Humphreys 2001) the stygofauna was found together with a rich stygobitic fauna in those portions of shallow aquifers that ran through areas of calcrete formation.

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This is the fourth paper in what has become a series of papers describing the stygobitic Dytiscidae of Australia (Watts & Humphreys 1999, 2000, 2001). In it we describe the new species found during fieldwork in Western Australia and in the Northern Territory in winter 2001 and discuss the associated stygofauna and chemical profiles of some of the aquifers in which the species were found.

Twenty-five new species are described, which significantly extends both the geographic and taxonomic range of the fauna. A rich fauna has been discovered in aquifers in the Ngalia Basin northwest of Alice Springs in central Australia; and stygobitic members of the genera *Bidessodes* Regimbart (*Bidessini*) and *Copelatus* Erichson (*Copelatinae*) have been discovered as well as numerous new species of the Hydroporine genus *Nirripiriti* Watts & Humphreys, previously known from only one species. The *Copelatus* is the subject of a separate paper that also includes preliminary results of a study of the phylogenetic

relationships between it and other Australian *Copelatus* using DNA sequence data (Balke et al 2003). A similar but separate study has been undertaken on the relationships of the Hydroporine stygobites and potential above-ground relatives (Cooper et al 2002). This study confirms the close relationship between the stygobitic bidessine genera *Nirridessus* Watts & Humphreys and *Tjirtudessus* Watts & Humphreys and the surface genera *Limbodessus* Guignot and *Boongurrus* Larson, as well as the Australian species of *Liodessus* Guignot. The study also suggests that the Hydroporine *Nirripiriti* is close to *Paroster* Sharp as we previously suggested (Watts & Humphreys 2001). This latter placement has been confirmed by Ignacio Ribera (pers. comm.), who included *Nirripiriti hinzeae* Watts & Humphreys in a worldwide study of relationships within the Dytiscidae using sequence data from the mitochondrial genome.

Based on sequence data, two of the new Bidessine species showed little genetic

relationship with either *Tjirtudessus* or *Nirridessus* but grouped somewhat distantly with Australian species of *Bidessodes* Regimbart. Mainly on this evidence they are described here as members of that genus, pending further study and additional specimens and possibly species.

The sequence data is unequivocal in saying what was becoming increasingly apparent morphologically: that any distinction between *Tjirtudessus* and *Nirridessus* is artificial and appears to be based primarily on size. Equally unequivocal is the paraphyletic nature of both these genera together with the Australian *Liodesussus* species. The sequence data also includes the genera *Boongurrus* and *Limbodessus* in a very bushy phylogenetic tree. *Allodessus* Guignot is only a little more distant. It is clear that the current taxonomy of this group of genera is untenable. To sort it out will require considerable study, beyond the scope of this paper. We have, however, decided that the existing evidence is too strong not to synonymise the genera *Tjirtudessus* and *Nirridessus*, which we formally do here, *Tjirtudessus* having page priority. We do this in the knowledge that in all probability they will be further synonymised with some or all of the above-ground genera mentioned previously (M. Balke & I. Ribera, pers. comm.).

The bulk of the new species are evenly split numerically between the Bidessine *Tjirtudessus* and the Hydroporine *Nirripirti*. Geographically the two genera appear to have generally different distributions: *Tjirtudessus* more southern and *Nirripirti* more northern. The two *Bidessodes* species are known only from the northern Gascoyne region and will probably also prove to have a northern distribution, as do their above-ground congeners.

As in previous years, the collection includes additional species, known only from either female specimens or partial specimens, and larval specimens of both *Tjirtudessus* and *Nirripirti*. However, these are not reported on at this time, primarily due to lack of suitable material or, in the case of larvae, no firm association with adults. The latter is currently under way utilising genetic typing.

As for the aquifer systems reported in our earlier papers, numerous specimens of Crustacea (bathynellids, harpacticoid and cyclopoid copepods, ostracods and oniscid isopods) and some Oligochaeta and Hydracarina were collected. In addition, some sites in the Northern Territory yielded a diversity of strongly stygomorphic Hydrobiidae (Gastropoda). As before, the beetles

and larger stygofauna were restricted to aquifers in areas of calcrete, as the stygofauna is largely found in the northern parts of the western shield (Poore & Humphreys 1998, submitted; Humphreys 1999a, 2001). As reported in our previous paper (Watts & Humphreys 2001), stygofauna were present both in narrow bore-holes drilled for geological purposes, water pumping or aquifer assessment, and in wide hand-dug wells established for pastoral purposes. The watertable in calcrete is often only 2–3 m below the surface; it is frequently exposed by calcrete quarries used for the purpose of road making or mineral processing, which, being left unfenced, are readily grossly contaminated by stock.

#### MATERIALS AND METHODS

The collection methods and measurements of physicochemical parameters in the water largely follow those used previously (Watts & Humphreys 2000). However, the use of a Horiba U22 multiparameter instrument in conjunction with previous methods permitted vertical profiles of the physicochemical conditions down some boreholes. Nitrate and Fe<sup>++</sup> were recorded using test strips in the field (Merck: respectively Merckoquant Nitrate Test 1.0020.001 and Merckoquant Iron Test 1.10004.0001). On analysis, mid-point values were used if a range had been recorded. Hydrogen sulphide was measured, when its odour indicated its presence, using a test kit (Chemetrics: CHEMets sulphide R-9510, range 0–1 and 1–10 ppm).

Abbreviations used:

- |      |  |
|------|--|
| BES  | Prefix for field numbers, WAM Biospeleology.   |
| SAMA | South Australian Museum, Adelaide.   |
| WAM  | Western Australian Museum, Perth.  |
| RN   | Prefix of water bore and well numbers, Water Resources Division, Department of Lands Planning and Environment in the Northern Territory. |
| NTM  | Northern Territory Museum, Darwin.   |

#### SYSTEMATICS

##### Key to Australian species of stygobitic Dytiscidae

1. — Body length approximately 1.0 mm; legs stout, without swimming-hairs on fore- and mid-legs..... *Kintingka kurutjutu* Watts and Humphreys

- Body length > 1.0 mm; legs normal, all with swimming-hairs ..... 2
- 2 (1) — Parameres one-segmented; metatibia approximately the same width throughout; without pronotal plicae; (Hydroporini) ..... 28
- Parameres two-segmented; metatibia narrow at base then strongly expanding towards apex; usually with pronotal plicae ..... (Bidessini) 2
- 3 (2) — Mesofemur with spines on hind edge approximately the same strength as those on mesotrochanter; length > 3.0 mm ..... 23
- Mesofemur with spines on hind edge much more robust than those on mesotrochanter; length 1.4–3.6 mm ..... 4
- 4 (3) — Lacking sutural line between abdominal sternites 1 and 2; length 3.2–3.6 mm ..... *Tjirtudessus sweetwatersensis* sp. nov.
- Abdominal sternites 1 and 2 separated by sutural line, at least in inner portion; length 1.3–3.2 mm ..... 5
- 5 (4) — Pronotal plicae strong, well marked, excavated on inside ..... 6
- Pronotal plicae weak, difficult to trace, may be absent, not excavated on inside ..... 10
- 6 (5) — Mesosternum with posterior portion triangular in midline ..... 7
- Mesosternum with posterior portion rounded in midline ..... 8
- 7 (6) — Prosternal process rounded at tip; tip of metatrochanter pointed; lobe on apical segment of paramere short .... *Tjirtudessus morgani* (Watts and Humphreys)
- Prosternal process pointed at tip; apex of metatrochanter rounded (Fig. 5); lobe on apical portion of paramere long (Fig. 3) ..... *Tjirtudessus bialveus* sp. nov.
- 8 (7) — Head broad, deflexed; metatrochanter round (Fig. 35); setae on mesofemur long (Fig. 34) ..... *Tjirtudessus silus* sp. nov.
- With none of above characters ..... 9
- 9 (8) — Metatarsi with combined length of segments 1 and 2 > combined length of segments 3 to 5; eye remnant present; paramere with long apical lobe ..... *Tjirtudessus pulpa* (Watts and Humphreys)
- Metatarsi with combined length of segments 1 and 2 approximately equal to combined length of segments 3 to 5 (Fig. 6); eye remnant reduced to single short suture; paramere with small apical lobe (Fig. 9) ..... *Tjirtudessus cunyuensis* sp. nov.
- 10 (5) — Elytron with row of large punctures adjacent to suture ..... 22
- Elytron without sutural punctures, other than a few weak ones near base ..... 11
- 11 (10) — Eye remnant reduced to a small oval or triangular structure ..... 19
- Eye remnant reduced to single short suture ..... 12
- 12 (11) — Mesofemur with six to seven spines on hind edge in basal half ..... 13
- Mesofemur with two to four spines on hind edge in basal half ..... 15
- 13 (12) — Protibia thick; protarsi moderately expanded, mesotarsi less so; mesotibia slightly angular ..... *Bidessodes gutteridgei* sp. nov.
- Protibia thin; protarsi and mesotarsi approximately the same size; mesotibia not angular ..... 14
- 14 (13) — Lobe of paramere as wide as rest of apical segment, flat on top, expanded slightly at tip ..... *Tjirtudessus masonensis* (Watts and Humphreys)
- Lobe of paramere shorter than rest of apical segment, rounded on top, tip pointed (Fig. 51) ..... *Tjirtudessus yuinmeryensis* sp. nov.
- 15 (12) — Mesofemur with four spines near base; segments 2 and 3 of antenna similar in length, segment 11 approximately 1.5x segment 10 in length; length > 2.0 mm ..... *Tjirtudessus cueensis* (Watts and Humphreys)
- Mesofemur with two to three strong spines on hind edge near base; segment 2 of antenna large and oval, segment 3 much smaller and thinner than segment 2, segment 11 approaching 2x length of segment 10; length < 2 mm ..... 16

- 16 (15) — Mesofemur with two strong spines on hind edge near base; apical segment of paramere with two finger-like projections ..... *Tjirtudessus pinnalesensis* (Watts and Humphreys)  
 — Mesofemur with three strong spines on hind edge near base; apical segment of paramere with one finger-like projection ..... 17
- 17 (16) — Metafemur with three spines grouped together near base ..... *Tjirtudessus fridaywellensis* (Watts and Humphreys)  
 — Metafemur with two spines near base and one more distant ..... 18
- 18 (17) — Pro- and mesotibia club-shaped; antenna with middle segments enlarged a little on inside ..... *Tjirtudessus hinkleri* (Watts and Humphreys)  
 — Pro- and mesotibia elongate/triangular in shape; middle segments of antenna virtually symmetrical ..... *Tjirtudessus karalundiensis* sp. nov.
- 19 (11) — Pronotum not constricted at base (Fig. 48); prosternal process reaching or almost reaching mesosternum; 1.4 mm long ..... *Tjirtudessus wilunaensis* sp. nov.  
 — Pronotum moderately constricted at base (Fig. 18); pronotal process not reaching mesosternum; >1.8 mm long ..... 20
- 20 (19) — Mesofemur with six spines close to base on hind edge ..... *Tjirtudessus bigbellensis* (Watts and Humphreys)  
 — Mesofemur with three to six spines spread out along basal half of hind edge (Fig. 16) ..... 21
- 21 (20) — Suture line between sternites 1 and 2 well marked; medial lobe of aedeagus parallel-sided, apex not upturned ..... *Tjirtudessus challaensis* (Watts and Humphreys)  
 — Suture lines between ventrites 1 and 2 weak, usually obsolete in lateral half; medial lobe of aedeagus distinctly narrower in middle, apex upturned (Fig. 13) ..... *Tjirtudessus jundeensis* sp. nov.
- 22 (10) — Distinct oval eye remnant present ..... *Tjirtudessus windarraensis* (Watts and Humphreys)
- Eye remnant reduced to single short suture ..... *Tjirtudessus lapostaae* (Watts and Humphreys)
- 23 (3) — Mesofemur with spines on hind edge arranged in two comb-like rows along hind edge from base to apex; mesotibia thin, curved ..... *B. limestoneensis* sp. nov.  
 — Mesofemur spines on hind edge spaced out, not dense and comb-like; mesotibia straight ..... 24
- 24 (23) — Pro- and mesotarsi with segment 1 much more expanded than other segments ..... 25  
 — Pro- and mesotarsi with segment 1 only moderately expanded compared to other segments ..... 26
- 25 (24) — Antenna with segments 8 to 11 noticeably thinner than others, segment 3 longer than segment 2 ..... *Tjirtudessus magnificus* Watts and Humphreys  
 — Antenna with segments 8 to 11 not noticeably thinner than others, segment 3 same length as segment 2 (Fig. 30) .. *Tjirtudessus macrotarsus* sp. nov.
- 26 (25) — Pronotum a little narrower than elytra; length 3.5–4.8 mm ..... 27  
 — Pronotum wider than elytra; length 3.2–3.5 mm ..... *Tjirtudessus eberhardi* Watts and Humphreys
- 27 (26) — Metatrochanters rounded at tip; central lobe of aedeagus straight, tip pointed; with small eye remnant... *Tjirtudessus raesideensis* Watts and Humphreys  
 — Metatrochanters pointed at tip; central lobe of aedeagus twisted, tip knobbed; without eye remnant .... *Tjirtudessus hahni* Watts and Humphreys
- 28 (27) — From the Northern Territory ..... 29  
 — From Western Australia ..... 33
- 29 (28) — Head short, very broad, strongly deflexed (Fig. 96); pronotum strongly narrowed at base (Fig. 96); pronotal process anvil-shaped ..... *Nirripiri macrocephalus* sp. nov.  
 — Head variably shaped, not deflexed, base of pronotum variable, pronotal process ‘normally’ shaped ..... 30
- 30 (29) — Protarsi with segment 3 not bilobed; pronotum not constricted at base (Fig. 126); antenna thin, segments 1 and 2

- subequal .....  
 ..... *Nirripiriti pentameres* sp. nov.
- Protarsi with segment 3 bilobed; pronotum weakly to moderately constricted at base; antenna thick, segment 2 much broader than segment 1 ..... 31
- 31 (30) — 1.8 mm long; body well chitinised ..  
 ..... *Nirripiriti napperbyensis* sp. nov.
- 1.2–1.6 mm long; body weakly chitinised ..... 32
- 32 (31) — 1.2 mm long; body only slightly constricted at junction of pronotum and elytra (Fig. 150) .....  
 ..... *N. wedgeensis* sp. nov.
- 1.5 mm long; body quite strongly constricted at junction of pronotum and elytra (Fig. 120) .....  
 .... *Nirripiriti newhavenensis* sp. nov.
- 33 (28) — Antenna with segment 2 larger and more oval than segment 1; < 2.5 mm long ..... 38
- Antenna with segment 2 more or less the same shape as segment 1 or smaller; > 2.5 mm long ..... 34
- 34 (33) — Elytron in ventral aspect, with visible portion broad except close to apex ..  
 ..... *Nirripiriti stegastos* sp. nov.
- Elytron in ventral aspect, with visible portion narrow except in basal quarter ..... 35
- 35 (34) — Metasternal plate parallel-sided; eight to ten metafemur spines, closely placed, very strong (Fig. 76); metatrochanter long and thin about 4x as long as wide (Fig. 77) .....  
 ..... *Nirripiriti fortisspina* sp. nov.
- Metasternal plate narrowing towards rear; four to eight metafemur spines, weak to moderately strong; metatrochanter moderately elongate 2 to 2.5x as long as wide ..... 36
- 36 (35) — Metasternal plate without wings .....  
 ..... *Nirripiriti plutonicensis* sp. nov.
- Metasternal wings obvious but short ..... 37
- 37 (36) — Metafemur with moderately strong spines; metacoxal plate nearly reaching mesocoxae ..... *Nirripiriti hinzeae* Watts and Humphreys
- Metafemur with thin spines (Fig. 70); metacoxal plate at least the width of metafemur from mesocoxae .....  
 ..... *Nirripiriti darlotensis* sp. nov.
- 38 (33) — Elytron with shoulder flared outwards (Fig. 84); tip of metatrochanter pointed (Fig. 83).....*Nirripiriti hamoni* sp. nov.
- Elytron with shoulder not flared; metatrochanter squat, tip rounded (Fig. 107) ..... 39
- 39 (38) — Eye remnant absent; metatrochanters large, squat (Fig. 107); hind legs stout; metasternal plate V-shaped; 1.2 mm long .....  
 ..... *Nirridessus milgunensis* sp. nov.
- Eye remnant represented by a short suture at side of head; metatrochanters elongate; hind legs elongate; metasternal plate U-shaped; 1.5–2.3 mm long ..... 40
- 40 (39) — Head narrower than base of pronotum, body boat-shaped (Fig. 138) ..... 41
- Head broader than base of pronotum, body not boat-shaped (Fig. 102) .....  
 ..... *Nirripiriti melroseensis* sp. nov.
- 41 (40) — 2.1–2.3 mm long; metatrochanter with tip sharply pointed (Fig. 137) .....  
 ..... *Nirripiriti skaphites* sp. nov.
- 1.5–1.9 mm long; metatrochanter with tip rounded (Fig. 89) .....  
 ..... *Nirripiriti killaraensis* sp. nov.

The following species descriptions are grouped in alphabetical order under genus, which are placed in the order *Tjirtudessus*, *Bidessodes*, *Nirripiriti*.

***Tjirtudessus* Watts & Humphreys, 1999**

***Tjirtudessus bialveus* sp. nov.**

*Types*

*Holotype*: m: 'BES 8118, Cunyu Station, Site 289, mineral exploration bore, 25°46'51"S 120°06'27"E, 24/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM. 32866. Slide mounted.

*Paratypes*: 17; 9, as for holotype, 6 WAM 32867–32872, 3 SAMA; 3, as for holotype except 'BES 8115', SAMA; 2, as for holotype except 'BES 8601, site 288', WAM 32873–32874; 3, as for holotype except 'BES 8602, site 288', SAMA.

*Description* (number examined, 18) Figs 1–7

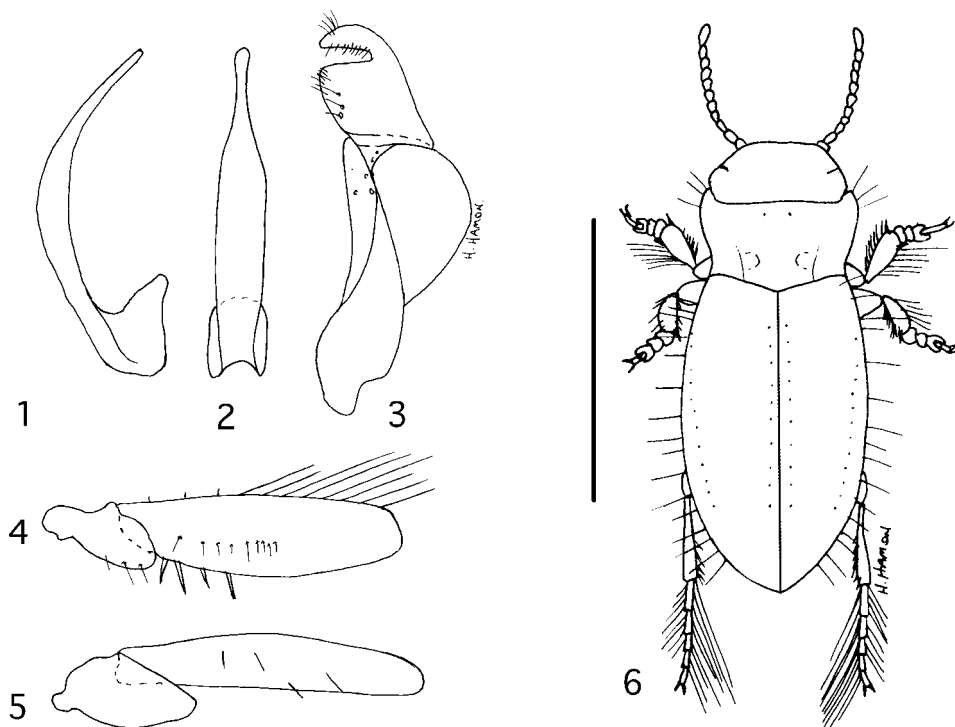
*Habitus.* Length 1.4–1.9 mm; elongate, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-quarter length of elytron.

*Head.* A little narrower than elytra; smooth, reticulation strong, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to short dark suture. Antenna stout, basal segment cylindrical, segment 2 oval, segment 3 shorter and narrower and narrowing towards base, segments 4 to 10 subequal, segment 11 about twice as long as segment 10. Maxillary palpus relatively stout, segment 4 about as long as segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

*Pronotum.* Almost as wide as elytra; anteriolateral angles projecting strongly forward;

base quite strongly narrowed, posterolateral angles acute; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin; basal plicae strongly marked, curved, reaching to about halfway along pronotum, deeply excavated inwards; with row of long setae laterally, denser towards front.

*Elytra.* Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, strongly reticulate, evenly but sparsely covered with small punctures each with a small seta, row of widely spaced larger punctures close to inner edge; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with a few setiferous micropunctures towards apex and sides. Epipleuron undifferentiated, that part of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.



FIGURES 1–6. *Tjirtudessus bialveus*: 1, lateral view of central lobe of aedeagus; 2, ditto dorsal view; 3, paramere; 4, mesotrochanter and mesofemur; 5, metatrochanter and metafemur; 6, dorsal view. Scale bar represents 1 mm (habitus only).

*Ventral surface.* Prosternal process relatively broad, strongly narrowed between coxae, almost reaching mesothorax, apical half narrow, almost parallel-sided, tip with long elongate point, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae almost in contact at midline. Metasternum sharply triangular in front in midline; wings short, narrow; triangular in midline behind not reaching halfway to metacoxae. Metacoxal plates large, metacoxal lines weak, moderately widely spaced, reaching to about halfway to metasternum, evenly diverging; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; strongly reticulate.

*Legs.* Protibia relatively broad, inner edge straight, outer edge bowed, widest near apex where it is about four times its basal width; protarsi moderately expanded, segment 1 round, segment 2 shorter, segment 3 as long as 1 but a bit narrower and deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about 1.5 times length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with two spines close together at base and one more distant along hind edge in basal half (Fig. 4); mesotarsi much less expanded than protarsi. Metatrochanter elongate, tip rounded, well separated from femur (Fig. 5); metafemur elongate, lacking spines; metatibia curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 longer than 4, segments 1 and 2 in combination about as long as segments 3 to 5; claws weak.

*Male.* Pro- and mesotarsi slightly stouter. Median lobe of aedeagus narrow, tip bluntly pointed; paramere broad, apical segment with long, narrow, apical portion well separated from rest of segment (Figs 1–3).

#### *Etymology*

Latin. 'Bi' – two, 'alveus' – pit, excavation; alluding to the two very strongly excavated areas on the pronotum.

#### *Remarks*

A relatively small species with strong reticulation and deep excavations inwards from the pronotal plicae. These pits partially undercut the plicae and

on their inner edge are ridged for a short distance. The purpose of these structures—which are much deeper than we have seen on any other Dytiscid—are unknown. They do not seem to have any sensory structures associated with them. They are often partially filled with a gritty material.

#### *Tjirtudessus cunyuensis* sp. nov.

#### *Types*

*Holotype:* m. 'BES 8156, Cunyu Station, Sweetwaters Well, 25°35'28"S 120°22'21"E, 23/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldo', WAM 32875.

*Paratypes* 3: 1, as for holotype, WAM 32876; 2, as for holotype except '8107', SAMA.

#### *Description* (number examined, 4) Figs 7–12

*Habitus.* Length 1.3 mm; narrowly oval, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

*Head.* Much narrower than elytra; smooth, reticulation strong, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to a short suture. Antenna stout, basal segment cylindrical, segment 2 oval, segment 3 smaller and narrower, segment 4 slightly smaller than 3, segments 5 to 10 subequal, segment 11 about 1.5 times length of segment 10. Maxillary palpus stout, segment 4 about as long as segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

*Pronotum.* As wide as elytra; anteriolateral angles projecting strongly forward; base moderately narrowed, posterolateral angles obtuse; smooth, with sparse, very weak punctures each with a short seta and a row of stronger punctures along front margin; basal plicae moderately marked, slightly curved, reaching to about halfway along pronotum, quite strongly excavated inwards; with row of long setae laterally, denser towards front.

*Elytra.* Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, moderately covered with small punctures each with a short setae, a short row of larger punctures close to inner edge on disc; a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with numerous setiferous micropunctures towards apex and near suture. Epipleuron undifferentiated, that

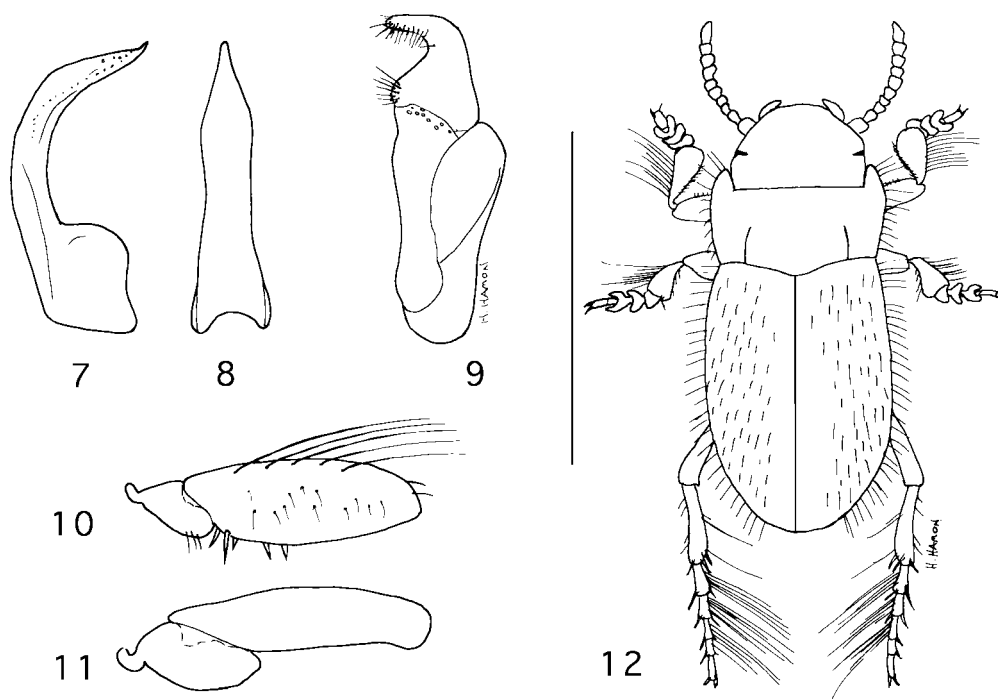
part of elytron visible ventrally narrow except close to base.

*Ventral surface.* Prosternal process relatively broad, strongly narrowed between coxae, not reaching mesothorax, apical half narrow, almost parallel-sided, weakly pointed at apex, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline; wings very narrow; broadly rounded in midline behind; not quite reaching halfway to metacoxae. Metacoxal plates large, metacoxal lines weak, widely spaced, almost parallel, reaching nearly to metasternum; a few small setae-bearing punctures towards midline; reticulation moderate, meshes uneven; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 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 relatively broad, inner and outer edges straight, widest past apex where it is about

four times its basal width; protarsi expanded, segment 1 broad, segment 2 as broad as and about one-third length of segment 1, segment 3 as long as 1 and as broad, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of four to five relatively weak spines unevenly spaced along hind edge in basal half (Fig. 10); mesotarsi less expanded than protarsi. Metatrochanter tip pointed, weakly separated from femur at tip (Fig. 11); metafemur relatively broad, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

*Male.* Median lobe of aedeagus relatively broad, tip sharply pointed; paramere broad, apical segment narrow, apical portion well separated from rest of segment (Figs 7–9).



FIGURES 7–12. *Tjirtudessus cunyuensis*: 7, lateral view of central lobe of aedeagus; 8, ditto dorsal view; 9, paramere; 10, mesotrochanter and mesofemur; 11 metatrochanter and metafemur; 12, dorsal view. Scale bar represents 1 mm (habitus only).



*Etymology*

Named after the pastoral station on which it was collected.

*Remarks*

A relatively small species with stout antennae and legs and well-marked pronotal plicae. Resembles *T. pulpa*, from which it differs in lack of oval eye remnant and short apical lobe to the paramere.

*Tjirtudessus jundeeensis* sp. nov.*Types*

*Holotype*: m. "BES 6475, Jundee Station, bore at Jundee Homestead, 26°21'12"S; 120°38'31"E, 11/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper", WAM 32877. Slide mounted.

*Paratypes*: 27; 1, as for holotype, WAM 32878; 17, 'BES 6581, Jundee Station. bore JSP 6, South Hill Well BF, Jundee Mine, 26°16'58"S 120°40'37"E, 11/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', 2 WAM 32879–32880, 15 SAMA; 1, as for holotype except 'BES 6582' and 'JE149', WAM 32881; 1, as for holotype except 'BES 6590' and 'JE124', WAM 32882; 3, as for holotype except 'BES 6594' and 'JE112', 3 WAM 32883–32885; 3, as for holotype except 'BES 6597' and 'JE150', 2 WAM 32886–32887, 1 SAMA; 2, as for holotype except 'BES 6603' and 'JE125', WAM 32888–32889.

*Description* (number examined, 28) Figs 13–18

*Habitus*. Length 2.3–2.6 mm; relatively flat, moderately constricted at base of pronotum; uniformly very light testaceous; hindwing reduced, about three-quarters length of elytron.

*Head*. Narrower than elytra; smooth, reticulation very weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to narrowly oval structure. Antenna relatively stout, segments 1 and 2 cylindrical, segment 3 slightly shorter than segment 2 narrowing towards base, segments 4 to 10 subequal but becoming progressively slightly broader, segment 11 1.5 times longer and slightly thinner than segment 10. Maxillary palpus moderately elongate, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

*Pronotum*. As wide as elytra; anteriolateral angles projecting strongly forward; base quite

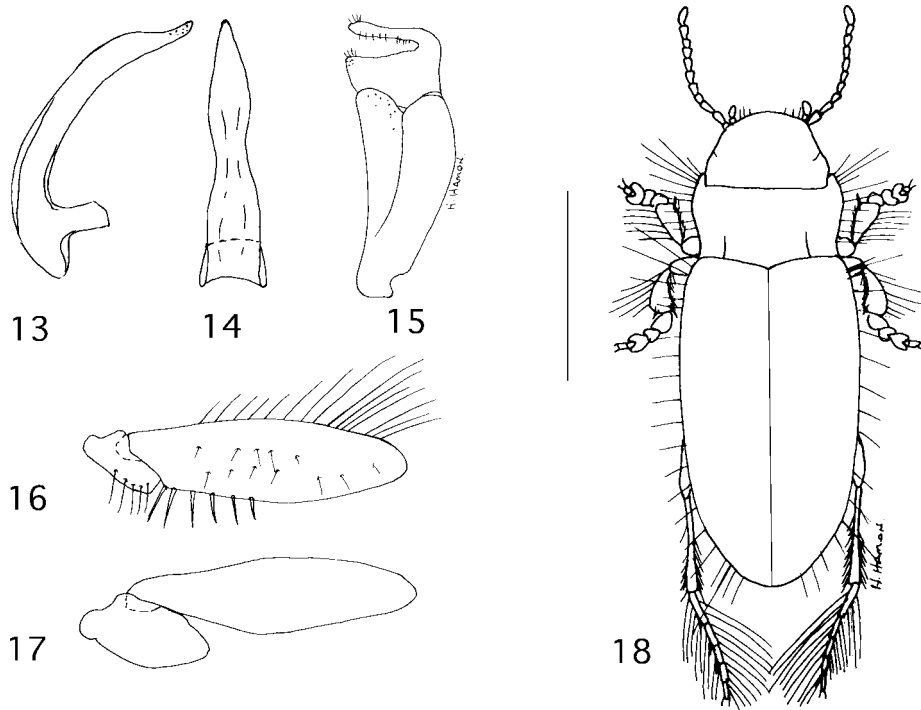
strongly narrowed, posterolateral angles acute; smooth with sparse, very weak punctures and a row of stronger punctures along front margin; basal plicae weakly marked, converging slightly towards front, reaching to about halfway along pronotum; with row of long setae laterally, denser towards front.

*Elytra*. Not fused, lacking inner ridges; elongate, almost parallel-sided, smooth, sparsely covered with very small punctures; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside with a few scattered setiferous micropunctures towards apex. Epipleuron weakly differentiated, that part of elytron visible ventrally moderately broad in anterior fifth, thin over rest of elytron.

*Ventral surface*. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half relatively broad, almost parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines obsolete; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 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 relatively narrow, triangular, widest at apex where it is about 2.5 times its basal width; protarsi moderately expanded, segment 1 as wide as long, segment 2 about as wide and about one-half length of segment 1, segment 3 as long and wide as first, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with very dense covering of adhesive setae; claws one-half length of segment 5. Mesotrochanter elongate with a few fine setae on inner edge; mesofemur with row of five to six moderately strong setae along hind edge in basal half (Fig. 16); mesotarsi similar to protarsi. Metatrochanter tip rounded, well separated from metafemur (Fig. 17); metafemur thin, elongate, lacking spines; metatibia thin, strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 longer than segment 4, in combination segments 1 and 2 about as long as others; claws equal, weak.

*Male*. Little external difference between median



FIGURES 13–18. *Tjirtudessus jundeeensis*: **13**, lateral view of central lobe of aedeagus; **14**, ditto dorsal view; **15**, paramere; **16**, mesotrochanter and mesofemur; **17** metatrochanter and metafemur; **18**, dorsal view. Scale bar represents 1 mm (habitus only).

lobe of aedeagus varying slightly in width along shaft, narrowing towards apex, bluntly pointed; parameres broad, apical segment relatively broad, short, with long, narrow, apical lobe well separated from rest of segment (Figs 13–15).

#### Etymology

Named after the pastoral station on which it was collected.

#### Remarks

A moderate sized, narrowly elongate, weakly chitinised species with the tip of the metatrochanter well separated from the femur, and weak pronotal plicae. Morphologically close to *T. challaensis* but with the suture line between first and second ventrites much less obvious and the apical lobe of the paramere well separated from the rest of the segment.

#### *Tjirtudessus karalundiensis* sp. nov.

#### Types

*Holotype*: m: 'Karalundi, unlined well, 26°08'S

118°41'E, 28/5/2001. Col. C.H.S. & G.A. Watts'. Field number 339-1. WAM 32890. Slide mounted.

*Paratypes*: 14, as for holotype 5, WAM 32891–32895, 9 SAMA.

*Description* (number examined, 15) Figs 19–24.

*Habitus*. Length 1.3–1.4 mm; relatively flat, moderately constricted at junction of pronotum/elytra; elytra relatively broad, uniformly light testaceous; hindwing reduced, about length of elytron.

*Head*. Narrower than elytra; smooth, reticulation moderate, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to short suture. Antenna relatively stout, segment 1 cylindrical, segment 2 oval, segment 3 about one-half length segment 2 and two-thirds width, narrowing towards base, segment 4 bit shorter and narrower than segment 3, segments 5 to 10 subequal and a little wider than 3 and 4, segment 11 about twice length of segment 10. Maxillary palpus elongate, segment 4 a little shorter than

segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

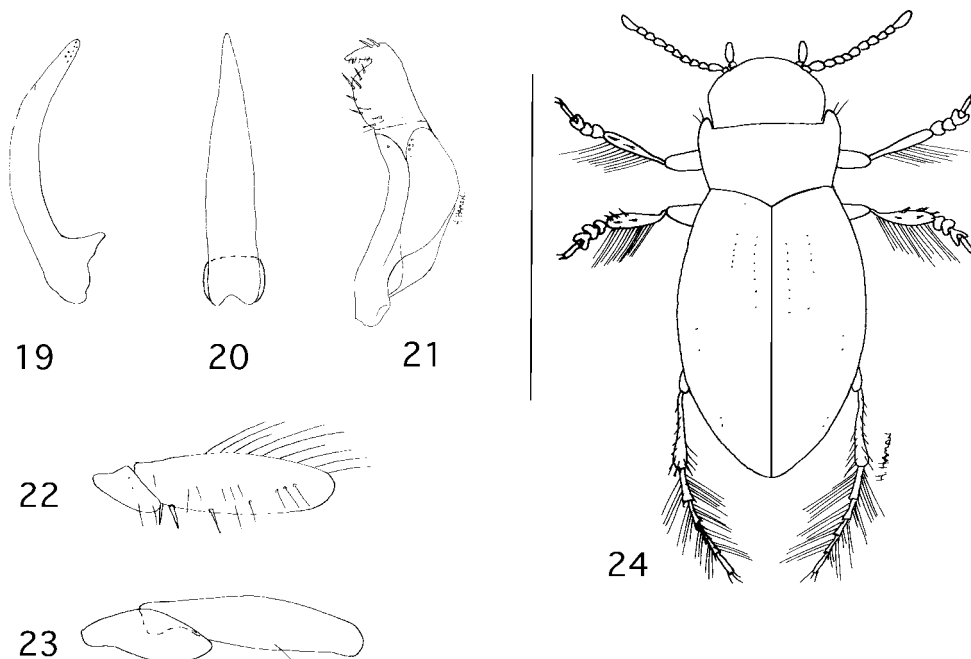
*Pronotum*. Narrower than elytra; anteriolateral angles projecting strongly forward; base moderately constricted, posterolateral angles acute; smooth, moderately reticulate, with sparse, very weak punctures and a row of stronger punctures along front margin, sparse covering of short setae; basal plicae absent, straight; with row of long setae laterally, denser towards front.

*Elytra*. Not fused, lacking inner ridges; oval, widest in middle, smooth, moderately reticulate, moderately densely covered with short setae, sparsely covered with very small punctures, row of widely spaced larger punctures close to inner edge; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with numerous setiferous micropunctures towards apex. Epipleuron only weakly differentiated; that portion of elytron visible ventrally narrow in anterior fifth, virtually absent along rest of elytron.

*Ventral surface*. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half relatively broad, almost

parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline; wings very narrow; posterior portion relatively narrow, rounded at apex. Metacoxal plates large, heart-shaped in combination, metacoxal lines absent, surface reticulate, a few small setae-bearing punctures towards midline; closely adpressed to abdominal ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, moderately rugose, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

*Legs*. Protibia triangular, widest at apex where it is about three times its basal width; protarsi moderately expanded, segment 1 about twice as long as wide, segment 2 a little broader and about one-half length of segment 1, segment 3 as long as first slightly broader, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with adhesive setae; claws short and simple. Mesotrochanter elongate with a few setae on inner edge; mesofemur with row of three relatively



FIGURES 19–24. *Tjirtudessus karalundiensis*: **19**, lateral view of central lobe of aedeagus; **20**, ditto dorsal view; **21**, paramere; **22**, mesotrochanter and mesofemur; **23** metatrochanter and metafemur; **24**, dorsal view. Scale bar represents 1 mm (habitus only).

strong setae along hind edge in basal half (Fig. 22); mesotarsi about one-half breadth of protarsi. Metatrochanter tip pointed, (Fig. 23); metafemur elongate, lacking spines; metatibia moderately curved, widening towards apex; metatarsi elongate, segment 1 longest, other segments approximately equal in length, in combination segments 1 and 2 about as long as others; claws weak.

*Male.* No external differences between the sexes. Median lobe of aedeagus parallel-sided narrowing towards apex, tip bluntly pointed; paramere broad, apical segment relatively long, with narrow apical lobe moderately separated from rest of segment, about one-half width of segment (Figs 19–21).

#### *Etymology*

Named after type locality.

#### *Remarks*

A small elongate/oval species moderately constricted at the base of the pronotum and with three stout spines on the mesofemur. It most closely resembles *T. hinkleri*, from which it is most easily separated by the smaller apical lobe on the paramere and the symmetrical rather than slightly asymmetrical middle antennal segments.

#### *Tjirtudessus macrotarsus* sp. nov.

#### *Types*

*Holotype:* m: 'BES 8118, Cunyu Station, Site 289, mineral exploration bore, 25°46'51"S 120°06'27"E, 24/8/2001 col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM 32896. Slide mounted.

*Paratypes:* 7: 5, as for holotype, 3 WAM 32897–32899, 2 SAMA; 2, as for holotype except 'BES 8115' SAMA.

*Description* (number examined, 8) Figs 25–30

*Habitus.* Length 4.2–4.4 mm; elongate, moderately flat, slightly depressed in midline, moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

*Head.* A little narrower than elytra; slightly deflexed; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to a short suture. Antenna thin, segments 1 and 2 cylindrical, segments 3 and 4 as long as segment 2 but narrower and slightly narrowing towards base, segments 5 to 9 subequal but

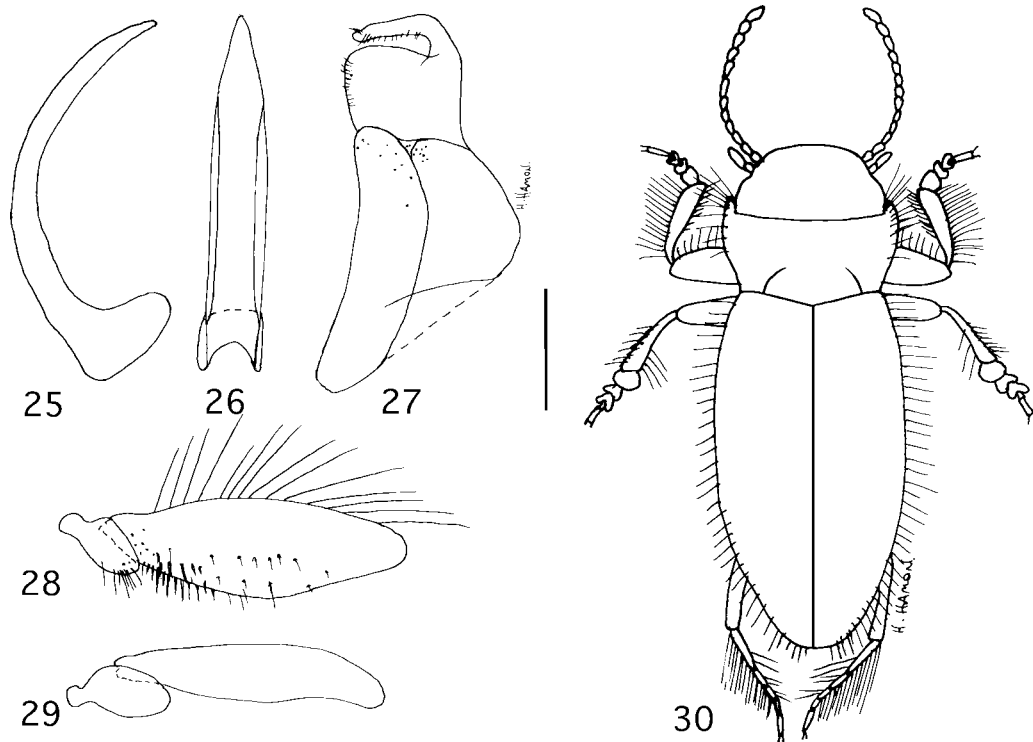
becoming progressively shorter, each weakly expanded inwards near apex, segment 10 cylindrical, segment 11 about 1.5 times as long as segment 10. Maxillary palpus elongate, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

*Pronotum.* Short, almost as wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute, overlapping elytra; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin, reticulation weak; basal plicae moderately marked, straight, short, reaching to about one-third way along pronotum, slightly excavated inwards; with row of long setae laterally, denser towards front.

*Elytra.* Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures, a loose row of larger punctures with long setae near centre of each elytron, a moderate number of additional large punctures with long setae, more frequent towards sides. Underside of elytron with a few setiferous micropunctures near base and some on epipleuron near base. Epipleuron very weakly differentiated, that part of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

*Ventral surface.* Prosternal process relatively broad, strongly narrowed between coxae, not reaching mesothorax, apical half broad, triangular, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum triangular in front in midline; wings very narrow; broadly rounded in midline behind; reaching well past halfway to metacoxae. Metacoxal plates large, metacoxal lines very weak, relatively close, reaching to about halfway to metasternum, evenly diverging; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; reticulation very weak.

*Legs.* Protibia relatively narrow, inner edge straight, outer edge bowed, widest past middle where it is about three times its basal width; protarsi expanded, segment 1 large broadly rounded, segment 2 much narrower, about one-third length of segment 1, segment 3 about half



FIGURES 25–30. *Tjirtudessus macrotarsus*: 25, lateral view of central lobe of aedeagus; 26, ditto dorsal view; 27, paramere; 28, mesotrochanter and mesofemur; 29 metatrochanter and metafemur; 30, dorsal view. Scale bar represents 1 mm (habitus only).

as long as segment 1, narrower than segment 2, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short, relatively robust. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of 10 to 15 weak spines along hind edge in basal half only slightly stronger than the setae on mesotrochanter (Fig. 28); mesotarsi a little less expanded than protarsi. Metatrochanter relatively small, broadly oval, tip rounded (Fig. 29); metafemur thin, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 much longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

*Male*. No external differences between the sexes. Median lobe of aedeagus variable in width along shaft, tip bluntly pointed; paramere broad, apical segment relatively large with long, narrow,

apical lobe moderately separated from rest of segment (Figs 25–27).

#### *Etymology*

Alluding to the large basal tarsal segment of the pro- and mesotarsi.

#### *Remarks*

A large narrow species recognised by the large basal segment of the pro- and mesotarsi, thin antenna and broadly oval metatrochanters.

#### *Tjirtudessus silus* sp. nov.

#### *Types*

*Holotype*: m: 'BES 8107, Cunyu Station, Sweetwaters Well, 25°35'38"S 120°22'21"E, 23/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM 32900. Slide mounted.

*Paratypes*: 25; 10, 'BES 8107, Cunyu Station, Sweetwaters Well, 25°35'38"S 120°22'21"E, 23/8/2001, col. W.F. Humphreys, T. Karanovic &

J.M. Waddock', 5 WAM 32901–32905, 5 SAMA; 4, ditto except 'BES 8156', WAM 32906–32909; 11, ditto except 'BES 8589', 5 WAM 32910–32914, 6 SAMA.

*Description* (number examined, 26) Figs 31–36

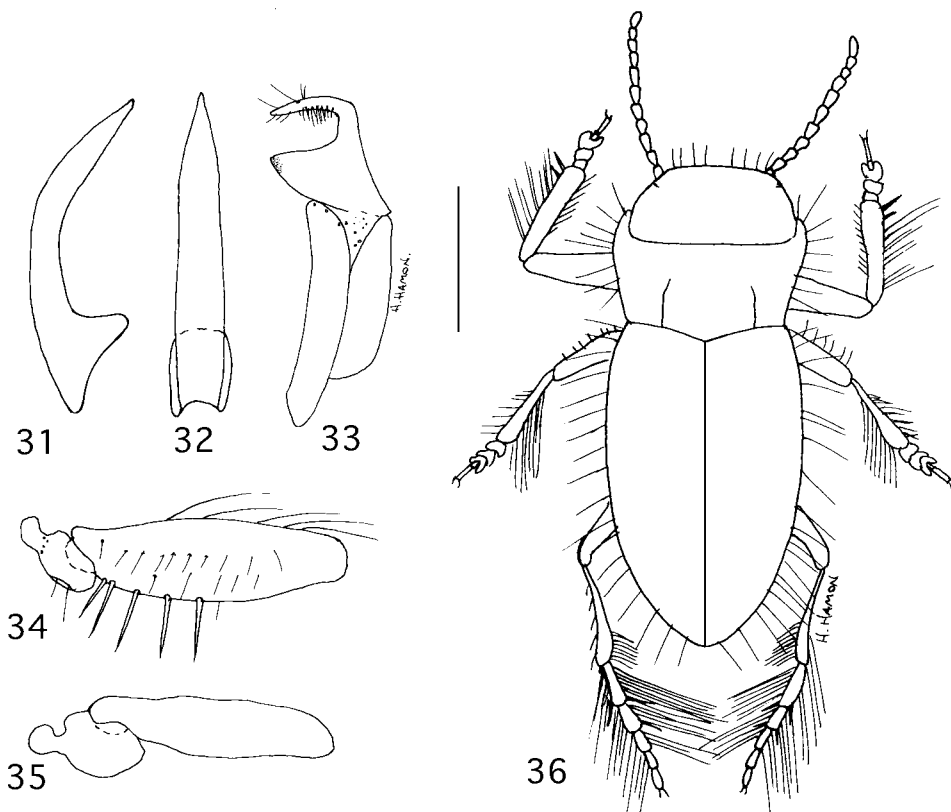
*Habitus*. Length 1.7–2.1 mm; relatively flat, head somewhat deflexed, weakly constricted at junction of pronotum/elytra; uniformly very light testaceous; hindwing vestigial, about one-third length of elytron.

*Head*. Short, about as wide as elytra, bulbous in lateral view; smooth, reticulation moderate, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to small triangular or oval structure on ventral surface near edge. Antenna relatively stout, segments 1 and 2 cylindrical, segment 3 shorter than segment 2, segments 4 to 10 subequal, slightly expanded at their apexes on inside, more so on middle segments, segment 11 a

bit longer and narrower than segment 10. Maxillary palpus elongate, segment 4 longer than segments 1 to 3 combined, oblique row of long setae on outer side.

*Pronotum*. Short, as wide as or a bit wider than elytra; anteriolateral angles projecting strongly forward; base weakly constricted, posterolateral angles obtuse; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin; reticulation very weak; basal plicae well marked, slightly sinuate, reaching to about halfway along pronotum, very strongly excavated inwards; with row of long setae laterally, denser towards front.

*Elytra*. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides, underside of elytron with a few setiferous micropunctures towards



FIGURES 31–36. *Tjirtudessus silus*: 31, lateral view of central lobe of aedeagus; 32, ditto dorsal view; 33, paramere; 34, mesotrochanter and mesofemur; 35, metatrochanter and metafemur; 36, dorsal view. Scale bar represents 1 mm (habitus only).

apex and on epipleuron near base. Reticulation weak. Epipleuron undifferentiated, that portion of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

*Ventral surface.* Prosternal process relatively broad, strongly narrowed between coxae, not reaching mesothorax, apical half narrow, weakly triangular, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines weak, moderately widely spaced, reaching about halfway to metasternum, subparallel; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines indistinct towards midline, absent laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; weakly reticulate.

*Legs.* Protibia elongate, narrow, inner edge straight, outer edge weakly bowed, widest near apex where it is about three times its basal width; protarsi moderately expanded, segment 1 rounded, segment 2 about one-half length of segment 1, segment 3 as long as segment 1 and very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of five to six relatively long spines along hind edge in basal half (Fig. 34); mesotarsi much less expanded than protarsi. Metatrochanter short (Fig. 35); metafemur thin, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, relatively robust, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

*Male.* Little external difference between the sexes. Median lobe of aedeagus variable in width along shaft, tip bluntly pointed; paramere broad, apical segment with long, narrow, apical portion well separated from rest of segment (Figs 31–33).

#### *Etymology*

Latin. 'Silus' – pug-nosed.

#### *Remarks*

A medium sized species easily recognised by its

broad pug-nosed head as well as thin legs, round metatrochanters, strong pronotal plicae and long spines on the mesofemurs.

#### *Tjirtudessus sweetwatersensis* sp. nov.

#### *Types*

*Holotype:* m: 'BES 8107, Cunyu Station, Sweetwaters Well, 25°35'38"S 120°22'21"E, 23/8/2001, col. W.F. Humphreys, T. Karanovic and J.M. Waldo', WAM 32915. Slide mounted.

*Paratypes:* 11; 6, as for holotype, SAMA; 2, as for holotype except 'BES 8156', WAM 32916–32917; 3, as for holotype except 'BES 8589', WAM 32918–32920.

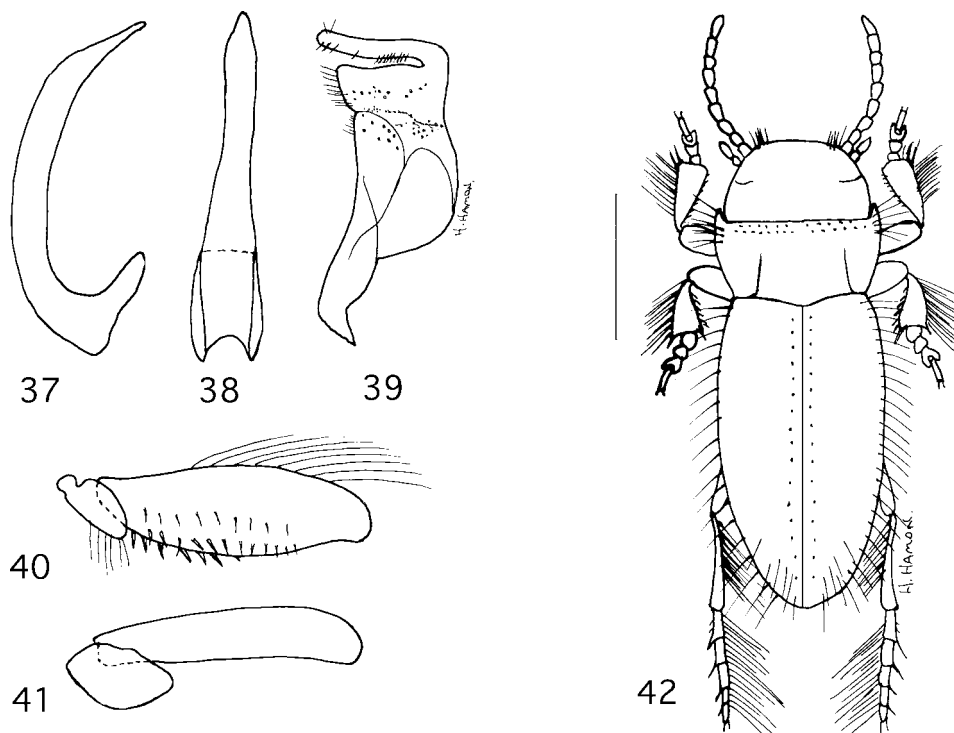
#### *Description* (number examined, 12) Figs 37–42

*Habitus.* Length 3.2–3.6 mm; elongate, relatively flat, moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

*Head.* About as wide as elytra; smooth, reticulation moderate, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to narrowly oval structure on underside of head behind antennal bases. Antenna relatively stout, segments 1 and 2 cylindrical, segments 3 and 4 similar, a little shorter than segment 2, segments 5 to 10 subequal, narrower at their bases, segment 11 a bit longer and narrower than segment 10. Maxillary palpus elongate, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

*Pronotum.* As wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute, slightly overlapping elytra; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin; basal plicae moderately marked, slanted inwards, reaching to about halfway along pronotum, with row of long setae laterally, denser towards front.

*Elytra.* Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures, row of widely spaced larger punctures close to inner edge; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with numerous setiferous micropunctures towards apex and near suture. Epipleuron undifferentiated, that part of elytron visible



FIGURES 37–42. *Tjirtudessus sweetwatersensis*: 37, lateral view of central lobe of aedeagus; 38, ditto dorsal view; 39, paramere; 40, mesotrochanter and mesofemur; 41, metatrochanter and metafemur; 42, dorsal view. Scale bar represents 1 mm (habitus only).

ventrally quite broad in anterior quarter, virtually absent along rest of elytra.

**Ventral surface.** Prosternal process rather narrow, strongly narrowed between coxae, not reaching mesothorax, apical half almost parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum triangular in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines weak, moderately widely spaced, reaching to about halfway to metasternum, almost parallel; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines absent, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; moderately reticulate.

**Legs.** Protibia relatively elongate, inner edge straight, outer edge bowed, widest past middle where it is about three times its basal width; protarsi weakly expanded, segment 1 broad,

segment 2 about one-third length of segment 1, segment 3 a little longer than segment 2 and deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of seven to nine relatively weak spines along hind edge in basal half (Fig. 40); mesotarsi a little less expanded than protarsi. Metatrochanter tip bluntly pointed (Fig. 41); metafemur elongate, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

**Male.** No external differences between the sexes. Median lobe of aedeagus a little variable in width along shaft, tip bluntly pointed; paramere broad, apical segment relatively short, with long, narrow, apical portion close to rest of segment (Figs 37–39).



*Etymology*

Named after the type locality.

*Remarks*

A relatively large species recognised by the lack of a sutural line between the first and second ventrites, the similarity of the basal two antennal segments and a relatively large oval eye remnant.

*Tjirtudessus wilunaensis* sp. nov.*Types*

*Holotype*: m: 'BES 6433, Wiluna Gold, Lake Violet Borefield bore XPIOB, 26°40'30"S 120°13'55"E, 9/5/200, col. W.F. Humphreys, C.H.S. Watts & S. Cooper'. WAM 32921. Slide mounted.

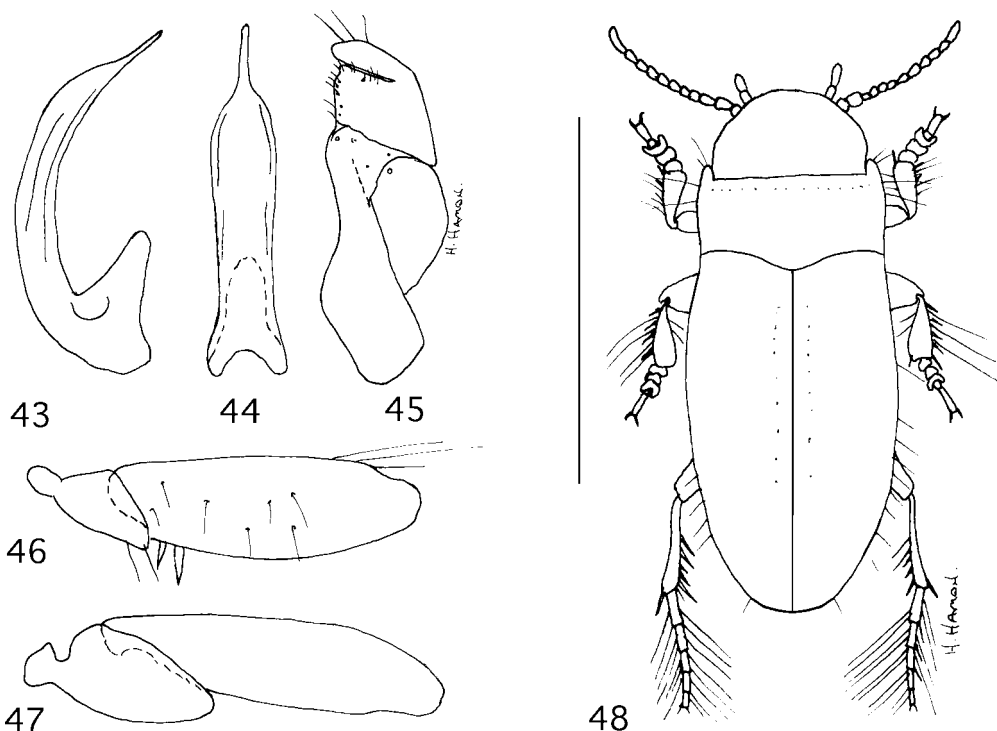
*Paratype*: 1, 'BES 5640, Millbillillie Pastoral station. Bore nr. Bubble Well, 26°33'39"S 120°02'27"E, 8/5/2001 coll. W.F. Humphreys, C.H.S. Watts & S. Cooper', SAMA. There is some doubt regarding this locality: the field notes suggest that it could have come from the same locality as the holotype.

*Description* (number examined, 2) Figs 43–48

*Habitus*. Length 1.4 mm; relatively flat, very weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing reduced, about three-quarters length of elytron.

*Head*. Slightly narrower than elytra; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, bulging just behind eye remnant; eye remnant reduced to a small triangular structure. Antenna stout, segment 1 large, cylindrical, segment 2 larger, barrel-shaped, segment 3 a bit shorter, about one-half as wide as long narrowing towards base, segment 4 bit narrower and one-half the length of segment 3, segments 5 to 10 subequal, segment 11 twice length of segment 10, thinner. Maxillary palpus stout, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

*Pronotum*. About as wide as elytra; anteriolateral angles projecting strongly forward; base very slightly narrowed, posterolateral angles obtuse; smooth, with sparse, very weak punctures and a row of stronger punctures along front



FIGURES 43–48. *Tjirtudessus wilunaensis*: **43**, lateral view of central lobe of aedeagus; **44**, ditto dorsal view; **45**, paramere; **46**, mesotrochanter and mesofemur; **47**, metatrochanter and metafemur; **48** dorsal view. Scale bar represents 1 mm (habitus only).

margin; basal plicae if present not visible on the two mounted specimens; with row of long setae laterally, denser towards front.

*Elytra*. Possibly fused, lacking inner ridges; elongate, widest in front of middle, smooth, covered with very small punctures, sparse row of large punctures near suture; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron undifferentiated, that portion of elytra visible ventrally relatively broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

*Ventral surface*. Prosternal process strongly narrowed between coxae, almost reaching mesothorax, apical half relatively broad, triangular with blunt tip, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae slightly separate. Metasternum sharply triangular in front in midline; wings very narrow; slightly pointed in midline behind. Metacoxal plates large, metacoxal lines obsolete; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 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, widest at apex where it is about three times its basal width; protarsi expanded, segments 1 to 3 broad, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with a covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few setae on inner edge; mesofemur elongate/oval with two strong spines near base on hind edge (Fig. 46); mesotarsi much less expanded than protarsi. Metatrochanter tip elongate/oval (Fig. 47); metafemur relatively broad, lacking spines; metatibia moderately curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

*Male*. No external differences between the sexes. Median lobe of aedeagus relatively broad, sharply narrowing to apex, tip bluntly pointed; paramere broad, apical segment moderately long, with long, club-shaped apical lobe tending to overlap rest of segment, slightly wider than adjacent part of apical segment (Figs 43–45).

#### *Etymology*

Named after the type locality.

#### *Remarks*

A very small almost parallel-sided species with almost no pronotal constriction and a short fourth segment of the antenna which is only a little more than one-half the length of the third. So far unique among the Australian dytiscid stygofauna in having the tip of the pronotal process meeting, or almost meeting, the forward extension of the mesosternum, slightly separating the mesocoxae.

The eye remnant is little more than a short bifurcation of the more usual suture line on the ventral surface. In the key it has been scored as present. The species will run to *T. pinnaclensis* if it is considered absent, from which the separate mesocoxae and lack of pronotal constriction will separate it.

#### *Tjirtudessus yuinmeryensis* sp. nov

#### *Types*

*Holotype*: m: 'BES 6654, Yuinmery Station, New Well, 28°32'62"S 119°05'28"E, 15/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32922. Slide mounted.

*Paratypes*: 53; 7, as for holotype, WAM 32923–32929; 46, as for holotype except 'BES 6653', 20 WAM 32930–32949, 26 SAMA; 1, 'BES 8063, Yuinmery Station, Nine Mile Well, 28°32'35"S 119°08'00"E, 15/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32950.

#### *Description* (number examined, 54) Figs 49–54

*Habitus*. Length 1.6–2.0 mm; relatively flat, narrow. Moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

*Head*. Narrower than elytra; smooth, reticulation very weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to single suture tending to widen or thicken ventrally. Antenna relatively stout, segment 1 cylindrical, segment 2 barrel-shaped, segment 3 a little shorter and much narrower and narrowing towards base, segment 4 shorter than segment 3, segments 5 to 10 subequal, segment 11 about twice length of segment 10. Maxillary palpus elongate, segment 4 about length of segments 1 to

3 combined, oblique row of long setae on outer side, tip truncated.

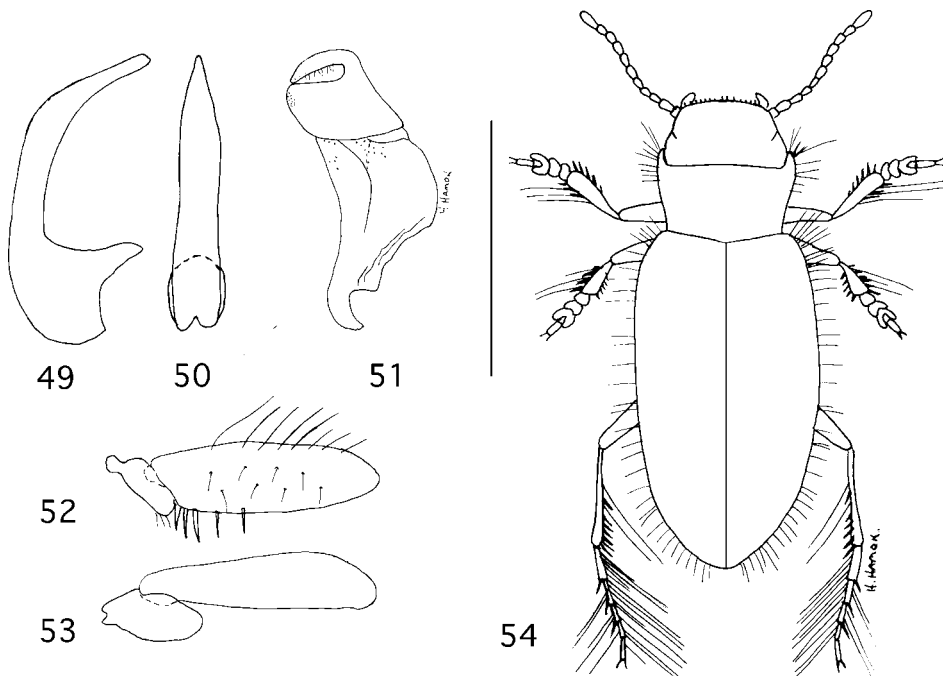
*Pronotum.* Almost as wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute; smooth, with sparse, very weak punctures; basal plicae moderately marked, straight, reaching to about halfway along pronotum, slightly excavated inwards; with row of long setae laterally, denser towards front.

*Elytra.* Not fused, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with a few setiferous micropunctures near base and on epipleuron near base. Epipleuron not differentiated, that part of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

*Ventral surface.* Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half moderately broad, almost parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum

sharply triangular in front in midline; wings very narrow; rounded in midline behind. Metacoxal plates large, metacoxal lines moderately widely spaced, reaching to about halfway to metasternum, diverging slightly towards front; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 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 relatively broad, inner edge straight, outer edge bowed, widest near apex where it is about four times its basal width; protarsi weakly expanded, segment 1 subrectangular, segment 2 as wide and about one-half length of segment 1, segment 3 as long as segment 1 but a little narrower and very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate/oval with a few setae near apex; mesofemur with row of five to six relatively strong spines along hind edge in basal half (Fig. 52); mesotarsi similar to protarsi.



FIGURES 49–54. *Tjirtudessus yuinmeryensis*: **49**, lateral view of central lobe of aedeagus; **50**, ditto dorsal view; **51**, paramere; **52**, mesotrochanter and mesofemur; **53**, metatrochanter and metafemur; **54** dorsal view. Scale bar represents 1 mm (habitus only).

Metatrochanter tip rounded (Fig. 53); metafemur elongate, widest beyond middle, lacking spines; metatibia thin, strongly curved, widening towards apex; metatarsi 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 difference between the sexes. Median lobe of aedeagus relatively narrow and narrowing to blunt point; paramere broad, apical segment with long, narrow, apical lobe well separated from rest of segment except near tip (Figs 49–51).

#### *Etymology*

Named after the station property on which the species was collected.

#### *Remarks*

A relatively small, pale, narrowly elongate species with five to six relatively strong mesofemoral spines. Closely resembles *T. masonensis*, from which it can only be separated by a slightly shorter apical lobe to the paramere and by DNA sequencing.

### ***Bidessodes* Regimbart**

#### ***Bidessodes gutteridgei* sp. nov.**

#### *Types*

*Holotype:* m.: 'BES 8651, Three Rivers Station, Limestone Well, 25°16'59"S 119°10'33"E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 32952. Slide mounted.

*Paratypes:* 18; 2, 'BES 8605, Three Rivers Station, bore MB4 Plutonic Borefield, 25°16'43"S 119°11'00"E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', 1 WAM 32953, 1 SAMA; 2, 'BES 8613, Three Rivers Station, Site 312, Old production bore, Plutonic Borefield, 25.26745°S 119.16398°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 32954–32955; 1 (partial), 'BES 8620, Three Rivers Station, bore MB5, Plutonic Borefield, 25.26730°S 119.16417°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 32956; 5, 'BES 8625, Three Rivers Station, Limestone Well, 25.28313°S 119.175773°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', 2 WAM 32957–32958, 3 SAMA; 3, Ditto except, 'BES 8651', SAMA; 2 (1 partial), 'BES 8633; Three Rivers Station, bore MB3, Plutonic Borefield,

25.26943°S 119.17202°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 32959–32960; 3, 'BES 8656/7, Three Rivers Station, bore MB2, Plutonic Borefield, 25.27360°S 119.17200°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', 2 WAM 32961–32962, 1 SAMA.

*Description* (number examined, 19) Figs 55–60

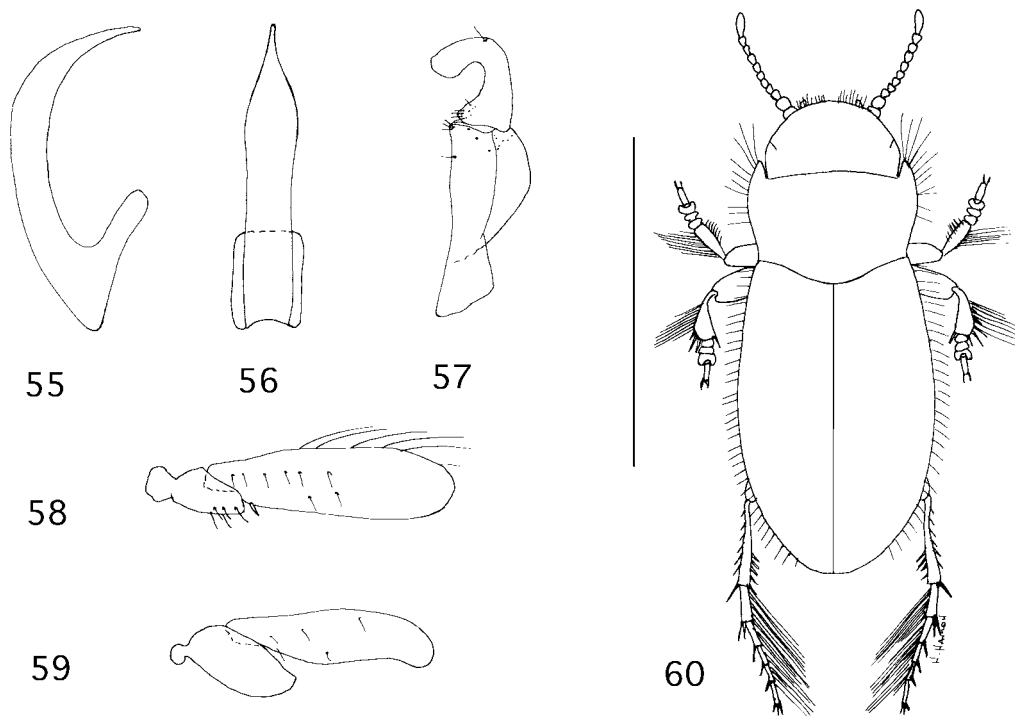
*Habitus.* Length 1.3–1.5 mm; broadly oval, relatively flat, weakly constricted at base of pronotum; uniformly light testaceous; hindwing vestigial, about one-quarter length of elytron.

*Head.* A little narrower than elytra; smooth, reticulation strong, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to single suture. Antenna relatively stout, segment 1 cylindrical, segment 2 oval, segment 3 much smaller and narrower, segments 4 to 10 equal in length becoming progressively wider, segment 11 about twice length of segment 10. Maxillary palpus stout, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

*Pronotum.* Almost as wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles obtuse; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin; strongly reticulate; basal plicae absent; with row of long setae laterally, denser towards front.

*Elytra.* Not fused but tightly closed, lacking inner ridges; elongate, widest in middle, smooth, sparsely covered with small punctures each with a short seta; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with a few setiferous micropunctures towards apex and sides. Epipleuron undifferentiated; portion of elytron visible ventrally thin except for extreme shoulder.

*Ventral surface.* Prosternal process relatively broad, strongly narrowed between coxae, not reaching mesothorax, apical half almost parallel-sided, tip with small point, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines relatively well marked, quite widely spaced, reaching nearly to metasternum, weakly diverging towards front; a few small setae-bearing punctures



FIGURES 55–60. *Bidessodes gutteridgei*: **55**, lateral view of central lobe of aedeagus; **56**, ditto dorsal view; **57**, paramere; **58**, mesotrochanter and mesofemur; **59**, metatrochanter and metafemur; **60** dorsal view. Scale bar represents 1 mm (habitus only).

towards midline; strongly reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; strongly reticulate.

*Legs.* Protibia broad, inner edge straight, outer edge bowed, widest near apex where it is about four times its basal width; protarsi quite strongly expanded, segment 1 broad, narrowing at base, segment 2 a little wider and a little shorter than segment 1, segment 3 as long as first and a bit wider, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with quite dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of three to four spines on inner edge; mesofemur with row of six short spines along hind edge in basal half (Fig. 58); mesotibia broad, slightly angular; mesotarsi narrower than protarsi. Metatrochanter tip

rounded, well separated from femur (Fig. 59); metafemur stout, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

*Male.* No external differences between the sexes. Median lobe of aedeagus variable in width along shaft, tip bluntly pointed; paramere broad, apical segment hook-shaped (Figs 55–57).

#### *Etymology*

Named after Rob Gutteridge, who has very ably illustrated many of these beetles.

#### *Remarks*

A small species best recognised by the stout antenna, slightly angular mesotibia and large metatrochanter with its tip well separated from the metafemur. Its placement in *Bidessodes* is based primarily on evidence from DNA sequence data which suggest a relationship with *B. limestoneensis* and, more distantly, with *B. bilita*

Watts and *B. mjobergi* (Zimmermann.) (See also under *B. limestoneensis*.) There are no morphological characters that would negate its placement in *Bidessodes* as currently defined.

***Bidessodes limestoneensis* sp. nov.**

*Types*

*Holotype*: m: 'BES 8625, Three Rivers Station, Limestone Well, 25°16'59"S 119°10'33"E, 26/8/2001, W.F. Humphreys, T. Karanovic & J.M. Waldo', WAM 32951. In spirit.

*Description* (number examined, 1) Figs 61–66

*Habitus*. Length 4.2 mm; relatively flat, strongly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

*Head*. About as wide as elytra; smooth, moderately reticulate with small meshes, punctures sparse, very small; subparallel in posterior half, widest in middle behind eye remnant; eye remnant reduced to two well-separated short sutures at side of head. Antenna very thin, segments subequal, apical segment a bit longer than penultimate (Fig. 66). Maxillary palpus thin, elongate, apical segment about same length as segments 1 to 3 combined.

*Pronotum*. As wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles obtuse; smooth, moderately reticulate, meshes small; punctures sparse, weak; basal plicae weak, straight, reaching to about one-quarter way along pronotum; with row of long setae laterally, denser towards front.

*Elytra*. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with small shallow punctures, row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated, that portion of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

*Ventral surface*. Prosternal process moderately broad, strongly narrowed between coxae, not reaching mesothorax, apical half almost parallel-sided, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline; wings short, very narrow; broadly rounded in

midline behind; reaching a little beyond midway to metacoxae. Metacoxal plates large, metacoxal lines weakly defined, relatively close, moderately widely spaced, reaching nearly to metasternum, evenly diverging; a few small setae-bearing punctures towards midline; finely reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, weakly reticulate, ventrites 3 and 4 with a long central seta or bunch of long setae.

*Legs*. Protibia very narrow, slightly bowed, widest past middle where it is about three times its basal width; protarsi expanded, segment 1 round, segment 2 a little broader and a little shorter, segment 3 about twice as long and as broad as segment 1 and very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with very dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with two comb-like rows of spines along hind edge (Fig. 64); mesotibia narrow, more strongly bowed than protibia; mesotarsi narrower than protarsi. Metatrochanter tip rounded (Fig. 65); metafemur elongate, lacking spines; metatibia thin, curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

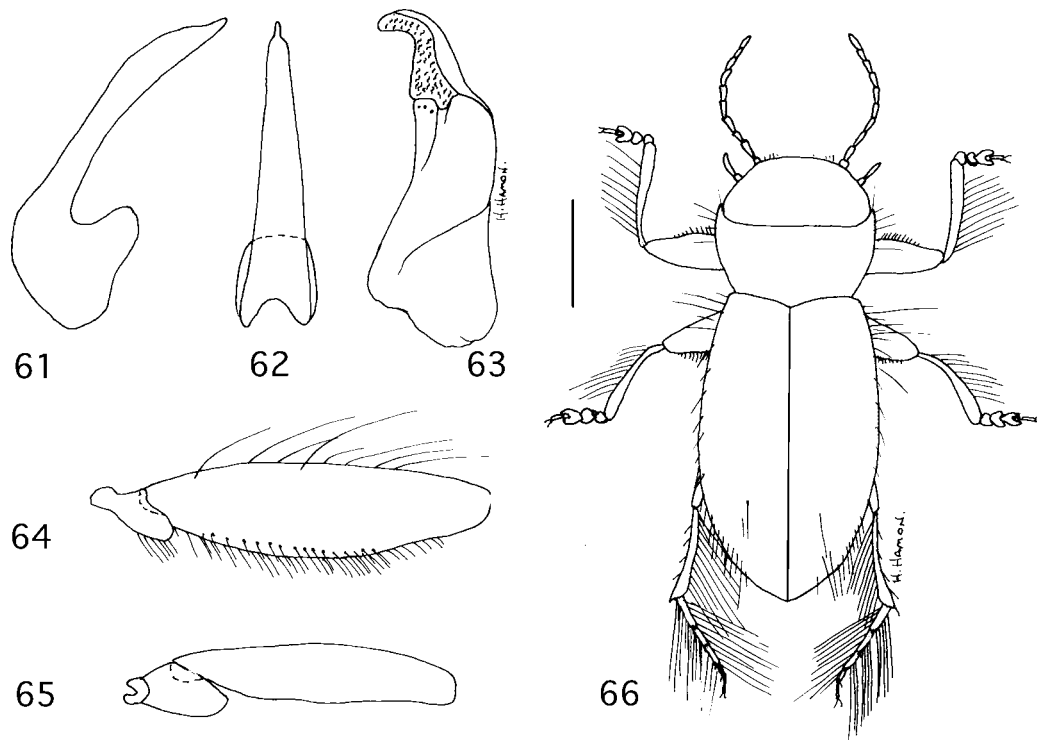
*Male*. Female not known. Median lobe of aedeagus progressively narrowing to near apex where it rapidly narrows to blunt tip; paramere narrow, apical portion without well separated apical lobe, apical segment with inner half with different surface texture to outer (Figs 61–63).

*Etymology*

Named after the type locality.

*Remarks*

A relatively large species with numerous characters setting it apart from other Australian stygobitic *Bidessini*. Most noticeably the long thin antenna, bowed mesotibia and unusually thin legs. The species will key to *Bidessodes* in Bistrom (1988) and the male genitalia resemble *B. flavosignatus* (Zimmermann). DNA sequence data (Cooper et al 2002) somewhat distantly groups it with the previous species, *B. gutteridgei* sp. nov., and with *B. bilita* and *B. mjobergi*. Its large size



FIGURES 61–66. *Bidessodes limestoneensis*: **61**, lateral view of central lobe of aedeagus; **62**, ditto dorsal view; **63**, paramere; **64**, mesotrochanter and mesofemur; **65**, metatrochanter and metafemur; **66** dorsal view. Scale bar represents 1 mm (habitus only).

and thin prolegs readily separate it from *B. gutteridgei*. Additional studies incorporating more specimens of Australian *Bidessodes* (which DNA sequence data strongly suggest are not closely related to the South American *Bidessodes*) and additional specimens are needed to confirm the placement of *B. limestoneensis* with the Australian *Bidessodes*.

*Nirripiriti* Watts & Humphreys

*Nirripiriti darlotensis* sp. nov.

*Types*

*Holotype*: m: 'BES 6635, Melrose Station (Lake Darlot), mineral exploration bore near Halfpenny Well, 27°41'48"S 121°20'22"E, 13/5/2001, coll. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32963. Slide mounted.

*Paratypes*: 11, 7 (2 partial) as for holotype, 5 (2 partial) WAM 32964–32968, 2 SAMA; 2, as for holotype except 'BES 6636', WAM 32969–

32970; 2, as for holotype except 'BES 6639', SAMA.

*Description* (number examined, 12) Figs 67–72

*Habitus*. Length 3.5–4.1 mm; elongate, relatively flat, slightly pug-nosed, moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing reduced to one-third length of elytron.

*Head*. Large, almost as wide as elytra; smooth, very weakly reticulate, scattered small punctures and dense band of setiferous punctures across rear; sides subparallel in posterior half; eye remnant reduced to a small suture in middle near edge. Antenna thin, segments 1 and 2 cylindrical, segments 3 to 10 subequal with segment 7 largest, segment 11 a bit longer than segment 10. Maxillary palpus thin, elongate, segment 4 a little longer than segment 3.

*Pronotum*. About as wide as elytra; anteriolateral angles thin, projecting strongly forward; moderately narrowed before base, sides slightly sinuate; posterolateral angles obtuse;

virtually impunctate except for band of strong punctures along front margin; long lateral setae restricted to apical third.

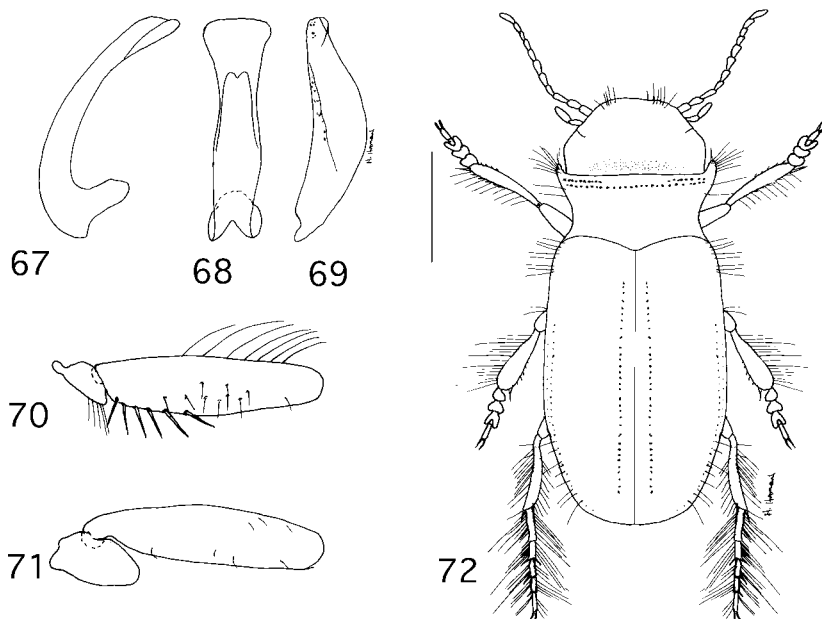
*Elytra*. Not fused but tightly closed, lacking inner ridges; elongate/oval, widest behind middle, smooth, a few scattered very small punctures, a row of punctures adjacent to suture; a few additional larger punctures with long setae, more frequent towards sides. Setiferous micropunctures over most of underside, denser at base, apex and along suture line. Epipleuron not differentiated from rest of elytron, that part of elytron visible ventrally relatively broad for almost the whole length of elytron.

*Ventral surface*. Prosternal process very narrow between coxae, not reaching mesothorax, apical half narrowly spatulate, point rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum triangularly pointed in front in midline; wings very narrow, short; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half indistinct towards sides, ventrites 3 to 5 mobile, virtually impunctate

except for a few long central seta or bunch of long setae.

*Legs*. Protibia narrow, widest a little past middle where it is about four times its very narrow basal width; protarsi moderately expanded, segment 1 transversely oval, segment 2 about size of segment 1, segment 3 about twice length of segment 2, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of seven to eight relatively long but weak spines along hind edge in basal half; mesotarsi less expanded than protarsi. Metatrochanter elongate/oval, tip rounded; metafemur thin, lacking spines; metatibia weakly curved, widening slightly towards apex; metatarsi elongate, segment 1 longest, segments 2 to 4 subequal, in combination segments 1 and 2 about same length as others, segments 2 to 5 without spines other than at apex; claws weak.

*Male*. Antennae of male slightly stouter than female. Median lobe of aedeagus broad, flat, widening at apex; paramere relatively narrow, apex rounded with small flap of tissue (Figs 67–69).



FIGURES 67–72. *Nirripiri darlotensis*: 67, lateral view of central lobe of aedeagus; 68, ditto dorsal view; 69, paramere; 70, mesotrochanter and mesofemur; 71, metatrochanter and metafemur; 72 dorsal view. Scale bar represents 1 mm (habitus only).



*Etymology*

Named after the type locality.

*Remarks*

A large species with the elytra tending to wrap around the abdomen, and with thin antennae with segment 3 a bit longer than segment 2. The only other species to have a broad band of small setiferous punctures across the back of the head is the much smaller *N. melroseensis* which was collected from the same bore hole.

*Nirripirti fortisspina* sp. nov.*Types*

*Holotype*: m: 'BES 6645, Pinnacles Station, Site 432, 28°15'27"S 120°07'37"E, 14/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32971. Slide mounted.

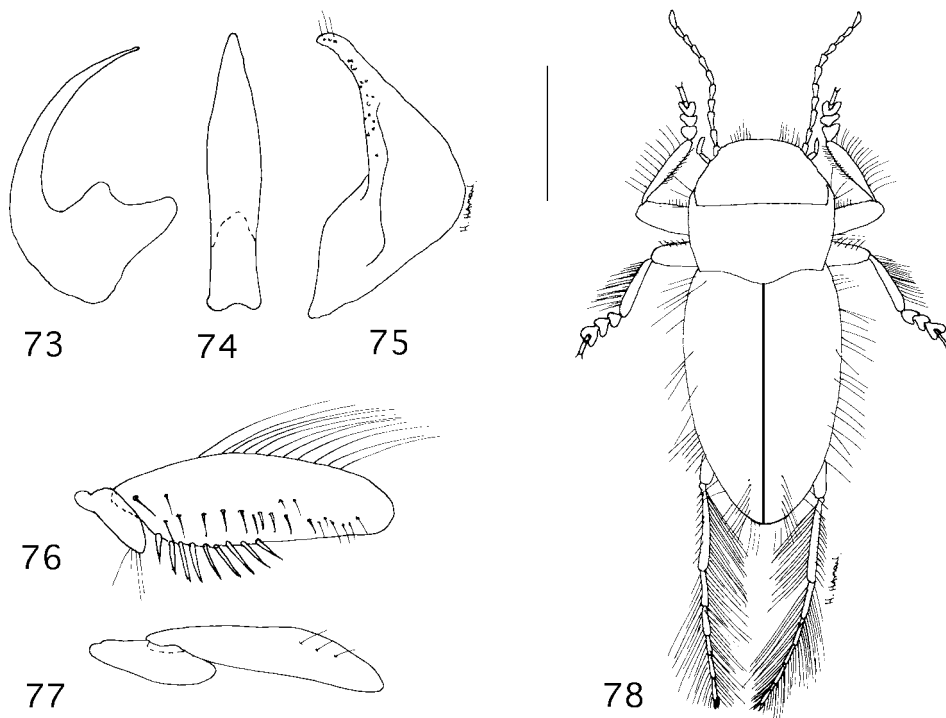
*Paratypes*. 15; 13, as for holotype, 7 WAM 32972–32978, 6 SAMA; 2, as for holotype except 'BES 6646', SAMA.

*Description* (number examined, 16) Figs 73–78

*Habitus*. Length 2.5–3.0 mm. elongate, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to small flap.

*Head*. Large, nearly as wide as elytra; smooth, weakly reticulate with small even meshes, a few small scattered punctures; sides subparallel in posterior half; eye remnant reduced to a short suture near edge. Antenna thin, segments 1 and 2 almost cylindrical, segments 3 to 10 approximately same length, widening slightly towards their apexes, segments 3 and 4 narrowest, segment 11 a bit longer and narrower than segment 10. Maxillary palpus elongate, thin, segment 4 a little longer than segment 3.

*Pronotum*. About as wide as elytra; anteriolateral angles projecting strongly forward; wider anteriorly, evenly narrowing towards rear, posterolateral angles obtuse; very weakly reticulate, virtually impunctate except towards front margin, numerous long setae at side towards front.



FIGURES 73–78. *Nirripirti fortisspina*: 73, lateral view of central lobe of aedeagus; 74, ditto dorsal view; 75, paramere; 76, mesotrochanter and mesofemur; 77, metatrochanter and metafemur; 78 dorsal view. Scale bar represents 1 mm (habitus only).

*Elytra*. Not fused but tightly locked, lacking inner ridges; elongate, widest a bit anterior of middle, smooth, covered with fine reticulation; moderate number of relatively large punctures laterally; underside with dense setiferous micropunctures at apex and along suture line. Epipleuron not differentiated from rest of elytron, that part of elytron visible ventrally broad in anterior quarter, then gradually narrowing, absent near apex of elytron.

*Ventral surface*. Prosternum very narrow, not much wider than procoxae; anterior half of prosternal process almost perpendicular to body, strongly narrowed between coxae, not reaching mesothorax, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum only weakly extended forward in midline; wings very short, narrow; main portion almost parallel-sided; rounded in midline behind. Metacoxal plates large, metacoxal lines absent; weakly reticulate, impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, weakly reticulate, virtually impunctate except for a few long central seta or bunch of long setae.

*Legs*. Profemur with small peg-like seta on hind edge adjacent to trochanter; protibia narrow, widest past middle where it is about twice its basal width; protarsi quite strongly expanded, segment 1 broadly elongate not symmetric, basal half expanded backwards, apical half more expanded forwards, segment 2 about one-half length of segment 1, outer lobe more expanded; segment 3 as long as segment 1, deeply bifid, lobes slightly asymmetric; segment 4 very small and hidden within lobes of segment 3; segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of eight to nine very strong spines closely spaced along hind edge in basal half; mesotarsi symmetric, less expanded than protarsi. Metatrochanter narrowly elongate, apical half well separated from femur; metafemur thin, elongate, lacking spines; metatibia thin, weakly curved, approximately the same width throughout; metatarsi thin, elongate, segment 1 and others subequal in length, in combination segments 1 and 2 much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

*Male*. Little external difference from female. Median lobe of aedeagus narrowing rapidly in

apical quarter; paramere broadest in middle, apical quarter thin, apex with a bunch of short stout setae (Figs. 73–75).

#### *Etymology*

Latin. 'Forte spina' – strong spines.

#### *Remarks*

A relatively large distinctive species easily recognised by the row of strong spines on the mesofemur and the peculiarly asymmetric protarsi, as well as the thin elongate metatrochanters and thin elongate antenna. The prosternum is short with little area in front of the mesocoxae, resulting in a very perpendicular anterior portion to the prosternal process.

#### *Nirripiriti hamoni* sp. nov.

#### *Types*

*Holotype*: m: 'BES 8662, Milgun Station, Earrie Well, 25°07'22"S 118°05'44"E, 28/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldo', WAM 32979. Slide mounted.

*Paratypes*: 3; 2, as for holotype, SAMA; 1, as for holotype except 'BES 8661, 27/8/2001', WAM 32980.

#### *Description* (number examined, 4) Figs 79–84

*Habitus*. Length 1.7 mm.; relatively broad, flat, strongly constricted at base of pronotum; elytra slightly flared at shoulders; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

*Head*. Relatively small, less than width of elytra; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases; subparallel in posterior half; eye remnant reduced to a dark suture in middle near edge. Apical half of antenna relatively thick, segment 1 cylindrical, segment 2 oval, segments 3 to 4 much thinner than rest, segments 6 to 7 subequal, broader than segment 5, apical segment a bit longer and narrower than penultimate. Maxillary palpus elongate, segment 4 a little longer than segment 3.

*Pronotum*. A little narrower than elytra; anteriolateral angles projecting strongly forward to sharp point, sides strongly curved outwards; base strongly narrowed, posterolateral angles acute; strongly reticulate, virtually impunctate except towards front margin and laterally. Numerous long setae at sides towards front.

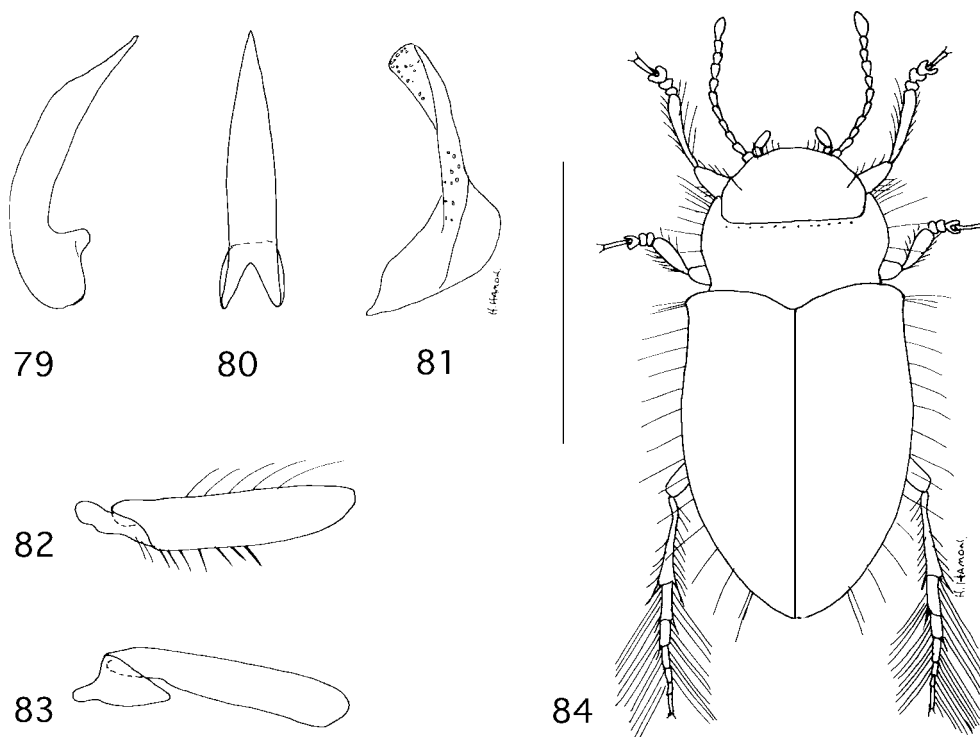
*Elytra*. Not fused but strongly locked, lacking inner ridges; elongate, widest in front of middle,

slightly constricted behind shoulders, smooth, covered with strong reticulation; moderately and evenly covered with small punctures; underside of elytron with a few additional larger punctures with long setae, more frequent towards sides; with numerous setiferous micropunctures densest towards apex and along suture line. Epipleuron not differentiated from rest of elytron, broad in anterior fifth, then rapidly narrowing to middle, virtually absent along rest of elytron.

*Ventral surface.* Prosternal process broad, strongly narrowed between coxae, not reaching mesothorax, apical half oval, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply pointed in front in midline; wings short, very narrow; narrowly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate, strongly reticulate with large meshes; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct except close to sides, ventrites 3 to 5 mobile, virtually impunctate except for a few long central setae or bunch of long setae.

*Legs.* Profemur noticeably grooved in apical half to accept protibia; protibia narrow, widest past middle where it is about three times its basal width; protarsi expanded, segment 1 broad, segment 2 about one-half length of segment 1, segment 3 relatively narrow, as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi a little less expanded than protarsi. Metatrochanter relatively small, tip pointed; metafemur thin, lacking spines; metatibia relatively stout, very weakly curved, approximately the same width throughout; metatarsi relatively stout, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

*Male.* Male appendages not known. Median



FIGURES 79–84. *Nirripiri hamoni*: **79**, lateral view of central lobe of aedeagus; **80**, ditto dorsal view; **81**, paramere; **82**, mesotrochanter and mesofemur; **83**, metatrochanter and metafemur; **84** dorsal view. Scale bar represents 1 mm (habitus only).

lobe of aedeagus narrowing rapidly in apical quarter; paramere broad at base, apical half thin, tip with a bunch of long setae (Figs. 79–81).

#### *Etymology*

Named after Harold Hamon, the illustrator of many of these beetles.

#### *Remarks*

A relatively small, strongly chitinised species easily recognised by its flared shoulders and strongly constricted pronotum and pointed metatrochanters.

#### *Nirripiriti killaraensis* sp. nov.

#### *Types*

*Holotype*: m: 'BES 5561, Killara Station, Two Mile Bore, 26°21'11"S; 118°59'34"E, 5/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32981. Slide mounted.

*Paratypes*: 19; 1, as for holotype, SAMA; 1, 'BES 5597, Killara Station, uncased mineral exploration bore, Site 130, 26.34194°S; 118.96071°E, 6/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', SAMA; 8, 'BES 8125, Killara Station, Site 130, 26°20'31"S, 118°57'39"E, 21/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM 32928–32989; 9, ditto, except 'BES 8128', SAMA.

#### *Description* (number examined, 20) Figs 85–90

*Habitus*. Length 1.5–1.9 mm; boat-shaped, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

*Head*, Narrower than elytra; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases arranged in lines; sides slightly curved; eye remnant reduced to a short suture in middle near edge. Antenna relatively thick, segment 1 narrow, cylindrical, segment 2 much larger, rounded, narrower at base, segments 3 and 4 narrow, segments 6 to 8 a bit wider than others, segment 11 is 1.5 times longer than penultimate. Maxillary palpus elongate, apical segment about as long as other segments combined.

*Pronotum*. Narrower than elytra; anteriolateral angles projecting strongly forward; sides weakly sinuate, posterolateral angles obtuse; quite strongly reticulate, a few small scattered punctures. Long setae at sides

*Elytra*. Not fused but tightly closed, lacking

inner ridges; elongate, widest behind middle, smooth, covered with fine reticulation; a few scattered small punctures, a few additional larger punctures with long setae, more frequent towards sides, underside with setiferous micropunctures at base, apex and along suture line. Epipleuron not differentiated; that portion of elytra visible ventrally, broad except near tip.

*Ventral surface*. Prosternal process strongly narrowed between coxae, tip pointed, nearly reaching mesothorax, apical half parallel with plane of body, anterior section perpendicular to plane of body, prosternum short and not much wider than procoxae. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate, reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner three-quarters and indistinct laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae, strongly reticulate, meshes small.

*Legs*. Protibia narrow, widest past middle where it is about twice its basal width; protarsi weakly expanded, segment 1 broadly triangular, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, a little longer than segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five spines along hind edge in basal half; mesotarsi much narrower than protarsi. Metatrochanter elongate/oval, apex bluntly pointed; metafemur elongate, lacking spines; metatibia almost straight, approximately the same width throughout; metatarsi elongate, segment 1 longest, segments 2 to 4 subequal, segments 1 and 2 in combination about same length as others, segments 2 to 5 without spines other than at apex; claws weak.

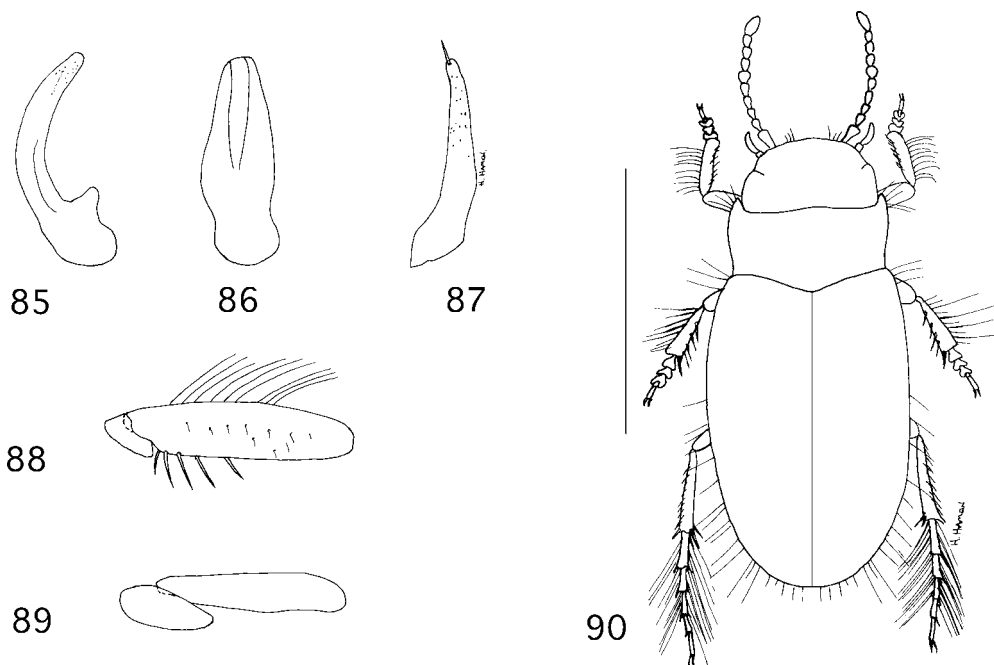
*Male*. Little difference from female. Median lobe of aedeagus narrowing rapidly in apical quarter; paramere broad at base, apical half thin, tip with a bunch of long setae (Figs. 85–87).

#### *Etymology*

Named after the pastoral station on which it was found.

#### *Remarks*

A moderately sized, boat-shaped species with



FIGURES 85–90. *Nirripiriti killaraensis*: **85**, lateral view of central lobe of aedeagus; **86**, ditto dorsal view; **87**, paramere; **88**, mesotrochanter and mesofemur; **89**, metatrochanter and metafemur; **90** dorsal view. Scale bar represents 1 mm (habitus only).

wrap-around elytra, and a pronotal process with a long point which nearly reaches the extension of the metasternum. A little smaller than the other boat-shaped Western Australian species, *N. skaphites*, and with the apex of the metatrochanters more rounded.

*Nirripiriti macrocephalus* sp. nov.

*Types*

*Holotype*: male: 'BES 8089 NT: Napperby Station; bore RN 1561@ Herbert Well; 22°54'32"S 132°43'45"E; 18/6/2001. Col. W.F. Humphreys & R. Read.', NTM, I 001174. Slide mounted.

*Paratype*: 1, as for holotype, SAMA.

*Description* (number examined, 2) Figs 91–96

*Habitus*. Length 1.9–2.0 mm.; oval, relatively flat, strongly constricted at junction of pronotum/elytra; light testaceous, head a little darker; hindwing vestigial, reduced to tiny flap.

*Head*. Large, short, broad, deflexed downwards, as wide as elytra; smooth, weakly reticulate, virtually impunctate except a few small ones near

antennae bases; sides subparallel in posterior half; eye remnant reduced to a short suture in middle. Antenna thin, segments 1 and 2 cylindrical, segments 3 and 4 much thinner, 5 to 10 triangular, broader middle segments slightly larger, segment 11 twice length of segment 10. Maxillary palpus thin, elongate, segment 4 much longer than segment 5, some long setae towards apex of segments.

*Pronotum*. A little wider than elytra, much broader than long; anteriolateral angles projecting strongly forward, anterior edge sinuate; strongly constricted just before base, posterolateral angles acute; a few scattered very small punctures; numerous long setae at sides particularly towards front.

*Elytra*. Not fused but tightly closed, lacking inner ridges; broad, widest at shoulders, smooth; weakly reticulate; a few scattered small punctures, some arranged in rows; a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with numerous, evenly spaced, setiferous micropunctures denser towards apex. Epipleuron not differentiated, that part of elytron visible ventrally broad in anterior fifth, rapidly

narrowing to be virtually absent along rest of elytron.

*Ventral surface.* Prosternum short, no longer than postcoxae, anterior portion of prosternal process rising perpendicularly with both a forward and a backward projection, anterior projection broad, rounded, posterior projection (process) broad, triangular; not reaching mesothorax. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in midline; wings absent; broadly rounded in midline behind. Metacoxal plates large, reaching episternum, metacoxal lines absent; virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half indistinct laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae.

*Legs.* Protibia very narrow, widest near apex where it is about twice its basal width; protarsi moderately expanded, segment 1 broadly triangular, segment 2 a little shorter, segment 3 longer than segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with long adhesive

setae; claws short and simple. Mesotrochanter elongate/ oval, with a few fine setae at apex; mesofemur with row of four strong spines along hind edge in basal half; mesotibia curved, moderately flanged on inside near apex, mesotarsi simple, not expanded. Metatrochanter oval; metafemur elongate, lacking spines; metatibia stout, curved, moderately widening towards apex; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 a little shorter than others, all segments without spines other than at apex; claws weak.

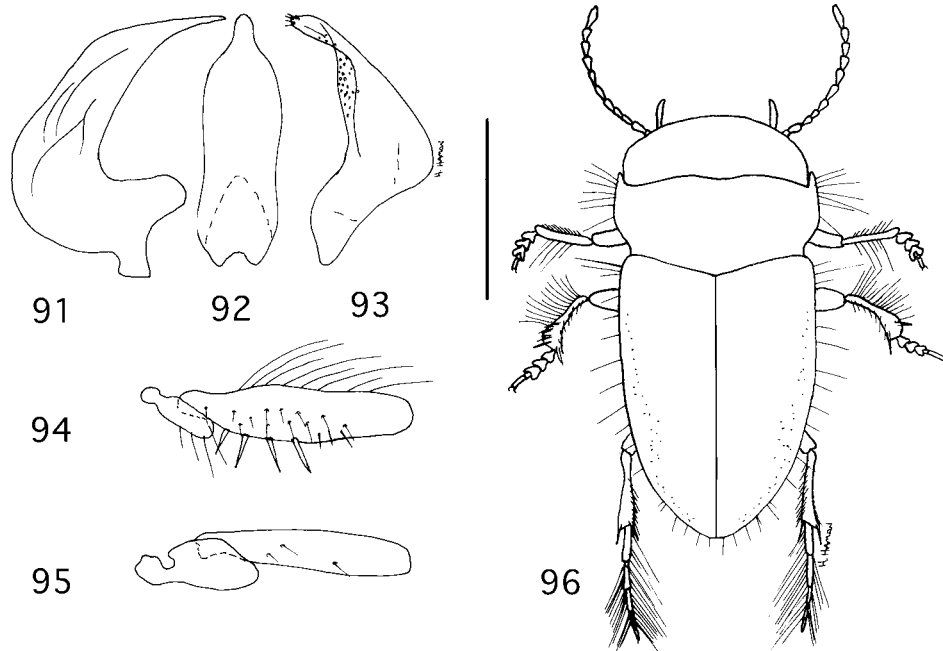
*Male.* Little difference from female. Median lobe of aedeagus broad, narrowing rapidly in apical quarter to sharp point, apical portion of paramere twisted, apex rounded (Figs 91–93).

#### *Etymology*

Latin. ‘Macrocephalus’ – big head; a reference to its unusually large deflexed head.

#### *Remarks*

A distinctive, moderate sized, well chitinised species, easily recognised by its very broad deflexed head as well as its thin legs and strongly constricted pronotum.



FIGURES 91–96. *Nirripiri macrocephalus*: **91**, lateral view of central lobe of aedeagus; **92**, ditto dorsal view; **93**, paramere; **94**, mesotrochanter and mesofemur; **95**, metatrochanter and metafemur; **96** dorsal view. Scale bar represents 1 mm (habitus only).

*Nirripirti melroseensis* sp. nov.

## Types

*Holotype*: m: 'BES 6635, Melrose Station (Lake Darlot), mineral exploration bore near Halfpenny Well, 27°41'48"S; 121°20'22"E, 13/5/2001, coll. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32990. Slide mounted.

*Paratypes*: 23; 10, as for holotype, SAMA; 2, as for holotype except 'BES 6639', WAM 32991–32992; 11, as for holotype except 'BES 6636', WAM 33927–33937.

*Description* (number examined, 24) Figs 97–102

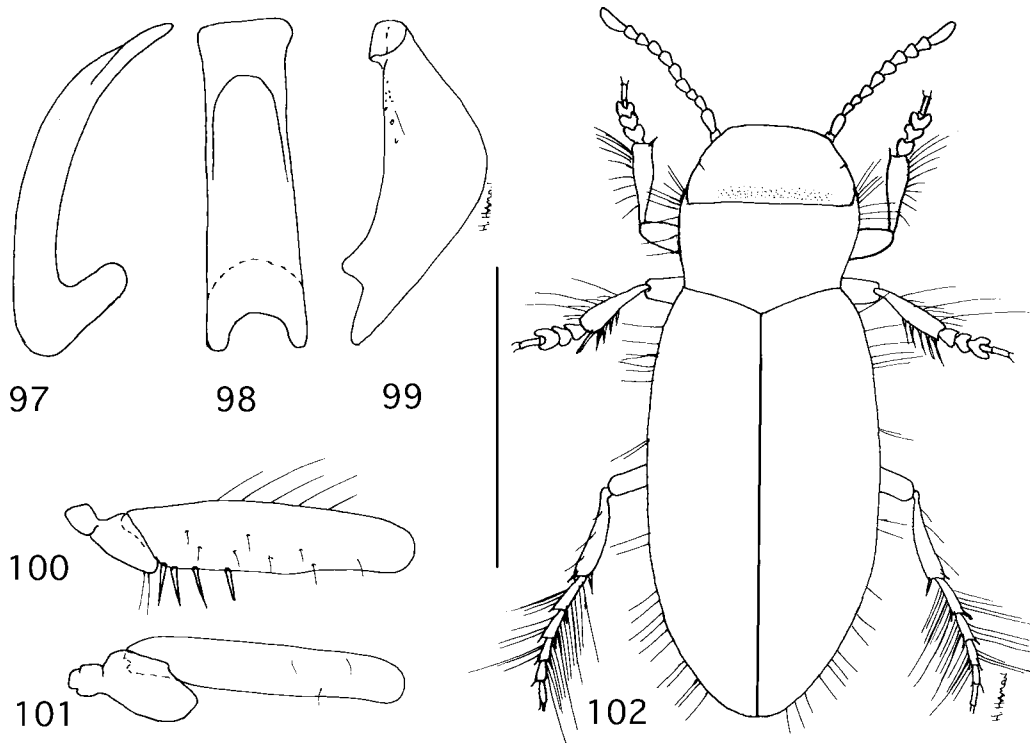
*Habitus*. Length 1.8–2.0 mm; elongate, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing reduced to one-third length of elytron.

*Head*. Much narrower than elytra; smooth, strongly reticulate with small even meshes, moderately dense band of setiferous punctures across rear; sides subparallel in posterior half; eye remnant reduced to a suture in middle at side. Antenna relatively thick, segment 1 robust,

cylindrical, segment 2 a little wider and more oval, segments 3 to 10 narrow and shorter, subequal, segment 11 about as wide and a bit longer than segment 10. Maxillary palpus elongate, apical segment about twice as long as segment 10.

*Pronotum*. Much narrower than elytra, about same width as head; anteriolateral angles projecting strongly forward; sides narrowing slightly posteriorly, posterolateral angles obtuse; strongly reticulate, virtually impunctate except towards front margin and rear corners. Long setae at sides, more extensive towards front.

*Elytra*. Not fused but tightly closed, lacking inner ridges; elongate, almost parallel-sided, smooth, covered with fine reticulation; a few scattered small punctures, several rows of widely spaced small punctures; a sparse row of large shallow punctures adjacent to suture; a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with quite dense setiferous micropunctures at apex and narrowly along suture line. Epipleuron not differentiated, that part of elytron visible ventrally



FIGURES 97–102. *Nirripirti melroseensis*: **97**, lateral view of central lobe of aedeagus; **98**, ditto dorsal view; **99**, paramere; **100**, mesotrochanter and mesofemur; **101**, metatrochanter and metafemur; **102** dorsal view. Scale bar represents 1 mm (habitus only).

moderately broad in anterior quarter, then gradually narrowing to apex.

*Ventral surface.* Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half relatively narrow, parallel-sided, tip pointed, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in midline; wings short, very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; strongly reticulate, virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 possibly fused, sutural lines distinct, ventrites 3 to 5 mobile, moderately reticulate, virtually impunctate except for a few long central setae or bunch of long setae.

*Legs.* Protibia elongate, relatively broad, widest near apex where it is about three times its basal width; protarsi weakly expanded, segment 1 cylindrical, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about one-half length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi a little less expanded than protarsi. Metatrochanter elongate/oval, apex somewhat truncated; metafemur thin, lacking spines; metatibia moderately curved, widening somewhat towards apex; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 slightly shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

*Male.* Little external difference between the sexes. Median lobe of aedeagus broad, widening slightly at apex; paramere broad, narrowing towards apex, apex bent over (Figs 97–99).

#### *Etymology*

Named after the pastoral station on which it was found.

#### *Remarks*

A moderate sized, elongate species, with head and pronotum about the same width and much narrower than elytra, rather squat metatrochanters and thin metafemurs and metatibia which are strongly curved in Bidessine fashion. Across the rear of the head is a relatively wide band of small setiferous punctures which are otherwise only

present in the much larger *N. darlotensis*, which was found in the same bore hole.

#### *Nirripiriti milgunensis* sp. nov.

#### *Types*

*Holotype:* m: 'BES 8661 Milgun Station, Earrie Well, 25°07'22"S; 118°05'44"E, 27/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM 32993. Slide mounted.

*Paratypes:* 4; 1, as for holotype, SAMA; 3 (1 partial), as for holotype except 'BES 8662, 28/8/2001', 2 (1 partial) WAM 32994–32995, 1 SAMA.

#### *Description* (number examined, 5) Figs 103–108

*Habitus.* Length 1.2–1.3 mm; elongate, almost parallel-sided, relatively flat, very weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

*Head.* Large, nearly as wide as elytra; smooth, moderate reticulation with small even meshes, virtually impunctate except a few near antennae bases; subparallel in posterior half; eye remnant absent. Antenna stout, segment 1 cylindrical, segment 2 large oval, segments 3 to 5 thinner than rest, segment 11 about 1.5 times as long as segment 10. Maxillary palpus stout, segment 4 much longer than segment 3.

*Pronotum.* About as wide as elytra; anteriolateral angles projecting strongly forward, sides straight, base not constricted, posterolateral angles obtuse; quite strongly reticulate, virtually impunctate except towards front margin; some long setae at side towards front.

*Elytra.* Not fused but tightly closed, lacking inner ridges; elongate, parallel-sided, smooth, covered with strong reticulation; a few scattered small punctures; additional larger punctures with long setae, more frequent towards sides; setiferous micropunctures over most of underside denser near base, at apex and along suture line. Epipleuron not differentiated, that part of elytron visible ventrally broad in anterior fifth, then progressively narrowing to near apex.

*Ventral surface.* Prosternal process relatively narrow, strongly narrowed between coxae, not reaching mesothorax, apical half spatulate, tip pointed, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum broadly pointed in front in midline; wings short, narrow; bluntly triangular in midline behind.



Metacoxal plates large, metacoxal lines absent; virtually impunctate; moderately reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half indistinct laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae.

*Legs.* Profemur relatively stout; protibia narrow, widest at apex where it is about three times its basal width; protarsi quite strongly expanded, segment 1 broadly triangular, segment 2 not much shorter than segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, broadening towards apex, a little curved, about length of segment 3; segments 1 to 3 a little asymmetric with the outer lobe larger than inner, with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate/oval with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi much less expanded than protarsi. Metatrochanter large, oval, tip separated from

metafemur; metafemur stout, lacking spines; swimming-hairs sparse; metatibia weakly curved, widening slightly towards apex; metatarsi stout, elongate, impunctate, segment 1 longest, segment 5 twice the length of segment 4, segments 2 and 3 subequal, segments 1 and 2 in combination about as long as others, segments 2 to 5 without spines other than at apex; claws weak.

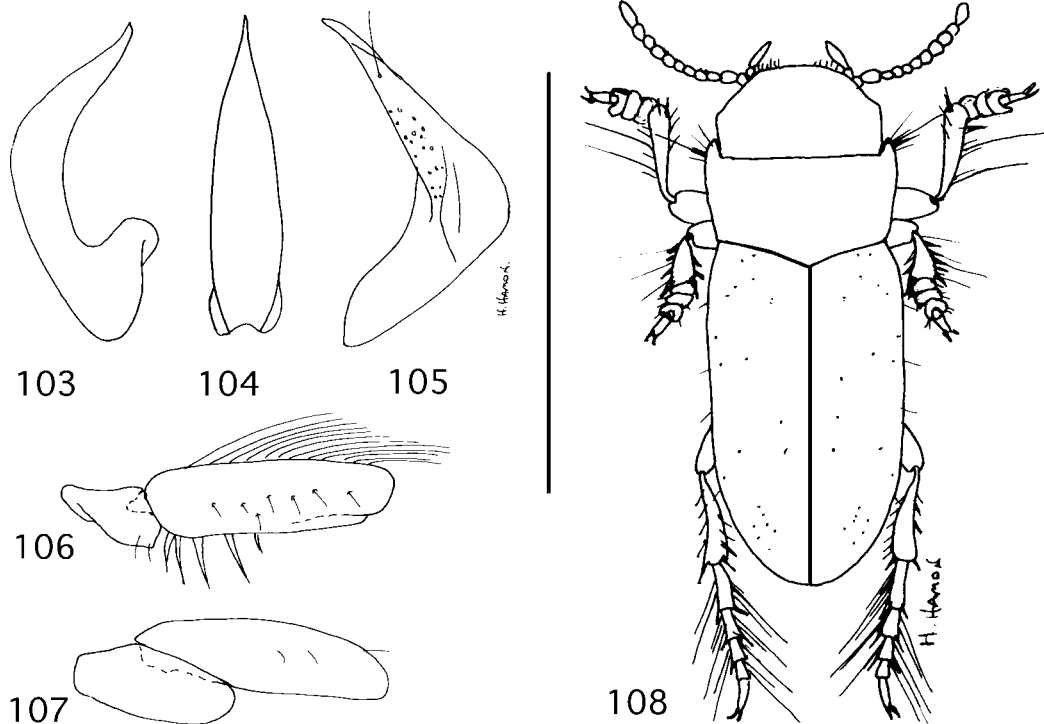
*Male.* Little difference from female. Median lobe of aedeagus narrowing rapidly in apical quarter; paramere broad at base, apical half thin, tip with a bunch of long setae (Figs. 103–105).

#### *Etymology*

Named after the pastoral station on which it was found.

#### *Remarks*

A very small species, virtually lacking any trace of an eye remnant, pronotum not constricted, strong spines on the mesofemur, large metatrochanters, and metatarsal segment 4 only about one-half the length of segment 3.



FIGURES 103–108. *Nirripiriti milgunensis*: **103**, lateral view of central lobe of aedeagus; **104**, ditto dorsal view; **105**, paramere; **106**, mesotrochanter and mesofemur; **107**, metatrochanter and metafemur; **108** dorsal view. Scale bar represents 1 mm (habitus only).

*Nirripirti napperbyensis* sp. nov.*Types*

*Holotype*: m: 'BES 8091. NT: Napperby Station., Bore RN 1561 at Herbert Well, 22°54'32"S 132°43'45"E, 17/6/2001, Col. W.F. Humphreys & R. Read', NTM I 001175. Slide mounted.

*Paratypes*: 7; 5, as for holotype, 2 WAM 32996–32997, 3 SAMA; 2, as for holotype except 'BES 8090', WAM 32998–32999.

*Description* (number examined, 8) Figs 109–114

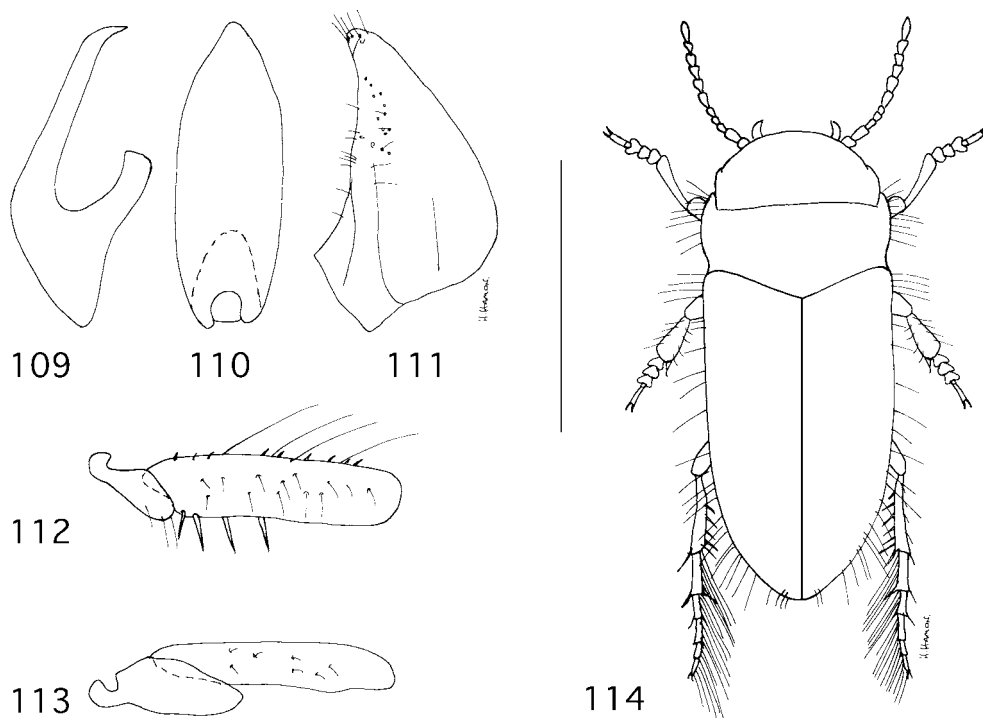
*Habitus*. Length 1.7–1.8 mm; elongate, relatively flat, weakly constricted at junction of pronotum/elytra; light testaceous, head a little darker; hindwing vestigial, reduced to tiny flap.

*Head*. Large, broad, a little narrower than elytra; smooth, very weakly reticulate, a few very small scattered punctures; sides slightly converging towards rear; eye remnant reduced to a very short suture. Antenna relatively thick,

segment 1 cylindrical, segment 2 enlarged towards apex, segments 3 and 4 much shorter and thinner, segments 5 to 10 similar in shape, middle ones slightly larger, segment 11 about twice as long as segment 10. Maxillary palpus stout, elongate, segment 4 twice as long as segment 3, some long setae towards apex of segments.

*Pronotum*. Almost same width as elytra; anteriolateral angles projecting strongly forward; sides weakly curved, weakly constricted before base; posterolateral angles acute; weakly reticulate, sparse small punctures, larger punctures laterally, denser towards front; long setae at sides in anterior half.

*Elytra*. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, very weakly reticulate, a few scattered small punctures, several loose rows of widely spaced small punctures, a few additional larger punctures with long setae; underside of elytron with numerous evenly spaced setiferous micropunctures more frequent towards sides and denser towards apex.



FIGURES 109–114. *Nirripirti napperbyensis*: **109**, lateral view of central lobe of aedeagus; **110**, ditto dorsal view; **111**, paramere; **112**, mesotrochanter and mesofemur; **113**, metatrochanter and metafemur; **114** dorsal view. Scale bar represents 1 mm (habitus only).

Epipleuron not differentiated, that part of elytron visible ventrally present only at extreme base.

*Ventral surface.* Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half broad, diamond shaped, tip sharply pointed, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternal plate bluntly pointed in front in midline; wings short, narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines weak, well separated, diverging in anterior half, not reaching metasternum; virtually impunctate, weakly reticulate; closely adpressed to first abdominal ventrite. Ventrites fused, sutural lines distinct in inner half absent laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae.

*Legs.* Protibia narrow, widest near apex where it is about twice its basal width; protarsi moderately expanded, segment 1 broadly triangular, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about 1.5 times length of segment 3, segments 1 to 3 with adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four strong setae/spines along hind edge in basal half; mesotarsi narrower and longer than protarsi. Metatrochanter relatively large, oval, apex well separated from metafemur; metafemur relatively stout, lacking spines; metatibia weakly curved, widening slightly towards apex; metatarsi with segment 1 longest, segment 4 shortest, in combination segments 1 and 2 much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

*Male.* Little external difference between the sexes. Median lobe of aedeagus short, flat, narrowing rapidly to sharp tip; paramere broad, apical half relatively broad, apex rounded (Figs 109–111).

#### *Etymology*

Named after the type locality.

#### *Remarks*

A moderately sized Northern Territory species with the ventrally visible parts of the elytra very short, and a broad pronotal process with a relative long sharp tip.

#### *Nirripiriti newhavenensis* sp. nov.

#### *Types*

*Holotype:* m: 'BES 6681: NT: Newhaven Station, bore RN 12787; 22°43'41"S; 131°09'59"E; 15/6/2001. Col. W.F. Humphreys & A. Russ', NTM I 001176. Slide mounted.

*Paratypes:* 9; 4, as for holotype, 2 WAM 33000–33001, 2 SAMA; 2, ditto except 'BES 6665' WAM 33002–33003; 3, as for holotype except 'BES 6680', 1 WAM 33004, 2 SAMA.

*Description* (number examined, 10) Figs 115–120

*Habitus.* Length 1.5–1.7 mm; elongate, relatively flat, moderately constricted at junction of pronotum/elytra; uniformly very light testaceous; hindwing vestigial, reduced to tiny flap.

*Head.* Large, broader than long, nearly as wide as elytra; smooth, a few scattered small punctures, moderately reticulate; sides subparallel in posterior half; eye remnant reduced to a short broad suture in middle near side. Antenna stout, segment 1 wide cylindrical, segment 2 large oval, segments 3 and 4 much shorter and narrower, segments 5 and 6 approximately the same shape but narrower at base, segments 7 to 8 same shape becoming progressively slightly narrower, segment 11 nearly twice as long and about same width as segment 10. Maxillary palpus elongate, segment 4 longer than segment 3, some long setae towards apex of segments.

*Pronotum.* About as wide as elytra; anteriolateral angles projecting strongly forward; base moderately narrowed, posterolateral angles obtuse; moderately reticulate, virtually impunctate except for some relatively strong punctures towards sides and front margin. Long setae at sides particularly towards the front.

*Elytra.* Not fused, lacking inner ridges; elongate, sides narrowing slightly towards apex, smooth, moderately reticulate, disc covered with moderately sized punctures, absent at sides; a few additional larger punctures with long setae, more frequent towards sides; setiferous micropunctures over much of underside of elytron except towards sides. Epipleuron not differentiated, that portion of elytron visible ventrally relatively broad for all but apical portion of elytron.

*Ventral surface.* Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in

midline; wings very short; broadly rounded in midline behind. Metacoxal plates large, reaching episternum, metacoxal lines absent; moderately reticulate, virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, virtually impunctate except for a few long central setae or bunch of long setae.

*Legs.* Protibia narrow, widest at apex where it is about twice its basal width; protarsi quite strongly expanded, segment 1 broadly oval, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about 1.5 times length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter narrowly oval with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi not expanded, much narrower and longer than protarsi. Metatrochanter large, bluntly pointed, apex well

separated from metafemur; metafemur relatively broad, lacking spines; metatibia weakly curved, widening slightly towards apex; metatarsi relatively stout, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

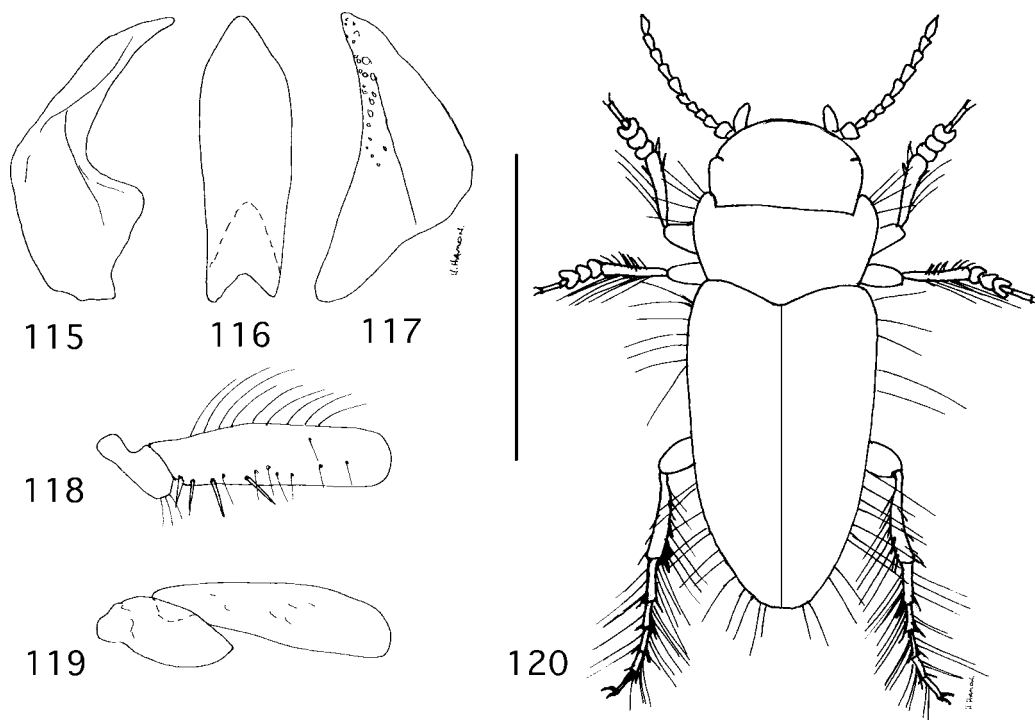
*Male.* Little difference from female. Median lobe of aedeagus narrowing rapidly in apical quarter; paramere relatively broad, apex blunt (Figs 115–117).

#### *Etymology*

Named after the type locality.

#### *Remarks*

A relatively small, lightly chitinised species with a large second antennal segment and the sides of the elytra wrapping over the abdomen for most of their length. Separated from the relatively similar *N. wedgeensis* by its larger size and quite strongly constricted base of the pronotum.



FIGURES 115–120. *Nirripiri newhavenensis*: **115**, lateral view of central lobe of aedeagus; **116**, ditto dorsal view; **117**, paramere; **118**, mesotrochanter and mesofemur; **119**, metatrochanter and metafemur; **120**, dorsal view. Scale bar represents 1 mm (habitus only).

*Nirripiriti pentameres* sp. nov.

## Types

*Holotype*: m: 'BES 6687: NT: Newhaven Station, Camel Well RN 15494, 22°22'56"S 131°11'23"E, 15/6/2001, col. W.F. Humphreys & A. Russ', NTM I 001177. Slide mounted.

*Description* (number examined, 1) Figs 121–126

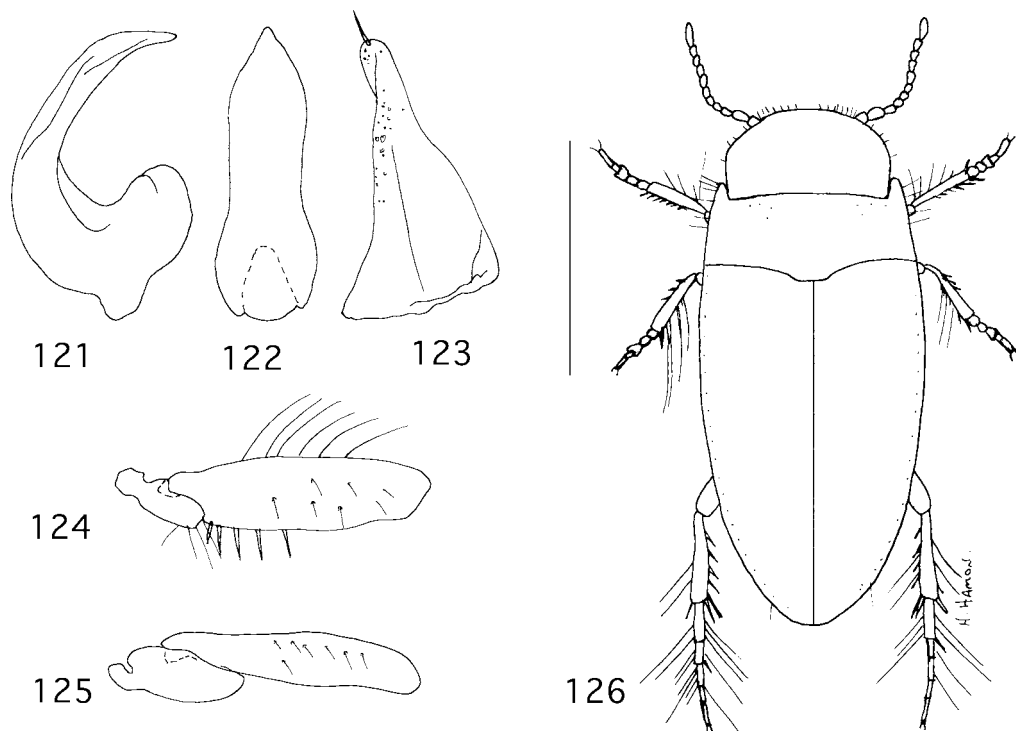
*Habitus*. Length 2.2 mm; elongate, relatively flat, slightly depressed in sutural region, not constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

*Head*. Large, narrower than elytra; smooth, very weakly reticulate, scattered small punctures; sides slightly converging in posterior half; eye remnant reduced to a short suture in middle near edge. Antenna relatively thin, segment 1 stout cylindrical, segment 2 slightly oval, segments 3 and 4 much thinner and shorter, segments 5 to 10 triangular, middle segments slightly larger, segment 11 nearly twice length of segment 10. Maxillary palpus elongate, segment 4 longer than segment 3.

*Pronotum*. About as wide as elytra; anteriolateral angles projecting strongly forward; sides weakly diverging posteriorly, not narrowed at base, posterolateral angles acute; scattered small punctures denser at sides; some long setae at sides in anterior half.

*Elytra*. Not fused, lacking inner ridges; elongate, widest in middle, smooth, a few scattered small punctures; a few additional larger punctures with long setae, more frequent towards sides; underside with scattered setiferous micropunctures over most of surface, denser towards apex and along suture line. Epipleuron weakly differentiated from rest of elytron, that part of elytron visible ventrally broad in anterior quarter, then gradually narrowing to middle, virtually absent along rest of elytron.

*Ventral surface*. Prosternal process damaged in specimen, Mesocoxae in contact at midline. Metasternum sharply pointed in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; with sparse uniform covering of small punctures; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines



FIGURES 121–126. *Nirripiriti pentameres*: **121**, lateral view of central lobe of aedeagus; **122**, ditto dorsal view; **123**, paramere; **124**, mesotrochanter and mesofemur; **125**, metatrochanter and metafemur; **126**, dorsal view. Scale bar represents 1 mm (habitus only).

distinct, ventrites 3 to 5 mobile, moderate number of small punctures and a few long setae or small bunch of long setae in the middle of each segment.

*Legs.* Protibia narrow, widest near apex where it is about twice its basal width; protarsi not expanded, segments 1 to 3 relatively small, subequal, segment 3 weakly bilobed, segment 4 about one-third length of segment 3, not hidden in lobes of segment 3, segment 5 robust, cylindrical, about twice the length of segment 3, segments 1 to 3 without adhesive setae; claws relatively strong. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of five to six strong spines along hind edge in basal half; mesotarsi similar to protarsi. Metatrochanter elongate/oval; metafemur elongate, lacking spines; metatibia weakly curved, approximately the same width throughout; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 a little shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

*Male.* Female unknown. Median lobe of aedeagus short, broad, flat with sharp tip; paramere with relatively broad apical half, apex rounded (Figs 121–123).

#### *Etymology*

Latin. 'Penta meres' – five segments; based on its obviously five-segmented protarsus.

#### *Remarks*

A moderate sized, distinctive species, with narrow protibia, small head and no constriction at the junction of pronotum and elytra. The pro- and mesotarsi are elongate, cylindrical, with the third segment only weakly bifid, exposing the relatively large fourth segment. This trend is also apparent in other Northern Territory *Nirripiriti* but is more pronounced in this species.

#### *Nirripiriti plutonicensis* sp. nov.

#### *Types*

*Holotype:* m: 'BES 8606; Three Rivers Station, bore MB4 Plutonic Borefield; 25°16'43"S 119°11'00"E; 26/8/2001. coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 33005. Slide mounted.

*Paratypes* 97; 11, as for holotype, 4 WAM 33006–33009, 5 SAMA; 8, 'BES 8651, Three Rivers Station, Limestone Well, 25°16'43"S 119°11'00"E, 26/8/2001, coll. W.F. Humphreys,

T. Karanovic & J.M. Waldock', 7 WAM 33010–33016, 1 SAMA; 7 ditto except 'BES 8625', 3 WAM 33017–33019, 4 SAMA; 9, 'BES 8620, Three Rivers Station, MB5, Plutonic Borefield, 25°16'43"S 119°11'00"E, 26/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', 5 WAM 33020–33024, 4 SAMA; 41, 'BES 8611/2, Three Rivers Station, Site 312, disused production bore, Plutonic Borefield, 25.26745°S 119.16398°E, 26/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', 10 WAM 33793–33802, 31 SAMA; 2, 'BES 8639, Three Rivers Station, bore MB1, Plutonic Borefield, 25.29213°S 119.18107°E, 26/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', SAMA; 16, 'BES 8656/7, Three Rivers Station, bore MB2, Plutonic Borefield, 25.27360°S 119.17200°E, 26/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', 10 WAM 33803–33812, 6 SAMA; 3 (1 partial), 'BES 8642, Three Rivers Station, new unused bore next to Gascoyne River; 25.11780°S 119.15115°E, 27/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', SAMA.

*Description* (number examined, 98) Figs 127–132

*Habitus.* Length 3.0–3.5 mm; elongate oval, relatively flat, moderately constricted at junction of pronotum/elytra; uniformly testaceous; hindwing vestigial, reduced to tiny flap.

*Head.* Large about same width as pronotum; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases; subparallel in posterior half; eye remnant reduced to short faint suture, not always visible. Antenna relatively thin, segments 3 to 4 thinner than rest, segment 11 a bit longer and narrower than segment 10. Maxillary palpus elongate, segment 4 a little longer than segment 3.

*Pronotum.* A little narrower than elytra; anteriolateral angles projecting strongly forward; base weakly narrowed, posterolateral angles obtuse; quite strongly reticulate, moderate number of scattered punctures and row along front margin. Sides with numerous long setae particularly towards front.

*Elytra.* Not fused but tightly closed, lacking inner ridges; elongate, nearly parallel-sided, smooth, covered with moderately strong reticulation; sparsely covered with small punctures, several indistinct rows of widely spaced small punctures; a few additional larger punctures with long setae, more frequent towards sides, underside covered with setiferous micropunctures, denser towards apex and along suture line. Epipleuron not

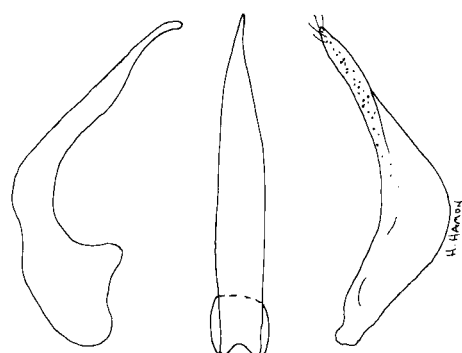
differentiated from rest of elytron, that part of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to middle.

*Ventral surface.* Prosternal process quite narrow, strongly narrowed between coxae, not reaching mesothorax, apical half spatulate, tip rounded; strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in midline; wings absent; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; strongly reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half indistinct laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae.

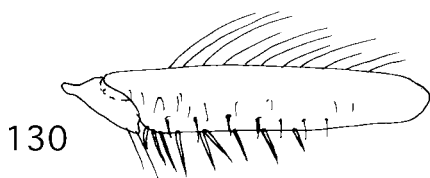
*Legs.* Profemur with weak peg-like seta on hind edge adjacent to trochanter; protibia narrow, almost parallel-sided in apical half; protarsi expanded, segment 1 broad, segment 2 about one-half length of segment 1, segment 3 as long as

segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of six to eight strong spines along hind edge in basal half; mesotarsi a little less expanded than protarsi. Metatrochanter elongate/oval; metafemur thin, elongate, lacking spines; metatibia very weakly curved, approximately the same width throughout; metatarsi elongate, segment 1 much longer than others, segment 5 about 1.5 times length of segment 4, segments 2 and 3 subequal in length, segments 1 and 2 in combination a little longer than others, segments 2 to 5 without spines other than at apex; claws weak.

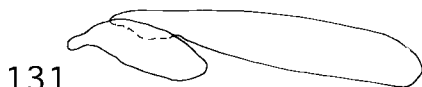
*Male.* Little external difference between sexes. Median lobe of aedeagus sinuate in lateral view, narrowing to sharp point in apical half; paramere broad at base, apical half thin, tip with a bunch of long setae (Figs 127–129).



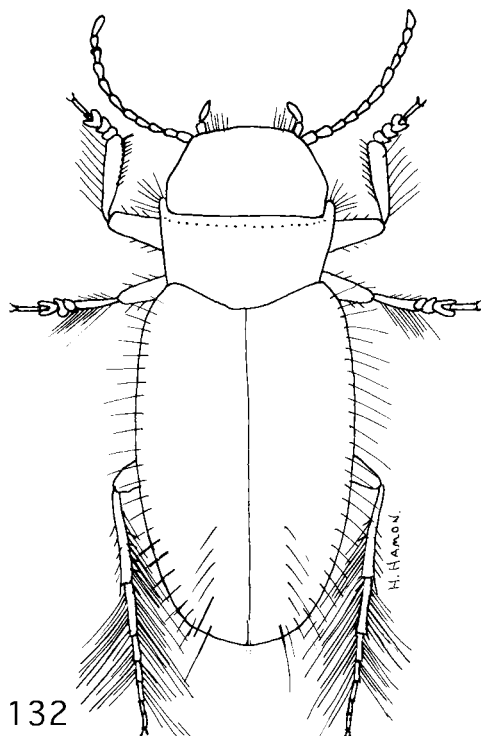
127 128 129



130



131



132

FIGURES 127–132. *Nirripiri plutonicensis*: **127**, lateral view of central lobe of aedeagus; **128**, ditto dorsal view; **129**, paramere; **130**, mesotrochanter and mesofemur; **131**, metatrochanter and metafemur; **132**, dorsal view. Scale bar represents 1 mm (habitus only).

*Etymology*

Named after the borefield in which it was found.

*Remarks*

A large strongly chitinised species with elytra not wrapping around abdomen, without metasternal wings, long thin hind legs and narrowly oval metatrochanters.

*Nirripiriti skaphites* sp. nov*Types*

*Holotype*: m: 'Karatundi, unlined well, 26°08'S; 118°41'E, 28/5/2001, coll.# 339-2 C.H.S. & G.A. Watts', WAM 33813. Slide mounted.

*Paratypes*: 3, as for holotype, 2 SAMA, 1 WAM 33814.

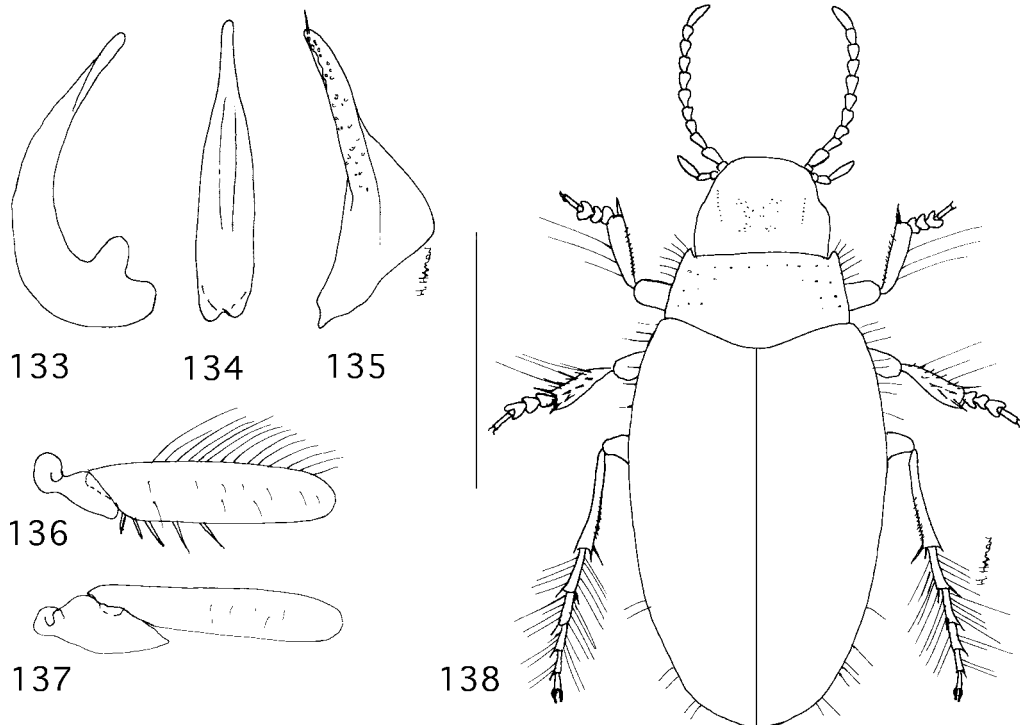
*Description* (number examined, 4) Figs 133–138

*Habitus*. Length 2.1–2.3 mm; elongate, boat-shaped, relatively flat, not constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

*Head*. Small, about half width of elytra; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases and on disc; sides slightly curved in posterior half; eye remnant reduced to a short suture in middle near anterior edge. Antenna moderately thick, segment 1 cylindrical, segment 2 widening towards apex, segments 3 to 10 approximately equal in length, widening progressively to segment 5, segment 11 about twice length of segment 10. Maxillary palpus elongate, segment 4 about twice length of segment 3.

*Pronotum*. Narrower than elytra; anteriolateral angles projecting strongly forward; sides slightly diverging towards rear; posterolateral angles obtuse; strongly reticulate, a few small scattered punctures; numerous long setae at sides towards front.

*Elytra*. Not fused but tightly closed, lacking inner ridges; elongate, widest in middle, smooth, covered with fine reticulation; a few scattered small punctures, underside with a few setiferous micropunctures at apex, a few additional larger punctures with long setae, more frequent towards



FIGURES 133–138. *Nirripiriti skaphites*: **133**, lateral view of central lobe of aedeagus; **134**, ditto dorsal view; **135**, paramere; **136**, mesotrochanter and mesofemur; **137**, metatrochanter and metafemur; **138**, dorsal view. Scale bar represents 1 mm (habitus only).



sides. Epipleuron not differentiated, that part of elytron visible ventrally very broad until close to apex of elytron.

*Ventral surface.* Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half broadly spatulate, weakly pointed, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum pointed in front in midline; wings short; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; a few small scattered very small punctures; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner two-thirds but absent laterally, ventrites 3 to 5 possibly immobile, virtually impunctate except for a few long central seta or bunch of long setae.

*Legs.* Protibia narrow, widest near apex where it is about twice its basal width; protarsi weakly expanded, segment 1 rectangular, segment 2 about one-half length of segment 1, segment 3 about as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate, rather angular, with a few fine setae at apex; mesofemur with row of five to six strong spines along hind edge in basal half; mesotarsi slightly less expanded than protarsi. Metatrochanter relatively broad, sharply pointed; metafemur elongate, lacking spines; metatibia weakly curved, widening a little towards apex; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 same length as others, segments 2 to 5 without spines other than at apex; claws weak.

*Male.* Antenna a little stouter. Median lobe of the aedeagus narrow, narrowing in apical quarter; paramere broad at base, apical half thin, tip with a long setae (Figs 133–135).

#### *Etymology*

Latin. 'Skaphites' – boat-like.

#### *Remarks*

A moderate sized species with small head and no pronotal constriction, which give it a pronounced boat-like shape. The sharply pointed metatrochanters are also distinctive and separate it from the rather similarly shaped but smaller *N. killaraensis*.

#### *Nirripiriti stegastos* sp. nov.

##### *Types*

*Holotype:* m: 'Karatundi, un-lined well; 118°41'E, 28/5/2001, coll. C.H.S. & G.A. Watts', WAM 33815.

*Paratypes:* 2, as for holotype, 1 WAM 33816, 1 SAMA.

*Description* (number examined, 3) Figs 139–144

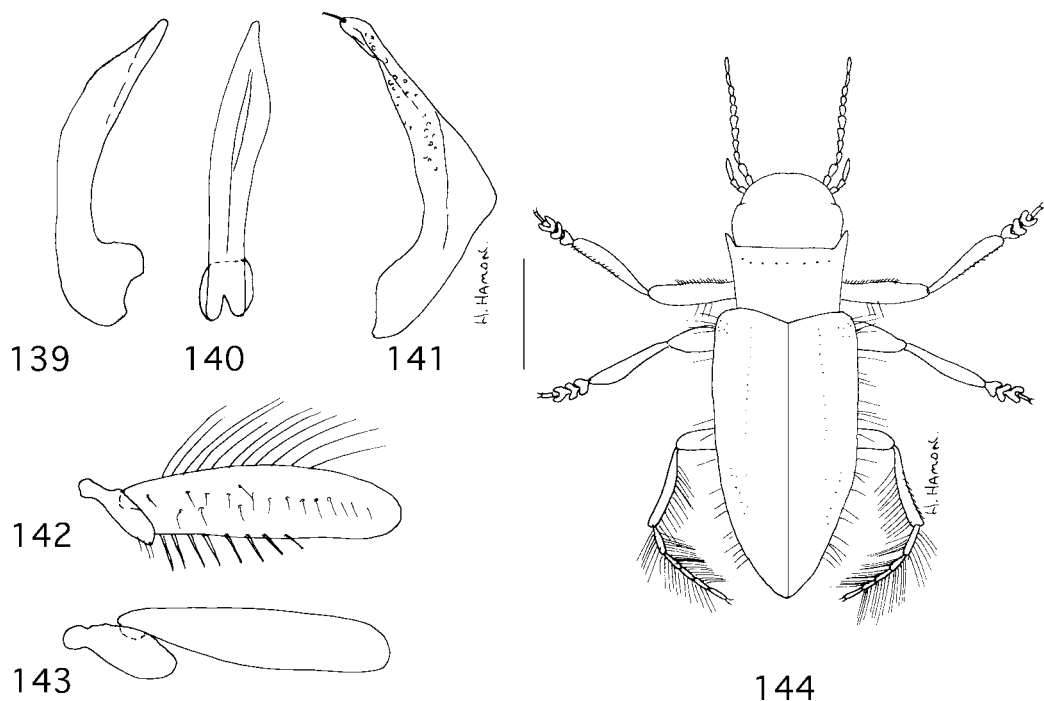
*Habitus.* Length 3.6–3.8 mm; elongate, relatively flat, slightly depressed in sutural region, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

*Head.* A little narrower than elytra; smooth, moderate reticulation with very small even meshes, a few scattered small punctures; sides subparallel in posterior half; eye remnant reduced to a small suture in middle near anterior edge. Antenna thin, segments 1 and 2 cylindrical, segment 3 about same length as segment 2 but much narrower, segment 4 a little shorter, segments 5 to 9 broader with narrow bases, segment 6 widest, segment 11 1.5 times length of segment 10. Maxillary palpus elongate, segment 4 a little longer than segment 3.

*Pronotum.* A little narrower than elytra; anteriolateral angles projecting strongly forward; sides slightly converging towards rear, weakly constricted just before base, posterolateral angles obtuse; weakly reticulate, virtually impunctate except for a row of strong punctures along front margin; long setae at sides in anterior third; moderately strongly reticulate with very small even meshes.

*Elytra.* Not fused but tightly closed, lacking inner ridges; elongate, almost parallel-sided, smooth, covered with fine reticulation; virtually impunctate except for a few moderate sized punctures with long setae, more frequent towards sides; underside of elytron with dense setiferous micropunctures towards apex. Epipleuron very weakly differentiated from rest of elytron, that part of elytra visible ventrally very broad along almost the entire length of elytron, tightly enclosing body.

*Ventral surface.* Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half narrowly triangular, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum not produced forward in midline; wings relatively short, very narrow; broadly rounded in midline



FIGURES 139–144. *Nirridessus stegastos*: **139**, lateral view of central lobe of aedeagus; **140**, ditto dorsal view; **141**, paramere; **142**, mesotrochanter and mesofemur; **143**, metatrochanter and metafemur; **144**, dorsal view. Scale bar represents 1 mm (habitus only).

behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half, indistinct laterally, ventrites 2 and 3 possibly fused, ventrites 4 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae; finely reticulate with small even meshes.

*Legs.* Protibia very narrow, widest just past middle where it is about twice its basal width; protarsi expanded, segment 1 short, broadly triangular, segment 2 about one-half length of segment 1, segment 3 about as long as segment 1 but narrower, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, relatively stout, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate, bluntly pointed, with a few fine setae at apex; mesofemur with row of nine strong spines along hind edge in basal two-thirds; mesotarsi a little narrower and more

elongate than protarsi. Metatrochanter moderately large, elongate/oval apex rounded; metafemur elongate, lacking spines; metatibia weakly curved, widening slightly towards apex; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 slightly shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

*Male.* Middle segments of antenna a little more expanded than in the female. Median lobe of aedeagus narrow, narrowing in apical quarter; paramere narrowing in apical half, apex rounded (Figs 139–141).

#### *Etymology*

Latin. ‘Stegastos’ – enclosed; a reference to the enclosing elytra.

#### *Remarks*

A relatively large well chitinised species with the elytra wrapping around the abdomen for most of its length.

*Nirripiriti wedgeensis* sp. nov.*Types*

*Holotype*: m: 'BES 8066, NT: Central Mt Wedge Station, bore RN 15504 at Coppocks Bore, 22°46'24"S 132°06'50"E, 17/6/2001, coll. W.F. Humphreys & R. Read', NTM I 001178. Slide mounted.

*Paratypes*: 5, as for holotype, 2 WAM 33817–33818, 3 SAMA.

*Description* (number examined, 6) Figs 145–150

*Habitus*. Length 1.2–1.4 mm; elongate, relatively flat, slightly constricted at junction of pronotum/elytra; uniformly very light testaceous; hindwing vestigial, reduced to tiny flap.

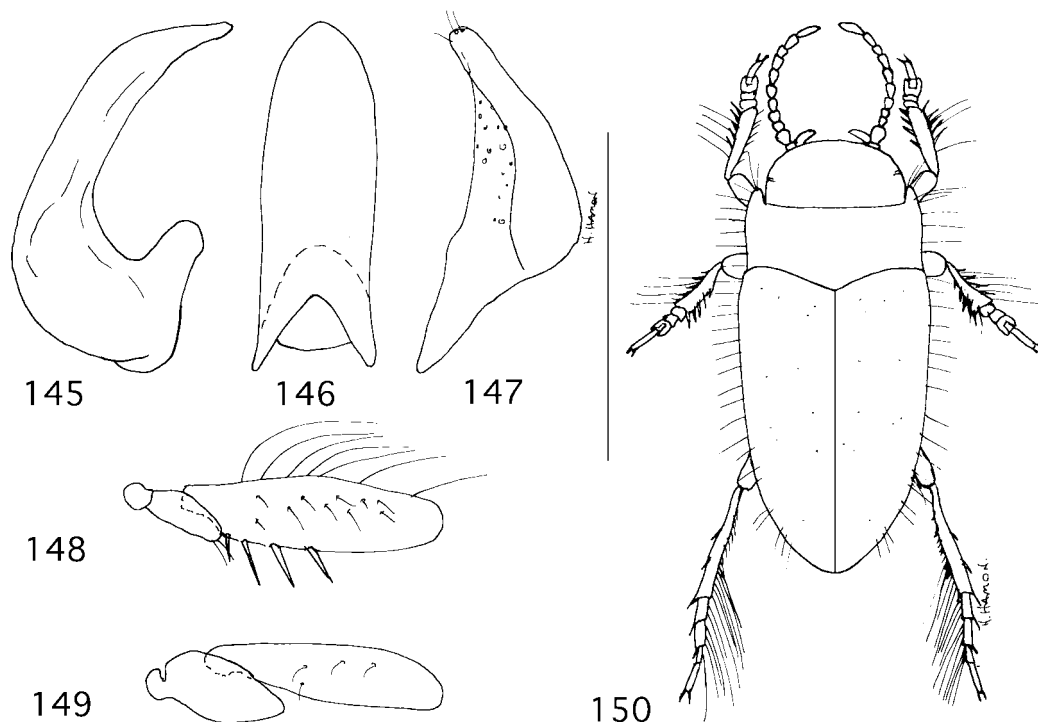
*Head*. Short, broad, narrower than elytra; smooth, moderate reticulation with small even meshes, virtually impunctate except a few near antennae bases; slightly wider behind; eye remnant reduced to a dark suture in middle near anterior edge. Antenna relatively thick, segment 1 cylindrical, segment 2 broader towards apex, segment 3 much shorter and narrower, segment 4

shorter, segment 5 about same length as segment 3 but wider, segments 6 to 10 subequal, becoming progressively a little narrower, segment 11 about twice length of segment 10. Maxillary palpus stout, segment 4 about twice as long as segment 10.

*Pronotum*. As wide as elytra; anteriolateral angles projecting strongly forward; base weakly constricted, posterolateral angles acute; moderately reticulate, virtually impunctate except towards front margin.

*Elytra*. Not fused but tightly closed, lacking inner ridges; elongate, widest near shoulders, smooth, reticulation weak; numerous scattered small punctures; a few additional larger punctures with long setae, more frequent towards sides; underside with numerous setiferous micropunctures at base, apex and along suture line. Epipleuron not differentiated from rest of elytron, that part of elytron visible ventrally broad in anterior quarter, then gradually narrowing to near apex.

*Ventral surface*. Prosternal process strongly narrowed between coxae, not reaching



FIGURES 145–150. *Nirridessus wedgeensis*: **145**, lateral view of central lobe of aedeagus; **146**, ditto dorsal view; **147**, paramere; **148**, mesotrochanter and mesofemur; **149**, metatrochanter and metafemur; **150**, dorsal view. Scale bar represents 1 mm (habitus only).

mesothorax, apical half broad, spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply pointed in front in midline; wings absent; broadly triangular in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, virtually impunctate except for a few long central setae or bunch of long setae.

*Legs.* Profemur broad; protibia narrow, widest near apex where it is about three times its basal width; protarsi expanded, segment 1 broadly triangular, segment 2 about one-half length of segment 1, segment 3 as long as segment 1,

deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi a little less expanded than protarsi. Metatrochanter relatively large, tip well separated from metafemur, bluntly pointed; metafemur elongate, lacking spines; metatibia curved, approximately the same width throughout; metatarsi elongate, segments 1 and 5 longest, subequal, segments 1 and 2 in combination much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

TABLE 1. The distribution of stygal species of dytiscids amongst discrete calcrete bodies in the Yilgarn district of Western Australia and the Ngalia Basin in the Northern Territory. The separate palaeodrainage systems (Fig. 151) and the Indian Ocean (Western) and inland drainages are indicated.

Calcrete	Palaeovalley	Species 1
<b>WESTERN DRAINAGES</b>		
1, Cue	Murchison	<i>Tjirtudessus magnificus</i>
2, Austin Downs	Murchison	<i>Tjirtudessus challaensis</i>
3, Challa North	Murchison	<i>Tjirtudessus challaensis</i>
4, Killara	Murchison	<i>Nirripiri killaraensis</i> sp. nov.
5, Windimurra	Murchison	<i>Tjirtudessus</i> sp. 1
6, Karalundi	Murchison	<i>Tjirtudessus karalundiensis</i> sp. nov.
7, Three Rivers Station	Gascoyne	<i>Bidessodes gutteridgei</i> sp. nov.
8, Milgun Station	Gascoyne	<i>Nirripiri hamoni</i> sp. nov.
9, Landor Station	Gascoyne	
<b>INLAND DRAINAGES</b>		
10, Paroo	Carey	<i>Tjirtudessus eberhardi</i>
11, Lake Violet	Carey	<i>Tjirtudessus wilunaensis</i> sp. nov.
12, Uramurdah Lake	Carey	<i>Tjirtudessus hahni</i>
13, Hinkler Well	Carey	<i>Tjirtudessus hinkleri</i>
14, Mount Windarra	Carey	<i>Tjirtudessus windarraensis</i>
15, Melrose Station (Lake Darlot)	Carey	<i>Nirripiri darlotensis</i> sp. nov.
16, Depot Springs	Raeside	<i>Tjirtudessus fridaywellensis</i>
17, Pinnacles Stn	Raeside	<i>Tjirtudessus pinnaclesensis</i>
18, Lake Mason	Raeside	<i>Tjirtudessus raesideensis</i>
19, Yuinmery	Raeside	<i>Tjirtudessus yuinmeryensis</i> sp. nov.
20, Jundee	Carnegie	<i>Tjirtudessus jundeeensis</i> sp. nov.
21, Cunyu: Sweetwaters	Nabberu	<i>Tjirtudessus cunyuensis</i> sp. nov.
22, Cunyu: SBF	Nabberu	<i>Tjirtudessus bialveus</i> sp. nov.
23, Napperby	Ngalia Basin: NT	<i>Nirripiri macrocephalus</i> sp. nov.
24, Newhaven	Ngalia Basin: NT	<i>Nirripiri newhavenensis</i> sp. nov.
25, Central Mount Wedge	Ngalia Basin: NT	<i>Nirripiri wedgeensis</i> sp. nov.

*Male.* Little external difference from female. Median lobe of aedeagus broad, bluntly pointed; paramere triangular (Figs 145–147).

*Etymology*

Named after Central Mount Wedge pastoral station where it was collected.

*Remarks*

A very small almost parallel-sided species with the base of the elytra noticeably wider than the pronotum, which is only slightly constricted. Separated from the slightly larger *N. newhavenensis* from an adjacent calcrete by the weakly constricted pronotum.

DISCUSSION

*Associated fauna*

The faunas associated with the Dytiscidae are largely unworked at this stage with only the Copepods having been studied in detail. Hence, only an indication of the associated fauna is given here. As is typical of stygofaunas, the associated fauna is predominantly Crustacean including Bathynellacea (Syncarida), Crangonyctoidea, Ceinidae and Bogidiellidae (Amphipoda), Oniscidea (Isopoda, including *Haloniscus* spp.), Cyclopoida: Cyclopidae; Harpacticoida: Diosacchidae, Ameiridae, Canthocamptidae

Species 2	Species 3	Species 4
<i>Tjirtudessus cueensis</i> <i>Tjirtudessus cueensis</i> <i>Tjirtudessus</i> sp. 2	<i>Tjirtudessus bigbellensis</i>	<i>Tjirtudessus</i> sp. 3
<i>Nirripirti skaphites</i> sp. nov. <i>Bidessodes limestoneensis</i> sp. nov. <i>Nirripirti milgunensis</i> sp. nov.	<i>Nirripirti stegastos</i> sp. nov. <i>Nirripirti hamoni</i> sp. nov.	<i>Nirripirti plutonicensis</i> sp. nov.
<i>Tjirtudessus pulpa</i> <i>Tjirtudessus morgani</i> <i>Tjirtudessus morgani</i> Undescribed <i>Tjirtudessus lapostaae</i> <i>Nirripirti melroseensis</i> sp. nov. <i>Nirripirti hinzeae</i> <i>Nirripirti fortisspina</i> sp. nov. <i>Tjirtudessus masonensis</i>	<i>Kintingka kurutjutu</i>       <i>Nirripirti</i> . Undescribed sp.	? <i>Nirripirti</i> larvae
<i>Tjirtudessus silus</i> sp. nov. <i>Tjirtudessus macrotarsus</i> sp. nov. <i>Nirripirti napperbyensis</i> sp. nov. <i>Tjirtudessus pentameres</i> sp. nov.	<i>Tjirtudessus sweetwatersensis</i> sp. nov.	

TABLE 2. Physicochemical environment recorded for various species of stygal Dytiscidae in the genera *Bidessodes*, *Nirripiriti* and *Tjirtudessus*. A single value or a range of values given. Note that the environment of all sites has not been recorded.

Species	Conductivity (mS cm <sup>-1</sup> )	Temp. (°C)	pH	DO (mg L <sup>-1</sup> )	Depth to/ of water	Calcrete
<i>B. gutteridgei</i>	2.38–3.54	25.1–26.6	7.18–7.96	–	5–6/7–40	Three Rivers
<i>B. limestoneensis</i>	2.38	25.1	7.55	–	–	Three Rivers
<i>N. darlotensis</i>	13.2	25.8	7.70	5.05	–	Melrose
<i>N. fortisspina</i>	13.37	23.6	7.43	2.67	–	Pinnacles
<i>N. hamoni</i>	1.66	25.1	7.78	–	?/0.5	Three Rivers
<i>N. killaraensis</i>	3.24	19.6	–	–	–	Killara calcrete
<i>N. macrocephalus</i>	–	–	–	–	–	Napperby, NT
<i>N. melroseensis</i>	13.2	25.8	7.70	5.05	?/0.5	Melrose
<i>N. milgunensis</i>	1.66	25.1	7.78	–	?/0.5	Three Rivers
<i>N. napperbyensis</i>	–	–	–	–	–	Napperby, NT
<i>N. newhavenensis</i>	1.98	25.1	–	–	2.67/?	Newhaven, NT
<i>N. pentameres</i>	–	–	–	–	–	Newhaven, NT
<i>N. plutonicensis</i>	1.82–11.49	25.0–26.6	7.14–7.96	–	3.5–5/11–40	Cunyu SBF
<i>N. wedgeensis</i>	7.11	24.7	–	–	2.5/10	Central Mount Wedge, NT
<i>T. bialveus</i>	6.63–11.49	25.2–26.4	7.32–7.50	–	3.5/10	Cunyu SBF
<i>T. cunyuensis</i>	8.55	17.2	8.30	–	8/0.5	Cunyu Sweetwater
<i>T. jundeeensis</i>	–	–	–	–	7/0.3	Jundee
<i>T. macrotarsus</i>	6.63	25.2	7.32	–	3.5/9.5	Cunyu SBF
<i>T. silus</i>	8.55	17.2	8.30	–	8/0.5	Cunyu Sweetwater
<i>T. sweetwatersensis</i>	8.55	17.2	8.30	–	8/0.5	Cunyu Sweetwater
<i>T. wilunaensis</i>	2.88	18.7	7.30	–	–	Millbillillie
<i>T. yuinmeryensis</i>	9.39–15.4	21.9–22.2	7.27–7.63	5.22–5.44	2.5/1	Yuinmery

Parastenocaridae (Copepoda) and Ostracoda. Hydrobiidae (Gastropoda) are important associates in the Ngalia Basin of the Northern Territory (Table 3); however, in the Western Fortescue Plains aquifer in the Pilbara, they occur with Spelaeogriphacea but no Dytiscidae are present (Poore & Humphreys 1998). Karanovic (2003) recently described four new genera and eight species in five families of Copepoda from the Yilgarn region of Western Australia collected as part of this study. Those indicated in Table 3 were directly associated with the dytiscids collected here. Several species of *Haloniscus* occur in some aquifers (Taiti & Humphreys 2001).

#### Site characteristics and water quality

As in previously reported work on Australian stygal Dytiscidae, samples were collected from a range of types of access into the groundwater calcrete aquifers (Table 1, Fig. 151), including: monitoring wells in working water borefields; sometimes within metres of functioning pumps; piezometers; aquifer exploration bores; uncased mineral exploration bores; pastoral bores; and

hand dug pastoral wells, some of which would have been enlarged traditional watering places (Table 2).

Some of the sites containing stygal dytiscid are quite saline (22 g L<sup>-1</sup> or greater) (Watts & Humphreys 2000) whereas others meet salinity standards for drinking water. Groundwaters in the Australian arid zone typically have high concentrations of nitrates (Jacobson 1993); those recorded in this study had a mean value of 80 mg L<sup>-1</sup> nitrate (range 0–250 mg L<sup>-1</sup>; Fig. 154).

Profiling various groundwaters in the Yilgarn has not only exposed a great variety of waters but has also shown that closely adjacent sites are often quite different, revealing considerable heterogeneity of groundwater (Table 4; Fig. 153).

Hydrogen sulphide is sometimes encountered in the water (or disturbed from the sediments). At Alice Well in the Austin Downs calcrete, greater than 10 ppm H<sub>2</sub>S was recorded, far higher even than that recorded in anchialine systems containing profuse sulphur bacteria colonies (Humphreys 1999a,b).

The distribution of the groundwater fauna and

TABLE 3. Stygofauna associated with collection of various species of stygal Dytiscidae in the genera *Bidessodes*, *Nirriparti* and *Tjirtudessus* reported in this paper. Column numbers denote: 1, Syncarida; 2, Amphipoda; 3, Crangonyctoidea; 4, Ceinidae; 5, Bogidiellidae; 6, Isopoda; Oniscidea: ?*Haloniscus*; 7, Copepoda; 8, Harpacticoida; 9, Cyclopoida; 10, Ostracoda; 11, Other; 12, Dytiscidae; 13, Calcrete.

Species numbers denoted in column 7 Cyclopoda: Cyclopidae: Halicyclopinae: 1, *Halicyclops kieferi* Karanovic 2003; 2, *Halicyclops eberhardi* Laurentiis Pesce & Humphreys 2001; Cyclopinae: 3, *Mesocyclops brooksi* Pesce Laurentiis & Humphreys 1996; 4, *Metacyclops laurentiisae* Karanovic 2003; 5, *Fierscyclops fiersi* (Laurentiis Pesce & Humphreys 2001); 6, *Microcyclops varicans* (Sars 1863); 7, *Goniocyclops unarticulatus* Karanovic 2003; 8, *Goniocyclops mortoni* Karanovic 2002; Harpacticoida: Diosaccidae: 9, *Schizopera austindownsi* Karanovic 2003; 10, *Schizopera jundeei* Karanovic 2003; Ameiridae: Ameirinae: 11, *Nitokra lacustris pacifica* Yeatman 1983; 12, *Haifameira pori* Karanovic 2003; Canthocamptidae: 13, *Australocamptus similis* Karanovic 2003.

	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Bidessodes gutteridgei</i> sp. nov.		•	•		•	•					•	<i>B. limestoneensis</i> ; <i>N. plutonicensis</i>	Three Rivers
<i>Bidessodes limestoneensis</i> sp. nov.		•	•		•	•					•	<i>B. gutteridgei</i> ; <i>N. plutonicensis</i>	Three Rivers
<i>Nirriparti darlotensis</i> sp. nov.		•	•	•			2, 11						Melrose Station
<i>Nirriparti fortisspina</i> sp. nov.		•		•			2, 3						Pinnacles
<i>Nirriparti hamoni</i> sp. nov.		•	•								•	<i>N. milgunensis</i>	Three Rivers
<i>Nirridessus karalundiensis</i> sp. nov.							4,						Karalundi
<i>Nirriparti killaraensis</i> sp. nov.		•	•			•	2, 6, 8						Killara
<i>Nirriparti macrocephalus</i> sp. nov.		•	•			•						<i>N. napperbyensis</i>	Napperby
<i>Nirriparti melroseensis</i> sp. nov.		•	•	•			•					<i>N. darlotensis</i>	Melrose
<i>Nirriparti milgunensis</i> sp. nov.		•	•								•	<i>N. hamoni</i>	Milgun
<i>Nirriparti napperbyensis</i> sp. nov.		•	•			•	•				•	<i>N. macrocephalus</i>	Napperby
<i>Nirriparti newhavenensis</i> sp. nov.						•							Napperby
<i>Nirriparti pentameres</i> sp. nov.						•	•				#1		Newhaven
<i>Nirriparti plutonicensis</i> sp. nov.		•	•		•	•					•	<i>B. limestoneensis</i> ; <i>B. gutteridgei</i> ; <i>N. plutonicensis</i> ;	Three Rivers
<i>Nirriparti wedgeensis</i> sp. nov.		•									#2		Central Mount Wedge
<i>Tjirtudessus bialveus</i> sp. nov.		•	•	•							•	<i>T. macrotarsus</i>	Cunyu SBF
<i>Tjirtudessus cunyuensis</i> sp. nov.		•	•	•					•	•	•	<i>T. sweetwatersensis</i> ; <i>T. silus</i>	Cunyu Sweetwaters
<i>Tjirtudessus jundeeensis</i> sp. nov.		•				•	1, 10,		•				Jundee
<i>Tjirtudessus macrotarsus</i> sp. nov.		•	•	•					•			<i>T. bialveus</i>	Cunyu SBF
<i>Tjirtudessus silus</i> sp. nov.		•	•	•					•	•	•	<i>T. cunyuensis</i> ; <i>T. sweetwatersensis</i>	Cunyu Sweetwaters
<i>Tjirtudessus sweetwatersensis</i> sp. nov.		•	•	•			4, 9		•	•	•	<i>T. cunyuensis</i> ; <i>T. silus</i>	Cunyu Sweetwaters
<i>Tjirtudessus wilunaensis</i> sp. nov.		•	•	•	•		1, 5, 7, 12, 13				•		Lake Violet
<i>Tjirtudessus yuinmeryensis</i> sp. nov.		•	•	•	•		2, 5,				•		Yummier

In column 11: #1, Hydrobiidae: Acarina: *Koenikea?* sp.; Gastropoda: Hydrobiidae aff. *Trochidrobia* n.sp. 1; #2, Gastropoda Hydrobiidae aff. *Trochidrobia* n.sp. 2

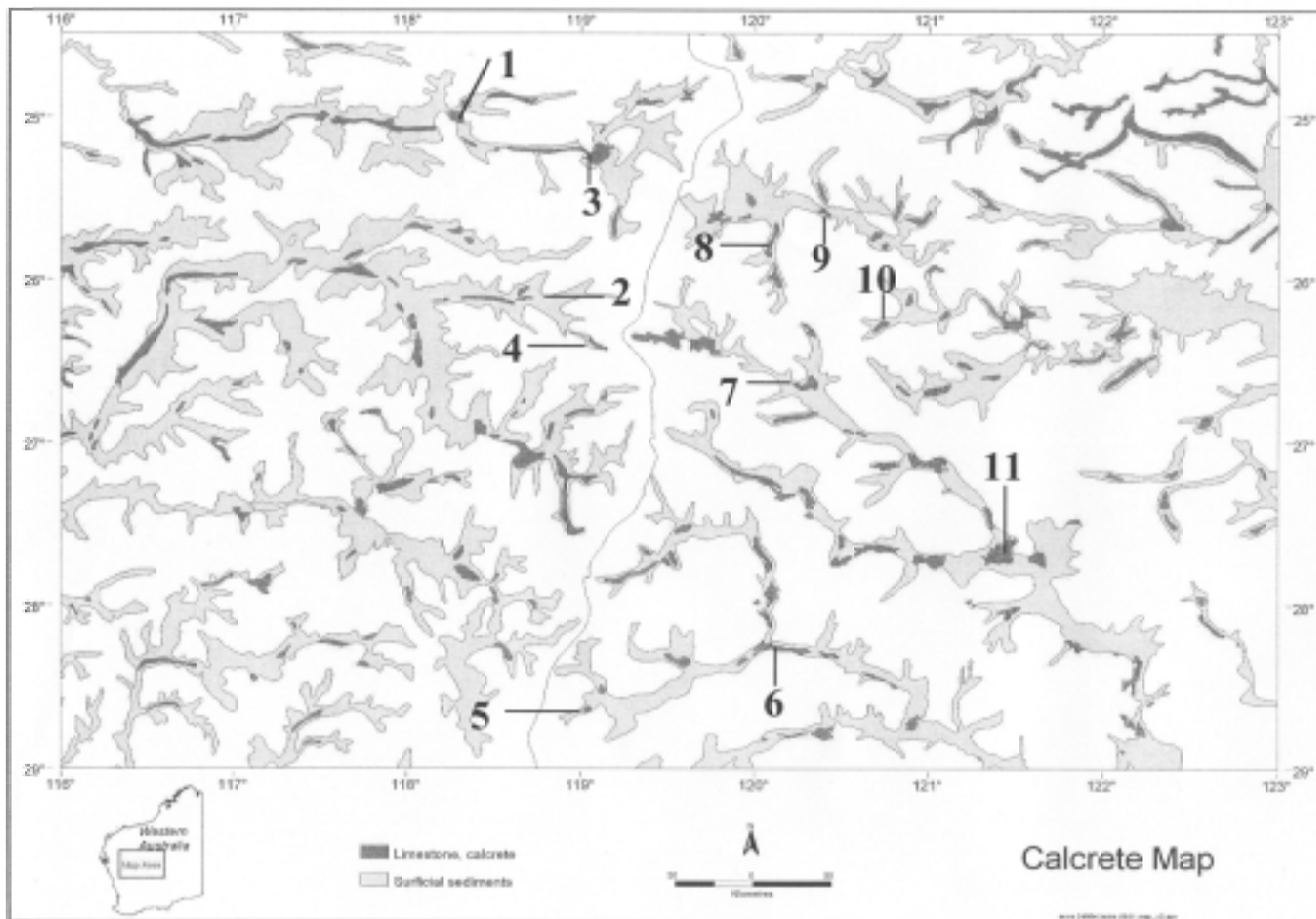


FIGURE 151. The location of calcrete areas (darker shading) and palaeodrainage systems (paler shading) in the Yilgarn region of Western Australia. Numbers proceed from west to east. **1**, Milgun calcrete; **2**, Karalundi calcrete; **3**, Three Rivers calcrete; **4**, Killara central calcrete; **5**, Yuinmery south calcrete; **6**, Pinnacles calcrete; **7**, Lake Violet calcrete; **8**, Cunyu, State Barrier Fence calcrete; **9**, Cunyu, Sweetwaters Well calcrete; **10** Jundee mine calcrete; **11**, Melrose (Lake Darlot) calcrete.



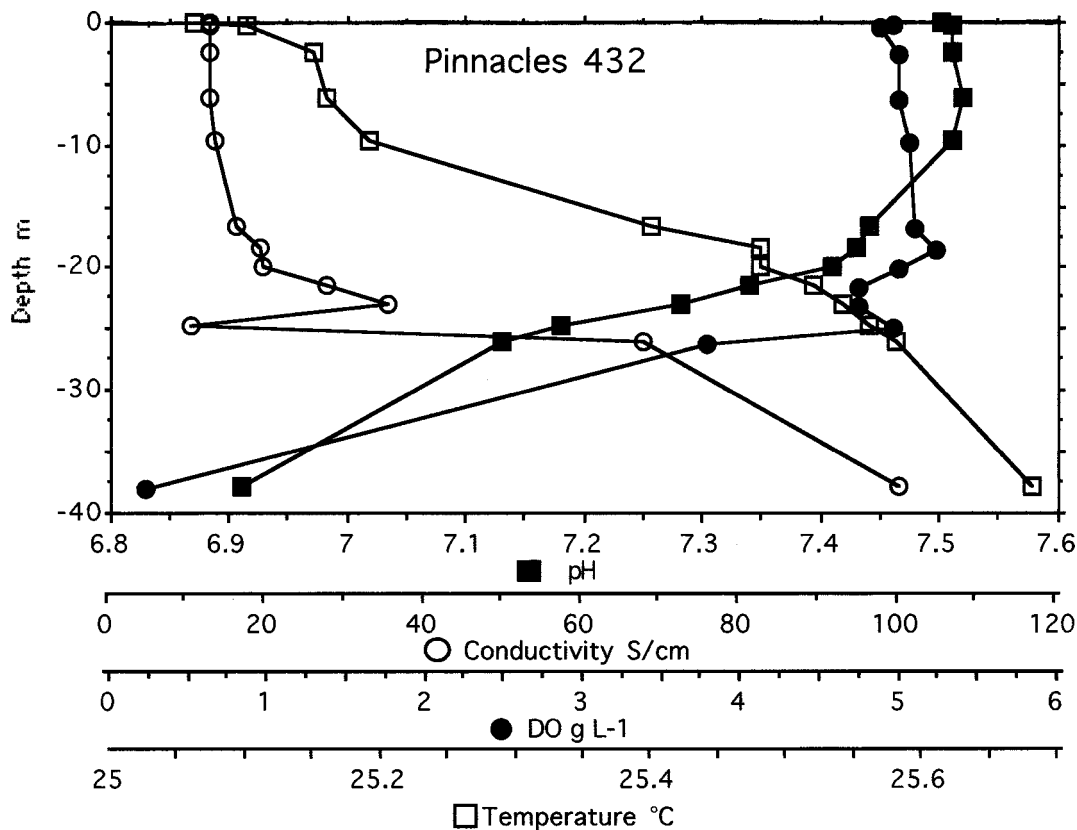


FIGURE 152. Distribution of physicochemical profiles at the Pinnacles, the type locality of *Nirripiri fortisspina* sp. nov.

the physicochemical environment within the calcrete aquifers appear to be quite heterogeneous, both within the groundwater profile and between areas (Figs 152, 153). For example, closely adjacent bores may yield consistently different faunas and have different water quality and profiles (Table 4; Fig. 153). Conversely, waters with different DO profiles may have rather similar faunas and provide no clear relationship between DO concentration and stygofauna (Table 5; Fig. 155). Interpretation of such trends requires a more detailed knowledge of water quality and particularly of the section(s) of the profiles inhabited by the various stygobites. It is possible that attributes other than water quality, in a physicochemical sense, are the determinants of suitability for stygofauna; microbiological characteristics appear to be important determinants of the presence of stygofauna in some German aquifers (H.J. Hahn, pers. comm., 2002).

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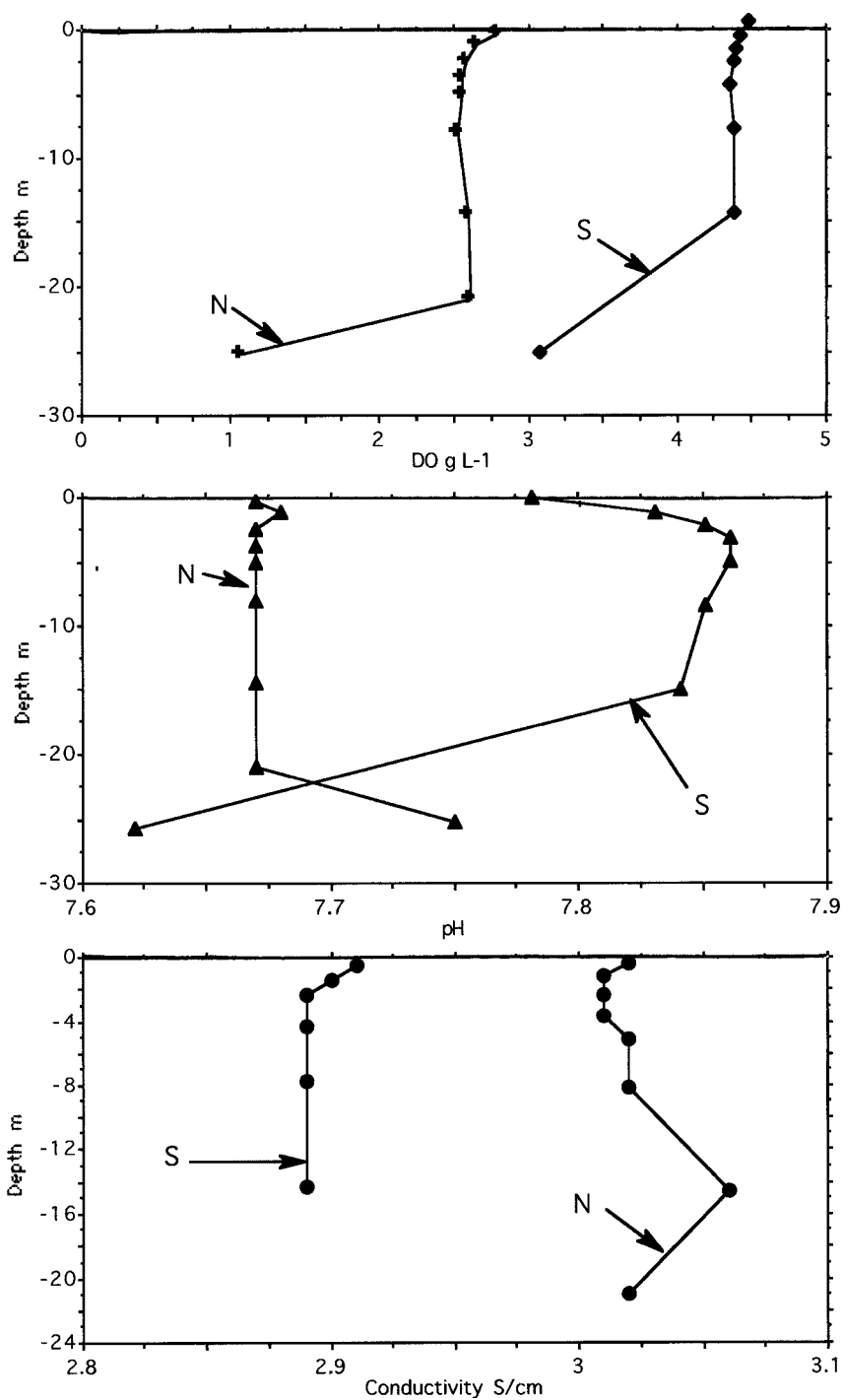


FIGURE 153. Profiles of physicochemical parameters through the water column of bores in the Hinkler calcrete (Table 4). The two bores, denoted N (north) and S (south), were drilled for the Main Roads Department at the same time to supply water and are less than 30 m apart. They have consistently yielded different fauna, even before they were used for water abstraction.

TABLE 4. The distribution of taxa between the two adjacent bores depicted in Fig. 153

Taxon	North	South
Amphipoda	4	3
Bathynellacea	98	431
Dytiscidae	99	5
Copepoda	20	0

TABLE 5. The distribution of taxa between bores in the Lake Violet area, depicted in Fig. 155

Taxon	Pump 1	OB 3	OB 4	OB 5	OB1
Ostracoda	255	–	–	9	66
Amphipoda	16	–	15	–	12
Bathynellacea	2	1	1	2	3
Dytiscidae	8	–	1	–	13
Copepoda	9	3	4	27	47

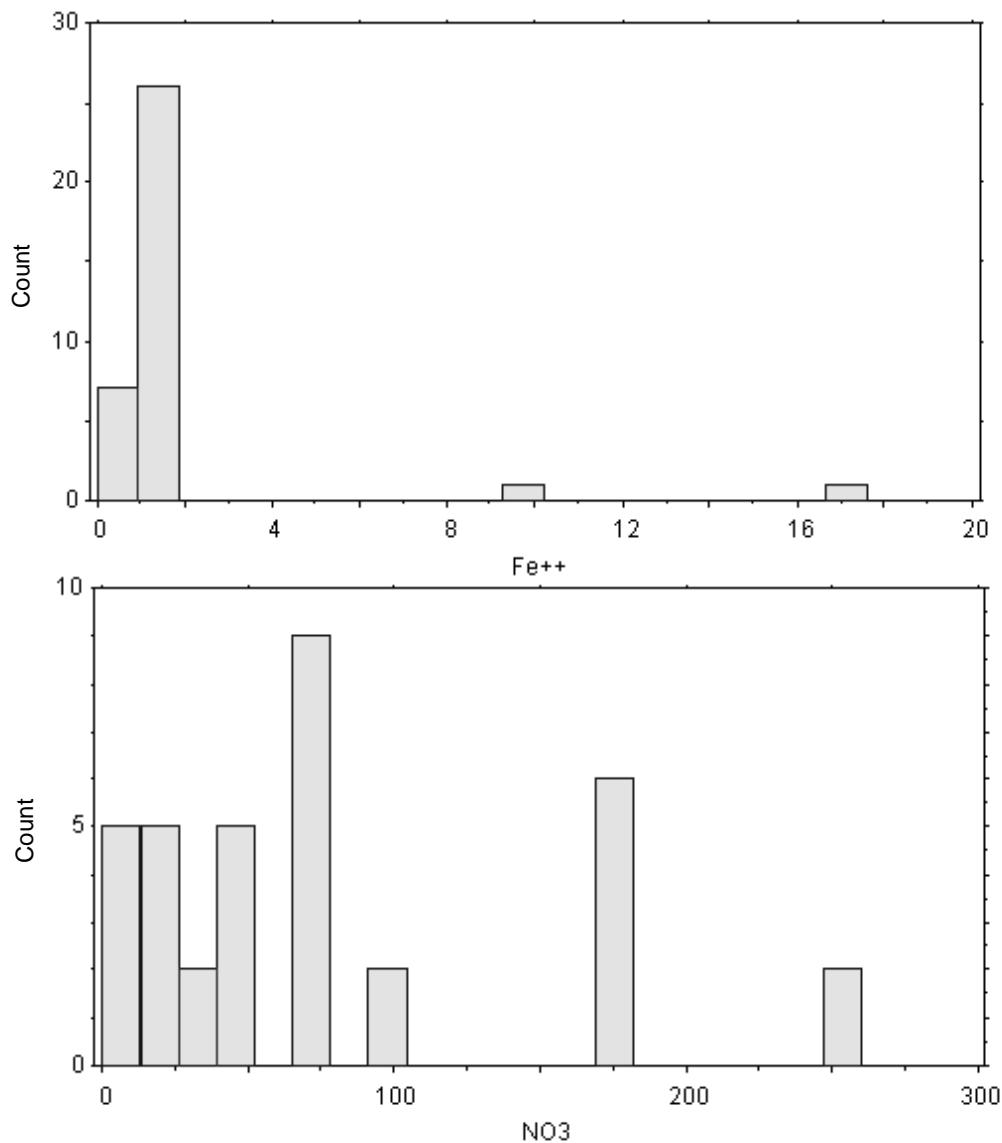


FIGURE 154. Distribution of iron (II) and nitrate in water samples from the Yilgarn groundwater calcrete samples. Upper: iron (II) (mg L<sup>-1</sup> Fe<sup>++</sup>) and lower: nitrate (mg L<sup>-1</sup> nitrate)

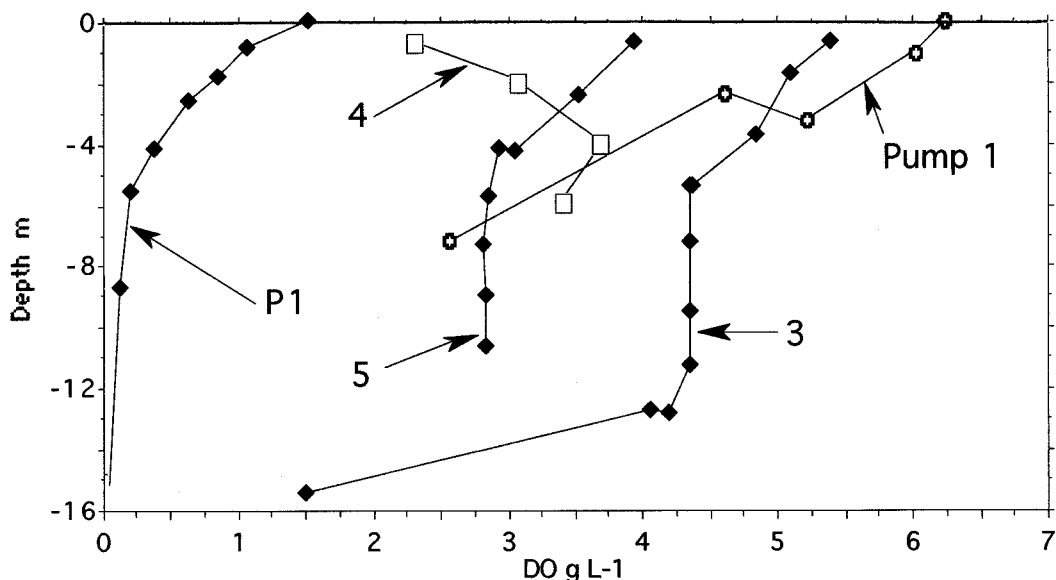


FIGURE 155. The vertical distribution of oxygen in the Lake Violet borefield area, an area of major water abstraction and the type area for *Tjirtudessus wilunaensis* sp. nov. The profiles are all from monitoring bores closely adjacent to an actively pumping well-field. P1 is the observation bore (OB1) for Pump 1 as denoted in Table 5.

#### REFERENCES

- Bistrom, O. 1988. Generic review of the Bidessini (Coleoptera, Dytiscidae). *Acta Zoologica Fennica* **184**: 1–541.
- Balke M, Watts CHS, Cooper SJB, Humphreys WF & Vogler AP. 2003 A highly modified stygobiont diving beetle of the genus *Copelatus* (Coleoptera, Dytiscidae): taxonomy and cladistic analysis based on mitochondrial DNA sequences. *Systematic Entomology* **28**: 1–9.
- Cooper, S, Hinze, S, Leys, R, Watts, CHS & Humphreys, WF. 2002. Islands under the desert: molecular systematics and evolutionary origins of stygobitic water beetles (Coleoptera: Dytiscidae) from central Western Australia. *Invertebrate Systematics* **16**: 589–598.
- Humphreys, WF. 1999a. Relict stygofaunas living in sea salt, karst and calcrete habitats in arid northwestern Australia contain many ancient lineages. In W Ponder and D Lunney (eds) 'The Other 99%. The Conservation and Biodiversity of Invertebrates', pp. 219–227. *Transactions of the Royal Zoological Society of New South Wales*, Mosman.
- Humphreys, WF. 1999b. Physico-chemical profile and energy fixation in Bundera Sinkhole, an anchialine remiped habitat in Northwestern Australia. *Journal of the Royal Society of Western Australia* **82**: 89–98.
- Humphreys, WF. 2001. Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity. In WF Humphreys & MS Harvey (eds) 'Subterranean Biology in Australia 2000', pp. 63–83. *Records of the Western Australian Museum*, Supplement No. 64.
- Jacobson, G. 1993. High nitrate groundwater in the Australian arid zone: origin of the nitrate and possible denitrification technology. *Australian Geological Survey Organisation, Research Newsletter* **16**: November 1993.
- Karanovic, T. 2003. Subterranean copepods (Crustacea: Copepoda) from arid Western Australia. *Crustaceana Supplement*, in press.
- Poore, GCB & Humphreys, WF. 1998. First record of Spelaegriphacea from Australasia: a new genus and species from an aquifer in the arid Pilbara of Western Australia. *Crustaceana* **71**: 721–742.
- Spangler, PJ. 1986. Insecta: Coleoptera. In L Botosaneanu (ed) 'Stygofauna. A Faunistic, Distributional, and Ecological Synthesis of the World Fauna Inhabiting Subterranean Waters (Including the Marine Interstitial)'. pp. 622–631. EJ Brill: Leiden.

- Taiti, S & Humphreys, WF. 2001. New aquatic Oniscidea (Crustacea, Isopoda) from groundwater calcretes of Western Australia. In WF Humphreys & MS Harvey (eds) 'Subterranean Biology in Australia 2000', *Records of the Western Australian Museum*, Supplement No. **64**: 133–151.
- Watts, CHS & Humphreys, WF. 1999. Three new genera and five new species of Dytiscidae (Coleoptera) from underground waters in Australia. *Records of the South Australian Museum* **32**(2): 121–142.
- Watts, CHS & Humphreys, WF. 2000. Six new species of *Nirridessus* and *Tjirtudessus* (Dytiscidae; Coleoptera) from underground waters in Australia. *Records of the South Australian Museum* **33**: 127–144.
- Watts, CHS & Humphreys, WF. 2001. A new genus and six new species of Dytiscidae (Coleoptera) from underground waters in the Yilgarn palaeodrainage system of Western Australia. *Records of the South Australian Museum* **34**: 99–114.