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NEW SPECIES AND A NEW GENUS OF THE SUBFAMILY POGONINAE FROM SOUTH AUSTRALIA (COLEOPTERA : CARABIDAE)

M. BAEHR & P. HUDSON

Summary

A new genus and a new species, *Syrdenoidius spinipes* gen. nov., sp. nov., and three new species of the genus *Pogonus* Dejean from salt lakes in South Australia are described: *Pogonus matthewsi*, *P. vicunus*, and *P. perovalis*. The first two species are closely related to *P. grossi* Moore from Lake Eyre and *P. saskiae* Baehr from Lake Gairdner and Island Lagoon and together they form a complex of four very closely related species. *Pogonus perovalis* sp. nov. is outstanding in its body shape and absence of wings, but may be remotely related to this complex. The new genus *Syrdenoidius* is highly similar in shape and structure to the Palaearctic genus *Syrdenus* Chaudoir, though it differs mainly in the asetose prosternum, the markedly spinose tibiae, the absence of wings, and a very unusual stylomere 2. *Syrdenoidius spinipes* sp. nov. and *Pogonus perovalis* sp. nov. are outstanding in their absence of wings and loss of flying ability, attributes that are extremely rare within Pogoninae. Most of the new species were collected by excavation of their burrows on the lake surface, or by pitfall trapping.

NEW SPECIES AND A NEW GENUS OF THE SUBFAMILY POGONINAE FROM SOUTH AUSTRALIA (COLEOPTERA: CARABIDAE)

M. BAEHR & P. HUDSON

BAEHR, M. & HUDSON, P. 2001. New species and a new genus of the subfamily Pogoninae from South Australia (Coleoptera: Carabidae). *Records of the South Australian Museum* 34(1): 1–18.

A new genus and species, *Syrdenoidius spinipes* gen. nov., sp. nov., and three new species of the genus *Pogonus* Dejean from salt lakes in South Australia are described: *Pogonus matthewsi*, *P. vicinus*, and *P. perovalis*. The first two species are closely related to *P. grossi* Moore from Lake Eyre and *P. saskiae* Baehr from Lake Gairdner and Island Lagoon and together they form a complex of four very closely related species. *Pogonus perovalis* sp. nov. is outstanding in its body shape and absence of wings, but may be remotely related to this complex. The new genus *Syrdenoidius* is highly similar in shape and structure to the Palearctic genus *Syrdenus* Chaudoir, though it differs mainly in the asetose prosternum, the markedly spinose tibiae, the absence of wings, and a very unusual female stylomere 2. *Syrdenoidius spinipes* sp. nov. and *Pogonus perovalis* sp. nov. are outstanding in their absence of wings and loss of flying ability, attributes that are extremely rare within Pogoninae. Most of the new species were collected by excavation of their burrows on the lake surface, or by pitfall trapping.

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INTRODUCTION

Most halophile pogonine species occupy habitats such as seashores and inland salt lakes and most are strong fliers that readily come to lights. Such habitats have been favoured collecting localities in other parts of the world for a very long time and there is a general belief that the taxonomy of the subfamily is well known. Nevertheless, several new species have been recently described throughout the world (Kryzhanovskij & Michailov 1971, Morvan 1973, Kryzhanovskij 1990, Bousquet & Laplante 1997, Baehr & Sciaky (in press), Hudson 2000). At present, there are 11 pogonine genera worldwide containing about 78 taxa. *Pogonus* s. str. is by far the most speciose genus with 49 described taxa (Lorenz 1998).

In Australia, the number of described pogonines was surprisingly low for a very long time (Chaudoir 1871, 1878; Sloane 1895). Moore (1977) described new species from Lake Eyre and since then a number of additional species have been detected and described (Baehr 1984, 1997, 1999; Moore 1991, Hudson 2000) resulting in a total of 12 species of *Pogonus* known from Australia. It is now evident that all parts of

Australia suitable for pogonines are colonised by at least one or another species. The salt lake belt from interior Western Australia through the southern half of South Australia to northwestern Victoria (and probably westernmost New South Wales) is the stronghold of pogonines in Australia, with many closely related but also some unusual species occurring there.

Four new species are described herein, including a representative of an unusual new genus. Although the pogonine fauna of Australia comprises predominantly the genus *Pogonus* s. str., it is one of the most speciose in the world with high morphological diversity and includes some very strangely shaped species.

The majority of the Australian pogonines are depigmented, many are extremely elongate and depressed ('syrdeniform'), characters which are evidence of an obligatory nocturnal and at the same time psammophile life. Apart from this, very little is known about habits, ecological preferences, and life histories of most of the Australian pogonine species, since most collections have been made using light traps. It is the scope of this paper, among other things, to increase ecological information about the Australian pogonines.

The present paper was prepared when the senior author (MB) worked through the unidentified carabid material in the South Australian Museum, Adelaide, and separated a number of pogonine specimens that turned out to belong to undescribed species. They had been mostly collected by the junior author (PH) during his ample collecting work on salt lakes throughout South Australia. Personal contact between MB and PH during MB's stay at the Museum revealed that PH had a number of additional, freshly caught specimens that were subsequently sent to MB for identification. Since PH has collected many taxa using pitfall traps and by excavation of burrows, both authors agreed to collaborate in a joint paper, with MB mainly responsible for the taxonomic section, and PH for the ecological part. Authorship of the new taxa is in joint names. Some records of known species from the SAMA collection and those made by MB during a recent collecting trip through northwestern Victoria and southern South Australia are also included, in cases where they enlarge the known range or add any other information.

MEASUREMENTS

Measurements were taken using a stereo microscope with an ocular micrometer. Length has been measured from apical margin of labrum to apex of elytra; measurements, therefore, may slightly differ from those of other authors. Length of pronotum was taken at the longest distance

(which is not always along midline!), and width between the posterior lateral angles.

LOCATION OF MATERIAL

The holotypes of the new species are located in the South Australian Museum, Adelaide (SAMA), paratypes of all species are kept in the working collection of the senior author (CBM) at the Zoologische Staatssammlung München. Paratypes of *Syrdenoidius spinipes* are also kept in the Australian National Insect Collection, Canberra (ANIC).

TAXONOMIC PRINCIPLES

Whereas one of the three new taxa of the genus *Pogonus* is very specialised in shape and structure and certainly merits full specific status, two taxa belong to a group of depigmented, elongate, depressed, syrdeniform species that so far include *Pogonus grossi* Moore and *P. saskiae* Baehr from saline inland habitats in South Australia. The four taxa now known to exist in this group are very similar and certainly they are closely related. They have been collected at four different localities throughout the salt lake belt of South Australia, and could be either subspecies of one widespread species, or closely related species. We have decided to rank them as species rather than subspecies for two reasons. Firstly there appear to be consistent, though minor differences, between them (see Tables 1 and 2). Secondly there are heuristic

TABLE 1. Some distinguishing characters within the *Pogonus grossi*-group

	<i>grossi</i> (L. Eyre)	<i>vicinus</i> (L. Frome)	<i>matthewsi</i> (Pernatty Lag.)	<i>saskiae</i> (Island Lag.)
body size	large	large	large	small
pronotum	wide	wide	wide	narrow
basal angle	slightly excised	not excised	not excised	excised
basal angle	not dentiform	dentiform	dentiform	not dentiform
lateral margin	evenly convex	rather straight	evenly convex	evenly convex
lateral margin	widest behind	widest in front	widest at	widest at
	anterior third	of anterior third	anterior third	anterior third
elytra	rather depressed	rather depressed	convex	depressed
intervals	slightly convex	slightly convex	strongly convex	slightly convex
striae	distinctly punctate	barely punctate	distinctly punctate	distinctly punctate
striae	rather deeply impressed	rather shallow	deeply impressed	rather deeply impressed
microreticulation	distinct	distinct	very distinct	distinct

TABLE 2. Summary of measurements and ratios for all species of the *Pogonus grossi*-group. For better recognition of the species the measurements and ratios for all species of the *P. grossi*-group are compiled in the following table.

	body length (mm)	ratio width/length pronotum	ratio width base/apex pronotum	ratio width pronotum/head	ratio length/width elytra	ratio width elytra/pronotum
<i>grossi</i>	5.2–6.4	1.18–1.21	0.91–0.93	1.13–1.15	1.85–1.91	1.27–1.35
<i>vicinus</i>	5.1–6.0	1.13–1.16	0.98–1.01	1.16–1.21	1.72–1.77	1.30–1.34
<i>matthewsi</i>	5.6–6.2	1.15–1.17	0.96–1.02	1.12–1.16	1.86–1.90	1.26–1.28
<i>saskiae</i> *	4.65–4.90(4.15)	1.07–1.11(1.21)	0.87–0.88(0.85)	1.03–1.10(1.12)	1.96–1.98(1.90)	1.29–1.40

* In *Pogonus saskiae* Baehr one extraordinary small specimen has some rather different proportions of pronotum and elytra (see Baehr 1997) that are added in brackets.

reasons for doing so since definition of subspecies is more difficult than that of species and would require more information about gene flow or hybrid zones. Further investigations should show which concept is better applicable to this difficult group.

TAXONOMY

There is no need for an extensive characterization of the subfamily Pogoninae (or tribe Pogonini, according to the preferred system). A list of synonymies including the most important citations, and an extensive diagnosis of the subfamily was recently given by Bousquet and Laplante (1997) that should be used by readers who want to receive more general information about the group. A summary of the presently known genera and species has been recently provided by Lorenz (1998). More information about the Australian *Pogonus* species can be obtained from Moore (1977), and the subsequent descriptions of additional species by Moore (1991), Baehr (1984, 1997, 1999), and Hudson (2000).

ADDITIONAL RECORDS OF DESCRIBED SPECIES

Pogonus grossi Moore

Moore 1977: 63; Moore *et al.* 1987: 146; Baehr 1997: 3; 1999: 147.

This species is only known from the type locality Lake Eyre (Moore *et al.* 1987). In the SAMA collection there is a large series of specimens from Madigan Gulf and Prescott Gulf (both Lake Eyre North). Thus, *P. grossi* seems to have colonised a large part of the shores of this lake.

Pogonus hypharpagioides Sloane

(Fig. 1)

Sloane 1895: 126; Moore 1977: 63; Moore *et al.* 1987: 146; Baehr 1997: 2, 3; 1999: 147.

In addition to its type locality, Lake Callabonna, *P. hypharpagioides* has previously been recorded from Lake Eyre (Moore *et al.* 1987) and Lake Frome (Baehr 1997). Collections made by the authors show this species is widely distributed throughout the salt lake belt from northwestern Victoria to the west coast of South Australia, including some near-coastal localities (see Fig. 1). A variety of techniques have been employed in collecting this species; many specimens were excavated from burrows, others were collected at light, in pitfall traps or while running on the surface at night.

Pogonus variabilis Moore

Moore 1991: 31; Baehr 1997: 2; 1999: 147.

In the collection of SAMA there is a series of specimens caught by N. B. Tindale and P. Aitken in 1963 at Normanton and on Mornington Island, both northwestern Queensland, that apparently escaped the attention of Moore when he described this species in 1991. They are evidence of the wide range of this species along the coasts of tropical Australia. Characteristically, they have been collected at light.

DESCRIPTIONS OF NEW SPECIES

Pogonus matthewsi sp. nov.

(Figs 2, 5, 8, 19)

Types

Holotype: male, P. Hudson. 3 Sept. 1996,

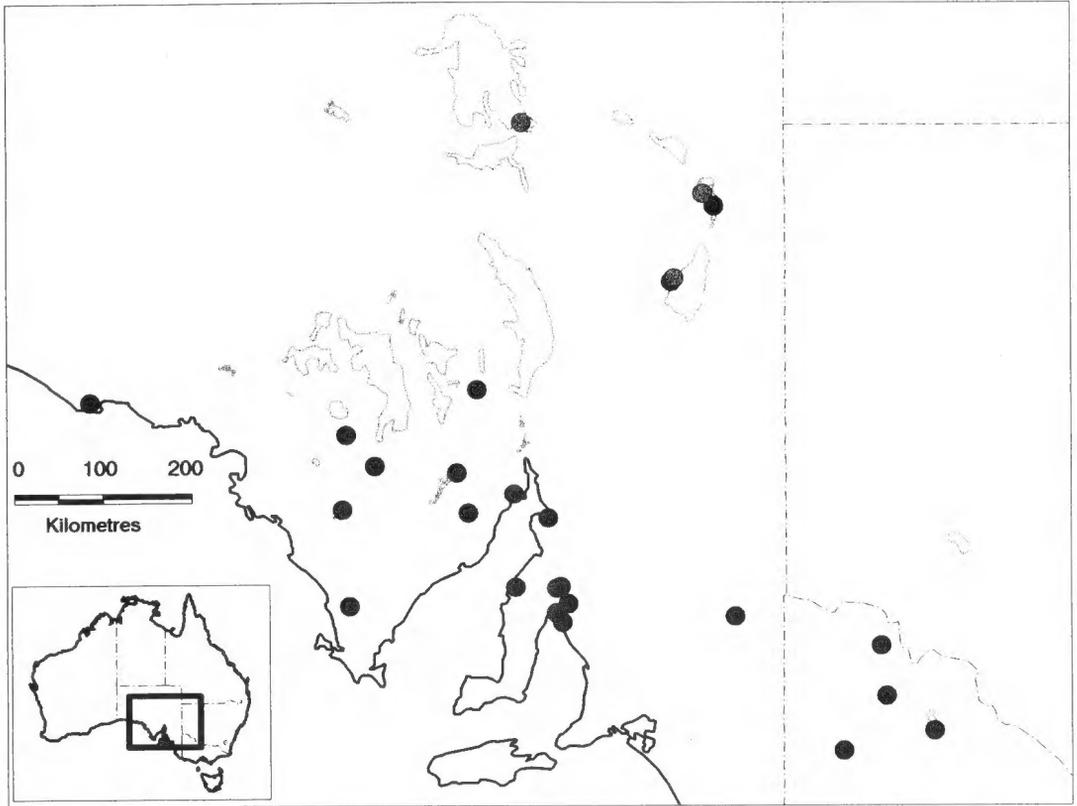


FIGURE 1. Distribution of *Pogonus hypharpagioides* Sloane, previous records (●), new records (●).

Pernatty Lagoon (sth), SA 31.6625°S 137.2375°E (SAMA). Paratypes: 5 females, same data (CBM, SAMA).

Diagnosis

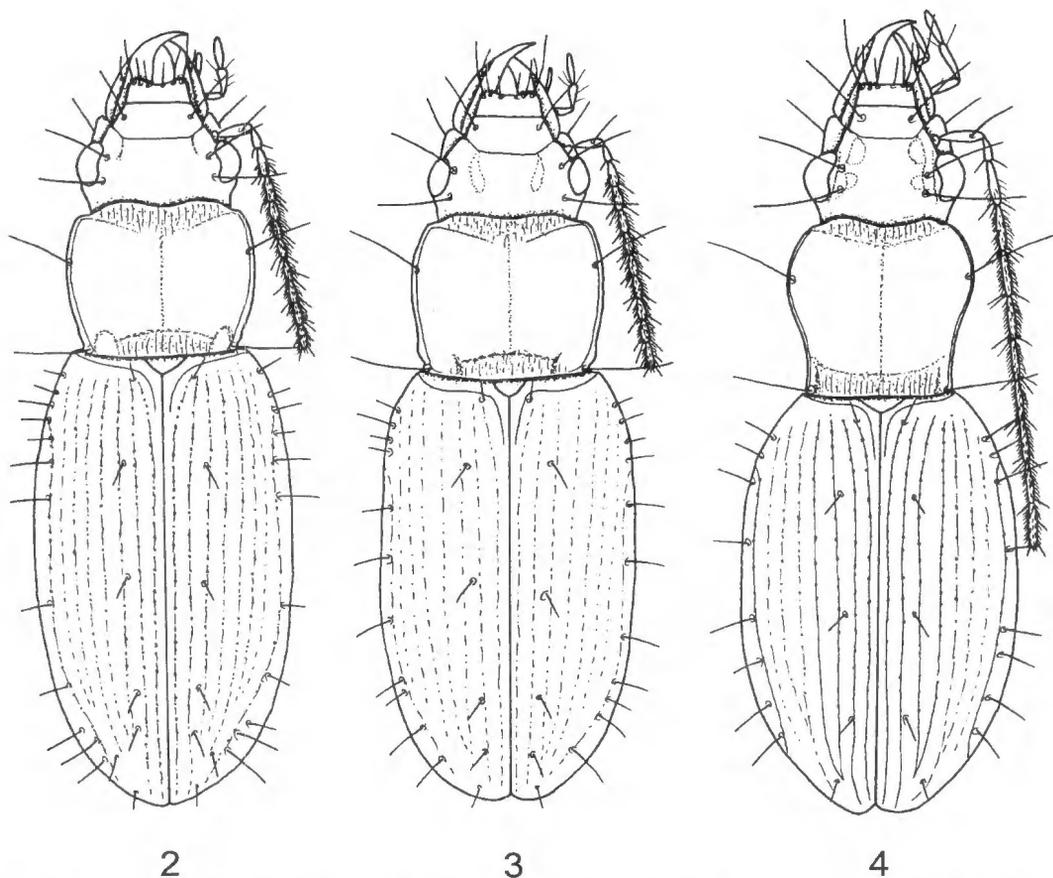
Moderately small, elongate, uniformly reddish 'syrdeniform' species, distinguished from related species mainly by its convex elytra with distinct microreticulation and markedly convex intervals, and its comparatively stout legs with wide metafemur and strongly depressed tibiae. Further distinguishing characters are in Tables 1 and 2.

Description

Measurements: Length: 5.6–6.2 mm; width: 1.9–2.0 mm. Ratios: Width/length of pronotum: 1.15–1.17; width base/apex of pronotum: 0.96–1.02; width of pronotum/width of head: 1.12–1.16; length/width of elytra: 1.86–1.90; width elytra/pronotum: 1.26–1.28. Elytral ratios are only based on two specimens since all are weakly sclerotised and most have their elytra opened and somewhat distorted.

Colour: All known specimens freshly hatched, hence mature colouration somewhat uncertain. Upper and lower surfaces including mouth parts, antennae, and legs yellow. Apex of mandibles dark.

Head (Fig. 2): Rather large and wide, fairly convex, slightly narrower than pronotum. Eyes rather small, depressed, laterally not much projecting, posteriorly slightly enclosed. Labrum short and wide, apex gently emarginate. Mandibles rather elongate, apex fairly incurved. Palpi of moderate size, penultimate palpomere of labial palpus fairly slender, slightly bowed. Submentum quadrisetose, tooth of mentum wide, slightly cleft, bidentate. Lacinia with elongate spines. Clypeus and frons in middle convex, frontal furrows fairly short, sinuate, rather shallow, posteriorly ending in an irregularly shaped impression. Impressions with irregular wrinkles. Antennae short, well short of reaching base of pronotum, median antennomeres little longer than wide, sparsely pilose from middle of 3rd antennomere, more densely pilose from 5th antennomere. Surface rather glossy, impunctate,



FIGURES 2-4. Habitus. 2. *Pogonus matthewsi* sp. nov. 3. *Pogonus vicinus* sp. nov. 4. *Pogonus perovalis* sp. nov. Lengths: 5.6 mm; 6.0 mm; 5.5 mm.

microreticulation rather superficial, approximately isodiametric.

Pronotum (Fig. 2): Slightly wider than long, moderately convex, not cordiform, widest at anterior third slightly behind position of anterior lateral seta. Base about as wide as apex. Apex well produced beyond anterior angles, convex, in middle emarginate. Anterior angles very sharply rounded off, almost rectangular. Lateral border evenly convex throughout, with a very short concavity just in front of basal angles. Marginal channel narrow, border slightly upturned. Basal angles rectangular, dentiform, base convex, laterally rather oblique. Both apex and middle of base unmarginated. Anterior transverse sulcus fairly distinct, median line very shallow, attaining base though not apex, basal transverse sulcus shallow though distinct. Basal grooves circular, merging into marginal channel. Anterior lateral seta

situated in front of anterior third and of widest diameter, posterior marginal seta arising from basal angle. Both apex and base rugosely punctate-striolate. Disk very finely punctate or almost impunctate, at least laterally with more or less distinct, somewhat isodiametric microreticulation, with very faint, irregularly transverse striae, glossy.

Elytra (Fig. 2): Elongate, narrow, rather parallel, dorsally remarkably convex, widest at middle. Humerali very obtusely angulate. Lateral margin straight over most of its distance, little narrowed towards humeri, contiguous at sutural angle. Marginal channel extremely narrow, margin not explanate. All striae complete, well impressed, coarsely punctate. Eighth stria not bowed away from margin. Basal margin evenly curved into short scutellar stria medially of 1st stria. Intervals rather convex. Third interval with 4, rarely

unilaterally 3 setiferous punctures, the anterior and median ones adjacent to 3rd stria, situated about at basal third and at middle, the third and fourth ones in posterior third attached to 2nd stria. 11–12 widely spaced submarginal punctures in a more or less uninterrupted row attached to 8th stria. Scutellar pore and seta present, at base of 1st stria. Intervals impunctate, with very conspicuous, isodiametric microreticulation. Wings fully developed.

Lower surface: Prosternum not pilose. Metepisternum rather elongate, slightly more than half longer than wide at apex. Terminal sternum in male bisetose, in female quadrisetose.

Legs: Rather short and stout, metafemur comparatively stout, tibiae strongly depressed, with sparse and weak spination. Tibial spurs moderately elongate. Tarsi rather short, 1st tarsomere of metatarsus much shorter than both following tarsomeres. Metatrochanter in both sexes short, wide, a third of length of metafemur, apex obtusely rounded. Tarsomeres 1–3 of male protarsus slightly asymmetrically widened on median side, 1st tarsomere biserially squamose, 2nd tarsomere with few squamae on median border only.

Male genitalia (Fig. 5): Genital ring rather regularly triangular, little sclerotised, because the holotype is freshly hatched. Aedeagus small, short and compact, laterally depressed, slightly asymmetric, lower surface regularly though gently curved, apex rather short, obtuse at tip, slightly turned to right side. Internal sac with a coiled, circular, sclerotised plate near base, and with a distinctly denticulate, triangular fold near apex. Right paramere narrow, slightly shorter than left, with 3 elongate apical setae. Left paramere large, convexly tapering to apex, with 2 elongate and 1 short apical setae, the short one situated below the longer ones.

Female genitalia (Fig. 8): Stylocere 1 without setae at apex. Stylocere 2 elongate, curved, with 1 or 2 small ventral ensiform setae near base, and 2 (attached) nematiform setae originating from a groove near apex.

Variation: Only some variation of relative length of elytra and width of pronotum noted.

Distribution (Fig. 19)

So far recorded only from Pernatty Lagoon, slightly west of Lake Torrens, South Australia.

Habits

Specimens were collected following excavation of their burrows. They were widely distributed on

parts of the lake surface lacking a salt crust.

Etymology

The name is a patronym in honour of Eric Matthews, Curator of Coleoptera at the South Australian Museum who kindly gave access to the rich collections of pogonines.

Relationships

The species belongs to the *grossi*-complex, and it appears to be most closely related to *P. grossi* Moore and *P. vicinus* sp. nov.

Pogonus vicinus sp. nov.

(Figs 3, 6, 19)

Types

Holotype: male, P. Hudson 9 July 1997 SEG Exp. Lake Frome 30.6667°S 139.6028°E (SAMA). Paratypes: 1 male, P. Hudson Jul 1997 pit trap, Lake Frome, SA 30.6667°S 139.6028°E (CBM); 1 male, G. Medlin 18 May, 1997 Lake Frome, SA 30.6667°S 139.6028°E (SAMA).

Diagnosis

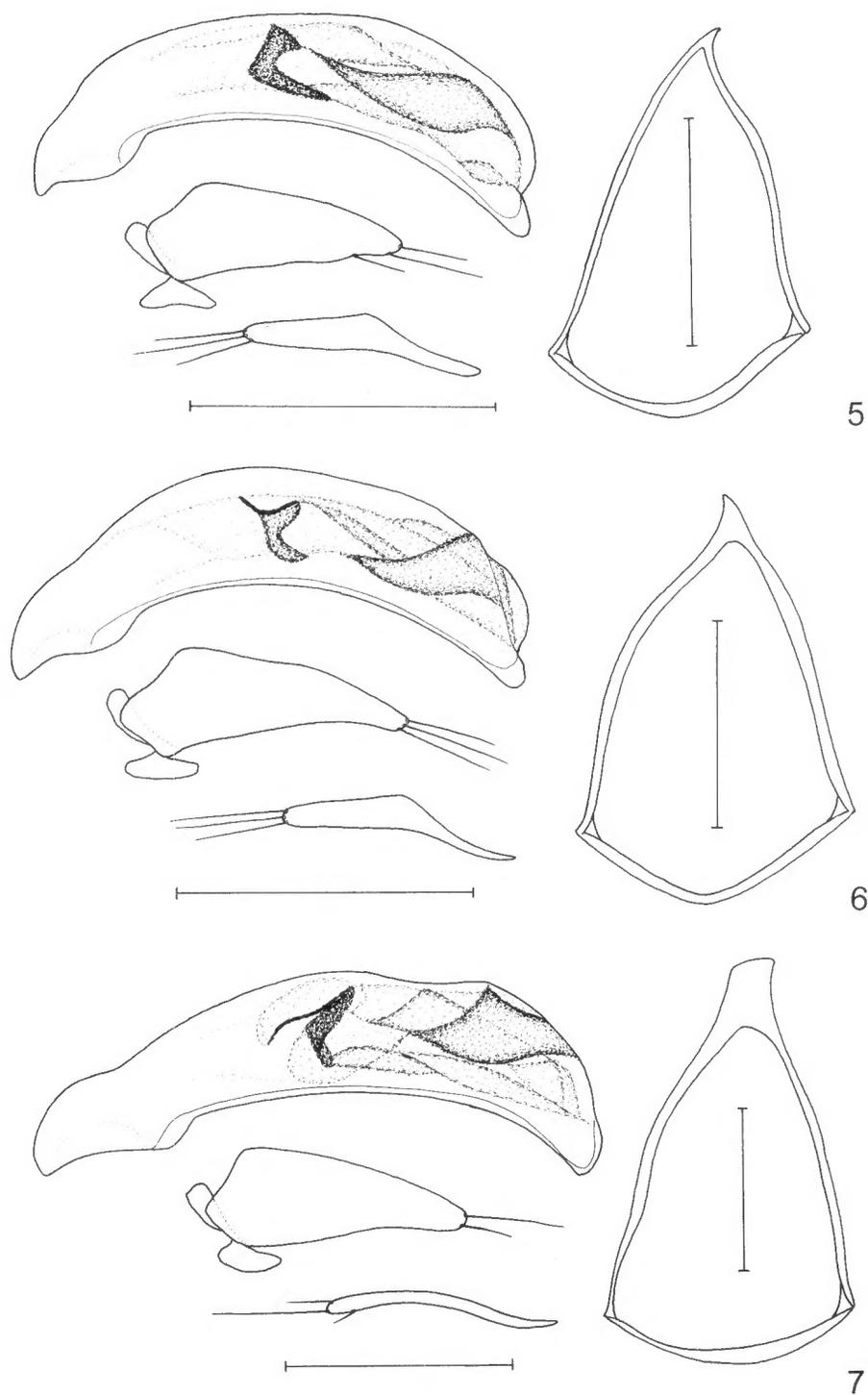
Moderately small, elongate, uniformly reddish 'syrdeniform' species, distinguished from related species mainly by its rather short and wide elytra with shallow, barely punctate striae, and the rather straight though anteriorly abrupt convex lateral margins of pronotum. Distinguishing characters are summarised in Tables 1 and 2.

Description

Measurements: Length: 5.1–6.0 mm; width: 1.85–2.10 mm. Ratios: Width/length of pronotum: 1.13–1.16; width base/apex of pronotum: 0.98–1.01; width of pronotum/width of head: 1.16–1.21; length/width of elytra: 1.72–1.77; width elytra/pronotum: 1.30–1.44.

Colour: Upper and lower surfaces including mouth parts, antennae, and legs dark yellow. Apex of mandibles dark.

Head (Fig. 3): Rather large and wide, fairly convex, slightly narrower than pronotum. Eyes rather small, fairly depressed, laterally not much projecting, posteriorly slightly enclosed. Labrum short and wide, apex gently emarginate. Mandibles moderate, apex fairly incurved. Palpi of moderate size, penultimate palpomere of labial palpus fairly slender, slightly bowed. Submentum quadrisetose, tooth of mentum wide, slightly cleft, bidentate. Lacinia with elongate spines. Clypeus and frons convex in middle, frontal furrows fairly



FIGURES 5–7. Male genitalia: Aedeagus, left side, parameres, genital ring. 5. *Pogonus matthewsi* sp. nov. 6. *Pogonus vicinus* sp. nov. 7. *Pogonus perovalis* sp. nov. Scales: 0.5 mm.

short, sinuate, fairly shallow, posteriorly ending in an irregular impression. Antennae rather short, not attaining base of pronotum, median antennomeres about a third longer than wide, sparsely pilose from middle of 3rd antennomere, more densely pilose from 5th antennomere. Surface glossy, impunctate, without microreticulation.

Pronotum (Fig. 3): Slightly wider than long, rather depressed, not cordiform, widest at anterior third slightly behind position of anterior lateral seta. Base about as wide as apex. Apex slightly produced beyond anterior angles, convex, emarginate in middle. Anterior angles very sharply rounded off, almost rectangular. Lateral border anteriorly convex or even almost oblique, then oblique and straight, just in front of basal angles incurved and forming a very small concavity. Marginal channel narrow, posteriorly slightly widened, border slightly upturned. Basal angles rectangular, very faintly dentiform, base convex, laterally rather oblique. Both apex and middle of base unmarginated. Anterior transverse sulcus fairly distinct, median line very shallow, attaining base though not apex, basal transverse sulcus moderately shallow, distinct. Basal grooves circular, merging into marginal channel. Anterior lateral seta situated in front of anterior third and point of greatest width, posterior marginal seta arising from basal angle. Apex and base rugosely punctate-striolate. Disk impunctate, without microreticulation, with very faint, irregularly transverse striae, glossy.

Elytra (Fig. 3): Comparatively short and wide for group, moderately narrow, not parallel, dorsally rather depressed, widest at middle. Humeri very obtusely angulate or almost rounded. Lateral margin gently convex over most of its distance, slightly narrowed towards humeri, contiguous at sutural angle. Marginal channel extremely narrow, margin not explanate. All striae complete, not much impressed, almost impunctate. Eighth stria not bowed away from margin. Basal margin evenly curved into short scutellar stria medially of 1st stria. Intervals depressed. Third interval with 4, rarely unilaterally 3 or 5 setiferous punctures, the anterior and median ones adjacent to 3rd stria, situated about at basal third and at middle, the third and fourth ones in posterior third attached to 2nd stria. 10–11 widely spaced submarginal punctures in a more or less interrupted row attached to 8th stria. Scutellar pore and seta present, at base of 1st stria. Intervals impunctate, with fairly superficial, isodiametric microreticulation. Wings fully developed.

Lower surface: Prosternum not pilose.

Metepisternum rather elongate, about a half longer than wide at apex. Terminal sternum in males bisetose, unknown in females.

Legs: Rather short and stout, metafemur moderately stout, tibiae fairly well depressed, with sparse and weak spination. Tibial spurs moderately elongate. Tarsi rather short, 1st tarsomere of metatarsus much shorter than both following tarsomeres. Metatrochanter in males short, wide, a third of length of metafemur, apex obtusely rounded. Tarsomeres 1–3 of male protarsus slightly asymmetrically widened on median side, 1st tarsomere biserially squamose, 2nd tarsomere with few squamae on median border only.

Male genitalia (Fig. 6): Genital ring rather regularly triangular. Aedeagus small, short and compact, laterally depressed, slightly asymmetric, lower surface regularly though gently curved, apex rather short, obtuse at tip, slightly turned to right side. Internal sac with a coiled, circular, sclerotised plate near base, and with a distinctly denticulate, triangular fold near apex. Right paramere narrow, slightly shorter than left, with 3 elongate apical setae. Left paramere large, comparatively elongate, tapering to apex, with 3 elongate apical setae.

Female genitalia: Unknown.

Variation: Only some variation of relative width of pronotum noted.

Distribution (Fig. 19)

So far recorded only from Lake Frome, southeast of Lake Eyre, South Australia.

Habits

Excavated from burrows in the lake surface and collected by pitfall trapping.

Etymology

The name refers to the strong similarity of this species to the related *P. grossi* Moore and *P. matthewsi* sp. nov.

Relationships

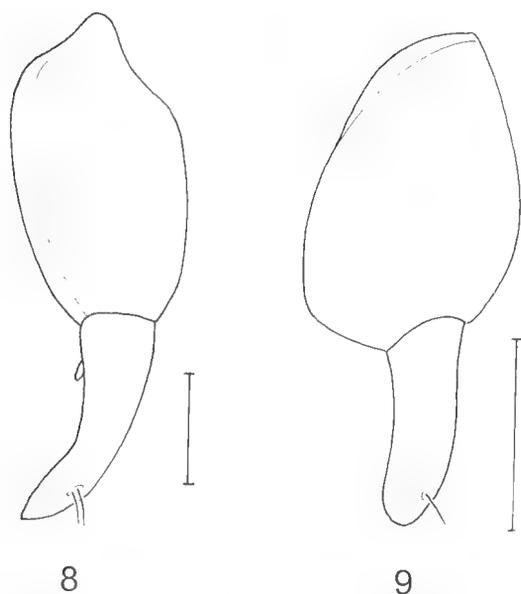
The species belongs to the *grossi*-complex, where it apparently takes a position near *P. grossi* Moore and *P. matthewsi* sp. nov.

***Pogonus perovalis* sp. nov.**

(Figs 4, 7, 9, 10, 19)

Types

Holotype: male, P. Hudson (SEG Exp 95) Jul



FIGURES 8–9. Female stylomeres 1 and 2. 8. *Pogonus matthewsi* sp. nov. 9. *Pogonus perovalis* sp. nov. Scales: 0.1 mm.

1995 pit traps Lake Gairdner, SA 32.3014°S 135.8867°E (SAMA). Paratypes: 2 males, 1 female, same data (CBM, SAMA); 1 female, P. Hudson 3 Sep 1996 Island Lagoon, SA 31.4139°S 136.9292°E (SAMA); 1 female, Remko Leijs 30 Jun 1996 Lake Hart, SA 31.2278°S 136.3792°E (SAMA).

Diagnosis

Rather small, convex, apparently depigmented species, at once distinguished by the oval-shaped, convex elytra, convex, rather cordiform pronotum, and elongate antennae.

Description

Measurements: Length: 4.35–5.70 mm; width: 1.60–2.10 mm. Ratios: Width/length of pronotum: 1.03–1.12; width base/apex of pronotum: 0.88–0.96; width of pronotum/width of head: 1.10–1.18; length/width of elytra: 1.49–1.53; width elytra/pronotum: 1.49–1.56. Elytral ratios are only based on a few specimens since all are weakly sclerotised and most have their elytra opened and somewhat distorted.

Colour: Apparently depigmented, though all known specimens freshly hatched, hence colouration somewhat uncertain. All specimens very light yellowish. Only apex of mandibles dark.

Head (Fig. 4): Fairly large, rather depressed, slightly narrower than pronotum. Eyes large, rather convex, laterally well projecting, posteriorly not enclosed. Labrum short and wide, apex straight. Mandibles very elongate, somewhat decussate, apex incurved. Palpi elongate, apical palpomeres somewhat incised, slightly subulate. Penultimate palpomere of labial palpus slender, slightly bowed. Submentum bisetose, tooth of mentum wide, slightly cleft, bidentate. Lacinia with elongate spines. Clypeus and frons convex in middle, frontal furrows fairly elongate, rather sinuate, fairly shallow, at posterior end forming an irregular impression. Irregular wrinkles within and between impressions. Antennae very elongate, surpassing base of pronotum by almost 4 antennomeres, median antennomeres > 3 x as long as wide, pilose from middle of 3rd antennomere. Surface glossy, impunctate, without any microreticulation.

Pronotum (Fig. 4): Slightly wider than long, convex, rather cordiform, widest at anterior third approximately at position of anterior lateral seta. Base slightly narrower than apex. Apex produced beyond anterior angles, feebly convex. Anterior angles sharply rounded off. Lateral border evenly convex in anterior two thirds, then gently concave to basal angles. Marginal channel extremely narrow, border slightly upturned, forming a sharp edge. Basal angles rectangular, base slightly convex. Apex and base unmarginated. Anterior transverse sulcus barely indicated, median line very shallow, attaining base though not apex, basal transverse sulcus very shallow. Basal grooves shallow, circular, merging into marginal channel. Anterior lateral seta situated at anterior third, at point of greatest width, posterior marginal seta arising from basal angle. Both apex and base rugosely punctate-striolate. Disk impunctate and without microreticulation, highly glossy, with some very faint, transverse striae.

Elytra (Fig. 4): Short, markedly oval-shaped, convex, widest at or slightly behind middle. Humeri angulate, more or less rectangular. Lateral margin evenly convex throughout. Marginal channel narrow, margin not explanate. All striae complete, well impressed, punctate. Eighth stria originating at basal fifth, slightly bowed away from margin. Basal margin evenly curved into short scutellar stria medially of 1st stria. Intervals depressed to very feebly convex. Third interval with 3 setiferous punctures, the anterior and median ones adjacent to 3rd stria, situated at about basal third and at middle, the third puncture in posterior third attached to 2nd stria. Nine, rarely 10

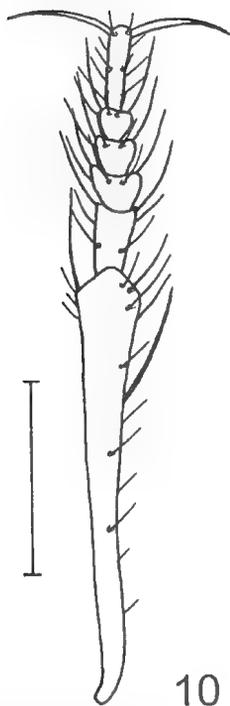


FIGURE 10. *Pogonus perovalis* sp. nov. Right protibia and tarsus, dorsolateral view.

widely spaced submarginal punctures in an uninterrupted row attached to 8th stria. Scutellar pore and seta present, at base of 1st stria. Intervals impunctate, though with very distinct, absolutely isodiametric microreticulation. Wings absent.

Lower surface: Prosternum not pilose. Metepisternum very short, shorter than wide at apex. Terminal sternum in male bisetose, in female quadrisetose.

Legs (Fig. 10): Remarkably slender and elongate, especially femora and tibiae. Tibiae not at all depressed, almost circular, with sparse and weak spination. All tibial spurs elongate. Tarsi rather short, 1st tarsomere of metatarsus shorter than both following tarsomeres. Metatrochanter in both sexes short, wide, a quarter of length of metafemur, apex obtusely rounded. Tarsomeres 1–3 of male protarsus slightly asymmetrically widened on median side, 1st tarsomere biserially squamose, 2nd tarsomere with few squamae on median border only.

Male genitalia (Fig. 7): Genital ring rather regularly triangular. Aedeagus comparatively large, fairly elongate, laterally depressed, slightly asymmetric, lower surface almost straight, in apical third markedly concave. Apex laterally very

depressed, scuriform, slightly turned to right side. Internal sac with a coiled, circular, sclerotised plate near base, and with a distinctly denticulate, triangular fold near apex. Right paramere very slender and elongate, slightly shorter than left, with one very elongate and two shorter apical setae, the elongate situated in middle. Left paramere large, comparatively elongate, tapering to apex, with 1 very elongate apical seta and a short, delicate seta below.

Female genitalia (Fig. 9): Stylomere 1 apparently without setae at apex. Stylomere 2 moderately elongate, barely curved, with wide, obtuse apex, without ventral ensiform setae, with 2 (attached) nematiform setae originating from a groove very close to apex.

Variation: Apart from some differences in size, little variation noted.

Distribution (Fig. 19)

Recorded from Lake Gairdner, Island Lagoon, and Lake Hart, all South Australia.

Habits

Collected in pitfall traps on the lake surface.

Etymology

The name refers to the markedly ovate elytra of this flightless species.

Relationships

Phylogenetically rather isolated species, but may be remotely related to the *P. grossi* species complex.

Syrdenoidius gen. nov.

Type species: *Syrdenoidius spinipes* sp. nov., by monotypy.

Diagnosis

Genus of subfamily Pogoninae. In many respects highly similar to the Palearctic genus *Syrdenus* Chaudoir, e.g. narrow, elongate, depressed body shape; absence of microreticulation on elytra; markedly angulate, even dentate humeri; wide 9th elytral interval; short, quadrate antennomeres. However, there are some striking peculiarities in *Syrdenoidius*: asetose prosternum; presence of several rows of remarkably elongate spines on all tibiae (particularly conspicuous on protibia), that occupy almost the whole length of the tibiae; prolongation of 8th elytral stria to humerus; absence of scutellar

striole and pore; absence of hind wings, and quadrate metepisternum; very elongate, forceps-like mandibles; very unusual female genitalia with extremely short, straight stylomere 2.

Etymology

The name refers to the strong similarity in external morphology to the genus *Syrdenus*.

Relationships

Whereas the similarity of some characters in *Syrdenus* and *Syrdenoidius* is probably coincidental, several could point to a closer relationship of both genera. This is especially true for the wide 9th elytral interval that bears on its median margin the marginal pores and setae that are, therefore, far removed from the lateral margin of the elytra. On the other hand, elongate, depressed body shape is an adaptation common within several pogonine genera, not only in *Syrdenus*, but also in *Pogonus* proper and in *Pogonistes*. We think that the genus *Syrdenoidius* is a highly isolated one though it possibly has closest affinities with *Syrdenus*. Whilst *Syrdenus* is so far decidedly a Palaearctic genus there is, however, an as yet undescribed species known from West Bengal, northeastern India, that demonstrates that the genus has a wider distribution than commonly believed. If the genus *Syrdenus* is a relict of the former Tethys fauna, then a relationship with the fauna of western and northwestern Australia might well be possible since it has been argued that this area formerly had contact with the Tethys or was even part of its southern shore (Eric Matthews, 1998, pers. com.). This question may be settled in the future by more intensive sampling along the coast and on the inland lakes of Western Australia.

Syrdenoidius spinipes sp. nov.
(Figs 11–19)

Types

Holotype: male, S. AUST. L. Gairdner 32°07'S 135°53'E 14 July 95 P. Hudson (SAMA). Paratypes: 6 males, 13 females, same data (ANIC, CBM, SAMA); 1 female, P. Hudson 14 July 1995 SEG Exp. 95 Lake Gairdner 32°07'47''S 135°53'19''E (SAMA).

Diagnosis

Medium-sized, very elongate, narrow, depressed, depigmented species with large, convex head, large though depressed eyes, very

elongate mandibles, almost regularly trapezoidal pronotum that is widest at apex, non-microreticulate surface, and remarkably spinose tibiae.

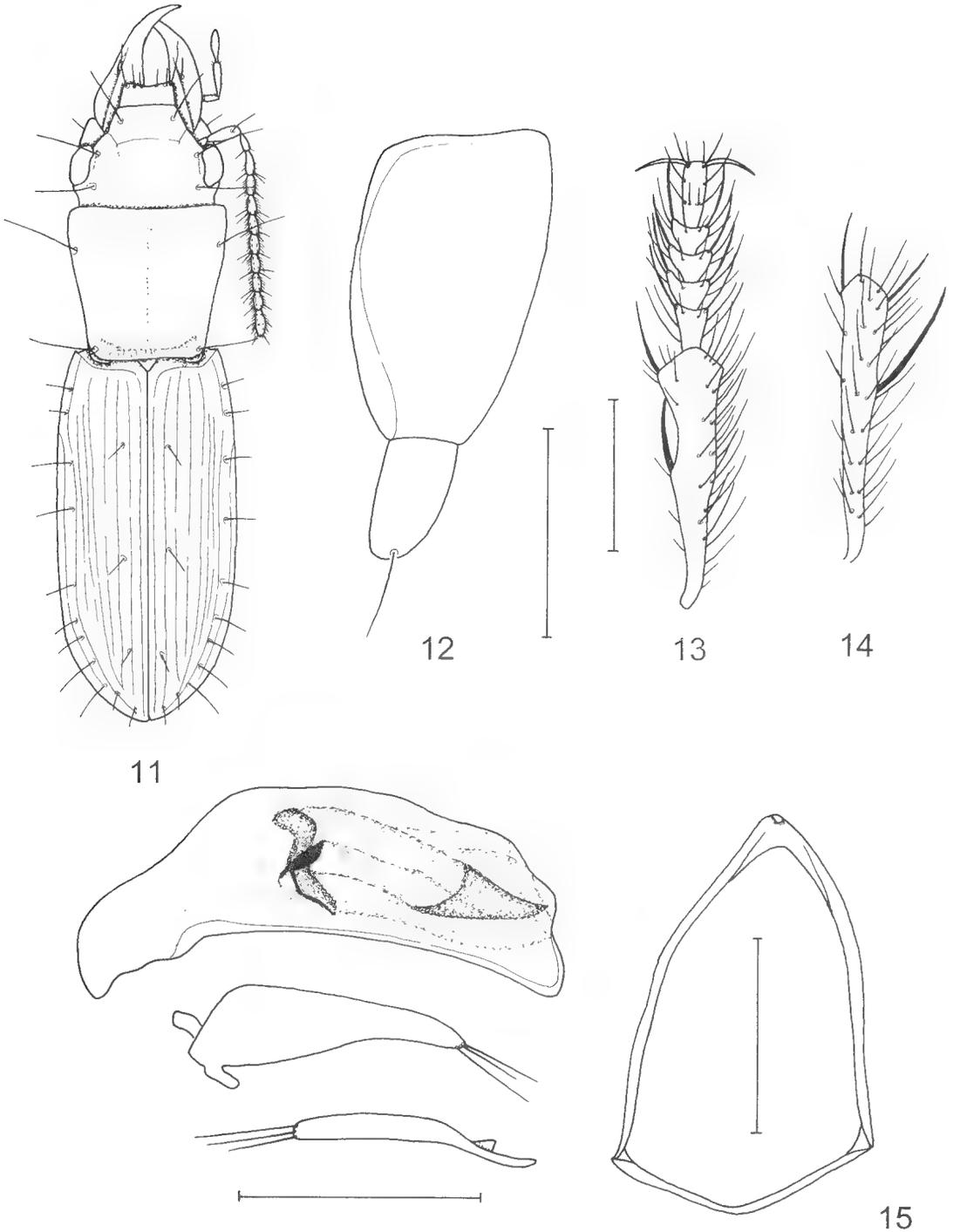
Description

Measurements: Length: 5.4–6.3 mm; width: 1.50–1.65 mm. Ratios: Width/length of pronotum: 1.03–1.08; width base/apex of pronotum: 0.73–0.77; width of pronotum/width of head: 1.04–1.07; length/width of elytra: 2.06–2.12; width elytra/pronotum: 1.12–1.16.

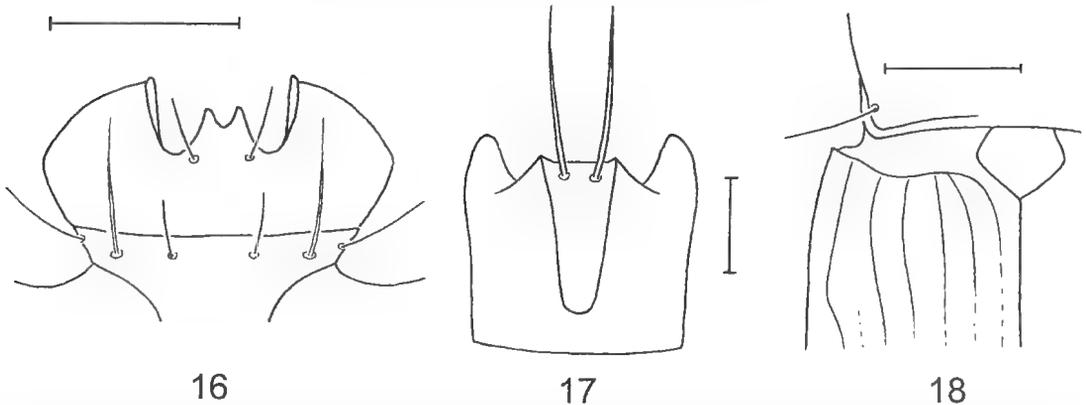
Colour: Upper and lower surface, including mouth parts, antennae, and legs light reddish, elytra very slightly lighter. Apex of mandibles darker.

Head (Figs 11, 16–18): Large, convex, slightly narrower than pronotum. Eyes large though remarkably depressed, laterally barely projecting, posteriorly not enclosed. Lower rim of eye forming a sharp edge that slightly surpasses the eye laterally. Labrum short and wide, apex fairly emarginate. Mandibles very elongate, somewhat decussate, apex strongly incurved. Palpi elongate, apical palpomeres somewhat incised, slightly subulate. Penultimate palpomere of labial palpus very slender, slightly bowed. Submentum sexsetose, tooth of mentum wide, deeply cleft, markedly bidentate (Fig. 16). Lacinia with very elongate spines. Ligula bisetose, paraglossae slightly surpassing glossa (Fig. 17). Clypeus and frons convex in middle, frontal furrows elongate, slightly sinuate, beginning on clypeus. Frons behind frontal furrows with a wide, circular, shallow impression on either side, irregular wrinkles between impressions. Antennae short, wide, not attaining base of pronotum, median antennomeres almost as wide as long, sparsely pilose from middle of 3rd antennomere, more densely pilose from 5th antennomere. Surface glossy, impunctate, without any microreticulation.

Pronotum (Figs 11, 18): Barely wider than long, remarkably trapezoidal, widest at apex. Surface moderately convex. Apex little produced beyond anterior angles, in middle with very shallow, triangular excision. Anterior angles broadly rounded. Lateral margin almost straight, oblique, slightly rounded only near apex, faintly incurved towards base. Border somewhat irregular, bearing several slight notches. Basal angles obtusely rounded, base almost straight. Marginal channel extremely narrow, margin forming a fairly sharp ridge. Apex unmarginated, base coarsely marginated, margin narrowly surrounding basal angles and meeting lower margin of epipleura, this margin



FIGURES 11–15. *Syndenoidius spinipes* gen. nov., sp. nov. 11. Habitus. Length 5.6mm. 12. Female stylomeres 1 and 2. Scale 0.1mm. 13. Right protibia and tarsus, dorsal view. 14. right protibia, dorsolateral view. Scale: 0.5 mm. 15. Male genitalia: Aedeagus, left side, parameres, genital ring. Scale 0.5mm.



FIGURES 16–18. *Syrdenoidius spinipes* gen. nov. sp. nov. 16. Mentum and submentum, ventral view. Scale: 0.5 mm 17. Ligula, ventral view. Scale: 0.1 mm. 18. Base of left elytron. Scale 0.5 mm.

sometimes even visible from above (Fig. 18). Anterior transverse sulcus barely indicated, median line very shallow, deepened near base, attaining apex and base. Basal transverse sulcus shallow though distinct. Base coarsely striolate, basal grooves rather shallow, irregular. Anterior marginal seta inserted at anterior fourth, posterior seta situated just in front of basal angle, anterior and posterior setae slightly removed from margin. Disk impunctate and without any microreticulation, highly glossy, though laterally with some transverse striolations.

Elytra (Figs 11, 18): Very narrow and elongate, parallel-sided, markedly depressed. Humeri very sharply projecting, markedly angulate. Lateral margin gently oblique or slightly convex in basal fourth, then parallel, only in apical fourth convex again. Marginal channel narrow throughout. Apical angles broadly rounded, apex in middle slightly incised. No internal plica visible from outside. Striae complete, deep, not punctate, but somewhat irregular, sometimes interrupted or with anastomoses. Eighth stria bowed away from margin in anterior fourth, laterally leaving a wide space, though anteriorly attaining humerus. Basal margin evenly curved into 1st stria, no scutellar stria present. Scutellar pore and seta absent. Intervals convex, though their surface rather uneven. Third interval with 3 setiferous punctures adjoining 3rd stria, the first situated in anterior third, the second in middle, the third in apical third, but their position rather variable. Submarginal punctures far removed from margin, adjoining lateral margin of 8th stria, consisting of 4 punctures in anterior group and 6 punctures in posterior group, with a wide space between them.

Also with 1 puncture at end of 5th interval and 2nd interval. Surface impunctate, without microreticulation, highly glossy. Wings almost completely reduced.

Lower surface: Prosternum not pilose. Metepisternum short, barely longer than wide at apex. Terminal sternum in male bisetose, in female quadrisetose.

Legs (Figs 13, 14): Moderately elongate. Protibia and mesotibia with 4 rows of remarkably stout and elongate spines all along dorsal, lateral, and latero-ventral surfaces. Metatibia less spinose. Apical tibial spurs of protibia and mesotibia remarkably elongate, much longer than 1st tarsomere. Tarsi rather short, 1st tarsomere of metatarsus shorter than both following tarsomeres. Tarsi remarkably hirsute. Tarsomeres 1–3 of male protarsus slightly asymmetrically widened on median side, 1st and 2nd tarsomeres with few squamae on median border. Metatrochanter in both sexes less than half as long as metafemur, obtuse at apex.

Male genitalia (Fig. 15): Genital ring wide, in basal half almost quadrangular, apically regularly triangular, rather symmetric. Aedeagus short and very compact, laterally depressed, slightly asymmetric, lower surface barely curved, apex very short, obtuse, barely turned laterally. Internal sac with a complexly coiled, in parts heavily sclerotised plate near base, and with a distinctly denticulate, triangular fold near apex. Right paramere moderately narrow, about a third shorter than left, with 3 elongate apical setae. Left paramere elongate, rather slender, abruptly narrowed to the downcurved apex, with 3 elongate apical setae.

Female genitalia (Fig. 12): Stylocere 1 apparently without setae at apex. Stylocere 2 very short, straight, almost quadrate, with wide, convex apex, without ensiform setae, though with an elongate nematiform seta arising from apex.

Variation: Very little variation noted.

Distribution (Fig. 19)

Only recorded from Lake Gairdner, South Australia.

Habits

Excavated from burrows in the lake surface.

Etymology

The name refers to the remarkably spinose tibiae of this species.

KEY TO THE GENERA OF AUSTRALIAN POGONINAE

- 1. — Elytra without microreticulation; humerus sharply angulate (Figs 11, 18); protibia with several rows of elongate spines on dorsal and lateral surfaces that occupy almost the whole length (Figs 13, 14); pronotum remarkably trapezoidal, widest at anterior angles (Fig. 4). Lake Gairdner, SA *Syrdenoidius* gen. nov. (only *S. spinipes* sp. nov.)

- 2. — Elytra with distinct microreticulation; humerus not so angulate (Figs 2–4); protibia with a short row of moderate spines on lateral surface only (Fig. 10); pronotum differently shaped, widest far behind anterior angles (Figs 2–4). Widely distributed in Australia *Pogonus* Dejean

KEY TO THE AUSTRALIAN SPECIES OF THE GENUS *POGONUS* DEJEAN

- 1. — Body completely metallic green or black 2
- Body entirely or in parts testaceous 5
- 2. — Colour shining black; punctures of elytra very coarse, microreticulation inconspicuous. Northeastern Queensland, coastal and inland *nigrescens* Baehr
- Colour greenish metallic; punctures of elytra finer, microreticulation conspicuous. Southern half of Australia 3
- 3. — Sixth and 7th striae almost similar to inner 5 striae; flightless; elytral margins ovate. Lake Yindarlgooda, Western Australia *fennelli* Hudson
- Sixth and 7th striae less marked than 5

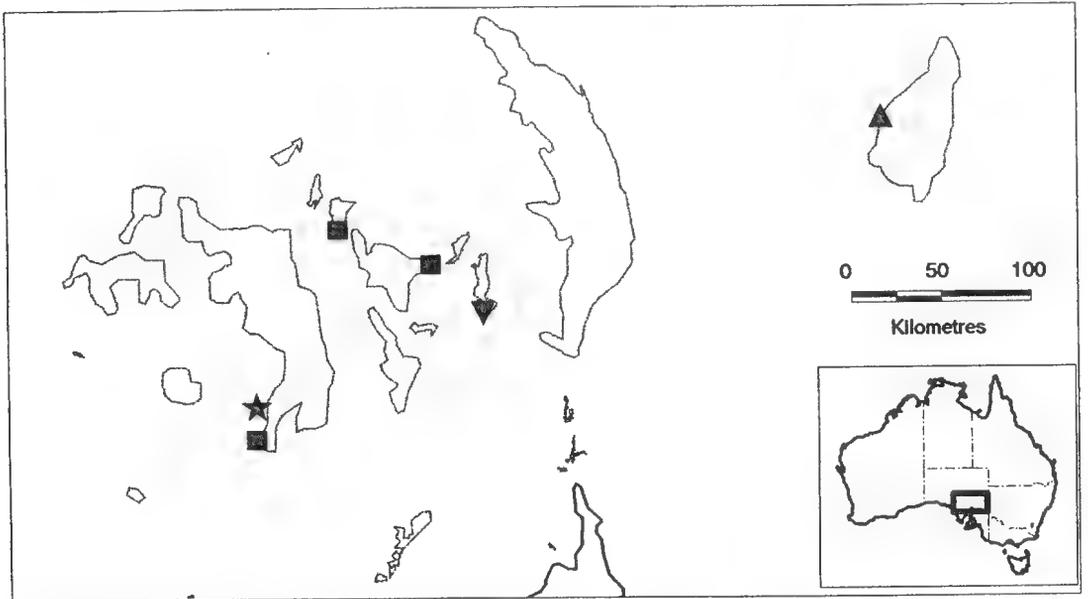


FIGURE 19. Distribution of *Pogonus matthewsi* sp. nov. (▼), *P. vicinus* sp. nov. (▲), *P. pervalis* sp. nov. (■), *Syrdenoidius spinipes* gen. nov., sp. nov. (★).

- inner striae; fully winged; elytral margins more parallel sided 4
4. — Smaller (body length 6.3–6.8 mm), body narrower, more convex; pronotum markedly sinuate in front of the acute basal angles, these being 90° or less; submarginal basal ridge of pronotum scarcely indicated. Southern Australia from Western Australia to Victoria along coast *australis* Chaudoir
- Larger (body length 7.5–8.5 mm), body wider, less convex; pronotum less sinuate, basal angles more obtuse, these being c. 100°; submarginal basal ridge of pronotum conspicuous. Coastal and inland from southern half of Western Australia to southeastern Queensland *cardiotrachelus* Chaudoir
5. — Bicoloured, head and pronotum distinctly darker than elytra 6
- Completely testaceous or light reddish, head and pronotum not perceptibly darker than elytra (variable species under both couplets) 7
6. — Large, convex species (body length 9–11 mm); pronotum not lobate, distinctly sinuate in front of basal angles. Northern Australia from northwestern Queensland to the Kimberleys, coastal and along tidal rivers *variabilis* Moore
- Small, depressed species (body length c. 6.5 mm); pronotum lobate, barely sinuate in front of basal angles. Inland saline habitats in Western Australia and South Australia *zietzi* Sloane
7. — Large species (body length >9 mm); either pronotum distinctly sinuate in front of basal angles and base about as wide as apex, or pronotum rather quadrate with characteristically bisinuate base, and elytra wide, oval-shaped, and depressed with wide, explanate lateral margin. Northern Australia from northwestern Queensland to Exmouth Gulf, coastal and along tidal rivers 8
- Smaller species (body length <8.5 mm); pronotum distinctly sinuate or not in front of basal angles; but when distinctly sinuate, then base markedly narrower than apex; when not sinuate, then elytra not wide, oval-shaped, and depressed; and with narrower, not explanate lateral margin. Inland in southern half of Australia 9
8. — Pronotum distinctly sinuate in front of basal angles, lateral margin not explanate at base; eyes convex, laterally markedly protruding; elytra less wide and depressed, lateral margin not explanate, striation deeper and more complete, striae distinctly punctate. Northern Australia from northwestern Queensland to the Kimberleys *variabilis* Moore
- Pronotum rather quadrate, lateral margin conspicuously explanate at base; eyes depressed, laterally little protruded; elytra wide and depressed, lateral margin explanate, striation shallow and laterally incomplete, striae more finely punctate. Coast of northwestern Australia south of Great Sandy Desert *sumlini* Baehr
9. — Pronotum distinctly sinuate in front of basal angles and base markedly narrower than apex; left paramere with 2 apical setae, right paramere with a single apical seta. South Australia, Lake Eyre Basin ..
..... *gilesi* Moore
- Pronotum either not distinctly sinuate in front of basal angles or base about as wide as apex; left paramere with 3, right paramere with 2 or 3 apical setae 10
10. — Large, convex species (body length 7.2–8.4 mm); head large, pronotum laterally markedly convex. South Australia, northwestern Victoria
..... *hypharpagioides* Sloane
- Smaller, more depressed species (body length <6.5 mm); head smaller, pronotum laterally less convex 11
11. — Pronotum rather quadrate, lateral margin evenly curved from apex to base, widest in middle; elytral striae shallow, only 3 inner striae distinct. Interior of Western Australia *diplochaetoides* Baehr
- Pronotum more narrowed to base than to apex, widest in anterior third, lateral margin not so evenly curved; elytral striae deeper, at least 5 inner striae distinct. South Australia 12
12. — Elytra laterally and dorsally convex, oviform; pronotum narrow, convex, with elongate situation in front of basal angles (Fig. 4); antenna elongate, median antennomeres >3 x as long as wide. Lake Gairdner, Island Lagoon, Lake Hart
..... *perovalis* sp. nov.
- Elytra elongate, parallel, dorsally

- depressed; pronotum wide, depressed, with at most a short sinuation in front of basal angles (Figs 2, 3); antenna short, median antennomeres $<1.5 \times$ as long as wide 13
13. — Smaller species (body length 4.1–4.9 mm); lateral margin of pronotum straight or slightly concave in front of base, basal angle almost 90° , distinctly projecting. Lake Gairdner, Island Lagoon, Lake Hart *saskiae* Baehr
- Larger species (body length 5.2–6.4 mm); lateral margin of pronotum convex to base, basal angle obtuse, or dentiform 14
14. — Elytra rather convex, intervals remarkably convex, microreticulation conspicuous. Pernatty Lagoon *matthewsi* sp. nov.
- Elytra rather depressed, intervals but slightly convex, microreticulation distinct though not conspicuous 15
15. — Lateral margin of pronotum evenly convex, basal angle not dentiform; elytra longer, striae rather deep, distinctly punctate. Lake Eyre *grossi* Moore
- Lateral margin of pronotum rather straight, in anterior third suddenly convex, basal angle dentiform; elytra shorter, striae rather shallow, barely punctate. Lake Frome *vicinus* sp. nov.

REMARKS

The collections included within this paper have been made from lakes ranging up in size from approximately 0.3 km^2 ('Artaming Lake', south of Lake Acraman) to large systems such as Lake Torrens, Lake Frome, Lake Gairdner, and Lake Tyrell. Usually the collections were made when the lakes were devoid of surface water. The beetles were usually collected during the day by excavating their burrows, the location of which was indicated by a small mound of mud on the lake surface. The beetles occupy a large part of the dry lake surface that is free of salt crust. Some collections have also been made using pitfall traps, even on surfaces covered with a thin salt crust and some specimens were detected while running on the surface at night.

From excavated specimens and pit-trapping at least two species are known to occur on Lake Gairdner, *Syrdenoidius spinipes* and *P. perovalis*. According to Moore (1977), at the shore of Lake

Eyre three species have been also found together at light, namely *P. hypharpagioides*, *P. gilesi*, and *P. grossi*. However, as on Lake Gairdner, the three species represent rather different life style types, namely a large, bulky one (*P. hypharpagioides*), a medium sized one (*P. gilesi*, comparable to *P. perovalis*), and an elongate, depressed one (*P. grossi*, comparable to *Syrdenoidius spinipes*). Hence, the species obviously occupy a special niche, at least with respect to food preferences which is demonstrated by their different head sizes and mandible lengths and shapes.

If this and other recent papers on the Australian pogonine fauna are any indication then it is most likely that there are numerous other taxa awaiting collection and description. With the existence of flightless taxa there is an increased likelihood that some species will be highly endemic. Clearly a systematic survey of the salt lake fauna of southern Australia is warranted, in the first instance to establish the extent of the Australian fauna and secondly for conservation purposes since many salt lakes, especially those in Western Australia, are sites of intense mining activity.

The 'island-like' nature of the Australian salt lake habitats and the range in their size and degree of geographic isolation make studies of their fauna particularly interesting from an evolutionary and genetic perspective (e.g. see Hudson and Adams 1996). Desender and Serrano (1999) have highlighted the value of using electrophoresis techniques in the study of variation in Atlantic and Mediterranean European populations of *Pogonus chalceus* and similar such studies could provide valuable insight to the Australian pogonines.

Wing atrophy and flightlessness in beetles has been documented by numerous authors (Kavanaugh 1985, Roff 1990, and references therein). In pogonines outside Australia, full wing atrophy is only known in the Californian *Thalassotrechus barbarae* (Horn), an intertidal species which is outstanding also in other morphological characters. Principally, all other known pogonines possess fully developed wings and are capable of flight. However, reduction in wing size and lack of functional flight musculature is known in some *Pogonus chalceus* populations (Desender 1989, pers. com. 1999), though the Mediterranean populations of that species are capable of flight (Ravizza 1972). Hence, from the viewpoint of wing development the Australian pogonine fauna seems to be highly unusual, because full reduction of wings is known in three rather different Australian groups, the

genus *Syrdenoidius* and the fully pigmented and depigmented species groups of the genus *Pogonus*.

It should be stressed, however, that in Australia at least, there is a clear difference between species inhabiting saline coastal habitats and those that exclusively live on inland salt lakes. Unlike in the Mediterranean, for example, the Australian sea shores are inhabited only by quite large, convex species of normal 'pogoniform' habitus (*P. australis*, *P. cardiotrachelus*, *P. nigrescens*, *P. sumlini*, *P. variabilis*), most of which are pigmented, whereas elongate, depressed, depigmented 'syrdeniform' species are completely absent from these environments. These latter species occur in saline inland environments together with pigmented species (*P. cardiotrachelus*, *P. fennelli*), and convex, medium-sized or large, either depigmented or partly depigmented species (*P. gilesi*, *P. hypharpagioides*, *P. zietzi*). Flightless species have been found only in inland environments (*P. fennelli*, *P. perovalis*, *Syrdenoidius spinipes*).

If we argue that the pigmented 'pogoniform' species, from the viewpoint of phylogeny, are most

plesiotypic, and the depigmented 'syrdeniform' species most apotypic, then the interior saline environment in Australia has a very diverse, highly evolved pogonine fauna, which is evidence of a long term history of the fauna. In the rich pogonine fauna of the Mediterranean region which likewise includes normal 'pogoniform' species and 'syrdeniform' species the latter occur only at the sea shore. The history of the Australian pogonine fauna thus is strikingly different and once more it demonstrates the island-like structure of the Australian inland saline habitats that must have been isolated for a long period.

ACKNOWLEDGMENTS

Lakes Gairdner and Frome are within the SA National Parks and Reserves system and permits Z23651-01 and Z23803-02 were issued for the collections made from these lakes. The Scientific Expedition Group is thanked for the opportunity to be involved in field trips to the Gawler Ranges and Balcanoon Station. Paul Fennell, Remko Leijds and Jayne Skinner are thanked for their collecting efforts. We thank Eric Matthews (SAMA) for the loan of most of the material.

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APPENDIX

Checklist of the recorded species of Pogoninae from Australia

<i>Pogonus australis</i> Chaudoir	s.WA, VIC
<i>Pogonus cardiotrachelus</i> Chaudoir	s.WA, VIC, s.QLD
<i>Pogonus diplochaetoides</i> Baehr	c.WA
<i>Pogonus fenelli</i> Hudson	s.WA
<i>Pogonus gilesi</i> Moore	c.SA
<i>Pogonus grossi</i> Moore	c.SA
<i>Pogonus hypharpagioides</i> Sloane	c.SA, w.VIC
<i>Pogonus matthewsi</i> sp. nov.	c.SA
<i>Pogonus nigrescens</i> Baehr	ne.QLD
<i>Pogonus perovalis</i> sp. nov.	c.SA
<i>Pogonus saskiae</i> Baehr	c.SA
<i>Pogonus sumlini</i> Baehr	n.WA
<i>Pogonus variabilis</i> Moore	n.QLD, n.NT, n.WA
<i>Pogonus vicinus</i> sp. nov.	c.SA
<i>Pogonus zietzi</i> Sloane	c.WA, c.SA
<i>Syrdenoidius spinipes</i> gen. nov., sp. nov.	c.SA

THE SIGNIFICANCE OF WHALES TO THE ABORIGINAL PEOPLE OF SOUTHERN SOUTH AUSTRALIA

PHILIP A. CLARKE

CLARKE, P. A. 2001. The significance of whales to the Aboriginal people of southern South Australia. *Records of the South Australian Museum* 34(1): 19–35.

Aboriginal people in the coastal region of South Australia had a broad relationship with whales. This is reflected in their hunting and gathering economy, mythology and totemism, and with their historical interaction with the first Europeans who arrived to hunt the whale. This paper provides a cultural geographical view of Aboriginal associations with whales.

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INTRODUCTION

The importance of whales to both Aboriginal people and Europeans had an impact upon the nature of their relationship on the frontier of British expansion into South Australia in the early nineteenth century. In earlier times, coastal Aboriginal people feasted upon stranded whales, which also had significance as totemic ancestors to some groups. In the Lower Murray region, whales were the mythological source of their ability to make fire. After official European settlement in 1836, many Aboriginal people were involved directly and indirectly in whaling activities. To Europeans, whales were the basis of an industry that they hoped would help the Colony of South Australia to develop and prosper. In the developing Australian colonies, the whaling establishments were in need of manual labour, which Aboriginal people sometimes supplied. The first Europeans recognised the skill of Indigenous hunters, sometimes employing them as harpooners and whale spotters. As a region, southern South Australia is defined in this paper as the whole of the coastal zone and the surrounding temperate parts of the state.

SOURCES

The present study is part of a series of papers by the author that considers the historical and mythological relationships between Aboriginal

people and the southern South Australian landscape (Clarke 1995, 1996, 1997, 1998, 1999a, 1999b). Europeans recorded the information upon which it is based from Aboriginal people who had lived in the southern districts prior to and during the early phases of European colonisation in South Australia. The material available consists of the observations from Europeans involved in the colonial process. The German missionaries, Christian G. Teichelmann, Clamor W. Schürmann and Heinrich A. E. Meyer actively recorded the culture of the local Aboriginal people. Their publications were essentially studies of Aboriginal language and religion (see Teichelmann & Schurmann 1840; Teichelmann 1841; Meyer 1843, 1846; Schurmann 1844, 1846). The records of William D. Wyatt (1879) from the late 1830s came from his official investigations into the admissibility of Aboriginal evidence in court.¹ Richard Penney was involved in the welfare of Aboriginal people in the Encounter Bay district. Later sources, such as George Taplin (Journals; 1874; 1879), acknowledged the first recorders, such as Meyer, as major sources of primary data. These observers had a practical interest in Aboriginal religion and traditions, in spite of the fact that their records were compiled before the development of anthropological theory. From them the early relationship between Europeans and Aboriginal people can be interpreted.

During the twentieth century, with the development of scientific methods with obtaining anthropological data, much additional

¹ Quarterly Report (1 October to 31 December 1837) from Wyatt to the Colonial Secretary, dated 1 January 1838 (Colonial Secretary Reports, 1838/3 & 1838/69, Public Records Office, Adelaide).

ethnographic material was collected from southern South Australia. Norman B. Tindale (1937, 1938, 1974, 1986, 1987), the Curator of Anthropology at the South Australian Museum, published the results of his fieldwork with the descendants of Aboriginal 'tribes' in southern South Australia.² The social anthropologists, Alfred R. Brown (1918), Ronald M. Berndt and Catherine H. Berndt (Berndt 1940; Berndt & Berndt 1993) recorded Aboriginal culture and traditions in this region. The twentieth century ethnographic sources are essentially attempts to record a pre-European culture, as it would have been lived by the generations preceding that of their informants. The popular accounts of southern South Australian mythology by Charles P. Mountford and Ainslie Roberts were chiefly based on the published records of Tindale. A more detailed analysis of the chief historical sources used in this paper is given elsewhere (Clarke 1994: 63–81, 417–425; 1995: 145–146; 1999a: 52–53).

PRE-EUROPEAN PRACTICES

The coastline of South Australia is part of the migration route of the southern right whale (*Eubalaena australis*) from the Southern Ocean. Occasional strandings of whales were events that attracted many Aboriginal people for feasting. Daisy Bates recorded that the Wanmaring local group at the Head of the Bight in western South Australia had 'occasional gorges in large fish food, dead whales and other large sea creatures being found after some great storm'.³ Aboriginal

people considered that they had an active role in some strandings. For example, songs were used by 'strong men' of the coastal Lower Murray groups to 'cause' whale strandings (Tindale 1974: 18, 23–24, 80).⁴ People from surrounding areas converged on the dead whale, being called by the aroma of a stranding, if not the messages sent out. In the Aboriginal languages around Adelaide and Encounter Bay the whales of all species were collectively called *kondoli*.⁵ Tindale records another term for them that referred to their water blowing. Tindale says:

The whales which frequented the shores off the mouth of the Murray River and the rocks at Encounter Bay where they often came close in shore were called *winkulare*, literally the 'whistlers' or 'blowers' from the intransitive verb *winkulun* 'whistle' because of their 'blowing'. Magical spells designed to entice the whales ashore were practised by the 'clever' men.⁶

For the Lower South East of South Australia, there is a transcription of a whale song in the 'Booandik' language (Smith 1880: 139). This was translated as 'The whale is come. And thrown up on land.' These lines were repeated over and over, perhaps to induce a stranding.⁷ Evidence from elsewhere in Australia, such as the rock art around Sydney in New South Wales, suggests that coastal Aboriginal people had a keen interest in whales.⁸

Aboriginal people of the whale descent group at Encounter Bay believed that some of them could 'sing' whales in towards the shore or out, by standing on a rock and singing some 'wordless chant'.⁹ Tindale (1937: 107, 112) recorded a whale song, in the Ramindjeri dialect

² Tindale's journals, field notebooks, and the 'Milerum' manuscript are also important ethnographic sources. This material is housed in the Anthropology Archives, S.A. Museum.

³ 'The Passing of the Australian Native. The Wanmaring Group (Head of the Great Australian Bight).' D. M. Bates manuscript collection at the Barr-Smith Library in Box 12/Section XIII/Part 6b.

⁴ Aboriginal people claimed in the early 1980s that an elderly Ngarrindjeri person living at Point McLeay, who had recently died, knew how to 'sing a song to bring in whales'. Also in the early 1980s, some elderly Ngarrindjeri informants knew that there was a myth concerning whales and fire, but had forgotten the details (audiotape of the Cameron family talking at Kingston South East with P. G. Jones, S. J. Hemming & P. A. Clarke, 23 April 1983. Anthropology Archives, S.A. Museum).

⁵ In the Adelaide area, whales were termed 'con-dol-ley' (Williams 1839 [1840: 295]), 'kondolli' (Teichelmann & Schürmann 1840 2: 12) and 'condolle' (Stephens 1889: 498). For the Lower Murray dialects, the name for whale is recorded as 'kondari' by G. Taplin (1879 [1874]: 1879) and F. Taplin (Point McLeay Letter Books, 1879–84, p.98), 'kondolle' (Wyatt 1879: 170), 'kandari' (Howitt 1904), 'kondolly' (M. Wilson in 'conventional mission script' [Tindale 1930–52: 161–165]), 'kondolly', 'kondal' (Tindale 1934–37), 'kondoli' by Tindale (1937), 'kondali' (Mountford & Berndt 1941), 'kondole' by Mountford and Roberts (1969) and 'kondili' by Berndt and Berndt (1993). This paper uses 'Kondoli' as a standard term for the Whale Ancestor.

⁶ Tindale ('Milerum' manuscript, stage A, no.3. Anthropology Archives, S.A. Museum).

⁷ After European settlement, Aboriginal people of the South East of South Australia also had a popular song about the 'whale fishery' at Rivoli Bay (Stewart n.d. [1977: 65–66]).

⁸ Whales are major elements in the rock art in the Sydney area. At least one site appears to show a feast around a stranded whale (Campbell 1899: 46–47, pl. 24, fig. 1; Stanbury & Clegg 1990: 22–23, 54, 80–83, 113, 119). In September 1790, Tench (1793 [1996: 134]) records the feasting of a stranded whale which was 'in the most disgusting state of putrefaction' in the Sydney region. Kingston (1876: 277–278, 327) gives a related account from north of Sydney.

⁹ *The Mail* newspaper, 19 August 1932. There are recent accounts recorded by Bell (1998: 320) concerning Aboriginal people formerly using whales for transport, although these are unsupported by the historical record.

of the northern end of Encounter Bay, to send whales away.¹⁰ This was sung by a man of the *kondoli nga:tji*, or whale descent group, in order to assist a female whale and calf escape the shallow waters of Encounter Bay.¹¹ In this account, other people who were 'evil-minded', desired the whales to be stranded so that *kraipunuk* or oil could be collected for 'spear poison', perhaps as a sorcery material used against people who had the whale as their totemic familiar or *nga:tji*. Tindale stated:

A man who had the whale as totem would not eat whale. If a whale became stranded on the coast, he would give permission for others to use it as food, but he himself would merely rub himself with the oil which it produced. If he saw a whale floundering off the shore, he would sing a magical song, telling the whale to avoid the shallows and escape to the sea.¹²

Tindale stated that to decorate themselves the men of the Warki and Tangani groups of the Lower Murray region would be ruddled with red ochre and whale oil.¹³ Elsewhere in southern South Australia, it is also likely that whales were considered to be totemic beings, although apart from the Lower Murray region, the available early ethnographic data is slim.

The whale was associated with the Latalindjera descent group, which received its name from the place, Latang, at Hindmarsh River near Victor Harbor at Encounter Bay (Berndt & Berndt 1993: 311). To the south of Encounter Bay, Kondilindjarung ('whale, place-name marker') was a death place for whales, where one or two often beached themselves during the winter months (Berndt & Berndt 1993: 81, 103, 320, 326–327, 342, 565). It is situated on the Younghusband Peninsula on the seaside, south east of the Murray Mouth but north west of Noonamena. It was claimed that Kondilindjarung was where the people of this group and their associated beings, the whales, attempted to return before death. The Coorong ocean beach was

renowned for its whale remains. Tindale records that:

On the ocean beach one might be the inhabitant of another world, composed of sand, sea, spume, and giant whale bones. The scattered bones of blue whales lie here and there along the beach, for this is a graveyard where the great circumpolar current impinges upon the shores of Australia and casts up its burden of flotsam.¹⁴

According to the Berndts, Kondilindjarung is in the Kondilindjera descent group territory, believed to be an offshoot of the Ramindjerar, but who spoke Tangani instead. The relationship between the Kondilindjera and the Latalindjera descent group described by Tindale above is uncertain.¹⁵ The presence of the Kondilindjera on the south eastern side of the Murray Mouth may well have been the result of a post-European adjustment in territory, as Taplin (1874 [1879: 2]; 1879: 34) recorded the Kondarlinyeri as a 'clan' based on the north western side of the Mouth. Kondarlinyeri was said to mean 'belonging to whales' (Taplin 1879–84: 98). Brown (1918: 252) provided evidence that suggests that there were no 'Kandarlinyeri'. He stated 'I was told by the natives that Kondarlindjeri (the place of the whales) is merely the name of a part of the country occupied by Pankinderar clan, and that there is no clan of this name (Brown 1918: 252).'

During his fieldwork, Brown (1918: 240) considered it too late to obtain detailed information on the totemism of the Yaraldi people. Nevertheless he claimed:

The men and women of a clan might eat, and did eat, their totem, if it were edible, but they were careful to destroy all the remains (bones etc.), lest they should fall into the hands of an enemy and be used for evil magic. Some part of the totemic animal was in some instances used as a badge of the clan. Thus the Liwurinderar used to carry pelican skins on their spears when they went out to fight (Brown 1918: 241).

¹⁰ See Tindale (1931–34 (1): 252–253) for notes of 'Kondoli Tungar or Whale Song of the Ramindjeri tribe at Encounter Bay, Song 14'.

¹¹ Tindale inscribes a draft typescript version of his paper with 'much of the song data given verbatim as dictated by Milerum'. Here it is stated that the whales were swimming in 'white sand water'. Other details include that the whales were 'mother' and 'son' and that whale 'slime' or oil was required to rub on their bodies with red ochre as a base for poison (copy in E. H. Davies papers, AA309, Accession no.1, Anthropology Archives, S.A. Museum).

¹² Tindale, *The Advertiser* newspaper, 14 May 1936. The symbolic importance of whales may be reflected in the rock art of the Sydney area, which depicts people inside whales. Stanbury & Clegg (1990: 22–23) suggest that this might be explained by the eastern seaboard practice of sick people lying inside the body of a stranded whale.

¹³ Tindale ('Milerum' manuscript, folder 1, draft A. Anthropology Archives, S.A. Museum).

¹⁴ Tindale, *The Advertiser* newspaper, 12 May 1936.

¹⁵ Tindale (Lower Murray Totems Chart, miscellaneous papers, Anthropology Archives, S.A. Museum) links together the descent groups of Kondolinyeri (Taplin 1874 [1879]), Kondarlinyeri (Taplin 1879), Kandarlinyeri (Howitt 1904), and Karagarindjeri [equivalent to Kondolindjeri] (Tindale ms). He does not list the Latalindjera.

This account is consistent with Meyer's claim that the *nga:tji* was a 'friend', 'countryman' or 'protector' (Meyer 1843: 86; 1846 [1879: 198]) and Taplin's definition of it as a 'tribal symbol' or 'tutelary genius' (Taplin 1874 [1879: 1, 63–64, 134]). The Berndts also record that some people were able to eat their *nga:tji*. Regarded as the flesh of the Kondilindjera, the members of this Lower Murray group alone could make the first cut on a beached whale carcass (Berndt & Berndt 1993: 81, 103, 320, 326–327, 342, 565). Other groups would wait until they had eaten.¹⁶ The spirit of Kondoli departed through Kondilindjarung, leaving its meat for its 'brothers'. In this area, Aboriginal people possessed a pre-European system giving certain groups rights and privileges to the resources of the sea (see Peterson & Rigsby 1998).

The Kondilindjera responded to a whale stranding by sending messengers with invitations to neighbouring groups to come in for a feast on whale blubber, *pailpuli*, and meat, *mami*.¹⁷ Normally, the coastal districts were sparsely populated during the wintertime (Tindale 1938: 21; 1974: 61–62; Clarke 1994: 182–183). The cutting of the flesh and blubber was performed with flint knives, *maki*. Aboriginal people cooked the fat before it was eaten and the oil was rubbed on their bodies for protection against the weather. The *witjeri*, leaves of the pigface (*Carpobrotus rossii*), were used as a relish with the meat. Ceremonies were held during the nights of the feast. The site of the stranding was not left until all the blubber was eaten. Aboriginal people used the ear bones as drinking containers and water storage vessels.¹⁸ Aboriginal midden material collected from Moana, a sand dune area near the mouth of Pedlar Creek south of Adelaide, by Tindale in the 1920s contains sperm whale teeth and dolphin vertebrae.¹⁹ This suggests that Aboriginal people had eaten beached whales and dolphins. Also, in the Rivoli Bay area, south of Encounter Bay, whales were also

sometimes stranded. Aboriginal people called this place Weirintjam or Wilitjam, which Tindale claimed meant 'place of whales' from the Potaruwutj word 'weirintj', a whale.²⁰ It was a place noted by Tindale's informants for the whales that became stranded there, providing big feasts for the local people.

It is unlikely that Aboriginal people in South Australia were able to use their watercraft, built for calm water conditions, in killing small whales.²¹ For marine animals stuck in shallow water or stranded on land, killing was a more straightforward task. Nevertheless, hunting across the open sea was limited. For instance, Ramindjeri people swam or travelled on rafts to West Island, which is less than a kilometre off the coast south west of Victor Harbor, to kill sea lions (*Neophoca cinerea*) and fur seals (*Arctocephalus forsteri*) (Tindale 1941: 241). They also travelled to Pullen Island on rafts in calm weather for sealing.²² Most distant islands, such as Kangaroo Island, were places beyond the range of Aboriginal hunters immediately prior to European settlement (Clarke 1996, 1998). There is no evidence to suggest that Aboriginal people actively hunted whales or dolphins.

WHALES IN ABORIGINAL MYTHOLOGY

The earliest written account of whale mythology in South Australia was by C. Teichelmann in 1840, presumably recounted by Aboriginal people who lived in the Adelaide area (see Amery 1998: 219, 224). He records:

When the lark and the whale were men, they fought against each other. The lark speared the whale twice in the neck. The whale, finding itself sorely wounded, made its escape, jumped from pain into the sea, became a whale and spouted through the two wounds water to heal them; but in vain, till this day.²³

¹⁶ Bates (1985: 197–198) records that the *mammang borungur* or whale totem people of Cape Leewin in the South West of Western Australia also ate the flesh of stranded whales, in spite of the fact that this was not the practice of people from other totems.

¹⁷ Wyatt (1879: 170) claimed that Encounter Bay people also called whale blubber 'kondolle'.

¹⁸ South Australian Museum specimen A49445; container made from a whale ear bone, collected from Pelican Point on the Coorong, donated by Mrs O. T. Cleggett, 1940s.

¹⁹ Ross (1984: 19–41) provides an overview of the archaeological investigations based at Moana. This material would be less than 6,000 years before present, when the coastline of present-day Adelaide was largely formed. The sperm whale teeth found in Moana 'Site C' may have come from a multiple stranding, as they are from at least two individuals, one young and one old specimen (C. Kemper, pers. com.).

²⁰ N. B. Tindale (Geographic Place Names Cards & Potaruwutj Vocabulary Cards, Anthropology Archives, S.A. Museum). Tindale thought that the variation in the place name, Wilitjam, is probably relatively modern.

²¹ In contrast, Aboriginal hunters in northern Australia had more access to the sea through their use of dugouts and outriggers gained through contact with Macassans and Torres Strait Islanders. For a description of their watercraft, see Haddon (1913), Tindale (1926: 103–112) & Baker (1988).

²² See also Tindale (Wunindjeri clan entry in 'Clan Data' folder in 'Milerum' manuscripts, stage 2 Anthropology Archives, S.A. Museum).

²³ *South Australian Colonist* newspaper, 7 July 1840.

The same corpus of whale mythology appears to have been shared by the Adelaide and Encounter Bay peoples, perhaps reflecting Aboriginal movements around the time of European settlement in the early nineteenth century. In a Ramindjeri account of the myth, whales are connected with the origin of fire (Meyer 1879: 202–204). Here, it was believed that once long ago, all the Ramindjeri people gathered to dance at Mootaparinga (Cut Hill, along Hindmarsh River).²⁴ They did not have a fire, so they had to dance all day and it was hot. Their perspiration dripped down and became the large ponds there, and hills and valleys formed through the buckling of the ground caused by the stamping of their feet. Eventually, they sent for Kondoli, a large and powerful man who possessed fire. He came, but hid his fire. This made the Ramindjeri angry. Another Ancestor, Riballi, threw a spear at Kondoli, hitting him in the neck.²⁵ The commotion this caused transformed most of the people there into different animals, such as fish and birds. Kondoli himself rushed into the sea and ever after blew water out of his wound. Riballi took Kondoli's fire and placed it in a grasstree (*Xanthorrhoea* species), where it can be removed by using the dried flower stems as fire-sticks.²⁶

The series of accounts recorded by Tindale in the twentieth century provide details that were not part of Meyer's account. In May 1934, Tindale received a Ramindjeri version of the Kondoli myth from Frank Blackmoor (Tindale 1930–52: 161–165; 1934–37: 181–184).²⁷ Here, Kondoli was a big man who possessed fire that fell from his body as he danced. He came to participate at a Ramindjeri ceremony. Kuoldambal the Owl argued with Krilbalil (= Krilbali) the Lark about who was to spear Kondoli to get the fire. Kuoldambal, who had large eyes, wanted

Krilbalil's spear to use, as his eyes were too small to see properly. But when the dancing was close enough, Krilbalil grabbed his spear and struck Kondoli at the back of the head, making the fire fall out. Krilbalil grabbed the fire and placed it amongst grasstrees, causing the scrub to burn. People now had access to fire. Kondoli dived into the ground, eventually coming out and going into the sea.

Tindale recorded a version of the 'Story of Kondoli' from Milerum, a Tangani speaker, in May 1936 (Tindale 1934–37 vol.2: 232–235). In this account a 'tribe' that was part Mereldi (Murray River people), part Ramindjeri and Yoltindjeri (= Joltindjeri) planned to have a *molkaldi* type ceremony at which all participants would perform. Messengers were sent out in all directions and people gathered at Mutabaringga (= Mootaparinga), a site on the largest bend of the Hindmarsh River. The dancing area was at a flat on top of a range that had a depression. Kondoli, who was a big man, was camped at Brown Hill. He carried the flint with which fire could be made.²⁸ A 'river man' (Murray River person) called Ratanangi, the Robin Redbreast Bird, was there. Seven or eight Teiwuri (Brown Treecreeper) women from a local group, who greatly desired Ratanangi, grabbed him.²⁹ Relatives among the 'river people' grabbed their weapons and a fight with spears and waddies (clubs) took place. Firesticks were also thrown through the air.

To escape the fight, Kondoli fled towards the sea down Hindmarsh Valley, carrying his flint. He also had pieces of granite, which he dropped as boulders along the creek. At the site of Gay Bridge, Port Elliot (Kandeining) he took a boulder out into the sea. After returning and heading a little further inland he rested before diving into the sea at Kantjoar, where there is a swamp.³⁰

²⁴ Colonists used Mootaparinga (or Murtaparri) in the 1830s as the name for the mouth of Hindmarsh River at Encounter Bay (Wade cited Gouger 1838: 25; Mann cited Gouger 1838: 39, 42; Teichelmann & Schürmann 1840 2: 75). In the Adelaide language Mootaparinga reputedly means 'brackish water' (Robinson 1975: 44). If so, then it appears to be a term from a language north west of the Lower Murray. Adelaide terms, such as *murta* ['excrements of animals'], *parri* ['river'] and *-ngga* [grammatical 'in'] (Teichelmann & Schürmann 1840 1: 22; pt 2: 25, 38, 76) appear relevant, possibly translating as 'animal manure water, place of'. Tindale ('Myths' folder in 'Milerum' manuscript collection, Anthropology Archives, S.A. Museum) says 'Mutabaringga' is known by Europeans as Cut Hill.

²⁵ The 'Riballi' of Meyer is probably his rendering of 'Krilbali', the brown skylark.

²⁶ The use of fire is a major element of the Waiyungari mythology (Clarke 1999b). Bell (1989: 321–322, 427) speculates that whales are of special significance to Aboriginal women due to the link with fire and through associating the protective nature of whales over their calves with human child-care responsibilities.

²⁷ Yaraldi man, Mark Wilson (Thalrum or Thralrum), wrote the original text using conventional mission script. Tindale then annotated it by working directly with Frank Blackmoor, a Yaraldi man of the Piltindjeri descent group. Although Tindale refers to the Skylark as 'Krilbalil', I prefer the form 'Krilbali', as written by other authors and as recognised by some contemporary Ngarrindjeri people (see foot note 44).

²⁸ The flints were struck whilst being held in a dry pad of fungus, *kumpalatingi* (Mountford & Berndt 1941: 342–344).

²⁹ Tindale (1934–37: 233) records that as a result of what happened then, 'today you always see him [Ratanangi, Robin Redbreast] with seven or eight wives'.

³⁰ According to Tindale (Geographic Place Names Cards, Anthropology Archives, South Australian Museum), Kantjoar is a site in the Ngurunderi myth where he urinated (*kaindji* = urine).

From here, Kondoli went west along the shore, sometimes walking and other times swimming in water for safety. He walked between Granite Island and the shore, looking back to see if the others were following him. When Kondoli reached Wunangg, the mouth of the Inman River, he saw his friend Yamakawi rushing down the Inman towards him.³¹ The 'wild men' were chasing Yamakawi for his firestick, made of *ngalaji* (dried flower stem of the grasstree), that he carried. Although Kondoli had eluded his first pursuers, he had to flee again, this time with Yamakawi. Kondoli went a little way into the sea and turned into a whale. There is a reef there today and the spray that rises with the waves is the whale spout, which represents smoke. Yamakawi went into the sea at Narailkang, near Waitpinga, and turned into a shark with big teeth.³² For some time, people on the land had no fire as Yamakawi had taken away the *ngalaji*. Kondoli did not go far away as he had left something back at his camp. The people 'sang' (charmed) him into the shore, where they jumped on him and took his flint so that they could make fire. They also grabbed Yamakawi's firestick, which had been used as a back fin.

In another of Tindale's records, Kondoli the Whale man chased the Shark man who had stolen Kondoli's fire-making equipment, *wintjimi*, comprised of flint and pyrites.³³ This occurred at Spring Mount, which was called Mutabaringga, said to mean 'sacred magic doctor's place'. The hill represents Kondoli, who later became a whale. A big hole at the summit was said to be the 'blow hole' of the whale. Kondoli chased the Shark man to Brown Hill, called Kondolanang.³⁴ From here Kondoli in anger rushed towards the sea in pursuit of the thief. Kondoli was transformed into a whale

at Elliot Beach, called Kandeining, which was translated by Tindale's informants as 'from here'.³⁵ The Shark man was transformed into the whale's enemy, the shark, who retains the fire flints as teeth in his mouth. Tindale linked this account to the name of the south western spur of the Brown Hill, Nangge-we:ke, which he claimed means the 'stolen sun', referring to the stealing of fire.³⁶ In what appears to be a related account, Tindale stated:

One of the myths of the area tells how there was contention between a man of the whale totem and another, the shark, for possession of the fire flints, without which the whale could not use his pyrites. At the climax of the story the men became animals and the shark fled taking with him the flint stones which were transmuted into his teeth.³⁷

These versions place emphasis on the origin of fire relating to conflict between Ancestors, involving the Whale and Shark.

Tindale recorded other elements of the 'Fire myth' in the Warki language of the Goolwa area. Mutabaringga or Cut Hill was one of the homes of the whale man, Kondoli.³⁸ According to Tindale it was derived from *muturi* (sacred), *bari* (river) and *-ingga* (at).³⁹ Kondolinggara or Mount Jagged was where Karilbali (= Krilbali) fought with Kondoli for the possession of fire, wounding him. The place-name was reputedly derived from *kondoli* (whale) and *nggaran* (to assault or wound).⁴⁰ Kondolanang (= Kondolanangg or Brown Hill), where Kondoli emerged from the ground, was said to mean 'refuge of whales', derived from *kondoli* (whale) and *nangare* (refuge or shelter).⁴¹ In another version, Kondoli, after being wounded by Karilbali:

set fire to the country. Hiding first at this place [Kondolanang] he [Kondoli] fled to Kandeining

³¹ According to Tindale (1934-37: 232-233), Yamakawi was related to Kondoli, their hunting grounds adjoined. The quartz stones that Yamakawi left behind when he fled were used for making the jags on spears. Some of these were given to Yamakawi, after he became a shark, for his use as teeth (Tindale 1934-37: 234). Tindale writes 'Yamakawi' as 'Jamakawi'.

³² Tindale ('Myths' folder in 'Milerum' manuscript collection, Anthropology Archives, S.A. Museum) claims that Yamakawi was the White Pointer Shark being who lived at Inman Hill.

³³ Tindale (Geographic Place Names Cards & 'Milerum' manuscript, stage A, no.3. Anthropology Archives, S.A. Museum). This is presumably a Raminjeri version of the myth. Tindale claims that Mootaparinga is erroneously ascribed to Hindmarsh River by Cockburn (1908: 58).

³⁴ See also Tindale (Wunindjeri clan entry in 'Clan Data' folder in 'Milerum' manuscripts, stage 2. Anthropology Archives, S.A. Museum).

³⁵ N.B. Tindale (Geographic Place Names Cards, Anthropology Archives, S.A. Museum). Informants not named.

³⁶ This place name is the Nangawooka of Tite, which Tindale (Geographic Place Names Cards, Anthropology Archives, S.A. Museum) claims Cockburn (1908: 63-64) incorrectly translates as 'place of springs'. Informants not named. See also Tindale (Wunindjeri clan entry in 'Clan Data' folder in 'Milerum' manuscripts, stage 2, Anthropology Archives, S.A. Museum).

³⁷ N. B. Tindale (no date) 'Strike-a-lights, Fire Flints', Tindale collection, miscellaneous papers, Anthropology Archives, S.A. Museum.

³⁸ Data recorded by Tindale ('Aboriginal Placename Cards', Warki Language, AA338, Anthropology Archives, S.A. Museum) from the Yaraldi informant, Albert Karlowan (Karloan) and the Tangani informant, Clarence Long (Milerum).

³⁹ The derivation of '*muturi*' (sacred) here seems less likely than as '*murta*' (animal excrement) [see footnote 23].

⁴⁰ Data recorded by Tindale ('Aboriginal Placename Cards', Warki Language, AA338, Anthropology Archives, S.A. Museum). Informants not named.

⁴¹ Data recorded by Tindale ('Aboriginal Placename Cards', Warki Language, AA338, Anthropology Archives, S.A. Museum) from the Yaraldi informant, Mark Wilson (Thalrum or Thralrum) and the Tangani informant, Clarence Long (Milerum).

where he entered the sea as a whale. There a shark being stole his fire flints. A wide spread story.⁴²

After entering the sea, the fire flints were then stolen by Ngarakkani (= Ngarankani) the Shark being and the property of fire making was transferred to grasstrees and wood.⁴³

In 1934 Tindale recorded an account, 'Story of the Stealing of Fire by the Whale' from Mark Wilson in the Yaraldi language.⁴⁴ Here, all the birds and animals, who were then human, met for a ceremony at Mutabaringga. Only Kondoli the Whale possessed fire; he guarded it jealously. Krilbali the Lark and another unnamed bird quarrelled over who should steal it. Kondoli was speared in the head by Krilbali and leaped into a cave on the hill before the fire could be taken from him. The Whale emerged in the deep water at Victor Harbor that is close to the beach and extends to Granite Island. The steam coming from Kondoli's wound was like that coming out of an earth cooking-oven, showing that there was fire inside. The whale still blows its steam out and stranded whales are quite hot, compared with other marine animals which are cold. In the sea, the Shark stole fire from the Whale and gave it to the birds, who were unable to control it and set fire to the country. The raging fire entered the trees, which means that they would now readily burn if set alight. Fire also entered the flints on the ground. Many of the birds got burnt, such as Tuta the Scarlet Robin being who had his breast burnt bright red. After the fire died, people discovered how to make fire from splitting grasstree sticks and rubbing them together and also by striking flints against ironstone pieces.

The anthropologists, Ronald and Catherine Berndt, also provided a record of the Kondoli mythology in the Encounter Bay district (Berndt & Berndt 1993: 16, 118, 235–236, 341–342, 450–451).⁴⁵ The Hindmarsh River area at Victor Harbor is associated with the Whale Ancestor and the origin of making fire with flints, *maki*. The flints were obtained from the Ramindjeri hills people. In the Berndts' version, many people

attended a dance meeting held at Kondilinar, which is inland. When Kondoli the Whale Ancestor danced, sparks came from inside him, which excited the onlookers who were at that time without fire. Krilbali the Brown Skylark and Retjurukuru the Wagtail planned to spear Kondoli whilst he was dancing, to get his fire. Krilbali speared him deep in the back of his neck. Then Krilbali grabbed some of the fire that gushed out of the wound and fled with it. The people assembled there laughed, but Kondoli, Ngarankani (Shark), Mulori (Stingray) and Pungari (Seal) jumped into the water and came out at Latang, near the coast at the mouth of Hindmarsh River.⁴⁶ The Berndts (1993: 311) stated that Latang meant 'place of spearing'.⁴⁷ The Whale stayed at Balgolin (Pultung, Victor Harbor).

One of the Berndt's chief informants for the Kondoli mythology was the Yaraldi speaker, Albert Karloan, from the Manangka descent group. He told the Berndts that the spear thrown at the Whale Ancestor had entered the back of the neck, penetrating as far as the jaw. It was the jaw that produced the sparks. Karloan claimed that when the Whale was speared, the fire that fell on the ground at Kondilinar turned to flints, *maki*, which could be used to make fire. Flints could be also found where the Skylark had dropped them whilst running all over the country. The method of the transference of the fire from the Whale Ancestor to humanity is different from Meyer's earlier account, when a fire-stick made from a grasstree flower stem was used.

The Mountford and Roberts (1969: 40–41) version has details that appear as poetic adjustments to the main recordings. Fire was needed here because the dancers required light to dance at night. The large and powerful Kondoli was the sole owner, but hid the fire. After Kondoli was speared, the people at the ceremony were transformed into animals, such as kangaroos, possums, birds and fish. Kondoli, as the largest man, became the largest animal, the whale. Ngarrindjeri writer, David Unaipon, wrote a story

⁴² Data recorded by Tindale ('Aboriginal Placename Cards', Warki Language, AA338, Anthropology Archives, S.A. Museum). Informants not named. The derivation of Karilbali is here and on other cards recorded as 'maggie-lark being' instead of 'lark', but this clearly an error. See end note 44.

⁴³ Data recorded by Tindale ('Aboriginal Placename Cards', Warki Language, AA338, Anthropology Archives, S.A. Museum). Informants not named.

⁴⁴ Tindale (1930–52: 48, 91, 272–273). In this account, Tindale incorrectly identifies Krilbali as the magpie lark (*Grallina cyanoleuca*). From other sources, including contemporary Aboriginal informants, this term refers to the skylark (*Alauda arvensis*) (Brown 1918: 242; Berndt & Berndt 1993: 235–236, 311, 450–451, 461–462).

⁴⁵ The Berndts write 'Kondoli' as 'Kondili'.

⁴⁶ Many of these Ancestors became *nga:tji* of Ramindjeri clans surrounding Victor Harbor (Berndt & Berndt 1993: 311). *Ngarankani*, shark, was the *nga:tji* of the Ngarakerindjera descent group, based at King Point. In the Tjirbruki mythology he was speared and become the gumny shark (Tindale 1987: 9). *Krilbali*, brown skylark, was the *nga:tji* of Kriibalindjera based near Kondilinar. *Pangari*, seal, was the *nga:tji* of the Ratalwerindjera at Middleton.

⁴⁷ Berndts (1993: 311) claimed that Latang was equivalent to 'Yalla-doola' as listed by Wyatt (1879: 179).

about Wondangar the Whale and Goon na Ghun the Starfish Ancestors.⁴⁸ Although some Ngarrindjeri words are used in the text, the inclusion of a lyrebird, which is a species not found in South Australia, suggests it was intended as a generalised eastern states account.

There are whale mythologies in other parts of southern South Australia that bear some resemblance to the Kondoli myth. The existence of the Whale Ancestor as a land-based person appears widespread. Schurmann recorded in the Adelaide Plains region that:

Nganno – travelled far and wide, seeking the murderers of his son, Gurltatakko, and while travelling named the country as we know it today. After killing the murderers he went home but his tribesmen on seeing him panicked and ran in fear into the sea where they were transformed into sea creatures. He told them not to do it but they responded ‘I am a shark’, ‘I am a whale’ etc. Nganno turned himself into a sea monster at the end (Schurmann Journals, 21 August 1839).

It is interesting to note that many of the terms and place-names used in the Lower Murray versions above are derived from the Aboriginal vocabulary of Adelaide. In the Tjirbruki mythology of Gulf St Vincent and western Encounter Bay, some of the Ancestors ran into the sea to become species of shark (Tindale 1987: 9). The language used in this account recorded by Tindale is a mixture of Adelaide and Lower Murray vocabulary.

Stealing the ability to make fire is a common theme in the mythology of Aboriginal Australia. There are other accounts that appear structurally similar to the Kondoli myths discussed above, but do not involve whales as one of the primary Ancestors. For example, in a version of a Western Desert myth recorded by Tindale, the Turkey Bustard Ancestor kept fire to himself and fled south towards the Southern Ocean at Eucla to place the flints under the water.⁴⁹ The Hawk Men rescued the flints, which are accessible today only at low tide on calm days. Similarly, Smith (1880: 18–20) records that the Booandik people between Mount Gambier and MacDonnell Bay in the South East of South Australia believed that fire

was once the sole property of Mar the Cockatoo, and was hidden on his head. At a meeting, people argued over how to find out more about Mar’s fire. Several people attempted to spy on Mar making the fire. As a result, Tatkanna the Robin Red Breast had his chest singed red from the heat of Mar’s fire. When fire was at last caught in a grasstree stick, it spread to the grass and dry underwood where it started a bushfire. Mar rushed to where the others were camped and a fight started. One of those there, a large man named Kounterbull, received a deep spear wound in the back of his neck. He rushed into the sea where, as a whale, he was afterwards to be seen spouting water from his wound. In Western Victoria, Crows had fire and the Fairy Wren and Hawk stole it (Dawson 1881: 54). In the West Coast district of South Australia, Aboriginal people possibly perceived whales as having a more sinister character. In the Miriny language, whales were called *muburn kailgaburdi*, with *muburn* (or *moburn*) recorded as ‘devil’.⁵⁰ Tindale claimed that there ‘are several versions of the [fire] story extending as far to the west as Perth and to the Tangane kald on the Coorong’.⁵¹ He cites the record of Grey (1839: 76) from the South West of Western Australia that lists *maad-jit-teeyl* as a ‘magic stone’ of the shark. Tindale also provided an account from the Murray Basin where a small species of hawk stole an ember from the shark as he was entering the sea and placed it for safe keeping in a grasstree.⁵² The similarity of the events in widespread accounts of this myth, along with the variety of language chosen by the informants to communicate them, make it difficult to determine the origin and range of the whale myths.

The Kondoli mythology of the Lower Murray has important cultural insights into both methods of fire-making. The use of fire-sticks in what is referred to as the rotation method is widespread across Australia. Tindale describes this process in the southern regions:

Fire making is practised using a dry grasstree flower stalk, the ‘male’, twirled into a split section of the same stalk, in which usually a notch has been cut. This is the ‘female’. Tinder is placed below the

⁴⁸ Unaipon, no date (Davis *et al.* 1990: 33–52).

⁴⁹ N. B. Tindale (no date) ‘Strike-a-lights, Fire Flints’. Tindale collection, miscellaneous papers, Anthropology Archives, S.A. Museum.

⁵⁰ D. M. Bates, ‘Native Vocabulary, Eucla District’, Barr Smith Library, University of Adelaide (box XII, 2A 4–5). According to Bates the shark appears to have been called by a related term, *kailga-kailga*. Similarly, the porpoise was *kailga-ailga* and the trapdoor spider was *kailga wurdi*.

⁵¹ Data recorded by Tindale (‘Aboriginal Placename Cards’, Warki Language, AA338, Anthropology Archives, S.A. Museum). The informants are not named. Tindale (1930–52: 273) lists Grey 1839 as a record relating to the Kondoli fire myth.

⁵² N. B. Tindale (no date) ‘Strike-a-lights, Fire Flints’. Tindale collection, miscellaneous papers, Anthropology Archives, S.A. Museum.

notch which supplements the hot powdered pith engendered by the rotary process. When a spark appears it is deftly transferred to a ball of dry, teased grass or other easily ignitable matter.⁵³

In the same reference, Tindale added that fine stone grit was sometimes placed in the female part of the apparatus to help fire-making by increasing friction. The use of percussion methods to make fire, generally by striking flint, together with 'ironstone' or iron pyrites, has been recorded in some parts of South Australia. In the Coorong region, Tindale's Tangani informant, Milerum, told him that flint, *marti*, was used for fire-making and came by way of trade from south of Cape Jaffa.⁵⁴ The flint was used by striking it across iron pyrites, *baruke*, that came from the Mount Lofty Ranges at a place called Whale Hill, just to the north of the western boundary of the Tangani speakers. Powdered sun dried kangaroo dung, fungus, bark and sandalwood scrapings were used as tinder (*narn*) and kept wrapped in possum fur. Although this method of fire-making was rarely recorded, Charles P. Mountford and Ronald M. Berndt (1941: 343–344) use the Karloan version of the Kondoli myth as proof that the percussion method existed in Australia before Europeans arrived. The Tjirbruki mythology of the Adelaide plains also mentions the use of iron pyrites in making fire (Tindale 1987).

EUROPEAN SETTLEMENT

In the first few months of the official British settlement of South Australia in 1836, Encounter Bay came under scrutiny as a possible site for the capital of South Australia. The large harbour and the proximity of a supposed navigable entrance to the Murray River were major factors in its favour. Nevertheless, it was Encounter Bay's suitability for whaling activities that started settlement there. Captain John Hart, who was familiar with the South Australian coast through his whaling and sealing activities during the early 1830s, was consulted by the South Australian Colonisation Commissioners in London (Blackett 1911: 431).⁵⁵

Whaling was the first official industry in the Colony of South Australia. Two 'shore' whaling stations were set up in Encounter Bay in 1837 – a group from Sydney headed by Captain Blenkinsopp and the other controlled by the South Australia Company.⁵⁶ The former was situated at Police Point (now Victor Harbor), and the latter at the foot of the ridge connecting Rosetta Head (now The Bluff) with the hills. Other stations were later set up at The Nob (now Port Elliot) and on Granite Island. In the case of the whaling establishments at Police Point and Granite Island, these were considered to be of 'lesser importance' and soon abandoned (Newland 1921: 16).

Maritime archaeological and historical studies have produced a list of whaling stations across the coast line of South Australia (Angas 1847a, text for plate XVI; Hosking 1973, legend: 2; Kostoglou & McCarthy 1991, Table 1, p.67). There were large whaling stations situated in Encounter Bay at Rosetta Head (1837 to 1855) and Freeman Nob (about 1840). On Kangaroo Island there were establishments at Hog Bay (1841 to 1844) and D'Estrees Bay (1843 to 1844). There were also smaller whaling stations at the mouth of the Onkaparinga River (from 1841 to about 1843) and at Fishery Cove near Cape Jervis (from 1842 to the early 1850s). Several establishments were present on the West Coast of South Australia at Thistle Island (1838 to 1839), Fowler Bay (1840s), Saint Peter Island (1840s), Streaky Bay (1843 to 1846) and Trial Bay (1845). In the South East of South Australia, there was the Rivoli Bay Station (1830s intermittently to the 1880s).

Two species of whale were commercially hunted in southern South Australia, the sperm or cachalot whale (*Physeter macrocephalus*) and the southern right whale (*Eubalaena australis*).⁵⁷ There were two distinct seasons for European whaling, referred to as 'in-shore' and 'off-shore'. The 'in-shore season' was during winter, with the southern right whales caught as they travelled along the coast of south eastern Australia from Tasmania (Fig. 1). This was known as 'bay whaling'. The 'off-shore season' aimed to catch

⁵³ N. B. Tindale (no date) 'Strike-a-lights, Fire Flints'. Tindale collection, miscellaneous papers, Anthropology Archives, S.A. Museum.

⁵⁴ N. B. Tindale (no date) 'Strike-a-lights, Fire Flints'. Tindale collection, miscellaneous papers, Anthropology Archives, S.A. Museum.

⁵⁵ In 1831, Captain Hart left a sealer at Baudin Rocks in the South East of South Australia (Kostoglou & McCarthy 1991: 63). After official British settlement in 1836, Hart became a successful merchant and politician in South Australia. He was Premier of the colony on three occasions (Blackett 1911: 431–432).

⁵⁶ 'Report on Whaling in South Australia' (1841 [reprinted in *Proceedings of the Royal Geographical Society of Australasia, South Australian Branch*, 1921: 15–20]) and Cameron (1979: 23). Newland (1936) gives a fictional account of whaling in the region in 'Paving the Way.'

⁵⁷ For descriptions of South Australian whaling practices refer to 'Report on Whaling in South Australia' (1841 [1921]), Hosking (1973, explanatory note: 1), Glover & Ling (1976), Whitelock (1985: 61, 64), Kostoglou & McCarthy (1991: 1–2) and Judd et al (1992: 13–14).

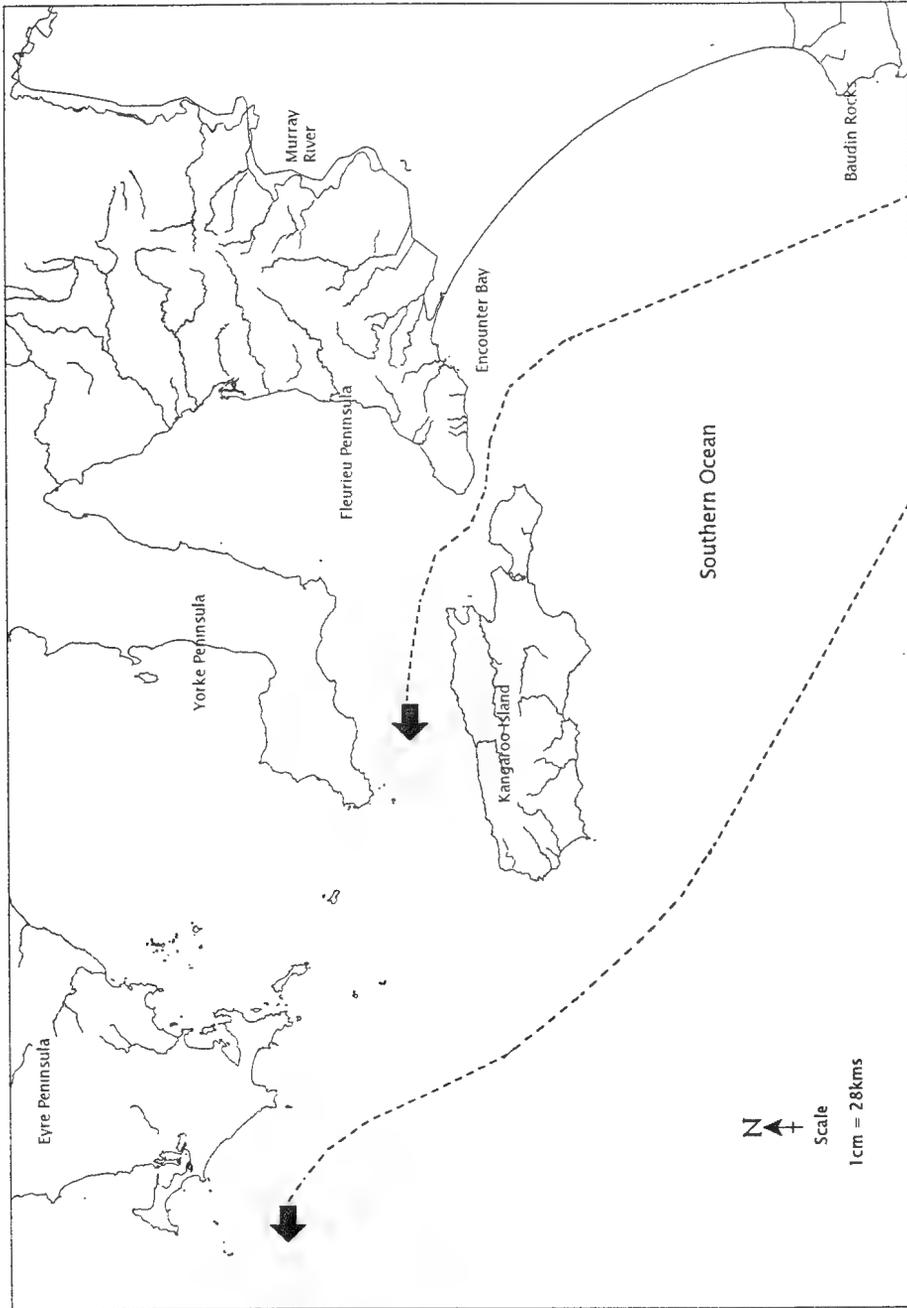


FIGURE 1. The possible winter migration routes of the southern right whale.

whales as they were returning from the west about 320 kilometres off the coast beyond the continental shelf. Sperm whales were generally only caught offshore, although, as with other whale species, they occasionally stranded along the coast. The 'off-shore' whaling was more expensive than 'bay whaling', as deep-sea activities required bigger boats. Whitelock (1985: 63) states that from 1836 to the end of 1840, 536 barrels of southern right whale oil, 158 barrels of sperm oil, and 655 bundles of whale bone were exported from Encounter Bay to London via Hobart.

IMPACT OF WHALING UPON ABORIGINAL PEOPLE

European whalers operating in South Australian waters utilised Aboriginal labour, being cheaply available when required (see Clarke 1996, 1998). For instance, it was reported in an Adelaide newspaper in 1839 that:

We are rejoiced to hear that the fishery at Encounter Bay is proceeding most prosperously, nearly 300 tons of oil having been already obtained. A fact connected with it has been communicated to us which is of an interesting and not unimportant nature. It appears that a boat is employed in the fishery which is entirely manned with natives. They take their part in the occupation equally with the white men, and are found to be not less expert than they. If the aboriginal inhabitants are competent to this laborious species of employment, what should prevent them being rendered efficient in many other paths of industry.⁵⁸

Furthermore, in 1846 Aboriginal people manned a boat run by Barton at Encounter Bay.⁵⁹ In the 1830s, the Kangaroo Island sealers knew an elderly Aboriginal man called Kondoy (Condoy), who was described as being a 'tribal chief' and apparently lived at Cape Jervis.⁶⁰ It is possible that this man's name referred to the whale. Since Kondoy was a senior member of his descent group, he may have taken on the identity of their main *nga:tji*, a whale. The sealers were part of a seafaring population originating in various Northern Hemisphere and Pacific countries. They and their Aboriginal wives were engaged in

various enterprises that were reliant on passing vessels, such as gathering salt, growing vegetables and the hunting wallabies, kangaroos and seals for their skins. On the frontier, the whalers and sealers were opportunistic. They were also the first direct contact that Aboriginal people had with Europeans. For example, in May or June 1838, whalers on the *Elizabeth* were blown ashore at the north end of Rivoli Bay (Stewart n.d. [1977: 78–79, 89]). They set up a station there, which attracted Aboriginal people looking for food. On at least one occasion these whalers rowed out in a boat to Penguin Rock with Aboriginal women, who caught for them the fat birds after which the islet was named. Similarly, Davies (cited Tindale 1986: 235) recorded a song in the Wirangu language that records the careening of a whaling boat at Denial Bay in the West Coast of South Australia.

From the outset, the whaling station at Encounter Bay attracted large numbers of Aboriginal people. Gouger (1838: 53) claims that the establishment of the whale fishery at Encounter Bay had made this area a favourite residence of Aboriginal people during the whaling season (presumably referring to the winter time). Penney noted this seasonal movement in November 1840, when he observed Aboriginal people leaving Encounter Bay and heading east. Penney reports:

I found the natives going or preparing to go to the Lower Murray. The natives of the Lower Murray tribes usually return at the end of the Whaling season, accompanied by some of the Encounter Bay tribe, to their stations on this river ...⁶¹

Leigh (1839: 163–164) describes how upon the capture of a whale, the local Aboriginal people came to the stations for feasts. A painting by George French Angas shows whalebones being used as the framework of an Aboriginal hut at the Encounter Bay whaling stations (Fig. 2). Cameron (1979: 4) suggests that the whalers encouraged local Aboriginal people to camp around the whaling station by distributing whale-meat and rum, so that the white men had access to Aboriginal women. In the 1840s, Richard Penney and David Wark treated Aboriginal people

⁵⁸ *The Southern Australian* newspaper, 1 August 1839.

⁵⁹ *The South Australian Register* newspaper, 8 August 1846. Aboriginal involvement in the whaling industry is noted elsewhere in Australia during the 1840s, with Aboriginal whalers present at Twofold Bay in southern New South Wales (Davidson & Davidson 1988: 25–34).

⁶⁰ See Thomas (1925: 45–46) and Clarke (1998: 39). Also see *The Advertiser* newspaper, 27 December 1886. An elderly Aboriginal man named 'Kondoy' is a character in Cawthorne's 'Kangaroo Islanders' (Cawthorne 1854 [1926: 110–111]).

⁶¹ Transcript of a letter from Penney to the Governor of South Australia, 7 January 1841. (Group 787; 1841, no.8 – AA309, Stirling collection, Anthropology Archives, S.A. Museum).



FIGURE 2. Aboriginal people living in camps on the edge of the Encounter Bay whaling stations used whale bones to make their shelters (G. French Angas watercolour, 1844 [lithograph version published in Angas 1847b, plate LVI]).

suffering from small pox and venereal diseases at Encounter Bay (Jenkin 1979: 46–49). Penney was concerned about the ill treatment of Aboriginal people by whalers. Of the Encounter Bay people, he said:

There are many individuals of this tribe, who have been content, whilst there was any employment, to live for months at the fisheries, and to do the work of whalers; and one was, the last season, rated amongst the crew of the chief headsman, Thomas, being considered as a good a hand as many of the white people.⁶²

The German missionary, Heinrich A.E. Meyer, operated a school for Aboriginal people near the whaling station.⁶³ The Lower Murray people living there were among the colony's first Aboriginal 'fringe dwellers', although at this stage they were

essentially opportunistic rather than dispossessed.

At the Encounter Bay whale fishery, it is claimed that Aboriginal men were employed to cart blubber to pots where Aboriginal women boiled it up in vats (Cameron 1979: 39).⁶⁴ Payment was usually made in gin and tobacco. The whalers employed at least one Aboriginal man, named Charlie Warner, as a 'spotter'.⁶⁵ He was a member of the Kondoli clan and it was said that Warner could also sing the whales to come in or to go out. The whalers believed in his abilities, paying him with rations. On one occasion, Warner did not receive his payment through an oversight. Sustie Wilson, an Aboriginal whaler, claimed:

So Charlie Warner ran out to a rock near the sea, and began his chanting. A huge whale which was lying in the bay vanished in a few seconds. The

⁶² Penney, *The South Australian Register* newspaper, 21 November 1840.

⁶³ Penney mentions a 'Rev. Mr Myers of Encounter Bay' [= H.A.E. Meyer] who was 'improving the natives' and studying their language (*The South Australian Register* newspaper, 26 June 1841).

⁶⁴ The origin of the historical source for this reference is not clear.

⁶⁵ *The Mail*, 19 August 1932.

whaling crew dashed out, but could not even find the wake which is usually left by the whales. They returned, and went to old Charlie, and give him his rations. He said, 'Now you catch him. You go back same place this afternoon. You catch him all right.' The same afternoon, they found the whale in the same place. I often saw him bring whales into the bay, as well.⁶⁶

Aboriginal men, such as One Arm Charley, Peter and Encounter Bay Bob, had experience in the whaling and sealing industries, dating back to before official European settlement (see Clarke 1991: 98–100; 1996: 56–59; 1998: 37). After 1836, when European colonists arrived at Encounter Bay, these men became important agents employed by the Europeans as trackers, guides and translators.⁶⁷

In the second half of the nineteenth century, some Aboriginal men were still engaged as whalers (Taplin Journals, 5 May & 22 July 1861). In 1932 an Aboriginal whaler, Sustie Wilson, claimed that many of the whalers from the 'Encounter Bay tribe' were much better than the Europeans. He was reported to have said that this 'was because they had been throwing spears all their lives, and took to harpooning naturally.'⁶⁸ Throughout the whaling industry, the use of Indigenous harpooners seems to have been the practice with some teams.⁶⁹ During the operation of the whale fishery on Granite Island, Aboriginal people were employed to take wood and drinking water out to the island along a connecting reef during low tide (Hodge 1932: 124). Whaling was hazardous employment. For example, when Sustie Wilson was still quite young and working in a whaling crew, their boat was dragged about nineteen kilometres out to sea by a huge whale. Sustie claimed that it 'took two days and two nights to row back ... it was hard going too, especially when the wind was against us. Not many of the young men of today could have done it.'⁷⁰

Transactions between Europeans and Aboriginal people did not always occur freely. During the 1837 season, a European named

Driscoll was travelling on a 'native pad' overland from Encounter Bay to Adelaide when he was murdered by 'waddy' (club) near Hindmarsh Valley by his Aboriginal guide, Reppindjeri, known by Europeans as 'Elic' (Cameron 1979: 4, 28, 39–42; Jenkin 1979: 52–55; Castles & Harris 1987: 11–13).⁷¹ This had resulted from a quarrel over Driscoll's apparent refusal to pay for sex with one of Elic's two Aboriginal women. The slain man was a whaler with Captain Blenkinsopp. Although the Aboriginal people involved kept the circumstances quiet, a local Aboriginal woman, Kalinga, who Europeans called 'Sarah', leaked the facts. She was the wife of a Kangaroo Island sealer and whaler, Walker. Reppindjeri was arrested by Walker and imprisoned by authorities for some months on the *South Australian* moored near the Bluff, before he allegedly escaped and disappeared.

Some Aboriginal people in the Lower Murray area apparently considered that there was an advantage in working with European colonists. At Encounter Bay in the 1840s Penney stated that:

The Encounter Bay natives have been properly brought up, they have never been accustomed to get anything, without working for it, and this has not only made them more industrious, but also made them pay that attention to the instruments and proceedings of Europeans, that renders them almost equal to them as general labourers.⁷²

This integration into a European pattern may well have been due in part to the disruption of hunting and gathering practices through European occupation of the land. Tindale blames early settlement by the whalers for loss of knowledge of indigenous place-names amongst Aboriginal people. He states:

Since occupation of much of the western head waters of the two rivers [Hindmarsh and Inman] had ceased after the early visits of white whalers, the names of places there never learned [by his Aboriginal informants].⁷³

⁶⁶ *The Mail* newspaper, 19 August 1932.

⁶⁷ See Pullen's account (*The South Australian Register* newspaper, 15 August 1840) of the investigations, involving the assistance of these three men, over the massacre of the *Maria* wreck survivors.

⁶⁸ *The Mail* newspaper, 19 August 1932.

⁶⁹ In the fiction of 'Moby Dick or The Whale', the main harpooner, Queequeg, was a Maori man (Melville 1851).

⁷⁰ *The Mail* newspaper, 19 August 1932.

⁷¹ The 'native pad' was a feature of the Aboriginal landscape that Europeans started to use. Meyer (1843: 52) refers to an Aboriginal song about 'a fine road ... winding between the hills' between Encounter Bay and Willunga. This was possibly the trail that Watts Newland and his party were taken on when two Aboriginal people guided them from Adelaide to Encounter Bay in 1839 (Robinson 1975: 21). In the case of the Encounter Bay track, this was originally just over half a metre wide, and so its use by Europeans was initially confined to foot and horse traffic (Sweetman 1928 [1988: 4]). Eventually, however, it was widened for use by coaches.

⁷² *The Examiner* newspaper, 28 January 1843.

⁷³ Tindale (Wunindjeri clan entry in 'Clan Data' folder in 'Milerum' manuscripts, stage 2. Anthropology Archives, S.A. Museum).

The pre-European culture of the northern parts of the Lower Murray region was, by the twentieth century, poorly known due to early European settlement there (see Clarke 1994: 58, 227–231, 241–242).

At Encounter Bay, Aboriginal people adapted to the new situation, quickly gaining skills in a wide range of European practices. Penney claimed:

that many of them can use the axe and the saw, and have been employed in cutting posts and rails for fencing, and two or three can drive bullock-drays; they are all of them very useful in tracking cattle and horses – they are very good hands in a boat, and in diving – and they have rendered great services to owners of the wrecks at Encounter Bay.⁷⁴

When a drowning occurred in the Encounter Bay and Lower Murray region, Aboriginal people invariably assisted in the recovery of the bodies (Linn 1988: 60).⁷⁵ Although Meyer ran an Aboriginal School at Victor Harbor (from 1840 to about 1846), Aboriginal people were relatively free to work for European colonists.⁷⁶ Encounter Bay people were frequent visitors to the Adelaide region in the 1840s.⁷⁷ Even with the establishment of the Point McLeay Aboriginal Mission in 1859, Aboriginal people in the Lower Murray region still moved around fairly freely.

Whaling declined in the early 1840s as gaslight in the Northern Hemisphere challenged the use of candles and oil lamps (Blainey 1977: 115). The use of whale oil declined further when kerosene from American oil wells became available (Hosking 1973, chap.2: 9, 32–35; Whitelock 1985: 66). The decreasing value of whale products led to the South Australia Company pulling out in 1842 (Cameron 1979: 23). By this time, European activities had already denuded much of the hills behind the whaling stations at Encounter Bay ('Baleineau', cited in Whitelock 1985: 65). Seasons of whaling continued sporadically up to the 1870s. In about 1870, whaling recommenced at Encounter Bay, after stopping in the 1860s (Hodge 1932: 127). For two seasons there was an Aboriginal crew on the whaling boats. Aboriginal labour became crucial to the colony at times when European labour was too expensive and scarce. Aboriginal people were

considered suitable for employment that demanded heavy use of the body. Nevertheless, in 1871 only one whale was killed and towed to the Bluff Station (Whitelock 1985: 66). In the early twentieth century, Aboriginal people in the Lower Murray area were able, on at least one occasion, to actively hunt a whale. They killed a 5.6 metre female whale trapped near Rabbit Island in the Coorong system. Parts of it were dragged into a boat, cut up and distributed among the people at the Point McLeay Mission (Ely 1980).

DISCUSSION

Versions of the Kondoli mythology establish that the main players were Ancestors and associated spirit familiars of various descent groups in the Encounter Bay area of the Lower Murray cultural region. Here, the whale mythology, although existing in many different forms, was used by Aboriginal people to explain the origin and making of fire. The involvement of particular bird ancestors and the shark vary widely across the corpus of this mythology. There are also parallels between these myths and others that do not involve the whale. In the coastal regions of southern Australia, the observation of whales spouting and the recognition of their warm bloodedness appear to have been major elements in the mythology. There is insufficient data for areas of coastal South Australia outside the Lower Murray to determine the totemic significance of whales, but there is an indication that whale strandings provided other coastal Aboriginal groups with occasional feasts of food. The records of who had access to the meat of stranded whales indicate that Aboriginal people had a system of determining ownership of food resources originating from the sea.

From the early nineteenth century, Aboriginal people were being incorporated into the world economy through their participation in the marine industries controlled from the Northern Hemisphere. European colonists used indigenous people as a cheap labour force. Aboriginal people in the Encounter Bay and Adelaide areas, through

⁷⁴ *The South Australian* newspaper, 21 November 1840.

⁷⁵ On 12 December 1837, Aboriginal people dragged the two surviving members of Captain Blenkinsopp's exploration party from the Murray Mouth in a whaleboat (*The South Australian Register* newspaper, 20 January 1838; Gouger 1838: 42–45; Hahn 1838–1839 [1964: 130]; Hosking 1973, chap.1: 21–22; Cameron 1979: 4, 28). In June 1838 Aboriginal people from east of the Murray Mouth assist the survivors of the wrecked 'Fanny' to return to Victor Harbor (*The South Australian Register* newspaper, 25 August & 8 September 1838).

⁷⁶ Meyer left the Encounter Bay district in 1848 and settled at Bethany in the Barossa Valley (Cameron 1979: 48).

⁷⁷ *The Observer* newspaper, 27 April 1844.

their interaction with the sealers and whalers, were the first groups in South Australia to gain extensive experience of Europeans. Thus whaling at Encounter Bay provided the background to Aboriginal and European interaction during the British colonisation of South Australia.

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TAXONOMIC REVISION OF THE AUSTRALIAN LIZARD PYGOPUS NIGRICEPS (SQUAMATA : GEKKONOIDEA)

BRIAN H. JAMES, STEPHEN C. DONNELLAN & MARK N. HUTCHINSON

Summary

Allozyme electrophoresis and analysis of scalation, colour pattern and body proportions were used to define species boundaries in the widespread, arid adapted legless lizard *Pygopus nigriceps*. Three species are recognised. *Pygopus nigriceps* (Fischer, 1882) is confined to the sandy deserts of central and western Australia. *Pygopus schraderi* Boulenger, 1913 inhabits mainly heavier soils and rocky substrates in the arid and semi-arid zones of eastern Australia. The third species is described a new, and occurs in the wet-dry tropics of northern Australia.

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Allozyme electrophoresis and analysis of scalation, colour pattern and body proportions were used to define species boundaries in the widespread, arid adapted legless lizard *Pygopus nigriceps*. Three species are recognised. *Pygopus nigriceps* (Fischer, 1882) is confined to the sandy deserts of central and western Australia. *Pygopus schraderi* Boulenger, 1913 inhabits mainly heavier soils and rocky substrates in the arid and semi-arid zones of eastern Australia. The third species is described as new, and occurs in the wet-dry tropics of northern Australia.

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Pygopods are a lineage of snake-like lizards endemic to Australia and New Guinea with evolutionary affinities to the geckoes (Kluge 1987; King 1990; Donnellan *et al.* 1999). There are 35 species of pygopods recognised, placed by most recent authors into eight genera (Kluge 1974, 1976; Wilson & Knowles 1988; Storr *et al.* 1990; Ehmann 1992; Cogger 1996). The genus *Pygopus* Merrem is considered (Kluge 1974; Cogger 1996) to comprise two species, *Pygopus lepidopodus* (Lacépède) which occupies the southwestern, southern and eastern margins of Australia, and *Pygopus nigriceps* (Fischer) which is widespread throughout the more xeric parts of Australia.

Kluge (1974) found considerable phenotypic divergence between populations of *P. nigriceps* from the western and eastern parts of Australia. They were separated by a narrow zone of character discontinuity located approximately along 135°E. In addition, he found that specimens from north of 18°S in Western Australia (WA) and the Northern Territory (NT) tended to be more like the eastern than the western form but Kluge had insufficient specimens to be able to identify the northern extension of the character discontinuity. He suggested that two subspecies be recognised, a western *P. n. nigriceps* and an eastern *P. n. schraderi* Boulenger, and that the northern specimens be treated as a taxonomically separate unnamed, problematical set.

Kluge's separation of *P. nigriceps* into two subspecies was continued by Storr *et al.* (1990) and Cogger (1996) who both ascribed the northern WA and NT specimens to *P. n. schraderi*. Wilson and Knowles (1988) suggested that northern populations were an intermediate form that could be tentatively regarded as undescribed. Ehmann (1992, 1995) provided two different interpretations for the status of *P. nigriceps*. In 1992, he suggested there were two separate species, *P. nigriceps* whose range he gave approximately as west of 135°E, including northern WA and the NT, and *P. schraderi*, whose range he gave approximately as east of 135°E including Cape York Peninsula. However, by 1995 he had altered this view and suggested there were two subspecies, *P. n. nigriceps* and *P. n. schraderi*. Their ranges were as he had suggested previously for *P. nigriceps* and *P. schraderi*, except that populations from northern WA and the NT were assigned to *P. n. schraderi* while those from Cape York Peninsula were not assigned to either subspecies.

In the present study, we have employed multilocus allozyme electrophoresis and morphology to examine the taxonomic status of *P. nigriceps* and to clarify species boundaries. This revision explicitly invokes the evolutionary species concept (Simpson 1951), the significant feature of which is that a species is a lineage evolving separately from others and with its own unitary evolutionary history and fate.

MATERIALS AND METHODS

Specimens

For the allozyme analysis, frozen liver samples from the Australian Biological Tissue Collection (ABTC) at the South Australian Museum, Adelaide were used. The samples had been dissected from fresh specimens and stored continuously at -80°C . In all, liver samples from 43 specimens of *P. nigriceps* were available for analysis. In addition, liver samples from nine specimens of *P. lepidopodus*, chosen to cover the known range, were used to provide a sister lineage for the *P. nigriceps* species-complex, and as a check on the authenticity of the *P. nigriceps* samples. An incidental aim was to gain preliminary data on possible cryptic speciation, given the extensive range and known colour variations in *P. lepidopodus*.

There was the potential for a very large number of *P. nigriceps* specimens to be available for morphological analysis from the Australian state museum collections. We concentrated on specimens from north of the Tropic of Capricorn ($23^{\circ}26'30''\text{S}$). All specimens whose liver tissues were examined in the allozyme study were examined for morphological characters, provided that the body was available for analysis, as were all specimens in the South Australian Museum collection and selected specimens from the other state museums. Museum registration numbers for all specimens examined electrophoretically and/or morphologically ($n = 260$) are given in the Appendix. Institutional acronyms follow Leviton *et al.* (1985).

Allozyme electrophoresis

Allozyme electrophoresis was conducted with liver homogenates on cellulose acetate gels (Cellogel, Chemetron) according to the methods of Richardson *et al.* (1986). Proteins and enzyme products of 35 presumed loci were scored. The enzymes and other products stained, abbreviations and Enzyme Commission Numbers are: aspartate aminotransferase (AAT, EC 2.6.1.1), aconitate hydratase (ACOH, EC 4.2.1.3), aminoacylase (ACYC, EC 3.5.1.14), adenosine deaminase (ADA, EC 3.5.4.4), alcohol dehydrogenase (ADH, EC 1.1.1.1), 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), guanine deaminase (GDA, EC 3.5.4.3), (S)-2-hydroxy-acid oxidase (GOX, EC 1.1.3.15), glycerol-3-phosphate dehydrogenase (G3PDH, EC 1.1.1.8), glucose-6-phosphate isomerase (GPI, EC 5.3.1.9), β -glucuronidase (β GLUR, EC 3.2.1.31), L-idoitol 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), lactogluthione lyase (LGL, EC 4.4.1.5), malate dehydrogenase (MDH, EC 1.1.1.37), 'malic' enzyme (MDHP, EC 1.1.1.40), mannose-6-phosphate isomerase (MPI, EC 5.3.1.8), nucleoside-diphosphate kinase (NDPK, EC 2.7.4.6), dipeptidase (PEP-A, EC 3.4.13.?), tripeptide aminopeptidase (PEP-B, EC 3.4.11.?), proline dipeptidase (PEP-D, EC 3.4.13.?), phosphogluconate dehydrogenase (PGDH, EC 1.1.1.44), phosphoglucomutase (PGM, EC 5.4.2.2), superoxide dismutase (SOD, EC 1.15.1.1) and triose-phosphate isomerase (TPI, EC 5.3.1.1). For the genetic analysis, geographically proximate specimens of a single genetic type that is, where there were no fixed allelic differences, were pooled to form Operational Taxonomic Units (OTUs). On this basis, 25 OTUs of *P. nigriceps* were designated. Each of the *P. lepidopodus* specimens was treated as a separate OTU. The OTU localities are shown in Fig. 1 and composition in the Appendix. Evolutionary distances between OTUs were estimated with Cavalli-Sforza chord distances (Cavalli-Sforza & Edwards 1967) calculated with BIOSYS-1 (Swofford & Selander 1981). The Neighbour-joining (NJ) algorithm, implemented in PHYLIP version 3.5c (Felsenstein 1993) was used to build trees from these distances. The maximum parsimony (MP) criterion optimality was also used to recover phylogenetic trees with each locus considered as a character and each allele as an unordered character state. Polymorphic loci were encoded as uncertainties using this option for multistate characters in PAUP* version 4.0b3. (Swofford 1999). The data were bootstrapped to assess confidence for individual nodes.

Morphology

Kluge (1974) assembled a large character set for morphological analysis of the pygopods. Many of these characters are not applicable to the genus *Pygopus* and some are difficult to score in that they depend upon arbitrary starting points or locations on the body. Initially, we selected those

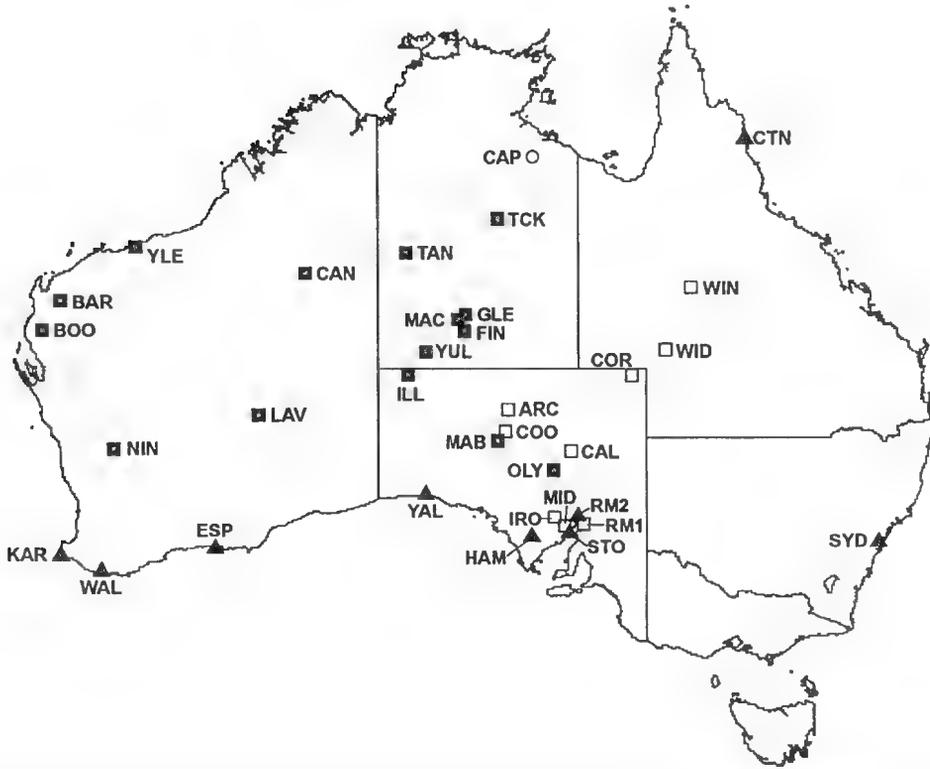


FIGURE 1. Map showing collection localities for the 34 *Pygopus* OTUs examined electrophoretically. See Appendix 1 for a key to the OTU labels. □ = 'eastern' group, ○ = 'northern' group, ■ = 'western' group, ▲ = *P. lepidopodus*.

characters reported by Kluge as varying significantly within *Pygopus* and were either quantitative in nature, or if qualitative, defined by unambiguous reference points. We added several new characters that seemed likely to be useful for taxonomic purposes. Measurements were made with vernier callipers to the nearest mm.

The characters and their abbreviations used in the morphological study are listed below. Where characters were defined by Kluge (1976), they are indicated by *; characters modified from those used by Kluge are indicated by #.

Subnostril scale* (SNS). The nostril may contact the first supralabial scale (0) or a thin strip of the nasal scale may separate the nostril from the supralabial (1). Kluge's 'subnostril scale' refers to the portion of the nasal underlying the nostril.

Ventral scales* (VS). The number of ventral scales between the posterior edge of the mental and the vent, including the preanal scale.

Orbital scales# (OS). The number of scales

along the anterior margin of the bony portion of the orbit between the anteriormost and posteriormost enlarged supraciliary scales.

Dorsal scale keeling* (DSK). Keels absent (0), scales weakly keeled (1), or scales moderately keeled (2). The keeled scales were always unicarinate.

Dorsal scale row keeling (DSRK). The number of dorsal rows of scales exhibiting keeling.

Preanal pores* (PP). The total number of preanal pores.

Dorsal interorbital pattern* (DIP). Pattern on the dorsal surface of the head between the orbits. Varies from no significant pigmentation to a mottled appearance, not distinctly different from the snout, to the presence of brown or black pigmentation forming a faint to strongly contrasting dark bar. Scored as no significant pigmentation, not distinctly different from snout (0), mottled appearance not distinctly different from snout (1), brown or black pigmentation present as a faint bar (2), or

TABLE 1. Allele frequencies expressed as a percentage for 34 OTUs of *Pygopus* at 35 loci. 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 mobility. Sample sizes are given at the head of each column, except when fewer individuals were successfully typed. In the latter case sample sizes are indicated by the number in superscript beside the first allelic frequency entry for a locus. Where allele frequencies are not given, the OTU is fixed for the allele. The following loci were invariant: *Ca*, β *Glur*, *Ldh-1*, *Ldh-2*, *Lap*, *Mdh* and *Tpi*.

Locus	'eastern'									'northern'						
	WIN 1	WID 2	COR 1	COO 1	ARC 1	CAL 1	MID 1	IRO 1	RM1 2	CAP 3	TCK 3	TAN 1	GLE 1	FIN 1	MAC 2	YUL 2
<i>Aat</i>	a	a	a	a	a	a	a	a	a	a	d(17) c(33) b(17) a(33)	a	a	c(50) a(50)	c(25) a(75)	c(25) a(75)
<i>Acoh-1</i>	b	b	b	b	b	b	b	b	b	b	a	a	b(50) a(50)	b(50) a(50)	c(50) a(50)	b
<i>Acoh-2</i>	c	c	d(50) c(50)	c	c	b	b	c(50) b(50)	c	a	b(83) a(17)	b	b	c	b1	c(50) b(50)
<i>Acyc</i>	b	b	b	b	c(50) b(50)	c(50) b(50)	b	c	c(75) b(25)	d	b	b	b	b	b	b
<i>Ada</i>	a	a	a	a	a	a	a	a	a	b	b	b	b	b	b	b
<i>Adh</i>	a	a	a	a	a	b(50) a(50)	a	a	a	a	a	a	a	a	a	a
<i>Dia</i>	b	b	b	a	a	b	b(50) a(50)	b	b	a	c	c	c	c	c	c
<i>Eno</i>	b	b(50) a(50)	b	b	b	b	b	b	b	b	b(67) a(33)	b	b	b	b	b
<i>Est</i>	c(50)	b b(50)	b	b	b	b	b	b	b	b(83)	b a(17)	b	b	b	b	b
<i>Fbp</i>	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	b(25) a(75)
<i>Fumh</i>	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b(75) a(25)
<i>Gapdh</i>	b	b	b	b	-	-	b	b	b	b	b	-	b	b	b	b
<i>Gda</i>	a	a	a	a	a	a	a	a	a	b(17) a(83)	b	b	b	b	b	b
<i>Gox</i>	b	b	b	b	b	c(50) b(50)	b(50) a(50)	c	b	c(83) b(17)	c(83) b(17)	c	c	c	c	c(25) b(75)
<i>G3pdh</i>	b	b	b	b	b	b	b	b	b	a	b	b	b	b	-	b
<i>Gpi</i>	a	a	a	a	-	-	a	a	a	a	a	a	a	a	a	a
<i>Iddh</i>	c	c	c	c	c	c	c	c	c	c	f	f	e	f(50) e(50)	-	f(50) e(50)

'western'									<i>P. lepidopus</i>								
ILL 1	OLY 3	MAB 7	LAV 2	NIN 1	CAN 1	BAR 2	BOO 1	YLE 1	YAL 1	ESP 1	HAM 1	STO 1	SYD 1	WAL 1	KAR 1	RM2 1	CTN 1
c(50) a(50)	c(17) a(83)	c(36) a(64)	c(25) a(75)	a	a	a	c(50) a(50)		a	a	a	a	a	c(50) a(50)	a	a	a
-	b	c(25) b(75)	b	b	-	c(25) b(50)	b a(25)	b	c	c	c	c(50) b(50)	a	c	c	c	c
-	b	c(14) b(86)	c(25) b(75)	b	-	c(50) b(50)	b	c(50) b(50)	e(50) d(50)	e(50) c(50)	d(50) c(50)	d	c	d	d	d	c
-	b	b	b	b	-	b	b	b	b	b	b	b	b	b	b	b	a
b	b	c(7) b(93)	b	b	-	b	b	b	-	b	b	b	b	c(50) b(50)	c(50) b(50)	b	b(50) a(50)
-	a	a	a	a	-	a	a	a	a	a	a	b	a	a	a	b(50) a(50)	b
-	c	c	c	c	-	c	c	c	-	d	d	d	d	d	d	d	c
b	b(33) a(67)	b(86) a(14)	b	b	b	a	a	b	c	b	c	c	a	c	c	c	a
b	b	b	b	b	b	b	b	b	b	b	b(50)	b a(50)	b	b	b	a	b
a	a	a	a	a	-	a	a	a	b(50) a(50)	a	a	a	a	b	b	a	a
b	b(83) a(17)	b(86) a(14)	b	b	-	b	b	b	b	b	b	b	b	b	b	b	b
b	b	b	b	b	-	b	b	b	a	a	a	a	a	-	-	a	a
-	b	b	b	b	-	b	b	b	b	b	b	b	b	b	b	b	b
-	d(25) c(50)	d(22) c(57) b(25)	c b(21)	c	-	c(75) b(25)	c	-	b	c	b	b	c(50) b(50)	-	-	c	c
-	b	b ⁶	b	b	-	b	b	b	-	b	b	c	a	-	-	b	a
a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	b
f(50) e(50)	g(8) f(50)	f(25) ⁶ e(75) e(42)	f	-	-	f ⁷	f	f	c	c(50) b(50)	b	c(50) b(50)	d	-	-	c	a

TABLE 1. (cont.)

Locus	'eastern'								'northern'							
	WIN 1	WID 2	COR 1	COO 1	ARC 1	CAL 1	MID 1	IRO 1	RM1 2	CAP 3	TCK 3	TAN 1	GLE 1	FIN 1	MAC 2	YUL 2
<i>Idh-1</i>	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a ¹	a
<i>Idh-2</i>	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b
<i>Lgl</i>	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b
<i>Mpi</i>	c	c(75)	d(50) b(25)	b c(50)	b	b	b	b	b	d	b	b(50)	b a(50)	b	b	b
<i>Ndpk</i>	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b
<i>Pep-A</i>		a	a	a	a	a	a	a	a	b(75)	b a(25)	c	b	b	c(50) ¹	b b(50)
<i>Pep-B1</i>		a	a	a	a	a	a	a	a	a	b	a	a	a	a ¹	a
<i>Pep-B2</i>	c(50) b(50)	b	b	d	e	b	d	d	d	c(50) b(33) a(17)	c	f(50) c(50)	c	c(50) b(50)	f(50) c(25) b(25)	c
<i>Pep-D</i>	c(50) b(50)	e(50) d(50)	e(50) a(50)	e	e	e	e	e	e	e(67) c(33)	g(17) f(83)	f(50) b(50)	g(50) f(50)	g(50) f(50)	f	g(25) f(75)
<i>Pgm</i>	a	a	a	a	a	a	a	a	a	a	a	a	a	a	c(25)	a a(75)
<i>Sod</i>	c	c	c	c	c	c	c	c	c	b	c(83) b(17)	c	c	c	c	c

brown or black pigmentation present as a strong bar (3).

Dorsal nuchal pattern* (DNP). The pattern on the dorsal surface of the head and neck immediately posterior to the parietal region varies in a similar way to the interorbital region. Scored as no significant pigmentation not distinctly different from snout (0), mottled appearance not distinctly different from snout (1), brown or black pigmentation present as a faint band (2), or brown or black pigmentation present as a strong band (3).

Orbital patch (OP). Dorsoventrally orientated darkly pigmented patch around and/or below the orbit extending to the supralabial scales and sometimes to the infralabial scales. Scored as absent (0), faint (1), moderately intense (2) or intense (3).

Narial patch (NP). Dorsoventrally oriented darkly pigmented patch or streak around and/or below the nostril extending to the supralabial

scales and sometimes to the infralabial scales. Scored as absent (0), faint (1), moderately intense (2) or intense (3).

Contrast of lateral head pattern (LHP). Relative intensities of the orbital and narial patches may vary. Whereas some specimens or species show an equally intense development of both patches, others may have a noticeably weak expression of the narial patch (even absence) compared to the orbital patch. The converse (narial patch more strongly developed than orbital patch) was not observed. Scored as intensities of both patches equal (1), differing by one on the NP and OP scores (2), differing by two (3), or differing by three (4).

Snout-vent length* (SVL). The horizontal distance between the median anterior-most extreme of the snout and the median posterior-most extreme of the middle preanal scale.

These characters were scored for each specimen from which liver samples had been taken for

'western'									<i>P. lepidopodus</i>								
ILL	OLY	MAB	LAV	NIN	CAN	BAR	BOO	YLE	YAL	ESP	HAM	STO	SYD	WAL	KAR	RM2	CTN
1	3	7	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1
-	a	a	-	a	-	a	a	a	-	a	a	a	b(50) a(50)	-	b(50) a(50)	a	a
-	b	c(7)	b b(93)	b	b	b	b	b	-	a	a	a	a	a	a	a	a
b	b	b(86)	b a(14)	b	-	b	b	b	b	b	b	b	a	-	-	b	a
b	b	b	b	c(50)	b b(50)	b	c(50)	b b(50)	b	b	b	b	b	b	b	b	b
b	b	b ⁶	b	b	b	b	b	b	b	b	b	a	c	c	c	b	b
c(25)	c(33) b(75)	b ⁶ b(67)	b	b	-	b	b	b	b	b	b	b	b	-	b	b	a
a	c(83)	a a(17)	b(25)	c(50) a(75)	- a(50)	c(25)	b(50) b(75)	a a(50)	-	a	a	a	a	c(50)	a a(50)	a	a
c	c	f(21) c(79)	c	c	-	c	c	c	-	-	-	-	-	-	-	-	-
-	f	h(7) f(86)	g(50) e(25)	f	g e(7)	g(25) f(50)	g(50) f(50)	f e(25)	-	f(50) b(50)	c	b	f	f	e	b	f(50) c(50)
a	a	a	a	a	a	b(50)	a a(50)	a	a	a	a	a	a	a	a	a	a
c	c	c	c	c	c	c	c	c	a	a	a	a	a	a	a	a	a

allozyme electrophoresis, except for three 'western' specimens for which vouchers were not available for examination (ABTC 6588, 31799, 31812). For statistical comparisons of the morphological characters except SVL, the significance of differences between taxa was assessed with the non-parametric Mann-Whitney *U* test. For comparisons of SVL, unpaired Student's *t* tests were used after testing for departures from a normal distribution for each taxon (Shapiro-Wilks test) and pairwise tests of equality of variances (Levene test). All tests were two-tailed with an α set at 0.05 and were carried out with STATISTICA (Statsoft Inc. 1997).

RESULTS

Table 1 shows the allelic profiles of the 25 OTUs of *P. nigriceps* and nine OTUs of *P. lepidopodus* for the 35 loci. These data were

converted into matrices of percentages of loci showing fixed allelic differences (FD) and Cavalli-Sforza chord distances between OTUs (not shown). A fixed allelic difference occurs at a locus when the two samples under comparison share no alleles (Richardson *et al.* 1986). Richardson *et al.* (1986) argued that percentage of loci showing fixed allelic differences is an appropriate genetic distance metric for species boundary studies and is relatively unaffected by small sample size. We present a phenogram constructed from Cavalli-Sforza chord distances between OTUs by NJ (Fig. 2A). A heuristic search under MP found 77 335 equally most parsimonious trees of length 53 steps. A strict consensus of the equally most parsimonious trees with bootstrap proportions from 10 000 pseudoreplicates is presented in Fig. 2B. For the NJ and MP analyses adjacent populations between which there were no fixed allelic differences were pooled and allele frequencies recalculated, making

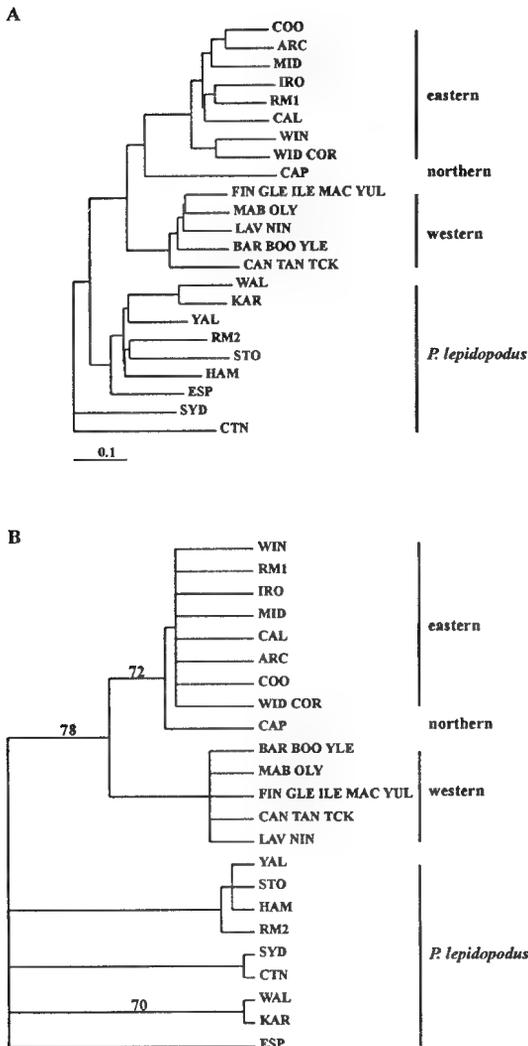


FIGURE 2. (A) A Neighbour-joining phenogram constructed from Cavalli-Sforza chord distances between OTUs; and (B) a strict consensus tree of more than 2000 equally most parsimonious trees found with a heuristic search. Bootstrap proportions >70% from 2000 pseudoreplicates are indicated to the left of relevant nodes.

a total of 14 OTUs within *P. nigriceps* for the final analyses.

The allozyme data (Fig. 2 and Table 1) show that the *P. nigriceps* OTUs are genetically more similar to one another than they are to any of the *P. lepidopodus* OTUs. Monophyly of the *P. nigriceps* OTUs received strong support (78%)

from bootstrapping (Fig. 2B). The *P. lepidopodus* OTUs exhibit considerable genetic heterogeneity suggesting that more study is warranted.

Within *P. nigriceps*, both the NJ and the MP analyses are concordant in showing the presence of three lineages herein designated 'eastern', 'northern', and 'western'. However, strong bootstrap support (>70%) was found only for the monophyly of the 'eastern' lineage (Fig. 2B). The primary split between the *P. nigriceps* OTUs occurs at a minimum of 14% FD and broadly distinguishes two groups, an 'eastern' and a 'western' group. These two groups show diagnostic allozyme differences at four loci (*Ada*, *Dia*, *Gda* and *Iddh*) and other differences that are diagnostic for some of the OTUs between each group at eight loci (*Aat-2*, *Acoh-1*, *Acoh-2*, *Acyc*, *Fumh*, *Pep-A*, *Pep-B1* and *Pep-D*). There is genetic divergence within both the 'eastern' and 'western' groups with seven loci (*Acoh-2*, *Acyc*, *Dia*, *Gox*, *Mpi*, *Pep-B2* and *Pep-D*) displaying fixed allelic differences between one or more OTUs in the 'eastern' group and six loci (*Acoh-1*, *Acoh-2*, *Eno*, *Iddh*, *Pep-B1* and *Pep-D*) displaying fixed allelic differences between one or more OTUs in the 'western' group. The greatest intragroup genetic divergence, at an average of 10% FD, is between the OTUs WIN, WID and COR from central Queensland (Qld) and the 'eastern' group OTUs situated in the corridor between the eastern and western deserts. This may reflect the well-known climatic-ecological barrier of the Simpson Desert on patterns of speciation (Cracraft 1986, 1991).

None of the OTUs of the 'eastern' and 'western' groups were found in strict sympatry. However, 'eastern' and 'western' groups were found in regional sympatry, i.e. within 30–80 km of each other, in the Coober Pedy/Mabel Creek area (OTUs COO and MAB). Fixed allelic differences at six loci (*Ada*, *Dia*, *Gda*, *Iddh*, *Pep-A* and *Pep-B2*) were found between the two OTUs. Given the null hypothesis that two OTUs are sampled from a single population of eight individuals, the probability of not observing a heterozygote at the six loci showing fixed allelic differences can be derived from the Hardy-Weinberg equation as $(1-[2 \times 0.125 \times 0.875])^{6 \times 8} = 7.035 \times 10^{-6}$ (see Richardson *et al.* 1986 for a fuller explanation of this approach). Hence, the null hypothesis can be rejected and a reasonable alternative hypothesis is that two species are present in the Coober Pedy/Mabel Creek area.

A second split among the *P. nigriceps* OTUs occurs at a minimum of 21% FD and distinguishes

the 'eastern' and 'western' groups from a single 'northern' OTU, CAP. There are diagnostic allozyme differences between the 'eastern' and 'northern' groups at six loci (*Acoh-2*, *Acyc*, *Ada*, *G3pdh*, *Pep-B1*, and *Sod*) and between the 'western' and 'northern' groups at five loci (*Acyc*, *Dia*, *G3pdh*, *Iddh* and *Mpi*). In addition, there are other differences that are diagnostic for some of the OTUs between the 'northern' and other two groups at 11 loci (*Acoh-1*, *Acoh-2*, *Dia*, *Gda*, *Iddh*, *Mpi*, *Pep-A*, *Pep-B1*, *Pep-B2*, *Pep-D* and *Sod*).

The magnitude of the genetic differences encountered, the evidence of separate evolutionary histories of the 'eastern', 'western' and 'northern' groups and direct evidence of lack of gene flow between two of the lineages is sufficient to reject the null hypothesis of a single species within *P. nigriceps*. Consequently, we considered the groups as three separate species for the purposes of morphological examination. The 'eastern' and 'western' groups correspond roughly in

geographic location with Kluge's (1974) suggested ranges for *P. n. schraderi* and *P. n. nigriceps* respectively. The 'northern' group comprises only one population in the samples available for electrophoresis thus preventing any delineation of its geographical distribution on allozyme data alone. These three groups proved to have a distinctive suite of morphological characters as outlined in the following analysis.

A summary of the variation in morphological characters is shown in Table 2 for the three groups. The data in Table 2 show that a suite of morphological features varies concordantly with the electrophoretic data. This table therefore provides the basic morphological characters for separating specimens into the 'eastern', 'northern' and 'western' groups.

The 'western' group is easily separated from the other two groups in that: the nostril is separated from the first supralabial scale by the nasal ('subnasal scale' present); dorsal scale keeling is absent; the mean number of ventral

TABLE 2. Morphological statistics for specimens of *Pygopus* for which allozyme data were collected. E = 'eastern' group, N = 'northern' group, W = 'western' group. See text for character abbreviations. \bar{x} = mean, *S* = standard deviation, *R* = range, *n* = sample size, * *P* for two-tailed Mann-Whitney *U* or unpaired Student's *t* tests, tests for normal distribution^a and equality of variances^c were not significant. See Materials and Methods for the definitions of characters.

Character	Group	Univariate Statistics			Pairwise Statistical Comparisons*		
		E (<i>n</i> =11)	N (<i>n</i> =3)	W (<i>n</i> =26)	E/N	E/W	N/W
SNS	\bar{x} (<i>S</i>)	0 (0)	0 (0)	1 (0)	0.88	<0.001	<0.001
VS	\bar{x} (<i>S</i>)	110.3 (4.6)	109.7 (1.2)	130.8 (5.9)	1.0	<0.001	<0.001
	<i>R</i>	105-122	109-111	114-140			
OS	\bar{x} (<i>S</i>)	9.18 (1.17)	10.7 (1.5)	11.8 (1.6)	0.17	<0.001	0.35
	<i>R</i>	7-11	9-12	10-16			
DSK	\bar{x} (<i>S</i>)	2(0)	1(0)	0(0)	0.005	>0.001	<0.001
DSRK	\bar{x} (<i>S</i>)	12.4 (0.8)	7.67 (1.58)	0 (0)	0.005	>0.001	<0.001
	<i>R</i>	12-14	6-9				
PP	\bar{x} (<i>S</i>)	13.0 (1.2)	13.3 (0.6)	10.2 (1.1)	0.45	<0.001	<0.001
	<i>R</i>	12-15	13-14	8-12			
DIP	\bar{x} (<i>S</i>)	0.45 (0.52)	0.33 (0.58)	2.32 (.80)	0.78	<0.001	0.004
	<i>R</i>	0-1	0-1	0-3			
DNP	\bar{x} (<i>S</i>)	2.09 (0.83)	1.33 (1.15)	2.92 (0.28)	0.29	0.001	0.002
	<i>R</i>	0-3	0-2	2-3			
OP	\bar{x} (<i>S</i>)	1.91 (0.70)	2.67 (0.58)	2.44 (0.71)	0.37	0.09	0.89
	<i>R</i>	1-3	2-3	1-3			
NP	\bar{x} (<i>S</i>)	1.82 (0.60)	0	1.2 (1.04)	0.005	0.02	0.06
	<i>R</i>	1-3	-	0-3			
LHP	\bar{x} (<i>S</i>)	1.09 (0.30)	3.67 (0.58)	2.24 (0.88)	0.005	<0.001	0.019
	<i>R</i>	1-2	3-4	1-4			
SVL	\bar{x} (<i>S</i>)	147.6 (23.1) ^a	136.0 (7.9) ^a	156.1 (33.2) ^a	0.42 ^c	0.45 ^c	0.31 ^c
	<i>R</i>	96-178	130-145	79-204			

scales is greater than 120; the mean number of preanal pores is less than 12; there is usually a well-developed blackish interorbital bar.

The 'eastern' group can be separated from the 'northern' group in that: The dorsal scales are moderately keeled with keeling occurring over ten or more rows in the 'eastern' group but weakly keeled over fewer than ten rows in the 'northern' group. The orbital and narial patches are present and are of moderate and equal intensities in the 'eastern' group, while in the 'northern' group the orbital patch is more strongly expressed than the nasal patch in any individual, and the nasal patch may be completely absent.

These characters were then used to separate the museum specimens for which tissues had not been available for allozyme electrophoresis. The great majority of specimens were readily separated ($n = 251$) but some difficulty was experienced in separating six 'eastern' and 'northern' specimens that had 'washed out' body patterns together with indeterminate scale keeling. The consistent allozyme and morphological differences between

the three groups is sufficient for each group to be given species status. The 'western' group is *P. nigriceps*, the 'eastern' group *P. schraderi* and the 'northern' group *P. steelescotti* sp. nov. A map showing the geographic distribution of the three species is shown in Fig. 3. Note that the distributions of *P. nigriceps* and *P. schraderi* overlap in south-western Queensland (Qld), eastern NT and central and eastern SA; and those of *P. nigriceps* and *P. steelescotti* sp. nov. overlap in northern NT and WA; and all three species are found in eastern NT.

Once separated into the three species, the characters used in the morphological study on the electrophoresed specimens were scored. The results are summarised in the species descriptions given below. An additional character of Kluge, tail length, was added. It was measured as the horizontal distance between the posterior-most extreme of the middle preanal scale and the tip of the tail. Measurements were made only on those few specimens with complete and unregenerated tails.

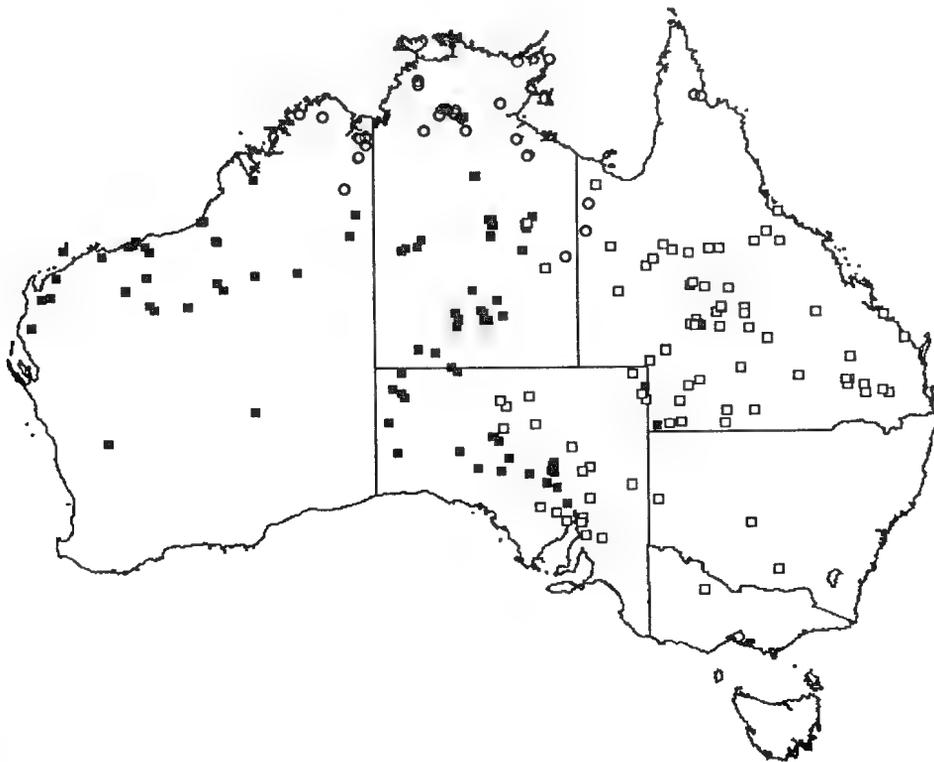


FIGURE 3. Map showing geographic distribution of specimens of *Pygopus* examined for morphological characters. ■ = *P. nigriceps*, ○ = *P. steelescotti*, □ = *P. schraderi*.

The *P. nigriceps* species complex conforms to Kluge's (1976) definition of the genus *Pygopus*. The dorsal surface of the head is covered with large and small scales, there are between three and five postmental scales, 21 or more midbody scale rows, nine or more preanal pores and the dorsal body scales are often keeled. The three species of the complex differ from the only other species in the genus, *P. lepidopodus*, in that the *P. nigriceps* complex has immaculate ventral surfaces (versus boldly variegated with black), smooth to moderately keeled dorsal scales (versus strongly keeled) and there is no dorsal snout pattern.

Pygopus nigriceps (Fischer, 1882)

Cryptodelma nigriceps Fischer, J. G. (1882), p. 290. Holotype SMNS 2259, Nickol Bay, WA. Type lost, believed destroyed during World War II (Schlüter and Hallermann 1997).

Delma (Cryptodelma) baileyi Günther, A. (1897), p. 170. Holotype BMNH specimen, now lost (Kluge 1974), from the neighbourhood of Cue, WA.

Pygopus territorianus Wells, R. W. and Wellington, C. R. (1985), p. 16. Holotype AMS R56823, near Tennant Creek, NT.

Notes

Both of the names that could be applied to the 'western' species are based on type specimens that are now lost. Fortunately, both have fairly precise type localities, which place them well outside the known distribution of the other two species. *Cryptodelma nigriceps* was described and figured by Fischer (1882) who proposed the new genus for this species, which appeared to combine the smooth scalation of *Delma* with preanal pores as in *Pygopus*. Fischer acknowledged that his very small specimen (SVL 64 mm) was almost certainly a juvenile, and its SVL is smaller than any we measured, although we did not extensively sample juveniles. The illustrations clearly depict the V-shaped preanal pore row (11 pores), large hindlimb flaps and head scalation (form of the two frontal shields and double row of loreal scales), a combination of features confined to *Pygopus* (*sensu* Kluge 1974). The dark head and nape markings are described and figured as confluent, unusual in specimens of the 'western' species but not unknown (e.g. SAMA R22932 from Barradale, WA).

Günther (1897) described his new species, *Delma (Cryptodelma) baileyi*, from an immature specimen (SVL 90 mm), noting that it was very close to Fischer's *nigriceps* but differed in its lower midbody scale count (22, versus 26 or 28). Fischer, however, implicitly included the ventrals in his midbody count, making his specimen's likely dorsal count 24 or 26, 24 being a frequent count in WA specimens. As with *C. nigriceps*, Günther's specimen had smooth scales and 11 preanal pores, both characteristic features of the 'western' group. Günther's illustration shows distinct black interorbital and nuchal colouring, with blackish narial and orbital patches extending on to the lower labials again features typical of the 'western' species.

Wells and Wellington (1985) proposed *Pygopus territorianus* as a new species from the Northern Territory, but provided little justification. They stated that this species could be 'readily diagnosed by consulting existing descriptive references' and the figure of a typical specimen (possibly the holotype) in Swanson (1976; Pl 34). They also added that the species lacks the distinctive keeling of the body scales seen in *Pygopus klugei* (*q.v.* = *P. schraderi*) and lacks the colour pattern ('reticulated patterning') of *P. schraderi*. The holotype is a specimen of the western form, and we therefore regard *P. territorianus* as a junior synonym of *C. nigriceps*. The body scales are completely smooth, the nostril is separated from the first upper labial and there are 11 preanal pores. The ventral count is relatively low (120) for the western form, but still within the sample range, and the colour pattern is markedly 'faded', with little black pigment remaining on top of the head, a trend in some populations of all of the *P. nigriceps* complex. The tail shows the strong pattern of dark-edged scales typically present in the 'western' form.

Neotype

To stabilise the name, a neotype, WAM R102063, has been selected for *Cryptodelma nigriceps*, from the same geographical area as the lost type (see notes). It was collected on the Yule River, WA (20°40'S, 118°21'E) by D. Robinson in 1990.

Diagnosis

A large pygopod (SVL up to 227 mm.) differing from other *Pygopus* in having smooth dorsal scales, the nostril entirely contained within the nasal, usually 120 or more ventral scales, and fewer than 14 preanal pores.

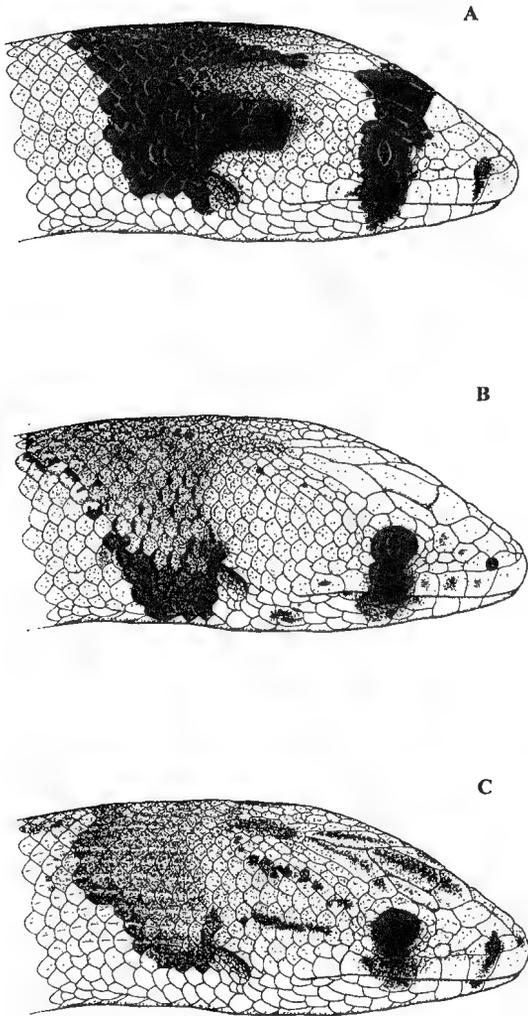


FIGURE 4. Representative head patterns of three species of *Pygopus*: (A) *P. nigriceps* (SAMA R48749); (B) *P. steelescotti* (NTM R20546); (C) *P. schraderi* (SAMA R46370).

Description

Ventral scales 114–143 (\bar{x} = 130.0, S = 5.9, n = 116); orbital scales 9–16 (\bar{x} = 11.6, S = 1.4, n = 118); nostril always completely enclosed by the nasal, separated from first supralabial scale (n = 119); preanal pores 8–14 (\bar{x} = 10.8, S = 1.1, n = 117); snout-vent length 73–227 mm (\bar{x} = 157.6, S = 33.7, n = 118); tail length ranges from 104% of SVL in smallest juveniles to 165% of SVL in largest specimens; no dorsal scale keeling (n = 118).

Colouration

In preservative, the basic head, body and tail colour is light tan to reddish brown. Scales, except for ventral scales, are speckled with brown or black pigmentation. Head, body and tail patterns are caused by the relative intensities and widths of the pigmented scale margins or by individual paler and darker speckled scales. Head patterns are formed with brown to black pigmentation and body and tail patterns by light to dark brown pigmentation. Ventral surfaces are immaculate with the scales a creamy-white or silver colour. There is a dark brown or black pigmented bar present on the dorsal surface of the head between the orbits which extends as a teardrop-shaped orbital patch descending to the supralabial scales and sometimes to the infralabial scales (Fig. 4A). A further area of dark pigmentation, but less intense, is found around the nostrils, again extending to the supralabial scales and sometimes to the infralabial scales. A brown to black nuchal band extends to the ear openings. There is no distinct body patterning. The tail is marked, often strongly, in the form of dark brown backward pointing chevrons that converge on the vertebral line. The smallest juveniles (SVL about 75 mm) are sandy-yellow with low levels of scale pigmentation except for the heavily black pigmented and contrasting head pattern. There is no distinct body pattern in juveniles and only weak light-brown chevrons on the tail. Coloration in life is shown in photographs in Storr *et al.* (1990: Pl 20, Figs 3–4), Glasby *et al.* (1993: Pl 4, Fig. 12), Cogger (1996: p. 297).

Distribution

West of 136°E and the far south-western corner of Queensland (Qld) (Fig. 3).

Pygopus schraderi Boulenger, 1913

Pygopus schraderi Boulenger, G. A. (1913), p. 564. Holotype BMNH 1946.8.27.2 (formerly 1913.7.28.2), collected at Milparinha [*sic* = Milparinka], NSW by P. Schrader.

Pygopus klugei Wells, R. W. and Wellington, C. R. (1985), p. 16. Holotype AMS field series 28686 (now registered as AMS R116980), 6.2 km S of Big Warrambool, NSW.

Notes

The holotype specimen is in good condition, with the colour pattern still readily discernible. It has an equal development of the orbital and narial

patches, but the interorbital area is only weakly pigmented. Although very young (SVL 65 mm), it has distinct low keels on the dorsal scales. There are 14 preanal pores. Boulenger (1913) gave the ventral count as only 97 pairs (enlarged scales only); the ventral count using our (Kluge's) method is 109. The characteristics of the type are completely concordant with the 'eastern' species in the complex.

Wells and Wellington's (1985) *Pygopus klugei* is a junior synonym of *P. schraderi*. The holotype specimen has 12 dorsal scale rows with distinct keels, there are 102 ventrals and the nostril contacts the first supralabial. There is a complex colour pattern on head body and tail, including well developed eye and nostril patches. Wells and Wellington were clearly influenced by the purported lack of keeling of the holotype of *P. schraderi*, a persistent misapprehension due to the rudimentary keeling in juveniles, including the holotype. Two illustrations said by Wells and Wellington to be *P. schraderi* (Cogger 1983; plates 104 and 495) show, respectively, a juvenile *P. nigriceps* and an adult *P. schraderi*.

Diagnosis

A large pygopod (SVL up to 198 mm) having uncarinate dorsal scale keeling extending over 10 or more rows, dark teardrop-shaped patches under both the orbits and nostrils, fewer than 120 ventrals, usually 13 or more preanal pores, nostril always in contact with the first supralabial scale and often strongly marked body and tail patterning.

Description

Ventral scales 100–122 (\bar{x} = 109.4, S = 4.9, n = 85); orbital scales 6–13 (\bar{x} = 9.87, S = 1.27, n = 85); nostril always in contact with first supralabial scale (n = 92); preanal pores 11–17 (\bar{x} = 13.8, S = 1.4, n = 85); snout-vent length 70–198 mm (\bar{x} = 142.6, S = 29.4, n = 91); tail length ranges from 99% of SVL for smallest juveniles to 170% of SVL for the largest specimens; dorsal scale rows with either weak or moderate keeling, usually moderate (80%), (\bar{x} = 1.88, S = 0.28, n = 86) extending over 9–14 dorsal rows (\bar{x} = 11.7, S = 1.8, n = 86).

Colouration

In preservative, the scales are pigmented in a manner similar to *P. nigriceps*. The background colour of the head, body and tail can vary from light tan to dark grey. The head is usually of mottled appearance. Head patterning is similar to

that of *P. nigriceps* except that there is no pigmented band on the dorsal surface of the head between the orbits, the relative intensities of the pigmented bands below the orbits and nostrils are approximately equal and the nuchal band is frequently indistinct (Fig. 4B). Often, there is a strongly marked body pattern in the form of a longitudinal series of light or dark brown uniformly pigmented scales on the dorsal surface and upper flanks giving the impression of discrete broken lines. Many individuals have an almost continuous stripe along the vertebral line. On the lower flanks is a similar series of discrete broken lines caused by a scattering of creamy-white scales. The tail patterning is in the form of narrow crossbands (occasionally posteriorly pointing chevrons converging on the vertebral line). The body patterning is caused by individual scales of differing levels of pigmentation whilst the tail patterning is caused by scale margin pigmentation. The intensity of patterning is very variable with many specimens being strongly marked, others having a light tan overall colour and a washed-out appearance, whilst still others are heavily pigmented all over. Body patterning does not appear to be geographically correlated. The smallest juveniles are similar in size and colouration to those of *P. nigriceps*. Head patterns are pronounced and are brown or black. There is no distinct body pattern and only weak light brown crossbands or chevrons on the tail. There is weak dorsal scale keeling.

Colouration in life is shown in photographs in Wilson and Knowles (1988: Fig. 263), Swan (1990: p. 47), Ehmann (1992: p. 102).

Distribution

East of 135°E, south of 17°S and west of the Great Dividing Range in New South Wales and Victoria (Fig. 3).

Pygopus steelescottii sp. nov.

Holotype

NTM R20546, collected at Cape Crawford, NT (16°34.3'S, 135°57.9'E) by P. Horner, 1994.

Diagnosis

A large pygopod (SVL up to 185 mm) similar to *P. schraderi* except for weaker uncarinate dorsal scale keeling usually extending over less than 10 rows and a less complex color pattern,

with a dark orbital patch but no or very weak nasal patch.

Description

Ventral scales 103–125 (\bar{x} = 114.2, S = 4.8, n = 43); orbital scales 7–13 (\bar{x} = 9.86, S = 1.10, n = 43); nostril always in contact with first supralabial scale (n = 44); preanal pores 12–17 (\bar{x} = 14.0, S = 1.0, n = 43); snout-vent length 79–185 mm (\bar{x} = 139.0, S = 24.2, n = 43); tail length ranges from 100% of SVL for smallest juveniles to 152% of SVL for the largest specimens; dorsal scale rows keeling either absent or weak, usually weak (86%), (\bar{x} = 0.86, S = 0.35, n = 44) extending over 0–13 dorsal rows (\bar{x} = 7.1, S = 3.46, n = 44).

Colouration

In preservative, the background head, body and tail colour is light tan to sandy-yellow with patterns similar to those found on the less heavily patterned individuals of *P. schraderi*. There is often no pigmentation around and below the nostrils; if it is present it is usually faint in intensity compared to the teardrop below the orbits (Fig. 4C). Many specimens are light tan in colour and have a washed out appearance and, unlike *P. schraderi*, there are no strongly patterned or darkly coloured specimens. The smallest juveniles are similar to those of *P. schraderi* differing only in the head pattern and in having no (or extremely weak) dorsal scale keeling. Colouration in life is shown in photographs in Wilson and Knowles (1988: Fig. 264) and Ehmann (1992: p. 101).

Etymology

The species is named in honour of the late Dr Colin Steele-Scott, a keen supporter of the South Australian Museum.

Distribution

North of 22°S in NT, Qld and WA (Fig. 3).

DISCUSSION

When considered as a single species, the concept of *P. nigriceps* that existed prior to this study was of an extremely successful, ecologically generalised arid zone lizard, adapted to a broad habitat range. The three species that we now recognise are each more restricted ecologically, as well as geographically. *Pygopus nigriceps* (*s.s.*) is primarily a sandy desert species, at least in Central Australia. *Pygopus schraderi* occupies a range of

habitats, and while it has been recorded from sandy terrain (e.g. far eastern S.A.) it is typically found on rocky hillsides or clayey or stony flats. *Pygopus steelescotti* is less well-known with respect to habitat selection but differs again in being confined to the wet-dry tropical belt across northern Australia.

All three species in the complex may be strictly nocturnal, relatively unusual in pygopods, most of which engage in significant diurnal activity (Shea 1993). Field experience with both *P. nigriceps* and *P. schraderi* in South Australia indicates that specimens are only seen actively foraging at night, and pitfall trapped individuals are taken only overnight, not by day (M. Hutchinson pers. obs.).

Of the three species, *P. nigriceps* is the most easily identified, based on its completely smooth dorsal scalation, the nostril completely contained by the nasal, and the high ventral and low preanal pore counts. By contrast, the other two species are very similar, exacerbated by the tendency of geographically proximate populations of *P. schraderi* to be the most weakly patterned and therefore most similar to *P. steelescotti*. The similarity of *P. schraderi* and *P. steelescotti* is such that specimens from the potential area of contact along the southern margin of the wet-dry tropics in the NT and Qld should be carefully checked. At present, *P. steelescotti* seems consistently identifiable by the lower number of keeled dorsal scale rows (usually nine or fewer), weakly developed keeling on dorsal scale rows and differential development of the dark nasal (absent or weak) and orbital (moderately well developed) patches.

Further taxonomic work will be useful to help in defining the variation and degree of sympatry of the three dark-headed species of *Pygopus*. Taxonomic work is also further warranted on the northeastern Qld populations of *P. lepidopodus*. Based on our samples, the Cooktown specimen appears to be completely distinct from the more southerly populations, which themselves show some heterogeneity in morphology and electrophoretic markers. The status of the eastern Australian *P. l. squamiceps* Gray is yet to be properly assessed.

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APPENDIX

Museum registration numbers for *Pygopus* specimens examined. The superscript * denotes specimens which were used in the electrophoretic study. The superscript # denotes specimens used in the electrophoretic study where the body was not available for morphological analysis. Abbreviations in bold upper case refer to OTUs designated in the allozyme electrophoresis analysis. Institutional acronyms (underlined) follow Leviton *et al.* (1985) and ABTC = Australian Biological Tissue Collection, South Australian Museum.

Pygopus nigriceps: AMS R60245–6. NTM CAMR531, NTM R30, R157–8, R291–3, R321, R444, R829, R905, R1427–8, R1630, R2209, R2216, R2356, R2532, R3228, R3316, R5314, R5907, R6387, R7092, R9530, R9691–6, R9701, R9703, R9808, R14021, R15153*(TAN—30 km SW Sangster's Bore, Tanami Desert, NT), R17571, R18058, R18079, R20670*(FIN—Finke Gorge National Park, NT). QM J28440, J33389. SAMA ABTC6588*(MAB—Mabel Creek Station, SA), ABTC31799*(MAC—MacDonnell Ranges, NT), ABTC31812*(MAC), R600, R876, R4791, R8116, R12911, R15548, R16279, R16768, R17459, R19251, R20711*(OLY—Olympic Dam, SA), R21029/33*(OLY), R21035, R22932–3*(BAR—8 km S Barradale, WA), R23197*(LAV—134 km ENE Laverton, WA), R23908*(LAV), R26198–200*(MAB), R26202*(MAB), R26222*(MAB), R26385, R26646, R26686*(MAB), R28546*(BOO—near Booloogaroo Homestead, WA), R33824, R34003*(NIN—Ninghan Homestead, WA), R36152*(YUL—Yulara, NT), R36169*(YUL), R37139, R38785–6*(TCK—Tennant Ck, NT), R38824*(TCK), R38841*(GLE—near Glen Helen, NT), R42026*(ILL—21 km WSW Illintjitja, SA), R45264, R48608, R48668, R48749, R48765, R48792, R48830, R48928, R49156, R49310. WAM R5328, R5329, R13350, R19239, R26071–2, R30930, R36327, R40238, R52727, R64002, R64704, R69525, R73631, R73842, R75119, R75143, R79010–1, R81513, R82599, R83574, R94761, R95028, R94957*(CAN—Canning Stock Route, WA), R95670, R102055, R102061, R102063*(YLE—Yule River, WA), R103677.

Pygopus schraderi: AMS R6691, R8974–5, R26083, R65966. NTM R31, R8526. QM J11029, J1266, J2917, J2918, J5092, J5238, J7282, J7288, J7473, J7489, J7919, J8008, J8436, J8882, J9116, J9241, J13010, J13028, J13560, J21444, J21965, J22714, J23319, J23677, J24988, J25386, J33390, J33391, J33392, J33393, J33394, J33395, J35362, J37060, J40323, J40701, J40717, J44420, J44711, J44942, J46952, J48459, J51198, J51527, J51717, J52546, J52547, J52778, J52863, J54617, J54618, J54900, J55109, J57197, J57228, J58079, J5921, J59359, J59931, J61825. SAMA R2234, R4996, R5051, R5386, R5397, R5626, R5893, R9860, R11752, R16712, R23120*(RM1—Mt Remarkable National Park, SA), R23269*(RM1), R28389*(IRO—25 km NW Iron Knob, SA), R28927, R30403*(COO—25 km NNW Coober Pedy, SA), R40948*(MID—Middleback Homestead, SA), R42131, R42750*(WIN—15 km S Winton, Qld), R42947*/63*(WID—85 km W Windorah, Qld), R44808*(COR—Cordillo Downs, SA), R46247*(ARC—17 km NNE Arckaringa, SA), R46370*(CAL—Callana Station, SA), R46786, R48303, R49061, R49087. BMNH 1946.8.27–2.

Pygopus steelescottii: AMS R13233, R17981, R26579, R80336, R133267. NTM R99, R370, R821, R828, R830, R2270, R2271, R3790, R4730, R5033, R5280, R5303, R6423, R6677, R6704, R6777, R11247, R12416, R20513*(CAP—Cape Crawford, NT), R20545–6*(CAP), R20588, R22333. QM J39061, J52746. SAMA R3510, R8117. WAM R23792, R56304, R70079, R70085, R70339, R75537–8, R83195, R83575, R87307, R99201, R101361.

P. lepidopodus: QM J47145*(CTN—Shipton's Flat, Qld). SAMA R33291*(SYD—Terry Hills, NSW), R20865*(STO—Stony Point, SA), R23629*(RM2—Mt Remarkable National Park, SA), R25341*(HAM—Hambidge Conservation Park, SA), R25689*(YAL—Yalata, SA), R30270*(ESP—Esperance, WA). WAM R77939*(WAL—Walpole-Nornalup National Park, WA), R90119*(KAR—Karridale, WA).

**OBITUARY PATRICIA MARIETJE THOMAS BSC, MSC AO 13 APRIL 1915
– 16 DECEMBER 1999**

ARCHIE MCARTHUR

Summary

Patricia Marietje Thomas, Pat to her many friends, died peacefully in Adelaide on 16 December, 1999 bringing to an end an outstanding career in parasitology. The elder of two daughters, Pat was born in Melbourne a year after her famous father, Sir Douglas Mawson, returned from the Antarctic but while he was in America. Pat was raised and educated in Adelaide, receiving her Bachelor of Science degree from the University of Adelaide in 1936, and her Masters degree two years later. She found employment in the Zoology Department as a part-time teacher in practical classes and researcher under Professor T. Harvey Johnston. After marrying marine biologist Ifor Thomas in 1947, and bearing three sons, Pat returned to academic life in 1950, spending most of it, apart from a short period overseas, in the Zoology Department until her retirement in 1980.

OBITUARY

PATRICIA MARIETJE THOMAS BSc, MSc, AO

13 April 1915 – 16 December 1999



Pat Thomas at Coolgubbin Camp, Connie Sue Hwy, Great Victoria Desert, June 1974.

Patricia Marietje Thomas, Pat to her many friends, died peacefully in Adelaide on 16 December, 1999, bringing to an end an outstanding career in parasitology. The elder of two daughters, Pat was born in Melbourne a year after her famous father, Sir Douglas Mawson, returned from the Antarctic but while he was in America. Pat was raised and educated in Adelaide, receiving her Bachelor of Science degree from the University of Adelaide in 1936, and her Masters degree two years later. She found employment in the Zoology Department as a part-time teacher in practical classes and researcher under Professor T. Harvey Johnston. After marrying marine biologist Ifor Thomas in 1947, and bearing three sons, Pat returned to academic life in 1950, spending most of it, apart from a

short period overseas, in the Zoology Department until her retirement in 1980.

From 1981 until failing health slowed her down in 1995, Pat transferred her activities to the South Australian Museum, where, as an Honorary Curator, she greatly enlarged the helminth collection to a position of pre-eminence in Australia, and successfully pressed for its recognition as the Australian Helminthological Collection. With this achievement, Pat then worked to find a successor to herself, to continue the work, and in 1994 Dr Sylvie Pichelin was appointed as the first Curator of Helminths. Ian Beveridge, a younger colleague of Pat's, has listed her many professional achievements in Obituaries, Royal Society of South Australia (2000).

Pat was a worker, a helper, quick-witted and sharp as a tack, could show kindness and sensitivity when needed, and abhorred irresponsibility. In the following, a little about her personal life has been compiled after talking to some of her friends.

Philippa Horton (Collection Manager, Birds, South Australian Museum). 'I first met Pat Thomas at Adelaide University in 1974 during Zoology 1 practical classes for which Pat was a demonstrator. As a shy student I was in awe of her wealth of experience and knowledge, and was somewhat terrified of her forthright and non-sense manner. During one particular class—the dissection of a rat—a fellow student and I were having trouble in locating an anatomical feature. On being called for help, Pat blustered over, tackled our rat with forceps and scalpel, and severed one of its arteries. The body cavity filled with blood, obliterating anything we might have seen, and rendering the three of us helpless with laughter. From then on any feelings of terror vanished and were replaced with warm affection. One other occasion which stands out in my memory showed the warmth which was not always obvious in Pat's personality. I was pregnant with my first child and, at morning tea at the Museum, expressed the hope that it wasn't going to be twins. Pat described her own experience of giving birth to a son only THEN to find out there was another about to follow. She would have been thrilled with just one but was absolutely delighted to have two beautiful babies. She was filled with maternal love as she spoke and her words were a great comfort to a new mother-to-be. Nurturing twins must call upon extra reserves of physical stamina and strength of character: I was sure Pat had both in abundance.'

Mrs Anne Hardy, Rostrevor. 'I began to work as a technologist in the Zoology Department, University of Adelaide, for 25 shillings per week in 1940. Then the Mawsons were living temporarily in Ruthven Mansions in Pulteney Street. My job was caring for the fish, newts, snails etc. used in the study of parasitic flatworms and often at weekends Pat did it to save me coming in to feed them.

'When the Department moved to the newly constructed Benham Building which overlooked the river on one side and the Jubilee Oval on the other, Pat had the task of packing the huge collection of 'preserves' (specimens from the two 1929–31 British, Australian, New Zealand

Antarctic Expeditions) a challenge which she excelled in.

'Once when the supply of dead rabbits for dissection turned up at the wrong time, it was necessary to skin them. Pat's technique was magnificent; a body held in one hand appeared to almost leap out of its fur. During the war, Pat took up marine biology and often accompanied groups to Port Willunga to study the reef. Her organising abilities were meticulous. As the war ended, undergraduate numbers ballooned out and the Professor deputed Pat and me, then a post-graduate student, to give repeat lectures. Pat had an engaging way with words.

'Occasionally Professor T. Harvey Johnston took us collecting near Tailem Bend and on one occasion, students were allowed to swim off a log in the river. One of the students got herself heavily entwined by the long strands of floating weed and submerged. When her panicky face surfaced, it was Pat who wrenched her out of danger. Typical of Pat, on having saved her life, she gave her a sharp rebuke for having done the wrong thing. One of my vivid memories was at the Spring School at the Marine Research establishment at Cronulla, NSW. Students at the school were housed a mile or more from the laboratories and used a bus to go to lectures unless there was a better offer, which in Pat's case, there soon was. As I waited for the bus, a motor bike with the school's tutor skilfully tackled the sandy track, and riding pillion was a passenger with bright red hair and skirts blowing and a face of blissful exhilaration as she clutched her future spouse Ifor Thomas.

'After her marriage, Pat had developed domestic enthusiasm. When I returned to teaching in the 60s and 70s in Zoology demonstration classes, she had won a shirt ironing contest at the Royal Adelaide Show, and with typical efficiency, produced three sons in fifteen months, sewed, organised and was soon back with her nematodes. I recall that names suggested for the twins were Son and MawSon. Later, Pat followed her mother as President of the Mothers and Babies Health Association.

'Pat and I took part in many of the ornithological excursions, led by Joan Paton, to the Simpson Desert, the Great Victoria Desert, Kakadu and many more. On one such, Pat complained about Rex Ellis's dog which took a dislike to her and protected the essential communal spade from Pat's urgent grasp.'

Mrs Anne Dow, Medindie. 'On an

ornithological excursion to Angorichina with Pat and Joan Paton, Pat overheard someone complaining about the food. Anne remembers Pat's quick response "I never complain about camp food, after all it goes in one end and out the other".

'Around the camp fire Pat had a delightful singing voice.'

Mrs Elizabeth Simpson, Stonyfell. 'The two Mawson girls and we three Cleland girls were great friends and spent much of our lives in the same pursuits. Pat and I were contemporaries at the University and many were the parties and excursions which we attended. I knew that if Pat was in attendance my enjoyment and performance would be heightened and all would be well.

'On many occasions in the bush after dinner I remember Pat with a Tilley lamp dissecting and searching for helminths. On one of Sir Douglas' geology excursions crossing a field, Pat and I noticed a cow giving birth to a calf. Although the cow was feeding placidly, the calf's head was protruding. Blushing hotly, for matters of that nature were a little taboo those days, Pat and I approached Sir Douglas and drew his attention to the phenomenon. Instead of leading the students in a different direction, he drew everyone's attention, in his loudest voice, to the plight of the cow. A minute later a calf was standing with wobbly legs alongside mother.

'Pat was a stimulating companion. She did not suffer fools gladly, even at times, her best friends. There were few of us who had not felt her critical tongue but this in no way detracted from the deep love and respect we held for her.'

Order of Australia Association, South Australian Branch Newsletter No 97; In Memoriam. Awarded AO, Queen's Birthday 1994, for service to the science of zoology in both research and teaching and the development of the Australian Helminthological Collection.

Slim Sommerville (retired zoologist, University of Adelaide) remembers how driving in the country with Pat was so appalling because she insisted on stopping to examine carcasses of dead animals. He also remembers being invited to dinner at the Mawson home in 1954. Sir Douglas sat tall at the head of the table and when kangaroo tail soup was served, he exclaimed 'What's this! I'll have none of it'. This surprised Slim knowing of the horrible food on which Sir Douglas had survived in Antarctica.

Dene Cordes (Department for the Environment), and **Noel Lothian** (formerly Director, Adelaide Botanic Gardens) were associated with Pat through the Board of the National Parks Commissioners and the Wildlife Advisory Council. There she was a particularly astute member whose lifelong interest in environmental matters enabled her to contribute greatly. She was interested in remote areas such as the Koonalda Caves which she urged should become a National Park, and this has since been achieved.

Sylvie Pichelin (Former Curator of Helminths, South Australian Museum). 'I first met Pat in 1995—the same day as the interview for the position of Curator of Helminths at the South Australian Museum. Both events made quite an impression on me. Although I had corresponded with Pat about the Collection, I did not know her personally. I knew of her impressive publication record but at the same time had heard tales of sherry in beakers next to kangaroo guts. I quickly learnt that Pat liked to call a spade a spade—a trait that was appreciated and helped me grasp the size and importance of the Helminth Collection. Pat was also very kind to me on my first visit and took me out to a delightful lunch. There are few like Pat—her death marks the closure of an era of parasitology in Australia.'

Cath Kemper (Curator of Mammals, South Australian Museum). 'Pat was always very interested in expanding the helminth collection so when I started to study (and dissect) cetaceans in the late 1980s she was keen for us to collect parasites and hand them on to her. Several times she came out to Bolivar herself and assisted with dissections. It was great to work with her because she always "hoed in" and nothing was too much trouble. I remember one day when she arrived at Bolivar before us and, not being able to get in and not wanting to do nothing, she set to work weeding the patio in front of the kitchen! It looked lovely and tidy when we arrived. I always had a great admiration for her because it would not have been easy to have been a female scientist earlier in her life. Science was something that men did and the few women involved were often considered odd. Pat was able to combine family and work so was just like everyone else, only much more determined than most!'

Archie McArthur (Honorary Research Associate, South Australian Museum). 'When I

started on the ant collection at the Museum it was Pat who “showed me the ropes”; she always found time to help me solve problems. She was often one of the first to start work in the mornings on the Invertebrate Floor of the Natural Science Building of the South Australian Museum, where as an Honorary Research Associate she built up the biggest collection of helminths from Australian animals. In addition to dissecting organs and extracting specimens, she spent months at a computer, cataloguing this vast collection. Occasionally, Joan Paton called in around noon and the three of us had lunch together in Pat’s lab where she kept a plentiful supply of sweet vermouth. This she served in little beakers and even though we knew that the same beakers had contained a kangaroo’s liver or a salmon’s gut only minutes before, we appreciated her generosity and the purifying effects of alcohol.

‘When her father Sir Douglas Mawson was teaching, Pat was often required as chaperone or cook on his many field trips. About one such expedition, Reg Sprigg reminisced in *Geology is Fun* (1989) “I relished an experience at the deserted Old Myrtle Springs Station ruins. We arrived out of Copley just before sunset. We carried little in the way of lamps so the race was on to beat the fading light. Patricia in commendably practical fashion grabbed a loaf of bread, placed it on the boards of a weather beaten and long abandoned old couch and got to work. Said Mawson “Whatever are you doing there Pat?” “Cutting the bread. Can’t you see?” “But Pat, you can never tell what dirty old swagman has been sleeping on that. We could all get syphilis.” Pat, never to be panicked, turned her head and nonchalantly answered, “You don’t get syphilis through the mouth, Daddy.” Father for once was stuck for words.’

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**CORRECTED IDENTIFICATIONS AND LECTOTYPE DESIGNATION FOR
POROCHILUS ARGENTEUS (ZIETZ) (OSTEICHTHYES :
SILURIFORMES: PLOTOSIDAE)**

PETER J. UNMACK

Summary

Australian plotosid catfishes are poorly understood (Merrick & Scmida 1984; Allen 1989) and, among other problems, the taxonomy of *Porochilus argenteus* (Zietz) is confused. The present note is intended to clarify the identification of the syntypes of *P. argenteus* and to designate a lectotype. Museum abbreviations follow Leviton et al. (1985).

CORRECTED IDENTIFICATIONS AND LECTOTYPE DESIGNATION FOR *POROCHILUS ARGENTEUS* (ZIETZ) (OSTEICHTHYES: SILURIFORMES: PLOTOSIDAE)

Australian plotosid catfishes are poorly understood (Merrick & Schmida 1984; Allen 1989) and, among other problems, the taxonomy of *Porochilus argenteus* (Zietz) is confused. The present note is intended to clarify the identification of the syntypes of *P. argenteus* and to designate a lectotype. Museum abbreviations follow Leviton *et al.* (1985).

Zietz's (1896b: 410, Plate 16, Fig. 7) description of *Plotosus* (= *Porochilus*) *argenteus* was based primarily on a single, 138 mm syntype from Cooper Creek near Innamincka, South Australia. Glover (1976) incorrectly listed this specimen (SAMA F1090) as the holotype. Zietz included other specimens but scarcely mentioned them. The specimen emphasized is clearly *P. argenteus* as recognized today by Allen (1989). Upon re-examination, it fits the description well, having a concave dorsal profile between snout and dorsal fin and a smooth inner face of the pectoral spine. Dorsal-fin ray counts were difficult to obtain as the fin is in poor condition; pectoral-fin ray counts were also difficult, although an approximate value of I-6 was obtained (*cf.* I-7 in Zietz [1896b]). It is the only plotosid listed from the Horn Expedition as 'type' in the original SAMA register. A second syntype, probably SAMA F1082 (Table 1), was discussed by Zietz (1896b: 411) as follows: 'A larger specimen of about eight inches total length, from Finke River, Hermannsburg, is of darkish colour; but this is most likely caused by having been dried formerly.' Additional syntypes are not specified, but localities were listed as Barcoo River, Finke River at Idracowra, and Palm and Ilpilla creeks, all in the Northern Territory. Extant syntypes are shown in Table 1.

Several lines of evidence identify all specimens except SAMA F1090 as *Neosilurus hyrtlilii* Steindachner. Specimens of *Porochilus argenteus* are generally lighter coloured, whereas *N. hyrtlilii*

are usually dark. Zietz (1896a, b) did not record *N. hyrtlilii* in other collections of the Horn Expedition, yet they are clearly present in the Finke River (Unmack in press). Specimens examined from the Horn Expedition (BMNH, NMV, SAMA) all are *N. hyrtlilii* based on the following characters: convex or straight dorsal profile; rough inner side of pectoral spine; higher pectoral-fin ray counts. (Dorsal-fin ray and pectoral-fin ray counts could not be obtained from some specimens due to the poor condition of those fins.) (Table 1). All additional plotosid specimens examined (AMS, AMNH, BMNH, NTM, SAMA, NMV, WAM) from Finke River not associated with the Horn Expedition are *N. hyrtlilii*. Finally, all SAMA *P. argenteus* syntypes (Table 1) were not registered until 1928 and, except for F1090, had been reidentified before cataloging as *N. hyrtlilii*. Records of *P. argenteus* from the Finke River system (Zietz 1908; Glover & Sim 1978; Glover 1982; Allen 1989; Glover 1990; Larson & Martin 1990; Davis 1996; Kerle & Fleming 1996) are thus based on Zietz's record or on misidentifications of *N. hyrtlilii*. The single specimen on which Zietz's (1896b) description was largely based (SAMA F1090) is hereby designated as the lectotype since it is the only specimen in the type series identified as that species; all remaining paralectotypes are reidentified as *N. hyrtlilii*. *Porochilus argenteus* does not occur naturally in the Finke River system, where the only known plotosid is *N. hyrtlilii* (Unmack in press).

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TABLE 1. Syntypes of *Porochilus argenteus* including present identification, number of specimens, size (SL = Standard length), dorsal (D) and pectoral (P) fin counts, locality and additional relative notes.

Catalogue no.	Species	No.	Size (SL)	D	P ₁	Locality	Notes
SAMA F1082	<i>Neosilurus hyrtlilii</i>	1	175 mm	I-5	I-9 (at least), right was I-10	Finke River, Central Australia, Hermannsburg	Specimen had dried out, collected by Kempe who was a missionary there. It was most likely collected prior to the Horn Expedition since the mission had closed for two years prior to the expedition (Gillbank & Maroske 1996), hence possibly explaining its dried state as originally noted by Zietz (1896b). Originally registered as <i>Neosilurus hyrtlilii</i> Steindachner
SAMA F1088	<i>Neosilurus hyrtlilii</i>	2	168 mm 192 mm			Finke River & Cooper Creek, Central Australia	Originally registered as <i>Neosilurus argenteus</i> Zietz (<i>hyrtlilii</i>)
SAMA F1089	<i>Neosilurus hyrtlilii</i>	2	101 mm 127 mm			Cooper Creek near Innamincka, Central Australia	Originally registered as <i>Neosilurus argenteus</i> Zietz (<i>hyrtlilii</i>)
SAMA F1090	<i>Porochilus argenteus</i>	1	138 mm		I-6	Cooper Creek near Innamincka, Central Australia	Originally registered as <i>Neosilurus argenteus</i> Zietz
SAMA F1091	<i>Neosilurus hyrtlilii</i>	3	114 mm			Idracowra, Finke River, Central Australia	Originally registered as <i>Neosilurus hyrtlilii</i> Steindachner
"	"		110 mm		I-10	"	"
"	"		85 mm			"	"
NMV F8632	<i>Neosilurus hyrtlilii</i>	1	82 mm		I-6	Finke Gorge	
BMNH 1897-1-20-46	<i>Neosilurus hyrtlilii</i>	1	89 mm		I-5	I-10, I-11 (right)	

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**A NEW SPECIES OF AUSTRALIAN CANTHYDRUS SHARP WITH A KEY
TO THE AUSTRALIAN SPECIES OF NOTERIDAE (COLEOPTERA)**

C. H. S. WATTS

Summary

A new species of Canthyrus, *C. ephemeralis* sp. nov. from Northern Australia is described and figured. It is distinguished from the other known Australian Canthyrus, *C. bovillae* Blackburn, 1889, by size and dorsal colour pattern as well as a number of structural characters. A key to the genera and species of the Australian Noteridae is included.

A NEW SPECIES OF AUSTRALIAN *CANTHYDRUS* SHARP WITH A KEY TO THE AUSTRALIAN SPECIES OF NOTERIDAE (COLEOPTERA)

C. H. S. WATTS

WATTS, C. H. S. 2001. A new species of Australian *Canthydrus* Sharp with a key to the Australian species of Noteridae (Coleoptera). *Records of the South Australian Museum* 34(2): 61–64.

A new species of *Canthydrus*, *C. ephemeralis* sp. nov., from Northern Australia is described and figured. It is distinguished from the other known Australian *Canthydrus*, *C. bovillae* Blackburn, 1889, by size and dorsal colour pattern as well as a number of structural characters. A key to the genera and species of Australian Noteridae is included.

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Manuscript received 22 November 2000.

Australia has a limited fauna of aquatic beetles of the family Noteridae consisting of only five described species in four genera; *Canthydrus* Sharp, 1882, *Hydrocanthus* Say, 1823, *Neohydrocoptus* Sato, 1972, and *Notomicrus* Sharp, 1882. All are essentially tropical although *Notomicrus tenellus* Clark, 1863 occurs in decreasing numbers down the east coast almost to the Victorian / South Australian border. Although all but *Neohydrocoptus* are extremely streamlined, they do not inhabit running water as their body form might suggest, but are found in still water in swamps, embayments and dams amongst emergent vegetation. All species are common, *Neohydrocoptus subfasciatus* Sharp, 1882, less so than the others. Most of the species fly readily to light.

In this paper I describe a distinctive new *Canthydrus* which is seasonally common in the escarpment country of coastal Northern Territory and adjacent Western Australia. All specimens are from the collection of the South Australian Museum.

SYSTEMATICS

KEY TO THE GENERA AND SPECIES OF AUSTRALIAN NOTERIDAE (AFTER PEDERZANI 1995)

- 1 — Fore tibia expanded beyond base of tarsi and with a strong hooked spur at the outer apical angle 2
- Fore tibia not expanded beyond base of tarsi, with several weak apical spines .. 5
- 2 — Prosternal process not broader than long,

its apex about 2 to 2.5x as wide as its breadth between postcoxae; < 3 mm long
Canthydrus 3

- Prosternal process broader than long, its apex very broad, at least 2.5 to 3x as wide as its breadth between postcoxae; > 4 mm long
Hydrocanthus 4

- 3 — Elytron with a pale spot towards apex, as well as a medial one (Fig. 7), metatarsi stout (Fig. 3), metatibial spines of equal length (Fig. 3) .. *C. ephemeralis* sp. nov.
- Elytron without apical pale spot (Fig. 5), metatarsi more elongate (Fig. 1), metatibial spines unequal in length (Fig. 1)
..... *C. bovillae* Blackburn

- 4 — Uniformly reddish; weak to moderately impressed row of punctures adjacent to the suture of the elytron
..... *H. waterhousei* Blackburn

- Uniformly black; lacking sutural row of punctures *H. australasiae* Wehncke

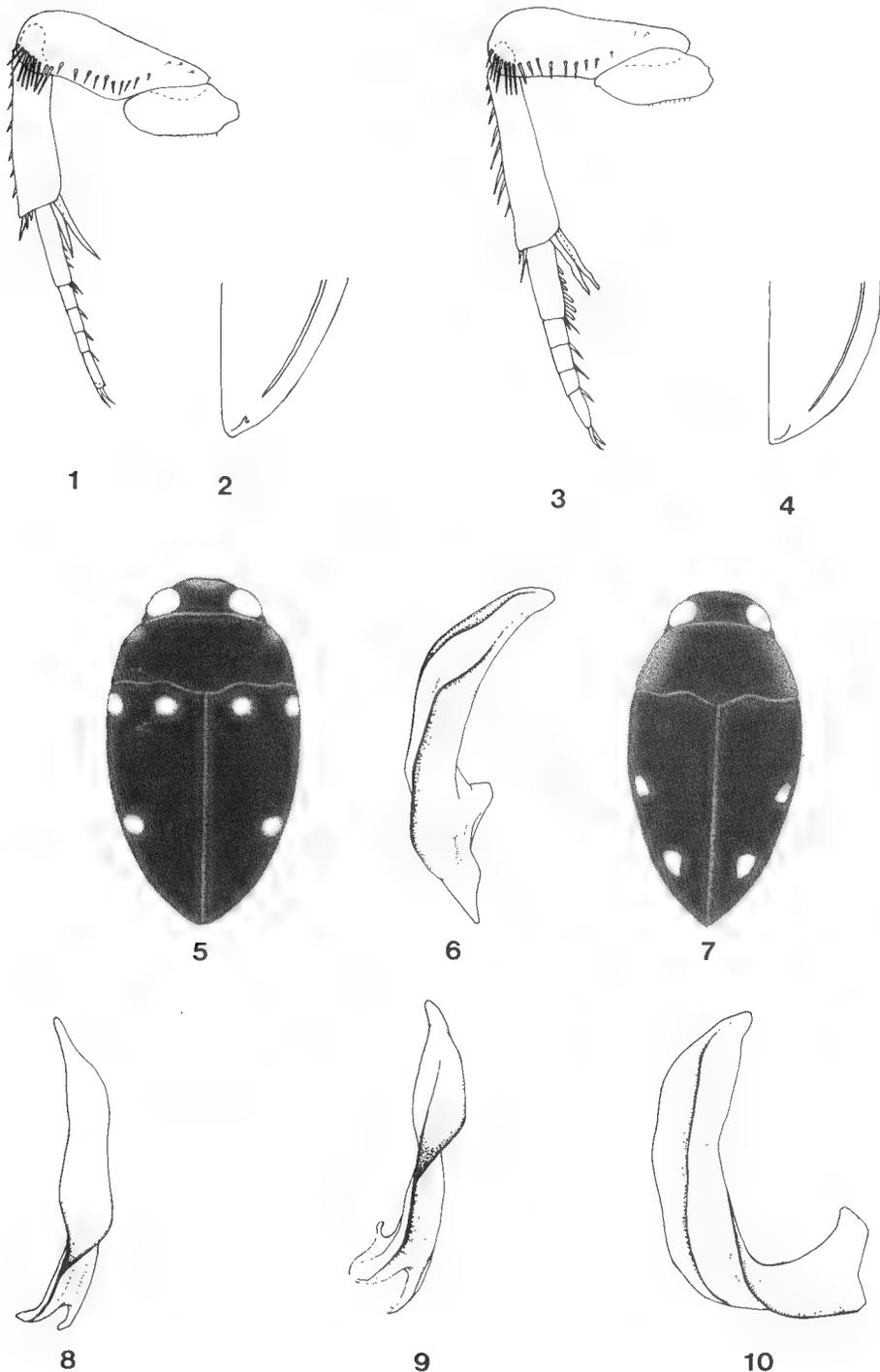
- 5 — Lateral margins of metasternal plate not bordered by a lateral ridge; < 2 mm long
..... *Notomicrus tenellus* Clark

- Lateral margins of metasternal plate with a lateral ridge; > 2 mm long
..... *Neohydrocoptus subfasciatus* Sharp

Canthydrus ephemeralis new species.
(Figs 3, 4, 6, 7, 9)

Types

Holotype: male: 'NT 5 km SE Mt Borradaile stn. 8/10/98 C. Watts'.



FIGURES 1-10. *Canthyrus bovillae*; 1, metaleg; 2, tip of elytron (ventral view); 5, habitus drawing; 8, dorsal view of central lobe of aedeagus; 10, lateral view of central lobe of aedeagus. *Canthyrus ephemeralis*; 3, metaleg; 4, tip of elytron (ventral view); 6, lateral view of central lobe of aedeagus; 7, habitus drawing; 9, dorsal view of central lobe of aedeagus.

Paratypes: 29, 'NT 5 km SE Mt Borradaile stn. 27.5.99 C. Watts'; 14, 'NT Mt Borradaile stn. 26.5.99 C. Watts'; 33, 'NT 1 km W Gubara Kakadu NP 17.3.98 C. H. S. Watts'; 25, 'NT 5 km SE Mt Borradaile stn. 8/10/98 C. Watts'; 2, '6 km SE Mt Borradaile NT 8/10/98 C. Watts'; 5, 'NT 1 km W Gubara 17/3/98 C. H. S. Watts'; 3, 'NT 1 km W Gubara Kakadu NP 29/1/99 C. Watts'; 1, 'Darwin NT 13.5.63 CW'; 23, 'W. AUST. Ck on Phillips Range 16° 53'S, 125° 48'E 4 Oct 1982 B. V. Timms'; 4, 'W. AUST Dawn Ck 15° 57'S, 126° 51'E 5 Oct 1982 B. V. Timms'. All specimens in the collection of the South Australian Museum, except for 10 from 1 km west of Gubara which have been deposited in the Australian National Insect Collection, Canberra.

Description (number examined, 141)

Habitus. Length, 2.5–2.9 mm long. Elongate oval, deep bodied, moderately accumulate behind; shiny black, labrum and sides of pronotum testaceous, elytron with two yellow/white lateral spots, one in the middle, the other three-quarters the way to the apex (Fig. 7), appendages dark testaceous.

Dorsal surface. Smooth, virtually impunctate except for serial punctures which are traceable but weak, covered with fine reticulation, meshes small, regular, much smaller than eye facet. Head relatively broad, eyes large, antennae relatively short, segments 8 to 10 somewhat thicker, apical segment twice the length of penultimate. Pronotum with thin well-impressed line a little behind anterior margin, weaker towards sides, lateral margin with somewhat more strongly impressed line delineating a distinct beading. Elytron with well-marked lateral flange/beading.

Ventral surface. Smooth, virtually impunctate, covered with fine reticulation similar to dorsal surface. Apical segment of labial palpus large, oval, bifid at tip. Pronotal process wide, flat, strongly setose, lateral margins weakly beaded, approximately parallel-sided, narrower between procoxae, hind angles extended. Elytron epipleura very broad in anterior quarter, then rapidly narrowing, very narrow in apical half, absent near tip; apical ligula a smooth curve (Fig. 4). Raised midsection of meso- and metasterna broad, flat, widening towards rear, hind edge strongly concave, outer hind angle with three to four strong setae, covered with strong setae similar to those on pronotal process. Protibia with strong spine, approximately half length of tibia. Metaleg stout, apical spines on metatibia equal in length (Fig. 3).

Hind margins of ventrites with row of setae, stronger laterally.

Male. External characters as for female. Central lobe of aedeagus with the apical 'overtum' which covers a broad medial groove less than half total length of lobe (Figs 6, 9).

Remarks

Canthyrus ephemeralis is most readily separated from *C. bovillae* Blackburn, 1889 by its smaller size (2.5–2.9 mm long against 2.9–3.4 mm) and dorsal colour pattern. *Canthyrus bovillae*, in general, is less strongly coloured with some specimens nearly completely black (identification from descriptions and specimens identified by Blackburn in the South Australian Museum). Well-coloured specimens (Fig. 5) differ from *C. ephemeralis* (Fig. 7) in having the front of the head testaceous rather than dark; the testaceous areas at the sides of the pronotum are restricted to the front, whereas in *C. ephemeralis* they extend along the whole side; two light-coloured areas at the base of the elytra (often indistinct) are lacking in *C. ephemeralis*; the absence of a subapical spot on the elytron which is present in *C. ephemeralis* (both species have a light coloured lateral spot in about the middle of the elytron). Other differences between the two species are: the shape of the ligula near the apex of the elytra—it has a pronounced indentation in *C. bovillae* (Fig. 2) which is lacking in *C. ephemeralis* (Fig. 4); the hind legs in *C. ephemeralis* (Fig. 3) are more robust than those of *C. bovillae* (Fig. 1); the metatibial spines in *C. ephemeralis* are of equal length (Fig. 3) whereas the inner one is longer in *C. bovillae* (Fig. 1); the meso-metasternal central plate is a bit broader in *C. bovillae*; the central lobe of the aedeagus has the medial groove covered for most of its length (Figs 8, 10) rather than about half as in *C. ephemeralis* (Figs 6, 9).

Distribution

Known only from the localities listed above under *Types*.

Habitat

All the collections of *C. ephemeralis* where the habitat details are known have been from small, temporary, wet-season, low gradient streams flowing off escarpments in the coastal Northern Territory and northern Western Australia. The substrate of these streams is clean sand or rock with accumulations of dead leaves and other debris in places. The adults forage in the open

sandy areas, at times in areas that may have water only after rain and are dry a few hours later. In contrast, *C. bovillae* lives in the more permanent flood-plain billabongs and is not found in the seasonal streams of the escarpment.

Etymology

In reference to its ephemeral appearance in streams that only flow during the wet season.

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TIMBU WARA FIGURES FROM PANGIA, PAPUA NEW GUINEA

PAMELA J. STEWART & ANDREW STRATHERN

Summary

This paper discusses wickerwork figures known as Timbu Wara, formerly made in the Pangia area of the Southern Highlands Province of Papua New Guinea. The paper sets the historical context of the described figures. The figures were associated with a fertility cult periodically celebrated with large sacrifices of pigs. Wickerwork figures of this same general kind are known also from the neighbouring Kewa and Enga areas. After the cult was abandoned in the 1960s people began making the figures for sale to tourists.

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INTRODUCTION

The wickerwork ritual objects that we describe here were manufactured in the Pangia area of the Southern Highlands Province of Papua New Guinea (Fig. 1). The name Pangia was originally given to a single small locality south of Mount Ialibu in the Wiru language area. The Wiru language is related to a set of neighbouring languages in the Highlands which includes those of the Enga, Huli, Mendi and Kewa peoples (Wurm 1964). Among these languages, Wiru appears as a Family-level isolate, less closely related to the others than they are related among themselves (Wurm & Hattori 1982).

The first non-New Guinean outsiders to go through the wider area were the gold mining prospectors, Michael and Danny Leahy, during the 1930s. In the late 1950s government officers selected Pangia for their station after the first patrol outward from Ialibu. Catholic and Lutheran missionaries arrived shortly thereafter and set up stations at Yaraparo and Tiripini in the close vicinity of the Pangia government station. Other missions followed—the Evangelical Bible Mission (at Mele) and the Wesleyans (at Takuru). Also, a linguist with the Summer Institute of Linguistics, Harland Kerr, came to live in the area at Poloko (Borona) where he studied the language and social practices of the people (Kerr 1975).

Relatively little has been published about the Pangia people. Jeffrey Clark, who worked in Takuru village, has written a number of articles about the impact of colonialism and Christianity on the people and his book *Steel to Stone*, which

brings together and synthesizes the content of these articles, has been posthumously published (2000). (For further materials on the Wiru see Strathern & Stewart 1999a, 1999b, 2000; Stewart & Strathern 1999a, n.d.).

The Wiru are horticulturalists and pig-keepers and their staple crop is the sweet potato. The area has little primary forest and is mostly grassland and regrowth, dotted by limestone outcropping and sinkholes. This landscape has figured greatly in local notions of sorcery and spirit beings that were thought to live around settlements (Stewart & Strathern 1999b). In the past, long houses were built, through the initiative of male leaders, for important pig-kill ceremonies (Strathern & Stewart 1999a).

Pangia is encircled on three sides by mountain ranges. During the 1960s and much of the 1970s, travel into and out of the area was difficult. This remained so until the building of the Ialibu–Pangia road during the 1970s. Further, the Wiru traditionally had only minor trading and exchange links with non-Wiru peoples. Thus the impact of the colonial government and Christian missionaries was more extreme in a number of ways than in other regions where there had been more historical contact and interaction with other Papua New Guineans (Clark 2000; Strathern 1984; Stewart & Strathern n.d.). In particular, colonial control came to Pangia late, some 30 years after first contact in areas to the north such as Ialibu and Hagen, and the Administration attempted to bring about a swift set of social transformations and bring to the area the same ‘developments’ as were established elsewhere.

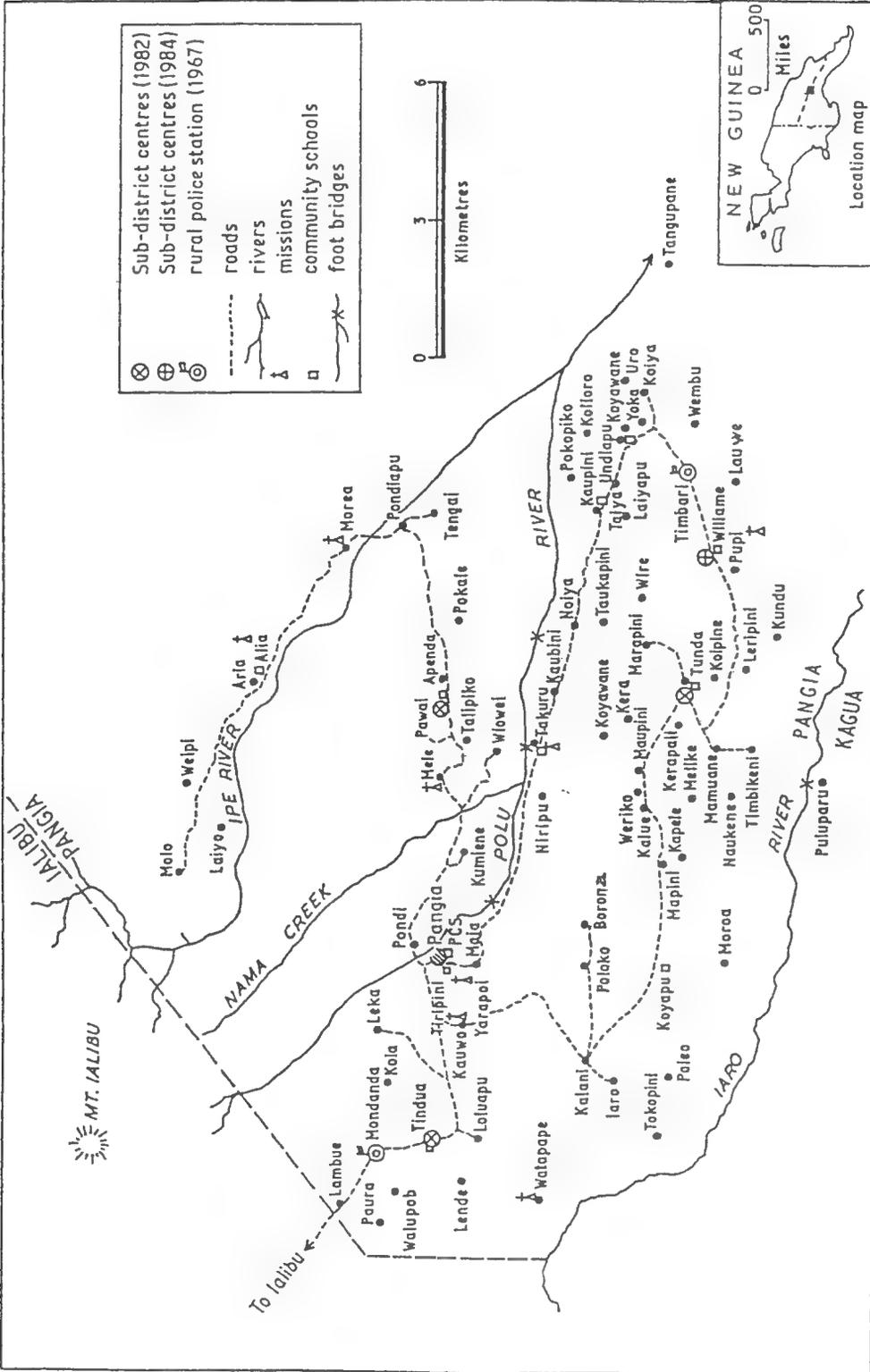


FIGURE 1. Map of the Pangia District, Southern Highlands Province, Papua New Guinea.

Prior to 1960, the Wiru had little experience in interacting with the colonial power. Non-New Guinean outsiders were said to have perhaps come from rivers (*uele nekenea*) because of their white color; hence their resemblance to spirit beings known to the Wiru people already. They were also referred to as 'red men' and 'spirits from the sky'. Non-New Guinean outsiders were seen as desirable and powerful entities since they were thought to have abundant wealth items. One way in which the Wiru adjusted to their presence was to make them feel, to some extent, as though they were insiders, thereby 'domesticating' them into the local transactional framework. They were identified as the wealth people, the people with possessions, as elsewhere in the Highlands also. This engendered a desire in the Wiru to obtain these possessions by whatever trading means were accessible to them. But the colonial powers had an agenda of 'development' that was not in harmony with the 'traditional' means of sociality familiar to the Wiru.

The colonial administration required people to work as labourers on road projects and government buildings and to seek permission to hold pig-kills which might disrupt road work schedules. There was a great push to bring Pangia up to the 'development' level of other, longer-contacted areas of the Highlands. Thus the Administration reduced the time that the people had to adjust to these outside pressures which had come into their lives. Since the missions had come into the area on the back of the colonial government, the Wiru in some ways conflated the two and their expectations of what would eventually be obtained by participating in 'development' projects and mission activities was very great indeed, escalating with every passing year.

Initially, the Administration regarded various 'traditional' practices as a hindrance to 'development' in the area and some of the missions labelled 'traditional' cult practices as satanic. This was particularly true of the Evangelical Bible Mission and the Wesleyans. The Wiru had accepted Christianity into their pantheon of cults as a powerful new practice that might assist them in obtaining the good health and wealth that they thought the non-New Guinean outsiders possessed. Christian missions did bring schools into the area, which many even today remember as a positive change. In 1999, a middle-aged Pangia man from Wiliame village told us that he had appreciative memories of the missionaries, saying that 'they brought schools,

roads and teaching about hygiene' which he felt allowed him to have a better life and his children to become educated and earn money.

But some missionary workers, notably indigenous evangelists, also ordered the smashing of cult stones and the burning of cult houses—a practice also followed in other areas of the Southern Highlands such as among the Duna (Strathern & Stewart 1998; Stewart & Strathern 2000). Before the coming of the missions, the Wiru held pig-kills in association with a number of religious cults: *Timbu*, *Tapa* and *Aroa Ipono* (Strathern & Stewart 1999b; Stewart & Strathern 1999a). These cults all aimed at bringing health and fertility to the people and involved the construction of specific ritual objects and buildings. The *Tapa* cult centered on ancestral stones belonging to subgroups in each settlement area, and had to do with sacrifices of pigs made on occasions of sickness. The *Aroa Ipono* belonged to a widely spread complex of such cult forms, also found in the Western Highlands Province.

THE TIMBU CULT

The *Timbu* cult involved the construction of a specific cult house, which contained a central post (*tungi*) onto which were attached the shoulder and jaw bones of many pigs that had been killed over the years prior to the culmination of the festival. The cult's cycle of enactment was approximately five to eight years, ending with a great feast in which hundreds of pigs, the raising of which involved innumerable hours of female labor, would be killed. Prior to the pig-kill and ceremonial exchange marking the end of the cult cycle, the cult participants would dance around the *tungi* post holding the *timbu wara*. Subsequently, the *tungi* post would be taken out from the cult house to the ceremonial ground where the pig-kill and ceremonial exchanges took place. This would be in the area of a main village (*tumbea ta*) where cult houses of various kinds were located.

The *Timbu* cult was aimed at restoring ecological balance and fertility to humans, pigs and the land. The cult looked outward and brought together clans from other neighbouring districts, reinforcing continued exchange relations. It also may have functioned to redress exchange imbalances and outstanding debts that arose from warfare deaths (Dosedla 1984). The term *timbu* means 'sky', so the cult may have had a

connection also with mythical Sky Beings who are seen as important in other Highlands cosmologies. A comparable cult complex known as *Timp* is found in the Mendi area (Lederman 1986).

The cult involved various male age and status grades. Prior to the cult's culminating pig-kill, the participants would receive lengths of sugar cane that demarcated the quantity of pork they would subsequently receive. Although only males were allowed into the cult house, females participated in the production of the foodstuffs for the festival and the pigs for the feast. They also had the highly significant role of carrying back to their respective settlements the pork received at the ceremonial distribution.

Central to the whole process by which a *Timbu* performance was organised was the sacrifice of large numbers of pigs over a period of time, so as to provide bones to festoon the central pole. Informants agreed that marsupial bones would also be attached to the pole; some declared that the bones of rats and eels were also used. There were probably local variations in this regard. The overall purpose was clearly to show how many animals had been sacrificed to the spirit. When the pole was covered with bones, it was said that 'it is ripe' (*nondokako*), that is ready for the climactic phase of the cult. Men and boys were the ones who entered the tall house in which the 'bones pole' was kept. Older men were in an inner circle, with younger men at their back. A ritual specialist made spells for health and fertility, which were said to come up from his stomach, his *tepe*. For each cult house there was a single leader who held the knowledge of these spells and was therefore said to be the man in charge of the cult site (*yopikango*). Such a position of leadership and knowledge might be passed from father to son. But the knowledge could also be passed on between specific lines of descent within the larger residential complex of the settlement.

Joint participation in the cult was a mark of unity; separate performances later would mark social processes of differentiation over time. Two performances might be held in the same place, then a shift would occur. Clearly the *Timbu* represented the ongoing social life of a named group and its diachronic extension and alteration.

The exclusion of women and young children from the inner cult area does not mean that the *Timbu* was an exclusive 'men's cult'. The whole purpose of concealing the post and festooning it with bones was so it could be brought out later and displayed to the community at large, when the

final dance for the 'coming out' of the pole was staged. One senior informant said that 'after this the young men could find wives for themselves'.

The parts of pigs that were taken inside the cult house for consumption were the tail-joints (regularly used in ritual contexts elsewhere in the Highlands, such as among the Duna of the Lake Kopiago area) and the sides. The inner parts, including the entrails, and the heads of the pigs were given to the women to eat. A woman would dance up to a 'fence' and hold up a pig to be killed. The men rushed at it calling out and clubbing it as it squealed. The women then stood at the fence and received their portions of the pig to cook. When the 'bones pole' was finally buried at the end of the performance, both men and women were said to have participated in this final ritual act.

The *Timbu* spirit was said to be male—*ali*, 'a man'. The bringing out of the pole was therefore like the bringing out of a male initiate from a condition of secrecy into one of display. Prior to this moment of display in the ritual process, women and children should not see the pole because if they did so, their legs, arms and vaginas would suffer from sores described as 'scabies'. That is, if they saw the *Timbu* when it was 'unripe', the result would be the opposite of the effect of showing the spirit to them when it was 'ripe', like a mature, healthy man.

The *Timbu* also presided over marsupials. If hunters failed to find marsupials in the forest they would attribute this to the spirit. Hence the point of hanging trophies on the pole as a sign of hunting success—these were both a return to the spirit for granting access to the game and a demonstration to the community of this access.

The spirit was said to dislike pigs' heads because pigs spoil people's gardens. If the *Timbu* saw pigs' heads it too would spoil gardens in the same way, it was declared. We see here a sign of the latent aggressiveness believed to be inherent in the spirit.

Other taboos were observed. The participants made small flutes and blew these to warn women and children not to look when cult paraphernalia were being carried into the house. The flutes were blown also when pork was cooked and divided out in the cult place, to prevent sickness in people and pigs. These flute sounds were said to imitate the calls of two marsupials known as *tekelepo* and *wapenge*, which came 'along with the *Timbu* cult itself', it was said. The marsupials' call of *tu-li*, *tu-li* inspired the flute-blowers to imitate them. The spirit's connection with the forest and its

game is reaffirmed in this detail, while the act of blowing the flutes links the cult to a wide spectrum of such practices in the Highlands region as a whole.

Finally, the cult's forest associations are shown in the practice of roofing the cult house with wild pandanus leaves and black palm thatch, into which pig bones were pushed. White and rusty brown forest leaves were used to decorate the house; these also appear as decorations on houses for spirit cults in the Hagen area north of Pangia. We are dealing here with the fluid transmission of cult elements from place to place, in which forest associations are a constant feature.

After the performance was over, the pole and all pig bones were carefully buried. At the burial site the participants planted a *kendo*, a cordyline shrub, as a long-lasting marker, surrounding the shrub with boards. (This would make them like the *pokla mbo* which marked *moka* events in the Hagen area.) It seems likely that the *kendo* marked the place where the spirit and its power was now located in a dormant mode. The actual dance for the culmination of the ritual activities also involved wearing tall cordyline sprigs as bustles at the back. Pairs of men danced facing each other with their bustles bouncing at their backs, singing songs to the *Timbu*. The dance was called *polo pendeko*, 'the bending dance'. Men cut a pandanus leaf and blew musical notes on it as they performed it.

The *timbu wara* wickerwork figures which are the focus of this paper were made to be worn on the heads of the male dancers who participated in the climactic phase of the cult. We quote here initially two statements in 1967 by senior knowledgeable male informants of two different settlement areas in the southern part of the Wiru speaking area:

We make a figure of a man with rope and decorate it. When we kill the pigs we carry it on our heads. We put tall cordyline sprigs in our rear bustles and we carry bows and arrows. (Longai of Tunda village)

We made a *wara*, like a man, and placed it on our heads. This was a good custom; it was our own. If this figure was not made, pigs, men, women, and children would all become sick. We killed a pig [as a sacrifice before constructing the figures] and we made a 'picture' [*yomini* in Wiru] of the spirit. One special kind of rope and one special liana were used to make the *wara* and we carried them on our heads at the time of cooking pigs. Women could not hold these *wara*, only men and their sons ...[After the performance was over] some *wara* were buried,

but some were kept. Out of fifteen, maybe ten were buried but five were kept. For the next performance we made new ones and finally buried the remaining old ones. But now all the *wara* have been thrown away. The Lutheran Mission men cut up the *wara* with their axes. (Kuluwa of Marapini village)

Another old ritual expert noted:

In the past we made gardens of taro, bananas, sweet potato, and they all grew big. Now that we have given up the *Timbu* our crops are small. In the past pigs and men were large because of the *Timbu*. Now they are small. (Wipai of Tunda village)

In spite of this tone of regret, shared by many others at the time, the *Timbu* cult had vanished from the Wiru area by 1967. In several instances it was reported that the *yopikango* of the cult had himself turned in its sacred stones to the missions or had declared that it would not be performed again. Since he was the authorized expert for the group, his decision could not be challenged. Such men were afraid of the messages of Hell and sin that the missions brought with them. When asked if the people could themselves have cut up the *wara* and destroyed them, informants unequivocally said 'No, we could not have done this, because we were sorry (*ela toka*) for the *wara*.'

In Tunda village in 1967, an effort was made to collect a number of these wickerwork figures used in the *Timbu*. Tunda village had a road into it, making access somewhat easier although the road was often barely passable to vehicles. The people were converted to the Lutheran and Catholic forms of Christianity, and the settlement itself was artificially structured through the actions of the government bringing previously separate small settlements together (Strathern 1984; Stewart & Strathern n.d.). Tunda was, however, a traditional *tumbea ta* or 'big place', functioning as a ritual and political centre for surrounding hamlets. Some villagers at this time still possessed the knowledge of how to make the wickerwork figures called *timbu wara*, even though the *Timbu* cult was no longer practised.

The Lutheran Mission in the area was very active, as was the Catholic mission. Tunda was divided between these two. Hageners from the Western Highlands were working with the Lutherans at this time, and these Hageners boasted that they were involved in removing the ritual cults of the local people. But the actual time period since the arrival of Christianity, and the changes associated with it, was short; thus,

the people still retained a great deal of knowledge about previous religious activities such as the *Timbu* cult, although they were sometimes reluctant to discuss these in any detail.

THE *TIMBU WARA* AND CHRISTIAN MISSIONS

Timbu wara ('the spears of the *Timbu* spirit') were very striking wickerwork figures known from only a few areas of the Southern Highlands. As indicated above, these figures were made specifically for a particular cult performance and then buried or allowed naturally to decay. They would not have been kept indefinitely, so there were no heirloom examples that one could purchase for a museum collection. Even if some had been retained in the past, the missionaries had ordered the people to destroy or burn any remaining items from their pre-Christian religious practices. Therefore, a request had to be made to the people to manufacture some of these figures for a collection to be sent to the Museum of Archaeology and Anthropology at the University of Cambridge.

Several local youths agreed to make them for a set fee. They were sons of men who had the right to wear such items in the past and there was no bar to learning from their fathers how to make them. In the past, these items were not made by the ritual experts, whose power lay in their knowledge of spells for the cult.

When the completed figures were presented they were placed vertically on top of the heads of the craftsmen to show how they had been worn in their ritual context. They were shaped like a human figure but they represented the *Timbu* spirit. At the time of presenting the figures, their makers carried them in this displayed manner through the village, which was close by a government road. At the moment that this parade was occurring, a local fundamentalist missionary from the Evangelical Bible Mission at Mele was walking along the road from Mamuane village, where he wanted to set up a mission station. The missionary's baggage carriers pointed at the men with the *timbu wara* figures and began to yell out, 'Satan, Satan, Satan figures are coming!' They were told that these were not Satan figures but rather artifacts that were commissioned to be made for a collection and not for any religious purpose, but these men were very afraid and went off. The missionary himself was rather upset and also

went off without any further discussion of the objects.

Ironically, this missionary later did subsequently set up a church in Mamuane village with the stated aim of bringing into congruence Christian ideology and aspects of indigenous culture. But in the course of doing this it was reported that he made a number of transactions in which the people felt they had not obtained enough in return for services rendered and they took revenge by burning the mission station down, forcing the missionary to leave.

The *timbu wara* figures were, as we have noted, objects made to celebrate the action of dancing for the *Timbu* spirit during the cult performance. The central ritual objects of the cult were items (which could include, for example, a tree fungus which was hard and stone-like and was called *timbu kapa*) that were kept in the specially constructed cult house, and pigs were sacrificed to these items. One of the senior men, who had himself been a custodian of the cult, explained further some of the ritual actions that were performed:

Inside the house they dug a hole and they made *man* [magical spells] over it. They used a pearl shell to scoop out this hole, speaking a spell over it also. Inside the cult house they planted tree saplings. They killed pigs and filled blood from them into a bamboo tube. They also took tree oil and poured it along with the blood into the hole. They took a special leaf, *timbu yombolu*, and buried it in the hole with the oil and blood. For every action they made a special *man*, including the house-building. When we had killed the pigs we made a special net bag, *tetaleme ka*, like a woman's net bag, made from rope, which we carried outside. The axes we used to cut this rope in the bush and to cut the wood for the house were all bespelled in advance. We used four different sorts of wood for the actual pole on which we hung the pigs' bones and also the bones of eels and marsupials. These woods were *tungi*, *lepa*, *walea*, and *pokota*. (Kuluwa of Marapini village)

This quotation gives some idea of the complexity and diversity of the ritual acts performed inside the cult house. The action of giving tree oil to the ground also parallels the Hagen male spirit cult sequence in which *Camptosperma* oil is poured into the 'spirit's eye' (see Stewart & Strathern 2001: 99–112). The *wara* in a sense marked the successful performance of these other acts: the creation of the spirit as 'a man' (*ali*), representing the regeneration or revivification of the community itself. The fact

that *wara* figures, like the 'bones pole', were all buried does not mean that they were casually discarded. Burying items in the ground is a way of preserving and containing their force, as is

abundantly testified from all over the Highlands. Since the pole was buried at a site where a *kendo* or *cordyline* was planted as a marker of group identity, we may reasonably suppose that the *wara*



FIGURE 2. These two boys are displaying decorations they have been involved in making to demonstrate the methods of manufacture of *timbu wara*. The boy on the left wears one figure attached to his head and holds another in his hand. The boy on the right wears an *alipo* wig with a set of bird plumes mounted on bamboo pieces above it as a headdress. The *alipo* wig style belongs especially to the Ialibu area north of Pangia. The house in the background is a newly made house for cooking food, beside a large dwelling house.

were buried in the same place. Elsewhere in the Highlands, ritual items were left to decay or were buried, for example the *gerua* boards or painted plaques found from the Wahgi area eastwards to the Siane (O'Hanlon 1989: 102ff.).

At this historical moment, in the 1960s, the

fundamentalist Christians from one of the missions were saying that these *timbu wara* objects were 'satanic' and should be destroyed. But the Lutherans and Catholics of the village were not making this a particular issue. The Catholic priests of the Capuchin order in the area



FIGURE 3. A close-up of the *timbu wara* figures.

had even used these objects to decorate their own houses and encouraged people to make them as tourist objects so as to obtain some income. By suggesting the objects be used as tourist items they were also deflecting the people away from associating them with the ritual itself.

THE TIMBU FIGURES

Figures 2-4 show the designs of the two figures that were constructed for sale in 1967 in Tunda village. The two boys were those assigned to carry the objects and who had been involved in their



FIGURE 4. Rear view of the *timbu wara* figure attached to the bast lining of an *alpo* wig, along with feather decorations mounted on rattan.

making. Both figures were flat constructions with protrusions representing arms and legs; they were coloured with earth pigments. One also had a rudimentary head on which a headdress was mounted. This figure had a central strip of white running from its head to its genital area. It is likely that this strip marked the presence of vital 'grease', of fluid in the body. The second figure had a softwood plaque marked alternately in dark and light colours to resemble the pearl shell ornament hung on the body. It may be thought to have signified the idea of the body as wealth, a significant notion in Pangia. It may also have represented a notched hornbill beak, a favourite design also painted on men's noses at pig-kills (*kaila timini* is the name of this design); each of the *timbu wara* in the South Australian Museum (A.66227, -8) has a real hornbill beak attached as the head (Figure 5).

COMPARATIVE MATERIALS

The *timbu wara* figures are one of a category of objects that are found also in other areas of New Guinea. Heinz Dosedla (1984) has written a review article on this category of woven figures

that are made from flexible materials. He discusses items from the Southern Highlands Province, including the Enga, Kewa and Wiru peoples. His classification, based on a survey of the literature available to him, includes a set of figures that are in the shapes of animals, 100–180 cm in length and decorated with earth pigments; and a second set of anthropomorphic figures, 60–90 cm in height, unpainted, and with an enclosed cavity. For both types, a spiral weaving technique was used in their manufacture, in which plant materials were bent and wound around a supporting frame that was made from stiffer materials, such as bark rope in some instances.

Dosedla states that among the East Kewa of the Kagua District, who had trading relations with both the Enga and Wiru peoples, the woven figures were significant in the cult known as *Rimbu*, which ensured fertility through sacrifices to the dead. The cult included the use of flat woven figures whose construction had been supervised by special ritual experts. These figures resembled those that the Wiru used, but these Kewa figures were in the shape of animals and they were worn by dancers on their lower chests. The figures were said to represent spirits of dead

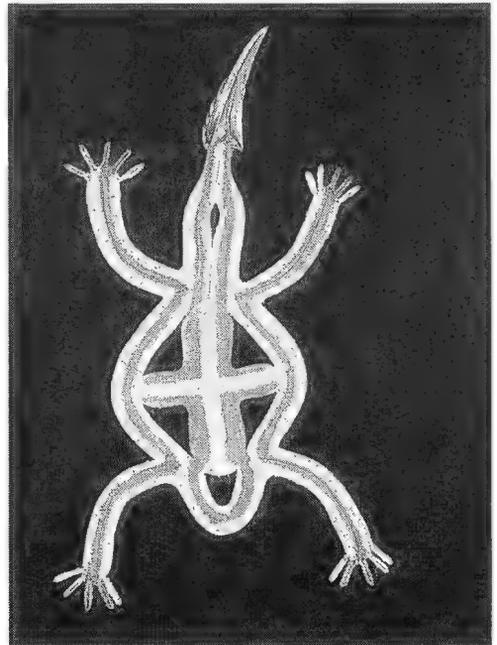
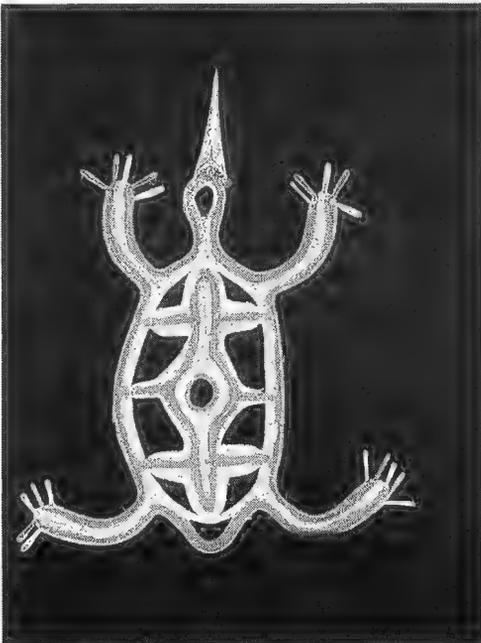


FIGURE 5. Two *Timbu wara* figures in the South Australian Museum (A.66227, -8), each with hornbill beak attached. Purchased from Stephen Kellner of Sydney in 1977. Kellner purchased from a private collector c.1972. Photo courtesy South Australian Museum.

members of the clan. The East Kewa *Rimbu* cult also employed the second category of woven figures—the hollow anthropomorphic ones—which were used as freestanding figures in conjunction with cult stones.

The *Rimbu* cult festival developed over a number of years with several stages of activity and involved two separate groups of men, the 'red' and the 'black' sections. These two colours are symbolically associated elsewhere in the Highlands with dualistic schemes of classification. The 'red' group took control of the anthropomorphic figures and the cult stones, while the 'black' group took control of the animal-shaped figures. The latter were displayed and carried at the end of the ritual by cult participants.

Dosedla also describes wickerwork figures from the Enga area. One type called *yupin* was kept in a special spirit house (*yainanda*, war house) along with cult stones. The *yupin* figure, seen as 'male' and marked by its prominent genitals, was thought to have intercourse with the rounded cult stones, bringing fertility to the land, pigs and humans. (See Wiessner & Tumu 1998: 199, 204, 207 for further details on Enga *yupin* or *yupini* figures.)

Neich (1976) provides a valuable survey of *yupin* figures derived from information provided by an Apostolic Church missionary, H. M. Reah, who lived in the Yandapu Enga area for some ten years in the 1960s and 1970s. Reah's account indicates that these figures were considered very powerful; that they were appealed to in times of drought; that their keepers would ritually place them on top of round flat female stones with holes in the centre; and that groups tended to have their own *yupin* figures. But several groups might come together on an inter-local basis to ask the *yupin* for health and prosperity in times of sickness.

Neich says that *yupin* figures had to be made from special vines (as was true for the *timbu wara* also); that their manufacture was commissioned and the maker rewarded handsomely with shells and axes; and that women and children were not allowed to see them. If a woman saw one, her next child would be born deformed. If a child saw one, he or she would fail to grow.

Here, the logic of time reversal was operating. Seen 'out of time', the *yupin* would harm, not help, the community. Most valuably, Neich provides information from a number of Enga areas, including those that are closer to the Kewa, on variant designs and names of *yupin*. One was from Margarima and was said to represent Tatagali-Wabe or Tali-eli, a major spirit appealed

to when gardens did not grow well. It is interesting to note that this is the name Glasse gave to a supreme spirit among the Huli people (Glasse 1965). The name *yupin* itself may mean 'root or base man', that is 'the source of things'.

All *yupin* figures are cylindrical, with a hollow area inside of them, in contrast with the flat *timbu wara*. While the Enga *yupin* practices and ideas are clearly cognate with the Wiru *wara* customs, the Wiru obviously developed their own ways of thinking about these objects.

Dosedla also briefly describes the Wiru *timbu wara* figures, which he says were painted with concentric rings of white and yellow with a background of red ochre. Such concentric rings are a significant motif for the Wiru. They appear on decorations women made around their navels for dances and in the bands of earth colours painted around the Female Spirit (*Aroa Ipono*) cult stones (Strathern & Stewart 1999b). He notes that they appeared only as the flat type, and not as animal but anthropomorphic forms. He suggests that the Wiru merged two types (the one seen in the East Kewa *Rimbu* cult and the other from the Enga area) into one type; that is, the Wiru figures were flat, not three-dimensional, but represented humans, not animals.

RITUAL AND CHANGE

As Dosedla points out, the Wiru *timbu wara* figures belong to a wider geographical area in which similar figures were made for cult contexts. Dosedla traces the provenance of these figures and analyses their distribution in cultural-geographical terms. For our purposes here, it is important to ask how the Wiru figures were used in the wider contexts of cult and political activity; and also why they so rapidly ceased to be made if they held ritual importance, and what consequences ensued.

The name of these figures is significant. *Wara*, 'spear', refers to the context of warfare and inter-group conflict. The cult performers looked out on the spectators in order to demonstrate their political power and solidarity. *Wara* can also be used to mean 'wealth', the ability to 'kill' objects by paying for them with wealth items, or to obtain wives by the payment of bride price. As the figures represented the human form, they could ambiguously take onto themselves an aura both of the dead ancestors and of the living men who carried them in the festival. Since, among the Wiru, the *Tapa* cult dealt with internal problems

of sickness centered on male ancestors and the Female Spirit cult was concerned with general fertility and alliance, the space occupied by the *Timbu* cult clearly had to do with the outward-looking political strength of settlements.

The decline of the *Timbu* cult thus predictably accompanied the decline in warfare between parishes and hastened the demise of the pre-colonial patterns of inter-parish competition and display, although aspects of these continued in the pig-kills held periodically (Strathern & Stewart 1999a). In addition, as we have seen, some fundamentalist Christian missions in the 1960s were able successfully enough to label cult practices as satanic, and the *timbu wara* figures were prominent and easily visible targets for disapproval, whereas cult stones could more easily be hidden and used still for healing rituals or small sacrifices. The *timbu wara* figures thus disappeared, only to reappear briefly as 'tourist' objects, once emptied of their meaning and dislocated from their political and ritual contexts. Their decline is one of the markers of the success of colonial hegemony, with a trajectory from prime ritual object to tourist object to forgotten piece of knowledge.

Tracing the decline of these sacred figures through time, we have first to note that the major cult leaders were often those who surrendered

their ritual power to the Christian missions in order to get the new ritual power that was on offer. In other words, they themselves in some sense began the process of desacralisation. Mission helpers then took this further by cutting the effigies into pieces, something their custodians themselves would not do because of *ela*. The same mission authorities, along with colonial government officers, completed the process by suggesting the items be made for sale, relying on people's desire for money.

The making of the figures for the Cambridge museum in 1967 pre-dated this process. These figures closely paralleled traditional designs. Those made later, for sale to tourists, showed variations. They were bigger, designed for display on hotel walls; more uniform in color and design; were turned out repeatedly; or were made in the shape of crosses or abstract designs. After Independence in 1975 and the departure of many expatriate missionaries and government officers, the people did not persist with this craft for long. Indeed, the figures were soon in over-supply: the patrol officer's space in the Pangia Station overflowed with them at one time, jumbled up and tangled together in disarray because of insufficient demand for them. As with other matters, the people became disappointed with their returns and ceased production.

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**SEPIA HEDLEYI BERRY, 1918 (CEPHALODA: SEPIIDAE): A COMPLETE
DESCRIPTION AND CLARIFICATION OF THE STATUS OF S.
DANNECIGI BERRY, 1918 AND S. REX (IREDALE, 1926)**

A. L. REID

Summary

Following the examination of both qualitative and quantitative morphological characters, *Sepia dannevigii* Berry, 1918 from off Kangaroo Island, South Australia and *Sepia rex* (Iredale, 1926) from eastern Australia (Manly Beach, NSW) are synonymised with *Sepia hedleyi* Berry, 1918, also from Kangaroo Island. These three species have never been satisfactorily delimited in the literature, so this synonymy is long overdue. A full description of *Sepia hedleyi* is provided.

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REID, A. L. 2001. *Sepia hedleyi* Berry, 1918 (Cephalopoda: Sepiidae): a complete description and clarification of the status of *S. dannevigii* Berry, 1918 and *S. rex* (Iredale, 1926). *Records of the South Australian Museum* 34(2): 79–97.

Following the examination of both qualitative and quantitative morphological characters, *Sepia dannevigii* Berry, 1918 from off Kangaroo Island, South Australia and *Sepia rex* (Iredale, 1926) from eastern Australia (Manly Beach, NSW) are synonymised with *Sepia hedleyi* Berry, 1918, also from off Kangaroo Island. These three species have never been satisfactorily delimited in the literature, so this synonymy is long overdue. A full redescription of *Sepia hedleyi* is provided.

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The cuttlefish *Sepia hedleyi* was described by Berry (1918) on the basis of a number of specimens collected from the Great Australian Bight, off the coast of South Australia. While the original description is detailed and relatively well illustrated, the cuttlebones of all the specimens were missing or damaged, and its structure was estimated in a reconstruction of the ventral side of the bone from fragments obtained from a single female specimen. In the same publication, another species from the same collection locality, *S. dannevigii*, was described on the basis of three female specimens, again with damaged cuttlebones.

Perhaps (in part) because the cuttlebones of these species were so incompletely known, another species, *S. rex*, was described by Iredale in 1926 on the basis of a cuttlebone collected on Manly Beach, Sydney (33°48'S 151°17'E). Iredale (1926) provided no justification for the erection of this new species: no comparison was made with other cuttlefish species. In addition, he placed *S. rex* in a new genus, *Decorisepia*, on the basis of its 'remarkable' rounded spine and the absence of an inner cone and ventral sulcus. Strangely, the two latter traits are clearly visible in his illustration accompanying the description (Iredale 1926: pl. xxii, figs 9–10) and are obvious on the type specimen. Following the comprehensive revision of the Sepiidae by Adam and Rees (1966), the validity of *Decorisepia* (and many other sepiid genera) has been questioned, and few workers follow this scheme, preferring to retain most sepiids within a single genus *Sepia*

until more is known about the phylogenetic relationships among species. The generic classification of Adam and Rees (1966) is the one followed in this paper.

In a later work, Adam (1979) placed two other species, *Decorisepia cottesloensis* Cotton, 1929 and *D. jaenschi* Cotton, 1931, both known only from cuttlebones, in synonymy with *S. rex*. However, the description of *S. rex* in Adam (1979) is clearly that of yet another species, *S. opipara* (Iredale, 1926), so Adam's synonymy is not valid. After examining the type cuttlebones of all these species, Lu (1998) confirmed that *D. cottesloensis* and *D. jaenschi* are indeed synonyms of *S. rex*, so that part of the story, at least, has been resolved.

The three names, *S. dannevigii*, *S. hedleyi* and *S. rex*, have persisted in the literature until now, though they have never been satisfactorily differentiated from each other. Lu (1998) gave a diagnosis for each species based on his examination of the type specimens and comparison with other material housed in the Museum Victoria collections. The only difference he noted between *S. hedleyi* and *S. rex* is that the cuttlebone striae are nearly straight in *S. hedleyi* (based on Berry's figure of the reconstructed cuttlebone), but rounded in *S. rex*. He also noted the similarity between *S. dannevigii* and *S. hedleyi* and suggested they may be conspecific.

The aim of the present study is to clarify the status and identity of the three putative species, *S. dannevigii*, *S. hedleyi* and *S. rex*.

MATERIALS AND METHODS

This work was based on museum material. The non-type material examined is listed in Appendix 1. Material examined in detail for both qualitative and quantitative characters is listed in the *Material examined* section of the species description below. Australian institutional abbreviations used are: AM, Australian Museum, Sydney; MV, Museum Victoria, Melbourne; SAM, South Australian Museum, Adelaide.

To determine whether *S. dannevigii*, *S. hedleyi* and *S. rex* are conspecific, the type specimens and their original descriptions were compared. In addition, specimens from close to the type locality of *S. rex* (Manly Beach, NSW, 33°48'S 151°17'E) were compared with specimens from southern Australia. Because the *S. rex* type specimen is a beachwashed cuttlebone, it may have drifted from any distance before reaching Manly Beach, so the selection of specimens for comparison is not entirely satisfactory, but unavoidable. Identification of these specimens could only be based on the appearance of the cuttlebones and their comparison with the type specimen.

Unfortunately, apart from the type specimens, no other material was available for study from the type locality of *S. dannevigii* and *S. hedleyi*, both from the 'Investigator St. Area, south of Kangaroo Island, South Australia' (Berry 1918: 263, 266). (Herein lies another difficulty: the Investigator Strait is actually north of Kangaroo Island, and no latitudes and longitudes are given in Berry's paper, so the exact type locality is unknown.) Some additional specimens were examined from sites that were as close as possible to Kangaroo Island, though some distance away (see Fig. 1). Apart from the appearance of the cuttlebone (see *Results* to follow), these specimens conformed in all other respects to Berry's (1918) descriptions and type specimens of both *S. hedleyi* and *S. dannevigii* (the two of which appear to be indistinguishable).

In addition to comparing qualitative characters, the statistics package 'Systat' (Systat Incorporated) was used to compare differences in morphometric characters between the populations from eastern Australia (ten males and ten females) and those from southern Australia (seven males and nine females). Sexes were treated separately.

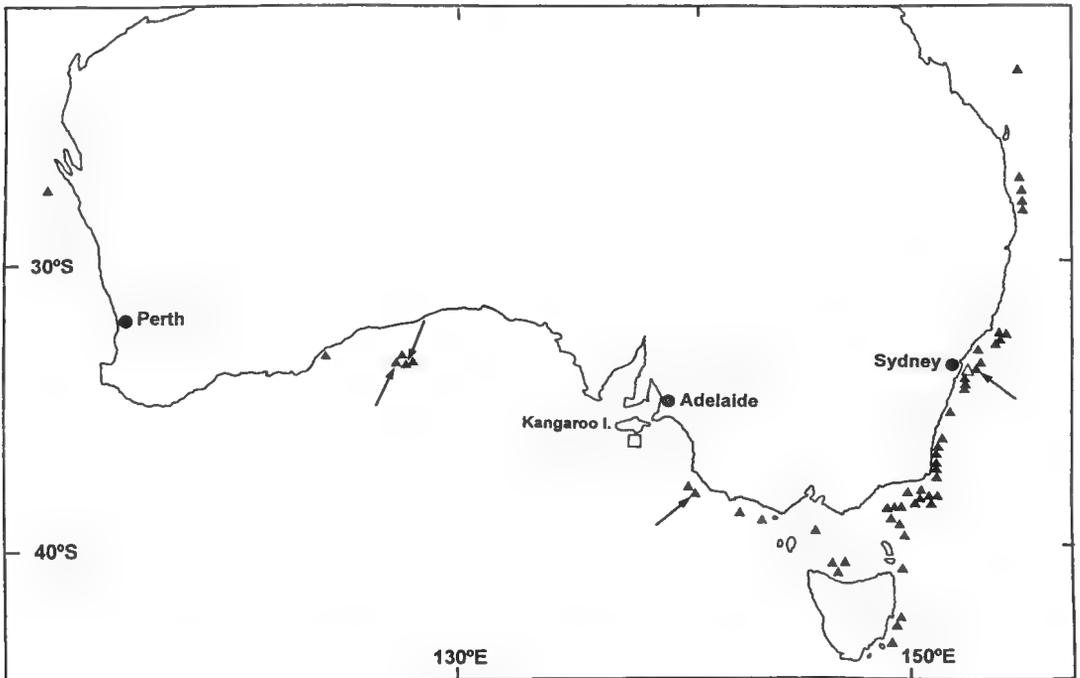


FIGURE 1. Distribution of *Sepia hedleyi* Berry, 1918 based on specimens examined in this study (solid triangles). The open square indicates the approximate type locality of *S. dannevigii* and *S. hedleyi* (see Materials and Methods), and the open triangle the type locality of *S. rex*. Arrows indicate the collection sites for specimens that were examined in detail for both morphological and morphometric characters.

In addition to preserved specimens, the measurements given in Berry's (1918) paper for *S. hedleyi* were included in the analyses. The measurements of one female specimen (E4377) were excluded for reasons given in the *Results* section below. Slopes and intercepts of regression equations were compared statistically between the eastern and southern Australian specimens for those characters showing a significant correlation with body size. For soft parts, mantle length was used as a size indicator. For cuttlebone measurements, cuttlebone length was used.

Measurements and indices used throughout this paper are primarily those given in Roper and Voss (1983), using dorsal mantle length (ML) as a size standard. Some additional measurements are used, and these with the definitions listed by Roper and Voss (1983) are given in Appendix 2. In the species description to follow, parts of the club and arm sucker rims are described using the terminology of Nixon and Dilly (1977) while nomenclature for the radula follows Nixon (1995). The beak was described following Clarke (1986). Diagrammatic illustrations of measurements and terminology used for key structures are shown in Reid (2000).

Measurements were made either using dial callipers, or an eyepiece micrometer inserted in a stereo microscope. All measurements are expressed in millimetres (mm). Measurements and counts for individual specimens and ranges of arm length indices, arm sucker diameter indices and arm sucker counts are presented in tables; ranges for all other characters appear in the text. In the species description and tables, the range of values for each character is expressed as: minimum–mean–maximum (standard deviation, SD). Values for each sex are given separately. Measurements were not taken from the *Sepia dannevigii* (AM C148249) or *Sepia hedleyi* (AM C148252) holotype specimens because of the poor state of preservation of these animals.

Measurements for structures that were clearly distorted or broken were not attempted; these, in addition to missing and unknown values, appear as a dash (–) in the appendices. Ranges for specific character traits given with the species description do not, therefore, always refer to the total number of specimens examined.

For examination of arm and club sucker rims, suckers were removed from the middle of designated arms and the tentacular club, mounted in glycerine jelly and viewed using a compound microscope. Radulae and beaks were dissected from the buccal mass and soaked for

approximately 30 minutes in a warm, saturated potassium hydroxide solution; then radulae were cleaned using forceps and a fine brush. Radulae were mounted in glycerol and the new, unused portion was examined. All characters refer to both sexes unless stated otherwise.

The species description was generated using DELTA (DEscription Language for TAXonomy) software (Dallwitz, 1980; Dallwitz et al., 1993; Partridge et al., 1993).

RESULTS

With a single exception, only minor differences were found between the type specimens and descriptions of *S. dannevigii* Berry, 1918, *S. hedleyi* Berry, 1918 and *S. rex* (Iredale, 1926). The exception is in the shape of the cuttlebone striae of *S. hedleyi* (Berry's figure pl. lxii, fig. 2, reproduced here as Fig. 2A), which are nearly straight compared with those of *S. rex* (Fig. 2C, D) which are an inverted U-shape (Fig. 2D). Unfortunately, the cuttlebone upon which Berry's illustration is based could not be found in the Australian Museum collection (Ian Loch, personal communication), so the accuracy of the reconstruction of the cuttlebone could not be checked. Assuming the shape of the striae as illustrated is true to the original specimen (a possibility that seems likely given that this section of the cuttlebone fragment is largely intact), a striking resemblance between this cuttlebone and that of another southern Australian species, *S. cultrata* Hoyle, 1885, is apparent (compare Fig. 2A and 2B). Females of *S. hedleyi* and *S. cultrata* are not easy to distinguish in most respects, however, the club suckers of *S. cultrata* are in 5–6 transverse rows and larger than those of *S. hedleyi*, which are in 9–12 rows. The tentacles were missing from the specimen Berry (1918) used for the illustration of the cuttlebone, so it is possible that this specimen may have been misidentified, and is actually *S. cultrata*. Both species inhabit similar depths and are often trawled together, so I believe this possibility is a real one. Given the doubt about the identity of the specimen (E4377, Berry's register [507]), its measurements were excluded from consideration in this study.

Morphometrics

Nine characters for males (MW, VML, FuL, HW, AS3, AS14, CIL, CIsV and CbL) and 19 characters for females (MW, AMH, VML, HW,

TABLE 1. Morphological parameters showing differences in eastern and southern populations for females. Regression data $Y = a + bX$, where Y = dependent variable, a = intercept, b = slope, X = ML, Sig. = significant difference between the regression lines of eastern (E) and southern (S) Australian populations (Pop.) with respect to intercept, N = number of specimens, r^2 = proportion of total variation accounted for by regression.

Y	Pop.	N	r^2	a	b	Sig.
VML	E	10	0.922	0.46	0.88	$P < 0.001$
	S	8	0.882	18.65	0.61	
AS3	E	10	0.508	-0.23	0.02	$P < 0.05$
	S	5	0.833	-0.41	0.02	
CIL	E	10	0.748	-9.83	0.27	$P < 0.001$
	S	4	0.980	-11.91	0.35	

ED, AL1, AL2, AL3, AL4, AS2, AS3, AS4, CIL, CILs, GiL, CbL, CbW, CbB and LoL) were significantly correlated with mantle length in both populations. Therefore, the slopes and intercepts of the regression equations could be compared statistically between the eastern and southern populations to determine whether there are any differences in these quantitative characters.

For males, no significant differences in either the slopes or the intercepts of the regression equations were found, suggesting that (for the characters that could be compared) the southern and eastern populations do not differ. Three characters differed between the eastern and southern populations in females: VML, AS3 and CIL (Table 1). To determine whether these differences are significant, or perhaps the result of geographic variation across the range of a single species, residual variables calculated for each of these characters were regressed against latitude and longitude of each specimen collection site following the methods detailed in Reid (1991). Residual values for VML and CIL were correlated with both latitude and longitude, indicating a strong geographic component in the difference between the eastern and southern populations (Table 2). The character AS3 was not correlated with either latitude or longitude and represents the

only significant difference between the two populations in quantitative characters. A difference in this trait alone, the diameter of the suckers on the third arm of females, does not warrant further detailed investigation and is of not sufficient magnitude to warrant distinct species recognition.

One further difference was noted in the number of club suckers, with CIRC for the southern Australian population 9–10 (Appendix 3) and 11–12 for the eastern Australian population (Appendices 4 and 5), though the *S. hedleyi* holotype clearly has 12 suckers in transverse rows as noted by Berry (1918). While this does not appear to be a significant difference between the two populations, and given the difficulty in determining the exact number of club suckers, particularly in species where the suckers are small, it may still be worth investigating this character when more material from southern Australia becomes available.

From all available evidence, I conclude from the examination of both qualitative and quantitative characters that all specimens currently referred to as *S. dannevigii*, *S. hedleyi* and *S. rex* belong to a single species. Unless specimens are found that match all parts of Berry's (1918) description of *S. hedleyi*, including the shape of

TABLE 2. Latitudinal and longitudinal regression of residual variables pooled from female specimens from eastern and southern Australia tested by $Y = a + bX$ where Y = the predicted dependent variable, a = y intercept, b = slope, X is either latitude or longitude, N = number of specimens, r^2 = proportion of total variation accounted for by regression, N/S = not significant.

Variable	X = Latitude					X = Longitude				
	N	r^2	a	b	Sig.	r^2	a	b	Sig.	
VML	28	0.511	54.40	-1.59	$P < 0.05$	0.360	-42.09	0.29	$P < 0.05$	
AS3	25	0.217	-1.84	0.06	N/S	0.032	0.75	-0.01	N/S	
CIL	28	0.670	-39.79	1.71	$P < 0.01$	0.354	23.61	-0.16	$P < 0.05$	

the cuttlebone striae, I believe his illustration of the cuttlebone of *S. hedleyi* is in fact the cuttlebone of a specimen of a different species, probably *S. cultrata*. *Sepia hedleyi* has date precedence (ICZN, 1999: Art. 23.1) with respect to *S. rex*, and page precedence (ICZN, 1999: Art. 69A.10) with respect to *S. dannevigii*, so the latter two species are placed in synonymy with *S. hedleyi* in the description to follow.

Counts and indices for individual specimens from southern Australia are given in Appendix 3, and from eastern Australia in Appendices 4 and 5. Ranges for arm length indices, arm sucker diameter indices and arm sucker counts for southern Australian specimens are shown in Appendix 6. Measurements included in the description refer only to southern Australian specimens.

TAXONOMY

Sepia hedleyi Berry

(Figs 1(in part)–7, Appendices 3, 6)

Sepia hedleyi Berry, 1918: 258–264, pls 71–72. – Lu, 1998: 169, fig. 10.

Sepia dannevigii Berry, 1918: 264–268, pls 73–74, figs 1–2. – Lu, 1998: 168, fig. 8.

Decorisepia rex Iredale, 1926: 193. – Lu, 1998: 180–181, fig. 22.

Material examined

Holotype. *Sepia dannevigii*, 1F (61.0 mm ML), Investigator St. Area, south of Kangaroo Is, South Australia, Jan–Feb 1912, FIS ‘Endeavour’ E2466 (AM C148249).

Holotype. *Sepia hedleyi*, 1M (56.9 mm ML), Investigator St. Area, south of Kangaroo Island, South Australia Jan–Feb, 1912, FIS ‘Endeavour’ E2464 (AM C148252).

Holotype. *Sepia rex*, 1 cuttlebone (107.0 mm CbL), Manly Beach, NSW [33°48’S 151°17’E] (AM C127593).

Other material examined. **Australia:** **New South Wales:** 1M (84.3 mm ML), 2F (83.1, 103.8 mm ML), 32°27’S 152°54’E, 244–242 m, 30 Jan 1982, coll. C. C. Lu & R. Tait (MV F77179); 1F (108.8 mm ML), 33°40’S 151°50’E, 210–204 m, 25 Jan 1982, coll. C. C. Lu & R. Tait (MV F77138); 5M (75.9–100.5 mm ML), 9F (72.6–107.7 mm ML), 33°42’S 151°51’E, 300–293 m, 25 Jan 1982, coll. C. C. Lu & R. Tait (MV F77136). **South Australia:** 3F (93.1–107.6 mm ML), 25.5

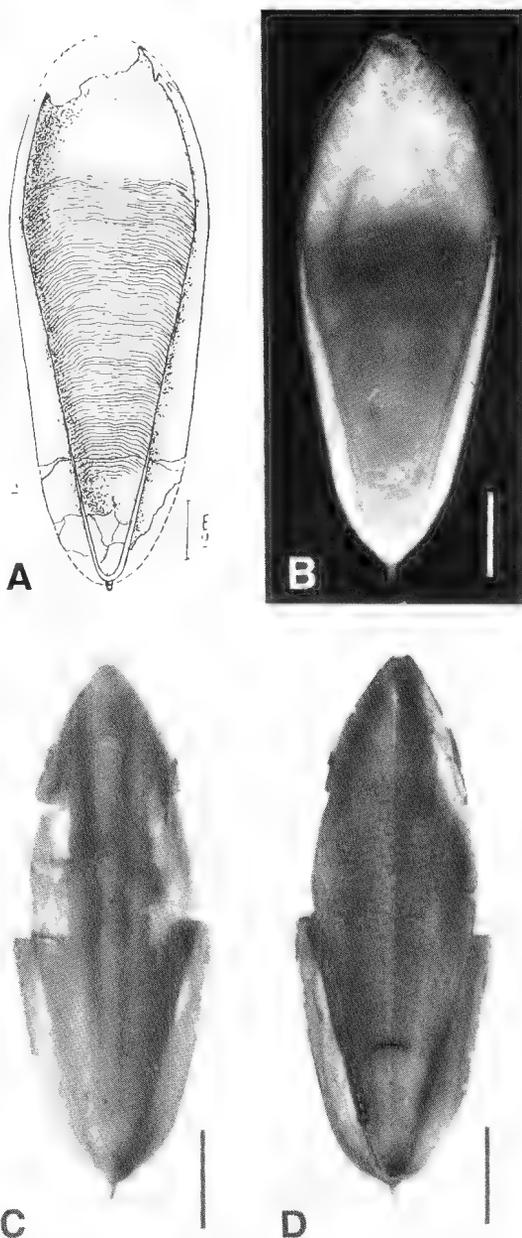


FIGURE 2. A, *Sepia hedleyi* Berry, 1918, reconstructed cuttlebone, pl. lxxii, fig. 2 Berry, 1918, female [507], 91.0 mm ML (E4377) (specimen possibly *S. cultrata* Hoyle, 1885); B, *Sepia cultrata* Hoyle, 1885, cuttlebone, ventral view, female, 67 mm ML (MV F66203); C, *Sepia rex*, cuttlebone, dorsal view, holotype, 107.0 mm CbL (AM C127593); D, *Sepia rex*, cuttlebone, ventral view, specimen as in C. Scale bars; A, B = 10 mm; C, D = 20 mm.

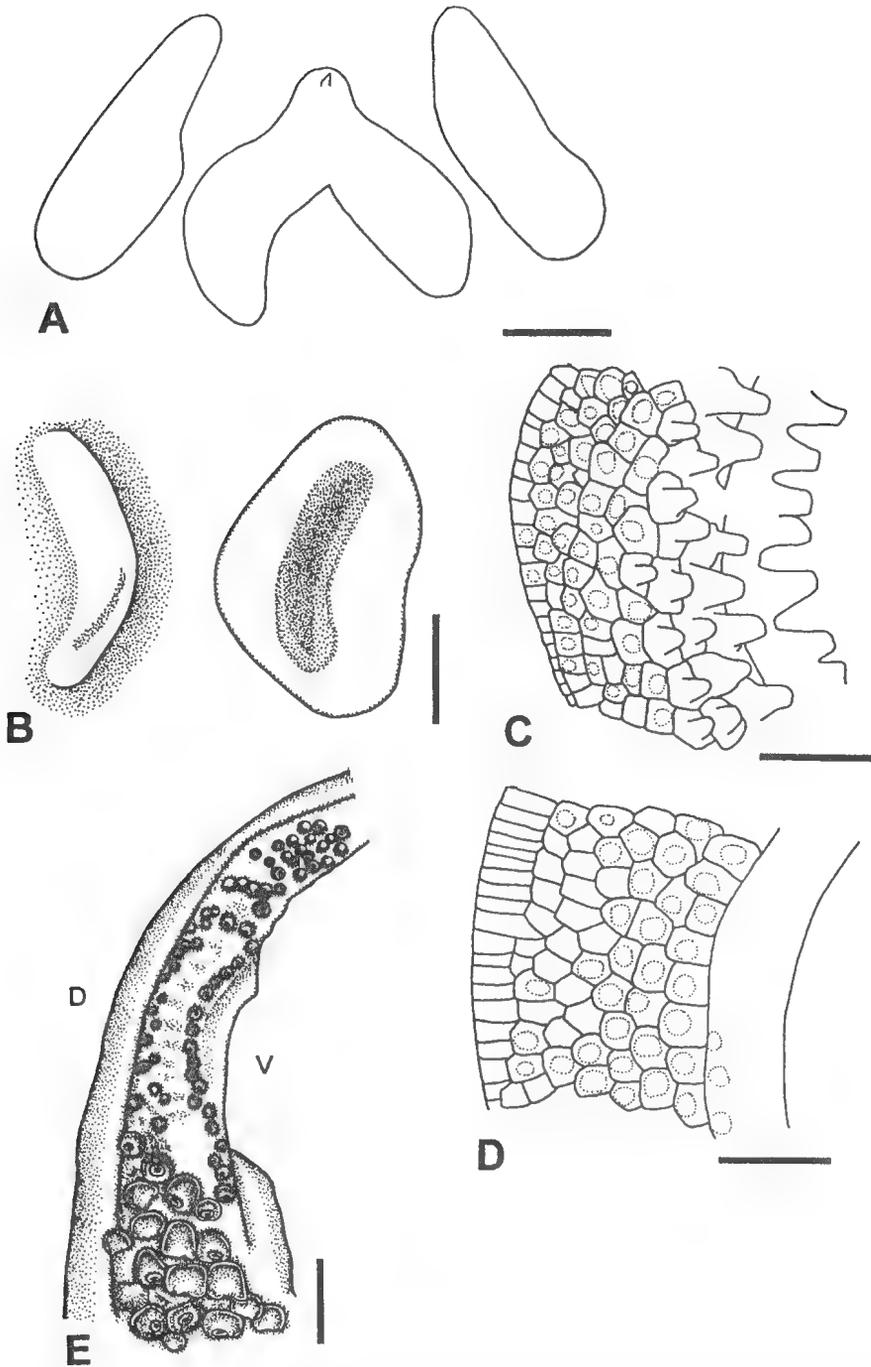


FIGURE 3. *Sepia hedleyi* Berry, 1918. **A**, funnel organ, male, 47.2 mm ML (SAM D19241); **B**, funnel-locking (right) and mantle-locking (left) cartilage, male, 47.2 mm ML (SAM D19241); **C**, sucker rim arm 1, portion of toothed half, male, 55.0 mm ML (SAM D19243); **D**, sucker rim, portion of non-toothed half, specimen as in **C**; **E**, portion of hectocotyliised arm, male, 75.7 mm ML (SAM D19241) (**D**, dorsal; **V**, ventral). Scale bars; **A** = 5 mm; **B** = 2 mm; **C**, **D** = 0.05 mm; **E** = 2.0 mm.

miles [41 km] SW of Cape Buffon, 37°58'S 139°45'E, 300 fm [549 m], May 1981, coll. J. Sealey (SAM D19240). **Western Australia:** 2M (47.2, 75.7 mm ML), Great Australian Bight, 115 nm SW Eucla, 33°18'S 127°40'E, 180 m, 16 Jan 1989, coll. W. Zeidler & K. Gowlett-Holmes (SAM D19241); 2F (67.9, 68.6 mm ML), Great Australian Bight, 110 nm SW of Eucla, 33°19'S 127°50'E, 250 m, 16 Jan 1989, coll. W. Zeidler & K. Gowlett-Holmes (SAM D19242); 1M (55.0 mm ML), Great Australian Bight, 115 nm SW of Eucla, 33°19'S 127°50'E, 180 m, 16 Jan 1989, coll. W. Zeidler & K. Gowlett-Holmes (SAM D19243).

Diagnosis

Male and female arms subequal in length; arm suckers tetraserial throughout. Hectocotylus present, left ventral arm of males modified: 6–8 rows of normal suckers proximally, 9–10 rows of reduced suckers, remaining suckers normal to arm tip; suckers in two dorsal series smaller than those in two ventral series, dorsal and ventral series widely spaced, those in ventral two series aligned in a single row. Club with 9–12 suckers in transverse rows, all similar sized, small; dorsal and ventral protective membranes not fused at base of club; swimming keel extends well beyond carpus along stalk. Cuttlebone acute anteriorly and posteriorly, with median rib dorsally; spine without keels; anterior striae inverted U-shape; inner cone limbs uniform width, narrow, V-shaped posteriorly.

Description

Counts and indices for individual specimens are given in Appendix 3; ranges for arm length indices, arm sucker diameter indices and arm sucker counts are shown in Appendix 6.

Small to moderate-sized species; ML males 47.2–70.7–83.0 (SD, 13.9); females 67.9–87.8–107.6 (SD, 13.9). Mantle broad, oval; MWI males 41.9–49.8–55.6 (SD, 5.4); females 44.2–51.6–59.8 (SD, 5.9); dorsal anterior margin triangular, acute; extending anteriorly beyond eyes; AMHI males 11.9–14.2–15.5 (SD, 2.0); females 12.8–14.6–17.8 (SD, 2.0). Ventral mantle margin emarginate, without distinct lateral angles; VMLI males 80.7–86.0–93.7 (SD, 4.4); females 75.3–83.1–88.4 (SD, 4.5); posterior gland and gland pore absent. Fins widest in posterior third; FWI males 7.2–9.7–11.7 (SD, 1.3); females 4.4–8.6–11.6 (SD, 2.4); anterior origin posterior to mantle margin; FIIa males 4.5–5.0–5.3 (SD, 0.4); females 2.0–3.7–5.7 (SD, 1.5); rounded posteriorly; with

narrow gap between; FIIP males 6.4–7.3–8.0 (SD, 0.8); females 4.7–7.9–12.4 (SD, 3.3). Funnel short, robust, broad; extends to level of anterior rim of eye; FuLI males 27.7–33.2–40.5 (SD, 5.5); females 25.6–30.0–34.6 (SD, 3.3). Funnel free portion approximately half funnel length; FFuI males 14.5–17.3–20.1 (SD, 2.8); females 12.6–15.3–19.3 (SD, 2.8). Funnel organ dorsal elements inverted V-shape with small anterior papilla; ventral elements oval with acute anterior tips (Fig. 3A). Mantle-locking cartilage curved, with semicircular ridge; funnel-locking cartilage with depression that corresponds to ridge (Fig. 3B). Head short; HLI males 17.6–23.2–29.7 (SD, 4.8); females 13.4–25.8–40.8 (SD, 9.4); broad, narrower than mantle; HWI males 33.8–37.8–44.4 (SD, 3.7); females 31.6–41.3–46.6 (SD, 5.1). Eyes moderate size; EDI males 12.7–14.2–16.5 (SD, 2.1); females 8.9–10.8–12.7 (SD, 1.6); ventral eyelids present.

Male and female arms subequal in length (Appendix 6). Arm length index (ALI) of longest arms in males (ALI4) 33.8–40.2–54.4 (SD, 7.2); ALI of longest arms in females (ALI4) 34.7–42.0–51.3 (SD, 4.8). Protective membranes in both sexes narrow. Non-hectocotylised arms normal, not thickened. Distal arm tips in both sexes not markedly attenuate. Arm sucker arrangement same in both sexes: arm suckers tetraserial. Male non-hectocotylised arm suckers normal in size (not greatly enlarged); smaller than female arm suckers in size (Appendix 6). Chitinous rims of arm suckers with elongate rectangular teeth on distal half of inner ring (Fig. 3C), teeth absent on proximal half of ring (Fig. 3D); infundibulum with 7–8 rows of hexagonal processes, inner 4–5 (variable) rows with elongate rounded pegs, pegs becoming smaller towards periphery of sucker; peripheral sucker rim processes radially arranged, elongate, without pegs.

Arm sucker counts range from 106 to 248; females with higher average counts than males (Appendix 6).

Hectocotylus present, left ventral arm modified; sucker size normal proximally, reduced medially, then normal to arm tip; from proximal to distal end of arm, 6–8 rows of normal suckers; 9–10 rows of reduced suckers (Fig. 3E). Suckers in two dorsal series smaller than those in two ventral series; reduced suckers much smaller than normal arm suckers: ASI_n4 1.32–1.46–1.69 (SD, 0.20) v. ASI_n4_m 0.26–0.36–0.42 (SD, 0.09). Oral surface of modified region wide, swollen, fleshy, with transversely grooved ridges. Suckers in two dorsal and two ventral series displaced laterally, suckers

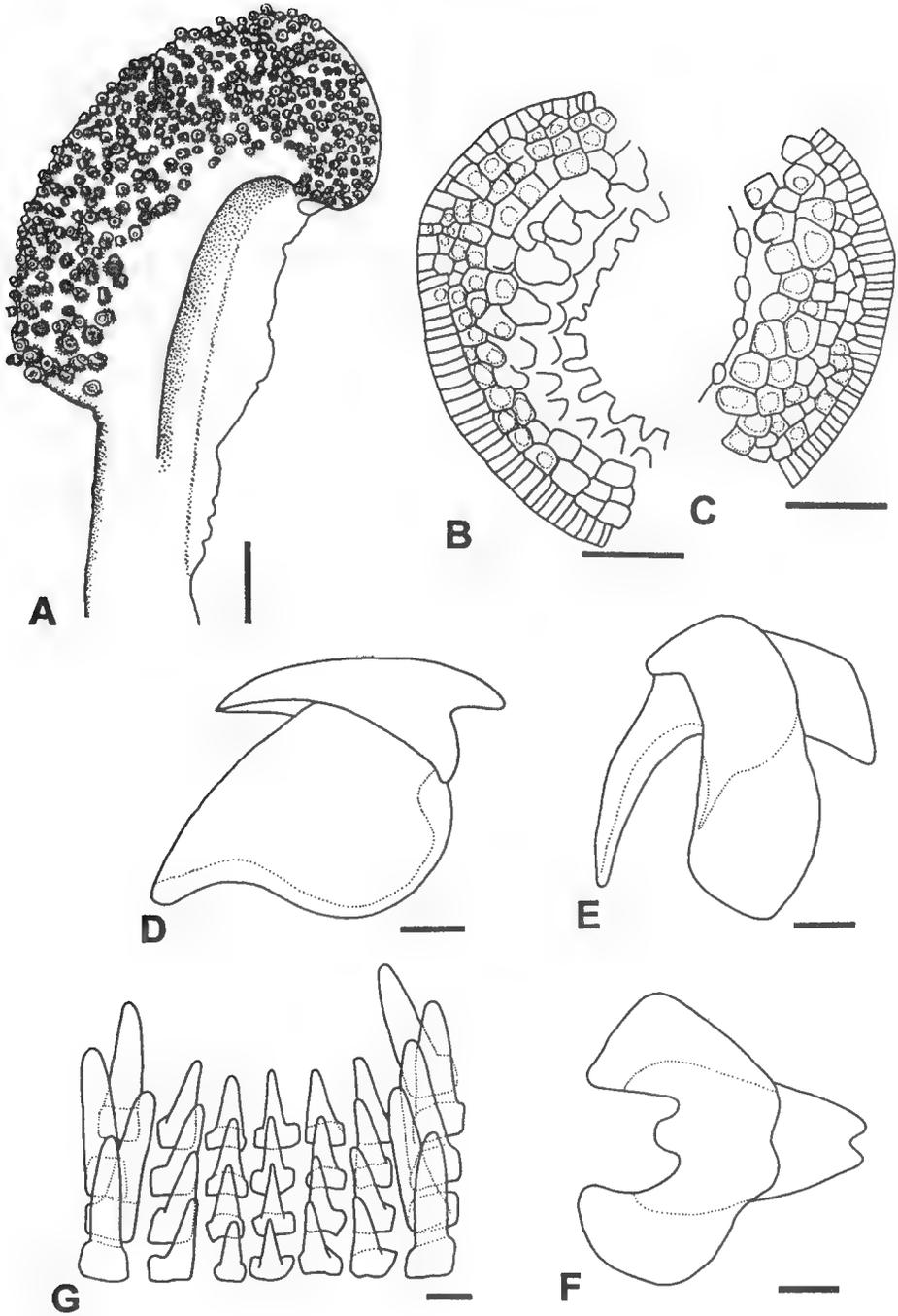


FIGURE 4. *Sepia hedleyi* Berry, 1918. **A**, club, male, 75.7 mm ML (SAM D19241); **B**, club sucker rim, portion of toothed half, male, 75.7 mm ML (SAM D19241); **C**, club sucker rim portion of non-toothed half, specimen as in **B**; **D**, upper beak, lateral view, female, 68.6 mm ML (SAM D19242) (stippling indicates extent of dark brown highly sclerotised portion of beak); **E**, lower beak anteriolateral view, specimen as in **D**; **F**, lower beak, ventral view, specimen as in **D**; **G**, radula, male, 75.7 mm ML (SAM D19241). Scale bars; **A** = 1.0 mm; **B**, **C** = 0.05 mm; **D**–**F** = 2.0 mm; **G** = 0.2 mm.

in two ventral series aligned in a single row (Fig. 3E). Hectocotylied arm not markedly attenuate distally.

Tentacular club longer in females than males; CILI males 9.9–13.9–17.2 (SD, 2.8); females 16.2–20.0–24.2 (SD, 3.4). Club crescent-shaped; moderate length; sucker-bearing face flattened. Club with 9–12 suckers in transverse rows; 32–42 suckers in longitudinal series. Suckers all similar size; small (Fig. 4A). Distal tip of club with pair of slightly larger suckers partially covered by a thick, fleshy flap. CISI males 0.40–0.45–0.53 (SD, 0.07); females 0.40–0.46–0.52 (SD, 0.05); dorsal and ventral marginal longitudinal series of suckers similar in size; CISI_d males 0.40–0.42–0.42 (SD, 0.01); females 0.40–0.46–0.52 (SD, 0.05); CISI_v males 0.29–0.37–0.42 (SD, 0.07); females 0.32–0.41–0.52 (SD, 0.10). Sucker dentition: half inner ring circumference in both sexes with elongate-rectangular teeth (Fig. 4B), remaining half with

blunt projections (Fig. 4C); infundibulum with 5–7 rows of hexagonal processes, innermost with elongate rounded pegs, pegs smaller towards periphery of sucker; at periphery, processes smaller, elongate-rectangular, without pegs (similar to arm suckers). Swimming keel of club extends well beyond carpus (Fig. 4A). Dorsal and ventral protective membranes not fused at base of club; joined to stalk; dorsal and ventral membranes same length; extend beyond carpus along stalk; approximately equal width; dorsal membrane forms shallow cleft at junction with stalk.

Gills with 29–30 lamellae per demibranch; GiLC males 29–29–29 (SD, 0); females 29–29–30 (SD, 0.7). Gill length: GiLI males 24.9–30.0–35.0 (SD, 5.0); females 29.5–33.9–38.2 (SD, 3.6).

Buccal membrane without suckers. Upper beak (Fig. 4D) rostrum pointed, short, length approximately equal to width, cutting edge

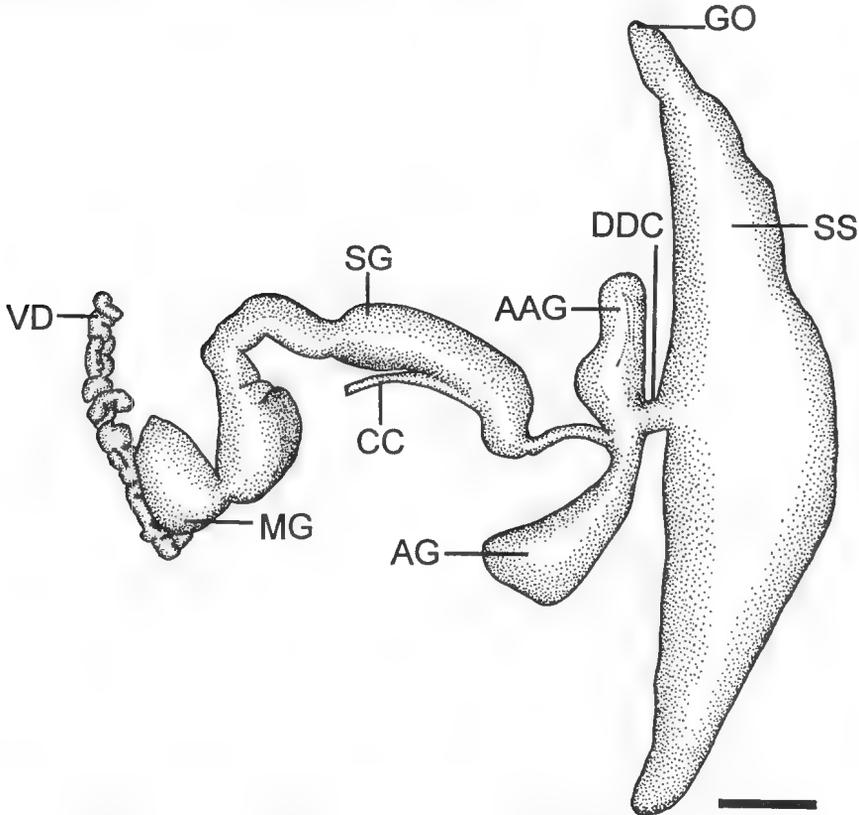


FIGURE 5. *Sepia hedleyi* Berry, 1918. Male reproductive tract (testis not shown), 55.0 mm ML (SAM D19243) (AAG, appendix of accessory gland; AG, accessory gland; CC, ciliated canal; DDC, distal deferent canal; GO, genital orifice; MG, mucilaginous gland; SG, spermatophoric gland; SS, spermatophoric sac (containing spermatophores); VD, vas deferens). Scale bar = 3 mm.

slightly curved; hood high above crest posteriorly; crest curved, lateral wall shallowly indented posteriorly; wings and hood narrow and short; jaw angle approximately 90 degrees; hood and crest dark brown. Lower beak (Fig. 4E, F) rostrum protrudes only slightly, cutting edge straight; hood low on crest; crest straight, no indentation on lateral wall edge; lateral wall edge angled posteriorly, not perpendicular to crest; hood and wings, width broad; hood notch shallow, broad; wings widely spaced; crest narrow; rostrum pigmented dark brown, wings dark brown on inner margin only, rest of wing light brown, crest dark brown. Radula (Fig. 4G) homodont; rhachidian teeth with truncate bases, slender, triangular, sides straight; first lateral teeth similar length and width to rhachidian teeth, asymmetrical with mesocone slightly displaced toward centre of radula; second laterals slightly longer than first, not distinctly curved on lateral margin, with broad heels; marginal teeth much longer than second lateral teeth, elongate with long tapered and curved mesocone. Digestive tract: (not illustrated) paired salivary glands approximately one-third length of buccal mass; paired digestive glands large, located close together, with narrow, elongate triangular lobes posteriorly, ducts connect digestive glands near midline with caecum, ducts with branched attached pancreatic tissue; oesophagus runs dorsally along median junction of digestive glands, joins sac-like stomach immediately posterior to digestive glands; caecum disc-like, grooved in a blunt V-shape anteriorly, surface lining finely pleated; intestine undifferentiated; ink sac very large, elongate; anal flaps well developed.

Male reproductive tract (Fig. 5): testis on left posterior side of visceropericardial coelom; at distal end, convoluted vas deferens opens into broad, cone-shaped mucilaginous gland, then narrower, curved, spermatophoric gland. Close to junction with lobe-shaped accessory gland and gland appendix, delicate ciliated canal joins spermatophoric gland; distal deferent canal connects appendix of accessory gland to spermatophore storage sac; genital orifice opens dorsal to left gill in anterior end of mantle cavity. Spermatophores (Fig. 6): cement body unipartite (not divided into distinct regions); flask-shaped, rounded posteriorly, connects to sperm reservoir via narrow duct; tapers abruptly following junction with middle tunic, which commences towards basal half of cement body; ejaculatory apparatus coiled, extends into oral dilation of

spermatophore. Spermatophores 5.8–7.9 mm long; 0.2–0.4 mm wide; SpLI 10.4–11.5–12.3 (SD, 0.9); SpWI 3.4–4.4–5.1 (SD, 0.8). Buccal membrane in females extends ventrally with spermatheca.

Female reproductive tract: (not illustrated) ovary hangs from dorsal wall of posterior visceropericardial coelom. Oviduct thin-walled, continuous with body cavity; distally with thickened, glandular walls (oviducal glands). Nidamental glands in mature animals occupy large portion of ventral side of mantle cavity. Accessory nidamental glands anterior to nidamental glands. Eggs spherical; 2.5–3.1 mm diameter; EgDI 2.5–2.8–3.2 (SD, 0.4).

Cuttlebone length approximately equal to mantle length. Subdermal cartilaginous layer

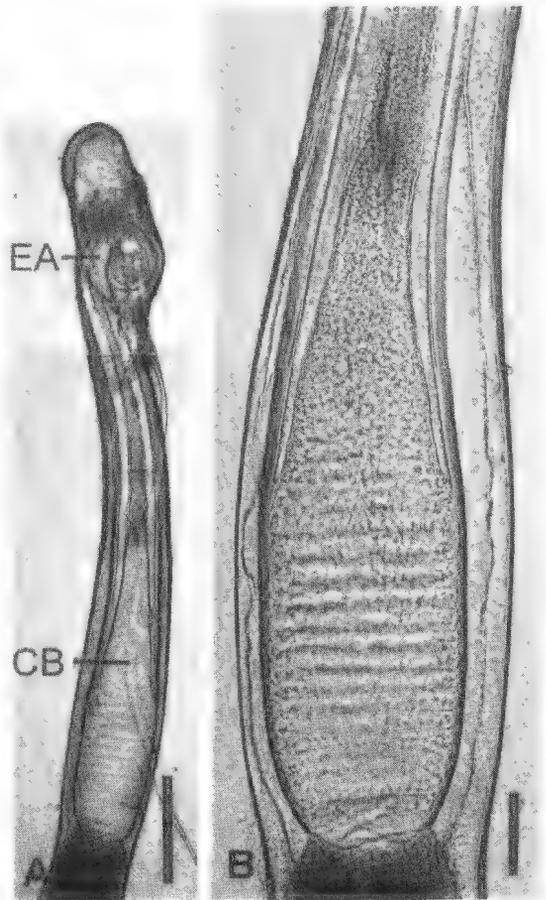


FIGURE 6. *Sepia hedleyi* Berry, 1918. **A**, spermatophore, oral end, male, 85.6 mm (MV F56762) (CB, cement body; EA, ejaculatory apparatus); **B**, enlargement of cement body, male, 90.0 mm ML (MV F57291). Scale bars; A = 0.15 mm; B = 0.10 mm.

between cuttlebone and skin absent. Cuttlebone outline oblong (Fig. 7); CbL males 46.2–50.6–55.0 (SD, 6.2); females 69.3–94.2–107 (SD, 16.9); CbWI males 34.7–36.4–38.1 (SD, 2.4); females 33.4–35.2–37.8 (SD, 2.0); not strongly convex in lateral view; CbBI males 9.6–10.0–10.4 (SD, 0.5); females 9.9–10.9–11.9 (SD, 1.1). Bone acuminate, acute anteriorly (Fig. 2C, D); acuminate, acute posteriorly (Fig. 2C, D and Fig. 7A, B); not strongly recurved ventrally. Dorsal surface creamy white; evenly convex; entire surface calcified with very fine granulose sculpture; spine and extreme posterior tip of bone covered with smooth glaze-like substance. Dorsal median rib present (Fig. 2C and Fig. 7A); distinct; sides approximately parallel, broaden slightly anteriorly; bordered laterally by distinct grooves; lateral ribs present, indistinct. Chitin surrounds entire margin of cuttlebone. Spine present; short, pointed; SLI females 4.7–4.9–5.1 (SD, 0.3); straight, parallel to bone; keel(s) absent; cuttlebone smooth between spine and outer cone;

ventral notch at base of spine absent. Dorso-posterior end of cuttlebone without median longitudinal ridge anterior to spine. Striated zone flat; extends laterally to inner cone; not separated from outer cone by smooth marginal zones; StZI males 61.3–63.2–65.1 (SD, 2.7); females 64.1–65.5–66.8 (SD, 1.3). Last locus convex; LoLI males 32.2–34.1–35.9 (SD, 2.7); females 28.7–30.8–33.6 (SD, 2.6); at midline half length of striated zone. LoL/StZ(%) males 49.4–54.0–58.7 (SD, 6.5); females 43.7–45.3–46.9 (SD, 2.2). Loculus ends at striated zone, does not extend posteriorly on each side of striated zone. Sulcus extends entire length of cuttlebone; shallow, narrow; not flanked by rounded ribs. Last locus with shallow median indentation, not very pronounced. Anterior striae inverted U-shaped. Limbs of inner cone extend anteriorly to end of striated zone; inner cone lateral limbs not separated from outer cone by two distinct smooth zones. Inner cone limbs uniform width, narrow, V-shaped posteriorly; not raised to form ledge



FIGURE 7. *Sepia hedleyi* Berry, 1918. **A**, cuttlebone, dorsal view, female, 93.1 mm ML (MV F57307); **B**, cuttlebone, ventral view, specimen as in **A**. Scale bars = 10 mm.

posteriorly; thickened; shiny; without calcareous ribs radiating into outer cone. Outer cone present; calcified; moderate width; narrow anteriorly, broadens posteriorly; posteriolateral wall without, or with weak, indentation in both sexes; lateral limbs not flared ventro-laterally; limbs forming thin rim ventral to spine.

Body papillae present; dorsal mantle with longitudinal row of ridge-like papillae along each side, close to base of each fin; up to six fin papillae (approximately) in each row. Ventral mantle without ridges; head and arm papillae absent.

Ground colour (alcohol preserved specimens) pale buff pinkish-brown; arms without markings. Paired dorsal eye spots absent; fins pale. Fins without markings at base. Ventral pigment present, pale. Ridges orange-pink in colour.

Distribution

Australia: Queensland, from off the southern Great Barrier Reef, 22°35.3'S 153°46.7'E around southern Australia to Western Australia, SW of Shark Bay, 27°07'S 112°49'E. Depth range 47–1092 m (average collection depth 218 m).

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APPENDIX 1. Complete list of non-type material examined (not all specimens were sexed and are cited only as number in each specimen lot).

- Australia: Queensland:** 1, off GBR, 22°35.3'S 153°46.7'E, 350–345 m, 4 Nov 1985, coll. FV 'Soela' (MV F57306); 1F, off Brisbane, 26°40'S 153°41.9'E, 380 m, 2 Aug 1982, coll. M. Potter on 'Iron Summer' (MV F57294); 2, 27°11.48'S 153°43.9'E, 230–210 m, 14 Dec 1982, coll. G. Smith on 'Iron Summer' (MV F57299); 1, W Moreton I., 27°35'S 153°50'E, 210 m, 15 Dec 1982, coll. G. Smith on 'Iron Summer' (MV F57309); many 27°46'S 153°51'E, 205 m, 23 Mar 1983, coll. C. C. Lu on 'Iron Summer' (MV F57308); 1M, 1F, 27°58'S 153°49'E, 220 m, 23 Mar 1983, coll. 'Iron Summer' (MV F57300); many, off N Stradbroke I., 27°58'S 153°51.5'E, 183 m, 28 Jul 1982, coll. 'Iron Summer' (MV F89852); 1M, 9F, 32°23'S 152°49'E, 278 m, 30 Jan 1982, coll. C. C. Lu & R. Tait on FV 'Soela' (MV F77180); 10M, 6F, off NSW, 32°23'S 152°59'E, 278 m, 30 Jan 1982, coll. C. C. Lu & R. Tait on FV 'Soela' (MV F77191); 3M, 6F, 32°23'S 152°59'E, 278 m, 30 Jan 1982, C. C. Lu & R. Tait on FV 'Soela' (MV F77182); 7M, 5F, 32°24'S 152°56'E, 246–244 m, 30 Jan 82, coll. C. C. Lu & R. Tait on FV 'Soela' (MV F77084). **New South Wales:** 4, off Port Stephens, 32°24'S 152°56'E, 240 m, 30 Jan 1982, coll. FV 'Soela' (AM C152609); 2M, 10F, 32°27'S 152°54'E, 244–242 m, 30 Jan 1982, coll. FV 'Soela' (MV F77178); 1M, 2F, 32°27'S 152°54'E, 244–242 m, 30 Jan 1982, coll. C. C. Lu & R. Tait (MV F77179); 14, off Port Stephens, 32°50–52'S 152°42–41'E, 550 m, 6 Dec 1978, coll. K. J. Graham, W. B. Rudman & P. H. Colman on FRV 'Kapala' (AM C152641); 2, 8 mls E of Port Stephens, 101 m, 18 Aug 1975, coll. K. J. Graham & C. Short on FRV 'Kapala' (AM C100805); many, off Newcastle, 33°01'S 152°01'E–33°03'S 151°58'E, 121 m, 28 Oct 1993, coll. FRV 'Kapala' (MV F89853); 17, 33° 06'S 124°33'E, 28 Nov 1981, coll. FV 'Soela' (MV F89854); 4, off Sydney 33°33–36'S 151°59–57'E, 373–366 m, 21 Dec 1976, coll. K. J. Graham & P. H. Colman on FRV 'Kapala' (AM C105862); 1F, 33°40'S 151°50'E, 210–204 m, 25 Jan 1982, coll. C. C. Lu & R. Tait (MV F77138); many, 33°42'S 151°51'E, 300–293 m, 25 Jan 1982, C. C. Lu & R. Tait (MV F77136); many, off Sydney, 33°45–34'S 151°39–40'E, 143 m, 5 Dec 1978, coll. FRV 'Kapala' (AM C152596); many, E of Cronulla, 34°05–11'S 151°19–14'E, 132 m, 22 Apr 1975, coll. FRV 'Kapala' (AM C152594); many, E of Wollongong, 34°19–20'S 151°19–18'E, 161 m, 12 Dec 1978, coll. K. J. Graham, W. B. Rudman & P. H. Colman on FRV 'Kapala' (AM C152646); many, Wreck Bay, 35°13'S 150°41'E–35°12'S 150°44'E, 60–47 m, 20 Oct 1993, coll. FRV 'Kapala' (MV F89855); many, off NSW, 36°20'S 150°20'E, 130 m, coll. FV 'Soela' (MV F77164); 1, 34°22'S 151°23'E, 26 Mar 1981, coll. FV 'Soela' (MV F89856); 1F, 36°26'S 150°12'E, 104 m, 21 Apr 1981, coll. FV 'Soela' (MV F77207); 2, off Tathra 36°35'S 150°11'E–36°39'S 150°10'E, 117–115 m, 8 Dec 1993, coll. K. Graham on FRV 'Kapala' (MV F89857); 2M, 1F, 25 km SSE Merimbula, 36°56.5'S 150°11.8'E–36°54.1'S 150°11.9'E, 115 m, 5 Aug 1993, coll. RV 'Southern Surveyor' (MV F89858); 1F, NE Twofold Bay, 37°05'S 149°54'E, 29 Dec 1960, coll. R. Slack-Smith (MV F89859); several, off Eden, 131.7 m, FRV 'Kapala' (AM C174072); 5M, 8F, E of Disaster Bay, 37°24'S 150°17.5'E, 172–162 m, 2 Aug 1993, coll. FRV 'Southern Surveyor' (MV F89860). **Victoria:** 4, 38°01.7'S 150°04.9'E, 3 Feb 1985, coll. FV 'Soela' (MV F89861); 5, 38°02'S 150°05'E, 4 May 1984, coll. FV 'Soela' (MV F51887); 1M, 3F, 38°06'S 149°55'E, 270–267 m, 18 Jan 1982, coll. C. C. Lu & R. Tait (MV F77112); 4, 38°09.1'S 149°54.0'E, 3 Feb 1985, coll. FV 'Soela' (MV F89862); 4, 38°13'S 149°43'E, 4 May 1984, coll. FV 'Soela' (MV F51888); 3, 38°15.4'S 149°19.5'E, coll. FV 'Soela' (MV F89863); 2, 38°34.25'S 148°32.25'E, 24 Aug 1982, coll. MSL (MV F89864); 1F, E Bass Strait 38°34.3'S 148°16.1'E, 86 m, 6 Jun 1984, coll. P. Moulton, MSL (MV F89865); 1F, 18 mls S of Cape Nelson, 38°44'S 143°33'E, 152.9 m, 26 Aug 1975, coll. FV 'Sarda' (MV F56764); 1F, off Portland, 38°50–51'S 141°46–55'E, 54.8 m, 5 Mar 1980, coll. M. Gomon on 'Halcyon' (MV F30332); 3, 38°50'S 141°46'E, 6 Mar 1980, coll. 'Halcyon' (MV F30843); 1M, 1F, eastern Bass Strait, 38°53.05'S 148°24.2'E, 126–101 m, 8 Feb 1981, coll. RV 'Hai Kung' (MV F57310); 1F, 38°55.6'S 148°27.7'E, 210–150 m, 27 Aug 1994, coll. FRV 'Southern Surveyor' (MV F89866); many, 39°16'S 145°05.08'E–38°77'S 145°07.64'E, 65.9 m, 3 Feb 1981, coll. M. F. Gomon et al. on RV 'Hai Kung' (MV F89867); 1 juv., E Bass Strait, 39°28.4'S 148°41.8'E, 110 m, 28 Mar 1979, coll. HMAS 'Kimbla' (MV F57292); many, central Bass Strait, 39°44.55'S 143°33.82', 78.7 m, coll. C. C. Lu on 'Hai Kung' (MV F57296). **Tasmania:** 1M, S of Flinders I., 40°43.79'S 148°32.7'E, 58.6–54.9 m, 7 Feb 1981, coll. FV 'Hai Kung' (MV F57311); 1F, SE Tasmania, 42°42.8'S 148°24.4'E, 446 m, 26 Jun 1984, coll. FV 'Soela' (MV F52265); 4, 42°38'S 148°24'E, 23 Jun 1984, coll. FV 'Soela' (MV F52100); 3, 42°42.8'S 148°24'E, 26 Jun 1984, FV 'Soela' (MV F51908); 6, 42°43.7'S 148°22.3'E, 15 Jun 1984, coll. FV 'Soela' (MV F52099); 1F, off Tasmania, 43°38.9'S 147°49.4'E, 160 m, 16 Feb 1976, coll. K. Nesis on RV 'Dmitry Mendeleev' (MV F57307). **South Australia:** 4F, 27 nm SW of Beachport, 37°50'S 139°46'E, 1092 m, 24 Oct 1981, coll. M. F. Gomon & R. Wilson on 'Halcyon' (MV F52793); 1F, off Beachport, 37°51'S 139°48'E, 437–400 m, 24 Oct 1981, coll. M. F. Gomon & R. Wilson on 'Halcyon' (MV F51369); 2F, off Beachport, 180 fm [329 m], Apr 1981 (SAM D19239). **Western**

Australia: 1M, 1F, SW of Shark Bay, 27°07'S 112°49'E, 248–238 m, 3 Mar 1981, coll. M. F. Gomon on 'Hai-Kung' (MV F56762); 1F, Great Australian Bight, 12.0 km S of Middini Beach, 33°17.4'S 127°44.5'E–33°17.1'S 127°31.25'E, 180–167 m, 14 Feb 1990, coll. R. Poole on FV 'Comet' (MV F89868); 1F, Great Australian Bight, 33°20'S 128°10'E–33°22'S 128°08'E, 200 m, 29 Sep 1980 (MV F56763).

APPENDIX 2. Description of measurements and counts. Definitions largely follow Roper and Voss (1983). New or modified definitions are indicated by an asterisk (*). Indices (shown in square brackets) are calculated by expressing each measure as a percentage of mantle length or, for cuttlebone characters, cuttlebone length (unless otherwise specified).

- Arm Length - **AL**: length of each designated (ie 1,2 etc) arm measured from first basal (proximal-most) sucker to distal tip of arm (Arm 1, dorsal; 2, dorso-lateral; 3, ventro-lateral; 4, ventral) [**ALI**].
- Anterior Mantle to Head length *: **AMH**: dorsal length of mantle measured from anterior-most point of mantle to intersection of transverse line joining dorso-lateral mantle margin [**AMHI**].
- Arm Sucker Count *: **ASC**: total number of suckers on each designated arm (eg. **ASC2**).
- Arm Sucker diameter: **AS**: diameter of largest normal sucker on each designated (ie 1,2 etc) arm [**ASIn**]; **ASl4m*** diameter of smallest sucker on modified portion of left ventral arm of males [**ASInl4m**].
- Cuttlebone Breadth*: **CbB**: greatest dorso-ventral width of cuttlebone.
- Cuttlebone Length: **CbL**: dorsal length of cuttlebone along midline, including spine.
- Cuttlebone Width: **CbW**: greatest lateral width of cuttlebone [**CbWI**].
- Club Length: **CIL**: length of tentacular club measured from proximal-most basal suckers (carpus) to distal tip of club [**CILI**].
- Club Row Count: **CIRC**: number of suckers in transverse rows on tentacular club.
- Club Sucker diameter: **CIS**: diameter of largest sucker on tentacular club [**CISI**].
- Club Sucker dorsal *: **CISd**: diameter of largest tentacular club sucker in dorsal-most (closest to swimming keel) longitudinal row [**CISId**].
- Club Sucker ventral *: **CISv**: diameter of largest tentacular club sucker in ventral-most (opposite swimming keel) longitudinal row [**CISIV**].
- Eye Diameter: **ED**: diameter of eye [**EDI**].
- Egg Length *: **EgL**: length of egg [**EgLI**].
- Egg Width *: **EgW**: width of egg [**EgWI**].
- Free Funnel length: **FFu**: the length of the funnel from the anterior funnel opening to the point of its dorsal attachment to the head [**FFuI**].
- Fin Insertion anterior *: **FIA**: anterior origin of fin measured from mantle margin to anterior-most junction of fin and mantle [**FIIa**].
- Fin Insertion posterior*: **FIP**: measured between posterior junctions of fins with mantle [**FIIp**].
- Funnel Length: **FuL**: the length of the funnel from the anterior funnel opening to the posterior margin measured along the ventral midline [**FuLI**].
- Fin Width: **FW**: greatest width of single fin [**FWI**].
- Gill Lamellae Count: **GiLC**: number of lamellae on outer demibranch including the terminal lamella.
- Gill Length *: **GiL**: length of gill [**GiLI**].
- Head Length: **HL**: dorsal length of head measured from point of fusion of dorsal arms to anterior tip of nuchal cartilage [**HLI**].
- Head Width: **HW**: greatest width of head at level of eyes [**HWI**].
- Loculus Length *: **LoL**: length of the last loculus (ventral anterior smooth zone of the cuttlebone) [**LoLI**].
- Mantle Length: **ML**: dorsal mantle length. Measured from anterior-most point of mantle to posterior apex of mantle.
- Mantle Width: **MW**: greatest straight-line ventral width of mantle [**MWI**].
- Spine Length *: **SL**: length of spine [**SLI**].
- Spermatophore Length: **SpL**: length of spermatophore [**SpLI**].
- Spermatophore Width: **SpW**: greatest width of spermatophore. Spermatophore width index is expressed as a percentage of spermatophore length [**SpWI**].
- Striated Zone length: **StZ**: length of striated zone of cuttlebone [**StZI**].
- Transverse Row Count: **TrRC**: number of suckers in longitudinal series on tentacular club (counted from proximal-most basal suckers (carpus) to distal tip of club).
- Ventral Mantle Length: **VML**: length of ventral mantle measured from anterior mantle margin at ventral midline, to posterior apex of mantle [**VMLI**].

APPENDIX 3. Measurements (mm), counts and indices of *Sepia hedleyi* Berry, 1918 from southern Australia.

Museum Reg. no.	SAM D19241	SAM D19243	SAM D19241	SAM D19242	SAM D19242	SAM D19240	SAM D19240	SAM D19240
SEX	M	M	M	F	F	F	F	F
ML	47.2	55.0	75.7	67.9	68.6	93.1	95.5	107.6
MWI	55.1	55.6	51.8	55.5	45.5	54.7	59.8	55.0
AMHI	11.9	15.5	15.3	14.7	13.0	12.8	14.8	17.8
VMLI	85.0	80.7	82.8	85.6	84.8	81.2	81.8	75.3
FWI	11.7	10.2	9.4	7.2	8.2	7.8	9.1	4.4
FIIa	5.1	4.5	5.3	2.8	3.2	4.9	5.7	2.0
FIIp	6.4	8.0	7.4	5.6	12.4	10.3	4.7	6.7
FuLI	40.3	34.5	27.7	34.6	34.3	25.6	30.4	28.8
FFuI	20.1	14.5	17.2	14.7	16.8	19.3	12.6	13.0
HLI	25.6	27.5	29.7	23.9	13.4	40.8	30.3	35.8
HWI	38.1	44.4	35.7	44.0	45.0	40.5	46.6	43.5
EDI	13.3	16.5	12.7	10.0	12.1	12.7	8.9	10.2
ALI1	33.9	34.5	35.7	33.1	34.3	37.6	49.2	42.3
ALI2	33.9	30.9	29.1	31.7	35.7	39.2	42.4	42.8
ALI3	38.1	33.6	29.1	37.6	34.3	41.4	44.0	43.7
ALI4	43.4	40.9	34.3	39.0	42.3	41.9	51.3	44.6
ASIn1	1.69	1.36	1.32	1.47	1.53	1.72	1.68	1.77
ASIn2	1.48	1.36	1.59	1.47	1.53	2.15	1.68	1.77
ASIn3	1.48	1.36	1.59	1.47	1.75	2.15	1.78	1.77
ASIn4	1.69	1.36	1.32	1.33	1.56	2.15	1.78	1.77
ASC1	118	112	116	148	144	106	106	144
ASC2	140	152	148	148	156	130	175	176
ASC3	148	132	144	200	172	157	164	172
ASC4	180	208	164	240	248	193	212	224
ASIn14m	0.42	0.40	0.26	–	–	–	–	–
CILI	17.2	–	13.2	18.6	16.2	–	21.2	24.2
CIRC	10	10	10	10	10	–	9	10
TrRC	42	–	32	36	32	–	40	34
CISI	0.42	0.40	0.53	0.40	0.47	–	0.52	0.46
CISId	0.42	0.40	0.42	0.40	0.47	–	0.52	0.46
CISiv	0.42	0.40	0.29	0.32	0.32	–	0.52	0.46
GiLC	29	29	–	29	30	–	–	–
GiLI	35.0	24.9	30.1	29.5	38.2	–	33.6	34.5
SpLI	12.3	11.6	10.4	–	–	–	–	–
SpWI	3.45	4.69	5.06	–	–	–	–	–
EgDI	–	–	–	–	–	2.7	3.2	2.5
CbL	46.2	55.0	–	–	69.3	100.5	99.8	107.0
CbWI	38.1	34.7	–	–	37.8	35.5	33.4	33.9
CbBI	10.4	9.6	–	–	11.8	9.9	10.2	11.9
SLI	–	–	–	–	–	4.7	5.1	–
StZI	61.3	65.1	–	–	66.8	65.6	64.1	–
LoLI	35.9	32.2	–	–	–	28.7	30.1	33.6
LoL/StZ (%)	58.7	49.4	–	–	–	43.7	46.9	–

APPENDIX 4. Measurements (mm), counts and indices of 10 male *Sepia hedleyi* Berry, 1918 from eastern Australia.

Museum Reg. no.	MV F77136	MV F77179	AM C152623	AM C152623	AM C152623	MV F77136	MV F77136	MV F77136	MV F77136	AM C152623
ML	75.9	84.3	84.8	85.7	86.1	87.0	90.9	91.7	100.5	103.5
MWI	53.0	49.2	50.7	48.4	49.2	54.6	51.7	54.1	48.1	46.6
AMHI	16.2	15.1	12.5	13.0	15.0	14.4	13.3	12.5	11.9	14.9
VMLI	88.8	88.3	89.2	91.4	87.8	90.9	90.4	88.3	81.9	88.3
FWI	9.6	11.4	9.4	10.5	8.2	10.5	12.7	9.8	5.6	10.9
FIIa	4.2	3.3	3.8	4.8	4.8	6.6	3.7	3.8	7.0	4.4
FIIp	5.8	3.0	5.8	5.6	7.7	7.5	5.5	8.2	4.5	8.6
FuLI	32.9	31.2	30.4	31.0	31.1	36.6	30.3	31.7	32.7	30.7
FFuI	14.5	15.4	15.2	17.7	15.2	18.4	15.4	20.7	16.8	13.0
HLI	30.4	23.3	31.7	27.3	31.6	30.9	23.7	30.9	30.3	26.5
HWI	38.3	38.7	35.1	36.6	36.5	40.9	40.9	38.8	–	34.3
EDI	15.5	11.0	13.2	14.0	11.0	12.0	13.1	15.7	12.5	12.3
ALI1	38.2	33.2	33.6	32.8	26.7	37.4	33.0	33.8	27.9	26.1
ALI2	34.3	32.0	30.7	31.5	25.6	37.4	34.1	31.6	27.9	32.9
ALI3	36.9	32.0	34.2	32.7	29.0	36.8	31.9	28.4	31.4	33.3
ALI4	40.8	37.4	36.6	30.2	30.8	40.2	34.1	37.6	40.6	32.8
ASIn1	1.54	1.59	1.42	1.27	1.21	1.64	1.43	1.42	1.42	1.22
ASIn2	1.45	1.48	1.13	1.33	1.02	1.49	1.43	1.56	1.42	1.28
ASIn3	1.37	1.48	1.49	1.46	1.30	1.64	1.43	1.56	1.42	1.39
ASIn4	1.45	1.48	1.27	1.25	1.11	1.64	1.43	1.42	1.42	1.16
ASC1	96	93	72	89	76	93	89	86	92	119
ASC2	136	128	105	106	93	126	124	120	135	121
ASC3	139	142	121	112	101	124	124	142	144	123
ASC4	204	202	171	151	102	185	178	196	–	140
ASIn4m	0.47	0.37	0.25	0.28	0.29	0.36	0.40	0.36	0.39	0.20
CILI	13.7	15.5	15.3	17.4	14.2	16.1	15.8	15.5	15.8	19.8
CIRC	12	11	11	12	11	12	12	12	12	12
TrRC	36	32	31	31	36	34	35	33	35	39
CISI	0.51	0.52	0.65	0.53	0.64	0.60	0.43	0.43	0.52	0.68
CISId	0.51	0.66	0.65	0.46	0.64	0.45	0.35	0.35	0.52	0.53
CISiv	0.38	0.52	0.35	0.42	0.35	0.45	0.43	0.39	0.39	0.48
GiLC	30	31	34	32	27	33	32	32	32	32
GiLI	30.3	26.0	27.9	30.9	33.7	33.6	26.7	29.8	–	22.2
SpLI	10.9	8.7	–	–	–	9.7	9.1	9.2	8.5	–
SpWI	3.15	3.01	–	–	–	4.62	3.15	4.62	4.55	–
CbL	75.8	85.1	84.8	–	–	86.5	92.7	90.0	100.2	101.6
CbWI	36.1	35.6	32.0	–	–	34.9	32.9	34.7	31.2	31.3
CbBI	10.0	10.5	10.0	–	–	9.5	9.2	9.9	10.0	9.0
SLI	–	4.3	4.1	–	–	–	2.8	3.0	3.9	2.6
StZI	63.6	60.2	59.0	–	–	46.6	66.1	61.7	65.0	64.5
LoLI	37.6	33.0	32.5	–	–	34.0	28.5	31.1	31.8	29.4
LoL/StZ (%)	59.1	54.9	55.2	–	–	73.0	43.1	50.5	49.0	45.6

APPENDIX 5. Measurements (mm), counts and indices of 10 female *Sepia hedleyi* Berry, 1918 from eastern Australia.

Museum Reg. no.	MV F77179	MV F77136	MV F77138							
ML	83.1	89.0	91.7	94.7	99.1	99.4	99.8	102.1	103.8	108.8
MWI	51.9	52.2	52.1	51.3	53.7	46.7	51.9	58.1	47.1	51.5
AMHI	16.1	12.9	12.3	14.8	15.9	13.6	13.9	14.8	13.2	14.8
VMLI	85.0	91.0	91.1	89.2	86.0	90.0	89.7	87.9	86.6	88.8
FWI	12.0	10.1	11.7	11.9	11.6	12.4	10.5	11.0	9.6	7.4
FIIa	4.5	7.0	4.1	4.9	3.6	4.0	4.2	3.1	4.6	6.3
FIIp	13.7	8.4	4.3	6.7	6.6	7.1	5.1	2.8	4.5	7.2
FuLI	30.7	38.3	34.4	32.5	32.2	33.7	33.6	32.6	27.3	35.2
FFuI	16.8	15.7	17.4	18.5	18.2	18.1	16.5	16.7	15.4	13.3
HLI	27.0	21.3	37.1	26.1	27.7	36.2	39.1	27.5	26.8	26.4
HWI	39.4	36.4	39.8	38.5	39.9	41.6	40.7	39.5	38.8	36.5
EDI	12.4	12.4	14.1	11.7	14.3	13.6	12.4	16.4	13.0	12.8
ALI1	33.7	32.6	38.2	35.9	41.4	37.2	36.1	41.1	34.3	31.3
ALI2	34.9	30.3	34.9	32.7	40.4	34.2	36.1	38.2	32.8	35.8
ALI3	36.1	34.8	39.3	34.3	40.4	41.2	41.1	42.6	36.6	32.2
ALI4	39.7	42.7	37.1	39.6	46.4	46.3	38.1	44.1	40.5	41.4
ASIn1	1.56	1.46	1.34	1.58	1.84	1.70	1.56	1.40	1.42	1.43
ASIn2	1.56	1.61	1.48	1.52	1.84	1.70	1.56	1.66	1.45	1.49
ASIn3	1.56	1.46	1.48	1.48	1.84	1.63	1.69	1.66	1.36	1.55
ASIn4	1.72	1.53	1.48	1.52	1.71	1.70	1.69	1.66	1.45	1.55
ASC1	106	112	94	110	120	96	106	102	98	92
ASC2	138	133	158	166	156	156	162	170	142	138
ASC3	150	142	148	192	168	162	154	168	162	138
ASC4	178	162	192	227	204	206	214	110	214	171
CILI	15.4	15.7	15.0	15.2	18.3	16.3	18.5	16.7	15.2	18.4
CIRC	12	12	12	11	12	12	12	12	12	12
TrRC	27	35	47	29	38	30	32	36	30	38
CISI	0.67	0.51	0.43	0.57	0.32	0.71	0.45	0.64	0.72	0.53
CISId	0.49	0.44	0.43	0.57	0.32	0.58	0.39	0.64	0.75	0.53
CISlv	0.42	0.40	0.43	0.57	0.32	0.52	0.42	0.44	0.54	0.41
GiLC	28	33	32	30	35	28	31	28	33	30
GiLI	24.5	23.0	25.8	25.3	32.0	30.5	27.5	30.7	27.2	31.6
EgDI	3.9	4.1	5.0	5.3	4.4	4.8	3.4	3.9	4.8	3.3
CbL	82.1	87.0	89.0	99.7	98.0	99.2	96.6	105.2	104.9	108.0
CbWI	34.0	35.3	34.2	32.1	36.8	34.6	37.9	37.0	35.3	34.3
CbBI	10.0	–	10.1	11.2	9.4	10.9	10.1	9.5	10.0	9.6
SLI	3.3	–	–	3.3	3.2	–	3.0	4.6	4.9	–
StZI	65.0	–	79.4	79.4	67.3	65.4	67.7	63.1	63.5	64.6
LoLI	22.4	–	20.6	20.6	21.1	20.3	27.3	30.6	30.9	35.4
LoL/StZ (%)	34.5	–	25.9	25.9	31.4	31.0	40.4	48.5	48.6	54.7

APPENDIX 6. *Sepia hedleyi* Berry, 1918; ranges of arm length indices (ALI), arm sucker diameter indices (ASIn) and arm sucker counts (ASC) of mature males and females from southern Australia; N = number of specimens, min. = minimum, max. = maximum, SD = standard deviation.

	Males					Females				
	N	min.	mean	max.	SD	N	min.	mean	max.	SD
ALI1	7	25.3	<u>34.9</u>	55.7	9.8	8	30.6	<u>37.4</u>	49.2	6.2
ALI2	7	25.9	<u>31.5</u>	45.6	6.8	8	27.6	<u>35.8</u>	42.8	5.6
ALI3	7	29.1	<u>33.5</u>	44.3	5.8	8	30.6	<u>33.7</u>	44.0	5.2
ALI4	7	33.8	<u>40.2</u>	54.4	7.2	8	34.7	<u>42.0</u>	51.3	4.8
ASIn1	3	1.32	<u>1.46</u>	1.69	0.20	5	1.47	<u>1.63</u>	1.77	0.13
ASIn2	3	1.36	<u>1.48</u>	1.59	0.11	5	1.47	<u>1.72</u>	2.15	0.27
ASIn3	3	1.36	<u>1.48</u>	1.59	0.11	5	1.47	<u>1.78</u>	2.15	0.24
ASIn4	3	1.32	<u>1.46</u>	1.69	0.20	5	1.33	<u>1.72</u>	2.15	0.30
ASC1	3	112	<u>115</u>	118	3	5	106	<u>130</u>	148	22
ASC2	3	140	<u>147</u>	152	6	5	130	<u>157</u>	176	19
ASC3	3	132	<u>141</u>	148	8	5	157	<u>173</u>	200	16
ASC4	3	164	<u>184</u>	208	22	5	193	<u>223</u>	248	22

**A NEW GENUS AND SIX NEW SPECIES OF DYTISCIDAE
(COLEOPTERA) FROM UNDERGROUND WATERS IN THE YILGARN
PALAEODRAINAGE SYSTEM OF WESTERN AUSTRALIA**

C. H. S. WATTS & W. F. HUMPHREYS

Summary

A new genus and six new species of stygobitic beetles of the family Dytiscidae, subfamily Hydroporinae, from relatively shallow calcrete aquifers in Western Australia, are described and figured. The new genus (*Nirripiriti*) and species (*N. hinzea*) are in the tribe Hydroporini, whilst the remaining species belong in the tribe Bidessini, namely, *Nirridessus challaensis*, *N. masonensis*, *N. fridaywellensis*, *N. pinnaclesensis* and *Tjirtudessus raesidensis*. The species are members of a rich, recently discovered, relictual stygofauna, predominantly of Crustacea and Oligochaeta, inhabiting calcretes lying along palaeodrainage channels. The new genus represents a significant taxonomic extension of the Australian stygobitic Dytiscidae, being the first Australian stygobitic member of its tribe. The new species represent a significant geographic extension of Australian stygobitic Dytiscidae into a new palaeodrainage channel unconnected with any previously examined. Each calcrete area examined contained a distinct assemblage of beetles often with two species in sympatry.

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WATTS, C. H. S. & HUMPHREYS, W. F. 2001. A new genus and six new species of Dytiscidae (Coleoptera) from underground waters in the Yilgarn palaeodrainage system of Western Australia. *Records of the South Australian Museum* 34(2): 99–114.

A new genus and six new species of stygobitic beetles of the family Dytiscidae, subfamily Hydroporinae, from relatively shallow calcrete aquifers in Western Australia, are described and figured. The new genus (*Nirripirti*) and species (*N. hinzeae*) are in the tribe Hydroporini, whilst the remaining species belong in the tribe Bidessini, namely, *Nirridessus challaensis*, *N. masonensis*, *N. fridaywellensis*, *N. pinnaclesensis* and *Tjirtudessus raesidensis*. The species are members of a rich, recently discovered, relictual stygofauna, predominantly of Crustacea and Oligochaeta, inhabiting calcretes lying along palaeodrainage channels. The new genus represents a significant taxonomic extension of the Australian stygobitic Dytiscidae, being the first Australian stygobitic member of its tribe. The new species represent a significant geographic extension of Australian stygobitic Dytiscidae into a new palaeodrainage channel unconnected with any previously examined. Each calcrete area examined contained a distinct assemblage of beetles often with two species in sympatry.

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The presence of an extensive stygofauna consisting of Crustacea, Oligochaeta and beetles of the family Dytiscidae living in near-surface aquifers of the Western Desert areas of Western Australia has recently been documented by us (Watts & Humphreys 1999, 2000). In this paper we report on significant geographic and taxonomic extensions to the known fauna of Dytiscidae.

In our two previous papers we described eleven species of Dytiscidae belonging to three genera all in the subfamily Hydroporinae. One genus, *Kintingka*, known from only one female specimen, could not unequivocally be placed in a tribe but the other two genera possessed the defining synapomorphy for the tribe Bidessini—two-segmented parameres. In the most recent collection reported on here most specimens again belonged in the same two Bidessine genera, *Tjirtudessus* and *Nirridessus*. A series of relatively large specimens from one location, however, had single segmented parameres and other morphological characters in both adults and associated larvae which place them in the tribe Hydroporini, the first underground members of this tribe to be recorded from Australia, although they are a

major component of the stygodytiscidae worldwide (Spangler 1986).

The Raeside palaeodrainage system (Fig. 40), from which some of the latest specimens were collected, is unconnected to the drainage systems from which we earlier reported underground Dytiscidae (Watts & Humphreys 2000: Fig. 38); this represents a significant extension of the geographical, as well as the taxonomic range, of the Yilgarn stygofauna. As for the systems reported in our earlier papers, numerous specimens of Crustacea—bathynellids, harpacticoid and cyclopoid copepods, ostracods and oniscid isopods—and some Oligochaeta and Hydracarina were collected. As before, the beetles and larger stygofauna were restricted to aquifers in areas of calcrete, as is the stygofauna found in the northern parts of the Western Shield (Poore & Humphreys 1998; Humphreys 1999 in press). But, unlike our previous observation that the stygofauna was found only in narrow bores, thus seemingly restricted to 'closed' aquifers (Watts & Humphreys 2000), in this recent survey stygofauna were found to be common in formed-wells dug for water as well as in narrow boreholes drilled for geological purposes, water monitoring, water pumping or aquifer assessment.

METHODS

The collection methods and measurements of physicochemical parameters in the water were the same as in our previous papers (Watts & Humphreys 1999, 2000).

Abbreviations used:

BES Prefix for field numbers, WAM Biospeleology.

SAMA South Australian Museum, Adelaide.

WAM Western Australian Museum, Perth.

SYSTEMATICS

KEY TO AUSTRALIAN SPECIES OF STYGOBITIC
DYTISCIDAE

1. — Profemur with small peg-like structure close to base; metatibia approximately the same width throughout
..... *Nirripiriti hinzeae* sp. nov.
- Profemur lacking such a structure; metatibia narrow at base then strongly expanding towards apex 2
2. — Body length approximately 1.0 mm; legs stout, without swimming-hairs on fore- and midlegs
Kintingka kurutjutu Watts and Humphreys
- Body length > 1.2 mm; legs normal, all with swimming-hairs 3
3. — Third and fourth (apical) segments of labial palpi subequal in length; setae on hind edge of mesofemur not greatly stronger than those on mesotrochanter; length > 3.0 mm (*Tjirtudessus*) 14
- Third segment of labial palpi half to two-thirds length of apical; setae on hind edge of mesofemur near base much stronger than those on mesotrochanter or elsewhere on femur; length 1.3–3.2 mm. (*Nirridessus*) 4
4. — Pronotal plicae strong, well marked 5
- Pronotal plicae weak, difficult to trace ..
..... 6
5. — Length of first two segments of metatarsi > rest; eye remnant present; parameres with long apical lobe
..... *N. pulpa* Watts and Humphreys
- Length of first two segments of metatarsi =< rest; without eye remnant; parameres with small apical lobe
..... *N. morgani* Watts and Humphreys
6. — Length => 2.9 mm; eye remnant present; group of six spines close to base of mesofemur on hind edge
... *N. bigbellensis* Watts and Humphreys
- Length < 2.6 mm; with or without eye remnant; spines on mesofemur spread out along hind edge or if restricted to base four or fewer 7
7. — Row of larger punctures adjacent to suture; metatrochanters rounded 8
- Without sutural punctures, metatrochanters bluntly pointed 9
8. — Length 2.2–2.3 mm; with eye remnant ..
N. windarraensis Watts and Humphreys
- Length 1.3–1.5 mm; without eye remnant
..... *N. lapostae* Watts and Humphreys
9. — Apical segment of antenna approximately the same size as penultimate, segments 3 and 4 subequal; pro- and mesotarsi strongly expanded, approximately equal in size ..
..... *Nirridessus challaensis* sp. nov.
- Apical segment of antennae approximately 1.5x length of penultimate, segment 3 > segment 4; protarsus moderately or weakly expanded, much more so than mesotarsi 10
10. — Mesofemur with four to five spines spread out along hind edge in basal half
..... *Nirridessus masonensis* sp. nov.
- Mesofemur with two to four strong spines clustered on hind edge close to base .. 11
11. — Mesofemur with four spines near base; segments 2 and 3 of antennae similar in size, apical segment approximately 1.5x penultimate in length
Nirridessus cueensis Watts and Humphreys
- Mesofemur with two to three strong spines on hind edge near base; segment 2 of antenna large and oval, segment 3 much smaller and thinner, apical segment approaching 2x length of penultimate ...
..... 12
12. — Mesofemur with two strong spines on hind edge near base; apical segment of paramere with two finger-like projections
..... *Nirridessus pinnaclesensis* sp. nov.
- Mesofemur with three strong spines on hind edge near base; apical segment of paramere with one finger-like projection 13

13. — Apical lobe of paramere overlapping rest of apical segment; central lobe pointed; protarsus weak, similar in size to mesotarsi; segment 3 of antenna >> segment 4 in length *Nirridessus fridaywellensis* sp. nov.
- Apical lobe of paramere well separated from rest of apical segment; central lobe blunt at tip; segment 3 of antenna > segment 4 in length; protarsus moderately expanded, mesotarsus less so *Nirridessus hinkleri* Watts and Humphreys
14. — Pro- and mesotarsi strongly expanded; apical four segments of antennae noticeably thinner than others *Tjirtudessus magnificus* Watts and Humphreys
- Pro- and mesotarsi only moderately expanded; apical four segments of antennae not narrower than others 15
15. — Length > 3.8 mm; pronotum a little narrower than elytra 16
- Length < 3.8 mm; pronotum wider than elytra *Tjirtudessus eberhardi* Watts and Humphreys
16. — Metatrochanters rounded at tip; central lobe of aedeagus straight, tip pointed; with small eye remnant *Tjirtudessus raesideensis* sp. nov.
- Metatrochanters pointed at tip; central lobe of aedeagus twisted, tip knobbed; without eye remnant *Tjirtudessus hahni* Watts and Humphreys

Tjirtudessus Watts and Humphreys, 1999

Tjirtudessus raesideensis sp. nov.
(Figs 1–7)

Types

Holotype: m. 'BES 8354, Salt Well, Lake Mason Station, 27°32'24"S, 119°37'27"E, 24/6/00, coll W. F. Humphreys, S. Hinz' in spirit, WAM 27601.

Paratypes: 32, as for holotype, 19 SAMA, 13 WAM 27602–27615; 22, ditto except 'BES 8355', 10 SAMA, 12 WAM 27616–27627; 2, ditto except 'BES 8350', SAMA.

Description (number examined, 57)

Habitus. Length 3.5–4.0 mm; relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about half length of elytron.

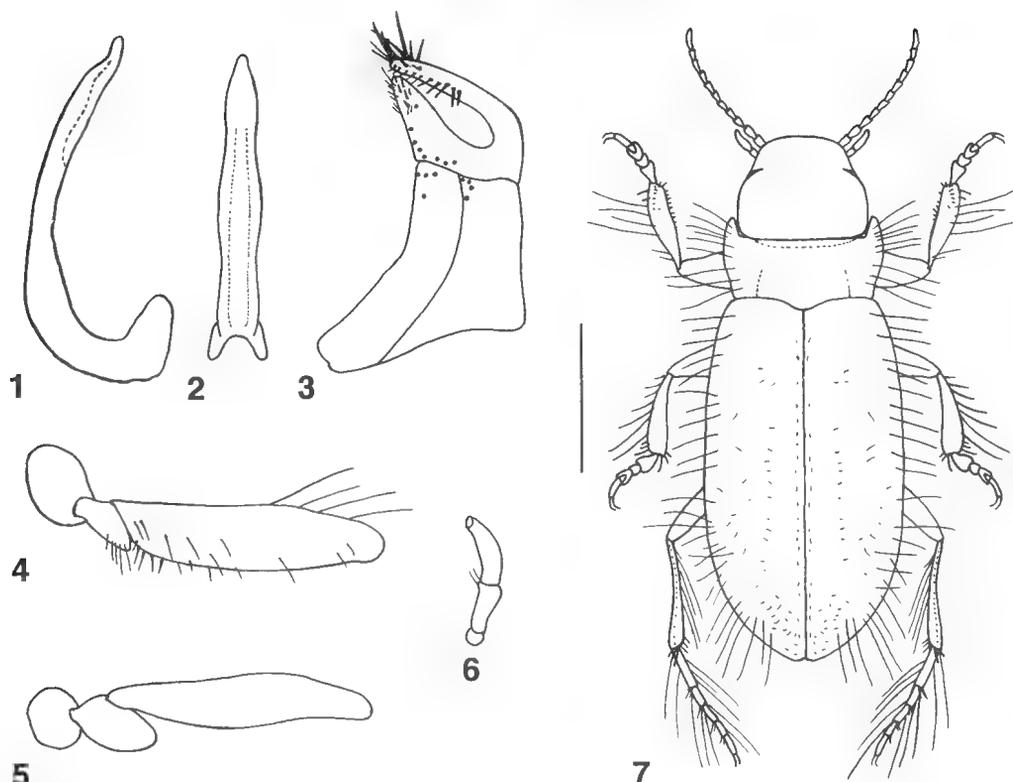
Head. Narrower than elytra; smooth, reticulation very weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to narrowly-oval structure. Antenna relatively stout; basal two segments cylindrical, third segment as long but narrower and narrowing towards base, next seven subequal but becoming progressively shorter, apical segment a bit longer than penultimate; each segment, except segment 1, with some very small setae on inside apically (Fig. 7). Maxillary palpus elongate, apical segment a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated. Labial palpus elongate, apical two segments subequal, tip weakly bifid, penultimate segment with two setae near tip (Fig. 6).

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

Elytra. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures, row of widely spaced larger punctures close to inner edge; numerous setiferous micropunctures towards apex and near base; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron broad in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching mesosternum, apical half narrow, almost parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal lines moderately widely spaced, reaching to about halfway to metasternum, evenly diverging; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively narrow, inner edge



FIGURES 1-7. *Tjirtudessus raesideensis*: 1, lateral view of central lobe of aedeagus; 2, ditto dorsal view; 3, paramere; 4, mesotrochanter and mesofemur; 5, metatrochanter and metafemur; 6, labial palpus; 7, dorsal view. Scale bar represents 1 mm.

straight, outer edge bowed, widest past middle where it is about 3x its basal width; protarsi expanded, first segment broad narrowing at base, second segment a little narrower about one-third length of first, third segment as long as first but much narrower and very deeply bifid, fourth segment very small and hidden within lobes of third segment, apical segment narrow, cylindrical, about length of third, segments 1 to 3 with very dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of eight to nine relatively weak setae along hind edge in basal half (Fig. 4); mesotarsi similar to protarsi. Metatrochanter tip rounded (Fig. 5); metafemur elongate, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment much longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Antennae a little stouter; pro- and mesotarsi a little stouter. Median lobe of aedeagus

variable in width along shaft, tip bluntly pointed; paramere broad, apical segment with long, narrow, apical lobe well separated from rest of segment (Figs 1-3).

Etymology

Named after the palaeodrainage system in which it was collected.

Remarks

In size and in the relatively narrow pronotum, *T. raesideensis* most nearly resembles *T. hahni* but differs from this species in the more gracile fore- and midlegs, thinner antennae, more rounded tips to the metatrochanters and the presence of a small eye remnant which is absent in *T. hahni*. The aedeagi of the two species are quite different. It is smaller than *T. magnificus* with a narrower prothorax and much weaker pro- and mesotarsi. *Tjirtudessus eberhardi* is a little smaller with a broad pronotum and different aedeagus.

Nirridessus Watts and Humphreys, 1999*Nirridessus challaensis* sp. nov.

(Figs 8–14)

Types

Holotype: m. 'BES 8319, Nyung well, Challa Station, 27°59'18"S, 118°31'03"E, 22/6/00, coll W. F. Humphreys, S. Hinze', slide mounted, in spirit, WAM 27668.

Paratypes: 1, as for holotype, WAM 27669; 3, 'BES 8346, Nyung well, Challa Station, 27°59'18"S, 118°31'03"E, 23/6/00, coll W. F. Humphreys, S. Hinze', 2 SAMA, 1 WAM 27671.

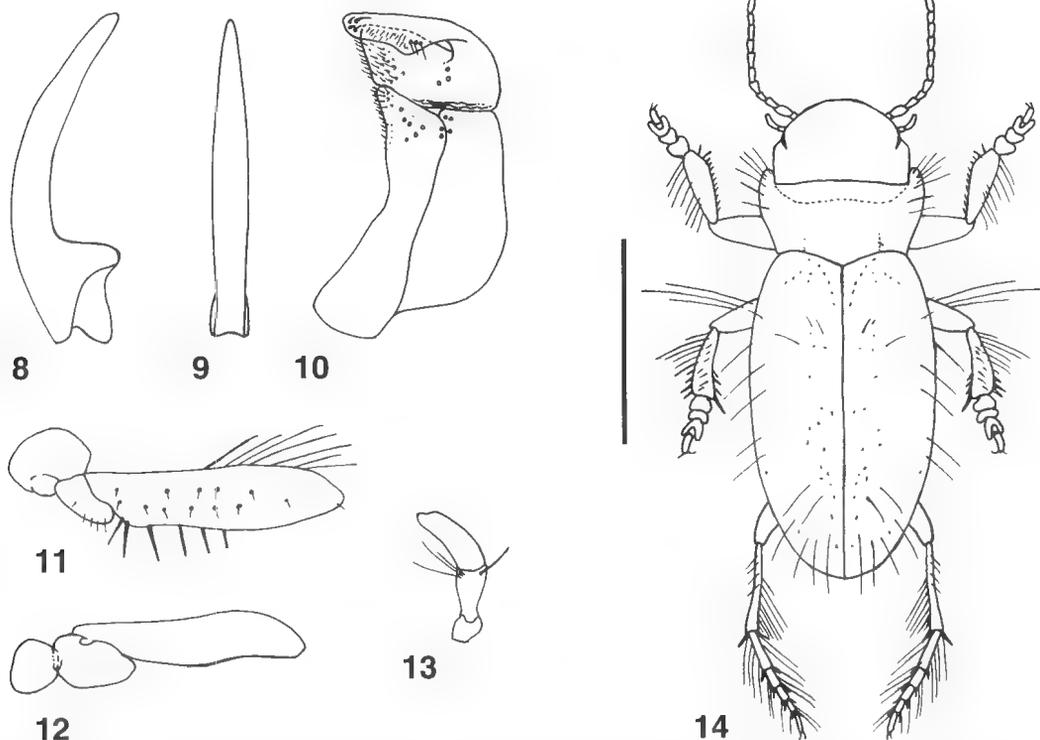
Description (number examined, 5)

Habitus. Length 2.3–2.5 mm; relatively flat, moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about half length of elytron.

Head. Large, nearly as wide as elytra; smooth, weakly reticulate, a few small scattered punctures more numerous near antennal bases; subparallel in posterior half; eye remnant reduced to small

triangular to oval area beneath head. Antenna relatively stout; basal segment cylindrical, second weakly ovoid, third segment about same length but narrower at base, fourth slightly smaller, next six subequal, apical segment a bit longer and slightly narrower than penultimate; each segment, except segments 1 and 4, with some very small setae on inside apically (Fig. 14). Maxillary palpus, elongate, apical segment large, about length of segments 1 to 3 combined, an oblique row of long setae on outer side near tip, tip truncated. Labial palpus moderate, apical segment longer than penultimate, tip weakly bifid, penultimate segment with small papilla near tip bearing two setae (Fig. 13).

Pronotum. Broad, as wide as elytra; anteriolateral angles projecting strongly forward; base moderately strongly narrowed, posterolateral angles acute; smooth, with sparse, very weak punctures more numerous towards the front margin; basal plicae very weak, slanting inwards, reaching to about halfway along pronotum, slightly excavated inwards; with row of long setae laterally, denser towards front.



FIGURES 8–14. *Nirridessus challaensis*: 8, lateral view of central lobe of aedeagus; 9, ditto dorsal view; 10, paramere; 11, mesotrochanter and mesofemur; 12, metatrochanter and metafemur; 13, labial palpus; 14, dorsal view. Scale bar represents 1 mm.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with scattered punctures larger laterally, row of small serial punctures in centre of elytron; setiferous micropunctures in basal fifth; a few scattered punctures with long setae, more frequent towards sides and apex. Epipleuron rather narrow in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching metasternum, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae nearly in contact at midline. Metasternum sharply triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal lines weak, widely spaced, reaching to about halfway to metasternum, diverging in anterior two-thirds; virtually impunctate except for a few towards midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct, ventrites 3 to 5 mobile, virtually impunctate except for some small seta-bearing punctures towards anterior edge of ventrites, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively narrow, edges straight, widest near apex where it is about 3x its basal width; protarsi moderately expanded, first segment broadly oval, second segment as broad, about one-third length of first, third segment as long as first but narrower and very deeply bifid, fourth segment very small and hidden within lobes of third segment, apical segment narrow, cylindrical, about length of third, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter oval with row of fine setae on inner edge towards apex; mesofemur with row of five to six relatively weak setae along hind edge in basal half (Fig. 11); mesotarsi similar to protarsi. Metatrochanter weakly pointed (Fig. 12); metafemur elongate, lacking spines; metatibia curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment a little longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Antennae a little stouter; pro- and mesotarsi a little stouter. Median lobe of aedeagus quite broad, weakly narrowing in apical quarter, tip blunt; paramere broad, apical segment with broad apical lobe folded over basal portion of apical segment (Figs 8–10).

Etymology

Named after Challa Pastoral Station, the location of the calcrete area in which it occurs.

Remarks

Nirridessus challaensis is a moderately large species without a row of large punctures adjacent to the suture. It can be recognised by the row of five relatively weak (for *Nirridessus*) spines on the mesofemur, the relatively broad pro- and mesotarsi, and by the antenna which has segments—including segments 3, 4 and the apical one—of approximately the same length.

Nirridessus fridaywellensis sp. nov. (Figs 15–21)

Types

Holotype: m. 'BES 8379, Bore at Shearing Quarters, Depot Springs Station, 27°55'50"S, 120°04'45"E, 26/6/00, coll W. F. Humphreys, S. Hinze' in spirit, WAM 27628.

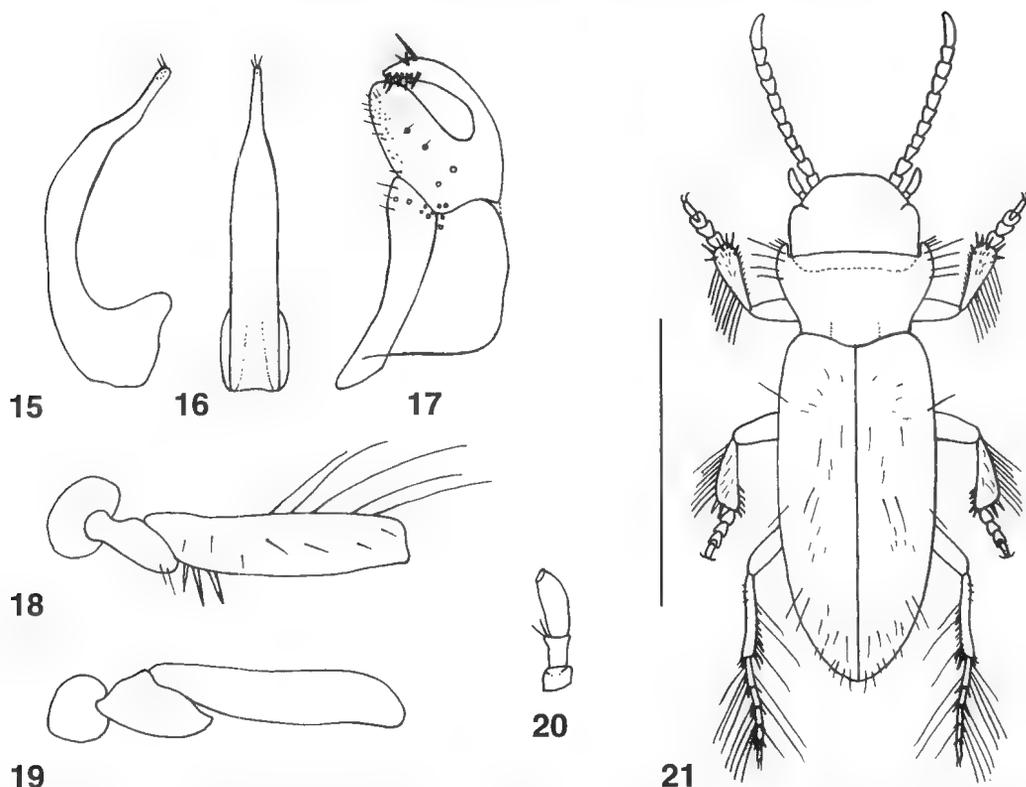
Paratypes: 2, as for holotype, 1 SAMA, 1 WAM 27629, slide mounted; 4, 'BES 8401, Site 425, Depot Springs, 28°03'00"S, 120°02'21"E, 28/6/00, coll W. F. Humphreys, S. Hinze', 2 SAMA, 2 WAM 27630–27631; 3, 'BES 8406, Friday Well, Depot Springs, 28°03'36"S, 120°04'03"E, 28/6/00, coll W. F. Humphreys, S. Hinze', 2 SAMA, 1 WAM 27632, slide mounted.

Additional specimen: 1, f., 'BES 8374 Gums Well Depot Spring' SAMA. This specimen may also belong to this species but a male is needed to confirm the identification.

Description (number examined, 10)

Habitus. Length 1.7–1.8 mm; relatively flat, strongly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about quarter length of elytron.

Head. Relatively small, narrower than elytra; smooth, weakly reticulate, almost impunctate; subparallel in posterior half; sides with dark suture in middle near anterior edge. Antenna relatively stout; basal segment cylindrical, second large, oval, third segment almost as long, much narrower, narrowing towards base, next six subequal, apical segment about twice as long as penultimate; each segment, other than 1 and 4, with some very small setae on inside apically (Fig. 21). Maxillary palpus thin, elongate, apical segment large, a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side near tip, tip truncated. Labial palpus moderate,



FIGURES 15–21. *Nirridessus fridaywellensis*: 15, lateral view of central lobe of aedeagus; 16, ditto dorsal view; 17, paramere; 18, mesotrochanter and mesofemur; 19, metatrochanter and metafemur; 20, labial palpus; 21, dorsal view. Scale bar represents 1 mm.

apical segment longer than penultimate, tip weakly bifid, penultimate segment with small papilla near tip bearing two setae (Fig. 20).

Pronotum. Narrower than elytra; anteriolateral angles projecting strongly forward; base strongly narrowed, posterolateral angles acute; smooth, with very sparse, very weak punctures more numerous towards the front margin; moderately reticulate; basal plicae absent; with row of long setae laterally, denser towards front.

Elytra. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, evenly covered with sparse very small punctures, central row of serial punctures hard to trace; some setiferous micropunctures near apex and along sutural line, very sparse or lacking at base; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; moderately reticulate. Epipleuron broad in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching metasternum, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; moderately reticulate; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct, ventrites 3 to 5 mobile, virtually impunctate except for ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively narrow, edges straight, evenly diverging, widest at apex where it is about 4x its basal width; protarsi little expanded, first segment oval, second segment as wide as about one-half length of first, third segment as long as first and as wide, deeply bifid, fourth segment very small and hidden within lobes of third

segment, apical segment narrow, cylindrical, about twice length of third, segments 1 to 3 with a few adhesive setae; claws short and simple. Mesotrochanter elongate oval with a few fine setae on inner edge; mesofemur with three strong setae/spines on hind edge close to base (Fig. 18); mesotarsi similar to protarsi. Metatrochanter weakly pointed (Fig. 19); metafemur elongate, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment a little longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Antennae a little stouter; pro- and mesotarsi a little stouter. Median lobe of aedeagus relatively wide, narrowing rapidly in apical quarter into a long thin tip; paramere broad, apical segment with narrow, curved, apical lobe not, or only marginally, overlapping basal portion of apical segment (Figs 15–17).

Etymology

Named after one of the wells in which it occurs.

Remarks

Nirridessus fridaywellensis is a small *Nirridessus* with elytron lacking a row of serial punctures. It can be separated from similar species by the lack of pronotal plicae, three spines on the mesofemur and the form of the aedeagus.

Nirridessus masonensis sp. nov.
(Figs 22–28)

Types

Holotype: m. 'BES 8357, Salt Well, Lake Mason Station, 27°32'24"S, 119°37'27"E, 24/6/00, coll W. F. Humphreys, S. Hinze', slide mounted, WAM 27633.

Paratypes: 36, as for holotype, 16 SAMA, 20 WAM 27634–27653; 13, as for holotype except 'BES 8356', WAM 27654–27666; 1, as for holotype except 'BES 8354', WAM 27667; 8, as for holotype except for 'BES 8351', SAMA.

Description (number examined, 59)

Habitus. Length 1.6–1.9 mm; relatively flat, moderately strongly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, a bit over half length of elytron (Fig. 28).

Head. Narrower than elytra; smooth, reticulation very weak, a few sparse small setae-bearing punctures; subparallel in posterior half;

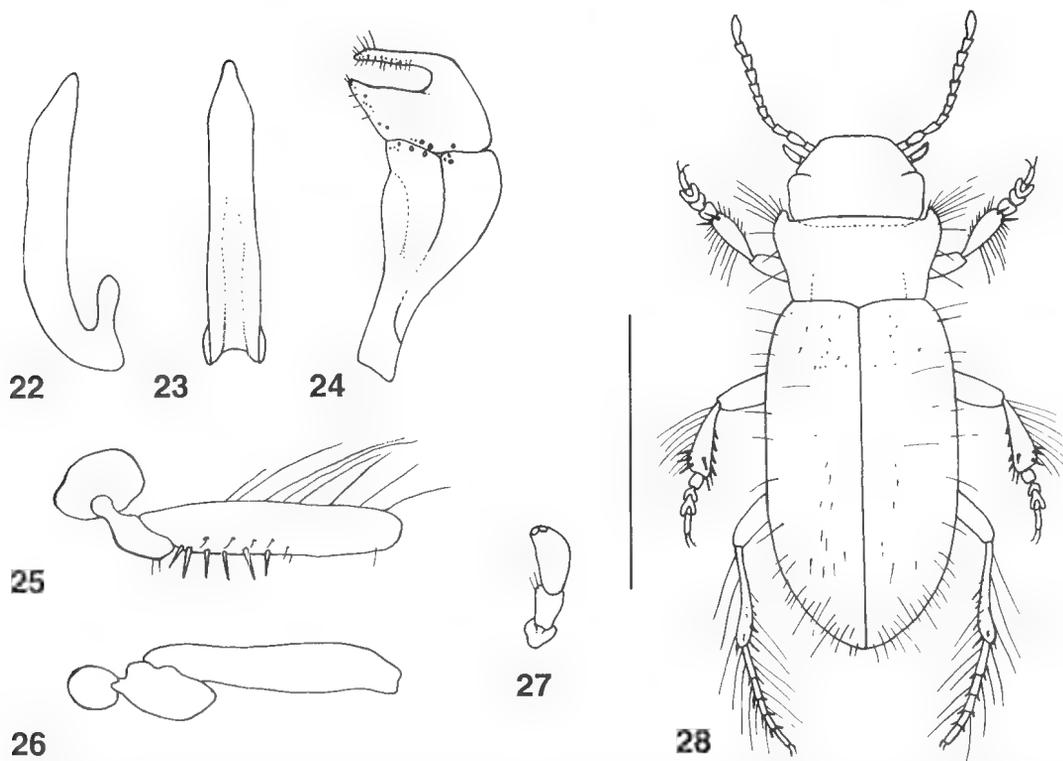
eye remnant reduced to single dark suture in middle near anterior edge. Antenna relatively stout; basal segment cylindrical, second large, oval, third segment shorter, narrower, narrowing towards base, fourth smaller, more parallel-sided, next six subequal, apical segment about twice length of penultimate; each segment, except segments 1 and 4, with some very small setae on inside apically (Fig. 28). Maxillary palpus elongate, apical segment large, a little longer than segments 1 to 3 combined, a diagonal row of long setae on outer side, tip truncated. Labial palpus moderate, apical segment longer than penultimate, tip weakly bifid, penultimate segment with small bulge near tip bearing two setae (Fig. 27).

Pronotum. A little narrower than elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute; smooth, with sparse, weak punctures more numerous towards front margin; basal plicae weak, reaching to about halfway along pronotum, slanting slightly inwards; with row of long setae laterally, denser towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures, a row of serial punctures in middle of each elytron; setiferous micropunctures in basal fifth and near apex; row of long setae near lateral edge; a few additional larger punctures with long setae, more frequent towards sides. Epipleuron broad in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching metasternum, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal lines very weak, widely spaced, reaching to about halfway to metasternum, diverging weakly in anterior third; virtually without punctures except for a few near midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural line distinct in inner half, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively narrow, inner edge straight, outer edge bowed, widest past middle where it is about 3x its basal width; protarsi weakly expanded, first segment reticulate, second segment as broad, about one-half length of first,



FIGURES 22–28. *Nirridessus masonensis*: 22, lateral view of central lobe of aedeagus; 23, ditto dorsal view; 24, paramere; 25, mesotrochanter and mesofemur; 26, metatrochanter and metafemur; 27, labial palpus; 28, dorsal view. Scale bar represents 1 mm.

third segment as long as first and as wide, moderately bifid, fourth segment very small and hidden within lobes of third segment, apical segment comparatively stout, cylindrical, about 1.5x length of third, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate-oval with one or two weak setae on inner edge; mesofemur with row of six to seven strong setae/spines along hind edge in basal half (Fig. 25); mesotarsi similar to protarsi. Metatrochanter bluntly pointed (Fig. 26); metafemur elongate, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment a little longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Antennae a little stouter; pro- and mesotarsi a little stouter. Median lobe of aedeagus relatively wide, narrowing in apical quarter to blunt tip; paramere broad, apical segment with pronounced, narrow, apical lobe well separated from rest of apical segment (Figs 22–24).

Etymology

Named after the type location.

Remarks

Nirridessus masonensis is a small *Nirridessus* with the elytron lacking a row of large sutural punctures. It can be recognised by the relatively numerous well spread out spines on the mesofemur, obsolete lateral portion of the suture between the first and the second ventrite, and the long apical lobe to the paramere, which is well separated from the rest of the apical segment.

Nirridessus pinnaclesensis sp. nov.

(Figs 29–35)

Type

Holotype: m. 'BES 8397, Site 432, Pinnacles Station, 28°15'27"S, 120°07'37"E, 28/6/00, coll W. F. Humphreys, S. Hinze', slide mounted, WAM 27672.

Description (number examined, 1)

Habitus. Length 1.5 mm; relatively flat, strongly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about half length of elytron.

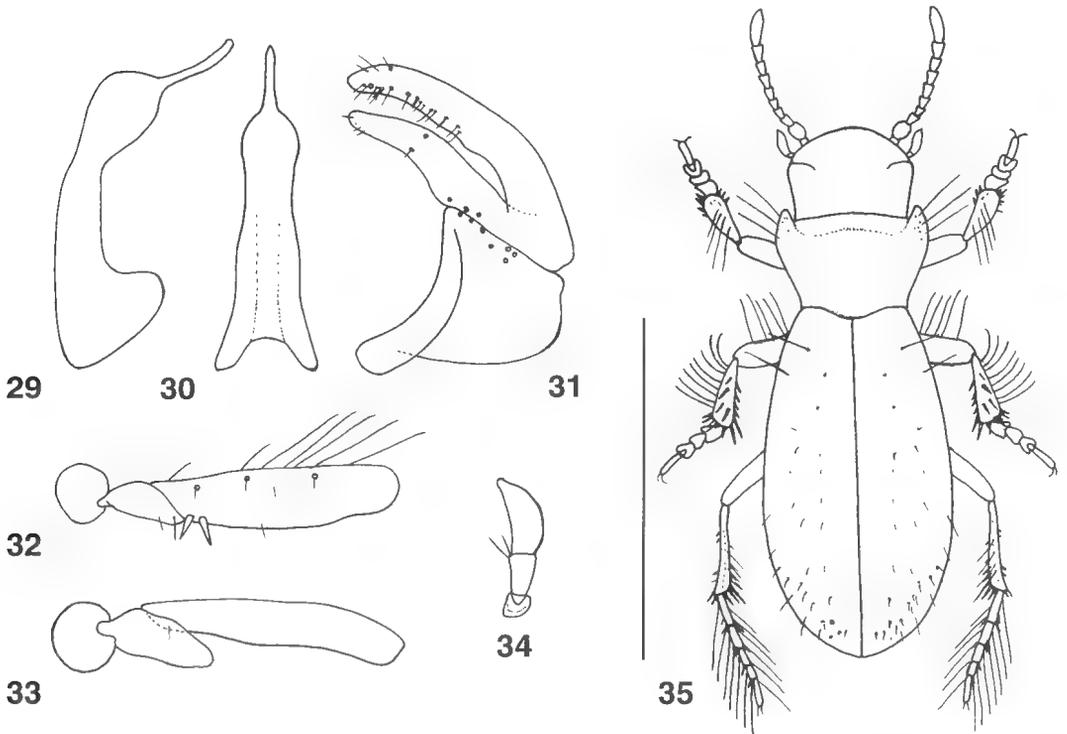
Head. Moderate, narrower than elytra; smooth, virtually without reticulation, virtually impunctate; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to broad dark suture in middle near anterior edge. Antenna stout; basal segment cylindrical, second almost round, third shorter, thinner, narrower at base, fourth about half length of third, next six subequal, apical segment twice as long as penultimate; each segment, except segments 1 and 4, with some very small setae on inside apically (Fig. 35). Maxillary palpus, elongate, apical segment large, a little longer than segments 1 to 3 combined, an oblique row of long setae on outer side towards tip, tip truncated. Labial palpus with apical segment longer than penultimate, tip weakly bifid, penultimate segment with small bulge near tip bearing two setae (Fig. 34).

Pronotum. About as wide as elytra;

anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute; smooth, virtually impunctate; basal plicae absent (or at least not traceable on mounted specimen); with some long setae laterally, denser towards front.

Elytra. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, weakly reticulate, very sparsely covered with small punctures, row of serial punctures in centre of elytron; setiferous micropunctures at apex, base and near suture; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron broad in anterior fifth, then rapidly narrowing to be virtually absent over rest of elytron.

Ventral surface. Prothoracic process strongly narrowed between coxae, not reaching metasternum, apical half triangular, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline, wings very narrow, broadly rounded in midline behind. Metacoxal plates large, metacoxal



FIGURES 29–35. *Nirridessus pinnaclesensis*: 29, lateral view of central lobe of aedeagus; 30, ditto dorsal view; 31, paramere; 32, mesotrochanter and mesofemur; 33, metatrochanter and metafemur; 34, labial palpus; 35, dorsal view. Scale bar represents 1 mm.

lines long, moderate, widely spaced, reaching to about halfway to metasternum, weakly diverging; sparsely covered with small setae-bearing punctures; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct, ventrites 3 to 5 mobile, very sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively broad, inner edges straight, widest past middle where it is about 3x its basal width; protarsi weakly expanded, first segment broadly oval, somewhat asymmetrical with outer side less expanded, second segment broad about one-half length of first, third segment as long and wide, quite deeply bifid, fourth segment small and hidden within lobes of third segment, apical segment narrow, cylindrical, about twice length of third, segments 1 to 3 with some adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae on inner edge; mesofemur with row of 2 very strong setae/spines on hind edge close to base (Fig. 32); mesotarsi less expanded than protarsi. Metatrochanter tip rounded (Fig. 33); metafemur elongate, row of small spines near inner edge; metatibia strongly curved, widening towards apex; metatarsi elongate, basal segment longest, apical segment a little longer than fourth, segments 1 and 2 in combination about as long as others; claws weak.

Male. Median lobe of aedeagus broad, apical quarter beak-like; paramere short, broad, apical segment formed into two long narrow lobes (Figs 29–31).

Etymology

Named after the Pinnacles Pastoral Station on which the specimens were found.

Remarks

Only one specimen is known of this small *Nirridessus*. Distinctive characters are the unusual beak-shaped central lobe to the aedeagus and two long lobes at the tip of the paramere, only two spines at the base of the mesofemur and short, stout antennae with a relatively long apical segment.

Nirripirti gen. nov.

Diagnosis/Description

Elongate—oval, relatively flat; eyeless; uniformly light testaceous; surface reticulate, meshes small,

relatively even; punctures small, sparse; scutellum not visible dorsally. Pro- and mesotarsi pseudotetramenous; metatrochanters almost completely exposed, metafemur narrow, impunctate, metatibia relatively even in width. Pronotal process strongly arched, not reaching mesosternum; mesocoxae meeting. Male with one segmented parameres; central lobe of aedeagus simple.

Remarks

We place this genus in the Hydroporini on the strength of its relatively small size, lack of visible scutellum, straight even-width hind tibia, simple hind tarsi, simple even-sized hind claws, relatively narrow pronotal process, and single segmented parameres.

Its relationships within the Australian Hydroporini are not obvious. Its pseudotetramenous pro- and mesotarsi would seem to rule out *Sternopriscus* and *Necterosoma*; likewise, the shape of and lack of punctuation on the metafemur would rule out *Megaporus*, *Antiporus*, *Tiporus* and *Sekaliporus*. By default as much as anything, we tentatively suggest that its sister genus could be *Paroster*. Its strong reticulation, elongate flattened shape and relatively simple aedeagus resemble some species in this genus but other characters, such as the elongate hind legs and lack of a basal epipleural stria on the elytra, negate any obvious relationship. A proper cladistic study, coupled with biochemical studies, will be needed to adequately determine its relations with other Australian genera.

Etymology

Western Desert Language; Nirri-nirri, beetle and pirti, well/shaft.

Type species

Nirripirti hinzeae sp. nov.

Nirripirti hinzeae sp. nov.

Types

Holotype: m. 'BES 8404, Friday Well, Depot Springs, 28°03'36"S, 120°04'03"E, 28/6/00, coll W. F. Humphreys, S. Hinze' in spirit, WAM 27673.

Paratypes: 3, as for holotype, WAM 27674–27676; 16, 'BES 8405, Friday Well, Depot Springs, 28°03'36"S, 120°04'03"E, 28/6/00, coll W. F. Humphreys, S. Hinze', 10 SAMA, 6 WAM 27677–27682.

Description (number examined, 20)

Habitus. Length 2.8–3.0 mm; elongate, relatively flat, slightly depressed in sutural region weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

Head. Large, nearly as wide as elytra; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases; subparallel in posterior half; eye remnant reduced to a dark suture in middle near anterior edge. Antennal segments 3 to 5 thinner than rest, apical segment a bit longer and narrower than penultimate, each segment with some very small setae on inside apically (Fig. 39). Maxillary palpus elongate, apical segment longer than penultimate segment, some long setae towards apex of segments. Labial palpus with apical two segments subequal, tip weakly bifid.

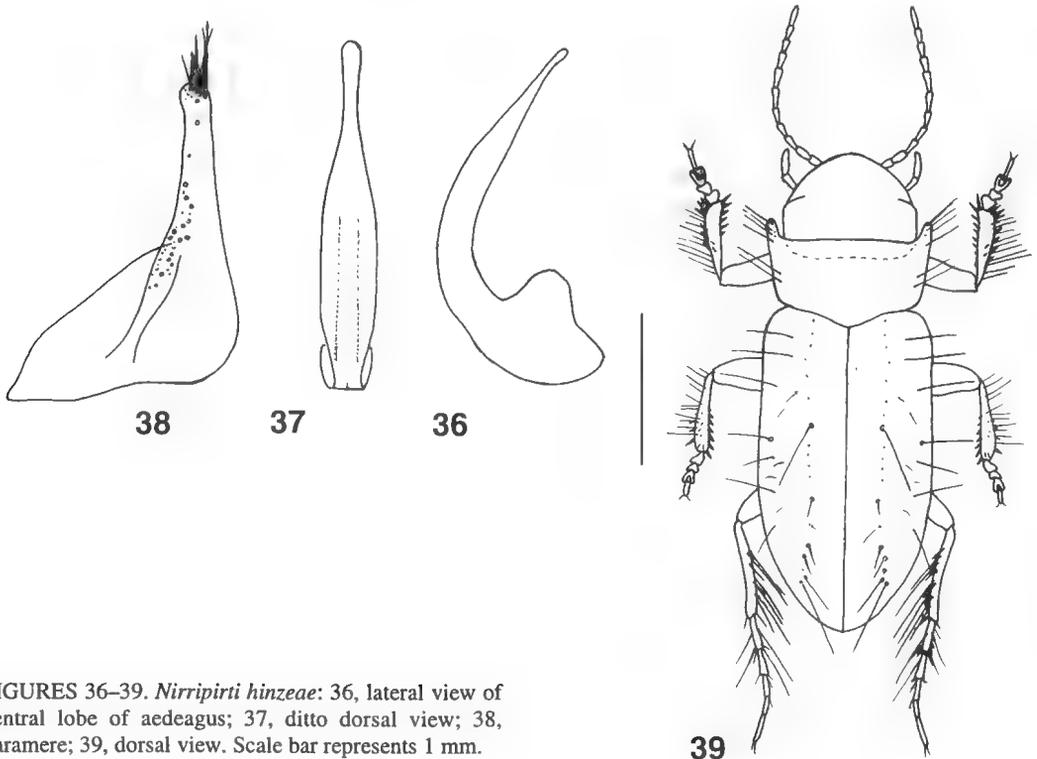
Pronotum. Narrower than elytra; anteriolateral angles projecting strongly forward; base moderately narrowed, posterolateral angles obtuse; quite strongly reticulate, virtually impunctate except towards front margin; some long setae at edge towards front.

Elytra. Not fused, lacking inner ridges;

elongate, widest behind middle, smooth, covered with fine reticulation; a few scattered small punctures, several rows of widely spaced small punctures; setiferous micropunctures at base, apex and along suture line, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron very weakly differentiated from rest of elytron, broad in anterior quarter, then gradually narrowing to middle, virtually absent over rest of elytron.

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

Legs. Profemur with small peg-like structure on



FIGURES 36–39. *Nirripirti hinzeae*: 36, lateral view of central lobe of aedeagus; 37, ditto dorsal view; 38, paramere; 39, dorsal view. Scale bar represents 1 mm.

hind edge adjacent to protrochanter; protibia narrow, widest past middle where it is about 3x its basal width; protarsi expanded, first segment broadly triangular, second segment about one-half length of first, third segment as long as first, deeply bifid, fourth segment very small and hidden within lobes of third segment, apical segment narrow, cylindrical, about length of third, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five strong setae/spines along hind edge in basal half; mesotarsi similar to protarsi. Metatrochanter elongate/oval; metafemur elongate, lacking spines; metatibia weakly curved, approximately the same width throughout; metatarsi elongate, basal and apical segments longest, subequal, segments 1 and 2 in combination much shorter than others; segments 2 to 5 without spines other than at apex; claws weak.

Male. Little difference from female. Median

lobe of aedeagus narrowing rapidly in apical quarter; paramere broad at base, apical half thin, tip with a bunch of long setae. (Figs 36–38).

Etymology

Named after Susan Hinze, the co-collector of the specimens.

DISCUSSION

Site characteristics and associated fauna

The material treated here represents the results of sampling from 89 sites, of which 44 were narrow tube bores and 45 were open pastoral wells. Thirteen of these sampling sites yielded Dytiscidae, seven from wells and six from bores (Fig. 40). Both Amphipoda and Ostracoda were taken from 19 sites, and Copepoda (cyclopoid and harpacticod) from 12 sites. All Dytiscidae were taken from calcrete aquifers. The dytiscids occur in a stygal assemblage that includes other dytiscid

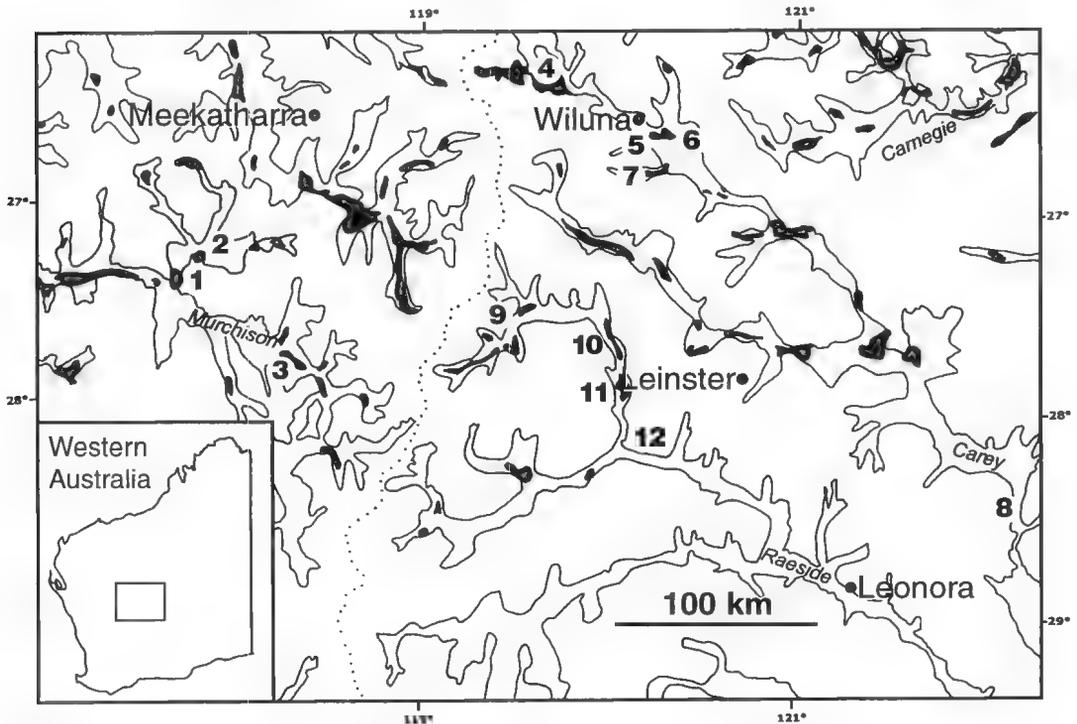


FIGURE 40. Map showing the distribution of stygobitic species of dytiscids in Australia. Numbers denote: 1, Austin Downs; 2, Cue; 3, Challa north; 4, Paroo; 5, Lake Violet; 6, NE Lake Way; 7, Hinkler Well; 8, Mount Windarra; 9, Lake Mason north; 10, Depot Springs north; 11, Depot Springs south; 12, Pinnacles. Outlined areas denote undifferentiated sediments in the palaeodrainage channels, while shaded areas denote calcrete. The northerly trending dotted line denotes the divide between the Indian Ocean and inland drainages (Beard 1998). Drawn from Geological Survey (1989).

TABLE 1. Taxa taken from the same wells as the dytiscid species

Dytiscid species	Sympatric taxa
<i>Nirridessus challaensis</i>	Amphipoda, Ostracoda, Copepoda, verms
<i>Nirridessus fridaywellensis</i>	<i>Nirripiriti hinzeae</i> , Amphipoda, Ostracod, Copepoda, Bathynellacea, verms
<i>Nirridessus masonensis</i>	<i>Tjirtudessus raesideensis</i> . Amphipoda, Copepoda
<i>Nirridessus pinnaclesensis</i>	–
<i>Tjirtudessus raesideensis</i>	<i>Nirridessus masonensis</i> . Amphipoda, Copepoda
<i>Nirripiriti hinzeae</i>	<i>Nirridessus fridaywellensis</i> . Amphipoda, Ostracoda, Copepoda.

species, amphipods, bathnellid syncarids, ostracods, cyclopoid and harpacticod copepods, and phreodrilid oligochaetes whose diversity has yet to be examined (Table 1). In other calcrete aquifers of the Western Shield of Australia, sympatry of congeners of various crustaceans is common (Bradbury 2000).

Water quality

The electrical conductivity of the water from which the Dytiscidae were recorded varied from 3.9 to 12.3 mS/cm, a salinity of approximately 2.3–7.3 g/L total dissolved solids (Table 2). While these waters are saline, they do not approach the high salinity, around 22 g/L, found near Lake Way (Watts & Humphreys 2000). However, the surface water may have been diluted by fresh water owing to unusually high rainfall in the six months prior to sampling; shallow calcrete aquifers are responsive to periodic recharge through the karst and may exhibit marked changes in both water

level and salinity (Watts & Humphreys 2000). The pH and oxygen levels were within the range previously recorded for the stygobit Dytiscidae (Watts & Humphreys 2000).

Distribution

The general geological, climatic and biogeographical setting of the fauna discussed here is described elsewhere (Humphreys 1999, 2001; Watts & Humphreys 1999, 2000). Dytiscid specimens were collected from five separate calcrete deposits (Table 3): 1, Challa north; 2, Lake Mason north; 3, Depot Springs north; 4, Depot Springs south; and 5, Pinnacles. Site 1 is located in the Austin palaeodrainage that drains towards the Indian Ocean and is part of the upper Murchison catchment lying to the east of Lake Austin. The other sites were from the inland-draining Raeside palaeodrainage that lies to the south of the Carey palaeodrainage, from which it has been entirely separated since at least the

TABLE 2. Physicochemical measurements of water at some dytiscid sites

Date	Conductivity (mS/cm)	Temp (°C)	pH	O ₂ (%)	Depth to/of water (m)	Dytiscids present
Friday Well 28/6/00	5.2	15.1	7.89	39%	2.5/1	<i>Nirripiriti hinzeae</i> sp. nov. <i>Nirridessus fridaywellensis</i> sp. nov.
Salt Well, Lake Mason 24/6/00	12.3	18	8.00	–	5.5/0.56	<i>Nirrid. masonensis</i> sp. nov. <i>T. raesidensis</i> sp. nov.
Shearing Quarters Bore, Depot Springs 26/6/00	6.8	22	7.38	–	1.5/9.5	<i>Nirrid. fridaywellensis</i> sp. nov.
Site 425, Depot Springs 28/6/00	5.5	25	–	–	2.7/10	<i>Nirrid. fridaywellensis</i> sp. nov.
Nyung well, Challa Station 22/6/00	3.9	20.4	7.67	39%	4/2	<i>Nirrid. challaensis</i> sp. nov.
Site 432, Pinnacles Station 28/6/00	11.4	24.5	7.62	–	4.5/36	<i>Nirrid. pinnaclesensis</i> sp. nov.

TABLE 3. The distribution of stygal species of dytiscids amongst discrete calcrete bodies (1–12) in the Yilgarn district of Western Australia. The separate palaeodrainage systems (A–C) and the Indian Ocean and interior drainages are indicated. Numbers denote the locations in Fig. 40. Common superscripts 1–6 denote sympatric species

Calcreted body	Genus			
	<i>Tjirtudessus</i>	<i>Nirridessus</i>	<i>Kintingka</i>	<i>Nuripirti</i> gen. nov.
A. Western drainage: Austin palaeodrainage				
1 Austin Downs	–	<i>bigbellensis</i>	–	–
2 Cue	<i>magnificus</i> ²	<i>cueensis</i> ²	–	–
3 Challa north	–	<i>challaensis</i> sp. nov.	–	–
B. Eastern drainage: Carey palaeodrainage				
4 Paroo	<i>eberhardi</i> ³	<i>pulpa</i> ³	<i>kurutjutu</i> ³	–
5 Lake Violet	–	undescribed sp.	–	–
6 NE Lake Way	<i>hahni</i>	<i>morgani</i>	–	–
7 Hinkler Well	–	<i>hinkleri</i>	–	–
8 Mount Windarra	–	<i>windarraensis</i> ⁴ <i>lapostae</i> ⁴	–	–
C. Eastern drainage: Raeside palaeodrainage				
9 Lake Mason north	<i>raesidensis</i> sp. nov. ⁵	<i>masonensis</i> sp. nov. ⁵	–	–
10 Depot Springs north*	–	<i>fridaywellensis</i> sp. nov.	–	–
11 Depot Springs south*	–	<i>fridaywellensis</i> sp. nov. ⁶	–	<i>hinzeae</i> sp. nov. ⁶
12 Pinnacles	–	<i>pinnaclesensis</i> sp. nov.	–	–

* Depot Springs north and Depot Springs south are separate expressions of calcrete at the surface but are considered to be a continuous calcrete body by the pastoralist (M. Cavallaro, personal communication, 26 June 2000).

Cretaceous (Humphreys 1999 in press), and in which there are many stygal dytiscid taxa (Watts & Humphreys 1999, 2000). The distribution of taxa by calcrete body is shown in Table 3.

As found previously (Watts & Humphreys 1999, 2000), each species is restricted to a single calcrete region (Table 3) and half the sites contain sympatric non-congeneric Dytiscidae. Owing to the sparse sampling of many species, a more detailed sampling of these aquifers would be expected to increase the number of sites containing Dytiscidae, and may show species to be more widely distributed than currently found.

The prediction of a much richer fauna of stygobitic Dytiscidae in Western Australia (Watts and Humphreys 2000) has been fulfilled. Since only about 10% of the major calcrete deposits in the palaeodrainage channels of Western Australia (Humphreys 1999) have been sampled for stygofauna, it is likely that numerous additional

subterranean Dytiscidae, as well as other stygobitic taxa, especially Crustacea, remain to be discovered in the northern Yilgarn region.

This paper reaffirms that the dytiscid fauna of the Northern and Eastern Goldfields areas of the Yilgarn is uniquely diverse by world standards. Molecular work has commenced to determine the origins and evolution of this diverse stygofauna.

ACKNOWLEDGMENTS

It is a pleasure to acknowledge the assistance of Susan Hinze in the field sampling and sorting; Julianne Waldock for laboratory processing; Rob Gutteridge (Adelaide) for drawing the illustrations. We thank Kevin Morgan and Philip Commander for access to information about bore locations and for unstinting access to their knowledge of the Yilgarn aquifers. Information about the locations of, and access to, sampling sites was kindly provided by many pastoralists in the region.

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AUSTRALIAN ABORIGINAL CULTURES GALLERY 'THE SPEAKING LAND': A REVIEW ARTICLE

J. V. S. MEGAW

Summary

[M]useums are representations of the societies in which they are situated ... They are repositories of culture, machines for recontextualization, and platforms for the creation and promotion of cultural heritage. (Ames 1992 : 47)

AUSTRALIAN ABORIGINAL CULTURES GALLERY 'THE SPEAKING LAND': A REVIEW ARTICLE

J. V. S. MEGAW

MEGAW J. V. S. 2001. Australian Aboriginal Cultures Gallery 'The Speaking Land': a review article. *Records of the South Australian Museum* 34(2): 115–125.

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[M]useums are representations of the societies in which they are situated...They are repositories of culture, machines for recontextualization, and platforms for the creation and promotion of cultural heritage. (Ames 1992: 47)

It has often occurred to me that the normal manner of reviewing various forms of major public manifestations, be they plays, opera or ballet, at the very beginning of their existence before they have grown into some degree of harmony with what is perceived to be the original intent of their creator(s), is about as meaningless as trying to assess a major new museum project too soon after its public opening.

The new Australian Aboriginal Cultures Gallery at the South Australian Museum is no longer so new. So how are we to offer a critique, now well over a year after that major event in the calendar of cultural innovations along the cultural drag that is Adelaide's North Terrace, the opening of the Gallery by the Premier of South Australia on 3 March 2000? Certainly it seems a far cry from the publication of the Edwards Report with its largely damning comments on the situation as it was then on the North Terrace and its guidelines for future improvement (Edwards 1981: 89–96).

Firstly, it must be remembered that, like all critiques purporting to be objective, this present article is one person's view of a complex whole which itself attempts to reflect varying human reactions to varying environments over more—almost certainly much more—than 50 000 years. Also, given the Museum's laudable and continuing involvement of indigenous Australians—another feature which continues a key recommendation of the Edwards Report—while my comments may reflect contemporary and personal contacts with varying groups and individuals from contemporary indigenous Australian society, I am of course not an indigenous Australian. Perhaps the Anthropology Editor of these *Records* should commission a

second article to add an indigenous voice to these whitefella comments—albeit that too would be only one voice among many.

It is no excuse—if excuse is needed—to add that, like practically any outsider who has been accepted into a remote indigenous community, I too have an indigenous name plus all the responsibilities of a whole new group of 'skin' relations. It hardly needs to be emphasised that there is nothing mystical in this system of 'honorary' relationships; it is a purely practical solution to a practical problem, of locating us others within the community. But any outsiders who find themselves in a similar situation and think that they are thereby entering a true state of 'Aboriginality', or that they have passed some form of initiation, are deluding themselves; Bruce Chatwin (1987), among others, has much to answer for.

Secondly, the enormity of the task that the Museum's curatorial and adjunct staff, materially assisted by the project's Sydney-based designers and multimedia consultants, set themselves has been nothing less than ambitious. Philip Jones, who wrote the original brief for the Australian Aboriginal Cultures Gallery (hereafter AACG—the plural in 'Cultures' is significant) but since then seems, enviously, to have moved from the hurly-burly of museum curatorial work to a life of almost uninterrupted research, stated in 1996 that the new gallery would seek

to present an encyclopaedic view of Aboriginal material culture and traditions which cannot be duplicated elsewhere. The depth of the Museum's artefact and archival collections, together with our commitment to a working partnership, will ensure that result' (quoted in Kean 2001).

Philip Clarke (2001), who really had the overall responsibility for bringing the AACG from concept to reality, has stated the aim rather more succinctly:

The main aim of the exhibition is to describe the technologies used by Aboriginal people who have lived in the climatically variable continent of Australia for over 50,000 years.

In its attempt to achieve this, the exhibition team has used 3000 of the Museum's total of around 30 000 Aboriginal ethnographic specimens. This is a very impressive proportion, considering that most museums rarely have more

than a twentieth of their collections on public display. Until very recently, ethnographical collections have been the Cinderellas of the museum world. Despite a renaissance of interest in material cultural studies (as Reynolds 1989 has noted), there is still a shortfall in staffing, both to curate and to manage collections. Leaving on one side the question of the disadvantages as opposed to the benefits of dividing these often ill-defined duties, Reynolds recorded the results of a survey of museums as sources of information. He commented that in Australia in 1981, the average number of artefacts for which curators in some



FIGURE 1 Level 1, Australian Aboriginal Cultures Gallery, South Australian Museum, showing Dress exhibit with MacDonnell Ranges exhibit at left rear. Photo © South Australian Museum.

nine museums were responsible was around 15 500, with four in his sample exceeding 20 000. At the present time there are two curators responsible for the ethnographic collections of the South Australian Museum and each have well in excess of 20 000 objects under their care.

The excitement of the opening long since over, missing labels placed in position, lighting levels tweaked—but I find them lower than conservation good practice demands—what are the impressions one now has as one turns into the Gallery from the panoramic airiness of the rebuilt main entrance of the Museum? One Saturday morning I followed a small school party of ten-year-olds around. The first reaction was, 'Isn't it dark?' So it mostly is (Figure 1) and while there are clearly good conservation reasons for this, I could see nowhere a visible (!) explanation. This, then, is not a place to experience, save in miniature, the hard light of the desert or the blue of the skies of the Great South Land.

In the AACG both the distant past and the immediate present appear only as rather slender bookends to the central theme. While the relative down-playing of the latter is defensible, particular in the light—literally—of the indigenous 'talking heads', the former, despite what may be gleaned from the touch-screens of the 'Speaking Land', seems little more than a display-in-progress, with precious little space let alone actual material to support the lengthy timeline. The Museum has indeed been too long without the services of a full-time Curator of Archaeology. This is a mere apology for antiquity which crams into a few cubic metres what is labelled with excessive conservatism 50 000–60 000 years of indigenous settlement. True, Roger Luebber's fascinating, if still largely unpublished, discoveries in 1973–74 of 10 000-year-old wooden artefacts at Wylie Swamp in south-east South Australia are featured on the 'Speaking Land'. I looked in vain, however, for any even halfway reasonable treatment of the late Graeme Pretty's excavations, also yet to be fully published, of the burial ground at Roonka Flat on the Murray, a site where archaeology and local indigenous concerns came together in complete harmony.

Nonetheless, the Australian Aboriginal Cultures Gallery has been designed not just for indigenous Australians (though it is clear that without the cooperation of many indigenous Australians there would have been no new gallery) and not just for all Australians, but for all visitors to the Museum, be they from Jogjakarta or Jamaica, Argentina or Aberdeen. So there is another test which needs to

be applied: how well does the AACG carry out its overall brief to inform all, whatever be the depth of their ignorance or their lack of interest in the face of more pressing matters, such as the latest modern Disney fairytale or a day at the footy?

There is an enormous plus to this display. Along the north wall of the gallery as one enters Level 1, there is a large panel of portraits selected by Fiona Macdonald. These are mostly monochrome photographs, with Norman Tindale and Unaipon sharing the honours with Pastor Johann Reuter and many others. A few 'windows' offer film clips in colour of smiling faces (an intentional choice to start things on a positive spin?) but there is no sound. For that one has to move on to the eight regional sections where individual voices (literally talking heads) speak to you (the viewer), drawing you in to the display, inviting you to be part of it. Everyone must be attracted to one or other screen, neatly activated when the visitor stops to read the brief descriptive label. For me, Judy Lucas speaking of her return from Adelaide to her family's ancestral land up the Birdsville Track eloquently represents the plight of many that have sought their roots after long separation.

Here is the *Leitmotiv* of the AACG. It is not the static displays which seem to catch the attention of every visitor but, in a neat marriage between new technology and ancient rights and beliefs, the 'Speaking Land', the title which greets you as you sink—oh bliss, oh joy—into the liberally distributed, leather-covered banquettes. Strategically placed, here are the various touch-screen monitors that allow one to self-drive through the various themes, technologies and regions which make up the AACG; '1600 images, 50 video clips, 20 audio clips and 12 virtual reality sequences' trumpeted the media release at the opening.

In parenthesis, while obviously the strengths of the Museum's holdings have determined the content of the 'Speaking Land', the total absence of any coverage of the first significant point of culture contact in the Sydney–Hawkesbury region, let alone demonstration of the same region's rich rock-art, borders on the parochial. Be that as it may, the technology—both the software and hardware, purpose designed and built—certainly works but one wonders for how long and at what cost to maintain. I have not been surprised to observe that most visitors under the age of thirty, early on in their visit, drift toward the screens like so many moths attracted to the light on a dark night.

But this is not to complain; on the contrary. The previous major indigenous ethnographic display at the South Australian Museum was *Ngurunderi: an Aboriginal Dreaming*. This exhibition had much the same curatorial team as for the AACG, followed the admirable policy of indigenous consultation and cooperation, and presented the story of the Lower Murray and the Coorong delta—roughly equivalent to the South-East region in the new display—from prehistory to the present, with an excellent introductory film, mixture of text panels, touch-screens, static displays and, most popular of all, a number of full-scale dioramas. As I observed some years ago (Megaw 1990: 81):

In preparing some of the three-dimensional exhibits for *Ngurunderi*, despite the long and almost universal popularity of the South Australian Museum's dioramas, the (non-Aboriginal) design team was concerned to get away from the earlier types of presentation of the Aborigine-as-showcase-artefact...In the end it was decided to use no three-dimensional figures at all and to restrict any humans to contemporary illustrations, two dimensional reconstruction drawings or indistinct background figures in a landscape...This was certainly not the wish of several of the Ngarrindjeri advisers as there have been many questions asked by a gratifyingly large number of Aboriginal visitors to the exhibition: 'Where have all the people gone?'

After one's voyage of discovery through the various modules—an uncharted voyage since it seems to have been the curators' and the designers' intent that there should be no set pathway, the wisdom of which I think may be debatable—many visitors who make their way to the second, upper, level of the exhibition, may well feel like the prisoners in the last act of Beethoven's *Fidelio* drawn to the light, in this case the Indigenous Information Centre. But few enter it. The Centre, which contains the archives of the Aboriginal Family History project, is serving a vital role in continuing to make available to indigenous Australians its unrivalled genealogical resources. It seems a pity that more of the general public are not availing themselves of yet another computer-based resource and of the opportunity to speak to indigenous staff, especially to the tour guides, graduates of Tauondi's Cultural Agency (formerly the Aboriginal Community College).

It has to be said that 'art', however you define that elusive little three-letter word, is not foregrounded in the AACG. This may be

intentional recontextualisation, to offset the decontextualisation (the 'you-don't-have-to-know-anything-about-art, just-feel-the-quality') approach of the sister institution next door, the Art Gallery of South Australia. Indeed, some of the artistic treasures of the AACG are almost hidden. At the northern end of the second level of the Gallery is the great acrylic painting, a cooperative exposition of four separate 'Dreamings', commissioned by the Museum in 1996 and executed over a three-day period by no less than 29 Warlpiri and Anmatyerre men and women. This cries out for more than the comparatively brief and distinctly dry explanatory panel in order fully to unpick the various 'webs of relatedness', to get something of the flavour—let alone smell—of the context out of which such art arises (for art it is by anyone's standards). I can remember, on my first visit to Papunya 20 years ago, the shock of realising that great art was being produced on the desert floor with the camp dogs lifting their legs on the canvas edges and the painters literally sitting on the canvas, the better to execute their share of the composition.

In the temporary display area on the ground floor there is some attempt to get away from a sanitised approach to art. Currently there is a selection from the 30 doors from the school at Yuendumu painted in 1983 at the invitation of the school principal by senior Warlpiri men, partly as an educational tool and partly as a riposte to their women folk who had already been producing works on canvas for sale (Warlukurlangu Artists 1987). I observed my sample visitor making a bee-line for one of the doors and exclaiming 'Look, Dad, are there any other tags?' and pointing to where—absolutely correctly in my opinion—ArtLab, in undertaking conservation of the doors, had not removed the word 'LIZZIE'.

There is work to be done here on the later associations of, and reactions to, the Yuendumu doors. This material should then be included in the data bank of the 'Speaking Land', though I was delighted to see inclusion of a clip from the Film Australia's film 'Dreamings' made by indigenous film-maker and photographer Michael Riley to accompany the block-buster exhibition of the same name. I looked but did not see evidence of use of the ABC's brilliant film made in 1989 starring Dr Christopher Anderson (Director of the Museum during the AACG's development stage), a work which demonstrated that a little liquid lubrication does wonders for one's fluency in speaking extempore to camera. *Market of Dreams* must surely rank as one of the best visual studies

dealing with aspects of 'ethnographic' art and is worthy to take its place beside Curtis Levy's *Sons of Namatjira*, made for the then Australian Institute of Aboriginal Studies in 1974.

Despite its relative down-playing of contemporary material culture, whether of outback communities or town and city, in many ways it seems to me that the AACG stands up well in comparison to the exhibits in other institutions. One may cite attempts in Melbourne, Canberra and Sydney to make the 'today' as well as the 'yesterday' of indigenous Australia intelligible to a world in which *we* not *they* are the 'other'. By

and large, these seem to have succumbed to the tyranny of the designer, liberally assisted by more than a touch of political correctness, not to be confused with sensitivity towards indigenous concerns, a sensitivity which clearly suffuses much of the AACG.

Consider in contrast *Bunjilaka* at the new mega-Museum of Victoria (which sidelines the archaeological perspective—Russell 2000), the 'Gallery of First Australians' in Canberra's National Museum of Australia (which opened in March 2001—for a brief description see: Anon. 2001 and for a less-than-enthusiastic review see



FIGURE 2. Level 2, Australian Aboriginal Cultures Gallery, South Australian Museum, showing Play exhibit, 'The kukuru game'. Photo © South Australian Museum.

Mundine 2001), or the first to redesign its public galleries, the Australian Museum in Sydney. All three demonstrate a clear polemic in favour of a number of contemporary issues, a matter by no means shirked in Adelaide's AACG. While these other new displays rate ten out of ten for presenting 'The Important Issues', they get barely a pass mark for presentation. In Canberra, the individual cases with their heavy stainless steel frames, and small objects often dominated by metal supports, together with the general open-plan design of the Museum, may be summed up in one word—'unsympathetic'. It is a relief to move into the reserve collections and return to the principles of open storage.

After all, there is nothing that dates so quickly as fashions in design. Certainly one can only admire, tinged with envy, the obviously generous publication budget available to the National Museum but, just as in its current displays (which seem at times to be closer to street theatre than to the stereotypical serried ranks of glass museum cases), there are some odd omissions. To produce a catalogue (Taylor 2001), let alone an exhibition, showing concepts of the land as seen through

contemporary indigenous art which includes neither the acrylic paintings of the Centre nor Hermannsburg watercolours is taking innovation too far.

Adelaide's AACG is in certain ways a surprisingly old-fashioned display. Examine the division into technological themes (Figure 2) such as boomerangs, spears, glue (vital indeed, since the development of adhesive permitted, for example, the manufacture of multibarbed projectiles), baskets, drugs, stone tools, watercraft (a popular item with younger visitors), string and fire (fire that can destroy and can regenerate life). In view of the fact that Philip Clarke started out his professional life as a biologist, it is no surprise that this taxonomic-cum-evolutionary approach should be to the fore.

Thus the AACG, despite its apparent 'modernity', may be likened to the displays in the South Australian Museum's Pacific Gallery. Further afield, one could point to the older displays at the Pitt Rivers Museum of the University of Oxford, which still reflect the principles of cataloguing and display by type of object (Figure 3) established by the museum's

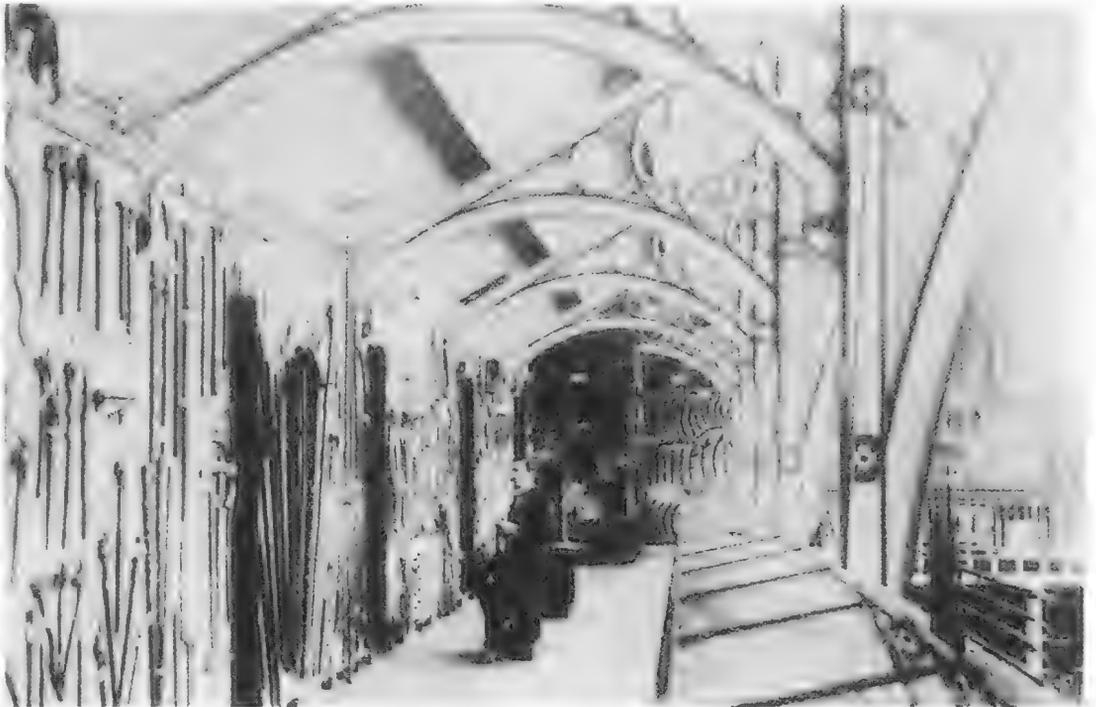


FIGURE 3. Pitt Rivers Museum, University of Oxford. Henry Balfour working on the weapons displays in the Upper Gallery, c. 1890. Photo: © Pitt Rivers Museum, University of Oxford.

original benefactor, Lieutenant General Augustus Henry Lane Fox Pitt Rivers (1827–1900). He espoused the then new principles of sociocultural evolutionism, or ‘applied anthropology’ as he called it. In the context of considering under what terms he might leave his collection to the Nation on his death, he declined to make any special stipulations about ‘the arrangement of the objects’:

If my system were accepted by men of science, it would be continued. If it were not, there would be no object in continuing it. Moreover, views become so much changed as knowledge accumulates that it would be mischievous to hamper the future with ideas of the present (quoted by Chapman in Cranstone & Seidenberg 1984: 16; see also Bowden 1991: 50–51, Petch 1996).

Thus he expressed his confidence that his system was scientifically objective and would stand the test of time. *Plus ça change . . .*

Classification, as we have already noted, is indeed what museums are about and there are continuing debates as to how to do it, especially in the area of (what it is no longer fashionable to call) ‘ethnographic displays’. In a very perceptive essay born of the author’s experience of the British Museum’s Museum of Mankind—currently being returned to its Bloomsbury home—Durrans considers differing approaches to the re-presenting (rather than representing) of cultures undergoing change. ‘Museums are increasingly criticized not only for the way they represent certain themes in exhibitions, but also for their choice in the first place’ and he adds, ‘appreciating the social and cultural setting of an object does not exhaust and is not a substitute for an appreciating of the object itself’ (Durrans 1988: esp. pp.155–158; on ethical issues and the use of photo archives see also Pinney 1989).

Michael Ames, the Canadian anthropologist and museologist, has frequently argued for ‘empowerment’ of those who in the past have so frequently been denied access to the strong rooms of their own material past, our museums. In 1976 Ames introduced in the University of British Columbia’s Museum of Anthropology—surely one of the world’s most perfectly sited public buildings—his system of visible storage.

The system operates like a large library or supermarket, with the exception that customers can handle objects only under staff supervision; meanwhile, they have unhindered visual access to collections *and to the catalogue data* (Ames 1992: 91, my emphasis).

And this is the difference. In Adelaide it is fine to have the opportunity not only of regular guided tours but, in particular, the resources of the Indigenous Information Centre. In the displays however, as we have already observed, it is visible information that is really noticeable by its absence, being either difficult to find or to read once found, or simply not there (for example, the 31 shields and the 13 feather decorations on the west wall of Level 2). It seems writ large over every designer’s CAD screen ‘Thou shall not use one word when you can get away with none’. The AACG’s labels, where they exist, are restricted to the briefest of information as to provenance and accession and it has become a truism of museum best practice that one underestimates at one’s peril the power of language to marginalise (Coxall 2000).

It is not enough to provide that 21st century equivalent to the fair ground fruit machine – the touch-screen. As recent research into the effect of early introduction to computers on learning skills has shown, it is often detrimental, rather than of assistance, to understanding. On my half-dozen or so visits since the Gallery opened, I have overheard at the Museum Shop requests for ‘more on the Aboriginal Gallery’ or ‘Haven’t you got something about the Yuendumu doors?’ There is of course, but bilingual texts don’t attract your average museum visitor wanting to know more but not *that* much more (see Warlukurlangu Artists 1987). Too many museum institutions underrate the public’s desire for portable information, the movable relic, the link with the artefact. It is rare to find in museum visitors’ books comments that echo Samuel Goldwyn Jnr’s Philistine cry: ‘Don’t confuse my mind with facts—it’s already made up’.

Commencing with the wall of portraits, the still images as well as archival film employed in the displays represent but the tip of another resource iceberg. The danger is that the archival images, like icebergs, can ‘sink the ship’. It may well be argued that photography retains a certain immediacy, an assurance of contextual truth and realism which can assist the appreciation of the object better even than three-dimensional reconstructions which, however realistic, remain just that. But the camera captures only an aspect of truth. For one thing, as soon as the photograph has been taken it becomes an historical document (and for some people irrelevant or, worse, mistaken as a representation of the present). Further, we see the subject not through the lens of the camera so much as through the eyes of the

photographer, a particular human being with his or her own cultural inheritance and assumptions. The best that can be hoped for is that the viewer can perceive *what* it was that drew the photographer's attention at that particular place and at that moment in time.

For many people, Baldwin Spencer's pioneering images of the turn of the 20th century, or Tindale's of no more than a generation ago, have become (mere) historic curiosities; they have started to represent just that kind of exotica which is what first attracted museums to collect. David Attenborough, who has done so much to broaden our horizons to encompass much of what has heretofore lain outside our normal ken, is still within the tradition of the exotica hunter.

We are reminded when we look at such technically superb still images as those produced by Charles Mountford or Axel Poignant, or more recently Penny Tweedie, that there is the *aesthetic* intent in photography to consider as well. In a study of a curator from the American Museum of Natural History who collected and photographed in the Congo before World War II, Mirzoeff (1998: 169) notes how the

photograph is transformed by intimacy from a document into art...Any reading of photography is dogged by the cultural construction of the photograph as either observed truth or transcendent art.

Conscious of this dilemma, the Edwards Report advises:

Great care must be taken to associate the audio-visual presentation directly with actual objects and displays in the museum, so it is not just an event in its own right, but also an integral part of the museum (Edwards 1981: 90).

Not so much a case of *caveat emptor* as 'beware anthropologists bearing cameras and exhibition teams waving photographs'.

One may add here that something of the same kind of problem of creation and control arises in the recording and subsequent storage of sound. Why is it that the archival voice-overs of the early film used in the AACG sound stilted, foreign, almost exotic in contrast to the immediacy, the 'relevance' of the indigenous talking heads? It is not just a matter of improved recording technology and playback facilities. 'Imagination' and 'political motivation' have been emphasised as being essential in exploiting the immense possibilities of recorded sound in the museum setting (Silver 1988: 194).

Despite the explicit statements of intent already

quoted, there is in fact something of a lack of detail in the philosophy behind the AACG. I do not know what sort of comparative research went into planning the AACG. If one were to look for prior guidance, despite the obvious common ancestry in the colonial foundations of our older museums and the best efforts of COMA (the Conference of [Australian] Museum Anthropologists), there has been comparatively little published in Australia on various aspects of museums and material culture, in contrast with the situation overseas. To whole volumes in the field one must add the admirable journal produced by the Museum Ethnographers Group in the United Kingdom, which I have had cause to cite at various points in this review (Barringer & Flynn 1998; Pearce 1989; Shelton 1997; compare Mulvaney 1990).

As to how the punters have reacted to this, the greatest—and, praise be—free show in Adelaide, why in fact they come at all, or why many of them do not first make a bee-line for the fossils and the much overrated Egyptian Room (a protected heritage site not so much because of the Ptolemaic—and frankly hideous—mummies but rather because the room is such a perfect example of museum display techniques c. AD 1940), these are questions to which as yet there are no answers.

According to the Museum, over 850 000 people have come through its doors during the 16 months since its re-opening, but it is not known how many of those visited the AACG, nor is there any information as to age, socioeconomic grouping or ethnicity. We know that there have been around 25 000 school children through the AACG during the same period and several hundred enquiries made at the Indigenous Information Centre; we do not know what sales of specifically indigenous Australian titles there have been at the Museum Shop strategically placed immediately to the left of the main entrance, though I have a shrewd idea that anything to do with dinosaurs would win hands down.

Certainly there is nothing available which is on a par with Merriman's (1989) examination of a decade ago as to the role that museum visiting plays in British culture. The total lack, as yet, of any information about the AACG in general or its component parts, in any language other than English, says little for the Museum's marketing department or its image in a multicultural world—though the Museum Shop sports copies of Wally Caruana's 1993 introduction to indigenous Australian art, in both German and French. Perhaps one needs to consider more the role of

the museum shop in our museums, again something which has been discussed for a number of years in the United Kingdom and elsewhere (White 1996, 2001).

Yet in one of a handful of serious reviews devoted to the AACG, or for that matter to any other display (on this lack see Wehner 2001), John Kean, far from decrying what he terms 'the traditional values of scholarship, the primacy of the collection and the legacy of the institution's

own history', concludes that 'the brave mood to run counter to the contemporary museological currents has resulted in an exhibition of sustained power and surprising emotive force' (Kean 2001).

Over all is the image and the voice of Norman Tindale, the butterfly collector turned anthropologist whose position in the annals of indigenous Australian studies has been assured by nearly 50 years of devotion to the life—past, present and future—of Aboriginal society and

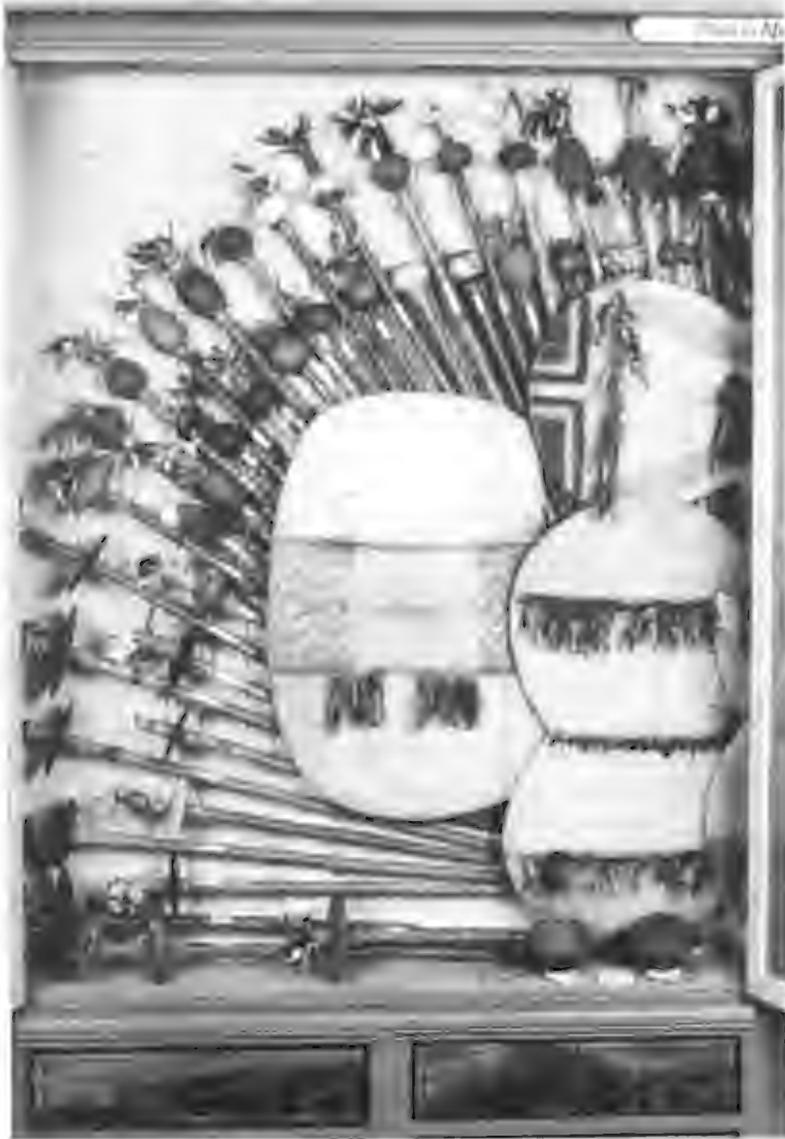


FIGURE 4. South Australian Museum, Pacific Cultures Gallery. Part of display of shields and stone-headed clubs from Central Province, Papua New Guinea. Photo: Barry Craig, 1998.

culture. Tinny's legacy is prodigious but Philip Clarke and his collaborators have produced something of which all who are interested in indigenous culture can be proud. Clarke (2001) is surely right when he comments:

The future challenge for the South Australian Museum is to maintain the relevance of the material it displays. Given the flexibility of the design and the use of the 'Speaking Land' interactives, it should be possible for future curators to reinvigorate the display without going through a total reinstallation.

Mindful of Pitt Rivers' words quoted above, we should remember that a truly static display is a dead display. By the terms of the definition with which I started this article, the AACG team has done well. While I hope that there will indeed be scope for revision and alteration in the years to follow (especially with regard to the 'bookends'),

the Australian Aboriginal Cultures Gallery should remain as a visible example of further movement towards indigenous empowerment together with maintenance of the highest standards of conservation and scientific enquiry—in other words, just what reconciliation should be all about.

A final thought: we have waited a long time for the Australian Aboriginal Cultures Gallery to become a reality. How much longer will we have to wait until the 'foreign' ethnographic collections are given the same makeover? (Figure 4). The disruption to that Gallery caused by the alterations to the buildings in 1999 have not been made good, with at least a third of the exhibits lacking information labels of any kind. And chicken wire has surely had its day as a feature at the cutting edge of display technique.

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ELASMOSAUR (REPTILIA : PLESIOSAURIA) BASICRANIAL REMAINS FROM THE EARLY CRETACEOUS OF QUEENSLAND

BENJAMIN P. KEAR

Summary

A near complete basioccipital and associated elements belonging to a juvenile elasmosaur are described from the Early Cretaceous (upper Albian) of northern Queensland. This is the first record of well-preserved elasmosaur basicranial remains from Australia. The basioccipital is comparable to those known from other elasmosaurs but is unusual in the contribution of the exoccipital-opisthotic facet to the margin of the occipital condyle (but not to its articular surface) and dorsal termination of the condylar groove. The significance of this morphology is discussed.

ELASMOSAUR (REPTILIA: PLESIOSAURIA) BASICRANIAL REMAINS FROM THE EARLY CRETACEOUS OF QUEENSLAND

BENJAMIN P. KEAR

KEAR, B. P. 2001. Elasmosaur (Reptilia: Plesiosauria) basicranial remains from the Early Cretaceous of Queensland. *Records of the South Australian Museum* 34(2): 127–133.

A near complete basioccipital and associated elements belonging to a juvenile elasmosaur are described from the Early Cretaceous (upper Albian) of northern Queensland. This is the first record of well-preserved elasmosaur basicranial remains from Australia. The basioccipital is comparable to those known from other elasmosaurs but is unusual in the contribution of the exoccipital-opisthotic facet to the margin of the occipital condyle (but not to its articular surface) and dorsal termination of the condylar groove. The significance of this morphology is discussed.

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Examination of juvenile elasmosaur remains (AM F87826) from the Early Cretaceous of Queensland has revealed a previously unrecognised near complete basioccipital. This represents the first record of well-preserved elasmosaur basicranial remains from Australia. The cranial remains of Australian elasmosaurs are extremely rare, being confined to a single badly crushed skull (QM F11050) in which the basicranium is obscured by overlying elements and matrix. This specimen was tentatively attributed to the genus *Woolungasaurus* by Persson (1982); however, Thulborn & Turner (1993) reassigned it to Elasmosauridae indet., following Welles (1962) who considered *Woolungasaurus* a *nomen dubium*. A small tooth-bearing bone interpreted as a plesiosauroid maxilla by Longman (1935) was shown to be an ichthyosaurian premaxillary, maxillary or dentary fragment by Persson (1960). This paper describes the recovered basioccipital and associated elements of AM F87826, and provides a brief character analysis of plesiosaur basioccipital morphology.

Cranial terminology follows Andrews (1910, 1913), Brown (1981) and Cruickshank (1994). Institutional abbreviations: AM, Australian Museum, Sydney; QM, Queensland Museum, Brisbane; UWA, University of Western Australia, Perth. All measurements were taken using callipers and are in millimetres (mm).

SYSTEMATICS

Class REPTILIA

Subclass SAUROPTERYGIA Owen, 1860

Order PLESIOSAURIA de Blainville, 1835

Superfamily PLESIOSAUROIDEA (Gray, 1825) Welles, 1943

Family ELASMOSAURIDAE Cope, 1869

Elasmosauridae genus and species indet.

Material

AM F87826, a partial neck and base of skull including the basioccipital, at least 33 cervical centra, parts of the neural arches, several partial cervical ribs and miscellaneous fragments. Lack of fusion between basicranial elements and associated vertebral centra, neural arches and cervical ribs indicates that the specimen is a juvenile.

Locality

'Dunraven' Station, near Hughenden, central-northern Queensland. Toolebuc Formation, upper Albian (Day 1969; Smart & Senior 1980).

Diagnosis

Basioccipital condyle with a squared dorsal margin and heart-shaped condylar outline. Exoccipital-opisthotic facets of the basioccipital contribute to the occipital condyle margin but do not form part of the condylar surface. Groove circumscribing the basioccipital condyle terminates dorsally at the posterolateral edges of the exoccipital-opisthotic facets. Cervical centra platycoelous with articular surfaces having an open V-shaped cross-section and margins which form an abrupt angle with the centrum sides. Length of the anterior cervical centra is greater than their height. Lateral surfaces of cervical centra bear distinct longitudinal ridges.

*Description**Basioccipital.* (Fig. 1, Table 1).

The basioccipital has suffered damage to the left pterygoid facet but is otherwise well preserved. The anterior basioccipital surface is dominated by a prominent, deeply rugose facet

TABLE 1. Measurements (mm) of basioccipital AM F87826, * - not including missing pterygoid facet portion

Description	mm
Total length	29.3
Total width*	34.9
Width across exoccipital-opisthotic facets	24.4
Condyle diameter	19.8

for contact with the basisphenoid. This is dorsoventrally compressed and reniform in outline, extending partly onto the anteroventral surface of the basioccipital. The dorsal-most facet margin is produced into a narrow transverse ridge, which borders the posteriorly inclined anterodorsal surface. This bears a prominent circular depression with median pit probably representing part of the posterior wall of the pituitary fossa or dorsum sellae (Cruickshank 1994). Chatterjee & Small (1989)

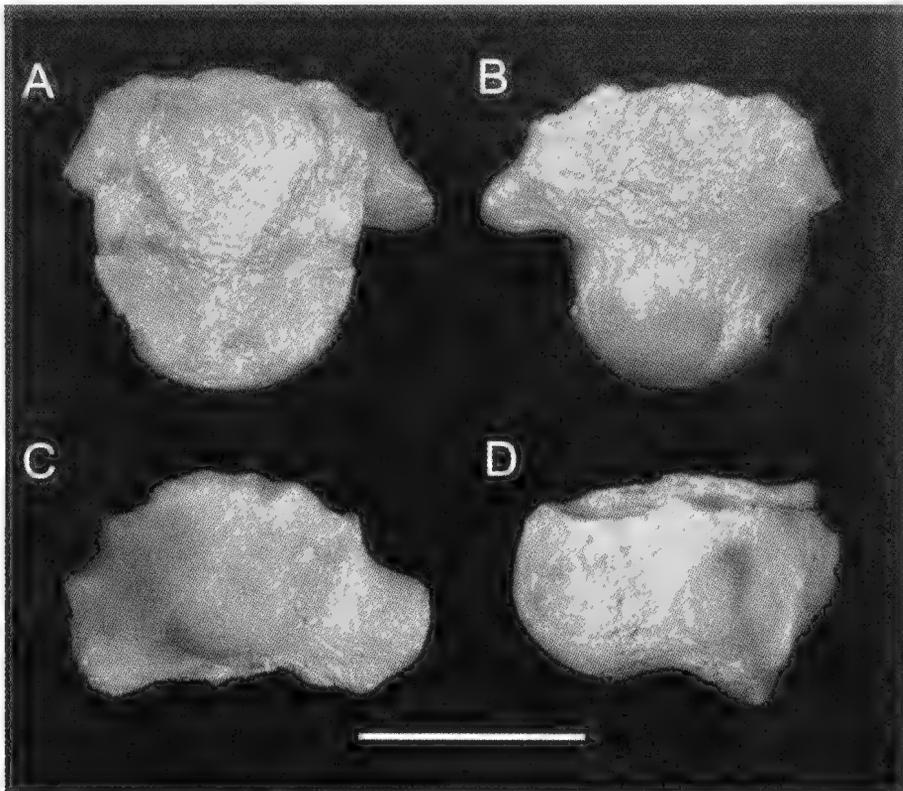


FIGURE 1. Basioccipital of AM F87826 in (A) dorsal, (B) ventral, (C) posterior and (D) lateral views. Scale bar is 20 mm.

interpreted a similar pit in the basioccipital of *Morturneria* (from the Maastrichtian of Antarctica) as representing the 'hypophyseal-basiscrania' fenestra. The anterodorsal circular depression is medially subdivided by a shallow vertical groove and bordered laterally by deep longitudinal channels. These extend posteriorly onto the rugose dorsal surface. The dorsal surface of the basioccipital bears a pair of broad ovoid facets for the exoccipital-opisthotic elements, which form part of the condylar margin but do not contribute to the articular surface (comprised entirely of the basioccipital). Between the exoccipital-opisthotic facets is the spindle-shaped floor of the endocranial cavity. Anteriorly, this expands into a raised triangular plateau, which bears a shallow longitudinal depression (extending to a notch in the anterodorsal margin of the dorsum sellae) possibly representing the sella turcica (see Welles & Bump 1949). Anteriorly, the exoccipital-opisthotic facets are separated from the small circular prootic facets by low transverse ridges. The anterior prootic facet margin is raised and irregular suggesting the presence of cartilage, possibly supporting a forward expansion of the prootic onto the basisphenoid. The anterolateral basioccipital surfaces are produced into short, massive pterygoid processes, which terminate in anterolaterally oriented, triangular pterygoid facets. The pterygoid facet surfaces are smooth and separated anteromedially from the rugose basisphenoid facet by a prominent vertical flange. The basioccipital condyle is rounded, lacks a notochordal pit and is weakly heart-shaped in outline, with the squared dorsal margin forming the edge of the foramen magnum. The condylar surface is partly circumscribed by a shallow groove which terminates dorsally at the posterolateral edges of the exoccipital-opisthotic facets.

Axial skeleton. (Fig. 2, Table 2).

At least 33 complete to fragmentary cervical vertebrae have been recovered, representing portions of the anterior (Figs 2A, 2B), middle (Figs 2C, 2D) and posterior (Figs 2E, 2F) cervical series. Fragmentary remains of the neural arches and some cervical ribs are also preserved. The anterior cervical centra are cylindrical and somewhat dorsoventrally compressed with centrum length always exceeding the height. This trend is lost in the middle and posterior cervical series where the centrum width exceeds the

length. There is a marked increase in overall size of the cervical centra from the anterior to posterior section of the neck.

The articular surfaces of the centra are platycoelous, smooth and ovoid in outline, becoming near elliptical posteriorly. In transverse cross-section, the articular surfaces of all centra are an open V-shape, with the margins of the face forming an abrupt angle with the centrum sides. A small notochordal pit shallowly indents the centre of each articular surface. Dorsally, each centrum bears a prominent median hourglass-shaped

TABLE 2. Measurements (mm) of AM F87826 vertebral centra. Numbering of centra begins at the anterior-most and does not include the atlas or axis. A gap including an unknown number of centra is present between C27 and C28. * - centrum represented only by fragments

Element	Length	Width	Height
C1	24.9	22.2	17.7
C2	26.4	22.9	19.1
C3*	-	-	-
C4	-	-	21.5
C5	-	-	28.1
C6	39.4	-	26.4
C7	42.9	-	29.4
C8	-	33.5	22.2
C9*	-	-	31.1
C10	49.8	-	33.9
C11	61.3	-	-
C12*	-	-	-
C13	-	-	52.4
C14	63.6	-	-
C15	62.7	70.8	49.8
C16	67.4	-	50
C17	65.1	74.7	53.9
C18	64.8	73.9	53.1
C19	-	75.6	-
C20	65.2	74.5	54.3
C21	67.1	-	55.9
C22	66.8	78.7	56.4
C23	67.8	78.5	56
C24	66.7	80.1	-
C25	67.7	78.3	56.8
C26	66.7	79.3	-
C27	61.6	91.3	58.9
C28*	-	-	-
C29*	-	-	-
C30	54.2	85.2	50.2
C31	-	80.6	-
C32	44.2	90.6	60.4
C33	57.4	93.1	61.2

depression marking the neural canal. In the anterior-most vertebra, this becomes transversely narrow towards the anterior margin of the centrum where the depression is bordered laterally by the large ovoid facets for the neural arches. The neural arch facets are deeply concave and situated close to the anterior margin, becoming more centrally placed and extending to the edges of both the anterior and posterior articular facet rims in successive centra. The neural arch facets are separated ventrally from the elliptical cervical rib facets by the deeply concave lateral centrum surface. The lateral surface of each centrum bears a distinct longitudinal ridge. The rib facets are

raised, deeply concave and situated close to the posterior articular rim. The ventral surface of each anterior centrum is markedly concave and bears paired nutrient foramina separated by a broad median-ventral keel. The nutrient foramina become progressively more laterally placed in successive vertebra with a corresponding reduction in prominence of the mid-ventral keel.

The neural arches are fragmentary but preserve parts of the neural arch body and neural spines. The neural arches possess thin lateral walls enclosing the neural canal, and deeply excavated anterior surfaces. The anterior excavation is tall and elliptical in outline with a narrow median

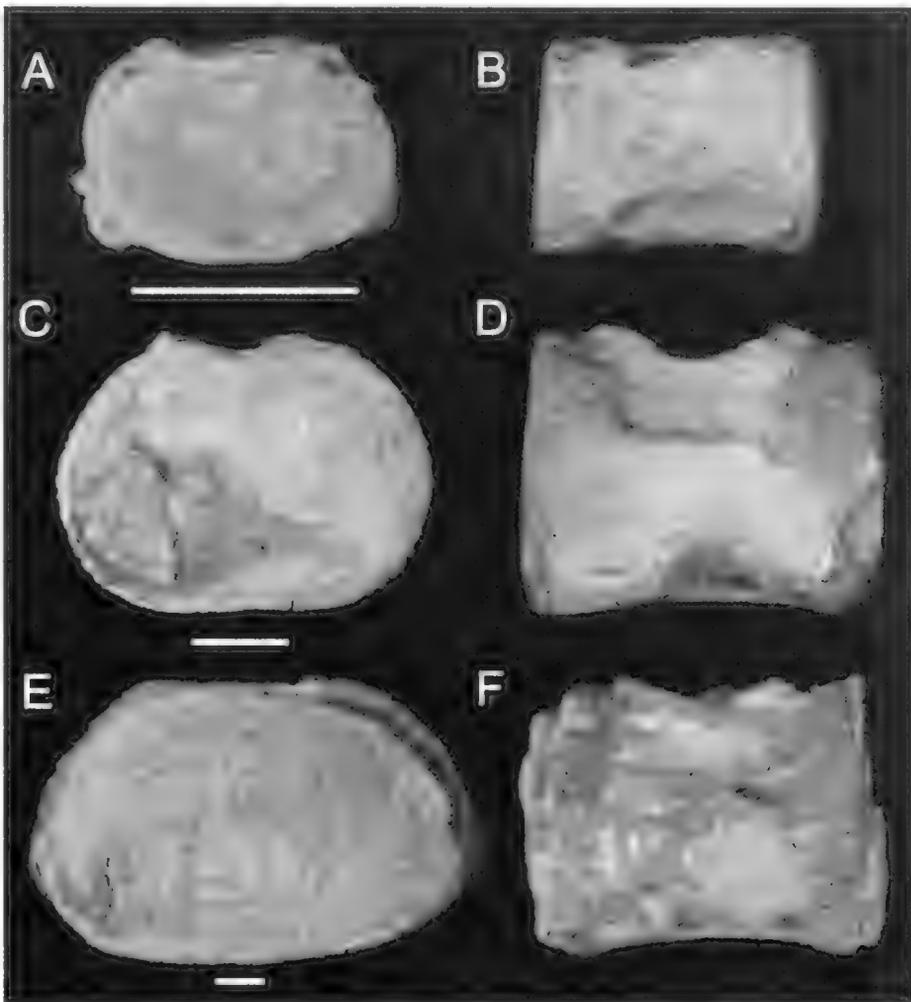


FIGURE 2. AM F87826 anterior (C2) cervical centrum in (A) anterior and (B) lateral views; middle (C15) cervical centrum in (C) anterior and (D) lateral views; and posterior (C27) cervical centrum in (E) anterior and (F) lateral views. Scale bars are 20 mm.

vertical septum. The neural spine fragments are strongly transversely compressed and elliptical in cross-section.

All recovered cervical ribs are fragmentary and lack unequivocal associations with the centra. The cervical ribs are all single headed with anteroposteriorly elongate and ovoid articular facets. The articular facet surface is concave and finely pitted with slightly flared flange-like margins. The rib shafts are dorsoventrally compressed and elliptical in cross-section.

Remarks

AM F87826 is comparable in its vertebral morphology to Cretaceous elasmosaurid material from elsewhere in Australia (eg Persson 1960, 1982; Murray 1987), particularly isolated remains from unspecified (probably Albian) deposits near Oodnadatta (Freytag 1964), and the Neales River region (SAM P6181, Persson 1960), South Australia; and the Late Cretaceous (Cenomanian–Turonian) Molecap Greensand, Western Australia (UWA 22034, Long & Cruickshank 1998). All of these specimens exhibit proportionately short posterior cervical centra.

AM F87826 can be assigned to Elasmosauridae indet. on the basis of: (1) platycoelous articular surfaces on the cervical centra. The presence of platycoelous articular surfaces is considered an elasmosaurid synapomorphy by Brown (1981, 1993) and Bardet et al. (1999). The character-state is also known to occur in the Maastrichtian cryptoclidid *Morturneria* (Chatterjee & Small 1989), however this taxon has more recently been reinterpreted as a derived elasmosaurid (Bardet et al. 1991); (2) articular surfaces of cervical centra with open V-shaped cross-section and margins which form an abrupt angle with the centrum sides. This is an apomorphic state potentially uniting all members of the Elasmosauridae (Brown 1993; Bardet et al. 1999) and can be distinguished from the plesiomorphic condition in cryptoclidids and plesiosaurids, in which the articular surfaces are sigmoidal in cross-section with a raised convex rim (Brown et al. 1986; Brown 1993); (3) anterior cervical centra with length greater than their height. The presence of anterior cervical centra which are elongate relative to their height is an unequivocal synapomorphy of all elasmosaurids (Welles 1952; Brown 1993; Bardet et al. 1999); (4) lateral longitudinal ridges on the cervical centra. Prominent longitudinal ridges are present on the lateral surfaces of the cervical centra in all elasmosaurids, representing a potential synapomorphy for the group (Welles 1943, 1952, 1962; Brown 1993; Bardet et

al. 1999). Brown (1981), however, noted that the feature is variable with ontogeny, being less well developed in younger individuals.

COMPARISONS AND DISCUSSION

AM F87826 is comparable in its basioccipital morphology to other elasmosaurs, particularly *Libonectes* which also exhibits a squared dorsal condylar margin and heart-shaped condylar outline (Carpenter 1997). The specimen is unusual, however, in the exoccipital-opisthotic facets participating in the condylar margin, and subsequent dorsal termination of the condylar groove. This differs from the common condition in elasmosaurs, and most other plesiosauroids, in which the condylar groove completely circumscribes the occipital condyle, excluding it from contact with the exoccipital-opisthotic facets (Welles 1962; Brown 1981; Bardet et al. 1999). Exclusion of the exoccipital-opisthotic facets from the condylar rim is also known to occur in nothosaurids (Rieppel 1994). A character-state similar to that of AM F87826 is present in the Rhaetian/Hettangian taxon *Thalassiodracon* (Storrs & Taylor 1996) and the Maastrichtian *Morturneria* (Chatterjee & Small 1989). Such comparable morphology may be the result of convergence in the case of *Thalassiodracon* (as suggested by the presence of the plesiomorphic condition in nothosaurids and most plesiosauroids including elasmosaurids); however, the recent reclassification of *Morturneria* as a derived elasmosaurid (Bardet et al. 1991) does raise the possibility of homology. Distinct condyle–facet contact is also known to occur in *Cryptoclidus* (Andrews 1910; Brown 1981), *Kimmerosaurus* (Brown 1981), *Euryclidus* (Cruickshank 1994) and pliosaurids (Andrews 1913) but involves contribution of the exoccipital-opisthotic to the basioccipital articular surface and absence of a distinct condylar groove. AM F87826 can therefore be interpreted as autapomorphic in its condylar morphology.

Incomplete dorsal closure of the condylar groove may, alternatively, represent an ontogenetic feature similar to the variable groove development present in juvenile specimens of *Muraenosaurus* (Brown 1981). Complete separation of the exoccipital-opisthotic facets and occipital condyle in all growth stages of *Muraenosaurus* (Brown 1981), however, supports interpretation of the facet–condyle contact in AM F87826 as a potentially apomorphic character state.

Molnar (1991) suggested that Australian plesiosaur faunas lacked extensive regional endemism and were composed of largely cosmopolitan forms. While this is almost certainly true for higher taxonomic categories, the presence of potentially autapomorphic elasmosaur remains suggests that at least some distinct taxa may have inhabited the Australian epicontinental seaway and surrounding coastal regions of eastern Gondwana during the Early Cretaceous.

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WARRABARNA KAURNA! RECLAIMING AN AUSTRALIAN LANGUAGE

PHILIP A. CLARKE

Summary

For many indigenous communities living in former European colonies, cultural change occurs on several fronts, such as with language loss, cessation of religious practices, decline in artefact and art traditions, the movement away from key places in the landscape, and the loss of biological distinctiveness through intermarriage and population decline. And yet, even for parts of the world where all of this has to a large degree occurred, the descendants of some pre-European indigenous groups remain today with some level of group identity.

WARRABARNA KAURNA! RECLAIMING AN AUSTRALIAN LANGUAGE.

Rob Amery. 2000. *Multilingualism and Linguistic Diversity Series 1*. Swets & Zeitlinger Publishers, Lisse, The Netherlands. 290 pp. Reviewed by Philip A. Clarke.

For many indigenous communities living in former European colonies, cultural change occurs on several fronts, such as with language loss, cessation of religious practices, decline in artefact and art traditions, the movement away from key places in the landscape, and the loss of biological distinctiveness through intermarriage and population decline. And yet, even for parts of the world where all of this has to a large degree occurred, the descendants of some pre-European indigenous groups remain today with some level of group identity.

In *Warrabarna Kaurna!*, Rob Amery provides a cultural history of the Kaurna Aboriginal community, whose members are the descendants of indigenous people living on the Adelaide Plains before British settlement began here in 1836. Chapters 1–3 provide a background to the linguistic literature on language reclamation, including non-Australian examples. The following two chapters, 4–5, provide a history of the Kaurna people and how their language and traditions were recorded by Europeans. The next five chapters, 6–10, deal with the Kaurna language reclamation attempts and their significance to the re-emerging Adelaide Aboriginal identity. Chapter 11 is the summary and conclusion. The book is richly endowed with maps, plates, graphs and tables.

Amery has had extensive experience with researching and teaching Aboriginal languages. He has been involved in a number of workshops on Aboriginal language reclamation and since 1997 has run the Kaurna Language and Language Ecology course at Adelaide University. Although the impact of language loss occurs widely to varying degrees across Aboriginal Australia, Amery has based his study in an area where the local Aboriginal groups have suffered much.

In the 'settled regions', generations of Aboriginal people were largely absorbed into the European community due to economic and social pressures or, until the mid 1960s, given a broader identity as marginalised Aboriginal people living as wards of the state. Starting in the late 1970s, many of their descendants have reclaimed their identity, marking a period of cultural revitalisation (Berndt 1977, Keen 1988). The descendants of the Aboriginal hunters and gatherers who lived on

the Adelaide Plains are one such group, referring to themselves as Kaurna people. Similar revivals have occurred elsewhere in the world, in particular North America (Clifford 1988). How much of this contemporary culture is due to an unbroken connection with the past, or to what degree it relies on an identity largely regained through external sources such as historical records and museum artefact collections, is debatable.

Warrabarna Kaurna! is a study of the rebuilding of a particular Aboriginal cultural identity, once considered vanished forever. Although Amery is deeply sympathetic towards the aspirations of contemporary Aboriginal people in being recognised as having a valid cultural identity, he nevertheless acknowledges the complex interplay of sources which produce the modern beliefs and perceptions of the Kaurna community. Amery brings Aboriginal cultural revitalisation into focus by studying an attempt by Aboriginal and non-Aboriginal agencies to reclaim an Aboriginal language.

When Europeans arrived in Australia, there were many Aboriginal languages. Estimates by linguists range from 150 to 650, depending on how one defines 'language' (Blake 1981, Yallop 1982). These indigenous languages are today threatened as more and more Aboriginal people adopt Aboriginal Pidgin English and creoles (Kriol) as their primary means of communicating (Wurm et al 1996). Many languages have vanished entirely. In temperate regions, where British settlement was most concentrated, the forms of speech used by Aboriginal people today approach standard Australian English. Amery concedes that the chances for a complete reversal of this process are slim. Despite this, he recognises that the study of indigenous languages has broad cultural importance, rather than being merely of linguistic interest. As stated in the foreword by Lester-Irabinna Rigney, a Kaurna descendant, 'the languages of colonised peoples cannot be meaningfully discussed outside the context of imperialism, colonialism and neocolonialism'.

It is in the context of the contemporary significance of the Kaurna language that Amery enters the debate about the use of terms such as

'extinct', 'dead' and 'sleeping' for forms of speech that have largely survived through recordings made by Europeans in the 19th century. *Warrabarna Kurna!*, which means 'Let Kurna be spoken', is about using the Kurna language to gain an insight into the pre-European indigenous culture and extending its use into a modern cultural context. Amery places the 'ownership' of the language in the hands of Aboriginal people who have identified genealogical links with the pre-European landscape of the Adelaide region, although he acknowledges that its development from the 1990s springs from a collaboration with non-indigenous people, such as linguists.

The Aboriginal culture of the Adelaide Plains has been elusive for many authors, partly due to the early demise of the local Aboriginal population with the onset of European settlement and through the impact of other Aboriginal cultural groups with whom the Adelaide people merged during the historic period (Clarke 1991a). By the early 20th century, the Curator of Ethnology at the South Australian Museum, Norman Tindale, was able to locate only a few Aboriginal people who were knowledgeable of what he considered as the 'traditional' pre-European culture of the region (Tindale 1974: 60–61, 213; Tindale & Mountford 1936: 500–501; Tindale & Pretty 1980).

Based upon his research, and with the aid of the now outdated 'tribe' theory, Tindale introduced and promoted the use of 'Kurna' to describe the cultural group encountered by German missionaries, such as Christian Teichelmann and Clamor Schürmann. He used 'Kurna' despite the fact that the Aboriginal informants of Teichelmann and Schürmann used different terms for themselves that were based upon smaller territorial units (Clarke 1991b). Although the exact origin of the term 'Kurna' is in question, with some suggestion that it is based on the Lower Murray word *korna*, for 'man', it is nevertheless a useful word when referring to the pre-European Adelaide inhabitants. *Warrabarna Kurna!*, which is the published form of Amery's much larger PhD thesis, provides a compendium of everything currently known to have been written about the early Aboriginal culture of the Adelaide Plains as it was encountered by the first Europeans to settle in South Australia.

Contrary to popular opinion in Australia today, Aboriginal people in pre-European times did not have a collective consciousness of being 'Aboriginal', or even a term covering this notion. Instead, there were numerous descent groups and language communities that in certain situations may have been defined in opposition to corresponding groups. Upon European invasion, the nature of group identity was radically altered. For instance, in the pre-European period it is likely that the Adelaide people would have been too culturally divergent from the Lower Murray people to be considered as having a sense of identity with them. Nevertheless, after British colonisation, many Aboriginal groups that were formerly distant, both socially and geographically, were placed in contexts where joint identity became possible or was even enforced by the welfare authorities.

As the Australian Aboriginal landscape was transformed to make agriculture possible, many Aboriginal people were removed to missions, such as Point McLeay in the Lower Murray and Point Pearce on Yorke Peninsula, or lived on pastoral properties and government stations. The population of the missions in southern South Australia was made up of Aboriginal people from northern South Australia, West Coast, Eyre Peninsula, Yorke Peninsula, Mid North, Adelaide, Murray Basin, Lower South-East and possibly even Tasmania.¹ Since breaking from their hunting and gathering past and becoming part of a rural landscape, southern Aboriginal people have primarily drawn their identity from their 'mission' homes (such as Koonibba, Point Pearce and Point McLeay), rather than from their pre-European background. Based on the shared elements of their history, these regional identities merge when southern Aboriginal people refer to themselves as 'Nungas' (pronounced 'Nangars').

By the 1980s, when several Aboriginal individuals living in Adelaide began to embrace Kurna identity, most Aboriginal people in southern South Australia had links to several areas across the State. Amery (2000:8) states 'For many older Kurna people, their primary identity remains Narungga [Yorke Peninsula] or Ngarrindjeri [Lower Murray], depending on whether they grew up at Bukkiyana [Point Pearce] or Raukkan [Point McLeay], respectively. For others, especially young people

¹ In addition to Amery's work, these regional links can be discerned from the work of Taplin (1859–79), Tindale (1938–39, 1952–54) and Clarke (1994, chapter 2).

who have grown up in Adelaide, Kaurna identity is all-important.'

Kaurna culture is comprised of elements formulated during the last two decades, with the emergent form being part of a new cultural environment. This new identity is focused on pre-European traditions, but has strong urban, rather than mission, influences. Amery provides an excellent account of the sociopolitical activities that have increased and refined awareness of Kaurna culture. Its revitalisation can be seen with the Kaurna song-writing project in 1990, and since this time by Aboriginal dignitaries using Kaurna vocabulary at official openings of cultural events.

The tension between variable anthropological records and equally variable contemporary Aboriginal perceptions is evident at several points through *Warrabarna Kaurna!*. For instance, the Tjilbruke Dreaming of the extended Adelaide landscape was recorded by several European writers, with most of the accounts in their unpublished form relating to a 'blue crane' ancestor, probably a brolga (Amery 2000: 101–102; Clarke 1991a: 66–68). Nevertheless, the most detailed published version, by Tindale, stated that Tjilbruke (Tjirbruki in Tindale) was a glossy ibis (Tindale 1987; Tindale & Mountford 1936). It is this account which has had the most influence with the contemporary Kaurna community and appears in modern renditions of this Dreaming (Education Department of South Australia 1989: 95–101, 213, 217).

For many readers, a less obvious example of the discrepancy between written and oral histories concerns the Aboriginal traditions of the Pleiades, often referred to as the 'Seven Sisters'. After describing the widespread distribution of such beliefs, including from the Adelaide region, Amery (2000: 103) states that 'Versions still survive amongst some Ngarrindjeri women, having been handed down orally from one generation to the next.' I dispute this statement on the basis of historical and ethnographic work done during the 1980s–90s.

Since the political struggles of the early 1990s, some Aboriginal people with Ngarrindjeri connections have become intensely interested in the 'Seven Sisters'. From my fieldwork experience, the versions of 'Seven Sisters' Dreaming accounts being told by Ngarrindjeri women in the early 1990s were said by them to

have come either entirely, or at least in part, from Western Desert people. This is supported by the literature. In the 19th century, the historical accounts of the Pleiades point to such elements of the Dreaming mythology as a group of men smoking and turkey eggs, although the records of Aboriginal beliefs about the cosmos are scant (Wells 1852–1855: 99).² Ngarrindjeri records of the early and mid 20th century do contain some references to the Pleiades that bear some similarity to the 'Seven Sisters', for example the six girls and one boy of the Yatuka, although they are not stated as siblings (Berndt & Berndt 1993: 163–164; Clarke 1997: 136; Kimber 1997: 229–231). There is also the account of the 'Seven stars' (no identity given) associated with climate (Rankine 1969 cited in Clarke 1994: 123). Nevertheless, these are shallow similarities, so we should be cautious of inferring continuity of belief.

Since European settlement, such widespread mythologies, as in the case of the Pleiades, are learnt not just from local Aboriginal sources, but also from other Aboriginal groups and from the media, as well as from the popular and academic literature. Opportunities for the transmission of ideas are provided by the post-European movements of Aboriginal people, the intermarriage between groups on missions and the engagement of Aboriginal people in broader Australian culture. I would argue that the Pleiades traditions of the 1990s are an example of what some anthropologists have termed the 'invention of tradition' (Hobsbawm & Ranger 1983). New embellishments gain force from contemporary sociopolitical situations, often imparting greater significance to the parent beliefs. Nevertheless, the processes that make them important will often obscure the origin of beliefs. Given that Aboriginal people have not lived in a cultural vacuum since European settlement, and that their culture has not been static but has changed in major ways, there are often other explanations to the evolution of contemporary beliefs that do not necessarily involve transmission through family lines. Studies of contemporary indigenous culture will continue to struggle with the issue of where to draw that blurred line between cultural continuity and transformation.

Warrabarna Kaurna! is well written and illustrated. It provides a useful guide to ethnographic sources on the Kaurna people of the Adelaide Plains. The book also has wider

² See Giles in the *Adelaide Register* newspaper, 5 October 1887.

significance, beyond the Adelaide landscape, giving important insights into the sociopolitical environment in which the modern study and use of indigenous languages is carried on. One of the

aims of the Multilingualism and Linguistic Diversity series in which it is published is the development of and respect for linguistic human rights. Amery's work rates highly in both regards.

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OBITUARY JUNE MAVIS SCRYMGOUR 1920 – 2000

NEVILLE S. PLEDGE

Summary

June Scrymgour was employed by the South Australian Museum for almost 20 years. She achieved curatorship of Minerals before retiring in 1982, and continued in an Honorary capacity for many more years. She died on 23 September 2000, after a long period of worsening illness.

OBITUARY

JUNE MAVIS SCRYMGOUR

1920—2000

June Scrymgour was employed by the South Australian Museum for almost 20 years. She achieved Curatorship of Minerals before retiring in 1982, and continued in an Honorary capacity for many more years. She died on 23 September 2000, after a long period of worsening illness.

June was born in Adelaide on 9 June 1920, the first of three children. Rheumatic fever as a child left her susceptible to strokes late in life. She did not complete high school, but left to work as a short-hand typist in the family hardware business. During World War II June joined the Australian Broadcasting Commission (ABC), and for a time became a radio announcer. After the war, she had several secretarial jobs, but with increasing dissatisfaction because of a frustrated interest in natural history.

In 1963 June applied for and obtained a position in the South Australian Museum, as assistant to the newly-arrived Curator of Geology, Dr David Corbett. Despite her lack of formal training in earth sciences, or even natural history, June threw herself wholeheartedly into the task, making notes of any comments by visiting researchers that were pertinent to specimens they were examining. In this way she built up a basic knowledge of the subject, insofar as it was represented in the collections. Subsequently, June found a love of conveying this information to the general public. A number of sets of minerals or fossils typical of different groups or ages were compiled and mounted in book-file boxes for transport to and display at talks she would give to various organisations and groups. At about this time she undertook night school classes and completed her high school matriculation. This enabled her to apply to do the Geology I course at Adelaide University, which she undertook with enthusiasm.

As Corbett had become involved as a lecturer in the Adelaide University's Department of Adult Education, so did June begin to help in the preparation of exhibits for the talks. From 1966 she started to participate, as children's tutor, in the annual Spring Schools organised by that department, the first being to Chowilla on the River Murray. Subsequent venues included Angorichina in the Flinders Ranges (1967),

Mulloorina near Lake Eyre (1971) and Nonning in the Gawler Ranges (1973). There were also weekend schools for children and Junior Field Naturalists trips in the Adelaide area.

In 1968, following the resignation of David Corbett, the Geology Department of the Museum was split into the Mineralogy and Palaeontology Sections, and a mineralogist, Geoff Milne, was appointed. June continued as assistant to both sections and, although the collections were already basically separated, she set about making the final separation—that of the sectional libraries—and preparing for the arrival of the new curators of each section. Milne arrived in November 1968 and relations with his assistant deteriorated, partly due to different attitudes to the mineral collections and June's natural protective feeling towards the specimens. The arrival of the new Curator of Fossils, Neville Pledge, in mid-1969 alleviated the situation slightly, as June now had a different focus of attention. When, in mid-1970, Milne suddenly resigned and Pledge was away on extended fieldwork, June was again in charge of both sections. On Pledge's return June was given responsibility, in the interim, of the Mineral Section, and subsequently it was decided not to seek a new Curator. With this new responsibility, June undertook an active acquisition program to increase the size, diversity and quality of the mineral collection, mainly by exchange, but she also undertook modest collecting trips around the State in later years. She took a special interest in meteorites and australites, the Museum collections of which had been catalogued by Corbett. Much of her time in later years would be spent with these objects.

In 1967, during the last months of Corbett's curatorship, when June was starting the physical separation of the collections, she began to research the origins of the Museum's collection of Lake Callabonna *Diprotodon* fossils which, with other things, occupied a number of large cupboards in the passage outside the Palaeontology room. As a result, she made contact with a number of descendants of Ragless, Stirling, and Zietz, who had been involved in the 1892–93 discovery and excavation of the bones. She was able to obtain copies of photographs and letters,

and started compiling them with newspaper and other archival reports pertinent to the story she hoped to write. Unfortunately, she was not able to do this. However, the information was not lost but used in an exhibition, and an article published by this writer (Pledge 1994), to celebrate the centenary of the Lake Callabonna expedition.

During this same period June started another project which had a more tangible outcome for her. Partly as a result of leading a South Australian Field Naturalists excursion to see the geology at Hallett Cove, she commenced active field research of the area for the preparation of a field guide. Working with two Museum Honoraries, botanist Margaret Kenny and archaeologist Harold Cooper, she edited and published 'Hallett Cove, a field guide' in 1970, at a time when interest in preserving more of that area was growing. A revised edition was published two years later as a result of the publicity gained for the Reserve in the midst of an encroaching suburban sprawl, and a third printing in 1976. Among other outcomes of the first edition were the discovery of the first fossils (other than the Pliocene shells of the Hallett Cove Sandstone) to be found at Hallett Cove—a much-abraded tooth of the Pleistocene *Diprotodon* found by two schoolboys in beach gravel, and arthropod trails preserved in the Permian glacial varves, found by schoolgirl Helen Bailey during one of the field days at the height of the conservation campaign. Helen had previously been tutored by June on one of the Spring Schools.

Other projects at this time were the production of an illustrated 'The geological timescale (and) evolution—from the rock record' (1973a), for students and the lay public, and co-authoring with David Corbett a chapter on geology in *Yorke Peninsula, a Natural History* (1973b). June was now realising a growing interest in and concern for geological type localities, those sites from which geologists had described new geological features or formations and rock units. This subject would increasingly occupy her time.

With the resignation of Dr Helene Laws, the Curator of Marine Invertebrata, in 1973, June became the mother figure for female staff, a role that sometimes put her in disagreement with management or other curators. However, out of this came some benefit in the form of a new assistant, Faye Gommers, to be shared between Minerals and Fossils, which enabled June to revise the catalogue of meteorites and start other projects. June was now attracting a small but

dedicated coterie of volunteers (Mesdames Bertie Koch, Natalie Worthley and Eugenie Pugh, and Mr Gerhard Hörr) and Honorary Research Workers (Messrs Jim Johnson, Barrie Risely and William Cleverly). With the help of many of them, June started compiling a register of geological type sections in South Australia, this information to be used in assessing the environmental impact of proposed mining and exploration activities.

The Geological Data Retrieval System, as it was called, came to occupy more and more of June's time and the Sectional resources as she obtained detailed maps and aerial photographs, and made field trips to various parts of the State to verify and document important geological localities. However, with Jim Johnson, she was also able to produce a popular illustrated booklet on the minerals of South Australia (1975, revised 1978), and with Cleverly (1978) the first of several papers on australites. With Johnson and others she co-authored a description of the Brachina Meteorite (1977), and this led her to start lobbying for legislation to protect meteorites found in South Australia from exploitation by (mostly foreign) commercial collectors. This legislation was passed in 1980, as an amendment to the *South Australian Museum Act, 1976–1978, Part IIA—Meteorites*.

The next few years were busy, with the consolidation of the Geological Data Retrieval System, fieldwork to check sites and search for australites and meteorites, and, from 1979, the requirements and designing of new quarters for the Section in the planned new science wing just approved by the Government. In this last, June was able to increase and improve substantially the collection storage space, laboratories and offices over what they had been in the basement of the old Museum east (Stirling) wing.

Because of her lack of formal academic qualifications, June's achievements were not officially recognised for some years but, after continued lobbying and support from other staff, she was made an acting Curator in 1976 and Curator Grade I in the following year. June was promoted to Curator II in 1981 and retired on 29 June 1982, with planning still in progress for the new science building. On retirement, she was put in charge of the Geoscience Data Centre, and supervised its installation as a separate entity in the new Natural Science Building in 1985. With the appointment of a new Curator of Minerals in 1984, June was appointed an honorary research associate in Mineralogy.

Retirement did not change June's activities

much. Although arthritis prevented her from coming into the Museum regularly, she continued to maintain and upgrade the geological data system with the help of Barrie Risely. Together, they compiled all this information and eventually published it as a book (1991). But this was not the end, although a series of mild strokes were beginning to take their toll. June had, for many years, envisaged a revision of her Geological Time Scale and Evolution chart, and to this end she had accumulated much data from colleagues and other experts. However, the field of palaeontology is, in many ways, changing very rapidly, with new discoveries that change our understanding of evolution almost a weekly event. The task proved, therefore, to be more than she could handle, even by proxy with Risely and Hörr finding and bringing references to her at home, where she had by then become housebound.

June moved in with her younger sister Molly at Brighton in 1995. When Molly died she moved

into a retirement home at Aberfoyle Park, and later a nursing home, just days before her death on 23 September 2000. Her last project was unfinished. June never married. She is survived by her brother Peter, and two nieces and a nephew and their families.

June was, within her limitations which she recognised, an outstanding custodian of the collections under her care, meticulous almost to the point of obsession. She engaged well with the public, particularly children, to the advantage of the South Australian Museum for almost 20 years, and was the author or co-author of a number of publications of lasting value.

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