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CONTENTS PAGES

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REVISION OF AUSTRALIAN HYDROCHUS (COLEOPTERA : HYDROCHIDAE)

C. H. S. WATTS

Summary

The Australian members of the hydrochid genus Hydrochus are revised and redescribed. Ten species are described as new: H. abditus, H. aenigmatis, H. atratus, H. burdekinensis, H. decorus, H. eurypleuron, H. cucullatus, H. macroaquilonius, H. numerosepunctatus and H. umbratilis. The following synonymies are proposed: H. adelaidae Blackburn = H. victoriae Blackburn ; H. australis Motschulksy = H. brunneonitens Lea = H. diversiceps Blackburn = H. parallelus MacLeay = H. polaki Makhan = H. rambarani Makhan = H. regularis Blackburn = H. serricollis Lea; H. aschnakiranae Makhan = H. schillihammeri Makhan; H. horni Blackburn = H. scabricollis Lea; H. imamkhani Makhan = H. schoenmanni Makhan; H. multicolor Lea = H. matthewsi Makhan; H. obscuroaeneus Fairmaire = H. insularis Lea = H. palmerstoni Blackburn = H. rodjani Makhan = H. wewalkai Makhan; and H. simplicicollis Lea = H. verae Makhan. A key to the 25 Australian species recognised in the genus is given.

REVISION OF AUSTRALIAN *HYDROCHUS* (COLEOPTERA: HYDROCHIDAE)

C. H. S. WATTS

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The Australian members of the hydrochid genus *Hydrochus* are revised and redescribed. Ten species are described as new: *H. abditus, H. aenigmatis, H. atratus, H. burdekinensis, H. decorus, H. eurypleuron, H. cucullatus, H. macroaquilonius, H. numerosepunctatus* and *H. umbratilis*. The following synonymies are proposed: *H. adelaidae* Blackburn = *H. victoriae* Blackburn; *H. australis* Motschulsky = *H. brunneonitens* Lea = *H. diversiceps* Blackburn = *H. parallelus* MacLeay = *H. polaki* Makhan = *H. rambarani* Makhan = *H. regularis* Blackburn = *H. serricollis* Lea; *H. aschnakiranae* Makhan = *H. schillhammeri* Makhan; *H. horni* Blackburn = *H. scabricollis* Lea; *H. imamkhani* Makhan = *H. schoenmanni* Makhan; *H. multicolor* Lea = *H. matthewsi* Makhan; *H. obscuroaeneus* Fairmaire = *H. insularis* Lea = *H. palmerstoni* Blackburn = *H. rodjani* Makhan = *H. wewalkai* Makhan; and *H simplicicollis* Lea = *H. verae* Makhan. A key to the 25 Australian species recognised in the genus is given.

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This is the first attempt to revise the Australian *Hydrochus* Leach since Lea (1927) tabulated the then known species and described several new ones. The genus is the only representative of the world-wide family Hydrochidae in Australia. It is taxonomically difficult. The species are numerous and characters few and variable. They fly readily to light which has resulted in large numbers of specimens being available to me, in contrast to earlier workers who had very sparse and inadequate material, often describing a species from a single individual. Despite this advantage, or perhaps because of it, I view this revision as very much a first attempt at making some taxonomic sense of the *Hydrochus* fauna of Australia, although I do not claim that there is much phylogenetic content to the work.

Individuals are often abundant in both still and running water in all areas of Australia where some surface water exists permanently, with the apparent exception of the channel country of south-west Queensland.

The collections from which specimens were examined are listed under the following abbreviations.

AM	Australian Museum, Sydney
ANIC	Australian National Insect Collection, Canberra
BPBM	Bishop Museum, Honolulu
BM(NH)	Natural History Museum, London
CAL	California Academy of Sciences, San Francisco
FIELD	Field Museum of Natural History, Chicago
CLH	Collection of Lars Heindrick, Berlin
DPIM	Queensland Department of Primary Industries, Mareeba
IRSNB	Institut Royal des Sciences Naturelles de Belgique, Bruxelles
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge
NHMW	Naturhistorisches Museum, Vienna
NMV	Museum of Victoria, Melbourne
NTM	Northern Territory Museum, Darwin
QM	Queensland Museum, Brisbane
SAMA	South Australian Museum, Adelaide
UQIC	University of Queensland Insect Collection, Brisbane
WAM	Western Australian Museum, Perth
ZMM	Zoological Museum, Moscow

The early taxonomy of Australian *Hydrochus* (Blackburn 1898, Lea 1926) is based primarily on the strength of grooves on the head, foveae on the pronotum, and the relative strength of punctures on the elytra. Having examined over 6 000 specimens it is clear that these characters are very variable within species and of limited taxonomic worth.

Early authors were also hampered by the very limited amount of material available, often working with only one or two specimens at a time. Makhan (1994, 1995) added characters of the aedeagi but otherwise relied on this same range of characters and a very limited number of specimens.

Oliva (1995) working on South American species also concentrated on dorsal surface characters in conjunction with the male genitalia but in addition used leg colour and spines on the tibiae in a few cases. In Europe the strength of the apical punctures on the elytra have proved useful (Angus 1977).

CHARACTERS USED IN THIS REVISION

Size

Australian *Hydrochus* vary in length from under one millimetre to over four millimetres. Variation in length within species is considerable: up to two to three times in all those species where a good number and geographic spread of specimens are available.

Dorsal Surface

Head

I found no character of the head to be useful, other than the strength of the setae (see later) and of the Y- shaped epicranial suture to a very minor degree. Blackburn (1898), and Lea (1926) used the relative strength of three longitudinal grooves on the back of the head as a key character. I found the interspecific variation in this character, not to mention its subjective nature, too great for it to be used taxonomically.

Pronotum

Shape: Most Australian species have a similarly shaped pronotum and hence this character has been used sparingly.

Lateral edges: The degree of serration of the pronotal edges can range from none to considerable. This character is a direct reflection of the degree of granulation of the pronotum and has not been specifically used.

Epipleuron: In many *Hydrochus* species the lateral edge of the pronotum is bent under by almost ninety degrees. The width of this portion and its distinctness from the top of the pronotum varies considerably between species and species groups, yet variation within species appears to be only moderate.

Anterior edge: In one species (*H. cucullatus*) the front edge of the pronotum for nearly three quarters of its length is noticeably thickened and hence raised. In all other species this thickening does not occur.

Punctures and granulation: Many Australian species have well developed peg-like granules on the pronotum (and head and elytra). These are positioned in the areas between the punctures and are usually about half the diameter of a puncture. The punctures themselves are relatively large and usually close together. In many species the granulations, particularly on the head, appear as if they are worn down like teeth, and are very low with a smooth flat surface. When the granules are well developed they can completely mask the underlying punctures. The relative mix and strengths of punctures and granules can vary enormously within species. There are species which appear not to have granules and an occasional species (e.g. *H. umbratilis*) that seem always to be strongly granulate. In the bulk of species however the relative mix of punctures and granules is too variable to use as a taxonomic character.

Foveae: A number of relatively large, shallow, depressed areas are found in many species. The boundaries of these foveae may be outlined by raised areas which are sometimes further accentuated by being devoid of punctures or granules. Variation within species is considerable and is usually too great to allow the foveae to be used to separate species but they have a limited use in delineating species groups.

Elytra

Striae and interstriae: All *Hydrochus* have clearly defined linear striae which are punctate, separated by interstriae which are impunctate. As far as I can tell the number of striae and number of punctures in each stria do not vary between species. The strial punctures vary considerably within species as to size, which limits the use of this character taxonomically. In all species the diameter of the punctures is less at each end of a stria and in most cases is relatively uniform over the rest of the stria (and also between adjacent striae). In a few cases the punctures continue to increase in diameter towards the disc and occasionally vary between adjacent striae.

The interstrial areas can be smooth or granulate, with granules placed at the four corners of a puncture, which may have a somewhat squared rather than rounded shape. As on the pronotum, the strength and number of these granules can vary from a few vestigial ones laterally to masking the punctures over the whole elytron. Again the large intraspecific variation limits the taxonomic usefulness of this character. Some interstrial areas are often raised, either partially or completely, and despite the usual large degree of variation, have proved of some taxonomic value.

Striae are numbered starting from the innermost stria. The first interstria is between striae one and two.

Plicae: In many *Hydrochus* there is a short raised portion of interstria eight just behind the middle. The degree to which the rest of interstria eight is raised and hence incorporates this structure is variable and is of some use in delineating species groups.

Apical punctures: A series of three to four punctures near the tip of each elytron are often differentially enlarged, and sometimes bounded behind by a raised area on the elytron. At the extreme tip there may be another one or two unusually large punctures. These punctures vary considerably between species and, unfortunately, also within most species.

Setae: Small, stout, pale setae are found on the elytra of a number of species. In most species, if present, they are restricted to the extreme apex of each elytron but in a few species they are also found on the interstriae over relatively large areas of the elytra. Similar setae are present in some species on the head and in one or two species on the pronotum as well.

Colour: The dorsal colour, particularly the presence/absence and pattern of elytral spots has proved a useful character. There is also a pronounced polymorphism in many species within my species group 2 where all or most of the dorsal surface can be either golden, silver, steely grey, testaceous or black within one species and often within one population.

Ventral Surface

Palpi and antennae

I have not made a detailed study of the antennae but I could find no obviously useful characters.

The form and colour of both the maxillary and labial palpi vary subtly between species. However I have been unable to usefully harness this variation, nor have I described it.

Legs

I have found the shape of the femora, the amount of pubescence at the base of the femora and the colour of the legs to be most useful characters to separate both species and species groups.

The profemora of most species are relatively similar in shape but vary in degree of basal pubescence. With the leg pointing forward, the pubescence is greatest on the upper surface next to the body. This surface is usually invisible with the leg in place and I have not used this character. On the lower surface the pubescence narrows to a thin band along the base of the femur adjacent to the trochanter. The area of the femur covered in this pubescence varies from none to quite a bit. In describing this I have compared the minimal length of the area covered (usually in the middle of the femur) with the width of the femur at that point. Within species variation is relatively moderate.

The mesofemora of different species vary considerably in both shape and amount of basal pubescence. Three main shapes are present: a relatively short, stout, parallel - sided form (Fig. 3); a little more elongate somewhat sinuate form with some narrowing towards the base (Fig. 4); and an elongate strongly spindle-shaped form greatly narrowed towards the base (Fig. 5). The amount of pubescence at the base also varies. With the leg pointed backwards the pubescence on the lower surface varies considerably between species but is relatively consistent within species. Usually the edge of the area of pubescence forms a C shape with the narrowest portion in the middle of the lower surface and the longest along the rear edge with a shorter portion along the front edge. The pubescence continues around the top surface of the leg but, as for the profemur, I have not described this surface since the variation is correlated with the variation on the more easily seen lower portion. In describing this character I have usually compared the distance the pubescence reaches along the rear edge of the femur with the width of the femur at that point.

The degree of pubescence and the shape of the femur are closely correlated. Thus strongly spindle-shaped mesofemora have little basal pubescence, stout mesofemora have a moderate amount, and the relatively robust sinuate mesofemora have a lot of pubescence.

There is some variation in the shape of the metafemora which tends to mirror that of the mesofemora. The upper side, with leg pointing backwards, has pubescence to a third to half of its length. The lower side lacks pubescence except for a small amount coming round from the upper side to a slight degree in some species.

The colour of the legs has also proved useful. Most species have legs which are testaceous with the knees, apex of the tibiae, parts of the tarsi and often much of the femora darker. Other species have yellowish legs with only the tarsi with darker portions. Within most species the degree of dark and light areas is surprisingly consistent.

Elytra

In most beetles the lower edge of the elytron has a narrow shelf-like portion, the epipleuron, which is clearly differentiated from the top of the elytron and turns sharply under the beetle. In most Australian *Hydrochus* the epipleuron is broadened by a modification of the most lateral stria of the elytron which is also turned under to the same degree as the epipleuron (Figs 6–8). As a consequence the most lateral interstria (number 10) effectively becomes the edge of the elytron. Within Australian species the proportion of the underturned shelf formed by the true elytral epipleuron and what is termed the pseudoepipleuron formed from the elytron proper varies considerably between species but within species the relative widths of each do not vary greatly. When describing this character I have used isolated elytra since in the normal closed position the epipleuron is partially hidden in front. Towards the front of the epipleuron all species have a shallow groove along the inner edge which is part of the locking mechanism of the elytra. This varies little between species.

In about the middle of the elytron under interstria eight is a short robust shelf which locks with a raised structure on the thorax when the elytron is closed. This varies a bit in length and inclination but I have not been able to use this variation taxonomically.

Mesosternum

Like the rest of the ventral surface the mesosternum is strongly sculptured. At the front in the centre most species have two well - separated longitudinal carinae (Fig. 1). The area between them can be shallow or relatively deep and can have a weak '+' or 'T'-shaped structure within it. There is certainly a tendency for different species to have particular patterns of infill of this central region but not consistently enough to be taxonomically useful.

Three species have a distinctly different sculpture in this area. In these there are three even, well marked, longitudinal carinae (Fig. 2).

Metasternum

The pattern of punctures on the metasternal plates is very uniform across the Australian members of the genus. The basic pattern consists of 12 to 15 large, well separated punctures arranged in lose rows and arcs. There is a tendency, more marked in some species than in others, for some or most of the punctures to split into two without destroying the underlying standard pattern. In one species, *H. numerosepunctatus*, the metasternum (and mesosternum) is evenly covered with small to moderate punctures with no discernible trace of the basic pattern.

Abdominal sternites

These are strongly sculptured with raised front margins, a central longitudinal raised carina, and four large punctures and a further carina on each side. Although there is variation in the strength of this sculpture I have been unable to use it taxonomically.

Aedeagus

The variation in form of the aedeagus within Australian *Hydrochus* is not as extensive as that shown by *Hydrochus* in other areas (Makhan 1994, Oliva 1995) and differences between species are often slight. Nevertheless I have used it extensively in this revision. In many cases it proved the only reliable character to separate close species. The basal piece is usually parallel sided when viewed vertically but in a number of species it narrows toward the base and in others has a distinct twist. Viewed laterally the basal piece in most species is strongly curved upwards towards the base. The apical piece, consisting of lateral parameres and a central (or medial) lobe, is in all but a couple of species shorter than the basal piece. The central lobe varies considerably between species in width and in length compared to the parameres.

The aedeagi of all but one species, which is identical to another, are illustrated by drawings made with the help of a camera lucida. Where my concept of the species includes a range of aedeagus shapes the extremes are illustrated. Virtually all drawings were made with the apical piece closed up as in nature. In this configuration the central gap between the parameres is neatly filled by the central lobe. Ventral views are given in all cases, which I considered give a slightly better view of any development of the central lobe.

TYPES

The primary types, and most of the secondary types, were examined unless specifically stated otherwise. Blackburn and, to a lesser degree, Lea seldom clearly designated a holotype in their publications. They did however in most cases clearly mark a specimen with a 'T' or 'Ty'or with a TYPE label. In those cases were it is clear from the original description that there was more than one specimen before the author I have designated the specimen marked as a type by the author as the lectotype. In those cases where only one specimen appears to be involved and it is clearly labelled I have, of course, treated it as a holotype.

KEY TO SPECIES GROUPS OF AUSTRALIAN *HYDROCHUS*

1\. — Front of mesosternum in centre with three longitudinal carinae (Fig. 2.) .... *Group 1*

— Front of mesosternum in centre with two longitudinal carinae (Fig. 1) 2

2\. — Elytra with dark spots (may be masked in dark specimens) (Figs 9–11). Mesofemur strongly to moderately spindle-shaped, at base < two thirds its greatest width (Fig. 5) .... *Group 2*

— Elytra without spots. Mesofemur cylindrical or weakly spindle-shaped, at base equal to or greater than two thirds its greatest width (Figs 3, 4) 3

3\. — Mesofemur cylindrical or weakly spindle-shaped (Fig. 3). Basal pubescence on mesofemur seldom reaches much beyond apex of trochanter (Fig. 3); pubescence on ventral surface of profemur interrupted or reduced to a very narrow band (Fig.3) .... *Group 3*

— Mesofemur weakly spindle-shaped (Fig. 4). Basal pubescence on mesofemur usually reaches > one third of the width of femur at that spot along its posterior edge; basal pubescence on profemur complete, reaching > quarter width of femur along ventral surface (Fig. 4). .... *Group 4*

KEY TO SPECIES IN GROUP 1

1\. — Pronotum and elytra without granules, except weakly at apex and sides, often dull bronze/golden, elytra often with dark spots, a subscutellar one prominent; elytral apex constricted, squared off. Northern .... *H. imamkhani* Makhan

— Pronotum and elytra granulate, without dark spots, elytral apex rounded 2

2\. — Elytral epipleuron as wide as pseudoepipleuron anteriorly, never with the elytral granules masking punctures ... . *H. adelaidae* Blackburn

— Elytral epipleuron narrower than pseudoepipleuron, often hardly visible when elytra closed, never with weakly granulate, strongly punctate elytra .... *H. umbratilis* sp. nov.

KEY TO SPECIES IN GROUP 2

1\. — Elytral epipleuron wide, pseudoepipleuron lacking, or virtually lacking, at least in front half (Fig. 8) 2

— Elytral pseudoepipleuron well marked, a quarter width of epipleuron or more (Figs 6, 7) 3

2\. — Dorsally dark brown to black, without elytral dark spots except very vague ones in some specimens. Base of parameres not narrower than top of basal piece of aedeagus (Fig.17) .... *H. eurypleuron* sp. nov.

— Dorsally usually iridescent green/gold, elytral spots usually present, often well marked. Base of parameres may be narrower than top of basal piece of aedeagus .... *H. decorus* sp. nov.

3\. — Yellow legs, apart from darker areas on tarsi. May have black head and much lighter pronotum. Never have: strongly granulate elytra, moderate to strong apical punctures, strongly serrated elytron edge, length >3.4mm 7

— Legs with darker areas, particularly knees and parts of femora and tarsi. May have strongly granulate elytra, strongly serrated elytron edge, moderate to strongly developed apical punctures, length >3.4mm. Never have: head (black) and pronotum a different colour unless teneral 4

4\. — East coast south of Mackay. Aedeagus with short broad central lobe (Fig.18). Base of mesofemur narrowing to about two thirds of its greatest width. Basal pubescence reaching well beyond end of trochanter. Length 2.5 –3.1mm. .... *H. aenigmatis* sp. nov.

— Northern. Aedeagus with longer central lobe (Figs 9–22). Base of mesofemur narrowing to about half of its greatest width. Basal pubescence not reaching beyond end of trochanter in middle of femur, except in *H. macroaquilonius* which is > 3.1mm in length 5

5. — Length < 2.5mm. Pronotal surface rugose to smooth but rather even with relatively shallow punctures and flat granules, apical piece of aedeagus triangular, central lobe narrow (Fig. 19*)*, often with silver and black patches on pronotum .... *H. atratus* sp. nov. (in part)

— Length >2.0mm. Pronotal surface uneven, apical piece of aedeagus bullet shaped, central lobe wider (Figs 20–22), never with silver and dark patches on pronotum 6

6. — Length >3.1mm. Without or with very weak granules. Basal pubescence on mesofemur reaching beyond apex of trochanter in middle of femur. Legs with weak development of dark areas .... *H. macroaquilonius* sp. nov.

— Length < 3.5mm. Usually granulate, often quite strongly. Basal pubescence on meso femur seldom reaching beyond apex of trochanter in middle of femur. Legs usually with well developed dark regions .... *H. interioris* Blackburn

7. — Front margin of pronotum in central half raised and thickened to about twice normal width. Elytral interstriae two and four often unevenly raised. Central lobe of aedeagus short. *H. cucullatus* sp. nov.

— Not as above 8

8. — Mesofemur proportionately narrower at base than metafemur. Anterior spot on elytron usually larger than others. Apical piece of aedeagus relatively small, may be narrower at base than top of basal piece (Figs 19, 24–27). 9

— Mesofemur and metafemur same general shape, although metafemur bit larger. Anterior sutural spot on elytron same size as others. Apical piece of aedeagus relatively longer, base of apical piece approximately same width as basal piece (Figs 28, 29)....................................... 11

9. — Length 0.9–2.4mm. Elytral epipleuron approximately half width of pseudoepipleuron in front half. Dorsal surface uniformly dark or with silver and dark patches on both elytra and pronotum. .... *H. atratus* sp.nov (in part)

— Length 1.6–3.3mm. Elytral epipleuron > half width of pseudoepipleuron in front half. Dorsal surface light to dark testaceous or green/gold (other than head which may be black), with darker spots on elytra 10

10. — Length 2.0–3.3mm. Ventral surface testaceous to black. Elytron, when spotted, with anterior sutural spot about same size as others (Fig. 11). Width of base of mesofemur equal to or greater than half its greatest width. Base of apical piece of aedeagus not narrower than top of basal piece (Fig. 24) .... *H. burdekinensis* sp. nov.

— Length 1.6–2.5mm. Ventral surface black; head and pronotum often greenish, elytra often testaceous/golden/ greenish with anterior sutural spot on each elytron usually much larger than others (Figs 9,10). Mesofemur strongly spindle-shaped with its basal width equal to or less than its greatest width. Base of apical piece of aedeagus narrower than top of basal piece, tendency for the central lobe to bulge out above parameres (Figs 25–27). .... *H. lateviridis* Blackburn

11. — Apical piece of aedeagus relatively longer (basal piece 1.0–1.4 times length of apical piece) (Fig. 28). Northern .... *H. simplicicollis* Lea

— Apical piece of aedeagus relatively shorter (basal piece 1.5–2.0 times length of apical piece) (Fig. 29). Southern .... *H. obsoletus* Lea

KEY TO SPECIES IN GROUP 3

1. — Punctures in inner elytral striae continue to enlarge towards middle of elytra after about puncture four from the base. Northern species 2

— Punctures in inner elytral striae do not increase much in size after about puncture four from base. If northern, < 2.6mm long 3

2. — Length > 3.2 mm. Mesosternum evenly covered with deep, relatively small punctures. .... *H. numerosepunctatus* sp. nov

— Length < 2.8mm. Mesosternum usually normally sculptured (relatively few rather large punctures unevenly distributed) .... *H. obscuroaeneus* Fairmaire

3. — Pronotum rugose to smoothly sculptured, seldom granulate on disc (mainly central Australian specimens). Area of pubescence at base of mesofemur approximately the same area as that of trochanter. Knees dark. Usually have: pinched elytral apex, weak apical punctures, pronotum with bare areas 4

— Pronotum granulate, lacking smooth areas. Area of pubescence at base of mesosternum < area of trochanter. Knees no darker than rest of legs. Apex of elytra rounded with strong apical punctures. N.S.W. .... *H. granicollis* Lea

4. — Length 1.8–2.3mm. Pronotal epipleura weak to absent. Central lobe of aedeagus with broad tip (Fig. 34. Northern (Cape York and Arnhem Land)) .... *H. gitaraiae* Makhan

— Length 2.0–3.4mm. Pronotal epipleura moderate, but often ill-defined. Central lobe of aedeagus with narrow tip (Figs 35, 36). Southern, rarely in North Queensland. .... *H. horni* Blackburn

KEY TO SPECIES IN GROUP 4

1. — Elytral interstria two raised for short distance near base, interstria four raised in central portion of elytron ending abruptly behind middle (occasional specimens have only weakly raised interstriae). Aedeagus with basal piece 1.7–1.9 times length of apical piece, which is narrowly triangular and sharply pointed (Fig. 40) ....*H. multicolor* Lea

— Elytral interstriae if raised then evenly and relatively weakly. Aedeagus with proportionately much longer apical piece (Figs 38, 39, 41–44)............................. 2

2. — Aedeagus with apical piece elongate, bases of parameres usually bulbous, parameres rapidly narrowing in middle, apical half thin, sometimes twisted; central lobe thin; basal piece not twisted. Elytral epipleuron equal to or greater than width of pseudoepipleuron in front half. Basal pubescence on ventral surface of mesofemur reaches a distance equal to or greater than half width of femur along hind edge. Pronotal epipleuron weak or absent. Often quite light to moderately testaceous dorsally ....*H. australis* Motschulsky

— Aedeagus not with above combination of characters. Elytral epipleuron equal to or less than pseudoepipleuron in width in front half. Basal pubescence on mesofemur reaches a distance equal to or less than half width of femur along hind edge. Pronotal epipleuron usually moderately developed. Black dorsally .. 3

3. — Aedeagus with base twisted, central lobe narrow with tip twisted to left (viewed ventrally), parameres weakly asymmetric to accommodate off-centre central lobe tip, parameres narrow towards tips (Fig. 38).................*H. aschnakinarae* Makhan

— Aedeagus with base with at most only a hint of a twist, central lobe moderately wide, parameres symmetric (Figs 39, 43, 44).. 4

4. — Aedeagus with parameres narrowing rapidly in middle, narrow and even in width in apical half, central lobe wide (Fig. 43) .... *H. abditus* sp. nov.

— Aedeagus with parameres relatively wide, tips paddle-shaped, may be waisted (Figs 39, 44)... 5

5. — Aedeagus with apical piece squat, parameres bulbous at base, apical piece approximately twice as long as wide, basal piece narrowing towards base (Fig. 39)...................... *H. kunarajahi* Makhan

— Aedeagus with apical piece more elongate, apical piece > twice as long as wide (Fig. 44) .... *H. radjiei* Makhan

DESCRIPTIONS

In the following sections the descriptions of species are arranged alphabetically within each of the four species groups.

Species Group 1

A group of three relatively large species characterised by having three rather than two longitudinal carinae at the front of the mesosternum and stout broad aedeagi. The two southern species, *H. adelaidae* and *H. umbratilis*, are very similar and seem distinct from the northern *H. imamkhani* which is the only Australian species with spotted elytra other than group 2 species.

The two southern species are found at the sides of poorly vegetated, often deeply shaded, pools most frequently among dead leaves and other detritus. *Hydrochus imamkhani* is found in more open areas amongst emergent vegetation in still or slow moving water.

Hydrochus roepnaraini Makhan from New Caledonia belongs in this group.

Hydrochus adelaidae Blackburn

Hydrochus adelaidae Blackburn, 1888 p. 832

= *Hydrochus victoriae* Blackburn, 1888 p. 834; syn. nov.

Types

Hydrochus adelaidae Blackburn. *Holotype*: 'T 1618 ?A' 'Australia Blackburn Coll. B.M. 1910–236' 'Hydrochus Adelaidae', BMNH. Blackburn (1888) gives the type locality as 'River Torrens near Adelaide'.

Hydrochus victoriae Blackburn. *Lectotype*: 'Type' 'T 1551 V' 'Australia Blackburn Coll. BM. 1910–236' 'Hydrochus victoriae Blackb.', BMNH. Herein designated. Blackburn (1888) gives the type locality as 'Ararat Victoria'.

Paralectotype: 1, '1551V' 'Victoria Blackburn' 'Hydrochus victoriae Blackb. Co-type' SAMA. Herein designated.

Description (number of specimens examined, 42)

Size 2.5 to 3.7mm. Broadly elongate, elytra wider than pronotum, widest just behind middle, apex rounded. Head black; pronotum black, often with vague testaceous front margin; elytra testaceous to dark testaceous; ventral surface dark testaceous to black; legs light testaceous lacking darker knees. Head with large granules, epicranial suture weakly to moderately marked. Pronotum weakly waisted, densely covered with granules, which mask punctures; foveae virtually absent; epipleuron distinct, about one puncture width wide. Elytra without granules to moderately granulate, punctures relatively large often increasing in size considerably towards centre of elytra within a stria, interstria four tends to be raised particularly just behind middle, plica indistinct, apical punctures weak. Setae on head and towards apex of elytra weakly developed. Front of mesosternum in centre with three longitudinal carinae, the distance between them greater than their widths. Pseudoepipleuron moderately developed, epipleuron weakly developed in apical half, quite strongly developed in anterior half where it is approximately same width as pseudoepipleuron. Profemur moderately stout, basal pubescence moderate, about a quarter width of femur at base. Mesofemur elongate, narrowing to about two thirds greatest width towards base, basal pubescence well developed reaching to about a half width of base of femur beyond trochanter on ventral rear margin. Metafemur elongate, bowed on front margin.

Male: Basal piece of aedeagus broad, subparallel, 1.4 to 1.8 times length of apical piece. Parameres wide in basal half, narrowing towards tip. Central lobe relatively narrow, sharply pointed, reaching to end of parameres. Similar to that of *H. umbratilis*, Fig. 14.

Distribution

South Australia
Williamstown, SAMA.

Tasmania
Launceston, SAMA.

Victoria
Buangor, SAMA; 5 km NW Portland, SAMA.

Remarks

This species appears close to *H. umbratilis* but the strongly punctate and usually granule-free elytra readily tell them apart. For those specimens with more strongly granulate elytra (usually with weaker punctures also) the wider elytral epipleura will separate them. The elytra are often lighter in colour than the pronotum which seldom is the case in *H. umbratilis*. The parameres appear to narrow a little less abruptly in this species but the aedeagi are otherwise very similar. The pronotal epipleura are a little narrower than in *H. umbratilis*. *Hydrochus australis* is superficially similar, particularly strongly granulate specimens, but the front of the mesosternum, and the very different aedeagi readily separate them. Nor do *H.*

australis have the large elytral punctures seen in most *H. adelaidae*.

Biology

The species is most often found amongst dead leaves at the edges of ponds, which are often shaded and poorly vegetated.

Hydrochus imamkhani Makhan

Hydrochus imamkhani Makhan, 1994

Type

Holotype: 'New Guinea; SE Weam, 9m 18.VI.1964' 'H. Clissold Light Trap BISHOP MUSEUM', BPBM.

Description (number of specimens examined, 94) Figs 2, 12, 13

Length 2.8 – 4.4mm. Elongate, elytra weakly to moderately broadened behind middle, narrowing quite abruptly near apex, obliquely truncate. Head dark brown to black, with iridescent sheen; pronotum dark brown, front margin sometimes lighter, often shiny iridescent green/gold; elytra dark brown to a shiny green/gold/silver surface, frequently with dark spots/markings, one of the more prominent around scutellum; ventral surface dark brown to black, legs light testaceous with parts of tarsi and knees darker. Head granulate/punctate, epicranial suture weak. Pronotum rugose/punctate, punctures relatively small, sides may be weakly to moderately granulate, foveae weak, not bounded by raised areas, tendency for central third longitudinally to be raised, epipleuron well marked, one to two punctures deep, often fluted. Elytra usually rather smooth with small to medium, even-sized punctures, not granulate or with relatively weak granules at sides and apex; without apical punctures, interstriae variable from almost unraised to quite strongly swollen, in the latter case alternate interstriae unevenly raised with interstria four having a more prominent portion at start of elytral declivity, interstriae in dark areas not swollen and may even be slightly sunken, in some specimens some other striae weakly raised in places also; plica usually recognisable but incorporated into interstria eight if raised. Setae small but well developed on head and towards rear of elytra. Pronotal epipleuron distinct, two to three puncture widths deep, often fluted. Pseudoepipleuron moderately to quite well developed; epipleuron absent towards rear, weak in front, ridge between pseudoepipleuron and epipleuron strong. Profemur moderately elongate, weakly sinuate, basal pubescence weak, reduced to a very narrow band ventrally < quarter width of femur. Mesofemur elongate narrowing in basal third to about two-thirds its greatest width, basal pubescence moderate, reaching between a fifth and a third of width of femur at that point along rear margin beyond end of trochanter. Metafemur elongate, front edge weakly bowed. Front of mesosternum in middle with three broad longitudinal carinae, the lateral two usually broader than central one, area between carinae much narrower than carinae, behind these are a row of four round punctures. Metasternal punctures smaller and more numerous than in most other Australian species.

Male: Basal piece of aedeagus broad, subparallel, 1.5–1.6 times length of apical piece. Apical piece bullet-shaped, parameres broad in basal half thin in apical quarter; central lobe relatively broad, sharply pointed, tip bent downwards, reaching to ends of parameres. Fig. 12.

Distribution

Northern Territory

Berry Springs, ANIC; Florence Falls, Litchfield NP, NHMW, CLH; Holmes Jungle, ANIC; Howard Springs, ANIC; Katherine, ANIC; Lake Bennett, NTM; Jabiru, SAMA; 10 km SW Jabiru, SAMA; 20 km SSW Jabiru, SAMA; Jim Jim Highway, Kakadu NP, CLH, NHMW; Jim Jim Falls, Kakadu NP, NHMW; 19 km E by S Mt Borradaile, ANIC; Murganella, NTM.

Queensland

8 km N Bluewater, SAMA; Cape Flattery area, DPIM; Dalby, SAMA; Dalhunty River, SAMA; Eubenargee Swamp, SAMA; 70 km SW Greenvale, SAMA; Iron Range, ANIC, UQIC; Jardine River, UQIC; Lockerbie, UQIC; Mareeba, NHMW; 21 km E Mareeba, DPIM; Mary Creek., ANIC; 8 km E Mt Cahill; 2 km S Mt Molloy, SAMA; 2 km N Mt Molloy, SAMA; 6 km ENE Mt Tozer, ANIC; 11 km ENE Mt Tozer, ANIC; 3 km NE Mt Tozer, ANIC; 2 km NNE Mt Tozer, ANIC; 3 km NE Mt Webb, ANIC; ANIC; Peach Creek, SAMA; 5 km W by W Rounded Hill, ANIC; Tolga, DPIM.

Western Australia

Carson Escarpment, ANIC; Drysdale River, ANIC; 12 km S Kalumburu Mission, ANIC; Mitchell Plateau, SAMA, ANIC; Peron Peninsula, WAM; Regans Ford, ANIC.

Remarks

A large, distinctive, isolated species unlikely to be confused with any other Australian species. *Hydrochus roepnaraini* Makhan from New Caledonia appears to be close. Based only on the type specimen, *H. roepnaraini* has a similar mesosternal front and similar dorsal colour and sculpture to those *H. imamkhani* which have most elytral interstriae raised to some degrees in some places. The aedeagi are quite different with *H. roepnaraini* having a much longer apical piece (see fig. 26 in Makhan 1994).

Hydrochus imamkhani was described from New Guinea but an examination of the type shows that it is conspecific with Australian specimens. Makhan (1994) thought it was similar to *H. rodjani* but this species is a junior synonym of *H. obscuroaeneus,* a very different species from *H. imamkhani.*

I have seen two specimens of *H. umbratilis* from near Cardwell in North Queensland. Their dark colour, lack of elytral spots, strongly granulate pronotum and stouter legs separate them from *H. imamkhani.*

Biology

Most frequently found amongst emergent vegetation in ponds, swamps or slowly moving water. Taken at light.

Hydrochus umbratilis sp. nov.

Types

Holotype: Male, 'VIC 10 km NE Mirranatwa 12/10/97 C. Watts', SAMA.

Paratypes: 35, same data as holotype, SAMA.

Description (number of specimens examined, 93) Fig. 14

Length 2.1 – 4.7mm. Broadly elongate, elytra widened somewhat behind middle, apex rounded. Dorsal surface testaceous to black; ventral surface dark brown, legs testaceous, parts of tarsi, knees and femora often darker. Head granulate, epicranial suture weak to moderate. Pronotum moderately to densely granulate, foveae virtually absent. Elytra moderately to very strongly granulate, punctures when visible small to moderate, alternate elytral interstriae weakly to strongly raised with interstria four often strongest; plica absorbed into interstria eight. Setae well developed on head and apical half of elytra. Pronotal epipleuron distinct, about one and a half puncture widths deep, often fluted. Front of mesosternum in centre with three longitudinal carinae, lateral ones about same width as central, area between them about equal to their width, tendency in some populations for this area to become relatively smooth and the carinae indistinct. Mesosternal punctures tending to be smaller and more numerous than usual. Pseudoepipleura moderately to quite strongly developed, epipleura absent behind, weak in front. Profemur moderately stout, basal pubescence relatively weak, reduced to very narrow band ventrally. Mesofemur elongate, narrowing a bit toward base, basal pubescence weak to moderate, at weakest reaching to end of trochanter at strongest reaching to about a quarter the width of base of femur beyond trochanter on ventral rear margin. Metafemur elongate, bowed on front margin.

Male: Basal piece of aedeagus broad, subparallel, 1.4 – 1.8 times length of apical piece. Parameres wide in basal half, rapidly narrowing, thin apically. Central lobe relatively narrow, sharply pointed, reaching to end of parameres (Fig. 14).

Distribution

Australian Capital Territory

25 km W Canberra, ANIC.

New South Wales

Armadale, ANIC; Berry, SAMA; Collector, SAMA; 14 km W Delagate, SAMA; Nerriga, SAMA; 6 km N Uralla, ANIC.

Queensland

Caloundra, SAMA; Cardwell, ANIC; 10 km S Cardwell, SAMA; Cunninghams Gap, SAMA

Tasmania

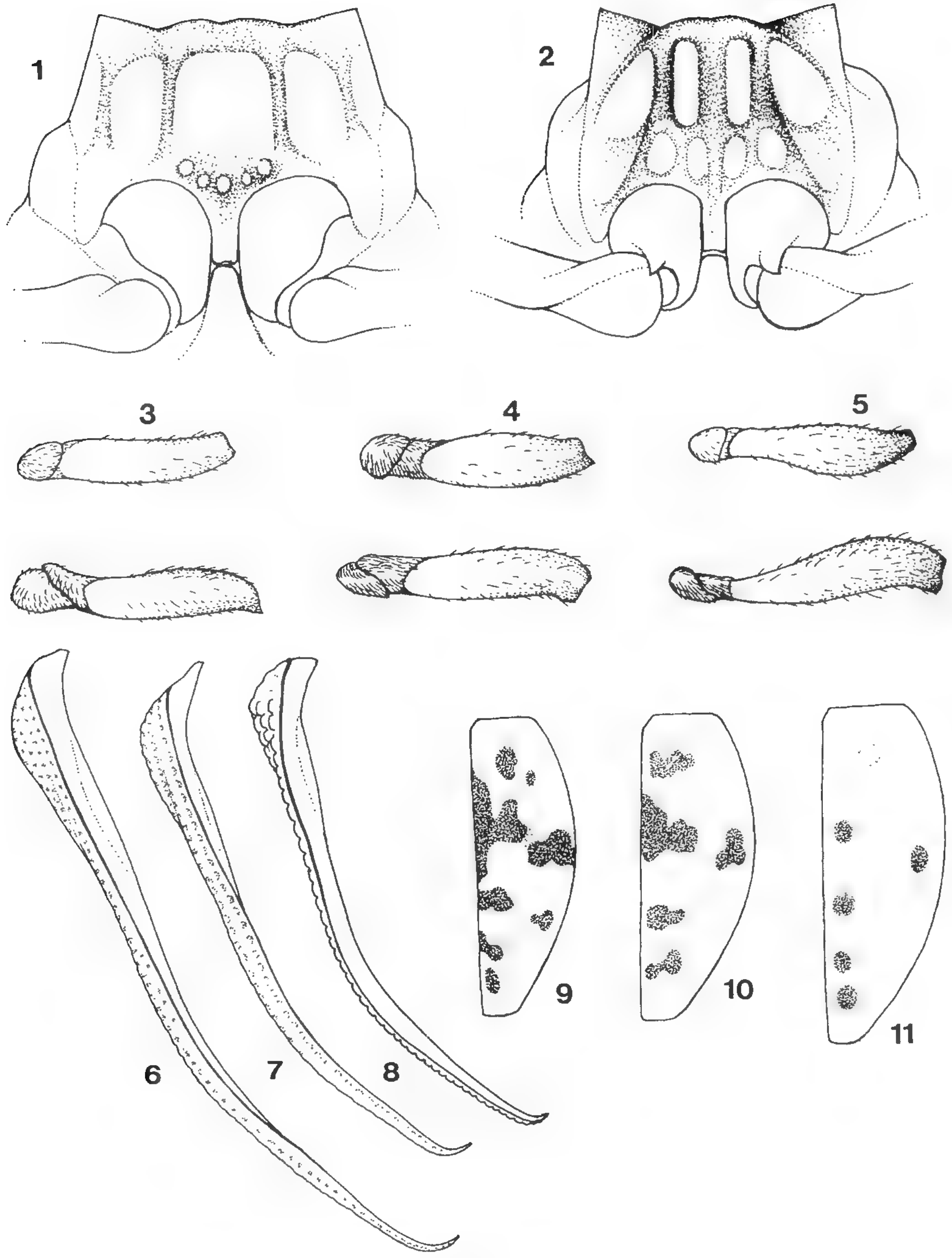
Launceston, SAMA; 5 km W Maydena, NHMW

Victoria

Buangor, SAMA; Eustace Gap Creek, NMV; Glenferrie, CAL; Grampians, SAMA; 18 km NW Licola, NMV; 10 km NE Mirranatwa, SAMA; 4 ml NE Nelson, NMV; 12 km SW Orbost, SAMA; 5 km NW Portland, SAMA; 3 km SE Taggerty, NMV.

Remarks

This species and *H. adelaidae* are the only species in southern Australia with three longitudinal carinae at the front of the mesosternum. The narrower elytral epipleura in this species is the only certain character to separate the two. However, *H. adelaidae* never



FIGURES 1–11. **1**, Front of mesosternum of *H. burdekinensis,* with two longitudinal carinae; **2**, Ditto of *H. imamkhani*, with three longitudinal carinae; **3**, Pro(top) and meso femora (below) of *H. obscuroaeneus*, a group 3 species; **4**, Ditto, *H. aschnakiranae*, a group 4 species; **5**, Ditto, *H. interioris*, a group 2 species; **6**, Ventral view of elytron edge in *H. australis* showing epipleuron (right) and pseudoepipleuron (left) of approximately equal widths; **7**, Ditto, *H. aschnakiranae* showing weaker epipleuron; **8**, Ditto, *H. eurypleuron* showing wide epipleuron and virtual lack of pseudoepipleuron; **9–10**, Dorsal views of elytra showing variants of the colour pattern in *H. lateviridis*; **11**, Ditto, *H. burdekinensis*.

have strongly granulate elytra and *H. umbratilis* never have elytra with large punctures which often increase in size towards the middle of the elytra within one stria (this character is best viewed when the specimen is dry since when wet the appearance of granules is enhanced). The three longitudinal carinae, and the weak elytral epipleura will separate it from strongly granulate forms of *H. australis*. It is also a wider and darker species than *H. australis* with stronger pronotal epipleura. It shares with *H. imamkhani* the three carinae on the front of the mesosternum and also a tendency for the mesosternal punctation to be composed of numerous rather small punctures. The aedeagi are also very similar but the apical piece is shorter and the central lobe narrower than in *H. imamkhani*. It can be separated from this species most readily by its strongly granulate dorsal surface, dark colour and rounded elytral apex.

Specimens from north coastal NSW to north Queensland are often chunkier with stouter legs, the alternate elytral interstriae more strongly raised and the elytral granulations usually weaker. Further specimens and study could well result in them being considered a separate species.

Biology

Found in dead leaves at the sides of still or slowly moving water, often in shaded situations.

Etymology

Latin. 'of the shade'– in reference to its dark colour and the fact that it is often found in deeply shaded ponds.

Species Group 2

The largest of the groups in terms of species, group 2 is characterised by having: two rather than three longitudinal carinae at the front of the mesosternum (Fig. 1); dark spots on the elytra which are often coloured in some way (Figs 9–11); thin spindle-shaped legs with weak basal pubescence (Fig. 5). All species have the elytral spotting to a greater or lesser degree but not all individuals. The only other Australian *Hydrochus* with similar markings is *H. imamkhani* in group 1. Other character states that tend to distinguish the group are: lack of, or virtually lack of, setae on the dorsal surface; pubescence on the mesofemora usually not reaching much past the end of the trochanter; pubescence on the profemora complete but narrow ventrally (Fig. 5); pronotum either lacks or has very weak foveae; pronotal epipleura usually well marked; head with only a weak development of the epicranial suture; elytra usually smooth or with only weakly raised interstriae (in one species, *H cucullatus*, they may be strongly raised) and the plicae are usually obvious.

All member species whose habitat is known live in relatively clean sand/gravel at the sides of rivers and streams. They are typically found in large numbers at the edges of sandy pools in the beds of drying rivers in tropical Australia where they are often concentrated just below the surface of the sand. All species in this group that I have observed, when dislodged, put their heads down and attempt, albeit weakly, to swim to the bottom, in contrast to species of other groups which use the surface film to crawl upside down until they reach the side or emergent objects or vegetation. They also appear more adept at clinging to sand grains etc. on the bottom than species in other groups. This is often seen in collecting trays where group 2 species tend to be on the bottom of the tray and species of other groups tend to float on the surface .

The group is primarily tropical with only *H. obsoletus* commonly found in southern Australia.

Hydrochus aenigmatis sp. nov.

Types

Holotype: male, 'Webers ck NSW 2/11/94', SAMA.

Paratypes: 4, same data as holotype, SAMA; 1, 'Megalong Vy. Blue Mts N.S.W. Jan 20`32,1000ft' 'Australia Harvard Esp. Darlington', MCZ; 1, '21 ml. S of Miriam Vale Q 24°38S 151°34E 14.xii.1968 E. Britton & S. Misko', ANIC.

Description (number of specimens examined, 10) Fig. 18

Length 2.5 – 3.1mm. Elongate, elytra a little wider in the middle, tip rounded or weakly obliquely truncate. Head and pronotum dark steely-grey often with silver reflections; elytra dull brown to steely-grey, three to four rather small dark spots near suture, usually indistinct, about equal in size; ventral surface dark brown to black, legs testaceous, parts of tarsi, knees and basal part of femora darker. Head shallowly and rather smoothly granulate/punctate, epicranial suture weak. Pronotum with rather sparse, small shallow punctures, occasionally weakly granulate laterally, surface uneven, foveae indistinct. Elytra with relatively small punctures, separated within striae by about same width as interstriae or a bit less; alternate interstriae not or only weakly raised; plica present; apical punctures usually well developed. Setae virtually absent from head and elytra. Pronotal epipleuron poorly defined, about two puncture widths wide, weakly fluted. Elytral pseudoepipleuron moderate, epipleuron absent apically, weak behind middle, widening to about same width as pseudoepipleuron in front. Front of mesosternum in centre with two narrow, raised, longitudinal carinae, the area between them shallow to moderately deep, particularly behind. Profemur rather stout, basal pubescence weak, reduced to a narrow band ventrally. Mesofemur elongate, weakly spindle-shaped, narrowing basally to about two thirds its greatest width, basal pubescence moderate, reaching to between a quarter and a half width of femur past trochanter on ventral edge. Metafemur elongate, bowed on front edge narrowing to about three quarters its greatest width basally.

Male: Basal piece of aedeagus straight sided, 1.5 to 1.7 times length of apical piece. Apical piece bullet-shaped, parameres narrow and weakly paddle-shaped in apical half. Central lobe very wide, considerably shorter than parameres; in lateral view ventral surface flat, width rapidly reducing in middle (Fig.18).

Distribution

New South Wales

Megalong Valley, MCZ; Webers Creek, SAMA.

Queensland

15 km W Gympie, NMV; 21 ml S Miriam Vale, ANIC.

Remarks

A rare species from the east coast, separable from other group 2 species with dark legs by its relative lack of granules, stouter legs and more extensive basal pubescence on the mesofemora. It can be confused most readily with the much commoner *H. interioris*, from which it differs in having stouter mesofemora with a greater amount of basal pubescence, and a broader central lobe to the aedeagus. Based on the few specimens known, *H. aenigmatis* also appears to be a more southern species than *H. interioris*.

In size and general colour *H. aenigmatis* approaches *H. obsoletus*, the only other group 2 species in the South-east. It differs from this species in the stronger basal pubescence on the mesofemur, which reaches more than a quarter the width of the femur past the trochanter whereas in *H. obsoletus* it usually is only a bit beyond the end of the trochanter; in the dark areas on the legs; in the rougher pronotal surface; narrow less distinct pronotal epipleura and in having the pronotum the same colour as the head whereas in *H. obsoletus* the head is often darker. The male genitalia approach those of *H. obsoletus* but have a much broader central lobe and, in lateral view, the apical piece is flat dorsally and narrows abruptly in the middle ventrally, in contrast to the more evenly narrowing shape in *H. obsoletus*.

Biology

Nothing known

Etymology

Latin. 'Obscure'– a reference to its rarity.

Hydrochus atratus sp.nov.

Types

Holotype: male, 'Qld. Burdekin r. E of Charters Towers 4 May 1998 C.H.S. Watts', SAMA.

Paratypes: 16 same data as holotype, SAMA.

Description (number of specimens examined, 221) Fig. 19

Length 0.9 – 2.4mm. Elongate, elytra wider behind middle, rounded or somewhat pinched near apex. Head shiny black; pronotum shiny black, granules if present often silver; elytra dark brown to black with vague darker spots in some, occasionally quite silvery; ventral surface dark brown to black, legs light to quite dark testaceous, parts of tarsi, knees and femora usually darker. Head granulate/punctate often with bare areas, epicranial suture weak to moderate. Pronotum variable, from strongly granulate/punctate to dense, rugose, rather large punctures, foveae absent. Elytra variably granulate/punctate, punctures moderate sized, within striae separated by about width of interstriae. Interstriae four and eight may be weakly raised in parts, plicae visible. Setae on head and elytra absent. Pronotal epipleuron poorly to moderately defined but relatively deep. Front of mesosternum in middle with two narrow longitudinal carinae, area between them quite deeply excavated in front, less so behind. Elytral pseudoepipleuron moderate to broad, epipleuron absent behind increasing to equal to width of pseudoepipleuron or a little less in front third. Profemur elongate, basal pubescence moderate, reaching to about a quarter width of femur ventrally. Mesofemur spindle-shaped, narrowing to more than half its greatest width in basal quarter, basal pubescence weak, reduced to a very narrow band ventrally. Metafemur rather broad, bowed on front edge, narrowing to nearly half its greatest width toward base.

Male: Basal piece of aedeagus with parallel sides or weakly converging toward base, 1.8 – 2.1 times length of apical piece. Apical piece moderately to strongly elongate triangular, in more elongate forms with constriction in middle. Central lobe narrow, nearly as long as parameres (Fig. 19).

Distribution

Northern Territory

Adelaide River, ANIC; Cooper Creek near Mt Borradaile, SAMA; 20 km SSW Jabiru, SAMA; Kongarra, NTM; Korlonjorlok Stream, Kakadu NP, NTM; 6 km E Mt Cahill, NTM; 8 km E Mt Cahill, ANIC; 19 km E by S Mt Borradaile, ANIC; 5 km SE Mt Borradaile Station, SAMA; 11 km S by W Nimbuwah Rock, NTM; 6 km SW by S Oenpelli, ANIC; UDP Falls, Kakadu NP, NTM; Woolwonga Fauna Reserve, ANIC.

Queensland

Archer River, SAMA; Borumba Dam, CLH, NHMW; Burdekin River, SAMA; Burdekin River E of Charters Towers, SAMA; Dalrymple, 30 km N Charters Towers, NHMW; 70 km SW Greenvale, SAMA; 2 km S Mt Molloy, SAMA; Starr River, SAMA.

Western Australia

Augustus Island, ANIC; Drysdale River, ANIC; 12 km S Kalumburu Mission, ANIC; 14 km S by E Kalumburu Mission, ANIC; 4 km W King Cascade, ANIC; Kunmunya Mission, ANIC; 4 km S by W Mining Camp Mitchell Plateau (15.38S 125.15E), ANIC; 10 km NW by N Mining Camp Mitchell Plateau, ANIC; Point d'Entrecasteaux, WAM.

Remarks

Specimens of the species are the smallest Australian *Hydrochus*, with Northern Territory and Kimberley specimens often less than a millimetre long. In certain parts of their range they can reach 2.5mm which overlaps the size range of the very similar *H. interioris*. *Hydrochus interioris* is larger, the pronotal surface is very uneven and the apical punctures on the elytra are often well developed whereas in *H. atratus* the pronotal surface (ignoring the punctures) is relatively smooth and the apical punctures seldom larger than adjacent punctures. Small individuals of *H. interioris* are difficult to separate from *H. atratus* other than by the aedeagus. In general *H. atratus* are darker, without elytral spots, rounded more than elongate and may have dark shadows on the pronotum. The aedeagus in *H. atratus* has a more triangular shaped apical piece and narrower central lobe.

Hydrochus atratus is easily separated from well coloured individuals of *H. lateviridis* but larger specimens can be very similar to dark specimens of *H. lateviridis*. From *H. lateviridis* it differs in the narrower elytral epipleura, in often having dark portions to its legs, in the stouter meso and metafemora which narrow to between two thirds and half their greatest widths basically, rather than to more than half in *H. lateviridis,* and in the pronotum and head of *H. lateviridis* often having a greenish tinge absent in *H. atratus. Hydrochus atratus* often has, uniquely in Australian *Hydrochus*, dark and light areas on the pronotum. The aedeagi of some *H. atratus* resemble those of some *H. lateviridis* but in *H. lateviridis* the central lobe is more exposed and bulbous, the base of the apical piece is always narrower than the basal piece and the aedeagus may be twisted (Figs 25 – 27).

Four specimens from Kunmunya Mission, WA, in ANIC belong to this species or possibly a new one. They differ in having broader pseudoepipleura, a more uneven pronotal surface and a narrower, waisted apical piece to the aedeagus.

Biology

Found most commonly in bare coarse sand at the edge of small pools beside seasonally drying large rivers. In such places they can be extremely abundant. Taken at light.

Etymology

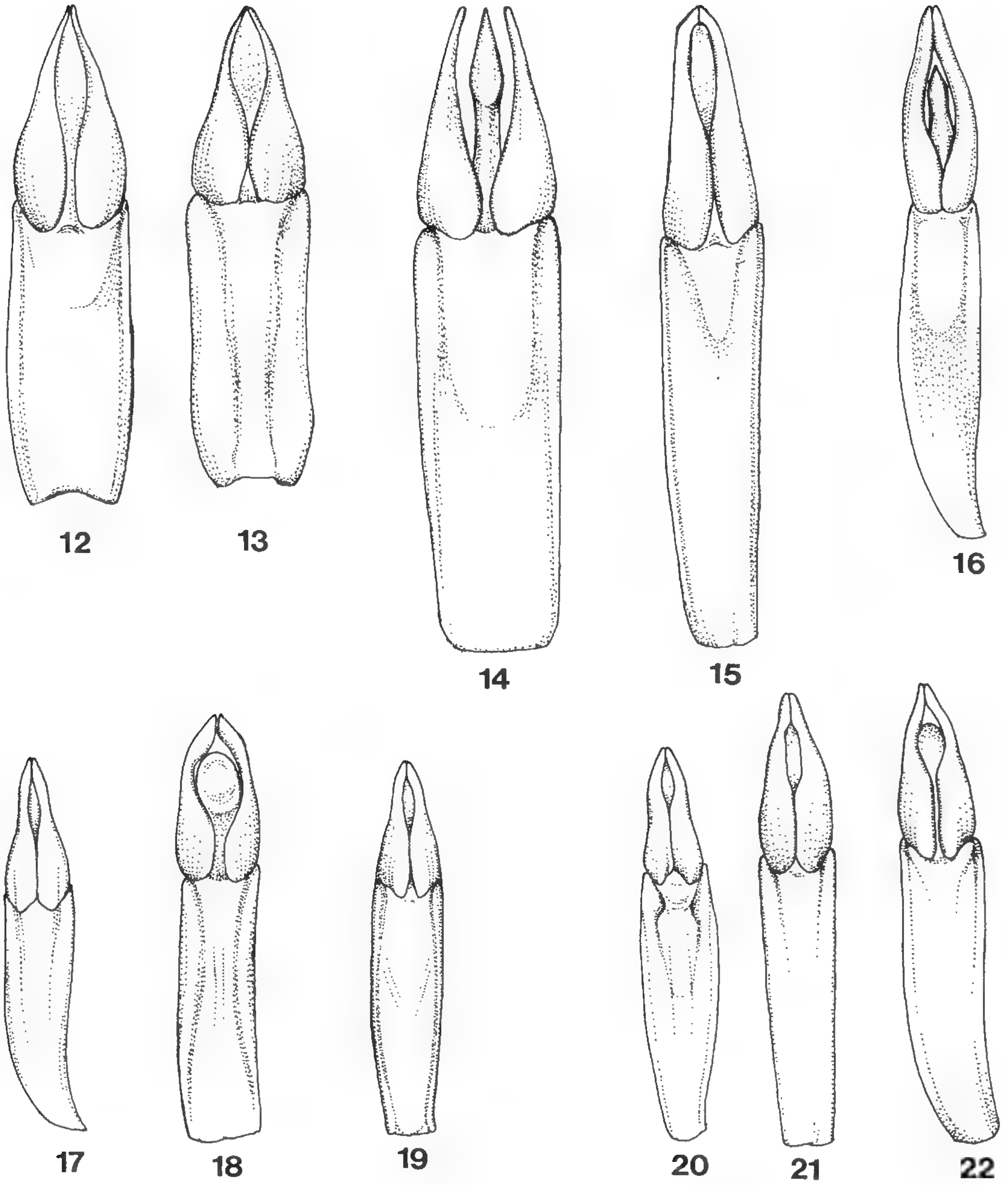
Latin. 'Dressed in black' – a reference to its black colouring.

Hydrochus burdekinensis sp. nov.

Types

Holotype: male, 'Qld. Burdekin r E of Charters Towers. 4 May 1998 C.H.S. Watts', SAMA.

Paratypes: 60, same data as holotype, SAMA.



FIGURES 12–22. **12–13**, Ventral views of two forms of aedeagus in *H. imamkhani*; **14**, *H. umbratilis*; **15**, *H. macroaquilonius*; **16**, *H. decorus*; **17**, *H. eurypleuron*; **18**, *H. aenigmatis*; **19**, *H. atratus*; **20–22**, forms of *H. interioris*.

Description (number of specimens examined, 380) Figs 1, 11, 24

Length 2.0 – 3.3mm. Broadly elongate, elytra weakly wider behind middle, constricted slightly towards apex. Head black, often with greenish iridescence; pronotum light testaceous, sometimes darker testaceous on disc or, rarely, over whole pronotum; elytra usually light testaceous to testaceous, with darker elytral spots varying from absent to moderate, spots sub equal in size (Fig. 11), occasional specimens mainly from western Arnhem Land are silver/golden/ greenish on most of the dorsal surface; ventral surface testaceous to black, legs yellow testaceous except for darker tip to tarsi. Setae lacking on dorsal surface. Head sparsely to moderately covered with weak punctures, epicranial suture weak. Pronotum varying from smooth with moderate punctures to rugose/ punctate to densely covered with small granules. Elytral punctures small to moderate, area between them within striae usually less than width of interstriae, occasionally with weak to moderate granules; interstriae not or only weakly raised; plicae present. Pronotal epipleuron distinct, shiny, two to three punctures deep, occasionally fluted. Pseudoepipleuron moderate, elytral epipleuron absent behind, narrow in middle, widening only slightly in front third. Front of mesosternum in centre with two longitudinal carinae, area between them moderately excavated. Profemur moderate, basal pubescence weak, reduced to narrow band ventrally. Mesofemur spindle shaped, narrowing to half to a third greatest width, basal pubescence very weak to moderate, reduced to a narrow band ventrally. Metafemur stouter than mesofemur.

Male: Basal piece of aedeagus with sides parallel, 2.0 – 2.7 times length of apical piece. Apical piece bullet-shaped, central lobe moderately wide, pointed, nearly as long as parameres (Fig. 24).

Distribution

Northern Territory

5 km SE Mt Borradaile Station, SAMA; 33 km SW Borroloola, ANIC; 14 km NW Cape Crawford, ANIC; Cooper Creek near Mt Borradaile, SAMA; Deaf Adder Gorge Kakadu NP, NTM; Edith Falls near Katherine, CAL; Jim Jim Creek, Kakadu NP, ANIC; Jim Jim Falls, Kakadu NP, CLH, NHMW; 1 km W Gubara, Kakadu NP, SAMA; Malapanbango Creek Kakadu NP, NTM; 8 km E Mt Cahill, ANIC; 9 km SSE Mudginbarry Homestead, ANIC

Queensland

Boar Pocket Road, ANIC; Burdekin River, SAMA; Burdekin River E of Charters Towers, SAMA; Bushy Creek, Mossman – Mt Lewis Road, ANIC; Cardstone, ANIC; Charters Towers, SAMA; Hann River, NMV; Kuranda, ANIC; 73 km NW by W Laura, ANIC; 70 km N Laura, DPIM; Lake Tinaroo, ANIC; Mary Creek, ANIC, SAMA; 60 km NW Mt Isa, SAMA; 60 km W Mt Garnet, DPIM; Musgrave, DPIM; 1 km W Petford, SAMA; 1 km WSW Petford, DPIM; Strathmore Station, DPIM.

Western Australia

17 km N by E Cane River Homestead, ANIC; De Grey River, ANIC; Gascoyne River, ANIC; 12 km S Kalumburu Mission, ANIC; 4 km W King Cascade, ANIC; Millstream, ANIC; Mitchell Plateau, ANIC; Regans Ford, ANIC; Synnot Creek, ANIC; West Peawah River, ANIC, SAMA; Winjana Gorge, CAL.

Remarks

Widespread and relatively common in northern Australia, *H. burdekinensis* can be most readily recognised by its testaceous legs and, in the majority of specimens, testaceous elytra and pronotum. The darker spots on the elytra are usually not well marked and often absent.

Hydrochus burdekinensis can most easily be confused with *H. simplicicollis* which is a rarer species known only from North Queensland. Its black ventral surface and extensive area of dark testaceous on the pronotum will separate *H. simplicicollis* from most *H. burdekinensis*. *Hydrochus simplicicollis* also has stouter mesofemora, which, unlike *H. burdekinensis*, are similar in shape to the metafemora although a bit smaller overall. The apical pieces of the male aedeagi differ considerably in comparative length between the two species (Figs 24 – 27). *Hydrochus lateviridis* is generally a smaller species with greenish tinges and much more strongly developed dark markings on the elytra (Figs 9, 10). Some specimens of *H. obsoletus* from New South Wales are identical in colour to some *H. burdekinensis* but differ in having stouter legs and a more elongate apical piece of the aedeagus. In the Northern Territory specimens are often a rather uniform greenish/golden on the dorsal surface and can be confused with smaller specimens of *H. macroaquilonius*. They can be separated from this species by their yellow legs, stronger elytral epipleura and better developed pronotal epipleura. The aedeagus of *H. macroaquilonius* can not be separated from the more elongate forms of the aedeagus of *H. burdekinensis* which can be found in the same region.

Biology

A common species in bare sand at the edge of moderate to large rivers. Taken at light.

Etymology

A reference to the river where the species is particularly common.

Hydrochus cucullatus sp. nov.

Types

Holotype: male, '2 km N Mt Molloy Qld. 5.2.97 C. Watts', SAMA.

Paratypes: 3, same data as holotype, SAMA; 1, 'Peach Ck. N. Qld. 24/7/82 C. Watts', SAMA; 3, '(19°10S 145°47E) Running River, Q 24 km W, of Paluma, 13.1.70, pools in sandy river bed Britton & Misko', ANIC; 3, 'Kambah Pool ACT 26/11/98 C. Watts' SAMA.

Description (number of specimens examined, 11) Fig. 23

Length 2.3 – 3.5mm. Broadly elongate, widest just behind middle of elytra. Head black with greenish iridescence; pronotum dark testaceous with lighter front edge; elytra steely grey to dark testaceous with small darker spots, spots near suture approximately same size, spot over plica tending to be stronger; ventral surface testaceous to black, legs testaceous, apex of tarsi darker. Head sparsely granulate/punctate, epicranial suture weak. Pronotum with quite dense, strong deep punctures, smaller and more rugose at sides, surface uneven, front edge thickened, raised, forming a weak hood over neck of head. Elytra with relatively strong punctures, separated within striae by same width or less than interstriae, interstriae two and four weakly to moderately raised, more strongly near base and again near middle, interstria eight moderately raised in front of plica and incorporating plica. Pronotal epipleuron moderately delineated, about two to three punctures deep, often fluted. Front of mesosternum in middle with two narrow longitudinal carinae, area between them quite deep, pseudoepipleuron weak to moderate, elytral epipleuron absent behind, very narrow in middle widening to about same size as pseudoepipleuron in front third. Profemur elongate, basal pubescence weak, reduced to narrow band ventrally. Mesofemur spindle shaped, narrowing toward base to between one third and one half its greatest width; basal pubescence moderate, reaching a little beyond end of trochanter. Metafemur somewhat thicker and less spindle shaped than mesofemur.

Male: Basal piece of aedeagus broad, narrowing a bit towards base, 1.6 – 1.7 times length of apical piece. Parameres bulbous at base, narrow and paddle-shaped in apical half. Central lobe broad, much shorter than parameres, leaving gap in front of it between the parameres (Fig. 23).

Distribution

Australian Capital Territory

Kambah Pool, SAMA.

Queensland

2 km N Mt Molloy, SAMA; 24 km W Paluma, ANIC; Peach Creek, SAMA.

Remarks

A seemingly rare species relatively close to *H. burdekinensis*. It differs from this species by the more uneven, almost foveate, pronotum and the greater tendency for the elytral interstriae to be raised. The raised, thickened front edge of the pronotum in *H. cucullatus* is distinctive, as is the male genitalia with wide basal piece, short central lobe and paddle-shaped tips to the parameres. The aedeagus most closely resemble that of *H. interioris* but in that species the parameres are shorter and the central lobe comparatively longer. Otherwise *H. interioris* is uniformly iridescent on the dorsal surface, has dark legs, lacks forms with testaceous ventral surface, often has the pronotum with foveae and lacks the raised front margin of the pronotum.

The testaceous ventral surface, raised interstriae, raised front margin of pronotum and aedeagus will separate it from the other species with wholly testaceous legs.

Biology

The few known specimens have been taken at the edge of sandy rivers or in sandy areas at the edge of ponds.

Etymology

Latin. 'Hooded' – in reference to the raised hood-like front edge of the prothorax.

Hydrochus decorus sp. nov.

Types

Holotype: male, 'Qld Greenvale 70 km SW at light 14–24 Mar. 1995 A. J. Watts', SAMA.

Paratypes: 28, same data as holotype, SAMA; 11, same data as holotype except 12–21 Apr., SAMA.

Description (number of specimens examined, 72) Fig. 16

Length 2.3 – 3.4mm. Relatively broad, elytra widening behind middle, rapidly narrowing to apex. Dorsal surface shiny, usually with strong greenish golden reflections; elytra typically with three to four darker spots near suture, one on shoulder and one on plica, anterior sutural spot usually largest. Ventral surface brown to dark brown, legs light to moderately testaceous, parts of tarsi, knees and parts of femora darker. Setae absent from dorsal surface, or virtually so. Head strongly granulate/punctate, epicranial suture weakly to moderately developed. Pronotum dorsally granulate/punctate, foveae weakly developed. Elytra with moderate, rather evenly sized punctures, interstriae granulate to varying degrees, alternate interstriae weakly to moderately developed, plica incorporated into interstria eight. Pronotal epipleuron moderately well marked, one to two puncture widths wide. Elytral epipleuron broad to very broad, narrowing rapidly in apical fifth, lacking pseudoepipleuron. Front of mesosternum in middle with two weakly raised longitudinal carinae, area between them with vague raised portions in a rough cross shape. Profemur stout, rapidly narrowing to base, basal pubescence weak, virtually lacking ventrally. Mesofemur extremely spindle-shaped with narrow basal portion about one third of greatest width, basal pubescence weak, in very narrow band along junction with trochanter ventrally. Metafemur elongate, narrowing basally to about half greatest width.

Male: Basal piece of aedeagus long, parallel sided or narrowing at base, sometimes weakly twisted, 1.5 – 1.7 times length of apical piece. Apical piece narrow at base, widening to middle then narrowing to sharp point. Central lobe moderately broad, a little shorter than parameres (Fig.16).

Distribution

Northern Territory

5 km SE Mt Borradaile Station, SAMA; Morianty Creek, SAMA; Palm Creek, NTM; Roderick Creek, Gregory N P, NTM.

Queensland

Burdekin River near Charters Towers, SAMA; Bushland Beach, 20 km N Townsville, SAMA; Dalrymple, 30 km N Charters Towers, NHMW; Einasleigh River, DPIM; 70 km S Greenvale, SAMA; Laura, SAMA; Mitchell River, DPIM; Mt Mulligan, DPIM; 16°28S 144°46E, ANIC.

Western Australia

Fitzroy River, ANIC; 12 km S Kalumburu, ANIC; 4 km W King Cascade, ANIC; 6.5 km N Mt Bell, WAM; 3 ml E Pago Mission, FIELD; Synnot Creek, ANIC.

Remarks

Hydrochus decorus is close to *H. eurypleuron* but the majority of specimens of *H. decorus* can be separated from *H. eurypleuron* by their broader shape, bright green/golden colour and darker spots on elytra. The aedeagus of *H. decorus* is unusual in having the base of the parameres narrower than the middle, otherwise there is little difference between the two species. In occasional specimens the colour is generally duller and the elytral spots indistinct. These can be difficult to distinguish from *H. eurypleuron* except by the aedeagi. The occasional specimen of *H. interioris* can be mistaken for *H. decorus* (or *H. eurypleuron*) but these have a more extensive development of the pseudoepipleura, are generally narrower and lack or virtually lack granulation on the pronotum and elytra.

Biology

I have collected this species from sandy areas at the side of moderate to large rivers in similar habitat to *H. burdekinensis* and *H. lateviridis.* Taken at light.

Etymology

Latin. 'splendid' – in reference to the bright green jewel-like qualities of some specimens.

Hydrochus eurypleuron sp. nov.

Types

Holotype: male, 'Qld. Greenvale 70 km SW at light 12–21 Apr 1995 A. J. Watts', SAMA.

Paratypes: 11, same data as holotype, SAMA; 12, same data as holotype except 14–24 Mar, SAMA.

Description (number of specimens examined, 50) Figs 8,17

Length 1.8 – 2.7mm. Moderately elongate, elytra widened behind middle, rapidly narrowing to apex, weakly to quite strongly serrate laterally. Dorsal surface dark brown to black; ventral surface dark brown to black; legs light to moderately testaceous, parts of tarsi and femora often darker. Head strongly granulate, pronotum densely and strongly granulate/punctate, foveae indistinct, shallow. Epicranial suture weakly to moderately impressed. Elytral punctures moderate, even sized over most of elytra, interstriae weakly to strongly granulate, alternate interstriae moderately raised, particularly towards apex and interstria eight, plica incorporated into interstria eight. Front of head and apex of elytra with weak-moderate setae. Pronotal epipleuron moderate, very poorly differentiated from top of pronotum. Pseudoepipleuron absent or weakly developed at apex only, elytral epipleuron wide, narrowing rapidly towards extreme apex. Front of mesosternum in the middle relatively smooth but with two short longitudinal carinae just traceable. Profemur stout but rapidly narrowing basally to less than half its greatest width, basal pubescence weak, reduced to a narrow band ventrally. Mesofemur elongate, becoming very narrow basally, basal pubescence weak stretching in a narrow band along junction with trochanter ventrally. Metafemur elongate, narrowing towards base to about half greatest width.

Male: Basal piece of aedeagus weakly twisted, narrowing near base, 1.5 – 1.7 times length of apical piece. Apical piece narrow, bullet shaped or weakly constricted towards apex. Central lobe narrow, nearly as long as parameres (Fig. 17).

Distribution

Northern Territory

Barramundi Gorge, Kakadu NP, CLH, NHMW; 8 km ESE Cape Crawford, ANIC; Edith Falls near Katherine, CAL; Katherine Gorge, DPIM; Kongarra, ANIC; 8 km ENE Victoria River Downs, ANIC.

Queensland

Boggy Creek near Cooktown, ANIC; Burdekin River, SAMA; 20 km NW Charters Towers, NHMW; Einasleigh River, DPIM; 70 km S Greenvale, SAMA; Iron Range, ANIC; Laura, DPIM; 21 km E Mareeba, DPIM; 23 km N Mareeba, DPIM; Palm Creek, DPIM; 5 km SE Mt Borradaile Station, SAMA; Reid River near Mingela, SAMA; 15 km NNW South Johnstone, DPIM; Tolga, DPIM.

Western Australia

Carson Escarpment, ANIC; Fitzroy River, ANIC; 14 km S by W Kalumburu Mission, ANIC; King Edward River, ANIC; Millstream, ANIC; 3 km NW Millstream, ANIC; 1 km NNE Millstream, ANIC; Mining camp Mitchell Plateau, ANIC; 4 km S by W Mining camp Mitchell Plateau, ANIC; Synnot Creek, ANIC; Wittenoom Gorge, CAL.

Remarks

Most readily separated from the closely related *H. decorus* by its duller dorsal colour and lack of elytral spots. In an occasional specimen, mostly from the Kimberley, vague dark spots can be seen in certain lights. In general it is a narrow species and does not reach the broad form with strongly serrated elytral edges quite frequent in *H. decorus*. Some specimens of *H. interioris* could be confused with this species due to their comparatively well developed elytral epipleura and weak pseudoepipleura. Apart from the presence of the pseudoepipleura, these lack, or virtually lack, granules on the pronotum and elytra and usually have quite well marked spots on the elytra.

Biology

The little habitat information available suggests that this species lives at the edge of small to moderate-sized sandy rivers. Taken at light.

Etymology

Greek. 'wide ribbed'– in reference to the very broad epipleura in this species.

Hydrochus interioris Blackburn

Hydrochus interioris Blackburn, 1896

Types

Lectotype: 'Ellery Cr' 'Cent-Aust Coll Horn Pres 7–97' 'Hydrochus interioris Blackb.', with more recent red labels 'Type' 'Syntype T-13206 Hydrochus interioris Blackburn, 1896', NMV. Herein designated.

Paralectotypes: 1 'Paisley Bluff Cent. Aust. Horn Exp.' 'Hydrochus interioris Blk del by Blkb' 'F.E. Wilson Collection' with more recent blue labels '2296 Cotype' 'Paratype T-2296 Hydrochus interioris Blackb', NMV; 1, '5489 Paisly, Bl' 'Hydrochus Horni Bl Co-t' 'Id by A.M. Lea Griffith Collection' 'Really is interioris Bl made a mistake in labelling co-types', SAMA; 1, '5489 Paisly Bl' 'Hydrochus Horni Blackb Co-type', SAMA; 1, '5489 Paisly Bl' 'Horni, Blackb' 'this is interioris, Bl', SAMA. Herein designated. I agree with Lea's comments on the SAMA specimens. See also Lea (1926). In NMV there are additional specimens obviously collected and labelled at the same time as the ones later labelled as cotypes. I am unaware why some have been labelled as cotypes and others not. The SAMA cotypes where labelled as such by Blackburn albeit incorrectly.

Description (number of specimens examined, 261) Figs 5, 20–22

Length 2.1 – 3.3mm. Narrowly to moderately elongate, elytra widened slightly to considerably behind middle, narrowing quite rapidly to apex. Head black/silvery/golden; pronotum black often with bright silver reflections; elytra dark brown-black, often with bright silver or occasionally golden reflections, black spots visible to varying degrees dependent on background colour; ventral surface dark brown; legs testaceous, parts of tarsi and femora darker. Head granulate/punctate, epicranial suture weakly to moderately impressed. Pronotum rugose/punctate to granulate. Elytra with moderate punctures, distance between them within striae same as distance between striae, granules absent to strong, apical punctures often well marked; elytral interstriae not or only slightly raised. Setae on head and apex of elytra weakly to moderately developed. Pronotal epipleuron moderately developed, two to three punctures deep, fluted. Pseudoepipleuron moderately to well developed, elytral epipleuron absent behind, increasing in front to about equal width of pseudoepipleuron. Front of mesosternum in middle with two longitudinal carinae, area between them deeper in front than behind. Profemur quite stout, narrowing to about half its greatest width basally, basal pubescence weak reduced to a narrow band ventrally. Mesofemur elongate, spindle-shaped, reduced to about half its greatest width in basal third, basal pubescence weak, reduced to narrow band ventrally, usually less than a quarter of its basal width. Metafemur elongate, bowed on front edge, reduced to almost half its greatest width near base.

Male: Basal piece of aedeagus straight sided, 1.5 – 2.6 times apical piece. Apical piece varying from elongate triangular to bullet-shaped. Parameres narrowly to moderately broad apically. Central lobe rather narrow to moderately wide, shorter than parameres, tip rounded, occasionally with a hint of a twist at tip (Figs 20–22).

Distribution

Northern Territory

32 km W Alice Springs, ANIC; Barramundi Creek, Kakadu NP, SAMA; Barramundi Gorge, Kakadu NP, NHMW, CLH; 22 km WSW Borroloola, ANIC; 80 km SW Borroloola, ANIC; 8 km ESE Cape Crawford, ANIC; 14 km NW Cape Crawford, ANIC; Cooper Creek near Mt Borradaile, SAMA; Ellery Gorge, ANIC, SAMA, NMV; 11 km E Jabiru, SAMA; 20 km SSW Jabiru, SAMA; Jim Jim Highway, Kakadu NP, NHWM, CLH; Jim Jim Falls, Kakadu NP, NHWM, 1 km W Gubara, Kakadu NP, SAMA; Gungurul Lookout, Kakadu, NHWM; Howard Springs, ANIC, SAMA; Kongarra, ANIC, NTM; Litchfield NP, ANIC; 1 km NNW Mudginbarry Homestead ANIC; 19 km E by S Mt Borradaile, ANIC, NTM; 6 km SE Mt Borradaile, SAMA; 19 km WSW Mt Cahill, ANIC; 8 km E Mt Cahill, ANIC; Nabarlek Dam, ANIC; 46 km WSW Mt Cahill, ANIC; 15 km E Mt Cahill, NTM; Nawurlandja, Kakadu NP, SAMA; 18 km E by N Oenpelli, ANIC; Orminston Gorge, SAMA; Paisley Bluff, NMV; Pine Creek, NTM; Roderick Creek, NTM; Simpsons Gap, SAMA; UDP Falls, Kakadu NP, NTM; Vaughan Springs, SAMA.

Queensland

20 km S Bloomfield, SAMA; Burdekin River, SAMA; Burdekin River E of Charters Towers, SAMA; 30 ml N Cooktown, UQIC; Coen, SAMA; 24 ml SE Einasleigh, CAL; 70 km SW Greenvale, SAMA; Iron Range, UQIC; McLeod River near Cooktown, SAMA; McIlwraith Ranges Weather Station, SAMA

Western Australia

Drysdale River, ANIC; 12 km S Kalumburu Mission, ANIC; 14 km S by E Kalumburu Mission, ANIC; 4 km W King Cascade, ANIC; King Edward Range, ANIC; Mining Camp Mitchell Plateau, ANIC; 4 km WSW Mining Camp Mitchell Plateau, ANIC.

Remarks

As I have interpreted it, *H. interioris* is a common, widespread and variable species across northern and central Australia. It does not appear to be present east of the Dividing Range. In the Kimberley and coastal Northern Territory most specimens are narrow, weakly granulate, often with a silvery or less frequently a golden sheen and their aedeagi are relatively broad. At the eastern edge of their range on Cape York, Queensland, they are strongly granulate and often broad, with narrower more elongate aedeagi, and darker although when wet the typical dark spots and silvery patches are usually clear. The type population in central Australia tends to be intermediate.

Hydrochus interioris can most easily be separated from related species by its dark legs, uneven surface to the pronotum, narrow mesofemur but only moderately narrowed metafemur, weak basal pubescence on mesofemur, the frequent presence of moderate apical punctures, often silvery elytra with simple but often masked pattern of dark spots and, particularly in Queensland specimens, very strong dorsal granules. The aedeagus is unusual in having the basal half of the parameres often swollen ventrally rather than the more usual dorsally.

It can be confused with *H. macroaquilonius* (see under that species) and *H. eurypleuron* which is superficially similar but has much broader elytral epipleura, and *H. aenigmatis*, a more southerly species, with broader mesofemora with stronger basal pubescence, elytra and pronotum not granulate and with a very broad short central lobe to the aedeagus. Small specimens are difficult to distinguish from *H. atratus* (see under that species).

Biology

This common and widespread species is found in bare sandy areas beside creeks and rivers or the pools left in drying river beds. Taken at light.

Hydrochus lateviridis Blackburn

Hydrochus lateviridis Blackburn, 1896

Type

Holotype: male 'Ellery ck' 'Cent. Aust. Coll. Horn Exp. Pres. 8.98' 'Hydrochus lateviridis Blackb' with more recent red labels 'Type' 'Holotype T-13211 Hydrochus lateviridis Blackburn, 1896', NMV.

Description (number of specimens examined, 290) Figs 9, 10, 25–27

Length 1.6 – 2.5mm. Broadly elongate, pronotum narrowed quite strongly behind, elytra quite strongly widened behind middle, rapidly narrowing to tip. Head black to golden, iridescent; pronotum dark brown to golden iridescent, front and rear margins occasionally narrowly testaceous; elytra dark brown, or steely grey, or silvery/golden, elytral dark spots often well marked, often extensive (Figs 9,10); ventral surface dark brown to black, legs yellow or light testaceous, usually lacking darker areas on knees or femora. Head granulate/punctate, epicranial suture weakly impressed. Pronotum rather evenly and smoothly covered in small to moderately sized punctures, moderately rugose. Elytra with small to medium sized punctures, distance between punctures often less than the width of interstriae, interstriae not or only very weakly raised; plica distinct; apical punctures small, may be weakly granulate. Setae on head and elytra virtually absent. Pronotal epipleuron well marked, two to three puncture widths deep, smooth with some large punctures. Elytral pseudoepipleura weak to moderate, epipleura absent behind, widening to about same width or a bit more than pseudoepipleura in front third. Front of mesosternum in centre with two longitudinal carinae, area between them shallow behind. Profemur elongate, narrowing toward base; basally pubescence weak, reduced to narrow band ventrally. Mesofemur strongly spindle-shaped, reducing to half or less its maximum width basally, basal pubescence very weak, reduced to narrow band ventrally. Metafemur spindle-shaped, narrowing to about half its greatest width basally.

Male: Basal piece of aedeagus straight sided to moderately twisted, 1.5 – 2.6 times length of apical piece. Apical piece bullet-shaped to elongate, occasionally twisted, base narrower than basal piece. Central lobe varying from relatively thin and parallel sided to quite strongly expanded apically, in both cases with a very thin apical piece which almost reaches tip, often bulging above parameres apically. The thin apical piece of the central lobe may be displaced laterally in strongly twisted or elongate forms (Figs 25–27).

Distribution

Northern Territory

Adelaide River, ANIC; Barramundi Creek, Kakadu NP, SAMA; Deaf Adder Gorge, Kakadu NP, NTM; 14 km NW Cape Crawford, ANIC; Cooper Creek near Mt Borradaile, SAMA; Edith Falls near Katherine, CAL; Ellery Gorge, ANIC; Gubara, Kakadu NP, NHMW, CLH; 20 km SSW Jabiru, SAMA; Kongarra, NTM; 19 km E by S Mt Borradaile, NTM, ANIC; 6 km SE Mt Borradaile, SAMA; 6 km E Mt Cahill, ANIC; 8 km E Mt Cahill, ANIC; 19 km WSW Mt Cahill, ANIC; 5 km SE Mt Borradaile Station, SAMA; 2 km N Mudginbarry Homestead, ANIC; 9 km SSE Mudginbarry Homestead, ANIC; 11 km S by W Nimbuwah Rock, ANIC, NTM; Nawurlandja, Kakadu NP, SAMA; 6 km SW by S Oenpelli, ANIC; Roderick Creek, NTM; Simpsons Gap, SAMA; South Johnstone River, Kakadu NP, SAMA; UDP Falls, Kakadu NP, NTM; Woolwonga Fauna Reserve, ANIC; 16.07S 130.25E, NTM.

Queensland

Borumba Dam, NHMW; Burdekin River, SAMA; Burdekin River E of Charters Towers, SAMA; 35 ml SE Burketown, UQIC; Cape Tribulation, DPIM; Dalrymple, NHMW; Funnel Creek, ANIC; 70 km SW Greenvale, SAMA; Hann River, NMV; Laura, DPIM; 73 km NW Laura, ANIC; 66 km NW Mt Isa, ANIC; 3 km ENE Mt Tozer, ANIC; Normanton, ANIC; 11 km NSW Petford, DPIM; 15 km WNW South Johnstone, DPIM; Windsor Table Land, DPIM.

Western Australia

Abydos, FIELD; Cadjeput Rockhole, WAM; 17 km N by E Cane River Homestead, ANIC; Drysdale River, ANIC; 12 km S Kalumburu Mission, ANIC; 3 km NW by W Millstream, ANIC; 4 km S by W Mining Camp Mitchell Plateau, (14°52S 125°50E), ANIC; 5.5 km NW Mt Bell, WAM; West Peawah River, ANIC; Winjana Gorge, CAL.; 13 km ESE Wittenoom, ANIC; Synnot Creek, ANIC.

Remarks

Typical *H. lateviridis* have a large triangular dark patch just before the middle of the elytra which separates them from all other Australian *Hydrochus* (Figs 9,10). However this patch can be obscured in dark specimens and, particularly in Arnhem Land, can be reduced to a small area no larger than other patches on the elytra which then resembles the pattern in other species such as *H. burdekinensis*. Dark specimens of *H. lateviridis* can be confused with *H. atratus*, particularly the occasional specimen of *H. atratus* with yellow legs, but can be separated by their wider elytral epipleura, more spindle-shaped mesofemora, and better defined pronotal epipleura. All these characters are subjective and can only really be appreciated when directly comparing specimens. The genitalia can be very similar but in *H. atratus* (Fig.19) the apical piece is more triangular and with a narrower central lobe than in *H. lateviridis*. In some *H. atratus* (if the specimens from Kunmunya are included in that species) (Figs 25–27) the apical piece is very like the short narrow form of *H. lateviridis* (Fig. 26) but is more waisted and the central lobe not bulbous as in typical *H. lateviridis*.

Darker specimens of *H. burdekinensis*, and *H. lateviridis* with poorly developed colour patterns, resemble each other. In most cases the more spindle-shaped mesofemora of *H. lateviridis* will separate them. Their aedeagi are relatively similar and the large degree of variation makes it difficult to reliably separate them on this character alone.

There are four rather distinctive forms of the aedeagus within the species as I interpret it.

The first form has a squat, bullet-shaped apical piece with a broad, bulbous central lobe with a weak, hard to see, apical spine (Fig. 25). It appears to be a more inland form and is the only one present in the type locality in Central Australia.

The second form has a short, thin apical piece with a narrow almost parallel sided central lobe (Fig. 26). It is more coastal in distribution.

The third form is similar to the second but has the apical piece strongly skewed, and the thin portion at the tip of the central lobe can appear twisted out of position. The few specimens known are from the Hann River/Iron Range area of Cape York.

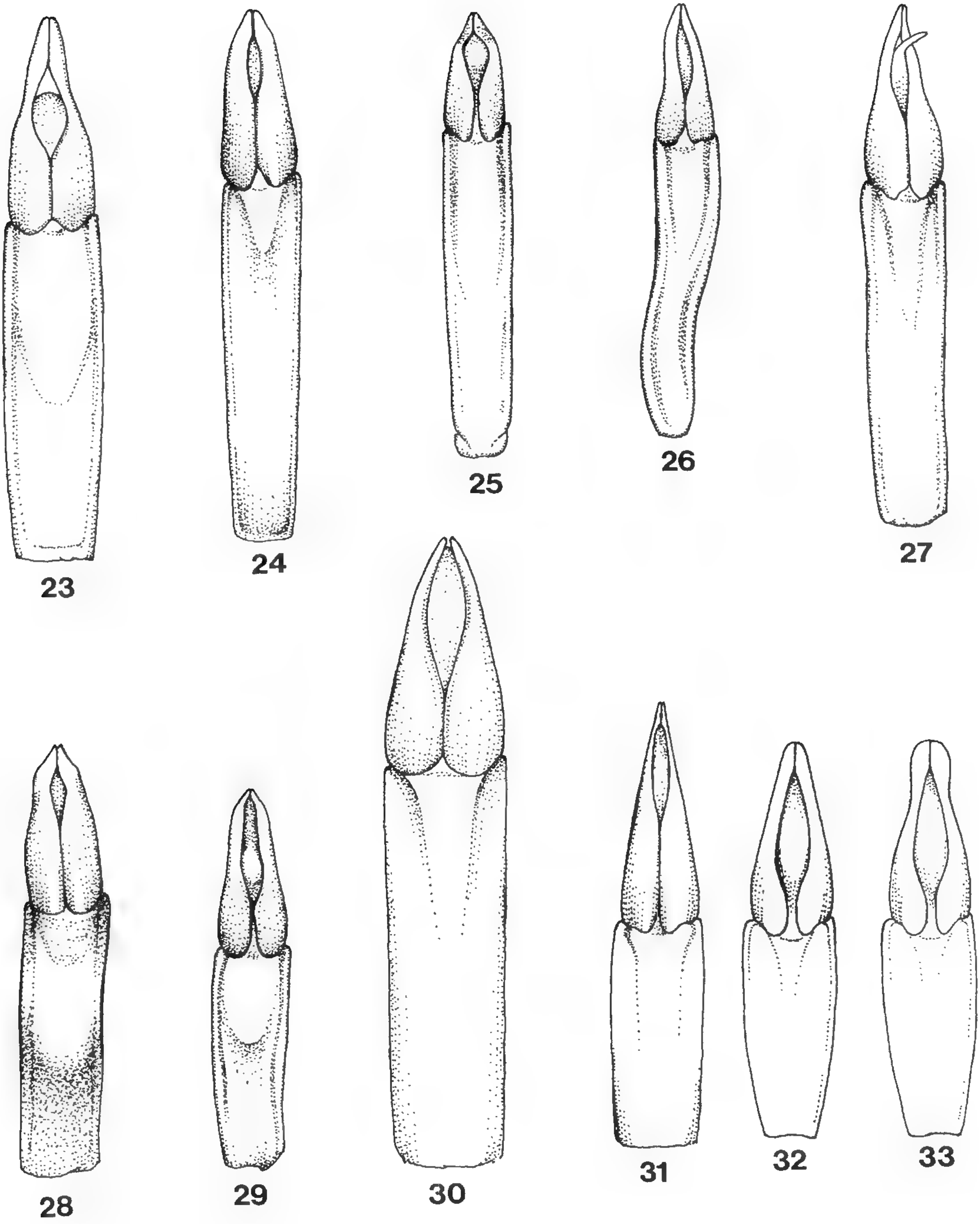
The fourth form has a longer more elongate apical piece with a correspondingly long thin central lobe, the terminal piece of which is bent at right angles in the four known specimens, presumably a post-mortem effect (Fig. 27). The specimens are from Cooktown, Hann River, Wenlock River and Archer River all on Cape York.

The first two forms are relatively common and widespread, occurring together in the same population at several locations (e.g. Greenvale and Kakadu). Although most specimens are clearly one or the other form enough intermediates exist for me to hesitate to consider them separate species.

Forms three and four are known from only a few specimens from a relatively restricted area of Cape York and are the only representatives of the species in the region so far collected. A few specimens from further south show a tendency to have a skewed apical piece to their aedeagi. Many more examples of *H. lateviridis* from Cape York will need to be examined before a better interpretation of these forms can be made.

Biology

Found in sand and gravel at the edges of rivers or in sandy pools in the beds of drying rivers. Taken at light.



FIGURES 23–33. **23**, *H. cucullatus;* **24**, *H. burdekinensis;* **25–27**, forms of *H. lateviridis;* **28**, *H. simplicicollis;* **29**, *H. obsoletus;* **30**, *H. numerosepunctatus;* **31–33**, forms of *H. obscuroaeneus.*

Hydrochus macroaquilonius sp.nov.

Types

Holotype: male, 'NT Magela ck Kakadu NP 19.3.98 C.H.S. Watts', SAMA.

Paratypes: 5, same data as holotype, SAMA; 2, '12°57S 132°33E Jim Jim Creek, N.T. 19 km WSW of Mt Cahill 24.x.72, E.B. Britton', ANIC; 2, '12°40S 132°54E Magela Creek, N.T. 9 km SSE of Mudginbarry HS, 6.xi, 72, at light, E. Britton', ANIC.

Description (number of specimens examined, 47) Fig. 15

Length 3.2 – 4.1mm. Elongate, elytra widest slightly behind middle, narrowing quite rapidly to apex which is moderately truncate. Head dark brown-black with metallic sheen; pronotum dark brown/steely grey; elytra dark brown/steely grey/ golden with dark spots which are masked in darker forms; ventral surface dark brown-black, legs testaceous, knees and base of femora often darker. Head quite densely but smoothly granulate/punctate, epicranial suture weak. Pronotum rugose/punctate, punctures relatively small and dense, foveae weak. Elytral punctures moderate, separated within striae by about width of interstriae, interstriae four and eight often weakly raised, plica present. Head and elytra virtually without setae. Pronotal epipleuron ill defined, one to two puncture widths wide, may be weakly fluted. Elytral pseudoepipleuron moderate, epipleuron absent apically, increasing towards middle and front where it reaches about same width as pseudoepipleuron. Front of mesosternum in middle with two longitudinal carinae, area between them often shallow. Profemur elongate, basal pubescence weak, reduced to narrow band ventrally. Mesofemur elongate, spindle shaped, towards base less than half its greatest width, basal pubescence moderate, reaching to about quarter width of femur beyond trochanter on rear edge. Metafemur elongate, weakly bowed on front edge.

Male: Basal piece of aedeagus parallel sided, 2.0 – 2.1 times length of apical portion. Apical piece elongate, narrow. Central lobe narrow, almost as long as parameres (Fig. 15).

Distribution

Northern Territory

Barramundi Creek, Kakadu NP, CLH, NHMW; Gungural Lookout, Kakadu NP, NHMW; 20 km SSW Jabiru, SAMA; Jim Jim Creek, Kakadu NP, ANIC; Magela Creek, Kakadu NP, SAMA; 30 km WSW Mt Cahill, ANIC; 8 km E Mt Cahill, ANIC; 9 km SSE Mudginbarry Homestead, Kakadu NP, ANIC; South Johnstone River, Old Jim Jim Road Crossing, Kakadu NP, SAMA.

Queensland

3 km W by S Black Mountain, ANIC; 20 km S Bloomfield, SAMA; Captain Billy Creek, SAMA; Coen, UQIC; Helenvale, SAMA; 7 km N of Hope Vale Mission, ANIC; Iron Range, DPIM; 73 km NW by W Laura, ANIC; Palm Creek, DPIM; Peach Creek, SAMA; McIlwraith Ranges Weather Station, SAMA; 9 km ENE Mt Tozer, ANIC; 11 km ENE Mt Tozer, ANIC; 3 km ENE Mt Tozer, ANIC; 1 km N Rounded Hill, ANIC; 5 km W by N Rounded Hill, ANIC.

Western Australia

8 km SW by W Cane River Homestead, ANIC; Gascoyne River, SAMA; 23 ml N Mundiwindi, WAM.

Remarks

One of the largest Australian *Hydrochus, H. macroaquilonius* is close to *H. interioris*. It differs in its larger size, lack of granules, somewhat more extensive basal pubescence on the mesofemur with the pubescence reaching beyond the hind edge of the trochanter even in the middle of the femur. In *H. interioris* it is seldom as well developed. The aedeagus resembles that seen in some of the highly granulate eastern specimens of *H. interioris* but has the central lobe a bit broader and longer than most of these. The epipleura also tend to be broader than in the majority of *H. interioris*. Most specimens have the legs with a much lesser extent of dark colour than in *H. interioris* and in a few specimens the legs are uniformly testaceous. The bright golden dorsal surface seems a rarity in this species, most specimens being a rather dull grey with the spots only vaguely visible. In general appearance it resembles *H. imamkhani* another large species with elytral spots, and sympatric with it. The structure of the front of the mesosternum will readily separate these two species.

Biology

Found among sand and gravel at the edges of rivers and small creeks. Taken at light.

Etymology

Latin. 'Large', 'northern' – a reference to its size and locality.

Hydrochus obsoletus Lea

Hydrochus obsoletus Lea, 1926

Type

Holotype: female 'obsoletus Lea TYPE Albury', SAMA

Description (number of specimens examined, 170) Fig. 29

Length 2.0 – 3.4mm. Broadly elongate, widest just behind middle of elytra. Head black or golden, weakly iridescent; pronotum testaceous to dark testaceous with green tinges, front and/or rear margins sometimes narrowly testaceous, or golden, or all black; elytra light testaceous with vague similar sized darker spots, or shiny silver grey with darker spots, or shiny golden with dark spots, or shiny black; ventral surface black, legs light testaceous with tips of tarsi, and occasionally base of femora diffusely darker. Head smooth, sparsely covered with small moderate punctures, frons area often granulate, epicranial suture weak. Pronotum smooth, rather sparsely covered with moderate punctures to rugose and closely punctured. Elytra with small to moderate punctures, separated within striae by the width or less of the adjacent interstriae, sometimes weakly granulated at sides and rear; interstriae not or only weakly raised – if so then interstria four is most prominent; plica weak to moderate. Dorsal setae absent. Pronotal epipleuron well marked, shiny, two to three puncture widths deep. Front of mesosternum in middle with two longitudinal carinae, area between them shallower behind. Pseudoepipleuron relatively broad, epipleuron absent behind, narrow in middle, widening to a bit less than width of pseudoepipleuron in front third. Profemur quite stout; basal pubescence weak, reduced to a narrow band ventrally. Mesofemur relatively stout for group 2 species, narrowing to about two thirds its greatest width basally, basal pubescence weak to moderate, reduced to narrow band about a quarter width of base of femur or less, ventrally. Metafemur a bit larger but similar in shape to mesofemur.

Male: Basal piece of aedeagus narrowing weakly toward base, 1.5 – 2.0 times length of apical piece. Apical piece narrowly bullet-shaped to triangular with suggestion of subapical constriction. Central lobe relatively narrow, weakly bulbous in its central portion, a bit shorter than parameres (Fig. 29).

Distribution

Australian Capital Territory

Black Mountain, ANIC; Canberra, SAMA; 30 km SW Canberra, SAMA; Kambah Pool, ANIC, SAMA.

New South Wales

Armadale, SAMA; Bombala, SAMA; Boonoo Boonoo River, UQIC; Cabbage Tree Creek near Nelligen, SAMA; Clarence River, NMV; Cooma, SAMA; Gilgandra, SAMA; Jenolan Caves, SAMA; 6 km N Uralla, ANIC; Valery, ANIC; Quaama, SAMA.

Queensland

Bowen, SAMA; 15 km W Gympie, NMV; Kenilworth State Forest, UQIC; 10 km W Imbil, NMV.

South Australia

Cudlee Creek, SAMA; Torrens Gorge, SAMA.

Victoria

11.5 km NNW Ballan, ANIC; Benong, CAL; 3.8 km WNW Blackwood, ANIC; Deddick River, NMV; 4.5 km SW Healesville FIELD; 4 km SW Healesville, NMV; Omeo, SAMA; 30 km N Orbost, SAMA; Stratford, SAMA.; Tambo Crossing, Jordan River, NMV.

Remarks

A southern species readily recognised from other southern species by its yellow spindly legs and coloured and spotted elytra. It resembles *H. burdekinensis* in general shape and colour but can be separated from this species by its similarly shaped meso and meta femora unlike *H. burdekinensis* which has the mesofemora more spindle-shaped. Although some *H. obsoletus* and some *H. burdekinensis* have identical dorsal colouring, apart from one specimen of *H. obsoletus* from Gilgandra, in SAMA, with a testaceous ventral surface, *H. obsoletus* always has a black, or very dark, ventral surface, whereas in most *H. burdekinensis* it is a much lighter testaceous colour. The aedeagi of both species are quite similar but in *H. obsoletus* the apical piece is comparatively longer (1.5 – 2.0 times the length of the basal piece) and the paramere tips a bit wider.

Hydrochus obsoletus closely resembles *H. simplicicollis* and can only be reliably separated by its aedeagus which has a relatively shorter apical piece compared to *H. simplicicollis* (Figs 28, 29). Future study, particularly of specimens from coastal Queensland, may well show these two species to be conspecific.

Biology

All specimens of this species that I have collected have been taken from among gravel at the edge of relatively large streams/rivers.

Hydrochus simplicicollis Lea

Hydrochus simplicicollis Lea, 1926

= *Hydrochus verae* Makhan, 1995; syn. nov.

Types

Hydrochus simplicicollis Lea. *Lectotype*: 'simplicicollis Lea TYPE Cairns' left hand specimen of two on same card with 'TY' below, SAMA. Herein designated.

Paralectotypes: 1, same data as holotype, SAMA; 1, 'Vicinity of Jenolan Caves (J.C. Wiburd)' 'Co-type' 'Griffith Collection Id. by A.M. Lea', SAMA. Herein designated. This specimen is labelled as a co-type but not by Lea. In the original description it is mentioned by Lea as 'probably belongs to the species'. Its paralectotype status is doubtful. This specimen belongs to *H. obsoletus*.

Hydrochus verae Makhan. *Holotype*: 'Australien QL (10,11) Dalrymple 300 m, 30 km N. Charters Towers 18.1.1993 leg Wewalka' 'Hydrochus verae det. D. Makhan 1994' with red Holotype label, NHMW.

Paratypes: 7, same data as holotype with yellow paratype labels, NHMW. (The paratype series includes three species; four are conspecific with the holotype, two are *H. lateviridis* and one is *H. atratus*).

Description (number of dissected males examined, 14) Fig. 28

Length 2.0 – 2.4mm. Broadly oval, widest just behind middle of elytra. Head black, often with greenish tinges; pronotum shiny dark brown, front and rear edges often narrowly testaceous; elytra light to dark testaceous, sometimes with vague darker spots approximately equal in size, or grey/black, or black; ventral surface dark brown to black, legs light testaceous, apical portion of tarsi maybe darker. Head smooth with sparse moderate punctures, occasionally with squat granules, epicranial suture weak. Pronotum smooth to rugose, punctures moderate sized, usually rather sparse. Elytra with small, moderate sized punctures, punctures separated by less than the width of interstriae in all but a few cases; interstriae not, or only very weakly raised; plica weakly distinct. Dorsal surface without setae. Pronotal epipleuron well differentiated, shiny, about three puncture widths deep. Pseudoepipleuron of elytra moderate, epipleuron absent behind, narrow in middle, increasing to about same width as pseudoepipleuron in anterior third. Front of mesosternum in middle with two longitudinal carinae, area between them shallower behind. Profemur relatively stout; basal pubescence moderate, reduced to a band about a quarter the width of the femur at that point or less ventrally. Mesofemur moderately spindle-shaped, narrowing basally to between a third to a half its greatest width; basal pubescence weak to moderate, reduced to a narrow band about a quarter of the width of the femur or less ventrally. Metafemur a little larger but approximately the same shape as mesofemur.

Male: Basal piece of aedeagus wide, narrowing a bit towards base, 1.0 – 1.4 times length of apical piece. Apical piece elongate, narrow. Central lobe rather narrow, weakly bulbous in its central portion, as long as parameres (Fig. 28).

Distribution

Queensland

Cairns, SAMA; Dalrymple, 30 km N Charters Towers, NHMW; 70 km SW Greenvale, SAMA; 15 km WNW South Johnstone, DPIM; Windsor Tableland, DPIM.

Western Australia

3 ml E Pago Mission, FIELD.

Remarks

Like the related species, *H. obsoletus, H. lateviridis* and *H. burdekinensis, H. simplicicollis* has a range of dorsal colours but in all known specimens the pronotum is dark, apart from front and rear margins in some, and the ventral surface black or almost so and, when present, the elytral spots are roughly equal in size. Although most specimens have small elytral punctures and wide interstriae, in some specimens the punctures are larger with the interstriae narrow and equal in width to the area separating punctures within a stria. Compared to *H. burdekinensis* and *H. lateviridis,* the mesofemora are relatively stout and roughly similar in shape to the metafemora. On average the elytral epipleura seem a bit wider than in related species but this difference is difficult to quantify. Males have longer and narrower apical pieces to their aedeagi than those of *H. burdekinensis* (Fig. 24) or *H. lateviridis* (Figs 25–27).

The species can only be separated from the southern *H. obsoletus* by the aedeagus which, in *H. obsoletus* (Fig. 29), has the apical piece comparatively shorter and broader and the central lobe is shorter and does not reach to the ends of the parameres. It is possible that the collection of specimens from the intermediate geographic areas could show them to be conspecific.

Hydrochus verae Makhan belongs to this species, although three of the seven paratypes do not. The specimens mentioned by Lea (1926) from Jenolan NSW and Bowen Qld are *H. obsoletus*.

Biology

No habitat notes are available although the general localities suggest that it lives at the edge of sandy/gravelly rivers as do related species.

Species Group 3

Group 3 species are characterised by having: two rather than three longitudinal carinae at the front of the mesosternum; stout, almost cylindrical legs, with the basal pubescence on the profemora interrupted ventrally or reduced to a very narrow band (Fig.3). Other character states that tend to define the group are: elytral interstriae, particularly the alternative ones, usually raised and the plica absorbed into interstria eight; pronotal foveae weakly to moderately developed and their edges often glabrous; pronotal epipleura moderately wide but ill-defined; head with a deep epicranial suture; dorsal setae often strong; basal pubescence on the mesofemora seldom reaches beyond the apex of the trochanter (Fig. 3).

Group 3 species are generally relatively small and chunky, although *H. numerosepunctatus* is among the largest of Australian *Hydrochus*. One species, *H. obscuroaeneus*, is extremely common across Northern Australia. The species are primarily inhabitants of smaller, often intermittent, streams where they live among stones and detritus at the edges. Two species appear to be at least partially terrestrial, having been collected from wet forest litter.

Hydrochus chitraae Makhan, 1994 and *H. chitaniei* Makhan, 1994, described from New Guinea, belong in this group.

Hydrochus gitaraiae Makhan

Hydrochus gitaraiae Makhan, 1994

Types

Holotype: male, 'New Guinea Neth Mol Maffen, 22 km E of Sarmi July 18, 1959' 'm.v. light trap Maa' 'Hydrochus gitaraiae det D. Makhan 1994', BPBM.

Paratype: same data as holotype. In Hungarian National Museum, Budapest. Not seen.

Description (number of dissected males examined, 5) Fig. 34

Length 1.8 – 2.3mm. Elongate-oval. Head shiny black; pronotum shiny dark brown to black; elytra shiny black; ventral surface dark-brown to black, legs dark testaceous, parts of tarsi, knees and much of femora darker. Head with scattered large punctures, frons weakly granulate, epicranial suture well marked. Pronotum with rather sparse large punctures, with bare areas in between, foveae obsolete. Elytra with rather even sized well marked punctures not or only slightly increasing in size towards middle within striae. Alternate interstriae weakly raised towards apex, interstriae eight weakly raised, incorporating plica. Pronotal epipleuron weakly delineated, narrow, about a puncture width wide, almost completely or partially absent in some. Pseudoepipleuron narrow posteriorly moderate anteriorly, elytral epipleuron absent behind, narrow in front. Profemur stout, basal pubescence weak, absent ventrally. Mesofemur relatively stout, weakly narrowing towards base, basal pubescence reaching to about end of trochanter on posterior margin. Metafemur moderately stout. Setae on head and basal half of elytra moderate to strong, weak to moderate on pronotum. Front of mesosternum in middle with two subparallel raised carinae, area between them moderately deep.

Male: Basal piece of aedeagus broad, weakly narrowing toward base, 1.2 – 1.5 times length of apical piece. Parameres broad at base, weakly constricted a bit before tip, tip relatively broad, diagonally truncated. Central lobe moderate, nearly as long as parameres (Fig. 34).

Distribution

Northern Territory

Muirella Park, Kakadu NP, DPIM.

Queensland

29 km S Bamaga, ANIC, SAMA; 9 km ENE Mt Tozer, ANIC.

Remarks

This seemingly rare northern species is the smallest group 3 species yet known (<2.5mm). Apart from its small size it differs from other group 3 species by its weak or, in some cases, virtually absent, pronotal epipleura, and the wide obliquely truncated tip to the parameres (Fig. 34). Among group 3 species, it shares with *H. horni* the relatively uniformly- sized elytral punctures, strongly developed setae on the head and elytra and bare shiny areas on the pronotum. Also occurs in New Guinea.

Biology

Nothing known.

Hydrochus granicollis Lea

Hydrochus granicollis Lea, 1926.

Types

Lectotype: female 'granicollis Lea TYPE Wahroonga', SAMA. Herein designated.

Paralectotypes: 2, 'Wahroonga H.J.C.1.24' 'Co-type' 'Griffith Collection id. by A.M. Lea', SAMA. Herein designated.

Description (number of specimens examined, 22) Fig. 37

Length 2.0 – 2.6mm. Relatively broad, elytra widest behind middle. Head shiny black; pronotum and elytra shiny dark brown to black; ventral surface dark brown, legs testaceous. Head rather smoothly granulate/punctate, epicranial suture well marked. Pronotum strongly granulate/punctate, foveae weak not bounded by raised carinae. Elytra with moderate sized well impressed punctures, those in any one stria of similar size apart from extreme base and apex, adjacent punctures in different striae same size; alternate interstriae moderate to quite strongly raised, some lateral interstriae may be granulate; plica absorbed into interstria eight; apical punctures usually strong, apex rounded. Pronotal epipleuron moderate, about two puncture widths wide. Pseudoepipleuron wide, elytral epipleuron absent behind, narrow in front. Setae weakly developed on head and at base of elytra. Front of mesosternum in middle with two subparallel raised carinae, area between them moderately deep. Profemur stout, basal pubescence weak, absent or very narrow ventrally. Mesofemur relatively stout weakly narrowed towards base, basal pubescence moderately developed, reaching a little past end of trochanter on hind margin. Profemur moderately bowed on front edge.

Male: Basal piece of aedeagus parallel sided, 1.3 – 1.4 times length of apical piece. Parameres weakly bulbous in basal half, twisted open in front half to cradle central lobe, narrowing towards tip. Central lobe moderately wide, narrowing in front (Fig. 37).

Distribution

Australian Capital Territory

Black Mountain, ANIC; Cotter River, ANIC; Kambah Pool, ANIC.

New South Wales

Cabbage Tree Creek, ANIC; Hawksbury River, SAMA; Kiola Forest Park, 15 ml N Batemans Bay, ANIC.

Remarks

A southern species known only from a limited area of the South-east, *H. granicollis* resembles *H. horni* in general appearance and in its relatively even-sized elytral punctures. In general it is a chunkier species with more strongly developed dorsal sculpture but much more poorly developed setae. The apex of the elytra is rounded rather than pinched as is often the case in *H. horni* and the apical punctures are usually very large in contrast to the small to moderately sized ones in *H. horni*.

Biology

Found among stones and leaves at the edges of running water. The specimens from Kiola are labelled as coming from wet sclerophyll litter.

Hydrochus horni Blackburn

Hydrochus horni Blackburn, 1896

= *H. scabricollis* Lea, 1926; syn. nov.

Types

Hydrochus horni Blackburn. *Lectotype*: 'Type' 'T 5488 Paisl. Bl.' 'Australia Blackburn Coll BM. 1910–236' ' Hydrochus interioris Blackb.' 'Hydrochus horni Blackb. Type fide Lea TRSSA 1926– 147 Balfour Browne det', BMNH. Herein designated.

Paralectotypes: 1, 'Cent-Aust Coll Horn Exp Pres 7.97' 'Hydrochus Horni, Blackb.' with more recent red labels' 'Type' 'Syntype T-13197 Hydrochus horni Blackburn 1896', NMV. This specimen cannot be considered the holotype since the BMNH specimen was clearly marked 'T' by Blackburn; 1, 'Paisley Bluff Cent Aust Horn. Exp' 'Hydrochus horni Blk. del. by Blkb.' 'F.E.Wilson Collection' with more recent blue labels '2295 Cotype' 'Paratype T2295 Hydrochus horni Black.', NMV; 1, '5488 Paisley B.' 'Hydrochus interioris, Blackb. Co-type', SAMA; 2, '5488 Paisl Bluff' 'interioris Blackb.' 'this is horni Bl', SAMA. Herein designated. I agree with Lea (1926) that the BMNH and SAMA specimens are *H. horni* and were mislabelled by Blackburn.

Hydrochus scabricollis Lea. *Lectotype*: 'Scabricollis Lea TYPE Parachilna', SAMA. The left hand specimen above `TY` of four specimens on one card herein designated.

Paralectotypes: 3, same data as holotype, SAMA; 1, 'S. Australia' 'A.H. Elston Collection' '2625 Hydrochus scabricollis Lea Co-type S. Australia' 'Paratype', AM; 5, 'Co-Type' 'Parachilna Hale Flinders Range' 'Griffith Collection id by A.M. Lea', SAMA; 1, 'Co-Type' 'Lucindale S. Australia', SAMA.; 2, 'Lucindale S Australia' 'Hydrochus scabricollis' 'Co-type 2795' 'Lea, Co-type', QM. Herein designated.

In NMV there are additional specimens obviously collected and labelled at the same time as the specimens later labelled as co-types. I am unaware of why some have been labelled as co-types and others not. The SAMA paralectotypes were labelled co-types by Blackburn, albeit incorrectly.

Description (number of specimens examined, 193) Figs 35, 36

Length 2.0 – 3.4mm. Elongate, elytra a little wider behind middle. Head shiny black; pronotum and elytra shiny dark brown to black; ventral surface dark brown, legs dark testaceous, parts of tarsi, knees and much of femora darker. Head granulate/punctate. Pronotum granulate/punctate varying from quite strongly and evenly rugose to relatively smooth with large areas bare of sculpture, foveae weak, often bounded by flat broad smooth areas. Elytral punctures well marked, not or only slightly increasing in size beyond the first few basal punctures. Punctures in adjacent striae similar sized, lateral interstriae occasionally granulate, interstriae not or only weakly raised particularly alternate interstriae toward apex, plica absorbed into interstria eight. Setae on head moderate to strong often present on pronotum as well, much of elytra setose. Pronotal epipleuron weak to moderate, 0.5 to 1.5 puncture widths wide, often poorly delineated. Pseudoepipleuron weak to moderate, elytral epipleuron absent behind, narrow in front. Front of mesosternum in middle with two weakly diverging longitudinal carinae, area between them moderately deep in front becoming very shallow behind. Profemur stout, basal pubescence weak to absent or virtually so ventrally. Mesofemur relatively stout to moderately elongate, narrowing towards base, basal pubescence moderate reaching end of trochanter or a bit past it on hind edge.

Male: Basal piece of aedeagus parallel sided or weakly constricted in middle, 1.6 – 2.0 times length of apical piece. Apical piece ranging from strongly dolphin-headed to almost smoothly triangular. Central lobe narrow reaching almost to tip of parameres (Figs 35, 36).

Distribution

Australian Capital Territory

25 km W Canberra, ANIC.

New South Wales

8 km N Bombala, SAMA; Kittys Crossing, ANIC; Monga, ANIC; Nerrigan, SAMA; Webers Creek, SAMA.

Northern Territory

33 km WNW Alice Springs, ANIC; Ellery Creek, NMV, SAMA; Ormiston Gorge, SAMA; Paisley Bluff, NMV; Simpsons Gap, SAMA; Standley Chasm, ANIC, SAMA: Vaughan Springs, SAMA.

Queensland

8 km N Bluewater, SAMA; Mary Creek 16°33S 145°12.5E, ANIC; Pentland, ANIC.

South Australia

Alligator Gorge, SAMA; Flinders Ranges, SAMA; Lucindale, QM; Mt Gambier, SAMA; 13 km W Meadows, SAMA; 1 km S Nangwarry, SAMA; Robe, SAMA; Williamstown, ANIC, SAMA.

Tasmania

8 km S Lake Leake, ANIC

Victoria

East Pomborneit, ANIC; Nathatia, SAMA; 4 km NNE Nelson, NMV; 5 km NW Portland, SAMA; Strathbogie, NMV; Tarra Valley, NMV; 6 km ENE Terang ANIC; 12 km SW Orbost, SAMA.

Western Australia

11 km E Ashburton Downs Homestead, WAM; Gill Pinnacle, WAM; 50 ml S Giles, WAM; Millstream, ANIC; 13 km ESE Mooka Station, WAM; 20 km NE Mt Sandiman, WAM; Murchison River, ANIC.

Remarks

Hydrochus horni is the southern counterpart of *H. obscuroaeneus,* occurring relatively commonly across southern Australia including semi-arid regions such as the Pilbara, Central Australia and the Flinders Ranges as well as more coastal regions of the South-east. It is also found, rarely, in Queensland as far north as the Atherton Tableland. It can be separated from *H. obscuroaeneus* by the more usually sized elytral punctures which, beyond the basal four to five, are subequal in size until nearing the elytron apex. Its clearest distinguishing character is the bare shiny areas on the pronotum of most specimens. (These are often absent on central Australian specimens.) Among group 3 species it tends to have the most elongate mesofemora with the greatest development of the basal pubescence. Both these characters occasionally approach the condition seen in some group 4 species. The weak basal pubescence on the profemur, the generally less elongate body, and strong development of dorsal setae separate it from any species in group 4.

Hydrochus granicollis resembles *H. horni* in many respects and is also sympatric with it in south-eastern Australia. *Hydrochus granicollis* tends to be a chunkier species, with a granulate pronotum without bare areas, has the apical punctures on the elytra often much larger than in *H. horni* and a more rounded apex to the elytra which often appears pinched in *H. horni.* The aedeagus of *H. horni* resembles that of *H. obscuroaeneus* with which it is sympatric in north Queensland. The two can be separated by the relatively smaller apical piece in *H. horni* (basal piece 1.6 – 2.0 times apical piece in length, in *H. horni*; 1.0 – 1.3 times in *H. obscuroaeneus*). Within *H. horni* there is a considerable degree of variation in the shape of the apical piece, although its comparatively short nature remains. In typical *H. horni* from central Australia the apical piece is particularly short and squat generally resembling the head of a dolphin. In other locations this shape is still present but other specimens tend to have the apical piece more elongated which has the effect of obliterating the dolphin-head shape and replacing it with the more usual triangular one in extreme cases. All intermediate shapes occur.

Hydrochus gitaraiae from Cape York and Arnhem Land closely resembles *H. horni*, particularly in the typical bare shiny areas on the pronotum, but is smaller and has a broader, differently shaped apical piece to the aedeagus.

Biology

Found at the edges of small rivers, creeks and ponds among stones and detritus.

Hydrochus numerosepunctatus sp. nov.

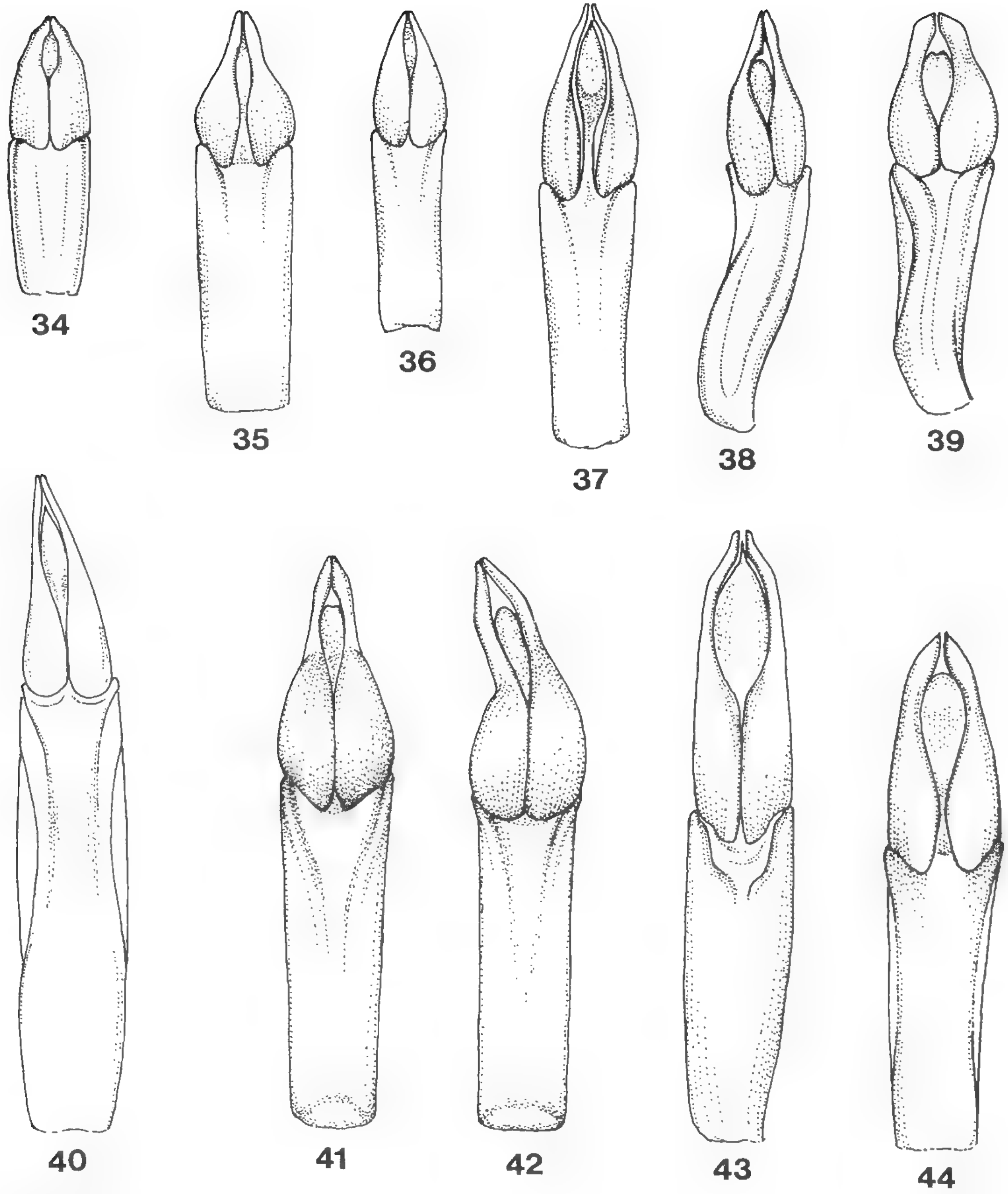
Types

Holotype: male, 'NT 1 km W Gubara Kakadu NP 17.3.98 C.H.S. Watts', SAMA.

Paratypes: 18, same data as holotype, SAMA; 10, 'AUSTRALIA: N.T. Kakadu NP Gubara 50 m. 25.10.1996 leg. L. Hendrich (1)', NHMW.

Description (number of specimens examined, 62) Fig. 30

Length 2.7 – 4.2mm. Elongate, elytra widest behind middle, quite rapidly narrowing to apex. Head shiny black, pronotum and elytra shiny dark brown to black; ventral surface dark red to black, legs testaceous, parts of tarsi, knees and much of femora darker. Head granulate/punctate, epicranial suture moderately impressed. Pronotum rugose, densely granulate/punctate, foveae weak to virtually absent. Elytra very deeply punctate, interstriae granulate to varying degrees, punctures in each stria increase in size toward middle from base and apex, punctures in adjacent stria same size or slightly larger from stria one to four. Alternate interstriae not or only weakly raised particularly toward apex and interstria eight. Plica absorbed into interstria eight. Pronotal epipleuron well marked about two punctures deep, fluted. Pseudoepipleuron moderate, elytral epipleuron absent behind, narrow in front, virtually invisible when elytra closed. Setae weak to very weak on elytron apex. Profemur moderately stout, basal pubescence weak, absent or virtually absent ventrally. Mesofemur relatively stout, narrowing somewhat toward base, basal pubescence weak, reaching approximately the end of trochanter on rear edge. Metafemur relatively stout, bowed on front edge. Front of mesosternum in middle with two longitudinal carinae, area between them deep in front becoming shallow behind. Metasternum evenly covered with relatively small (for *Hydrochus*) punctures not arranged in any pattern.



FIGURES 34–44 **34**, *H. gitaraiae*; **35–36**, forms of *H. horni*; **37**, *H. granicollis*; **38**, *H. aschnakiranae*; **39**, *H. kunarajahi*; **40**, *H. multicolor*; **41–42**, forms of *H. australis*; **43**, *H. abditus*; **44**, *H. radjiei*.

Male: Basal piece of aedeagus parallel sided 1.2 – 1.6 times length of apical piece. Apical piece bullet shaped, parameres rather regularly narrowing toward pointed tip. Central lobe moderately broad reaching to tips of parameres (Fig. 30).

Distribution

Northern Territory

Bamboo Creek near Wangi, NTM; Cooper Creek 19 km E by S Mt Borradaile, ANIC; 6 km SE Mt Borradaile, SAMA; 5 km SE Mt

Borradaile Station, SAMA; Gubara, Kakadu NP, NHMW, CLH, SAMA; 1 km S Gubara, Kakadu NP, SAMA; Holmes Jungle, NTM; 1 km S Jim Jim Falls, Kakadu NP, NHMW; Katherine Gorge, NTM; Koongarra, ANIC; Murganella, NTM; 6 km SW by S Oenpelli, ANIC.

Remarks

One of the largest of Australian *Hydrochus*, *H. numerosepunctatus* appears to be relatively common in coastal Northern Territory. It shows, with *H. obscuroaeneus*, the character of increasing size of elytral punctures from the elytral base to the middle. The species can be separated from most *H. obscuroaeneus* by its generally larger size (2.7 – 4.2mm against 1.8 – 3.0mm), deep but not particularly large elytral punctures, lack of pronotal fovea and granulate elytra. The male genitalia resemble those of some *H. obscuroaeneus* but the apical piece is relatively smaller. The numerous, evenly distributed, metasternal punctures are unique within Australian *Hydrochus*, although occasional specimens of other species may approach the condition seen in *H. numerosepunctatus*.

Biology

Little known, but appears to be associated with small creeks.

Etymology

Latin. 'many punctured' – in reference to the numerous punctures on the mesothorax.

Hydrochus obscuroaeneus Fairmaire

Hydrochus obscuroaeneus Fairmaire, 1879

= *Hydrochus palmerstoni* Blackburn, 1895; syn. nov.

= *Hydrochus insularis* Lea, 1926; syn. nov.

= *Hydrochus rodjani* Makhan, 1994; syn. nov.

= *Hydrochus wewalkai* Makhan, 1994; syn. nov.

Types

Hydrochus obscuro-aeneus Fairmaire. *Holotype*: not located, type locality given as Pt. Makay (?= Mackay), Queensland.

Hydrochus palmerstoni Blackburn. *Holotype*: female: 'T 3921 NT' 'Australia Blackburn Coll. B.M.1910–236' 'Hydrochus Palmerstoni, Blackb.', BMNH.

Hydrochus insularis Lea. *Lectotype*: male, 'insularis Lea TYPE Groote Eyl.' 'Groote Eylandt N.B.Tindale', SAMA. Herein designated.

Paralectotypes: 3, 'Groote Eylandt N.B. Tindale' 'Co-type' 'Griffith Collection Id by A.M.Lea', SAMA. Herein designated.

Hydrochus rodjani Makhan. *Holotype*: 'New Guinea Papua Brown River May 21,1956' 'E.J. Ford jr. Light trap', BPBM.

Hydrochus wewalkai Makhan. *Holotype*: male 'Australien 17.1.1993 Queensland Townsville 10m leg Wewalka (8)' 'Hydrochus wewalkai det D. Makhan 1994' with red Holotype label, NHMW.

Description (number of specimens examined, 162 dissected males) Figs 3, 31, 32, 33

Length 1.8 – 3.0mm. Moderately elongate, a little wider behind middle of elytra, elytral apex not greatly 'pinched'. Head black; pronotum dark brown-black with metallic tinges, extreme front margin often lighter; elytra dark testaceous to black; ventral surface dark brown to black, antennae and palpi testaceous, palpi usually with darker tips; legs light testaceous, parts of tarsi and knees darker. Head moderately to strongly punctate/granulate, epicranial suture moderate. Pronotum strongly punctate/granulate, foveae weak-quite strong, occasionally delineated by narrow raised areas. Elytra strongly sculptured, punctures well marked, very variable in size, relatively small to very large, those in each stria increasing in size towards disc from both base and apex of elytra, adjacent punctures in different striae approximately same size, weakly to moderately granulate, alternate interstriae, particularly numbers 4, 6 and 8 weakly to moderately raised for most of their lengths, plica absorbed into interstria 8. Weak to moderate setae on head and apical half of elytra. Pronotal epipleuron distinct, about two puncture widths wide, fluted. Elytron with relatively narrow pseudoepipleuron, epipleuron absent behind, very narrow in front half. Front of mesosternum in centre with two narrow carinae, area between them moderately deep. Profemur stout, basal pubescence weak, lacking or virtually so ventrally (Fig. 3). Mesofemur moderately elongated, weakly sinuate, narrowing slightly towards base, basal pubescence moderately developed not, or only slightly, extending beyond trochanter on posterior edge (Fig. 3). Metafemur moderately sized, weakly bowed on front edge.

Male: Basal piece of aedeagus parallel sided or narrowing towards base 0.8 – 1.3 times length of apical piece; parameres variable from narrowly triangular to quite broad, waisted and with rounded tip, central lobe variable from narrow to broad, only slightly shorter than parameres. There is considerable variation in the degree of elongation of the apical piece resulting in a corresponding variation in degree of constriction of parameres, expansion of the central lobe, narrowness of the parameres and the comparative length of the basal and apical pieces (Figs 31, 32, 33).

Distribution

Northern Territory

1 km SE Batchelor, SAMA; Barramundi Creek, Kakadu NP, SAMA, CLH, NHMW; Berry Springs, ANIC; Bessie Springs, ANIC; 11 km SW by S Borroloola, ANIC; 46 km SSW Borroloola, ANIC; 22 km WSW Borroloola, ANIC; 54 km S by W Borroloola, ANIC; 80 km SW Borroloola, ANIC; 5 km NNW Cahills Crossing, ANIC; 1 km N Cahills Crossing, ANIC; 8 km ESE Cape Crawford, ANIC; Coomalie Creek, CAL; Darwin, SAMA; Edith Falls near Katherine, CAL, ANIC; Gubara, Kakadu NP, NHMW, CLH, SAMA; 1 km W Gubara, Kakadu NP, SAMA; Gungurul Lookout, Kakadu NP, NHMW; Holmes Jungle, ANIC, SAMA; Howard Springs, NMV, ANIC, SAMA; Humpty Doo, DPIM; 10 km SW Jabiru, SAMA; 12 km E Jabiru, SAMA; Jim Jim Falls, NHMW, CLH; Katherine, ANIC; Koongarra, ANIC; Litchfield NP, NHMW; Magela Creek, ANIC; Manton Dam, ANIC; 19 km E by S Mt Borradaile, ANIC; 6 km SE Mt Borradaile, SAMA; 5 km SE Mt Borradaile Station, SAMA; 19 km E by N Mt Cahill, ANIC; 10 km E by N Mt Cahill, ANIC; 1 km NNW Mudginberry Homestead, ANIC; Naberlek Dam, ANIC; Nawurlandja, Kakadu NP, SAMA; Nourlangie Creek, ANIC; 18 km E by N Oenpelli, ANIC; 31 km SE by S Pine Creek, ANIC; South Alligator River, ANIC; South Alligator Inn, ANIC; South Johnston River, Old Jim Jim Road Crossing, SAMA; Tindal, NMV; Wildman River Lagoon, ANIC.

Queensland

Archer River, SAMA; Bloomfield, ANIC; Boggy Creek near Cooktown, ANIC; Burdekin River near Charters Towers, SAMA; Captain Billy Creek, SAMA; Cairns, CAL; Cape Tribulation, ANIC; 30 ml N Cape Tribulation, ANIC; Coen, MCZ; 60 km S Coen, SAMA; 40 km N Coen, SAMA; 21 km W by N Cooktown, ANIC; 29 km NW by N Cooktown, ANIC; Dalhunty River, SAMA; Dalrymple, 30 km N Charters Towers, NHMW; Giru, ANIC; 10 km SW by W Gordonvale, ANIC; Greenvale, NHMW; 70 km SW Greenvale, SAMA; Hann River, NMV; 7 ml N Hope Vale Mission, ANIC; Iron Range, ANIC; 7.5 km NNW Kuranda, DPIM, ANIC; Laura, DPIM; 73 km NW by W Laura, ANIC; 30 km N Laura, DPIM; 12 km N Laura, SAMA; 31 km NW by N Longreach, ANIC; 9.5 km SW Mareeba, DPIM; McIllwraith Ranges., SAMA; 1 km W Mingela, SAMA; 3.5 km SW by S Mt Baird, ANIC; Mt Garnet, SAMA; 40 ml SW Mt Garnet, CAL; 21 ml up Mt Lewis Road, DPIM; Mt Spec, ANIC; 11 km ENE Mt Tozer, ANIC; 2 km N Mt Tozer, ANIC; 9 km ENE Mt Tozer, ANIC; 3 km NE Mt Webb, ANIC; Peach Creek, SAMA; 11 km WSW Petford, DPIM; 1 km W Petford, SAMA; Reid River E of Mingela, SAMA; Rockhampton, CLH; Shiptons Flat, ANIC; Silver Plains, MCZ; Tolga, DPIM; Townsville, CAL, MCZ, NHMW; 10 km NW Townsville, SAMA; Thornton Range, ANIC; Walkamin, DPIM; Weipa, DPIM;

Western Australia

Carson Escarpment, ANIC; Drysdale River, ANIC; Gallery Hill, WAM; 14 km S by E Kalumburu Mission, ANIC; 4 km W King Cascade, ANIC; Millstream, ANIC; Mitchell Plateau, FIELD, ANIC; 3 ml SE Pago Mission, FIELD; Prince Frederic Harbour, ANIC; 2 km SW Rolly Hill, ANIC; Mitchell Plateau, ANIC; Synnot Creek, ANIC.

Remarks

A very common and widespread species in northern Australia. It shares, with *H. numerosepunctatus*, the character of the elytral punctures in at least the inner rows increasing in size until about the middle of the elytra. In other group 3 species (and most other Australian *Hydrochus)* the size of the elytral punctures increases rapidly from small to moderate within the basal one to four or five punctures and remaining approximately the same size until close to the apex. In *H. obscuroaeneus* the increase continues, albeit at a reduced rate well onto the elytral disc. The actual size of the elytral punctures is very variable from comparatively modest to extremely large.

Hydrochus obscuroaeneus can be separated from *H. numerosepunctatus* by the latter's unusual punctation of the mesosternum. Most specimens of *H. numerosepunctatus* are also larger (2.7 – 4.2mm) than *H. obscuroaeneus* (1.8 – 3.0mm).

Hydrochus obscuroaeneus is unusually variable in both size of elytral punctures and in the shape of the aedeagus. However, study of over a thousand specimens, 162 of which were males with their aedeagi extracted, has convinced me that only one species is involved. I could detect no strong pattern in either character, with extremes of both occurring throughout its geographic range, except possibly a preponderance of specimens with strong punctures and wide, waisted aedeagi (Fig. 33) on Cape York. Nor is there any apparent linkage between puncture size and aedeagus shape. All intermediate shapes exist but the relatively weakly punctured elytra and thin elongate triangular-shaped aedeagi are by far the most common forms.

I have been a unable to trace the holotype of *H. obscuroaeneus* and base my identification on the brief description; primarily its small size, nondescript colour, large elytral punctures and locality.

The holotype of *H. palmerstoni* is a female and has moderately large elytral punctures; the lectotype of *H. insularis* has moderately sized elytral punctures and an aedeagus with a broad central lobe but the apical piece is not waisted (similar to Fig. 32); the holotype of *H. wewalkai* has slightly larger elytral punctures and a broad, weakly waisted, apical piece to the aedeagus. The holotype of *H. rodjani* is similar to that of *H. insularis* in elytral punctation and aedeagus. All of these fall within my concept of *H. obscuroaeneus.*

Biology

Most specimens have been taken among stones and vegetation at the edges of small rivers, creeks and ponds. Some specimens from Cape Tribulation in ANIC were collected from 'rainforest leaf & log litter'.

Species Group 4

Group 4 species are characterised by having: two rather than three longitudinal carinae at the front of the mesosternum; the mesofemur weakly spindle-shaped (Fig. 4); the pubescence at the base of the mesofemora usually reaching > a third the width of the femur at that spot along the rear edge; the basal pubescence on the profemora complete and reaching > a quarter the width of the femur at that spot along the femur. Other character states that help to define the group are: elongate; plain darkish in colour—although often with a slight metallic sheen; some interstriae may be weakly raised (in *H. multicolor* interstriae two and four are often strongly raised for part of their length); dorsal setae weak to moderate; pronotum with moderate to strong fovea; pronotal epipleura weak to moderate; head with weak epicranial suture.

Perhaps the most phylogenetically coherent group with most species only identifiable by the form of the aedeagus. *Hydrochus multicolor* stands a bit apart from the others.

They are the predominant group in southern Australia where they are often abundant but are also widespread and common in the north. They are still-water species most frequently found amongst emergent vegetation in relatively shallow water.

Hydrochus abditus sp. nov.

Types

Holotype: male, 'S. Aust Meadows 13 km W 35°11S 138°36E 28 Sept 96 C.H.S. Watts', SAMA.

Paratypes: 18, same data as holotype, SAMA; 14, 13 km W Meadows S.A. 26.9.98 C.H.S. Watts', SAMA.

Description (number of specimens examined, 50) Fig. 43

Length 2.4 – 3.5mm. Relatively broad, particularly elytra, widening slightly behind middle of elytra, narrowing apically. Dorsal surface black, ventral surface black, antennae and palpi testaceous, legs testaceous, parts of tarsi, knees and much of femora darker. Head with rather sparse large punctures, occasionally granulate; epicranial suture strongly impressed. Pronotum moderately punctate, granules absent or confined to sides; foveae weak, shallow, usually without raised margins. Elytral punctures relatively large; alternate interstriae not or only slightly raised; plicae weak. Setae on head moderate, often quite extensive over posterior half of elytra. Pronotal epipleuron well marked, relatively broad with strong vertically elongate punctures/grooves. Pseudoepipleuron moderately broad; elytral epipleuron absent posteriorly, enlarging anteriorly to about one quarter to one third width of pseudoepipleuron in same position. Front of mesosternum in centre with two longitudinal carinae, the area between them rather shallow. Profemur with basal pubescence moderate, about one quarter width of femur ventrally. Mesofemur weakly narrowing towards base, basal pubescence well developed, about one third width of femur along posterior margin. Metafemur weakly bowed.

Male: Basal piece of aedeagus straight sided 1.1 – 1.3 times length of apical piece. Parameres thick in basal half, rapidly narrowing to a slim, weakly sinuate apical third. Central lobe wide, only a little shorter than parameres (Fig. 43).

Distribution

New South Wales

Armadale, ANIC; Congo, ANIC; 2 km N Batemans Bay, SAMA; 8 km N Failford, SAMA; MacLean, SAMA; 2 km S Nowra, SAMA; Royal National Park, CAL; Tamworth, CAL.

Queensland

North Pine River, MCZ; Yungaburra, MCZ.

South Australia

Adelaide, SAMA; 13 km W Meadows, SAMA; Myponga, SAMA; Williamstown, SAMA.

Tasmania

35 km E Hobart, NHMW; Launceston, QM; 40 km E Launceston, NHMW; 60 km E Launceston, NHMW; St. Helens, SAMA.

Victoria

11 km E Bruthen, SAMA; Cann River, ANIC; Dartmoor, SAMA; Ferntree Gully, SAMA; 4.5 km SW Healesville, FIELD; 4 ml NNE Nelson, NMV; 12 km SW Orbost, SAMA; Wyperfield NP, ANIC.

Western Australia

Millstream, ANIC; 1 km N Millstream, ANIC.

Remarks

A relatively common species in coastal southern Australia. Two other group 4 species are sympatric with it in southern Australia: *H. australis* and *H. multicolor. Hydrochus abditus* can be readily separated from *H. australis* by its broader shape, dark colour, weak elytral epipleura and by the greater development of the pronotal epipleura. *Hydrochus multicolor* differs from *H. abditus* by its usually strongly raised elytral striae, raised central panel on the pronotum and its usually iridescent dorsal sheen, in contrast to the shiny black of *H. abditus.* In northern Queensland I have been unable to reliably separate *H. abditus* from *H. kunarajahi, H. radjiei* and *H. aschnakiranae* other than by the male genitalia. In general it is larger, darker and with the elytra proportionally wider than the pronotum than in most *H. aschnakiranae*. From *H. radjiei* it has more weakly developed pronotal fovea and in general a smoother elytra. Specimens from the seemingly isolated population at Millstream in Western Australia are rather more strongly sculptured than others. I have found no characters that will help separate *H. abditus* from *H. kunarajahi* other than in the male genitalia.

Biology

A still water species found among vegetation in ponds or slow moving water.

Etymology

Latin. 'Hidden'–in reference to the species being 'hidden' within *H. adelaidae.*

Hydrochus aschnakiranae Makhan

Hydrochus aschnakiranae Makhan, 1994

= *Hydrochus schillhammeri* Makhan, 1995; syn. nov.

Types

Hydrochus aschnakiranae Makhan. *Holotype*: male, 'Solomon is. Guadalcanal: Roroni 35 km E of Honiara 10 m, 6.V1964' 'R. Straatman Light Trap', BPBM.

Hydrochus schillhammeri Makhan. *Holotype*: male, 'Australien QL (26) 10 km S Tully S Innisfail, 30 m 25.1.1993 leg Wewalka' 'Hydrochus schillhammeri det D. Makhan 1994' with red holotype label, NHMW.

Description (number of specimens examined, 117; dissected males, 38) Figs 4, 7, 38

Length 2.7 – 3.3mm. Elongate, subparallel, with elytra weakly expanded. Dorsal surface black shiny, elytra and pronotum a little lighter in some, ventral surface black, antennae and palpi dark testaceous, legs light testaceous with knees and parts of femora and tarsi darker. Head moderately punctate with weak flat granules, epicranial groove usually well marked. Pronotum with weak to moderate punctures, lacking granules; foveae shallow to moderate, usually delineated with weak to moderately raised areas. Elytra with moderately large punctures, alternate interstriae tend to be raised, particularly four and eight, plica moderately strong. Head with weak to moderate setae, elytra with weak to moderate setae apically and on interstriae toward apex. Pronotal epipleuron moderate, about a puncture width wide. Elytron with moderately developed pseudoepipleuron (Fig. 7), epipleuron very narrow posteriorly, weak anteriorly where it is about one third the width of pseudoepipleuron. Front of mesosternum in centre with two longitudinal carinae, area between them relatively deep, shallower behind. Profemur stout, a little sinuate, basal area of pubescence relatively large, narrowest portion ventrally about a quarter width of femur at that point. Mesofemur elongate, weakly narrowing towards base; basal pubescence well developed, at narrowest ventrally about one third to one half width of femur at that point (Fig. 4). Metafemur relatively stout, anterior edge bowed.

Male: Basal piece of aedeagus 1.2 – 1.4 times length of apical piece, slightly to moderately twisted. Parameres rounded at base rather evenly narrowing to blunt tip, left hand paramere (ventral view) indented to accept tip of central lobe to greater degree than right hand one. Central lobe relatively narrow, shorter than parameres, with tip weakly expanded and weakly to moderately skewed to left (Fig. 38).

Distribution

Northern Territory

11 km SW by S Borroloola, ANIC; Canon Hill, Kakadu NP, SAMA; Cahills Crossing, ANIC; Coastal Plains Research. Station, ANIC; Coomalie Creek, CAL; Darwin, SAMA; 6 km E Humpty Doo, DPIM; 12 km E Humpty Doo, DPIM; Gungurul Lookout, Kakadu, NHMW, CLH; Kongarra, ANIC; Jabiluka Billabong, Kakadu, ANIC; Ja Ja Billabong near Mudginberry, ANIC; Jabiru, SAMA; 5 km NNW Cahills Crossing, ANIC; Mt Borradaile, SAMA; 6 km SE Mt Borradaile, SAMA; 5 km SE Mt Borradaile Station, SAMA; 8 km N Mt Cahill, ANIC; 19 km NE by E Mt Cahill, ANIC; South Alligator Inn, Kakadu, ANIC; Ubirr, Kakadu, NHMW.

Queensland

Archer Bend, SAMA; Annan River ANIC; 20 ml NW Ayr, CAL; 14 ml NW Ayr, CAL; Bundaberg, SAMA; Bushland Beach, 20 km N Townsville, SAMA; Caloundra, SAMA; Coen, DPIM, SAMA; 40 km N Coen, SAMA; 110 ml S Coen, NMV; 25 ml N Cooktown, ANIC; 8 km N Bluewater, SAMA; Home Hill, SAMA; Laura, SAMA; 12 km N Laura, SAMA; 50 ml W Mackay, ANIC; McIvor River 40 ml N Cooktown, UQIC; 1 km W Mingela, SAMA; 2 ml SW Mt Inkerman, ANIC; 2 km N Mt Molloy, SAMA; 10 km S Mt Molloy, SAMA; 3 km ENE Mt Tozer, ANIC; Musgrave, ANIC; 14 ml SE Normanton, ANIC, CAL; Reid River E of Mingela, SAMA; Rockhampton, ANIC, SAMA; Townsville, CAL, SAMA; 40 km S Townsville, SAMA; 20 km S Townsville, SAMA; 12 km NW Townsville, SAMA; 25 km S Townsville, SAMA; 40 km S Weipa, DPIM.

Western Australia

Mitchell Plateau, FIELD.

Remarks

A moderate-sized, dark species, separable from most *H. australis* by its weaker elytral epipleura, moderate pronotal epipleura and apparent lack of granules other than on front of head. Most *H. australis* have the pronotum and elytra lighter in colour than the head and often quite strongly so, whereas, apart from teneral individuals, *H. aschnakiranae* is uniformly black dorsally. The degree of pubescence on the femora is generally weaker than in *H. australis* but not enough to reliably separate the two. Separation of this species from *H. radjiei* and *H. kunarajahi* can only be done reliably from the aedeagus shape as outlined in the key.

Hydrochus aschnakiranae was described from Guadalcanal in the Solomon Islands but apart from the elytra and pronotum of the holotype being lighter in colour than in most Australian specimens I can't distinguish it from Australian material. (Makhan was mistaken in describing the colour of the head, pronotum and elytra of the holotype as black.)

I consider *H. schillhammeri* Makhan, described from a specimen from North Queensland, to be synonymous with this species. (Makhan's description of the type of *H. schillhammeri* is misleading: its colour is a shiny black, not green; the pronotum is uneven but to say it has ten large, deep depressions is far fetched; alternate elytral interstriae (2, 4, 6, 8 not 3, 5 & 8) are weakly raised but hardly carinate.)

Biology

Found amongst emergent vegetation in still or slowly flowing water. Taken at light.

Hydrochus australis **Motschulsky**

Hydrochus australis Motschulsky, 1860

= *Hydrochus parallelus* Macleay, 1873; syn. nov.

=*Hydrochus regularis* Blackburn, 1898; syn. nov.

= *Hydrochus diversiceps* Blackburn, 1898; syn. nov.

= *Hydrochus brunneonitens* Lea, 1926; syn. nov.

= *Hydrochus serricollis* Lea, 1926; syn. nov.

= *Hydrochus polaki* Makhan, 1994; syn. nov.

= *Hydrochus rambarani* Makhan, 1994; syn. nov.

Types

Hydrochus australis Motschulsky. *Lectotype*: 'Type' 'Pt Philip' 'Hydrochus australis Motsch Nov. Holl.' with yellow type label, ZMM. Two specimens now mounted on two cards on one pin, the upper specimen, a dissected male, herein designated.

Paralectotype: 1, same details as lectotype, lower specimen, herein designated, ZMM.

Hydrochus parallelus MacLeay. *Lectotype*: 'Hydrochus parallelus M.L.W. Gayndah' 'K 19664'. Left hand specimen of two mounted on one card, AM, herein designated,

Paralectotype: 1, same details as lectotype, right hand specimen, AM, herein designated.

Hydrochus regularis Blackburn. *Lectotype*: female, 'T 1532 V' 'Australia Blackburn Coll B.M. 1910–236' 'Hydrochus regularis, Blackb', BMNH. Herein designated. Blackburn mentioned a specimen from Murray Bridge (SA) and one from Western Victoria in the original description.

Hydrochus brunneonitens Lea. *Holotype*: female, 'brunneonitens Lea, TYPE Queensland', SAMA.

Hydrochus serricollis Lea. *Lectotype*: 'serricollis Lea TYPE Launceston', with 'TY' on card, SAMA. Herein designated.

Paralectotypes: 6, same data as lectotype, SAMA (*H. australis*);1, 'Lucindale S. Australia' 'Co-type' 'serricollis S. Australia Cotype', SAMA (*H. australis*); 2, 'Launceston' 'Co-type' 'Griffith Collection Id. by AM Lea', SAMA (*H. abditus*); 3, 'Davenport Tas: Lea' 'Tasmanian Towers' 'Griffith Collection Id by AM Lea' '14009 Hydrochus serricollis Lea Tasmania Cotype', SAMA (*H. australis*); 1, 'Strahan Tas: Lea & Carter' 'Hydrochus serricollis Lea Co-type' 'K 48448' 'Paratype', AM (*H. australis*); 2, 'George Town' 'K50043' 'Hydrochus serricollis Lea Co-type' 'Paratype', AM (?*H. abditus*); 1, 'George Town' 'Hydrochus serricollis Lea Co-type' a more recent Cotype blue label 'Paratype T-13212 Hydrochus serricollis Lea 1926', NMV (?*H. abditus*); 1, 'George Town' 'Paratype T-13213 Hydrochus serricollis Lea 1926', NMV (?*H. abditus*); 2, 'Launceston' 'Co-type' 'Hydrochus serricollis Lea, Co-type', QM (*H. abditus*); 2, 'Co-type' 'Launceston' 'Australia Brit Mus 1924-156' 'Hydrochus serricollis Lea, Co-type', BMNH (*H. australis*); 1, 'Co-type' 'Australia Brit. Mus.1924–156' 'East Tammar', BMNH (? *H. abditus*). Herein designated.

Hydrochus diversiceps Blackburn. *Holotype*: female, '6371 T' 'Albion Brisbane C. Wild. 17.7.92' 'Blackburn coll. 1910–236' 'Hydrochus diversiceps, Blackb.', BMNH.

Hydrochus polaki Makhan. *Holotype*: 'Coll. R.I.Sc.N.B. Australien Ex Coll. Weyers' 'Hydrochus polaki det. D. Makhan 1994' with red holotype label, IRSNB.

Hydrochus rambarani Makhan. *Holotype*: 'Coll. R.I.Sc.N.B. Australien N.S. Wales Coll Knisch Coll d'Orchymont' 'det Knisch parallelus' 'Hydrochus rambarani det. D. Makhan' with red holotype label, IRSNB.

Paratypes 3, same data as holotype, IRSNB.

Description (number of specimens examined, >1000) Figs. 6, 41, 42

Length 2.0 – 3.6mm. Elongate, relatively narrow and parallel sided or elytra weakly expanded. Head black; pronotum dark brown to black, sometimes with anterior margin lighter; elytra light testaceous to dark reddish brown; ventral surface black; antennae and palpi variably testaceous; legs light testaceous with knees, parts of tarsi, and sometimes parts of femora darker. Head and pronotum variably sculptured from smooth and weakly punctured to strongly granulate, pronotal foveae moderately developed, weakly delineated by raised areas. Elytral punctures moderate; interstria four may be weakly raised, plicae weak, granulation lacking to quite strongly developed. Pronotal epipleuron very narrow, virtually lacking in many specimens. Pseudoepipleuron moderate posteriorly, narrowing anteriorly; elytral epipleuron narrow, absent posteriorly, relatively broad anteriorly where it is equal in width or greater (usually) than pseudoepipleuron in same place (Fig. 6). Profemur stout, weakly constricted at base, basal pubescence well developed, on ventral surface about half width of femur. Mesofemur moderately elongate, weakly narrowing towards base; basal pubescence well developed, reaching approximately the equivalent of the width of the femur along posterior/ventral margin. Metafemur moderately elongate, posterior edge straight, anterior edge evenly bowed, incomplete ventrally. Front of mesosternum in centre with two longitudinal carinae, area between them deep anteriorly but with weakly raised T shaped structure posteriorly. Head with weak to moderate setae; elytra with weak setae at apex and on some interstriae towards apex.

Male: Aedeagus with basal piece approximately five times as long as apical piece, parallel sided. Apical piece often twisted to left (viewed ventrally) to varying degrees; parameres bulbous in basal half, narrow and sinuate apically; central lobe narrow, slightly shorter than parameres (Figs 41, 42).

Distribution

Australian Capital Territory

Black Mt, ANIC; Canberra, SAMA; 30 km SW Canberra, SAMA; 25 km W Canberra, ANIC; Deakin, ANIC; Gungahlin, ANIC.

New South Wales

Armadale, ANIC; 8 km N Bombala, SAMA; Bulla Bulla Tank, SAMA; Clarence River, SAMA; Congo, ANIC; Cooma, SAMA; Coonabarabran, ANIC; 9 km NNE Coonabarabran, ANIC; 28 km N Dubbo, ANIC; Forbs, SAMA; Gilgandra, SAMA; Gindera, CAL; Hay, ANIC; 8 km W Hay, ANIC; 10 km W by S Jindabyne, ANIC; Lake Cowal, ANIC; MacLean, SAMA; Menindee Lake, ANIC, UQIC; Megalong Valley, MCZ; Mittagong, SAMA; 6 ml ESE Nelson Bay, ANIC; 20 ml W Nerringa, SAMA; Nyngan, CAL; Tumut River, CAL; 10 ml N Wagga Wagga, UQIC; Whitton, SAMA.

Northern Territory

Adelaide River, ANIC; Canon Hill, Kakadu NP, SAMA; Coastal Plains Research. Station near Darwin, ANIC; Darwin, SAMA; 15 km SW Elliot, SAMA; 2 km E Ja Ja Billabong, ANIC; 6 km N by E of Mudginberry, ANIC; Jim Jim Creek, ANIC; 8 km E Mt Cahill, ANIC; 18 km WSW Borroloola, ANIC.

Queensland

Alligator River, 20 km S Townsville, SAMA; Barcaldine, QM; 23 km NE Bauhina Downs, ANIC; Bushland Beach 20 km N Townsville, SAMA; Davison River, SAMA; Dalby, SAMA; Gayndah, SAMA; Gladstone, SAMA; Borumba Dam, NHMW, CLH; Brisbane, SAMA, NMV; Cardstone, ANIC; Cairns, QM; Condomine River, QM; Dawson River, QM; Emerald, QM; Goomeri, UQIC; Goondiwindi, SAMA; Greenbank, UQIC; 70 km SW Greenvale, SAMA; 15 km W Gympie, NMV; Hann River, DPIM; 10 km W Imbil, NMV; Inglewood, UQIC; Jarding Crossing, ANIC; Laura, SAMA; Kenilworth State Forest, UQIC; 13 km NW Lowood, UQIC; Mary Creek, ANIC; 14 km N Mt Molloy, ANIC; 50 km SW Mackay, ANIC; 8 km SW Mapleton, NMV; Moggill, QM; 21 ml S Miriam Vale, ANIC; Mt Borradaile, SAMA; 5.5 km SW by S Mt Biggenden, ANIC; Mt Garnet, SAMA, DPIM; 2 ml SW Mt Inkerman, ANIC; Oxley, QM; 10 km W Petri, SAMA; N Pine River, QM; S Pine River, QM; Rockhampton, SAMA, UQIC; 50 ml SW Rockhampton, ANIC; 29 ml SSW Rockhampton, ANIC; Taroom, QM; Townsville, SAMA, UQIC; 40 km S Townsville, SAMA; 25 km S Townsville, SAMA; 30 km SE Townsville, SAMA; Yeppoon, QM.

South Australia

10 km N Coonawarra, SAMA; Fairview Park Conservation Park, SAMA; Mannum, SAMA; Mt Gambier, SAMA; Mt Lofty, SAMA; Murray River, SAMA, UQIC; Murray Bridge, SAMA; 1 km S Nangwarry, SAMA; Naracoorte, SAMA; Penola, SAMA; Warradale, SAMA.

Tasmania

Deloraine, SAMA; Launceston, SAMA; Tooms River, ANIC.

Victoria

Ballan, NMV; 2 km W Brimpaen, SAMA; Buangor, SAMA; Cann River, ANIC; 12 km W Casterton, SAMA; Clines, NMV; Corryong, NMV; Dartmoor, SAMA; Dondangadale, NMV; Dromana, NMV; East Pomorneit, ANIC; Echuca, UQIC; 21 ml E Echuca, ANIC; Grampians, SAMA; Fyans Creek, SAMA; 7 km N Glenisla, SAMA; 5 km NW Halls Gap, SAMA; 3 km NE Hamilton, SAMA; Healesville, SAMA; 4.5 km SW Healesville, FIELD; 4 km SW Healesville, NMV; Inglewood, NMV; Jordon River, NMV; Lake Hattah, ANIC, NMV; Macallaster River, NMV; Melbourne, NMV; Merrijig, NMV;

Moyston, NMV; 10 km NE Mirranawa, SAMA; Mitchell Gorge, NMV; Nathalia, SAMA; Natya, NMV; 4 ml NNE Nelson, NMV; Nhill, NMV; 5 km NW Portland, SAMA; Ringwood, NMV; Stawell, SAMA; Swan Hill, NMV; 3 km SE Taggerty, NMV; 6 km E Terang, ANIC; Warrandyte, NMV; Wellington River, Werribee, NMV; Yarra River, NMV.

Western Australia

Armadale, SAMA; Belmont, FIELD; Boyup Brook, ANIC; Bridgetown, MCZ; Bunburry, ANIC; Darling Ranges, SAMA; 14 ml E Denmark, ANIC; Harvey River, NMV; Kerridale, ANIC; 4 km W King Cascade, ANIC; Maidavail, SAMA; Mandaring Weir, MCZ; Margaret River, NMV; Picton Junction, ANIC; Pinjarra, SAMA; 8 m E Pinjarra, ANIC; 6 km S Pinjarra, SAMA; Thomas River 101ml E Esperance, ANIC; Wilga, ANIC.

Remarks

Perhaps the commonest, most widespread and sculpturally variable of Australian *Hydrochus* which is reflected in the fact that it has been named seven times. If the variation in punctation/granulation of the dorsal surface is ignored the degree of variation is actually surprisingly little as I interpret the species. Most specimens are relatively distinctive, but some specimens, particularly from northern areas, may be inseparable from other species without dissection. Within group 4 it has the strongest pubescence on its legs and the widest elytral epipleura in contrast to the pseudoepipleura. No other group 4 species has the elytra lighter in colour than the head and pronotum, unless teneral. The weak to absent pronotal epipleura in *H. australis* also separates most specimens from related species, although some *H. abditus* also have weakly developed pronotal epipleura. In many specimens, particularly from more southern populations, the apical piece of the aedeagus is skewed sideways. Within Australian *Hydrochus* this character is shared only with *H. aschnakiranae* but in this species all specimens that I have seen have the aedeagus skewed to some degree whereas in *H. australis* there is considerable variation from straight to strongly skewed. In *H. australis* the parameres and the central lobe are equally skewed in contrast to *H. aschnakiranae* in which only the central lobe is skewed. (The type of *H. brunneonitens* is a teneral individual with a relatively light coloured dorsum and the darker colour on the legs apparently not yet developed.)

Biology

A very common species amongst emergent vegetation in still or slowly flowing water. Taken at light.

Hydrochus kunarajahi Makhan

Hydrochus kunarajahi Makhan, 1994.

Type

Holotype: male, 'AUSTRALIA: NQ Tulley Falls 111–10–1956' 'Light Trap J.L. Gressitt' 'Hydrochus kunarajahi det D. Makhan 1994', BPBM.

Description (number of dissected males examined, 21) Fig. 39

Length 2.7 – 3.5mm. Elongate, widening slightly behind middle of elytra. Head shiny black, pronotum and elytra shiny dark brown to black; ventral surface black; antenna and palpi testaceous, palpi tips darker; legs testaceous, parts of tarsi, knees and much of femora darker. Head moderately punctate/granulate, granules flat, epicranial suture distinct. Pronotum moderately punctate, foveae moderate, usually delineated by thin raised margins. Elytra with moderate sized but deep punctures, alternate interstriae not or only weakly raised, plicae moderate. Head and apical portion of elytra weakly to moderately setose. Pronotal epipleuron well marked, about a puncture width wide. Elytron with weak to moderate pseudoepipleuron, epipleuron absent to weak posteriorly, enlarging to one third to one half width of pseudoepipleuron anteriorly. Front of mesosternum in centre with two longitudinal carinae, area between then deep anteriorly, becoming shallower behind. Profemur weakly sinuate, basal pubescence well developed, ventrally about one quarter width of femur at same place. Mesofemur weakly sinuate, slightly narrower towards base, ventral pubescence well developed about one half to equal width of femur along posterior margin. Metafemur slightly bowed anteriorly.

Male: Basal piece of aedeagus narrowing towards base, about 1.5 – 1.7 times apical piece. Parameres bulbous, at base wider than basal piece, weakly narrowing in middle, slightly widening toward tip. Central lobe wide, about two thirds to three quarters length of parameres (Fig. 39).

Distribution

Northern Territory

14 km SW Cape Crawford, ANIC; 8 km ESE Cape Crawford, ANIC; Darwin, NMV; 19 km SSE Mataranka, ANIC.

Queensland

8 km N Bluewater, SAMA; Burdekin River E of Charters Towers, SAMA; 25 km N Laura, DPIM; Mary Creek 14 km N Mt Molloy, ANIC; Mackay, NMV; Reid River E of Mingela, SAMA; Rockhampton, NHMW, CLH; Townsville, CAL, FIELD.

Western Australia

12 km S Kalumburu Mission, ANIC.

Remarks

A relatively large, dark species very similar to *H. abditus*, *H. radjiei* and *H. aschnakiranae* but seemingly much rarer. From *H. aschnakiranae* it can be separated by the male genitalia (see key and Figs 38, 39). From *H. radjiei* it differs in having a weaker pronotal and elytral sculpture, and seemingly lacks the pronotal granules quite frequently found in *H. radjiei*. The male genitalia resemble those of *H. radjiei* and for a while I considered *H. kunarajahi* to lie within that species. They differ however in the narrowing towards the base of the aedeagus, the squatter apical piece and the strongly bulbous paramere bases (Fig. 39).

Biology

Found amongst stones, detritus and emergent vegetation at the edge of slow moving water. Taken at light.

Hydrochus multicolor Lea

Hydrochus multicolor Lea, 1926

= *Hydrochus matthewsi* Makhan, 1995; syn. nov.

Types

Hydrochus multicolor Lea. *Lectotype*: 'multicolor Lea TYPE Mt Macedon'. Right hand specimen of two mounted on one card and identified by 'TY' below it, SAMA, herein designated.

Paralectotypes: 1, same details as lectotype, SAMA; 1, 'Forest Reefs N.S.W. Lea' 'Co-type', SAMA; 1, 'Adelaide Blackburn' 'Co-type' 'C125', SAMA; 2, 'Mt Macedon Victoria H.W. Davey' 'Co-type', SAMA; 2, 'Mt Macedon Victoria H.W. Davey' 'F.E. Wilson Collection' 'Hydrochus multicolor Lea Cotype' with more recent blue label '2287-98 Cotype', NMV. Herein designated.

Hydrochus matthewsi Makhan. *Holotype*: male, 'Australien (19) Queensland Mareeba, 700m 22.1. 1993 leg Wewalka' 'Hydrochus jii det. D. Makhan 1994' with red Holotype label, NHMW. See note below.

Description (number of specimens examined, 78) Fig. 40

Length 2.7 – 4.4mm. Elongate, elytra weakly widened in middle, rapidly narrowing at apex. Head black, usually with iridescent sheen; pronotum dark brown to black usually with iridescence sheen; elytra dark-brown to nearly black shiny; ventral surface dark-brown, legs testaceous with parts of tarsi, knees and parts of femora darker. Head strongly granulate/punctate, granules often only at sides; epicranial suture weak to moderate. Pronotum rather smoothly granulate/punctate, foveae weak, the central third (longitudinally) of pronotum somewhat raised with sides falling away, almost flanged. Elytron with relatively small, even punctures, moderately to strongly granulate, interstriae two and six usually strongly raised in basal fifth, interstria four usually strongly raised from about level of end of raised portion of interstria two to the apical quarter, where the raised portion ends abruptly; interstria eight raised in basal three quarters incorporating plica. Head and elytra with none to a few setae. Pronotal epipleuron well developed, two to three puncture widths wide, sometimes fluted. Pseudoepipleuron moderately wide, epipleuron absent behind narrow in front. Front of mesosternum in centre with two narrow sharply raised longitudinal carinae, the area between them quite deep. Profemur moderately stout, basal pubescence moderately developed, about a quarter width of femur on ventral surface. Mesofemur elongate narrowing a bit toward base, basal pubescence moderately developed reaching about a quarter width of femur at base along hind ventral margin. Metafemur moderately elongate, weakly bowed on front edge.

Male: Basal piece of aedeagus narrow, straight sided, 1.7 – 1.9 times length of apical piece. Apical piece very narrowly triangular, pointed. Central lobe narrow, expanded a bit towards apex, a little shorter than parameres (Fig. 40).

Distribution

New South Wales
2 km N Batemans Bay, SAMA; 8 km N Bombala, SAMA; Collector, SAMA; Hartley Vale, MCZ; Megalong Valley, MCZ; Nyngan, SAMA.

Queensland
Mareeba, NHMW

South Australia
7 km N Forreston, SAMA; Inglewood, SAMA; 5 km NE Inglewood, SAMA; 13 km W Meadows, SAMA; Myponga, SAMA; Williamstown, SAMA.

Victoria
Ballan, NMV; 4.8 km WNW Blackwood, ANIC; Grampians, SAMA; Melbourne, NMV; 12 km SW Orbost, SAMA; Warrandyte, NMV.

Remarks
A large species from south-eastern Australia and the Atherton region of north Queensland. Well sculptured specimens are easily recognisable by the strongly raised elytral interstriae and the unusual raised central region of the pronotum, although this latter character is hard to describe adequately. In a few specimens the elytral interstriae are only weakly raised but even in these the abrupt ending to the raised portions is usually diagnostic. The aedeagus is distinctive and can only be mistaken for some group 2 species which are otherwise very different.

In NHMW there is a specimen collected by Wewalka from Mareeba, Queensland that has been labelled as the holotype of *Hydrochus jii* Makhan. This appears to be a *nomen nudum*. The locality data are identical to those given for the type of *H. matthewsi* Makhan. The male genitalia also match the illustration of *H. matthewsi* given by Makhan. Makhan's brief description would also match the specimen. Since I can find no trace of a labelled holotype of *H. matthewsi* I suspect this specimen is the holotype and I am treating it as such. It agrees with *H. multicolor* Lea in most aspects including aedeagus and pronotum. The elytral interstriae are much less strongly raised than in typical *H. multicolor* although within the variations found in this species. I consider it a junior synonym of *H. multicolor* Lea.

Biology
Found amongst emergent vegetation in still and slow moving water.

Hydrochus radjiei Makhan

Hydrochus radjiei Makhan, 1994

Type
Holotype: male, 'AUSTRALIA: NQ Tulley Falls 111-10-1956' 'Light Trap J.L. Gressitt', BPBM.

Description (number of specimens examined, 123: dissected males, 48) Fig. 44
Length 2.6 – 3.8mm. Elongate, widening slightly behind middle of elytra. Dorsal surface shiny, black, ventral black; antennae and palpi testaceous, palpi usually with dark tip, legs testaceous, parts of tarsi, knees and parts of femora darker. Head granulate/punctate. Pronotum with deep strong punctures, often granulate, foveae moderate to strong, bounded by narrow raised areas. Elytra with strong deep and regular punctures, alternate interstriae vary from weakly to quite strongly raised, plicae although strong tend to be absorbed into raised interstria eight. Head and apex of elytra weakly to moderate setose. Pronotal epipleuron well marked, about one puncture wide or a little wider. Pseudoepipleuron relatively narrow, elytral epipleuron absent to very narrow posteriorly, expanding anteriorly to one third to one half times the width of pseudoepipleuron in same place. Front of mesosternum in centre with two longitudinal carinae, area between them deep in front, becoming shallow in posterior half. Profemur stout, relatively parallel sided, basal pubescence about a quarter width of femur. Mesofemur rather narrow, weakly narrowing basally, basal pubescence strong, reaching one third to one half width of femur along posterior margin. Metafemur relatively elongate, weakly bowed on anterior edge

Male: Basal piece of aedeagus straight 1.4 – 1.7 times length of apical piece. Parameres thick, narrowing in middle, expanding towards tip, central lobe relatively thick, two thirds to three quarters length of parameres (Fig. 44).

Distribution

New South Wales
Maclean, SAMA; Yuragin NP, ANIC

Northern Territory
Adelaide River, ANIC; Berry Springs, ANIC; 46 km SSW Borroloola, ANIC; Coastal Plains Research Station, ANIC; Coomalie Creek, CAL; Cooper Creek near Mt Borradaile, SAMA; 52 km

S Darwin, ANIC; Groote Eylandt, ANIC; 12 km NE Howard Springs, ANIC; Humpty Doo, DPIM; 10 km SW Jabiru, SAMA; 20 km SSW Jabiru, SAMA; Katherine, ANIC; Koongarra, ANIC; Lake Bennet, NTM; Manton Dam, ANIC; 11 km SW by S Borroloola, ANIC; 6 km SE Mt Borradaile, SAMA; 19 km E by S Mt Borradaile, ANIC; 5 km SE Mt Borradaile Station, SAMA; 8 km E Mt Cahill, ANIC; 19 km NE by E Mt Cahill, ANIC; 8 km E Mt Cahill, ANIC; Muirella Park Kakadu, DPIM; Murganella, NTM; Pine Creek, SAMA.

Queensland

Archer Bend, SAMA; Archers Creek, ANIC; Ayr, CAL; Bamaga, SAMA, UQIC; Bowling Green Bay NP, SAMA; Bundaberg, SAMA; 8 km N Bluewater, SAMA; Caloundra, SAMA; Cape Flattery, ANIC; Cardstone, ANIC; 40 km N Coen, SAMA; Cooktown, ANIC; 25 km N Cooktown, ANIC; 14 ml NW; Dalhunty River, SAMA; Eubenargee Swamp, SAMA; Green Hills, ANIC; Hann River, DPIM; 10 km N Howard, NHMW, CLH; 7 km N Hope Vale Mission, ANIC; Iron Range, ANIC, UQIC; Mackay, NMV; 40 ml N Cooktown, UQIC; Mt Molloy, SAMA; 9 km ENE Mt Tozer, ANIC; 73 km NW by W Laura, ANIC; 25 km N by W Mareeba, ANIC; Mary Creek, ANIC; 20 ml N Maroochydore, ANIC; Mission Beach, ANIC; Mt Webb NP, ANIC; 3 km NE Mt Webb, ANIC; 5 km ESE Mt Finnigan, ANIC; 17 km N Mt Molloy, ANIC; 52 km SW by S Mt Garnet, ANIC; Rockhampton, NHMW, SAMA; 15 km WNW South Johnstone, DPIM; Strathmore Station, DPIM; 3 km ENE Mt Tozer, ANIC; 2 km NNE Mt Tozer, ANIC

Western Australia

Mitchell Plateau 14°49S 125°50E, ANIC; 3 ml E Pago Mission, FIELD.

Remarks

A relatively large, dark species which is common in coastal northern Australia. Although most specimens can be separated from *H. australis* by colour and weaker elytral epipleura not all can, in which case dissection is required. It is even more similar to *H. aschnakiranae*, but tends to be larger and more robustly sculptured, often with granules on the pronotum which are lacking in *H. aschnakiranae*. Again reliable separation should be based on the male genitalia. These vary a bit in the degree of elongation of the apical piece, and extremely elongated examples can be confused with *H. aschnakiranae*, but *H. radjiei* lacks the twisted basal piece, the asymmetric parameres and narrower skewed central lobe of *H. aschnakiranae*. (The male genitalia of the holotype appear to have the central lobe distorted and not to be naturally skewed: see figure in Makham, 1994). At the other extreme *H. aschnakiranae* aedeagi can approach those of *H. kunarajahi* (see discussion under that species).

Biology

Found amongst emergent vegetation in still and slow moving water. Taken at light.

ACKNOWLEDGMENTS

I thank the curators of the collections listed earlier for allowing me ready access to specimens in their care, and in particular, Dr M. A. Jach of NHMW for arranging the loan of the type of *H. australis*. I would also like to thank Ms C. Horne and Ms D. Churches for helping with the typing of the manuscript, Mr R. Gutteridge for preparing the figures, and Mrs M. Anthony and Mrs J. Evans for help with the library references.

CHECKLIST OF AUSTRALIAN *HYDROCHUS* LEACH

H. abditus sp. nov.
H. adelaidae Blackburn
H. aenigmatis sp.nov.
H. aschnakiranae Makhan
H. atratus sp. nov.
H. australis Motschulsky
H. brunneonitens Lea = *H. australis* Motschulsky
H. burdekinensis sp. nov.
H. cucullatus sp.nov.
H. decorus sp.nov.
H. diversiceps Blackburn = *H. australis* Motschulsky
H. eurypleuron sp.nov.
H. gitaraiae Makhan
H. granicollis Lea
H. horni Blackburn
H. imamkhani Makhan
H. insularis Lea = *H. obscuroaeneus* Fairmaire
H. interioris Blackburn
H. kunarajahi Makhan
H. lateviridis Blackburn
H. macroaquilonius sp.nov.
H. matthewsi Makhan = *H. multicolor* Lea
H. multicolor Lea
H. nadesui Makhan = *H. obscuroaeneus* Fairmaire
H. numerosepunctatus sp.nov.
H. obscuroaeneus Fairmaire

H. obsoletus Lea
H. palmerstoni Blackburn = *H. obscuroaeneus* Fairmaire
H. parallelus MacLeay =*H. australis* Motschulsky
H. polaki Makhan = *H. australis* Motschulsky
H. radjiei Makhan
H. rambarani Makhan = *H. australis* Motschulsky
H. regularis Blackburn = *H. australis* Motschulsky
H. rodjani Makhan = *H. obscuroaeneus* Fairmaire
H. scabricollis Lea = *H. horni* Blackburn
H. schoenmanni Makhan = *H. imamkhani* Mahkan
H. schillhammeri Makhan = *H. aschnakiranae* Makhan
H. serricollis Lea = *H. australis* Motschulsky
H. simplicicollis Lea
H. umbratilis sp.nov.
H. verae Makhan = *H. simplicicollis* Lea
H. victoriae Blackburn = *H. adelaidae* Blackburn
H. wewalkai Makhan = *H. obscuroaeneus* Fairmaire

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DESIGNATION OF A LECTOTYPE AND DESCRIPTIONS OF FOUR NEW SPECIES OF AUSTRALIAN BUPRESTIDAE (COLEOPTERA).

SHELLEY BARKER

BARKER, S. 1999. Designation of a lectotype and descriptions of four new species of Australian Buprestidae (Coleoptera). *Records of the South Australian Museum* **32**(1): 45–49.

A lectotype is designated for *Cisseis nubeculosa* Germar. The following four new species of Buprestidae are described: *Cisseis ernestadamsi* sp. nov., *Cisseis robertfisheri* sp. nov., *Astraeus acaciae* sp. nov., *Neocuris carnabyae* sp. nov.

S. Barker, Department of Entomology, South Australian Museum, North Terrace, Adelaide, South Australia 5000. Manuscript received 1 September 1998.

MATERIAL

Specimens examined came from the following institutions and collections:

ANIC — Australian National Insect Collection, CSIRO, Canberra.
BMNH — The Natural History Museum, London.
HUMB — Humboldt University Museum, Berlin.
MHSA — Mr T. M. S. Hanlon, Hunters Hill, Sydney.
MPWA — Mr M. Powell, Melville, Western Australia.
SAMA — South Australian Museum, Adelaide.

INTRODUCTION

Cisseis and *Ethon*, closely related genera in the tribe Agrilini (Coleoptera: Buprestidae), were proposed by Gory and Laporte (1839). Subsequently Blackburn (1887) separated *Neospades* from *Cisseis* on the basis of the structure of the tarsi and their claws described as double in *Neospades* and single in *Cisseis (s.s.)*. Examination of available material has shown that there is a gradation in the tarsal claws from one condition to the other and *Neospades* should be delimited by other characters or abandoned. Carter (1923) was the last reviser of *Cisseis* which now needs to be re-examined. *Cisseis* species are difficult to identify and all of the types need to be examined before a revision can be completed. It is now known that the genus occurs in Australia, New Guinea and nearby islands and in the Philippine Islands. In Australia the genus is largely, but not exclusively, associated with *Acacia* species.

The location of the Germar types of *Cisseis* in the Humboldt University Museum, Berlin has been established and I have examined the types of *Cisseis nubeculosa* Germar, *Cisseis chalcoptera* Germar and *Cisseis notulata* Germar, all collected in Adelaide. The first two are female and male specimens respectively of the same species, common in South Australia. The third is an uncommon species confined to South Australia as far as I know. Two new species of *Cisseis* were discovered by veteran collectors: the first in Queensland by Mr E. E. Adams, beetle collector extraordinaire; the second in South Australia by Mr R. H. Fisher, well known butterfly expert. Herein I name both species to honour their collectors.

Astraeus is a well known genus in which more than half the species are associated with *Allocasuarina* species (Barker 1975; 1977; 1989). Thus it is unusual that a new species has been found in Western Australia associated with *Acacia*, the first record of an association between the two genera. On the other hand *Neocuris* is poorly known and difficult to identify. The group has not been revised for over seventy years (Carter 1928) and there is no reliable key for their identification. A very distinctive species has come to hand from a remote locality in Western Australia and is described herein.

DESIGNATION OF LECTOTYPE

I have examined two female syntypes of *Cisseis nubeculosa* Germar (HUMB no. 42752) and two male syntypes of *Cisseis chalcoptera* Germar

(HUMB no. 42752) all collected in South Australia (Germar 1848) and held in the Humboldt University Museum, Berlin. These specimens all belong to the same common species which is confined to South Australia. Thus *C. chalcoptera* Germar is a synonym of *C. nubeculosa* Germar. I have placed a fluorescent red label with the following handwritten words: LECTOTYPE, *Cisseis nubeculosa* (Germar), selected S. BARKER 1998, on the pin of one of the two female syntypes. I hereby designate this specimen as the lectotype of *C. nubeculosa* Germar.

DESCRIPTIONS OF NEW SPECIES

Cisseis ernestadamsi sp. nov.
(Fig. 1A)

Types

Holotype: ♂, ii.1946, Edungalba, Qld, on brigalow, E. E. Adams, ANIC. *Allotype:* ♀, summer 1975/76, Separation, Qld, leg. A. Smith, E. E. Adams, SAMA I21 406. *Paratypes:* Qld. 3 ♀♀, xii.1945, Mourangee, Edungalba, E. E. Adams, ANIC; 1 ♀, same data as holotype, ANIC; 1 ♀, 1969, Edungalba, 80 km SW (sic) of Rockhampton, E. E. Adams, ANIC; 1.xii.1973, Mr Emlen, Milmerran, J. McQueen, ANIC.

Colour

Head and antennae coppery. Pronotum coppery with green reflections. Scutellum green or coppery with green reflections. Elytra dull green with coppery reflections; irregularly spotted with clumps of white pubescent setae. Ventral surface dull green, much of the sternum covered with dense white pubescent setae, abdomen with thick white pubescent setae laterally. Legs dull green.

Shape and sculpture

Head flat, deeply punctured, moderately setose; interocular width 0.6 of maximum head

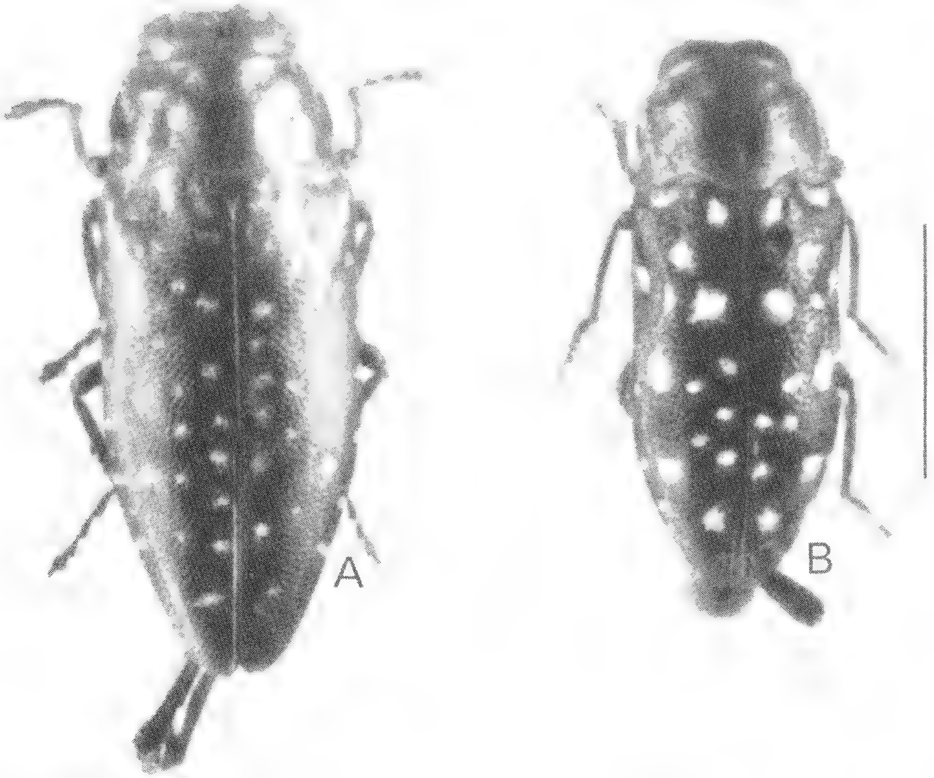

FIGURE 1. Habitus illustrations of the following *Cisseis* species. **A**, *C. ernestadamsi* sp. nov. **B**, *C. robertfisheri* sp. nov. Scale bar = 5mm.

width, dense pubescence around ventral margins of eye and lateral to the mouth. Antennomeres: 1–3 obconic; 4–11 triangular. Pronotum shallowly punctured medially, striolate and with irregular foveae laterally; anterior margin straight, basal margin sinuate; dorsal carina diverging from ventral carina at base for short distance, then more or less parallel until again diverging towards anterior margin which it reaches, space between deeply punctured and with some pubescence in well preserved specimens. Scutellum scutiform, anterior margin rounded, flat with punctures. Elytra heavily scutellate with small, stiff clumps of setae scattered more or less evenly over the whole surface. Ventral surface shallowly punctured, setae sparse medially, clumped and pubescent laterally. Legs: tarsal claws with inner tooth; hind tibial comb from middle to apex with three rounded projections.

Size

Male, 13.0 x 4.5 mm (1). Females, 14.7 x 5.0 mm (7).

Remarks

This species is closest to *C. niveosparsa* Carter and has been misidentified as that species. It can be distinguished by its green colour, *C. niveosparsa* is brown; it is a larger species; male genitalia are reasonably similar but not identical. It was collected on *Acacia harpophylla* F. Muell, ex Benth., brigalow, at all localities.

Etymology

This species is named after its collector Mr E. E. Adams, Edungalba, Queensland.

Cisseis robertfisheri sp. nov.

(Fig. 1B)

Types

Holotype: ♂, Melrose, S. Aust., 1.iii.1986, R. H. Fisher, SAMA I21 407. *Allotype:* ♀, Melrose, S. Aust., 23.i.1978, R. H. Fisher, SAMA I21 408. *Paratype:* S. Aust.: ♂, same data as holotype, SAMA.

Colour

Head, antennae, pronotum, scutellum dark green. Elytra black with spots formed from clumps of white pubescent setae. Ventral surface dark green with lateral white spots formed by pubescent setae. Legs dark green.

Shape and sculpture

Head deeply punctured, deep anterior median fovea, interocular width 0.6 maximum head width. Antennomeres: 1–3 obconic; 4–11 triangular. Pronotum shallowly punctured medially, deeply punctured laterally; anterior margin projecting slightly medially, basal margin sinuate; dorsal carina not meeting ventral carina posteriorly, diverging for short distance then more or less parallel, not reaching anterior margin, space between punctured and covered with squamiform setae. Scutellum scutiform, the sides extended laterally, flat, without punctures. Elytra with numerous white spots formed by clumps of pubescent setae, the eight largest arranged in a circular pattern, with a number of smaller inner and outer spots including one on each side at the basal margin. Ventral surface shallowly punctured medially, scutiform laterally; with dense lateral clumps of pubescent setae. Legs: tarsal claws with small inner tooth; hind tibia with setal comb from just before middle to apex in three distinct clumps.

Size

Males, 12.0 x 4.1 mm (2). Female, 13.5 x 5.0 mm (1).

Remarks

All specimens were collected on *Acacia victoriae* Benth. The species most resembles *C. leucosticta* Kirby (holotype BMNH) but can be separated from that species by the dark green colour of the head and pronotum which are bronze-green or coppery in *C. leucosticta;* the elytra which are black in *C. robertfisheri* and brown or bronze in *C. leucosticta;* and the male genitalia which are narrower and parallel-sided in *C. robertfisheri* and wider and rounded in *C. leucosticta.*

Etymology

This species is named after its collector Mr R. H. Fisher, Adelaide.

Astraeus acaciae sp. nov.

(Fig. 2)

Types

Holotype: ♂, Wooramel R., W.A., on *Acacia* sp., 23.ix.1980, S. Barker & D. J. Williams, SAMA I21 409. *Allotype:* ♀, 11 km S Billabong roadhouse, W.A. on *Acacia sclerosperma,* 7.ix.1996, M. Golding & M. Powell, WAMA.

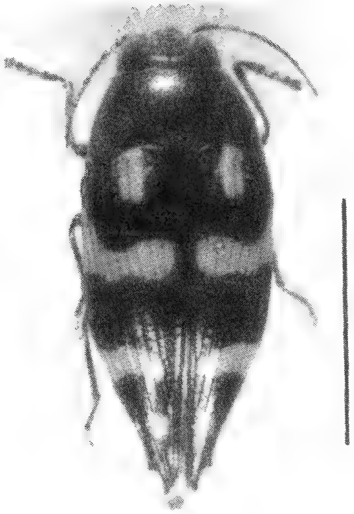

FIGURE 2. Habitus illustration of *Astraeus acaciae* sp. nov. Scale bar = 5mm.

Paratypes: 1 ♂, same data as allotype, MPWA; 3 ♂♂ & 1 ♀, 11 km S Billabong roadhouse, W.A., 9.ix.1996, M. Golding & M. Powell, MPWA; 3 ♀♀, 1 ♂ 11 km S Billabong roadhouse, W.A., 11.ix.1998, T. M. S.Hanlon MHSA; ♂, 11 km S Billabong roadhouse, 11.ix.1998, M. Golding & M. Powell, MPWA.

Colour

Head black with purple reflections. Antennae black with blue-green reflections. Pronotum black with purple reflections. Elytra black with blue and purple reflections and the following pale yellow markings: elongate basal spot almost reaching basal margin; pre-medial fascia, concave forwards touching margin but not reaching suture; post-medial fascia, concave backwards touching margin reaching little more than half way to suture; elongate pre-apical spot. In one of the specimens in the type series there is an elongate, narrow spot between the two fasciae close to but not touching the suture. Ventral surface black with blue and purple reflections. Legs black with blue-green reflections. Setae silver.

Shape and sculpture

Head closely punctured; with small apical median keel; setose. Antennae: males with antennomeres more or less equal in length; females with antennomeres progressively decreasing in length towards apex. Pronotum closely punctured; laterally rounded and narrowed from base to apex; small basal crypt at apex of medial lobe, setose. Elytra costate, intervals flat and smooth, each interval with row of punctures; parallel-sided from base, rounded posteromedially and tapered to sharp marginal spine; sutural spine sharp, rounded inner margin; humeral fold moderately developed, angled (*vide* Barker 1975 Fig. 1C). Ventral surface shallowly punctured, moderately setose, setae short.

Size

Males, 8.7 x 3.5 mm (7). Females, 9.1 x 4.1 mm (5).

Remarks

In my revised key to *Astraeus (s.s.)* (Barker 1989 p. 191) this species keys out at 18. Add: 'Short, compressed species.... *A. acaciae* Barker.'

Etymology

This species is named for its association with *Acacia sclerosperma* F. Muell.

Neocuris carnabyae sp. nov.
(Fig. 3)

Types

Holotype: ♂, Coral Bay, W.A., 9.ix.1974, K. & E. Carnaby, ANIC. *Allotype:* ♀, same data as holotype, ANIC. *Paratypes:* W.A.: 6 ♂♂, Coral Bay, 8.ix.1974, K. & E. Carnaby, ANIC; 5 ♂♂ & 2 ♀♀, same data as holotype, ANIC & SAMA; 1 ♂, 112 km S Onslow, 28.viii.1971, T. F. Houston, SAMA.

Colour

Male. Head and antennae green with yellow reflections. Pronotum blue-green medially, green laterally with yellow reflections. Scutellum green.

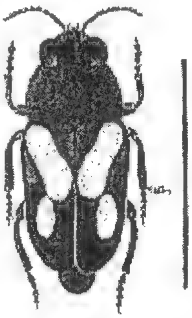

FIGURE 3. Habitus illustration of *Neocuris carnabyae* sp. nov. Scale bar = 5mm.

Elytra green surrounding scutellum and along suture for short interval; green at margin at the level of the interval between second and third coxae; elsewhere dark blue except for yellow marking in the form of a central X, the arms completely connected in some specimens and not in others. Ventral surface and legs green. Setae silver.

Female. Head and antennae blue. Pronotum and scutellum dark blue. Elytra same markings as in male but blue replaces green. Ventral surface blue, legs royal blue. Setae silver.

Shape and sculpture

Ovoid. Head shallowly but closely punctured with medial sulcus. Antennomeres: 1–2 obconic; 3–11 triangular. Pronotum shallowly but closely punctured; projecting medially from apical margin, basal margin bisinuate; laterally rounded and narrowed from base to apex, a few punctations each with central sensillum. Scutellum scutiform, without punctures. Elytra shallowly punctured, humeral callus prominent, apically rounded and subserrate. Ventral surface with shallow punctures.

Size

Males, 5.8 ± 0.08 x 2.5 ± 0.04 mm (12). Females, 6.5 ± 0.32 x 2.8 ± 0.15 mm (3).

Remarks

The elytral markings most closely resemble those of *Neocuris ornata* Carter, a Queensland species in which the pale markings take the form of a **W**. The head and pronotum of that species are bright metallic green.

Etymology

The name honours the collector Mrs Edith Carnaby of Wilga.

ACKNOWLEDGMENTS

I am indebted to the following for assistance: Mr E. E. Adams for long-time assistance with specimens; Mr R. H. Fisher for specimens; Mr T. M. S. Hanlon, Sydney for specimens; Mr M. Powell, Melville for specimens; Mr T. A. Weir, ANIC; Mr Martin Brendell, BMNH; Dr Manfred Uhlig, HUMB; Mr A. McArthur for photography.

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WAIYUNGARI AND HIS RELATIONSHIP TO THE ABORIGINAL MYTHOLOGY OF THE LOWER MURRAY, SOUTH AUSTRALIA

PHILIP A. CLARKE

CLARKE, P. A. 1999. Waiyungari and his relationship to the Aboriginal mythology of the Lower Murray, South Australia. *Records of the South Australian Museum* **32**(1): 51–67.

The ethnographic record of Aboriginal mythology in the Lower Murray cultural region of South Australia is dominated by accounts of male ancestral heroes, particularly Ngurunderi, Waiyungari and Nepeli. The analysis of the ethnographic accounts of the Waiyungari mythology in this paper gives greater understanding of the cultural landscape and provides further insights into local Aboriginal perceptions of the seasons and of their cosmos. A critique of writers who have drawn upon the Waiyungari mythology for popular work is included. Here is a study of cultural geography, focusing upon the interaction between culture and the physical landscape.

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INTRODUCTION

The available literature on Aboriginal mythology in the Lower Murray contains many apparently conflicting accounts of major ancestors, such as Waiyungari.[1] The mythological corpus of south-eastern Australia derives its broad defining character from a number of congruent local variations, as previously noted in the case of the eaglehawk and crow (Blows 1975) and Ngurunderi myths (Clarke 1995). Although the literature for the Lower Murray acknowledges the importance of Ngurunderi in establishing particular traditions and creating many topographical features, the significance of events attributed to Waiyungari has been treated as secondary. This paper follows previous work that discusses how Aboriginal mythology provides an image of the dynamic aspects of cultural relationships to landscape (see Berndt & Berndt 1989: 408–427; Bos 1988; Charlesworth 1984: 383–387; Clarke 1991a: 66–69, 1995, 1999; Rose 1988). The investigation of the Waiyungari myth is an important vehicle for the study of Aboriginal cosmological beliefs in the Lower Murray region. In this myth are explanations of the seasonal changes that Aboriginal people observed in their landscape. Similarly, their social lives were considered by them to be subject to some of the forces that generated the seasons. In the early years when Europeans commenced mainland settlement, the Lower Murray cultural region could be defined as the area bounded by Rapid Bay in the west, across to the southern side of Murray Bridge, and south to Kingston (Fig.1). This takes in the southern part of the Fleurieu Peninsula, all of Encounter Bay, Lake Alexandrina and Lake Albert, and the Coorong.[2] The region includes territories occupied by dialect groups, such as the Ramindjeri, Tangani and Yaraldi-speaking people, who are each in turn represented by a number of smaller descent groups. The Lower Murray region was essentially a single cultural bloc, with strong connections to the north east. The cultural geography of the Aboriginal people associated with this region is discussed in detail by Clarke (1994, 1995, 1997).

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[1] There are many versions of this name in the literature, such as Waijungngari (Meyer 1846); Wyungare (Taplin 1874 [1879]; Smith 1930; Mountford 1971); Waiungare (Taplin 1879); Waiongari (Mathew 1928: 530); Waiangari (Tindale 1934–37); Waijungari (Tindale 1935); Waijunggari (Harvey 1939 MS); Wyungarre (Roheim 1971: 292); and Wyungara (Reed 1980). This paper uses the spelling Waiyungari, as used by Meyer (1843) and Berndt & Berndt (1993). Similarly, the spellings of the names of other spirit ancestors, Ngurunderi and Nepeli, follow the standards used by Berndt & Berndt (1993) and Clarke (1995).

[2] The placement of the northern boundary of the Lower Murray cultural region at Rapid Bay reflects Aboriginal movements after European settlement, as described by Tindale (1934–37: 41), the Berndts (1993, map 10, p.330) and Clarke (1991: 66–69). Prior to the 1830s, this boundary was east of Cape Jervis (see Amery 1998: 66).

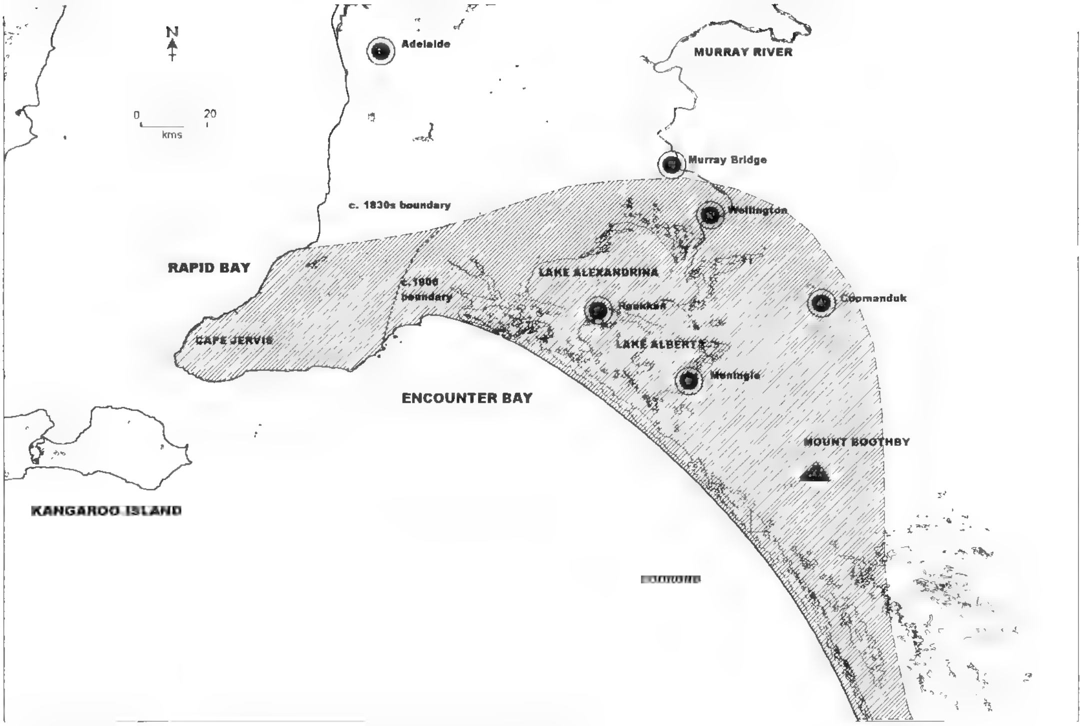

FIGURE 1. The Lower Murray cultural region (after Clarke 1994).

The Sources

The Dresden missionary, Heinrich A. E. Meyer (1843), first recorded the Waiyungari mythology from the Raminyerar (Ramindjeri people) of southern Fleurieu Peninsula in the early nineteenth century. Later, versions were recorded predominantly from Yaraldi people of the area around the eastern side of Lake Alexandrina and surrounding Lake Albert. During the late nineteenth century, accounts of Waiyungari appeared in scholarly papers and newspaper articles by the Aborigines' Friends Association missionaries George Taplin (1874, 1879) and his son Frederick Taplin, who were based at Point McLeay on the Narrung Peninsula on the shore of Lake Alexandrina.[3] The Christian influences on their records is significant and has been commented upon elsewhere (Clarke 1994: 64, 65, 247–252, 418, 419; 1995: 146, 150–153; 1997: 125–127). Laurie (1917) published another account of Waiyungari in the form of a reminiscence from an early pastoralist C. J. Hacket of the Narrung Peninsula area. The Aboriginal sources for the versions mentioned so far are not recorded, nor are the transcripts of exactly what the recorders were told. As ethnographic sources, there is no way to ascertain how literal the translation was and whether the recorders, unwittingly or deliberately, introduced their own new elements into the mythology.

In the twentieth century, with the advantage of the development in fieldwork techniques within the discipline of anthropology, a number of

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[3] There is a suggestion that G. Taplin's records are a blending of Ramindjeri and Yaraldi data. Initially he engaged English-speaking Ramindjeri people to help to elicit information from Yaraldi people at Point McLeay (see Taplin Journals 5 May 1861). Taplin also used the Meyer (1843) Raminyerar dictionary as a basis for his own work (Taplin Journals 10 April 1859; Clarke 1994: 247, 418, 419). G. Taplin (1879: 50,51) obtained the account of the Tanganarin group at Goolwa from police trooper T. Moriarty. Other references include G. Taplin (*Register*, 30 January 1862) and F. Taplin (*Register*, 24 April 1889). The F. Taplin data appears to be based on that of his father, G. Taplin.

researchers investigated aspects of pre-European Aboriginal cultures in southern South Australia. This period of ethnographic recording produced a number of accounts of the Waiyungari mythology. In the 1930s, Museum curator Norman B. Tindale (1934–37; 1935) recorded two major versions of the mythology while working with a Tangani-speaking man Clarence Long (Milmendjeri descent group, northern Coorong area) and a Yaraldi-speaking man Frank Blackmoor (Peltindjeri descent, near Point Sturt).[4] The social anthropologists Ronald M. and Catherine H. Berndt (1993) worked in the late 1930s and early 1940s, recording aspects of Yaraldi culture. They obtained information from Aboriginal people such as Mark Wilson (Liwurindjeri descent group, eastern Narrung Peninsula), Albert Karloan (Manangka descent group, eastern Narrung Peninsula) and Pinky Mack (Piltindjeri descent group, Poltalloch Station, Lake Alexandrina). Some of the accounts provided by Tindale and the Berndts are accompanied by transcripts and sound recordings of what was said by their Aboriginal sources. For this reason, and because of a more rigorous scientific approach, their material is more useful than the nineteenth century data for ethnographic reanalysis, with less likelihood of the recorders making errors in formulating their written versions. Another field worker, Alison Harvey (1939 MS), recorded supplementary data from various Lower Murray people in 1939. A more detailed evaluation of the biases of each of these sources is given elsewhere (Clarke 1994, 1995, 1997). Popular writers have used these base texts in their own compilations. An analysis of these is provided in a later section of this paper.

THE ETHNOGRAPHIC ACCOUNTS

The account recorded from the Raminyerar by Meyer (1846: 201, 202) is not tied to a particular part of the landscape, although appears to refer to a coastal region. A brief overview is as follows. The mother of Waiyungari was Ningarope, and his older brother was Pungngane. Ningarope gave birth to Waiyungari in the form of 'excrement' that was red due to menstruation. This colouring gave Waiyungari the status of *kainjani* (*kaindjani*, initiate) from birth. Pungngane, who had a normal birth, lived with his two wives near the sea. Pungngane's wives found Waiyungari asleep in his hut one day. They attracted his attention by imitating the noise of an emu and seduced him.[5] Ningarope was angry at the behaviour of the women and informed Pungngane what had happened. Pungngane searched for his wives and brother, but found the hut deserted. He placed a fire upon the hut and told it to burn later when Waiyungari and the wives were asleep. During the evening the fire increased and started to fall on the skins of the occupants, forcing them to run to the sea. From a position of safety, Waiyungari wondered how he could escape his brother's wrath. Waiyungari threw a spear into the sky, which made contact but fell to earth again. He then used a barbed spear that he sent skyward with all his force. It remained stuck and was used by Waiyungari and the wives to climb into the sky. Pungngane and Ningarope saw them there and followed. Waiyungari was recorded in the Ramindjeri dialect as meaning the 'name of a star' (Meyer 1843 (2): 105). The Raminyerar attributed the abundance of kangaroo and *pondi* (Murray cod, *Maccullochella peeli*) to the actions of Pungngane and Waiyungari. Pungngane caught a *pondi* and divided it into small pieces, each of which, when thrown into the sea, became another *pondi*.[6] Apparently Waiyungari increased the number of kangaroos in a similar way.

The main accounts of Waiyungari recorded by Taplin (1874 [1879: 55–58]; 1879: 38, 39) are geographically located around the Point McLeay Mission Station on the Narrung Peninsula. According to Taplin, Waiyungari had a mother (not named), a brother called Nepeli, but no father.[7] Waiyungari and Nepeli, along with Ngurunderi, were great hunters. Waiyungari was particularly renowned for hunting kangaroos. Both Waiyungari and Nepeli pegged out the skins

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[4] Tindale (1931: 189,211–219; 1938–56: 79–107) also recorded a version of Waiyungari in Yaraldi language from Albert Karloan. He never translated this.

[5] Roheim (1971: 292) interpreted this incident in Meyer's account as meaning that the women were 'emu wives of the All-Father', a possible link to the native companion and emu story of south-eastern Australia (see Tindale 1931–34: 207–209; 1938–56: 33–61).

[6] The fish creation episode is similar to that recorded for Ngurunderi (Clarke 1995: 148). Meyer recorded *pondi* as *ponde*.

[7] In the 1874 version by Taplin, there is no stated relationship between Waiyungari and Nepeli. In the 1879 account, Taplin states they are brothers. In most other ways the accounts are similar.

of kangaroos, which formed the many salt lagoons in the area (see Fig.2). Waiyungari once tore a large kangaroo into many pieces, thus creating smaller kangaroos.[8] It was Ngurunderi and Nepeli who performed the division of fish. A mound of limestone, called Pulluwewal (Pullawewal), on the Narrung Peninsula was perceived by local Aboriginal people to be the hut of Waiyungari. Waiyungari lived at Rauwoke (hill at Point McLeay) with his mother. He had been a 'red man' from his infancy. Once, whilst drinking water through a reed at Oulawar on the lake, Nepeli's two wives saw him and fell in love with Waiyungari.[9] Together they waited until he was asleep and made a noise like two emus running past. Waiyungari yielded to their demands and took them as wives. When Nepeli learned of this he was angered and went looking for his brother and his wives, but found Waiyungari's hut vacant. Nepeli placed a fire in the hut and told it to wait until Waiyungari and the wives were asleep inside and then burn them. The flames from the burning hut chased the occupants along the lakeshore until they reached Lowanyeri at Lake Albert Passage, where they escaped into the mud. Waiyungari decided to live in Wyirrewarre (Skyworld), away from Nepeli's hatred. He threw a spear with a line attached into the sky. Although it stuck, it would not hold Waiyungari's weight. He had more success with a barbed spear, pulling himself up and then hauling up the women. In Taplin's time three stars, which he did not identify, were still pointed out by local Aboriginal people as Waiyungari and the wives. From the hill of Rauwoke, Nepeli placed his canoe in the heavens, forming the dense part of the Milky Way. Then he went skyward in the same manner as Waiyungari.

Taplin (1879: 50, 51) published a small account of Waiyungari obtained from the 'Goolwa clan'. The police trooper T. Moriarty had recorded it on a survey return. In this version, Ngurunderi had two wives (not named) who caught two fish: a large fish, which they baked for themselves, and a small one that was given to their husband. This attempt at concealment made Ngurunderi angry. He punished all people of the local group, called Tanganarin, by giving them death and taking away their knowledge. As a result, the Tanganarin became 'like beasts in the field'. Ngurunderi left them and went up to the sky. Taplin (1879: 51) records that 'After a long time there was born of a virgin a good and wise man, who was named Wyungare [Waiyungari].' This man was a 'great teacher' who gave back much of what the Tanganarin had lost, and also taught them sorcery. Ngurunderi eventually took Waiyungari up to the sky where he became 'the second king of that place'. When a Tanganarin person died, Waiyungari took their spirits up into the sky and found them a country to live in.

Under a section titled 'The Translation of Heroes', Mathew (1928: 530) provides a brief overview of Lower Murray mythology based upon an interview with a Ngarrindjeri man, David Unaipon.[10] He says:

> Nurunderi [Ngurunderi], the reputed ancestor of the Narrinyeri [Ngarrindjeri], came down the Darling, and then down the Murray, where he and his followers displaced a tribe that were dwelling there, whose leaders were Neppele [Nepeli] and Waiongari [Waiyungari], the latter being a nephew of Neppele. These two were ultimately translated to the sky and became with their wives, the stars in the tail of Scorpio (Mathew 1928: 530).

And Ngurunderi 'drove away Neppele and Waiongari who had possessed the country before him' (Mathew 1928: 536). This account clearly establishes an antagonistic relationship between Ngurunderi and Nepeli and Waiyungari.

In 1934 Tindale (1934–37: 32–36, 64) recorded a version of the Waiyungari mythology from Clarence Long, a Tangani man with connections to the Coorong and the Upper South East. Although obtained from a Tangani informant, the sites involved are clearly within the descent group territories of the Yaraldi dialect region. In Long's

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[8] In the 1879 version, Taplin assumes that the tearing apart of fish and kangaroos was designed to make them smaller. A more likely explanation was that the ancestors were increasing the abundance of the food. Roheim (1971: 292) gives other examples of ancestors increasing the numbers of animals and people by tearing apart larger spirit beings.

[9] The act of drinking through a reed is a clear indication that Waiyungari was an initiate. Taplin (1874 [1879: 17]) claims that this was the practice for youths made *kaingani* (*kaindjani,* sacred initiate status), and adds that they were not allowed to use drinking vessels for several months. Harvey (1939 MS) was told by Pinky Mack that Lower Murray 'men during initiation have to drink water from a reed: not allowed to touch water with their feet.' Howitt (1904: 674), Tindale (1935: 267), Berndt (1974: 26) and Berndt & Berndt (1993: 177–178) noted this practice amongst Lower Murray people.

[10] The source of Mathew's Lower Murray data is not stated as David Unaipon in his paper (1928). P. G. Jones (pers. com.) claims that this was the case.

account, Waiyungari and his elder brother, Nepeli, lived with their elderly mother at an unspecified place on Narrung Peninsula. Nepeli was an 'old man' (fully initiated?) about to marry two women from another group, when his mother took Waiyungari to Pullawewal to avoid trouble. Nepeli's wives were not told that he had a younger brother. On one occasion, all the men went down to Waintjang where Yoldi (ancestral shag man) was camped with other bird men. Here Waiyungari was being covered with ochre and made a young man. Yoldi had red rubbed on to his chin and on his mainly grey chest through holding Waiyungari while ochre was put on him. Jungundjeri (pronounced Yungunderi?) was a reddish bird that lived in the reeds, and it was he who actually applied the ochre. Nepeli's wives were curious about what was happening. Waiyungari was in the habit of going to Ngawulwara (Ngulawar, Woodrow Point near Narrung) to drink and swim in Lake Alexandrina. Nepeli forbade his wives to go in this direction, restricting them to Wangaroka (Wangarawar, Taplin's Landing). One day, when Nepeli was asleep, the wives wanted a change of food, desiring to eat fresh-water mussels. They had strayed past Wangaroka when they saw red ochre floating in the water, which was due to Waiyungari swimming nearby. The women followed the ochre trail back through the reeds and eventually found his camp at Pullawewal where he lived with his mother. The two women tricked Waiyungari to come out by imitating an emu. Waiyungari wanted to get some emu meat to send down to the little reed bird (presumably the one involved in his initiation). The two women lured him away and seduced him. The mother, who had earlier heard Waiyungari leave the camp, told him that he should have kept away from the women. She left Waiyungari and went to tell Nepeli. The 'old man', Nepeli, sneaked upon Waiyungari's camp to kill him and the women with fire.[11] Waiyungari and the wives escaped to Tembatung (an inland hill on Narrung Peninsula), where they watched the camp burn. They knew of Nepeli's anger as they could see his spear shining. Because of their shame, the Rekkaldi people at Ngararang (the town site Narrung) would not look at them. Waiyungari and the wives made a reed raft and crossed the Lake Albert Passage and walked into the mallee scrub. At Komantuk (the town site Coomandook), Waiyungari tried to spear the sky but he was not high enough. They travelled further to Mulgarap-ngawan (the place Cold and Wet near Mount Boothby). Waiyungari 'sang' the spears: the first went nearly out of sight into the sky, and then the second struck the first. The third spear had a 'hair line' attached, and when thrown it struck the others. Waiyungari tightened the line by attaching the free end to a 'waddy' (club). Waiyungari and the women climbed up into the sky where they can be seen as stars. When Nepeli had lost his wives, he made another one from the flowering stem of a *ngalaji* (grasstree flower stem, *Xanthorrhoea* species) at Retjeri (bluff at Point McLeay).[12] He went down to the edge of the lake to secure his canoe and he saw the flowering stem of *pantaruki* (ribbon weed, *Triglochin procerum*). This was a pretty plant that took his fancy, so he made a second wife out of that. Nepeli now had two wives again.

In Tindale's published Yaraldi version of this myth (1935), which Frank Blackmoor gave him in 1934, Waiyungari was the brother of Nepeli, who in turn was the brother in-law to Ngurunderi. His mother created him from her own 'red excrement'.[13] The red colour meant that he was instantly *narambi* (sacred). Nepeli and his two wives lived at Ngulawar[14], while Waiyungari lived at Pulaweiwalth (Pullawewal). One day Nepeli's two wives went to Wangarawar (Wangaroka, Taplin's Landing) which was near the camp of Waiyungari at Pullawewal. Waiyungari was at Wangarawar also, drinking water through a reed stem. This was the 'watering place' of the youth whilst undergoing initiation and young women

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[11] Although Nepeli controlled the use of fire, its introduction in the creative period was attributed to events surrounding Kondoli the whale (Meyer 1847:203–204; Berndt & Berndt 1993:235–236,450–451).

[12] Information on plants provided in the 'Tanganekald Vocabulary Cards' (no date) compiled by N.B. Tindale, Anthropology Archives, S.A. Museum. The grass tree flower stems were used by Aboriginal people in the Lower Murray region as a source of edible nectar when in season, and were used as firesticks when dry (Clarke 1986:11; 1994: 175). Both the grass tree and the ribbon weed have edible tubers (Clarke 1988: 69–70; 1994: 175).

[13] It is not clear whether this is menstrual blood or faeces.

[14] In Taplin's version, Ngulawar appears as Oulawar. A note by Tindale (on a copy of his 1935 paper in the reprint file, Anthropology Archives, S.A. Museum) says 'Note by Milerum [Clarence Long] 13.5.36. Ngulawar is name for any lookout hill; this one is really Retjerawar ie. the Bluff at Pt McLeay.'

were forbidden to go near there. He was a *kaindjani* (initiate) and therefore covered with red ochre and emu oil and was not to be seen by women. Ochre fell from Waiyungari's body and that made the water red. The two women watched Waiyungari in secret and followed him back to his camp. They forced Waiyungari out of his hut by mimicking emus, and then grabbed him by the penis and seduced him. Nepeli, upon discovering the involvement of his wives with Waiyungari, seized a fire-stick and some grass, and hid this above the hut. He told the fire to burst into flame when Waiyungari and the two wives snored. When this happened, they fled through the scrub towards the Lake Albert Passage, with the fire following them. The kangaroo skins, dropped as they fled, were transformed into a line of salt pans, which remain today as a marker of their flight. At Malbindjerang, on the western side of Narrung Passage, they were forced into the mud and for a time were safe there. After the fire, Waiyungari looked about for a means of escape. He threw a spear towards the sky, but this fell back. Then he threw another, which lodged there. As a result, the sky fell downwards towards the terrestrial landscape. Reaching up to his spear, Waiyungari climbed into the sky. He found it to be 'good ground' and so asked the two women to follow him. They remained in the sky as three stars, the central one being Waiyungari.

The records of Harvey (1939 MS) briefly mention an event surrounding Nepeli, Waiyungari and the wives. She writes that her informants, Creighton Unaipon (Potawalin people, Wellington area) and Jacob Harris (Mungkarrulp people, Tatiara district), told her that 'Pulawaiwal [Pulluwewal]' is a 'hill back of Mission where Nepelle saw his two wives follow Waijunggari'. Harvey also provides another account of how Nepeli gained two more wives after the others went into the Skyworld with Waiyungari. She records that 'Nepelle turned a grass-tree into a woman on Thornley's place [at the south-eastern side of the Narrung township] by touching it. Touched Jew lizard (*manuartiki* [*Amphibolurus barbatus*]) and it turned into a woman.' Both pieces of information from Harvey vary from other accounts in detail, although they are structurally similar to Tindale's version from Clarence Long.

The account provided by the Ronald and Catherine Berndt (1993: 191,228–231, 317, 341, 366–367, 400, 442–444) from Yaraldi people is similar to that of Tindale. A detail the Berndts make explicit is that Waiyungari was living in total seclusion as an initiate. He was the younger brother of Nepeli and their two sisters were the wives that Ngurunderi chased. The two wives of Nepeli were returning to their camp after having been out diving for mussels at Yawaiperung (site on the shore of Lake Alexandrina), when they noticed that the ground at Puleweiwald (hill of Pullawewal) was red from the red-ochred Waiyungari. The women were attracted to him. Waiyungari was also willing to break the rules and sleep with the wives. Nepeli found them and set the fire trap. After escaping the fire, Waiyungari and the wives of Nepeli crossed the lake, regaining the land at Yaltung (site on the south-western side of Lake Albert Passage) and fled to the Sky to avoid punishment. This was achieved by climbing on a string composed of spears, which Waiyungari used to drag the sky down. Waiyungari, because of his red covering of ochre, became identified as the planet Mars. He and Nepeli's wives sit in Ngurunderi's Canoe (Milky Way), with Waiyungari's spears alongside. The emu constellation is nearby in the west.

THE CULTURAL IMPORTANCE OF WAIYUNGARI

The data for all of south-eastern Australia suggests that there was a definable 'set' of dominant ancestors, often described as 'Supreme Beings', who are male, and whose personae or identities overlap from region to region.[15] These dominating figures originated from outside the local cultural area and their point of origin was always obscure. Their travels through the region provided the main founding drama of the society, defining cultural and geographical boundaries, and setting limits to social action. In the process the dominant ancestors encountered people and other spirit beings already living in the area, even if, like Nepeli, they may also have been traceable in their origins beyond the cultural region. Waiyungari is one such local being – he is born in the country and most of his actions, before leaving for the Skyworld, take place there. He is therefore not classed as a 'Supreme Being'.

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[15] In the recorded mythology of south-eastern Australia such male 'supreme beings' include Baiame, Bunjil, Waku, Korna, Nepeli, Nurelli and Ngurunderi. For an overview of these ancestors see Berndt (1974) and Clarke (1995).

The name of Waiyungari refers to his relationship to the Skyworld, which was called Waiyuruwar.[16] There were also other spirit beings, other than the major creators, that the Lower Murray people closely associated with the Skyworld. For example, there is the myth of the 'dream man' Kulda, who came out of the Southern Cross to prepare people for death and to take their spirits to the Land to the West (see Clarke 1997:137). The ethnographic sources of south-eastern Australia contain many examples of ancestors, of greater and lesser importance, who finished up in the sky (Howitt 1904: 488–508; Mathew 1928: 528–531; Eliade 1958: 41–43; Berndt 1974: 24–30). In Lower Murray culture the male ancestors, such as Waiyungari and Ngurunderi, were more prominent in their beliefs than the totem-protectors (*ngatji*) tied to specific descent groups (Berndt 1974: 26; Berndt & Berndt 1993: 243). Although described as 'ancestors', these male beings stand apart from the kinship system.

The predominance of 'Supreme Beings' in the Aboriginal mythologies of south-eastern Australia appears to have been reinforced by interaction with Europeans. There are some clearly Christian influences in the recorded Lower Murray mythology (see Clarke 1995: 150, 152). For instance, Taplin's account of Waiyungari from the 'Goolwa clan', which is blended with the Ngurunderi mythology, appears to have appropriated elements from the Old and New Testament. The acts of a Supreme Being punishing people by giving them death, his forgiveness, together with the birth of a great teacher from a virgin indicate direct Christian influence. Swain (1993, chapter 3) suggests that in south-eastern Australia it was the European colonisation process that generated Aboriginal world views dominated by 'high gods'. Full treatment of the 'high god' debate is beyond the scope of this paper (see Morton 1994: 904–95; Hiatt 1996: 100–119). Nevertheless, it has been previously suggested that the smallpox epidemic that struck southern South Australia just prior to official settlement in 1836 would have devastated local Aboriginal populations and possibly led to some adjustment to cultural practices (Clarke 1995: 145).

The sealers also would have had an impact upon the world views of the coastal Aboriginal people with whom they interacted (Clarke 1995: 145; 1996: 56–59,65–70; 1998: 24–28). The earliest official accounts concerning the Aboriginal inhabitants often occurred some twenty years after the arrival of the first Europeans. These records are therefore of a culture that was coming to terms with European contact. Furthermore, realignment of Aboriginal mythology may well have occurred in the 1880s during the last initiatory sequence in southern South Australia, which was attended by Aboriginal groups from widespread areas.[17] To what extent 'high gods' existed in south-eastern Australian cultures prior to Aboriginal experience with non-Aboriginal people will never be known for certain. Nevertheless, there is a possibility that the rapid demise of Aboriginal population on the frontier significantly enhanced the importance of their beliefs in certain ancestors, particularly those associated with death, living in the Skyworld. The intensive contact between Aboriginal people and European colonists in the Lower Murray region favoured the development of syncretic traditions.

The events of the Waiyungari myth were said to have occurred during early spring, a season recognised by Yaraldi speakers as *riwuri,* running from August to October (Berndt & Berndt 1993: 76, 229–231). This was a time of growth and mating. The illicit involvement of Waiyungari with women was perceived as causing poor fishing initially, but improving upon the arrival of the Young Men (Orion) and Women (Pleiades) constellations in September (Berndt & Berndt 1993: 164). Waiyungari was said to disappear in October-November at the onset of *luwadang*, the time of warmth. According to the Berndts, Waiyungari was symbolic of spring: 'witness his hot-bloodedness, his personification as the red planet, his role of a contravener of the law ... he was responsible for all natural growth' (Berndt & Berndt 1993: 230). There were no rituals for the renewal of seasons or species, apart from the pervasive influence of Waiyungari (Berndt & Berndt 1993: 75). Waiyungari's 'original mythic act of coitus with Nepeli's wives symbolised the propagation of all species – he made possible their recurrent renewal through copulation' (Berndt &

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[16] See Clarke (1991, 1997) for a discussion of the Skyworld concept.

[17] Berndt & Berndt (1993: 163–185,) describe the last initiation sequence in the 1880s at which Lower Murray people were present. Clarke (1995: 151) comments on the impact of widespread participation of Aboriginal groups from south-eastern South Australia, the Mid North of South Australia and adjacent parts of Victoria and New South Wales.

Berndt 1993: 75). This was strongly supported by text translated from Yaraldi that was recorded from Karloan (Berndt & Berndt 1993: 341). Waiyungari's appearance in the sky was a marker for Lower Murray people of the arrival of the breeding seasons of animals and the beginning of the growth period for many economically important plants. In contrast, Ngurunderi was described by the Berndts (1993: 76, 230) as symbolic of winter (*yutang* – cold season from May to July): his actions had set the scene for the later events involving Waiyungari. In the case of autumn (*marangalkadi* –from February to April), this was the time of Marangani the crow.

The starting of a bush fire was a major element in the Waiyungari mythology and another possible reference to seasonal changes. In southern South Australia, fire was important to Aboriginal people as a tool in 'fire-stick farming', which took care of their country and produced new plant growth for the animals they hunted (Clarke 1988: 73, 74).[18] The Berndts (1993: 230) state that Waiyungari:

> was responsible for all natural growth. This theme was latent in all Kukabrak living and thinking at the level of the group as a whole.

The combined activities of Waiyungari and the two wives of Nepeli refer to seasonal changes, which also caused increased sexual activity between men and women. For instance, *narambi* initiates were said to be dangerously attractive to young women (Berndt & Berndt 1993: 178). During spring, sorcery activity was suspended as it was considered too dangerous then and perhaps, as the Berndts (1993: 261, 262) suggest, there was a prohibition 'to honour the season sponsored by the mythic Waiyungari'.

Waiyungari was considered a great hunter, with kangaroo skins often mentioned in the myth versions, and he was also associated with fishing. Wallaby carcases were sometimes thrown into a fire as a ritual offering to Waiyungari before a large hunting expedition (Taplin Journals, 23 September 1859; Berndt & Berndt 1993: 76). Taplin (1874 [1879: 57]) states that although Waiyungari was perceived as being in heaven, he 'is said to sit up there and fish for men with a fishing-spear, and when people start in their sleep it is thought to be because he touches them with the point of his weapon.' His prowess with the spear is also a feature of the mythology. Nevertheless, the act of throwing a spear into the Skyworld and the use of this as a form of ladder to climb up from the terrestrial landscape is not unique in Australian mythology. For example, there is a recorded belief from the Adelaide Plains people of how the Monana (ancestral beings)[19] climbed into the sky. Wyatt (1879: 16) states that his Adelaide Aboriginal source, Konoocha, claimed that 'Monana':

> was one day throwing large spears in various directions, east, west, north, south; when, having thrown one upwards, it did not return to earth. He then threw another, and another, and so continued throwing; each spear sticking fast to the former one until they reached the ground, and he climbed up by them to the sky, where he has ever since remained.[20]

Tindale (1935: 266) uses the similarity of Wyatt's account with that of Waiyungari to state that the 'Kaurna or Adelaide tribe' knew Waiyungari as 'Monana'. Nonetheless, without further connections between Waiyungari and the Monana, this conclusion appears tenuous in light of the wider distribution of some mythological themes.

The bridging of the gap between the Skyworld and the terrestrial landscape was variously recorded as achieved by the length of one or several spears, or on other occasions with the aid of a line attached. In two accounts the spear caused the Skyworld to fall down. In the case of the line attached to the end of the spear, this may relate to the use of 'magic rope' or 'hair cord' reported as used by Aboriginal doctors and sorcerers across Australia (Elkin 1977: 53, 54; Berndt & Berndt 1993: 262). It was believed that certain people could make this rope travel to the Skyworld, up trees, or through space itself. From the above accounts of the mythology, both Nepeli and Waiyungari had special powers. Regardless of the stated method employed by Waiyungari to escape the lower landscape, all these accounts

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[18] In the Lower Murray region during the 1850s, some colonists offered Aboriginal people incentives in the form of goods, if they could get through the dry season without starting a serious bushfire (Aboriginal Protectors Report of 1850, *South Australian Gazette & Colonial Record*, 20 April 1850, p.4.)

[19] Teichelmann & Schurmann (1840(2): 25) list 'Munana' as 'former; late; ancient' and 'Munaintyerlo' as 'of a very remote time; ancient'.

[20] The throwing of spears in various directions into the Skyworld is structurally similar to a myth from the Mid North of South Australia concerning the throwing of boomerangs in different directions to return the Sun from the Skyworld (Tindale 1937).

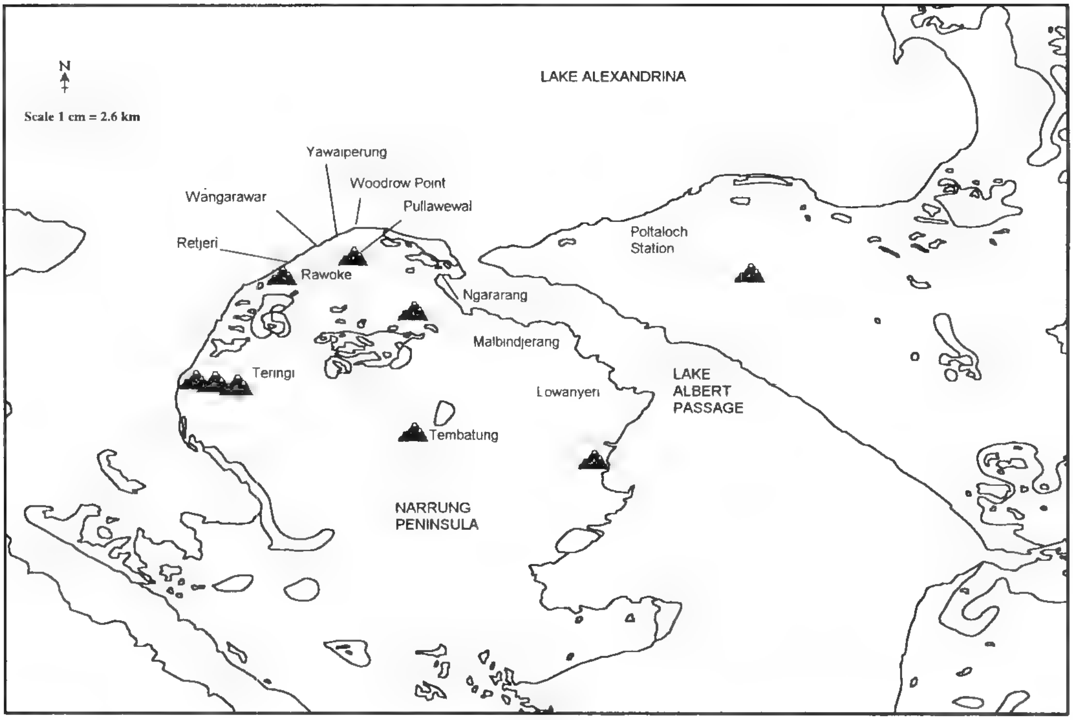

FIGURE 2. Places relating to the Waiyungari mythology in the Narrung Peninsula area (after Tindale 1935).

emphasise the great power of the ancestors in bridging the gap between land and sky. To ancestors, such as Waiyungari and Nepeli, the crossing of this boundary was achievable at high places like Rauwoke and Mulgarap-ngawan.

Tindale's Yaraldi informant, Frank Blackmoor, used the account of Waiyungari to explain the Aboriginal perception of the origin of fires on the Narrung Peninsula. In this manner, landscape-transforming events, such as bushfires, were given a human dimension. Tindale considered that the geographical context in his recorded Yaraldi version is a determinant of the cultural relevance of the Waiyungari story. For instance, due to the configuration of the Narrung Peninsula, bushfires in this region formerly had a tendency to sweep down the path along which Waiyungari fled, particularly in the face of summer north-westerly winds. The sites in the chase sequence of mythological events progressed to the south-east: from Wangaroka, to Malbindjerang and on to Mulgarap-ngawan (Fig.2). This track is entirely contained within the Lower Murray region, unlike that of Ngurunderi that passes right through. The Raminyerar version of the Waiyungari myth may also have had this directional theme, although terminating in the sea rather than the lakes. It is significant that the account of the myth obtained by Tindale from Clarence Long was predominantly located in the Narrung Peninsula landscape, even though this area was not directly relevant to Tangani-speaking people. The Waiyungari myth does not appear to relate directly to areas of the Coorong. The landscape is a crucial aspect of the mythology. As Tindale (1935: 273–274) stated:

> Lifted from this setting they [the myths] lose a great deal of their significance ... the legends, when associated with their geographical context, enable us to understand the people in a manner denied to those who know only the anglicised, generalised stories.

Through myths such as that of Waiyungari, not only the origins of the landscape are 'explained' but so too are such associated physical phenomena as bushfires. Nevertheless, apart from the bushfires, the seasonal and fertility aspects of the Waiyungari mythology are not stressed in Tindale's recording.

Many of the ethnographic accounts discussed in this paper involve Waiyungari's sacred status as an initiate, visibly indicated by his red colouring. His association with young women was discouraged, although he had contact with older women, such as his mother. Young men during initiations were *narambi*, both taboo and sacred (see Berndt & Berndt 1993, chapter 10). Nevertheless, the main restriction in Lower Murray people divulging their acquired knowledge appears to have been by age. The Berndts state that for the young men, 'what they were told at this time, although sacred, was not secret; nor was it information that should be kept from women, because they already knew about these things' (Berndt & Berndt 1993: 163). The four myth cycles focussed upon during the initiations were of Ngurunderi, Marangani (Crow [= Raven]), the Young Men and Girls stars, and of Waiyungari and the two wives of Nepeli with whom he fled. The last cycle was apparently of particular importance to male initiations, the men being symbolic of Waiyungari and the women, whom they were to avoid, of Nepeli's wives. The events associated with Waiyungari are therefore of particular relevance to the prohibitions relating to young men. The initiations were usually commenced in September, when Waiyungari (as Mars?), was still present in the sky (Berndt & Berndt 1993: 169, 178). The themes of ancestors chasing wives and the temptation of initiates by young women are also to be found outside the Lower Murray region.[21] Nevertheless, local interpretations of particular myths were formulated according to specific landscapes.

Myths concerning Waiyungari are heavily interwoven with those of both Nepeli and Ngurunderi. There is a bias towards Ngurunderi in much of the literature. For example, Taplin (1879: 38) states:

> The great god of the Narrinyeri is Nurunderi [Ngurunderi]. They also believe in several demi-gods called Waiungare, Nepelle, and demons Pepi [Prupi?], Melapi [Muːldapi?], Nalkaru, Mulgewanke, and Karungpe.

This may, in part, be a reflection of the recorder's greater interest in landscape-creating ancestors, than those associated with seasonal behaviour. The mythological accounts of Waiyungari, Ngurunderi and Nepeli are linked to the extent that it is not possible to entirely separate them. For example, in the Waiyungari mythology there is some variation in the identity of the angry man who made the fires. It is sometimes a man named Pungngane or Nepeli and in one case it is Ngurunderi. In the latter case, it is likely that this is the result of a mistake by the publisher.[22] Waiyungari and Nepeli were generally considered to be brothers, although one source had the former as the nephew of the latter. In the case of Ngurunderi, he was often said to be Nepeli's brother in-law, although it is not stated whether he has the same relationship with Waiyungari. The kinship links also fan out to the north east of the Lower Murray towards the Darling River (see Berndt 1974: 25–27; Clarke 1995: 150). For instance, Ngurunderi's wives are also said to be the Bakindji sisters originally married to Tulu, who was the Kingfisher spirit killed in the Eaglehawk and Crow myth. Nepeli was also said to be the same being as the Nureli 'All-Father' spirit ancestor from further upriver. Rather than a high level of consistency in the mythology across the Lower Murray region, the roles of the ancestors were often interchangeable. Their actions were sometimes complementary, and at other times apparently antagonistic. For these reasons, they are best treated together as a myth complex, rather than as individual accounts of the landscape. The Berndts propose that whilst Ngurunderi's influence upon the Lower Murray people was perceived by them as mainly spiritual, that of Waiyungari was chiefly physical, with his sexual activity increasing the fertility of all natural species.[23]

WAIYUNGARI MYTHS AS EUROPEAN 'STORIES'

Aboriginal myths have often been used as a

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[21] For instance, the Pulyallana mythology of Eyre Peninsula involves the ancestor chasing two wives across the landscape whilst creating landforms (see Clarke 1997: 128). There is also a version of the Ngurunderi myth, of dubious origin, that has his two wives attempting to elope with another unnamed ancestor (Bonwick 1870: 204). The chasing of two women occurs in the eagle and crow myths of the Maraura people, Lower Darling River, New South Wales (Tindale 1939). White (1975: 131,132) lists similar examples to Waiyungari of temptation in myths from across Australia.

[22] From a comparison between Hacket's own account (*Narrung Alpha*, August 1915 – personal collection of L. Padman) with that cited from him by Laurie (1917) there is clearly a discrepancy. In the first account (written by Hacket), the maker of the fire is nameless, being referred to as 'mighty man'. In the second (written by Laurie who cites Hacket), 'Nurundie' fills this apparent gap. Clarke (1995: 157, end note 14) noted this apparent error.

[23] In particular see Berndt & Berndt (1993, pp.75,287). The sexual influence of the Marangani constellation was also perceived as important, but relates more to the autumn season (see Clarke 1997: 137).

source of plots for stories written for a non-Aboriginal audience. One scholarly reader noted that Waiyungari appeared to be an Australian 'natives' version of 'Jack and the Beanstalk', presumably referring to the climbing into the Skyworld episode.[24] Some versions of Waiyungari written for wide readership, such as those by C. P. Mountford (1971: 36–37) and J. Isaacs (1980: 154–155), closely follow the outline of the detailed ethnographic account provided by Tindale (1935). Nevertheless, the geographical and seasonal aspects have been reduced. Stories written by other authors, who are discussed further in this section, appear to contain new elements that significantly alter the structure of the mythology.

In the Lower Murray mythology described by W. Ramsay Smith (1930: 183, 331), there is the 'Great Spirit' and lesser beings such as Ngurunderi, Nepeli and Waiyungari.[25] Smith (1930: 249–251) gives an account of Waiyungari in a section titled 'The Love-story of the Two Sisters'. As a child, Waiyungari was a gift from Ngurunderi to a childless widow who was mourning the death of her husband. Waiyungari was to become a 'deity', so great care was taken in his training and he could therefore not be given women in marriage. During one spring, the Mar-Rallang[26] sisters 'caught the spirit of the season' and became known to Waiyungari through them imitating the cry of the emu and then the 'love-note' of the swan. When he married the sisters, his 'uncle', who is not named, was angered and asked Nepeli to punish Waiyungari. A fire was made to separate Waiyungari and his two wives, and they fled into the lake. Waiyungari appealed to Nepeli for help, and then threw a spear with a bulrush fibre cord attached to it into Heaven. Nepeli caught the spear, thus allowing Waiyungari and the Mar-Rallang sisters to escape into the sky and become three stars.

The collection of Australian myths told as children's stories by E. Wilson contains 'The Story of Wyungare' (1950: 77–84). This version has Waiyungari as the son of Ngeringa, a woman of the 'Tilmuri' or musk duck 'totem'. Waiyungari was a gift from Ngurunderi to Ngeringa, who found the baby in the branches of a *Casuarina* tree.[27] It was said that Waiyungari would become a great warrior, but would one day return to the 'Sky-Land'. His name was said to mean 'One-Who-Returns-To-Sky-Land'. Ngeringa and her son lived with other 'Narrinyeri' (Ngarrindjeri) people on the shore of a 'big, shallow sea-lake', which was presumably Lake Alexandrina. Waiyungari became a renowned hunter and was permitted to visit the men's only 'bora-ground', where the voice of 'Kunapipi, the Roaring Devil-Devil' was heard. Due to his importance, he was given a hut and tract of hunting land to himself alone. Waiyungari was not allowed to marry. There were two young sisters, called 'Mar-Rallang' which reportedly meant 'Two-In-One', who lived on a neighbouring piece of land. They went to Waiyungari and became his wives. Wewat-Thelari, who was the 'chief' of Waiyungari's group, changed into a hawk and flew to the Sky-Land to consult Ngurunderi over the indiscretion. It was decided that the women must be driven away. This was attempted by starting a large bushfire, which drove Waiyungari and his two wives out onto a point in the lake. Due to the heat, they were forced into the water. Waiyungari appealed to Ngurunderi for help. He threw a spear with a 'magic rope' attached a long way into the sky. Ngurunderi caught the spear in his hands, and pulled up the wives and then Waiyungari. They were all allowed to live in the Sky-Land and 'shine forever'.

In A. W. Reed's (1980: 60–63) account, titled 'The Husband and Wives Who Became Stars', Waiyungari was a gift to a grieving childless widow from the 'ruler of the heavens'. In this

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[24] Letter from Charles Chewings to N.B. Tindale, dated 2 November 1935 (Chewings collection, AA59/1/1, Anthropology Archives, S.A. Museum).

[25] There is some evidence to suggest that the bulk of the mythology appearing in Ramsay Smith's volume was collected by a Ngarrindjeri man, David Unaipon (see Jones 1990: 303–305; Clarke 1997: 142, endnote 4). P. Jones (pers. com.) suggests that Ramsay Smith tampered with the cultural information in Unaipon's account, when producing the published version, thereby reducing its reliability as an ethnographic source.

[26] The name Mar-Rallang appears to be derived from *marrari* – 'sister', and *-engk-* 'they two' (Meyer 1843(2): 59,78). Related forms, Meralang and Maralangk, were names used for the Pages Islands as sites in the Ngurunderi mythology, which were reported to mean the 'Two Sisters' (Berndt 1940: 181; Berndt & Berndt 1993: 226).

[27] The choice of a Casuarina or sheoak tree may not have been accidental. The Casuarina tree has significance elsewhere in Lower Murray mythology, being the tree that Ngurunderi sat under before going into the Skyworld (Berndt 1940: 182). The large size of some trees allowed them to be perceived as a link between the Skyworld and terrestrial landscape (see Clarke 1997: 127,128).

version, the 'ruler' was Nepeli and his servant was Ngurunderi. As a young man, Waiyungari was initiated. He met the Mar-rallang (Mar-Rallang) sisters who called to him separately: one of whom was imitating the cry of an emu, the other the mating call of a swan. Waiyungari married them both. Nepeli considered this to be a illicit union between 'spirits of heaven' with 'daughters of the earth'. Ngurunderi was commanded to separate Waiyungari and the sisters, which was done by fire that pursued them into a shallow swamp. When the surrounding rushes began to burn, Waiyungari had the women climb onto his spear which he threw into the sky 'like a star that had mistaken its direction and was fleeing from earth', leaving himself behind. Due to his heroic act, Nepeli took pity on him and his spirit was lifted to join the two wives in living in the heavens, as three stars.

The popular accounts mentioned above are of mixed value as ethnographic sources of Aboriginal mythology. Some elements in Ramsay Smith's version relate closely to accounts of the mythology produced by anthropologists, although there are points where it differs significantly. For instance, the seasonal aspect of the story is important. Ramsay Smith (1930: 250) stated:

> The spring-time of the year is a great time in the training of the young people of the tribe. They are taught to become quick and observant in detecting the different love-notes of the wooing birds, and the mating impulses of the animals.

The impact of this time of the year on all people and creatures is a strong feature of this account. Nevertheless, there is no mention here of the *narambi* status of young men in providing a reason why the relationship between Waiyungari and the sisters was prohibited. The absence of ochre leads to the final destination of Waiyungari in the heavens as simply as a star, and not Mars (a red planet).

In the case of the Wilson account, the elements introduced have been appropriated from Aboriginal cultures elsewhere in Australia. The use of 'bora-ground' and Kunapipi are obvious inclusions from New South Wales and Arnhem Land respectively.[28] The use of Tilmuri ('Musk Duck'), Tinneware ('Bream'), and Ponde ('the Big Cod') are consistent with a Lower Murray origin of this account.[29] Other words, such as Milla-Milla ('child'), Bulwarra ('Pelican'), Dondu ('Black Swan'), Towrie (land), gunyah (shelter, hut), Ngurrung-Ngura ('the Red Sunset'), Gur-Gur ('Hawk'), and the phrase 'Hala-hala mai, oknira bata' ('Come here, great Teacher; here you and your wives shall live and shine forever!'), are not.[30] The gift of a baby to a childless woman by Ngurunderi, who appears to be a high god, has some resemblance to Christian beliefs concerning the birth of Jesus. In this respect, there appears to be some similarity with the Moriarty account published by Taplin. The uncertainty over the sources of Aboriginal ethnographic data and the lack of place names in such accounts militates against their use in describing local Aboriginal cultural landscapes.

There is a similarity in story structure and word usage between the accounts of Reed and Ramsay Smith (1930). Nonetheless, the roles of the three main characters in Reed's version is somewhat distorted from the main ethnographic accounts and popular accounts given above, with Nepeli given primacy over a subordinate Ngurunderi. The method of the women gaining access to the Skyworld is also different, involving one spear rather than many or, as with Ramsay Smith, with one spear and a cord. In Reed's account, the stated principal that prevented the marriage between Waiyungari and the sisters was the prohibition between the union between beings of different landscapes. The apparent replacement of the reason being initiate prohibitions with that of a type of taboo prohibiting unions between gods and mortals suggests that the author introduced this element, perhaps borrowed from classical Greek and Roman mythology. The impetus for changing the basic story may have come from the author's desire to create some original work.

The Waiyungari myth has had an impact upon the local place-names around Point McLeay. Pulawelwal Hill is a large mound situated between the Narrung township (near Point McLeay) and the Mann Cemetery on the road to Mark Point. The hill was sign-posted in the late

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[28] See Berndt (1970, 1974).

[29] Taplin (1879: 40,130) lists all these terms.

[30] These are either words derived by the writer or terms obtained from Aboriginal languages in eastern and northern Australia.

FIGURE 3. A Point McLeay resident, Susan Rankine, at 'Pulluwewal', 'Wyungare's Hill' (Photo: P.A. Clarke, 1990).

1980s by Narrung farmers as 'Pulluwewal', 'Wyungare's hill' (Fig.3).[31] Apparently, earlier this century a local farmer whose paddock covered most of the hill was in the habit of calling all his cows with names starting with 'Pulluwewal', for example 'Pulluwewal Daisy', 'Pulluwewal Mary' etc (L. Padman, pers. com.). The reinstating of the Aboriginal name for the hill therefore commemorates both Aboriginal and non-Aboriginal traditions. Wangarawar, the place in the myth where the wives first saw Waiyungari, is a point jutting into Lake Alexandrina on the north side of the Point McLeay township. This name is still used by Aboriginal residents and it appears on published local maps. Raukkan (a version of Rauwoke) is the local name for the area of the Point McLeay settlement, which is on the side of the hill where in mythology Nepeli lived. This has been used consistently by Aboriginal people since European settlement.[32] Several years ago this Aboriginal place-name officially replaced Point McLeay as the town name.

For eleven years, between 1988 and 1999, the major Aboriginal cultural exhibition at the South Australian Museum was 'Ngurunderi: a Ngarrindjeri Dreaming'. This took the theme of the Ngurunderi mythology and used it as a display device to describe the Ngarrindjeri culture of the Lower Murray region. The exhibition and the associated film have been a significant influence on public attitudes towards Aboriginal cultures in south-eastern Australia. The impact of these upon primary and secondary school curricula and university Aboriginal studies has also been significant.[33] This exhibition has been a successful exercise, judged in terms of giving the broader population an appreciation of the cultural complexity of a particular Aboriginal group. Nevertheless, although the ethnographic literature clearly gives Ngurunderi primacy, the result of this bias in the perceptions of people in more recent times is to underplay or ignore altogether the important roles of other beings, such as Waiyungari, in Lower Murray mythology.

CONCLUSION

In Lower Murray cosmology the spirit ancestor, Waiyungari, was important at the onset of spring to help bring about the change of seasons. Aboriginal people perceived that the fertility of their region relied upon this ancestor and the

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[31] This placename has been listed by a number of recorders: Pulluwewal – 'at the house'; a spot near Point McLeay and said to be 'Waiungare's house' (Taplin 1874 [1879: 55,56,130]); Pulluwewal – isthmus between Lake Alexandrina and Lake Albert (Ramsay Smith 1930: 249); Pul:uwewal – camp of the spirit ancestor Waijungari (Tindale site recording map, Anthropology Archives, S.A Museum); Puleweiwald – Waiyungari's camp (Berndt & Berndt 1993: 191,228,317,400,442,443).

[32] There are number of variations of the placename, Raukkan. These include Rauukki, Rauwoke – 'the ancient way'; Point McLeay (Taplin 1874 [1879: 56,57,130,139,140]); Rewuk – Point McLeay (Yallop & Grimwade 1975, map and p.100); Rawukung – Point McLeay, site of the mission and primary living area of the Retjerindjeri clans people before mission established (Tindale site recording map, Anthropology Archives, S.A Museum); Rawukung – Raukkan (Berndt & Berndt 1993).

[33] For the exhibition booklet see Hemming & Jones (1989). Hemming (1988) describes the making of the film. Clarke (1995) discusses aspects the changing role of the Ngurunderi mythology. Examples of school use are seen in Education Department of South Australia (1990, 1991).

forces associated with him. His appearance in the sky was a marker of the arrival of the breeding seasons of animals and the beginning of the growth period for many plants. Firing the landscape was an important part of this regeneration. Waiyungari's influence was not restricted to animals and plants, but was important to people as well. Initiates were symbolically linked to the Waiyungari mythology. The ethnographic accounts of Waiyungari demonstrate the same range of variation in detail as previously discussed for other south-eastern Australian myths. The Waiyungari mythology appears to be chiefly relevant to the area bounded by Narrung Peninsula and Lake Albert Passage in terms of sites, and is therefore not of the same order in landscape modifications as, for instance, with Ngurunderi. Nevertheless, there are linkages with Waiyungari to the mythologies of Ngurunderi and other major spirit ancestors to the north east. The use of Waiyungari in popular writings has largely stripped out the important mythological elements that explained local Aboriginal perceptions of their land. This component of the literature is unreliable as an ethnographic source, and is best treated as fiction written for a non-Aboriginal readership with a partial relationship to Aboriginal cultural landscapes. Nevertheless, Aboriginal mythology is important to a much wider audience, forming a basis to investigate the Indigenous background of Australian culture. As the present cultural contexts for this mythology change, Waiyungari may yet re-emerge as an important vehicle for discovering the Aboriginal cultural landscape.

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THE PACIFIC CULTURES GALLERY* IN THE SOUTH AUSTRALIAN MUSEUM

CARSTEN HENN AND BARRY CRAIG

HENN, C. & CRAIG, B. 1999. The Pacific Cultures Gallery in the South Australian Museum. *Records of the South Australian Museum* **32**(1): 69–89.

This paper recounts the history of the Pacific exhibits in the South Australian Museum, focussing after 1895 on those exhibits located on the top floor of the North Wing. This space has become known as the Pacific Cultures Gallery even though natural science exhibits have shared the space. Over the decades there has been a consistent evolution of the display until now, just over a century after the opening of the North Wing, the opportunity exists for the Gallery to be devoted solely to the display of Pacific cultural material.

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PACIFIC FOUNDATIONS

From its foundation in 1856, the South Australian Museum has had a strong and continuing interest in the Pacific.

> It was in 1860 that the Museum secured as a donation from William Owen, M.P. a large series of articles from Fiji, including tapa cloth, clubs, spears and clothing, and also some Malayan models of pirate praus; thus, as far as can be ascertained, the Museum secured the first of its now extensive Pacific Island and Indonesian collections (Hale 1956: 12).

One of the first exhibits of this museum was a display of Fijian material.

> [William] Owen's collection of Fijian "curiosities", installed in a special "Fijeean room", was the centrepiece of the museum's ethnographic exhibits when it opened to the public for the first time [on 2 January 1862]. By the 1860s Australian Aborigines and their objects no longer retained their capacity to evoke the exotic from the inhabitants of Adelaide – this role was filled by Pacific artifacts, particularly those from Fiji. Owen's Fijian collection was complemented by New Caledonian objects . . . contributed by Robert Gouger[1] (Jones 1993: 21).

* **Note**: The Pacific Gallery is closed for renovations and will reopen in March/April 2000.

Elsewhere Jones (1996b: 28) informs us that 'Among the ethnographic objects it was the Fijian rather than the Aboriginal artefacts which evoked most critical and public interest' and Hale (1956: 13) noted that, 'the Fijian collections had been exhibited from time to time' even before the Museum opened in the South Australian Institute building in 1862.

The Institute building soon became overcrowded for its three functions as Museum, Library and Art Gallery and in 1878 a complex to the east of the existing building was planned. This was to consist of four multi-storied structures set around a courtyard (ibid., Plate oppos. p.35), only two of which have been built. The westernmost wing was commenced in November 1879 and was occupied progressively until its official opening in December 1884 as the Jervois (or West) Wing.[2] Each of the cultural institutions occupied about a third of the space in the new building. Dr Wilhelm Haacke was appointed as the first Director of 'The South Australian Museum' in February 1883 and began a vigorous program of expansion of the functions and collections of the Museum (ibid.: 39ff.).

Amandus Heinrich Christian Zietz (Fig. 1) was engaged as a preparator in 1884 and by 1888 had progressed to Assistant Director under Stirling who, as Chairman of the Museum Committee, was acting unofficially as the Director following

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[1] Gouger's collection is not identifiable in the present collections; labels were lost from many objects before registration was formally commenced in 1911 and where objects could not be matched with various lists they were labelled 'Old Collection'.

[2] In 1884 the South Australian Institute became the Public Library, Museum and Art Gallery of South Australia. This arrangement was not changed until separation of each institution by Acts of State Parliament in 1939.

FIGURE 1. Amandus Heinrich Christian Zietz (from Hale 1956, oppos. p.41).

the departure of Haacke in 1884.[3] Zietz, born in Denmark, had previously been a preparator and then a curator at the Zoological Institute Museum at Kiel, interested mainly in birds and fishes, and became 'right hand man to Stirling for 25 years' (Hale 1956: 41). Edward Charles Stirling (Fig. 2) was appointed Honorary Director in 1889, confirming the role he had been playing unofficially.

As a result of Haacke's short but energetic Directorship, the Museum had quickly outgrown its accommodation. By 1883 the Museum's ethnological collection had been boosted by other Pacific material from New Guinea (ibid.: 42). Although in 1884 'ethnological material from Fiji and the southeast of New Guinea was in hand, but very little other Pacific Islands material' (ibid.: 46), by 1887 this ratio had changed in such a way that Zietz was able to state that 'the New Guinea collection now forms the most noteworthy part of the ethnological collection' (*Annual Report* of 1886–87: 19).

A detailed inventory by Zietz can be found in the *Annual Report* 1887–88: 18:

> Fiji represented by about 100 specimens; . . . Solomon Islands represented by about 23 specimens; New Britain Islands represented by about 80 specimens; . . . New Guinea Islands represented by about 300 specimens; Australia (including all the colonies) about 400 specimens, exclusive spears. . . . Nearly the whole of the Fijian collection was presented by W. Owen, Esq., and

FIGURE 2. Edward Charles Stirling (from Hale 1956, oppos. p.51).

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[3] One of the reasons for Haacke's untimely departure was some dissatisfaction with his readiness to send specimens to other institutions abroad. Hale notes (1956: 47) that among these were 'Fijian collections said to have been sent to Germany (apparently most of the William Owen collection, donated in 1860)'. It is also of interest that after he left the Museum, Haacke joined the 'Bonito' expedition to Papua sponsored by the Royal Geographical Society of Australia, which spent June to December 1885 exploring the Strickland River, a tributary of the Fly. The ethnographic collections from this expedition were lodged in the Colonial (now State) museums in Brisbane, Sydney and Melbourne.

> contains many valuable specimens. New Guinea, represented by about 300 specimens, forms undoubtedly the most attractive and valuable part of the whole collection . . . Some sketches, showing native houses, villages, and scenery, are included in the collection, but photographs of the Papuans are still wanted.

Jones (1996b: 55–63) attributes the marked increase in South Australian interest in ethnographic material during the 1880s to the popularity of the International Exhibitions (especially South Australia's constribution to the Colonial and Indian Exhibition in London in 1886) and their counterparts in Sydney, Melbourne and Adelaide. Hale (1956: 64) especially remarks on the Jubilee Exhibition in Adelaide in 1887, for which a special building was erected on North Terrace and which featured 'a splendid collection of Malayan products, including a complete series of ethnological objects' provided by the Sultan of Johore, and 'good New Guinea ethnological material – the Theodore Bevan collections from "the Douglas and Jubilee Rivers"'; both collections were obtained for the Museum after the Exhibition closed.

> The Exhibitions elevated the notion of civilisation's progress by means of sophistication in technology. It was natural that the tools and weapons of 'savage' societies would be regarded in juxtaposition to this sophistication, providing a measure of progress for the throngs of visitors (Jones 1996b: 57).

THE MUSEUM'S NORTH WING – 'A BUILDING PROVIDED SOLELY FOR ITS PURPOSE'

Stirling kept abreast of museum developments abroad and embraced the taxonomic classification system which treated ethnographic material in much the same way as natural history specimens. Thus he 'became aware of the potential for filling those gaps in collections which taxonomic systems made evident' (ibid.: 64). Ethnographic material was classified primarily on the basis of object type and presented by geographic regions to facilitate comparison. This motivated Stirling to seek out specimens from geographic areas not hitherto represented in the Museum's collections. To supplement the Australian Aboriginal ethnographic collections he issued a circular to police and telegraph officers during the mid-1890s appealing for material (ibid.: 196) and several Lutheran missionaries provided well-documented Aboriginal material around the turn of the century. Stirling also obtained several Pacific collections from Anglican, Presbyterean and Methodist missionaries based in Adelaide but these were usually poorly documented.

All this activity rapidly increased the size of the Museum's ethnographic collection and Stirling worked energetically to gain new space for the Museum. This was accomplished by the construction of a building where the north wing of the cultural institutions complex was meant to be located but there were insufficient funds to build in the style of the first structure (the Jervois Wing).[4] Meanwhile, in 1889, the Art Gallery was moved out of the Jervois Wing into the Jubilee Exhibition Building[5] further to the east on North Terrace.

In January 1895, the North Wing[6] was officially opened (Hale 1956: 69). This was a modest red-brick structure with a ground floor and an upper floor gained by an impressive staircase. Two large light wells in the upper floor allowed light from a glass roof to illuminate the ground floor (Fig. 3). This same year Stirling was appointed salaried Director, a position he retained until 1913.

Regarding the move of the collections when the building work had finished, Jones writes (1993: 27):

> [Stirling's] organization of the transfer of museum collections from the Jervois Wing to the new North Wing of the Museum in 1893 enabled him to further gauge the strengths and weaknesses of the Pacific collections.

Although Stirling undoubtedly provided overall direction of the operation, Hale (1956: 72–3) attributes much of the detailed work to Zietz:

> So rapid was the progress in occupying the two

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[4] Presently occupied by the Mortlock Library, a part of the State Library.

[5] Although arguments were put to government in 1882 to complete the building of the four wings of the cultural institutions as proposed in 1878, to house the Jubilee exhibitions of 1887 and then use these buildings for the Library, Museum and Art Gallery, this was not done (Hale 1956: 69). Instead the Jubilee Building was constructed and after the 1887 Exhibition was used for a number of purposes, finally being demolished in the 1960s to make way for a University of Adelaide underground car park.

[6] The North Wing is sometimes referred to as the West Wing in Reports and correspondence. Although it was the North Wing in the original 1878 plan it was thought of as the West Wing when the Museum's second (East) wing was built.

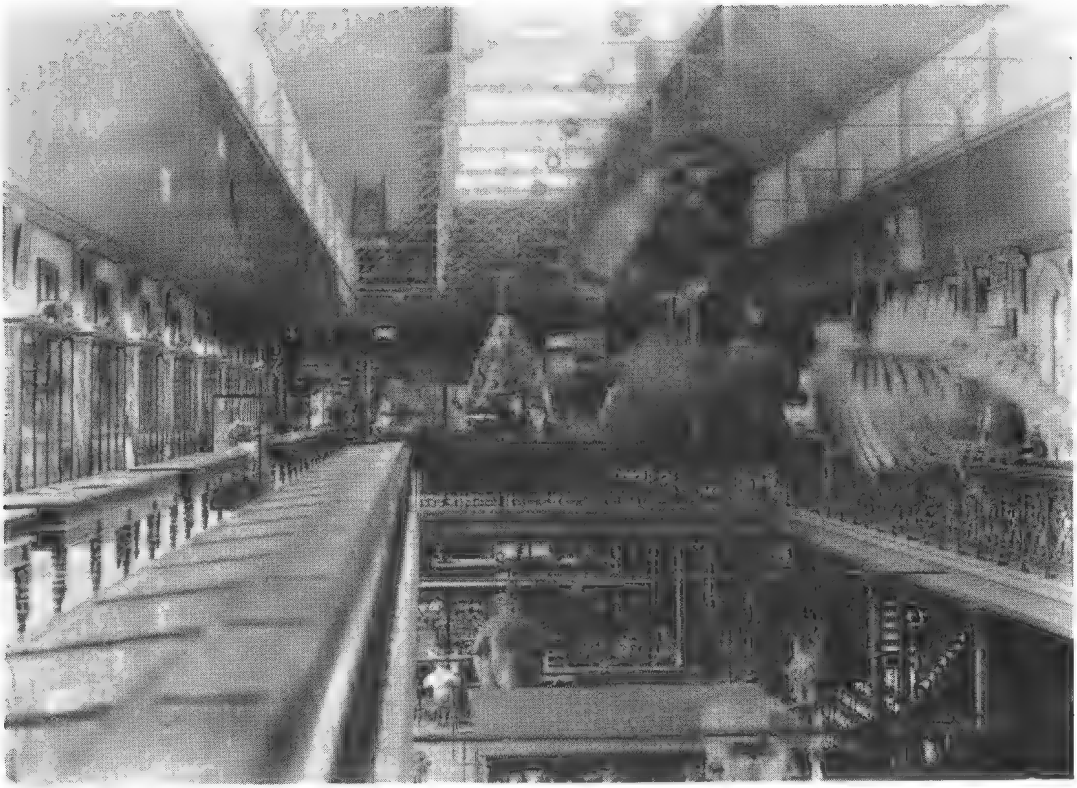

FIGURE 3. Photograph of top floor, West (ie. North) Wing, 31 November 1899 by Mr A. Treichel; view from eastern end of Gallery looking west; eastern lightwell in mid-ground and 'Bridge Case' in centre of Gallery. Note Fijian exhibit in south-western corner where it has remained to this day.

> floors of this building, 230 feet in length, and so pleasing was the arrangement to Stirling, that he enthusiastically reported to his committee that Zietz, 'on whom fell the chief labour of the removal and rearrangement of the collections has dealt with this tedious and arduous undertaking with an intelligent energy that deserves commendation'.

The Pacific Islands displays at that time were only a small part of the total exhibitions but they have expanded and evolved in that space ever since. Hale records (ibid.: 81):

> The Pacific Island ethnological material had so increased by 1898 that it occupied the whole of the wall cases on the southern side of the Museum. This was soon augmented by Fijian weapons and tools, 133 in all, presented by James Angas Johnson.[7]

However, the collection was far from being arranged in a pedagogically sensible way. Most exhibits lacked labels. As a result, visitors neither knew where exactly the specimens hailed from nor what they were in the first place: 'The ethnological cases are so congested that a systematic or scientific arrangement, or any descriptive labelling, is quite impossible' (Stirling in *Annual Report* 1902–03: 9).

Missing labels, though, were a shortcoming which could be set right with comparatively small financial means. Zietz, responsible for the ethnological department as Assistant Director from 1888–1909, wrote: 'The Fijian Collection has been temporarily re-arranged and printed labels attached to the specimens' (ibid.).

Thus it appears that the installation of the Pacific Cultures Gallery on the upper floor of the North Wing was largely the work of Zietz, presumably with some general direction from

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[7] Johnson obtained the collection on behalf of the Museum from Mr D. Garner Jones of Levuka, Fiji, in 1900. The most valuable of these items is a headrest (*kali*), A.7313, which 'Belonged to Tanoa, King of Fiji'.

FIGURE 4. Edgar Ravenswood Waite (from Hale 1956, oppos. p.95).

Stirling. Amandus Zietz retired in December 1909 and his son, Robert, took up his father's duties in ornithology.[8]

At the end of 1912, after 32 years of working at various posts at the South Australian Museum, Stirling resigned from his position as Director but continued for a short time as Honorary Director. In 1914, Edgar Ravenswood Waite (Fig. 4) took over as Director (Hale 1956: 95–6); Stirling concentrated on the displays of Australian and Pacific ethnography 'and continued to exert strong influence within the institution as Honorary Curator of Ethnology until his death in 1919' (Jones 1993: 27). It was during this period that Stirling put his mark on the Pacific Gallery exhibits.

The famous anthropologist, Bronislaw Malinowski, who had extensive knowledge of the Melanesian region and especially of its trade relations, had a brief association with the Museum, Jones reports (1993: 27):

> Stirling was . . . [indirectly] responsible for the acquisition of at least one item attributable to the anthropologist Bronislaw Malinowski . . . This object, a 'woman's dress' (A.7703), was deposited in the Museum collection by Edward Stirling's daughter, Nina, to whom Malinowski had become briefly engaged during his stay in Adelaide at the Stirlings' Mt. Lofty home in 1914.

It is most likely that Malinowski visited the Pacific displays and made comments on them. However, it remains uncertain to what extent Stirling would have been influenced by these comments in the re-arrangement which was conducted only a few years later.

THE MUSEUM'S EAST WING – 'THE AUSTRALIAN COURT'

The possibility of a re-structuring arose in 1915 with the opening of the East Wing[9] (Fig. 5) of the museum, which became known as 'the Australian Court'.

> Exhibition space on the galleries was now almost trebled and for the first time in the history of the Museum it was possible, for a while, to segregate the Australian material from the extra-Australian or so-called 'general collections' (Hale 1956: 103).

It was this re-organisation of museum exhibits which made space for the expansion of the Pacific exhibits and their occupation, eventually, of all the wall cases on the upper level of the North Wing (ibid: 107).

Over-crowding of the cases was a problem alluded to repeatedly in Annual Reports. Because there was inadequate provision for storage of reserve collections, the safest course was to put as much as possible on display, where the condition of the objects could be monitored. The only other solution would have been to create more space in the galleries and it was not possible to consider increasing floor space by filling in the light-wells until illumination of cases by cheap electric lighting became feasible with the general availability of fluorescent tubes. Still, Stirling tried to make the most of the situation, to improve the displays and to make them ethnologically more sensible.

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[8] Several years later, Robert Zietz was also given the task of registering all the ethnological specimens on display, which took three years to accomplish (Hale 1956: 107) but there is no indication that he was involved in reorganising the Pacific displays.

[9] The East Wing was designed to match the style of the Jervois Wing which by then was completely occupied by the State Library. Thus half of the original 1878 plan was executed (Hale 1956: 97).

FIGURE 5. The East Wing of the South Australian Museum; North Wing to left.

In 1917, he re-arranged the material from Fiji yet again:

> Fiji – This series, containing some very valuable specimens collected in the old days, and now not procurable, which was before very overcrowded, has been rearranged to better advantage, but the cases are even now still rather congested (Stirling in *Annual Report* 1916–17: 13).

However, it was still impossible to structure the gallery systematically. All Stirling could really do was fill 'gaps' with newly acquired material which was kept safest in the display cases. It is hardly surprising that it was not always possible under these circumstances to integrate the specimens in a regionally or thematically correct way.

> On the days of writing I am engaged on the work of their arrangement [i.e. of some newly acquired specimens from New Guinea] and, though an interesting exhibit may be possible, it is evident that all the specimens cannot be placed on view. This is unfortunate, as they are interesting, attractive, and intrinsically good. In any case, owing the want of sufficient and suitable cases, a systematic arrangement cannot be strictly followed (ibid.).

It was another ten years after the East Wing was opened to the public in 1915 before all the Australian ethnological material was removed from the North Wing allowing more Pacific exhibits the use of the space.[10] In the Annual Report 1917–18: 10, Waite wrote:

> The gallery of this court [ie. the upper level of the North Wing] is devoted mainly to Ethnology; about half the space is occupied with the overflow from the Australian court, the remainder accommodating the Pacific Islands material, of which we possess a very unequal display. Advantage was taken of about 30 small hanging wall cases to house some of the more remarkable or beautiful objects of native manufacture.

The small hanging wall cases Waite mentioned,[11] as well as another re-arrangement,

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[10] Upon completion of the East Wing, the available space had to be shared with some of the collections of the Art Gallery, curtailing the building's use for Museum purposes until the completion of the Art Gallery's Melrose Wing in 1937 (Stirling 1956: 147).

[11] These small 'hanging wall cases' may have been those located above the main wall cases along the north wall of the Gallery. These were criticised several years later by a visiting overseas museum professional as being too high for people to see their contents clearly.

were the last things Stirling was occupied with before his death in 1919:

> The time at my disposal during the past year has been almost exclusively devoted to the re-arrangement of the Papuan, Melanesian, and Polynesian collections in the gallery of the General Court. With the specimens from these localities formerly displayed there have now been incorporated the valuable and extensive series of stone clubs, ceremonial, and other articles from Papua presented by Major Balfour Ogilvy, which form a notable addition. Various other similar collections acquired by donation from other sources and by purchase have also been similarly incorporated. The result of these additions is that the collections from the regions mentioned have been very considerably augmented, both in number and value. About 2 200 specimens in this category have been catalogued and placed on exhibition. By the re-arrangement these objects, many of them of a striking character, are now shown more effectively and somewhat more methodically than was previously the case. It is, however, admitted that the cases are still undesirably overcrowded, and, owing to the stringent limitations of space, it has been found impossible to adhere strictly to a geographical classification, which would have been highly desirable. However, under existing conditions, nothing better could be done. The main advantage gained is, that the specimens in question, many of them of a fragile or perishable nature, can now be constantly kept under observation, so that we shall be free from the anxieties as to the fate of articles that are packed up and stored (ibid.).

No doubt a major impetus for the expansion of the Pacific exhibits in the post-World War One period was the collecting expedition by Edgar Waite to the Bismarck Archipelago of New Guinea for four months in 1918 (Craig 1995; Hale 1956: 115–116; Jones 1992), following Australia's military occupation of German New Guinea in 1914. 'Waite brought back with him collections which occupied six tons of shipping space' (Hale 1956: 115). These collections consisted of both natural history and ethnographic specimens.

The ethnographic material collected by Waite is today prominently represented in the Pacific Gallery, particularly in the New Ireland displays. Other collections from New Guinea were obtained from officers (e.g. Major H. L. S. Balfour Ogilvy) serving there with the Australian Military Expeditionary Force, some of whom (e.g. Captain A. J. Hunter) stayed on as District Officers when civil administration resumed after the conclusion of the War.

On 20 March 1919, Sir Edward Stirling died. He left a legacy of an amazing 10 000 Australian Aboriginal and Pacific ethnological specimens on exhibition (ibid.: 107). Temporarily, Director Waite took over the Department of Ethnology and had soon to admit:

> Your Director is . . . responsible for the care and conduct of the Ethnological collections formerly controlled by the late Sir Edward Stirling; it cannot be surprising, therefore, if he is unable to produce much evidence of scientific research (*Annual Report* 1920–1921: 9).

Despite his increased responsibilities, Waite launched a project in 1920 which indirectly led to the upper level of the North Wing being stocked exclusively with ethnological exhibits from the Pacific, although the mineral exhibits remained. In the *Annual Report* 1919–20: 10, Waite set out his plan:

> Of these needs the following are the principal . . . The complete fitting with cases of the annexe to the Stirling Gallery of Australian Ethnology. The space thus obtained would relieve the General Court [North Wing] of the Australian weapons there exhibited, and permit of much valuable material from the Pacific Islands being shown.

It is hard to date precisely, from the archival sources available, when the Pacific Gallery had expanded to the point where it 'occupied the wall cases on all sides of the upper floor' (Hale 1956: 107), but Hale comments upon it immediately after noting that 'the Australian ethnologia from the north wing was removed in 1924' (ibid.). Probably it took place progressively over the next year or so. Waite, in the *Annual Report* 1924–25: 11, stated:

> The space set free rendered it possible to re-arrange considerably the general collection, and to add many fine exhibits, including specimens obtained by the Director, in 1918, in New Guinea, New Britain, and especially New Ireland.

In 1928, Waite died on his way to a Science Congress in Hobart, Tasmania. Herbert Hale was appointed 'Museum Curator' after applying for the position of Director and three years later, in 1931, was appointed Director. Also in 1928, Norman Barnett Tindale (Fig. 6), the next person to have a significant impact on the Pacific Gallery, became the museum's ethnologist (Hale 1956: 138; Jones 1996a). He had started at the museum in 1918 in the entomological section (under a kind of apprenticeship rather than as an academic student) but within a few years had developed an interest in ethnology as well.

Tindale's first experience in collecting ethnographic material was in 1921–2 on Groote

FIGURE 6. Norman Barnett Tindale

Eylandt. In preparation for this work, he consulted with Baldwin Spencer in Melbourne, who gave him his own copy of the 1912 edition of *Notes and Queries on Anthropology* (Jones 1996b: 336). Jones describes Tindale's theoretical position as:

> . . . a salvage ethnographer from a natural science background . . . in the same company as Alfred Cort Haddon, Baldwin Spencer, or more appositely, Franz Boas. But despite sharing his [Boas's] relativist perspective, placing ethnographic objects within their specific cultural contexts, Tindale never repudiated evolutionist theory as Boas had done. In fact, Tindale's application of natural science taxonomic principles to ethnographic collections and exhibitions . . . more clearly echoed the career and achievements of the Smithsonian Institution's Otis B. Mason (ibid.: 337).

With regard to his responsibilities for the Pacific exhibits, Tindale had to deal with a lot of difficulties. Apart from the lack of space, the South Australian Museum had further problems. In the 1933 *Report on the Museums & Art Galleries of Australia*, sponsored by the Carnegie Corporation of New York, the lighting in the museum was criticized (Markham & Richards 1933: 43f.):

> In the Australian Museum a particularly notable exhibit is the New Guinea Ravi. In the Tasmanian Museum the aboriginal habitat case is delightful and attractive in every way. Somewhat similar cases are to be found in the Brisbane, Adelaide and Melbourne Museums, but the last two are spoilt by unfortunate lighting, resulting in excessive reflections.

After Waite expanded Stirling and Zietz's arrangement of specimens in the Pacific Cultures Gallery, little seems to have been changed until after World War II. Paul Lawson came to the Museum's team in 1936 as lunch attendant but after the War he was employed in the Exhibitions section. In an interview, 19 June 1997, he related:

> There was very little movement . . . in the layout of the specimens prior to the War. Except when Frank Tose from the Californian Academy of Sciences came out here, and he made quite a few suggestions about better visibility in the East Wing. He made some suggestions and we followed those, and in what we call the West Wing, now the North Wing . . . He made his suggestions on the grounds that eye-level material was valuable and [the] other was lost . . . The cases on the north wall that were above the main [wall] cases he considered were superfluous [because] he couldn't see the specimens. And we know that those specimens originally were put in those cases for visible storage because there was no other space around the area where you could store the stuff. When those cases were disbanded we used [them] in various ways, but the material had to be stored . . . I don't recall any dramatic changes until post-War days.

THE WAR – REMOVAL TO SLEEPS HILL TUNNEL

Alarmed by the Japanese attack on Pearl Harbour on 7 December 1941, the South Australian Museum took steps to protect its collections in case of air raids. After some time looking for an adequate storage place for the collections' most valuable pieces, an abandoned railway tunnel was identified at Sleeps Hill, south of the City. However, to this day it remains unclear which parts of the collections were chosen for safe-keeping. In a letter to Hale dated 31 December 1941, Tindale wrote:

> In preparing the above list of material, it has been estimated that the only practicable method of dividing the general collections is to take each alternate specimen, or each alternate container, leaving the other in position. By this means,

> sufficient material will remain on display, and the division will ensure that the risk is halved.

Paul Lawson, who went to the War before the specimens were removed to the Sleeps Hill tunnel, and came back after they had been returned, understood that the division had been carried out on other grounds (Interview, 19 June 1997):

> They took any material off display that was considered extremely valuable. It couldn't all go, but the reference collections[12] . . . went up there because they are really the key.

This seems to be confirmed by the following excerpt from Tindale's letter to Hale, quoted above, which also gives an idea of the quantity of material that had to be transported:

> I have made an inventory of the material in this Museum which it seems desirable should be placed in safe keeping in a war emergency. I have divided the list into two, namely (a) Essential Documentary Records, (b) List of the Total Weights and Cubic Measurements (net), of the irreplaceable or unique specimens in the collection.
>
> In this survey I have taken into special account the Ethnological collections, most of which belong to peoples now extinct . . . Ethnology 700 Cub. ft. 6 tons; Ethnology Gallery Annexe 300 Cub. ft. 3 tons; Australian Ethnology Store 900 Cub. ft. 8 tons; Australian Crania 150 Cub. ft. 1/2 tons; Ethnological General Court 1200 Cub. ft. 10 tons.[13]

It is surprising that although this transport must have called for so much work, time and planning, few records of it can be found. One reason for this might be that the documents were lost during the disruptions of wartime, another that they are stored somewhere as confidential documents, or perhaps they are yet to be found in the still-not-completely-explored archives of the Museum.

In January 1942, Tindale left the South Australian Museum 'to act as an interpreter [in the R.A.A.F.] in the Japanese language of which I have rather extensive knowledge' (Tindale to Director Hale, 13 January 1942). In his absence, Harold Cooper was appointed on a part-time basis as Assistant Ethnologist (Hale 1956: 172).

Although nothing had been transported to the Sleeps Hill tunnel at the time of Tindale's departure, he must have been at least partially involved in the preparations for the transport, since we read in a letter by Hale which was written only about 10 days after Tindale's departure: 'It now seems certain that we will shortly be transferring a good deal of our material to the country. It is probable that some of our galleries will be at least temporarily closed' (Hale to Scott, Director of Queen Victoria Museum and Art Gallery, Launceston, Tasmania, 30 January 1942). The last sentence supports the belief that the exhibited collections were not moved entirely, otherwise he would not have used the word 'some'.

On 7 April 1942, Hale informed Tindale:

> We have removed most of the entomological collections and some of the ethnological to one of the pavilions in the National Park. We were lucky to get this as everything is being occupied by military camps. Apparently work has been well started in the Tunnel and we have all the rest of the ethnological material ready to go at a moment's notice. Cooper and Vogelsang have worked like Trojans on the packing job and, in fact, have both knocked themselves out.

On 18 May 1942, Hale reported in a letter to Professor Hill of the Medical College in Colombo, Ceylon that: 'The major part of our ethnological material is packed away for safekeeping and will not be available until after the war.'

Little is known about which galleries were closed and which objects remained on display during the time the specimens were stored in the Sleeps Hill Tunnel. The *Annual Report* 1942–43: 3 notes: 'Collections stored away from Adelaide as an air raid precaution and those in reserve in the Museum are regularly inspected and are in good condition.'

The specimens remained in the tunnel for two years. Then Cooper reported: 'all the ethnological material removed to Sleeps Hill some time ago has now been returned to the museum with the exception of six canoes' (Cooper to Hale, 24 May 1944).

After the disruption caused by the removal and subsequent return of the Museum's collections, it seemed like a good time to assess the Museum's situation:

> During this year the Board has devoted considerable time to discussion of possible post war extension of

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[12] 'Reference collections' are the type specimens with which all subsequent specimens are compared for identification; this term is normally used in relation to natural history collections not ethnographic collections. Lawson is unsure whether the ethnographic material was considered in the same way as the natural history material for the purpose of the removal.

[13] By comparison, the mammals were listed in this survey with merely 400 Cub. ft. 2 tons.

> the Museum. Lack of adequate exhibition and storage space became acute years ago, and the position is now extremely unsatisfactory . . . Exhibition space is so limited that justice cannot be done to displays illustrative of our fauna and of our aborigines . . . Particularly, one may mention our Ethnological collections which could be made a feature of a new Museum. Many of the 40,000 objects of this collection were secured years ago, and today it can be said that literally some of them are worth their weight in gold. Some of the material from the Pacific Islands for example cannot be duplicated. Portion of it is displayed in the old red brick Museum, but necessarily the specimens are placed close together in the cases with the idea of affording safe housing for as much of this valuable material as is possible. To the public such an arrangement is meaningless and these stored specimens alone could be spread out to fill a very large hall so as to illustrate by means of labels, maps and photographs, the life and interests of the Pacific peoples. This and other projects cannot be considered until vastly more floor space is available (*Annual Report* 1944–45: 3).

The problem of relying upon natural light for the viewing of exhibits is reviewed in the *Annual Report* 1945–46: 2:

> The need for adequate artificial lighting has been stressed again and again. In our State, conditions in the Museum buildings may be said to present a violent contrast, in that on summer days it is difficult to exclude the bright light, which causes irreparable damage to furred and feathered animals placed on exhibition, while on the other hand, in the winter months, when during the weekends the Museum is thronged, it is difficult to see some of the exhibits, and recently at 3.30 p.m. on a dull Sunday afternoon there was observed the ludicrous spectacle of a visitor striking matches in order to read some of the labels in the General Court [North Wing].

The conclusion drawn from this difficulty was that the light-wells in the East and North Wings would have to be filled in and electric lighting installed. This would have the bonus of greatly increasing floor space for the exhibits. But the money to fill in the East Wing light-wells would not become available for another twenty years, and to fill in the North Wing light-wells, almost another ten years after that.

TINDALE'S 'REARRANGEMENT' OF THE PACIFIC GALLERY

In July 1946, Tindale returned from war service to the South Australian Museum and took over from Harold Cooper who continued as an Assistant. In addition, Harold Burrows was employed as Museum Assistant to further support Tindale.

During his time in the R.A.A.F., Tindale had collected a small amount of material from the Pacific region (the Markham Valley, and other parts of New Guinea and the Solomon Islands – see *Annual Report* 1946–47: 3). It is also probable that Tindale deepened his knowledge of Pacific cultures during his military service. In Tindale's *Report on State of Ethnological Collections*, prepared for the Director (7 November 1946), he attested that Cooper:

> has done a most excellent job in protecting the specimens, registering new material, and supervising the laborious tasks of packing and unpacking that half of the collection which was consigned to Sleeps Hill tunnel for safe keeping during the Emergency. Mr. Cooper also rearranged a large part of the Ethnological Gallery for temporary display . . . It will be noted that during the shifting of the specimens, many of the flimsily tied-on metal tags used in former years became detached, and it became unfortunately necessary to re-register some specimens as being without data.

In the *Annual Report* 1945–46: 3 can be read the following about Cooper's work: 'The interior of a number of cases was painted, their contents re-arranged, and additional labels and photographs added to make the exhibits more attractive.' However, it seems that this remark was made with reference to the Stirling Gallery (Australian Aboriginal) cases, not the Pacific cases (see Hale 1956: 172). Also it would be inconsistent with Tindale's stated reason for starting on the Pacific Gallery first (see below).

After the War, there was much disorder despite Cooper's work and everything had to be re-organized (Interview with Paul Lawson, 19 June 1997). Even before Tindale commenced on the installation of an Indonesian Gallery or took care of the Australian Aboriginal exhibits, he began re-structuring the Pacific Cultures Gallery. The reason for this can be found in the *Annual Report* 1946–47: 3):

> Although the Australian ethnological galleries need attention and should have had priority, the re-organization of the old ethnology gallery had to be hastened owing to the unfortunate use of low grade war-time carbon bisulphide, containing free sulphur, in the fumigation of the specimens. This caused the paint in the cases to darken. Painting was overdue since much of this portion of the gallery had not been decorated since 1894.

Paul Lawson recalled the Pacific Gallery cases as follows (Interview, 19 June 1997):

> The fronts of the cases, the woodwork, was black, . . . a French polish black. The insides of the cases were painted a flat grey . . . They were all changed when we started to work on the cases . . . Up until after the war they were still black.

The painting of display cases was not confined to the Pacific Gallery; there was a general change of colour throughout the Museum, from 'the old "museum colour"– a funereal black' (Hale 1956: 146, 189) to lighter colours.

In the Pacific Cultures Gallery, Tindale could not work with new ways of presentation as he did later for the 'Indonesian Gallery' because there were too many specimens. In fact, he added even more because the safest place for storage remained the display cases.

> Shortage of storage room space for these valuable specimens under cover necessitates the continuation of the highly undesirable practice of overcrowding the exhibition cases. In some instances, where perishable material has to be protected, even more material than was formerly present in the cases is being placed on exhibition. However, every endeavour is being made, by massing the exhibits, to preserve some semblance of spaciousness in the displays (*Annual Report* 1947–48: 3).

It is not certain if the colours for the inside of the cases were chosen to make the cases appear spacious despite the over-crowding or if this was just a fortunate side-effect. Paul Lawson said about this: 'It was done because the coloured backgrounds, [those] pale pastels, . . . looked more acceptable' (Interview, 19 June 1997).

The question that needs to be asked at this point is to what extent Tindale changed Stirling's and Zietz's arrangements. Were whole cases repainted but otherwise left unchanged?

Lawson rejected this supposition in the interview even though the wall case exhibits in the Pacific Cultures Gallery give the impression of a uniform style of display. Further, Tindale speaks repeatedly of 're-arrangement' in his correspondence; he also mentions the inclusion of completely new pieces: 'Opportunity is being taken to incorporate some of the more important accessions which have been lying in the storerooms' (*Annual Report* 1947–48: 3).

On the one hand, many of the wall case exhibits (e.g. X1, X2 – Papuan Gulf-Fly River; X3 – Central Papua; X4–X6 – Milne Bay; X7, X8 – Vanuatu; X9 – New Caledonia; X10–X15 – Fiji; etc) have only a few objects incorporated into them that came into the Museum after the early 1930s, suggesting that they may not have been much changed after the War. On the other hand, the Sepik/Madang/Huon Gulf cases (X25–28) incorporate large numbers of objects obtained just before, during and immediately after the War. This suggests that where the cases were more radically re-arranged, the exhibits were set up deliberately to conform to the older style of display.

Apart from new specimens, photographs and graphics also were introduced into the display cases. As at 1998, the old displays in the Gallery[14] featured more than 50 photographs and a number of graphics. As Hale (1956: 65) noted, the idea of using photographs in displays had a long history, dating back to about 1890:

> [Zietz] proposed that ethnological objects, such as those from Malaya, New Guinea and Fiji, could be 'explained' much better by the use of photographs showing them in use. He found it impossible to secure suitable pictures but the idea was reborn and carried out half a century later.

In a memorandum to Hale dated 9 July 1947, about the offer of an ethnological collection by a certain Miss Woods, Tindale wrote:

> Among the material from the Pacific Islands is much which is of special interest to us in view of the fact that we are re-arranging our collections from that area. There is an outstanding bird-beaked club from New Caledonia, which is better than one we possess.

In another letter from that time (Tindale to Rev. Barnes, 6 October 1947) he wrote: 'It is hoped that during the forthcoming re-arrangement of the New Guinea collections it will be possible to find a place for it [a model canoe from Barnes] on exhibition.'

In the *Annual Report* 1946–47: 3) we read:

> Activities of the department have been concentrated on the re-arrangement of the Pacific Island collections in the old gallery, together with their catalogue registration. Approximately one-quarter of the gallery has now been re-arranged after the cases had been painted . . . There is sufficient ethnological material displayed in this gallery alone to occupy twice the present space in order that it may be displayed more adequately. Removal of paint from the glass on the south side of the lantern [ie. glass roof] has improved the lighting conditions in the old

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[14] That is, excluding the 1993 and subsequent additions to the Gallery curated by Barry Craig.

> gallery by more than 50 per cent. In dull weather the cases are still inadequately lighted and to complete the re-organization it seems essential that internal lighting of fluorescent tube type be installed.

In 1948, when Tindale was working on the re-arrangement for the third year running, he wrote (Tindale to Deland, 5 August 1948):

> we are at this moment re-arranging all our gallery collections of New Guinea material . . . We are trying to separate the ethnological specimens from the various parts of New Guinea to bring out the essential differences between such groups as the Sepik area, the Huon Gulf area, the Massim districts and the Gulf of Papua. In doing this we have naturally struck quite a number of problems on borderline material.

This quote makes it clear that Tindale not only added more specimens to the cases but worked on a new arrangement, at least in part of the Gallery, but he kept to the basic rule of exhibiting a representative series of object types arranged in a geographical sequence. He was not alone in his work:

> During the re-organization of the Pacific Island collections, the ethnologist received much advice and help in the re-identification of material from Rev. H. K. Bartlett, Rev. A. S. Webb, Mr. E. C. Deland, and others who have first-hand knowledge of the natives of these islands; as a result it is hoped that most of the material is now better known and more adequately labelled than formerly (*Annual Report* 1946–47: 3).

By 1948 the difficult and expensive work was not finished yet. Paul Lawson (Interview, 19 June 1997) described it as follows: '[the arrangement of specimens for] each case had to be laid out on the floor or on boards, then the actual putting in of the specimens was a slow job because they're all fragile.' The *Annual Report* 1947–48: 3 notes progress as follows:

> The ethnologist (Mr. N. B. Tindale) reports that the principal activity of the Ethnological Section during the year has been the re-organization of the Pacific Islands Ethnology collections exhibited in the old gallery. Approximately one-half of the gallery has been re-organized. This has involved the dismantling, card cataloguing of specimens, re-painting of cases and the re-installation of exhibits from Fiji, Solomons, New Britain, New Ireland, New Caledonia, New Hebrides and the Admiralty Islands.

The procedure was described by Paul Lawson (Interview, 19 June 1997):

> Tindale and Harold Burrows worked on that [the re-arrangement of the Pacific Cultures Gallery] and Tindale would tell Burrows what he wanted to put in there and then Burrows would try to arrange it the way he thought and then Tindale would okay it. So there were definitely changes. Admittedly some of those cases would resemble the previous arrangement very closely.

In 1949 the end came into sight at last:

> The re-arrangement of the South-west Pacific Ethnology Gallery by Mr. N. B. Tindale, assisted by H. Burrows and L. Wills, is nearing completion. By the addition of photographs, models and the use of bright background colours, they have transformed the presentation of the extensive collections (*AGMA – News Bulletin of the Art Galleries and Museums Association of Australia and New Zealand* No.3, September 1949; Sydney: 6).

In the *Annual Report* 1948–49; 4), relief about the imminent completion of the work can be felt:

> The ethnologist reports satisfactory progress in a major project of the section, namely the re-organization of the Pacific Island ethnological collections exhibited in the old red brick building.

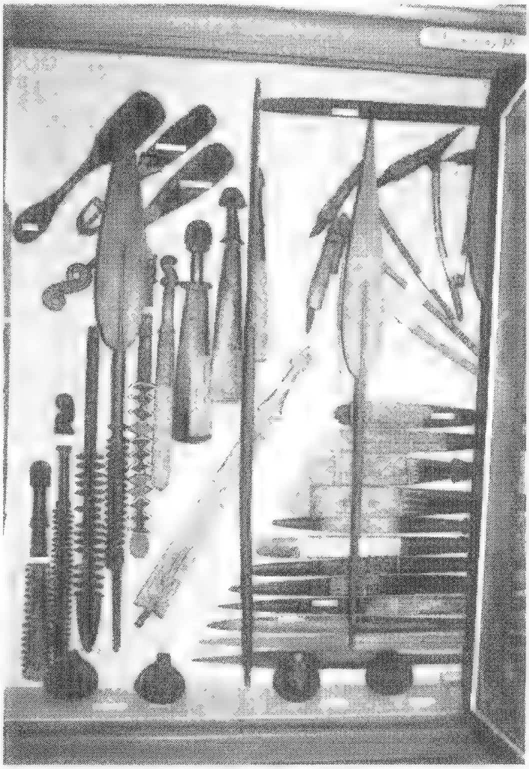

FIGURE 7. Left half of wall case exhibit (X05 – Milne Bay Province, PNG) showing aesthetic of display arrangement.

FIGURE 8. One of the window cases ('New Hebrides') installed by Norman Tindale in 1949 and removed in 1976.

> The greater part of the top floor of this gallery is now devoted to the display of our collections from New Guinea and the Melanesian portions of the Pacific Islands. Despite delays due to shortage of material and labour the interiors of almost all the cases are refurnished and the specimens newly installed. The Architect-in-Chief is installing fluorescent lighting in cases at the eastern end of the gallery. In continuation of this re-arrangement all plaster casts of fossil animals, formerly displayed on the walls over the main stairways, have been removed to other situations and the walls are being repainted.

In all, Tindale worked for more than four years on the re-arrangement of the Pacific Cultures Gallery. It must have been somewhat disappointing to him that he could not use new display methods like dioramas and that better contextualization was impossible due to lack of space but he did get fluorescent lighting for the wall cases.[15] The main task was to store as many specimens as possible in the cases, to renew the regional classification of objects (since Stirling had made many mistakes here) and to arrange everything in the most aesthetically pleasing way, which can be seen in the placement of specimens into triangular, parallel and diagonal patterns (Fig. 7). Further, 'In its basic arrangement, it still reflects the geographic organization imposed upon it by Edward Stirling during the 1890s' (Jones 1993: 29).

Work in the Pacific Cultures Gallery was not confined to the wall cases. In the table cases around the light-wells, and in the flat cases which were in front of the windows along the southern wall between the wall cases, Tindale used a then up-to-date display method. He arranged the smaller specimens, such as tools and ornaments, into geographically-defined series to supplement the wall case exhibits, presented other material on the basis of types of objects such as betel-chewing equipment and neck-rests, and other cases illustrated particular technologies, such as tapa-making. These displays contained more pictures with longer accompanying texts (Fig. 8). Above all they were not over-crowded. Rather, they seem spacious by comparison with the layout of specimens in the wall cases.

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[15] It seems hardly credible that electric lighting was installed in the Museum only 50 years ago!

By the end of Tindale's work on the Pacific Gallery there were 4 200 specimens on display in 82 cases, 'making this one of the outstanding collections of its kind' (*Annual Report* 1949–50: 4). This compares with 3 000 on display today.

Tindale's exhibits in the Indonesian Hall,[16] which was opened in 1954 and dismantled in August 1982, were completely different to those in the Pacific Gallery:

> The Indonesian Gallery came after this [the Pacific Gallery] was completed . . . Display methods were different then. We did have a little bit of money, not very much, but we had a little bit more than we had when we were doing all this [Pacific Gallery] work – [which could use] only virtually petty-cash left over from something else (Interview with Paul Lawson, 19 June 1997).

In the Indonesian Hall, miniature dioramas were used; this constituted a different genre of display. Objects in the evolutionary sequence for which specimens were lacking were represented by replicas, models, graphics and photographic 'reproductions' (Hale 1956: 191).

THE POST-TINDALE ERA

When Tindale retired from the Museum in October 1965, he left a young Assistant, Graeme Pretty, to continue his interest in the Pacific collections. Pretty, a History graduate from the University of Sydney, had joined the Anthropology staff in 1962 as Assistant Curator and was promoted to the new position of Curator of Archaeology in 1964. His interests included both Melanesian and Australian prehistory. Robert Edwards was appointed Curator of Anthropology when Tindale left and his interest was in Australian Aboriginal ethnography. A year after Edwards resigned in 1973, Pretty became Senior Curator of Anthropology and Archaeology.

In the late 1960s, the Director reported that because of increased overcrowding, extensions to the existing buildings were being considered (*Annual Report* 1969–70: 6 and *Annual Report* 1970–71: 6). The damage being caused to specimens by the sunlight coming through the glass roof was also of grave concern. Lawson pointed out a detail on an 1899 photograph of the table cases (Interview, 19 June 1997):

> Those black covers were to stop the light getting in because the light from up the windows [ie. from the glass roof] was quite devastating. It was ordinary glass which was painted with white wash on the inside. The surrounds leaked, the white wash came off, the water dripped down onto the cases, especially these flat cases. If they happened to be underneath where the drips were it would get in there . . . get in the cases. But the light was a real problem, until [the ordinary glass] was replaced with anti-UV glass and that did quite well. It was a greenish-blue tinge; that was an improvement.

To gain additional space in the West (North) Wing and eliminate the problems caused by sunlight through the glass roof of that Wing, the filling in of the light-wells was commenced. When the light-wells were filled in, floor space was gained.

> The closing in of the light wells in the West [ie. North] Wing allowed us to reopen the top floor to public exhibition late in the year [1972]. Some material which was stored away, usually in unsatisfactory areas, while this work was in progress, was able to be returned but the lower floor is still empty and the material originally housed there is distributed in a series of temporary areas (*Annual Report* 1971–72: 6).

As Paul Lawson reported (Interview, 19 June 1997), the reconstruction had originally been planned differently:

> It was decided to fill the light-wells in. And then it was going to be only a light floor, just to separate the two galleries [upstairs and downstairs] and to put some light material on. I was able to talk with the architecture and public buildings departments [and explain], 'We can't afford that space not to be walked on.' So they increased the strength of it.

The *Annual Report* 1972–1973: 9 optimistically stated:

> Reconstruction of the ground floor of the West [North] Wing is nearing completion, with the installation of air conditioning, a sprinkler system and glass for the display cases the largest outstanding tasks. Plans are being prepared for a general refurbishing of the upper floor [the Pacific Gallery] in which it is hoped to disturb only a

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[16] The Indonesian Hall, located at the southern end of the top floor of the East Wing, was a bit of a misnomer and was later called the Human Cultures Gallery. Hale (1956: 191) states: 'The [Indonesian] Hall was designed to illustrate the earlier cultures of man and also more modern collections from South-eastern Asia. The last-named series have been arranged to show the origins of civilized man and his development through the stages of neolithic agriculture and the early Iron Age in the lands of South-west Asia . . .treating in turn the Indus Valley cultures, India, Malaya, Eastern Asia, Indonesia and the Pacific Islands around Australia'.

> minimal number of display cases around the walls and to create new exhibits in the central space, now occupied by mineral and fossil displays.

The intention not to re-arrange or add something new in the wall cases is clearly stated. Lawson's recall is consistent with this (Interview 19 June 1997):

> There was no dramatic re-arrangement of specimens or cases because of the light-well filling . . . Where we could, we used the [existing] cases . . . We didn't touch the contents . . . There was no re-arrangement of the contents.

That the Pacific Cultures Gallery looks the way it does today is due to the diplomatic skills of the museum's staff:

> [The air-conditioning] was put in after the floor came about . . . it wasn't in the original specifications but by a little bit of careful talking to the right people we were able to get the modifications. The whole project, as I admitted afterwards, would never have been accepted because of the cost. But because we had one little piece done at a time and then, because that was done, they had to do something else, it worked. But I was told never to come with that trick again (Interview with Paul Lawson, 19 June 1997).

These additional developments might have been why the *Annual Report* 1973–74: 9) explained:

> There have been unavoidable delays in the completion of the West Wing and Stirling Galleries. In the absence of a Curator (Senior) of Anthropology and because of some necessary building alterations, reconstruction of the Stirling Gallery has not proceeded. Attempts have been made to keep it open with limited displays, but these are far from satisfactory and do not reflect the wealth of our Aboriginal collections. A postponement, therefore, of work on the Pacific Cultures Gallery was necessary to keep it open, if we were to avoid effectively closing about three-quarters of the Museum.

These alterations which, apart from the air-conditioning, involved also the installation of a ceiling, spotlights and carpet, were delayed year after year and it wasn't until 3 October 1977 that Premier Dunstan officially opened the remodelled Pacific Cultures Gallery 'to coincide with the Annual Conference of the Museums Association of Australia' (*Annual Report* 1977–78: 22). However, although the Fossil displays had been relocated, the Minerals displays continued to occupy the central area of the Gallery.

Most of the table cases which since the late nineteenth century had been located around the light-wells remained (and remain today) but the window cases along the southern wall were removed in 1976 towards the end of the long period of reconstruction. Lawson has provided an album of photographs which show that the three air-conditioning units were installed along the southern wall by removing the flat window-cases, covering the windows and moving the wall cases closer together to provide the necessary space.

When the filling in of the light wells began, the vision was grander: 'It is planned . . . to redesign the entire Stirling (Aboriginal), Human Cultures, and Pacific Islands Galleries commensurate with the Museum's extensive holdings in these fields' (*Annual Report* 1972–73: 9). However, nothing on that scale happened either then or in the following quarter century, presumably because of lack of funding. Also, in 1975 the Premier had announced that a new Museum would be built, commencing about 1978, on a site occupied by a bus depot about a kilometre east of the present site. Perhaps it was not considered worthwhile allocating too many resources to a grand redesign if everything was to be moved to an entirely new Museum. But this never eventuated either.

One project that did add substantially to the Pacific Gallery was the purchase by The Friends of the South Australian Museum of 'a complete specimen of a traditional ocean going vessel from the Trobriand Island group of South-East Papua . . . [which] makes a splendid showing in the Pacific Islands Gallery' (*Annual Report* 1974–75: 19).

Although Pretty did go on two significant collecting expeditions to the Pacific region (in 1968–69 to the Southern Highlands of PNG and in 1972 to island Melanesia, accompanied by A. L. Crawford), he later concentrated more on an archaeology project at Roonka on the Murray River of South Australia. It is appropriate that his most obvious contribution to the Pacific Gallery was the addition of a small Melanesian Pre-history display in 1981. This display reflects the didactic genre typical of that period, utilising relatively few objects embedded in a large amount of text and graphics (Fig. 9). There was no attempt, however, to incorporate into the Pacific Gallery the Southern Highlands or island Melanesian material he collected.

Another, relatively minor change in the Pacific Cultures Gallery took place in 1986. During the 1970s reconstructions in the North Wing, a lift had been built at the northern end of the East Wing but a stop at the Pacific Cultures Gallery had not been included. In the mid-eighties this was added at last, which resulted in a loss of

FIGURE 9. 'Melanesian Pre-history' display installed by Graeme Pretty in 1981.

space for the Huon Gulf exhibit in the north-east corner of the Gallery. A new arrangement for the smaller case was designed by Sandy Hanson (Interview with David Kerr, 20 June 1997). The display technique chosen for this case stands out from that of other cases in the Pacific Cultures Gallery by its use of glass shelving and a more spacious arrangement of specimens but the use of minimal labelling was consistent with the old displays.

During the early 1990s, the greatly expanded Museum shop was squeezed into the central space on Level 3 adjacent to the main stairs. During that time the Trobriand *kula* canoe and the surrounding table cases were moved from the western to the eastern end of the Gallery to join the one-third-scale Rogea (Massim) hut and its surrounding table cases; the Mineral exhibits were moved to the western end.

THE LAST FIVE YEARS

By the time the Pacific Arts Association conference was held in Adelaide in 1993, the shop had moved to its present location in the space vacated by the Director and Administration at the south end of Level Two in the East Wing. The Trobriand canoe and surrounding table cases were returned to the west end of the Gallery and the Mineral exhibits to the centre; the Director and Administration relocated to the renovated Armoury Building immediately north of the Museum's North Wing. The wall cases also received some attention—the geographic labels on some of the cases were changed to reflect the political status of recently independent nation-states (e.g. Vanuatu) and the Vanuatu exhibit in the Bridge Case[17] (which included a large number of over-modelled and painted skulls) was removed and a series of model Melanesian canoes placed in it to complement the adjacent Trobriand *kula* canoe but there was minimal, even incorrect, information supplied about these canoes.

There have been other changes to the Gallery in recent years. In late 1992, Barry Craig was contracted to go to New Ireland and New Britain for seven weeks. His objective was to identify

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[17] The 'Bridge Case' was so named as it was located on the section of flooring above the central foyer of the ground floor of the North Wing, separating the two sections of the light-well. This case appears to have been in this location since the 1890s

FIGURE 10. 'La-Sisi' malangan canoe display installed by Barry Craig in May 1997.

two men from each area to come to the Pacific Arts Association's 5th Symposium, to be held at the South Australian Museum in April 1993. They were to bring and dance masks from those two areas—masks that would match masks obtained by the Museum 75 years earlier (Craig 1993, 1994, 1995). The display, in a large eastern wall case, of a rare, double-headed Sulka *hemlaut* mask from Wide Bay, New Britain, had been almost completely obscured by a wide range of other material from Papua New Guinea. These objects were cleared and smaller Sulka masks collected by Craig in 1993 were displayed alongside the *hemlaut* mask with photographs and text. A *hemlaut* mask he purchased during the trip was danced into the Gallery and mounted opposite the old mask with two panels of photographs, a map and information. An information sheet was produced and is available free at the exhibit (and also on the Museum's Home Page).[18]

Similarly, the New Ireland exhibits were slightly modified by removing two *malangan* from positions in the wall cases where they could barely be seen and placing them in a table case in the space opposite, along with a selection of material collected by Craig, explained by two panels of photographs, a map and information.

To avoid offending Pacific Islanders at the PAA Symposium, the Director (Dr Chris Anderson) decided to have black cloths suspended in front of, or laid over, any skulls or other skeletal material on display in the Gallery. These cloths have recently been removed.

In December 1995, Barry Craig was appointed Curator of Foreign Ethnology. He was a graduate in Social Anthropology from the University of Sydney strongly influenced by the work of Bryan Cranstone of the British (later Pitt Rivers) Museum (Craig & Hyndman 1990: iii–iv) had extensive experience in Papua New Guinea since 1962 and had been Curator of Anthropology at the PNG National Museum during 1980–83. This was the first time a position had been created at the South Australian Museum to care exclusively for the non-Australian (i.e. 'Foreign') ethnographic collections.

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[18] www.samuseum.sa.gov.au

FIGURE 11. Part of 'Spirits of Vanuatu' display installed by Barry Craig in March 1998.

In 1996, Craig was responsible for a display of 42 photographs which were mounted on the large panels which conceal the three air-conditioning units along the southern wall of the Gallery.[19] These photographs had been taken in the Papuan Gulf area, New Guinea and the Solomons by an Oil Exploration geologist/surveyor, Ernest Sterne Usher, in 1914–16. An information sheet was prepared for this exhibit as well. Three large Papuan Gulf masks, removed from the Sulka *hemlaut* case in 1993, were set up opposite the Papuan Gulf wall cases.

In 1997, Craig arranged the borrowing and installation of the privately-commissioned, 8-metre-long La-Sisi Malangan Canoe (Fig. 10); additional New Ireland material was displayed in association with this exhibit. Again, an information sheet was produced.

The most recent changes and additions to the Gallery were associated with an event in March 1998 timed for the Adelaide biennial Festival of Arts. This required Craig to go to Vanuatu to identify two men to come to the Museum and repaint a large Ambrym slit-drum (A.74765) donated to the Museum in 1996. The drum was installed in the main foyer of the Museum along with a tree-fern grade figure (A.74757) collected by Craig in 1997. This took place as a public event and included pork and vegetables cooked in a ground-oven and supplemented by *kava*, a beverage considered essential for all ceremonial events in Vanuatu. The model canoes were removed from the Bridge Case and a display of Vanuatu material took their place. This exhibit (Fig. 11) was designed to demonstrate the continuity of Vanuatu traditions by displaying pots, mats, musical instruments and other material collected by Craig corresponding to pieces obtained by the Museum 100 years previously. An information sheet was produced for this display.

A plan to redevelop the Aboriginal exhibits in the Museum, to be completed in the year 2000, required that the Pacific Gallery be moved to another space. However, in addition to certain design considerations, estimates of the cost of moving the Pacific exhibits and restoring the interior of the Gallery to its Victorian style, including the removal of the ceiling, proved too great for the amount of money provided and this part of the plan was dropped and the New Aboriginal Cultures Gallery is now being developed in the bottom two levels of the East Wing.

It now remains to find modest resources over the next several years to progressively upgrade the Pacific Gallery (Fig. 12) and provide more information through several levels of interpretation of the material on display, while maintaining most of the wall case displays as they have been since the late 1940s (in some cases possibly since the late 19th century). The floor case displays will be changed considerably to provide more information about various technologies and types of objects on a comparative basis. Concurrently, the exhibits in both wall and floor cases will be utilised to explain the nature of the relationship between South Australia and the

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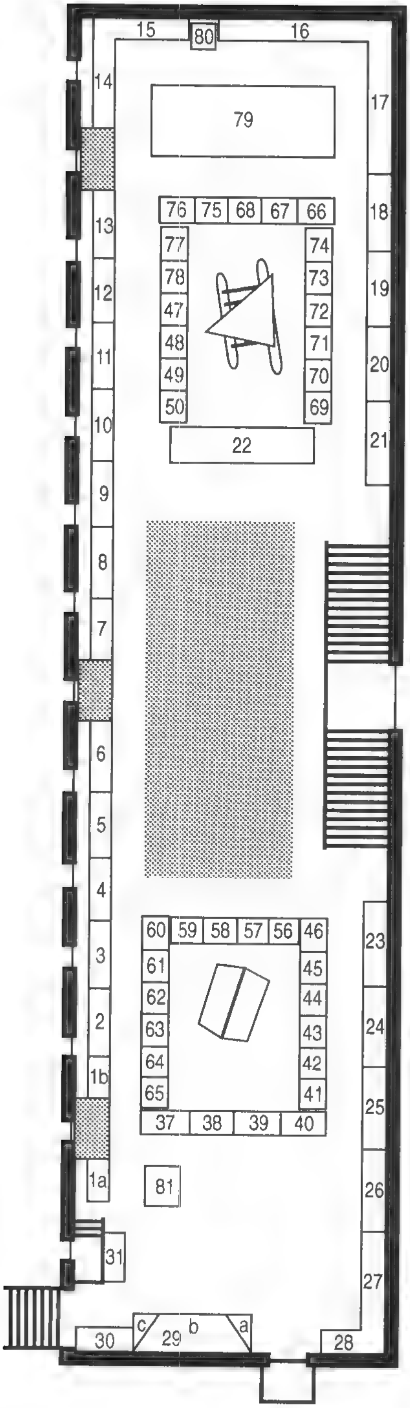
[19] This exhibit was suggested by Scott Bradley, contract photographer for the Museum, and much of the research on this collection was carried out by Grahame Pike (see Pike & Craig 1998).



1 a, 1b	Papuan Gulf
2	Western Papua and Torres Strait
3	Central Papua
4	South-east Papua
5 – 6	Milne Bay Province, Papua
7 – 8	Vanuatu
9	New Caledonia
10 – 15	Fiji
16 – 17	New Ireland
18 – 19	New Britain
20 – 21	Solomon Islands
22	Spirits of Vanuatu
23	Santa Cruz
24	Admiralty Islands
25 – 27	Sepik Region
28 – 29a	North-east New Guinea
29b	Sulka, New Britain
29c – 30	Papuan Gulf
31	Melanesian Pre-history
37 – 40	Betel-chewing equipment, PNG
41	Headrests, PNG
42 – 43	Tapa cloth, PNG
44 – 46	Massim region, S-East Papua
47 – 50	Vanuatu
56 – 57	Mountain Papuans
58 – 59	Papuan Gulf
60 – 63	Sepik-Ramu-Madang, PNG
64 – 65	Stone tools, PNG
66 – 68	Fishing, PNG
69 – 74	Shell ornaments and tools
75 – 76	Fishing, PNG
77 – 78	Maori, New Zealand
79 – 80	New Ireland and La-Sisi Canoe
81	Sulka, New Britain

FIGURE 12. Plan of the Pacific Gallery as at March 1998.

Pacific through the agency of the many people—missionaries, government officers, soldiers, scientists, etc.—who were the collectors (Jones 1993).

With the removal of the Minerals exhibits from the centre of this space, it is hoped that a display of New Guinea highlands cultures can be added, a project towards which Tindale was moving in the 1940s but was unable to bring to fruition (Fitzpatrick 1999: 183, 202). There may be space also for a more comprehensive exhibit dealing with Pacific prehistory, especially that of the Austronesian origins of Polynesia, with associated exhibits of Polynesian and Micronesian material, at present not on display. The model canoes and maritime trade articles in the collections will provide the basis for a display on the significance of maritime trade in Melanesia and its origin in the cultures of the Austronesians several thousand years ago.

The South Australian Museum's Pacific Gallery is the largest and most comprehensive display of its kind in Australia. Visitors to the exhibits value the old style of display and the large number of objects available for viewing. With careful use of modern technologies, the present lack of information in the Gallery can be addressed, as has already commenced with the Sulka, New Ireland and Vanuatu exhibits. The linking of these refurbishments with performances conducted by people of the areas from which the objects came, will become standard procedure. The opportunity also exists to take back photographs of objects to the descendants of those who made these objects, to obtain more information and to provide the basis for future co-operative use of these things, including repatriation.

What was once an asymmetric relationship between tribal peoples and foreign curio and museum collectors can become more balanced, and projects can be developed (such as the 1993 New Ireland/New Britain and 1997/8 Vanuatu initiatives described above) which bring the museum's public into direct relationship with the descendants of those peoples. The covert messages conveyed by the old, essentially 'Victorian', style of exhibits in the wall cases can be objectified and the Gallery can then function also as a museum within a museum.

ACKNOWLEDGMENTS

This paper evolved out of a research project by Carsten Henn, a International Programs student from the Institute of Cultural Anthropology, University of Cologne, whilst he was studying at the University of Adelaide. He was supervised by Dr Deane Fergie, Department of Anthropology, and assisted her research on the Pacific Gallery of the South Australian Museum. Dr Fergie was preparing a submission (see References) to the State Heritage Branch, Department of Environment and Natural Resources, to establish the heritage significance of the Gallery and recommend its preservation under the *Heritage Act* of 1993. Because of Henn's involvement in that research, there is content and wording that is common to both Fergie's report and this paper. Barry Craig filled some gaps in the historical information and wrote the final section. Thanks are due to Harry Bowshall and Paul Lawson, retired Museum employees, for their reminiscences on the history of the Pacific Gallery and to Ian Maidment who prepared the floor-plan of the Pacific Gallery.

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THE CHIEFS OF KIRIWANA

RALPH S. LAWTON

Summary

This paper is a socio-linguistic study of chiefly status in the northern portion of Kiriwina, the largest of the Trobiand Islands off the eastern end of New Guinea. It describes chiefly privilege, chiefly authority and the chiefly hierarchy. Reference is made to relevant items of material culture held in the collections of the South Australian Museum. An appendix describing the choice of certain Kiriwinan terms for use in Bible translation reveals the subtlety of the terminology used by Kiriwinans when referring to chiefly matters.

THE CHIEFS OF KIRIWINA

RALPH S. LAWTON

LAWTON, R. S. 1999. The Chiefs of Kiriwina. *Records of the South Australian Museum* **32**(1): 91–118.

This paper is a socio-linguistic study of chiefly status in the northern portion of Kiriwina, the largest of the Trobriand Islands off the eastern end of New Guinea. It describes chiefly privilege, chiefly authority and the chiefly hierarchy. Reference is made to relevant items of material culture held in the collections of the South Australian Museum. An appendix describing the choice of certain Kiriwinan terms for use in Bible translation reveals the subtlety of the terminology used by Kiriwinans when referring to chiefly matters.

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INTRODUCTION

This study of Kiriwinan chiefly hierarchy was originally prepared in 1968 for presentation at a translation workshop conducted by the Bible Society in Banz, Papua New Guinea, and has never been published. The initial purpose was lexical research.[1] However it developed into a study of the distinguishing features of the Kiriwinan chiefly hierarchy with special reference to the lexicon of chiefly terms and the semantic reference of authoritarian words, and as such was presented at a meeting of the Anthropological Society of South Australia in June 1996. At the suggestion of Barry Craig, Curator of Foreign Ethnology at the South Australian Museum, it has been enhanced to include reference to relevant artefacts in the collections of the South Australian Museum.

This hereditary order of chiefs in Kiriwinan society has been commented on by many anthropologists, particularly those who have carried out research in the Massim region of eastern Papua. Seligman (1910: 663) commented that 'chieftainship appears to be more highly developed in the Trobriand Islands than elsewhere in British New Guinea' and noted many of the rights and privileges peculiar to chiefly status (ibid.: 695ff.).

Bronislaw Malinowski, primary chronicler of this culture, makes frequent reference to the chiefly order (e.g., 1922: 10, 24f.; 1932: 52; 1935: 80) but his published works do not include any specific study of the things which mark rank in the chiefly hierarchy, or the level of authority borne by different ranks. He comments that his brief outline of chieftainship (1935: 38–40) 'cannot do justice to the complexity of the subject'.

A more recent scholar, Annette Weiner, has made a clear reference to the chiefly order (1976: 45), citing its hereditary nature, its 'effective means of rank separation' through 'the paraphernalia of decorations and social and physical taboos', and the political importance of polygamy for the highest ranks. She lists on the same page the names of those who have made significant reference to the subject.

In this paper I have tried to delineate the order of rank in the Kiriwinan chiefly hierarchy, with special attention to two marks of chiefliness — *karaiwaga* or authority (both ancient and modern) and *koni* or privilege at its various levels for each rank. I have not given special attention to the taboos peculiar to chiefs. So far as I know, the hierarchy has not been delineated in this way by any other student of Kiriwinan society.

My main sources were two men of high rank within the Tabalu sub-clan of the Malasi clan. The first of these, and the one who encouraged me to make this study, was Antonio Lubisa Bunaimata (Fig. 1). Antonio had refused to yield to pressure

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[1] Its purpose was to show how chiefly concepts and the vocabulary attached to chiefly rank had influenced my work as a Bible translator. I had intended to omit that part in this presentation. But as it is relevant to translation theory and could be of interest to linguists, I have included it as Appendix V.

from those wishing him to become chief of the Kavataria village community because he preferred to retain his place as a pastor within the (then) Methodist Church in Kiriwina. The second, recommended by Antonio, was Tolosi, a blind Kiriwinan who was an acknowledged repository of reliable information and legend relating to chiefly status in Kiriwinan society.

Together Antonio and Tolosi discussed the various questions I posed about chiefly sub-clans and the various degrees of authority and privilege which traditionally belonged to each family. The discussions occupied about twenty hours over several meetings during 1967 and this paper seeks to present their conclusions and pronouncements. It is acknowledged that certain matters may have evolved over the past three decades and I do not want the reader to assume that this paper refers to Kiriwinan chieftainship as it exists in the late 1990s, nor that it represents the view of chiefly matters held by others than Antonio and Tolosi, though there will of course be many consistencies.

KIRWINIAN SOCIETY

The Kiriwina people live in the Trobriand Islands at the northern fringe of Milne Bay Province, Papua New Guinea. The population on Kiriwina when this paper was first researched in 1967 was about 13 500 but by 1996 had almost doubled to 26 000. Also, there are at least 4 000 Kiriwinans living in various urban centres in Papua New Guinea.

One language only (with dialect variations) is spoken throughout the Trobriand Islands and in the Lusancay and Marshall Bennett islands nearby. This linguistic uniformity is not common in polyglot Papua New Guinea society and is especially unusual for island-dwelling communities, as geographical divisions usually provide conditions which ensure linguistic diversity. As an example of this, in the much larger D'Entrecasteaux Islands immediately south of the Trobriand Islands, a linguistic survey conducted in the 1960s recorded 19 separate languages for a population of around 35 000.

The residents of the Trobriand Islands are more correctly to be called the Kilivila people but due to an early mis-naming of the main island of the group as the island of Kiriwina, and also for what could be called political expediency,[2] the people are generally known as Kiriwinans; indeed, many *mina Kilivila* today prefer to use it of themselves and I will so refer to them here.

In order to appreciate the social order in which the class system of Kiriwina is set, it is necessary to look at both the clan groupings into which the whole society is divided and at the sub-clans which form a chiefly hierarchy within each clan group. These two divisions of the society may be seen as a vertical (clan) and a horizontal (class) division which uniquely defines the place of each member of society.

The Clans of Kiriwina

The matrilineal clan grouping is the vertical dimension which divides the whole of Kiriwinan society into four separate groups. Each clan is further divided into a number of matrilineal sub-clans. I will look now at these two social groups. A clan is called *kumila* and a sub-clan *dala*.

A *kumila* may be defined as a group of *dala* held together by certain customs or obligations; these customs or obligations separate them from other *kumila*. One clan is related to another by an exogamous marriage relationship. Each *kumila* has a pair of totem animals. The *kumila* in Kiriwina are four in number. Their names are Malasi, Lukuba, Lukosisiga and Lukulobuta.

The Malasi has the dove (*bubuna*) and pig (*bunukwa*) as its totem animals. Its chiefly *dala* include most importantly the Tabalu, from which the so-called 'paramount chief' of Kiriwina comes. Its two other chiefly *dala* are Osusupa and Bwaitaitu.

The Lukuba has the sea eagle (*mluveka*) and the dog (*kaukwa*). Its chiefly *dala* are Mlobwaima, Mwauli and Tudava.

The Lukosisiga has the coconut parrot (*karaga*) and the snake (*keiyuna*). Its chiefly *dala* include Kwainama, Sakapu (now probably extinct, their place being taken by Wabali — see footnotes 19

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[2] One of the locally-recognised political divisions is the Kilivila area and this is both numerically and politically the strongest part of Kiriwinan society. I believe that other areas of Kiriwina feel threatened today if they are all collectively referred to as 'mina Kilivila' (people of Kilivila). I once asked a man who lived in the Kuboma area, which abuts the southern border of the Kilivila area, whether he preferred to be called 'Tolela Kilivila' or 'Tolela Kiriwina' (a man of Kilivila or a man of Kiriwina) and he replied unhesitatingly 'Kiriwina!' When I asked him why, he muttered to himself for a while, and then replied, 'Because Kiriwina is the name on the map!'

TABLE 1. Structure of Kiriwinan Society

	Malasi clan	Lukuba clan	Lukosisiga clan	Lukulobuta clan
gweguya or chiefly families	**Tabalu** **Osusupa** **Bwaitaitu**	**Mlobwaima** **Mwauli** **Tudava**	**Kwainama** **Sakapu (Toliwaga),** but now **Wabali** **Kailai** **Kulutula**	**Kaitotu** **Kabata**
tokai or commoners	**many**	**many**	**many**	**many**

and 20), Kailai and possibly Kulutula. The Sakapu *dala* bore the honorary title of Toliwaga, conferred upon it by the Tabalu in the forgotten past.

The Lukulobuta has the banana parrot (*gegila*) and the goanna (*kailavasi*). Its chiefly *dala* are Kaitotu and Kabata.[3]

Within each clan group there are also a number of non-chiefly or 'commoner' *dala*. I have named only chiefly *dala* because they are the cross-clan group I have referred to as horizontal. Because marriage relationships are exogamous, and because chiefly *dala* only marry into other chiefly *dala* (never into the *dala* of *tokai*, the commoners), there is a clear division of Kiriwinan society across all clans.

The most important feature of the clan grouping is the marriage relationship and the children which issue from the women who take their place in the clan's membership. The marriage bond is, as I have stated above, exogamous, which means that the husband is not a member of his wife's clan and children take their clan membership from their mother.

The exogamous relationship by which the four clans are related is said to be breaking down these days, although most people feel that marriages within the clan are improper. In the past, marriage or sexual contact of any sort within a clan was seen as shameful or incestuous and if brought to public attention was often followed by a public confession and suicide attempt (usually successful).

Apart from the public scrutiny of relationships in marriage, clan membership of any person has no particular prominence except when clan membership is terminated by death. However at the time of death the entire village is thrown into turmoil because of clan obligations in mourning customs.

The three clans who have not been depleted by death must immediately do everything necessary for the proper conduct of burial and associated acts. It is in their interest to do so, for the bereaved clan is obliged to pay back every act of grief and every service to the deceased. Every tear shed, every clod of earth moved for the burial, every finger laid on the shroud when the body is moved, is carefully noted and acknowledged in subsequent distributions of food, betel nut, pork, etc. Such mortuary distributions are called *kaimelu*.

Then the clan in mourning has a second distribution (called *yawali*), strictly within the clan, when the entire possessions of the former household of the deceased are distributed. The widowed partner owns nothing and must return to his/her own clan. In this distribution, not only the pots, tools, wealth items, etc. are distributed, but the very house in which they lived may be dismantled and distributed.

A third mortuary distribution is conducted by the women of the clan when skirts and skirt-making material ('women's wealth') are distributed in payment of obligations. This is called *sagali paila baloma* (Weiner 1976: 91).

A fourth mortuary distribution, the last one, takes place at harvest time[4] when either the food

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[3] My two colleagues were unsure as to whether these two are separate *dala* or whether they come from one older *dala*. I could not find anyone else who could clarify this for me.

[4] Kiriwina is a yam culture with a specific annual harvest.

from the garden planted by the deceased, or the food produced by a special garden planted by clan members after the death, is distributed. In this distribution of food, all obligations of the deceased and his/her relatives are finally settled.

This exchange is usually within the year of death but may in some cases take place several years after the death, as the clan will wait until a good enough harvest is gathered to enable them to do sufficient honour to the deceased. In such cases the unfortunate bereaved must continue to wear and display the signs of mourning[5] for years, to do due reverence to the deceased until that final distribution is concluded. This final exchange is called *sigiligula*.

Thus the clans of Kiriwina are involved in a continuing succession of mortuary exchanges and counter-exchanges, so much so that people may be more important and socially significant in death than they ever were in life.

The Sub-clans of Kiriwina

Each of these four clans (*kumila*) is further divided, as noted above, into sub-clans (*dala*); and a fundamental division into chiefly and non-chiefly sub-clans must be seen as a horizontal division of the whole society into chiefly (*gweguya*) and commoner (*tokai*) classes (Table 1). All four clans are affected by this division.

A *dala* is not a family unit of parents and children but a group of matrilineally-related people who can trace their relationship to a common mythical ancestor. Each *dala* (more especially, chiefly *dala*) is able to point to one geographical point of origin, perhaps a cave or some topographical feature, which is the place where that ancestor first came into Kiriwina. This place is called the house (*bwala*) of that *dala*.[6] Needless to say, the ability to recount genealogies and long lists of descent from the original ancestor is an important mark of authenticity for any one *dala*. Surprisingly, I do not think that anyone has done any field-work on gathering these genealogies (*liliu*), even though they would be important oral sources for Kiriwinan prehistory.

I found it difficult to get information on commoner *dala*. There was a general feeling amongst chiefly informants that there were very many such *dala* but that most *tokai* did not know the name of the *dala* to which they 'belonged'. My informants did name eleven *dala* of the *tokai*, but they knew of these because they were special families which had certain privileges recognised by the *gweguya*. They did not know (or would not name) the sub-clans which had no special privileges or authority.

The Chiefs Of Kiriwina

I now proceed to examine the chiefly *dala*, which is the main concern of this study. The whole group of chiefly *dala* is collectively referred to as the *gweguya*, which is the plural form of *guyau*, 'chief'.

The *gweguya* of Kiriwina are made up of the ten or perhaps eleven *dala* shown in Table 1 above. Those shown high in the list for each *kumila* are of a higher rank than those placed below. I must say two things about this group of sub-clans.

A Separate Social Set

First (as stated above), the *gweguya* are a separate social set, having more to do with each other across clan boundaries than they do with commoners within their own clan. This is reinforced by the fact that the *gweguya* only marry into sub-clans that are chiefly. This marriage relationship holds the *gweguya* together. A parallel may perhaps be seen in the royal houses of Europe in the 18th–19th Centuries. Although conscious of the differing levels of privilege and authority (noted below) yet they are a homogeneous social unit within Kiriwinan society.

This homogeneity was demonstrated in the 1960s when, at the time of the first formation of a

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[5] These include such things as a shaved head, blackened unwashed body, mourning beads and skirts, etc.

[6] I was once granted the privilege of visiting the *bwala* of the Tudava sub-clan. (Tudava was a legendary hero who slew the cannibal giant Dokanikani and liberated Kiriwina.) The track to the sacred spot was significant at almost every point with various legendary associations being attached to a mound or a rock. At one point my guide pointed out a flat area in a grove of trees as 'the house of the Tabalu sub-clan'. After a rough journey through rugged limestone formations we came to the cave which was said to be Tudava's *bwala*, the point of origin of the Tudava sub-clan. Lovely grottoes sparkled before our torches, encrusted with stalactites and stacked with heaps of ancient human bones, some completely encased in limestone from the dripping water. These were said to be the bones of ancient Tabalu ancestors, whose *bwala* I had been shown earlier.

Local Government Council for all Kiriwina, the Government was able successfully to convene a parallel Council of Chiefs as an advisory body.

Secondly, it depends on whom you ask as to whether all sub-clans in this group may be considered chiefly. If the question is directed to a *dala* fairly low in the pecking order, such as Tudava, then certainly all of these sub-clans are chiefly, only differing in the amount of privilege or weight of authority. If however the same question is asked of a Tabalu chief (as I did on one occasion ask the then paramount chief Vanoi of Omarakana), only the top three (Tabalu, Mlobwaima, Wabali) and maybe a fourth (Kwainama) are truly *gweguya*, whereas the others are merely *tokwaraiwaga* (people with authority).

In this paper, however, I am assuming that all the families listed are of chiefly rank, for each has a definable level of authority and a recognised set of privileges, and I see these two distinctive features (authority and privilege) as the things which determine membership within the chiefly order. Here it is my purpose to show the different level of privilege and authority that each *dala* is accorded by Kiriwinan society.

The word *gweguya* is the plural form of *guyau*, 'chief', and refers to everybody within the various chiefly *dala* whether they hold the place of a village chief or not.

Those who become village chiefs rank high in the *liliu* ('legend') of their *dala*. Certain villages are traditionally occupied by chiefs of a particular *dala*. For example, the high-ranking Tabalu *dala* traditionally hold the office of chief in the villages of Omarakana, Gumilababa, Tukwaokwa, Kavataria, Mlosaida, Sinaketa and Kaduwaga,[7] while another *dala* would traditionally provide the chief of a different set of villages.

The Two Distinctive Features of a Chief

The distinctive features of the *gweguya* recognised by all Kiriwinan society are two, which they call *koni*, 'privileges' and *karaiwaga*, 'authority'. A description of the range of meaning attached to these two will show the total distinctive field of the *gweguya* of Kiriwina.

The feature of *karaiwaga* belongs only to the one who holds the position of *guyau* or village chief, whereas the feature of *koni* is shared in some measure by all the members of the chiefly *dala*. But the full glory of *koni* only belongs to the actual chief of a village; only the chief is able to put on or exercise all the rightful marks of his class. Other members of his *dala* benefit from the same privileges, but in a lesser degree, with due regard being paid at all times to the principle of *kautuwota* referred to below.

Thus, in the comments on *koni* below, I will frequently refer to the chief as the recipient, because he is the highest-ranking one present; but in a lesser degree the remarks will apply to other *gweguya*.

CHIEFLY PRIVILEGE

Koni as a word in general use means a burden carried on the head or shoulders; or, the particular part of a task for which one is held personally responsible. As applied to the *gweguya, koni* has reference to chiefly privilege, rights and responsibilities which they as chiefs are entitled or expected to bear.

Under the heading of *koni* therefore I group the wearing of certain adornment, adornment of a house, certain aspects of personal behaviour or bearing, the right to certain yams, the receipt of an annual tax, certain special chants and honours due to him on occasions, the right to a number of wives, and the elevation of the chief's person above others near him. I now consider the details of these *koni*.

Body Ornaments

The wearing of ornaments or decoration of the body is one of the facts of life for every Kiriwinan, whether chiefly or not. However, certain ornaments are reserved for the *gweguya* as their particular right or privilege. Alternatively some particular modification is made to an ornament commonly worn by all *tokai* which makes it the particular prerogative of the chiefly sub-clans.

Personal adornment is generally referred to as *kala katububula*, 'his adornment' (Fig. 2). On an occasion when a chief is dressed in all his finery, this highly decorated state is

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[7] The villages of Oyuveyova and Oluvilevi are traditionally Tabalu also, but for a number of reasons are currently under the rule of a chief from a different *dala*. See the distribution of these villages under Tabalu chiefs in the map in Appendix IV.

described as *kala kalugologusa*, 'his splendour' (used only of a regnant chief).[8] The various items of personal adornment for general daily wear or for dancing decoration of the *gweguya* are listed in Appendix I.

House Adornment

The second *koni* item is the practice of adorning houses with boards painted in a particular pattern, or by attaching various other ornaments. Such a practice is exclusively the right of the chiefly sub-clans. The total process of decorating a house is called *bomileilai*. The house of a high-ranking chief, when completely decorated and ornamented, is spectacular and colourful. Such a house is called a *ligisa*. It is on the *ligisa* that the various house ornaments listed in Appendix II are displayed.

Many of the same house decorations may also appear on the chief's yam-house (*bwaima*) (Figs 3, 4) and the chief's council house (*buneyova*).

In addition, all of the *gweguya* resident there have the right to use some ornament and some painted decorations on their houses and their *bwaima* (the quantity of decoration being determined by the comparative standards known as *kautuwota*, referred to in the next paragraph).[9] But only the chief who rules a village has the right to have and live in a *ligisa* (Fig. 3).

Chiefly Behaviour

Koni refers also to a particular quality of chiefly behaviour known as *kautuwota*. This is the chief's accepted right to do anything in a superlative manner, and the superlativeness varies according to the rank of the person, so that from members of the Tabalu *dala* (who can do everything in the 'mostest' fashion) down the scale to people from those sub-clans who are barely distinguishable from commoners, this behaviour appears in varying degrees. The higher the rank of a person, the more positively, or loudly, or openly, is he able to do everything. This affects the way a person coughs, or clears his throat, or smokes a cigarette, or rattles his limestick in the lime gourd, or talks.

The form of the chiefly lime-gourd (*yaguma*) and lime spatula (*kena*), with customs and rituals relating to their use, would illustrate *kautuwota* in action but are perhaps too much of a diversion to chronicle here. These two items are discussed briefly below and are included in Appendix II.

In any form of behaviour in public the chief is expected to (or has the right to) be more self-assertive, better dressed, more finely adorned than any other person present. So in accordance with this principle, if at some public gathering of Kiriwinan people a chief of lower rank is wearing an ornament to which his rank normally entitles him, he would be reluctant to continue to wear it that day if it was more splendid than the ornaments worn by another chief of higher rank who happened to be present.

I would not like to convey the impression in this description that the chief is a self-assertive, loud-mouthed individual constantly displaying his own importance. He has the right to be but more often the reverse seems to be the case. A chief, especially one of high rank, usually carries with him a quality of quiet, settled dignity. He doesn't have to assert himself; he is already important and everyone knows it. But the right of *kautuwota* is the lot to which he is born and he has to exercise it on occasions. It is his *koni*, his prerogative, the burden of prominence that he must bear.

Yam Harvest Privileges

Koni privilege invokes certain specific privileges related to the annual yam crop. This includes the right to possess certain yams.[10] When these yams grow to the largest size, then no matter who has produced them they automatically belong to the chief. Such yams are kept by the chief in his council house and are usually kept there for display. Only on a very important occasion would they be given away and such a gift would indicate the approbation or generosity of the chief towards the recipient individual or occasion. This level of generosity would be recognised as the *kautuwota* principle in action.

The very best yams are called the 'feather of

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[8] On a recent visit I discovered a second equally splendid word describing the same thing: *kala mitakakanukula*, which derives from the verb *-kanekukwa*, 'to hang down loosely', and translates as 'his visible loosely hanging adornment'. This imparts a whole new cultural dimension to the term 'hang loose'! It seems that a Kiriwinan speaker sees no point in describing something with a simple short word if a polysyllabic alternative is available.

[9] The houses of *tokai* (commoners) do not, and cannot, have any ornamentation or painted decoration.

[10] Some of these were named *taitukesa, kuvibanena, kuvipiti, danuma, bugwa, mwedamwada*.

the village' (*kala dagula valu*, or *digulela valu*) and the very famous ones are kept for some years until they rot away from the stick to which they have been lashed. So while 'belonging' to the chief they are effectively a public display of that village's wealth and prestige.

In 1968 I saw one of these yams, a *kuvipiti*, on display in Omarakana, the village of the 'paramount chief', which I measured at 3.15 metres in length. This yam was not very heavy, being only 75 to 100 mm thick. Another yam dug the same year measured only 1.95 metres long but was very thick and branched (a *kuvibanena*) weighing approximately 50 kgs. The owners sought to present it to the Omarakana chief in payment of a long-standing obligation. However it had to be carried past another village, the chief of which believed himself entitled to possess it, and in the resulting fight one man was killed and some fifty other belligerents were detained at Her Majesty's pleasure for a specified period.

I have since seen another yam on display, described to me as the 'feather of the village', 3.45 metres in length. While inspecting and praising it I was regaled with stories of much bigger ones dug and displayed in previous years; the Kiriwinan, in common with the rest of mankind, loves a credulous auditor.

Two other yam-related privileges which are part of the chiefly *koni* may be mentioned here. One is the right a chief has to a certain chant being sung over his yams when they are being brought in from the gardens at harvest time. In the harvest month (*milamala*) there is a great deal of noise and fun, and the commoners' yams are brought in from the garden with a lot of noise and 'fun-nothing'[11] chants and songs. But the *sawila* chant is reserved for the chief's yams.

The second applies when a gift of yams, or an obligation payment yam, is being brought to the chief. On such an occasion, someone blowing a *tauya* (shell-trumpet) precedes the bearers announcing the action. The shell-trumpet is a common feature in many Melanesian societies. In Kiriwina, however, the *tauya* is reserved to announce actions related to the chief or public functions to which the chief has given his open support. For this reason it is included as part of chiefly *koni* in Appendix II.

Annual Tax and Other Privileges

An annual obligation called *pokala*, a form of tax or tribute, is paid to the chief. This is usually paid as a gift of ready-cooked fish.[12] When the people pay *pokala* to the chief in this way, he is obliged to make a return by feeding the people who have done so. This repayment may take place a few days after the tribute is given. I am not sure who wins, but as the winner is always the one who gives most away, the chances are that the chief, who must be well-practised in giving, would come out of this with the greatest prestige.

The chiefly sub-clans alone have the right (or is it the burden?) of contracting polygamous marriages, the number of wives you are entitled to varying with your rank. This practice, known as *vilayawa*, is not so strong today. When missionaries first went to Kiriwina in 1894, the then 'paramount' chief Enamakala, a powerful Tabalu of Omarakana village, had 40 or more wives. Today, chiefs having similar status may have about ten. In 1994 a Kiriwinan chief visited Canberra accompanied by his eleven spouses. (Sadly, I did not hear of it until afterwards.) The rights of respective ranks of chiefs in this regard are listed in Appendix III.

A further example of chiefly *koni* is known as *kavagina*. This custom involves ensuring that the chief's head is always higher than the heads of any others of lower rank. The lower-ranked person will stoop, or walk in a stooped position, when he passes or approaches a standing chief. If the chief is seated, then he must approach him crawling or shuffling very low. While this may not be observed so rigidly today, the practice of showing respect to people of importance by trying to keep the head low in approaching or talking with them is observed as a common every-day courtesy by Kiriwinan people.[13]

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[11] Neo-Melanesian Pidgin for 'nothing but fun' ie. no serious religious or political implications.

[12] For the Kavataria area, the fish is *mamila*. For inland areas, *kwau* (shark) is bought from the shark-fishing specialists in the northern villages and presented.

[13] A custom related to the practice of *kavagina* is called *vatala*, which is an early warning system used when a chief is travelling to another village. As he walks along, someone walks beside him and when they come to the outskirts of a village the chief's companion calls out, '*Guyauuuu!*'. By the time the chief enters the village, all are in respectful positions with their heads lower than that of the chief. Other customs relate to chiefly movement, such as someone blowing softly on a *tauya*, or a child walking before him carrying his *yaguma* on her head which would jingle as they walked, a surprisingly penetrating sound. All had the purpose of an early announcement of the chief's imminent entry.

Death Honours for a Chief

A final and fitting example of *koni* is the death honours paid to a chief or to any of the *gweguya*. Mourning customs due to a clan member are of course the lot of all but the *gweguya* are mourned longer. His widow or widows will wear some of his personal adornment. Special dirges are sung during the mourning period. In times past these laments (called *kavamwala*) were sung morning and night for several months after the death.

The mortuary exchange referred to above as *sigiligula* is often delayed for some years after the death of a high-ranking chief, as it is not every year that a yam harvest is large enough to do fitting honour to the deceased chief. As an example of this, one of the most powerful Tabalu chiefs, Mitakata, died in 1961, the year I first went to Kiriwina. When this paper was being first written in 1968, his mortuary *sigiligula* had not been held and his *bwaima* still stood in the village. Not until that mortuary distribution was held, several years after his death, could the yam house be ceremonially dismantled and destroyed, enabling the succeeding chief Vanoi to build his own *bwaima* and to assert the full glory of his chiefly standing.

The *koni* of a chief or of the *gweguya* has been sketched above. However, the rank of the various *dala* from high to low cannot be seen until the actual limits of privilege for each *dala* are defined. This ordering of the *koni* of each *dala*, as delineated by my colleagues Antonio and Tolosi, I have set out in Appendix III.

CHIEFLY AUTHORITY

I now take up the second distinctive feature of the *gweguya*, the authority or *karaiwaga* which is accorded them by Kiriwinan society.

The word *karaiwaga* in general use refers to the giving of orders, the wielding of authority, or the possession of special powers. It is a word with a very high functional load in Kiriwinan speech. In relation to a chief, *karaiwaga* refers to his area of authority, either the actual territory he rules over or the powers he exercises directly over the lives of his subjects.

Vested in the regnant chief

The right to exercise chiefly authority does not lie in the hands of all *gweguya* within a chiefly *dala*. Only those who actually hold office as chief of a village may be said to exercise chiefly *karaiwaga*. I have already noted that *koni* belongs in some measure to all the *gweguya*. But the dual possession of both *koni* and *karaiwaga* is the acknowledged right of the village chief only. This chief alone is addressed as *guyau*, and the total territorial area of his authority is referred to as *la guyau*, 'his area of chiefly power'.

Only one chief holds authority over a village as its *guyau*. Each village is traditionally the territory of one particular sub-clan of *gweguya* and if there is one of the right sub-clan chosen to govern that village then he will have the position of chief. If the particular families which hold the traditional right to supply a chief for one village die out, then other families from within the same *dala*, but of lower rank, would supply the chief. Rarely does another sub-clan take over the chiefly role for that village.

It has been pointed out that one *dala* does not occupy a cluster of villages so as to rule over a single area of territory. Rather, the chiefs of one particular sub-clan are chiefs for villages scattered over the whole area (Kiriwina Island and adjacent islands)[14] while other chiefs from different sub-clans rule villages between them. In any one village, when the highest-ranking man takes his position as *guyau*, other people of importance in that village and within the chief's own *dala* become members of a village advisory body known as *kaidadala valu* (see below).

Succession to chieftainship

The succession to chieftainship is necessarily someone chosen from within the chief's own *dala*. As the chief's wife (or wives) do not belong to the chief's *kumila*, the chief's own biological children are not in the line of succession. The line of succession for the new chief is through the present chief's sister's children. The eldest sister is the highest in rank,[15] so her sons will be

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[14] See above, where Tabalu villages are named. See also the map in Appendix IV where the Tabalu villages are marked, showing that they are widely dispersed, with many other villages in between.

[15] Within each *dala* there are subdivisions descended from the six legendary female members of the first family. The eldest is termed the *vilitomoya*, the second *isakaili*, third and others *iluluwala*, and the youngest is *vilagwadi*. As membership of the *dala* is determined by matrilineal descent, the children of these six women are the *dala* originators. The children of the *vilitomoya* are of the highest rank but if all the female descendants were to die out, then the descendants of the next *dala* originator in line would be of the highest rank. The Tabalu chief in Omarakana in 1968 was a descendant of the original *vilitomoya* of the Tabalu *dala*. This means he was very powerful but the title of 'paramount chief' is a concept from outside Kiriwinan culture and does not really apply.

candidates. The choice of which son is completely in the hands of the regnant chief and not necessarily the eldest son would be chosen. A wise chief would be guided by the opinions of his advisory group, the *kaidadala valu*, but the final choice is his.

When the chief has chosen his successor, then the nephew chosen comes and lives in a house beside his uncle. He may live there for many years before the death of his uncle clears the way for him to become the new chief but by then he is known and accepted and has for many years watched his uncle and listened to the collective wisdom of the *kaidadala valu*.[16]

Consideration of the extent of the *karaiwaga* authority of a chief must include two levels; one is the traditional ancient *karaiwaga* which myth and tradition claim for that chief and the second is the actual power a chief will be expected to hold even by those who no longer believe in his ancient powers.

Traditional ancient authority

The *dala* are arranged in this section in a descending order of authority. The highest ranking *dala* is the Tabalu *dala*, both as to *koni* and *karaiwaga*. The authority of the old Tabalu chiefs literally had no limits, as informants frequently have told me. They controlled the rising and setting of the sun and movements of the moon and stars. The wind and tides, both foul and fair weather, rain and dry spells all occurred because of their knowledge and manipulation of their magic powers. Some sicknesses, and death itself, was ruled by them. If the annual yam harvest was excellent or if there was grievous famine, the Tabalu chief was at the back of it. Certain special forms of magic, such as *tokovasila* and *salokuva*, and the possession of certain stones having terrifying magic powers,[17] belong to the Tabalu.

Perhaps their most feared power of old was the communion they held with the dreaded *bogau* spirits and the death sorcery they worked through them.[18] This sorcery took various forms, culminating in the poisoning of the victim using either a slow-acting poison or one which killed the victim in a few hours.

Of all these ancient powers, probably only the last-named is still retained and that, for the most part, in secret. The others are today largely ceded to the Christians' God.

The second-highest *dala* was in times past the Sakapu (who bore the distinguished title of Toliwaga), a *dala* which is today almost extinct.[19] The Wabali *dala* is replacing them in this position of second in chiefly rank as to *karaiwaga*.[20]

Their special area of authority was in matters of war. If war was to be fought between the

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[16] I knew of one case where the chief changed his mind after the chief-elect had lived close by his uncle for many years. He considered his first choice had turned out to be *tonunumata* (stupid, lit. 'a person of dead mind'). So another nephew was established in the position and residence of honour. But when the old chief died, each of the nephews had a following and both claimed chiefly rank, so that considerable social unrest followed. The situation was never resolved and the split in chiefly authority has now been woven into the structure of chiefly power for that particular area. This demonstrates the flexibility of the system.

[17] I have been shown some of these and refused the viewing of one.

[18] If anyone had an enemy, or someone they considered blame-worthy on some count, they could go to a Tabalu chief and get his consent for the death of that person. Such an act was costly and had to be paid for with *veiguwa*, (wealth items). If the chief agreed, then he was responsible to see that the victim died (either by his act or by the act of one under his direction) and to choose the manner of death. In this and other sorcery killings, the chief held a position akin to that of a public executioner except that the deaths were effected secretly. The high level of respect and fear traditionally accorded the Tabalu comes in large measure from this.

[19] The Sakapu *dala* was the one which from long ago bore the title of Toliwaga (which means 'Captain or owner of the boat'). This was conferred upon them by the Tabalu for some unknown favour in the past; the right to use the title is highly treasured and is currently in dispute. There were two subdivisions within the sub-clan which were considered of sufficiently high rank to hold both the *koni* and *karaiwaga* which marked them as Toliwaga; one (Tomwalu) is now extinct and the other (Uweilasi) in 1968 had one surviving member, Tonuwabu of the village of Kaitagava. According to my colleagues he is the last person able to bear rightfully the title of Toliwaga. See also the following footnote.

[20] The Wabali *dala* will take the place of the Sakapu when the two ruling subdivisions noted in the previous footnote are completely extinct. They are in fact in the process of taking this position over for themselves. (The process by which such a transfer of powers and privileges within the class system takes place would make an interesting study and clarify some of the mechanisms by which flexibility is maintained to ensure good fit between the ideal and the reality of chiefly status.) The present position appears to be that they have assumed most of the *karaiwaga* and *koni* formerly held by the Sakapu *dala* but there remains one last step — to possess for themselves the honoured title of Toliwaga. Some of the Wabali chiefs have in fact already done this. Many Kiriwinans are angry at their presumption but the Wabali *dala* seem to be holding the title without any retaliatory action being taken. There are still sections of the Sakapu *dala* which have a certain amount of *koni* but have no acknowledged right to possess *karaiwaga*. These are descended from the *vilugugwadi* (younger female members) of the *dala*. It is in this context worth noting that in the late 1990s the Kwainama *dala* is attempting to increase its chiefly rank

traditional war zone territories of Kiriwina[21], or with an outside enemy, the decision as to whether the zone would engage in war lay with the Toliwaga. If he said 'War!' it was war; if he said, *Desi* ('Stop!') then they did not prepare for war. Also he had the power (the recognised authority) to stop a war which was in progress between two groups of Kiriwinan warriors. As a symbol of this authority he held in his hand an ebony club (*puluta*) or walking stave (*kaitukwa*); if he went into the middle of a battle in progress and thrust the club or stick into the ground, this was the signal for fighting to cease.[22]

That this authority is still in some measure recognised is illustrated by the story of Mitigilagela. In 1943 when Kiriwina was occupied by some 3000 Americans and a small Australian force, and all resident Europeans had been evacuated by compulsory orders, there was a temptation for Kiriwinan people to plunder what had been left behind by missionaries and traders. Then Mitigilagela, a Toliwaga chief from Kabwaku, walked several miles from his own village to Oyabia (the central mission station of the Methodist Mission) and plunged his ebony club into the ground in the middle of the mission station. All who saw and heard of this knew that there was to be no advantage taken by the absence of European mission leaders, that they were not at war with them. So while the head station of another mission, and properties of other European residents, were stripped and devastated by thieves, Oyabia was not touched. The reason why Mitigilagela did this is not known, as he had no known connection with the Methodist Mission and no reason to feel obliged to help it.[23]

From this it may be seen that the authority of the Toliwaga was not restricted to his own village area and was generally recognised in a war-related matter. Although the Toliwaga's *karaiwaga* has largely become irrelevant today, yet the Kiriwina people still recognise and obey him when he exercises his *karaiwaga* in its own proper sphere.

The third in *karaiwaga* rank was the Mlobwaima, which had the right to prevent war. The difference between the traditional authority of this *dala* and the Toliwaga seems to be that the Mlobwaima had the role of mediator or war-preventer but once the Toliwaga had pronounced for war, the Mlobwaima power was ended. He could not stop what had already started — only the Toliwaga could do this.[24]

Then comes the Kwainama *dala*, which had a small area of authority in relation to the distribution of the food (i.e. yams) which rightfully belonged to a chief, separating it from the yams of the *tokai* and deciding what shares were to be allotted to the various ranks of *gweguya*.

The ancient authority held by other lesser chiefs as distinct from that of the more powerful *gweguya* seems to be of little account. The chief of Omarakana village, Vanoi, a Tabalu of the highest possible rank, i.e. descended directly from the *vilitomoya* (eldest female member of the *dala*) declares that they are not in reality *gweguya* but merely *tokwaraiwaga* (men with authority). However, he looks down from a lofty eminence, scorning to recognise any powers they may have held; but other Kiriwinan informants from the lower ranks of *gweguya* do not support his viewpoint.

Some of these latter suggest that the Mwauli and the Osusupa *dala* held powers similar to the Mlobwaima but to a much lesser extent, while Tudava *dala* had certain powers relative to sorcery

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[21] The island of Kiriwina was traditionally divided into zones where each considered they had a particular loyalty in war. These zones are delineated in the map in Appendix IV.

[22] When he thrust the stick into the ground, the Toliwaga would say something like, *Lawai gai. Gala bigabu valu!* 'I have struck in the ebony; the village will not burn!' (in the case when warriors were preparing to burn the houses of an enemy village). When they met on the the traditional battle-ground of Duguveiyusa, between the villages of Omarakana and Kwaibwaga, he could secure cessation of the battle by laying a line of branches across the battle ground. Anyone from either side who crossed the line could be speared but if no-one crossed the line (called *kaligei*) then the battle was over.

[23] A Toliwaga had to be paid to perform his office. I did hear a rumour that a prominent church leader, Inose Ugwalubu, paid Mitigilagela in the traditional fashion with *veiguwa* and that he then went and performed his office. But I was never able to check this.

[24] Clearly there was much interplay between areas of *karaiwaga*. Due regard for Tabalu authority would have a place here as well. For only Tabalu could give the word that a person was to die and sometimes these deaths were effected within the melee of a traditional battle. Thus, there would have to be an understanding between Tabalu and Toliwaga regarding such a battle (which would prevent the Toliwaga from entertaining any Mlobwaima overtures) and the time of stopping a battle could depend on whether the Tabalu-sanctioned death had actually occurred. Thus the *karaiwaga* of a Toliwaga would have been in some measure subsidiary to the Tabalu in order to effect the death and the Mlobwaima *karaiwaga* would be in a position below that of the other two.

which made them an unpopular group with little real standing in the community.

The Kaitotu *dala* is said to have possessed no particular traditional ancient *karaiwaga* but only had *koni*. This was because the *dala* came long ago from Myuwa (Woodlark Island) where they had extensive powers; but when they migrated to Kiriwina their powers were not recognised. Instead they were given a limited amount of *koni* privilege so they do belong in the group of *gweguya* as I have defined them.

The other three *dala* (Kailai, Kulutula, Bwaitaitu) are on the lowest level having a little *koni* and no ancient *karaiwaga*.[25]

Tabalu supremacy

One thing that is clear from this study of ancient *karaiwaga* (as also is abundantly clear from the different levels of *koni* shown in Appendix III) is that the Tabalu *dala* is virtually in a class of its own above the *gweguya*, for both in ancient *karaiwaga* and in *koni* it is widely separated from all other *dala*. This was in fact what was asserted by Vanoi, who put the Tabalu (Fig. 6) at the top as the only real ruling class, named the Wabali (Toliwaga), Mlobwaima and Kwainama sub-clans as *gweguya*, and the other four as merely *tokwaraiwaga*.

But (on the other hand) it may be said that his viewpoint is both typical of and worthy of a powerful Tabalu chief who must of necessity exercise his right of *kautuwota*. The general mass of Kiriwinan opinion does not separate the Tabalu *dala* totally but is emphatically unanimous in supporting the fact of Tabalu supremacy. Such supremacy may not be easily seen by looking at the outward manifestations of their ruling authority; but people remember the glories of their past and still hold them in honour today through the *koni* that is accorded them and by their daily expectation that *kautuwota* will set them apart from all others.

Also (as one man told me quietly) everyone still fears the sorcery poisonings, which many believe still take place today; this fear will ensure the Tabalu of their supreme position for many years yet.[26]

Modern authority of chiefs

I now look at those ruling powers which mark the day-to-day *karaiwaga* of a village chief. For purposes of ordering the daily life of the village it may be said that all village chiefs have approximately the same range of authority but those who are considered to be higher on the chiefly scale of rank are more likely to be effective in their exercise of that daily *karaiwaga*.

The yam crop

The ownership and disposal of the staple yam crop is the real foundation and purpose of any effective chieftainship. For it is the chief's task and privilege to feed his people when necessary. Not that other members of the village community do not own food—they do; but the chief has great wealth in this regard, partly through his chiefly right to possess the best of certain yams and partly because of the annual yam harvests which must

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[25] These three *dala* were named to me almost as an afterthought by my colleague Tolosi, a man of the Tabalu *dala*. I found that one of the present *gweguya* of Kiriwina (i.e. someone having recognised chiefly authority over a village) was Guyau Lubatolu of Kudukwaikela, of the Bwaitaitu *dala*. It is clearly the case that if he can be recognised as *guyau* of that village then he is one of the *gweguya*. But his level of *karaiwaga* within the totality of *gweguya* is on the lowest level. There are *dala* below the Bwaitaitu which have some *koni* but which cannot have any *karaiwaga* and so cannot ever become the *guyau* of a village. I was also told that the *dala* who possess no *koni* at all are very few in number. These *dala* therefore rank as *tokai*, as the *gweguya* comprise those who possess some *koni* and have a potential share of ancient *karaiwaga*. The limited *koni* of these lesser *dala* is in being allowed to wear certain ornaments for dancing, provided that the *guyau* first gives permission, and provided that they are taken off immediately after the dance is concluded.

[26] A former Governor-General of Australia, Bill Hayden, actually made reference to the eating of poisoned food by the Trobriand Islanders, in a 1995 speech supporting euthanasia! His astonishing assertion was that the food was consumed knowingly, because the consumer has elected to die, having the desire to put an end to a useless old age in the interests of society! I can assure him that this is never the case. I have it on reliable authority that secrecy and duplicity surround the preparation of the poison (which may be eaten, drunk or smoked) so that the consumer partakes in innocence. But as soon as he has swallowed, he knows; and recipes for powerful and revolting emetics have been dictated to me. I am told he may survive if he can vomit within minutes of swallowing; but if not, he knows he is marked for death and usually succumbs rapidly. Also, the consumers are never the 'useless' aged, whose continued life is treasured by a family, but generally hale and hearty men who have overstepped some social boundary and are being made to bear the penalty. The act of administering poison in this way may be expeditiously dubbed as execution or assassination, or bluntly as murder.

by tradition be given each year to his wives by their brothers.[27]

This responsibility (and privilege) of feeding his people comes whenever the whole community is jointly engaged in a project of work, such as garden clearing, harvest, the building of major village structures, and at the time of *pokala* (tax).

A task may be initiated by the chief calling the workers together and reaching an agreement with them (*kabutu*) for some task. Then they will eat the chief's food[28] and afterwards go and work. While they work, the women cook more food supplied from the same source.

When the month of *Yavata* comes (about February), when food is scarcest (this season of scarcity is called *kuluvasaga*), the chief will take all the yams from his *bwaima* and share them out to the whole village.

When visitors from other villages come, as when *kula* trading canoes or canoes carrying clay pots for sale anchor off-shore, or when groups arrive on foot from neighbouring villages on some important visit, then it is the chief's task to feed them. This task of hospitality is nowadays shared by the village pastor, the village councillor and the chief, according to the nature of the business occasioning the visit.

The gardening cycle

The chief's decision is required in the gardening cycle—which land is to be cleared for gardening, the time of planting, weeding and harvesting, the gathering-in of the harvested yams to the village for display and storage, and any other communal decisions affecting yams. However such decisions would be made in consultation with his councillors (the *kaidadala valu*) and in particular with the *Towosi*[29] or garden magician (if the village has one).

The chief decides when the annual ceremony marking the conclusion of the harvest and the old year takes place. This Kiriwinan New Year celebration involves drumming the spirits of the dead out of the village (where, out of interest and with mischievous intent, they have been 'hanging round' throughout *yoba*, the harvest period!) so that they may return to their resting place, the island of Tuma, several miles west of Kiriwina Island. This ceremony may not be done every year but is one of the marks of a good harvest, when the spirits of the recently dead are expected to be part of the general rejoicing.[30] Everyone knows that if the spirits do not return to Tuma thoroughly satisfied with village affairs, some of them may be inclined to come back to their old homes, with uncomfortable and inconvenient results.

It falls to the chief to decide whether the harvest has been sufficiently good to justify a period being spent in dancing (*kaiwosi*). Such a period, which occurs during the month following harvest, gives opportunity for all who have any level of *koni* to display it; for at this time bodies will be painted and oiled, hair bedecked with feathers and ornaments, and whatever ornaments each is permitted to wear will be made ready. After a day spent in preparation, there will follow a night of drumming and dancing, the old men singing the legends which each dance celebrates. But the chief would only decide on a time of dancing if he considered it acceptable; in some years the transition from harvest to preparation of the new

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[27] The yams which are harvested by a household (man and wife) are the property not of that family but of the man's sister. His household will eat what is provided by his wife's brother. Thus it follows that a chief with (say) six wives will have six complete harvests to store and dispose of each year. If he has married wisely, the men who produce his yams will be the skilled gardeners (*tokwaibagula*) of Kiriwina. A great deal of personal status attaches to a recognised *tokwaibagula*; he is the generator of social and political power, power which becomes the *karaiwaga* wielded by the chief.

[28] The two words 'food' (*kaula*) and 'yams' (either *kuvi* or *taitu*) are used inter-changeably by Kiriwinans; and I find myself falling into the same pattern as I write! Whenever I use the word 'food', it must be understood that things like sweet potato, tapioca and cooking bananas are *not* referred to, as these are not regarded as 'true food' (*kaulotoula*) but as something to eat when there is no 'true food' available. Offhand I am not sure of the status of taro, for this is highly regarded; probably it falls into that other class of comestibles which includes pork, fish, crab and poultry, the things 'which season food' (*biwaki kaula*) and are used to mark very special occasions.

[29] The *Towosi*, who uses ancient magic spells at the inception of any community gardening activity, is a man greatly skilled in knowledge of the stars and the elements, especially in relation to the cycle of seasons. The magical side of the *Towosi*'s function is less in evidence today; he is more prominently an expert rather than a magician.

[30] This is a happy occasion when a special 'spirit food' made of mashed yams is baked in ground ovens, forming cakes the size of a large dinner plate. This food is laid out before food houses, and the village retires to rest, so the spirits can enjoy their feast. Then about 3 a.m. the entire village population rises and assembles on the Eastern boundary of the village and sweeps through the village towards its Western extremity, with yells, beating pots, drums, etc, driving the replete spirits before them towards Tuma. It has been pointed out to me that of course the spirits eat their food because by morning not a single scrap of the spirit food is to be found anywhere.

garden sites is so quick that there is no time for dancing.

All of the current authority noted above has some connection with the gardening cycle. Because they rely on the yam as staple, the Kiriwinans are bound to the annual cycle of clearing, planting, weeding, harvest and storage, and thus any person holding authority over this succession is inevitably their ruler, calling the tune for each day's activity.

Some today are prone to claim that the day of the chief is past and that the state of affairs described by Malinowski (e.g. in 'Coral Gardens and their Magic') no longer exists. This claim has no foundation in fact. Certainly many of the ancient powers are thought no longer to exist but the same was true in Malinowski's day, for many of the things he described were merely accounts of things Kiriwinan people said used to happen. These things aside, the chief's authority in the gardening cycle is little changed from eighty years ago, and his position and power as chief are still sure and firm.

The chief's lime gourd

The lime gourd used by a chief, together with its accompanying spatula, often becomes a symbol or tool of chiefly authority. When the chief walks from one village to another, the gourd is sometimes carried before him by an underling. If he wishes to make a public statement, he will remove the stopper and insert the spatula and, as both stopper and spatula are liberally decorated with *bwibwi* (see Appendix II), this causes a loud jingling sound. Rattling the spatula in the mouth of the gourd is a signal for talking to cease so the chief may speak. A chief on the move is seldom without his *yaguma* (gourd) and *kena* (spatula) (see Fig. 6). The chiefly lime gourd usually has no decorative patterns engraved on it.

Authority in other matters

Other matters are also the responsibility of the chief to decide, such as the decision where a house may be built in the village, arbitration in disputes over land or marriage relationships, some decisions regarding village participation in *kula* trading, and so on. There is also the exercise of his authority in protecting the *koni* rights of the *gweguya*. The chief generally, and a Tabalu chief particularly, is the guardian and 'policeman' over the rights of personal adornment and the decoration of houses.

Two examples of the exercise of this latter authority may be of interest. In the first, one of the *gweguya* was decorated for a dance wearing more of the *mmakata*[31] plumes (Fig. 7) in his hair than tradition entitled him to wear. This had the effect of a public statement that he considered himself of higher standing than the chief. I do not know to what extent the chief acted personally — usually they are men of a dignified mien who leave action to their subjects—but in the resulting tangle between two villages, after the Government constabulary had restored order, some sixty men were given prison sentences for 'riotous behaviour'.

In the second example, Vanoi, the Tabalu chief of Omarakana, told me that he was going to speak to the people of Tukwaokwa village to find out who had given permission for the local tourist hotel owned by a European to be decorated with the *kaibilabeta*[32] motif. 'I am not angry with the European,' he explained, 'he doesn't know any better. If the Tabalu chief of Tukwaokwa has done this or consented to it, it is all right, the symbol is his property. But if any of the lesser *gweguya* or the *tokai* have done this, then I will ask them, "Why did you do this?" And I will see that they pay a fine because to take *koni* which doesn't belong to you and give it to someone else is stealing.'

I need to note the existence and role of the village advisory group already referred to above. The chief rules his people with the assistance of a group of influential village men known as the council or *kaidadala valu*. Membership of this group is not restricted to *gweguya*, although all members of the *gweguya* living in that village seem to belong to it. Membership is determined by the possession of a *bwaima* (with yams stored in it), so that all members of the village who possess the food-wealth of the village have a say in the conduct of village affairs. The chief and the council meet in the village council house, the *buneyova* (Fig. 5). This building, as noted above, is the place where all the splendid 'feather of the village' yams are displayed and it may be decorated in addition with some of the chiefly house decorations listed in Appendix II.

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[31] See Appendices I and III for *mmakata* use and number permitted.

[32] See Appendix II for *kaibilabeta* decoration.

THE CHIEFLY HIERARCHY

I am now able to list the hierarchy of the chiefly *dala* of Kiriwina. They are first listed in their *kumila* in the order which my two Tabalu colleagues dictated. I then list the order of precedence which their level of *koni* indicates and the ranking they hold in respect of chiefly *karaiwaga*. The orderings are not mine but are those which my two colleagues say are correct.

Readers may check their analysis against the differing levels of *koni* and *karaiwaga* that are shown in this paper.

Ranks within the clans

Table 1 shows the ordering of chiefly *dala* within each *kumila*. As already noted, there is little that holds *kumila* members together, apart from possessing certain things in common.

Malinowski makes this clear (1932: 421) where he points out that 'in respect of rank, it is the sub-clan [the *dala*] rather than the clan that matters, and this holds good with regard to local rights and privileges . . . The clan is primarily a social category rather than a group . . . not of great importance . . . only to be seen at work in certain big ceremonies'.

The *kumila* also attains some significance because of the exogamous marriage custom, which means that a chiefly family must look beyond the chiefly families of its own clan for marriage alliances.

Chiefly rank in privilege and authority

One interesting fact that emerged from this study is that the chiefly *dala* are perceived as ranking in a different order depending on whether one is considering the privileges (*koni*) that Kiriwinan society accepts for each, or whether one takes into account the traditional (often archaic) areas of authority (*karaiwaga*).

In the case of privileges, the amount of *koni* which may be publicly displayed is often dependent on historic acts of 'grace and favour', where a *dala* of high rank has awarded one of low rank with some special privilege which thereafter elevates the recipient.

In the case of authority, however, there is little change, as modern authority is static and fairly uniform for all chiefly *dala*; thus traditional ancient authorities which do not change become the means of stating the position of a chiefly *dala* within the hierarchy.

TABLE 2. The ranking of chiefly *dala* according to *koni* and *karaiwaga*

Ranking	***Koni*** **(privilege)**	***Karaiwaga*** **(authority)**
1	Tabalu	Tabalu
2	Mlobwaima	Wabali
3	Mwauli	Mlobwaima
4	Kwainama	Kwainama
5	Osusupa	Mwauli
6	Wabali	Osusupa
7	Tudava	Tudava
8	Kaitotu	Kaitotu
9	Kailai	Kailai
10	Kulutula	Kulutula
11	Bwaitaitu	Bwaitaitu

Table 2 sets out the rank of chiefly *dala* which Tolosi and Antonio considered correct, showing the different order for privilege (*koni*) and for authority (*karaiwaga*). The differences in order may not seem great to the outside observer but to members of that society, where a feather wrongly worn or a yam given to the wrong person is able to spark a major riot and precipitate a death, these apparently small differences are of major significance. Re-ordering does occur and is in fact in progress for some *dala* right now but it takes place very publicly and is finally effected with full community awareness of the new privileges which one *dala* is now able to display without incurring the anger of other members of that society.

CONCLUDING COMMENT

The rather annoying conclusion which must be stated is that there can be no conclusion as yet. For even though Kiriwinan society has been extensively studied, there is yet much that has not been researched which would be valuable for a better understanding of the chiefly hierarchy.[33]

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[33] But see Powell (1960). This scholarly and well-researched paper does examine the economic forces at work in chiefly political activity but he explicitly leaves 'to other publications the full analysis of the main social institutions . . . namely those of rank and of kinship and marriage' (p. 118).

I am aware that in answering some questions I am begging others. If I had further opportunity for field study, I would want to do the following:

- examine the genealogical placing of all currently regnant chiefs within one *dala*;
- put the same questions to members of *dala* other than Tabalu;
- collect genealogies and lists of names peculiar to each *kumila*;
- investigate the migrations of recent (but prior to 1890) arrivals in Kiriwina;
- record each clan's origin stories and try to get a better understanding of clan structures;
- study the historical and contemporary politics of the Toliwaga;
- study recent Kwainama movements challenging Tabalu supremacy;
- do a detailed study of at least one *kaidadala valu*;
- identify the traditional chiefs who rule each village and map the pattern for each *dala*;
- investigate the possibility of the Tabalu *dala* being descendants of immigrants who came to dominate an earlier culture.

Much of this would have a bearing on the history of the rise of a class system which is, I believe, unique among the societies of Papua New Guinea. I find myself a little astonished that it is now almost 30 years since I first wrote this paper but still I am working on that language and studying that culture. If anything, the questions I would like answered increase with the years!

APPENDICES

Appendix I. Ornaments worn by the different class levels of the *gweguya*

(NB. 'A.' numbers refer to objects in the collections of the South Australian Museum)

bunodoga — a belt of *buna* shells (Fig. 8(A), A.8871).

bwibwi — small pieces of shell which jingle whenever an object or its wearer moves. They are attached as pendants to *soulava*, *saveva*, lime gourd stoppers, lime spatulas, etc. A high ranking chief would have many *bwibwi* as ornaments (see Fig. 6).

ikwalasi — a pair of *buna* shells worn suspended from one side of the *vivia*, at front, or from the waist-band of a *doba* (A.52469).

kaisapi — a bracelet of *buna* shells, worn on both wrists.

kala doga — in its simplest form (Fig. 8(D,E), A.8882, 8886), this ornament may be worn by the *tokai*. It consists of a boar's tusk which has grown into a circle (or the end cut off the large cone shell used in making a *mwali*, which has the same appearance), worn suspended from the neck by a string. When used by a chief the string is replaced by a small *soulava*, with the end tied behind his head, terminating in a *buna* shell. Clusters of *bwibwi* are added. A small *katudababila* may be used in place of the string or the beads.

katudababila — a belt of *kaloumwa* discs, worn with or without the *bunodoga*. The number of lines of discs indicate the rank of the wearer, the maximum being five as worn by the Tabalu. A small *katudababila* or fragment of the same may be worn as part of a *kala doga* (q.v.) (Fig. 8(B), A.58657).

kwasi — a woven arm-band made from a fern fibre (*kusikwasi, kasuma, degila*). There are three different forms:

a) simplest, worn as a wide armband on each upper arm and known as *kwasi kaewa* (A.61997, 62000).
b) *mlipwapwa* worn on the upper arm, between the *kwasi kaewa* and the elbow, by all regardless of class.
c) *kwasi tilawa* or *mtuwetuwa,* worn on the forearm by *gweguya* only, of greater width for higher ranks (Fig. 10, A.74493, 74494).

An addition to the *kwasi* is the placement of scented leaves for important occasions, while some may add long streamers of *wowona* (pandanus); these are called *bisila* and indicate that there is some particular reason for rejoicing, or some project of considerable importance in progress

lubakaidoga — a pair of *buna* shells worn on the leg just below the knee (A.66709).

luluboda – an anklet of *buna* shells worn on both legs; pairs of *buna* shells (known in this use as *puluweiwa*) are sometimes suspended from this ornament.

mmakata — a long plume made up of two or three long feathers joined end to end, decorated along the side with the red breast feathers of the *karaga* parrot; worn in the hair for dancing.

midimidi — small woven leaf streamers (see *kwasi*) tied to the wrists for dancing.

saisai — *buna* shells tied to the hair at the back of the head (A.52469).

saveva — a headband consisting of a (usually) single line of *kaloumwa* discs worn across the forehead (Fig. 6; Fig. 8(C), A.8875). Higher ranks wear this with the addition of pairs of *buna* shells suspended from it. The pairs of shells are called *bunavigula*.

segadulu — a *soulava* 'necklace' terminating in a large *buna* shell or pearl-shell crescent, with *bwibwi* made of scraps of pearlshell, etc (A. 55332). This is worn suspended from the back of the head, letting the beads hang down behind usually to about the buttocks, longer for higher ranks.

soulava — a necklace of *kaloumwa* discs (A.17925). The length varies considerably, from 40cm to 150cm, and may be single or double; the longest are worn crossed across the breast and are called *tabala*.

tabala — a long *soulava* worn crossed (see Fig. 6).

Appendix II. Houses, house decorations and other objects used by *gweguya*

(NB. 'A.' numbers refer to objects in the collections of the South Australian Museum)

Houses:

buneyova — the council house of the chief, where he meets with his *kaidadala valu*. The *buneyova* usually has a raised platform where the chief sits elevated above others for due observance of *kavagina*. In the *buneyova* are hung the best long yams on display; fifteen or twenty may hang there at harvest time, and the number dwindles as obligation payments are made, leaving only the one or two *kala dagula valu* which are never given away.

bwaima — the yam storehouse, built near the *ligisa* and decorated in manner similar to it. It is always the biggest yam storehouse in the village and is placed in a prominent position for the public exhibition of the annual yam crop.

ligisa — the chief's sleeping house (see Figs 3, 9), erected in highest point of the village, often elaborately decorated with items listed below; walls made of *niniva* (sago palm walling), the use of which is reserved for chiefly dwellings.

House decorations:

gola — small carvings (of birds, bats, crocodiles, etc) and decorated discs (eg. A.9728) mounted on the *salala* sticks (see below).

kaduguwai — a pole projecting from the ridge pole of the *ligisa* at the apex of the decorated gable (also on the *bwaima* and *buneyova*); it may be 2 to 3 metres long, decorated with clusters of crescent-shaped coconut husks lashed at several points along the pole. Each cluster of six or seven husk segments is called a *kovisalu*. Each house so decorated may have eight or nine *kaduguwai* projecting from each end of the ridge pole (see Fig. 3).

kaibilabeta — a carved house board which is the base of the triangle formed by gable boards.

kaisikalu — another house board which is placed vertically in the centre of the gable, the base resting on the *kaibilabeta*.

kaivalapula — the two gable boards (carved and painted), the usual motif being the *udowala* (a bird).

kapiwa — a rope decorated at several intervals with *buna* shells which hangs from the gable peak or the *kaduguwai* pole of the *ligisa*, terminating in a cluster of several *buna* shells. The length varies with the rank of the resident chief, those belonging to the Tabalu chief almost touching the ground.

laba — a smaller version of *kaibilabeta* used on the gable of the *bwaima* (yam storehouse — see Fig. 4); a difference in the gable construction is that no *niniva* (sago palm walling) is used in the centre of the gable construction.

salala — spiked sticks projecting a metre or so from the roof down each side of the gable of the *ligisa* (see Fig. 3); *gola* (see above) are sometimes mounted on them.

tataba — a portable houseboard suspended usually under the *kaibilabeta*, carved and decorated with motifs similar to the *kaibilabeta* (A.55309; see also Fig. 4 where the chief's *tataba*, complete with shells, is hung). Under the *tataba* hang three or four rows of *buna* shells (about 30 shells in each row). The number of rows gives some indication of the owner's rank. When a chief dies, the *tataba* complete with *buna* shells will decorate his grave for some years. The chief may give his support to some public event by loaning his *tataba*, which would be hung on public display.

Other chiefly items:

kaitukwa — the ebony stave used by the Toliwaga as a symbol of his authority; an ebony club (*puluta*) also could be used for this.

kena — the lime spatula, which for a chief is large and fine, usually made of bone (eg. A.19699), and extensively decorated as noted for the *yaguma*, the addition of many *bwibwi* giving audible prominence to every flourish of the chiefly lime spatula. In times past the bone used was that of a deceased relative (a leg or arm bone). The rattling of the *kena* in the mouth of the *yaguma*, which for all others is done in a subdued or gentle way, is for the chief a statement of his authority, being done in a pronounced fashion in accordance with *kautuwota*, and being used to call for silence or to announce his intention to speak to the village (see Fig. 6, where chief Pulitala holds his *kena* in his right hand).

tauya — the shell trumpet, the use of which is reserved for chiefly concerns, or used only with chiefly permission.

yaguma — the lime gourd (e.g. A.19700) used in the social process of betel-nut chewing (*kaui*); while everyone has his lime gourd, that used by the chief is much larger, elaborately embellished with many *bwibwi* (hanging decorations), with a *doga* (pig's tusk) stopper much larger than others, and frequently a rope for wearing it suspended from the shoulder or with a special basket for carrying (see Fig. 6).

Appendix III. Hierarchy in *koni*

See pages 108–109.

Appendix IV. War zones

The island of Kiriwina was in former times divided into areas each of which was unified by common loyalty in times of war. On occasions, two or three zones would make an alliance and so fight another group or groups. The political loyalty that this implies is still recognised today although the highly formalised acts of war no longer take place.

The Northern section of Kiriwina Island shown on the map (Fig. 11) was divided into five zones which had a collective loyalty in war. These five groups fought or raided one another but did not go out to the nearby islands of the Trobriands, nor did they go to the part of Kiriwina Island south of Kwabula. These zones are as follows:

North-west section	Wakaisa
North-east section	Kulakaiwa
Central section	Katumatala
South-west section	Kuboma
South-east section	Luba

Traditionally, Katumatala and Kuboma were called in by Wakaisa to fight Kulakaiwa, or by Kulakaiwa to fight Wakaisa. Their services were bought with *veiguwa*. If Kulakaiwa was successful in buying their services, these two hired areas would congregate at Obwelia or Okaikoda to eat (the custom of *kabutu*), and then prepare for battle. They would paint their bodies (*biputumasi*), decorate their hair with feathers (*bikalaisi*) and work up a battle fervour by certain dances (*biseiwausi*) before going to the battle-ground. If Wakaisa was the successful bidder in hiring their services, they would congregate at Yalaka for the same meal and battle preparation.

War took two forms. The warriors would go to a village or succession of villages, burning the houses, killing pigs and destroying food gardens. Or else they would assemble to fight an opposing force of warriors at the traditional battle-ground Duguveiyusa (close to Omarakana village).[34] If the latter form was chosen, all the women went along to watch. Such battles were highly formalised and deaths were generally those which the Tabalu chief had decided would take place.

It is recorded of one such battle that when all the warriors were drawn up ready to begin, it was found that the sun shone into the eyes of one side, giving their opponents an unfair advantage; so the disposition of both sides was re-arranged to even things up, after which battle was joined. Some of these battles are described in detail in Seligman 1910: 663-668.

Villages that are traditionally ruled by Tabalu *dala* chiefs are noted in the map (Fig.11) by suffixing (T) to the village name.

Appendix V. Chiefly terms used in Bible translation

Translation is never a mere substitution of words which 'mean the same'. The cultural context of any word used in a translation is all-important if a translator wishes his readers to enter into the same understanding of a translated text as the original hearers had.

Thus words from or related to the chiefly

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[34] This area is still used today for competitive cricket matches!

Appendix III. Hierarchy in *koni*

Koni (privileges)	TABALU	MLOBWAIMA	OSUSUPA	MWAULI	KWAINAMA
saveva	+	+	+	+	+
saveva with ***bwibwi***	+	-	—	-	-
mmakata (no.)	10 or 11	4	1 or 2	2	3 or 4
tabala	+	-	-	-	-
luluboda	+	+	+	+	+
luluboda with ***puluweiwa*** (no.)	8	4	-	-	-
katudababila (men; no. of rows)	5	4 or 3	4 or 3	4 or 3	4 or 3
lubakaidoga	+	+	+	+	+
segadulu	+ 3 or 4, long	+ 2, short	+ short	+ short	+ short
kaisapi	+	+	+	+	+
mtuwetuwa	+ wide	+ narrow	+ narrow	+ narrow	+ narrow
ikwalasi	+ women only	+ men & women	-	-	-
saisai	+	+	+	+	+
bunodoga (if ***katudababila*** not worn)	+	+	+	+	+
bunodoga (women with ***puluweiwa***)	+	+	-	-	-
vilayawa (no. of wives)	many	3 or 2	1	1	2 if women agree
kaibilabeta	+	+	+	+	+
laba but no ***niniva***		-	-	-	-
kaisikalu	+	-	-	-	-
kaivalapula	+	+	+	+	+
tataba (no. of rows of ***buna***)	many	5 to 3	3	3	3
kapiwa	+ long	+	+	+	+
kaduguwai	+	+	+	+	+
gola & salala	-	-	-	-	-
youlala	+	+	+ little	+ little	+

WABALI	TUDAVA	KAITOTU	KAILAI	KULUTULA	BWAITAITU	TOKAI
+	-	+	+	+	+	-
-	-	-	-	-	-	-
10 or 11[1]	1 or 2	1 or 2	1 or 2	1 or 2	1 or 2	-
-	-	-	-	-	-	-
+	-	-	-	-	-	-
-	-	-	-	-	-	-
4 or 3	4 or 3	3 (low)	3 (low)	3 (low)	3 (low)	2 or 1 (low)
+	+	+	+	+	+	-
	+	-	+	+	+	-
short	short		short	short	short	
-	+	-	-	-	-	-
+	+	+	+	+	+	-
narrow	narrow	narrow	narrow	narrow	narrow	
-	-	-	-	-	-	-
+	-	+	-	-	-	-
+	+	+	+	+	+	Some *dala*
-	-	-	-	-	-	-
5 or 4	2 if women agree	1	1	1	1	1
-	+	-	-	-	-	-
-	+	-	-	+	+	- -
-	-	-	-	-	-	-
+ (no paint)	+	-	-	-	-	-
3	3	-	-	-	-	-
+	+	+	-	-	-	-
+	+	+	-	-	-	-
+	-	-	+	+	-	-
+	+	+ little	+ little	+ little	+ little	-

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[1] This is a special favour accorded the Wabali by the Tabalu because long ago the Wabali rendered them a service and this *koni* is their payment. It is called *kulututu paila mapula tomota* (*Kulututu* for the price (answer) of a person) but no one today remembers why, or what the service was.

hierarchy of Kiriwinan culture have a necessary place in translation of hierarchical concepts, but they must be used with care lest the full local equivalence of a term enters into and distorts the translation of what is essentially a foreign culture concept.

As an example, the island Tuma (to which the spirits of dead Kiriwinans go) could be seen as an excellent translation for Hades or similar words used in the Bible for the shadowy abode of departed spirits. But Kiriwinans believe that it is only their spirits which abide there. They know, for instance, that the Dobu people's spirits go to a mountain near Dobu called Bwebweso. So using Tuma as a substitution for Hades, implying that the spirits of the prophet Samuel and King Saul are mixing with those of Kiriwinan chiefs of renown, would not be appropriate. However the presence and understanding of Tuma is too valuable to be cast aside. So it may be used to elucidate a transliteration of Hades (*Edesi*) by adding a reference like *Baisa mina Yudia idokaisi Tuma, si valu tomata.* 'This is what the Jews call their place Tuma, the village of the dead' (as was done in Luke 16.23). Or on occasions it is entirely appropriate to substitute Tuma for Sheol (an equivalent for Hades), as in Psalm 6.5 'In the world of the dead you are not remembered' (*gala availa biļuluwaim metoya mapilana Tuma*).

I comment here on some words from within the lexicon of the Kiriwinan chiefly hierarchy, which I have used in Bible translation.

First, use of the word *guyau*. This has been taken to be a superlative title of overlordship, and so has been used for some translations of the Greek term *Kurios* — for the divine name, 'Lord' and for the title given to Jesus after his resurrection. It is also used where rank is indicated, as in Matthew 9.34, *si guyau baloma gaga,* 'the chief of the evil spirits'. We have had to be careful over its use at other times, where it was used as a means of respectful address, on occasions to Jesus or to the disciples, and to some others. For these occasions we have used another title of respectful address which is used for anyone regardless of rank or nationality (*tomoya,* 'old man'; or *toboma,* 'distinguished one'). Another of the uses of *guyau,* as a reference to the area in which a chief's authority applied, was entirely correct in John 18.36, *ulo guyau gala metoya ovalu watanawa* 'my authority (kingdom) is not from this world'.

The Greek term *doxa,* 'glory' (with similar Hebrew equivalents as *kabod*) has been in part served by chiefly terms describing the greater decoration of the chief's person, his superior *koni.* When in reference to any earthly glory, as in Matthew 4.8, 'kingdoms in all their greatness', or the richly adorned Temple in Luke 21.5, the term *kala katububula* 'his (its) adornment' is adequate. But when 'Solomon arrayed in all his glory' (Matthew 6.29) is translated, the term which is applied to a chief when he is wearing his full extent of *koni* is precise and accurate, *kala kalugologusa.* In fact this is an instance in which the highly specific Kiriwinan term is a more accurate statement of the meaning and intention of Jesus's word than the comparatively weak Greek original!

The chief's house, *ligisa,* sometimes spectacular in its decoration, is forbidden to all but the chief himself. It is the highest structure in the village, with its floor frequently on a level with the ridge-poles of other houses, most of which are built on the ground. Only the chief is allowed to enter it and anyone daring to break the prohibition would be marked for death. Thus we have used *ligisa* for the Holy of Holies within the Jewish Temple, which the High Priest alone may enter and at that only once a year.

The chief's council-house, *buneyova,* has been used to translate God's judgment seat, for it is in the *buneyova* that the chief makes his decisions; and if he is involved in settling disputes amongst his people or deciding village matters, then from the *buneyova* and in the hearing of all he makes his pronouncements. Thus *buneyova* conveys to the people the idea of a place where the rights and wrongs of a case are considered and decided on. It was also used in Matthew 26.3 to define the place where the chief priests and elders met and decided to have Jesus killed.

The annual tax, *pokala,* due to a chief comes into obvious use for temple tax, taxes due to Rome, etc. The only thing against it is that the Roman authorities, unlike Kiriwinan chiefs, did not do the grand thing and immediately respond with a feast!

The physical act of reverence given to a chief, *kavagina,* while not so pronounced now as in old times,[35] is very strongly imprinted on Kiriwinan people's daily behaviour in the way they show respect. This affects cross-cultural behaviour

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[35] See, for instance, Monckton 1921:91, where the traditional *kavagina* accorded Guyau Enamakala is described; *kavagina* today is not practised to the level Monckton describes.

patterns which are often mis-interpreted. Thus to stand alert before a seated person in authority, which a European may consider both polite and proper, a Kiriwinan would interpret as belligerent and rude. He would immediately sit, an action the European may see as a careless act in defiance of authority! For biblical reference to a physical posture adopted in honour of someone, *kavagina* is accurately used in many instances where the translation of actual words would be misleading. When the leper 'falls down before' Jesus, or in expressions like 'threw himself down' before Jesus or 'fell on his knees before the king', their literal translation would convey the message of some accidental fall or movement not involving reverence; whereas *ikavagina omatala* 'he reverence-stooped before him' shows clearly the bodily posture and the purpose of it. He is approaching the chiefly figure in an attitude of reverence and with the intent of petitioning or thanking. Degrees of reverence may also be defined by describing how low the stooping act is, which adds to the precision of translation in some cases (e.g. 2 Samuel 1.2, 'He bowed to the ground in respect').

The word *karaiwaga* comes into translation a lot, as it bears a high functional load in the language and can be used in many contexts denoting Jewish Law, giving orders, authoritarian acts, etc. Because of its role in describing chiefly authority, it has had ready application to the New Testament concept conveyed by the Greek *basileia theou,* 'Kingdom of God'. It may be even more specific, more accurate, in describing the nature of that concept than the English translation which brings to mind a territorial rather than an authority area of rule.

The chiefly practice of agreeing on consultation with his people and sealing the agreement with a meal, known as *kabutu*, is the best equivalent yet found for 'covenant'. When the chief and people *kabutu* for some work, it means that the people have agreed to do what the chief asks and he in turn agrees to provide for them while they do that work. Thus this word has become the term used for 'Old Testament' and 'New Testament' (*Kabutubogwa, Kabutuvau*), the terms describing those books which tell of God's relationship with his people.

The term *koni* has the dual reference either to a physical load anyone may carry, or to the special prerogatives of chiefly rank (recalling the old and rather unfortunate term, 'white man's burden'). While generally used for burdens borne, it is rightly used in Luke 22.29, *isakaigu ulo koni bayosi karaiwaga, tuvaila makawala asakaimi mi koni bukuyosisi mi karaiwaga* ('he has given me the right to rule, so I will give you the same right'). Also in John 1.12, *si koni matausina (bimila litula Yaubada)* correctly translates 'their right (to become children of God). Thus the text may refer to special privileges and rights which others recognise as belonging to some, the possession of which becomes an obligation to their use in the correct way.

Many other words listed above could be shown as appearing in translation but I think those listed here are the major ones in which an understanding of their role within the chiefly hierarchy has enabled translators to make a proper and highly specific use of them.

Some words have been carefully excluded. For example, *Tabalu* (to describe rulers of high rank) has not been used, lest it should seem that the Bible gave specific commendation of one social group in Kiriwina!

Also the term *kautuwota*, which describes the chief as being the 'mostest' in any field, or the loudest in any situation, should have a proper place somewhere. But to date I have not been able to bring it to bear on any passage; either to describe supremacy in God (which may well be good) or to show loud-mouthed bragging or harsh authority (which could be dangerous).

Appendix VI. Lexicon of words used in this study

bagula	food garden
baloma	spirit
bisila	a pandanus
bogau	dangerous spirit
bomileilai	house decoration
bubuna	dove
bugwa	species of yam
buna	eggshell cowrie
buneyova	council house
bunodoga	shell belt
bunukwa	pig
bwaima	yam storehouse
bwala	house
bwibwi	a decoration
dagula	feather
dala	matrilineal sub-clan
danuma	species of yam
degila	a weaving string
desi	stop
digulela	its feather
doga	tusk

gabu	to burn
gai	ebony
gala	no, not
gegila	a parrot
gola	carved ornament
gugwadi	children
guyau	chief
gwadi	child
gweguya	chiefs
ikwalasi	shell cluster
iluluwala	next in line
isakaili	second in line
kabutu	agreement
kaduguwai	house pole
kaibilabeta	a houseboard
kaidadala	council
kailavasi	goanna
kaimelu	a death custom
kaisapi	shell bracelet
kaisikalu	a houseboard
kaitukwa	walking stave
kaivalapula	gable boards
kaiwosi	dancing
kala	his, her, its
kaligei	boundary
kaloumwa	a red shell
kalugologusa	chiefly splendour
kanekukwa	to hang down
kapiwa	spider web
karaga	a parrot
karaiwaga	authority
kasuma	a weaving string
katububula	adornment
katudababila	shell belt
kaukwa	dog
kaula	food
kaulotoula	true food
kautuwota	act chiefly
kavagina	act of reverence
kavamwala	a dirge
keiyuna	snake
kena	lime spatula
koni	burden, privilege
kovisala	house ornament
kula	wealth trading
kulututu	mortuary payment
kuluvasaga	scarcity
kumila	clan
kusikwasi	a weaving string
kuvi	yam family
kuvibanena	large yam
kuvipiti	long yam
kwasi	woven armband
kwasikaewa	wide armband
kwasitilawa	chief's armband
kwau	shark
la	his, her, its
laba	a houseboard
ligisa	chief's house
liliu	legend
lubakaidoga	shell cluster
luluboda	shell anklet
mamila	a fish
midimidi	flag
milamala	harvest month
mina	people of
mitakaka-nukula	chiefly splendour
mlipwapwa	narrow armband
mluveka	eagle
mmakata	feather plume
mtuwetuwa	chief's armband
mwali	wealth armband
mwedamwada	type of yam
niniva	sago leaf walling
paila	for
pokala	tax
puluta	club
puluweiwa	shell cluster
sagali	a distribution
saisai	shell cluster
salala	house ornament
salokuva	type of magic
saveva	a headband
sawila	a chant
segadulu	a necklace
sigiligula	a death custom
soulava	wealth necklace
tabala	a necklace
taitu	the staple yam
taitukesa	type of yam
tataba	a houseboard
tauya	shell trumpet
tokai	commoner class
tokovasila	type of magic
tokwaibagula	expert gardener
tokwaraiwaga	an authority
tolela	a man of
toliwaga	captain of boat
tomoya	old man
tonunumata	stupid person
towosi	garden magician
udowala	a bird
valu	village, place

vatala	respect
veiguwa	wealth items
vila	a woman of
vilagwadi	youngest female
vilayawa	many wives
vilitomoya	eldest female
waga	canoe
wai	to strike
waki	to season (food)
wowona	streamers
yaguma	lime pot
yavata	month of dearth
yawali	a death custom
yoba	harvest time
youlala	painting on houses

FIGURE 1. Antonio Lubisa Bunaimata with a chief's lime gourd (Note: chief's lime gourds are usually plain, lacking the curvilinear designs of this one) (Photo: R. Lawton, 1968).

FIGURE 2. Young man of Tukwaokwa village wearing his father's chiefly wealth (Photo: D. Lawton, 1994).

FIGURE 3 Chief's house (*lisiga*). Note gable boards (*kaivalapila*) and *tovalu* with pendant *buna* shells; the *kaduguwai* project from the peak of the gables (Photo: R. Lawton, 1972).

FIGURE 4 Chief of Kavataria village in front of his yam storehouse (*bwaima*) (Photo: R. Lawton, 1991).

FIGURE 5 A chief's council house (*bunevova*) at Omarakana displaying the long yams (*kuvi duguba valu*) lashed between two poles (Photo: R. Lawton, 1972).

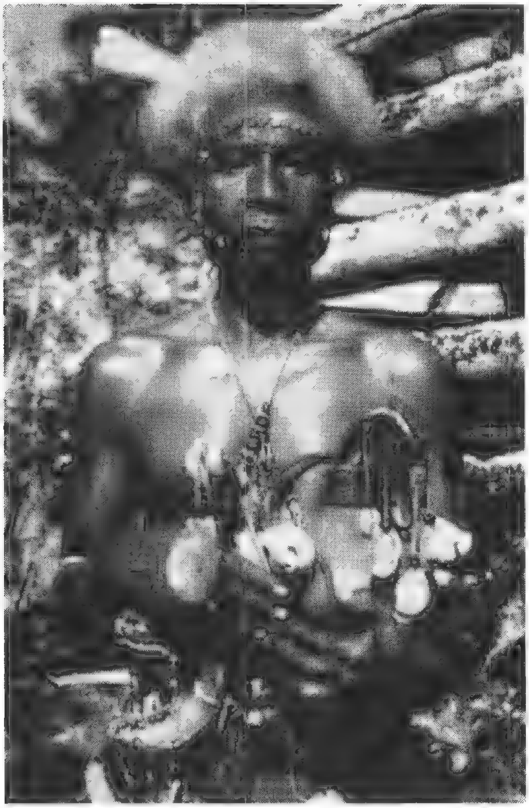

FIGURE 6. Pulitala, a Tabalu chief, holding his lime gourd and spatula (Photo: R. Lawton, 1972).

FIGURE 7. Dancers wearing *mmakata* plumes which stand above their white cockatoo feather head-dresses (Photo: R. Lawton, 1972).

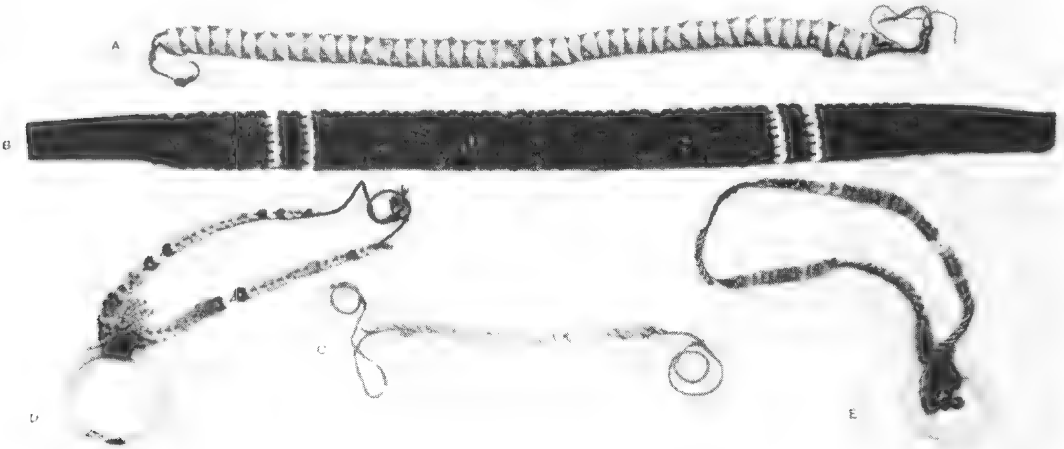

FIGURE 8. Chiefly ornaments in the South Australian Museum collections (Photo: Elizabeth Murphy, Artlab). **A.** A belt of small *buna* shells (*bunodoga*) A.8871. **B.** A belt of *kaloumwa* shell discs (*katudababila*) A.58657. **C.** A headband of *kaloumwa* shell discs with pendant *buna* shells (*saveva*) A.8875. **D.** A necklace of *kaloumwa* shell discs with pair of pig tusks attached (*kala doga*) A.8882. **E.** A necklace of *kaloumwa* shell discs with shell ring attached (*kala doga*) A.8886.

FIGURE 9. Gable of chief's house (*lisiga*) at Omarakana. Note gable boards (*kaivalapula*) on either side, central vertical gable board (*kaukikala*), the *kaibilabeu* at the base of the gable and the *kaulaa* with three rows of *buna* shells below that (Photo: R. Lawton, 1972).

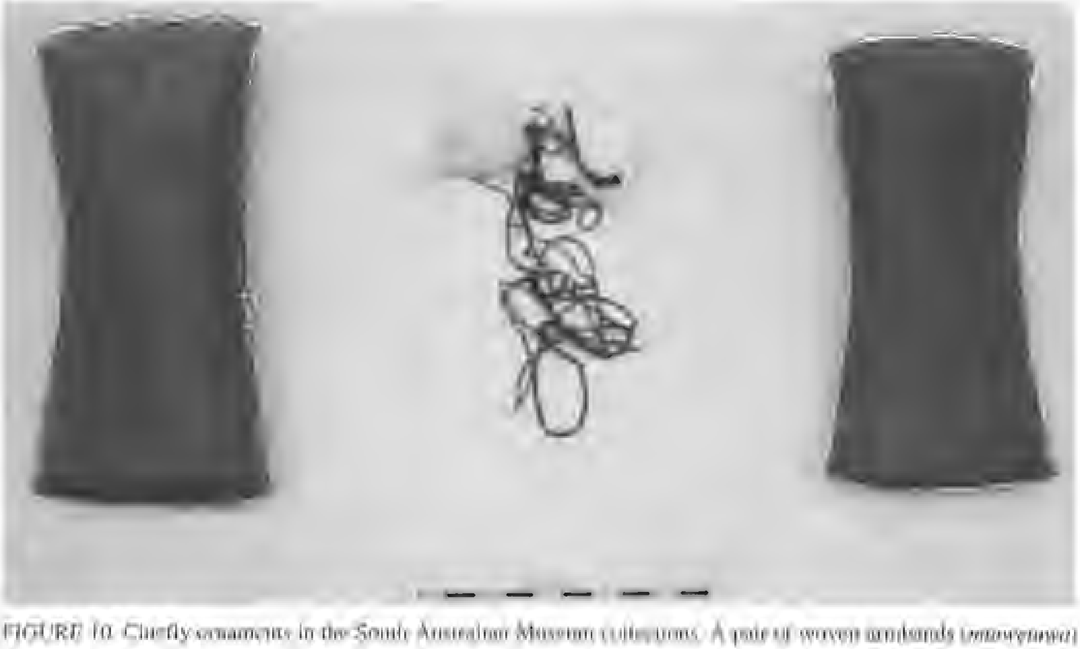

FIGURE 10. Chiefly ornaments in the South Australian Museum collections. A pair of woven armbands (*wawoyowa*) (A.74493, -4) and head ornament (*saisai*) of *buna* shells (A.52469) (Photo: Elizabeth Murphy, Artlab).

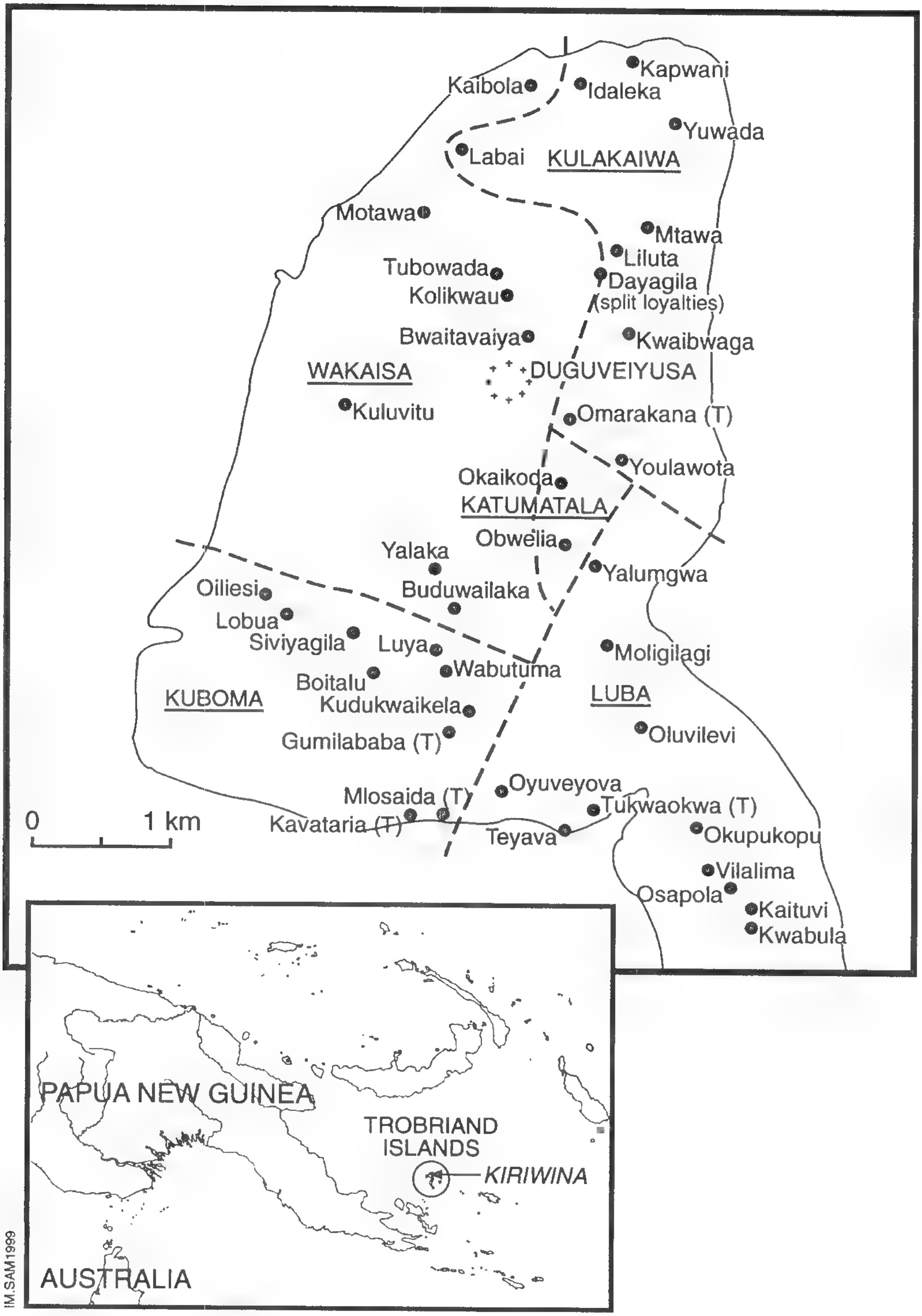

FIGURE 11. Map of the northern part of Kiriwina, showing the five war zones.

ACKNOWLEDGMENTS

Especial thanks to my wife Margaret for editing this paper and casting it into its present form.

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Note: This paper is a study of the Kiriwina chiefly hierarchy as viewed by two high-ranking Tabalu in 1967. For this reason I merely glanced at the literature and so the references are few. The reader is referred to the excellent bibliography in Weiner 1976: 261–273 which *inter alia* includes the major references in other works to the Kiriwinan chiefly order. There are undoubtedly more recent references of which I am unaware.

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REDISCOVERY OF ENOCHRUS PEREGRINUS IN AUSTRALIA (COLEOPTERA, HYDROPHILIDAE)

C. H. S. Watts

Summary

In a recent paper (Watts, 1998) I cast strong doubts on the record of Enochrus peregrinus Knisch, 1922 from Australia. This record was based on a single collection of three specimens from Sydney prior to 1921 only one of which survives. It has not been collected since. In addition, E. peregrinus belongs in the subgenus Enochrus (Watts 1998) which is otherwise only known from the Holarctic region. I report here the recent collections of two additional specimens. One specimen is male which allows the description of the male genitalia for the first time.

REDISCOVERY OF *ENOCHRUS PEREGRINUS* IN AUSTRALIA (COLEOPTERA, HYDROPHILIDAE)

In a recent paper (Watts 1998) I cast strong doubts on the record of *Enochrus peregrinus* Knisch, 1922 from Australia. This record was based on a single collection of three specimens from Sydney prior to 1921 only one of which survives. It has not been collected since. In addition, *E. peregrinus* belongs in the subgenus *Enochrus* (Watts 1998) which is otherwise known only from the Holarctic region. I report here the recent collection of two additional specimens. One specimen is a male which allows the description of the male genitalia for the first time.

The specimens were both collected from a small shallow drainage ditch in an area of peaty soil three kilometres north of Bulli in New South Wales, the first on 2/11/1997 and the second on 27/11/1998. This locality is some 50 kilometres south of Sydney, the only previously known locality. The specimens are now in the collection of the South Australian Museum.

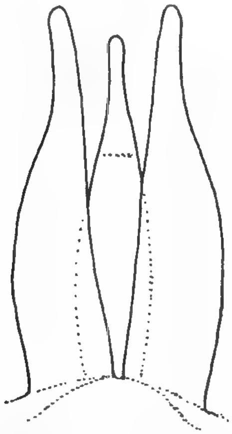

FIGURE 1. Dorsal view of apical portion of male genitalia of *E. peregrinus.*

The dorsal surface of the specimens is as previously described. Ventral surface (which has not been previously described): dark testaceous to black with appendages slightly lighter; evenly and quite strongly rugose/punctate, covered with short fine setae including the femora; mesosternal keel narrow, well developed, sharply triangular in side view, with a low, sharp ridge extending backwards between the mesocoxae.

Male: central lobe of aedeagus relatively thin, bluntly pointed, apical pad weak, collar closer to tip than to base; parameres narrowing towards tips, which are rounded and slightly splayed outwards; claws not greatly modified.

ACKNOWLEDGMENT

I would like to acknowledge Mr R Gutteridge for preparing the figure.

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WATTS, C. H. S. 1998. Revision of Australian *Enochrus* Thomson (Coleoptera: Hydrophilidae). *Records of the South Australian Museum* **30**(2): 137–156.

C. H. S. WATTS, South Australian Museum, North Terrace, Adelaide, 5000. *Records of the South Australian Museum* **32**(1): 119, 1999.

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CONTENTS

ARTICLES

NOTE

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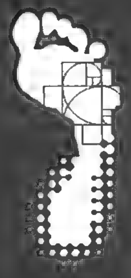

RECORDS OF THE SOUTH AUSTRALIAN MUSEUM

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THREE NEW GENERA AND FIVE NEW SPECIES OF DYTISCIDAE (COLEOPTERA) FROM UNDERGROUND WATERS IN SOUTH AUSTRALIA

C. H. S. WATTS AND W. F. HUMPHREYS

Summary

Three new genera and five new species (Nirridessus pulpa, N. windarraensis, N. lapostaae, Tjirtudessus eberhardi and Kintingka kurutjutu) of stygobiontic beetles of the family Dytiscidae, subfamily Hydroporinae, tribe Bidessini, from relatively shallow, calcrete aquifers at Paroo near Wiluna, and at Windarra near Laverton in Western Australia, are described and figured and their relationship with other Bidessini discussed. Two different species of bidessine larvae were also collected and are described and figured. The species are members of a rich, recently discovered, relictual stygofauna, predominantly of Crustacea and Oligochaeta, inhabiting calcretes lying along the line of the Lake Way-Lake Carey palaeodrainage channel.

THREE NEW GENERA AND FIVE NEW SPECIES OF DYTISCIDAE (COLEOPTERA) FROM UNDERGROUND WATERS IN AUSTRALIA

C. H. S. WATTS AND W. F. HUMPHREYS

WATTS, C. H. S. & HUMPHREYS, W. F. 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.

Three new genera and five new species *(Nirridessus pulpa, N. windarraensis, N. lapostaae, Tjirtudessus eberhardi* and *Kintingka kurutjutu)* of stygobiontic beetles of the family Dytiscidae, subfamily Hydroporinae, tribe Bidessini, from relatively shallow, calcrete aquifers at Paroo near Wiluna, and at Windarra near Laverton in Western Australia, are described and figured and their relationship with other Bidessini discussed. Two different species of bidessine larvae were also collected and are described and figured. The species are members of a rich, recently discovered, relictual stygofauna, predominantly of Crustacea and Oligochaeta, inhabiting calcretes lying along the line of the Lake Way-Lake Carey palaeodrainage channel.

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Manuscript received 16 February 1999.

The presence in both fresh and brackish waters of communities of animals living in subterranean water bodies is well known (Botosaneanu 1986; Marmonier *et al.* 1993), but the presence of rich subterranean faunas, both aquatic and terrestrial, in arid Australia has only recently been established (Humphreys 1993a, 1993b, 1993c, in press a), and their derivation debatable (Humphreys in press c)

The Australian aquatic systems either contain faunas of predominantly marine derivation inhabiting anchialine waters (Humphreys 1993b, in press a, in press c; Yager and Humphreys 1996; Poore and Humphreys 1992; Bruce and Humphreys 1993; Bradbury and Williams 1997), or faunas comprising predominantly freshwater lineages inhabiting the groundwater in the shield regions (Poore and Humphreys 1998; Humphreys in press c; Wilson and Keable in press). The faunas respectively appear to be associated with those of the Tethys sea (Humphreys 1993b, in press b, in press c; Yager and Humphreys 1996) and Gondwana (perhaps Pangea; Poore and Humphreys 1998; Humphreys in press c). We report here the discovery of populations of five new species in three new genera of Coleoptera (Dytiscidae, Hydroporinae) living in calcrete aquifers occurring along the line of the large Lake Way–Lake Carey palaeodrainage channel. The dytiscids have been collected from Paroo, near Wiluna, and from Windarra, c. 345 km to the southeast in central Western Australia where they occur in communities comprising Syncarida, Amphipoda, Copepoda, Ostracoda and Oligochaeta.

Abbreviations used

BES	Prefix for field numbers.
GSWA	Prefix for Geological Survey of Western Australia monitoring bore number.
OP	Prefix for piezometer number in the Windarra Calcrete Quarry associated with the Murrin Murrin Nickel Cobalt Project run by Anaconda Operations Pty Ltd. (Dames and Moore 1998).
SAMA	South Australian Museum, Adelaide.
WAM	Western Australian Museum, Perth.

SYSTEMATICS

KEY TO AUSTRALIAN SPECIES OF STYGOBIONTIC BIDESSINI

1. — Body length >3.0 mm; pronotum wider than elytra (Fig. 6); protibia bow-shaped (Fig. 6) ... *Tjirtudessus eberhardi* sp. nov.
   — Body length < 3.0 mm; pronotum same width or narrower than elytra (Figs 3–5); protibia triangular (Figs 3–5) 2

2. — Body length approximately 1.0 mm, surface strongly reticulate, legs stout, without swimming hairs on fore and

midlegs (Fig. 7) ....
.... *Kintingka kurutjutu* sp. nov.

— Body length >1.2 mm, surface at most with weak reticulation, legs normal, all with swimming hairs (Figs. 3–5) ....
.... *Nirridessus* 3

3. — Pronotal plicae strong with inward excavations, metatrochanters pointed, basal two metatarsal segments longer in combination than apical three (Figs 3, 14). .... *N. pulpa* sp. nov.

— Pronotal plicae weak, area between them without excavations, metatrochanters rounded, basal two segments of metatarsi in combination equal to or shorter than apical three (Figs 4, 7, 12, 13) 4

4. — Body length > 2.0 mm; eye remnant small, triangular ....
.... *N. windarraensis* sp. nov.

— Body length < 2.0 mm; eye remnant reduced to a single suture ....
.... *N. lapostaae* sp. nov.

Tjirtudessus gen. nov.

Description

Bidessini. Relatively flat, narrowed at base of pronotum/elytra, eyeless. Head large, without strong sculpture, lacking cervical line. Pronotum very wide, wider than elytra, smooth, basal plicae weakly impressed. Elytron elongate, smooth, evenly covered with very small punctures each with a small seta; epipleuron without basal carina. Hindwing vestigial. Maxillary palpus elongate with large apical segment about same length as segments one to three combined. Labial palpus moderately elongate with apical two segments subequal. Prothoracic process arched, not reaching mesothorax, apical half spatulate. Post-coxal plates with very weak coxal lines, without punctures, adpressed to first abdominal segment. Post-coxae and first and second sternites fused. Protibia widest in middle; protarsi pseudotetramerous. Metatrochanter large, wholly exposed. Metatibia curved, widening towards apex; tarsi elongate; claws equal, very weak.

Etymology

Western Desert Language of the region: *tjirtu,* a beetle-like insect found swimming in water holes; *dessus*, the suffix of the type genus of the tribe, *Bidessus.*

Remarks

Separated from the other eyeless Bidessini described here by its large size, very broad head and pronotum, weak pronotal plicae and metacoxal lines, and non-triangular shape of the protibiae.

Tjirtudessus eberhardi sp. nov.

Description (number examined, 3) Col. Pl. and Figs 6, 11, 15.

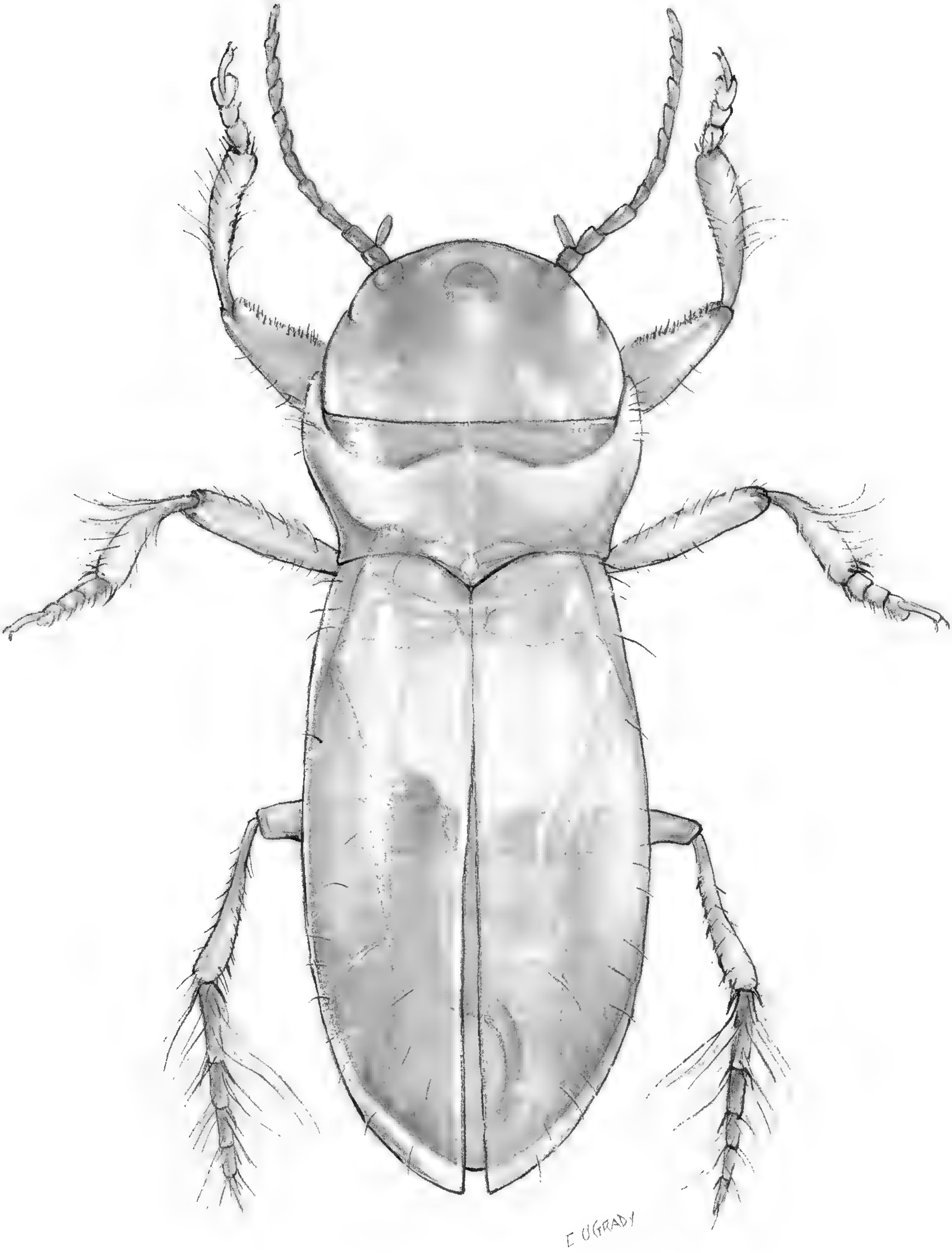
Habitus. Length 3.2–3.5 mm. Strongly constricted at junction of pronotum/elytra; relatively flat; eyeless; uniformly light testaceous. Hindwing vestigial, about half length of elytron.

Head. Large, smooth with a very fine reticulation and sparse weak punctures, subparallel in posterior half, sides with small triangular/oval area outlined by dark sutures in middle near anterior edge. Antenna relatively stout, basal two segments largest, third segment longer and narrower, then progressively shorter and stouter to penultimate, apical segment a bit longer and narrower than penultimate, each segment with some very small setae on inside apically. Maxillary palpus elongate with apical segment large, a little shorter than segments one to three combined, three long setae on outer side and some sensilla towards tip, tip truncated. Labial palpus moderate, apical two segments subequal.

Pronotum. Very broad, wider than elytra, anterolateral angles projecting strongly forward, base quite strongly narrowed, posterolateral angles produced backwards, smooth, with sparse, very weak punctures and a row of stronger punctures along front margin, basal plicae very weakly impressed, only visible in some lights, with row of long setae laterally, denser towards front.

Elytra. Not fused, lacking inner ridges. Elongate, widest behind middle, smooth, sparsely but evenly covered with very small punctures each with a small seta, row of long setae near lateral edge, a few additional long setae more frequent towards sides, some setiferous micropunctures at base and near apex. Epipleuron very broad in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron..

Ventral surface. Prothoracic process relatively broad, strongly narrowed between coxae, not reaching mesothorax, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae meet. Metathorax bluntly triangular in front in



COLOUR PLATE. Adult *Tjirtudessus eberhardi*. Length 3.2–3.5 mm. Artist: Elyse O'Grady.

midline, wings very narrow, virtually absent. Metacoxal plates large, not differentiated into raised central portion and lateral portion, metacoxal lines very short and weak, widely spaced, almost obsolete; punctures very sparse, very weak; closely adpressed to first abdominal sternite. First and second sternites fused, sutural line virtually obliterated, sternites three to five mobile, very sparsely covered with small seta-bearing punctures, sternites three and four with a large central seta or bunch of setae.

Legs. Smooth, without reticulation or punctures. Profemur moderately broad, with a sparse row of thin spines on anterior and posterior edges, a short row of short stout closely spaced spines on front edge at apex; protibia moderately broad, inner edge straight, outer edge bowed, widest near middle, where it is about four times its basal width, with several stout spines at apex, a closely spaced row of small peg-like spines on inner edge and a row of long swimming hairs along outside edge; protarsi with fourth segment very small and hidden within deeply lobed third segment, basal segment broadest, apical segment long and relatively thin, segments one to three with adhesive setae, claws short and simple. Midleg as for foreleg except for lack of small spines. Metatrochanter large, broadly oval, wholly exposed; metafemur elongate, lacking spines, a few short setae; metatibia strongly curved, widening towards apex, a row of about seven relatively long spines on inner edge, two large spines on inner apex, a row of long swimming hairs on ventral surface and a few scattered spines on outer edge; tarsi elongate, with swimming hairs on two sides, basal segment longest, apical segment a little longer than fourth, segments one and two in combination a little longer than others; claws weak (Fig. 15).

Male. Antennae a little stouter, pro- and mesotarsi a little stouter, three basal segments covered on ventral surface with small adhesive setae. Central lobe of aedeagus narrow, narrowing rapidly in apical fifth; paramere broad, two-segmented, apical segment with pronounced, narrow, apical lobe (Fig. 11).

Types

Holotype: ♂. BES 6026, GSWA Bore # 6(B) Paroo Station 25/6/98, 26°26'S 119°47'E, collected by S. M. Eberhard, in spirit, WAM. Registration number WAM 99/60.

Paratype: ♂. Same data as holotype, mounted on slide, WAM. Registration number WAM 99/61.

Associated specimen: ♂. BES 5999 GSWA Bore # 15(A), trap, Paroo Station 25/6/98, 26°24'S 119°46'E, collected by S. M. Eberhard, in spirit, SAMA.

Etymology

Named after Stefan Eberhard in recognition of his expertise and enthusiasm in collecting subterranean fauna.

Nirridessus gen nov.

Description

Bidessini. Broadly elongate, flattened, narrowing somewhat at base of pronotum. Head broad, without strong sculpture, lacking cervical line. Pronotum with sparse weak punctures, basal plicae moderately to strongly impressed. Elytra subparallel, with fine dense punctures; epipleuron quite rapidly narrowing before middle, without basal carina. Hindwing vestigial. Maxillary palpus robust, apical segment equal in length to other three combined. Labial palpus short, stout, apical segment about twice length of penultimate segment. Pronotal process arched, not reaching metathorax, apical half spatulate. Metacoxal plates with relatively short, widely separated coxal lines, weakly granulate/punctate, adpressed to first abdominal sternite. Metacoxal plates and first two sternites probably fused. Protibia strongly triangular; protarsi pseudotetramerous. Metatrochanter large, completely exposed. Metatibia curved, thickening apically; tarsal segments variably elongate; claws equal, weak.

Etymology

Western Desert Language of the region: *Nirri-nirri,* a general term for beetle; *dessus*, suffix of the type genus of the tribe, *Bidessus.*

Remarks

Separated from *Tjirtudessus* by its less expanded head and pronotum (Figs 3–5), relatively strong pronotal plicae, triangular pro- and mesotibiae and presence of a row of large punctures adjacent to the elytral suture; and from *Kintingka* by its larger size, less robust legs, much weaker reticulation, much sparser setae and the presence of swimming hairs on all legs.

Type species

Nirridessus pulpa sp. nov.

Nirridessus pulpa sp. nov.

Description (number examined, 3) Figs 3, 10, 14.

Habitus. Length 2.0–2.2 mm. Elongate, flattened; pronotum broad, narrowing somewhat at base; uniformly testaceous. Hindwing vestigial, reduced to about one quarter length of elytron.

Head. Broad, small; narrow triangular area delineated by dark sutures in middle at edge; very weak reticulation; punctures sparse, weak, row of punctures running backwards from above antennal base. Antenna relatively stout, robust, basal two segments largest, third and fourth smaller then slowly increasing in size to penultimate, apical segment a little longer than penultimate; a few small setae near apex of each segment. Last segment of maxillary palpus elongate, tip truncated, a few small setae near tip.

Pronotum. Broad, a little narrower than elytra; narrowing behind, strongly extended forward at anterolateral angles; very sparse weak punctures and a few larger punctures along front edge; two strongly impressed basal plicae, curving slightly inwards, which reach about half way along pronotum, a depression inwards from each plica at their bases; row of long, thin setae in front half at edges.

Elytra. Fused, lacking inner ridges; subparallel; with sparse small setiferous punctures, small areas of micropunctures at apex and base, a row of much larger weakly impressed punctures beside suture; sides of elytra strongly vertical with scattered, short, fine setae; row of long thin setae at edge, denser towards front.

Ventral surface. Pronotal process arched in lateral view, highest (viewed ventrally) between coxae, apical half narrowly spatulate, narrowing between coxae; not reaching metathorax. Metathorax weakly reticulate, a few fine punctures; sharply triangular in midline in front; wings very narrow, subobsolete, metacoxal plates with weakly raised central portion; coxal lines well separated, weakly diverging anteriorly, reaching to between one half and one third way to mesosternum; weakly reticulate, virtually impunctate; adpressed to abdominal sternite. Metacoxal plates and first and second sternites fused but sutures evident, other sternites free, sternites three and four with central group of setae, otherwise virtually without setae; sparsely and weakly punctate. Epipleuron very broad in front quarter, narrowing quite rapidly to middle then thin to apex, difficult to differentiate from disc, without basal carinae.

Legs. Protibia triangular, about four times as broad at apex than at base which is very narrow, with long swimming hairs; profemur with row of closely spaced small spines on front margin in apical one third to one half with scattered larger spines; protarsi weakly expanded, the fourth segment very small and hidden within deeply bilobed third segment; adhesive setae weak or absent; claws weak. Midleg similar but without small spines. Metatrochanter large, completely exposed, tapering to a broad point, well separated from femur at apex; femur narrowly elongate, anterior edge straight, impunctate, without spines; tibia strongly curved, thickening apically, with a row of long setae in apical half; segments relatively stout, progressively smaller towards apex, apical segment a little longer than fourth, basal two segments longer in combined length than apical three, with two rows of long setae and a number of stout setae at apex of first four segments; claws weak, equal in length (Fig. 14).

Male. Appendages and legs as for female. Central lobe of aedeagus narrow, weakly narrowing to rounded, slightly upturned tip; parameres broad, two-segmented, apical segment with pronounced narrow apical portion (Fig. 10).

Types

Holotype: ♂. BES 6032, Bore # GSWA 5, Paroo Station, 25/6/1998, 26°26'S 119°46'E, collected S. M. Eberhard, in spirit, WAM. Registration number WAM 99/72

Paratypes 3: 1, ♂. BES 6015, Bore # GSWA 6(A), Paroo Station, 25/6/1998, 26°26'S 119°46'E, collected by S. M. Eberhard, lacking head, mounted, WAM. Registration number WAM 99/73; 2, ♀. BES 6002, Bore # GSWA 15(C), trap, Paroo Station, 25/6/1998, 26°24'S, 119°46'E, collected by S. M. Eberhard, in spirit, WAM. Registration number WAM 99/74, ♂, SAMA.

Etymology

Western Desert Language of the region: *pulpa*, "cave".

Remarks

Nirridessus pulpa differs from both *N. windarraensis* and *N. lapostaae* in its much stronger pronotal plicae, much more pointed metatrochanters, narrower more elongate metafemora and stouter metatarsi with relatively short apical segments.

Nirridessus lapostaae sp. nov.

Description (number examined 10) Figs 4, 9, 12.

Habitus. Length 1.3–1.5 mm. Elongate, pronotum narrowing strongly at base; uniformly very light testaceous. Hindwing vestigial, reduced to about one third length of elytron.

Head. Broad, parallel-sided in basal half; rapidly narrowing forward of area where eye would be; a short dark suture at each side in middle at edge; very weak reticulation; punctures sparse, weak, row of setiferous punctures running backwards from above antenna base. Antenna relatively stout, robust, basal two segments broad, third and fourth smaller, then progressively widening until penultimate, apical segment thinner and longer, a few small setae near apex of each segment. Tip of last segment of maxillary palpus truncate, a few small setae towards tip.

Pronotum. Broad in front, narrowing quite markedly behind, strongly extended forward at anterior lateral angles, very sparse weak punctures and a few larger punctures towards front edge; two finely impressed basal plicae, straight, reaching about a third way along pronotum; row of long, thin setae in front half at edges and on forward extensions.

Elytra. Not fused but tightly locked, lacking inner ridges; sides subparallel; with very fine, sparse punctures each with a small seta, a few punctures with longer setae; moderately covered with micropunctures at base and apex, a row of much larger weakly impressed punctures beside suture; sides of elytra quite strongly vertical; with row of long thin setae at edge, denser towards front.

Ventral surface. Pronotal process arched in lateral view, highest point (viewed ventrally) between coxae, apical half broadly spatulate, narrowing between coxae, not reaching metathorax. Metathorax with a few very small punctures; quite sharply triangular in midline in front, wings very narrow, subobsolete. Metacoxal plates with weakly raised central portion; metacoxal lines weak, well separated, diverging in anterior third, reaching about halfway to mesosternum; sparsely punctate; adpressed to first abdominal sternite. Metacoxal plates and first and second sternites fused but sutures evident, other sternites free, sternites three and four with central group of setae, otherwise virtually without setae; virtually impunctate. Epipleuron very broad in front quarter, narrowing quite rapidly to middle, then thin to apex, difficult to differentiate from disc.

Legs. Protibia about five times as broad at apex than at base which is very narrow, with long swimming hairs, row of closely placed small spines on most of inner margin and some large spines towards apex; profemur with row of closely spaced small spines on front margin in apical one third, with scattered larger setae; protarsi quite strongly expanded, the fourth segment very small and hidden within deeply bilobed third segment, adhesive setae weak or absent; claws weak. Midleg similar except for less strongly expanded tarsi and lack of small spines. Metatrochanter large, completely exposed, elongate oval, well separated from femur at apex; femur relatively narrow, anterior edge weakly sinuate, impunctate, without spines; tibia strongly curved, thickening apically, with a row of long setae in apical half; segments elongate, progressively smaller towards apical segment which is a little longer than penultimate, combined length of basal two segments approximately equal to other three, two rows of long setae and a number of stout setae at apex of first four segments; claws weak, outer one slightly smaller than other (Fig. 12).

Male. Appendages and legs as for female. Central lobe of aedeagus moderately broad, concave above, narrowing rapidly close to tip; parameres moderately broad, two-segmented, apical segment with pronounced narrow apical portion (Fig. 9).

Types

Holotype: ♂. BES 6712, piezometer OP122, Windarra W.A. 28°28'40"S 122°07'40"E 18/11/1998, collected by W. F. Humphreys, in spirit, WAM. Registration number WAM 99/65.

Paratypes 6: 1, ? same data as holotype, WAM, registration number WAM 99/66, in spirit; 1, ♀. BES 6548, piezometer OP124, Windarra W.A. 28°29'04"S 122°07'22"E, 18/11/1998, WAM, registration number WAM 99/67, in spirit; 1, ♂. same data, mounted, SAMA; 1, ♀. BES 6559, piezometer OP123, Windarra W.A. 28°28'46"S 122°08'08"E, 18/11/1998, in spirit, WAM, registration number WAM 99/68; 1, ♀. BES 6564, piezometer OP122, Windarra W.A. 28°28'40"S 122°07'40"E, 19/11/1998, in spirit, WAM, registration number WAM 99/69; 2, ♀. BES 6549, piezometer OP122, Windarra W.A. 28°28'40"S 122°07'40"E, 18/11/1998, in spirit, WAM, registration numbers WAM 99/70 & 99/71. All collected by W. F. Humphreys.

Associated specimens: 1, ♂. BES 6712 same data as holotype, in spirit, damaged, SAMA; 1, ♀. BES 6549, piezometer OP122, Windarra W.A.

28°28'40"S 122°07'40"E, 18/11/1998 in spirit, SAMA; fragments of two specimens, same data, in spirit, WAM.

Etymology

Named after Daniella LaPosta of the South Australian Museum for her essential but unsung accounting help and skills.

Remarks

Nirridessus lapostaae differs from *N. pulpa* by its much weaker pronotal plicae and the shape of the midleg. It is more similar to *N. windarraensis* from which it differs in its smaller size, more reduced eye remnant, broader pronotal process, stouter pro- and mesotarsi, relatively shorter apical segment of metatarsi and stouter antennae.

Nirridessus windarraensis sp. nov.

Description (number examined 4) Figs 5, 8, 13.

Habitus. Length 2.2–2.3 mm. Elongate, eyeless, pronotum constricted at base, uniformly light testaceous. Hindwing vestigial, reduced to about one third length of elytron.

Head. Broad, straight-sided in basal half; a very narrow triangular area delineated by dark sutures in middle at edge; punctures sparse, weak, two or three rows of small setiferous punctures running backwards from above antenna base.

Pronotum. Broad, a little narrower than elytra, narrowing smoothly to base, posterolateral angles right angled, anterolateral angles strongly extended forward; very sparse weak punctures; plicae weak, almost straight, reaching to about halfway along pronotum; sparse row of long, thin setae in front half at edges with concentration on anterolateral projections.

Elytra. Elytra not fused but tightly locking, lacking inner ridges; elongate, subparallel in middle half; with sparse weak setiferous punctures, a row of much larger weakly impressed punctures beside suture, quite large areas of micropunctures near base and near apex, sparse over rest of elytra; sides of elytra quite strongly vertical with short fine setae; with row of moderately long thin setae at edge, denser towards front. Antenna moderately stout, basal two segments relatively broad, third segment narrowly triangular, successive segments gradually shortening and thickening, except apical segment which is bit longer than penultimate, a cluster of small setae near apex of each segment. Apical segment of maxillary palpus weakly bifid at tip, oblique ring of small setae near tip.

Ventral surface. Pronotal process relatively narrow, strongly arched in lateral view, highest point (viewed ventrally) between mesocoxae, apical half spatulate, narrowing between coxae, not reaching metathorax. Metathorax with a few scattered weak punctures; broadly pointed in midline in front, wings very narrow, subobsolete. Metacoxal plates large, with weakly raised central portion, coxal lines weak, well separated, moderately diverging in anterior half; reaching to about one third way to mesosternum; smooth, virtually impunctate except a few towards midline; adpressed to first abdominal sternite. Metacoxal plates and first and second sternites fused, suture lines between first and second sternites obliterated laterally, other sternites free, sternites three and four with central group of setae, otherwise virtually without setae; weakly and very sparsely punctate. Epipleuron broad in front quarter, narrowing quite rapidly to middle then thin to apex, difficult to differentiate from disc.

Legs. Protibia triangular, about five times as broad at apex than at base which is very narrow, with long swimming-hairs, row of closely spaced small spines on inner margin and some strong spines towards apex; profemur with row of closely spaced small spines on front margin in apical one third, with scattered larger setae; protarsi weakly expanded, the fourth segment very small and hidden within deeply bilobed third segment, adhesive setae small; claws weak. Midleg similar except for lack of fine spines. Metatrochanter large, completely exposed, oval, well separated from femur at apex; femur relatively narrow, anterior edge weakly sinuate, virtually impunctate, without spines; tibia strongly curved, thickening apically, with a row of long setae in apical third; segments relatively thin, apical one longer than penultimate, basal two segments shorter in combined length than apical three, with two rows of long setae and a number of stout setae at apex of first four segments; claws weak, inner one slightly shorter than outer (Fig. 13).

Male. Appendages and legs as for female. Central lobe of aedeagus narrow, concave on top, narrowing rapidly near apex to narrow tip; parameres not particularly broad, two-segmented, apical segment with pronounced narrow apical portion (Fig. 8).

Types

Holotype: ♂. BES 6712, piezometer OP122, Windarra W.A. 28°28'40"S 122°07'40"E 18/11/

1998, collected by W. F. Humphreys, in spirit, WAM. Registration number WAM 99/62.

Paratypes 2: 1, ♂. BES 6549, piezometer OP122, Windarra W.A. 28°28'40"S 122°07'40"E, 18/11/1998, mounted on slide, WAM, registration number WAM 99/63; 1, ♂. BES 6559, piezometer OP123, Windarra W.A. 28°28'S 122°08'08"E, 18/11/1998, in spirit, WAM, registration number WAM 99/64. All collected by W. F. Humphreys.

Associated specimens: 1 ♀. BES 6549, same data as paratype, in spirit, SAMA; parts of two specimens, BES 6558, piezometer OP123 same data as above.

Etymology

Named after the type locality.

Remarks

Separated from *N. pulpa* by its much weaker pronotal plicae and the structure of the midleg. From *N. lapostaae* it differs in its larger size, more parallel-sided elytra, presence of small triangular areas where eyes would be, narrower pronotal process, more elongate metatarsi, and less robust pro- and mesotarsi.

Kintingka gen. nov.

Description

?Bidessini. Narrowly oval, weakly flattened, eyeless. Head very broad, strongly reticulate, lacking cervical line. Pronotum strongly reticulate, basal plicae finely, sharply impressed. Elytron strongly reticulate, with numerous short fine setae, epipleuron without basal carina. Hindwing vestigial. Maxillary palpus broad, apical segment greater than length of other three combined. Labial palpus stout, approximately the same size and length as maxillary palpus. Pronotal process moderately arched, apical half spatulate, not reaching mesosternum. Metacoxal plate strongly reticulate, coxal lines weak; coxal lobes adpressed to but possibly not fused to first abdominal sternite. First two abdominal sternites possibly fused. Protibia strongly triangular; protarsi pseudotetramerous. Metatrochanter completely exposed; metatibia stout, straight, expanding a bit towards apex; tarsal segments robust; claws equal, very small. Fore and midlegs without swimming hairs.

Etymology

Western Desert Language of the region; *Kintingka,* a beetle-like insect found swimming in water holes.

Remarks

Separated from the other eyeless Bidessini described here by its small size, strong reticulation, relatively dense covering of setae, stout palpi, stout legs and lack of swimming hairs on fore and midlegs.

Kintingka kurutjutu sp. nov.

Description (number examined, 1) Figs 7, 16.

Habitus. Length 1.0 mm. Narrowly oval, weakly flattened; uniformly testaceous; hindwing vestigial.

Head. Broad, bulges outwards at sides behind where eyes normally are; strongly reticulate; a few setiferous punctures on each side about where inner edge of eye would be; small suture at side of head in middle. Antenna stout, basal two segments largest, next two smallest, then slowly increasing in size to penultimate, apical segment twice length of penultimate; a few very small setae on inside at apex of each segment. Maxillary palpus very broad; apical segment greater than length of other three combined; tip narrowed, truncated, a diagonal row of a few setae towards tip. Labial palpus broad, approximately the size and length of maxillary palpus.

Pronotum. Broad, narrowing towards rear; anterolateral angles strongly projecting forward; posterolateral angles bluntly produced backwards; reticulate, sparsely covered with very small punctures each with a relatively long fine setae; pronotal plicae very fine, sharply impressed, reaching half way along pronotum.

Elytra. Not fused; without inner ridge; reticulate; moderately covered with minute punctures, each with a relatively long fine setae; with a row of long thin setae at edges.

Ventral surface. Pronotal process moderately arched in lateral view, highest point (viewed ventrally) between coxae; spatulate in apical half; very narrow between coxae; not reaching metasternum. Mesocoxae meet. Metasternum sharply triangular in midline in front; wings very narrow; reticulate; a few relatively long setae in mid line. Metacoxal plate not raised in midline; coxal lines virtually absent; strongly reticulate; with sparse, very small punctures, more frequent towards midline, each with a quite long seta; adpressed to, but possibly not fused to first abdominal sternite. First and second sternites fused, with obvious suture; sternites three to five free, covered with rather long setae; three and four with small patch of very long setae in middle. Epipleuron rather narrow in front, progressively narrowing to apex.

Legs. Foreleg very stout; femur strongly reticulate, virtually without spines; tibia triangular, about five times as broad at apex than at base; reticulate; a row of closely spaced small spines on inner margin and some strong spines towards apex; tarsi with fourth segment very small and hidden within deeply bilobed third segment, basal three segments moderately expanded, almost bare of setae ventrally, apical segment stout; claws rather weak. Midleg very stout; femur and tibia strongly reticulate; tibia and tarsi a little less stout than on foreleg. Metatrochanter reticulate, completely exposed, very large, inner edge rounded, outer edge straighter, apex well separated from femur; femur reticulate, stout, without setae, with one spine at apex on inside; tibia stout, straight, much narrower at base than apex, with numerous spines, some strong; tarsi robust, with numerous stout spines, segments progressively smaller except apical which is a bit smaller than fourth, basal two segments in combination about same length as other three; claws equal, extremely small. Fore and midlegs without swimming hairs, swimming hairs weakly developed on metatibia and tarsi (Fig. 16).

Male. Not known.

Types

Holotype: ♀. BES 6032, GSWA 5, Paroo Station 25/6/1998, 26°26'S 119°46'E, coll. S. M. Eberhard, mounted on slide, WAM. Registration number WAM 99/75.

Etymology

Western Desert Language of the region; *kurutjutu*, "blind".

Larva form 1. Figs 17–22

Length 4.2 mm (not including urogomphi). Light testaceous, head darker than rest; eyeless; head proportionally very broad. Head capsule broad, relatively round without marked neck region, sides with some quite strong spines; nasal large, as long as the rest of head, broad, without lateral notches but with a prominent downward pointing small spine/tooth on each side near middle, band of small spines/teeth around front edge ventrally (Fig. 19). Mandibles relatively strong. Labium small, with a few long setae, palpus long and slender (Fig. 20). Maxillary stipe simple, palpus long and slender (Fig. 18). Antenna a little shorter than maxillary palpus, second and third segments same length, apical segment smaller, accessory appendage well developed, a little shorter than apical segment. Thoracic segments weakly sclerotized, sparse row of quite strong setae on posterior edges dorsally. Abdominal segments weakly sclerotized, quite numerous strong setae on posterior edges dorsally and at sides, microsetae arranged in rather short irregular lines. Apical segment with moderate siphon. Trachea in siphon and those at sides of abdominal segments of normal size. Urogomphi broken, only a short basal portion of one remaining which has a long ventral setae near base, a very small dorsal seta near base and a slight notch on the outer side which is the attachment point of a seta which has been broken off; shaft microreticulate, meshes moderate with very fine microsetae along edges of reticulation, becoming noticeably stronger near base. Legs long, relatively thin, with standard set of hydroporine primary setae, moderate number of secondary setae, lacking setae TR2 (Nilsson 1987), lacking swimming hairs (Figs 21, 22). A few very long setae on sides of thoracic and abdominal segments, more frequent posteriorly.

Association with adult

We think that this larval specimen is an early final instar that will thicken and elongate considerably before pupation. Most probably it is the larva of *T. eberhardi* since it would seem to be already too large to belong to *N. pulpa.*

Specimen data

1, BES 6017, Bore # GSWA 6(A), Paroo Station, 25/6/1998, 26°26'S 119°47'E, collected by S. M. Eberhard, mounted on slide, WAM.

Larva form 2. Figs 23–29

Length 1.2 mm (not including urogomphi). Almost transparent, head a very light testaceous. Head broad, relatively large, eyeless, without neck region, without lateral spines, with a few very long setae towards front at sides; nasal very broad, lacking lateral notches, about as long as rest of head, row of very large strong setae/teeth around much of ventral edge (Figs 24, 26, 27). Labium small; palpus robust, apical segment narrower in apical half (Fig. 25). Maxillary stipe simple; palpus robust, apical segment small (Fig. 23). Antenna short, stout, apical segment thin, accessory appendage about half length of apical segment. Mandibles relatively thin. Thoracic and abdominal segments weakly sclerotised; a few moderate setae and some very long ones laterally, more numerous posteriorly; microsetae relatively dense, in long lines. Apical segment with moderate siphon; urogomphi moderately long, two segmented, basal segment with three long setae plus a group of three long setae at apex, apical segment with one long seta attached a short distance from apex; microreticulation meshes large, almost annular, with short fine microsetae along edges. Tracheae absent. Legs relatively stout with only the standard hydroporine set of primary setae, TR2 absent, swimming hairs absent; tarsal claws moderately strong (Figs 28, 29).

Association with adult

All four specimens are similar in size and structure. Their fragile appearance, absence of tracheae, sparseness of abdominal setae, and lack of secondary setae on the legs suggest that they are first instar larvae. If so, their size would associate them with *N. pulpa.* Their very stout cephalic appendages and broad squat nasal are too different from those of form 1 for them to belong to the same species.

Specimen data

1, BES 6028, Bore # GSWA 6(B), Paroo Station, 25/6/1998 26°26'S 119°47'E, mounted on slide, WAM; 1, same data, in spirit, SAMA; 1, BES 6022, Bore # GSWA 6, Paroo Station, 25/6/1998 26°26'S 119°47'E, in spirit, WAM; 1, BES 5994, Bore # GSWA 16, Paroo Station, 24/6/1998 26°26'S 119°44'E, in spirit, WAM. All collected by S. M. Eberhard.

SYSTEMATIC RELATIONSHIPS

Tribal placement

The small size, lack of a visible scutellum, pronotal process on two planes, pseudotetramerous protarsi and larval nasal, place these new genera in the subfamily Hydroporinae. They all lack defining synapomorphies for the Hydrovatini (incised metacoxal process, very broad pronotal process, modified apical sternite [Biström 1996]), and Hyphydrini (unequal metatarsal claws) and appear, quite clearly, to belong within Bidessini and/or Hydroporini.

We place all three new genera in the Bidessini. Our reasons, in descending order of importance, are as follows.

The two genera whose parameres are known possess the unique Bidessini synapomorphy of two-segmented parameres (Biström 1988, 1996).

The two known larval species lack notched nasals and hence would seem to lie outside of the Hydroporini, if Wolfe's identification of this character state as a synapomorphy for Hydroporini is correct (Wolfe 1985). This is true within Australia. However the larvae of *Haideoporus* and *Morimotoa* which are both subterranean and currently placed in the Hydroporini (a placement supported by their single segmented parameres) do not have notched nasals (Young and Longley 1976; Longley and Spangler 1987; Uéno 1957).

The species lack spines along the outside edge of the metatarsi. Such spines are present in all Australian hydroporini but are absent in all Australian bidessini except for one or two on the basal segment in some species. The usefulness of this character outside Australia or its polarity is unknown (*Hydrovatus* and *Hyphydrus* lack such spines, whereas *Laccornis* has them).

The presence of pronotal plicae. Although found in the Australian hydroporines, *Sternopriscus, Necterosoma* and *Barrethydrus,* this character is more typical of bidessines (Biström 1988).

Open metatrochanter bases. Typical of bidessines but also approached in some hydroporines, particularly the Australian *Paroster, Necterosoma* and *Carabhydrus* and in Hyphydrini. Not present in the Hydrovatini (Biström 1996).

Fusion of metacoxal plates and first and second abdominal sternites. Again almost universally present in the Bidessini but also present in some hydroporines (Biström 1988; Wolfe 1985; Larson and Storey 1994).

Metatibia strongly narrowed at base and, in *Tjirtudessus* and *Nirridessus,* also strongly curved. This is a typical bidessine character but is also present in some Hydroporini including the Australian *Sternopriscus* (Biström 1988; Larson and Storey 1994).

There are three other possible tribal placements that need to be considered.

Smrz (1982) created a separate tribe, Siettitini, specifically for Hydroporinae living below ground and exhibiting such characters as eyelessness, flightlessness, lack of pigment, development of long sensory setae and prosternal process not reaching the mesosternum. Although useful taxonomically, it is widely recognised that this is an artificial classification, grouping together phylogenetically unrelated taxa simply because of common adaptations to an underground existence

(Young and Longley 1976; Pederzani 1995).

Watts (1978) created the tribe Carabhydrini for the peculiar Australian genus *Carabhydrus*. Larson and Storey (1994) discussed this placement, concluding that although some uncertainty regarding its true position remained, it was probably best to consider *Carabhydrus* to be a member of the Hydroporini. We accept their argument and tentative conclusion.

The new genera could be considered as a separate tribe. We can find no good reasons to suggest this.

Relationships within the Bidessini

None of the new genera appears close to any Australian Bidessini. However the presence of pronotal plicae, the form of the parameres, the simple central lobe of aedeagus, the lack of or weak development of elytral setae, the lack of sutural striae, the weak punctation and lack of basal carinae on the epipleura point quite strongly to a relationship to *Limbodessus*, *Liodessus* or *Boongurrus*, even though the new genera lack a cervical stria, identified by Biström (1988) to be a phylogenetically significant character in the Bidessini, and which is present in *Liodessus* and *Boongurrus*. However this character appears in the process of being lost in *Boongurrus* (Larson and Storey 1994), which is a very small species found in sand and gravel at the headwaters of small streams and shows signs of an incipient underground existence suggesting that this character could have been lost in the truly subterranean genera.

Beyond Australia four genera of subterranean Bidessini (based primarily on the presence of two-segmented parameres [Biström 1988]) have been reported: *Trogloguignotus* Sanfilippo, 1958 from Venezuela; *Comaldessus* Spangler and Barr, 1995 from the United States of America; *Sinodytes* Spangler, 1996 from China; and *Glareadessus* Wewalka and Biström, 1998 from the Persian Gulf region. In addition a species of *Uvarus* Guignot, 1939 *(U. chappuisi* [Peschet 1932]) has been collected from a well in Upper Volta (Burkina Faso). Of these, *U. chappuisi* is little modified from its surface congeners and the two species of *Glareadessus* are not greatly different from *Hydroglyphus* Motschulsky, 1853 (Wewalka and Biström 1998). Both *Trogloguignotus* and *Comaldessus* differ from the Australian genera in the presence of elytral plicae, and in having the prosternal process reaching the metasternum. *Sinodytes* is more similar but differs in its four segmented pro- and mesotarsi, the prosternal process reaching the metasternum, relatively strong punctation and, from *Tjirtudessus* and *Nirridessus*, lack of swimming hairs on legs. None of these non-Australian genera appear to be close to the new Australian ones.

A much more detailed phylogenetic study is needed before a clear idea of the relationships of the new genera is obtained but we predict the sister group, or groups, will be found within the current Australian bidessines, possibly near *Liodessus*, *Limbodessus* or *Boongurrus*.

Relationships between the new genera and species

The three new genera share a number of characteristics which suggest a relatively close relationship between them within the Bidessini, based on Biström's 1988 review. All lack a cervical stria, a basal carina on the epipleuron, a margined frons, elytral plicae or sutural striae and all have short, moderate to strongly arched pronotal processes not reaching the metasternum which is rarely found in the Bidessini and not found in any Australian genus. This would seem to suggest a relatively recent common origin from within a restricted section of the Bidessini. Unfortunately the polarity of these character states is unknown. They may also, as is likely in the case of the short, arched pronotal process, represent adaptations to a subterranean existence and hence have little phylogenetic content.

Of the five species *K. kurutjutu* appears more distant than the others. Its rounded shape, stout legs and appendages and unusually strong reticulation appear to be characters retained from its terrestrial ancestor and to suggest a more distant phylogenetic origin to the others. In all these characters it most closely resembles *Paroster*, and the blind, terrestrial, *Terradessus*, both in the Hydroporini, although, as argued above, we have placed it in the Bidessini, a position that must be considered tentative until the discovery of the male.

The strikingly similar parameres of the four other species, a character perhaps less subject to evolutionary change in a new environment, suggest a relatively close relationship between them. Within these the large size, cordate shape, subobsolete pronotal plicae and metacoxal lines, and bow-shaped protibiae separate *T. eberhardi* from the remaining species which seem relatively closely related to each other, reflected in our placement of them in the one genus, *Nirridessus*. Within *Nirridessus* the rounded metatrochanters, sinuate metafemora and elongate metatarsi seem, on a first analysis, to be derived characters and to link *N. windarraensis* and *N. lapostaae* as sister species. They also lack the strong pronotal plica of *N. pulpa*. These differences are quite large in terms of bidessine taxonomy and it is quite possible that future studies will support their separation into two genera.

The two larvae, which we have associated with *T. eberhardi* and *N. pulpa*, are very different with ? *T. eberhardi* having long legs, elongate cephalic appendages, enlarged nasal but without strong spines/teeth in contrast to the stout legs and cephalic appendages and greatly developed spines/teeth on the nasal in ? *N. pulpa*, and, if the associations are correct, support the generic separation of the two species.

In summary we tentatively suggest that *N. windarraensis* and *N. lapostaae* are sister species. *Tjirtudessus* and *Nirridessus* are sister genera with the position of *Kintingka* more distant and problematical.

ADAPTATIONS TO SUBTERRANEAN LIFE

Many species found living underground display certain characteristic traits that are thought to be adaptive to underground life. These include both the reduction or loss of characters (regressive evolution) and the enhancement of others (constructive evolution), which together produce the convergence characteristic of cave-adapted animals, that is termed troglomorphy. These adaptations include morphological, ecological, physiological and behavioural characteristics (Christiansen 1992; Culver et al. 1995).

General shape and size. Enlarged head, flattening of the body and narrowing at the pronotal elytral junction are common features of subterranean Hydroporines. *Tjirtudessus* exhibits these characters to the greatest degree with *Nirridessus* and *Kintingka* seemingly less altered. Size is a character that often changes in animals exhibiting marked adaptation to subterranean life, those living in large voids are larger while those inhabiting interstices are smaller than is typical for their lineage. *Kintingka* is among the smallest Dytiscidae while on the other hand *Tjirtudessus* is unusually large for a Bidessine, only *Bidessodes grossus* approaches it in size within the Australian fauna. Whether these size characteristics reflect the spaces they inhabit or some other aspect of niche partitioning is unknown; nonetheless the size (length) ratios of the two series of sympatric species are well beyond that considered necessary for niche separation, being for Paroo 1.6 and 2.1 (mid-point of range) and for Windarra 1.6.

Eyes. Loss of eyes is typical of subterranean animals. All three genera are eyeless. In some lights "ghosts" of ocelli can be seen in *N. pulpa*. At the sides of the head, where the eyes would have been, there is a cuticular area bounded by sutures. In *T. eberhardi*, *N. pulpa* and *N. windarraensis* this is a small, narrowly oval area. This is further reduced to a small suture in *K. kurutjutu* and *N. lapostaae*.

Wings. The elytra of *N. pulpa* are fused. In all the other species the elytra separated on dissection/preparation. In most Hydroporinae there is an inner ridge near the side of the elytron, thought to be associated with locking the elytra against the abdomen (Wolfe 1985). This is lacking in the new species suggesting that even in *Tjirtudessus* and *Kintingka* the elytra are normally tightly closed by some other mechanism.

In *T. eberhardi* and the three *Nirridessus* species and probably also in *K. kurutjutu*, the forewing is quite long but narrow, flimsy and veinless. In all five species it is obviously well on the way to being lost.

Sensory structures. All five species have the long thin sensory setae around the body recorded for all subterranean Hydroporinae (Spangler 1986). On the antennae and palpi there are small setae that probably have a sensory function. All the species have concentrations at the base and apex of the elytra of minute setae-bearing punctures. Apart from their very small size and seeming absence in the few terrestrial species we have looked at, these appear normal but they may have a specific sensory function. In *Kintingka* there are a few cuticular sensilla on the top of the head, but otherwise we have been unable to find any sensory organs, such as described by Smrz (1983) for other subterranean Hydroporinae. More detailed investigation of new material may well find more such organs.

Colour. As in most subterranean animals the new genera lack pigment and all are partially transparent, particularly the larvae.

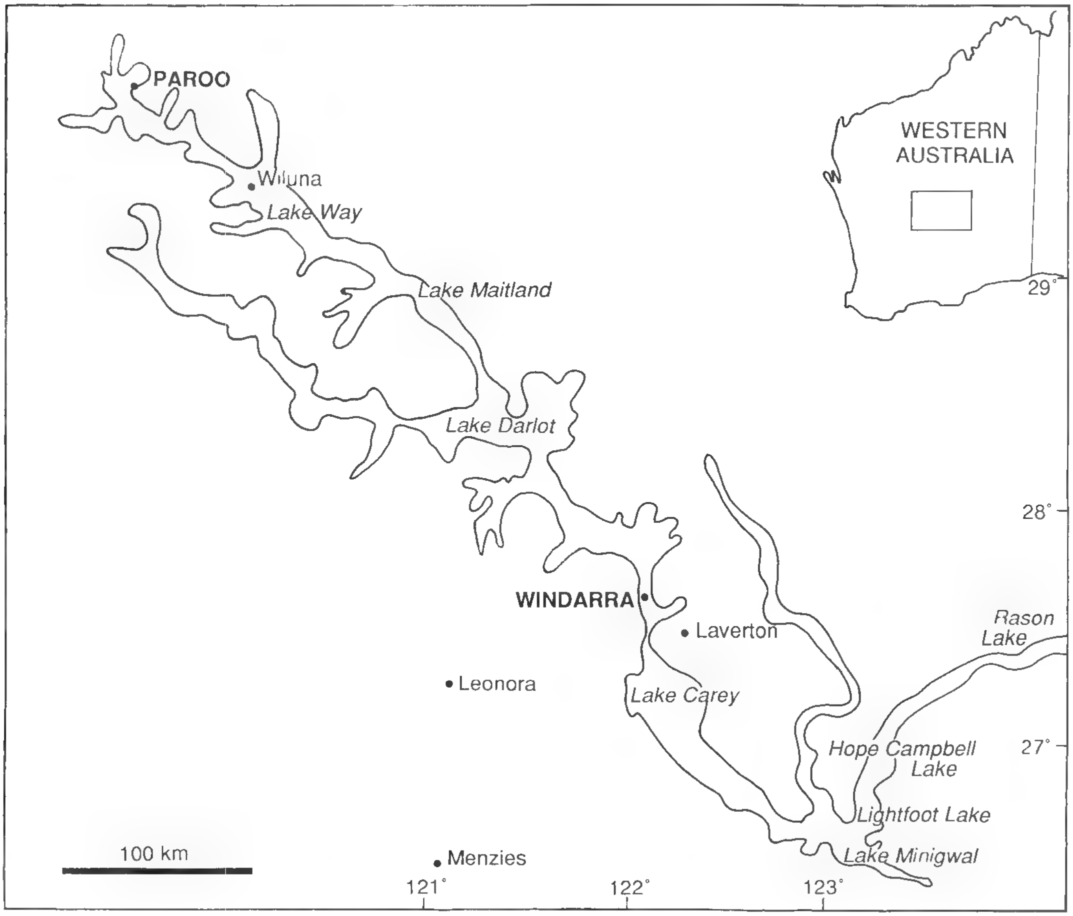
Sculpture. All known subterranean Hydroporinae have smooth shiny surfaces, with weak to very weak punctures or setae on both dorsal and ventral surfaces. Only two, *Trogloguignotus* and *Uvarus*, have raised structures such as plicae or striae. In both *Tjirtudessus* and *Kintingka* pronotal plicae are traceable but very fine, suggesting that they are in the process of being lost. However in *Nirridessus* the plicae are relatively strong and, in *N. pulpa*, have a well marked excavation inside them. In *Kintingka* the reticulation on both surfaces is unusually strong, even for a terrestrial bidessine. The setae in the dorsal punctures are strong in *Kintingka*, although the density of punctures is not great.

Larvae. Both larval types show the typical loss of eyes and colour of subterranean animals. Compared with Australian terrestrial Bidessini larvae the larger larva form 1 has a disproportionately large head and long legs and a strong nasal. The smaller larva form 2 is most noticeable for its strong development of nasal spines (Fig. 21).

HABITAT

All the beetles were taken by plankton net or trap from boreholes in calcrete aquifers associated with the Lake Way–Lake Carey palaeodrainage channel (Fig.1) on the Yilgarn craton of Western Australia.

The palaeodrainage channels in the Yilgarn are old – they contain patches of Permian fluvio/glacial sediments – and were deeply incised into a plateau of Precambrian rocks during the Permian or earlier: there is an absence of sediment between the Permian and Eocene throughout the Western Proterozoic basins (L. Worrall, personal



D.R. West

FIGURE 1. Map showing the extent of the Lake Way-Lake Carey palaeodrainage channel on the Yilgarn craton. The channel continues through Rason Lake to the Eucla Basin. The adjacent palaeodrainage channels are not shown. Groundwater calcretes are mostly associated with the ‘lakes’ (salinas, playas) that overlie the palaeodrainage channel in places. **Inset**: location of the site in Western Australia.

communication 1998). Towards the south the minor palaeodrainage lines probably formed after the uplift of the Darling Plateau and Eocene marine transgressions deeply penetrated the palaeovalleys along the western margin of the Eucla basin (Jones 1990; L. Worrall, personal communication 1998) when conditions were tropical. It is of interest that the amphipods from the southern sites are Ceinidae (J. Bradbury, personal communication 1998), a family of marine ancestry (Barnard and Karaman 1984) while those from the northern site are crangonyctoids, an ancient freshwater lineage (J. Bradbury personal communication).

The northern samples were from an aquifer in Tertiary calcrete deposits on Paroo Pastoral Station (altitude 520 m AHD) in the Paroo sub-basin of the Lake Way Basin in central Western Australia (Figs 1 and 2). All bores from which stygofauna were obtained overlay Proterozoic shale. Locally the calcretes overlay Proterozoic dolomite, sandstone and shale, and are overlain in places by Quaternary alluviums and colluviums (Fig. 2), and this juxtaposition is probably the source from which this possibly old fauna – by analogy with other areas (Humphreys 1993; in press a, in press b; Poore and Humphreys 1998) – invaded these inland-draining palaeochannels. Bores in the Proterozoic and Quaternary facies (Fig. 2) were also investigated but no stygofauna was found.

Calcretes are carbonate deposits forming near the water table in arid lands as a result of concentration processes by near-surface evaporation (Jacobson and Arakel 1986). Groundwater calcretes (Arakel 1996) often

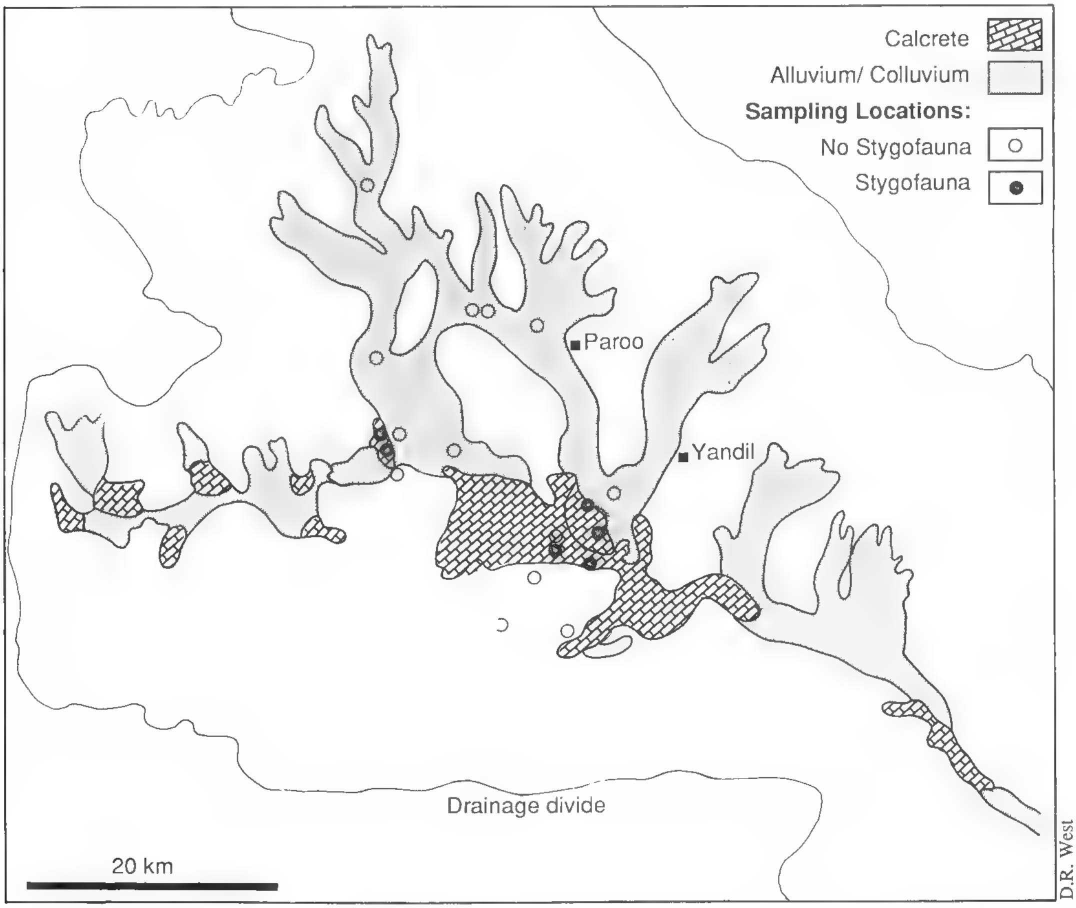


FIGURE 2. Location of the sample sites in the Paroo sub-basin of the Lake Way Basin in Western Australia. **Inset**: location of the site in Western Australia. Base map after Sanders (1973).

TABLE 1. Data for collecting localities.

Bore	Latitude	Longitude	Depth(m)	Comments
GSWA Bore#15	26° 24' 02" S	119° 45' 47" E	27.4	cavernous calcrete/ shale
GSWA Bore#16	26° 25' 31" S	119° 43' 43" E	15.0	shale
GSWA Bore#5	26° 26' 25" S	119° 46' 19" E	22.3	shale
GSWA Bore#6 (A)	26° 26' 02" S	119° 46' 38" E	30.5	observation well, shale
GSWA Bore#6 (B)	26° 26' 02" S	119° 46' 38" E	•	observation well
GSWA Bore#6 (C)	26° 26' 02" S	119° 46' 38" E	•	observation well
OP 113	28° 29' 28.4" S	122° 07' 07.2" E	4.20 (0.05)	piezometer
OP 118	28° 29' 11" S	122° 07' 13" E	5.25 (1.55)	piezometer
OP 122	28° 28' 40" S	122° 07' 40" E	3.50 (0.40)	piezometer
OP 123	28° 28' 46" S	122° 08' 08" E	2.05 (0.15)	piezometer
OP 124	28° 29' 04" S	122° 07' 22" E	3.95 (0.10)	piezometer

develop typical karst features (Barnett and Commander 1985). Such a calcrete aquifer covers c. 90 km^2 of Paroo Station. The upper surface of the calcrete is rubbly and sometimes karstic and so the surface is permeable because of sinkholes and caverns. Opaline silica occurs at about the water table. Below this layer caverns and interconnected conduits have also developed in the friable calcareous material as the result of groundwater circulation. The calcrete varies in thickness between 7.6 and 11.6 m with an average saturation thickness of 4.5 m (Sanders 1973).

Groundwater occurs widely in the Paroo subbasin and as close to the surface as 4.3 m in places (Table 1). The calcrete is recharged by rainfall through the porous surfaces. Rainfall in the region is low, c. 200 mm per year, and highly episodic with storm rainfalls of 76 mm and 119 mm expected at frequencies of once every two years and five years respectively (Sanders 1973). In consequence the groundwater table varies quite widely between storm events.

When investigated in 1973 – attributes may now differ – the total salinities within the Paroo calcrete ranged from 710–1330 mg L^{-1} TDS when the borefield characteristics were established (Sanders 1973) but was not much stratified within boreholes. There is a general increase in salinity downstream up to 4400 mg L^{-1} TDS. The calcrete aquifers eventually drain to the salt lakes in the Lake Way system which act as evaporation basins.

The southern samples were taken from piezometers (altitude 416–418 m AHD) associated with a calcrete quarry at Windarra (Fig. 1), adjacent to the lower reaches of the Lake Way–Lake Carey palaeodrainage system at depth. In this region no subterranean fauna was recovered from either the Roy-Valais Borefield or the Korong North Borefield developed in aquifers in basal palaeosands overlain by substantial layers of clays in the palaeovalley deposits.

The calcrete deposit at Windarra reaches a maximum thickness of about six metres – it is overlain by c. 1 m of ferruginous, clayey, unconsolidated sand – and is typical of the groundwater calcretes widely occurring in the Australian arid zone. There are well developed karst features within the area covered by the piezometric field that are typical of those found elsewhere in calcrete (Sanders 1973) and in those supporting stygofauna (Poore and Humphreys 1998; W. F. Humphreys, unpublished). In the quarry area the water table is shallow (3.34 m [s.d. 0.89 range 1.90–4.15 below the natural surface,] at the time of sampling) (Table 1). As such the calcrete comprises a highly permeable aquifer with limited saturation thickness. The salinity in the Windarra Calcrete Quarry area ranged from c. 1500–3200 mg L^{-1} TDS at the time of sampling but has been reported as high as 4100 mg L^{-1} TDS in places (Dames and Moore 1998).

ASSOCIATED FAUNA AND BIOLOGY

The three genera of dytiscids are sympatric at Paroo (Table 2) and two congeneric species are sympatric at Windarra (Table 3) and they are found together with syncarid crustacea (Bathynellacea), crangonyctoid amphipods (gen. nov.; J. H. Bradbury, pers. comm.), phreodrillid oligochaetes (a Gondwanan lineage), cyclopoid copepods and candonine ostracods (Tables 2 and 3). Undoubtedly more comprehensive sampling of the aquifer will add to this fauna, especially at Windarra where the entire volume of water accessible for sampling was only c. 4.4 L.

TABLE 2. The distribution of stygofauna in the Paroo area. Ten bores were sampled from six sites and only one site yielded no fauna. The numbers under 'Wells' denote the number of wells out of 12 from which taxon was sampled. L denotes larvae presumed to represent *N. pulpa* and *T. eberhardi*. Note the more or less complete restriction of stygofauna to bore samples as opposed to open wells.
* = stygofauna, otherwise epigean species.

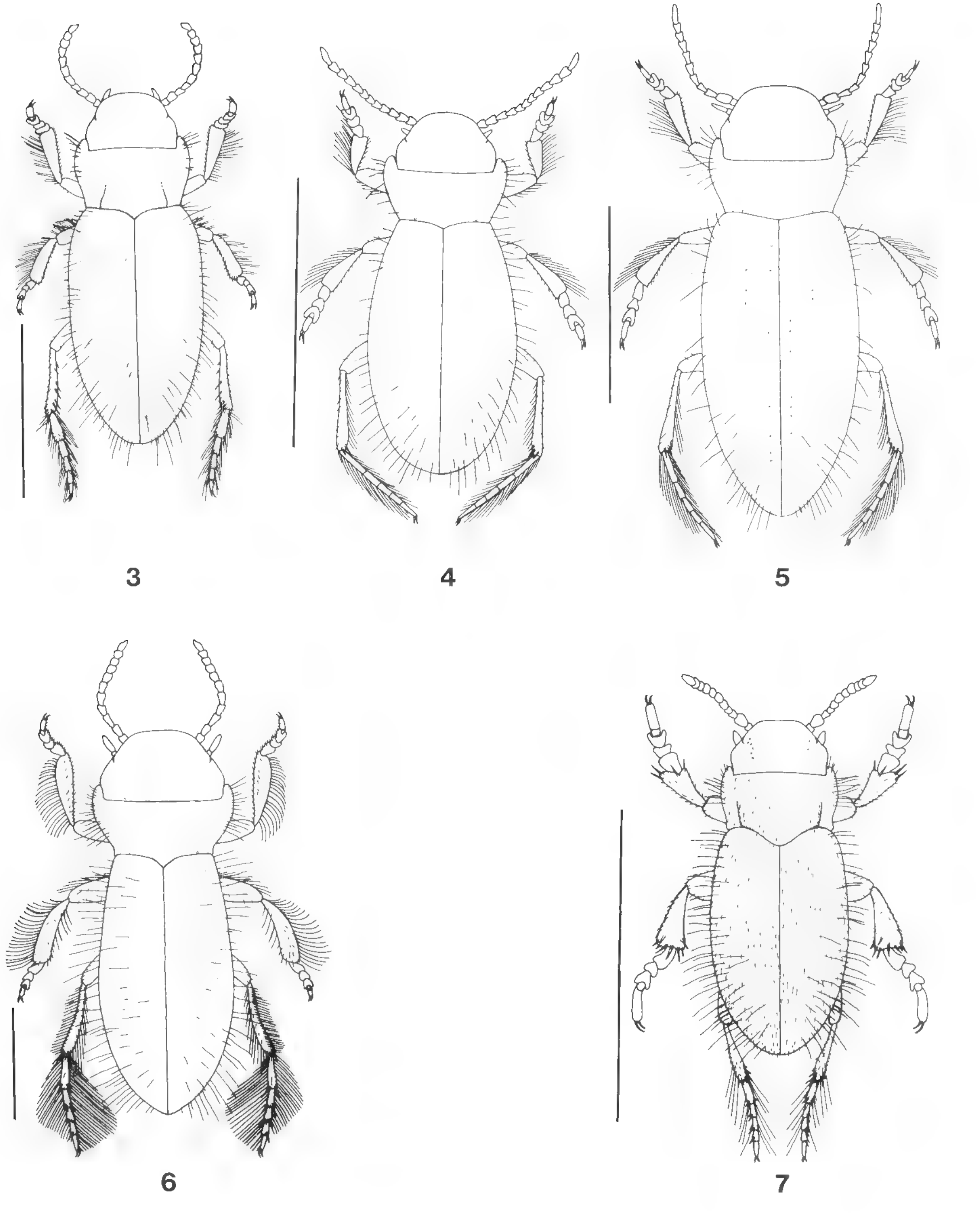
	GSWA Bore	5	6	15	16	20	Wells
Dytiscidae	*Tjirtudessus eberhardi* sp. nov.*	–	+L	+	–	–	–
	Nirridessus pulpa sp. nov.*	+	+L	+	L	–	–
	Kintingka kurutjutu sp. nov.*	+	+	–	–	–	–
Crustacea	Bathynellacea*	–	+	+	–	+	+
Amphipoda	Crangonyctoid*	+	+	+	+	+	–
Copepoda	Cyclopidae	+	+	+	+	+	+
Ostracoda	Cypridinae	–	–	–	–	–	1
	Sarcypridopsis cf *aculeata* (Cypridinae)	–	–	–	–	–	6
	Cypretta sp. (Cypridinae)	–	–	–	–	–	2
	Candoninae*	–	+	+	+	–	–
Hydracarina	*Arrenurus (Micuracarus) separatus* Smit	–	–	–	–	–	3
Oligochaeta	Phreodrillidae*	–	+	+	–	+	–
Minimum number of species		4	8	7	4	4	6

Owing to their habitat little is known of the biology of subterranean dytiscids. The fullest account is by Uéno (1957) who reports that *Morimotoa phreatica* swam weakly, walked on the substrate and did not surface for air. The adults of *Tjirtudessus* and *Nirridessus* have swimming hairs on all their legs, so presumably they need to swim at times. *Kintingka* have weak swimming hairs only on their hind legs and their small size and proportionally very strong fore and midlegs suggest an adaptation to crawling forcibly through gravel/sand – this is consistent with the hypothesis that their small size for their lineage is an adaptation to interstitial life as discussed under 'Adaptations to subterranean life'. Both species of larvae lack swimming hairs but still have urogomphi and long cerci suggesting that they are still air breathing and need to hold their urogomphi above the water with the help of the cerci. Larva form 1 have tracheae of normal appearance. Against this is the very small body size of the small form-2 larva which, like similar-sized larvae of surface species, would allow it to breathe cutaneously. It is doubtful if the much larger form-1 larva could do so.

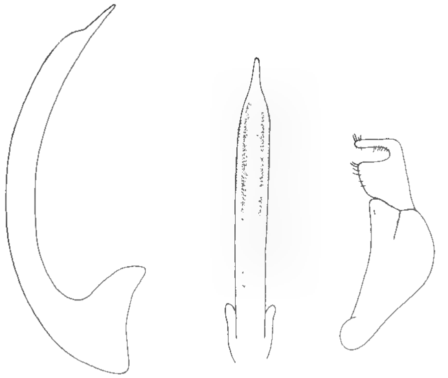
Most adult Dytiscidae are scavengers on freshly dead animals rather than active predators and live off moribund or newly dead animals. Uéno (1957) reported that *M. phreatica* fed both on living (copepod) and dead (isopod, amphipod) crustaceans and we suspect that the new genera have similar feeding habits and are feeding on the range of subterranean crustaceans including amphipods, copepods and syncarids (Table 2) which were found with them. In contrast to the adults, larval dytiscids are active predators. The large head and relatively weak body and legs of the larger larva suggest an ambush predator. The

TABLE 3. Fauna in the Windarra Calcrete Quarry piezometric field. L and W refer to *Nirridessus lapostaae* and *N. windarraensis* respectively.

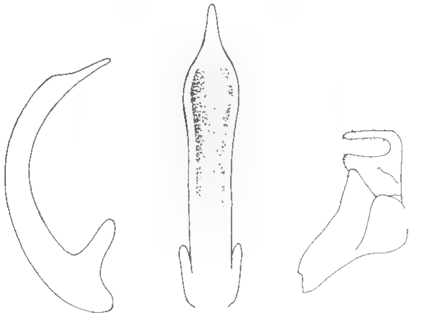
Location	Amphipoda	Copepoda Cyclopoida	Copepoda Harpacticoida	Coleoptera Dytiscidae	Oligochaeta
OP 113	+	–	–	–	–
OP 118	+	–	–	LW	–
OP 122	+	+	–	LW	+
OP 123	+	+	–	LW	–
OP 124	+	–	–	L	–



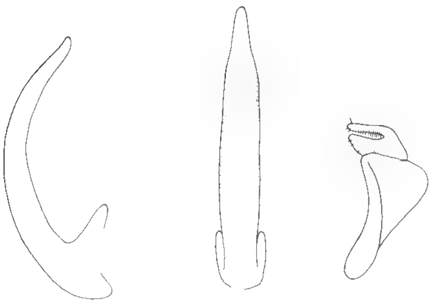
FIGURES 3–7. Dorsal views. **3**, *Nirridessus pulpa*; **4**, *N. lapostaae*; **5**, *N.windarraensis*; **6**, *Tjirtudessus eberhardi*; **7**, *Kintingka kurutjutu*. Figs 3–6 male; Fig. 7, female. Scale bar = 1mm.



8



9



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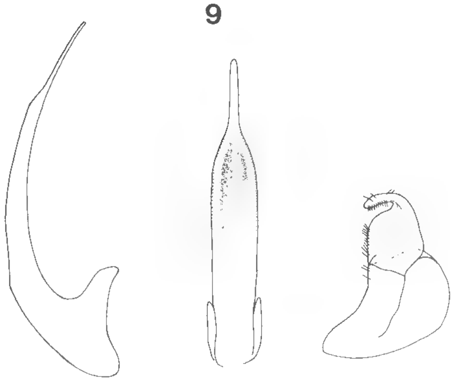

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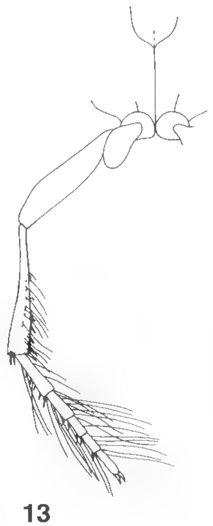

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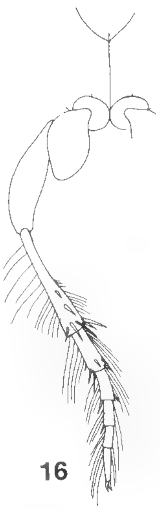

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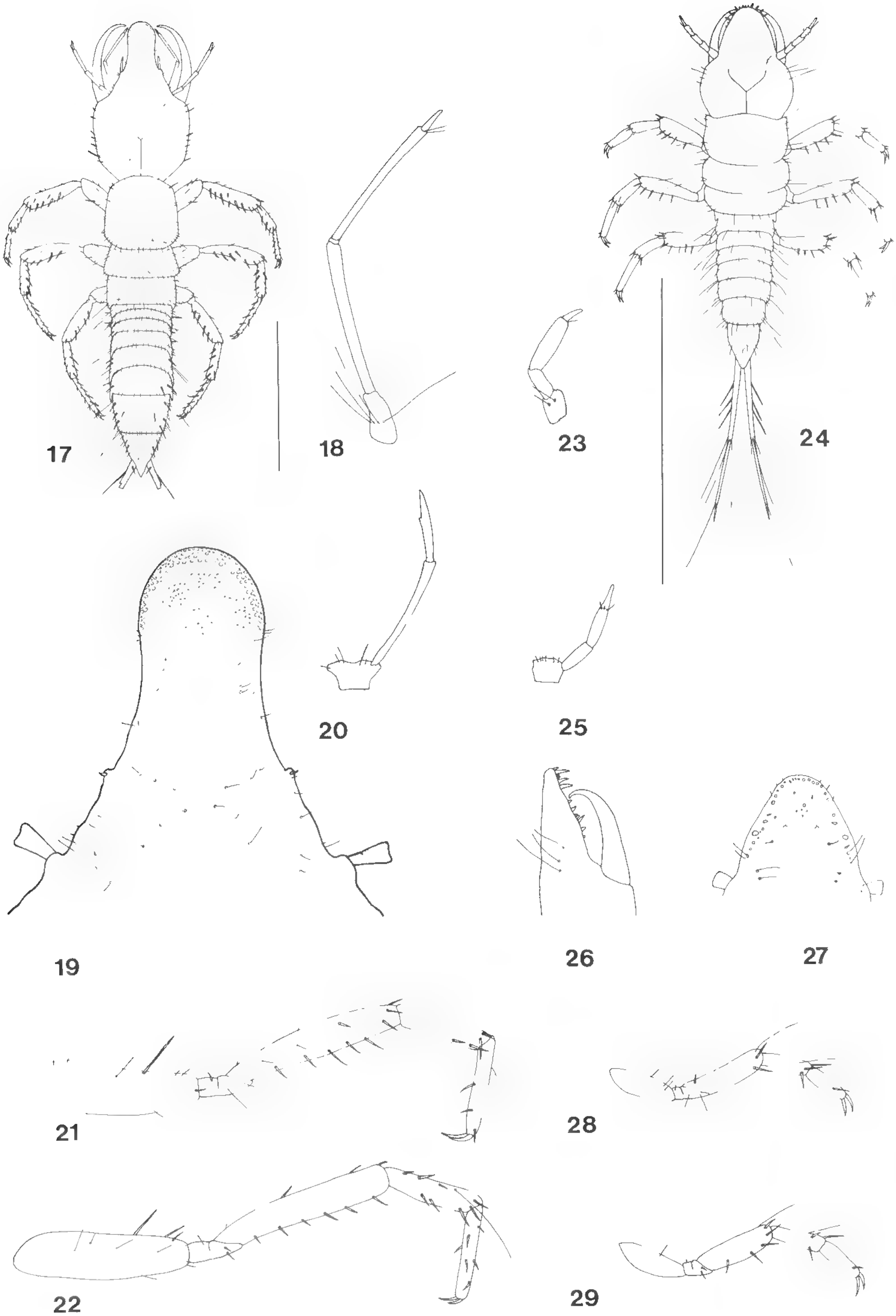
FIGURES 8–11. Lateral and ventral views of central lobe of aedeagi and lateral view of a paramere. **8**, *Nirridessus windarraensis*; **9**, *N. lapostaae*; **10**, *N. pulpa*; **11**, *Tjirtudessus eberhardi*. Figures 12–16. Ventral views of hindlegs. **12**, *N. lapostaae*; **13**, *N. windarraensis*; **14**, *N. pulpa*; **15**, *T. eberhardi*; **16**, *Kintingka kurutjutu*. Drawn to approximately same size, not to scale.



FIGURES 17–22. Larva form 1. **17**, dorsal view; **18**, maxillary palpus; **19**, ventral view of nasal; **20**, labial palpus; **21**, anterior view of foreleg; **22**, posterior view of foreleg. Figures 23–29. Larva form 2. **23**, maxillary palpus; **24**, dorsal view; **25**, labial palpus; **26**, lateral view of nasal; **27**, ventral view of nasal; **28**, anterior view of foreleg; **29**, posterior view of foreleg.

strong nasal spines and strong legs of the smaller larvae suggests a much more active pursuit of a rather slippery prey.

Three of the seven adults at Paroo were taken in traps, while the remainder, and all those from Windarra, were captured in plankton nets hauled through the water column in the bores. The bore samples may not reflect the density of the fauna in the general groundwater because the bores may serve to concentrate the stygofauna owing to the steady influx of organic matter dropping down the mosly capped but not sealed bore heads.

CONSERVATION

Groundwater calcretes mostly occur in palaeodrainage channels in arid climates where the annual rainfall is less than 200 mm and potential evaporation exceeds 3000 mm per year (Mann and Horwitz 1979). Hence, they occur widely throughout mid-latitudes of central and western Australia (map in Humphreys in press c).

The Lake Way Basin has been examined for its water potential (Sanders 1969, 1972a, 1973, 1974). Some work has been conducted on the hydrogeochemistry of aquifers in the region (Mann and Deutscher 1978; Passmore 1983). Such aquifers are actually and potentially much exploited for water resources (Environmental Protection Authority 1981), often inappropriately (Sanders 1972b). There has been and is considerable mining in the general vicinity of Wiluna and further expansion of mining activity is planned.

We need to recognise that these ecosystems may face significant risks resulting from the lowering of the water table below ecologically appropriate levels as a result of surface operations (sealing or clearing), as well as those below ground (water abstraction, mine dewatering). This is especially the case for the shallow and thin calcrete aquifer at Windarra. In addition, such processes may result in the physical modification or loss of subterranean environments through general surface slumping in floodplain calcrete aquifers resulting from the withdrawal of supporting water.

The recent discovery that these aquifers contain rich relictual faunas (Poore and Humphreys 1998; Humphreys in press c; this paper) poses challenging management issues as these aquifers often constitute the principal water supply for human activities in the arid zone.

From evolutionary and hydrological considerations it is likely that the areas occupied by these relict faunas are small and isolated, as found in the Pilbara (Poore and Humphreys 1998; W. F. Humphreys, unpublished), analogous to rainforest patches in Eastern Australia. In these conditions the threat of unwittingly harming these ancient relictual communities (discussed by Humphreys in press c) is ever present. We hope that harm can be avoided, or at least minimised, by an active program of discovery and description of these newly discovered unique faunas followed by sound management of the water resource.

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NEW SPECIES OF ANTIPATHES AND PARANTIPATHES (CNIDARIA : ANTHOZOA : ANTIPATHARIA) FROM COASTAL WATERS OF SOUTH AUSTRALIA AND TASMANIA

DENNIS M. OPRESKO

Summary

One new species of the genus Antipathes and two new species of Parantipathes are described from the coastal waters of South Australia. Antipathes antrocrada sp. nov. resembles A. bifaria Brook, 1889 and A. late Silberfeld, 1920, but differs from these two species in having less crowded polyps, larger pinnular spines, and thinner pinnules that are more spreading and not as strong distally. Parantipathes helicosticha sp. nov. differs from the closely related P. tetrasticha (Pourtalès, 1868) by having shorter pinnules, larger spines and smaller polyps. Parantipathes triadocrada sp. nov. is similar to P. columnaris (Duchassaing, 1870), but is branched to a greater degree, does not have a reticulated worm run along the stem or branches, is extensively subpinnulated, and rarely has more than three pinnules or subpinnules in each verticil-like cluster.

NEW SPECIES OF *ANTIPATHES* AND *PARANTIPATHES* (CNIDARIA: ANTHOZOA: ANTIPATHARIA) FROM COASTAL WATERS OF SOUTH AUSTRALIA AND TASMANIA

DENNIS M. OPRESKO

OPRESKO, D. M. 1999. New Species of *Antipathes* and *Parantipathes* (Cnidaria: Anthozoa: Antipatharia) from Coastal Waters of South Australia and Tasmania. *Records of the South Australian Museum* **32**(2): 143-154.

One new species of the genus *Antipathes* and two new species of the genus *Parantipathes* are described from the coastal waters of South Australia. *Antipathes antrocrada* sp. nov. resembles *A. bifaria* Brook, 1889 and *A. lata* Silberfeld, 1920, but differs from these two species in having less crowded polyps, larger pinnular spines, and thinner pinnules that are more spreading and not as strongly directed distally. *Parantipathes helicosticha* sp. nov. differs from the closely related *P. tetrasticha* (Pourtalès, 1868) by having shorter pinnules, larger spines and smaller polyps. *Parantipathes triadocrada* sp. nov. is similar to *P. columnaris* (Duchassaing, 1870), but is branched to a greater degree, does not have a reticulated worm run along the stem or branches, is extensively subpinnulated, and rarely has more than three pinnules or subpinnules in each verticil-like cluster.

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INTRODUCTION

This is the second in a series of papers dealing with the antipatharian fauna of the waters off southern Australia and Tasmania. Species of the genus *Leiopathes* have been previously described (Opresko 1999). The holotypes and paratypes of the new species are deposited in the South Australian Museum (SAM), Adelaide, S. Australia. Schizotypes are deposited in the U.S. National Museum of Natural History (USNM) in Washington, DC.

TAXONOMIC SECTION

Order Antipatharia Milne Edwards, 1857

Family ANTIPATHIDAE Ehrenberg, 1834

Genus ***Antipathes*** Pallas, 1766

Remarks

In 1834 Ehrenberg used the name Antipathina for a family-level taxon in the Order Scleropoda of the Class Bryozoa. Although it is likely that Ehrenberg was actually referring to a bryozoan that was encrusting an antipatharian axis, his usage has priority over subsequent designations in which the family was more correctly identified as anthozoan corals (see Gray 1840 and Dana 1846). Note: if the taxonomic revision of van Pesch (1914) is followed, over 150 nominal species must be assigned to the genus *Antipathes*. This arrangement totally obscures the natural affinities of the various species complexes in the genus. Because a revision of the order focusing on the identification of these species complexes and the establishment of new genera and/or subgenera is currently being undertaken, diagnoses and keys for the currently recognized genera will not be presented here.

Antipathes antrocrada **sp. nov.**
(Figs 1–3)

Diagnosis

Corallum branched and pinnulated. Primary pinnules on branches and branchlets arranged alternately, generally bilaterally, and inclined distally. Secondary pinnules arranged uniserially near base of primaries, projecting out of plane containing primary pinnules, and inclined distally relative to primary pinnule on which they arise. Distal secondary pinnules bilateral, with narrow interior angle; interior angle generally increasing with increasing size of branchlets. Spines on pinnules simple, conical to subcylindrical with an acute apex; inclined distally; generally 0.10 to 0.14 mm tall on highest order pinnules, increasing to about 0.2 mm on lower order pinnules and

FIGURE 1. *Antipathes antrocrada* sp. nov., holotype, SAM H-746, entire corallum, height about 22 cm.

branches; maximum size about 0.3 mm. Polyps usually 0.8–0.9 mm in transverse diameter; arranged uniserially, with 9–10 polyps per centimetre.

Description of Holotype

The holotype (SAM H-746; Fig. 1) may only be a branch from a larger colony; a basal plate is not present. It is about 25 cm tall and 12 cm wide and the 'stem' or primary branch is 3.0 x 4.5 mm in diameter at its basal end. Several large branches come off the 'stem' in an irregular fashion and at irregular angles, and they bear smaller branches. Both branches and branchlets are curved to varying degrees, and all are pinnulate. The arrangement of the pinnules and subpinnules is

FIGURE 2. *Antipathes antrocrada* sp. nov., holotype. SAM H-746. **A**, outer edge of corallum showing the arrangement of the pinnules, approx. x 1.2. **B**, pinnules with polyps, approx. x 3.0.

not perfectly regular throughout the colony. In general, primary pinnules on the branches and branchlets have the appearance of being arranged alternately in two nearly opposite rows (Fig. 2A). The primary pinnules are mostly 1–2.5 cm long and 0.1–0.15 mm in diameter at their base excluding spines (0.2–0.3 mm wide including spines). They are spaced 3–5 mm apart in each lateral row and within each row they arise anterolaterally such that the interior angle formed by the two rows is 60–90° at the point of insertion on the branch. However, the more distal sections of the primary pinnules are recurved such that two pinnular rows have the general appearance of being nearly opposite one another. The primary pinnules are also inclined distally (distal angle 45–70°). The primary pinnules, in turn, often have a series of 3–6 secondary pinnules (Fig. 2A), mostly 4–5 mm long and 0.14 mm in diameter (up to 10 mm long and 0.16 mm in diameter), and spaced 2–4 mm apart. The lowest secondary pinnule is 4–6 mm from the base or point of insertion of the primary pinnule. The lowermost secondary pinnules on each primary are arranged uniserially, inclined distally, and tend to lie in a plane at nearly right angles to the plane containing the primary pinnules. Pinnules longer than 1.5–2 cm become branchlets with the distal-most secondary pinnules becoming bilateral and alternating, usually with a very narrow interior angle. Thus, over the entire corallum, and even on the larger branches, there is a pattern in which the pinnules go from a uniserial arrangement proximally to a bilateral arrangement distally, and for the interior angle formed by the two lateral rows of pinnules to increase with increasing length and thickness of the branchlets.

The skeletal spines (Figs 3A–3C) are simple, conical to subcylindrical, with a smooth to slightly coarse distal surface and an acute apex. The polypar spines are larger than the abpolypar spines; both tend to be inclined distally. Polypar spines on the lower portions of the higher order pinnules (axial diameter 0.1–0.15 mm) are generally 0.10 to 0.14 mm tall (distance from the midpoint of the base to the apex); the abpolypar spines are 0.08–0.10 mm. On the pinnules the spines are arranged in axial rows, 4–7 of which are visible in lateral view (excluding rows in which spines are only partially visible). The distance between adjacent spines in each row ranges from 0.08–0.18 mm, and there are 6–8 spines per millimetre in each row. The spines increase in number and size and become more acicular with increasing thickness of the axis; on pinnules or branchlets having a diameter of 0.2–

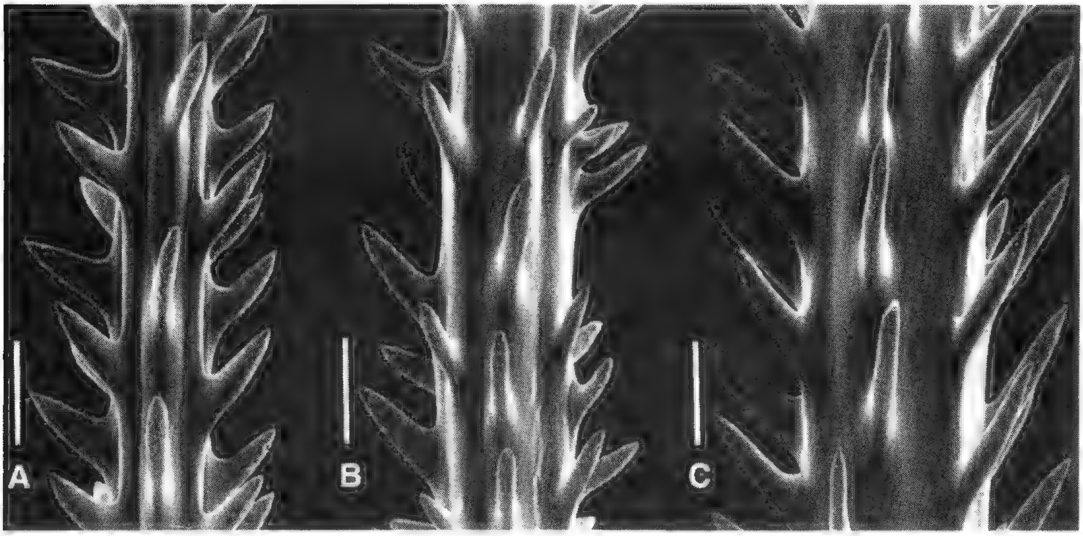

FIGURE 3. *Antipathes antrocrada* sp. nov., scanning electron micrographs of holotype, SAM H-746. **A**, Spines on pinnule 0.09 mm in diameter. **B**, spines on pinnule 0.12 mm in diameter. **C**, spines on branchlet 0.19 mm in diameter. Scale bars 0.1 mm.

0.3 mm the spines are 0.12–0.18 mm tall; on larger branches (0.3–0.4 mm in diameter) they are up to 0.22 mm tall. The spines on the lowest part of the 'stem' (diameter 3.2 mm) are mostly simple, 0.2–0.24 mm tall (maximum about 0.32 mm) and 0.02–0.03 mm in diameter; a few are forked at the apex.

The polyps (Fig. 2B) are distributed uniserially and generally restricted to the pinnulated side of the branches and branchlets. On the primary pinnules the polyps are found on the side having the subpinnules; they are at right angles to the direction of the branch on which the pinnules occur, or they can be offset somewhat towards the upper side of the pinnules relative to the direction of the branch. Where the interior angle of the pinnules is narrow, the polyps in opposing lateral pinnular rows face towards each other. On the secondary pinnules the polyps are positioned laterally (at right angles) relative to the direction of the primary pinnule, or they are offset, to varying degrees, towards the upper side (in the direction of the distal end of the primary pinnule). The polyps range in size from 0.6 mm to 0.9 mm (transverse diameter as measured from the distal side of base of distal lateral tentacles to the proximal side of the base of the proximal lateral tentacles), but most are 0.8–0.9 mm. The interpolypar space ranges from 0.1 to 0.2 mm, the smaller space usually found between two larger polyps. On average, there are 9–11 polyps per centimetre. The mouth is often slit-shaped and elongated along the sagittal axis and surrounded by a wide oral disc, and the tentacles are up to 0.3 mm long (in the alcohol-preserved material). Polyps are restricted to one of the two wider sides of the stem, but they are more scattered and not in a single series.

Discussion

The paratype (SAM H-745) shows the same general growth form as the holotype; however, in this specimen there is more variability in the interior angle formed by the two rows of pinnules, and many pinnules are inclined distally to a greater degree than those in the holotype. Furthermore, the lowermost (most basal) secondary pinnules often occur further away (i.e., up to 10 mm) from the base of the primary pinnule than those in the holotype.

Comparisons

Antipathes antrocrada sp. nov. resembles *A. bifaria* Brook, 1889 and *A. lata* Silberfeld, 1909. In all of these species the corallum is irregularly branched and pinnulate, and the pinnules are arranged uniserially to biserially. However, based on the descriptions given by Brook (1889) and Silberfeld (1909), the pinnules in *A. bifaria* and *A. lata* are more strongly directed distally (distal angle less than 45°), and the interior angle formed by the two pinnular rows is much narrower than the condition occurring in *A. antrocrada*. In addition, the pinnules in these species appear to be thicker than those in *A. antrocrada* [as suggested by the illustration given by Silberfeld (1909)], but the spines on the pinnules may be slightly smaller (0.1 mm vs. 0.1–0.14 mm in *A. antrocrada*). The polyps in *A. lata* appear to be more crowded; Silberfeld (1909) reported a polyp density of 12 per centimetre, whereas the polyp density is, on average, 9–11 per centimetre in *A. antrocrada*. Polyps were not present in the type specimen of *A. bifaria* described by Brook (1889).

Etymology

The specific name is derived from the Latin '*antrorsus*' (directed forward and upward) and '*crada*' (twig), in reference to the curving of the pinnulated branchlets.

Material Examined

Australia, Great Australian Bight, approx. 100 nautical miles (185.2 km) SSW of Eucla, 33°16'S, 128°09'E, 170 m, R/V *Comet*, 14 January 1989, coll: W. Zeidler and K. Gowlett-Holmes (holotype, SAM H-746; schizoholotype, USNM 99415). Great Australian Bight, approx. 100 nautical miles (185.2 km) SSW of Eucla, 33°16'S, 128°16'E, 190 m, R/V *Comet*, 14 January 1989, coll: W. Zeidler and K. Gowlett-Holmes (paratype, SAM H-745; schizoparatype, USNM 99413).

Distribution

The species is known only from waters off South Australia at depths of 170–190 m.

Genus ***Parantipathes*** Brook, 1889

***Parantipathes helicosticha* sp. nov.**

(Figs 4–6)

Diagnosis

Corallum sparsely branched and pinnulate. Pinnules simple, arranged biserially in 6–8 (rarely 9 or 10) rows, and in semi-spiral groups of 3–4 (rarely 5) pinnules each. Pinnules extending at nearly right angles to the direction of stem or branch on which they occur. Spines simple, smooth, acute, inclined distally; 0.10–0.20 mm from centre of base to apex. Spines arranged in axial rows, three or four of which are visible in lateral view; spaced 0.3–0.8 mm apart in each row; with 2–3.5 spines per millimetre. Polyps transversely elongated, 1.6–1.8 mm in diameter from proximal edge of proximal tentacles to distal edge of distal tentacles. Polyps arranged uniserially on upper side of pinnules, facing towards the distal end of the stem or branches. Interpolypar space about 0.6 mm, resulting in four polyps per centimetre.

Description of Holotype

The holotype (SAM H-903) is a nearly complete colony with basal plate and polyps intact (Fig. 4). It is about 55 cm tall and 27 cm wide and has a basal stem diameter of 3.5 x 4.5 mm. It is very laxly branched (only about 14 branches in all), with the branches spaced at varying distances, some only several millimetres apart, others several centimetres apart. The branches are long; the largest is about 33 cm and has a basal diameter of about 2 mm. At their point of origin, the branches project at nearly a right angle to the stem or lower order branch from which they arise; they are straight or irregularly curved over most of their course. Both the stem and branches have a columnar growth form due to the presence of multiple rows of simple elongate pinnules that lie perpendicular to the direction of the stem or branch from which they arise (i.e., distal angle about 90°). The rows of pinnules are arranged biserially, usually with an equal number on each side (Fig. 5). The most common condition is three or four rows on each side, but rarely there may be four on one side and up to five on the other. The pinnules are also arranged in alternating semi-spiral groups along the length of the branches, each group consisting of one member from each row. The pinnules in each semi-spiral group on one side of the axis follow a clockwise direction, those on the opposite side follow a counterclockwise pattern. The semi-spirals on both sides thus appear to follow an ascending pattern when viewed from one side of the corallum and a descending pattern when viewed from the opposite side. Each semi-spiral covers an axial distance of about 2 mm and often the most distal pinnule of one semi-spiral is at about the same level as the most basal pinnule of the next group on the same side. In some cases, the lowest or highest pinnule in each semispiral is located near the middle of the front or back of the axis. There are usually four semi-spiral groups per centimetre in each series. The pinnules are simple, 1.5–2 cm long and about 0.2 mm in diameter at their base. The pinnules are straight or curved upward slightly.

FIGURE 4. *Parantipathes helicosticha* sp. nov., holotype, SAM H-903, entire corallum, height about 55 cm.

The skeletal spines (Fig. 6) are simple (very rarely forked), smooth, conical to horn-shaped, very acute, and inclined distally, particularly on the mid to distal part of the pinnules. They are about 0.10 mm tall on the basal portion of the pinnules, 0.14–0.16 mm tall along the mid portion and up to 0.20 mm tall on the distal portion. The abpolypar spines are usually 0.02–0.04 mm smaller than the polypar spines, but they are sometimes larger. On the pinnules the spines are arranged in axial rows, 3–4 of which are visible in lateral view (excluding rows in which spines are only partially visible). The distance between adjacent spines in each row is variable (0.3–0.8 mm), but on average there are 2.0–3.5 spines per millimetre in each row. Spines are reduced in size on the stem and branches. On the stem the spines are no more than about 0.06 mm tall.

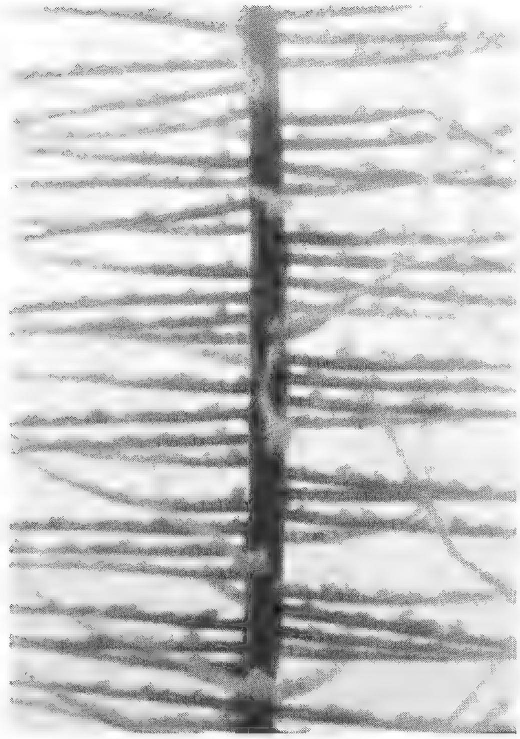

FIGURE 5. *Parantipathes helicosticha* sp. nov., holotype, SAM H-903; section of corallum showing arrangement of pinnules and polyps, approx. x 4.

The polyps (Fig. 5) on the pinnules are arranged uniserially on the upper side, facing towards the distal end of the branch on which they occur. They are mostly 1.6–1.8 mm in transverse diameter, as measured from the distal edge of the distal lateral tentacles to the proximal edge of the proximal lateral tentacles. The interpolypar space is 0.6 mm, and there are usually 4 polyps per centimetre.

Discussion

Paratypes SAM H-904 and H-901 are similar to the holotype in the growth form of the corallum, and in the size, number, and arrangement of the pinnules. The remaining paratype (SAM H-752) is more densely branched than the holotype and its pinnules are less regularly arranged, more often in semi-spiral groups of 2–3 (4 on the thicker branches), and the pinnules are spaced further apart. Each semi-spiral group takes up as much as 3 mm; therefore, there are only three groups per centimetre on each side as compared to 4 in the holotype. The spines are also slightly smaller than in the other specimens. Analysis of additional specimens may show that this specimen represents a species distinct from *P. helicosticha.*

Comparisons

Parantipathes helicosticha, sp. nov. resembles *P. larix* (Esper, 1790) and *P. tetrasticha* (Pourtalès, 1868) in the general

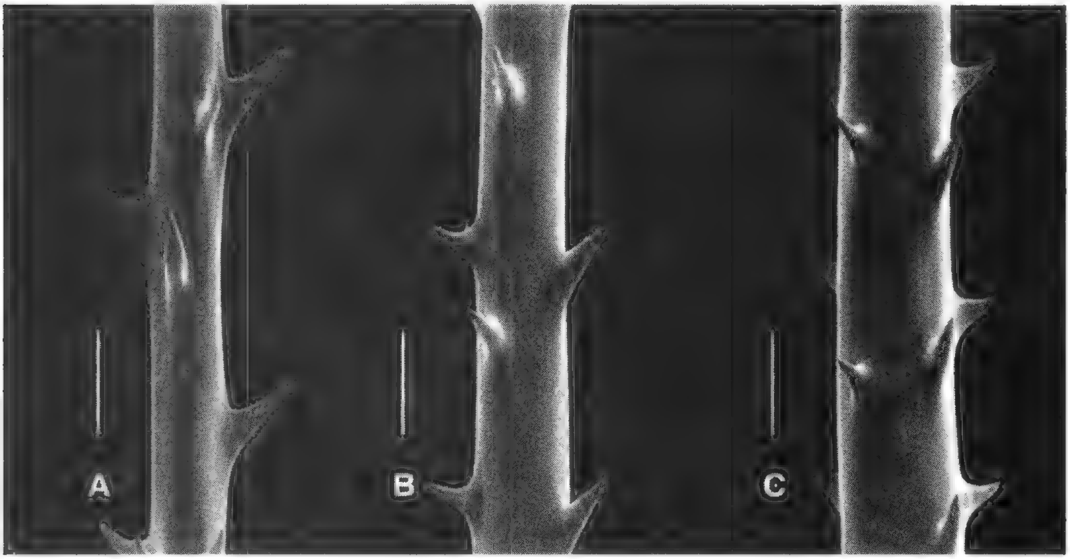

FIGURE 6. *Parantipathes helicosticha* sp. nov., scanning electron micrographs of holotype, SAM H-903. **A**, Spines near tip of pinnule 0.13 mm in diameter. **B**, spines on pinnule 0.16 mm in diameter. **C**, spines near base of pinnule 0.2 mm in diameter. Scale bars 0.2 mm.

appearance of the corallum, but differs from these species in the length or number of rows of pinnules or in the size of the spines. *P. larix* typically has only 6 rows of simple pinnules, and depending on the size of the corallum, the pinnules can be 3.5 cm to as much as 12 cm in length (Brook 1889). The spines of *P. larix* are much smaller than those in *P. helicosticha*; only 0.06–0.09 mm, as estimated from the illustration given by Brook (1889), and the polyps are slightly longer, about 2.0 mm in transverse diameter (Brook 1889). In *P. tetrasticha*, there can be up to 8 rows of pinnules, as in *P. helicosticha*, but the pinnules are longer (up to 4 cm), the spines are shorter (0.04–0.08 mm), and the polyps are more transversely elongated (2.5 mm). Both *P. larix* and *P. tetrasticha* were originally described from the Atlantic. *Parantipathes larix* has also been reported from the Pacific (van Pesch 1914). However, van Pesch's description more closely resembles that of *P. helicosticha* than *P. larix*.

Etymology

The specific name is derived from the Latin '*helico*' (helix) and Greek '*sticha*' (twig) in reference to the arrangment of the pinnules in a quasi helical pattern.

Material Examined

Australia, approx.125 nautical miles (231 km) E of Cape Arid, W. Australia, 33°03'S, 125°31'E, 1011–1020 m, F/V Adelaide Pearl, K. Gowlett-Holmes, K. Olsson and M. Cameron, 31 July 1988, (holotype, SAM H-903; schizoholotype, USNM 99401). Approx. 125 nautical miles (231 km) S of Eucla, S. Australia, 33°45'S, 129°17'E, 999–1110 m, F/V Adelaide Pearl, K. Gowlett-Holmes, K. Olsson and M. Cameron, 1 August 1988 (paratype, SAM H-904: schizoparatype, USNM 99400). Approx. 46 nautical miles (85 km) SE of SE Cape, Tasmania, 44°14.8'S, 147°27.5'E, 1080–1130 m, F/V Belinda, K.L. Gowlett-Holmes, 9 February 1992 (paratype, SAM H-901; schizoparatype, USNM 99412). Great Australian Bight, approx. 130 nautical miles (240.8 km) SSW of Cape Adieu, 34°06'S, 131°20'E, 1124–1131 m, F/V Longa III, K. Gowlett-Holmes, 15 December 1989 (paratype, SAM H-752; schizoparatype, USNM 99414).

Distribution

The species is known only from the waters off Tasmania and South Australia at depths of 999 to 1130 m.

Parantipathes triadocrada **sp. nov.**

(Figs 7–9)

Diagnosis

Corallum sparsely branched, but densely pinnulate. Primary pinnules arranged in three irregular axial rows, two lateral and one posterior. Lateral primary pinnules more complexly subpinnulate than posterior primary pinnules. Pinnules and subpinnules (six or more orders) also grouped together in clusters (pseudo-verticils) containing one pinnule from each row. Pinnules and subpinnules adhering. Spines simple, conical, smooth, with acute to rounded apex; usually 0.06–0.08 mm from centre of base to apex. Spines on pinnules and subpinnules arranged in axial rows; up to 6–7 rows visible in lateral view. Spines 0.16–0.30 mm apart in each row, with 5–6 spines per millimetre, on average. Polyps not more than 1.2 mm in transverse diameter from proximal side of proximal lateral tentacles to distal side of distal lateral tentacles. Polyps arranged uniserially on upper or anterolateral sides of pinnules and subpinnules; with 7–8 polyps per centimetre.

Description of Holotype

The holotype (SAM H-908; Fig. 7) is about 22 cm tall and 12 cm wide and has at its basal end a reticulated skeletal structure formed by the irregular cross-linking of adjacent branches by thick branchlets. This part of the colony has a stem-like branch about 2 mm in diameter. Several branches 10–20 cm in length originate along this 'stem' and extend vertically, one becoming fused apically with pinnules of the stem. Both the stem and major branches have a columnar growth form due to the presence of pinnules along their length. Although the pinnules can occur singly and in pairs, the most common arrangement is in three irregular vertical rows and also in clusters each containing three (very rarely four) members. Two of the vertical rows are bilateral and the third is on the posterior side of the axis. The pinnules in the two lateral rows are usually much more higher developed (complexly subpinnulate) than those in the posterior row (Fig. 8A); consequently, the stem and individual branches have a somewhat bilateral structure. The clusters of pinnules consist of one member of each row arising from nearly the same location on the axis; however, the members of a group rarely arise at exactly the same point. Instead, they are separated by intervals of 0.1–0.3 mm (Fig. 8B). Therefore, the clusters might best be referred to as pseudo-verticils. The arrangement of the pinnules within each pseudo-

FIGURE 7. *Parantipathes triadocrada* sp. nov., holotype, SAM H-908, height about 22 cm.

verticil is irregular; a spiral or helical pattern not being apparent. The pseudo-verticils are spaced, on average, about 3 mm apart, but the distance can range from 2.5 to 4.5 mm. On some parts of the corallum the pseudo-verticils are incomplete due to the absence of one or even two members, and consequently, the pinnules and subpinnules are spaced irregularly along the axis.

The lateral primary pinnules on the stem and branches have as many as six orders of subpinnnules; in contrast, the posterior primary pinnules have relatively few subpinnules (Fig. 8A). The subpinnules develop in the same manner as the primary pinnules, usually in pseudo-verticils of three, spaced about 3 mm apart. Any one or more of the subpinnules can, in turn, have similar subpinnules, and this pattern can be repeated over several higher orders of

FIGURE 8. *Parantipathes triadocrada* sp. nov., holotype, SAM H-908. **A**, cross section of branch showing arrangement of pinnules, approx. x 1.7. **B**, lateral view of clusters of pinnules, approx. x 3.5. **C**, pinnules with polyps, approx. x 5.

subpinnules. Although many exceptions occur, pinnules less than 1 cm long are likely to have only one order of subpinnules (and sometimes only one or a bilateral pair, rather than three); those about 2 cm long often have 1 or 2 orders of subpinnules; those 3 cm long have four or five; and those 4 cm long have as many as 6 orders. The subpinnules do not develop to the same extent from pinnule to pinnule; therefore the pattern of subpinnulation is not symmetrical. The largest unpinnulated pinnules or subpinnules are rarely more than about 7 mm in length and have a basal diameter of 0.14–0.16 mm (excluding spines). The pinnules and subpinnules arise from the lower order ramifications at nearly a right angle, but in most cases they curve upward towards the distal end of the stem or branch on which they occur. Overall, the apparent distal angle is 45–60°. Fusions of overlapping pinnules and subpinnules occur frequently and as a result, the lateral sides of the stem and branches (and also the anterior side in some places) form a dense mass of anastomosing subpinnules. Subpinnules of some adjacent branches are also fused together.

The skeletal spines (Fig. 9) are simple, smooth, and conical with an acute to rounded apex. They are mostly subequal in size around the circumference of the axis, although in places they can be slightly larger to twice as tall on one side. Spines on the pinnules and subpinnules are usually 0.06–0.08 mm tall from the midpoint of the base to the apex; a few near the base of the larger pinnules (diameter 0.14–0.16 mm) reach a size of 0.10–0.12 mm. The majority of spines project at right angles to the axis; some are inclined distally, particularly those near the distal end of the pinnule. The spines are arranged in axial rows with 3–4 rows visible in lateral view (including only rows in which the base of the spines can be seen). However, on some pinnules, and primarily near the base of the pinnules, as many as 6–7 rows are visible. The distance between adjacent spines in each row varies from about 0.16 to 0.30 mm; on average there are 5–6 spines per millimetre in each row. Although the distribution and spacing of the spines is quite regular on many pinnules and subpinnules, the pattern becomes less regular near the base of the pinnules, with new spines developing between the rows. There are only a few scattered spines on the larger branches at the base of the corallum, some of these are relatively narrow and acicular, but few are more than 0.06 mm tall.

The polyps (Fig. 8C) on the subpinnules and pinnules are distributed uniserially on the upper or anterolateral sides of axis, thereby facing toward the distal end of the branch on which the pinnules occur. Because the pinnulation is more strongly developed on one side of the axis, there is a distinct polypar and abpolyar side of the

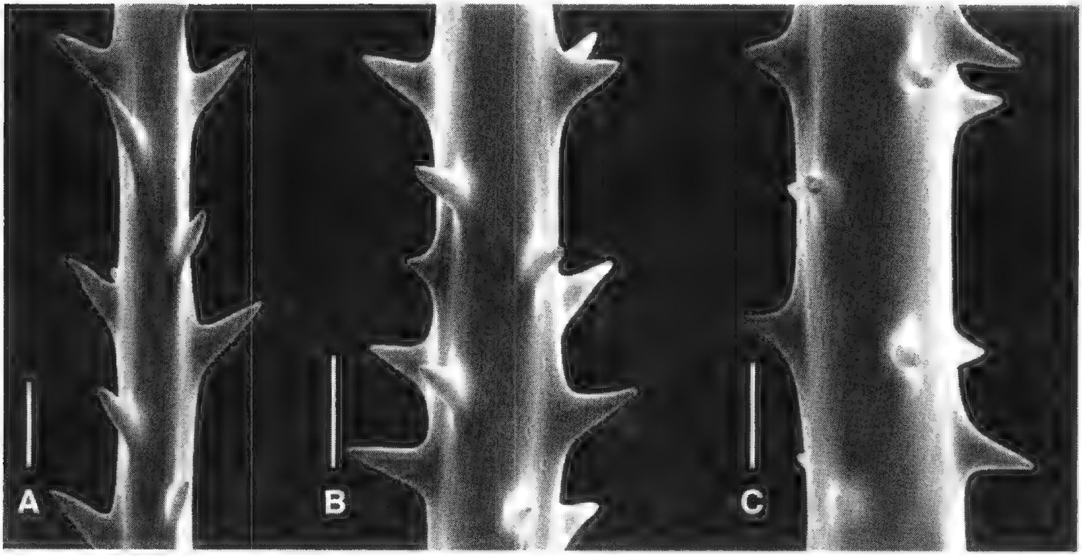

FIGURE 9. *Parantipathes triadocrada* sp. nov., scanning electron micrographs of holotype, SAM H-908. **A**, Spines near distal end of pinnule 0.08 mm in diameter. **B**, spines on middle of pinnule 0.1 mm in diameter. **C**, spines on pinnule 0.15 mm in diameter. Scale bars 0.1 mm.

corallum when viewed from above (Fig. 8A). The polyps are 0.8–1.1 mm in transverse diameter, as measured from the distal side of the base of the distal lateral tentacles to the proximal side of the base of the proximal lateral tentacles, and the interpolypar space is 0.3–0.4 mm. Seven to 8 polyps occur along one centimetre of axis. The mouth is often slit-shaped and elongated along the sagittal axis, and the tentacles are up to 0.3 mm long (in the alcohol-preserved material). Some polyps appear very elongated along the transverse axis such that transverse diameter is about three times longer than the sagittal diameter (e.g., 0.8 mm vs. 0.25 mm).

Discussion

A second specimen collected at the same station as the holotype is about 25 cm tall and 6 cm wide (SAM H-986). At its basal end (as well as at several points higher up on the corallum) it has a reticulated skeletal structure similar to that seen in the holotype. This colony and the other two paratypes exhibit the same general growth form as the holotype, with the major branches directed vertically and with numerous anastomosing pinnules and subpinnules. Young colonies are likely to have a simple corallum with few if any branches. In one of the two paratypes (which is broken in three pieces) a well-defined stem is present which, just above the holdfast, is 4.5 x 5.5 mm in diameter. As in the holotype, the axis of the stem and major branches is compressed laterally (oblong in cross section) such that the widest diameter is at right angles to the plane formed by the lateral pinnules.

Comparisons

This species resembles *Parantipathes columnaris* (Duchassaing, 1870) in having the pinnules and subpinnules arranged in pseudo-verticils. However, in *P. columnaris* the corallum is usually monopodial, always has reticulated worm run along the stem, has fewer orders of subpinnules, and usually more than three subpinnules in each pseudo-verticil.

Several species currently placed in the genus *Parantipathes*, including *P. columnaris* (Duchassaing, 1870), *P. tenuispina* Silberfeld, 1909, and *P. cylindrica* Brook, 1889, differ from the type species *P. larix* (Esper, 1790) in having polyps that are not much more then 1.0 mm in transverse diameter. These species also form a natural assemblage united by the tendency of parts of the corallum to anastomose. These species may also have affinities to several flabellate species (i.e., *Tylopathes crispa* Brook, 1889 and *Antipathella contorta* Brook, 1889) which have similar sized polyps and anastomosing branches and branchlets. Further study may show that these species merit separate taxonomic recognition.

Etymology

The specific name is derived from the Latin '*triado*' (in groups of three) and '*crada*' (twig) in reference to the arrangement of the pinnules and subpinnules into pseudo-verticillate clusters of three.

Material Examined

Off Tasmania, approx. 46.5 nautical miles (86 km) SSE of South East Cape, 44°22.7'S, 147°07.3'E, 1060–1170 m, F/V *Belinda*, 12 February 1992, coll: K. Gowlett-Holmes (holotype, SAM H-908; schizoholotype, USNM 99410; paratype, SAM H-986). South Australia, Great Australian Bight, approx. 80 nautical miles (148 km) WSW of Pearson Id, in Investigator Group, 34°11'S, 132°38'E, 160 m, F/V *Comet*, 14 April 1979, coll: K. Gowlett-Holmes (paratype, SAM H-759). South Australia, Great Australian Bight, approx. 90 nautical miles (167 km) W of Cape Wiles, 38°04'S, 133°59'E, 625–890 m, F/V *Longa III*, 9 November 1989, coll: K. Gowlett-Holmes (paratype, SAM H-760).

Distribution

The species is currently known only from the waters off Tasmania and South Australia at depths of 160 to 1170 m.

ACKNOWLEDGMENTS

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SOUTHERN RIGHT WHALE REMAINS FROM 19TH CENTURY WHALING AT FOWLER BAY, SOUTH AUSTRALIA

CATHERINE M. KEMPER AND CATHERINE R. SAMSON

Summary

A study of surface and excavated whale bones at Fowler Bay, South Australia, was carried out in 1994. Bones partially exposed at the surface were located over a 1 km transect and included up to 10 skulls and many postcranial bones. Eight sites were excavated and yielded 104 bones, many of which were well preserved and entire. Cranial and postcranial bones were excavated: six crania, a bulla, periotics, a mandible, ribs, vertebrae, chevrons and a sternum. All of the identifiable bones (two-thirds) were Eubalaena australis. Body lengths of five animals were derived from skull measurements and yielded estimates in the order of 15-18 m. Postcranial bones were also from full- or nearly full-grown right whales, as indicated by their size and developmental state. No bones of small animals were found. The minimum number of individual right whales in the deposit was six. It is likely that the remains were a result of whaling during the early part of the 19th century. The only available record of the number of whales taken at Fowler Bay is that of the log of the American ship 'Amazon' which took 33 right whales and 8 humpbacks in 1840. Indirect evidence suggests that at least 65 right whales were taken by shore- and/or ship-based whalers during 1840-1844. Although few right whales have visited Fowler Bay in the last decade, it must have been an important calving or nursery site before European settlement.

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Whaling in Australia underwent several phases. From about 1805 to 1845 bay whaling was at its height in suitable places along the southern coast (Dakin 1938) and the main target of the industry was the southern right whale, *Eubalaena australis*, during winter months when it came close to shore to calve and mate. Bay whaling included shore-based operations, both ephemeral and longer term, and ship-based operations from ocean-going American, British, French and Australian vessels which sheltered temporarily in safe inlets and often hunted whales from there (Dakin 1938).

Shore-based operations and Australian-registered ships took two-thirds of the estimated at least 26 000 right whales caught from 1827 to the early 1900s in New Zealand and southeastern Australian waters (Dawbin 1986). Three-quarters of these were caught between 1835 and 1844. British vessels were predominant until 1830, followed by a period of mostly American and French vessels after the mid 1830s. Eyre (1845) believed that at least 300 of the latter types were present each year in the general region. Records of the species and numbers taken are few, and rarely include details of size or maturity of the animals present in the catch. Historical estimates of right whale catches, therefore, are often based on oil yields by converting barrels, gallons or tuns to whales (Dawbin 1986).

Matthew Flinders was the first European to record having visited Fowler Bay, in January 1802, and he noted its good anchorage but lack of water and sparse vegetation (Faull 1988). Between November 1840 and January 1841 Edward John Eyre camped at Fowler Bay using it as a staging post for crossing the Nullarbor Plain. Good water was available in the sandhills. He later wrote:

> Upon walking round the shores of Fowler's Bay, I found them literally strewed in all directions with the bones and carcases of whales, which had been taken here by the American ship I saw at Port Lincoln, and had been washed on shore by the waves. To judge from the great number of these remains, of which very many were easily recognisable as being from those of distinct animals, the American must have had a most fortunate and successful season. (Eyre 1845: 227).

We have assumed that the skeletons observed by Eyre and/or taken in subsequent whaling operations at Fowler Bay made up the remains which formed the basis of our study.

The presence of large bones partly exposed in sand along the northern side of Fowler Peninsula was brought to attention of the South Australian Museum in 1990. A preliminary trip was made in 1992 to locate these and photograph what was exposed. They were identified as whale bones, possibly *E. australis*. In August 1994 an expedition was mounted by the Australian and New Zealand Scientific Exploration Society (ANZSES), the South Australian Museum and Flinders University to excavate the bones and determine whether a whaling station had been set up at Fowler Bay. Archaeological expertise was provided by Mark Staniforth and Michael Jones,

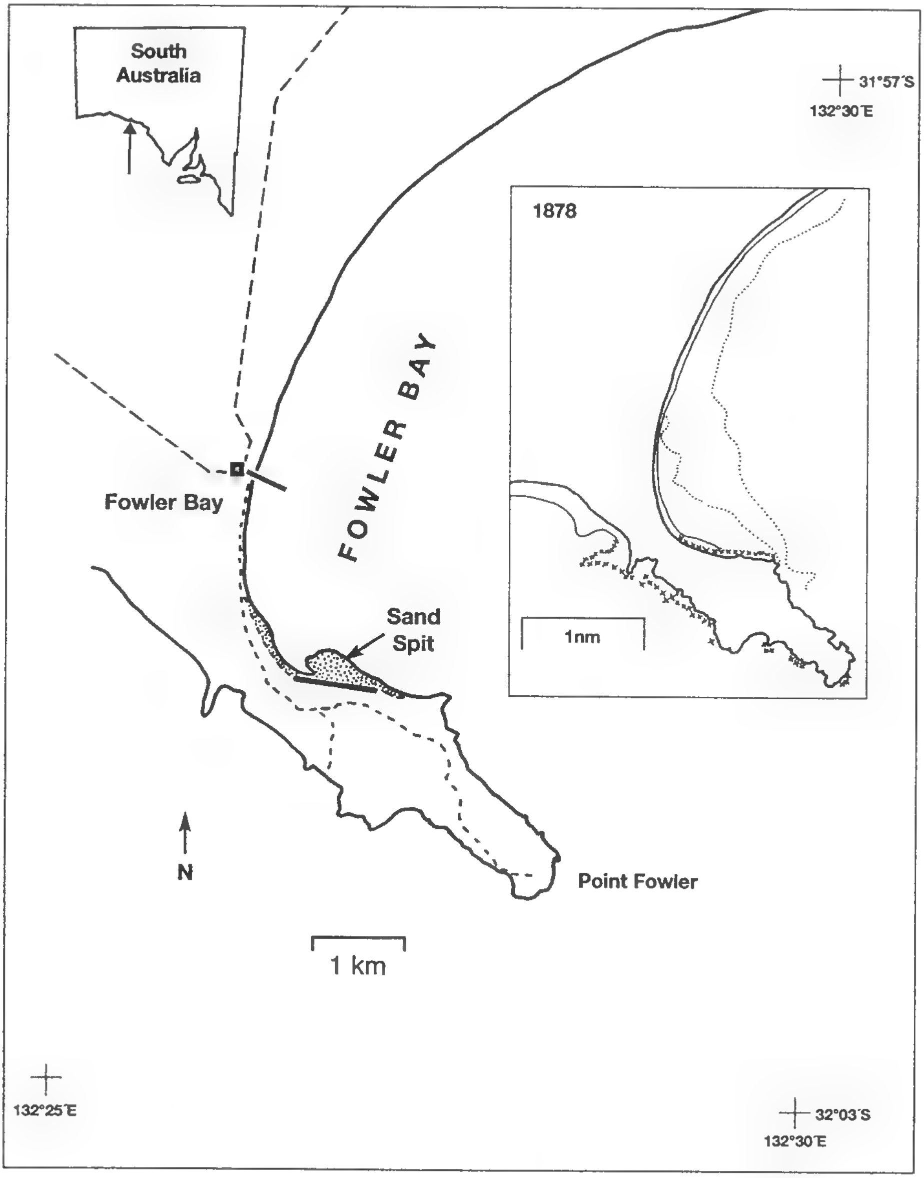

FIGURE 1. Fowler Bay area based on 1982 aerial photography and (insert) nautical chart based on 1878 survey by W. N. Goalen, Royal Navy. Solid bar near sand spit is position of study site. Broken lines are vehicle tracks and roads. Stippled lines on 1878 map indicate approximate positions of 2 and 6 m water depths. Low tide mark shown on 1878 map. Small crosses indicate rocky areas.

Flinders University, and is summarised in Jones and Staniforth (1996). Zoological expertise was provided by the authors and is reported here.

The aims of the zoological component of the project were to 1) identify the species represented by the bones, 2) determine the minimum number and relative age of whales present, 3) shed some light on whether shore- or ship-based whaling had taken place and 4) obtain reference specimens for the Museum's collection.

Study Site

Fowler Bay is near the head of the Great Australian Bight, about 300 km east of the South Australian/Western Australian border (Fig. 1). The bay is protected on its southwestern side by a calcarenite peninsula now covered by wind-blown, sandy hummocks and low vegetation. Mobile sand dunes are found where the peninsula meets the coast and these are gradually covering the old buildings of Fowler Bay township (Short, Fotheringham and Buckley 1986). Low coastal cliffs are present around the south and western side of the peninsula. A long sandy beach extends from about half way along the peninsula to Clare Bay, 25 km east. The beach and inshore area are gently sloping, resulting in a stable, low-energy and shallow bay along the coast to about 3 km north of the township of Fowler Bay (Short *et al.* 1986). The peninsula is part of Fowlers Bay Conservation Reserve.

An early nautical chart of the area, surveyed in 1878 (The Admiralty, 1939), showed no sign of the extensive sand spit now found on the northern side of the peninsula (Fig. 1). The first illustration which we could trace, showing the spit, was an aerial photo taken in 1963 (State Library of South Australia). Earlier maps, dated 1892, 1915 and 1951, are all very similar and appear to be based on the same survey. It is likely that the spit formed from eroded sands blown off the peninsula as a result of overgrazing by stock and rabbits during the early part of the 20th century. A vehicle track is now found along what is believed to be the old shore line.

Methods

Mapping and stratigraphy

A surface transect 1 km by 30 m was searched, using a line of 15 people spaced at 2 m intervals,

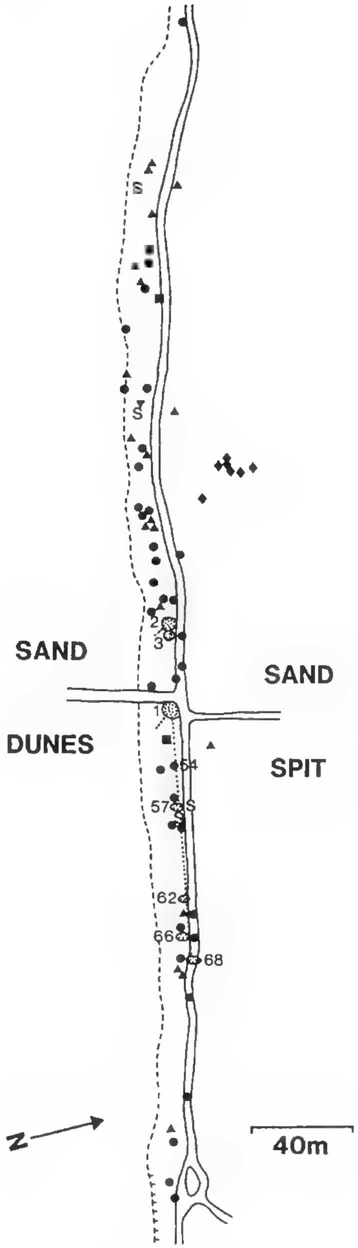

FIGURE 2. Location of surface bones, excavated sites and trenches in study site. Excavated sites shown as stippled areas with identifying W number (W1, W2, W3, W57, W62, W66, W68), except W54, which was found in a trench. Symbols of surface bones: ▲ vertebra, ■ rib, ▼ mandible, S possible right whale skull (not excavated), ● unknown large whale bone, ◆ beaked whale bones. Dotted lines are trenches. Position of track (between solid lines) and edge of sand dune/low limestone cliff (broken line and ⊥) shown.

for exposed bones and cultural material along the length of the southwestern edge of the sand spit. The resulting sites (W1-77) were then surveyed by theodolite (Jones and Staniforth 1996).

A 40–50 cm-wide transect was established, digging 2 m out of each 5 m segment, between W1 and W68 sites (after the sites themselves had been excavated) to establish whether the bones were clumped or randomly spread between sites (Fig. 2). At 20 m intervals along this main trench, 2 m side trenches (total = four) were dug bearing south. Exploratory trenches were also dug from W1 (5.5 m bearing 126°) and W2 (3.3 m bearing 144°). All trenches were excavated to limestone platform level (<55 cm).

The stratigraphy of the sediments was recorded along the trench and at W1 site.

Excavations

When choosing sites for excavation, preference was given to those where exposed skulls rather than postcranial bones were already evident. Eight sites were excavated, of which two contained bones encountered during digging the trenches. At each site, excavation began at the exposed bone and worked down and around it, usually encountering other bones in doing so. Because so many bones were found piled on top of each other, the process was one of working towards the edge of the pile (which was not always reached due to time constraints) and leaving the bones in situ as the excavation progressed. Trowels, buckets, brushes and shovels were used. Each site was dug to the level of the limestone platform.

Photographs were taken of each site before, during and at the end of excavation. Sketches were also made of the site at completion and then each bone was numbered, measured and photographed (with a 1 m scale bar marked in 10 cm black and white bands) in situ. Measurements were taken (straight line, in cm) at the site using a tape measure. A few were later calculated from scaled photographs. The measurements are listed and defined in Appendix 1.

Twenty-six bones were collected for the South Australian Museum (Appendix 1). These were wrapped in toilet paper then jacketed in hessian and plaster before being transported to Adelaide. After preparation (including desalination), they were registered into the mammal collection (M18071). Some bones were also collected for National Parks and Wildlife South Australia and for display at Fowler Bay township.

After the two-week study was completed, the sites were filled-in with sand and the vegetation replaced. A sign explaining the results of the study has been erected at the site.

Identification

Preliminary identifications were made on-site by comparing excavated bones with published photographs and drawings of large whale skeletons. All identifications were then confirmed at the South Australian Museum. Reference material of large whale species there includes: the skull of an 11.5 m *E. australis* (M14135) plus the postcranial skeleton of two neonates (M16470, M17766), two skulls and part skeletons of juvenile humpback whales (*Megaptera novaeangliae*), skulls and skeletons of blue (*Balaenoptera musculus*) and Bryde's whales (*B. edeni*) and skulls and skeletons of a range of sizes of male and female sperm whales (*Physeter macrocephalus*). Published illustrations of northern right whale (*Eubalaena glacialis*) skulls and skeletons were also studied (True 1904, Allen 1908, Omura, Ohsumi, Nemoto, Nasu and Kasuya 1969, Omura, Nishiwaki and Kasuya 1971).

Estimating animal length

Maximum skull width was estimated from maximum available width by comparing photos of the incomplete, excavated skulls with drawings of skulls of *E. glacialis*. The proportion missing was then calculated and added to the maximum available width for each specimen. Maximum skull widths of 12 *E. glacialis* of known body length were obtained from published sources (True 1904, Allen 1908, Turner 1913, Omura *et al.* 1969, Omura *et al.* 1971) and measured in three *E. australis* (SAM M14135, WAM M40552, British Museum ZD.1934.7.23.1). Body lengths of these animals ranged from 7.6 to 17.1 m. Mean predicted body lengths and prediction limits were then computed following the methods in Kemper and Leppard (1999) using 17 m as the average adult length.

RESULTS

Surface remains

The 1 km transect located 78 whale bones, or parts thereof, at 77 surface sites (Fig. 2). Of the 10 skulls located, all were initially identified as possible *E. australis* without excavating them (see example in Fig. 3). The remaining bones included whole or parts of 3 mandibles, 19 vertebrae, 2 ribs and 37 unknown bones. Of these, the recognisable

FIGURE 3. Weathered, posterior portion of *E. australis* skull at site W1 two years before excavation. Photo: A McLennan, 1992.

ones were identified as possible *E. australis*. Seven strap-toothed beaked whale *Mesoplodon layardii* bones (M18070) were located at the surface in seagrass above high tide mark during the transect. They were probably the remains of a recent stranding.

Surface bones were not evenly distributed throughout the transect area. Few bones were found at the extremities of the area and only four (except the beaked whale bones) were located on the seaward (northern) side of the vehicle track. In some places groups of surface bones were observed.

Excavated sites

The stratigraphy of the deposit appeared to be similar. Fine grey/brown sand layers were mixed with layers of decomposed seagrasses. A layer of coarse beach sand, of variable thickness and sometimes including cobbles, was present just above the limestone platform. A black layer, including charcoal fragments, was present at a depth of about 20–25 cm at most places where the stratigraphy was recorded. At two places it was nearer the surface. This layer, and the fact that many of the bones were charred, suggests that a fire had occurred at the site when many of the bones were still exposed at the surface.

Six of the surface bone sites were excavated (W1, 2, 3, 57, 62, 68). Another two sites (W54, W66) were located while digging the trenches. A total of 104 entire or partial bones were located during excavations (Appendix 1). These included: 6 crania, 2 periotics, 1 bulla and periotic, and 7 skull fragments; 1 almost complete mandible and 5 possible (part) mandibles; 1 cervical mass, 29 thoracic and lumbar vertebrae, 6 caudal vertebrae, 7 part vertebrae and 5 loose epiphyses; 11 complete or almost-complete ribs and 12 rib fragments; 2 chevrons; 1 sternum; and 9 unknown fragments of bone.

At site W1, 29 bones, including a large cranium, were located in the 4.2 x 6.6 m excavated area. The site contained bones from several animals of various degrees of physical maturity e.g. large thoracic vertebrae with unfused or very well-fused epiphyses, posterior lumbar vertebrae with unfused epiphyses and mid

FIGURE 4. Overall view of site W2 looking south east. Bones in situ. Photo: J. Thurmer.

FIGURE 5. Postero-dorsal view of *E. australis* cranium W2-11 after it had been lifted upright and broken across occipital region. Scale bar is marked in 10 cm and 1 cm units. Photo: C. Kemper.

lumbars with well-fused epiphyses, a loose caudal epiphysis, and three periotics (Appendix 1). Several large ribs or part ribs were also found at this site. A continuous limestone platform was located 55 cm below the surface. No bones were found in the 5.5 metre-long side trench.

The area excavated at site W2 was 4.2 x 7.4 m and contained 45 whole or partial bones of various types and a large cranium (Figs 4, 5, Appendix 1). Bones from several individuals of differing stages of physical maturity were present: thoracic vertebrae with free or fused epiphyses and a caudal vertebra with unfused epiphysis; also bones encasing pterygoid fossae in addition to the skull. A continuous limestone platform lay 45 cm below the surface and limestone cobbles ranging in size from 5 to 25 cm long were common throughout the site. No bones were found in the 3.3 metre-long side trench.

W3 was a small site centred just 3 m east of the edge of W2 and eventually coalescing with it. The 14 bones were more broken up than at other sites and included a cranium of which only the basioccipital and right occipital condyle remained. The presence of both a thoracic vertebra with fused epiphyses and a caudal vertebra with unfused epiphyses indicated that at least two individuals, of different relative ages, were represented.

Site W57 contained a large cranium, large mandible and six other bones or fragments. Sites W62 and W68 each contained only a large cranium.

Three bones were located, each at different positions, in the trench between sites W1 and W68. In the main trench, 2 m from W68, a rib was located and at 7 m from W68, an almost complete, large cervical mass and a vertebra (W66) were found. One of the side trenches went very close to surface site W54 and a transverse process of a lumbar vertebra was found in the trench there. Further excavation of W54 revealed four other bones, including the rest of the same lumbar vertebra.

Species identification

Sixty-nine bones were sufficiently intact to identify them as *Eubalaena* sp. Since the southern right whale, *E. australis*, is the only species known to occur in Australian waters, we have

FIGURE 6. Postero-ventral view of *E. australis* cranium W57-1 in situ. The skull is partly resting on a large mandible (W57-2). Photo: C. Kemper.

FIGURE 7. Ventro-lateral view of right bulla and periotic (W1-28) of *E. australis*. Black and white scale bar is cm. Photo: Trevor Peters.

assumed that this is the species present in the material at Fowler Bay. Vertebral epiphyses, even when complete, were considered too difficult to assign to genus or species.

No skull was complete and what remained of five of the six excavated crania were the robust parts, including the occipital region and the squamosal bones (Figs 5, 6). The rostrum and frontals were missing and what remained of the skull looked worn. Distinctive features that the Fowler Bay skulls had in common with *Eubalaena* spp. were the large, squarish occipital shield (Fig. 5), the well-developed and ventroanteriorly projecting postglenoid process of the squamosal (Fig. 6), the deep pterygoid fossae (Fig. 6) and the large, distinctively-shaped bulla (Fig. 7). Identifiable fragments of skulls included the posterolateral tips of a frontal bone and maxilla. The part cranium at W3 was much less well preserved than the other excavated skulls and consisted of one half of a large occipital condyle, similar in shape to the condyles of the other skulls, and the adjacent portion of the squamosal. This skull was later identified as probable *E. australis* (Appendix 1).

The vertebrae were large, dense and robust, all of which are features typical of *Eubalaena* spp. The cervical vertebrae (Fig. 8) were fused into

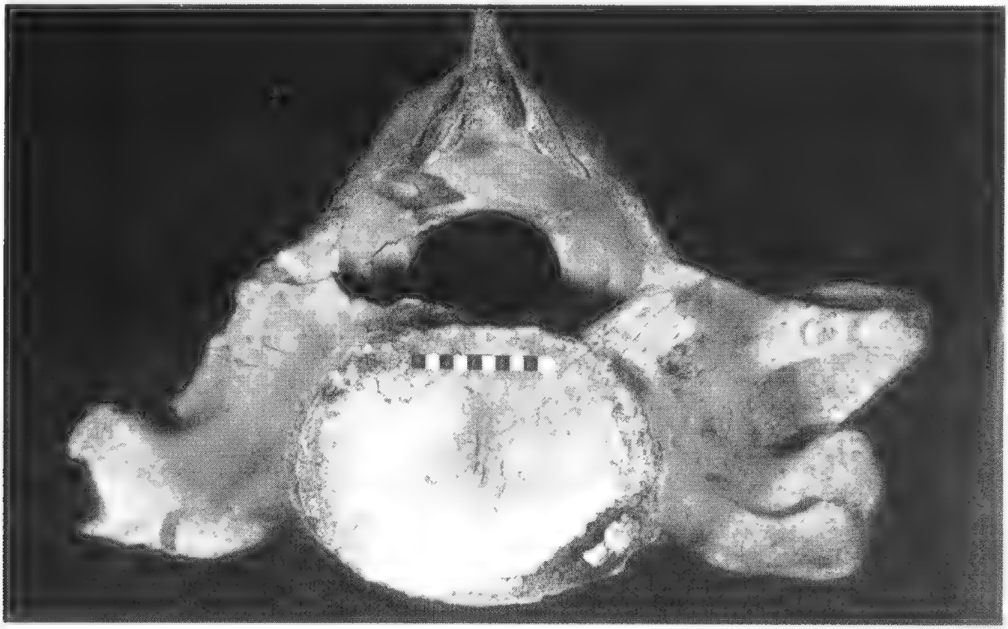

FIGURE 8: Posterior view of broken *E. australis* cervical vertebrae (W66-1). Thoracic vertebra, fused to seventh cervical, is in foreground. Scale bar is 10 cm long and marked in 1 cm units. Photo: Trevor Peters.

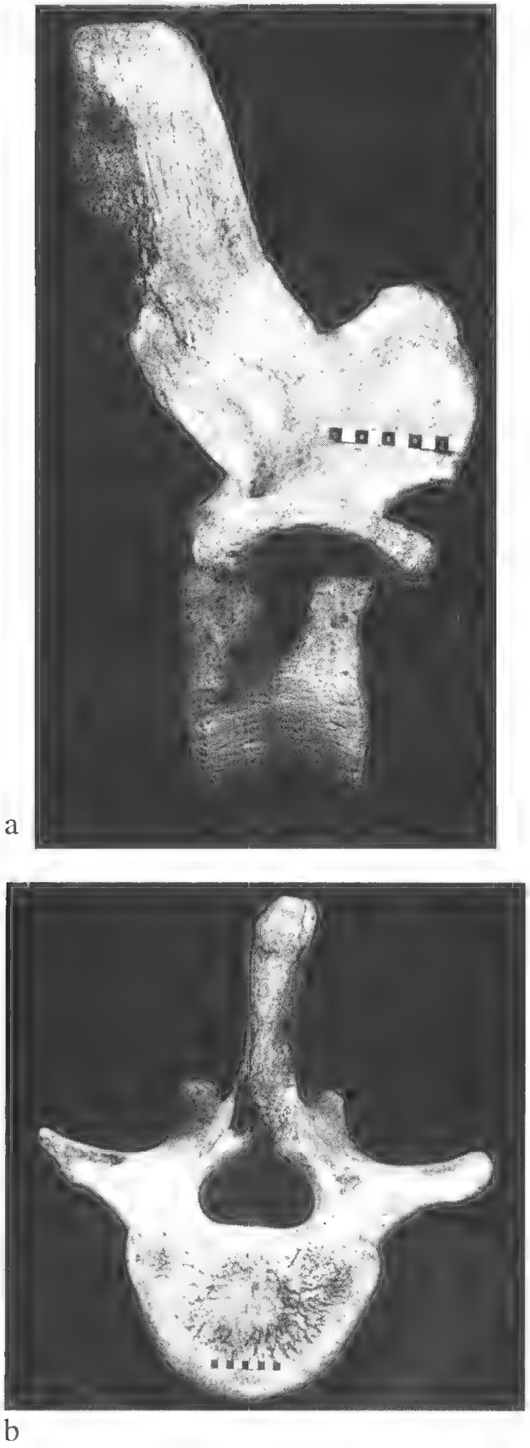

FIGURE 9. Right lateral (a) and posterior views (b) of mid-thoracic vertebra (W2-4) of *E. australis*. Black and white scale bar is cm. Photo: Trevor Peters.

one mass, a feature of Balaenidae and the very much smaller Neobalaenidae. In the Fowler Bay specimen the first thoracic vertebra was also fused to the cervical mass, suggesting it could have been from an old animal. The thoracic vertebrae had sub-triangular centra when viewed from front or back and the distal ends of their transverse processes were positioned well above the centra (Fig. 9). The prezygapophyses of the lumbar vertebrae projected quite far anteriorly and the transverse processes were narrow anteroposteriorly and thick dorsoventrally. The caudal vertebrae were almost round in cross-section and the neural spine of the mid-caudals had a rounded profile and remained the most obvious feature on the dorsal surface, relative to the prezygapophyses (Fig. 10).

The proximal end of the anterior ribs (ribs 1 and 2 were not found) had a tapered capitulum, a weakly developed tuberculum and an elongate collum. A deep depression was present on the anterior face of the proximal end of the anterior ribs (Fig. 11). The two excavated chevrons (Fig. 12) were comparable in size and shape with the ninth or tenth chevron of the 17 m *E. glacialis* studied by Omura *et al.* (1969). The almost-complete sternum was simple in outline (Fig. 13) and lacked the lateral 'wings' found in some balaenopterids. It was roughly similar in shape to the *E. glacialis* illustrated in Omura *et al.* (1969).

Size, relative age and number of individuals

The body lengths of the *E. australis* from Fowler Bay were estimated by comparing estimated maximum skull widths with those of known-length *Eubalaena* spp. using the same statistical procedures described in Kemper and Leppard (1999) for the pygmy right whale, *Caperea marginata* (Tables 1, 2). The resulting estimated body lengths of the five animals were in the order of 15 to 18 m.

The one almost-complete mandible, measured in situ, was at least 340 cm long. Compared with the mandible length of a 12.6 m female *E. glacialis* (318 cm) and 15.2 m male (446 cm) (Omura *et al.* 1969), the Fowler Bay specimen would have been at least 13 m body length.

The surface of the only bulla found was rugose (Fig. 7), suggesting that it was from an old animal. It was somewhat smaller (maximum length = 14.0 cm) than the bulla of the 11.5 m specimen at the South Australian Museum (M14135 maximum bulla length = 15.3 cm) but this could in part have

TABLE 1. Prediction statistics for estimating body length from measurements of maxmum skull width of 15 known-length *Eubalaena* spp.

Maximum Skull Width (cm)	Mean Predicted Body Length (m)	Lower Predicted Body Length (m)	Upper Predicted Body Length (m)
50	6.58	5.72	7.45
100	7.97	7.01	8.94
150	9.75	8.68	10.81
200	11.93	10.74	13.13
250	14.39	13.06	15.73
300	16.52	15.12	17.92

TABLE 2: Estimated skull widths and body lengths of *Eubalaena australis* from Fowler Bay, SA. Specimen numbers cross-referenced to Appendix 1.

Specimen No.	Available Width (cm)	Proportion Available	Estimated Skull Width (cm)	Estimated Body Length (m)
W1-8	205	73%	280	15–17
W2-11	202	58%	290	15–17
W57-1	240	75%	324	16–18
W62	200	60%	290	15–17
W68	214	67%	285	15–17

FIGURE 10. Anterior view of *E. australis* mid-caudal vertebra (W2-35). Dark areas are charred bone. Black and white scale bar is cm. Photo: Trevor Peters.

been because the Fowler Bay specimen was quite weathered. The *E. australis* bullae listed by Dixon (1990) had maximum lengths of 14.1 to 16.9 cm. Bulla size has limited use as a predictor of body length of baleen whales (Kemper and Leppard 1999).

All of the excavated postcranial bones were large and well formed, and were therefore not from calves or young subadults. Of the 36 vertebrae, 24 had fused epiphyses and were therefore from animals having reached or approaching physical maturity. Of the 24 vertebrae with fused epiphyses, 11 were thoracic and therefore from physically mature animals. The vertebrae with unfused epiphyses were all large and appeared to be from

TABLE 3: Centrum widths (cm) of two known-length *Eubalaena glacialis* (Omura *et al.* 1971) compared with those of Fowler Bay vertebrae. Centrum widths of known-length animals are means of the full series for each skeleton. n = number of vertebrae.

Vertebral region	15.2 m male	12.6 m female	Fowler Bay
Anterior thoracic	29	26	24–32 (n = 6)
Posterior thoracic	32	29	28 (n = 2)
Lumbar	35	30	25–30 (n = 3)

FIGURE 11. Proximal ends of anterior ribs (W1-6, W1-7) in situ. Scale bar is marked in 10 cm and 1 cm units. Photo: C. Kemper.

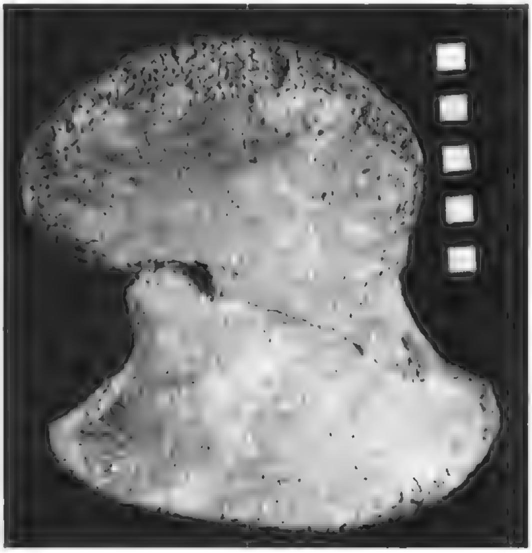

FIGURE 12. Left lateral view of *E. australis* chevron (W1-30). Black and white scale bar is cm. Photo: Trevor Peters.

animals that were at least 12 m body length (Table 3). The 11 complete or almost-complete ribs measured 104–210 cm in length. Anterior ribs measured 174 to >203 cm and were roughly comparable to the lengths of the anterior ribs (193–237 cm, excluding the first rib) of the 17 m *E. glacialis* studied by Omura *et al.* (1969).

The number of individual whales found in the remains was determined by counting the skulls: five excavated and positively identified as *E. australis*, one excavated and probably *E. australis* and four not excavated and possibly *E. australis*. The minimum number is therefore six, possibly 10, individual right whales.

DISCUSSION

An estimate of the number of right whales taken by local bay whaling operations in Western Australian coastal waters in the period 1836–1878 was made by Bannister (1986), while Dawbin (1986) compiled a total for southeastern Australian coastal waters and New Zealand, taken

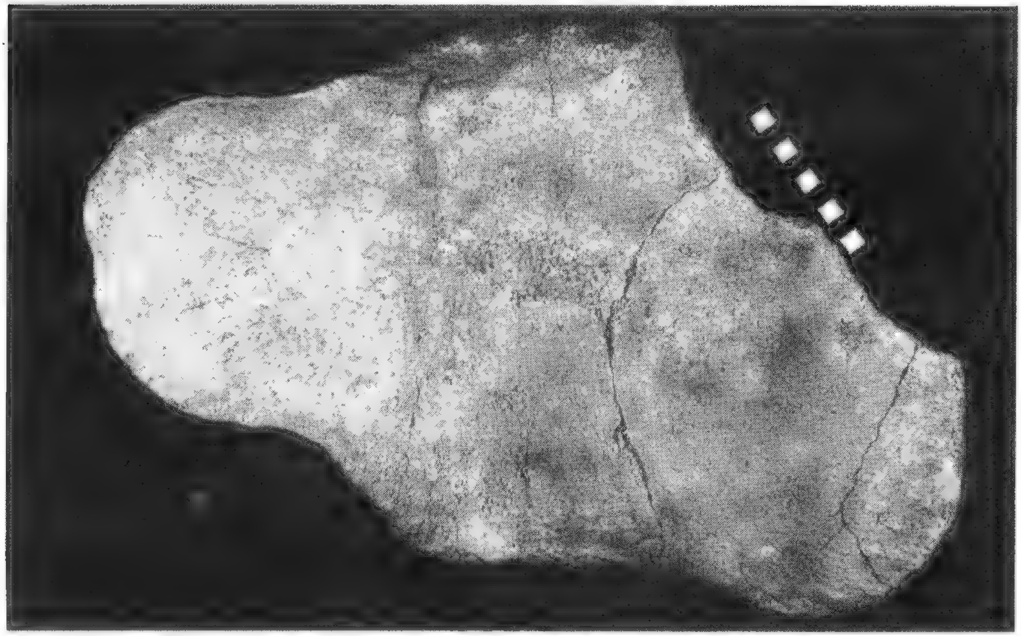

FIGURE 13. Ventral view of probable *E. australis* sternum (W3-11). Black and white scale bar is cm. Photo: Trevor Peters.

by both local and pelagic whalers. At least 13 000 right whales were taken from coastal waters of Victoria, New South Wales, Tasmania and South Australia, three quarters during the decade 1835–1844 (Dawbin 1986). The total for South Australia was 379 and all were from east of Port Lincoln. Bannister (1986) totalled at least 266 for southwestern Australia during 1836–1866. In addition, he noted a number of pelagic bay whaling catches, including that of the 'Amazon', which caught 33 right whales (including 13 calves) and 8 humpbacks (including 3 calves) in 80 days between 10 June and 28 August 1840. The other ship logs listed by Bannister (1986) are all too far south or west to have been in the Fowler Bay area. Sexton (1990) noted that another American whaling ship, 'Martha', was in Fowler Bay during the winter of 1840 but no records are available of the number of whales caught or the barrels of oil it carried when it visited Port Lincoln on 22 September.

Other vessels must certainly have caught whales in the area, some probably at Fowler Bay itself. Parsons (1981) reported that during 1840 four French and one American whaler 'fished' between Port Lincoln and Fowler Bay, and in 1841 six foreign whalers were in the same region. In 1843 and 1844, Copping (State Library of Tasmania reference CRO.Q.639.22, in Jones and Staniforth 1996) recalls taking about 70 and 90 'tons' of oil, respectively, at 'Fowlers Bay' on the Tasmanian ship, 'Grecian'. In the early 19th century whale oil was usually measured in tuns or barrels (volume measurements) but it could also have been measured in tons (weight measurement). We have assumed that Copping's reminiscences really meant 'tuns'. The conversion for tuns of oil to whale individuals used by Bannister (1986) and Dawbin (1986) was 5 tuns per whale. Assuming that it was right whales that were being taken and that most were adults, the catches made by the 'Grecian' during 1843 and 1844 were therefore about 14 and 18 whales, respectively. This brings the minimum total catches for right whales at Fowler Bay to at least 65 animals during 1840–1844. It is likely that the true number taken there was much higher.

The period of whaling at Fowler Bay was probably very short-lived, with its height during 1840–1844, as it was elsewhere (Dawbin 1986, Bannister 1986). Recent surveys of southern right whales in the Great Australian Bight have shown that animals are now rare at Fowler Bay. On annual survey flights in the period 1993–98, the only animals recorded in Fowler Bay have been two cow-calf pairs in 1993 and five adults in 1997 (J. Bannister, pers. comm. 1998). This is in contrast to the Head of Bight, 150 km to the west, where 179 individual adult (i.e. non-calf) whales have been recorded during shore-based studies from 1991 to 1994 (Burnell and Bryden 1997). Since Fowler Bay was a good anchorage for whaling ships, many more whales may have been taken there than at Head of Bight, where it would have been unsafe to anchor during foul weather. Southern right whales have an approximately 3 year calving cycle and adult females return to the coast at least once during that time to give birth (Bannister 1990, Best 1990). If fidelity to calving site is a feature of the life history of this species, it could have taken less than 10 years to decimate this important pre-European calving or nursery site.

The log of the 'Amazon' recorded 13 calves yet no bones of calves were found in our sample of 69 identifiable bones. The skeleton of a calf whale is not fully developed, is fragile and the bones of the skull are not fully fused. Wave action and exposure to ultraviolet rays could have easily weathered the bones to such a degree that they would not remain intact over the intervening 150 years. If the bones of calves are still present they may be in the deeper silts of the spit that has built up on the northeastern side of the peninsula since last century or on the sea floor. However, a cursory search by snorkelling in sediment-filled water at the edge of the spit found no bones during our study in 1994. Cumbaa (1986) found many submerged and well-preserved bones of *E. glacialis* and bowhead whales *Balaena mysticetus* at a Basque whaling site in Labrador 400 years after the animals had been taken. Only one animal in the <1 year age group (and one possible foetus) was found in Cumbaa's sample of 17 individuals but this low proportion is to be expected since Labrador was unlikely to have been a calving ground for *B. mysticetus* (Burns, Montague and Cowles 1993).

Estimating body length from maximum skull width has been used by researchers of bowhead whale hunt remains in the Canadian Arctic (Savelle and McCartney 1994) and to predict body length of stranded *C. marginata* (Kemper and Leppard 1999). In our study of *E. australis* remains at Fowler Bay the predicted body lengths were considered rough approximations because two sources of error were likely. The skull measurements of known-length animals were obtained from a variety of publications which did not illustrate the points of measurement and we had to estimate skull width itself due to the incompleteness of the skulls.

Maximum body length of *E. australis* is 17.5 m (Bannister, Kemper and Warneke 1996) and recent estimates of live adults off South Africa are 12.4–15.5 m (Best and Ruther 1992). Physical maturity, when all vertebrae have fused epiphyses and body length is maximum, occurs at about 16 m and sexual maturity at 12–13 m (Bannister *et al.* 1996). Body lengths of five Fowler Bay animals were estimated (from skull measurements) at 15–18 m and most of the postcranial bones were from large and/or physically mature animals. Their size suggests that they were also sexually mature. The fact that the bones of no obvious yearlings or subadults (i.e. about 8–12 m) were located suggests that these were not common in the deposit, although a much larger sample of bones would be required to confirm this. The log of the 'Amazon' reported that 13 of the 33 right whales taken were calves (Bannister 1986). Assuming that at least an equal number of adult females were taken (i.e. the mothers of the calves), this leaves seven animals that could have been adults or subadults.

There are no confirmed records of the existence of a shore-based whaling station at Fowler Bay (Kostoglou and McCarthy 1991). During the present study no concrete archaeological evidence of a shore-based operation was found, although the presence of an extensive rock platform under the bones suggested that it would have been a suitable site for one (Jones and Staniforth 1996). However, a shore-based operation would not have had any advantage over flensing the animals by the side of the whale ship and boiling the blubber on deck as they would if the ship were out to sea. There may even have been disadvantages on shore in that the southwestern part of the bay was very shallow (Fig. 1).

When Eyre (1845:227) visited Fowler Bay in 1840 he noted that whale bones and carcasses 'were strewed in all directions' on the beach. Without a thorough search of the whole shore and bay, including under water, we do not know whether our study site was extraordinarily dense in bones compared with the rest of the bay. It may have been that the bones simply persisted there for longer because they were protected from the prevailing southwesterlies, and because they were covered by sand and silt blown from the peninsula to the south and deposited in this low energy section of the bay (Short *et al.* 1986). The excavated skulls and many of the other bones were broken, worn and disarticulated, and there were large cobbles amongst them. This suggests that the skeletons experienced strong wave action at some time after the carcasses disintegrated, probably during easterly or southeasterly storms. Coarse material, suggesting that it had been deposited during storms, was found in the lower stratigraphic layers at the excavated sites (Jones and Staniforth 1996). If the study site was the densest accumulation of bones, there are two explanations for it being in the southwesterly part of the bay. 1) Whalers processed animals on the extensive rock platform there (not found elsewhere in the bay) and/or 2) the ships often anchored just to the east of our study area. Here the water depth would have been >4 fathoms (about 7 m), possibly deep enough for a whaling barque of up to 300 tons and drawing about 15–20 feet of water (4.5–5.5 m, Church 1938), and it would have been relatively close to shore. This position would have provided the most protection during the prevailing winter south and southwesterly winds (Bannister, pers. comm.). Wave refraction around Point Fowler (Short *et al.* 1986) could have deposited carcasses and/or bones, and subsequently silt and sand, where our study site was.

If future studies of the whale bones at Fowler Bay are carried out they should include submarine searches for bone and archaeological material. This may provide better information on the number of animals taken and the proportions of different whale age classes, as well as evidence of either shore- or ship-based whaling.

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National Parks and Wildlife South Australia gave permission to conduct the study in the reserve and put up the information sign which now stands at the site.

Phillip Leppard ran the statistics for estimating whale body length. Richard Sabin kindly measured a *E. australis* skull in the Natural History Museum (London). Trevor Peters took the photos of the collected bones and Jennifer Thurmer provided advice on the line drawings.

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APPENDIX 1. Details of excavated bones at the Fowler Bay site. Reliability of identification; 1 = *E. australis* with certainty, 2 = *E. australis* probable, 3 = unknown large whale species. Measurements; L = length, W = width, H = height, CW = maximum centrum width, CH = maximum centrum height, TPW = distance between the extremities of the transverse processes, TH = height of the vertebra from the ventral side of the centrum to the dorsal extremity of the neural spine, WBPF = width between pterygoid fossae, GW = maximum available width of skull, SOW = supraoccipital width, bulla L = maximum length of bulla, rib length = maximum length in a straight line from end to end, chevron length = length of dorsal articulating surface. ( ) = measured from photographs. * = collected for SA Museum.

Bone Type	Species	Measurements (cm)	Specimen Number
Site W1			
cranium	1	GW>205, SOW = 70	W1-8
left periotic*	1		W1-26
left periotic*	1		W1-27
right bulla and periotic*	1	bulla L = 13.4, max. L = 14.0	W1-28
unknown part of skull	3	L =45, W = 15	W1-5
possible part mandible	3		W1-15
single-headed, posterior rib	2	L = 185, W = 10	W1-1
single-headed, posterior rib	2	L = 210, W = 16	W1-2
double-headed, anterior rib	3	L = 185, W = 10	W1-3
part anterior rib	2		W1-4
double-headed, anterior rib	2	L = 174, W = 12	W1-6
double-headed, anterior rib	2	L = 207, W = 13	W1-7
possible posterior rib	3	L >104, W = 5	W1-10
part rib	3		W1-9
mid-thoracic vertebra, epiphyses fused*	1	CW = 35, TPW = 33x2	W1-11
anterior thoracic vertebra, no epiphyses*	1	CW = 24, CH = 19, TPW = 47, TH = 49	W1-14
anterior thoracic vertebra, epiphyses fused*	1	CW = 26, CH = 23, TH = 63	W1-18
anterior thoracic vertebra, epiphyses free	1	CW = 25, CH = 21, TPW = 49	W1-22
posterior lumbar vertebra, epiphyses free*	1	CW = 25, CH = 22, TPW = 69	W1-16
mid-lumbar vertebra, epiphyses fused	1	CW = 29, CH = 25, TPW = ~88	W1-19
mid-lumbar vertebra, epiphyses fused*	1	CW = 33, CH >23	W1-20
anterior caudal vertebra, epiphyses fused	1	CW = 34, CH = 32, TPW >66	W1-17
anterior caudal vertebra, epiphyses fused ?	1	CW = 30, CH = 31	W1-29
caudal vertebral epiphysis	3	–	W1-13
transverse process of vertebra	2	L = 35	W1-21
chevron*	1	H = 19.4, ventral L = 15.6	W1-30
possible rib or premaxilla	3		W1-23
unknown mass of bone	3		W1-12
bone fragments	3		W1-24
Site W2			
cranium	1	GW >202, WBPF = 56	W2-11
pterygoid fossae of skull*	1		W2-6
posterior tip of maxilla*	1	W = 15	W2-42
distal tip of frontal*	1	~50	W2-43
possible part of skull	3		W2-38
possible part mandible	3	W >22, L>110	W2-13
possible part mandible	3	W ~ 28	W2-15
possible part mandible	3	L >146, W >33	W2-27
double-headed, anterior rib	1	L = 193, W = 12	W2-8
double-headed anterior rib	1	L = 190, W = 14	W2-10
posterior rib	2	L = 173, W = 12	W2-12
double-headed, anterior rib*	1	L >200	W2-23
possible anterior rib	2	L >203	W2-26

Bone Type	Species	Measurements (cm)	Specimen Number
part rib	3		W2-32
possible part rib	3		W2-5
part rib	3	L >78	W2-25
anterior thoracic vertebra, epiphyses free*	1	CW = 32, CH = 23, TPW = 60, TH = 64	W2-4
anterior thoracic vertebra, epiphyses fused*	1	CW = 29, CH = 21, TPW = 45	W2-14
anterior thoracic vertebra, epiphyses free?	1	CW = 29, CH = 23	W2-22
anterior thoracic vertebra, epiphyses fused*	1	CW = 28, CH = 19, TPW = 52	W2-29
mid-thoracic vertebra, epiphyses fused	1	CW = 27, CH = 23, TPW = 40x2	W2-30
thoracic vertebra, epiphysis free	1	CW = 28, CH ~26	W2-33
mid-thoracic vertebra, epiphyses fused	1	CW = 28, CH = 22	W2-34
anterior thoracic vertebra, epiphyses fused	1	CW = 27	W2-36
anterior thoracic vertebra, epiphyses fused	1	CW = 26, CH = 21, TPW = 28x2	W2-37
anterior thoracic vertebra, epiphyses free	1	CW = 27, CH = 23	W2-44
posterior lumbar vertebra, epiphyses fused	1	CW = 34, CH = 32	W2-2
mid-lumbar vertebra, epiphyses fused	1	CW = 34, CH = 21, TPW = 45	W2-16
mid-lumbar vertebra, epiphyses free	1	CW = 30, CH = 27, TPW >86	W2-20
mid-lumbar vertebra, epiphyses fused	1	CW = 32, CH = 31, TPW = 44x2	W2-28
lumbar vertebra, epiphyses free	1	CW = 28, CH ~25	W2-39
possible lumbar vertebra, epiphyses fused?	2	CW ~30, CH ~32	W2-17
posterior caudal vertebra, epiphyses fused*	1	CW = 31, CH = 32	W2-19
mid-caudal vertebra, epiphyses free?*	2	CW = 33, CH = 33	W2-35
posterior caudal vertebra, epiphyses free*	1	CW = 28, CH = 30	W2-40
caudal vertebral epiphysis*	3	diameter = 31	W2-1
thoracic or lumbar vertebral epiphysis*	3	W = 29	W2-9
vertebral epiphysis*	3	W = 24, H = 18	W2-21
transverse process of vertebra ?	3		W2-31
neural spine of vertebra*	2		W2-18
transverse process of vertebra	2		W2-7
possible neural spine of vertebra	3		W2-3
chevron*	1	H = 19, L = 4	W2-45
unknown	3		W2-41
unknown	3		W2-24
Site W3			
part cranium (occipital condyle, part squamosal)	2		W3-3
part of frontal bone of skull	1	W = 24	W3-2
part rib	3	W =12	W3-10
rib fragment	3	W = 8	W3-13
rib? fragment	3		W3-14
distal part of rib	3	W = 11	W3-5
anterior thoracic vertebra, epiphyses free	1	CW = 24, CH = 20, TPW = 23x2	W3-1
thoracic vertebra, epiphysis fused	2	CH = 23	W3-7
part thoracic vertebra	3		W3-12
transverse process of thoracic or lumbar vertebra	2	L = 28	W3-4
caudal vertebral epiphysis	3	diameter = 29	W3-9
sternum*	2	L = 45, W = 29	W3-11
unknown	3		W3-6
unknown	3		W3-8
Site W54			
possible part mandible	3		W54-4
proximal fragment of rib	2		W54-3
lumbar vertebra, epiphyses fused	1	CW = 31, CH = 29, TPW = 44x2, TH = 75	W54-1
posterior caudal vertebra, epiphyses fused	2	diameter = 31	W54-2

Bone Type	Species	Measurements (cm)	Specimen Number
Site W57			
cranium	1	(GW >240)	W57-1
left mandible	1	L >340	W57-2
double-headed, anterior rib	1	L >153	W57-3
mid-thoracic vertebra, epiphyses fused	1	CW = 24, CH = 22, TPW = 28x2	W57-5
lumbar vertebra, epiphyses fused	1	CW = 42, CH = 26, TH = 80	W57-4
unknown	3		W57-6
unknown	3		W57-7
unknown	3		W57-8
Site W62			
cranium	1	(GW >200)	W62
Site W66			
cervical vertebrae*	1	max. H ~ 45, max. W ~ 74	W66-1
posterior thoracic vertebra, epiphyses fused	1	(CW = 28, CH = 26)	W66-2
Site W68			
cranium	1	(GW >214)	W68

GENETIC VARIATION AND TAXONOMY OF THE LIZARDS ASSIGNED TO CTENOTUS UBER ORIENTALIS (SQUAMATA : SCINCIDAE) WITH DESCRIPTION OF A NEW SPECIES

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Summary

Analysis of allozyme and morphological variation reveals that at least two scincid lizard species are presently confused under the trinomial Ctenotus uber orientalis. The status of orientalis is reassessed here with its elevation to a full species, while a new species is described from central South Australia, extending narrowly into adjacent areas of the Northern Territory, New South Wales and Queensland. This study reveals that significant genetic divergence has occurred within and between species groups of the large genus Ctenotus.

GENETIC VARIATION AND TAXONOMY OF THE LIZARDS ASSIGNED TO *CTENOTUS UBER ORIENTALIS* STORR (SQUAMATA: SCINCIDAE) WITH DESCRIPTION OF A NEW SPECIES

MARK N. HUTCHINSON & STEPHEN C. DONNELLAN

MARK N. HUTCHINSON & STEPHEN C. DONNELLAN 1999. Genetic variation and taxonomy of the lizards assigned to *Ctenotus uber orientalis* Storr (Squamata: Scincidae) with description of a new species. *Records of the South Australian Museum* **32**(2): 173–189.

Analysis of allozyme and morphological variation reveals that at least two scincid lizard species are presently confused under the trinomial *Ctenotus uber orientalis*. The status of *orientalis* is reassessed here with its elevation to a full species, while a new species is described from central South Australia, extending narrowly into adjacent areas of the Northern Territory, New South Wales and Queensland. This study reveals that significant genetic divergence has occurred within and between species groups of the large genus *Ctenotus*.

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Storr (1969) described *Ctenotus uber* from Western Australia as part of his initial taxonomic review of *Ctenotus*, Australia's largest genus of terrestrial vertebrates. In 1971 he described an eastern subspecies, *C. u. orientalis*, the only form recognised east of Western Australia. A third taxon, *C. u. johnstonei* was later described from northern Western Australia (Storr 1980). These taxa are all members of the *Ctenotus leonhardii* species group, one of several defined by Storr (1970, Storr *et al.* 1981, King *et al.* 1988) to aid identification. The phylogenetic relationships within and between Storr's species groups are yet to be studied.

There is considerable morphological variation in populations assigned to both of the widespread subspecies, *C. u. uber* and *C. u. orientalis*. The latter subspecies includes blackish, heavily spotted lizards, mostly distributed in the semi-arid to dry temperate woodlands of southern South Australia, Victoria and southern New South Wales, as well as populations of much plainer animals which inhabit arid chenopod and gibber habitats in the Lake Eyre basin through eastern South Australia to western New South Wales. Such apparent ecological and morphological plasticity is unusual in a single species and prompted us to question whether one or more cryptic species might be included within *C. u. orientalis* (Donnellan *et al.* 1993). It also led us to revisit the taxonomy of *orientalis* with respect to *uber*.

MATERIALS AND METHODS

We followed Storr (1969 *et seq.*), Greer (1982), King *et al.* (1988) and Hutchinson and Rawlinson (1995) in defining and describing morphological characters, such as scalation and proportions. Specimens examined were from the collections of the South Australian Museum, Adelaide (SAMA) and Western Australian Museum, Perth (WAM), and eastern Australian specimens in the Australian Museum, Sydney (AMS) and the Museum of Victoria, Melbourne (NMV).

Thirty-one specimens of South Australian *C. u. orientalis* were analysed for electrophoretic variation. These encompassed all of the morphological variation known and represented a wide geographical sampling. In order to assess the significance of any variation found, we also typed samples of three other morphologically similar South Australian species of *Ctenotus*—*C. leonhardii*, *C. regius* and *C. septenarius* (members of the *C. leonhardii* species group, Storr 1970). The morphologically distinct *Ctenotus strauchii varius* (*C. colletti* species group) was included as a more distant outgroup.

Our methods for allozyme electrophoresis using cellulose acetate gels ('Cellogel', Chemtron, Milan) follow Richardson *et al.* (1986). We scored the protein and enzyme products of 42 presumed loci for patterns of allelic variation. The proteins that were stained, abbreviations used and their Enzyme Commission numbers (International

Union of Biochemistry 1984) were: aspartate aminotransferase (AAT, EC 2.6.1.1), aconitate hydratase (ACOH, EC 4.2.1.3), acid phosphatase (ACP, EC 3.1.3.2), aminoacyclase (ACYC, EC 3.5.1.14), alcohol dehydrogenase (ADH, EC 1.1.1.1), albumen (ALB), carbonate dehydratase (CA, EC 4.2.1.1), diaphorase (DIA, EC 1.6.99.?), enolase (ENO, EC 4.2.1.11), esterase (EST, EC 3.1.1.?), fructose-bisphosphatase (FBP, EC 3.1.3.11), fumarate hydratase (FUMH, EC 4.2.1.2), glyceraldehyde-3-phosphate dehydrogenase (GAPDH, EC 1.2.1.12), glycerol-3-phosphate dehydrogenase (G3PDH, EC 1.1.1.8), glucose-6-phosphate dehydrogenase (G6PDH, EC 1.1.1.49), glucose-6-phosphate isomerase (GPI, EC 5.3.1.9), glutamate dehydrogenase (GTDH, EC 1.4.1.3), 3-hydroxybutyrate dehydrogenase (HBDH, EC 1.1.1.30), L-iditol dehydrogenase (IDDH, EC 1.1.1.14), isocitrate dehydrogenase (IDH, EC 1.1.1.42), cytosol aminopeptidase (LAP, EC 3.4.11.1), L-lactate dehydrogenase (LDH, EC 1.1.1.27), lactoylglutathione lyase (LGL, EC 4.4.1.5), malate dehydrogenase (MDH, EC 1.1.1.37), mannose-6-phosphate isomerase (MPI, EC 5.3.1.8), dipeptidase (PEP-A, EC 3.4.13.?), tripeptide aminopeptidase (PEP-B, EC 3.4.11.?), dipeptidase (PEP-C, EC 3.4.13.?), proline dipeptidase (PEP-D, EC 3.4.13.?), phosphoglycerate mutase (PGAM, EC 5.4.2.1), phosphogluconate dehydrogenase (PGDH, EC 1.1.1.44), phosphoglycerate kinase (PGK, EC 2.7.2.3), phosphoglucomutase (PGM, EC 5.4.2.2), purine-nucleoside phosphorylase (PNP, EC 2.4.2.1), superoxide dismutase (SOD, EC 1.15.1.1), and triose-phosphate isomerase (TPI, EC 5.3.1.1).

We based our initial analysis of the allozyme data on the null hypothesis that all samples stemming from a single panmictic species, which predicts genotype frequencies will conform to Hardy-Weinberg expectations. We examined multi-locus genotypes of individual skinks from a single locality for the Wahlund effect, a deficiency of heterozygotes from that predicted under Hardy-Weinberg expectations due to a sample with two or more genetically differentiated populations. The presence of two or more species in sympatry is often evident from the presence of fixed allelic differences at one or more loci where the genotypic classes are concordant among individuals (see Richardson *et al.* [1986] for a more detailed explanation). When we observed evidence of departure from Hardy-Weinberg expectations at one or more loci, individuals classified according to these multi-locus genotypes were treated as a population. Where no evidence of departure from Hardy-Weinberg expectations was observed, we treated all of the individuals at each of these locations as a population. Given our null hypothesis, this meant that in some cases we pooled distinct locations in the absence of genetic differentiation between the samples. We expressed phenetic diversity among populations using the Unweighted Pair-Group (UPGMA, Sneath & Sokal 1973) method. We also made a preliminary assessment of the phylogenetic relationships of the populations studied using the Fitch-Margoliash method (Fitch & Margoliash 1967), based on Rogers' D, and a parsimony analysis, scoring the electromorphs using the method of Georges and Adams (1992). Software used for the analysis were the FITCH algorithm from Felsenstein's PHYLIP package, with input order randomised using the SHUFFL routine (25 passes), and the heuristic parsimony algorithm of Swofford's PAUP*.

RESULTS

The allozyme data identified 15 genotypic populations from among the specimens identified as *C. u. orientalis*, with 10 additional populations identified among the outgroup species (Table 1). Figure 1 shows the UPGMA phenogram of the percentage fixed allelic differences between populations, while Fig. 2 shows a phylogenetic hypothesis for these populations based on the Fitch-Margoliash tree. The parsimony analysis produced the same topology.

The populations of *C. u. orientalis* fell into one of three clusters. Most belonged to two groups, one primarily southern and one primarily central, separated by a minimum of three fixed allelic differences at the *Adh, Dia* and *Pep-A* loci. A third group, is represented by the single specimen from Arrabury, Queensland which has a minimum of three fixed (or almost fixed) allelic differences at the *Acoh*, *Pep-B* and *Sod-1* loci compared with the other two groups. Our sampling is not adequate to examine geographic patterns of variation within each cluster but the presence of some within-group allelic variation suggests that future, more detailed sampling would yield useful information.

Ctenotus leonhardii, *C. regius,* and *C. septenarius*, also members of the *C. leonhardii* species group, were distinct from the three *C. u. orientalis* groups and from *C. strauchii varius.* Interspecific levels of genetic divergence within the *C. leonhardii* group ranged from an average

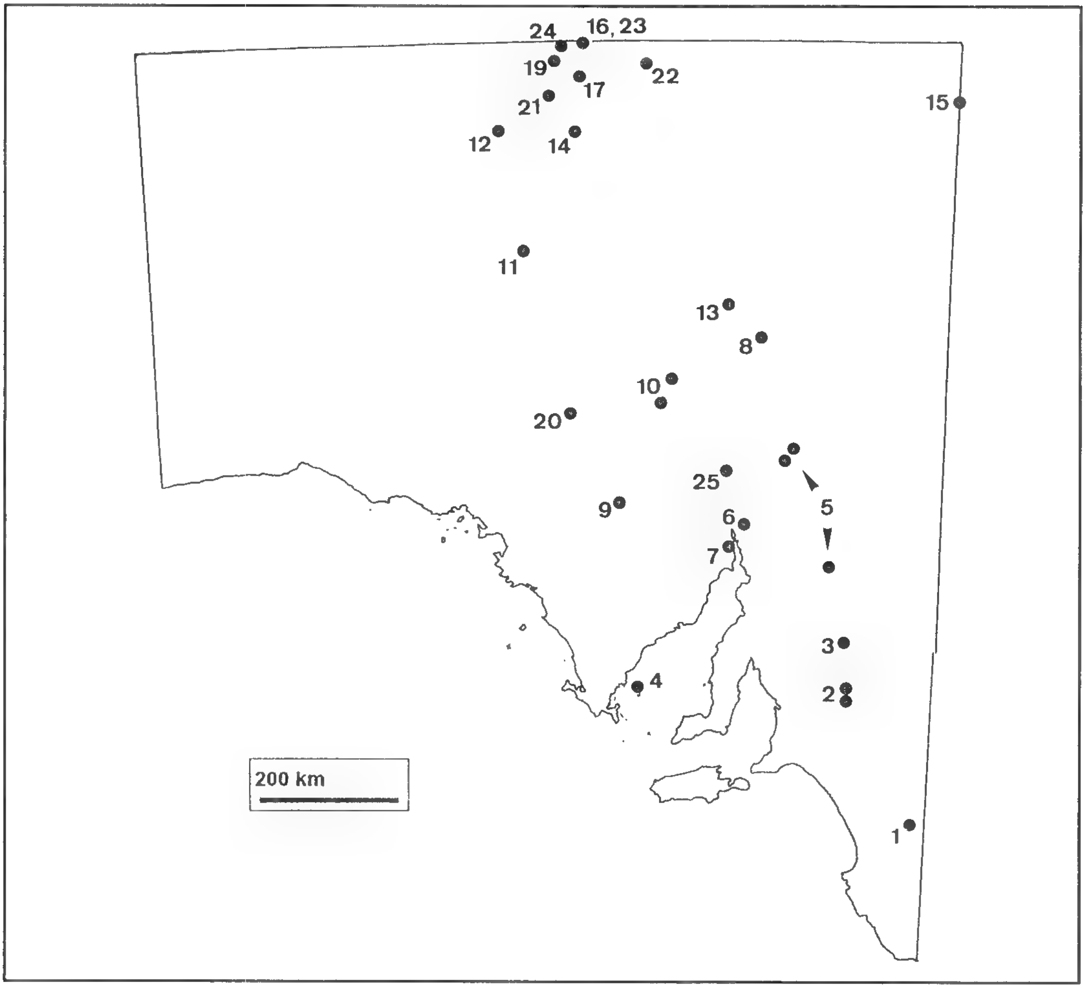

FIGURE 1. Map of South Australia showing the geographic origin of the populations sampled for allozyme data. See appendix for details of localities and specimens.

of 9% fixed differences between 'southern' and 'central' *C. u. orientalis* to 20% between *C. leonhardii* and the other species group members. As expected, *C. s. varius* was the most divergent taxon, with an average of 34% fixed allelic differences compared with any member of the *C. leonhardii* species group.

The three genetic groups within *C. u. orientalis* can be distinguished morphologically. The 'southern' group is identical to the holotype of *C. u. orientalis*. The pale dorsolateral stripe is prominent and continuous, the black laterodorsal stripes have straight medial edges and completely enclose single series of pale dots or short dashes and there is always a light-edged, black vertebral stripe. The lateral pattern consists of two to four series of small white dots, bordered below by a white midlateral stripe which is continuous posteriorly but which normally breaks up well before reaching the axilla.

The 'central' group has variable development of a light dorsolateral stripe and the black laterodorsal stripes are absent or ragged-edged medially; if a laterodorsal series of pale dots is present, the spots are not completely surrounded by blackish background colour, but contact the light laterodorsal region. The dorsum is usually metallic medium brown with a black vertebral stripe which lacks distinct pale edges. The lateral pattern is similar to that of the 'southern' group.

TABLE 1. Allele frequencies at 31 loci, expressed as a percentage, in 25 populations of *Ctenotus*. Alleles are designated alphabetically, with a being the most cathodally migrating allele. Where enzymes are encoded by more than one locus, the loci are designated numerically in order of increasing electrophoretic mobility. Where the allele frequencies are not given, the frequency is 100. The number of individuals sampled is indicated in parentheses. The following 11 loci were invariant: *Enol*, *Fdpase*, *Gapd*, *Gdh*, *Got-1*, *Gpi*, *Ldh-1*, *Mdh-1*, *Mpi*, *Np* and *Pgam*.

	Species 1						Species 2								Species 3	*septenarius*		*leonhardii*			*regius*			*strauchii*	
Locus	1 (1)	2 (5)	3 (1)	4 (5)	5 (3)	6 (1)	7 (1)	8 (1)	9 (4)	10 (4)	11 (1)	12 (1)	13 (1)	14 (1)	15 (1)	16 (5)	17 (1)	18 (1)	19 (2)	20 (1)	21 (2)	22 (1)	23 (1)	24 (3)	25 (1)
Acon	c	d(30) c(70)	c	d(30) c(70)	c	c	e(50) c(50)	c	c	d(50) c(50)	c	c	c	c	d	d(30) c(70)	c	d	d	d	b(25) a(75)	b(50) a(50)	c(50) b(50)	d(50) c(50)	c
Acp	b	b	b	b	b(83) a(17)	b	b	b	c(50) b(50)	b	b	b	b	b	b	b	b	b	c(25) b(75)	-	b	b	b	b	b
Acyc	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	-	a	a	a	b(17) a(83)	a
Adh	a	a	a	a	b(17) a(83)	a	c(50) b(50)	b	b	b	b	b	b	b	b	b	b	d(50) c(50)	d(50) c(50)	c	b	b	b	e(17) d(83)	d
Alb	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	a	a
Ca	a	b(10) a(90)	a	a	a	a	b(50) a(50)	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a
Dia	c	d(20) c(80)	c	c	c	c	b	b	b	b	b	b	b	b	c	a	a	b	b	b	b	b	b	e	f(50) e(50)
Est	b	b	b	b	b	b	b	b	b(75) a(25)	b(87) a(13)	b	b	b	b	b	c(10) b(90)	c(50) b(50)	b	c(25) b(75)	b	b	b	b	b	b
Fum	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	b	c
Glo	a	a	a	b(20) a(80)	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a
Got-2	a	a	a	a	b(17) a(83)	a	a	a	b(25) a(75)	a	a	a	a	a	b(50) a(50)	a	a	a	a	b(50) a(50)	a	a	a	a	a
G6pd	b	b(90) a(10)	b(50) a(50)	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b
Gpd	c	c(90) b(10)	c	c	c(83) b(17)	c	b	b	c(16) b(67) a(17)	c(12) b(88)	c(50) b(50)	c(50) b(50)	b	b	b	b	b	b	b	b	b	b	b	d(17) c(83)	c
Gpi	b	b	b	b	b	b	b	b(75) a(25)	b	b	b	b	b	b	b	b	b	b	b	b	b	b	a	a	a

Hbdh	b	d(10) b(90)	b	b	b	b	b(50) a(50)	b	b(87) a(13)	b	b	b	b	b	b	c	c	b	b	b	b	b	b	c	c
Idh-1	b	b	b	b(90) a(10)	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b
Idh-2	a	a	b(50) a(50)	a	a	a	a	a	a	a	a	a	a	a	a	b(20) a(80)	a	a	c(25) a(75)	a	a	a	a	a	a
Lap	a	a	a	a	a	a	a	a	b(25) a(75)	a	a	-	a	a	a	a	a	a	a	a	a	a	a	b	b
Ldh-2	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	b	b(50) a(50)	a	a	a	a	a	a
Mdh-2	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	c(20) b(80)	b	b	b	b	b	b	b	a	a
PepA	d	d	f(50) d(50)	d	e(17) d(83)	d(50) c(50)	c(50) b(50)	b	c(37) b(63)	c(62) b(38)	c(50) b(50)	b	c	b	b	b	b	b(50) a(50)	b	b	d(25) c(75)	c	c	c(17) b(83)	b
PepB	a	a	a	a	a	a	a	a	a	a	a	a	a	a	b	b	b	b	b	b	b	b	b	c(17) b(83)	b
PepC	c	c(40) b(60)	d(50) b(50)	c(40) b(60)	c(33) b(67)	b	b	b	b	c(12) b(88)	b	b	b	b	b	b	b	a	a	a	c(50) b(50)	b	b	c	c
PepD	d	d	d(50) c(50)	d	e(17) d(83)	d	d	d	d(87) c(13)	d	d	b	d	d(50) b(50)	b	a	a	e	f(75) e(25)	e	b	b	b	e(33) d(50) a(17)	d
6Pgd	d	d(70) c(30)	d	d	d	f(50) d(50)	d(50) c(50)	d	d	e(12) d(75) a(13)	d	d	d	d	d	d	d(50) b(50)	d	d	d	d	d(50) a(50)	d	f(17) d(83)	d
Pgk	a	a	a	a	a	a	b	b	b	a	a	a	b(50) a(50)	a	b	b	b	b	b	b	b	b	b	a	a
Pgm	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	b(17) a(83)	a
Sod-1	a	a	d(50) a(50)	a	a	a	a	a	a	a	a	a	a	a	c	b	b	c	c	c	c	c	c	a	a
Sod-2	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	b	b	b	a	a	a	a	a
Sordh	c	c(50) b(30) a(20)	c	c(20) b(30) a(50)	e(17) d(33) c(50)	c	c	d(50) c(50)	d(12) c(75) b(13)	h(12) f(50) d(25) c(13)	g	d	c	g	d	g(20) c(80)	g(50) c(50)	c	c	c	g	g	g	a	c(50) a(50)
Tpi	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	b	b	b	a	a

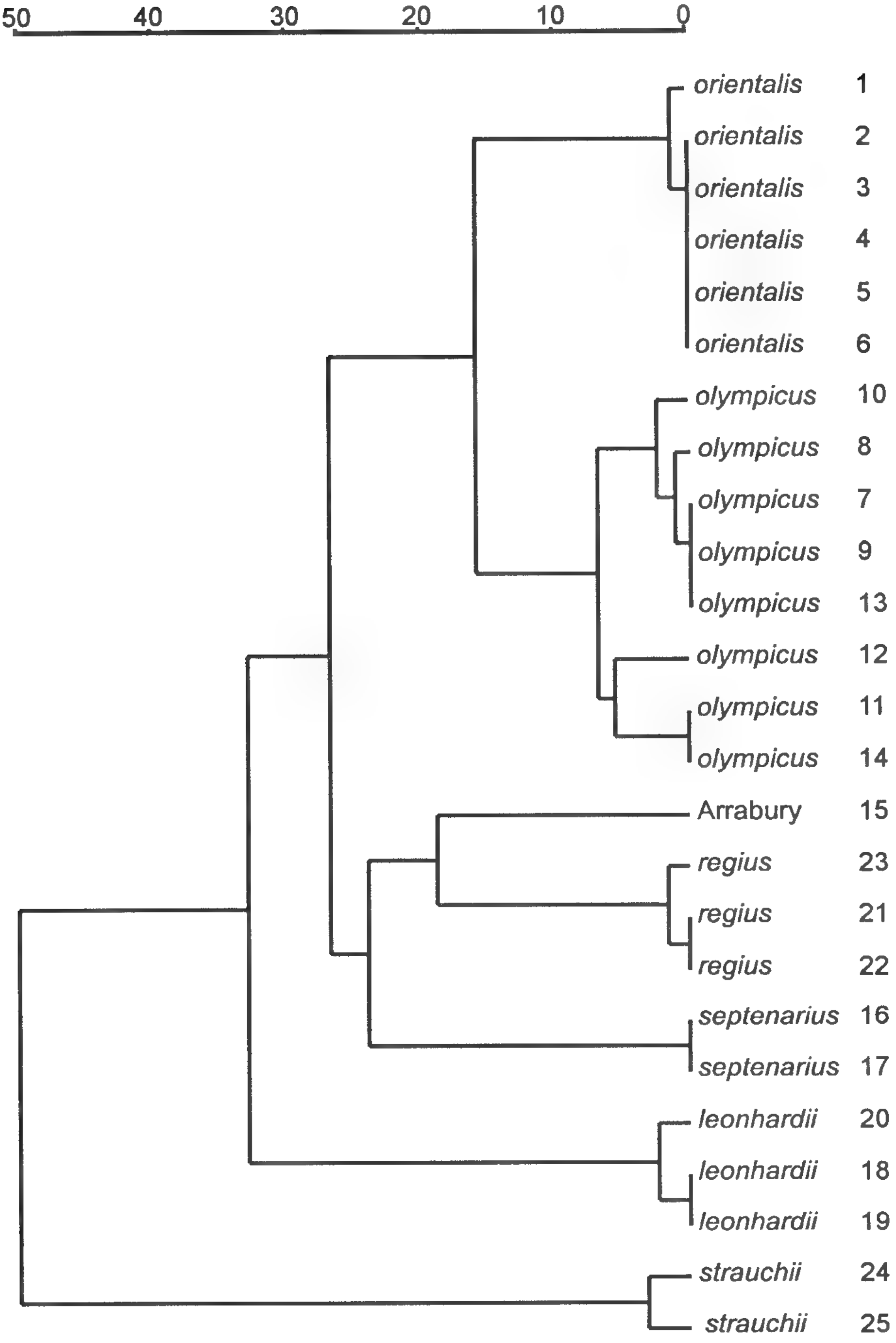

FIGURE 2. Phenogram of percentage fixed differences, constructed by UPGMA, for 25 populations of *Ctenotus* species.

The single specimen from Arrabury is heavily speckled dorsally and laterally, but with weakly contrasting dorsal stripes, the upper lateral and laterodorsal stripes being medium brown rather than blackish. The light dorsolateral stripe consists of dark-edged, light-centred scales and is indistinct due to the presence of other pale-centred scales which pattern the laterodorsal and upper lateral zones.

Two cases of syntopy are known, from the Flinders ranges (AMS R60053–54, 21 km S of Copley, P. Rankin & G. Husband, 22 January 1977) and the Olary Spur (SAMA R13156, R39266, near Oulnina homestead, R. Forsyth, 1 April 1972), and the distributions of the 'southern' and 'central' groups abut or overlap in the Gawler Ranges, Flinders Ranges and on the Olary Spur. There is no suggestion in the morphology or the allozyme data of clinal or other variation which might indicate genetic continuity between the two groups, while the groups maintain internal genetic uniformity over wide geographic ranges.

Typical *C. u. uber* was not available for electrophoretic comparisons, but it represents a fourth and highly distinctive morphological group, characterised by rufous rather than grey-brown dorsal colouring, different pattern details and longer tail (see also Storr 1971). *Ctenotus u. uber* itself encompasses considerable morphological variation. The ranges of *C. u. uber* and 'southern' group do not contact but no obviously intermediate specimens or populations are known. There seems to be no grounds for assuming, as Storr's taxonomy implied, that *uber* and *orientalis* are genetically continuous or even sister taxa.

At least three of the four taxa discussed here, *C. uber* and the 'southern' and 'central' groups of *C. u. orientalis* are species. The distinctive morphology, together with multiple concordant fixed allelic differences at allozyme loci (in the case of *C. u. orientalis*), and lack of intergradation indicate that reticulate evolution has ceased between populations of the different groups, which are therefore on their own evolutionary trajectories (Frost & Hillis 1990). The Arrabury specimen we leave indeterminate at present, as its taxonomic treatment will undoubtedly involve other poorly understood populations and nominal species from the eastern inland of Australia. Further work is also needed to address the taxonomic problems posed by the considerable variation that exists within Western Australian *C. uber*, including the status of *C. u. johnstonei*.

Taxonomy

All of the following species are members of the *Ctenotus leonhardii* species group, defined originally by Storr (1970) and subsequently modified by Storr *et al.* (1981) and King *et al.* (1988). The latter authors defined the *C. leonhardii* species group in part by two colouration characteristics, a predominance of reddish rather than olive pigmentation, and the replacement of black by dark brown pigmentation. Neither of these is true for all species; indeed, the second is scarcely true for any! In addition, the toes are said to be distinctive in being compressed, with subdigital lamellae tipped by obtuse keels or narrow to moderately wide calli. This characteristic is generally true for all species we have examined, but leaves considerable leeway for observer bias and confusion in applying the definition to particular specimens. Species groups, and more particularly phylogenetic groups, within *Ctenotus* need to be redefined as lineages rather than (as at present) being merely tools to simplify identification.

Ctenotus uber Storr, 1969

Ctenotus uber Storr, 1969, p. 102. Holotype: WAM R17654, 22 miles SE of Yalgoo, WA [approx. 28° 35' S, 116° 26' E].

Diagnosis

Ground colour of body reddish orange. Black vertebral stripe very narrow (occupying no more than the median one-quarter of each vertebral scale row) or absent. Laterodorsal dark brown to black stripes bearing a series of distinct pale spots. Original tail averages more than 200% of snout-vent length (SVL).

Description

Storr's (1969) description of scalation and proportions is not significantly altered by the larger sample now available for examination. Midbody scales in 28–33 rows, the mean of 30.2 (±1.19), based on a sample of 52 specimens, is very close to Storr's figure of 30.8. The value for relative tail length, reported by Storr to average 222% of SVL based on eight specimens, is comparable to the value of 216% (±44.6) obtained by us, based on Storr's specimens plus a further 27 specimens. Nasals almost always separated (frequency = 0.96). Prefrontals usually separated (frequency = 0.63). Storr's data (1971) suggested

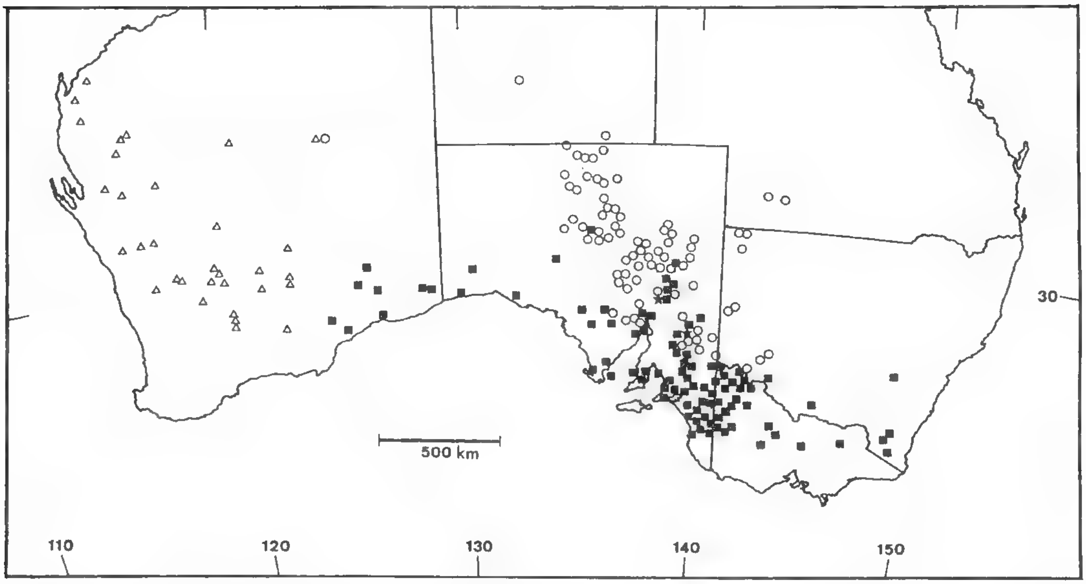

FIGURE 3. Geographic distributions of *Ctenotus uber* (Δ), *C. orientalis* (■) and *C. olympicus* (○). Stars indicate two instances of syntopy of *C. orientalis* and *C. olympicus*.

that loreal proportions could help differentiate *uber* and *orientalis*, but our measurements indicate that the two species are very similar in this respect; posterior loreal length/height ranges 0.8–1.6 in both species, and mean values are 1.2 (±0.17) for *C. uber* and 1.1 (±0.18) for *C. orientalis*.

Colour is medium reddish to orange brown on the dorsal surface of the head, limbs and tail. Laterodorsal and dorsolateral zones black, divided by a pale brown to whitish dorsolateral line. A narrow black vertebral stripe may be present or absent. Laterodorsal dark zone with a single longitudinal series of pale brown to whitish spots. Upper lateral zone demarcated ventrally by a midlateral white stripe beginning in the inguinal region, but breaking up anteriorly (about midway to forelimb) into a series of whitish spots. Upper lateral zone bearing several series of small whitish dots. Lower lateral zone variable, with irregular grey ventrolateral blotching or spotting.

Colour photograph in Storr *et al.* (1981).

Distribution

Western Australia, from the Exmouth Gulf area, south and east as far as the edge of the Nullarbor Plain. Southeastern limits roughly along the line connecting Mullewa–Lake Hillman–Parker Range–Norseman. Northeastern limit poorly defined but few specimens have been recorded northeast of a line connecting Dampier and Rawlinna.

Notes

Storr's type series included specimens now assigned to other species: *C. orientalis* (WAM R17268, R17284–85) from the Nullarbor Plain and *C. septenarius* (R20759) from the Rawlinson Range. Three specimens, from Mungilli Claypan (R26894–5) and 18 km E of Mungilli Claypan (R26897, i.e. the vicinity of Mt Johnston at the northern end of the Fame Range), are also not typical *C. uber* and are considered further in the 'Discussion' section below.

Ctenotus uber is mostly confined to the west and southwestern interior of Western Australia. There is marked geographic variation in colour pattern. The pattern which conforms most closely with Storr's original description is that of the holotype, in which the zone of dorsal ground colour along the vertebral region, which separates the laterodorsal zones, is narrow, occupying no more than half a paravertebral scale on each side, but almost always includes a dark vertebral stripe (sometimes fading on the posterior one-third of the dorsum). In south-central Western Australia, this 'median strip' of rufous colouring is often much wider, occupying up to one paravertebral scale on each side, narrowing the laterodorsal zones so that the laterodorsal series of spots almost contact the middorsal colour, and there is usually little or no trace of a dark vertebral stripe posterior to the shoulder region. Northwestern specimens, from about the latitude of Shark Bay northwards, are generally paler with more pronounced spotting and less contrasting dorsolateral stripes.

Ctenotus orientalis Storr, 1971

Ctenotus uber orientalis Storr, 1971, p.8. Holotype: NMV D825, Ouyen, Victoria [35° 04' S, 142° 19' E].
Minervascincus monaro Wells and Wellington, 1985, p. 35. Holotype: AMS R92239, 6 km along Cambalong Rd, Bombala, New South Wales (36° 53' S, 149° 08' E).

Diagnosis

Ground colour of body beige to medium brown, without reddish tinge. Black to dark chocolate or dark reddish brown laterodorsal zone generally reduces exposure of the ground colour to a pair of paravertebral lines and a series of pale dots or dashes within each laterodorsal dark zone. Black to dark brown vertebral stripe always present and usually occupying about one-third of each vertebral scale row. A pale brown to white dorsolateral stripe always present and straight-edged.

Description

Storr's original description was based on few specimens and on a composite type series (see below). Examination of a series of 31 South Australian specimens results in the following redescription.

Midbody scales in 30–35 rows (mean 32.3±1.49). Nasals usually separated (frequency = 0.77). Prefrontals separated (frequency = 0.58) or in contact. Supraoculars 4, the first three in contact with the frontal. Supraciliaries 6–8, mode 7. Second (posterior) loreal 0.8–1.6 (mean 1.2) times as wide as high. Supralabials 8, with occasional asymmetric presence of 7 or 9. Ear lobules 4–6, variably shaped and proportioned, but generally obtusely pointed and with the second (from the top) the largest. Lamellae under fourth toe 20–27 (mean 23.9± 1.64), slightly to moderately compressed, each with a dark brown callus.

Adults (sexes similar): SVL (n = 26) 56–82 mm; hindlimb length (n = 26) 28–39 mm (41–57% SVL); tail length (n = 12) 109–158 mm (168–223% SVL, mean 171%±55.2).

Head, limbs and tail light grey-brown to tan. Body usually best described as black to dark brown with a pair of narrow, straight-edged pale brown paravertebral lines separating a dark vertebral stripe from the dark laterodorsal zones (Fig. 4A). The vertebral stripe occupies about one-third of each paravertebral scale row and terminates on the base of the tail. Each laterodorsal dark zone contains a single series of pale brown spots or short dashes. Light dorsolateral stripe well-developed, straight-edged. Upper lateral zone blackish, enclosing numerous small off-white dots, arranged roughly in two to four longitudinal series. A whitish midlateral stripe begins in the groin and runs anteriorly to about two-thirds of the axilla-groin distance, where it breaks up, becoming indistinguishable in the axillary region. Tail and limbs light grey-brown to yellowish-brown, the colour sometimes extending anteriorly along the posterior third of the back, between the vertebral and laterodorsal dark stripes. Dorsolateral dark zone extends along the tail as a dark brown lateral stripe. Ventral surface pearly white in life.

Colour photographs in Jenkins and Bartell (1980, p. 137), Knowles and Wilson (1988, fig. 413) and in Cogger (1996, p. 448).

Distribution

Southern semi-arid to dry temperate Australia from the Nullarbor Plain in Western Australia across southern South Australia (north to Anna Creek), through northwestern Victoria and the far south of New South Wales. Scattered populations extend further east into dry woodlands of the Great Dividing range in northeastern Victoria, southeastern New South Wales and the Australian Capital Territory.

Notes

Storr (1971) described *orientalis* as a subspecies of *uber*, presumably on the basis of the shared dorsal pattern of laterodorsal spots and heavily spotted flanks. Since then other spotted-backed *Ctenotus* have been recognised or redescribed, so that the shared colour pattern is no longer unique to these two species. We separately assessed morphological variation in a sample of 23 Western Australian *C. orientalis* to see if any trends suggested intergradation with *C. uber*. None was apparent. Western Australian *C. orientalis* are if anything more different from *C.*

uber in colour pattern than eastern *C. orientalis*, with less contrast between the light and dark hues, and the tail shorter (mean 166 % SVL, ± 8.4%, n = 9).

Peterson and Shea (1987) reassessed Peters' description of *Lygosoma schomburgkii*, redefined as *Ctenotus schomburgkii* by Storr (1969), which has a mixed syntype series, including both *schomburgkii* and *uber orientalis*, *sensu* Storr (1969, 1971). Peterson and Shea concluded that Peters' description applied strictly to the larger taxon, i.e. Storr's *uber orientalis*, which should therefore bear the name *schomburgkii* with nomination of a new lectotype. Storr (1987) in reply asserted that the description was more ambiguous than suggested by Peterson and Shea and that, in his opinion, Peters' description was composite. Peters' description of *schomburgkii* would most likely apply to Storr's *uber orientalis*, but Storr's notion of a composite type description by Peters remains reasonable; his usage as first reviser, and lectotype designation, is accepted here.

Storr's type series of *uber orientalis* is itself composite, including specimens now recognised as *orientalis* (NMV D00825, SAMA R0023–24, R01507, R05738, R10122), *olympicus* sp.nov. (SAMA R02789, R09466–69, R10017, R10027, R10030, R10044, R10055) and *septenarius* (SAMA R09735). Our redefined *C. orientalis* shows one major pattern of geographic variation, with most specimens from the Nullarbor Plain being markedly lighter coloured, with the laterodorsal and upper lateral zones being medium to dark reddish brown rather than black, reducing the contrast between the light and dark dorsal colours. Note that this variation does not imply intergradation with *C. uber*, as the rufous colouring of the latter species is confined to the lighter areas while upper lateral and laterodorsal colour is strongly contrasting black. Some southeastern Australian specimens have only a single series of rather large pale spots in the upper lateral zone and a more continuous midlateral stripe.

Minervascincus monaro Wells and Wellington, 1985 is based on a New South Wales specimen of *C. orientalis*. The authors provided no description of the holotype specimen or the species, nor any differential diagnostic data. They declared the species to be 'readily identified' by the photograph in Jenkins and Bartell (1980, p. 137), and that it was 'clearly evident' that the illustrated animal was not *C. uber*, but made no comparison with *C. orientalis*. Examination of both the holotype and the cited photograph shows the colour and pattern are completely concordant with typical *C. orientalis*, although the holotype specimen does have an unusually low midbody scale count of 28. It also has the less common condition of two other head scale attributes, nine supralabials and the nasals in contact.

Ctenotus orientalis occurs in a variety of warm-temperate to semi-arid woodland and heathland habitats, including open forest, woodland (including mallee) and low shrubland. It occurs patchily in the more heavily wooded areas, confining itself to especially dry or exposed microhabitats. It is syntopic with *C. robustus* through most of its range, but also occurs with *C. regius* in drier areas. From both it is distinguished by the presence of dorsal spotting and the incomplete pale lateral stripe. These lizards usually build their own burrows in sandy soil or under rocks.

Three specimens (AMS R59784–6) registered as *C. u. orientalis* from the western slopes of the Dividing Range in New South Wales, in the Cassilis area, are distinctive in colouration and from outside the range of typical *orientalis*. These are excluded from the distribution map, and for now their identification is left as indeterminate.

Ctenotus olympicus sp. nov.

Holotype: SAMA R20949, male, 48 km S of Olympic Dam, SA, 30° 48' S 136° 52' E.

Paratypes: 13 specimens from South Australia: SAMA R18620, approx. 20 km S of Port Augusta, 32° 38' S, 137° 35' E; R20936, Olympic Dam area, 30° 19' S, 136° 57' E; R20944–45, 48 km S of Olympic Dam, 30° 48' S, 136° 52' E; R25877, Witchelina Station, near homestead, 30° 01' S, 138° 03' E; R28203, 37 km N of Oodnadatta on road to Hamilton homestead, 27° 15' S, 135° 17' E; R28494, 118.5 km NE of Minnipa, 32° 15' S, 136° 14' E; R28503, 119.3 km NE of Minnipa, 32° 18' S, 136° 16' E; R28517, 115–120 km NE of Minnipa, 32° 20' S, 136° 17' E; R28543, 115 km NE of Minnipa, 32° 16' S, 136° 11' E; R30407, Breakaways Reserve, 25 km NNW of Coober Pedy, 28° 50' 40" S, 134° 41' 15" E; R35937, 95 km E of Marla, 27° 09' S, 134° 21' E; R36360, 1 km NE of Alberrie Creek, 29° 37' S, 137° 33' E.

The type series is restricted to the specimens used in the electrophoretic analysis.

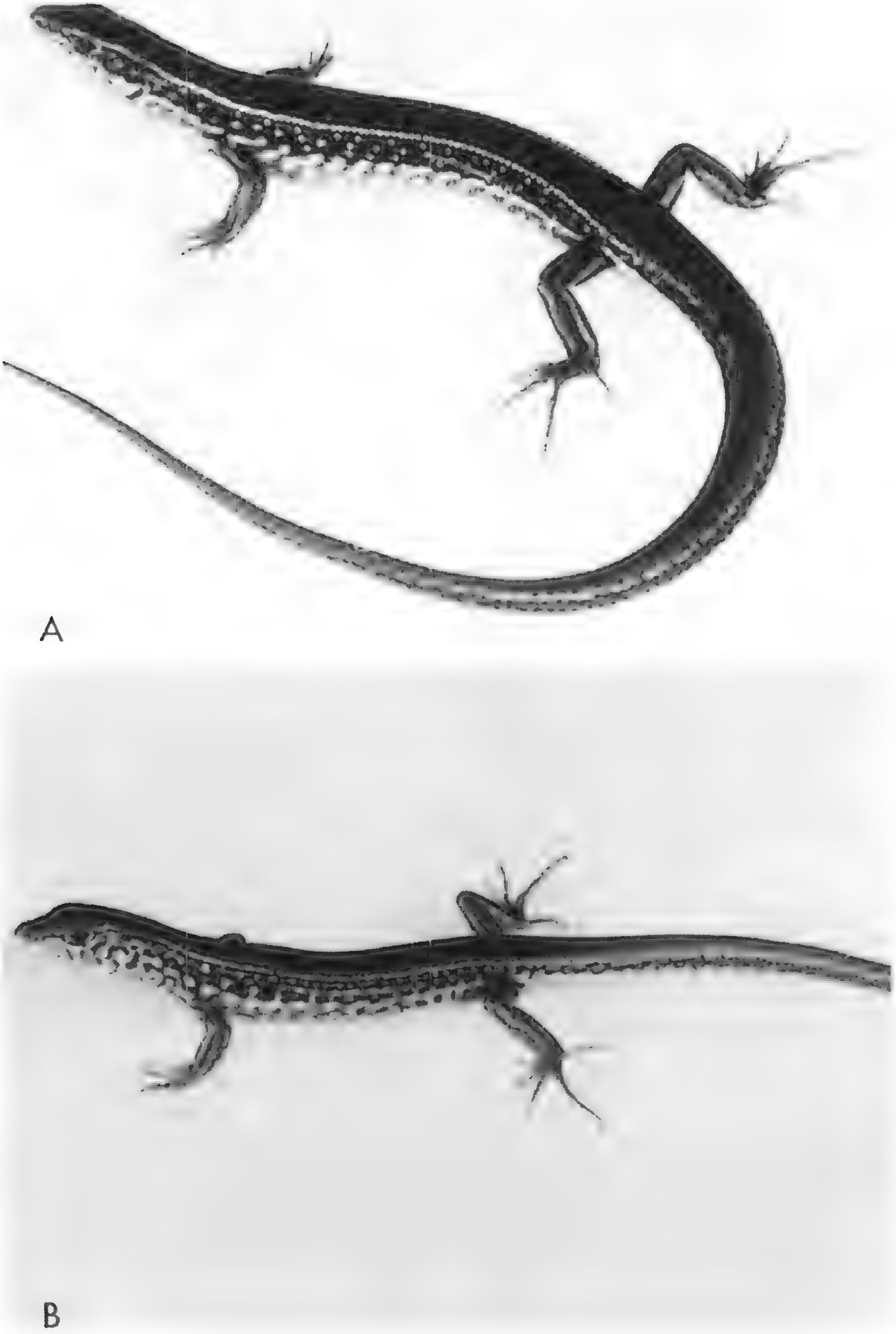

FIGURE 4. (A) *Ctenotus orientalis* from Whyalla, SA. (B) *C. olympicus* from the Davenport Range, SA. Photographs: T. Peters, SA Museum

Diagnosis

A member of the *C. leonhardii* species group with the dorsal ground colour pale beige to medium brown, often with a metallic lustre. Black vertebral stripe usually present, occupying no more than one-quarter of each paravertebral scale row and with very weak or no pale edging. Laterodorsal dark brown to black stripes, if present, with medial margins irregular, broken up by scattered lighter centred scales. Light dorsolateral line present or absent. Midlateral white stripe, if present, not extending anteriorly beyond midbody and often completely reduced to a zone of whitish spots. Size relatively small, SVL usually less than 70 mm; tail moderate (mean 187% SVL).

Description.

Based on type series (n = 14). Midbody scales in 28–32 rows (mean 30.9). Nasals usually separated (frequency = 0.64). Prefrontals usually in point to broad contact (frequency = 0.64) or separated. Supraoculars 4, the first three in contact with the frontal. Supraciliaries 7, rarely 6 or 8. Second loreal 0.8–1.6 (mean 1.2) times as wide as high. Supralabials 8, with occasional asymmetric presence of 7 or 9. Ear lobules 4–6, mostly obtusely pointed, the second or third (from the top) the largest. Lamellae under fourth toe 23–29 (mean 26.2), slightly to moderately compressed, each with a dark brown callus.

Adults (sexes similar; n = 13): SVL 52–69 mm; hindlimb length 26–35 mm (45–59% SVL); tail length (n = 11) 98–137 mm (170–211% SVL, mean 191%).

In preservative light brown, golden or medium brown dorsally. A narrow black vertebral stripe almost always present, occupying the corners of the paravertebral scale rows and no more than one-quarter of a paravertebral scale in width, runs from the nape to the base of the tail (Fig. 4B). This stripe sometimes poorly contrasting with dorsal colour and with no, or only a weakly contrasting, pale edge. A cream dorsolateral stripe, bordered medially by black, begins behind the supraciliaries. The posterior extent of this stripe is variable, sometimes continuing as far as the hips, but more often breaking into a zone of light and dark spots between forelimbs and hindlimbs. In specimens with a more continuous light dorsolateral stripe, the dark medial border (laterodorsal stripe) is usually narrow with a ragged medial edge. This stripe may include pale spots as in *C. orientalis* but in these cases the dorsolateral light stripe is often poorly defined posteriorly due to the adjacent dark areas being heavily speckled with whitish. Upper lateral zone blackish, with three to four longitudinal series of small, irregular pale spots. Upper lateral zone continues along the sides of the tail as a brown lateral stripe irregularly dotted with black. Lower border of upper lateral zone demarcated by a series of pale spots and dashes, sometimes forming an irregular midlateral stripe posteriorly. Lower lateral zone whitish irregularly smudged with grey. Ventral surface white. In life hind limbs and tail have a reddish tinge.

Examination of an additional 35 referred specimens in the SAMA collection indicates that the above counts and measurements are representative. In the larger sample, midbody scales averaged 30.4, frequency of separated nasals was 0.60 and of prefrontals in contact, 0.66. Maximum SVL was 75 mm (SAMA R03618, male, one of the paratypes of *C. u. orientalis*).

Etymology

Named for Olympic Dam, the type locality, but also in the spirit of the Greek mythological bent behind many *Ctenotus* specific epithets.

Distribution

Lake Eyre and Lake Torrens basins of central and northern South Australia, extending northwards into the southern NT and east and south through the northern Flinders Ranges to the Olary Plains of eastern South Australia and the adjacent west of New South Wales.

Notes

Three species of the *C. leonhardii* group are superficially similar to *C. olympicus* and are sympatric or parapatric through significant parts of its range. *Ctenotus orientalis* differs in having a pale margin to the black vertebral stripe and straight-edged black laterodorsal stripes completely enclosing a single series of pale dots or dashes. *Ctenotus septenarius* has a rusty orange dorsal colour with contrasting yellowish tail, multiple dark dorsal lines anteriorly and a well-developed midlateral stripe. *Ctenotus leonhardii* lacks laterodorsal pale spots, has a pale-edged vertebral stripe, straight-edged, light dorsolateral stripe and distinctive cheek and neck pattern of white spots on a purplish-brown background.

Most populations include a range of colour pattern variations, but plainer animals are more common in the west of the species' range while more heavily speckled animals are more common

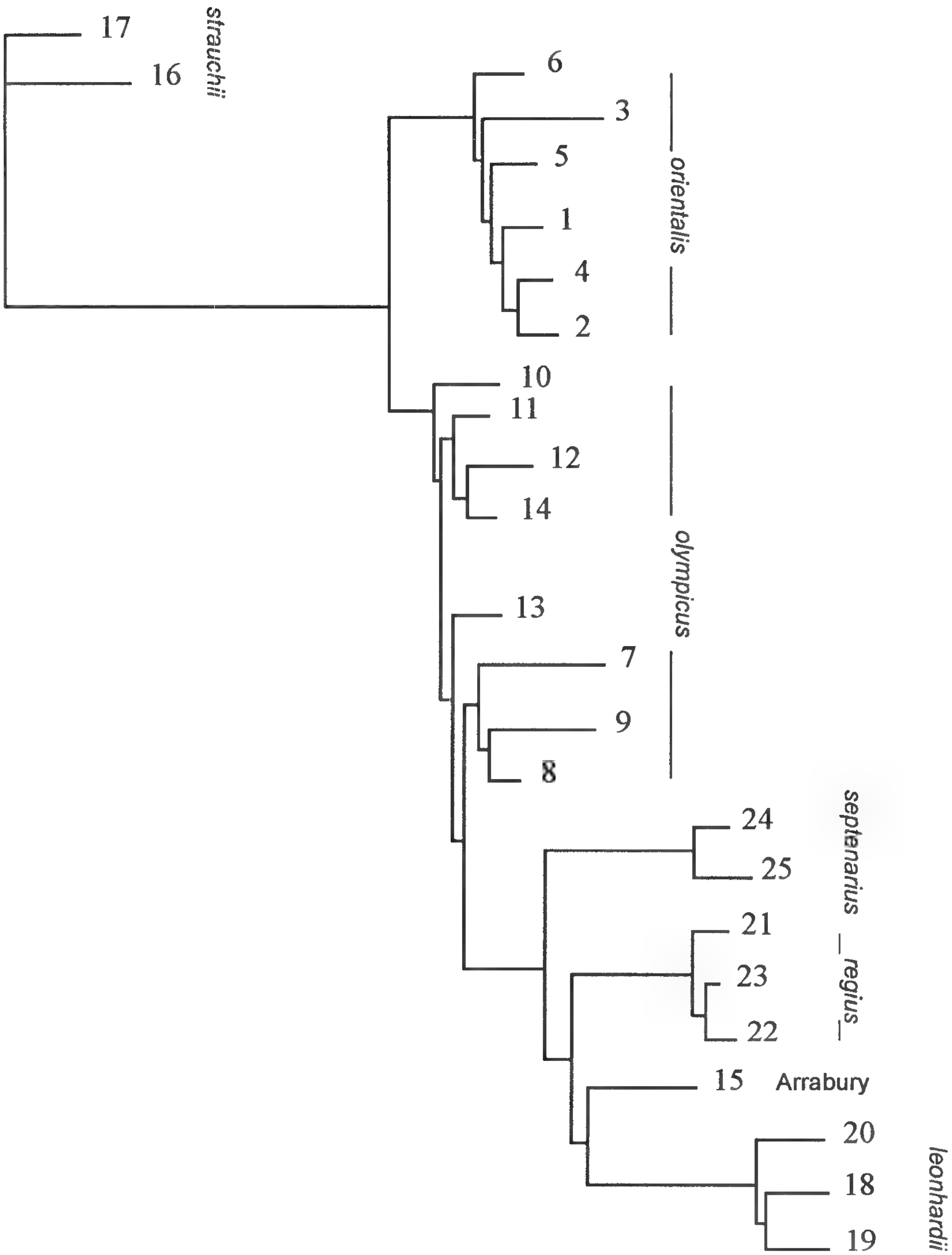

FIGURE 5. Phylogenetic relationships of 25 populations of *Ctenotus* skinks (analysis of Rogers' D using the FITCH algorithm from PHYLIP), showing paraphyly of *C. olympicus*. *Ctenotus strauchii* was designated as the outgroup to root relationships among the remaining species, all members of the *C. leonhardii* species group.

in the north. In the Flinders Ranges and the stony hills of the Olary Spur and Barrier Range, many specimens are much darker than elsewhere, with dorsal colour dark blackish brown, as in *C. orientalis*.

The most distinctive populations, included here with some reservation, are those from the northeastern limits of the species' range in northwest New South Wales and southwest Queensland. The five specimens examined (SAMA R10044, R36877, R36986, AMS R32604, R69731) are distinctively marked with black paravertebral and laterodorsal black lines or series of flecks on the nape and shoulders. Four of the five also have almost no trace of a light dorsolateral line, having only a zone of pale speckling. Henle (1996) also pointed out the difficulties of identifying specimens from this area, and of the variation within the similar southwestern Queensland species, *Ctenotus astarte*. However, his figured specimen is more like our unassigned 'Arrabury' specimen (and *C. astarte*) than the five assigned here to *C. olympicus*.

This species is found on heavy soils, generally with a stony component and a ground cover of chenopods. On plains, the species digs a burrow under a stone or bush. In the north of South Australia it occurs on and around gibber rises, sheltering in natural holes and spaces under rocks. Sometimes the only *Ctenotus* where it occurs, but often found with *C. strauchii varius*, *C. leonhardii*, *C. septenarius* and *C. saxatilis* in central and northern South Australia. Sadlier and Shea (1989) figure and describe the habitat of this species as *C. uber orientalis*. The photographs illustrating *C. uber* in Swan (1990, p. 96) and Ehmann (1993) also depict specimens of *C. olympicus*.

Discussion

Our revised taxa are species because they are diagnosable, show evidence (fixed allozyme differences) that reticulate evolution has ceased between them, and maintain their morphological distinctiveness in sympatry (Wiley 1981, Frost & Hillis 1990). We cannot demonstrate reciprocal monophyly of these species, however, so that one of the current species concepts, the Phylogenetic Species Concept (PSC, de Queiroz & Donoghue 1988; Echelle 1990), cannot be applied. Failure to establish strict monophyly of all species may be no more than we should expect if the prevailing allopatric and sympatric speciation models are true. Our experience of cryptic species in several taxa (Hutchinson & Donnellan 1992; Donnellan *et al.* 1993) suggests that it is common for differentiation to be achieved by frequency shifts in the states of shared characters or fixation of polymorphisms (applicable to both allozyme and external morphological data) rather than the acquisition by each species of evolutionary novelties.

The taxonomy of this complex is still far from final resolution. The restricted concept of *Ctenotus uber* adopted here still encompasses considerable variation and suggests that detailed study may reveal further cryptic species within this binomial. In eastern Western Australia, genetic study of populations assigned to *Ctenotus greeri*, *C. tanamiensis* and *C. uber* (including *C. u. johnstonei*) would help to unravel inter and intraspecific variation among these 'spotted-back' members of the *C. leonhardii* species group.

Three paratypes of *C. uber* from the vicinity of Mungilli Claypan (WAM R26894–95, R26897) all have the very long tail of *C. uber*, but R26897 is otherwise identical in colour to typical South Australian *C. olympicus*, while the other two are more like *C. uber* but have anomalous dorsal patterns, with relatively broad vertebral stripes and broad paravertebral zones of ground colour margining straight-edged laterodorsal stripes containing pale markings that run together to form ragged longitudinal pale lines. At present, we allocate R26897 to *C. olympicus* and retain the other two in *C. uber* but further collection in this area to examine the range of local variation will be necessary to clarify the status of these populations.

There are also several central and eastern-inland species, such as *Ctenotus aphrodite*, *C. astarte*, *C. hebetior*, *C. septenarius* and *C. serotinus* in which interpopulation variation is poorly understood and which may be closely related to *C. orientalis* and *C. uber*. One of these, *C. septenarius* is a more widespread and variable species than is indicated by the original description (King *et al.* 1988), and was included by Storr in the type series of both *C. uber* and *C. u. orientalis*. In the type series of *C. septenarius*, the dorsal colour pattern includes seven dark lines, a broad vertebral, a faint paravertebral and laterodorsal on each side and a wider dorsolateral. The two faint lines are the result of a single dark laterodorsal line on the nape developing a pale centre as it runs posteriorly but in many South Australian specimens the laterodorsal line does not fade as it runs back, so that the resulting pattern consists of five bold dorsal lines, rather than three bold and four faint lines. Whatever the pattern it generally fades posteriorly, often reducing to three lines and then one (vertebral) on the posterior third of the back. A minority of specimens have only a vertebral line. *Ctenotus aphrodite* from southwest Queensland appears to be very similar to the single-lined pattern variant of *C. septenarius*, while some specimens of *C. astarte* and *C. serotinus* are similar to *C. olympicus* and to our distinctive Arrabury specimen. Future work should aim to sample these populations for biochemical or molecular systematic study.

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APPENDIX

The following specimens were used in the electrophoretic study and scored for morphological data (all locations but one in South Australia).

Ctenotus orientalis. population 1: SAMA R27220, Hensley Scrub, 8 km NW of Bordertown; population 2: R26069–71, Swan Reach; R26164, R26166, Swan Reach Conservation Park; population 3: R26184, White Dam Conservation Park; population 4: R18275–79, Reevesby Island; population 5: R24797, Pitcairn Station; R24875, Ti Tree Well, Flinders Ranges; R24876, 'The Bunkers', Flinders Ranges; population 6: R25074, Stoney Creek.

Ctenotus olympicus. population 7: R18620, approx. 20 km S of Port Augusta; population 8: R25877, Witchelina Station, near homestead; population 9: R28494, R28503, R28517, R28543, 115–120 km NE of Minnipa; population 10: R20936, Olympic Dam area; R20944–45, R20949, 48 km S of Olympic Dam; population 11: R30407, Breakaways Reserve, 25 km NNW of Coober Pedy; population 12: R35937, 95 km E of Marla; population 13: R36360, 1 km NE of Alberrie Creek; population 14: R28203, 37 km N of Oodnadatta on road to Hamilton homestead.

Ctenotus sp. population 15: R20839, Arrabury Station, Qld.

Ctenotus septenarius. population 16: R35895–96, R35931–32, Finke River valley, Witjira National Park; population 17: R28214, Dalhousie ruins.

Ctenotus leonhardii. population 18: R35878, Finke River valley, Witjira National Park; population 19, R28244–45, 'Big Mill' area, Witjira National Park; population 20: R22246, Kingoonya.

Ctenotus regius. population 21: R35860, R35938: 1 km S of Hamilton homestead; population 22: R35915, Mokari, Witjira National Park; population 23: R35940, Finke River valley, Witjira National Park.

Ctenotus strauchii varius. population 24: R35887, 26 km ESE Mt Dare homestead, Witjira National Park; R35889–90, Mt Dare homestead metal dump; population 25: R34780, South Gap Station.

Additional specimens which provided scalation and mensural data.

Ctenotus uber. R17335, 24 km SSE of Karonie (Paratype); R17654, 35 km SSE Yalgoo (Holotype); R25118, Jiggalong (Paratype); R26894–95, Mungilli Claypan (Paratype); R30334, Koordarrie; R33967, 46 km S of Karalee; R36112, 18 km SW of Winning Pool; R40216, S of Carnarvon Ranges; R40537–38, R40539–42, Yinnietharra, Mica Well; R44246, 46 km NNE of Beacon; R47708, Weedarra, Gascoyne River; R48323, 48 km N of Beacon; R48402, 51 km N of Beacon; R49945, Wandagee; R54209, Tallering; R57692, Wilroy Reserve, 19 km S of Mullewa; R58155, 12 km NE of Dalwallinu; R58697, 13 km SE of Diemals; R62303, 5 km N of Jindabinbin rockhole; R63664, 25 km NNW of Winning HS; R64742, Mt Manning Ra.; R65814, 7.5 km NE of Comet Vale; R65910, 3 km NE of Mt Linden; R65976, 2.5 km [from] Mt Linden; R67017, 1.5 km S of Mt Jackson; R67133, 5 km N of Bungalbin Hill; R67983, Hell Gates, 37 km 87° from Dandaraga HS; R68889, 2 km N of Mt Narryer HS; R71822, 16.5 km 80° from Toomey Hills; R71824, 15 km 90° from Toomy Hills; R72017, 1.5 km W of Mt Jackson; R72201, R76231, 12 km NNE of Bungalbin Hill; R72584, near Comet Vale; R72645, 7.5 km NE of Comet Vale; R72733, 6.75 km NE of Comet Vale; R72792, 2.5 km N of Mt Linden; R73287, R73308, 7 km 238° from Black Flag; R73222, 2 km 97° from Yowie rockhole; R73373, 1 km 260° from Mt Manning Ra. (SE peak); R74400, Boorabbin; R76095, Mt Jackson Hill; R76119, 12 km SSW Mt Jackson Hill; R78517, 7 km WSW of Black Flag; R78541, 12 km WSW of Black Flag; R78700, 2 km NW of Mt Manning Ranges (SE peak); R78777, 16 km E of Toomey Hills; R78796, 15 km E of Toomey Hills; R78810, Boodarding Rock; R81301, Koordarrie HS; R81965, Chiddarcooping nature reserve; R82623, 15 km SSE of Mt Jackson; R84146, 17 km SSW of Muralgarra HS; R87655, 13 km SSW of Mt Phillip HS; R87758, 4 km NNE Mt Phillip HS; R91036, 9 km N of Yinnietharra.

Ctenotus olympicus. South Australia: SAMA R02789, R09466–69, Pernatty or South Gap Homestead (Paratypes of *Ctenotus uber orientalis*); R04314, Ediacara; R10017 (Paratype of *Ctenotus uber orientalis*); R10027, R10030, Mern Merna (Paratypes of *Ctenotus uber orientalis*); R12845, near Carrapateena Arm, Lake Torrens; R12846, Wirrappa Hills, 29 km SE of Woomera; R12847, Yarra Wurta cliff, north end of Lake Torrens; R13156 B, near Oulnina HS, Olary Ridge; R13912 8 km from Carriewerloo Woolshed on road to Illeroo; R14160 A–B, R14917 A–C, Waukaringa; R14932, Mern Merna; R15111, Disputed Creek; R15439, 10 km SW of Matin Wells Homestead; R16082, Mt Serle; R17789, Dutton Bluff, 17 km ESE of Bookaloo; R17799, Wooltana Station, 4–Mile Creek Bore; R19026–27, 10 km N of New Mulgaria Homestead; R19048, 15 km E of Frome Downs Homestead; R20039–40, Pimba; R21518, Moolawatana; R26828, 25 km S of Mabel Creek Homestead; R28403, 28 km NW of Iron Knob; R29072–73; 128 km ENE of Minnipa; R29083, 130.8 km ENE of Minnipa; R33282, 14 km W of Pimba.

WAM R64576, Pimba. Northern Territory: SAMA R10055. (Paratype of *Ctenotus uber orientalis*). New South Wales: SAMA R10044, Milparinka; WAM R92962, 2 km E of Mungo HS. Western Australia: WAM R26897, 18 km E of Mungilli Claypan (Paratype of *Ctenotus uber*)

Ctenotus orientalis. South Australia: SAMA R00023–24, Bowhill (Paratype); R03618, Lake Palankarinna (Paratype); R05738, Panaramitee Station (Paratype); R01507, Pinnaroo (Paratype); R10122, Blue Range Creek (Paratype); R11202, 1.6 km NE of Tea Tree Gully; R12718, Artimore Station; R12986, Reevesby Island; R14569, Marble Range, Eyre Peninsula; R15390, Wilpena Pound; R16225, Ninety Mile Desert; R18224, 6 km N of Cook; R18488, Reevesby Island; R20868, Stony Point; R21490, N end of Younghusband Peninsula; R24797, Pitcairn Stn; R26118–19, Reevesby Island; R28425, 37.5 km NE of Minnipa; R31453, Wardang Island; R35384, Reevesby Island. WAM R9863, Reevesby Island. New South Wales: AMS R92239, 6 km along Cambalong Rd, Bombala (Holotype of *Minervascincus monaro*).Victoria: NMV D00825, Ouyen (Holotype). Western Australia: WAM R17268, Forrest (Paratype of *Ctenotus uber*); R17284–85, Seemore Downs (Paratype of *Ctenotus uber*); R41592, 92 km NNE Rawlinna; R41593, 39 km S of Forrest; R41594, 24 km S of Forrest; R45615, 22 km N of Rawlinna; R77772, 32 km NW of Toolinna rockhole; R77777, 25 km N of Eyre Homestead; R91322, 3 km S of Haig; R91324, R91327, R91761, R91770, 7 km ESE Kilidwerinia Granite Rock; R91326, R91328, R92001, 16 km SSE of Haig; R91595, 18 km S of Haig; R91748, 13 km SSE of Haig; R91753–54, 1 km S of Haig; R91766, R91777, 5 km ESE Kilidwerinia Granite Rock; R91767, R91784, 15 km ESE Kilidwerinia Granite Rock; R92119, 50 km NE of Balladonia Hotel-Motel; R94707, Haig; R96723, 67 km N of Eucla.

Ctenotus septenarius. South Australia: SAM R09735, Dalhousie Homestead (Paratype of *Ctenotus uber orientalis*). Western Australia: WAM R20759, Pass of the Abencerrages, Rawlinson Range (Paratype of *Ctenotus uber*).

In addition, all specimens registered as *C. uber* from New South Wales, Victoria and Queensland in the NMV, SAMA and WAM collections (up to 1993), plus a large series from the AMS were examined and their identities revised and used to plot the distribution map (Fig. 3).

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