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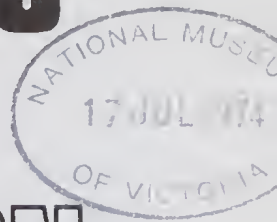
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EDITORS' NOTE

This journal, now entitled the *Records of the Western Australian Museum (Rec. West. Aust. Mus.)*, is the continuation of the *Records of the Western Australian Museum and Art Gallery*, published between 1910 and 1939, of which 2 volumes were issued in 4 parts in the years 1910, 1912, 1914 and 1939.

It is intended that in future the *Records* will be published in parts of varying size depending upon material submitted and at intervals not greater than six months.

New volumes will commence at intervals determined by the number of pages published since the last and not at time-intervals.

The purpose of the continued *Records* remains that intended by the Director in vol. 1, part 1, i.e. "to contain the results of original research, of collecting expeditions, and will also include brief notes on other matters connected with this Institution". For the information of contributors the term "results of original research", where it concerns growth of knowledge in the areas of responsibility of the Museum, will include (in addition to papers comprising complete studies) notes on, descriptions, or analyses, of significant specimens, progressive results of surveys or archaeological excavations, lists of types, partial taxonomic revisions and bibliographic lists of papers published by the staff of the Western Australian Museum in other journals.

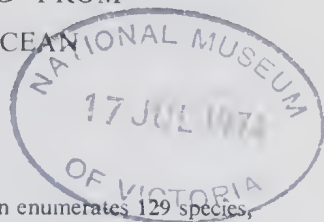
Papers submitted to the *Records* by workers other than staff and researchers working in the Museum, or Honorary Associates, will be required to be based upon the collections of the Western Australian Museum or such other functions of the Western Australian Museum which in the view of the Records Committee are relevant to the publication.

A LIST OF THE FISHES RECORDED FROM
CHRISTMAS ISLAND, INDIAN OCEAN

R. J. MCKAY*

ABSTRACT

A list of the fishes recorded from Christmas Island, Indian Ocean enumerates 129 species, 65 of which are new records for the island.



INTRODUCTION

At the kind invitation of the British Phosphate Commissioners, Dr Gerlof F. Mees and Mr Eric J. Car of the Western Australian Museum visited Christmas Island between June 14th and July 15th, 1961, and made extensive zoological collections. The most important collection was that of the fish fauna, and apart from the papers by Regan (1909), Palmer (1950), and Allen (1972), the fishes of the island were completely unknown. All the fishes collected by the party, and those forwarded to the W.A. Museum by British Phosphate Commissioners' staff members Mr T. Houston, Mr D. Powell, and Mr R. Forrester, are housed in the Western Australian Museum. Until his resignation from the Western Australian Museum on June 28th, 1963, Dr Mees continued to work on the Christmas Island material and fish identified by him (17 specimens) bear the numbers P5145 to P5762. The writer continued with the examination of the collection, and apart from a few unidentified specimens, the material, comprising some 380 specimens, is now fully registered. As Dr Mees did not have the opportunity to check his identifications before publication full responsibility for any misidentifications is accepted by the writer.

A cursory glance at the list presented below will suffice to show that a great deal of collecting will be required before a comprehensive check list of the fishes of Christmas Island can be compiled. The fishes recorded by Regan (21 species) and Palmer (42 species) have been included in this brief list of 129 species, 65 of which are new records for the island.

Order ANGUILLIFORMES

Family *Muraenidae* (Moray eels)

Arndha zebra (Shaw & Nodder)

One specimen, P5984.

Echidna nebulosa (Ahl)

Three specimens, P5989, P8435-6. Recorded as *Muraena nebulosa* by Regan (1909, p. 403).

Uropterygius concolor Rüppell

Two specimens, P8468-9.

Uropterygius marmoratus (Lacépède)

Fifteen specimens, P8451-5, P8457-66. Recorded as *Gymnomuraena marmorata* by Palmer (1950, p. 203).

* Queensland Museum, formerly Western Australian Museum

Uropterygius macrocephalus (Bleeker)

Recorded as *Gymnomuraena macrocephalus* by Palmer (1950, p. 203).

Uropterygius micropterus (Bleeker)

Sixteen specimens, P8456, P8470–83, P9215.

Gymnothorax flavimarginatus (Rüppell)

One specimen, P8467.

Gymnothorax meleagris (Shaw & Nodder)

Recorded by Palmer (1950, p. 203).

Gymnothorax picta (Ahl)

One specimen, P8439. Recorded as *Muraena picta* by Palmer (1950, p. 203)

Order SALMONIFORMES

Family **Synodontidae** (Lizardfishes)

Synodus variegatus (Lacépède)

One specimen, P11977.

Saurida undosquamis (Richardson)

One specimen, P5460.

Order GADIFORMES

Family **Ophidiidae** (Eelpouts)

Brotula multibarbata Temminck & Schlegel

Recorded by Regan (1909, p. 406).

Order ATHERINIFORMES

Family **Exocoetidae** (Flyingfishes)

Cypsilurus oxycephalus (Bleeker)

Recorded by Palmer (1950, p. 203).

Family **Belonidae** (Longtoms)

Belone crocodila Lcsueur

One specimen, P5458. Recorded as *Strongylura annulatus* (= *B. crocodila*) by Palmer (1950, p. 203).

Belone platynra Bennett

One specimen, P5459.

Order BERYCIFORMES

Family **Holocentridae** (Squirrelfishes)

Holocentrus bleekeri Weber

Seven specimens, P5456-7, P12653-7.

Holocentrus caudimaculatus Rüppell

Recorded by Palmer (1950, p. 200).

Holocentrus microstomus Günther

Recorded by Palmer (1950, p. 200).

Holocentrus tiereoides Bleeker

Recorded by Palmer (1950, p. 200).

Myripristis murdjan (Forskål)

Three specimens, P5469, P12651-2. Recorded by Palmer (1950, p. 201).

Order GASTEROSTEIFORMES

Family **Aulostomidae** (Trumpetfishes)

Aulostoma chinensis (Linnaeus)

Two specimens, P7935-6. Recorded as *Aulostoma valentini* (= *A. chinensis*) by Palmer (1950, p. 203).

Family **Solenostomidae** (Ghost Pipefishes)

Solenichthys cyanopterus (Bleeker)

Two specimens, P5470.

Family **Syngnathidae** (Pipefishes)

Choeroichthys sculptus (Günther)

Two specimens, P21084-5.

Order SCORPAENIFORMES

Family **Scorpaenidae** (Scorpionfishes)

Pterois volitans (Linnaeus)

One specimen, P5972. Previously recorded by Regan (1909, p. 404), and Palmer (1950, p. 202).

Pterois radiata Cuvier

Six specimens, P5968-71, P5988, P8282. Recorded by Palmer (1950, p. 202).

Pteropterus antennata (Bloch)
Four specimens, P8278–81.

Sebastapistes sp.
Two specimens, P21064, P21089.

Scorpaenodes guamensis (Quoy & Gaimard)
One specimen, P21087.

Dendroscorpaena cirrhosa (Thunberg)
Two specimens, P21086, P21088.

Family **Caracanthidae** (Velvetfishes)

Caracanthus unipinna (Gray)
Recorded by Regan (1909, p. 404).

Order PERCIFORMES

Family **Serranidae** (Gropers, Rock Cods)

Epinephelus merra Bloch
Recorded by Palmer (1950, p. 201).

Epinephelus corallicola (Valenciennes)
Two specimens, P21045–6. These specimens agree well with the description of
E. spilotoceps (*E. corallicola*) given by Schultz (1953, pp. 357–60).

Cephalopholis leopardus (Lacépède)
Two specimens, P21042–3.

Cephalopholis urodelus (Valenciennes)
One specimen, P21044.

Cephalopholis miniatus (Forskål)
One specimen, P21047.

Family **Grammistidae** (Six-lined Perch)

Grammistes sexlineatus (Thunberg)
One specimen, P5990.

Family **Plesiopidae** (Roundheads)

Plesiops nigricans (Rüppell)
Two specimens, P5991, P21766.

Plesiops melas Bleeker
Recorded by Regan (1909, p. 403).

Family **Kuhliidae** (Flagtails)

Kuhlia taeniura (Cuvier)

Recorded by Palmer (1950, p. 201).

Family **Priacanthidae** (Red Bullseyes)

Priacanthus cruentatus (Lacépède)

Recorded by Palmer (1950, p. 201).

Family **Apogonidae** (Cardinalfishes)

Apogon savayensis Günther

One specimen, P21081.

Family **Echeneidae** (Suckerfishes)

Remora remora (Linnaeus)

Two specimens, P7208–9.

Family **Carangidae** (Trevally, Darts)

Trachinotus bailloni (Lacépède)

Recorded by Palmer (1950, p. 203).

Family **Lutjanidae** (Hussars)

Macolor niger (Forskål)

One specimen, P21763.

Lutjanus vaigiensis (Quoy & Gaimard)

Recorded by Palmer (1950, p. 201).

Aphareus furcatus (Lacépède)

Recorded by Palmer (1950, p. 201).

Caesio lunaris Cuvier

One specimen, P8697.

Caesio xanthonotus Bleeker

One specimen, P21765.

Family **Nemipteridae** (Sea Breams)

Gnathodentex aurolineatus (Lacépède)

Thirty specimens, P11884–911, P21762, P21764.

Monotaxis grandoculis (Forskål)

Recorded as *Sphaerodon heterodon* (= *M. grandoculis*) by Regan (1909, p. 403).

Family **Mullidae** (Goatfishes)

Parupeneus bifasciatus (Lacépède)

Two specimens, P21037–8. Recorded as *Parupeneus andrewsii* (= *P. bifasciatus*) by Regan (1909, p. 403, pl. 65).

Family **Pempheridae** (Bullseyes)

Pempheris otaïtensis Lesson

Recorded by Palmer (1950, p. 203).

Pempheris oualensis Cuvier

Four specimens, P13423–6.

Family **Ephippidae** (Batfishes)

Platax teira (Forskål)

Recorded by Palmer (1950, p. 204).

Family **Chaetodontidae** (Coralfishes)

Forcipiger longirostris (Broussonet)

Ten specimens, P5981–3, P6083–9. Recorded by Palmer (1950, p. 204) and Regan (1909, p. 403).

Chaetodon trifasciatus Park

One specimen, P5465.

Chaetodon ephippium Cuvier

One specimen, P7909.

Chaetodon citrinellus Cuvier

Four specimens, P5762, P8798–9, P10747. Recorded by Palmer (1950, p. 201).

Chaetodon ornatissimus Cuvier

Three specimens, P5978–9, P10769.

Chaetodon meyeri Bloch & Schneider

Two specimens, P5464, P5467.

Chaetodon hmula (Lacépède)

Four specimens, P5462, P10753, P10835–6.

Anisochoetodon unimaculatus (Bloch)

One specimen, P5461.

Hemitaurichthys zoster (Bennett)

One specimen, P5463.

Pomacanthus imperator (Bloch)

Recorded by Palmer (1950, p. 204).

Pomacanthus semicirculatus (Cuvier)

One specimen, P12150.

Pygoplites diacanthus (Boddaert)

Four specimens, P5973-5, P5980.

Family **Pomacentridae** (Demoiselles)

Pomacentrus nigricans (Lacépède)

Four specimens, P10872-4, P10936.

Abudefduf sordidus (Forskål)

Six specimens, P10742-6, P10994. Recorded as *Glyphisodou sordidus*, by Regan (1909, p. 404).

Abudefduf saxatilis vaigiensis (Quoy & Gaimard)

Two specimens, P10855-6. Recorded as *Abudefduf saxatilis* by Palmer (1950, p. 201).

Abudefduf notatus (Day)

Twelve specimens, P10976-87. Recorded by Palmer (1950, p. 204).

Abudefduf biocellatus (Quoy & Gaimard)

Three specimens, P10752, P10849-50.

Abudefduf xanthurus (Bleeker)

One specimen, P10969.

Dascyllus triinaculatus (Rüppell)

One specimen, P10878.

Dascyllus marginatus (Rüppell)

One specimen, P10879.

Chromis ternatensis (Bleeker)

Two specimens, P10973-4.

Amphiprion perideraion Bleeker

Nine specimens, P21542-50.

Amphiprion clarkii (Bennett)

One specimen, P10892. Recorded by Allen (1972, p. 116).

Family **Cirrhitidae** (Hawkfishes)

Cirrhitichthys oxycephalus (Bleeker)

Recorded as *Cirrhitichthys murrayi* (= *C. oxycephalus*) by Regan (1909, p. 404, pl. 66, fig. 6).

Paracirrhitichthys hemistictus (Günther)

Two specimens, P21034-5.

Family **Mugilidae** (Mulletts)

Crcninugil crenilabis (Forskål)

Recorded as *Mugil crenilabis* by Palmer (1950, p. 205).

Family **Labridae** (Wrasses)

Novaculichthys bifca (Lay & Bennett)

One specimen, P11706.

Gomphosus tricolor (Quoy & Gaimard)

Recorded by Palmer (1950, p. 204).

Gomphosus cacruleus Lacépède

One specimen, P21080. Recorded by Palmer (1950, p. 202).

Thalassoma hardwicki (Bennett)

Recorded by Palmer (1950, p. 204).

Pseudojulis notospilus Günther

Recorded by Palmer (1950, p. 204).

Stethojulis strigiventer (Bennett)

Recorded by Palmer (1950, p. 204).

Halichoeres marginatus (Rüppell)

Two specimens, P21082-3.

Halichoeres hyrtlii (Bleeker)

Recorded as *PlatyGLOSSUS hyrtelii* by Regan (1909, p. 404).

Pseudocoris heteropterus (Bleeker)

One specimen, P21259.

Family **Mugiloididae** (Grubfishes)

Parapercis clathrata Ogilby

One specimen, P5455.

Family **Blenniidae** (Blennies)

Andania heteroptera (Bleeker)

Recorded by Palmer (1950, p. 204).

Andania reyi (Savage)

Seventeen specimens, P5145, P10451-65, P10520.

Alticus saliens (Lacépède)

Twelve specimens, P10486-96, P10525.

Praealticus natalis (Regan)

Sixteen specimens, P10509-19, P10688-92. Recorded as *Blennius natalis* by Regan (1909, p. 405).

Istiblennius bellus (Günther)

Twenty-four specimens, P10479-85, P10570-80, P10694-9.

Istiblennius hasseltii (Bleeker)

Recorded as *Salarias hasseltii* by Regan (1909, p. 405).

Istiblennius lineatus (Valenciennes)

Two specimens, P10468, P10683.

Minnoblennius atrocinctus (Regan)

Recorded as *Blennius atrocinctus* by Regan (1909, p. 405).

Nannosalarias nativitatis (Regan)

Recorded as *Blennius nativitatis* by Regan (1909, pp. 404-5).

Entamacrodus epalzeocheilus (Bleeker)

Two specimens, P10595-6.

Entamacrodus caudofasciatus (Regan)

Thirteen specimens, P10673-82, P10701-3. Recorded as *Salarias caudofasciatus* by Regan (1909, p. 405).

Ecsenius bicolor (Day)

Recorded as *Salarias melanosoma* (= *E. bicolor*) by Regan (1909, p. 406, pl. 66, fig. 5).

“ *Salarias tridactylus* Günther ”

I am unable to trace a description of any species named *Salarias tridactylus* by Günther as recorded by Palmer (1950, p. 204), and suspect that Palmer's record refers to the *S. tridactylus* listed by Günther (1861, p. 242) which is an employment by Günther in new combination of *Blennius tridactylus* Bloch 1801, a species shown to be a junior primary homonym of *Blennius tridactylus* Lacépède 1800, by Smith-Vaniz and Springer (1971, p. 60).

Family **Gobiidae** (Gobies)

Bathygobius fuscus (Rüppell)

One specimen, P10693. Recorded as *Gobius albopunctatus* (= *B. fuscus*) by Regan (1909, p. 404).

Bunaka gyrinoides (Bleeker)

Recorded by Palmer (1950, p. 204).

Eviota epiplanes Jenkins

Recorded by Palmer (1950, p. 204).

Family **Acanthuridae** (Surgeonfishes, Moorish Idols)

Zanclus canescens (Linnaeus)

Six specimens, P5985-7, P8659, P8692, P8794.

Naso hexacanthus (Bleeker)

Three specimens, P7101, P8660-1.

Naso lituratus (Bloch & Schneider)

Six specimens, P5997-8, P6044-6, P8693.

Zebrasoma flavescens (Bennett)

One specimen, P8691.

Acanthurus triostegus (Linnaeus)

Four specimens, P5994-5, P10890-1. Recorded by Palmer (1950, p. 202).

Acanthurus guttatus Bloch & Schneider

Recorded by Palmer (1950, p. 204).

Acanthurus lineatus (Linnaeus)

Thirteen specimens, P5993, P6047-56, P8095-6.

Acanthurus glaucopareius Cuvier

Twenty specimens, P5996, P5999-6016, P6042. Recorded by Palmer (1950, p. 202).

Acanthurus oblivaceus Bloch & Schneider

Two specimens, P6043, P8694.

Ctenochaetus strigosus (Bennett)

Recorded by Palmer (1950, p. 202).

Order PLEURONECTIFORMES

Family **Bothidae** (Left-handed Flounders)

Bothus mancus (Broussonnet)

Recorded by Palmer (1950, p. 205).

Order TETRAODONTIFORMES

Family **Balistidae** (Triggerfishes)

Melichthys niger (Bloch)

Three specimens, P8097-9. Recorded as *Melichthys radula* (= *M. niger*) by Palmer (1950, p. 203).

Melichthys vidua (Richardson)

Three specimens, P6017, P6209, P8658.

Balistapus undulatus (Park)

Thirteen specimens, P6018–28, P7927–8.

Balistes bursa Bloch & Schneider

Four specimens, P6268, P8100–2.

Rhinecanthus echarpe (Anon.)

Recorded as *Balistes rectangulus* (= *R. echarpe*) by Regan (1909, p. 406).

Xanthichthys sp.

One specimen, P8662.

Cantherhines pardalis (Rüppell)

One specimen, P21090.

Family **Ostraciontidae** (Boxfishes)

Ostracion meleagris Shaw & Nodder

Four specimens, P6269–70, P8699–700.

Family **Tetraodontidae** (Pufferfishes)

Canthigaster amboinensis (Bleeker)

One specimen, P5992.

Family **Diodontidae** (Porcupinefishes)

Diodon hystrix Linnaeus

One specimen, P9199. Recorded by Regan (1909, p. 406).

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THE FOOD RESOURCES OF THE ABORIGINES OF THE SOUTH-WEST OF WESTERN AUSTRALIA

SARA J. MEAGHER

INTRODUCTION

The Aborigines in the South-West of Western Australia, in common with Aborigines in other parts of Australia, were hunters and gatherers. Like them they neither reared domestic animals nor cultivated crops, and were dependent on the environment for their food supply, moving from place to place within defined areas as the availability of food and the seasons dictated.

From our present knowledge of the fauna and flora of the south-west area of Western Australia, the sources of food most readily available to the Aborigines would have been mammals, birds and their eggs, most reptiles, some frogs, fish (where there was adequate water, especially in marine inlets) and some invertebrates (e.g. larvae of beetles), but most invertebrates seem to be unpalatable. As far as it is known the plant species available for food did not lend themselves to cultivation and no crops were grown. Seeds, fruits and roots of various sorts were gathered.

Few observers, apart from Nind (1831, p. 36), make positive statements on the division of labour between the sexes of their hunting and gathering activities, but from their descriptions it is reasonable to infer that the men were the hunters, they procured the larger animals, in particular kangaroos and emus, while the women were the gatherers, they collected seeds, dug for roots, and caught some of the smaller animals; but it is known that men also caught smaller animals and gathered roots. A further inference as to this division of labour can be drawn from the distribution between them of their implements; spears, axes, throwing-sticks or clubs, and boomerangs belonged to and were used by the men, while the women's main implement was the digging-stick.

The men and women usually went about their hunting and gathering activities independently; however, there were some of these, such as fishing, or catching animals by setting fire to the bush, in which they all took part.

By comparison with native peoples of most continents the Australian Aboriginal had access to relatively few major sources of animal protein, because, despite the appearances of the above list, mammals, with the exception of the great kangaroos, were mostly small, and the major protein sources available to man elsewhere in the world, which are provided by the ungulates (e.g. sheep, cattle, antelopes, deer, horses, etc.), are lacking in Australia (Ride 1971, p. 5).

Large mammals may once have been available to Aboriginal man in Australia because large marsupials of the families Diprotodontidae and Sthenuridae certainly occurred in Australia in Aboriginal times (Merrilees 1968, p. 1) and would almost certainly have provided a major food source.

It is one thing to go through the lists of the species of fauna and flora and say what could be eaten by man; it is quite another thing to be sure that the species were in sufficient numbers to be a recognized source of food, or that the Aborigines had techniques which were adequate to take and use them.

The object of this paper is to discover from records of explorers and early settlers, tradition, and archaeological data, which of these food sources were utilized and what techniques were employed in taking and using them. A list of animal foods, mostly from literature sources, is given in Appendix 1; it is arranged in alphabetical order of

Aboriginal names. Where these have been identified to species, the identification is included. The same species are arranged in alphabetical order of scientific names grouped according to major zoological taxa, e.g., mammals, birds, etc., in Appendix 2.

FOOD SOURCES

Kangaroos

The grey kangaroo (*Macropus fuliginosus*) is the largest mammal in the area. It is widely distributed, being found on the coastal plain as well as the forest and woodland areas. It occurs in small mobs and was probably common throughout the area.

There is no doubt that the kangaroo was taken and eaten by the Aborigines as there are many references to it in the literature as a source of food (Anon. [Collie] 1834, p. 315; Armstrong 1871, p. 27; Backhouse 1843, p. 541; Bradshaw 1857, p. 98; Browne 1856, pp. 490, 534-5; Chauncy 1878, p. 248; Drummond 1843a; Eyre 1845, vol. 2, p. 277; Grey 1841, vol. 2, pp. 268-75; Hammond 1933, p. 29; Irwin 1835, p. 22; Moore 1884b, pp. 18, 37; Nind 1831, pp. 28, 29-30; Roth 1903, p. 47).

Skeletal remains of kangaroos are common in bone deposits in southwestern caves but, with the exception of Devil's Lair (Dortch & Merrilees 1971), they are not definitely associated with man. In the case of Devil's Lair, Dortch and Merrilees suggest (p. 112) that the presence of charred grey kangaroo remains in the deposit reveals that they were left by man.

Of the other large kangaroos the wallaroo (*Macropus robustus*) occurs on rocky outcrops in the area, but is only common at a few restricted localities. The red kangaroo (*Megaleia rufa*) occasionally enters the area in the vicinity of Morawa, but it is not known whether it did so before European settlement opened up the country.

The two main ways of taking kangaroos were by spearing them or catching them in traps. The methods used in spearing kangaroos varied according to the number of people involved. An individual hunter, or a small party, stalked a kangaroo until close enough to spear it. In winter they took advantage of the wind and/or rain to conceal their approach (Anon. [Collie] 1834, p. 315; Browne 1856, p. 534; Grey 1841, vol. 2, pp. 268-70, 273-4; Moore 1884b, p. 18; Nind 1831, p. 29). Moore (1884b, p. 18) also described the use of a portable leafy screen by the hunter.

When a large number of people were assembled they hunted kangaroos by surrounding an area frequented by them, and then they gradually closed in, driving the kangaroos from their retreats, and speared them as they attempted to escape (Anon. [Collie] 1834, p. 315; Backhouse 1843, p. 541; Bradshaw 1857, p. 98; Browne 1856, p. 490; Grey 1841, vol. 2, pp. 270-1; Moore 1884b, p. 37; Nind 1831, p. 28-9, 30). In the winter they drove the kangaroos out by shouting and striking their spears and spear-throwers together (Browne 1856, p. 490), while in the summer they set fire to the bush (Grey 1841, vol. 2, p. 270; Nind 1831, p. 28). Although hunting was primarily a task for the men, Nind (1831, p. 28) noted that the women sometimes went with them when they set fire to the bush to catch kangaroos or wallabies. According to Bradshaw (1857, p. 98) and Irwin (1835, p. 22) dogs occasionally accompanied the Aborigines when they were hunting kangaroos. [White (1972, p. 204) in a study of hunting dogs at Yalata, which lies outside the area of this study, questions whether native dogs were suitable for hunting. However the point which she raises does not rule out the contribution which semi-domesticated dogs could make in creating a fuss and flushing game from cover.]

The most common type of traps used to catch kangaroos were deep narrow pits, which were lightly covered with branches and earth. These pits were dug along the tracks frequented by kangaroos, or near their watering places. A kangaroo falling into one of these pits was wedged in by the narrow sides and was unable to get a footing to escape (Anon. [Collie] 1834, p. 315; Armstrong 1871, p. 27; Breton 1834, p. 22; Drummond 1843a; Eyre 1845, vol. 2, pp. 288-8; Grey 1841, vol. 2, p. 273;

Nind 1831, p. 30; Roth 1903, p. 47; Stokes 1846, vol. 2, p. 230; *pers. comm.*, Doust). The branches placed over the pits seem to have played some part in preventing the escape of the kangaroo from them (Drummond 1843a; Eyre 1845, vol. 2, p. 278). The pits were also sometimes associated with a system of fences (Drummond 1843a).

A less common type of trap was a row of pointed stakes placed on the banks of streams where the kangaroos usually crossed. However it is not known whether the kangaroos impaled themselves on these stakes when crossing the stream, or whether they were caught on them only when attempting to escape from the Aborigines (Anon. [Collie] 1834, p. 315). Netting and ambushing at drinking places seem also to have been employed (Grey 1841, vol. 2, p. 273).

There are very few accounts of how the kangaroo was cooked. The most detailed of these is that by Grey (1841, vol. 2, pp. 274-5) in which he describes two methods, the animal was either placed in a hole, covered with ashes and a slow fire built over it, or it was cut up and the pieces broiled on the fire. The blood, entrails and the marrow were considered delicacies, and the young men were not permitted to eat these (Grey 1841, vol. 2, p. 275). Bradshaw (1857, p. 100) described an Aboriginal eating the entrails and drinking the blood of a freshly killed kangaroo before it was cooked.

The by-products obtained from kangaroos included cloaks and bags made from the skins; nose-bones and awls from the bones; sinews from the tails (which were used for sewing cloaks and binding implements); and scrapers made from the teeth (see Dortch & Merrilees 1971, p. 109, for archaeological evidence of this).

Wallabies

The other principal source of large to medium-sized mammals is treated here under the generic grouping "wallaby" (including rat-kangaroos). This is not particularly meaningful zoologically, but informants do not often distinguish between the various species occurring in the area which go to make up the group unless, like the woylie (see below), they have distinctive habits.

The principal species are:—

Brush wallaby (*Macropus irma*). This species, which is the largest of the wallabies, is confined to the forested areas and extends on to the Swan coastal plain.

Tammar (*Macropus eugenii*). This is the principal wallaby of the South-West inland¹ of the jarrah forest area, and occurred in fairly large numbers in thickets.

Quokka (*Setonix brachyurus*). This small wallaby occurred in large numbers in swampy thickets where it makes runs and tunnels through dense undergrowth.

Woylic (*Bettongia penicillata*). This rat-kangaroo was a fairly common mammal in the sclerophyll woodland. It makes its nest under bushes.

Various other species of wallaby occurred (Shortridge 1910, pp. 803-48), but were probably never common through the south-west area.

Most descriptions of how wallabies were caught refer to those which lived in thickets. The Aborigines surrounded an area in which these animals lived and destroyed their runs by trampling or breaking down the bushes (Grey 1841, vol. 2, p. 290; Nind 1831, p. 30; *pers. comm.*, Blakers, Brockman). In some areas fences or snares were constructed at the ends of the runs (Drummond 1844 MS.).

¹Both the tammar and the quokka occur on offshore islands; the tammar on Garden Island, the Recherche Archipelago and the Aboilhos, and the quokka on Rottneest and Bald Islands (Ride 1970), but as far as is known the Aborigines did not visit these islands.

Towards the end of the summer the Aborigines set fire to the bush to drive the wallabies from their retreats (Anon. [Collie] 1834, p. 335; Gilbert (*in* Wagstaffe and Rutherford 1955, p. 12); Grey 1841, vol. 2, p. 291; Nind 1831, p. 28). At other times of the year they drove them out with their dogs, or by making a loud noise (Drummond 1844 MS.; Nind 1831, p. 30; *pers. comm.*, Blakers, Broekman).

As the wallabies attempted to escape they were speared, elubbed, caught in snares set at the ends of the runs, or they became entangled in the trampled bush and were easily taken (Anon. [Collie] 1834, p. 335; Drummond 1844, MS.; Gilbert (*in* Wagstaffe and Rutherford 1955, p. 12); Grey 1841, vol. 2, p. 291; Nind 1831, p. 30; Roth 1903, p. 47; *pers. comm.*, Blakers, Broekman).

Nind (1831, p. 30) notes that they were also caught in pits in the same manner as kangaroos.

There are no details as to how wallabies were cooked, but since they are like small kangaroos the techniques were probably the same.

According to Goldsworthy (1886, p. 338) the *bullua* (or conjurors) would not eat the male wallabies.

The rat-kangaroo, (*Bettongia penicillata*), known by the Aborigines as *walyo*, *woail*, or *woile* (see Appendix 1), which made its nest on the ground, was taken and eaten by them. The Aborigines speared them in their nests, or jumped on the nests, crushing the animal; if an animal tried to escape, it was chased until it took refuge, often in a hollow tree, where it was speared (Anon. [Collie] 1834, p. 339; Grey 1841, vol. 2, p. 290; Moore 1884b, p. 72).

As in the case of kangaroos, wallaby bones are present in eave deposits but, apart from the study made by Dortch and Merrilees (1971), there is no attempt to associate these with human utilization. Dortch and Merrilees list (p. 107) the following species in the upper part of the deposit in Devil's Lair which they associate with human activity: brush wallaby (*Macropus irma*), tammar (*Macropus eugenii*), roek wallaby (*Petrogale penicillata*), quokka (*Setonix brachyurus*), woylie (*Bettongia penicillata*), potoroo (*Potorous tridactylus*). Bones of the woylie were charred, possibly as the result of their having been cooked or discarded into a fire (p. 112).

Possums

Of the arboreal mammals in the area the principal moderately large-sized ones were the following species of possums:—

Brush possum (*Trichosurus vulpecula*). This species was common and widely distributed throughout the area; it sheltered in the broken limbs of large trees.

Ringtail possum (*Pseudocheirus peregrinus*). This species was usually restricted to swampy thickets, and was really only common in the peppermint country of the coastal area of the South-West; it made nests or dreys in trees.

The common brush possum, known by the Aborigines as *comal*, *gunal*, *kuual* (see Appendix 1), was taken and eaten by them: that the ringtail possum, known as *uvorra* (see Appendix 1), was taken at King George Sound can only be inferred from the statement by Nind (1831, p. 32) that the fur of both species was easily detached from the skin. Although Grey (1841, vol. 2, p. 263) lists two species of possum as being eaten by the Aborigines, my informant Elvard said that the ringtail was not eaten.

On moonlight nights the Aborigines hunted brush possums with their dogs. The possums were speared as they fled, or were driven into hollow trees from which they were extracted (Grey 1841, vol. 2, p. 285; Nind 1831, p. 32). However most descriptions of eating possums refer to those which were taken by day (Anon. [Collie] 1834, p. 319; Armstrong 1871, p. 27; Chaunev 1878, p. 248; Grey 1841, vol. 2, pp. 285-6; Hammond 1933, p. 41; Moore 1884b, p. 45; Nind 1831, p. 32; *pers. comm.*, Broekman, Elvard).

The most usual method of taking the brush possum was to extricate it from its haunt in a hollow tree. The Aborigines were able to determine whether a possum had ascended a tree and whether or not it had come down again by examining the bark (Armstrong 1871, p. 27; Bradshaw 1857, p. 99; Chauncey 1878, p. 248; Grey 1841, vol. 2, p. 286; Hammond 1933, p. 40; Nind 1831, p. 32).

The Aborigines climbed trees to catch possums, cutting toe-holds in the bark of the larger ones with their stone axes (Bradshaw 1857, p. 99; Chauncey 1878, p. 248; Grey 1841, vol. 2, p. 286; Moore 1884b, p. 45; Nind 1831, p. 32; *pers. comm.*, Brockman, Elvard, Hassell (W); see Eyre 1845, vol. 1, plate facing p. 68 for an illustration of this method being used in South Australia).

The easiest way to take a possum was to pull it out of its haunt by the tail; however, if it could not be reached, then it was smoked out, or poked out with a stick, the stick sometimes being twisted into the fur (Bradshaw 1857, p. 99; Grey 1841, vol. 2, p. 286; Nind 1831, p. 32; *pers. comm.*, Elvard). A possum which tried to escape by running along a branch was shaken off or knocked down with a stick (Grey 1841, vol. 2, p. 287).

Possums, like most of the other smaller animals, were cooked whole. They were roasted on the hot coals, or were covered with hot ashes. Before being cooked, however, the intestines were taken out, and the fur plucked off and stuffed into the stomach which was then pinned together with a stick. When the possum was cooked the fur, which had been stuffed into it, was removed and sucked to obtain the juices it had soaked up (Bunbury 1930, p. 88; Hammond 1933, p. 29; Knight *et al.* 1886, p. 329; *pers. comm.*, Brockman, Hassell (W)). Knight *et al.* (1886, p. 330) states that before it was cooked, the thigh bones of the possum were invariably bent back and broken, "this being a superstitious observance which is never neglected".

The main by-product from the possum was its fur, which was spun into long strands for use as belts and bands (see Meagher *in preparation*).

Dortch and Merrilees (1971, p. 107) include both brush and ringtail possums among the species associated with man in the Devil's Lair excavation. Bones of the brush possum were charred (p. 112). Roc (1971, p. 184) records both species in a deposit in a cave near Poison Hill, Gingin where struck flakes also occur at the same levels in the deposit.

Burrowing mammals

The two principal burrowing mammals of the South-West are the dalgyte (*Macrotis lagotis*), and the boodie, a rat-kangaroo (*Bettongia lesueur*). Both were fairly common in the dry country of the inland part of the area.

Dalgytes, known as *dalgyte*, *dolgyt* (see Appendix 1), were dug out of their burrows, or were taken when they were feeding (Grey 1841, vol. 2, p. 291). They were also caught when the Aborigines set fire to the bush to drive out the larger animals such as the kangaroos and wallabies.

Burrowing mice *djilyur* (see Appendix 1), were also eaten (Moore 1884b, p. 105).

Dortch and Merrilees (1971, p. 107) record the remains of the boodie (*Bettongia lesueur*) associated with man in the Devil's Lair deposit; and Roe (1971, p. 184) records it associated with struck flakes in the cave near Poison Hill, Gingin. The dalgyte is not known to have occurred in the area of Devil's Lair (*pers. comm.*, Ride).

Dingoes

The dingo (*Canis familiaris*) was eaten by the Aborigines (Grey 1841, vol. 2, p. 279; Hassell 1936, p. 688; Nind 1831, p. 29). No information is given on how they were taken; Grey only noted that there was "nothing peculiar in their mode of killing wild dogs". The puppies were regarded as a delicacy, although these were sometimes reared by the Aborigines for hunting.

According to Hassell (1936, p. 688) the young people were not allowed to eat dingos, and if they caught one then they had to give it to the old people.

Dingoes were not cut up before being cooked. They were placed in a hole and covered with hot ashes (Grey 1841, vol. 2, p. 279).

Bracclets were made from the tails (King 1827, vol. 2, p. 143), and fur from the tail was worn as an ornament across the forehead (Moore 1884b, p. 26).

Other land mammals

Grey (1841, vol. 2) notes that among the food eaten by the Aborigines there were "five animals, something smaller in size than rabbits" (p. 263), and "nine species of rats and mice" (p. 264). Moore (1884a, p. 285) lists mice as being one of the staple foods.

Bandicoots (*Isoodon obesulus*, *Perameles* sp., and ? *Chaeropus ecaudatus*) were eaten (as was the dalgyc *Macrotis lagotis*—see above under burrowing mammals) (Anon. [Collie] 1834, p. 339; Moore 1884b, p. 45). Nind (1831, p. 37) notes that "girls, after eleven or twelve years of age, seldom eat bandicoots, such food being considered a preventive to breeding".

Names given for various small mammals which were eaten include *kundi*, *mardo*, *nuiji*, *quoit* (see Appendix 1).

Dortch and Merrilees (1971, p. 107) list the species associated with human artifacts in the Devil's Lair deposits. These include the bandicoots, *Isoodon obesulus* and *Perameles* cf. *P. bougainville*; and the mardo, *Antechinus flavipes*.

In addition to the species which fall into the categories for which we have historical evidence (already discussed above) the Devil's Lair deposit includes the native cat, *Dasyurus geoffroii*; the wambenger, *Phascogale tapoatafa*; the dunnart, *Sminthopsis murina*; the Tasmanian devil, *Sarcophilus harrisii*; the mundarda, *Cerartetus concinnus*; the native rats and mice, *Pseudomys praeconis*, *Ps. alboinereus*, *Ps. shortridgei*, *Notomys* cf. *N. mitchellii* and *Rattus fuscipes*; and unidentified bats. Only one of these species (*Ps. praeconis*) occurs exclusively at levels above the first recovered human artifact (as do the known prey-species, the wallabies, *M. irma*, *M. eugenii*); it is therefore not possible to allocate these species unequivocally to human prey-species. The record of *Ps. praeconis* is probably not significant; it is represented by the remains of a single individual.

The probability that some of these (e.g. *Notomys* cf. *N. mitchellii*, the Tasmanian devil, the dunnart and the native cat) were taken by man is suggested by an apparent increase in their numbers in the upper levels of the deposit (i.e. those believed by Dortch and Merrilees, p. 112, to represent, "in part, food remains and other debris of human predators"). These authors point out that artifacts do not occur in lower parts of the deposit excavated by them and that it is in these lower parts that small animals predominate over large ones. That this increase means that they were taken by man is supported by a similar increase of numbers of individuals shown by the known prey-species (wallabies and possums) which also occur at these levels. Dortch and Merrilees (p. 112) suggest that the Tasmanian devil was a prey-species.

A small cave excavated near Poison Hill, Gingin, by Roe (1971, pp. 183-4), which contained human artifacts as well as mammal and plant remains, in two defined horizons, also yielded the remains of bandicoots (i.e. the quenda, *Isoodon obesulus*) and the following species of small mammals (as well as possums and the boodie—see above): ? mardo, *Antechinus flavipes*, ? dunnart, *Sminthopsis* sp., and the rats and mice *Pseudomys shortridgei*, ? *Ps. alboinereus*, and *Rattus* sp.

Other records of fauna obtained from deposits containing human remains or artifacts do not clearly indicate the nature of the association between the artifacts and animal specimens. Thus Glauert (1948, pp. 103-4), in listing material obtained from

Yonderup Cave by D. S. Davidson, merely states that grey kangaroo, (*Macropus fuliginosus*), brush wallaby (*M. irma*), tammar (*M. eugenii*), potoroo (*Potorous tridactylus*), boodie (*Bettongia lesueur*), woylie (*B. penicillata*), brush possum (*Trichosurus vulpecula*), ringtail (*Pseudocheirus peregrinus*), quenda (*Isoodon obesulus*), native cat (*Dasyurus geoffroii*), and Tasmanian devil (*Sarcophilus harrisii*) were obtained in addition to human remains. Butler (1969, pp. 87-8) lists from coastal sand dunes lying between the Scott River and the Southern Ocean (east of Augusta) *Macropus* "probably *M. fuliginosus*", *Setonix*, *Bettongia penicillata*, *Pseudocheirus*, *Isoodon*, *Dasyurus*, and *Sarcophilus* as well as Aboriginal implements and other bone material including much of marine origin. The deposit is actively weathering out of the dunes and is clearly an admixture of a number of horizons. Hallam (1971a, p. 102) indicates that she has identified a fauna from Orchestra Shell Cave, near Wanneroo, upon which she intends to publish.

Birds

Many species of birds occurring in the South-West of Western Australia could have been eaten since almost all are palatable and a number are relatively easy to capture because of their behaviour. Grey (1841, vol. 2, p. 281) says that birds "formed a very considerable article of food for the natives, and their modes of killing them are so various that it would be impossible to enumerate them all".

Those birds which one might expect to identify from general descriptions in historical accounts are the emu, various species of water fowl, flocking birds such as parrots and cockatoos, and colonially nesting birds such as mutton birds (shearwaters) and various gulls and terns. Although Moore (1884b) includes the Aboriginal names for a number of birds in his vocabulary, and most of these names have been identified to species by Serventy and Whittell (1962), apart from the emu and the swan he does not state which of these were taken and eaten by the Aborigines.

The emu (*Dromaius novaehollandiae*) occurred throughout the area. It was stalked and speared by the Aborigines (Chauncy 1878, p. 248; Moore 1884b, p. 78; Nind 1831, p. 30; Roth 1903, p. 47). Grey (1841, vol. 2, p. 281) says that emus were caught in the same manner as kangaroos (see above), but Roth (p. 48) says that they were never trapped in pitfalls or nets. Nind (p. 30) noted that they were mainly speared in the winter, when they were nesting.

The flesh of the emu was highly prized, and, according to Grey (1841, vol. 2, p. 281) there were restrictions on its distribution and heavy penalties were "pronounced against young men, and unauthorized persons", who ventured to touch it.

I was unable to find any descriptions of how emus were cooked.

The feathers were used as decorations.

Grey (1841, vol. 2, pp. 283-4) described how water fowl in general were either speared or caught with a noose, but, apart from the black swan, there are no references to species by name.

The black swan (*Cygnus atratus*) is abundant in the South-West and is particularly common in inlets and estuaries such as Peel Inlet, Leschenault Estuary, Augusta, Wilson Inlet, Pallinup, and Bremer Bay estuary where large flocks occur (Serventy and Whittell 1962, p. 127). It was easily taken by the Aborigines when it was moulting (Grey 1841, vol. 2, p. 283; Moore 1884b, p. 30), and large numbers of both young and old birds and eggs were also taken when it was nesting (Bunbury 1930, p. 72).

According to my informant Doust, water fowl were cooked by first being covered with mud, placed in a hole, and then covered with ashes, where they were left for several hours. When the baked mud was cracked open the feathers came away in the mud leaving the body clean. Chauncy (1878, p. 250) noted that this method of cooking large birds was also used in other parts of Australia. Hammond (1933, p. 29) however, says that large birds were always cut up before being cooked. Grey (1841, vol. 2,

p. 285) says that birds were plucked before being cooked but Hammond (p. 29) says that the feathers were wetted and then burnt off.

References to the taking of flocking birds are given by Grey (1841, vol. 2, pp. 281-2), Roth (1903, p. 47) and Brockman (*pers. comm.*); of these, the most complete description (of taking cockatoos) is given by Grey who describes the use of boomerangs and spears. This description also includes the use of a wounded bird as a decoy.

Some birds were restricted to classes of people by prohibition, thus young men could not eat wedge tails ("eagle hawk": Hassell 1936, p. 688; "black eagle": Nind 1831, p. 37), and quails were old men's diet (Nind, p. 37).

Pigeons were noted as being eaten (Grey 1841, vol. 2, p. 285; Nind 1831, p. 3.1). Scrventy and Whittell (1962, p. 239) state that:

"Bronzewing Pigeons . . . are given to feeding on the seeds of the box-poison plant, *Gastrolobium bilobum*, and as a result their entrails and bones, but not the flesh, are poisonous to dogs and cats. After eating such pigeons, dogs and cats are apt to have fits, become mad, bit at anyone within reach, and finally die in convulsions."

There is nothing in the literature to suggest that the Aborigines took any special precautions to avoid possible poisoning from eating bronzewing pigeons, although it is possible that the custom of drawing birds as described by Grey (1841, vol. 2, p. 285) is in part related to this problem.

Birds' eggs were taken and eaten (Grey 1841, vol. 2, p. 263; Moore 1884b, p. 49; Nind 1831, p. 31; Ogle 1839, p. 63). Nind (p. 31) says that:

"At the spring time of the year, they live principally upon the eggs and young of birds, chiefly of the parrot tribe, but also of hawks, ducks, swans, pigeons, etc."

When eggs were cooked they were placed on end in moderately hot ashes. A small hole was pierced in the upper end to prevent them from bursting (Goldsworthy 1886, p. 338).

I have not been able to find any reference in the literature to the collection of the eggs or young of colonial nesters.

Snakes and lizards

Snakes and lizards are extremely numerous in the South-West, and for women and children would probably have provided the most abundant, and most easily obtained, source of animal protein. Except in cold weather they are active during the day and can be easily caught by such methods as digging, turning over stones or logs, and searching through leaf litter, and lifting bark.

Grey (1841, vol. 2, p. 263) included in his list of animals eaten by the Aborigines "eight sorts of snakes", and "seven sorts of iguana". From the literature (see Appendix 2—Reptiles) it is possible to identify six kinds of snakes and four kinds of lizards known to the Aborigines. These are the dugite (*Demansia affinis*), known as *dubyt*, *karbarda*, *tornock*, or *tookyte*; the tiger snake (*Notechis scutatus*), known as *norne*; the carpet snake (*Python spiloptus*), known as *wakel*, or *wackul*; the bardiek, which was also the Aboriginal name, (*Brachyopsis curta*); Mueller's snake (*Rhinoplocephalus bicolor*), known as *torkite*; and the crowned snake (*Denisonia coronata*), known as *werr*; the common goanna (*Varamus gouldii*), known as *carta* or *mumnaar*; the King skink (*Egernia kingii*), known as *wandie*; the bobtail lizard (*Tiliqua rugosa*), known as *youern*; and Burton's snake-lizard (*Lialis burtonis*), known as *kerrygura* or *william lunger*. While Moore (1884b) includes the Aboriginal names for a number of other snakes and lizards in his vocabulary, his descriptions of these are very brief and it is not possible to identify them.

Snakes were caught behind the head, either by hand or with a forked stick, to prevent them from biting themselves or their captors (Neill 1845, p. 417; *pers. comm.*, Doust, Brockman).

Although some snakes (and in particular the tiger snake) were feared by the Aborigines, they were eaten nevertheless, but only if they had been killed by an Aboriginal. Neill (1845, p. 417) says that this was due to some superstition, but it is more likely that it was so that they could be sure that the snake had not bitten itself. Nind (1831, p. 31) noted that, after a snake had been killed, its head was beaten to pieces. He also noted that, if its stomach contained undigested food the Aborigines would not eat the snake, as they believed that this would make them ill.

There are no detailed descriptions of lizard-catching. According to Hassell (1936, p. 690) the eggs of the common goanna were roasted in the ashes and eaten, but these were restricted to the old men and women.

Snakes and lizards were placed in a fire (Pl. 24 in *Histoire du voyage; atlas, vol. 1. Voyage de . . . l'Astrolabe . . . pendant . . . 1826-29, sous le commandement de M. J. Dumont d'Urville.* Paris, Tastu, 1830-33.) or roasted in the ashes.

Frogs

Frogs are abundant in the area, but numbers of species are poisonous, or at least distasteful, and one would have expected to find rather specialized treatment of them by the Aborigines, but the only indication that they differentiated between different species is given by Moore (1884a, p. 281):

“It appears that the natives do not consider every frog fit for eating, for some of a greenish colour were under the stack, but they would not eat them, and said they lived above the waters, but the good ones lived in the ground.”

Various frogs, known as *goya*, *guya*, or *wurgyl*, (see Appendix 1), were collected from the swamps and shallow lakes throughout the year, but the greatest number were taken in the summer, when the water in these areas was low. They were dug out of the ground with the aid of the digging-stick (Grey 1841, vol. 2, p. 287; Moore 1884a, p. 265; Moore 1884b, p. 79).

As noted above not all frogs were considered as being fit to eat; and, in some cases, the females were preferred to the males because their eggs were regarded as a delicacy (Moore 1884a, pp. 265, 281; Moore 1884b, p. 79).

Frogs were cooked in the ashes (Grey 1841, vol. 2, p. 288; Moore 1884a, p. 184). Knight *et al.* (1886, p. 329) noted that before being cooked the thigh bones, like those of the possum, were invariably bent back and broken “this being a superstitious observance which is never neglected”.

Fish

Fish were a major source of food for people living near the coast, particularly during the summer months (Browne 1856, p. 492; King 1827, vol. 2, p. 122; Nind 1831, p. 32; Neill 1845, p. 425; Stirling 1826 MS.).

The Aborigines confined their fishing activities to sheltered areas such as lakes, rivers and estuaries. They were not a seafaring people; they had no form of water transport; at King George Sound it was noted that they could not swim and were afraid of the water, although those living on the western coast were good swimmers (Armstrong 1871, p. 27; Barrow 1831, p. 12; Browne 1856, p. 540; Flinders 1814, vol. 1, p. 66; King 1827, vol. 2, p. 137; Hammond 1933, p. 17; Loekyer 1827a MS.; Moore 1884b, p. 9; Nind 1831, p. 32; Roth 1903, pp. 61, 65; Stirling 1926 MS.).

Fish were either speared or caught by hand. The Aborigines did not have any nets or lines with which to catch fish; nor is there any account of poisonous or narcotic plants being used to stun the fish.

Weirs or dams made from stones, bushes and/or sticks were built across rivers and streams; fish trapped in these were either speared or caught by hand (Anon. [Collie] 1834, p. 335; Armstrong 1871, p. 27; Bunbury 1930, pp. 69, 87; Grey 1841, vol. 2, p. 275; Hackett 1886, p. 343; Hammond 1933, p. 46; Irwin 1835, p. 22; Lockyer 1827a MS.; Nind 1831, p. 32; Paterson 1896, p. 288; Roth 1903, p. 47; Stirling 1826 MS.).

When a shoal of fish was sighted in the shallows of an estuary it was driven towards the shore, the fish penned in with branches and stones, and then either speared or taken by hand (Anon. [Collie] 1834, p. 335; Browne 1856, pp. 492-3; Chauncey 1878, p. 248; Grey 1841, vol. 2, p. 275; Neill 1845, p. 425; Nind 1831, p. 32).

Catching fish in weirs or drives was a group activity in which both men and women took part, and these methods were used when a large number of people were gathered together. However fish were also speared by individual fishermen in shallow water, or when crossing fords in the rivers (Anon. [Collie] 1834, p. 335; Baekhouse 1843, p. 527; Hammond 1933, pp. 19, 46; King 1827, vol. 2, p. 122; Nind 1831, p. 32; Neill 1845, p. 425).

Bait was sometimes used to attract fish; the fisherman sitting on a rock that jutted out into the sea, pounded up pieces of small shell-fish and threw it into the water; fish attracted by this bait were speared (Neill 1845, p. 424; Nind 1831, p. 32; *pers. comm.*, Hassell). There is no record of baited spears being used (as mentioned generally for Australia by Aflalo, 1896). Fish were also speared at night with the aid of torehes made from *Xanthorrhoea* (Bunbury 1930, p. 76; Irwin 1835, p. 22; Neill 1845, p. 425; Nind 1831, p. 32).

By these various methods large quantities of fish were caught, particularly in weirs or drives (Anon. [Collie] 1834, p. 335; Browne 1856, p. 493; Chauncey 1878, p. 248; Hammond 1933, p. 46; Irwin 1835, p. 22; Nind 1831, pp. 32-3). When the Aborigines caught more than they could eat they either left them to die (Irwin 1835, p. 22; Hammond 1933, p. 46), buried a quantity for another day (Anon. [Collie] 1834, p. 335), or cooked them, and wrapped the flesh in soft bark (Nind 1831, p. 33).

There were a number of fish which could be easily caught, but were not eaten by the Aborigines; Bunbury (1930, p. 133) found that the Aborigines would not eat King Fish (? *Belone gavialoides*) or "Guard" Fish (? *Hyporhamphus melanochir*), as they believed that green-boned fish were poisonous, and Neill (1845) noted that they would not eat *Rhynchana greyi*, *Ostracian flavigaster*, or *Platyrrhina*. Sharks, sting-rays and maiden-rays were sometimes caught, but it seems that this was done mainly for sport as they were not eaten (Grey 1841, vol. 2, p. 275; Moore 1884b, p. 4; Neill 1845, pp. 428-431; Nind 1831, p. 33).

The larger fish were cut up before being cooked on the fire (Hammond 1933, p. 29), while the smaller ones were either roasted whole on ashes, or were wrapped in soft bark and covered with hot ashes (Bunbury 1930, pp. 87-8; Grey 1841, vol. 2, p. 276; Hammond 1933, p. 29; Irwin 1835, p. 23).

The only by-product obtained from fish was the oil from the mullet. The Aborigines used this for greasing their heads and bodies (Neill 1845, p. 426).

Marine mammals—whales and seals

Whales and seals inhabit the waters off the coast of the south-west area of Western Australia. But as the Aborigines were not a seafaring people they did not actively hunt these animals and depended upon their coming ashore, or being washed ashore, or stranded in the shallow waters. Some indication of the frequency of strandings of whales (including the small species such as dolphins) is given by records held at the Western Australian Museum. For example, between 1960 and 1967, from just north of Perth to Eucla, there are 20 records, comprising approximately 130 individuals, of remains washed up or animals stranded (*pers. comm.*, J. L. Bannister). The greatest

number of animals stranded at one time was approximately 45. The species most commonly represented are the sperm whale (*Physeter catodon*), the false killer whale (*Pseudorca crassidens*) and the bottle-nosed dolphin (*Tursiops* sp.); the two former generally strand in schools, the latter occurs most often as single carcases, probably washed ashore. Some areas, e.g. Doubtful Island Bay and the Bremer Bay area on the south coast, are more prone to strandings than others, presumably because of the proximity of the continental shelf to the shore (allowing oceanic species to come close to land) and the configuration of the coast line.

When a whale, known by the Aborigines as *mimauga* (see Appendix 1) was washed ashore they feasted upon it, cutting off pieces of its flesh and roasting it on the fire (Grey 1841, vol. 2, p. 277; Johnston 1962, p. 71; Moore 1884b, p. 53; Nind 1831, p. 34). They greased their bodies with the blubber (Grey 1841, vol. 2, p. 277).

Seals were speared or struck with an axe when they were stranded in shallow water or came in close to the shore (Grey 1841, vol. 2, p. 278; King 1827, vol. 2, p. 126).

Insects

Edible insect larvae, known by the names *bardi*, *bardie*, or *wulgang*, (see Appendix 1), were obtained from a number of trees including *Xanthorrhoea*, *Acacia*, *Eucalyptus*, and *Banksia*.

The grubs found in the blackboy (*Xanthorrhoea*) were the larvae of the beetle *Bardistus cibarius*. These were small white grubs and were to be found in large numbers, up to as many as a hundred, in the one tree.

The larvae of *Bardistus cibarius* occur in decayed or rotting trees, and so, to ensure a supply of them, the Aborigines killed the blackboy trees by knocking the tops off them (Grey 1841, vol. 2, p. 289; Nind 1831, p. 34). The grubs which were later found in such trees were regarded as the property of the man who had knocked the top off, and were jealously guarded by him (Grey 1841, vol. 2, p. 289; Nind 1831, p. 34).

The grubs which were found in the other trees were the larvae of the ghost moths (Hepialidae) which deposit their eggs in living *Acacia*, *Eucalyptus* and *Banksia*. The larvae were larger than those of *Bardistus cibarius*, but only one or two were found in each tree.

The larvae of both beetles and moths were eaten either raw or roasted; they were sometimes tied in a piece of bark before being roasted (Bradshaw 1857, p. 99; Hammond 1933, p. 30; Hassell 1936, p. 688; Moore 1884b, p. 5; Grey 1841, vol. 2, p. 289).

Scale insects (Hemiptera, superfamily Coccoidea) and their secretions known as *meenah*, *waunilyar* or *womela* (see Appendix 1) which were found on particular plants and trees, were collected and eaten by the Aborigines (Hammond 1933, p. 29; Moore 1884b, p. 75).

Ants' eggs (? larvae) were also collected and eaten (Hassell 1936, p. 690; Nind 1831, p. 34).

Vegetable foods

Vegetable foods collected and eaten by the Aborigines included roots, bulbs, tubers, seeds, nuts, fruit and fungus. In addition to these nectar was obtained from the flowers of *Banksia*, *Dryandra* and *Eucalyptus*, and gum was collected from *Acacia*. A list of vegetable foods, mostly from literature sources, is given in Appendix 3; it is arranged in alphabetical order of Aboriginal names. Where these have been identified to species, the identification is included. The same species are arranged in alphabetical order of scientific names in Appendix 4.

Roots, bulbs and tubers appear to have been the main sources of vegetable food, some of which were available throughout the year. Those collected and eaten by the Aborigines included species of *Caesia*, *Dioscorea*, *Haemodorum*, *Platysace*, *Praso-*

phyllum, and *Typha*. Gathering roots was a task for the women and children, and for this the women used a long "digging" stick (Baekhouse 1843, p. 546; Bradshaw 1857, p. 99; Browne 1856, p. 537; Grey 1841, vol. 2, pp. 292-3; Hammond 1933, p. 28; Hassell 1936, p. 691; Moore 1884b, p. 73; Nind 1831, p. 36; Ogle 1839, p. 63; Roth 1903, p. 69). Vegetable foods were eaten either raw or roasted. The women and children ate some of them during their day's activities and took the remainder back to their camp.

It is known that complex methods of preparation were used for certain items, probably to rid them of poisonous or injurious qualities, for example Irwin (1835, p. 23) mentions that certain bitter nuts (not identified) were made edible by being rubbed with clay and baked in hot ashes. Another example is provided by the roots of *Haemodorum spicatum* and *Haemodorum* sp., known as *mean*, *meen*, *meernes*, *mein*, or *mene* (see Appendix 3). These roots, which had a hot taste when eaten raw, were roasted, and then pounded with a quantity of a particular type of earth, or "mould", which the women carried in their bags (Anon. [Collie] 1834, p. 319; Baekhouse 1843, p. 527; Grey 1841, vol. 2, p. 266). Different reasons for adding earth, or mould, to these roots have been given, including that it was a type of seasoning (Anon. [Collie] 1834, p. 319; Grey 1841, vol. 2, p. 293), or that it was rubbed on the grinding stones to prevent the roots from sticking to them (Nind 1831, p. 34), but, as it was known that these roots, when eaten by themselves could cause dysentery, it would seem that the most likely reason for the Aborigines using the mould was to remove the noxious qualities from the roots (Grey 1841, vol. 2, p. 293).

Another food which required considerable preparation before it could be eaten was the fruit of the *Zamia* palm (*Macrozamia riedlei*) which, being one of the few trees in the area which bore edible fruit (see below), was an important source of food. The "Zamia nuts", known as *baio*, *bayio*, *boyoo*, or *byyn* (see Appendix 3), caused vomiting if they were eaten raw, and were considered poisonous by the Aborigines (Grey 1841, vol. 2, p. 295; Drummond 1839a MS.).

Towards the end of March, when the fruit was ripe, it was collected, soaked in water for a period, and then buried until the pulp was then safe to be eaten either raw or roasted (Baekhouse 1843, p. 541; Grey 1841, vol. 2, p. 296; Hammond 1933, p. 28; Moore 1884b, p. 17; Stokes 1846, vol. 2, p. 132).

Neectar was obtained from the flowers of *Banksia*, *Dryandra* and *Eucalyptus*. *Banksia grandis* flowered in September and October, *Banksia sphaerocarpa* from October till January, and *Dryandra fraseri* and *Eucalyptus calophylla* in February and March.

The flowers of *Banksia grandis*, and the neectar obtained from them, were known by the same name, *mangaitch*, *mangite*, *mangyt*, *moncat*, *mungat*, *munghite*, *mungite*, or *mungyte* and those of *Banksia sphaerocarpa* as *mugoo* (see Appendix 3). Neectar was primarily obtained by sucking the spikes (Anon. [Collie] 1834, p. 319; Bunbury 1930, p. 80; Hassell 1936, p. 689; Irwin 1835, p. 23; Moore 1884b, p. 7; Nind 1831, p. 35; Roth 1903, p. 49; Drummond 1839a MS.), but a sweet drink was also made from them. This was done by lining a hole in the ground with paper-bark, filling it with the spikes, and then covering these with water and leaving them to soak (Moore 1884b, pp. 7, 63; Roth 1903, p. 49).

The flowers of *Eucalyptus calophylla* (red-gum), known as *ngunbit*, *numbit*, or *numbrid* (see Appendix 3) were used to make a similar drink (Drummond 1843c; Moore 1884a p. 213; Moore 1884b, pp. 62, 67).

Neectar was also sucked from the flowers of *Dryandra fraseri* which were known as *budjan* or *butyak* (see Appendix 3).

In the summer months gum known as *galyang*, *kwonnat*, *manna*, *meen*, or *menna* (see Appendix 3) was collected from *Acacia* trees and made into cakes, which could be eaten as required (Bradshaw 1857 p. 115; Drummond 1839b MS.; Hassell 1936

p. 689; Grey 1841 vol. 2 p. 294; Moore 1884b pp. 27 52; Moore 1884b also adds p. 3 *balga* [= *Xanthorrhoea*] and p. 23, *dolgar* [= *Hakea*]; Drummond 1843c comments on another substance called *mnkar* obtained from a *Eucalyptus*—see Appendix 3 under *mnkar*).

As mentioned above edible fruits were not common, but, in addition to the *Zamia*, the fruit of the Quondong, the “wild cherry”, the “small Hottentot fig”, and a creeper known as *kuruba*, were collected and eaten by the Aborigines. (Hammond 1933, p. 28; Hassell 1936, p. 689; Moore 1884b, pp. 46, 48.)

The women collected seeds from the *Acacia*, known as *kunart* or *kwonnart* (see Appendix 3). These were ground up when required and made into cakes, which were baked in the ashes (Hammond 1933, p. 30; Hassell 1936, p. 690; Moore 1884b, p. 45).

The seeds from the sandal-wood tree, *poilyenum* or *willarak* (see Appendix 3) were sometimes eaten but they were mainly collected for the oil which they contained. The men used this oil for rubbing on their bodies (Hassell 1936 p. 689; Moore 1884b p. 77).

Of fungi growing in the South-West some species, including the common mushroom, were considered inedible by the Aborigines. However other species, including those known as *butogo*, *bwyego*, *dtalyil*, *mord*, *numar*, and *wurdo* (see Appendix 3) were eaten by them (Anon. [Collie] 1834, p. 339; Drummond 1839b MS.; Grey 1841, vol. 2, p. 294; Moore 1884b, pp. 16, 17, 98; Nind 1831, p. 35; *pers. comm.*, Brockman).

From discussion with my informants it is clear that it would still be possible to gain considerable knowledge of gathering, from the women, although some of the Aboriginal names of material gathered may not be known, these having been replaced by European names.

The following example illustrates the potential for study which still exists and should be pursued in depth. That studies are possible outside the South-West is clear from the recent literature (e.g. Gould 1968, Scott 1972).

I cannot judge whether first hand experience of traditional hunting techniques by men can still be gained in the South-West.

On August 19 and August 20, 1967, I accompanied two part-Aboriginal women (Maggie Bell and Nellie Parker of Mingenew) while they collected vegetable foods. We visited five sites and collected samples of eleven kinds of plants eaten by the Aborigines.

The plants were subsequently identified by the Department of Agriculture in Perth.

Site 1 (4.3 kilometres south-east of Mingenew)

Dioscorea hastifolia. This plant, which was called *worrain*, has a long tuber which grows to a considerable depth (i.e. about 2 metres) and was dug up with a digging-stick. It was cooked in the ashes and pounded before being eaten.

Platysace maxwellii. This plant, which was called *karno*, has a large number of round tubers; eighty-four were collected from one plant. The tubers are about half a metre below the ground and are dug up with a digging-stick. The younger tubers, which were nearer the surface, were preferred. These tubers are available throughout the year and, besides being roasted in the ashes, are sometimes eaten raw to quench the thirst.

Thysanotus patersonii. The leaves and flowers of this creeper, which was known as *tjungoori*, were collected and rolled into a ball. It was cooked in the ashes for about ten to fifteen minutes and then ground with a grinding stone. The green powder which resulted from this was eaten with the root of the York gum, *Eucalyptus loxophleba*.

Site 2 (8 kilometres south-east of Mingenew)

Haemodorum paniculatum. The tuberous root of this plant, known as *mutta*, has a hot taste when eaten raw. It was usually roasted in the ashes before being eaten.

Haemodorum spicatum. This plant, known as *koolung*, has a tuberous root similar to *H. paniculatum*.

Prasophyllum sp. This plant is known as the "wild potato". It has a tuber which grows about a quarter of a metre below the ground, and is dug with a digging-stick. It was roasted before being eaten.

Site 3 (0.8 kilometres east of Mingenew)

Amyema fitzgeraldii. This plant, which is a parasite, grows on the jam tree. The Aboriginal name was not known and it was referred to as "mistletoe". The berries were eaten by the Aborigines.

Astroloma serratifolium. The small green berries of this plant, known as *murrumburru*, were eaten by the Aborigines.

Brachysema aphyllum. This plant has a red flower. The Aborigines sucked the flowers to obtain nectar from them.

Site 4 (c. 22 kilometres west of Mingenew)

Banksia sphaerocarpa. Nectar was obtained from the flowers of this plant which were known as *nugoo*. On cool damp days the nectar was sucked from the spikes, but at other times the spikes were soaked in water which was then drunk.

Site 5 (c. 25 kilometres east of Dongara)

Haemodorum simulans. The tuberous root of this plant, known as *mutta*, was similar to *H. paniculatum* and *H. spicatum* (see above).

It has been noted in the literature (see p. 25) that special treatment was used in the preparation of the roots of *Haemodorum* but neither of my informants volunteered information that any special method was used in cooking these roots.

Seasonal utilization of food resources

There is considerable evidence in the literature that the contemporary writers were struck by the mobile nature of Aboriginal groups (Anon. [Collie] 1834, pp. 315, 331, 335; Browne 1856, pp. 492, 534; Grey 1841, vol. 2, pp. 260, 262, 292, 297, 298; Hallam 1971b, pp. 2-3; Irwin 1835, p. 22; Nind 1831, pp. 28, 35, 36; Roth 1903, p. 59). Most writers attributed these movements to the abundance or lack of food in certain areas at certain seasons. There is particular evidence of movement between the coastal areas and the interior; the coastal areas being inhabited during the summer months and the interior during the winter (Anon. [Collie] 1834, pp. 315, 335; Browne 1856, pp. 492, 534; Nind 1831, pp. 28, 36). Hallam (1971b, pp. 5-6) has discussed other data showing movement between various places on the Swan Coastal Plain.

Information on the seasonal distribution and abundance of food species (e.g. kangaroos, fish, etc.) in the South-West of Western Australia, may in due course allow further interpretation of historical records and, in particular, the hypothesis that movements are related to these. Information that a prey species does not move (e.g. that the grey kangaroos in eastern Australia are sedentary—*pers. comm.*, Oliver), may be directly contrary to the inferences drawn by contemporary observers but this need not rule out the possibility that movement was the result of a shift in predation onto a more abundant, or concentrated, part of a non-mobile resource. In assessing modern zoological data it must also be remembered that factors causing seasonal abundance of species today may be different from those in the past as the result of European development. Social motives not understood by observers may also have underlain the reason for seasonal movement by the Aborigines. Finally, climatic effects may have played a considerable part.

In this section is presented, without comment, month by month, and season by season, such information as is in the literature which may reveal seasonal utilization of food resources. The information is summarized in the accompanying table. In literature the writers use months, European seasons, and Aboriginal seasons. In the table these have been translated into months, but in the body of the text I have listed them under the temporal headings used by the original observers.

TABLE 1.

	Swon River Colony Moore 1884b	King Georges Sound Nind 1831	Anon. [Collie] 1834
August	jilba	meerningal	?
September			mainungull
October	kambarang	maungernan	?
November			
December	birok	beruc	mondyeunung
January			
February	burnoru	meertilluc	peerruck
March			
April	wanyarang	pournner	
Moy			
June	maggoro	mawkur	mokkar
July			

Aboriginal names for seasons: MOORE (1884b, p. 10) "The aborigines seem to distinguish six particular seasons. They are:—1. Maggoro—June and July—*Winter*. 2. Jilba—August and September—*Spring*. 3. Kambarang—October and November. 4. Birok—December and January—*Summer*. 5. Burnoru—February and March—*Autumn*. 6. Wanyarang, or Geran—April and May." NIND (1831, p. 50) "Seasons, beginning with June and July, or Winter. Mawkur, Meerningal, Maungernan, Beruc, Meertilluc, Pournner". ANON. (Collie) (1834) p. 315 "... on the 24th May, after some rain had fallen, and in the commencement of *Mokkar*, (winter, or the rainy season,) ..."; p. 339 "In the middle of July (end of *Mokkar*,) ..."; p. 331 "As the spring advanced (in the native season of *Mainungull*) ..."; p. 335 "At this period of the year (*Mondyeunung* of our tribe) comprising from the latter part of October to the middle of January, ..."; p. 335 "The native season of *Mondyeunung* is succeeded by *Peeruk*, which continues till about the 20th of March, ...".

TABLE 2: SEASONAL UTILIZATION OF FOOD RESOURCES

Tabular arrangement of bibliographic references according to kinds of food and their monthly and seasonal distribution. The superscript to each reference indicates whether it is to a month * or a season **.

MONTH*	SEA- SON**	MAMMALS	BIRDS	REPTILES	FISH	ROOTS	NECTAR GUM	FRUITS BERRIES ETC.	GRUBS FROGS
SEPTEMBER		Nind (1831, p. 30)**	Nind (1831, p. 31)**		Anon. [Collie] (1834, p. 331)** Nind (1831, p. 36)*	Moore (1884b, p. 12)** Moore (1884b, pp. 20, 36)* Nind (1831, p. 36)*			Grey (1841, vol. 2, p. 287)**
OCTOBER		Nind (1831, p. 30)**	Anon. [Collie] (1834, p. 335)** Moore (1884b, p. 27)* Nind (1831, p. 31)**		Anon. [Collie] (1834, p. 331)** Anon. [Collie] (1834, p. 335)* Nind (1831, p. 36)*	Gilbert (<i>in</i>) Wagstaffe & Rutherford 1954, p. 496)* Moore (1884b, p. 12)** Moore (1884b, pp. 20, 22)* Nind (1831, p. 36)*	Anon. [Collie] (1834, p. 335)**		Grey (1841, vol. 2, p. 287)**
NOVEMBER		Nind (1831, p. 30)**	Anon. [Collie] (1834, p. 335)** Moore (1884b, p. 27)* Nind (1831, p. 31)**		Anon. [Collie] (1834, p. 331)**	Moore (1884b, p. 12)**	Anon. [Collie] (1834, p. 335)**		Grey (1841, vol. 2, p. 287)**

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TABLE 2: SEASONAL UTILIZATION OF FOOD RESOURCES—continued

MONTH*	SEA- SON**	MAMMALS	BIRDS	REPTILES	FISH	ROOTS	NECTAR GUM	FRUITS BERRIES ETC.	GRUBS FROGS
DECEMBER		Anon. [Collie] (1834, p. 335)* Bradshaw (1857, p. 102)** Nind (1831, p. 28)** Nind (1831, p. 36)*	Anon. [Collie] (1834, p. 335)** Grey (1841, vol. 2, p. 283)**	Moore (1884b, p. 10)* Nind (1831, p. 28)**	Browne (1856, p. 492)** Bunbury (1930, p. 80)* Grey (1841, vol. 2, p. 279)* Moore, (1884b, p. 73)** Neill (1845, pp. 419, 425)** Nind (1831, pp. 32, 34)**	Moore (1884b, p. 12)**	Bradshaw (1857, p. 100)** Bunbury (1930, p. 80)* Grey (1841, vol. 2, p. 294)** Moore (1884b, p. 45)**		Grey (1841, vol. 2, p. 287)**
		Anon. [Collie] (1834, p. 335)* Backhouse (1843, p. 541)* Bradshaw (1857, p. 102)** Nind (1831, p. 28)**	Anon. [Collie] (1834, p. 335)** Grey (1841, vol. 2, p. 283)**	Moore (1884b, p. 10)* Nind (1831, p. 28)**	Browne (1856, p. 492)** Grey (1841, vol. 2, p. 279)* Moore (1884b, p. 73)** Neill (1845, pp. 419, 425)** Nind (1831, pp. 32, 34)**	Backhouse (1843, p. 540)* Moore (1884b, p. 12)**	Bradshaw (1857, p. 100)** Grey (1841, vol. 2, p. 294)** Moore (1884b, p. 45)**		Grey (1841, vol. 2, p. 287)**
JANUARY		Anon. [Collie] (1834, p. 335)* Bradshaw (1857, p. 102)** Nind (1831, p. 28)**	Anon. [Collie] (1834, p. 335)** Grey (1841, vol. 2, p. 283)**	Nind (1831, p. 28)**	Browne (1856, p. 492)** Moore (1884b, p. 16)* Moore (1884b, (p. 73)** Neill (1845, pp. 419, 425)** Nind (1831, pp. 32, 34)**	Moore (1884b, p. 12)**	Bradshaw (1857, p. 100)** Grey (1841, vol. 2, p. 294)** Moore (1884b, p. 45)**	Moore (1884b, p. 16)*	Grey (1841, vol. 2, p. 287)**
		Anon. [Collie] (1834, p. 335)* Bradshaw (1857, p. 102)** Gilbert (<i>iii</i>) Wagstaffe & Rutherford (1955, p. 12)** Nind (1834, p. 28)**	Anon. [Collie] (1834, p. 335)** Grey (1841, vol. 2, p. 283)**	Nind (1831, p. 28)**	Browne (1856, p. 492)** Moore (1884b, p. 16)* Moore (1884b, (p. 73)** Neill (1845, pp. 419, 425)** Nind (1831, pp. 32, 34)**	Moore (1884b, p. 12)**	Bradshaw (1857, p. 100)** Grey (1841, vol. 2, p. 294)** Moore (1884b, p. 45)**	Moore (1884b, p. 16)*	Grey (1841, vol. 2, p. 287)**

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TABLE 2: SEASONAL UTILIZATION OF FOOD RESOURCES—continued

MONTH*	SEA- SON**	MAMMALS	BIRDS	REPTILES	FISH	ROOTS	NECTAR GUM	FRUITS BERRIES ETC.	GRUBS FROGS
MARCH					Moore (1884b, p. 16)* Nind (1831, pp. 32, 33, 36)**	Moore (1884a, p. 220)* Moore (1884b, p. 12)**	Moore (1884a, p. 213)*	Grey (1841, vol. 2, p. 296)* Moore (1884b, p. 16)* Stokes (1846, vol. 2, p. 132)*	Grey (1841, vol. 2, p. 287)** Moore (1884a, p. 220)*
APRIL					Nind (1831, pp. 32, 33, 36)**	Moore (1884a, p. 220)* Moore (1884b, p. 12)** Moore (1884b, p. 81)*			Grey (1841, vol. 2, p. 287)** Moore (1884b, p. 33)*
MAY		Anon. [Collie] (1834, pp. 315, 319)* Nind (1831, p. 36)**			Nind (1831, pp. 32, 33, 36)**	Anon. [Collie] (1834, p. 319)* Moore (1884b, p. 12)** Moore (1884b, p. 81)*		Moore (1884b, p. 17)*	Anon. [Collie] (1834, p. 319)* Grey (1841, vol. 2, p. 287)** Moore (1884a, pp. 184, 265)* Moore (1884b, p. 33)*

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TABLE 2: SEASONAL UTILIZATION OF FOOD RESOURCES—continued

MONTH*	SEA- SON**	MAMMALS	BIRDS	REPTILES	FISH	ROOTS	NECTAR GUM	FRUITS BERRIES ETC.	GRUBS FROGS
JUNE		Anon. [Collie] (1834, p. 315)** Bradshaw (1857, p. 98)** Browne (1856, p. 534)**	Bradshaw (1857 p. 98)** Nind (1831, p. 30)**		Anon. [Collie] (1834, p. 331)** Eyre (1845, vol. 2, p. 97)* Moore (1884b, p. 47)* Neill (1845, p. 426)** Paterson (1896, p. 289)**	Grey (1841, vol. 2, p. 294)* Moore (1884b, pp. 12, 74)** Moore (1884b, p. 36)*		Grey (1841, vol. 2, p. 287)**	
JULY		Anon. [Collie] (1834, p. 315)** Bradshaw (1857, p. 98)** Browne (1856, p. 534)**	Bradshaw (1857, p. 98)** Nind (1831, p. 30)**		Anon. [Collie] (1834, p. 331)** Moore (1884b, p. 47)* Neill (1845, p. 426)**	Moore (1884b, p. 12)**			Grey (1841, vol. 2, p. 287)**
AUGUST		Anon. [Collie] (1834, p. 315)** Bradshaw (1857, p. 98)** Browne (1856, p. 534)**	Bradshaw (1857, p. 98)** Nind (1831, p. 30)**		Anon. [Collie] (1834, p. 331)** Neill (1845, p. 426)**	Moore (1884b, p. 12)** Moore, (1884b, p. 36)*			Grey (1841, vol. 2, p. 287)**

W I N T E R

SEPTEMBER

Moore (1884b, p. 20)

Djakat,—A small root eaten by the natives; in season in the months of September and October.

Moore (1884b, p. 36)

Jilba,—The spring; August and September. Djubak is now in season.

Nind (1831, p. 36)

They begin to return to the coast about September or October, and at this season they chiefly subsist on roots. In calm weather, however, they procure a few fish.

OCTOBER

Anon. [Collie] (1834, p. 335, October 24)

Every hand engaged procured about a dozen [fish], and I think there were ten of them. Nor was this the only shoal they caught that morning, so that they feasted all day to gorging, buried a quantity for another day, and gave us several.

Gilbert (*in* Wagstaffe & Rutherford, 1954, p. 496, October 9, 1842)

. . . their [the Aborigines'] Season of meeting in great numbers to dig the edible Root called by them Wargae is now in full force . . .

Moore (1884b, p. 20)

[see *SEPTEMBER*]

Moore (1884b, p. 22)

Djubak,—An orchis, the root of which is the size and shape of a new potato, and is eaten by the natives. It is in season in the month of October.

Moore (1884b, p. 27)

Kambarang,—Beginning of summer—October and November. The natives leave off building huts about this time. Young birds begin to be plentiful.

Nind (1831, p. 36)

[see *SEPTEMBER*]

NOVEMBER

Moore (1884b, p. 27)

[see *OCTOBER*]

DECEMBER

Anon. [Collie] (1834, p. 335)

In December, but more particularly in January and February, the natives burn large tracts of country to catch wallabee, or bush kangaroo. For this purpose they generally go in considerable numbers and select a fine and warm day, and, having fired a portion of thick shrub or grass where they know these animals to live, they watch their being driven by the fire, and either spear them or knock them down with a short and rather slender baton called *toollila*. As the fire when once lighted cannot be extinguished when they have supplied themselves with a sufficient number, they go on catching not to lose the opportunity, and having thus procured a superabundance, they are glad to exchange them in the Settlement for bread, rice &c.

Bunbury (1930, p. 80)

At this season [December] food was plentiful—both fish, the favorite of which seems to be the Mullet, and “Munghites” as they call the flower of the Banksia,

from which they extract by suction a delicious juice resembling a mixture of honey and dew.

Grey (1841, vol. 2, p. 279)

. . . fresh-water turtle are extremely abundant, (p. 280) and are in high season about December and January. At this time the natives assemble near the fresh-water lakes and lagoons in large numbers; . . . I have known two or three of them to catch fourteen turtle, none of which weighed less than one, and many of them as much as two or three pounds, in the course of a very short time.

Moore (1884b, p. 10)

Birok,—The summer season, December and January. . . This is the very height of summer, when iguanas and lizards abound.

Nind (1831, p. 36)

About Christmas they commence firing the country for game, and the families, who through the winter have been dispersed over the country, reassemble.

JANUARY

Anon. [Collie] (1834, p. 335)
[see *DECEMBER*]

Backhouse (1843, p. 540, January 20, 1838)

We examined some holes, where the Natives had been digging for roots of a *Dioscorea*, or Yam, for food.

Backhouse (1843, p. 541, January 22, 1838)

Much of the bush, on the road, had been recently burnt, and one house had been consumed by fire. The Natives are now setting fire to the scrub, in various places, to facilitate their hunting, and to afford young herbage to the Kangaroos.

Grey (1841, vol. 2, p. 279)
[see *DECEMBER*]

Moore (1884b, p. 10)
[see *DECEMBER*]

FEBRUARY

Anon. [Collie] (1834, p. 335)
[see *DECEMBER*]

Moore (1884b, p. 16)

Burnur, or Burnuro,—The autumn of Western Australia, including the months of February and March. . . This is the By-yu or *Zamia*-fruit season; and mullet, salmon and tailor-fish abound.

MARCH

Grey (1841, vol. 2, p. 296)

The native women collect the nuts from the [*Zamia*] palms in the month of March, and having placed them in some shallow pool of water, they leave them to soak for several days.

Moore (1884a, p. 213, March 6, 1834)

Have been beset all day by natives. They pull the blossoms of the red gum tree (now in flower), steep them in water, and drink the water, which acquires a taste like sugar and water by this process.

Moore (1884a, p. 220, March 29, 1834)

They [the natives] are now busy digging the root of a broad sort of flag which grows in a swamp near this; some people say that this makes sago, or rather arrowroot.

Moore (1884a, p. 220, March 30, 1834)

The natives have been feasting on a sort of grub or worm which they find in numbers under the bark of the red gum trees. . . . The grub is a sort of long four-sided worm or maggot, with a thick flat square head and a small pair of strong brown forceps set on the end of the head.

Moore (1884b, p. 16)

[see *FEBRUARY*]

Stokes (1846, vol. 2, p. 132)

[*Zamia* palm] Red fruit, nut, called *baio* ripe in March, is considered a delicacy by the natives.

APRIL

Moore (1884a, p. 220, April 2, 1834)

Got from the natives a piece of bread made of the root of the flag which they called *yandyett*.

Moore (1884b, p. 33)

Gu-yu, or Goya,—A species of frog that burrows in the sand, and is eaten by the natives. It is in season in the months of April and May.

Moore (1884b, p. 81)

Yanjidi,—An edible root of a species of flag (*Typha angustifolia*), growing along fresh-water streams and the banks of pools. . . . The natives dig the roots up, clean them, roast them, and then pound them into a mass, which, when kneaded and made into a cake, tastes like flour not separated from the bran. This root is in season in April and May, when the broad leaves will have been burned by the summer fires, by which the taste, according to native ideas, is improved.

MAY

Anon. [Collie] (1834, p. 315)

. . . on the 24th of May, after some rain had fallen, and in the commencement of Mokkar, (winter, or the rainy season,) . . . they took their departure from the coast, and even to a boy proceeded inland for the purpose of spearing kangaroo—the season for that species of hunting commencing at that time.

Anon. [Collie] (1834, p. 319, May 3 & 4)

The animals which they [two men, a woman and child] had consisted of a possum, bandicoot, kangaroo rat, and frogs; . . . Next day, which was at first very rainy, our native companions followed us and stopped when we did to lunch. They had picked out of the hollow of some trees as they went along, an opossum or two, which were treated as the preceding night, but our afternoon's march did not lead through so good a foraging country, and they came to the evening's bivouac with empty hands and unfilled bags. As this place, however, was early selected, they made an excursion and returned before dark laden with mean, (*Haemodorum spicatum*), and this constituted their supper, . . .

Moore (1884a, p. 184, May 4, 1833)

Two natives came here today: . . . One of them had a number of frogs (which I think he called "dweep") nicely packed up in the bark of the tea-tree, and tied with grass; these he signified they roasted for food, with a long white root, growing like a parsnip, which they dig up in wet weather.

Moore (1884a, p. 265, May 6, 1835)

One of the little native boys was busy eating frogs today. They looked so tempting that I ate one also, and it was delicious. The part I ate, however was the eggs of the female, which they seem to prize most, as they say, "the men frogs are no good," the taste was much like that of an egg. . . . The natives dig them out of the ground with their hands.

Moore, (1884b, p. 17)

By-yu,—The fruit of the *Zamia* tree. This in its natural state is poisonous; but the natives, who are very fond of it, deprive it of its injurious qualities by soaking it in water for a few days, and then burying it in sand, where it is left until nearly dry, and is then fit to eat. They usually roast it, when it possesses a flavour not unlike a mealy chestnut; it is in full season in the month of May.

Moore (1884b, p. 33)

[see *APRIL*]

Moore (1884b, p. 81)

[see *APRIL*]

JUNE

Eyre (1845, vol. 2, p. 97, June 28, 1841)

Upon getting up [near East Mount Barren] this morning we saw the smoke of native fires along the margin of the lake, at less than a mile from us. . . . Soon afterwards we saw them in the midst of the lake carrying boughs, apparently fishing.

Grey (1841, vol. 2, p. 294)

The former of these [roots] resembles, in appearance and taste, the unripe seeds of Indian corn; it is in season in June, and is really very palatable.

Moore (1884b, p. 36)

Jetta,—The root of a species of rush, eaten by the natives, in season in June. It somewhat resembles a grain of Indian corn, both in appearance and taste.

Moore (1884b, p. 47)

Maggoro,—The winter of Western Australia, including the months of June and July. . . . At this period of the year cobbler-fish abound, and the mullet become blind, occasioned it is supposed, by the superabundant mixture of the fresh water with the salt water in the estuaries.

JULY

Moore (1884b, p. 47)

[see *JUNE*]

AUGUST

Moore (1884b, p. 36)

[see *SEPTEMBER*]

SPRING

Anon. [Collie] (1834, p. 331)
[see *WINTER*]

Anon. [Collie] (1834, p. 335)

At this period of the year (Mondyeunung of our tribe) comprising from the latter part of October to the middle of January, the Natives bring in considerable numbers of young parrakeets, and some cockatoos, to exchange for food. In the commencement of it, too, they brought us a liquid they had long talked about, which they call mungat, and, from some similitude or other, compared it to our oil and to honey. . . . It proved in reality to be the nectareous fluid of the flowers of the banksia, . . .

Grey (1841, vol. 2, p. 287)

The season of the year in which the natives catch the greatest quantity of frogs, and fresh-water shell-fish, is when the swamps are nearly dried up; these animals then bury themselves in holes in the mud, and the native women with their long sticks, and long thin arms, which they plunge up to the shoulder in the slime, manage to drag them out; at all seasons however they catch some of these animals, but in summer a whole troop of native women may be seen paddling about in a swamp, slapping themselves to kill the mosquitoes and sandflies, and every now and then plunging their arms down into the mud, and dragging forth their prey. I have (p. 288) often seen them with ten or twelve pounds weight of frogs in their bags.

Moore (1884b, p. 12)

Bohn, or Bohrn,—A small red root of the *Haemodorum spicatum*. This root in flavour somewhat resembles a very mild onion. It is found at all periods of the year in sandy soils, and forms a principal article of food among the natives. They eat it either raw or roasted.

Nind (1831, p. 30)

They [kangaroos] are also sometimes killed in *woits*, but this plan is more used for the small or brush kangaroo. In this case a portion of the brush is surrounded, and each person begins breaking it down and treading over it, so as to make a complete road all round, carefully stopping the runs of the animals. One or two of the hunters then go in with their dogs, and as the game attempts to pass the clear spot, they are entangled in the brush and knocked on the head. In this way they kill a great many; it is practised almost entirely in the spring before the burning season commences, but it requires a number of people, and the whole of the males of the tribe are generally present.

Nind (1831, p. 31)

At the spring time of the year, they live principally upon the eggs and young of birds, chiefly of the parrot tribe, but also of hawks, ducks, swans, pigeons, &c.

SUMMER

Anon. [Collie] (1834, p. 335)
[see *SPRING*]

Bradshaw (1857, p. 100)

During the summer months the natives collect quantities of fine gum which they make into cakes, it is equally good as gum arabic; . . .

Bradshaw (1857, p. 102)

During the summer months they often get game by setting fire to the bush and burning out the different animals concealed amongst the logs of timber and scrub.

Browne (1856, p. 492)

During the summer months the tribes of the interior generally make towards the sea coast for the purpose of enjoying a feast on the various kinds of fish which are there to be obtained.

Gilbert (*in* Wagstaffe & Rutherford, 1955, p. 12)

It [a small kangaroo " which I suppose is identical with the *Halmaturus brachyurus* "] inhabits thickets and is destroyed in great numbers at the close of the dry Season, by firing the Bush; the Natives waiting in a clear space to spear them in their attempts to escape the Fire.

Grey (1841, vol. 2, p. 283)

During the period of the moulting season, they catch many black swans.

Grey (1841, vol. 2, p. 287)

[see *SPRING*]

Grey (1841, vol. 2, p. 294)

Kwon-nat is the kind of gum which most abounds, and is considered the nicest article of food. It is a species of gum-tragacynth. In the summer months the acacias, growing in swampy plains, are literally loaded with this gum, and the natives assemble in numbers to partake of this favourite esculent.

Moore (1884b, p. 12)

[see *SPRING*]

Moore (1884b, p. 45)

Kunart, or Kwonnat,—A species of acacia abundant on the banks of estuaries, and in districts having salt lakes. It produces a great quantity of gum in the summer months.

Moore (1884b, p. 73)

Wappi,—A small species of fish, found in the pools of rivers in summer, and taken by pushing boughs through the water from one end of the pool to the other.

Neill (1845, p. 419)

It [*Australuzza novaehollandiae*, or *Sphyraenella obtusata*] comes into the shallow bays in summer; and being a sluggish fish, is easily speared by the (p. 420) natives, who esteem it to be excellent food.

Neill (1845, p. 425)

Very common in all shallow bays in the summer time, where it [? *Phyllichthys punctata*] may be taken by the seine. The natives detect it when its body is buried in the sand, by the glistening of its eyes, and spear it. When fishing with the torch, in the night time, the natives feel for this fish with their naked feet.

Nind (1831, p. 28)

During the winter and early spring they [the Aborigines] are very much scattered; but as summer advances they assemble in greater numbers. It is at that season that they procure the greatest abundance of game. It is done by setting fire to the underwood and grass, which, being dry, is rapidly burnt. . . . As soon as the fire has passed over the ground, they walk over the ashes in search of lizards and snakes, which are thus destroyed (p. 29) in great numbers, and those which have escaped in their holes are easily discovered.

Nind (1831, p. 32)

During the summer and autumn months, the natives derive a large proportion of their food from fish. They have no canoes, neither can they swim, . . . They can, therefore, only catch those fish which approach (p. 33) the shores, or come into shoal water. They have neither nets, nor hook and line, and the only weapon they use is the spear, with which they are very dexterous. In the mouths of streams or rivers, they take large quantities, by weirs made of bushes, but the most common method is pursuing the fish into shoal waters, and spearing them, or as they lie basking on the surface. During calms, they walk over the mud and sand-banks, in search of flat fish, which are easily detected while lying at the bottom. At night, too, they light torches of grass-tree, and thus see the fish at the bottom, apparently asleep, when they very rapidly spear them. By these methods, vast quantities are taken, but it can only be done in dead calms. Another common method is to sit on a rock, motionless, and occasionally throw into the water pieces of limpet, or other shell-fish, keeping the spear under water until the bait is seized by a fish, when they are almost certain of striking it.

Nind (1831, p. 34)

The fresh-water swamps abound with a species of cray-fish, called *challows*, very like those found in rivulets in England. The procuring of these is the employment of the women. In the summer months when the water is partly dried up, they find them in holes in the ground, a foot or more deep, the entrance being small, but sufficiently wide within for the arm to be thrust to the bottom; they are very abundant, . . . The natives roast them in the ashes, and eat them in large quantities.

Nind (1831, p. 36)

At the dry seasons of the year large districts are abandoned for want of water.

AUTUMN

Grey (1841, vol. 2, p. 287)
[see *SPRING*]

Moore (1884b, p. 12)
[see *SPRING*]

Nind (1831, p. 32)
[see *SUMMER*]

Nind, (1831, p. 33)

In the autumn, when the smaller species of fish approach the shores in large shoals, they surround them, and keep them in shallow water upon the flats until the tide falls and leaves them, when they are easily speared, and very few escape.

Nind (1831, p. 36)

The greatest assemblages, however, are in the autumn (*pourner*), when fish are to be procured in the greatest abundance. Towards the end of autumn, also, they kill kangaroos, by surrounding them.

WINTER

Anon. [Collie] (1834, p. 315)

. . . on the 24th of May, after some rain had fallen, and in the commencement of Mokkar, (winter, or the rainy season,) . . . they took their departure from the coast and even to a boy proceeded inland for the purpose of spearing kangaroo—the season for that species of hunting commencing at that time.

Anon. [Collie] (1834, p. 331)

During the winter (Mokkar of the Natives) scarcely any of them came into the Settlement. They appeared for some reasons already adduced to obtain their food more easily in the interior; and I may also mention that the floods at that season of the year, and more particularly when the waters of the rivers retire in the spring, afford great opportunities of procuring fish by means of wares.

Bradshaw (1857, p. 98)

In the winter months they often meet in large parties with their dogs for hunting the kangaroo and emus. When the bush is soft from the heavy rains a number will surround a herd of kangaroos and then close on them when they spear them with ease on account of their being unable to run.

Browne (1856, p. 534)

On the approach of winter the tribes draw off from the coast into the interior of the country, where, encamped in the depth of the forest, they lie sheltered from the severe storms with which the Australian shores are then visited. The fact of the kangaroo, their principal source of sustenance also seeking the shelter of the interior at this season, has, of course, great influence in attracting them from the coast.

Grey (1841, vol. 2, p. 287)

[see *SPRING*]

Moore (1884b, p. 12)

[see *SPRING*]

Moore (1884b, p. 74)

Warran.—One of the Dioscoreae. A species of yam, the root of which grows generally to about the thickness of a man's thumb; and to the depth of sometimes of four to six feet in loamy soils. It is sought chiefly at the commencement of the rains, when it is ripe, and when the earth is most easily dug; and it forms the principal article of food for the natives at that season.

Neill (1845, p. 426)

“The flat-nosed mullet” of the natives. . . . In Wilson's Inlet, about forty miles west of King George's Sound, it abounds in the winter months; and the different tribes, from all parts of the coast, assemble there, by invitation of the proprietors of the ground, (the *Murrymin*,) who make great feasts on the occasion.

Nind (1831, p. 30)

The emu is speared chiefly in the winter, at which time they lay their eggs. When a nest is found, the hunters conceal themselves behind a bush near it, and endeavour to secure the male bird first. The female they are pretty certain of, unless she has been disturbed, when she will forsake the nest. Emus, however, are not very often procured by the natives, but, with the kangaroo, are highly esteemed as articles of food.

Paterson (1896, p. 289)

Sometimes very large catches [of fish] were made this way [in fish traps], particularly at the beginning of the winter, when, with the increased rains, the fish returned from the spawning places up stream. At this time the blacks would watch day and night for the fish to come, relieving each other.

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APPENDIX I

List of animal foods arranged in alphabetical order of Aboriginal names; references to quotations and scientific names are also given. The latter were provided by Drs W. D. L. Ride and G. M. Storr, and Mr R. J. McKay, of the Western Australian Museum.

- ballawara** Moore (1884b, p. 4)
 "A small squirrel-like opossum."
- banggap** Moore (1884b, p. 4)
 "The Walloby, a small species of kangaroo."
- bardi** Moore (1884b, p. 5) *Bardistus cibarius*
 "The edible grub found in trees. . . . The Bardi of the Xanthorea [sic] are small, and found together in great numbers."
 Chauncy (1878, p. 248)
 ". . . the larvae of a species of cerambyx called bardi. . . . They are about an inch long, and sometimes fifty or a hundred are found boring their way through one grass-tree."
- bardick** Neill (1845, p. 416) *Brachyapis curta*
 [Snake.] "Dirty olive green over the whole back; belly dirty white; . . . The natives state that the bite produces great swelling of the part for a day or two, and goes off."
- bardie** Hassell (1936, p. 688) Hepialidae
 "A large white grub found in roots and under the bark of many trees. It was greatly prized and eaten raw or roasted. The taste resembles pounded almonds and cream."
 Hammond (1933, p. 30) *Bardistus cibarius*
 "The 'bardie' grub—a fat white grub found in blackboys or wattle trees—was either eaten raw or cooked. . . . The grubs from the black-boy and wattle were the best. The grubs from the banksia were always woody."
- bibilyer** Moore (1884b, p. 8) *Eupodotis australis*
 "A bustard; colonially, the wild turkey. A fine large bird, frequently weighing twelve to fifteen pounds, and extending full six feet from tip to tip of the wing. It is excellent for eating."
- burdi** Moore (1884b, p. 16) *Bettongia lesueur*
 "Macropus; a species of small kangaroo, having the habits of a rabbit."
- carta** Hassell (1936, p. 690) *Varanus gouldii*
 "The iguana (Gould's Monitor). The eggs were highly prized for food. They are about the size of pidgeon eggs and have a tough outer skin but no shell. When roasted in wood ashes they taste like a rich custard, for the yolk and white seem mixed together. They were restricted to the old men and women."
- chondelar** Neill (1845, p. 425) *Phyllichthys punctata* ?
 [Fish.] "Very common in all the shallow bays in the summer time, . . . The natives detect it when its body is buried in the sand, by the glistening of its eyes, and spear it. When fishing with the torch, in the night time, the natives feel for this fish with their naked feet. Specimen caught August, 1841."
- chudela** see chondelar.

- comal** Nind (1831, p. 32) *Trichosurus vulpecula*
[A species of possum] “living chiefly in lofty and thick woods, . . . [It] is of a larger size [than the ring-tail], and much lighter in colour, with a brownish bushy tail: it is also fatter; the fur is longer, of a whitish colour, . . .”
- cooljaik** Bunbury (1930, p. 73) *Cygnus atratus*
“ . . . black swans . . . during the breeding season they succeed in taking a good many swans (Cooljaik), both old and young, as well as eggs (Nooro).”
- cumbeak** *see ianont.*
- dalgyte** Grey (1841, vol. 2, p. 291) *Macrotis lagotis*
“ . . . an animal about the size of a weasel, burrow in the earth; these the natives surprise when they are feeding, or dig them from their burrows.”
- djilyur** Moore (1884b, p. 21)
“A small field-mouse, eaten by the natives.”
- docat** *see norne.*
- dolgyt** Moore (1884b, p. 23) *Macrotis lagotis*
“A marsupial animal allied to the kangaroo, except that it has no incisors or cutting teeth, and that the opening to the pouch is from below instead of from above. This seems to be a provision of nature suited to the habits of the animal, for the creature burrows in the ground, and it would be difficult for the young ones to seek shelter suddenly in the parent’s pouch if it were otherwise formed, and which they can readily do now, though she should have entered her burrow; and, also, when she burrows, the earth would be thrown into the pouch, if the opening were in the usual position.”
- dubyt** Moore (1884b, p. 24) *Demansia affinis*
“A very venomous yellow-bellied snake, from five to six feet long, much dreaded but eaten by the natives.”
- dyinda** Moore (1884b, p. 26)
“A species of opossum. Portions of the fur of this animal are worn by the aborigines among the hair as an ornament.”
- garlgyte** Moore (1884b, p. 28) *Potorous gilbertii*
“Hypsiprymnus Gilbertii. A species of kangaroo.”
- goya** Moore (1884b, p. 33)
“A species of frog that burrows in the sand, and is eaten by the natives. It is in season in the months of April and May.”
- guijak** Moore (1884b, p. 30) *Cygnus atratus*
“Black swan. This bird may be readily taken when moulting, and soon becomes tame.”
- gumal** Moore (1884b, p. 31) *Trichosurus vulpecula*
“Phalangista vulpina. Large grey opossum.”
- gurhra** Moore (1884b, p. 33) *Macropus irma*
“Macropus caeruleus. The brush kangaroo. A very fleet, active animal of about twenty pounds’ weight, having fur of a silver grey colour, with a white stripe on each side of its face.”
- guya** *see goya.*
- ianont** Neill (1845, p. 427) *Haletta semifasciatus*
[Fish.] “Inhabits weedy places in deep water, and along sandy bays. Sometimes taken by the natives on the edge of banks. Specimen caught March 18, 1841.”

- kangaronga** Moore (1884b, p. 40)
 "Female kangaroo."
- karbarda** Moore (1884b, p. 37) *Demansia affinis*
 "A species of snake, cream-coloured with dark spots. It is considered deadly, and is much dreaded by the natives; . . ."
- kerrygura** Neill (1845, p. 415) *Lialis burtonis*
 [Lizard.] "Considered by the natives as harmless; the scales of the back are very minute; the tail when broken is sometimes terminated by three horny blunt ends; tongue divided and rounded."
- knamler** Neill (1845, p. 425) *Aldrichetta forsteri*
 [Fish.] "Frequents shores with sandy beaches, and forms a principal article of food to the native youths, who are continually practising throwing their spears at this fish. Specimen caught April 12, 1841."
- kordong** Neill (1845, pp. 419, 20) *Australuzza novaehollandiae* or *Sphyaenella obtusata*
 "The 'Common Baraceota' is found off the whole coast of New Holland, but the *Kordong* seems to be peculiar to Western Australia. It comes into the shallow bays in summer; and being a sluggish fish, is easily speared by the natives, who esteem it to be excellent food. It will lay for a minute looking with indifference at its enemy, while he poises the fatal and unerring spear. Specimen caught December 1841."
- kubit** Moore (1884b, p. 45)
 "The male kangaroo."
- kumal** Moore (1884b, p. 45) *Trichosurus vulpecula*
 "Phalangista vulpina; large grey opossum. This animal forms a great resource for food to the natives, who climb the tallest trees in search of them, and take them from the hollow branches."
- kundi** Moore (1884b, p. 45) ? *Isoodon obesulus*
 "A species of marsupial rat. Colonially, Bandicoot. It is something like a guinea-pig, and is very good eating."
- kwakar** Moore (1884b, p. 46) *Setonix brachyurus*
 "A small species of kangaroo."
- madawick** Neill (1845, p. 425) *Caranx georgianus*
 [Fish.] "Very common in shallow sandy bays, and forming the staple food of the natives, who assemble in fine calm days, and drive shoals of this fish into weirs that they have constructed of shrubs and branches of trees. Specimen caught May 12, 1841."
- mardo** Moore (1884b, p. 50) *Antechinus flavipes*
 "A species of rat or mouse eaten by the natives."
- marel** Moore (1884b, p. 51)
 "A species of unio, or fresh water musel [sic]. Not eaten by the natives, because supposed by them to be poisonous. It has been eaten by the settlers with impunity."
- neenah** Hammond (1933, p. 29) Hemiptera
 "A white scale which formed on the leaves of the blue gum tree was called 'Mee-nah'. It was not very plentiful but the natives used to eat it and also the insect that was found underneath the scale."

- memon** (1) Neill (1845, p. 424) *Scorpius aequipinnis*
[Fish.] "It is a gross feeder and poor eating. Very common on rocky shores. Being a bold voracious fish, it is easily speared, . . . Specimen caught June 15, 1841."
- memon** (2) Neill (1845, p. 424) *Kyphosus sydneyanus*
[Fish.] "Is a gross feeder, and its flesh has a strong disagreeable smell, but is much relished by the Aborigines. Specimen caught May 3, 1841."
- merrong** Neill (1845, p. 426) *Mugil cephalus*
[Fish.] "In Wilson's Inlet, about forty miles west of King George's Sound, it abounds in the winter months; . . . In the summer it retires to the ocean. Specimen caught September, 1841."
- mimanga** Moore (1884b, p. 53)
"A whale. Both sperm and black whales abound on the coast. Sometimes a dead whale is thrown on the shore, and affords luxurious living to the natives."
- mirrong** *see merrong.*
- moorhait** Nind (1831, p. 49) *Phaps chalcoptera*
"Bronze Pigeon."
- muddier** *see memon* (2).
- munnaar** Nind (1831, pp. 30, 31) *Varanus gouldii*
". . . appears to resemble an iguana found at Sydney; it is long, and generally very lean and lank. At one season, however, it is fat, and very good eating. It makes a hole in the nest of a species of ant, which is a mound of earth four or five feet high, the inner parts consisting of cells constructed of a gummy substance mixed with earth, and is very hard; yet the munnaar burrows from the top nearly to the bottom, and there deposits its eggs, which are the size of a large pigeon's egg, covered with a thick pellicle as tough as parchment. The eggs are about ten or twelve in number, and adhere together. The ants soon repair the hole made by the munnaar, and the warmth of the nest is sufficient to hatch the eggs."
- norn** Neill (1845, p. 417) *Notechis scutatus*
(or **norne**) "This is the most fatal of the New Holland snakes; the animal bitten seldom recovers. The Aborigines have a great dread of this reptile; they however eat of it if they kill it themselves, but there is a superstition amongst them about snakes, which prevents their eating them if killed by a European."
Nind (1831, p. 31)
"The *norne* and the *docat* are much alike, of very dark colour, six and seven feet in length, and their bite generally fatal."
- nuji** Moor (1884b, p. 62)
"A large species of mouse eaten by the natives."
- nworra** Nind (1831, p. 32) *Pseudocheirus peregrinus*
". . . the common ring-tail [possum] . . . frequently found in swamps and the low brush which surrounds them."
- pining** Neill (1845, p. 428) *Gonorhynchus greyi*
[Fish.] "When the skin was removed the flesh was very fat, resembling that of an eel, had an unpleasant smell, and could not be eaten. The natives also were averse to eating it, and only one man acknowledged to have seen it before. Specimen caught April 7, 1841."

- quoit** Anon. [Collie] (1834, p. 339) ? *Perameles*
 “. . . bandicoots (*perameles nasutus* and *ecaudatus*) . . .”
- tabeduck** Neill (1845, p. 430) ? *Nehusetta ayraud*
 [Fish.] “Inhabits deep water in rocky places, and is very common. It is esteemed for food by the Aborigines: . . . Specimen caught May 12, 1841.”
- tchark** Neill (1845, p. 420) *Sciaena antarctica*
 [Fish.] “Grows to a great size; as I am informed by the natives, that they often spear individuals weighing sixty or seventy pounds. This fish enters the fresh-water periodically, . . . to spawn, . . . Specimen caught August 30, 1941.”
- tdunjar** Moore (1884b, p. 69)
 “A species of frog eaten by the natives.”
- tookyte** see **tornock**.
- toorjenong** Neill (1845, p. 422) *Psilocranium nigricans*
 [Fish.] “They are sluggish, and easily speared by the Aborigines, whose chief food it constitutes at certain seasons. The specimen was speared in my presence by Wallup, on the 8th of June, 1841. The Toorjenong grows to a large size, exceeding twenty pounds in weight. It is a gross feeder, and its flesh is hard and dry, but the head and sides are much prized by the natives, . . .”
- tornock** Neill (1845, p. 415) *Demansia affinis*
 [Snake.] “The women of King George’s Sound declare the bite of the Torn-ock mortal: but the men laugh at that, and maintain that three days ‘couple’, (sleep) will restore the patients. This is a favourite food of the natives of King George’s Sound.”
- torkite** Neill (1845, p. 416) *Rhinoplocephalus bicolor*
 “Not at all dreaded by the natives; venomous, but not deadly, the bite merely producing a bad ulcer for a day or two.”
- tuk** Moore (1884b, p. 70)
 “A species of frog eaten by the natives (thus named from the noise it makes).”
- wackul** Nind (1831, p. 31) *Python spilotos*
 “The *wackul* is the common diamond snake of New South Wales, and is not venomous.”
- wait** Nind (1831, pp. 30, 49) *Dromaius novaehollandiae*
 “The emu is speared chiefly in the winter, at which time they lay their eggs. . . . Emus, however, are not very often procured by the natives, but, with the kangaroo, are highly esteemed as articles of food.”
- wakel** Neill (1845, p. 417) *Python spilotos*
 “This snake is considered by the natives a great delicacy, and by their account resembles mutton in flavour, being also remarkably fat. . . . easily caught by the women, who seize them behind the head and wring their necks.”
- walyo** Moore (1884b, p. 72) *Bettongia penicillata*
 “The Kangaroo-rat. An animal nearly as large as a wild rabbit, tolerably abundant, and very good eating. The natives take them by driving a spear in the nest, . . . which is formed of leaves upon the ground.”

- wandie** Nind (1831, p. 31) *Egernia kingii*
 “The . . . lizard, called *wandie*, is of a very dark colour, has a long round tail. It is generally found among rocks, and conceals itself under them; it also inhabits hollow trees or holes in the ground; and is a very lively animal, and quick in its motions.”
- wango** Moore (1884b, p. 72)
 “. . . a species of snake particularly liked as food by the aborigines.”
- wappi** Moore (1884b, p. 73)
 “A small species of fish, found in the pools of rivers in summer, and taken by pushing boughs through the water from one end of the pool to the other.”
- waumilyar** Moore (1884b, p. 75) Hemiptera
 “Colonially called Manna. A white sweetish substance, found on and under certain trees and plants, supposed to be some insect secretion. It is much prized by the natives. . . . When the native women find a quantity of it collected about an ant-hill, they fling the furry side of their cloak upon it, to which it adheres. They then carry off the cloak and secure their prize, the ants have dropped off the fur in the meantime.”
- waunugur** *see pining.*
- werr** Neill (1845, p. 416) *Denisonia coronata*
 [Snake.] “Doubtful if poisonous; little dreaded by the natives.”
- widji** Moore (1884b, p. 76) *Dromaius novaehollandiae*
 “An emu. . . . A full-grown one, when erect, stands seven feet high. The natives creep on them and spear them. The flesh is very good for eating in the proper season, tasting something like veal.”
- william
lunger** Neill (1845, p. 415) *Lialis burtonis*
 [Lizard.] “Tongue not forked, broad, and rounded off at the point. Not poisonous or at all dreaded by the natives; finely striped down the back, and spotted with deep brown equal marks; has a lappel [sic] on each side of the vent.”
- woail** Anon. [Collie] (1834, p. 4) *Bettongia penicillata*
 “. . . kangaroo rats (wo-ail) . . .”
- wodta** Moore (1884b, p. 78) *Phaps chalcoptera*
 “Columba. The Bronze-winged pigeon. Most delicate eating. It abounds in summer, when the acacia seeds are ripe.”
- woile** Moore (1884b, p. 78) *Bettongia penicillata*
 “A small species of kangaroo.”
- womela** Drummond (1843c) Hemiptera
 “They also collect a saccharine substance resembling manna, which they call ‘womela’ from the leaves of the York Gum.”
- worogut** *see ianont.*
- wulgang** Moore (1884b, p. 78)
 “A grub found in the Xanthorea [sic] or Grass tree, distinguished from the Bardi by being much larger, and found only one or two in a tree, whereas the Bardi are found by the hundreds.”
- wurak** Moore (1884b, p. 79) ? *Lagorchestes hirsutus*
 “Macropus elegans; a species of kangaroo.”

- wurgyl** Moore (1884b, p. 79)
“ A frog. When this species of frog has the embryo within it in the state of the young roe of a fish, it forms a favourite food of the natives, and marks a particular season. They are found in great abundance in the swamp and shallow lakes.”
- yangor** Moore (1884b, p. 81) *Macropus fuliginosus*
“ The kangaroo species in general.”
- yinbi** Moore (1884b, p. 82)
“ A species of *Unio*, or fresh-water muscle [sic]. The natives will not eat it, though the settlers have used it with impunity.” [See **marel**.]
- youern** Nind (1831, p. 31) *Tiliqua rugosa*
“ The . . . short-tailed *youern*, has a large head, and an enormous mouth, which, when attacked, it immediately opens, and exhibits a purplish coloured tongue; its body is covered with large scales of a grey colour, but having traverse patches of brown. It is very sluggish, and does not burrow in holes, but conceals itself in the long grass. They are frequently found in pairs. The female, when pregnant, has two large eggs in her, but I have never seen them deposited. According to the natives she buries them in the sand very near the surface, and they are hatched by the warmth of the sun. These *youerns* are frequently found in ants' nests, constructed of straw or leaves, with minute portions of sand.”
- youangur** Moore (1884b, p. 83)
“ A species of frog eaten by the natives.”

APPENDIX 2

LIST OF ANIMALS USED FOR FOOD

	Scientific name			Aboriginal name	
MAMMALS	<i>Antechinus flavipes</i>	....	....	mardo
	<i>Bettongia lesueur</i>	....	....	burdi
	<i>Bettongia penicillata</i>	....	....	walyo woail woile
	<i>Isoodon obesulus</i>	....	....	kundi
	<i>Lagorchestes hirsutus</i>	....	....	wurak
	<i>Macropus fuliginosus</i>	....	....	yangor
	<i>Macropus irma</i>	....	....	gurhra
	<i>Macrotis lagotis</i>	....	....	dalgyte dolgyte
	<i>Perameles</i> sp.	....	....	quoint
	<i>Potorous gilberti</i>	....	....	garlgyte
	<i>Pseudocheirus peregrinus</i>	....	....	nworra
	<i>Setonix brachyurus</i>	....	....	kwakar
	<i>Trichosurus vulpecula</i>	....	....	comal gumal kumal
	BIRDS	<i>Cygnus atratus</i>	cooljaik guijak
		<i>Dromaius novaehollandiae</i>	wait widji
<i>Eupodotis australis</i>		....	....	bibilyer
<i>Pliaps chalconoptera</i>		....	....	moorhait wodta
REPTILES		<i>Brachyopsis curta</i>	bardick
	<i>Demansia affinis</i>	....	....	dubyt karbarda tornock
	<i>Denisonia coronata</i>	....	....	werr
	<i>Egernia kingii</i>	....	....	wandie
	<i>Lialis burtonis</i>	....	....	kerrygura william lunger
	<i>Notechis scutatus</i>	....	....	norn norne
	<i>Python spilottus</i>	....	....	wackul wakel
	<i>Rhinoplocephalus bicolor</i>	....	....	torkite
	<i>Tiliqua rugosa</i>	....	....	youern
	<i>Varanus gouldii</i>	....	....	carta munnaar
FISH	<i>Aldrichetta forsteri</i>	....	....	knamler
	<i>Australuzza novaehollandiae</i>	....	....	kordong
	<i>Caranx georgianus</i>	....	....	madawick
	<i>Gonorrhynchus greyi</i>	....	....	pining

Scientific name				Aboriginal name
<i>Haletta semifasciatus</i>	....	....	....	ianont worogut
<i>Kyphosus sydneyanus</i>	....	....	....	memon (2)
<i>Mugil cephalus</i>	....	....	....	merrong
<i>Nelusetta ayraud</i> (?)	....	....	....	tabeduck
<i>Phyllichthys punctata</i> (?)	....	....	....	chondelar chundela
<i>Psilocranium nigricans</i>	....	....	....	toorjenong
<i>Sciaena antarctica</i>	....	....	....	tchark
<i>Scorpiis aequipinnis</i>	....	....	....	memon (1)
<i>Sphyraenella obtusata</i>	....	....	....	kordong
INSECTS				
<i>Bardistus cibarius</i>	....	....	....	bardi bardie
Hemiptera	....	....	....	meenah waumilyar womela
Hepialidae	....	....	....	bardie

APPENDIX 3

List of plant foods arranged in alphabetical order of Aboriginal names; references to quotations and scientific names are also given. The latter were provided by Mr Paul Wilson of the Western Australian State Herbarium and Dr G. M. Storr of the Western Australian Museum.

A. Area from which information given in the list was collected

Anon. [Collie]	:	Albany
Bell	:	Mingenew
Drummond	:	Perth—Toodyay area
Gilbert	:	Perth
Grey	:	Perth—South-West area
Hammond	:	Perth—Pinjarra
Hassell	:	Jerramungup
Irwin	:	Perth
Moore	:	Perth (some from Albany)
Nind	:	Albany
Parker	:	Dongara
Roth	:	Bunbury

B. List of plant foods

adtjikoh	Hammond (1933, p. 23) "The 'Warryn' or 'Adtjikoh' was a white root which grew best amongst the loose stones and rocks of the Darling Ranges, generally in a very damp place. These roots were known to grow up to three feet in length and had a diameter of from half an inch to two inches."	<i>Dioscorea hastifolia</i>
baio	Stokes (1846, vol. 2, p. 132) "Red fruit, nut, called <i>baio</i> ripe in March, is considered a delicacy by the natives."	<i>Macrozamia riedlei</i>
bayio	Ward & Fountain (1907, p. 211) "There is one palm (<i>Zamia media</i> —native, gherge), the nut of which, called bay-i-o by the blacks, is much sought after by them, as they are very fond of it."	<i>Macrozamia riedlei</i>
balga	Moore (1884b, p. 3) "The flower-stem yields a gum used for food."	<i>Xanthorrhoea preissii</i>
bhon	Drummond (1842b) "The Bhon is the root of <i>Haemodorum Spicatum</i> ."	<i>Haemodorum spicatum</i>
biara	Moore (1884b, p. 7) "The <i>Banksia</i> tree, with long narrow leaves; colonially, honeysuckle, from the hairy, long, cone-shaped flowers, producing abundance of honey, which the natives are fond of regaling upon, either by sucking or soaking the flowers in water."	<i>Banksia attenuata</i>
bohn	Moore (1884b, p. 12) "Bohn, or Bohrn. A small red root of the <i>Haemodorum Spicatum</i> . This root in flavour somewhat resembles a very mild onion. It is found at all periods of the year in sandy soils, and forms a principal article of food among the natives. They eat it either raw or roasted."	<i>Haemodorum spicatum</i>
boon	Hammond (1933, p. 29) " 'Boon' was the name of the red bulb which grew in sandy country."	? <i>Drosera</i>
boyoo	Hammond (1933, p. 28) "The 'Boyoo' was the fruit of the <i>zamia</i> palms, and grew in the centre of the palm in clusters that looked much like a large pineapple."	<i>Macrozamia riedlei</i>

- brigo** Moore (1884b, p. 14)
 "An edible root resembling the Bohrn."
- budjan** Moore (1884b, p. 14) *Dryandra fraseri*
 "Dryandra Fraseri (a shrub). The flower abounds in honey, and is much sought after by the natives."
- butogo** Moore (1884b, p. 16)
 "A species of edible fungus."
- butyak** Moore (1884b, p. 16) *Dryandra fraseri*
 "Dryandra Fraseri. The flowers are thistle-shaped, and abound with honey; they are sucked by the natives like the Man-gyt or Banksia flowers."
- bwyego** Moore (1884b, p. 17)
 "A species of fungus eaten by the natives."
- byyu** Grey (1841, vol. 2, p. 295) *Macrozamia riedlei*
 "This name is applied to the pulp of the nut of a species of palm; which, in its natural state, acts as a most violent emetic and cathartic; . . ."
 Moore (1884b, p. 17)
 "The fruit of the Zamia tree."
- cara** Drummond (1842b)
 "... round white roots called . . . Cara, by the natives, which they sometimes eat."
- ehokern** Nind (1831, p. 35) *Prasophyllum* sp.
 "Before the young root [of the *tuboc*] comes to maturity it is called chokern."
- choket** Nind (1831, p. 35)
 "The choket is the small bulbous root of a rush; it is very fibrous, and only edible at one season."
- ehuek** Hassell (1936, p. 689) *Exocarpos sparteus* or *E. odoratus*
 "Wild cherry. This is a graceful tree something like a weeping willow in habit, with pale green and narrow leaves. The fruit grows all along the stems between the leaves and is like a small red currant. Green seeds, about the size of grape seeds, grow on the outside near the ends. They have a sharp bitter flavour. The fruit is sub-acid like a currant. It was collected by spreading cloaks under the trees and shaking them."
- eonna** Drummond (1839a *MS. date*) *Eucalyptus wandoo*
 "The White Gum . . . has large tuberous roots, sometimes 3-4 inches in diameter or more, the natives eat this root, which they call Conna, it is very juicy; the juice having a sweetish taste with a slight flavour of celery, the root seems to contain very little starch . . ."
- djakat** Moore (1884b, p. 20)
 "A small root eaten by the natives; in season in the months of September and October."
- djanbar** Moore (1884b, p. 20)
 "The same as Madja; an edible root; a coarse kind of Bohrn."
- djettah** Hammond (1933, p. 29)
 "'Djettah' was a white bulb that grew in and around water holes."
- djubak** Moore (1884b, p. 22) ? *Prasophyllum fimbria*
 "An orchid, the root of which is the size and shape of a new potato, and is eaten by the natives. It is in blossom in the month of October. The flower is a pretty white blossom, scented like the heliotrope."

- djunbar** Moore (1884b, p. 22)
 "A sort of gum caten by the natives."
- doatta** Drummond (1839a *MS. date*) *Eucalyptus loxophleba*
 "The Eucalyptus found on the sandy loam, is called by the settlers York Gum, by the natives Doatta; they use the bark of the root as food in the dry season chewing it along with the gum of the Manna."
- dolgar** Moore (1884b, p. 23)
 "An edible gum of the Hakea."
- dtalyil** Moore (1844b, p. 24)
 "A small species of fungus eaten by the natives."
- dtulya** Moore (1884b, p. 24) *Exocarpos odoratus*
 "Exocarpos cupressiformis. This with the By-yu and the Kolbogo, and a few other things deserving no better name than berries, of no particularly good flavour, are all that have yet been found in the country in the way of fruit."
- dulgar** Moore (1884b, p. 23)
 "The gum of the Hakea. Eaten by the natives."
- dumbung** Moore (1884b, p. 25) *Xylomelum occidentale*
 "Xylomela occipentalis; the native pear-tree. It bears a hard solid woody substance which has a most tantalising outward resemblance to a good fruit."
- eringo** Irwin (1835, p. 23) *?Platysace* sp.
 "The principal root they use is the eringo, or wild parsnip, which grows to a depth of three or four feet in loam and other strong soils."
- galyang** Moore (1884b, p. 27) *Acacia microbotrya*
 "The gum of the Gal-yang, or wattle tree, eaten by the natives. It is soluble in water, and is one of the best gums in the country for all common purposes."
- ganno** Moore (1884b, p. 28)
 "A root found at York, eaten by the natives, and resembling a potato in shape."
- goatta** Drummond (1843 *MS. date*) *Eucalyptus loxophleba*
 "The natives use the bark of the Goatta as food, chewing it until they separate the saccharine matter which the root contains when they spit out the residue, which is generally to be seen in quantities near their bivouacs."
- gurago** Moore (1884b, p. 32)
 "A root caten by the natives."
- guardyn** Moore (1884b, p. 34)
 "A root eaten by the natives; it somewhat resembles the Bohn, but is tougher and more stringy."
- jetta** Moore (1884b, p. 36) *Typha* sp.
 "The root of a species of rush, eaten by the natives, in season in June. It somewhat resembles a grain of Indian corn, both in appearance and taste."
- jitetgoran** Moore (1884b, p. 37)
 "A root eaten by the natives."
- jitta** Drummond (1842b)
 "Round white roots called Jitta . . . by the natives, which they sometimes eat."
 Moore (1884b, p. 36)
 "The bulbous root of an orchis, eaten by the natives, about the size of a hazel-nut."

- joobuck** Hammond (1933, p. 29)
 “ ‘Joo-buck’ was a white bulb with a long stalk. Some of the bulbs were as large as a tennis ball, and they were very nice to eat.”
- kamak** Moore (1884b, p. 39)
 “ A small kind of Kuruba, found in the York district.”
- karhrh** Moore (1884b, p. 41) *Caesia* sp.
 “ A tuberoso root, like several small potatoes. It belongs to the Orchis tribe.”
- karno** Bell (*pers. comm.*) *Platysace maxwellii*
 “ Roots from this plant are collected throughout the year. Each plant has a number of roots about 18–24 inches below the ground. A digging stick is used to reach the roots, which are brown on the outside and white inside. The younger ones which grow nearer the surface are preferred to the older ones. The roots are eaten either raw or roasted. The raw roots contain moisture and are sometimes eaten to quench thirst.”
 (Collected by Maggie Bell 19 August 1967.)
- kolbogo** Moore (1884b, p. 43) *Carpobrotus* sp. probably *C. virescens*
 “ Mesembryanthemum equilateralis; the Hottentot fig-plant. The inner part of the fruit is eaten by the natives. It has a salt sweetish taste.”
- koolah** Hammond (1933, p. 28) *Podocarpus drouyniana*
 “ . . . the ‘Koolah’ was to be found only in the Augusta and Albany districts. In many respects it resembled the stone of the plum. Another peculiarity of this fruit was that it had two small blooms on the end of it.”
- koolung** Bell (*pers. comm.*) *Haemodorum spicatum*
 “ A bulb with a hot flavour when eaten raw. Usually roasted before being eaten.”
 (Collected by Maggie Bell 19 August 1967.)
- koragong** Moore (1884b, p. 44)
 (or **wurdo**) “ A species of fungus growing on the ground, of a sweetish taste, red-coloured, and very juicy.”
- kunart** Moore (1884b, p. 45) *Acacia microbotrya*
 “ A species of acacia abundant on the banks of estuaries, and in districts having salt lakes. It produces a great quantity of gum in the summer months. From the seeds of this tree the natives to the south obtain, by pounding them, a flour, which they make into dampers, or unleavened bread.”
- kuredjigo** Moore (1884b, p. 46)
 “ A root eaten by the natives.”
- kurren** Moore (1884b, p. 46) ? *Baeckea camphorosmae*
 “ A species of shrub to which medical properties are attributed by the natives of King George’s Sound. It is a sensitive plant, and when drying assumes an unnatural pale yellow colour, and emits a smell like most powerful garlic: in this state the natives use it in case of headache, waving it under the nose of the patient.”
- kuruba** Moore (1884b, p. 46) ? *Sollya*
 “ The fruit of a creeper eaten by the natives. It is of a long slender, ovate shape, and when roasted in the fire is of a pleasant lemon peel flavour. It is one of the very few things which can be considered as approaching to an indigenous fruit.”

kwonnat	Grey (1841, vol. 2, p. 294) "Kwon-nat is the kind of gum which most abounds, and is considered the nicest article of food. It is a species of gum-tragacynth. In the summer months the acacias, growing in swampy plains, are literally loaded with this gum, and the natives assemble in numbers to partake of this favourite esculent."	<i>Acacia ? microbotrya</i>
madge	Drummond (1842b) "The Madge is the root of <i>Haemodorum paniculatum</i> ."	<i>Haemodorum paniculatum</i>
madja	Moore (1884b, p. 47) "Haemodorum paniculatum, an edible root."	<i>Haemodorum paniculatum</i>
majerak	Moore (1884b, p. 48) "The small Hottentot fig. The fruit is eaten by the natives."	<i>Carpobrotus</i> sp.
manbibi	Moore (1884b, p. 49) "The small Hottentot fig."	<i>Carpobrotus</i> sp.
mangaitch	Roth (1903, p. 49) "Upon this sandy tract of country, . . . two species of <i>Banksia</i> grew abundantly, one conspicuous by its broad leaf, the other by its narrow leaf. Each species bore cones with pitcher-shaped flowers, which, containing a quantity of honey, were especially visited by the black cockatoos. The natives appreciated the honey also, and, . . . would bite into them and suck the saccharine matter out. At other times they utilized the honey by making a fermented drink of it, . . . The aboriginals called the cones and the fermented liquor produced therefrom by the same name—the mangaitch."	
mangite	Drummond (1939a <i>MS. date</i>) "One large <i>Banksia</i> the native Mangite . . . the natives, men, women and children live for five to six weeks particularly upon the honey which they suck from the flowers of this fine tree."	? <i>Banksia grandis</i>
mangyt	Moore (1884b, p. 50) "The large yellow cone-shaped flowers of the <i>Banksia</i> , containing a quantity of honey, which the natives are fond of sucking. Hence the tree has obtained the name of the honeysuckle tree. One flower contains at the proper season more than a tablespoon of honey."	? <i>Banksia grandis</i>
manna	Drummond (1839a <i>MS. date</i>) ". . . the <i>Acacia</i> called Manna by the natives, which produces great quantity of gum resembling gum-arabic in the dry season, forming an important article of their food: . . ."	<i>Acacia microbotrya</i>
marang	Moore (1884b, p. 50) "One of the edible roots."	
mean	Backhouse (1843, p. 527) "Among their articles of food, is the long bulb, of <i>Hemodorum</i> [sic] <i>teretifolium</i> , which they call Mean; and poor fare, it truly is, occasioning their tongues to crack grievously; it is prepared for eating by being roasted, and beaten up with the earth, from the inside of the nest of the White Ant, or with a red substance, found on burnt ground."	<i>Haemodorum</i> sp.
meen (1)	Anon. [Collie] (1834, p. 319) ". . . they made an excursion and returned before dark laden with mcen (<i>Haemodorum spicatum</i>) and this constituted their supper, . . . they prepared the root by roasting and beating on one stone with the other, . . ."	<i>Haemodorum spicatum</i>

- meen** (2) Hassell (1936, p. 689) *Acacia microbotrya*
 "Gum from the wattle tree. It forms in soft and sticky lumps gathered by the women and pressed into large, round balls. When wanted for food, lumps were knocked off and chewed."
- meernes** Nind (1831, p. 34)
 "The meernes, . . . are scarlet roots, not unlike, in shape and size, tulip-roots."
- mein** Hassell (1936, p. 689) *Haemodorum spicatum*
 "A tall, edible, rush-like plant with a black stem. The roots are bright red in color and like a leek in shape. The juice leaves a red stain. The roots are sweet, juicy and hot."
- mene** Grey (1841, vol. 2, p. 293) *Haemodorum* sp.
 ". . . the *mene* has rather an acid taste, and when eaten alone is said, by the natives, to cause dysentery; they never use it, in the southern districts, without pounding it between two stones, and sprinkling over it a few pinches of an earth which they consider extremely good and nutritious; they then pound the mould and the root together into a paste, and swallow it as a *bonne bouche*, the noxious qualities of the plant being destroyed by the earth."
- menna** Moore (1884b, p. 52) *Acacia microbotrya*
 "The gum of one species of acacia, which is sometimes prepared by being first pounded, then mixed with spittle, and made into a ball, and finally, beaten into a flat cake, when it is kept by the natives, as a provision against a time of want."
- mini** Moore (1884b, p. 53)
 "An edible root. A large species of Bohn."
- mncar** Drummond (1843e) ? *Eucalyptus calophylla*
 "The trunk of the red gum produces a remarkable saceharine substance which they call mncar and esteemed much as food."
- moncat** Nind (1831, p. 35)
 "When the different species of Banksia first come into bloom, they collect from the flowers a considerable quantity of honey, of which the natives are particularly fond, and gather large quantities of the flowers (*moncat*) to suck."
- mord** Anon. [Collie] (1834, p. 339)
 ". . . fungus . . . species of boletus . . . grows out of the ground, of a greyish colour, and globular form."
- mungah** Hassell (1936, p. 689) *Nuytsia floribunda*
 "A tall tree with deep orange-coloured blossoms. The natives dug up the suekers, which are numerous, peeled off the pale yellow outer bark, and ate the moist brittle center which tastes like sugar eandy."
- mungat** Anon. [Collie] (1834, p. 319) *Banksia* sp.
 ". . . they brought us a liquid they had long talked about, which they call mungat . . . the nectareous fluid of the flowers of the banksia, . . ."
- munghite** Bunbury (1930, p. 80) *Banksia* sp.
 ". . . Munghites as they call the flower of the Banksia, from which they extract by suction a delicious juice resembling a mixture of honey and dew."
- mungite** Hassell (1936, p. 689) *Banksia* sp.
 "A species of banishia (?) which shows on the coast and near creeks. . . The flowers are about four inches long and are composed of slender stems. The podless ones have the longest blossoms. At the base of the flowers there are quantities of honey, which can easily be sucked out."

- murrumburru** Parker (*pers. comm.*) *Astroloma serratifolium*
 "Small green berries eaten by the Aborigines."
 (Collected by Nellie Parker 20 August 1967.)
- mutta (1)** Bell (*pers. comm.*) *Haemodorum paniculatum*
 "A red bulb which when eaten raw has a hot taste. It is usually
 roasted before being eaten."
 (Collected by Maggie Bell 19 August 1967.)
- mutta (2)** Parker (*pers. comm.*) *Haemodorum simulans*
 "Small red bulb which has a hot taste. Eaten either raw or roasted."
 (Collected by Nellie Parker 20 August 1967.)
- naank** Nind (1831, p. 35) *Prasophyllum* sp.
 "... the old one [root of the *tuboc*] is called *naank*."
- namman** Moore (1884b, p. 59) ? *Sollya* sp.
 "A sort of fruit growing on a low shrub like the Kamak."
- nangergun** Moore (1884b, p. 59)
 "An edible root."
- ngonyang** Moore (1884b, p. 66)
 "The honey or nectar of flowers; sugar. The flower of the Budjan.
 It abounds in honey. Also a saccharine juice, which exudes plentifully
 from the red-gum tree in the warm season."
- ngulya** Moore (1884b, p. 67)
 "An edible root of a reddish colour, something like Bohn in flavour,
 but tougher and more stringy."
- ngumbit** Moore (1884b, p. 67) *Eucalyptus calophylla*
 "The flower of the red-gum tree, which, steeped in water, affords a
 honey-sweet beverage, much relished by the natives."
- nguto** Moore (1884b, p. 67)
 "An edible root."
- nugoo** Parker (*pers. comm.*) *Banksia sphaerocarpa*
 "The nectar from the spikes of a Banksia. On a wet day the nectar is
 sucked straight from the spikes, at other times the spikes are soaked in
 water for a few minutes and then the water is drunk."
 (Collected by Nellie Parker 20 August 1967.)
- numar** Anon. [Collie] (1834, p. 339)
 "... fungus ... species of boletus ... growing out of trees, of a
 beautiful crimson colour above."
 Drummond (1839b *MS. date*)
 "The natives use several species of Boletus as food: two of the principal
 they call Numar or Woorda, ... the Numar has the stem at one side,
 it divides into several lobes and when full grown weighs many pounds,
 it is seen near the roots of Mahogany trees and seems to be a para-
 sitical."
- numbit** Drummond (1843e) *Eucalyptus calophylla*
 "They collect the flowers of the red gum which they call 'numbit'
 and washing them in their cloaks, drink the water which is sweetened
 by the honey they contain."
- numbrid** Moore (1884b, p. 62) *Eucalyptus calophylla*
 "The flower or blossoms of the red-gum tree, from which the natives
 make a favourite beverage by soaking the flowers in the water."

- poilyenum** Hassell (1936, p. 689) *Santalum spicatum*
 "A sandal-wood which has a round red seed. The skin of the seed is tough and tastes like alum. The nut has a smooth surface, a brown colour, and is about the size of a large marble. The kernals are oily and have a bitter flavour."
- quarandine** Drummond (1842b) *Haemodorum* sp.
 "The Quarandine is the root of *Haemodorum Planifolium*."
- quirting** Hassell (1936, p. 689) ?*Typha* sp.
 "A plant which grows like a flag. It has a broad, light green leaf and a root like a leek. It grows six or eight inches into the ground and is deep salmon in colour. The taste is like a chili or pepper."
- quonert** Hassell (1936, p. 690) *Acacia saligna*, *A. acuminata* and *Eucalyptus cornuta* or *E. occidentalis*.
 "A native food consisting of the mixture of seeds from the black wattle and raspberry jam tree ground into a meal and mixed with *yate*."
- tjungoori** Bell (*pers. comm.*) *Thysanotus patersonii*
 "A creeper with mauve flowers. The vine and the leaves are collected and rolled into a ball. The ashes from the fire are cleared away and the tjungoori placed on the hot ground and covered with ashes where it is left for about 10 minutes. It is then ground producing a green powder. This is eaten with the root of the York Gum."
 (Collected by Maggie Bell 19 August 1967.)
- tuboc** Nind (1831, p. 35) *Prasophyllum* sp.
 "The *tuboc* is of the tribe Orchindae: it is very pleasant eating, when roasted. In the early part of spring it throws up a single stem, hollow, and similar in appearance to that of the onion, but is mucilaginous, and sweetish to the taste."
- twotta** Moore (1884b, p. 70) *Eucalyptus loxophleba*
 "A Eucalyptus, of which the natives chew the bark of the roots, wrapped about gum, or pounded up with it into a cake. Colonially, the York gum-tree, being the principal timber which characterises that district."
- wargae** Gilbert in Wagstaffe & Rutherford (1954, p. 496)
 "... Natives, for their Season of meeting in great numbers to dig the edible Root called by them Wargae is now in full force . . ."
 (October 1842.)
- warran** Moore (1884b, p. 74) *Dioscorea hastifolia*
 "One of the Dioscoreae. A species of yam, the root of which grows generally to about the thickness of a man's thumb; and to the depth of sometimes of four to six feet in loamy soils. It is sought chiefly at the commencement of the rains, when it is ripe, and when the earth is more easily dug; and it forms the principal article of food for the natives at that season. It is found in this part of Australia, from a short distance south of the Murray, nearly as far to the north as Gantheaume Bay. It grows in light rich soil on the low lands, and also among the fragments of basaltic and granite rocks on the hills."
- warryn** Hammond (1933, p. 28) *Dioscorea hastifolia*
 "The 'Warryn' or 'Adtjikoh' was a white root which grew best amongst the loose stones and rocks of the Darling Ranges, generally in a very damp place. These roots were known to grow up to three feet in length and had a diameter of from half an inch to two inches."
- willarak** Moore (1884b, p. 77) *Santalum spicatum*
 "Santalum latifolium, Sandalwood tree. The smoke of it when burning produces nausea in most persons. It bears a nut, having a white

- kernel of the size of a musket bullet, from which oil of a pure quality, without taste or smell, may be expressed. This nut, though not disagreeable, is not eaten by the natives."
- wolgol** Hassell (1936, p. 689)
 "A kind of nut called quondong in eastern Australia. The trees are tall and not unlike a cherry tree, while yellowish pale green leaves are shaped like a narrow pear leaf. The berries are red, resembling a large deep-red cherry. The thick skin is separated from the stone by only a little flesh. The deeply crinkled stones have a slightly tart flavour. The kernals taste like Brazilian nuts. Stones vary from the size of a small marble to that of two thumbs."
- worrain** Roth (1903, p. 48) *Dioscorea hastifolia*
 "Many kinds of roots and yams were eaten; among the latter the wor-rain, showing thick yellow blossoms, was very common, growing down to a depth of quite 3 feet, and running from the thickness of the finger to that of the wrist."
 Bell (*pers. comm.*)
 "The tubers which grew to a considerable depth were dug up by the women with a digging-stick. The tubers were roasted and then pounded."
 (Collected by Maggie Bell 19 August 1967.)
- wuanga** Hassell (1936, p. 690) *Acacia saligna*
 "The seed of the black wattle is called *wuanga*."
- wurdo** Moore (1884b, p. 44)
 "A species of fungus growing on the ground, of a sweetish taste, red-coloured, and very juicy."
- wyrang** Drummond (1842a) *?Dioscorea hastifolia*
 "The native Yam, called Wyrang, by the natives, the finest esculent vegetable the colony naturally produces is now [4 May 1842] beginning to flower."
- yandijut** Drummond (1842c) *Typha* sp.
 "*Typha angustifolia*. This plant is an important one to the natives, as it furnishes them with, at one season of the year, with a large portion of their food. . . . The plant is abundant in most of our lakes and rivers, but it is only in the autumn months, when the plant is in a state of rest, that it contains much starch in the roots."
- yandyett** Moore (1884a, p. 220) *Typha* sp.
 "Got from the natives a piece of bread made of the root of the flag which they call *yandyett*. . . . They peel the root, roast it and pound it, and bake it. The root is as thick as your finger, and a foot long."
- yanjidi** Moore (1884b, p. 81) *Typha* sp.
 "An edible root of a species of flag (*Typha angustifolia*), growing along fresh-water streams and the banks of pools. It consists of many tender filaments with layers of a farinaceous substance between. . . . This root is in season in April and May, when the broad leaves will have been burned by the summer fires, by which the taste, according to the native ideas, is improved."
- yate** Hassell (1936, p. 690) *Eucalyptus cornuta* or *E. occidentalis*
 "The *yate* is a species of Eucalyptus from which the sap was secured by scrapping pieces of bark stripped from the tree. The sap is a thick, purplish syrup, which is very sweet."

- yoke Nind (1831, p. 35)
" They describe various kind of roots in the interior that are eaten by them. One species they call *yoke*, and say that it resembles our potato, being as large and as well tasted; but it has only one tuber to a stem, and is altogether different in its leaf and appearance."
- youck Hassell (1936, p. 689) *? Platysace* sp.
" A sort of yam. The size varies from that of a thumb to as large as three-quarters of a pound. The roots may be red, pink or yellowish white according to the color of the ground they are in. The plants are round, small, scrubby bushes about two feet high and have a small sage green leaf. The roots spread over a considerable area and have tubers at their extremities."
- Bell (*pers. comm.*) *Prasophyllum* sp.
" This plant has only one bulb about 9 inches below the ground. Women use a digging-stick to collect it. Usually roasted before being eaten."
(Collected by Maggie Bell 19 August 1967.)
- Parker (*pers. comm.*) *Amyema fitzgeraldii*
" This is a parasite which grows on *Acacia acuminata*. The berries are eaten by the Aborigines."
(Collected by Nellie Parker 20 August 1967.)
- Parker (*pers. comm.*) *Brachysema aphyllum*
" The flowers of this shrub contain nectar, which is sucked out by the Aborigines."
(Collected by Nellie Parker 20 August 1967.)

APPENDIX 4

LIST OF PLANTS USED FOR FOOD

Scientific name	Aboriginal name
<i>Acacia acuminata</i>	
<i>Acacia microbotrya</i>	galyang kunart kwonnat manna meen (2) menna wuanga
<i>Acacia saligna</i>	
<i>Amyema fitzgeraldii</i>	
<i>Astroloma serratifolium</i>	murrumburru
<i>Baeckea camphorosmae</i> or <i>Astartea fascicularis</i>	kurren
<i>Banksia attenuata</i>	biara
<i>Banksia grandis</i>	mangite mangyt mungat mungite nugoo
<i>Banksia sphaerocarpa</i>	
<i>Brachysema aphyllum</i>	
<i>Caesia</i> sp.	karhrh
<i>Carpobrotus</i> sp.	majerak manbidi kolbogo adtjikoh warran warryn worrain wyrang
<i>Carpobrotus virescens</i>	
<i>Dioscorea hastifolia</i>	boon
<i>Drosera</i>	budjan
<i>Dryandra fraseri</i>	butyak
<i>Eucalyptus calophylla</i>	mnkar ngumbit numbit numbrid
<i>Eucalyptus cornuta</i> or <i>E. occidentalis</i>	yate
<i>Eucalyptus loxophleba</i>	doatta goatta twotta
<i>Eucalyptus wandoo</i>	conna
<i>Exocarpus sparteus</i> or <i>E. odoratus</i>	chuck dtulya
<i>Haemodorum</i> sp.	mean mene quaradine
<i>Haemodorum paniculatum</i>	madge madja
<i>Haemodorum simulans</i>	mutta (1) mutta (2)

Scientific name	Aboriginal name
<i>Haemodorum spicatum</i>	bhon bohn koolung meen (1) mein
<i>Macrozamia riedlei</i>	baio bayio boyoo byyu
<i>Nuytsia floribunda</i>	mungah
<i>Platysace maxwellii</i>	karno
<i>Platysace</i> sp.	cringo youck
<i>Podocarpus drouyniana</i>	koolah
<i>Prasophyllum</i> sp.	chokern naank tuboc
<i>Prasophyllum fimbria</i>	djubak
<i>Santalum spicatum</i>	poilyenum willarak
<i>Sollya</i> sp.	kuruba namman
<i>Thysantus patersonii</i>	tjungoori
<i>Typha</i> sp.	jetta quirting yandijut yandyett yanjidi
<i>Xanthorrhoea preissii</i>	balga
<i>Xylomelum occidentale</i>	dumbung

REVISION OF THE *SPHENOMORPHUS RICHARDSONII*
SPECIES-GROUP (LACERTILIA, SCINCIDAE)

G. M. STORR

ABSTRACT

Two species are recognized, *S. richardsonii* (Gray) and *S. fasciolatus* (Günther), neither of which is divisible into subspecies. *Hinulia pallida* Günther is synonymized with *S. fasciolatus*.

INTRODUCTION

In an earlier paper (Storr 1967) I had difficulty in setting taxonomic limits to certain forms of *Sphenomorphus*, viz. *richardsonii*, *fasciolatus* and *pallidus*. In the south of the Northern Territory *S. fasciolatus* showed some morphological approach towards *S. richardsonii*, and in the far north it showed a marked approach towards *pallidus*. Yet the end members of this sequence, *richardsonii* and *pallidus*, occurred in the Pilbara region of Western Australia with no indication of interbreeding. Clearly the complex comprised at least two species. I tentatively drew the specific boundary between *S. richardsonii* and *S. fasciolatus*, relegating *pallidus* to a subspecies of *S. fasciolatus*.

A little later, through the courtesy of Lt Cdr A. Y. Norris, I was able to examine the collections made by the British Joint Services Expedition to the southwest of the Northern Territory. In the Petermann Range the Expedition collected three specimens of *S. richardsonii*. On Armstrong Creek (only 33 miles east of the easternmost *S. richardsonii*) they collected a *pallidus*. About 100 miles further east, at Curtin Springs and Mt Conner, seven specimens were collected of what I took to be "*fasciolatus* tending towards *richardsonii*".

It thus became necessary to re-assess the characters used for separating *S. richardsonii* from *S. fasciolatus* and above all to extend the study to eastern Australia. Specimens were borrowed from the eastern States, where both species are apparently rare. Though this eastern material is scanty and often so old as to retain little or no colour pattern, it confirms my original division of the complex into two species. It has, however, become fairly certain that "*pallidus*" is no more than an ecotypic variant of *S. fasciolatus* which may crop up anywhere in the sandier parts of the latter's range.

For the loan of specimens I am grateful to Dr E. R. Pianka, University of Texas (numbers prefixed with ERP); Mr B. L. Bolton, Northern Territory Administration, Alice Springs (NTM); the late Mr F. J. Mitchell, South Australian Museum (SAM); Miss J. M. Dixon, National Museum of Victoria (NMV); Dr F. H. Talbot, Australian Museum, Sydney (AM); and Miss J. Covacevich, Queensland Museum (QM). The prefixes WAM and JSE refer to specimens in the Western Australian Museum and the collections of the British Joint Services Expedition.

Sphenomorphus richardsonii

Hinulia richardsonii J. E. Gray, 1845, Catalogue of the specimens of lizards in the Collection of the British Museum, p. 271. Houtman Abrolhos, Western Australia (B. Bynoe).

Lygosoma monotropis G. A. Boulenger, 1887, Catalogue of the lizards in the British Museum (Natural History). 2nd ed. 3: 237. Champion Bay, Western Australia (F. H. du Boulay).

Hinulia ambigua C. W. De Vis, 1888, Proc. Linn. Soc. N.S.W. (2) 2: 817. Charleville, Queensland.

Distribution.—Western Australia, except far north and deep southwest: far southwest of Northern Territory; South Australia, except Eyre Peninsula and southeast; southern Queensland, except humid southeast; northern two-thirds of New South Wales, east to the western slopes of the Great Dividing Range.

Diagnosis.—Very similar to *S. fasciolatus* but caudal bands fewer (19–32, v. 35–40), wider and less regular (often oblique and branching). Dorsal pattern generally stronger: dark bands usually fewer (8–14, v. 10–19) and wider (up to as wide as interspaces), sharper-edged and more strongly contrasting with pale ground colour. Tail longer (131–171% of snout-vent length, v. 114–142).

Geographic variation.—In my previous paper six Western Australian populations were briefly characterized. Here another six are analyzed from further east.

Southwest of Northern Territory: Ruined Ramparts, Petermann Range (JSE 172); Hull River (JSE 149); Shaw Creek (JSE 134). Differs from the neighbouring "Northeast" population of Western Australia by having more scale rows (33–34, v. 29–32), more dorsal bands (10–13, v. 9–12) and more caudal bands (32, v. 24–26). Observe that these divergences are all in the direction of *fasciolatus* from the immediate north and northeast. Two tailless specimens from Charlotte Waters (NMV 3381, 3392) possibly belong here; they have 34 scale rows and 9–12 dorsal bands.

Western interior of South Australia: Ooldea (WAM 2270; SAM 678; NMV 390, 396–7); Immarna (SAM 689); "Overland Railway" (NMV 2647, 2661, 2670, 2672); Wynbring (SAM 696, 712, 9400–4). Generally like the "Eastern" population of Western Australia, with which it shares high frequency of 2 (rather than 3) supraoculars in contact with frontal (56%) and numerous lamellae under fourth toe (24–29, av. 26·7). The frequency of specimens with frontal not clearly longer than frontoparietal plus interparietals is high (44%); and, as in other South Australian populations, more than half the specimens have the frontoparietal longer than interparietals. The number of scale rows is extremely low (28–32, av. 29·8). Labials mostly 8 (7 in four specimens). Supraciliaries 7–9 (mostly 8). Dorsal bands 8–11 (av. 9·6) and, as in all populations east of the Western Australian border, considerably narrower than interspaces.

Eastern interior of South Australia: Lambina (NTM 1553–4); Muloorinna (SAM 3708); Alicoota-Angepcna (SAM 5357); Mern Merna (SAM 2649); Lake Gilles (SAM 4981). Generally similar to preceding population but has fewer lamellae (21–26, av. 23·8) and a tendency for hindlegs to be cross-banded; it may also be larger (SVL up to 93, v. 77). Labials and supraciliaries 8. Dorsal bands 9–14; but only the northernmost (Lambina) specimens have more than 11, in which respect they agree with nearby Northern Territory specimens.

Central districts of South Australia: Tarlee (SAM 2763); South Hummocks (SAM 1693, 9394); Pricc (SAM 9395); Curramulka (SAM 5775, 9393); Port Vincent (SAM 4065); Portee (SAM 8585). Agrees with the next and differs from two preceding populations in the numerous scale rows (31–36, av. 33·3). As in all populations east of the Western Australian border, about half the specimens have only 2 supraoculars in contact with frontal. Both specimens from South Hummocks exhibit a trait which becomes more frequent further east, viz. 3 secondary temporals (rather than 2), which results in the last labial being much smaller than the penultimate. Labials 8. Supraciliaries 8 (except one specimen with 7). Lamellae 21–26 (av. 23·2). Dorsal bands 9–11 (av. 10·3).

New South Wales: Mt Brown (AM 900); White Cliffs (AM 12573); Inverell (AM 13285); Nyngan (AM 11793, 12532); Darlington Point (AM 7276–7). Generally similar to the preceding population but has fewer dorsal bands (8–10, av. 9·0), more labials and supraciliaries (both usually 8, occasionally 9) and fewer lamellae (20–25, av. 22·3). All but the specimens from White Cliffs and Inverell have 3 secondary temporals. Scale rows 32–36 (av. 33·1). Caudal bands 22–29 (av. 25·0).

Queensland: Port Curtis (AM 6384); Waratah, near Cunnamulla (QM 11984). These specimens differ from the New South Wales series in having fewer scale rows (31 and 32 respectively), labials (8 and 7) and supraciliaries (7 and 6/7). Both have 23 lamellae, 3 supraoculars in contact with frontal, and only 2 secondary temporals. The Waratah specimen has more dorsal bands (13) and caudal bands (30); but the Port Curtis specimen has only 8 dorsal bands.

Sphenomorphus fasciolatus

Hinulia fasciolata A. Günther, 1867, Ann. Mag. nat. Hist. (3) 20: 47. Rockhampton and Port Curtis, Queensland (G. Krefft).

Hinulia pallida A. Günther, 1875, in J. Richardson & J. E. Gray's Zoology of H.M.S. Erebus & Terror, 2: 12. Nickol Bay, Western Australia (F. H. du Boulay).

Lygosoma (Hinulia) fasciolatum intermedium R. Sternfeld, 1919, Senck. biol. 1: 81. Hermannsburg, Northern Territory (M. von Leonhardi).

Distribution.—Arid zone of the western two-thirds of Australia; Western Australia (north of the Tropic), Northern Territory (north to Larrimah), northeastern South Australia, far southwestern Queensland, western New South Wales and far north-western Victoria; and subhumid zone of mid-eastern Queensland.

Diagnosis.—Distinguishable from *S. richardsonii* by caudal bands more numerous (35–40, v. 19–32), narrower and more regular (usually one scale wide, perfectly transverse, and separated by interspace of two scales). Dorsal pattern weaker: dark bands usually more numerous (10–19, v. 8–14) and much narrower than interspaces, often breaking mid-dorsally and not so much darker than ground colour. The last two tendencies, singly or combined, may produce a skink with little or no trace of dorsal bands. Usually in these paler variants (“*pallidus*”) the caudal bands are discernible and the darker dorsum is well defined from the white venter; but in what appears to be an extreme ecotype (the “Ghost Skink” of Lake Eyre) pigments are completely absent.

Geographic variation.—Six populations are analyzed, beginning with the typical population. The “Ghost Skink” is left to last; being colourless, it is not certainly identifiable with this species.

Mid-eastern Queensland: Port Curtis (QM 1837; AM 6382–3); Burnett River (AM 5334). Dorsal bands (where still discernible) very narrow; 15 in the single specimen (AM 5334) where they can be counted. Labials 8. Supraciliaries 8 (one specimen with 9). Frontal in contact with 2 or 3 supraoculars. Scale rows 33–35. Lamellae 17–20 (av. 18.0). SVL up to 98. All specimens have 3 secondary temporals and small last labial; this trait, common in southeast Australian *richardsonii*, was not observed in other populations of *fasciolatus*.

Arid interior of eastern Australia. NORTHERN TERRITORY: Ayers Rock (NMV 8191); Curtin Springs (JSE 16a–c, 52a–b); Mt Connor (JSE 63a–b; ERP 9772); Horseshoe Bend (ERP 9899); Charlotte Waters (NMV 528–9). NO PRECISE LOCALITY: “Central Australia” (NMV 889, 1187–90, 1458). SOUTH AUSTRALIA: Killalpaninna (SAM 9407–12); Mulka (NMV 155); Kings Lookout (SAM 8738). QUEENSLAND: 14 mi. N of Fortville Tank (NMV 11995–6). NEW SOUTH WALES: Menindee (SAM 8737). VICTORIA: Mildura (NMV 9846). Dorsal bands usually present, 10–17 (av. 13.0). Caudal bands 37–40. Labials 8 (rarely 7 or 9). Supraciliaries 7 or 8 (rarely 6). Frontal in contact with 2 or 3 supraoculars. Scale rows 28–33 (av. 30.3). Lamellae 22–30 (av. 25.0).

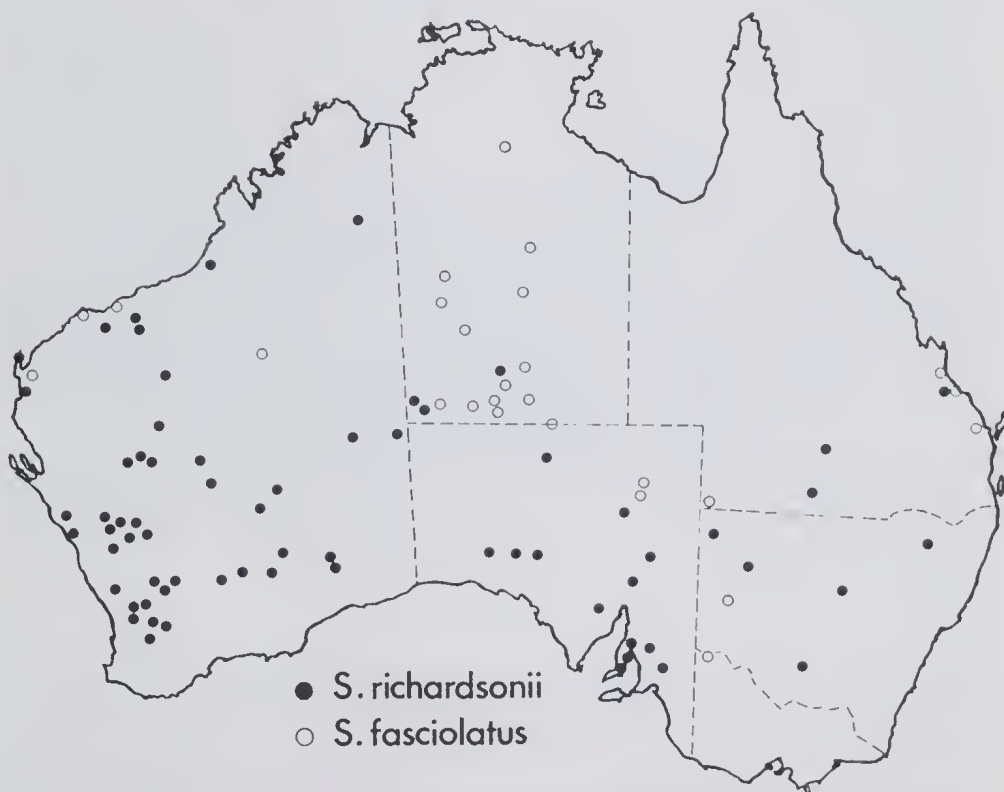
Central highlands of Northern Territory: Tennant Creek (SAM 6134, 9396–9; NMV 2909, 2917, 2924, 2936–7); Renahans Well (ERP 11627); Horn Camp XXV (NMV 286); Illamurta (NMV 455, 457, 467); Armstrong Creek (JSE 99); plus 14 specimens listed in Storr (1967: 14–15). Generally similar to preceding population

but smaller (SVL up to 87, v. 93), tail longer (120–142% of SVL, av. 134; v. 114–135, av. 128), fewer labials (usually 7, seldom 8), fewer supraciliaries (usually 7, seldom 6 or 8, rarely 9), more scale rows (30–36, av. 33·3) and fewer lamellae (20–28, av. 23·4). Dorsal bands 10–17 (av. 13·1). Caudal bands 35–40. Frontal in contact with 2 or 3 supraoculars.

Northern interior of Northern Territory: Larrimah (WAM 24144–5). Differs from preceding population in having more dorsal bands (17–19) and fewer lamellae (18–22).

Northwest of Western Australia: Mundabullangana (WAM 17060, 26762–4); between the Ashburton and Gascoyne Rivers (SAM 9406); Well 24, Canning Stock Route (WAM 27025). Generally similar to last two populations, between which it is intermediate in number of dorsal bands (13–17, av. 15·6). Labials 7. Supraciliaries 7 (8 in one specimen). Frontal in contact with only 2 supraoculars. Scale rows 30–34 (av. 32·0). Lamellae 21–26 (av. 23·0). In all specimens the dorsal pattern is weakly developed (“*pallidus*”).

Lake Eyre, South Australia: Prescott Point, Madigan Gulf (SAM 3335, 3370, 9333, 9405); Emu Camp (NMV 1106–7). Labials 8 (7 in one specimen). Supraciliaries 7 (6 in one specimen). Frontal usually in contact with 3 supraoculars, occasionally 2. Scale rows 28–30 (av. 29·5). Lamellae 23–25 (av. 23·7). SVL up to 88. Tail 127% of SVL (one specimen). All specimens are colourless (“*Ghost Skinks*”).



Map of Australia showing location of specimens of *Sphenomorphus richardsonii* and *S. fasciolatus*
Drawn by Miss Kim Cannon

DISCUSSION

The distribution of *S. fasciolatus* overlaps that of *S. richardsonii* in the Pilbara region of Western Australia and, if old labels are trusted, also at Port Curtis, Queensland. In western New South Wales *S. richardsonii* has been collected in hilly country (Mt Brown and White Cliffs); while *S. fasciolatus* has been collected in the surrounding lowlands (Menindee and near Fort Grey). In the southwest of the Northern Territory, *S. richardsonii* occurs on the upper courses of creeks flowing north from the Petermann Range; whereas a few miles further down one of these creeks *S. fasciolatus* has been collected (where the Armstrong loses itself among the sand dunes south of Lake Amadeus).

The two species are well differentiated only in the Pilbara. There they are distinguishable on several characters, including the much greater size of *S. richardsonii*. On the opposite side of Australia differences between the species are much less marked, and the representative populations of each form share a character not observed elsewhere in either species, namely three secondary temporals and small last labial. In the centre of the continent the species approach each other in so many characters that one can only conclude that gene-flow has not long ceased between them. Because of this, it is not easy to identify Central Australian specimens lacking a tail or from which all colour has faded.

This brings us to the identity of the "Ghost Skink" of Lake Eyre (photographed in Worrell 1963, p. 16). In this region size, proportions and meristics are much the same in both species. However, in relative length of tail and number of supraciliaries the "Ghost Skink" agrees better with *S. fasciolatus* than *S. richardsonii*. A more cogent reason for aligning it with *S. fasciolatus* is now discussed.

Throughout its range, *S. richardsonii* undergoes little or no ecotypic variation. The "western interior" population of South Australia inhabits the southeastern tongue of the Great Victoria Desert. The "eastern interior" population of South Australia occupies a very different habitat: the vicinity of watercourses in stony tableland country. Yet, as we have seen, differences between these populations are slight. Wherever *S. richardsonii* shows any substantial departure from normal, as in the southwest of the Northern Territory or in far northern South Australia, it is correlated not with habitat but with geographic proximity to *S. fasciolatus*.

S. fasciolatus is much more plastic. On hard soils it tends to have a moderately strong pattern and to be similar in habitus to *S. richardsonii*. In sandy country it tends to lose pattern and to develop a depressed snout (as in "*pallidus*"). It is thus easier to believe that *S. fasciolatus*, rather than *S. richardsonii*, should have evolved such an extreme ecotype as the "Ghost Skink".

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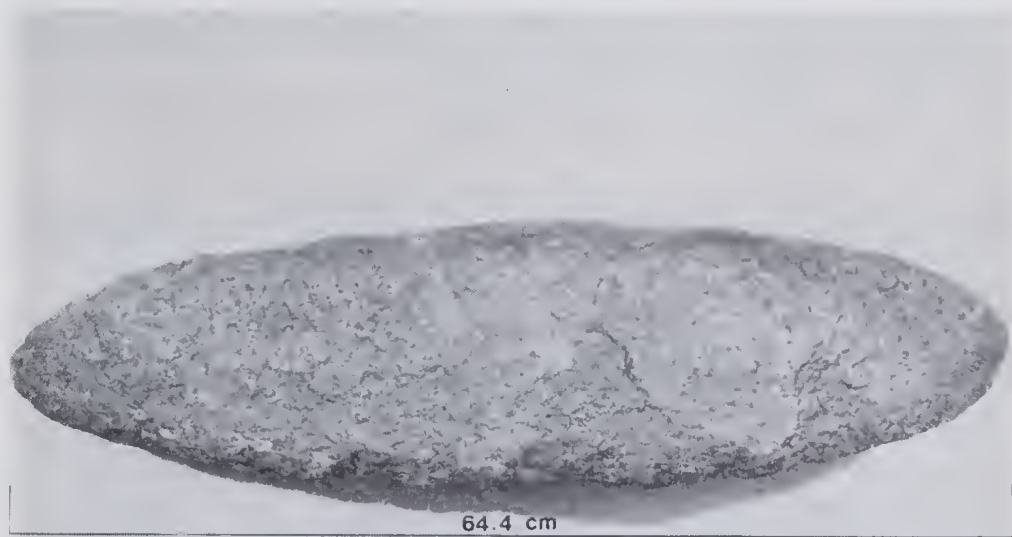
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A STONE ARTIFACT WITH POSSIBLE PHALLIC SYMBOLISM

M. E. LOFGREN

Mr Allan Cooke recently presented to the Western Australian Museum an unusual large stone artifact, first discovered on his property near Minnivale, W.A. in 1923. While clearing land, Mr Cooke uncovered the object during ploughing, and removed it to a nearby creek bed for use as part of the fill in a temporary dam. About ten years later, Mr Cooke was ploughing the then silted-over creek bed, and once again uncovered the same stone object. This time, he took it to the homestead, where it remained until being presented to the Museum in early 1973.

The stone itself, W.A.M. no. A 22189 (fig. 1), is 64.4 cm in length, 17.5 cm in diameter at its widest point, and weighs about 27.5 kg. It is torpedo-shaped, roughly circular in section, with its thickest section being about one third of its length from one end. The stone is granitic, and bears a number of scars, one or more of which may be the result of being struck by the blades of the plough. Other scars are probably associated with the natural weathering and fracturing features of this particular type of rock. There are no other notable features on its surface, and patination is uniform, except on the scars.



A 22189

Fig. 1

The stone's general shape and overall regularity implies human workmanship. Its surface texture is irregularly pitted and suggests the possibility of a very rough hammer-dressing technique, but there is no clear-cut and definite surface evidence to confirm this impression. By itself, it would be difficult to clearly associate this stone with the Aboriginal inhabitants of the area. However, Mr Cooke obtained an identification and description of usage from an Aboriginal informant, establishing the stone's Aboriginal associations.

Mr Cooke's informant told him that this artifact had both a ceremonial and a utilitarian use. No actual details of the ceremonial usage were related, but there are a number of reports of phallic objects, both artificial and natural. Black (1942), McCarthy (1939, 1967), and Mountford (1930, 1960) have all discussed various objects of a phallic nature. However, their material appears to be smaller than this particular artifact, and generally carefully worked. The natural specimens previously reported are also smaller than this artifact.

In addition, stone arrangements have been recorded which feature upright phallic stones (W.A.M.—Registrar of Aboriginal Sites Files). Current ceremonial usage also involves upright phallic stones on specially prepared ceremonial grounds, and this writer has seen one such ground early in 1973 in the Western Desert. Stones used in such a ceremonial context are often highly decorated with ochre, feathers, and various other substances, and occasionally have small sacred objects affixed during actual ceremonies. After ceremonies are completed, these stones may be taken down and stored until they are next used.

The second usage described to Mr Cooke involved employing this type of stone in obtaining water from soaks and gnamma holes. The heavy artifact was said to be repeatedly dropped on the appropriate spot, producing the required deepening depression with each successive blow. Such a heavy weight would be useful for breaking the hardened crust of a potential soak, and it is conceivable that such an implement might be used in reshaping an existing gnamma hole. However, an alternate possibility would have been a combination of these two functions, in that digging for water at a particular site required the appropriate corresponding ceremonial actions, involving a specific ceremonial object. There are soaks in the vicinity of the site where this artifact was discovered.

Until other examples of this type of stone artifact are discovered, it must remain a unique specimen, difficult to more fully evaluate.

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KURUMI: POSSIBLE ABORIGINAL INCIPIENT AGRICULTURE ASSOCIATED WITH A STONE ARRANGEMENT

W. C. DIX and M. E. LOFGREN

In early November 1971 the authors recorded an Aboriginal site in the North Eastern Goldfields region of Western Australia. Local Aborigines were deeply concerned about the integrity of this site because of prospecting and mineral claim pegging in the area.

Kurumi, the name given to this site, is a term referring to both the seed-producing food plant and the actual seed of the plant associated with the site. It is a site of significance to Aboriginal people living in the Leonora-Mt Margaret-Laverton area and, to a lesser extent, to other people of the Western Desert. The site itself consists of two stone arrangements on and adjacent to a clay pan, one of the few fresh water storages in an area of major salt lakes, including Lake Darlot. This region has been previously reported as being of particular significance and traditional importance to its Aboriginal inhabitants. (Elkin 1945:115; Berndt 1943:59; 1964:257; Tindale 1936:170.)

Of the two stone arrangements associated with this site, the first, on the west of the pan itself, consists of approximately thirty small piles of stones, varying between fifteen to twenty, to as few as three or four stones per pile. There is a recognizable line of stones extending along one side of this site, and two isolated stones are embedded in the clay pan, as shown in the accompanying diagram.



KURUMI
Photograph by W. C. Dix

The second arrangement lies in an easterly direction from the first. It consists of a large heap of stones in a single pile, being approximately two metres across, and one metre high. Sand has built up around this pile, and there are no signs of any recent cleaning or maintenance activity. Within a few metres of this central pile, as shown on the accompanying plan, are further small piles of stones, all roughly similar in size. This arrangement is on a well-vegetated sandy ridge protruding into the clay pan.

In the vicinity of these arrangements, a quantity of flaked material as well as fragments of a grinding stone were found as surface deposits, suggesting long-term camping in the area around this site. The stone arrangements are primarily made with a type of banded chert, brown in colour when broken. Most of the stones used in the arrangements are encrusted with calcrete, presenting the appearance of limestone.

Informants described the general meaning of this site in the following manner. The stone arrangement first described represents a woman preparing a damper out of *Kurumi* seed for the people camped beyond the windbreak. A man (the larger of the two isolated stones) is helping with the chore. After enjoying this satisfying meal, the men move across to the second arrangement where an important ceremony is held. This second site is said to represent a group of dancers, surrounded by a series of camp fires.

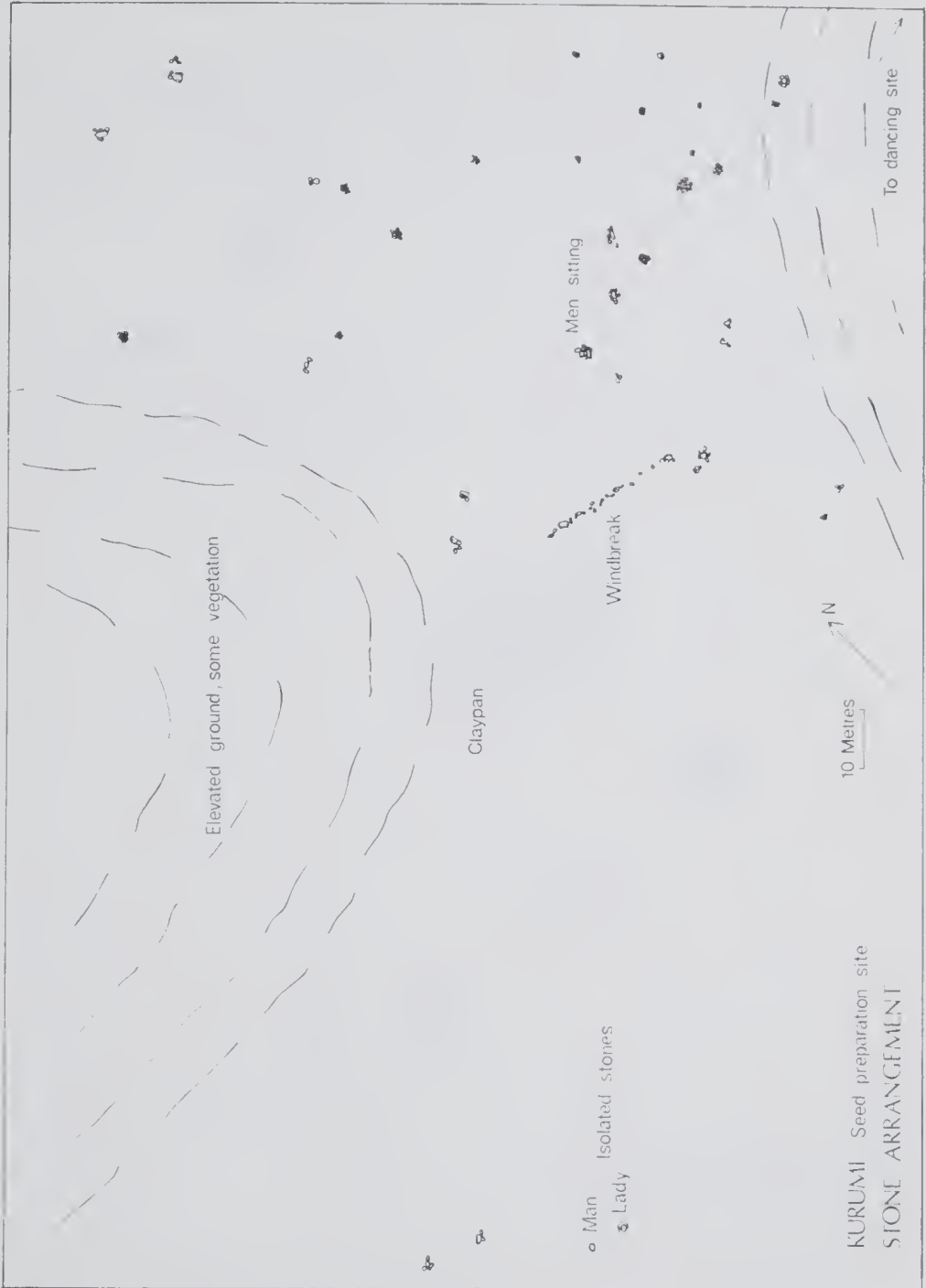
Various relationships to well-known mythological tracks and figures were mentioned. Because of a similarity in pattern, the banded chert used in the first arrangement is said to be related to the better known stones of religious significance found in the same area. However, these mythological associations are of some importance to living people, and will not be discussed in this paper.

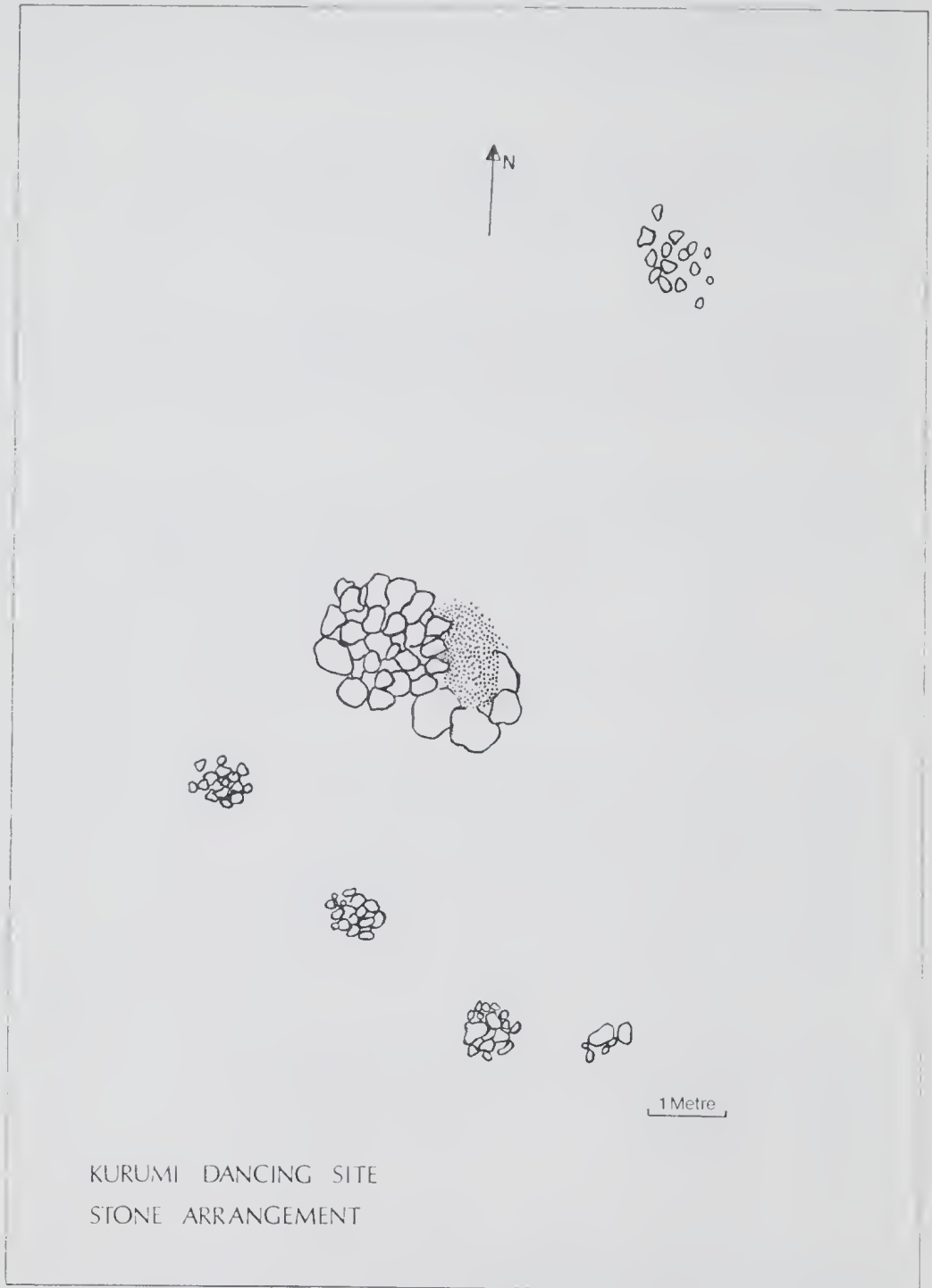
A detailed and complete explanation of this site has yet to be recorded, and this task may prove to be impossible because of the existing relationship between the current custodians and their site. Many sites in this area are not well understood by their custodians in traditional terms, in contrast with other areas of relatively unbroken custodial succession.

The rapid social disintegration and patterns of migration which closely followed first contact with Europeans involved in many cases newcomers to an area quickly assuming custodial rights and obligations to specific sites which they imperfectly understood. Complete new traditions were not invented, and these sites have remained at this fragmentary level of understanding. Because of these factors, the meaning now associated with a particular site may well be at some variance with older traditions. However, regardless of what may be the current explanation, the continuity of a site's importance generally remains unbroken through the administrations of successive custodians, and this pattern expressed may be much older than just the recent chaotic contact period.

Of particular ethnographic interest is the association of these stone arrangements with a specific food plant and its product seed, i.e. *Kurumi*. Informants stressed the importance of this relationship, and stated that a damper prepared with this seed was of superior quality and importance. They produced a quantity of the seed, carefully stored in an old meat tin, and demonstrated various methods of grinding, used to produce a variety of types of flour. Also, informants pointed out dried specimens of the plant still *in situ* in the clay pan, as shown in the accompanying photograph.

In addition, informants stated that seeds were carefully scattered in the cracks of the clay pan to ensure that after the next heavy rains, a bountiful crop would be produced. This reference to a type of incipient agricultural activity is fascinating in this Australian context, but must be considered in the light of the relative sophistication of the informants. They have a small garden next to their camp well, including





both native and domesticated plants, and have been taught some aspects of successful irrigated gardening. However, they insist that the sowing of *Kurumi* seed in the clay pan was traditional behaviour, taught to them by their ancestors. A survey of several surrounding clay pans failed to locate any other clay pans where this plant could be found.

Samples of seed and a dried specimen of the plant itself from the clay pan have been tentatively identified as *Tecticornia arborea*, but firm identification awaits a living specimen. This region has had a few years drought, and return visits to the site have yet to provide a living specimen of *Kurumi*. However, recent heavy rainfall in the area suggests that an example may be soon obtainable, and a firm identification will be noted.

Kurumi is now a protected area under the Aboriginal Heritage Act, and its exact location is recorded with the Registrar of Aboriginal Sites.

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THE REVEREND C. G. NICOLAY
WESTERN AUSTRALIA'S FIRST MUSEUM CURATOR

PHILLIP E. PLAYFORD* and ISOBEL PRIDMORE‡

The Reverend Charles Grenfell Nicolay was well known in Western Australia as a clergyman-scholar from 1870 until his death in 1897. He is especially remembered for his pioneer work on the geography and geology of the colony and as the founder of its first publicly owned museum, at Fremantle in 1881. His collection was transferred to the old Gaol building in Perth in 1889 and 1890, to form the nucleus of the original Perth Museum collection which by the addition in 1892 of the collection of the Swan River Mechanics Institute (formed 1860) became the Public Museum—later the Western Australian Museum.

Charles Nicolay was born at Cadogan Place, Chelsea, England, on 3 August 1815. He was the seventh child of Frederick Nicolay, clerk of His Majesty's Treasury, and Maria Georgina Nicolay, nee Granville. His great-grandfather, Caspar Nicolay, came to England from Germany in 1736 in the suite of Augusta of Saxe-Gotha, who married Frederick Louis, Prince of Wales. His grandfather, Frederick Nicolay, was the Principal Page to Queen Charlotte and was a confidant of George III; he was also a renowned musician and was known to Haydn and Mozart.

Nicolay was only two years old when his father died, leaving his mother with eight children to support, the youngest only one month old. She was left destitute and was obliged to petition the Earl of Liverpool for financial support. Details of Charles Nicolay's education have not been traced, but it is clear that he did not receive university training, presumably because of his mother's impecunious position. In 1841 he was ordained as Deacon in the Church of England by the Bishop of Exeter, and on 28 March of that year he was licensed to a curacy at Tresco in the Scilly Isles. On 7 June 1841 he married Mary Ann Raven, daughter of Henry Baldwin Raven, by whom he had eight children.

In 1843 Nicolay was appointed librarian of King's College, London, and he held the position until 1858. During this period he acquired an extensive knowledge of geography, geology, and history (presumably mainly through reading) and made the acquaintance of some eminent scholars of that period. He acted as chaplain of the King's College hospital for some time, and was lecturer in geography at the College from 1854 to 1858. He was elected as a Fellow of the Royal Geographical Society in 1844, and retained his membership of the Society until 1866.

Nicolay played a major part in the founding of Queen's College, London, in 1848. This was the first institution for the higher education of women to be established in England, and Nicolay is regarded as being its co-founder with F. D. Maurice. He undertook most of the work associated with the opening of the College and in obtaining its Royal Charter in 1853. He held the positions of Dean, Deputy Chairman, and Professor of Geography and Ancient History. Nicolay carried out his duties at College efficiently during its early years, but by 1856 a good deal of dissension had developed between him and some of the female tutors and Lady Visitors, and as a result an official enquiry was held by the Committee of Education. It was concluded that a lack of confidence in Nicolay existed in the College, and that he had shown certain "defects of temper", in consequence of which he should not continue as Dean. Although he was asked to retain his professorships Nicolay offered his resignation from all his positions with the College. However, he was unable to find

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another opening and was humiliated at having to return to lecturing at the College during late 1857 and early 1858.

In March 1858 Nicolay was appointed chaplain to the British residents of Bahia, Brazil, and as a result finally relinquished his remaining posts with King's and Queen's Colleges. He was then elected as a Fellow of King's and an Honorary Fellow of Queen's, positions which he held for the rest of his life.

During the period 1846 to 1859 Nicolay published a number of papers and books dealing with geography, history, and social matters. These included "The Oregon Territory" (1846), "On the dwellings of the working classes in British North America" (1852), "A manual of geographical science, mathematical, physical, historical, and descriptive" (1852, 1859), and "The principles of physical geography" (1858).

The Church of St George in Bahia, where Nicolay became chaplain, had been consecrated in 1857 by Matthew Hale while on his way to Western Australia to take up his duties as Bishop of Perth. Part of Nicolay's salary at Bahia was paid by Bishop Hale. Nicolay remained in Brazil until 1867, when he returned to England on leave. Early in the following year the subscribers to the Church in Bahia resolved that Nicolay be requested to resign: apparently he had aroused the antagonism of certain British residents there. He was then left without a clerical position until 1870, when he was appointed chaplain at Geraldton in Western Australia.

Nicolay arrived in Fremantle on the *Lady Louisa* on 25 April 1870. He immediately interested himself in the affairs and natural resources of the Colony, and evidently impressed Governor Weld and the Colonial Secretary with his ability. Soon after moving to Geraldton in June he recommended that an experimental coffee plantation be established near Geraldton, as the climate seemed similar to that of some parts of Brazil where coffee flourished. In July 1870 Governor Weld authorized the setting aside of a reserve for coffee cultivation covering the Valley of Waggrakine on the west side of the Moresby Range. Nicolay proceeded diligently with development of the reserve, planting coffee seed from Aden, and later from Brazil. His son Frederick came to Geraldton from Melbourne to assist with the plantation. However, by the end of 1873 it was apparent that the experiment was a failure, and Nicolay recommended sale of the reserve. The only remnants of the plantation today are a small cottage built by Nicolay and known locally as the "Coffee-pot" (a corruption of "coffee plot"), a well beside the cottage, and a solitary fig tree (one of several planted originally by Nicolay).

In 1874 Nicolay accepted editorship of the *Perth Gazette and W.A. Times*. He endeavoured to retain temporarily the position of chaplain at Geraldton while carrying out his editorial duties in Perth, but this was strongly resisted by Bishop Hale, who eventually obtained his resignation from Geraldton. The newspaper had been bought by a syndicate including the Colonial Secretary, Frederick Barlee (who appears to have become a close friend of Nicolay's). Previously the paper had been strongly anti-Government, but under Nicolay this policy was reversed. He probably continued as editor until 1875. Later, in 1886 and 1887, he wrote a series of editorials on European political affairs for the *Inquirer*.

Between December 1873 and May 1874 Nicolay carried out engineering investigations on behalf of the Government to determine the feasibility of constructing a ship canal between Rocky Bay, in the lower reaches of the Swan River, and the coast. The scheme was intended to make this deep section of the river available as the main harbour for Fremantle. Nicolay was in favour of the canal, but it was rejected soon afterwards by a committee set up to examine the various schemes for development of the harbour. Nicolay's joint role at this time of newspaper editor and scientific adviser to the Government (said to include such diverse fields as engineering, geology, botany, astronomy, and conchology) was scathingly criticized in *The Herald* of 23 May 1874.

Nicolay was commissioned by the Government in 1875 to lead an expedition to investigate reports of coal in the bed of the Fitzgerald River, near the south coast. This appointment was condemned by the *Inquirer* of 11 August 1875 on the grounds of Nicolay's lack of qualifications and experience in coal prospecting, describing him as "whilom chaplain, whilom coffee-planter, whilom editor, whilom engineer, and the Fates alone know whilom what else". The opinion probably reflects the attitude of many in the colony towards Nicolay at that time. He found no coal seams in the Fitzgerald River area, although it has recently (1970-71) been shown that coal having possible economic value does in fact occur there.

Governor Robinson commissioned Nicolay in 1876 to prepare a "Handbook of Western Australia" to give an account of the geography, history, and state of development of the colony for the use of prospective migrants. The manuscript was completed in August 1877, but it was not published until 1881. This volume gives a comprehensive picture of the colony at that time and is remarkable for the breadth and detail of its coverage. During the '90's Nicolay revised the volume, and the second edition was published in 1896, a year before his death. However, this edition did not come up to the standard of the first, no doubt because of Nicolay's advanced age.

In 1877 Nicolay was responsible for the preparation of a report for the Intelligence Branch of the War Office dealing with the defence organization of the colony. At that time he was acting as curate in the Parish of Perth and as chaplain at the Perth Gaol. He was appointed chaplain at the Fremantle convict establishment in 1878, and retained this post until his death. From 1880 to 1882 he assisted Bishop Parry with the instruction of theological students at Bishop's College, Perth, the Society for the Propagation of the Gospel (in London) being responsible for his salary.

Nicolay was the founder of Western Australia's first publicly owned museum. In 1881 he was authorized by Governor Robinson to begin a collection of rocks and minerals which would eventually form the nucleus of a museum in Perth. The old Guard Room at the convict establishment was set aside for this purpose. It was originally named the Registry of Mines and Minerals, later amended to the Registry of Minerals, and finally it became known as the Geological Museum. The collection was transferred to the old Gaol building in Perth in 1889 and 1890, and in 1891 Mr Bernard H. Woodward, who was Curator to the Geological Department, was appointed Curator of this new museum. The museum was opened in September 1891, and in June 1892 the museum of the Swan River Mechanics Institute was purchased and added to it. It became known as the Public Museum and it included exhibits of geology, zoology, botany and ethnology.

From 1881 to 1889 Nicolay acted as geological adviser to the Government, reporting on various minerals sent in for examination and (in 1887) on the geology of the railway route between Guildford and Clackline. He also prepared a circular on prospecting for gold (1886) and published "Some notes on the geology of Western Australia" and "Notes on the Aborigines of Western Australia" for the Colonial and Indian Exhibition in 1886.

In 1886 he became involved in a dispute (through correspondence) with E. T. Hardman (formerly Government Geologist of Western Australia) regarding the incorrect labelling of some specimens deposited by Hardman in the Geological Museum. Hardman was scathing in his criticism of Nicolay, making it quite clear that he regarded him as incompetent. Nicolay's reply was dignified, stating that he had "never assumed the character of an accomplished geologist" and that his "knowledge of geology was, originally, such as was required for me as Professor of Physical Geography, the only one then in London".

Nicolay took a keen and sympathetic interest in the welfare of the Aborigines. His humanitarian views, ably expressed in the 1881 Handbook, were far more liberal than those held by the majority at that time, or indeed by many today. In 1878 he

was responsible for the Governor setting aside a reserve for Aborigines, covering 50,000 acres in the upper Murchison area. In 1892 he was appointed by the Government to the Aborigines Protection Board, holding this position until his death.

Nicolay died suddenly at Fremantle on 9 May 1897. His wife had predeceased him by 10 years, on 31 January 1887, after having been an invalid for many years. Some of their descendants, through their son Frederick, are still living in Western Australia. Their daughter, Sister Mary Nicolay, was well known as a pioneer of nursing in this State.

In Western Australia Nicolay's principal achievements were his 1881 Handbook and the part he played in the founding of the Western Australian Museum. Nicolay's mark in education and science in Great Britain was made through his part in the educational emancipation of women, in the founding of Queen's College, London. The years at Queen's marked the peak of his career, and it was a tragedy that he was forced to leave there. Nicolay was clearly a talented and scholarly man, who must have suffered through his lack of university education. The loss of his father at an early age, and the impecunious position of his mother, must have played an important role in moulding his character and career. He never seemed to have been deeply interested in the Church, but was essentially a humanist with broad interests in science. Despite his lack of formal qualifications outside the Church, he was able to adopt, with varying degrees of success, the role of an expert in many fields, from newspaper editing to geology. However, Nicolay apparently had the unhappy facility of antagonizing some people and, combined with his quick temper, this resulted in several personal clashes which seriously influenced his life.

Our research on Nicolay was carried out originally for a contribution to volume 5 of the Australian Dictionary of Biography, which was to have been published in 1972. The present article is slightly amended from one published in the Journal and Proceedings of the Royal Australian Historical Society, Volume 7, Part 1, pages 29-33, 1969, and is an expanded version of the contribution submitted to the Dictionary. Detailed source material is contained in file PR 5382, Battye Library, Perth, entitled "Reverend C. G. Nicolay—biographical data" by P. E. Playford and Isobel Pridmore.

RATTUS VILLOSISSIMUS (WAITE)—A NEW MAMMAL RECORD
FOR WESTERN AUSTRALIA

J. H. CALABY*

SUMMARY

Two specimens of *Rattus villosissimus* collected in Western Australia in August 1968, the first known occurrence of the species in the State, are recorded and described.

Rattus villosissimus (Waite) is normally resident in relatively low numbers in parts of western Queensland, the eastern margin of the Northern Territory, and north-eastern South Australia. At intervals it increases enormously in numbers and invades other parts of the country in which it presumably does not usually occur. The mechanisms involved in its population fluctuations and the nature of its movements are obscure. Because of its periodic appearance in large numbers it is commonly called the plague rat.

One of the greatest irruptions occurred during the years 1967–1969. The most westerly locality from which specimens have been recorded is Humbert River Station, N.T. (130° 39'E, 16° 29'S). The specimens, taken in 1968, are housed in the American Museum of Natural History, New York, and CSIRO Division of Wildlife Research, Canberra (Taylor and Horner, 1973). Parker (1973) gives an anecdotal report of the species presence in 1968 at Mongrel Downs (129° 44', 20° 34') near the western border of the Northern Territory. Taylor and Horner also record an old skull found in a cave near the south coast of South Australia, approximately 80 km east of the Western Australian border.

Two specimens representing the first known occurrence of *R. villosissimus* in Western Australia, were collected by Dr G. F. Mees in August 1968. They were preserved in alcohol and subsequently prepared as skins and skulls, and are housed in the Rijksmuseum van Natuurlijke Historie, Leiden. The collection data and some measurements of the two specimens are given in Table 1. The body measurements and weight are those recorded on the labels; the wet spirit-preserved animals were measured according to the methods described by Husson (1960) (A. M. Husson, *pers. comm.*).

TABLE 1
COLLECTION DATA AND MEASUREMENTS OF *Rattus villosissimus* SPECIMENS FROM
WESTERN AUSTRALIA

Registration No.	.....	.....	.....	20682	20683
Locality	.....	.....	.....	bed of Wolf Creek approx. 1.5 km from Carranya Homestead (127° 45', 19° 15')	approx. 32 km NE of Sturt Creek Homestead (128° 22', 18° 55')
Date	.....	.....	.....	26 August 1968	28 August 1968
Age and sex	.....	.....	.....	juv. ♀	juv. ♀
Head and body length	.....	.....	.....	137 mm	127 mm
Tail length	.....	.....	.....	131 "	112 "
Hindfoot length (with claw)	.....	.....	.....	34 "	31 "
Ear length	.....	.....	.....	17 "	17 "
Weight	.....	.....	.....	77 g	—
Skull, overall length	.....	.....	.....	35.7 mm	33.8 mm
Basal length	.....	.....	.....	31.9 "	30.2 "
Zygomatic width	.....	.....	.....	18.7 "	17.9 "
Interorbital width	.....	.....	.....	4.5 "	4.7 "
Braincase width	.....	.....	.....	15.6 "	15.3 "
Mastoid width	.....	.....	.....	13.0 "	12.4 "
Nasals length	.....	.....	.....	12.4 "	11.5 "
Nasals width	.....	.....	.....	3.9 "	3.5 "
Palatal length	.....	.....	.....	19.2 "	17.9 "
Incisive foramen length	.....	.....	.....	7.6 "	7.0 "
Incisive foramina width	.....	.....	.....	1.9 "	1.7 "
Inside m ¹⁻¹ width	.....	.....	.....	2.0 "	1.9 "
Outside m ¹⁻¹ width	.....	.....	.....	7.2 "	7.2 "
Bulla length	7.3 "	7.0 "
Crowns m ¹⁻³ length	7.2 "	6.7 "
Alveoli m ¹⁻³ length	7.4 "	7.1 "
Crowns m ¹⁻² length	5.7 "	5.3 "

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The skins have the characteristic pelage colour of *R. villosissimus*. Dorsally they are a pale grey-brown. The main dorsal hairs have medium grey bases with buff to white tips and are about 14 mm long on the rump. The guard hairs are long and black, a few have white tips. On the larger specimen they are up to 25 mm long on the rump. Ventrally the skins are pale grey. The hairs have pale grey bases and white tips. On the larger specimen the greater part of each hair is white. There are patches of white hair on the chin and throat. The dorsal surface of the feet is white. The tail hairs are comparatively long as is usual in this species. Specimen 20683 had suffered superficial injuries some time prior to death. On the rear portion of both sides there are patches on which new short pale brown hair was growing. Supra-orbital-temporal ridging is poorly developed and there is only a suggestion of ridging above the orbits in the smaller specimen. There is very little tooth wear. The elongated narrow incisive foramina and relatively large bullae help to distinguish the skulls as *R. villosissimus*.

Both specimens were found freshly dead and undamaged on vehicle tracks. On the night of 27 August Dr Mees saw a burrow system in the form of a mound of sand about one m in diameter and 15 cm high, with several entrance holes. Near it was a small pale-greyish mammal which appeared to be of the same species as the two specimens.

ACKNOWLEDGMENTS

I am most grateful to Drs A. M. Husson and G. F. Mees of the Rijksmuseum van Natuurlijke Historie for permission to examine the material, and to Dr Mees for providing his field notes and discussing the occurrence with me.

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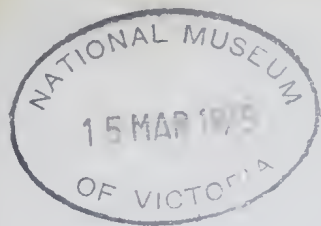
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RECORDS
OF THE
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VOLUME 3
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1974

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A NEW SPECIES OF *HEMIBOECKELLA* (FRESHWATER COPEPODA CALANOIDA) FROM WESTERN AUSTRALIA

I.A.E. BAYLY *

[Received 23 August 1973. Accepted 15 February 1974]

INTRODUCTION

The genus *Hemiboeckella* was established by Sars (1912) to accommodate a form which had a general resemblance to *Boeckella* but which differed from this genus in certain significant features. Marsh (1924) could see 'no good reason for separating it from *Boeckella*' and accordingly made *Hemiboeckella* a synonym of this genus. Bayly (1964), however, disagreed: in support of Sars, he maintained that there were very real differences between *Hemiboeckella* and all species of *Boeckella* which should be given nomenclatural expression — a view which is reaffirmed. Bayly (loc. cit.) retained full generic status for *Hemiboeckella* partly for nomenclatural simplicity, but expressed the opinion that ideally subgeneric status might perhaps have been more appropriate. However, as a result of further consideration of the nature of the maxilliped the author now believes that full generic status is adequately justified in terms of structural differentiation.

Until now *Hemiboeckella* has remained monotypic and consequently there has been doubt as to which of the features possessed by *H. searli* Sars should be incorporated into the generic definition. However, a recent collection from a temporary freshwater pool in Western Australia contained numerous specimens of a form which agrees with *H. searli* in several important respects, but cannot be accommodated in either *Boeckella* or *Calamoecia*, the two main genera of freshwater calanoids in Australia. This new species, apart from being of interest in its own right, now makes it possible to put the definition of *Hemiboeckella* on a sound basis, and vindicates Sars' original decision to erect this genus.

REDEFINITION OF THE GENUS

Order	Calanoida
Family	Centropagidae Sars
Genus	<i>Hemiboeckella</i> Sars
<i>Hemiboeckella</i> Sars, 1912, pp. 13-14.	
Type (by monotypy) <i>Hemiboeckella searli</i> Sars	

Generic definition

Hemiboeckella are centropagids with three-segmented endopodites on P1-P4 of both sexes and P5 of the female and in which the number and

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arrangement of spines and setae on P1-P4 agrees with that of *Boeckella* and the following formulae:

	Endopodite	Exopodite
P1	1.1.321	1.1.421 (or 1.1.322)
P2 and 3	1.2.422	1.1.521
P4	1.2.322	1.1.521

Hemiboeckella differs from *Boeckella* most importantly in the following features:

- (i) the maxillipeds are relatively shorter and stouter and the number of setae on segments 4 and 5 (or 2 and 3 excluding the two basal segments) are reduced from 4 and 3 respectively to 2;
- (ii) the exopodite of the male fifth left leg, which is shorter than the right exopodite, consists of two segments plus a straight terminal spine, and the distal segment and terminal spine are not combined to form a long curved claw;
- (iii) the distal protopodite segment of the male fifth left leg is produced into an inner process which extends beyond the proximal segment of the left exopodite;
- (iv) a greater degree of sexual size differentiation.

Remarks

Apart from the above characteristics *Hemiboeckella* also differs from most species of *Boeckella* and *Calamoecia* in that the antennules are only about as long as the metasome. This feature, however, is also found in some, mainly large, species of *Boeckella*, such as *B. robusta*, *B. pseudochelae* and *B. major*, which inhabit small, temporary bodies of water. It may be noted that *Hemiboeckella* is also restricted to this type of habitat, so far as is known.

The degree of sexual size differentiation in *Hemiboeckella* is greater than that in *Boeckella* and *Calamoecia*.

Sars (1912, pl. ix, fig. 8) shows segments 4 and 5 of the female maxilliped of *H. searli* bearing only one seta. However, a critical examination of 5 female maxillipeds shows that this is incorrect; there are two large or fully developed setae, and sometimes a very short and slender vestigial (third) one is visible as well. The general form of this appendage is similar in both species of *Hemiboeckella* and distinctly less elongated than that in *Boeckella* and *Calamoecia*.

DESCRIPTION OF SPECIES

Hemiboeckella andersonae sp. nov.

(Figs 1a-e, 2a-d)

Specimens examined

Numerous specimens of both sexes were present in a collection made by Mrs D. Anderson on 9 October 1972 from a shallow freshwater pool near a freshwater swamp on Culeenup Island, Western Australia (lat. 32° 35'S., 115° 47'E.). This island is in the Yundurup delta at the point where the Murray River enters Peel Islet. Both the pool and the swamp are ephemeral and dry out in summer (D.L. Serventy, pers. comm.). Water is usually present only between June and October. Dr Serventy reports that he found

a copepod (probably *H. andersonae*) very abundant in the pool on 10 August 1970.

Type material

Holotype ♂, allotype ♀, paratypes 3♂, 3♀ (these eight stained, dissected, and mounted on microslides), paratypes 10♂, 10♀ (unmounted in vial); Aust. Mus. Reg. Nos. P19238-46. Paratypes 3♂, 3♀ (stained, dissected, and mounted on microslides) and 10♂, 10♀ (unmounted in vial); West. Aust. Mus. Reg. Nos. 182-73, 183-73 and 184-73. Type locality: Culeenup Island, Yundurup Delta, Western Australia.

Description of female

Size:— Mean length (ten specimens) to end of metasome (measured mid-dorsally so as to exclude posterior 'wings') 0.70 mm, to end of furcal rami 1.01 mm and to end of longest furcal setae 1.25 mm.

General body proportions:— See Figure 1a.

Maxilliped (Figs 1e-f):— Shorter and stouter than in *Boeckella*. All segments with only two setae on anterior side, except for two large basal segments and minute terminal one.

Fifth legs (Figs 1c-d):— Distal protopodite segments with prominent distal process arising from posterior face, but that on right side somewhat longer than that on left making legs asymmetrical; terminal exopodite segments with only four spines (1 inner, 2 terminal, 1 outer); endopodites 3-segmented, first two segments devoid of setae, terminal segment with three setae near distal extremity but one of these inserted distally on outer edge.

Urosome (Figs 1a-b):— 3-segmented; genital segment with slightly greater distance between lateral bulges than between anterior and posterior margins, with conspicuous spine on anterior half of right side; furcal rami with oblique insertion into anal segment, mean length (line half way between inner and outer edges and parallel to them) about 3.3 times mean width.

Description of male

Size:— Mean length (ten specimens) to end of metasome (measured mid-dorsally) 0.50 mm, to end of furcal rami 0.68 mm, and to end of longest furcal setae 0.81 mm.

General body proportions:— See Fig. 2a.

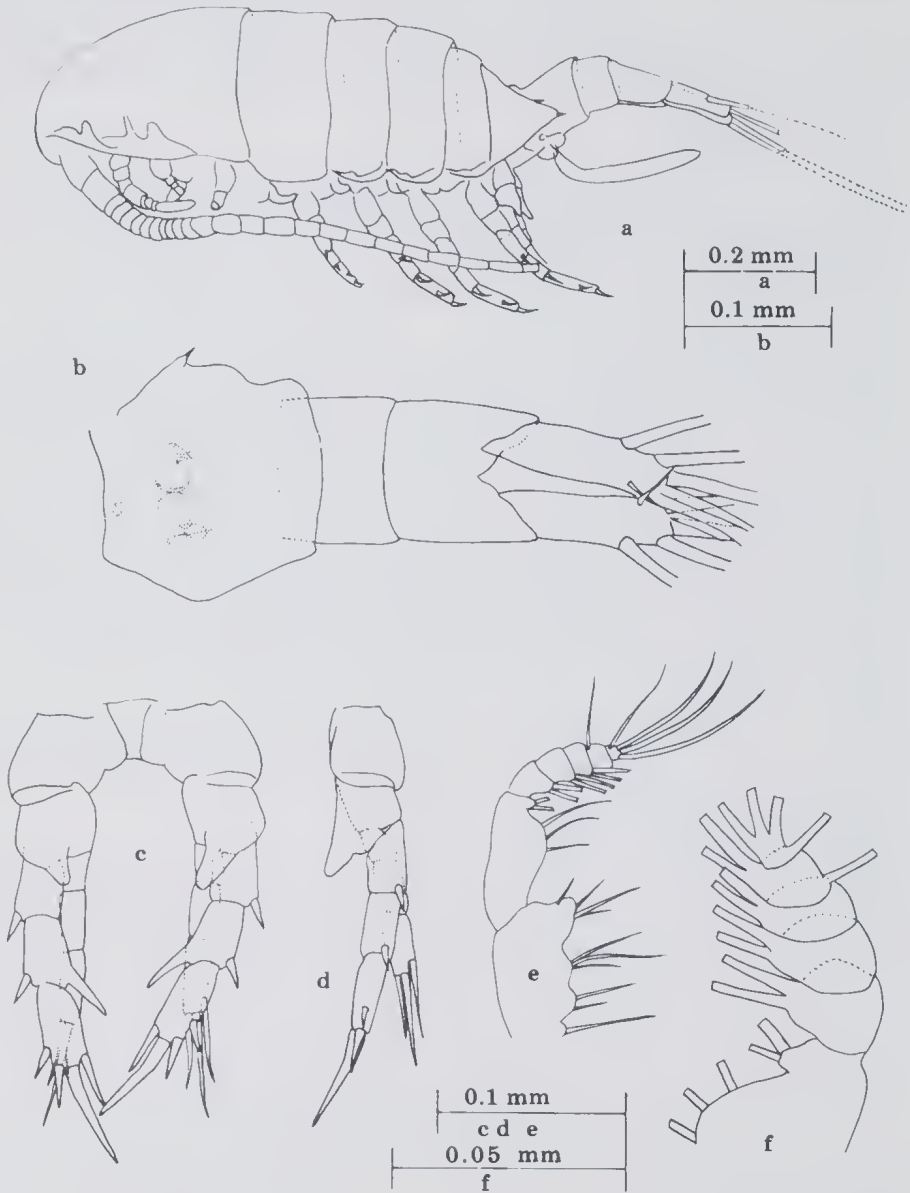
Maxilliped:— As for female.

Fifth legs (Figs 2b-d):— Right exopodite 3-segmented, distal segment consisting of a long, curved claw as in *Boeckella*; right endopodite 3-segmented, proximal and middle segments lacking setae, terminal segment with three spines (or setae) at distal extremity, outermost spine longest, innermost spine shortest; left distal protopodite segment produced at inner distal corner into a stout process extending beyond the distal edge of the proximal exopodite segment; left exopodite 2-segmented and much shorter than right exopodite, proximal segment much larger than distal one and with small spine near outer distal corner, distal segment with straight terminal spine almost as long as segment itself and with minute spine on outer edge, no spines present on inner edge of distal segment (cf. *H. searli*) but under high magnifications minute tubercles visible immediately inside point of insertion of terminal spine; left endopodite 2-segmented, terminal segment with three spines at distal extremity.

Remarks

Previously (Bayly, 1964, pp. 184 and 231) the terminal spine of the exopodite of the male fifth left leg was referred to as a 'segment' on the

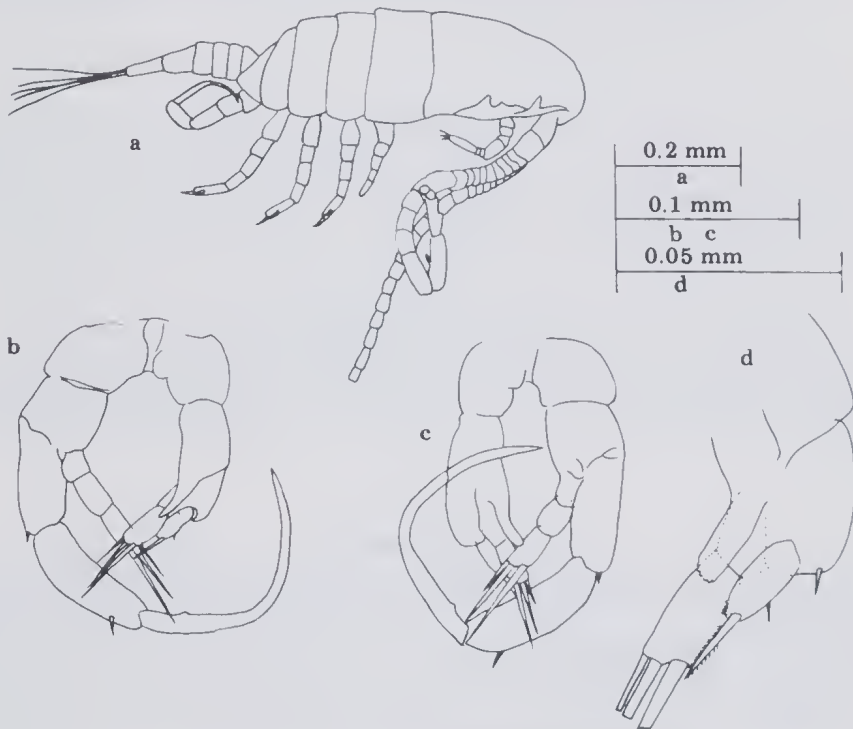
Fig. 1. *Hemiboeckella andersonae* sp. nov., female. a, lateral aspect; b, ventral aspect of urosome; c, posterior aspect of fifth legs; d, lateral aspect of fifth leg; e, maxilliped; f, distal portion of maxilliped.



grounds of its probable developmental homology with the distal half of the claw of *Boeckella* (which was described as a segment). This usage is abandoned in this paper.

The degree of sexual size differentiation in this species is unusually great; the average value of the ratio (mean female length):(mean male length) for the three different measures given above is 1:48. The corresponding ratio for *H. searli*, based on metasome length and length to the end of the furcal rami, is 1:51. In both cases this ratio is distinctly greater than that for any species of *Boeckella* (Bayly, in manuscript) and for this reason the high degree of sexual size differentiation has been incorporated into the generic diagnosis.

Fig. 2. *Hemiboeckella andersonae* sp. nov., male. a, lateral aspect; b, anterior aspect of fifth legs; c, posterior aspect of fifth legs; d, anterior aspect of distal portion of fifth left leg.



KEY TO SPECIES

(Based on the structure of the fifth pair of legs.)

Males

- (a) Right endopodite with middle segment produced at inner distal corner into seta-like process, distal segment lacking setae; left endopodite with two small setae laterally placed; distal segment left exopodite with prominent spine on inner edge

H. searli Sars, 1912

- (b) Right endopodite with middle segment devoid of outgrowths, distal segment with three setae; left endopodite with three setae

(or spines) at distal extremity; distal segment left exopodite lacking spine on inner edge

H. andersonae sp. nov.

Females

- (a) Fifth legs fully symmetrical; distal protopodite segments lacking distal process on posterior face; terminal exopodite segments with total of seven spines (formula 421); endopodites usually with one seta on inner edges of segments 1 and 2, segment 3 usually with total of six setae (formula 222)

H. searli Sars, 1912

- (b) Fifth legs slightly asymmetrical; distal protopodite segments with prominent distal process on posterior face; terminal exopodite segments with total of only four spines (formula 121); endopodites lacking seta on inner edge of segments 1 and 2, segment 3 with only 3 setae (formula 021)

H. andersonae sp. nov.

A feature that allows the easy discrimination of the two species in both sexes without dissection is the very unequal length of the furcal setae in *H. searli*. In this species the third seta from the outside on both rami is exceptionally long and the fourth very short. The third seta may thus be more than twice the length of the fourth.

ACKNOWLEDGEMENTS

I am indebted to Mrs D. Anderson who collected the sample containing this new species, and to Dr D.L. Serventy who forwarded it to me and supplied valuable background information concerning the nature of the habitat.

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THE SEA SNAKES OF WESTERN AUSTRALIA (SERPENTES: ELAPIDAE, HYDROPHIINAE) WITH A DESCRIPTION OF A NEW SUBSPECIES

L.A. SMITH

[Received 15 January 1974. Accepted 29 April 1974]

ABSTRACT

The following 15 taxa recorded from Western Australia are described and keyed out: *Aipysurus laevis laevis* Lacépède, *A. laevis pooleorum* subsp. nov., *A. duboisii* Bavay, *A. apraefrontalis* M.A. Smith, *A. tenuis* Lönnberg and Andersson, *A. eydouxii* (Gray), *Hydrophis ocellatus* Gray, *H. major* (Shaw), *H. kingii* Boulenger, *H. elegans* (Gray), *Acalytophis peronii* (Duméril), *Astrotia stokesii* (Gray), *Hydrelaps darwiniensis* Boulenger, *Ephalophis greyii* M.A. Smith and *Pelamis platurus* (Linnaeus). A neotype is selected for *Aipysurus laevis*.

INTRODUCTION

This work began as a synopsis of the sea snakes of Western Australia. However, the discovery of a new subspecies of *Aipysurus laevis* necessitated settling the identity of the holotype of *A. laevis*. To do this I examined all *Aipysurus* from Australian seas which were in Australian museums and some material from the Museum of Comparative Zoology. I have supplied a full synonymy for *A. laevis*. Readers are referred to M.A. Smith (1926) for the synonymies of other species. I have also used extralimital material in the descriptions of species of *Aipysurus* where there are few Western Australian specimens.

I have adopted M.A. Smith's method of counting scales (see M.A. Smith 1926: XVI).

The three species which appear in the key in brackets are species recorded from Ashmore Reef. I have included them in anticipation of their eventual collection on the Western Australian coast.

The following descriptions are based on material from the Western Australian Museum, Queensland Museum, Australian Museum and the Museum of Comparative Zoology; registered numbers of these specimens are prefixed with WAM, QM, AM and MCZ respectively.

KEY TO SPECIES

- | | | | |
|-----|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----|
| 1. | Black above, yellow or brown below, the two colours sharply defined by a straight line. Tail yellowish with black spots or bars | <i>Pelamis platurus</i> | |
| | Not so | | 2 |
| 2. | Preocular absent | <i>Hydrelaps darwiniensis</i> | |
| | Preocular present | | 3 |
| 3. | Ventrals bifurcate, strongly imbricate | <i>Astrotia stokesii</i> | |
| | Ventrals entire, juxtaposed or weakly imbricate | | 4 |
| 4. | Three upper labials, the second by far the largest | <i>[Emydocephalus annulatus]</i> | |
| | At least 6 upper labials | | 5 |
| 5. | Ventrals broad, at their widest about 3 times as wide as adjacent dorsals | | 6 |
| | Ventrals narrow, at their widest not more than twice as wide as adjacent dorsals | | 13 |
| 6. | Head shields (excluding rostral and nasals) broken up into small irregular tuberculate scales | <i>Aipysurus duboisii</i> | |
| | Head shields smooth, more or less symmetrical | | 7 |
| 7. | Prefrontals absent | <i>Aipysurus apraefrontalis</i> | |
| | Prefrontals present | | 8 |
| 8. | Loreal present | | 9 |
| | Loreal absent | | 12 |
| 9. | Midbody scale rows 19 | | 10 |
| | Midbody scale rows 21 or 23; ventrals 142-159 | <i>Aipysurus laevis</i> | |
| 10. | Ventrals 187-192 | <i>Aipysurus tenuis</i> | |
| | Ventrals not more than 172 | | 11 |
| 11. | Ventrals 139-153, each with a deep median notch; all other scales on body very strongly imbricate | <i>[Aipysurus foliosquama]</i> | |
| | Ventrals 156-172, median notch weak or absent; subcaudals 24-37; scales imbricate | <i>[Aipysurus fuscus]</i> | |
| 12. | Midbody scale rows 17 | <i>Aipysurus eydouxii</i> | |
| | Midbody scale rows 19 or 21 | <i>Ephalophis greyii</i> | |
| 13. | Scale rows at widest part of body 27-28; nasal in contact with the preocular | <i>Acalyptophis peronii</i> | |
| | Scale rows at widest part of body 33-57; nasal not in contact with the preocular | | 14 |

14.	Ventrals 197-255; head yellowish with darker markings	... ..	<i>Hydrophis major</i>
	Ventrals more than 255 head not yellowish	... ..	15
15.	Ventrals 354-401; colour pattern if well defined consisting of bands, constricted on flanks, or dorsal and ventral bars	... ..	<i>Hydrophis elegans</i>
	Ventrals not as many as 354; colour pattern if well defined has no ventral bars	... ..	16
16.	Head black with a white orbital ring; ventrals black; scales at widest part of body 34-39	... ..	<i>Hydrophis kingii</i>
	Head olivaceous; ventrals never black; scales at widest part of body 47-57	... ..	<i>Hydrophis ocellatus</i>

DESCRIPTION OF SPECIES

Genus *Aipysurus* Lacépède

Reference

M.A. Smith (1926:13)

Description

A relatively large genus with 7 species of which 5 occur in Western Australia.

Size moderate to large. Ventrals 142-192 increasing in width posteriorly to about 3 times the width of adjacent dorsals, usually with a median notch. Midbody scale rows 17-23, the scales weakly to strongly imbricate, vertebral row usually enlarged. Tubercles, if present, confined to males. Head shields entire and symmetrical, or fragmented. Females more massive than males (at least in *A. laevis*).

Ground colour usually yellowish to brown, sometimes with a purplish blue sheen in fresh specimens. Dorsal pattern variable, even within species; usually dark spots mid-dorsally which align to form broken longitudinal stripes, or cross bars which taper rapidly to a point on the flanks.

Aipysurus laevis Lacépède

In 1804 Lacépède described a new sea snake *Aipysurus laevis* from 'New Holland'. Until 1864 Lacépède's name was applied to the snake now known as *A. eydouxii*, but since 1864 almost all workers have followed Gunther in applying *laevis* to the present species.

The identity of Lacépède's snake became further complicated when I discovered that *A. laevis* was divisible into two subspecies:

Aipysurus laevis laevis Lacépède

Aipysurus laevis Lacépède, 1804, *Ann. Mus. Hist. Nat. Paris* 4: 197, 210, pl. lvi fig. 3. New Holland [restricted hereunder to Locker Island, off Onslow, Western Australia].

Hypotropis jukesii Gray, 1826, *Ann. Mag. Nat. Hist.* 18: 284. Darnley Island, Torres Strait.

Aipysurus fuliginosus Duméril and Bibron, 1854, *Erpétologie Générale* 7: 1327.

Diagnosis

The species *laevis* is distinguished by 21 or 23 (rarely 19) scale rows and the presence of a loreal. For diagnosis of subspecies see under next taxon.

Description

The most massive member of the genus, maximum length: males 777 mm (subad.); females 1703 mm. Maximum girth: males 102 mm (subad.); females 225 mm. Head shields irregularly divided but generally retaining their colubroid outline.

Rostral wider than high. Nasals entire separated from 1 or 2 (rarely 3) preoculars by a loreal. Postoculars 2 or 3. Prefrontals 2 (in 86% of specimens), 3 or 4 (see comments under variation). Frontal rarely entire, usually divided asymmetrically into 3 or 4 pieces. Supraoculars transversely divided into two. Parietals always divided, their boundary indistinct. Anterior temporals usually 3. Upper labials 8-10 (9 in 74% of specimens); usually the first 3 (but up to the first 5) small owing to horizontal division: fourth to sixth entering orbit. Lower labials 7-9 (usually 8). One or two pairs of chin shields prominent; anterior pair sometimes, posterior pair always separated by one or two small scales.

Midbody scale rows 21 or 23 (once 19), the scales weakly imbricate. Ventrals: 142-159. Subcaudals: males 31-34, females 22-32.

Uniform creamy-yellow or golden brown (one specimen brown). Head usually darker brown. Juveniles dark bluish-brown on back, broken by irregular pale golden bands one scale wide and 2-4 scales apart. Predominance of blue-brown decreases with age, it being superseded by golden brown. Blue-brown recedes to tips of scales and persists longest on the back where it sometimes remains in subadults as several longitudinal rows of spots.

Variation

All specimens display some division of head shields. Most variable are the prefrontals; their number and orientation are related to variation in frontal length. When the frontal is not unduly prolonged forwards, the two prefrontals are roughly rectangular and in broad contact. With increasing frontal length the prefrontals become long and narrow, obliquely orientated and only in short contact. A high prefrontal obliquity can be attained before the elongate anterior corner of the frontal is split off to form a median shield. In extreme cases of frontal elongation not only a median shield is formed but the elongate prefrontals each divide transversely to form 4 prefrontals (or occasionally 3 when only one side divides). (See M.A. Smith 1926: 20 fig. 10.)

Upper labials, especially the anterior ones, are prone to horizontal division, usually the first 3, sometimes 2 or 4 (once 5) divided. Ten

upper labials occur occasionally, mainly because of vertical division of the basal portion of the horizontally divided sixth labial. Eight labials occur when the first and second labials fuse. With one exception (count of 22) subcaudal range is 25-34.

Distribution

From Torres Strait south in the Gulf of Carpentaria to Weipa and on the Australian East Coast to about Brisbane, occasionally wandering as far south as Kiama, New South Wales and on the Western Australian coast from Broome south to Exmouth Gulf.

Material examined

New South Wales: AM 7118 (Kiama). *Queensland:* QM J3773 (Woody Point); QM J3310 and QM J3335 (Moreton Bay); QM J4675 (Caloundra); QM J4359 (35 miles east of Mooloolah Heads); QM J8734 (Pialba); AM R15089 (Heron Island); AM R19137, AM R21450-51, R21453-55 (Swain Reefs); AM 7740 (Port Denison); AM 6804 (Cleveland Bay); AM R18254, WAM R14151 and R23635 (Weipa). *Western Australia:* (unless otherwise stated WAM material) R14136, 949 and MCZ 29786 (Broome); R14207 (Roebuck Bay); R14505 and R14366 (Dampier Archipelago); R22384-85 (Locker Island, off Onslow); R27206 (Onslow area); R26414 (Exmouth Gulf).

Aipysurus laevis pooleorum subsp. nov.

Holotype

R21366 in Western Australian Museum. An adult male collected by Messrs W. and W. Poole in September 1963 at Shark Bay, Western Australia.

Paratypes

WAM R11140-41, R21364-65, R22419, R25608 (Shark Bay), R21367 (presumably Trigg, near Perth).

Diagnosis

Distinguishable from the nominate race by its darker colour and smaller size and by males having tuberculate dorsals and ventrals.

Description

Maximum length: males 943 mm, females 1140 mm. Maximum girth: males 112 mm, females 185 mm. Head shields susceptible to variation as nominate race, although extremes of prefrontals-frontal fragmentation are not present.

Rostral wider than high. Nasals entire, separated from 1 or 2 preoculars by a loreal. Postoculars 2 or 3. Prefrontals 2, showing only a low degree of intrusion by the frontal. Frontal entire in 5 (out of 8) specimens. Parietals divided. Anterior temporals usually 3. Upper labials 8-10 (mostly 9), usually the first 3 horizontally divided, usually fourth to sixth entering the orbit. Lower labials 8 or 9. Usually both pairs of chin shields prominent, posterior pair separated by one or more small scales.

Dorsal and ventral scales tuberculate in males, tubercles most pronounced on rows closest to ventrals.

Ventrals: 146-159. Subcaudals: males 30-33, females 25-28.

Females dark purplish-brown, flanks with fairly regular oblique pale bars on flanks, most pronounced posteriorly. Males generally brownish on back, merging with paler brown of flanks.

Distribution

Mid-west coast of Western Australia at Shark Bay.

Variation

Two specimens have the frontal unequally transversely divided; in another it is divided into 5. In one specimen the third to fifth labials enter the orbit.

Remarks

Named after the Poole brothers, professional fishermen who have collected many sea snakes in Shark Bay including the holotype and most of the paratypes of this subspecies.

DISCUSSION

Concerning the type of *A. laevis* M.A. Smith (1926: 20) writes 'the specimen is now lost and, except for Lacépède's brief description and the crude figure which accompanies it, there is no record to tell us what it really was'. On the contrary I consider the following information from the original description sufficient to identify Lacépède's snake.

- (i) The head is flattened and covered with 13 shields of which the 7 first from the direction of the snout form 2 rows of 2 pieces and a row of 3 and of which the eighth is surrounded by 5 other pieces disposed like the petals of a rose. [The 2 rows of 2 probably refer to the nasals and prefrontals; the row of 3 to the supraoculars and frontal; the eighth with 5 pieces disposed around it to the divided parietals.]
- (ii) 151 ventrals
- (iii) 28 subcaudals
- (iv) length at least 1290 mm
- (v) dorsals 'en losange'.

Four of the seven species of *Aipysurus* have either ventral or subcaudal counts (or both) inconsistent with the original description. They are: *A. tenuis* (ventrals 187-192, subcaudals 37); *A. fuscus* (v 156-172, s 24-37); *A. apraefrontalis* (v 144-160, s 19-25); and *A. duboisii* (v 154-181, s 25-30).

A. apraefrontalis, *A. duboisii* and *A. fuscus* have additional inconsistencies. The nature of the dorsal scales of *apraefrontalis* is not consistent with (v) above. The character of the head shields of *duboisii* (which with the exception of the rostral and nasals are entirely fragmented) makes a head shield count of 13 impossible. *A. fuscus* has not been recorded from the Australian coast; moreover its length does not exceed 720 mm.

Similarly *A. foliosquama* has not been recorded from the Australian coast

and barely attains half the length of Lacepede's snake. The nature of its dorsal scales also eliminates it from consideration.

A. eydouxi is a relatively small species (up to 950 mm); parietals are always entire, which allows a count (using Lacépède's method) of only 9 head shields. *A. laevis* (*sensu* Günther and others) is thus the only species of *Aipysurus* consistent with all data in the original description.

The type of *A. laevis* was collected by the Baudin Expedition in 'New Holland'. The only part of the Australian coast explored by the Baudin Expedition which encompasses the range of *A. laevis* is that between Shark Bay and Broome. As two subspecies of *A. laevis* occur in these seas the question arises which is the nominate. There are really too few data for identifying Lacépède's snake to subspecies, but in view of its length it almost certainly belonged to the northern. However, to put the matter beyond argument I select a northern specimen as neotype of *A. laevis*, viz. WAM R22384 an adult female collected by J. Seabrook on 2 August 1963 near Locker Island, off Onslow [in Lat. 21° 44' S, Long. 114° 46' E], Western Australia.

Aipysurus duboisii Bavay

Reference

M.A. Smith (1926: 21)

Diagnosis

Distinguished by the fragmentation of the head shields (with exception of rostral and nasals) into small, irregular tuberculate scales.

Description

A moderately large snake, the largest specimen being 1036 mm.

Rostral wider than high. Upper labials 9, only the first entire, remainder horizontally divided, fifth to seventh entering orbit. Lower labials 8 or 9, the first excluded from the oral margin. No chin shields prominent.

Midbody scale rows 19; scales smooth, imbricate. Ventrals 181, subcaudals 15.

Ground colour creamy brown with 24 blue grey bands on the body, confluent on the back, tapering rapidly to a point on the flanks. Head dark brown.

Distribution (Western Australia)

Known from a single female collected in Exmouth Gulf.

Remarks

M.A. Smith's series comprised only males. He records ventrals 154-163; subcaudals 27-30. I have examined two females and a male (extralimital material). The females have ventral counts of 169 and 175, subcaudals 25 and 27.

Material examined

WAM R26416 (Exmouth Gulf); AM 8641 (McCulloch Reef, Great Barrier Reef); AM R20779 (Chesterfield Reef, Coral Sea); AM 6723 (Australia).

Aipysurus apraefrontalis Smith

Reference

M.A. Smith (1926: 24)

Diagnosis

Prefrontals absent.

Description

A moderately large snake, the largest specimen being 1083 mm. Head extremely small. Head shields entire, symmetrical.

Rostral wider than high. Nasal in contact with the preocular, supraoculars and frontal. Preocular single, much longer than deep; postoculars 2, the lower fused with the sixth or seventh upper labial. Lower labials 6 or 7.

Midbody scale rows 17; scales smooth, strongly imbricate. Ventrals 150-160. Subcaudals 18-22.

Ground colour creamy with 24-27 bluish brown bars on the back which taper rapidly to a point on the flanks. Head brown.

Distribution

North-west coast of Western Australia from Broome south-west to Exmouth Gulf.

Remarks

Head figured by M.A. Smith (1926: 25, fig. 13).

Material examined

WAM R26716 (Broome); R22961 (Roebourne); R26415, R41261 (Exmouth Gulf).

Aipysurus tenuis Lönnberg and Andersson

Diagnosis

Ventral and subcaudal counts high (187-192 and 37 respectively).

Description

A moderately large species (up to 1020 mm) resembling *A. laevis* but much more slender, especially anteriorly.

Rostral much wider than high. One preocular, postoculars 2. Frontal partly divided. Upper labials 7 or 8, often horizontally divided, especially anteriorly. Parietals irregularly divided. 2 or 3 small anterior temporals.

Scale rows 19, all scales smooth and imbricate in the female; the outer three or four rows with a small tubercle in the male. Ventrals with a series of small tubercles along the free margin. Ventrals 187-192; subcaudals 37.

Light brown with dark brown spots on tips of scales forming longitudinal lines on the back and more or less distinct cross bars on sides. Belly almost unspotted. Head above dark brown.

Distribution

Known only from the type locality (Cape Jaubert, south of Broome,

Western Australia).

Remarks

The above description is based on the original (Lönnberg and Andersson 1913: 13) and M.A. Smith (1926: 18).

Aipysurus eydouxii (Gray)

Reference

M.A. Smith (1926: 14).

Diagnosis

The presence of prefrontals distinguishes this sea snake from *A. aprae-frontalis* (the only other *Aipysurus* with 17 scale rows).

Description

A relatively small *Aipysurus* (up to 950 mm). Head shields symmetrical and entire.

Rostral slightly wider than high. Nasal in contact with the single preocular. Postoculars 2. Frontal 1-1.3 times as long as wide, and as wide as or slightly wider than the supraoculars which are entire. Upper labials 6, the fourth under the eye; lower labials 6. Anterior temporals 1, 2 or 3 (mostly 2).

Scales in 17 weakly imbricate rows at midbody. Ventrals 139-150, subcaudals 27-33 (males 32 and 33, females 27-30).

Ground colour brownish yellow to golden brown with a dorsal pattern of ill defined greyish or brownish bars, most conspicuous on the flanks, tending to break up on the back. Scales on the back and those of lateral bars dark edged.

Distribution (Western Australia)

North-west coast of Barrow Island and (?) Broome.

Remarks

The above description is based on 7 specimens from Queensland and 1 from Western Australia.

Specimen WAM R14118 is unique in having: 164 ventrals; 33 subcaudals; the fourth and fifth upper labials entering the orbit; each parietal divided into 2; the prefrontals very small and triangular, their apices meeting the anterior point of the frontal and the median suture of the nasals at a common point. The high ventral and subcaudal counts and the divided parietals suggest that this specimen could be referred to *A. fuscus*. However, the chance that other characters it possesses (17 scale rows; 6 upper labials and a banded body pattern) which are all rare in *A. fuscus* should coincide in one specimen is very unlikely; consequently I refer it tentatively to *A. eydouxii*.

The specimen MCZ 29786 referred to *eydouxii* by Loveridge is in fact *A. laevis laevis*.

Material examined

Queensland: QM J4681 (Sandgate); AM 6703 and 8301 (Port Denison); AM R17623 (Weipa); WAM R23624 (Gulf of Carpentaria); QM J2001

(Queensland); AM 13805 (North Australian coast). Western Australia: WAM R14118 (Broome); R28496 (Barrow Island).

Genus *Hydrophis* Latreille

Reference

M.A. Smith (1926: 40).

Four species of *Hydrophis* occur in Western Australian waters. They are moderate to large in size.

Head shields symmetrical and entire; second upper labials in contact with the preocular; a short cleft runs from the nostril to second labial. Ventrals 197-401, at most twice as wide as adjacent dorsals. Scale rows at widest part of body 33-57, the scales juxtaposed to weakly imbricate.

Owing to the similarities of the following four species a combination of characters is required to separate them. One of the most useful characters is colour pattern; the younger the specimen the better the definition. Age decreases the contrast between ground colour and dorsal pattern, reducing its reliability as a character.

Hydrophis ocellatus Gray

Reference

M.A. Smith (1926: 84).

Diagnosis

Distinguished from the other species of *Hydrophis* by its high number of scale rows (47-57).

Description

A moderately large snake (to 1262 mm), slender anteriorly. Canthus rostralis may or may not be prominent.

Rostral wider than high. Nasals less than twice as wide as rostral. Nostril pierced closer to the posterior border than the lateral border of the nasals. One preocular; 2 postoculars (once 3). Temporals: 1 or 2 anterior, sometimes one large posterior. Upper labials 6, 7 or 8, third and fourth entering orbit. First 4 or 5 lower labials much deeper than long, remainder gradually decreasing in size backwards. Anterior pair of chin shields only partly divided by the first pair of lower labials; posterior pair usually just in contact by small scales.

Nuchals 33-37; scale rows at widest point of body 47-57 (increase 14-24); scales juxtaposed, hexagonal and with a short keel. Ventrals 290-340, each with a pair of short keels.

Olivaceous, grey or whitish with a series of ovals or broad bars (never bands) on the back and scattered spots on the flanks. Some specimens with narrow dark bars anteriorly, 1 or 2 scales wide and 3 or 4 scales apart.

Distribution

North-west coast of Western Australia from 65 miles west of Dampier south-west to Exmouth Gulf, straggling to lower west coast south as far as Busselton.

Material examined

WAM R36669-72 (65 miles west of Dampier), R26523 (Exmouth Gulf), R13554 (Rottnest Island), R9578 (Busselton).

Hydrophis major (Shaw)

Reference

M.A. Smith (1926: 70).

Diagnosis

Distinguished from other species of *Hydrophis* by having not more than 255 ventrals.

Description

A robust snake of fairly uniform thickness throughout body. Head short and thick; canthus rostralis always prominent. Grows to 1094 mm. (M.A. Smith records 1710 mm).

Rostral as wide as, or slightly wider than high. Nasals not less than twice as wide as rostral. Nostril pierced closer to the posterior border than the lateral border of the nasal. Preocular 1; postoculars 2 (rarely 1). Anterior temporals usually 2. Upper labials 7 or 8, third and fourth entering orbit. First 3 lower labials deep, the first partly or almost separating the well developed anterior chin shields. Remaining lower labials small and of equal size. Posterior pair of chin shields usually poorly developed. Nuchals in 31-36 rows. Scales around thickest part of body in 33-41 rows (increase 2-10) weakly imbricate and keeled. Ventrals 197-255, each with a pair of keels.

Ground colour yellowish or white with 24-30 blackish dorsal bars (never bands). Interspaces between bars with a very narrow bar. There is a spot on the flanks at either end of each narrow bar. Ventrals usually edged with black. Head yellowish with darker markings.

Distribution

North-west and upper west coasts of Western Australia from Broome south to Shark Bay, straggling to lower south coast.

Material examined

WAM R37220-27 (Koks Island, 20 miles NW of Carnarvon); R11304 (Bernier Island), R26827 (Dorre Island); R12485, R13469 (Dirk Hartog Island); R13869-70, R20576, R21360-63, R22424, R22606-07, R22627, R25603-04, R25874, R26863-64, R27207-08 (Shark Bay), R22295, R22039-40, R24016 (Carnarvon), R40559-60 (off Carnarvon); R4962 (Bunbury).

Hydrophis kingii Boulenger

Reference

M.A. Smith (1926: 46).

Diagnosis

Distinguished from other species of *Hydrophis* by its black head with a white orbital ring.

Description

Body long, slender anteriorly. Head small, elongate; canthus rostralis weak or absent. Grows to 1630 mm.

Rostral as wide as, or slightly wider than high. Nasals never as much as twice as wide as rostral. Nostril pierced closer to the posterior than the lateral border of the nasals. Preocular 1, postoculars 2 (once 3). Temporals: 1 anterior, 2 posterior. Upper labials 7 or 8, third and fourth entering orbit. First 2 or 3 lower labials large, remainder small. Two pairs of chin shields, prominent, in contact medially.

Nuchals 22-29; scales at thickest part of body 34-39 (increase 12-17), the scales keeled and imbricate mid-dorsally to smooth and weakly imbricate on flanks. Ventrals 299-337.

Ground colour yellowish with a light grey back, becoming darker posteriorly. 45-46 darker grey bars, more or less oval anteriorly, becoming truncate posteriorly. No narrow dark bars in the interspaces. Ventrals black. Head with a narrow white bar separating the black of the head from the first dorsal bar; white orbital ring present.

Distribution

North-west coast of Western Australia and (?) Barrow Island, straggling to lower south-west coast.

Material examined

WAM 17 (Cape Jaubert), R29170 (? near Barrow Island); R23830 (Safety Bay).

Hydrophis elegans (Gray)

Reference

M.A. Smith (1926: 54).

Diagnosis

Distinguished from other species of *Hydrophis* by its high ventral count (354-401) and its colour pattern which consists of black bands, constricted on sides (of thinner parts of body) and bars on back and belly where the bands have been broken (thicker parts of body). No white orbital ring.

Description

Body long, slender anteriorly. Head small, elongate. Canthus rostralis never prominent. Grows to approximately 1525 mm (M.A. Smith records 2240 mm).

Rostral as wide as high. Nasals less than twice width of rostral. Nostril almost touching posterior and lateral borders of nasal. Preocular 1; postoculars 2 (rarely 1). One large anterior temporal. Upper labials 6 or 7, third and fourth entering orbit. First two or three labials deep, remainder small. Two pairs of chin shields prominent; anterior pair the longest, always in broad contact; posterior pair always separated by a small scale.

Nuchals in 25-30 rows. Scales around thickest part of body in 35-45 rows (increase 10-20); weakly imbricate, smooth or with a short keel. Ventrals smooth, 354-401 (? 314), slightly wider than adjacent dorsals. 39-44 blackish dorsal bars or bands, the bands tending to be constricted on flanks and confined to tail and thinner parts of body. Bands which have been broken at constriction form a dorsal and ventral bar. These bars are confined to thicker parts of body. Interspaces between bars and bands on back have a row of small black dots, while on flanks there is a small black spot. Ventrals with a dark longitudinal line (most pronounced in juveniles). Head blackish in juveniles, grey or olivaceous in adults.

Distribution

North-west and upper west coasts of Western Australia from King Sound south to Shark Bay, straggling to lower west coast.

Material examined

WAM R13839 (Telegraph Pool, Fitzroy River); R37218-19 (Koks Island, 20 miles NW of Carnarvon); R12453 (Dirk Hartog Island); R37228, R40555-58 (off Carnarvon); R1940-41 (Carnarvon), R24841 (10 miles west of Kalbarri); R8197, R8577 (Perth metropolitan beaches); R17323 (Safety Bay); R14165, R19121 (Mandurah); R11464, R7437 (Geographe Bay).

Genus *Acalyptophis* Boulenger

Reference

M.A. Smith (1926: 101).

Acalyptophis peronii (Dumeril)

Reference

M.A. Smith (1926: 102).

Diagnosis

Distinguishable from other sea snakes whose ventrals are only slightly wider than adjacent dorsals by nasal being in contact with preocular.

Description

A large species (up to 1230 mm); slender anteriorly and with a small head, the shields of which are spinose owing to their posterior borders being raised and pointed, a condition which becomes more pronounced with age.

Rostral wider than high. Nasals not entire, in contact with single preocular. Postoculars 3. No temporals distinguishable. Upper labials 6 or 7, second to

fourth entering orbit. Lower labials 9 and 10, the first 4 in contact with two pairs of chin shields.

Scale rows at widest part of body 27-28, the scales subimbricate, keeled and wider than long posteriorly. Ventrals 142-203.

Colour varies from drab grey on back and whitish on flanks and belly to a pale cream with darker cross bars tapering to a point on the flanks.

Distribution

North-west coast of Western Australia from Broome south-west to Barrow Island.

Remarks

Head figured by Smith (1926: 103 fig. 29).

Material examined

WAM R20360 (Broome); R16c (Cape Jaubert); R29585 (Barrow Island).

Genus *Astrotia* Fischer

Reference

M.A. Smith (1926: 113).

Astrotia stokesii (Gray)

Reference

M.A. Smith (1926: 113).

Diagnosis

The strongly imbricate, bifurcate ventrals distinguish this sea snake from all others.

Description

A massive snake. A specimen in the WAM collection is about 1500 mm long and 262 mm in girth. Head shields symmetrical, entire.

Rostral slightly wider than high. A short cleft running from nostril to second labial. Preocular 1; postoculars 2. Frontal about 1.5 times as long as wide and twice as wide as the supraoculars. Anterior temporals 2. Labials often horizontally and vertically divided. Upper labials 10 or 11, third to fifth entering orbit. Lower labials 12 or 13, a sharp decrease in size after second or third. No chin shields prominent.

Midbody scale rows 54-60, scales strongly imbricate. Ventrals 252-280, all but a few anterior ones bifurcate.

Ground colour yellowish or pale brown with large black or darker brown bars (sometimes almost ovals) between which there are narrower bars. Head black or dark brown. The dorsal pattern of the Exmouth Gulf specimen is almost obliterated, being a fairly uniform greyish green.

Distribution

North-west coast of Western Australia from Point Coulomb south-west to Exmouth Gulf.

Material examined

WAM R40281 (Point Coulomb); 10705, R21359 (Port Hedland); R26524 (Exmouth Gulf).

Genus *Hydrelaps* Boulenger

Reference

M.A. Smith (1926: 30).

Hydrelaps darwiniensis Boulenger

Reference

M.A. Smith (1926: 30).

Diagnosis

Distinguished from all other sea snakes by the absence of preocular.

Description

A small snake (up to 525 mm) of fairly uniform thickness throughout body. Head moderately large; head shields entire, symmetrical, no canthus rostralis. Tail slightly downcurved.

Rostral as wide as, or slightly wider than high, and as wide as, or slightly wider than frontal, which is as long as, to twice as long as, wide (mostly as long as, or slightly longer than wide). Supraocular as wide as, to half as wide as, frontal. One postocular, Temporals: 1 anterior, 1 or 2 posterior. Upper labials 6 (5 once on one side), third and fourth entering orbit; lower labials mostly 7 (sometimes 6), the fourth the largest. Two pairs of chin shields prominent, in contact; posterior pair the longer.

Midbody scale rows 25 or 26 (mostly 25), the scales smooth; rows on lower flanks juxtaposed; remainder of dorsals imbricate. Ventrals 160-179; twice as wide as adjacent dorsals. Subcaudals 20-36 (males 29-36, females 20-29).

Ground colour light grey or yellowish with 35-44 (occasionally confluent) bands on body, widest on back where they may enclose a pale spot and (sometimes) be widened on the belly; the adjoining ventrals on either side of each band blackened so that the majority of ventrals appear black. Head bluish grey.

Distribution

Kimberley and north-west coasts of Western Australia from Cambridge Gulf south-west to Cossack.

Material examined

WAM R11176 (Forrest River Mission); R13679, R19990 (Derby); R14119, R14206, R28115, R22346, R31205 (Broome).

Ephalophis greyi M.A. Smith

Diagnosis

Distinguished from *Aipysurus duboisii* (the other species of sea snake with 19 scale rows and broad ventrals) by its smooth symmetrical head shields and from *Hydrelaps darwiniensis* (the other small, greyish dark banded species) by presence of a preocular.

Description

A small sea snake (up to 661 mm). Body slightly tenuous anteriorly. Head small, canthus rostralis discernible but not prominent. Tail downcurved.

Rostral as wide as, or slightly wider than the frontal, which is 1.5 to 2 times as long as wide, and always wider than a supraocular. Preocular 1; postocular 1. Temporals: 1 anterior and 2 posterior (3 on one side once). Upper labials 6, second in contact with preocular, third and fourth entering orbit. Lower labials 7 (once 6), the fourth largest. Two pairs of chin shields prominent, in contact, posterior pair (the longer) almost separated by a small scale.

Midbody scale rows 19 (once 21), scales on the lower 4-6 rows on the flanks hexagonal, juxtaposed and smooth. Remaining dorsals imbricate, bluntly keeled, often with darker edgings. Ventrals 151-184 at midbody, at least 3 times as wide as adjacent dorsals; narrower anteriorly. Subcaudals 24-33 (males 27-33, females 24-27).

Ground colour of adults grey with 27-30 dark grey to black incomplete bands (broken at ventrals), widest on back, their boundaries sometimes indistinct, and often confluent, and forming a zig-zag pattern down the back. In some specimens bands are faded mid-laterally leaving a dorsal bar and a spot on the lower flanks.

Ground colour of juveniles almost white or light grey with dark bands much more conspicuous. Ventrals light grey. Subadults with head mottled light and dark grey, the light grey remaining as a pale mark on posterior edge of upper and lower labials.

Distribution

North-west and upper west coasts of Western Australia from King Sound south to Carnarvon.

Remarks

Figured by Smith 1931: 399. It inhabits mangrove creeks where it moves in and out with the tide searching crab holes for food.

The specimen MCZ 29788 referred to *Lapemis hardwickii* by Loveridge (1934: 295) is in fact *Ephalophis greyi*.

Material examined

WAM R3771 (Derby); R8820, R29158, R31203 (Broome); R28114, R36715 (La Grange); R2136 ('New De Grey Station'); R13658-59 (Cossack);

R25668(Point Samson); R29582-84 (King Bay, 20° 38' S, 116° 45' E); R5043 (50 miles from Exmouth Gulf), R32024 (Carnarvon).

Genus *Pelamis* (Daudin)
See Smith (1926: 116)

Pelamis platurus (Linnaeus)
See Smith (1926: 116)

Diagnosis

The yellow belly which is sharply defined from the bluish black back by a straight line distinguishes this sea snake from all others.

Description

A relatively small snake from 473-815 mm.

Rostral as wide as high. Preoculars 1 (rarely 2), postoculars 2 (rarely 3). Upper labials usually 7 (sometimes 8, once 6), the fourth and fifth usually separated from the orbit by suboculars. Lower labials 10 or 11, the first 5 usually large. Anterior pair of chin shields usually prominent.

Midbody scale rows 48-69; ventrals 240-375. hardly distinguishable from from adjacent dorsals, often bifurcated.

Distribution

Lower west coast of Western Australia from Dongara south to Busselton.

Remarks

This is the sea snake most commonly found derelict on south-west beaches; 87% of specimens examined were collected on Perth metropolitan beaches in June, July, August and September, usually after heavy winter storms.

Smith (1926: 118) lists 7 colour varieties. Western Australian specimens with one exception belong to colour varieties 1 and 2, that is, they are black above, yellow below (var. 1) or black above, brown below with an intervening stripe of yellow (var. 2). The yellow stripe is often indistinct. The tail is usually lighter yellow than the belly, and spotted or barred with black.

The colour pattern of the specimen from Dongara is unique. It fits Smith's description of var. 6 except that the anterior half is immaculate pale yellow.

Material examined

WAM R29609 (Dongara); R21574 (Ledge Point); 38 specimens from Perth metropolitan beaches (Waterman Bay to Shoalwater Bay); R15363, R779 (Rottnest Island); R15815 (Garden Island); R1147, R14168 (Mandurah); R10351, R20575 (Bunbury); R1965 (Wonnerup); R10282, R22682, R150 (Busselton).

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I am grateful to Benjamin Shreve, Research Associate in Herpetology, Museum of Comparative Zoology for examining specimen MCZ 29788 for me. It is *Ephalophis greyi* and not *Lapemis hardwickii*.

I am grateful to Dr G.M. Storr, Western Australian Museum for his criticism of the manuscript.

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THE GENUS *NOTOSCINCUS* (LACERTILIA, SCINCIDAE) IN WESTERN AUSTRALIA AND NORTHERN TERRITORY

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ABSTRACT

The genus *Notoscincus* comprises a single species which is divisible into two weak subspecies, *N. ornatus ornatus* (Broom) and *N. ornatus wotjulum* (Glauert).

INTRODUCTION

Superficial resemblances between *Notoscincus ornatus ornatus* and species of the *Ctenotus schomburgkii* group led me to suspect that *ornatus* was really a small *Ctenotus* which had evolved an ablepharic eye (as had the smaller species of *Lerista*). I therefore began with *ornatus* in my current revision of the *Ctenotus* of the Kimberley and North-West Divisions but soon discovered that it was far too divergent to be included in that genus.

All the material used in this study is lodged in the Western Australian Museum.

Genus *Notoscincus*

Notoscincus Fuhn (1969: 72). Type-species (by original designation): *Ablepharus ornatus* Broom and *Ablepharus wotjulum* Glauert.

Very small, smooth, terrestrial, pentadactyl skinks with lower eyelid immovable and bearing a large circular transparent disc completely surrounded by granules; no supranasal or postnasal; prefrontals large, one overlapping the other (resulting in a long oblique 'suture' between them); frontal very wide; frontoparietals fused; interparietal large; supraoculars 3, first as large as others combined, broadly in contact with frontal and frontoparietal; supraciliaries mostly 5 or 6, decreasing in height backwards, first in contact with frontal; upper labials 6, fourth subocular and much the widest; ear aperture smaller than palpebral disc, longer axis orientated upwards and slightly backwards, with 0.3 (usually 2) very small and obtuse lobules on anterior margin, uppermost usually largest; laterally expanded nuchals 0.8 (mostly 3) on each side; subdigital lamellae divided.

One species, patchily distributed in rocky, less humid parts of northern Australia.

Notoscincus ornatus ornatus

Ablepharus ornatus Broom, 1896, Ann. Mag. Nat. Hist. (6) 18: 343.
Muldiva, North Queensland (R. Broom).

Diagnosis

Distinguishable from *N. o. wotjulum* by its brown upper lateral stripe broken into a series of rectangular spots, and by paler, more heavily spotted back.

Distribution

Pilbara region of Western Australia and arid interior of Northern Territory. Extralimital in Queensland (semi-arid southern interior of Cape York Peninsula).

Description (characters additional to those listed under genus)

Snout-vent length (mm): 19-39 (N=17, mean 31.5). Length of appendages (% SVL): foreleg 25-30 (N=11, mean 27.7), hindleg 37-49 (N=13, mean 40.8); tail 130-177 (N=4, mean 163).

Nasals separated. Supraciliaries usually 6, occasionally 5, rarely 7. Mid-body scale rows 26-30 (N=13, mean 28.0). Lamellae under fourth toe 20-25 (N=10, mean 22.6).

Dorsally pale bronzy brown, becoming reddish on tail, usually with three longitudinal series of dark brown dots or short dashes on back. Upper lateral zone comprising a series of alternating brown and whitish rectangular spots. Whitish midlateral stripe extending forward to upper lip and back to middle of tail or further, margined above and below by a brown line. Legs pale brown irregularly spotted with dark brown.

Remarks

Depuch Island specimens were misidentified by Storr (1962) as '*Sphenomorphus ocellatus*', and Barrow Island specimens were listed by Butler (1970) under '*Ctenotus wotjulum*'

Material

North-West Division (W.A.): Depuch Island (14552, 14557); Barrow Island (27994-5, 29033-4, 45636-44); Cockeraga River, Chichester Range (39052).

Northern Territory: Hurst Creek, 10 km S of Wauchope (34638).

Notoscincus ornatus wotjulum

Ablepharus wotjulum Glauert, 1959, West. Aust. Nat. 6: 192. Wotjulum Mission, Yampi Sound, Western Australia (K.G. Buller and A.M. Douglas).

Diagnosis

Distinguishable from *N. o. ornatus* by broad unbroken blackish upper lateral stripe, and darker, less spotted back; also slightly smaller with relatively shorter legs and tail, and fewer subdigital lamellae.

Distribution

Far north of Western Australia south to Yampi Sound, the King Leopold

Range and Lake Argyle, and far north of Northern Territory (Arnhem Land plateau).

Description (characters additional to those listed under genus)

Snout-vent length (mm): 17-36 (N=20, mean 28.7). Length of appendages (% SVL): foreleg 21-30 (N=19, mean 25.3), hindleg 28-43 (N=18, mean 36.8), tail 122-158 (N=6, mean 149).

Nasals narrowly separated (in short contact in one specimen). Supraciliaries 5 or 6. Midbody scale rows 25-30 (N=10, mean 28.2). Lamellae under fourth toe 17-24 (N= 14, mean 20.6).

Dorsally olive grey (one specimen with a vertebral series of dark spots). Broad blackish brown upper lateral stripe extending forward to lores and back on to tail (on which it breaks up into a series of spots), usually margined above by a white dorsolateral line. Whitish midlateral stripe. Lower lateral zone dark brown, markings tending to form 2-4 longitudinal lines.

Remarks

It is not yet certain whether recognition of *N. o. wotjulum* is justifiable. The two specimens (27996 and 42793) from the Ord drainage, significantly the driest part of the subspecies' range, approach the nominate subspecies in having the dark upper lateral stripe broken by a series of small pale spots. On the other hand our single specimen (39052) of *N. o. ornatus* from the Pilbara



Map of Western Australia and Northern Territory showing location of specimens of *Notoscincus ornatus ornatus* and *Notoscincus ornatus wotjulum*.

mainland has the upper lateral zone (but not the back) precisely as in *N.o. wotjulum*. Thus the differences between the two subspecies are partly bridged by individual or regional variants. Moreover each isolated population of both subspecies seems to have characters of its own, e.g. low subdigital lamellar counts at Oenpelli and wide separation of brown upper lateral spots at Wauchope.

Material

Kimberley Division (W.A.): Sir Graham Moore Island (44068); Kalumburu (28000); South-west Osborne Island (41499); Crystal Creek, Admiralty Gulf (43108); Amax Camp, Mitchell Plateau (44264-5); Katers Island (41473-5); Wollaston Island (41467); Bigge Island (41441); Boongaree Island (44092); Augustus Island (41295); Wotjulum (11129, 11799-800); Inglis Gap (27999); Parry Creek (27996); Hicks Creek (right-bank tributary of the Ord) (42793).

Northern Territory: 8 km SE of Oenpelli (37171-2).

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HALOPHRYNE OCELLATUS, A NEW SPECIES OF FROGFISH (BATRACHOIDIDAE) FROM WESTERN AUSTRALIA

J.B. HUTCHINS

[Received 12 August 1974. Accepted 4 September 1974]

ABSTRACT

A new species of frogfish, *Halophryne ocellatus*, is described from Western Australia. It differs from the only other known species in the genus, *H. diemensis*, by a combination of characters which include an ocellated colour pattern, absence of skin ridges on the anterior part of the body and enlarged pores on the head.

INTRODUCTION

Gill (1863) introduced the batrachoidid genus *Halophryne* to accommodate a single species, *H. diemensis*. This species is represented in the Western Australian Museum, Perth (abbreviated WAM in subsequent text) by numerous specimens from Western Australia. This paper describes a second species of *Halophryne*, *H. ocellatus*, which is easily recognised by its colour pattern.

The type series (holotype and 21 paratypes) of *H. ocellatus* is deposited at WAM. In addition, 36 specimens (44 — 218 mm standard length) of *H. diemensis* at WAM were examined. Measurements of the holotype and paratypes were made with a needle-point dial caliper to the nearest millimetre. Where the last 2 rays of the soft dorsal and anal fins are joined at their bases, they are counted as a single ray. The lateral line count is the number of tentacles in a continuous longitudinal line from the large open pore above the base of the uppermost opercular spine to below the last dorsal ray. The peculiar morphology of batrachoidid fishes necessitates the following definitions:

Head length — from the anteriormost point of the upper jaw to a point on the nape in line with both upper ends of the gill openings;

Body depth — vertical distance from the origin of the soft dorsal fin to the abdomen;

Snout length — from the anteriormost point of the upper jaw to the mid-point of a line joining the front borders of the eyes;

Eye diameter — horizontal diameter of bony orbit;

Interorbital width — least width of bony interorbital.

Halophryne ocellatus sp. nov.

Figs 1, 2a and 3a; Table 1

Holotype

WAM P5956, 190 mm standard length (SL), female, collected in the Easter Group, Houtman Abrolhos, Western Australia, at 80 metres in craypot, P. McMillan, 16 May 1963.

Table 1. Measurements in mm and fin ray counts of selected type specimens of *H. ocellatus*.

	P5956	P24829	P6164	P14833	P13767	P14702	P6287	P7148	P24830
Total length	226	283	215	155	121	107	84	59	30
Standard length	190	213	173	124	98	79	65	47	23
Head length	65	76	55	43	34	30	24	17	9
Snout length	13	15	11	8	5	5	4	2	1
Eye diameter	17	18	16	13	10	9	8	5	3
Interorbital width	9	12	10	7	4	4	3	2	1
Body depth	60	70	59	32	28	18	19	13	7
Soft dorsal base	99	115	96	66	52	39	32	24	12
Anal base	75	91	70	49	41	35	29	22	11
Pectoral length	45	52	43	29	24	18	18	13	7
Ventral length	47	50	38	30	24	24	19	12	8
First dorsal spine length	15	18	12	8	7	*	5	*	*
Soft dorsal fin	21	20	21	20	20	20	20	*	20
Anal fin	17	18	18	17	17	17	17	*	*
Pectoral fin	22	22	22	22	*	*	22	*	*
Sex	Female	Male	Female	Female	Female	Female	Male	Juv.	Juv.

* Some measurements and counts were not taken due to damage, distortion or extremely small size.

Paratypes

WAM P3364, 138 mm SL, Pelsart Island, Houtman Abrolhos, V. Serventy, 1950; P5851, two specimens 109 – 127 mm SL, trawled in Shark Bay, W. & W. Poole, July 1963; P5955, 102 mm SL, Shark Bay, R.J. McKay, 1960; P6149, 136 mm SL, Dirk Hartog Island, at 60 metres in craypot, LFB *Saturn*, 6 March 1957; P6260, 130 mm SL, Shark Bay, R.J. McKay, 1960; P7148, 47 mm SL, Dampier Archipelago, R.D. Royce, 27 May 1960; P9393-4, 43-45 mm SL, Exmouth Gulf, R.J. McKay, no other data; P12073, 38 mm SL, Exmouth Gulf, R.J. McKay, 1960; P13767-9, 75-98 mm SL, Shark Bay, R.J. McKay, 1962; P14653, 101 mm SL, Shark Bay, R.J. McKay, 2 June 1962; P14833, 124 mm SL, trawled in Shark Bay, A. McKenzie, August 1965; P16296, 102 mm SL, trawled in Exmouth Gulf, D. Bathgate, 1967-68; P16483, 88 mm SL, Fisheries Dept. Broome, 1961; P23604, 99 mm SL, dredged off Carnarvon in 26 metres, D. Heald, 19 July 1972; P24562, 101 mm SL, prawn trawl off Onslow, G. Lang, November 1973; P24829, 231 mm SL, Kalbarri (Murchison River), R. Lilly, 5 June 1970; P24830, 23 mm SL, trawled off Carnarvon, W. & W. Poole on *Bluefin*, 1967.

Diagnosis

A species of *Halophryne* characterised by its ocellated colour pattern,

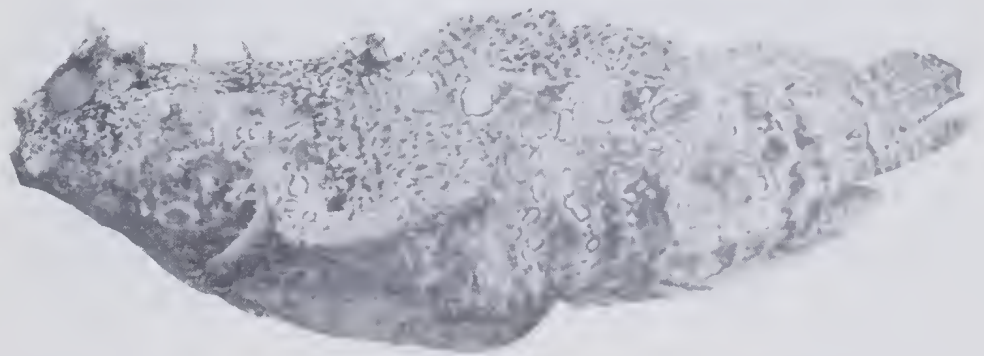


Fig. 1. *Halophryne ocellatus*, holotype, P5956, female, 190 mm SL.



Fig. 2. Skulls (dorsal view) of *Halophryne*: a, *H. ocellatus*, 152 mm SL; b, *H. diemensis*, 136 mm SL.

absence of skin ridges on the anterior part of the body and enlarged pores on the head.

Description

Measurements and counts of the holotype and selected paratypes are presented in Table 1. The counts and proportions given below are those of the holotype, with the range for the paratypes appearing in parentheses.

Dorsal rays III, 21 (III, 20-21); anal rays 17 (17-18); pectoral rays 22 (22-23); caudal rays 14 (14-15); pores in lateral line 28 (26-29).

Head 2.9 (2.6-3.1) in SL; eye 3.8 (3.0-4.2), snout 5.0 (4.9-9.0). interorbital 7.2 (5.5-10.0), pectoral 1.4 (1.3-1.5), all in head; interorbital 1.9 (1.5-3.0) in eye.

Body cylindrical, head depressed, tail compressed; snout short, rather blunt; eyes prominent, elevated; interorbital space concave; jaws equal, gape horizontal, maxilla reaching almost below centre of eye; operculum and suboperculum each with 2 prominent spines joined at their bases, the lower spine 1/2 length of upper; opercular spines about 1/3 longer than those on suboperculum, the uppermost equal to eye; gill opening a vertical slit on upper 2/3 of pectoral base (about 1/2 pectoral base in small specimens).

Skin smooth and scaleless, loosely attached to body and fins; 3 fringed tentacles above each eye (largest equal to vertical diameter of eye); similar but smaller tentacles arranged around mouth, along pre-opercular border and adjacent to opercular and subopercular spines; 3 series of bifid tentacles on sides, 4 series along occiput and a series below eye (each bifid tentacle surrounds a small sensory pore); anterior nostril tubular, projecting forward from a bulbous clump of tentacles on either side of snout tip; posterior nostril near inner front border of eye, without an elongated rim; large open pores on head joined by large underlying canals, several above upper lip, a row along lower surface of mandible and continued along border of pre-operculum, 1 anterior to each posterior nostril and 3 in a longitudinal line behind each eye.

Jaws, palate and pharyngeals with bands of sharp, cardiform teeth (villiform in small specimens); premaxilla with 2-3 series of small teeth, widening near symphysis to form 3-4 series; teeth on vomer and palatines larger and in 4-5 series, an elliptical-shaped band on each bone; mandibular teeth similar in size to those on palate, in 2-3 series expanding near symphysis forming 2 round patches; teeth on lower pharyngeals canine-like, larger than those on palate; those on upper pharyngeals separated into anterior and posterior bands, the anterior teeth small, almost villiform and posterior teeth larger, especially near symphysis; 3-5 knob-like gill rakers on lower limb of first gill arch terminating in small patches of slender, recurved teeth.

A mid-dorsal, longitudinal groove sometimes present on nape; origin of dorsal fin just behind head; spinous dorsal covered by thick skin, first spine equal to snout, second slightly longer, third spine shortest, joined to soft dorsal by a low fold of skin; rays of soft dorsal, except last 2-3, about equal in length, first ray equal to snout plus eye; rays of anal, except first 2-3 and



Fig. 3. Colour patterns of *Halophryne*: a, *H. ocellatus*, P16296, 106 mm SL; b, *H. diemensis*, P15289, 138 mm SL.

last 2-3, about equal but shorter than soft dorsal rays; pectoral and caudal rounded, equal in length; ventral fin consists of 1 hidden spine and 2 rays, the first ray much longer and fleshier, equal to pectoral.

Gas bladder of adult male large, about 3 times larger than that of female; no pore in pectoral axilla; vertebrae 10 + 18-19.

Colour in 70% ethanol

Sides and head pale brown with dark brown blotches forming 8-9 irregular transverse bars, the first across interorbital and continued below eyes sloping posteriorly across cheek, the last across caudal peduncle; sides and head with scattered white ocelli outlined by prominent dark brown margins, the largest below anterior part of dorsal fin; in large specimens the ocelli may be very numerous, merging to form blotches (see Fig. 1); small specimens may only have a few ocelli; ocelli absent on fins and ventral surface; fins with series of bars, those on dorsal and anal forming continuation of bars on side of body, angled obliquely forward; with increasing size the fin bars become

more numerous and break up into small blotches; the presence of a mucous coating imparts a yellowish brown colour.

Comparison with *Halophryne diemensis* (Lesueur) 1824

H. ocellatus is easily distinguished from *H. diemensis* by the characters indicated in the diagnosis and certain features of the skull (see Fig. 2). The interorbital region is narrower in *diemensis*, postorbital processes of the frontal more posteriorly raked and the postorbital fossae larger and of a different shape; related to the difference in pore sizes is a discrepancy in the size of grooves in the frontals (and in the mandible, supramaxilla and preoperculum); these are relatively wide in *ocellatus*, narrow in *diemensis*. There is also a difference in the premaxillary dentition; teeth of *ocellatus* occur in 2-3 series and those of *diemensis* in 1-2 series. Furthermore, bands of teeth on the vomer and palatines of *ocellatus* tend to be wider and more elliptical in shape.

The 4 prominent tentacles running across occiput, immediately behind orbital region are nearly in a straight line in *ocellatus*, but more rectangular in *diemensis*. The open pores on the head of *diemensis* are small and sometimes difficult to detect. Preserved and live specimens of *diemensis* have many longitudinal ridges of skin on the head which become thicker and usually more reticulated beneath the pectorals.

There are no white ocelli on *diemensis* and the last 2 dark body bars (when present) are always continuous medially rather than separated as in *ocellatus* (see Fig. 3). In addition, the lips of *diemensis* are always much darker.

Distribution

H. ocellatus is known only from Western Australia, from Fremantle north to Broome. It has been collected in greatest numbers from Shark Bay and only a few have been found north of Exmouth Gulf. The southernmost limit of *H. diemensis* in Western Australia is Shark Bay, its range extending across to southern Queensland and throughout the Indo-Australian Archipelago. *H. ocellatus* appears to prefer deeper waters. It has been trawled and taken by craypot in 20-80 metres, whereas *diemensis* is found intertidal as well as in deeper waters.

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I would like to express my thanks to Mr R.J. McKay, Curator of Fishes at the Queensland Museum, who suggested this study. I would also like to thank Dr G.R. Allen for helpful advice during the study, and assistance in the preparation of this paper. Finally, I would like to thank Dr R.W. George for reading the manuscript.

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AGAMID LIZARDS OF THE GENERA *CAIMANOPS*, *PHYSIGNATHUS* AND *DIPORIPHORA* IN WESTERN AUSTRALIA AND NORTHERN TERRITORY

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[Received 11 February 1974. Accepted 15 February 1974]

ABSTRACT

Caimanops gen. nov. is proposed for *Diporiphora amphiboluroides* Lucas & Frost. The following species and subspecies of *Physignathus* and *Diporiphora* are studied: *P. longirostris* (Boulenger), *P. temporalis* (Günther), *P. g. gilberti* (Gray), *P. g. centralis* Loveridge, *D. convergens* nov., *D. a. albilabris* nov., *D. a. sobria* nov., *D. b. bennettii* (Gray), *D. b. arnhemica* nov., *D. magna* nov., *D. lalliae* nov., *D. reginae* Glauert, *D. winneckei* Lucas & Frost, *D. b. bilineata* Gray, *D. b. margaretae* nov., and *D. superba* nov.

INTRODUCTION

Recent collections have made it increasingly clear that there are many more species of *Diporiphora* in the far north of Western Australia than previously believed. The main purpose of this paper is to define these additional species of *Diporiphora*. Because juvenile *Physignathus* have often been mistaken for *Diporiphora*, that genus has been included in this study, and so too has *Caimanops* gen. nov., whose single species was long placed in *Diporiphora*.

Generally Western Australian species of reptiles seldom extend further east than about longitude 140°E. Brief study of Queensland material showed that *Diporiphora* and *Physignathus* were not exceptional in this respect and that most, if not all, specimens belonged to different species or subspecies. It therefore seemed unnecessary to include the Eastern States species in this account of the Western species.

The three species of *Physignathus* and single species of *Caimanops* are strongly characterized, and their identification should present students with no problems. However, *Diporiphora*, as restricted herein, comprises a group of closely related species whose separation will undoubtedly prove difficult. Colour pattern in most species of *Diporiphora* tends to disappear at maturity. One therefore relies heavily on the dorsal scutellation and presence or absence of three folds in the region of the neck:

- (1) gular fold, which is located on the ventral surface of the neck;
- (2) scapular fold, *i.e.* the curving continuation of the gular fold upwards and backwards on to the shoulder;
- (3) postauricular fold, a straight fold behind the ear, extending upwards and slightly backwards to the dorsolateral stripe.

Post-mortem puckerings of loose skin must not be mistaken for true folds. Conversely the presence of folds must be recognized even when the skin is

not actually folded. What is to be looked for is not so much the fold itself as the potentiality for a fold. A true fold can only occur where there is sharp difference in scale size, e.g. a scapular fold is found where the granular scales about the insertion of the foreleg meet relatively large scales on the side of the neck; if the former scales grade into the latter no fold can form. A gular fold is scored as present when one or more transverse rows of granular scales separate the gulars from the pectorals. The postauricular fold at its strongest forms a pouch; at its weakest it is more of a ridge than a fold.

In the following descriptions length of appendages is expressed as percentage of body length (i.e. snout-vent length less length of head). Limbs are measured to end of longest digit exclusive of nail.

In the lists of material examined, registered numbers without prefix refer to specimens in the Western Australian Museum. All other material is prefixed with the initials of the collection, viz. SAM (South Australian Museum), NMV (National Museum of Victoria), QM (Queensland Museum), NTR (CSIRO Division of Wildlife Research, Darwin), JSE (British Joint Services Expedition to Central Australia — specimens now lodged in the British Museum), ERP (Pianka Collection — specimens now lodged in the Los Angeles County Museum of Natural History), BM (British Museum), and MCZ (Museum of Comparative Zoology). For the loan of these specimens I am grateful respectively to Dr T.F. Houston, Mr A.J. Coventry, Miss J. Covacevich, Mr J. Wombey, Lt Cdr A.Y. Norris, Dr E.R. Pianka, Mr A.F. Stimson, and Dr E. Williams.

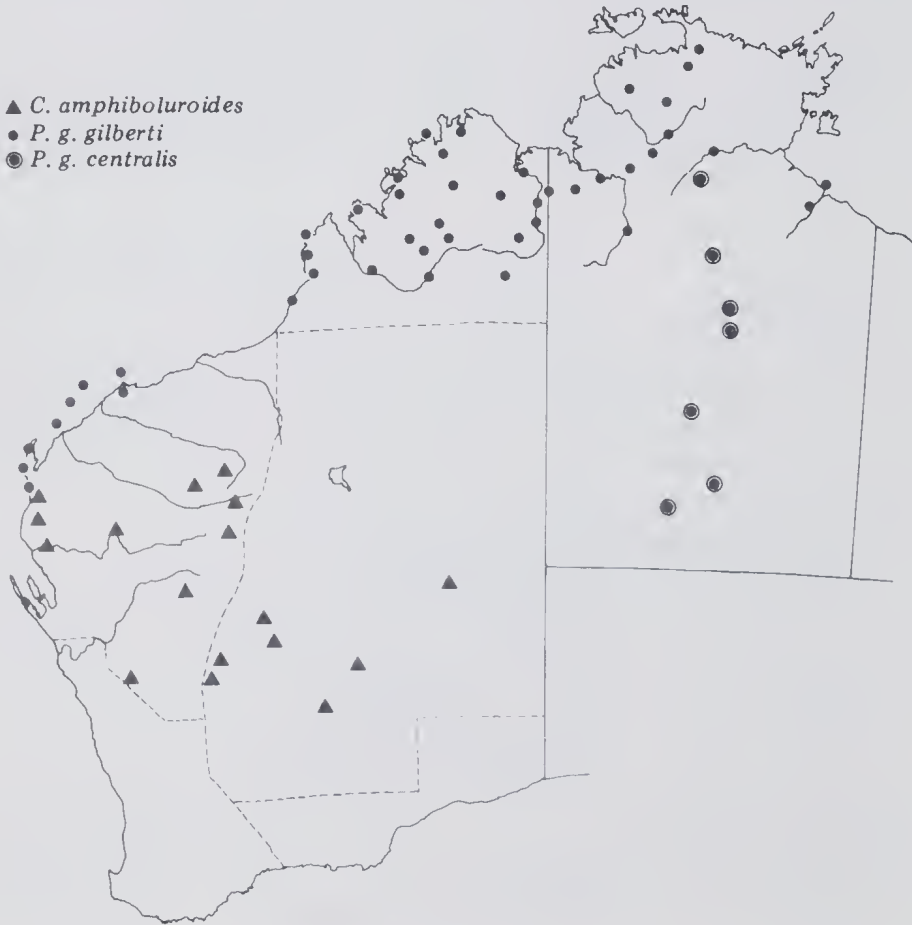
KEY

1. Vertebral scales larger and higher than other dorsals, forming a low crest; nuchal crest of high, laterally compressed scales 2
 No crest along midline of back; nuchal crest low or absent. (Genus *Diporiphora*) 6
2. Five low crests along back (a vertebral and on each side a dorsal and dorsolateral); no dorsolateral stripe; no femoral pores; tip of tail obtuse *Caimanops amphiboluroides*
 Only one crest on back (vertebral); broad whitish dorsolateral stripe; one or more femoral pores; tip of tail acute. (Genus *Physignathus*) 3
3. Keels of all dorsal scales converging on midline 4
 Keels of all or some dorsals parallel to midline 5
4. Femoral pores 4-11; white labial stripe not or only narrowly continuous with dorsolateral stripe and not or only narrowly extending to upper jaw; usually a large dark maroon spot immediately behind ear *Physignathus longirostris*
 Femoral pores 1-3; white labial stripe broadly continuous with dorsolateral stripe and extend-

	ing broadly to upper jaw	...	...	...					<i>Physignathus temporalis</i>
5.	Dorsal scales subequal in size, keels of all rows parallel to midline; dorsolateral stripe solidly white; usually a short white stripe between eye and ear	...	...	...					<i>Physignathus gilberti gilberti</i>
	Dorsals markedly heterogeneous in size and orientation, keels of inner rows parallel to midline and of outer rows converging on midline; dorsolateral stripe usually barred or spotted with dark brown; usually no white stripe between eye and ear	...	...	...					<i>Physignathus gilberti centralis</i>
6.	Keels of dorsal scales parallel to midline	...	...	...	...	...	...	...	7
	Keels of dorsal scales converging on midline								<i>Diporiphora convergens</i>
7.	Dorsal scales heterogeneous, including a series of enlarged scales immediately outside of paravertebrals	...	...	...	...	...	...	...	8
	Dorsal scales subequal in size	...	...	...	...	...	...	...	10
8.	Gular and postauricular folds present	...	...	...	...	...	...	...	9
	No gular and postauricular folds	...							<i>Diporiphora bilineata bilineata</i>
9.	Lips conspicuously white; dorsolateral stripe well developed anteriorly	...	...						<i>Diporiphora albilabris albilabris</i>
	Little or no colour pattern	...	...	...					<i>Diporiphora albilabris sobria</i>
10.	Gular fold present	...	...	...	...	...	...	...	11
	No gular fold	...	...	...	...	...	...	...	14
11.	Postauricular fold present; dorsal scales strongly keeled	...	...	...	...	...	...	...	12
	No postauricular fold; dorsals weakly keeled								<i>Diporiphora winneckeii</i>
12.	A femoral pore present	...	...						<i>Diporiphora bennettii arnhemica</i>
	No femoral pores	...	...	...	...	...	...	...	13
13.	Posterior lateral scales directed upwards; gular fold weak, sometimes broken medianly; dark dorsal crossbands (when present) narrow and ill-defined; grey vertebral stripe (when present) as narrow as dorsolateral stripe	...							<i>Diporiphora bennettii bennettii</i>
	Posterior laterals parallel in orientation to dorsals; gular fold strong; dark dorsal crossbands (when present) rectangular, clear-cut and as wide as interspaces; grey vertebral stripe (when present) much wider than dorsolateral stripe	...	...	...	...	...	...	...	<i>Diporiphora lalliae</i>
	Postauricular fold long and strong	...	...						<i>Diporiphora magna</i>
	Postauricular fold short and weak or absent	...	...	...	...	...	...	...	15

15. No indication of postauricular fold or spine 16
 One (occasionally two) postauricular white
 spines present and occasionally a short
 weak fold *Diporiphora bilineata margaretae*
16. A femoral pore present *Diporiphora reginae*
 No femoral pores 17
17. Gulars smooth; dorsals more strongly keeled
 than ventrals; usually some indication of
 dark dorsal crossbands and grey ventral
 stripes *Diporiphora winneckeii*
 Gulars keeled; dorsals less strongly keeled
 than ventrals; no dorsal crossbands or ventral
 stripes *Diporiphora superba*

Fig. 1. Map of Western Australia and Northern Territory showing location of specimens of *Caimanops amphiboluroides*, *Physignathus gilberti gilberti* and *Physignathus gilberti centralis*.



Caimanops gen. nov.

Type species

Diporophora amphiboluroides Lucas & Frost.

Diagnosis

Moderately large agamid lizards with short limbs and tail; tympanum, nuchal crest, gular fold and pre-anal pores present. Agreeing with *Physignathus* and *Diporiphora* in having each pre-anal pore perforating a scale and in the alignment of the pores being directed backwards towards midline, but differing from both of those genera in having nasal located on (not below) canthus rostralis, tail terminating obtusely (as in *Chelosania*), five low crests along back, dark dorsal markings longitudinal (not transverse) in orientation, and complete absence of white dorsolateral stripe. Agreeing with *Physignathus* (but not *Diporiphora*) in having nuchal crest of laterally compressed scales, snout low and truncate in profile, and no vertebral stripe.

Distribution

That of the single species, *Caimanops amphiboluroides*.

Caimanops amphiboluroides

Diporophora amphiboluroides Lucas & Frost, 1902, Proc. Roy. Soc. Vict., new series 15: 76. Western Australia.

Diagnosis

As for genus.

Distribution

Western Australia between 23°15' and 29°20'S, mainly in mulga and other arid scrubs.

Description

Snout-vent length (mm): 45-94 (N=26, mean 74.0). Length of appendages (% length of body): head 29-42 (N=26, mean 34.7); foreleg 44-56 (N=26, mean 49.2); hindleg 60-79 (N=26, mean 70.2); tail 197-242 (N=24, mean 218). Width and depth of head (% length of head) respectively 59-74 (N=26, mean 67.5) and 43-63 (N=26, mean 52.1). Upper labials 14-19, including 1-5 small posterior scales. Pre-anal pores 1-3 (N=21, mean 2.0). Lamellae under fourth toe 18-24 (N=25, mean 20.8).

Strong nuchal crest composed of pointed scales, alternate scales being 2-3 times as high as others. Dorsal scales mostly small, juxtaposed and weakly keeled. A vertebral row and on each side a dorsal and dorsolateral row of enlarged scales, more strongly keeled and imbricate than ordinary dorsals and forming five very low crests, the vertebral being continuous, the others discontinuous (*i.e.* enlarged scales separated by 1-4 ordinary scales). A spiny postauricular fold, gular fold, and weak scapular fold present. Laterals, gulars and ventrals weakly keeled.

Upper surface pale grey marked with dark brown as follows: a median streak on posterior half of snout, a mark between eyes shaped like pair of

bat's wings, an oblique streak running back from brow towards nuchal crest, and three short, slightly curving, longitudinal streaks on each side of back. Broad whitish midlateral and ventrolateral stripes discernible in some specimens. Underneath pale, marked with numerous brown longitudinally orientated anastomosing streaks.

Material

North-west Division (W.A.): Newman (30929); Turee Creek (17686); 6 km SE of Warroora (14466); 13 km SE of Warroora (16954); 34 km S of Warroora (14464-5); 32 km W of Mundiwindi (25154); Kumarina (24010); Yinnietharra (40636); between the Ashburton and Gascoyne Rivers (SAM 4838 *b-e*); Gascoyne River crossing (SAM 6097); Belele (10612); Gullewa (5297); 'Western Australia' (NMV D1581, 8813 holotype). Eastern Division (W.A.): Gahnda Rockhole (28849); Albion Downs (19779-80, 28286); Kathleen Valley (14367); Mt Sefton (544); 24 km S of Atley (ERP 13643); Youanmi (39044); Mt Linden (12034).

Genus *Physignathus* Cuvier

For references to original description and synonyms, see Wermuth (1967: 91). For a description, see Boulenger (1885: 395).

Physignathus longirostris

Lcphognathus longirostris Boulenger, 1883, Ann. Mag. Nat. Hist. (5) 12: 225. Champion Bay, Western Australia (DuBoulay).

Physignathus eraduensis Werner, 1909, in Michaelsen & Hartmeyer's Fauna Südwest-Australiens 2: 275. Eradu, Western Australia (Michaelsen & Hartmeyer).

Physignathus longirostris quattuorfasciatus Sternfeld, 1924, Abh. Senckenberg. Naturf. Ges. 38: 236. Hermannsburg, Northern Territory (von Leonhardi).

Diagnosis

A slender long-tailed *Physignathus* with dorsals nearly uniform in size, their keels converging on midline; distinguishable from *P. temporalis* by more numerous femoral pores (more than 3) and by labial stripe not or only narrowly continuous with dorsolateral stripe and not or only narrowly extending to upper jaw.

Distribution

Western Australia: north nearly to the Fitzroy (St George Range), and south to the lower Greenough, the middle Murchison, Kathleen Valley, and the Great Victoria Desert. Northern Territory: north to Tennant Creek. South Australia: extreme north, about watercourses flowing south-easterly into Lake Eyre.

Description

Snout-vent length (mm): 27-114 (N=336, mean 74.2). Length of appendages (% length of body): head 34-56 (N=327, mean 42.4), foreleg 47-75 (N=323, mean 57.9), hindleg 100-145 (N=325, mean 123.4), tail 298-540 (N=316, mean 440). Width and depth of head (% length of head) respectively 49-78 (N=327, mean 58.2) and 37-63 (N=327, mean 48.4).

Upper labials 11-19, including 0-5 small posterior scales. Femoral pores 4-11 (N=182, mean 7.5). Pre-anal pores 1-4, usually 2 or 3 (N=182, mean 2.5). Lamellae under fourth toe 31-43 (N=224, mean 36.8).

Nuchal crest high. Enlarged vertebral scales forming a low dorsal crest. Remaining dorsals uniformly small, their keels directed back towards mid-line. Spiny postauricular and strong gular and scapular folds present. Gulars smooth. Ventrals weakly keeled.

Dorsally reddish brown with or without narrow dark reddish brown cross-bands which are usually widely broken in middle. Broad white dorsolateral stripe extending back to level of hindleg and forward to a little beyond foreleg, narrowly or not continuous with labial stripe (a white streak passing under tympanum and forward along lips nearly to end of snout). Dark reddish brown blotch behind tympanum. A narrow whitish midlateral stripe often discernible on posterior two-thirds of flanks. Tail and legs indistinctly crossbanded with pale brown. Chin and throat clouded with dark brown and occasionally flecked with white.

Material

Kimberley Division (W.A.): St George Range (167, 32133-4); Mt Phire, 23 km ESE of Anna Plains (27616-7).

North-west Division (W.A.): Bulgamurgat Soak, 70 km SE of Wallal (36147); Mundabullangana, including homestead and localities 13, 29 and 45 km SE and 20 km W (14370-5, 14379-90, 17076, 19370-5, 30142); Sherlock (14414); Jones River (14415-6); Harding River (13980); Roebourne (14417); Nickol Bay (17055); Maitland River (13993); Eramurra Creek (14428); 25 km E of Yarraloola (25638); Mt Herbert (14418-20, 20010); Millstream (14421-4, 20129, 20131, 34733-4, 34739); Tambrey (20009, 20011, 20124-8, 20130); Abydos (10807, 10809); Woodstock (12621, 13826, 14391-2); Marble Bar (NMV R895); Bamboo Creek (33418-9); Warrawagine (13257); Braeside (14585); Meentheena (14410-3); Mt Edgar (14393-409, 14429-30); Mosquito Creek (13255); Budjan Creek (13256); Nullagine (39080); Marillana (13281, 22637-8, 29073-6); Yampire Gorge (29106-8); Wittenoom Gorge (29104, 39167); Tom Price (31005-8); Duck Creek (13282); Barlee Range (25266); Yardie Creek (13274-7, 27618); Exmouth (14431, 31411); Shothole Canyon (14031); Learmonth (14432-6, 16995, 25624, 36298); Marrilla (5332); Cardabia (32600-1); Mia Mia (5006-8); Warroora (8164-6, 14437-41, 30381-3, 32577-9); Minglya (14442); Middalya (NMV D1773, 1781, 1793); Turee Creek (17685); Prairie Downs (19206-8); Newman (23987, 25197-9, 30914-7); Jiggalong (13332, 13349, 13662); 48 km SW of Bulloo Downs (22698); Mt Vernon (22820-2, 25238); Chalk Springs, Ethel River (22796-8); 32 km N of Beyonde (23938-9);

Kumarina (22743-5, 23965-9); Quobba (32620); Carnarvon and district (13683, 14443, 22944); Wooramel (14445-6, 19931); Gladstone (14447-8); Shark Bay (12207-8); Mileura (15755, 15757-61, 15801, 16756, 28234-5, 28342).

South-West Division (W.A.): Yallalong (13966, 14444); Murchison House (33852-3); Kalbarri (town and National Park) (14449-51, 27267-8, 29778, 33462-6, 33469, 33543-52, 33558-73, 33596, 33801-2, 33806-8, 33852-3, 33866-7, 33869, 33900); Galena (11116-7, 11132, 29787); Wicherina (14455-6); Ellendale Pool, Greenough River (14452-4); 26 km E of Walk-away (24907).

Eastern Division (W.A.): Well 49, Canning Stock Route (40878); Well 46, CSR (40900-1); Well 41, CSR (8716); Well 37, CSR (3969); Well 24, CSR (44197); 32 km W of Well 23, CSR (27065-7); 32 km S of Durba Hills (40359); Wari Soak, 145 km N of Carnegie (40609); Walter James Range (34224); 93 km ENE of Carnegie (21062); Well 14, CSR (8420); Pierre Spring, CSR (33389); 32 km NE of Millrose (ERP 11748-52); Wiluna (6339, 6456-7, 26233, 26512); 26 km E of Wiluna (15857); Warburton Range (31360); 68 km SW of Warburton Range (34304); Muggan Rockhole (15720); Albion Downs (30991); Kathleen Valley (40532); 8 km NE of Dunges Table (ERP 12130); Neale Junction (40949).

Northern Territory: Tennant Creek (NMV D69-70); Barrow Creek (NMV D4945-6); 10 km SW of Barrow Creek (24357); Alice Springs (NMV D183, 185-8, 190-1, 193-4, 197); Ormiston Gorge (NMV D12749-51, 12753, 13389); Derwent Creek (NMV D239); Ehrenberg Range (JSE 378, 388 a-b, 389, 399 a-f, 405); Willie Rockhole (23° 16'S, 129° 45'E) (JSE 324, 328-9, 352, 360); Kintore Range (JSE 267); Davenport Hills (44339; JSE 228); 5 km NE of Hermannsburg (20852); Palm Valley (20866-7); Finke River (NMV D2336, 3481); Ruined Ramparts, Petermann Ranges (JSE 160); Chirnside Creek (JSE 144-5); Curtin Springs (JSE 32); Charlotte Waters (NMV D509-10).

South Australia: Ernabella (NMV D10902); Oodnadatta (NMV D95-6, 210, 238); Wintinna Creek (NMV D12748).

Physignathus temporalis

Grammatophora temporalis Günther, 1867, Ann. Mag. Nat. Hist. (3) 20: 52. Port Essington, Northern Territory (Lord Derby).

Lophognathus labialis Boulenger, 1883, Ann. Mag. Nat. Hist. (5) 12: 225. Port Essington (Richardson, Gilbert).

Diagnosis

A slender *Physignathus* with dorsals nearly uniform in size, their keels converging on midline; distinguishable from *P. longirostris* by fewer femoral pores (less than 4) and by labial stripe broadly continuous with dorsolateral stripe and extending broadly to upper jaw.

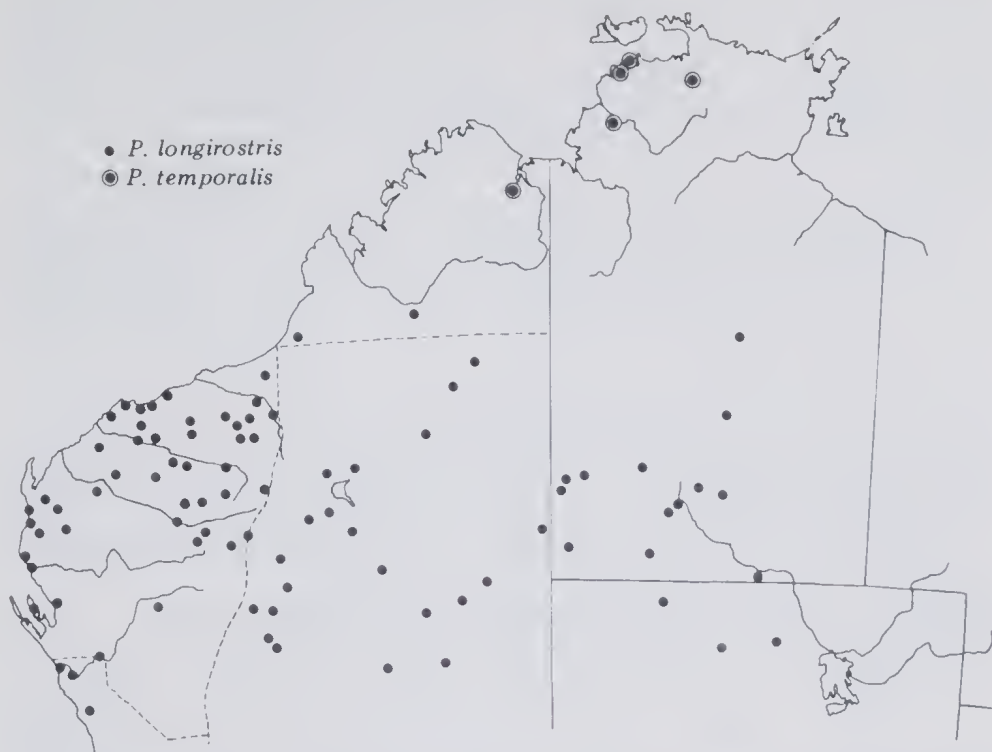


Fig. 2. Map of Western Australia, Northern Territory and South Australia showing location of specimens of *Physignathus longirostris* and *Physignathus temporalis*.

Distribution

Western Australia: far north of Kimberley Division.

Northern Territory: far north-west, from Cobourg Peninsula south to the Daly River.

Description

Snout-vent length (mm): 67-105 (N=15, mean 86.1). Length of appendages (% length of body): head 36-49 (N=15, mean 42.0), foreleg 54-63 (N=15, mean 59.7), hindleg 97-136 (N=15, mean 121.1), tail 366-457 (N=12, mean 422). Width and depth of head (% length of head) respectively 55-70 (N=15, mean 60.8) and 42-54 (N=15, mean 49.7).

Upper labials 11-14, including 0-3 small posterior scales. Femoral pores 1-3 (N=12, mean 1.9). Pre-anal pores 0-2, usually 1 (N=13, mean 1.0). Lamellae under fourth toe 28-40 (N=15, mean 34.1).

Nuchal crest high. Enlarged vertebral scales forming a low dorsal crest. Remaining dorsals uniformly small, their keels directed back towards mid-line. Oblique fold on side of neck terminating on ventrolateral surface of jaw in a line of high compressed scales. Gular and scapular folds strong. Gulars smooth. Ventrals weakly keeled.

Dorsally greyish brown with or without a few irregular dark reddish brown crossbands, especially on foreback. Broad whitish dorsolateral stripe, usually flecked or narrowly cross-banded with dark brown, posteriorly becoming obscure and anteriorly continuous with white labial stripe after curving forward and downward on side of neck. Upper edge of labial stripe diverging from lip and reaching canthus rostralis between nostril and eye. Tail and legs pale brown, indistinctly crossbanded with dark brown.

Material

Kimberley Division (W.A.): King River, 15 km S of Wyndham (34602).

Northern Territory: Darwin (23502; NMV D5517); 20 km NE of Stokes Hill (32217-20); Woolwonga Wildlife Sanctuary (41890-2, 42940-1); Red Lily Lagoon, Daly River (23502); 'Northern Territory' (NMV D4551).

Physignathus gilberti gilberti

Lophognathus gilberti Gray, 1842, Zoological Miscellany, p. 53. North coast of New Holland.

Redtenbacheria fasciata Steindachner, 1867, Reise der Österreichischen Fregatte Novara . . . Reptilien, p. 31. New Holland.

Physignathus incognitus Ahl, 1926, Zool. Anz. 67: 190. Australia.

Diagnosis

A relatively stout *Physignathus* with dorsals fairly uniform in size, their keels parallel to midline; a white horizontal streak usually present between eye and ear.

Distribution

Western Australia: south in the Kimberley Division to Lagrange, the Fitzroy and Halls Creek; and coasts and islands of the North-West Division from the Dampier Archipelago south nearly to the Tropic.

Northern Territory: far north, south to Wave Hill, the upper Roper and Borroloola, but excluding wet north-west corner (Darwin region).

Description

Snout-vent length (mm): 28-128 (N=186, mean 78.1). Length of appendages (% length of body): head 35-50 (N=180, mean 43.5); foreleg 48-68 (N=180, mean 58.5); hindleg 105-146 (N=177, mean 123.9); tail 294-466 (N=142, mean 406). Width and depth of head (% length of head) respectively 52-82 (N=179, mean 64.4) and 41-61 (N=180, mean 50.8).

Upper labials 10-16, including 0-4 small posterior scales. Femoral pores 1-4 (N=108, mean 2.3). Pre-anal pores 1-3 (N=108, mean 2.0). Lamellae under fourth toe 25-38 (N=139, mean 31.8).

Nuchal crest lower than in congeners, composed of enlarged very strongly keeled scales. Enlarged, raised vertebral scales forming a low dorsal crest. Remaining dorsals fairly uniform in size and relatively large, their keels parallel to midline; scales becoming smaller laterodorsally with their keels directed back towards midline. Postauricular fold weak. Gular and scapular

folds strong. Laterals small and weakly keeled. Gulars smooth or very weakly keeled. Ventrals weakly keeled.

Dorsally greyish brown or reddish brown, with or without laterodorsal remnants of dark reddish brown crossbands. Broad white dorsolateral stripe reaching forward to side of neck and reappearing between ear and eye. Usually a broad white labial streak extending back to side of neck, located mainly on lower lip and lateroventral surface of lower jaw. A wide whitish midlateral stripe occasionally discernible, usually (like dorsolateral stripe) dark-edged.

Remarks

Certain populations in the Victoria River and Roper River drainages are affected by the proximity of *P. g. centralis*. Some Timber Creek specimens are almost intermediate between the two subspecies in the heterogeneity and orientation of the dorsal scales and in the development of the white stripe behind the eye. The upper Roper specimen has the dorsals slightly heterogeneous, no white stripe behind the eye, and the dorsolateral stripe barred; it could be placed almost as well with *centralis* as with the nominate subspecies.

The southern populations in Western Australia, though geographically very distant from *P. g. centralis*, tend towards that subspecies in coloration. In specimens from Broome and further south the dorsolateral stripe is often barred and the labial stripe weakly developed.

Material

Kimberley Division (W.A.): Pago (43549); Kalumburu (13568-9, 13571-5, 13577-9, 27630-3, 27635, 34576, 40494, 43548); King Edward River (28188-92, 28209); Crystal Creek (41877, 42932); Mitchell Plateau (43130, 43142-5, 43172-3, 43202, 43474, 43508-11); Port George IV (NMV D2360, 2365); 18 km E of Kuri Bay (40420-2, 40486); Drysdale Crossing (28237-9); New York Range (41878-81); Parry Creek (27628); 37 km SE of Kununurra (23114); Lake Argyle (42689-97, 42699-702, 42706-9, 42714-6, 42718, 42727, 43927-52); Lissadell (42732); Turkey Creek (14457); Mt Barnett (32339); Marion Downs (32286); Inglis Gap (27629, 32265); Mt Hart (24071, 24079); Wotjulum (11231, 11875); Lacepede Islands (43961-6); Coulomb Point (40252-7); Broome (14069-71, 14089, 14094-7, 14105-6, 14113-4, 29745, 31202); Langey Crossing (23019); Mt Anderson (32088, 32095); Fitzroy Crossing (21352); Halls Creek (23069); Lagrange (27619-20).

North-West Division (W.A.): Karratha (13942); Legendre Island (14339, 14355-6); Dolphin Island (37273-9); Kendrew Island (41855-6, 42967); Lowendall Island (12889); Barrow Island (27623-4, 28940); Sandy Island (27621-2); Thevenard Island (22894-5, 27625-7, 43953-4); Yardie Creek (13273); Ningaloo (14458); Coral Bay (41888).

Northern Territory: Oenpelli (32254; NMV D290, 5222); Woolwonga Wildlife Sanctuary (41882, 41884); Coomalie Creek (23254-5, 23760-2); Adelaide River (23770); 26 km NE of Pine Creek (23210); Katherine (13940-1, 13944-6, 14488, 16513, 21586, 21931-2, 23887, 24926); 16 km E of Daly River Settlement (37120); 30 km NE of Willeroo (23150); 42 km

SW of Willeroo (23144-6); 56 km SW of Willeroo (23143); Timber Creek (NMV D10440-4, 10838, 10887); 25 km SW of Auvergne (23136-8); 34 km NW of Newry (23128); Camfield River (28244); Wave Hill (13717); upper Roper River (NMV D5150); Borroloola (NMV D5096, 5123); Craggy Island, Sir Edward Pellew Group (40306-7).

Physignathus gilberti centralis

Physignathus gilberti centralis Loveridge, 1933, Proc. New Engl. Zool. Club 13: 71. Anningie, 42 km NW of Tea Tree Well, Northern Territory (Schevill).

Diagnosis

A moderately stout *Physignathus* with dorsals markedly unequal in size, the keels of only the innermost rows being parallel to midline. Further distinguishable from *P. g. gilberti* by increase in spininess (especially on back of head and neck) and by reduction or other modification of white longitudinal stripes (detailed below).

Distribution

Interior of Northern Territory, from Larrimah south to the James Range, *i.e.* between 15°30' and 24°20'S.

Description

Snout-vent length (mm): 68-122 (N=21, mean 95.8). Length of appendages (% length of body): head 36-51 (N=20, mean 43.8); foreleg 53-68 (N=19, mean 58.0); hindleg 108-130 (N=18, mean 118.6); tail 356-464 (N=13, mean 402). Width and depth of head (% length of head) respectively 56-72 (N=19, mean 62.6) and 42-54 (N=19, mean 47.5).

Upper labials 11-16, including 0-5 small posterior scales. Femoral pores 1-4 (N=21, mean 2.1). Pre-anal pores 1-3 (N=21, mean 1.8). Lamellae under fourth toe 26-37 (N=20, mean 31.4).

Nuchal crest high, composed of strongly compressed scales; 2 or 3 similar but shorter longitudinal series of spinose scales on each side of back of head. Vertebral scales enlarged, strongly keeled, and (in some specimens) laterally compressed; forming a low to moderately high dorsal crest. On each side of vertebral series two or three rows of small scales, their keels usually parallel to midline. Next are one or two longitudinal rows of enlarged dorsals, their keels parallel to or convergent on midline. Remaining dorsals much smaller, their keels directed back towards midline. Dorsolateral row (along bottom of white stripe) of enlarged spinose scales forming a low crest.

Dorsally brownish, variegated with darker and paler tints. Broad white dorsolateral stripe extending forward to side of neck, its upper margin usually dark and wavy; often barred or flecked with blackish brown. Usually no white stripe between eye and ear. White labial stripe extending back to postauricular fold, usually not reaching upper lip.

Material

Northern Territory: 10 km N of Larrimah (24121); Larrimah (24139);

Elliott (24174-5); Attack Creek (NMV D11166); Tennant Creek (NMV D2934, 4986-9, 4991-2, 5630); Anningie (MCZ 35207 holotype); Alice Springs (NMV D175-6, 182, 184, 189, 196); Illamurta (NMV D492).

Genus *Diporiphora* Gray

For references to original description and synonyms, see Wermuth (1967: 44). For a description, see Boulenger (1885: 393).

Diporiphora convergens sp. nov.

Holotype

R42931 in Western Australian Museum, collected by Messrs N. McNally and C. Pollett in May 1972 at Crystal Creek, Western Australia, in 14° 30'S, 125° 47'E.

Diagnosis

A small, long-legged *Diporiphora* with gular and scapular folds but no postauricular fold; distinguishable from all other species by keels of dorsal scales converging on midline.

Distribution

North-west coast of Kimberley Division (Admiralty Gulf), Western Australia.

Description of holotype (the only available specimen).

Snout-vent length (mm): 34. Length of appendages (% length of body): head 41; foreleg 61; hindleg 125; tail 288. Width and depth of head (% length of head) respectively 74 and 51.

Upper labials 11 or 12, including a small posterior scale. Lamellae under fourth toe 31.

No nuchal crest. Dorsals uniform in size, slightly smaller than vertebrae, their keels somewhat obtuse and converging on midline. Laterals nearly as large as dorsals and converging on them. One or two postauricular spines. Gular and scapular folds very strong. Gulars very disparate in size, three rows nearest to lower labials much larger than others. Gulars and ventrals weakly keeled.

No pattern apart from faint narrow dark bands across back, widely broken in middle. Edge of eyelids white.

Diporiphora albilabris albilabris sp. nov.

Holotype

R43517 in Western Australian Museum, collected by Dr D.J. Kitchener on 7 September 1971 at Mitchell Plateau, Western Australia, in 14° 48'S, 125° 50'E.



Fig. 3. Map of part of Western Australia and Northern Territory showing location of specimens of *Diporiphora albilabris albilabris* and *Diporiphora albilabris sobria*.

Diagnosis

A small *Diporiphora* with postauricular and gular folds and markedly heterogeneous dorsals; distinguishable from *D. australis* of Queensland in vertebrals (as well as paravertebrals) much smaller than innermost row of dorsals.

Distribution

North-west coast and adjacent plateaux of the Kimberley Division, Western Australia.

Description

Snout-vent length (mm): 27-55 (N=19, mean 43.3). Length of appendages (% length of body): head 39-52 (N=19, mean 46.0); foreleg 55-74 (N=19, mean 63.1); hindleg 85-117 (N=19, mean 102.3); tail 231-342 (N=14, mean 290). Width and depth of head (% length of head) respectively 69-87 (N=19, mean 73.9) and 48-62 (N=19, mean 53.8).

Upper labials 10-13 (including 1-3 small posterior scales). Femoral pores 0-2 (N=13, mean 1.0). Pre-anal pores 1-3 (N=13, mean 2.2). Lamellae under fourth toe 18-24 (N=18, mean 20.6).

Keels of enlarged dorsal scales (row immediately outside of paravertebral series) strong and well-aligned longitudinally. Scales of dorsolateral stripe enlarged, strongly keeled, slightly raised, and forming sharp boundary between flat upper surface and side of body. Postauricular fold very strong. Gular fold moderately strong. Scapular fold weak or absent.

Dorsal ground colour brown. Narrow grey vertebral stripe barely discernible. Dorsolateral stripe white anteriorly, usually becoming grey and hard to discern posteriorly. Five or six dark brown bands across body, interrupted by dorsolateral and vertebral stripes. Lips conspicuously white. Flanks greyish brown, dotted with white or pale brown. Tail and limbs brown, indistinctly ringed with dark brown. Underneath whitish; throat usually marked with two or three grey chevrons, the smaller inside the larger.

Paratypes

Kimberley Division (W.A.): Kalumburu (13780); Crystal Creek (41870, 42938); Mitchell Plateau (43167-9, 43212, 43343, 43515-6, 43532, 43534-7); King Edward River (14° 55'S, 126° 19'E) (28193, 41871-2).

Diporiphora albilabris sobria subsp. nov.

Holotype

R23180 in Western Australian Museum, collected by G.M. Storr and A. M. Douglas on 12 September 1964 at 35 km SE of Pine Creek, Northern Territory, in 14° 04'S, 131° 58'E.

Diagnosis

Distinguishable from *D. a. albilabris* by absence or near absence of colour pattern.

Distribution

Hilly north-western interior of Northern Territory from the Manton River south to the Fergusson River.

Description

Snout-vent length (mm): 36-41. Length of appendages (% length of body): head 44-47; foreleg 54-66; hindleg 98-112; tail 260-290. Width and depth of head (% length of head) respectively 67-75 and 54-62.

Upper labials 11 or 12, including 1 or 2 small posterior scales. No pores. Lamellae under fourth toe 19 or 20.

Folds and dorsal scutellation as in *D. a. albilabris*.

Specimens 23180-1 have ground colour reddish (like the rocks they were found under) and are completely devoid of pattern. The other specimens are not so reddish and have a trace of dorsolateral stripe and crossbands but no trace of white labial streak.

Paratypes

Northern Territory: 72 km SSE of Darwin (37133); 35 km SE of Pine Creek (23181-2).

Diporiphora bennettii bennettii

Gindalia bennettii Gray, 1845, Catalogue . . . lizards . . . British Museum, p. 247. North-west coast of Australia (Richardson).

Diagnosis

A moderately large *Diporiphora* with gular and postauricular folds and homogeneous dorsals; distinguishable from *D. lalliae* by its stronger postauricular fold, weaker gular and scapular folds, narrower vertebral stripe, narrower and less distinct dorsal crossbands, and laterals converging on dorsals.

Distribution

Kimberley Division of Western Australia, south to Yampi Sound, the King Leopold Range and Geikie Gorge, and east to Wyndham and Lake Argyle.

Description

Snout-vent length (mm): 23-80 (N=134, mean 50.9). Length of appendages (% length of body): head 35-53 (N=119, mean 43.0); foreleg 48-73 (N=117, mean 59.3); hindleg 82-126 (N=111, mean 106.3); tail 219-430 (N=85, mean 340). Width and depth of head (% length of head) respectively 59-77 (N=119, mean 67.9) and 43-63 (N=119, mean 52.0).

Upper labials 9-14, including 0-3 small posterior scales. Pre-anal pores 1-3 (N=70, mean 1.7). Lamellae under fourth toe 16-28 (N=109, mean 22.6).

Low nuchal crest. Dorsals moderately large and strongly keeled. Posterior laterals converging on dorsals (*i.e.* rows directed upwards and backwards). Postauricular fold strong and spiny. Gular fold weak, occasionally broken in middle. Scapular fold weak or absent.

Juveniles dorsally brown, narrowly and usually indistinctly crossbanded with dark brown; pale dorsolateral stripe best developed anteriorly, sometimes extending forward to eye; grey vertebral stripe narrow to moderately wide, barely discernible; flanks dark brown, usually dotted with white. Most adults and many immatures are patternless except for a large black spot above insertion of foreleg.

Material

Kimberley Division (W.A.): Kalumburu (27649-53, 28942-3, 40493, 43541-2, 43863-4, 43866, 43869-71); Crystal Creek, Admiralty Gulf (42926-7, 42929, 42931); Port Warrender (43310); Mitchell Plateau (40464-6, 43132, 43139, 43203, 43236-9, 43527-31, 43533); King Edward River (28204, 28208, 41860-1); largest of Coronation Islands (40458-9, 41410, 41419, 41421-5); Augustus Island (40480, 41279-82, 41318); largest of Heywood Islands (40452-3); Champagny Island (41435); Careening Bay (43955); Port George IV (NMV D2357, 2359, 2363); 16 km ESE of Kuri Bay (40399-416, 40487-92); 18 km E of Kuri Bay (40483-5); 8 km N of Wyndham (13562, 13592, 13598, 32362, 41862-6, 42924, 42933); Parys Creek (43898-901); Grotto Creek (26784-7, 26789); New York Range (42933); Lake Argyle (42920, 42922); Koolan Island (27639-42, 27646, 29137); Wotjulum (11226-9, 11235-6, 11727-32, 11734-6, 11846-52, 11854-5, 11857-9, 11862-4, 11866-7); Secure Bay (27647); Inglis Gap (27643); Mt Caroline (32287); Geikie Gorge (32151); holotype (BM 1946.8.12.77).

Diporiphora bennettii arnhemica subsp. nov.

Holotype

NTR 135 in Darwin collection of Wildlife Survey Division, CSIRO, collected by Mr John Wombey on 27 August 1971 near the upper Katherine River, Northern Territory, in 14° 13'S, 132° 36'E.

Diagnosis

A moderately stout *Diporiphora* with gular fold, weak scapular fold, strong spiny postauricular fold, and homogeneous dorsals; distinguishable from *D. b. bennettii* by femoral pore.

Distribution

Arnhem Land Plateau of Northern Territory.

Description of holotype (the only available specimen)

Snout-vent length (mm): 49. Length of appendages (% length of body): head 46; foreleg 62; hindleg 107; tail 298. Width and depth of head (% length of head) respectively 76 and 51.

Upper labials 12 or 13, including one or two small posterior scales. One femoral pore. One or two pre-anal pores. Lamellae under fourth toe 21.

Dorsals large and sharply keeled. Laterals small, parallel in orientation to dorsals. Gulars and ventrals weakly keeled.

Dorsally brown with blackish brown crescentic bars across back and tail. Flanks brown (darkest above insertion of foreleg), spotted yellow.

Diporiphora magna sp. nov.

Holotype

R42786 in Western Australian Museum, collected by Dr D.J. Kitchener on 19 October 1971 at Old Lissadell, Western Australia, in 16° 30'S, 128° 41'E (now submerged by Lake Argyle).

Diagnosis

A large *Diporiphora* with homogeneous dorsals and postauricular and scapular folds but no gular fold.

Distribution

Kimberley Division of Western Australia, west to Napier Broome Bay and south to Lissadell. Northern Territory in the Victoria, Roper and McArthur River drainages.

Description

Snout-vent length (mm): 27-87 (N=99, mean 61.6). Length of appendages (% length of body): head 30-49 (N=98, mean 39.8); foreleg 51-65 (N=96, mean 57.7); hindleg 83-114 (N=97, mean 98.0); tail 286-428 (N=84, mean 358). Width and depth of head (% length of head) respectively 61-84 (N=98, mean 67.1) and 44-61 (N=98, mean 53.0).

Upper labials 10-17, including 0-4 small posterior scales. Pre-anal pores 1-3 (N=82, mean 1.9). Lamellae under fourth toe 19-28 (N=93, mean 23.8).

Low nuchal crest. Dorsals moderately large and strongly keeled. Posterior laterals parallel to dorsals or diverging from them. Postauricular fold spiny. Scapular fold weak to moderately strong.

Juveniles dorsally pale brown, with dark brown, rectangular, usually narrow bands across back; grey vertebral stripe narrow to moderately wide; white dorsolateral stripe; flanks usually dotted white; occasionally a pale midlateral stripe discernible, especially posteriorly. Most adults are patternless except for a large black spot above insertion of foreleg and occasionally a trace of dorsolateral stripe anteriorly.

Paratypes

Kimberley Division (W.A.): Pago (43550-8); Kalumburu (40479, 40495, 43547, 43867-8, 43872-80); 29 km N of King Edward River (28228); Durack River crossing, New York Range (41867-8); Grotto Creek (26788); 37 km SE of Kununurra (23126); Lake Argyle (40723-4, 40760-71, 40782, 42676-80, 42698, 42703, 42710-3, 42719, 42726, 42737, 42741-2, 42744, 42746, 42918, 42923, 43862); Lissadell (11778).

Northern Territory: Delamere (SAM 8167); Maranboy (23787-8); Mataranka (37108); Roper River Mission (NMV D10085); 10 km N of Larrimah (24115-20; NTR 203); Larrimah (24142-3); Borroloola (NMV D5095, 5097, 5124, 5179-92); Wearyan River crossing (40305).

Diporiphora lalliae sp. nov.

Holotype

R23030 in Western Australian Museum, collected by G.M. Storr and A.M. Douglas on 2 September 1964 at Langey Crossing, Western Australia, in 17° 39'S, 123° 34'E.

Diagnosis

A moderately large *Diporiphora* with gular, scapular and postauricular folds and homogeneous dorsals; distinguishable from *D. bennettii* by wider vertebral stripe, wider and clearer-cut crossbands, and posterior laterals parallel to dorsals.

Distribution

Northern interior of Western Australia, from the Fitzroy River southeast to the Rawlinson Range. Interior of Northern Territory, from Elliott south to Charlotte Waters.

Description

Snout-vent length (mm): 35-76 (N=32, mean 55.9). Length of appendages (% length of body): head 33-42 (N=32, mean 36.8); foreleg 47-59 (N=32, mean 52.9); hindleg 79-109 (N=32, mean 93.3); tail 273-410 (N=26, mean 345). Width and depth of head (% length of head) respectively 63-81 (N=32, mean 68.3) and 45-63 (N=32, mean 52.3).

Upper labials 10-16, including 0-3 small posterior scales. Pre-anal pores 1-3 (N=28, mean 2.0). Lamellae under fourth toe 23-29 (N=31, mean 24.7).

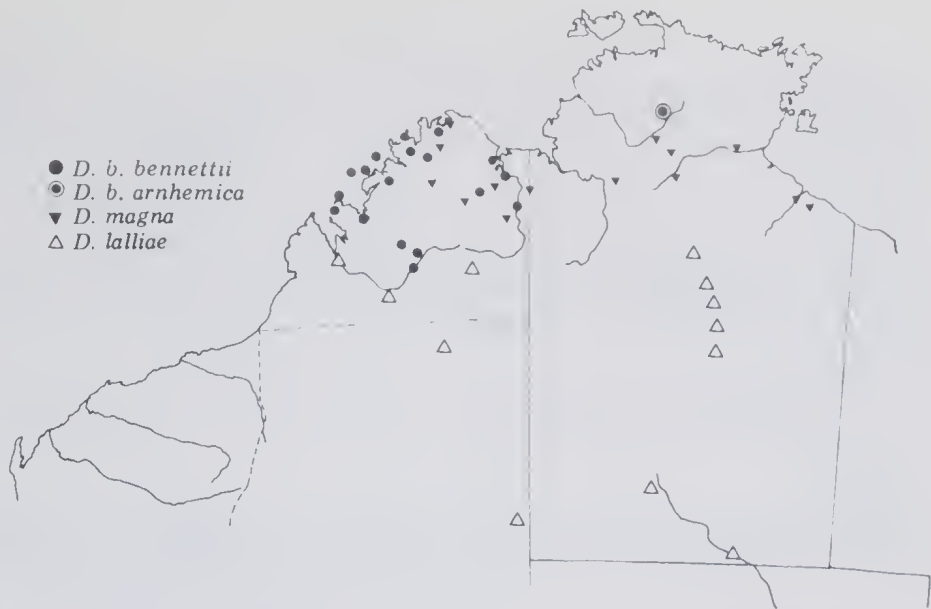


Fig. 4. Map of Western Australia and Northern Territory showing location of specimens of *Diporiphora bennettii bennettii*, *Diporiphora bennettii arnhemica*, *Diporiphora magna* and *Diporiphora lalliae*.

Low nuchal crest present, except in north of Northern Territory range (Elliott to Banka Banka). Postauricular fold weak in Kimberley Division, stronger and spinier further south and east. Scapular fold weak to moderately strong. Gular fold strong.

Dorsally pale brown with squarish dark brown crossbands about as wide as pale interspaces and broadly interrupted by wide grey vertebral stripe. White dorsolateral stripe, sometimes extending forward to eye. Pale mid-lateral stripe occasionally discernible, especially posteriorly. Under surface, especially throat, often streaked faintly with grey.

Remarks

Named after Mrs G.E. (Lally) Handley of the Western Australian Museum, in appreciation of her excellence as a typist of scientific papers.

Paratypes

Kimberley Division (W.A.): Langey Crossing (23012-3); St George Range (32135-6); Moola Bulla (SAM 3536).

Eastern Division (W.A.): between Wells 39 and 51, Canning Stock Route (4014); Giles (SAM 5352).

Northern Territory: Elliott (24176); Helen Springs (24200); 11 km S of Banka Banka (24203-4); 40 km N of Tennant Creek (24234-5); 16 km NW of Tennant Creek (SAM 13539A-B); Tennant Creek (SAM 4824A-C; NMV D2914); 10 km E of Tennant Creek (21424-7, 21436-9); 40 km S of Tennant Creek (24265); Palm Valley (SAM 5047); Charlotte Waters (NMV D2691, 2695).

Diporiphora reginae

Diporiphora reginae Glauert, 1959, Proc. Roy. Zool. Soc. N.S.W. 1957-58: 10. Kalin Rock, 15 km WNW of Cundelee Mission, Western Australia (Butler).

Diagnosis

A medium-sized, small-headed *Diporiphora* with a gular fold but no postauricular fold or spine; distinguishable from *D. winnecke* by its femoral pore, more robust habit, stronger keels and reduced pattern (e.g. no grey ventral stripes).

Distribution

A small part of arid southern interior of Western Australia, from Goddard Creek south-west to the Frazer Range.

Description

Snout-vent length (mm): 29-72 (N=16, mean 47.7). Length of appendages (% length of body): head 27-38 (N=16, mean 34.3); foreleg 44-63 (N=16, mean 51.5); hindleg 74-107 (N=16, mean 94.7); tail 258-360 (N=13, mean 301). Width and depth of head (% length of head) respectively 66-85 (N=16, mean 72.6) and 47-73 (N=16, mean 57.1).

Upper labials 11-15, including 2-4 small posterior scales. Femoral pore one. Pre-anal pores 2. Lamellae under fourth toe 23-29 (N=10, mean 26.2).

No nuchal crest. Dorsals homogeneous, keels moderately strong. Scapular fold weak or absent. Gulars keeled.

Dorsally rufous brown, without crossbands or vertebral stripe. Usually some indication of pale dorsolateral stripe. Flanks rufous brown, flecked with brownish white. Under surface white.

Material

Eastern Division (W.A.): Kalin Rock (12960-4, 42583-8); 8 km S of Cundelee Mission (21703-4); 17 km E of Zanthus (12224, 14491); Frazer Range (14083).

Diporiphora winnecke

Diporiphora winnecke Lucas & Frost, 1896, Horn Expedition, Reptilia 2: 132; pl. 12, fig. 5. Charlotte Waters, Northern Territory (Spencer).

Lectotype designated by Coventry, 1970, Mem. Nat. Mus. Vict. 31:117.

Diagnosis

A small slender *Diporiphora* with a very small head and no postauricular fold or spine; scales less strongly keeled than in other species, under surface being silky in texture and often broadly striped with grey.

Distribution

Western Australia, north generally to about lat. 20°S but extending considerably further north in coastal regions (to Dampier Land and Derby), and south to Exmouth Gulf and the Great Victoria Desert. Interior of Northern Territory, north to lat. 21°S. Interior of South Australia, south to northern Eyre Peninsula.

Description

Snout-vent length (mm): 21-65 (N=118, mean 47.8). Length of appendages (% length of body): head 29-42 (N=115, mean 34.5); foreleg 44-67 (N=116, mean 53.2); hindleg 71-112 (N=115, mean 89.4); tail 228-415 (N=106, mean 322). Width and depth of head (% length of head) respectively 56.84 (N=115, mean 68.6) and 42-64 (N=114, mean 53.4).

Upper labials 11-16, including 0-4 small posterior scales. Pre-anal pores 1-3 (N=51, mean 1.8). Lamellae under fourth toe 19-30 (N=89, mean 24.6).

Usually no nuchal crest. Dorsals homogeneous. Weak gular and scapular folds in most populations; absent in north-west (*i.e.* absent in all specimens from Broome and northwards and in some from Pilbara coastal plain). White tubercle at end of labial stripe (not to be confused with postauricular spine of *D. bilineata*).

Dorsally pale brown. Dark brown crossbands reduced to small blotches contiguous to dorsolateral stripe. Grey vertebral stripe very wide. White dorsolateral stripe usually extending forward to eye after a short break above ear. White stripe extending back from lips nearly to side of neck. White midlateral stripe occasionally present.

Remarks

The above description applies especially to material from sandy regions. Where the soil is heavier, *e.g.* at Derby, Tom Price and Kumarina, specimens tend to be more robust, larger headed and less smooth.

Material

Kimberley Division (W.A.): Derby (15185, 20317-28, 26834; NMV D2111); 24 km S of Derby (32167); Coulomb Point (40266); 130 km E of Broome (36336); Streeters Station, near Broome (116).

North-West Division (W.A.): De Grey (2123); 16 km S of Port Hedland (30427-33); Boodarie (17059); mouth of Turner River (14461); 8 km E of Mundabullangana (14459-60); 39 km W of Cane River (41873); 13 km W of Barradale Crossing (42939); Marrilla (5050, 5333-4); Tom Price (31009); 3 km S of Turee Creek (25135); Jiggalong (21618); Kumarina (23970-4).

Eastern Division (W.A.): Joanna Spring (SAM 4823B); 3 km S of Mt Romilly, Canning Stock Route (40896); Well 41, C.S.R. (40933); Well 30, C.S.R. (40943); 32 km S of Durba Hills (40360); 27 km N of Weld Spring (15840); 32 km NE of Millrose (ERP 11733); 30 km ENE of Jupiter Well (43968); Dover Hills (43967); 29 km N of Alexandra Springs (28862); 8 km NE of Dunges Table (ERP 12142-3).

Northern Territory: 60 km SE of The Granites (SAM 11168); Alice Springs (NMV D181); Ehrenburg Range (JSE 398a-g); Willie Rock-hole (23° 16'S, 129° 45'E) (JSE 334, 340a-d, 348a-r); east Bonython Range (JSE 192, 204a-b); 8 km W of Churnside Creek (JSE 144a-c); Curtin Springs (JSE 18, 34); Charlotte Waters (NMV D10155-6 paralectotype and lectotype respectively); E of Old Andado (NTR 319).

South Australia: Cordillo Downs (SAM 5001 A-B); Lake Coongie (SAM 4985 A-E); near William Creek (SAM 13223 A-D); Watson (SAM 10822-6); 37 km ENE of Wirrulla (24529-30).

Diporiphora bilineata bilineata

Diporiphora bilineata Gray, 1842, Zoological Miscellany, p.54. Port Essington, Northern Territory (Gilbert).

Diagnosis

A small *Diporiphora* with no gular, scapular and postauricular folds, and seldom with more than one pre-anal pore; distinguishable from *D. winneckeii* by its heterogeneous dorsals and white postauricular spine.

Distribution

Far north of Northern Territory, south to the Roper River.

Fig. 5. Map of Western Australia, Northern Territory and South Australia showing location of specimens of *Diporiphora bilineata bilineata*, *Diporiphora bilineata margaretae*, *Diporiphora winneckeii* and *Diporiphora reginae*.



Description

Snout-vent length (mm): 36-64 (N=94, mean 49.7). Length of appendages (% length of body): head 33-48 (N=90, mean 40.2); foreleg 48-66 (N=89, mean 57.7); hindleg 79-117 (N=89, mean 97.4); tail 240-389 (N=62, mean 318). Width and depth of head (% length of head) respectively 62-81 (N=90, mean 69.1) and 44-65 (N=90, mean 53.3).

Upper labials 9-13, including 0-3 small posterior scales. Pre-anal pores one (rarely 2). Lamellae under fourth toe 18-28 (N=87, mean 22.5).

Two or three median rows of scales on back, *i.e.* two rows of paravertebrals and (when present) the vertebral row, smaller than adjacent dorsals. Dorsolateral row of enlarged and raised scales. Posterior laterals in rows parallel to those of dorsals. Postauricular spine (occasionally two, rarely more) nearly always white, separated from ear by distance about equal to diameter of tympanum.

Dorsally brown with 6-9 pairs of dark crossbands, trapezoid in shape and widest at contact with narrow grey vertebral stripe. Dorsolateral stripe best developed anteriorly, the scales often dark with white edges. Very rarely a pale midlateral stripe. Pattern disappearing with age, dorsolateral stripe usually persisting longest.

Material

Northern Territory: Port Essington (BM 1946.8.12.75 holotype); Yirrkala (SAM 2858); Oenpelli (37174-5; SAM 2847 A-C; NMV D5168-75, 5177-8, 5213-28); Mt Tolmer (NTR 261); 20 km NE of Stokes Hill (32230-3); Darwin, including Casuarina Beach, Rapid Creek and Berrimah (21973, 23503-6, 23526-8, 23531-40; SAM 4825 A-H; NMV D800, 4543, 4556, 5159-60, 8215; NTR 167); Berry Springs (SAM 8934A-F); Howard Springs (23627); 6 km S of Darwin River Dam (NTR 165); 72 km SSE of Darwin (37132); Adelaide River (23227); 13 km S of Adelaide River (23226; NTR 346); 26 km NE of Pine Creek (23207-9); 5 km NW of Pine Creek (23212); 39 km SE of Pine Creek (23179); upper Roper River (NMV D5147-9); Dryfield Creek (NMV D5128-9).

Diporiphora bilineata margaretae subsp. nov.

Holotype

R27648 in Western Australian Museum, collected by Mr W.H. Butler on 8 July 1965 at Kalumburu, Western Australia, in 14°18'S, 126°30'E.

Diagnosis

A small *Diporiphora* with no gular fold and little or no indication of postauricular fold; distinguishable from *D. b. bilineata* by its homogeneous dorsals, and from *D. winnecke* by its white postauricular spine.

Distribution

Far north of Kimberley Division of Western Australia; also Groote Eylandt in Gulf of Carpentaria, Northern Territory.

Description

Snout-vent length (mm): 29-59 (N=37, mean 43.1). Length of appendages (% length of body); head 34-46 (N=37, mean 39.3); foreleg 46-60 (N=37, mean 55.4); hindleg 82-110 (N=37, mean 98.0); tail 258-356 (N=29, mean 308). Width and depth of head (% length of head) respectively 65-81 (N=37, mean 70.7) and 48-65 (N=37, mean 55.0).

Upper labials 10-15, including 0-3 small posterior scales. Pre-anal pores usually 2, occasionally 1. Lamellae under fourth toe 22-28 (N=37, mean 24.1).

Nuchal crest weak or absent. Scapular fold weak or absent. White post-auricular spine (rarely brown or more than one) separated from ear by space about equal to diameter of tympanum. Lateral scales at midbody almost as large as dorsals.

Dorsally brown with 5-8 (mostly 7) pairs of dark brown bands across body, widest where contacting broad grey vertebral stripe, narrowest where broken by dorsolateral stripe; bands on one half of body often not aligned with those of other half. Flanks dark brown, spotted with pale brown. Pattern disappearing with age, dorsolateral stripe usually persisting longest.

Geographic variation

The two widely separated segments of this subspecies are surprisingly similar. Groote Eylandt specimens differ in having a stronger scapular fold, longer hindleg, more numerous subdigital lamellae, narrower vertebral stripe, and wider and whiter dorsolateral stripe.

Remarks

Named after Margaret Butler, wife of Mr W.H. Butler who collected the holotype and much of the other material studied in this paper.

Paratypes

Kimberley Division (W.A.): Anjo Peninsula (43960); Kalumburu (13600, 43865, 43881-3); Crystal Creek (41869); King Edward River (28194, 28223); New York Range (42942).

Groote Eylandt (N.T.): (SAM 2848, 13483 A-Z).

Diporiphora superba sp. nov.

Holotype

R43178 in Western Australian Museum, collected on 14 January 1973 by Messrs L.A. Smith and R.E. Johnstone on the Mitchell River, Western Australia, in 14° 25'S, 125° 50'E.

Diagnosis

A large slender *Diporiphora* with short narrow head, long tail, long slender limbs and digits, and no folds, crests, ridges, spines or tubercles.



Fig. 6. Map of part of Western Australia showing location of specimens of *Diporiphora superba* and *Diporiphora convergens*.

Distribution

North-west of Kimberley Division, Western Australia.

Description

Snout-vent length (mm): 61-88 (N=10, mean 72.2). Length of appendages (% length of body): head 29-34 (N=10, mean 31.4); foreleg 53-64 (N=10, mean 58.2); hindleg 93-120 (N=10, mean 104.4); tail 430-553 (N=10, mean 479). Width and depth of head (% length of head) respectively 50-58 (N=10, mean 54.3) and 41-55 (N=10, mean 48.7).

Upper labials 11-13, including 0-3 small posterior scales. Pre-anal pores 2. Lamellae under fourth toe 26-31 (N=10, mean 28.3).

Lepidosis relatively uniform, but ventrals noticeably larger and more strongly keeled than dorsals.

In life uniformly green above and yellow below, quickly fading *post mortem* to bluish grey and white respectively (a few specimens have a brown median dorsal strip).

Paratypes

Kimberley Division (W.A.): Kalumburu (13576); Mitchell Plateau (41263-4, 41266); Boongaree Island (43956-8); Prince Regent River (43959); Manning Creek (32066).

DISCUSSION

In southern Australia *Amphibolurus* far outnumbers other agamid genera in species and individuals, but in the north it is largely replaced by *Diporiphora* and *Physignathus*. The latter genera are represented by 11 species in the Kimberley Division of Western Australia, compared to three of *Amphibolurus*. In the South-West Division of Western Australia there are eight species of *Amphibolurus* but only one *Physignathus* and no *Diporiphora*.

The sub-humid north-west coast of the Kimberley Division (annual rainfall 800-1400 mm) is the richest known region with respect to number of *Diporiphora* species. Here occur five species: *D. bennettii*, *D. bilineata*, *D. albilabris*, *D. superba* and *D. convergens*. The first three of these, after a break in the dry hinterland of Cambridge Gulf, re-appear (but as different subspecies) in the sub-humid north-west corner of the Northern Territory. Similar disjunctions between north-west Kimberley and the north-west of the Northern Territory are well known in birds, e.g. the pigeons *Ptilinopus regina*, *Ducula spilorrhoea* and *Chalcophaps indica*.

Adding *Physignathus gilberti* and *P. temporalis* we have seven species of *Diporiphora* and *Physignathus* for the sub-humid zone of the Kimberley Division; moreover all of these species except *P. gilberti* are restricted to this zone. In the semi-arid zone of the Kimberley Division (annual rainfall 500-800 mm) the number of species falls to four, namely *D. magna*, *D. winneckeii*, *D. lalliae* and *P. gilberti*. In the arid southern interior of the Kimberley Division (annual rainfall 300-500 mm) only *D. winneckeii* and *P. longirostris* have been recorded.

Apart from rainfall, the distribution of these species is influenced by the nature of the substrate. *D. bennettii* (both subspecies) and *D. bilineata margaretae* (but not *D. b. bilineata*) are almost wholly confined to sandstone country. *D. magna* is mainly found on relatively heavy soils in broad river valleys, *D. lalliae* on light to moderately heavy soils covered with *Triodia*, and *D. winneckeii* on desert sand-dunes. In the arboreal genus *Physignathus*, the nature of the vegetation is more important than the substrate. *P. longirostris*, for example, attains its greatest densities in the river gums (*Eucalyptus camaldulensis*) lining watercourses in the North-West Division.

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AN UNUSUAL AUSTRALITE FROM KOOKYNIE, WESTERN AUSTRALIA

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ABSTRACT

A bluntly conical feature on the posterior flight surface of an australite core is interpreted as the basal remnant of a 'tail' on the parental australite body.

A round australite core (W.A. Museum no. 1645) from Kookynie (29° 20'S., 121° 30'E.) is unique in my experience in having upon its posterior surface of flight a small, truncated, conical protuberance resembling in profile a miniature volcano (Fig.1).

Though somewhat abraded, the australite is better preserved than many recovered from semi-arid terrain. Minor sculpture on the posterior surface includes some lightly etched schlieren. The approximately radial pattern of these schlieren on the flanks of the conical structure shows that the internal flow lines converge upward into the cone. The rim is regular and well defined. The equatorial zone, 1.0 — 1.2 cm wide, is limited anteriorly by a distinct shoulder. The anterior surface is irregular in form and its profile is asymmetrical with a blunt peak (arrowed in Fig. 2) which is not antipodal to the conical structure on the posterior surface.

The dimensions of the core are 3.04 x 3.01 x 2.66 cm, the mass 29.256 g and the specific gravity 2.456. The radius of curvature of the posterior surface in the plane of the posterior pole and the width dimension was accepted as the radius of the primary body because the profile in that plane is unaffected by the presence of the conical structure. The same radius was therefore used in the reconstruction through the length dimension (Fig.2), where the conical structure accounts for the slightly larger dimension and makes the estimate of original diameter less reliable.

The diameter (thickness) of the parent sphere was 3.35 cm and its volume, including an estimated 0.22 cm³ for the remnant conical structure, was c.19.90 cm³. Thickness and volume losses from the parent body, principally by ablation and the stress shell, were approximately 20% and 40% respectively.

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ORIGIN OF THE CONICAL STRUCTURE

The conical structure on the posterior surface, a weathered remnant (28%) of the primary surface, is likely to date from the period of formation of the primary body because there is no evident way in which it could form upon the cold, rearward-facing surface during atmospheric transit. An upstanding primary feature would be retained if high viscosity resulting from unusual chemistry or from lowered temperature prevented the adoption of a spherical shape. It would be of interest to know the refractive indices of various parts of the core as a guide to silica content and viscosity, but measurement was impracticable.

An extensive volume of material of unusual composition would affect the specific gravity of the core but it is an expected value for the site of find. The modal values for large samples of australites from Boyce Creek (50 km to the S.E.) and from two more distant localities in the region are in the range 2.45 — 2.46 (Chapman 1971), within which lies also the value for the Kookynie specimen. An extensive anomaly in mass distribution associated with the conical structure would be expected to cause alignment of the structure with the flight axis, as has occurred with unusually large bubble cavities (Baker 1966 fig.1), or alternatively, to cause some instability in flight. The regular rim and width of equatorial zone suggest that this australite, like nearly all others, was stably oriented during ablation flight. A more localized compositional and mass anomaly might be possible in the same way that bubbles of more modest size can occur well off the flight axis in stably oriented specimens.



Fig. 1. Oblique view of australite from Kookynie emphasising posterior surface and blunt conical structure at upper left.

A 'tail' could originate by the drawing out of material during detachment of the primary body from the mass of original melt. Chapman (1964) has figured the tailed spherules which were the most common form produced when melt of high viscosity was used in experiments designed to simulate formation of primary bodies. Such bodies often had a pinched 'nose', not necessarily aligned with the tail (Fig.2), which suggests that the anterior asymmetry of the Kookynie specimen could be inherited from a surface feature of the primary body. However, asymmetry of the surface exposed by loss of the stress shell is sufficiently common for its presence on the Kookynie specimen to be fortuitous.

Much smaller (~ 1 mm), tailed, glass spherules from various sources have long been known, for example, amongst the 'smoke bombs' of coal-burning locomotives (Fenner 1934), and more recently amongst the so-called 'microtektites' of deep ocean sediments (Glass 1968). The retention of the tails on small primary forms was a consequence of their rapid solidification. The survival of a tailed form amongst australites would likewise require a high degree of viscosity, and additionally, a flight orientation which would afford some measure of protection during atmospheric transit. When the reconstructed australite is compared with a very small form (Fig.2), its tail appears disproportionately short. A longer cooling history would allow some resorption of the tail into the ideal spherical form until the process was terminated by increasing viscosity.

The drawing apart of primary bodies following glancing collision is con-

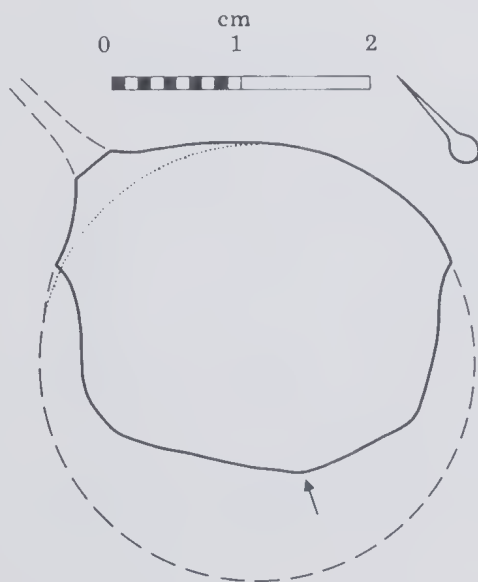


Fig. 2. Profile of australite core (firm line) with partial restoration of primary form (broken lines). The dotted line indicates the ideal spherical surface. Direction of flight towards bottom of page. At upper right, generalised form of tailed spherules produced in experimental formation of primary bodies.

sidered an unlikely mechanism for producing the structure because of the perfection of curvature of the remnant of the primary surface. It would be necessary to postulate that little distortion resulted from collision, or that the shape was restored except in the vicinity of the drawn out material.

The rise of a gas bubble towards the surface might produce the structure if the present concavity of the flanks was immediately succeeded by convexity above. Bubble pits resulting from degassing in the primary stage of formation are so common on the posterior surfaces of the better preserved australites that it would be surprising if generally similar structures over shallow bubbles had not previously been observed.

Dismissing any thought of destructive examination of this rare specimen, the origin of the conical structure must remain in some measure a matter of conjecture. The favoured view is that the structure is the base of the tail formed during detachment of the primary body from the parent melt, and that it was retained — at least in part — because of high viscosity arising from unusual, but localised, chemical composition. The base of the structure was protected during flight through the atmosphere but its height could have been reduced by ablation because the region of 'dead air' behind a sphere is conical (Baker 1958 fig.1). Alternatively, since the blunted top of the cone is approximately at right angles to its axis, the relatively fragile part of the tail could have been lost on impact or since arrival on the earth's surface, and the scar later smoothed by abrasion.

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THE GENUS *CARLIA* (LACERTILIA, SCINCIDAE) IN WESTERN AUSTRALIA AND NORTHERN TERRITORY

G.M. STORR

[Received 8 April 1974. Accepted 29 April 1974]

ABSTRACT

The eight species and subspecies of *Carlia* known from Western Australia and the Northern Territory are defined and keyed, viz. *C. fusca fusca* (Duméril & Bibron), *C. foliorum* (De Vis), *C. rufilatus* nov., *C. gracilis* nov., *C. triacantha* (Mitchell), *C. amax* nov., *C. johnstonei johnstonei* nov., and *C. johnstonei grandensis* nov.

INTRODUCTION

The morphological gap between species of *Carlia* is much smaller than usual in congeneric lizards. Long series are therefore needed for distinguishing individual from interspecific variation. Earlier workers, such as Macleay (1878) and De Vis (1885), underestimating individual variation, were liable to describe certain species several times, e.g. *C. fusca*. More recently Loveridge (1934) and Mitchell (1953) were inclined to make the opposite error and include several species under a single name, e.g. *C. pectoralis*.

Until the last few years the material for such a paper as this was grossly inadequate. As late as 1961, when he was revising the lizards of Western Australia, Glauert had only three specimens of *Carlia*. Since then many hundreds of specimens have been collected in the Kimberley Division by the Western Australian Museum. Our smaller Northern Territory collection has been augmented by generous loans from other institutions.

Specimens in the Western Australian Museum are cited without prefix. The registered numbers of borrowed specimens are prefixed with the initials of the collection: QM (Queensland Museum), AM (Australian Museum, Sydney), NMV (National Museum of Victoria), SAM (South Australian Museum), JSE (British Joint Services Expedition to Central Australia), NTM (Northern Territory Administration, Alice Springs), and NTR (CSIRO Division of Wildlife Research, Darwin). For the loan of these specimens I am indebted respectively to Miss J. Covacevich, Dr H.G. Cogger, Mr A.J. Coventry, Dr T.F. Houston, Lt Cdr A.Y. Norris, Mr D. Howe, and Mr J. Wombey. I am grateful to Mr Glen Ingram of Brisbane for the donation of Queensland material and for much information on Queensland species of *Carlia*, and to Messrs L.A. Smith and R.E. Johnstone for descriptions and photographs of live Kimberley specimens.

The characters used in this paper are snout-vent length, length of tail, keeling of nuchals and mid-dorsals, contact or separation of prefrontals, number of supraciliaries, relative size of palpebral disc, size and shape of ear aperture and ear lobules, number of midbody scale rows, number of lamellae under fourth toe, and coloration (including that of breeding male). 'Smooth' in this paper means without keels or striae.

Genus *Carlia*

Heteropus Duméril & Bibron, 1839, *Erpétologie générale* 5: 757. Based on *H. fuscus* and *H. peronii* Duméril & Bibron, not *Heteropus* Fitzinger.

Carlia Gray, 1845, *Catalogue of the specimens of lizards in the collection of the British Museum*, p. 271. Type-species (by monotypy): *C. melanopogon* Gray.

Myophila De Vis, 1885, *Proc. Roy. Soc. Qd* 1: 77. Type-species (by monotypy): *M. vivax* De Vis.

Lygisaurus De Vis, *ibid.* Type-species (by monotypy): *L. foliorum* De Vis.

Small terrestrial scincid lizards with digits 4 + 5; lower eyelid movable and bearing a transparent disc; dorsal and lateral scales keeled in most species; ear aperture usually margined with lobules; no supranasal or postnasal; prefrontals well developed but usually separated; supraoculars 4, first 2 in contact with frontal; supraciliaries low, usually 5-7; frontoparietals fused; interparietal small and free, except in *rhomboidalis* and some *fusca* (where fused to frontoparietals); usually one pair of nuchals; loreals 2, in horizontal series; labials normally 7, fifth subocular and much the largest; ventral scales and subdigital lamellae smooth.

Numerous species (many of them undescribed) in northern and eastern Australia, New Guinea, the Moluccas and Timor, with centre of abundance apparently in North Queensland.

KEY

- | | | | | | | | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|--------------------|
| 1. Mid-dorsal scales smooth or tristriate | ... | ... | ... | ... | ... | ... | ... | ... | 2 |
| Mid-dorsal scales keeled | ... | ... | ... | ... | ... | ... | ... | ... | 3 |
| 2. Ear aperture not smaller than palpebral disc, vertically elongate with long acute lobules on anterior margin; dorsally and laterally dark brown without pattern | | | | | | | | | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | <i>fusca fusca</i> |
| Ear aperture much smaller than palpebral disc, horizontally elongate, with or without a short lobule on anterior margin; dorsally and laterally olive with a white line from under eye to top of ear aperture and backward from bottom of ear aperture | | | | | | | | | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | <i>foliorum</i> |

3. Mid-dorsal scales tricarinate 4
 Mid-dorsal scales bicarinate 8
4. Ear aperture not smaller than palpebral disc, vertically elongate with long acute lobules on anterior margin; mid-dorsal keels very weak *fusca fusca*
 Ear aperture smaller than palpebral disc, circular or horizontally elongate, with no long acute lobules; mid-dorsal keels very weak to strong 5
5. Ear aperture circular with a lobule on anterior margin and several shorter and sharper lobules around remainder of aperture; mid-dorsals tricuspidate, moderately to strongly keeled, not well aligned longitudinally; prefrontals usually forming a median suture; snout-vent length up to 52 mm *triacantha*
 Ear aperture horizontally elongate, with or without a very small lobule anteriorly and minute lobules elsewhere; mid-dorsals seldom tricuspidate, very weakly to moderately strongly keeled, moderately to very well aligned longitudinally; prefrontals rarely forming a median suture; snout-vent length up to 44 mm 6
6. Palpebral disc occupying not much more than half of eyelid; no white stripe from lores to ear aperture; nuchals usually striate or weakly keeled *gracilis*
 Palpebral disc occupying much more than half of eyelid; a white line or pale stripe from under eye to top of ear aperture and sometimes back for varying distances from bottom of ear aperture; nuchals smooth 7
7. Mid-dorsal keels very weak; white stripe on side of face and body narrow and well defined; supraciliaries usually 5 (except in North Kimberley, where usually 6 or 7) *foliorum*
 Mid-dorsal keels weak to moderately strong; pale stripe on side of head and body broad and often ill defined; supraciliaries usually 7 (except in Kimberley, where usually 6) *rufilatus*
8. Ear aperture not much smaller than palpebral disc, circular or vertically elongate, with a moderately large acute lobule on anterior margin and several small acute lobules around remainder of aperture; supraciliaries usually 7; midbody scale rows usually 34 or more *johnstonei johnstonei*

Ear aperture much smaller than palpebral disc, horizontally elongate, with a lobule on anterior margin and usually none on other margins (occasionally one or two minute lobules posteriorly in *amax*); supraciliaries usually 6; mid-body scale rows usually 32 or fewer 9

9. Side of body black flecked white; under surface greyish, chin and throat scales broadly edged with black *johnstonei grandensis*

Side of body brown; under surface whitish *amax*

Carlia fusca fusca

Heteropus fuscus Duméril & Bibron, 1839, *Erpétologie générale* 5: 759. Islands of Waigiou and Rawack (Quoy & Gaimard).

Diagnosis

A large *Carlia* with mid-dorsal scales tristriate or very weakly tricarinate; distinguishable from *C. foliorum* and *C. rufilatus* by its large, vertically elongate (rather than small, horizontally elongate) ear aperture, margined anteriorly with large acute (rather than small obtuse) lobules.

Distribution

Far north-east of Northern Territory (north-east Arnhem Land and Groote Eylandt). Extralimital in western New Guinea.

Description

Snout-vent length (mm): 39-57 (N=3). Tail (%SVL): 174-192 (N=2).

Prefrontals separated. Supraciliaries 7. Ear aperture as large as or slightly larger than palpebral disc, margined anteriorly with 3 long acute lobules and elsewhere with short acute lobules. Nuchals smooth. Midbody scale rows 32-36. Lamellae under fourth toe 27-29.

Dorsally and laterally dark brown without pattern.

Remarks

I follow Mitchell (1953: 77) in allotting this population to the nominate subspecies of *C. fusca*. For a description of this subspecies based on adequate material, see Mitchell (*supra cit.*).

Material

Northern Territory: Yirkala (AM 12093); Groote Eylandt (AM 25782-3).

Carlia foliorum

Mocoo melanopogon Gray, 1845, Catalogue of the specimens of lizards in the collection of the British Museum, p.81. Port Essington, Northern Territory (John Gilbert). [Name rejected by Boulenger (1887: 288) as secondary homonym of *Lygosoma melanopogon* Duméril & Bibron.]

Lygisaurus foliorum De Vis, 1885, Proc. Roy. Soc. Qd 1: 77. Brisbane, Queensland (H. Tryon).

Heteropus mundus De Vis, 1885, Proc. Roy. Soc. Qd 1: 172. Warro, Port Curtis, Queensland (F.A. Blackman).

Diagnosis

A small *Carlia* with mid-dorsal scales smooth, tristriate or very weakly tricarinate, a white line from below eye to top of ear aperture and a white line for varying distances back from bottom of ear aperture. Further distinguishable from *C. fusca* by its much smaller ear aperture and lobules. Very similar to *C. rufilatus* but differing in its flatter head, smoother scales, narrower and better defined white line on side of head, neck and body, and in Northern Territory by fewer supraciliaries (usually 5 vs usually 7).

Distribution

Northern half of Western Australia south to the Cape Range, Hamersley Range and Mundiwindi; also Sir Graham Moore Island. Northern Territory south to lat. 21°S; also Bathurst and Melville Islands. Extralimital in Queensland.

Description

Snout-vent length (mm): 19-44 (N=130, mean 35.2). Tail (%SVL): 122-186 (N=34, mean 158).

Prefrontals usually separated, rarely forming a median suture. Supraciliaries 5-7 (N=125, mean 5.4), mostly 6 or 7 in North Kimberley, mostly 5 elsewhere. Ear aperture much smaller than palpebral disc, horizontally elongate, usually with a small lobule anteriorly and occasionally still smaller lobules elsewhere. Nuchals smooth. Midbody scale rows 27-34, mostly 30 (N=105, mean 30.1). Lamellae under fourth toe 19-30 (N=104, mean 25.3).

Dorsally and laterally olive, dotted with black and occasionally with white. White line extending from under eye to top of ear aperture margined above by black line, and white line from bottom of ear aperture back for varying distances (at one extreme failing to reach foreleg, at other extreme reaching nearly to hindleg). In breeding male top of head darkening and face, chin and throat becoming black (especially on edges of scales).

Remarks

Despite its ranging over half a continent, *C. foliorum* undergoes little geographic variation. Perhaps it has only recently spread into the Northern Territory and Western Australia and is now replacing the closely related *C. rufilatus*.

Material

Kimberley Division (W.A.): Sir Graham Moore Island (44013); Kalumburu

(43543-5, 44467-8, 44494, 44496-9, 44505); Crystal Creek (43100); Mitchell Plateau, including Surveyors Pool (43141, 43519-22, 44262); 8 km NE of Mitchell River HS (43248); Port George IV (NMV D2362); 18 km E of Kuri Bay (40427); Manning Creek (32306); Ninbing (27922); 6 km W of Kununurra (44523-4); Lake Argyle and vicinity (42766-9, 42771-2, 42777, 42797-9, 42812-6, 42906-8).

North-west Division (W.A.): Pilgagnoora Well (SAM 3446*a-b*); Shothole Canyon, Cape Range (17000); Millstream (34745); 16 km N of Tambrey (45027-8, 45035); near Tom Price (31013); Weeli Wolli, Marillana (26715).

Northern Territory: Bathurst Island (NMV D1653, 1655-7, 1659-64); Melville Island (NMV D5240, 5243, 5245, 5259); Port Essington (31179); King River (NMV D1646-7); Darwin (NMV D5686-7, 8216-8); Oenpelli (32256-9); Woolwonga Reserve (AM 38840); Koongarra, Mt Brockman Range (AM 38814, 38828); Murrakai (NTM 4598); Batchelor (37126); El Sherana (SAM 6223-5); 27 km S of Pine Creek (23196-8); Katherine (19896-9, 21582-5, 21924-8); Timber Creek (NMV D10779); Roper River (SAM 1131); Groote Eylandt (SAM 1116; AM 9719*a-d*, 9720*a-e*); Bing Bong (SAM 13540); Borroloola (NMV D5091, 5093, 5106-11, 5113, 5194); Newcastle Waters (NTM 5367); 6 km E of Tennant Creek (SAM 13537); 42 km SW of Wauchope (24324); 'Northern Territory' (NMV D2212, 4558); Dryfield Creek (NMV D5133).



Fig. 1. Map of Western Australia and Northern Territory showing location of specimens of *Carlia foliorum*.

Carlia rufilatus sp. nov.

Holotype

R23271 in Western Australian Museum, collected by G.M. Storr and A.M. Douglas on 14 September 1964 at Tumbling Waters, Northern Territory, in 12°46'S, 130°57'E.

Diagnosis

A small *Carlia* with mid-dorsal scales weakly to moderately tricarinate and moderately regular in alignment; distinguishable from *C. foliorum* by stronger dorsal keels and broader, fainter, less extensive white stripe on side of head and body; and distinguishable from *C. gracilis* by larger palpebral disc and broader, more depressed, less cylindrical body. Further distinguishable in Northern Territory from *C. foliorum* and *C. gracilis* by more numerous supraciliaries (usually 7 vs usually 5).

Distribution

Wet north-west corner of Northern Territory in vicinity of Darwin. Far north of Western Australia (East and West Kimberley).

Description

Snout-vent length (mm): 28-42 (N=39, mean 36.3). Tail (% SVL): 120-184 (N=18, mean 159).

Prefrontals usually separated (forming a median suture in one specimen). Supraciliaries in Northern Territory usually 7, occasionally 6 (N=25, mean 6.9); in Western Australia 5-7, mostly 6 (N=10, mean 6.2). Palpebral disc large. Ear aperture much smaller than palpebral disc, longer axis horizontal, with or without a very small lobule anteriorly. Nuchals smooth. Midbody scale rows 28-32 (N=27, mean 30.1). Lamellae under fourth toe: in Northern Territory 24-31 (N=23, mean 26.8); in Western Australia 21-27 (N=10, mean 23.3).

Dorsally and laterally dark olive or dark brown, back dotted with black. Whitish stripe from under eye to top of ear aperture, and occasionally from bottom of ear aperture to foreleg, but stripes often faint or reduced to a remnant in vicinity of ear. In breeding male a red midlateral stripe.

Geographic variation

The isolated Kimberley populations, as described above, differ from the Northern Territory population in having fewer supraciliaries and subdigital lamellae.

Remarks

This seems to be a dying species, surviving only where the widespread *C. foliorum* is scarce or absent.

Paratypes

Northern Territory: Gunn Point (NTR, 10 unnumbered specimens); Darwin, including Rapid Creek and Berrimah (23312, 23315, 23512-6, 32234-5; NTR 249; QM J2619-20, 7789); Tapa Bay, Cox Peninsula (NTR 216-7); 'Northern Territory' (SAM 5367a-c, 5367e).

Western Australia: Cockatoo Springs, 37 km SE of Kununurra (23115-24); Derby (45025-6).

Carlia gracilis sp. nov.

Holotype

R43219 in Western Australian Museum, collected on 14 January 1973 by Messrs L.A. Smith and R.E. Johnstone at Mitchell Plateau, Western Australia, in 14°52'S, 125°50'E.

Diagnosis

A small slender *Carlia* with mid-dorsal scales tricarinate and very regular in longitudinal alignment; distinguishable from *C. rufilatus* by its smaller palpebral disc, absence of white stripe from lores to ear aperture, nuchals usually striate or weakly keeled (rather than smooth), stronger dorsal keels, and fewer supraciliaries (usually 5 rather than usually 7).

Distribution

Far north of Western Australia (North Kimberley south to Mitchell Plateau and east nearly to Wyndham). Far north of Northern Territory south to the Roper River; also Melville Island.

Description

Snout-vent length (mm): 18-41 (N=143, mean 34.0). Tail (%SVL): 123-195 (N=41, mean 161).

Prefrontals usually separated (just touching in one specimen, forming a median suture in two specimens). Supraciliaries usually 5 (90% of specimens), occasionally 6, rarely 7 (N=140, mean 5.1). Palpebral disc small (occupying not much more than half of lower eyelid). Ear aperture usually smaller than palpebral disc, longer axis usually horizontal, with 0-3 (usually one) very small lobule anteriorly. Midbody scale rows 24-32, mostly 28-30 (N=129, mean 28.3), mid-dorsally with three moderately strong keels, each triad of keels widely separated from those of laterally adjacent scales (as depicted for *C. pectoralis* by Mitchell, 1953: 87, fig. 3*b*). Lamellae under fourth toe 19-27 (N=122, mean 23.2).

In Kimberley dorsally and laterally brown or grey, becoming blackish brown on head, face and temples and anterior third of dorsal scales; in breeding male foreleg and anterior half of flanks coppery. In Northern Territory ground colour more coppery and lateral pattern better developed — usually a small streak of white on upper margin of ear aperture occasionally extending forward as a faint subocular line, and less commonly a faint whitish midlateral stripe.

Paratypes

Kimberley Division (W.A.): Kalumburu (13911, 31257, 40477-8, 44469, 44471-4, 44478-9, 44482, 44486-9, 44492, 44500-4); Surveyors Pool, Mitchell Plateau (43133); King River, 14 km S of Wyndham (34596-8).

Northern Territory: Melville Island (NMV D5257); King River (NMV D6142-4); Yirkala (AM 12715*a-h*); Gunn Point (NTR 2-5); Charles Point (NMV D4327); Darwin, including East Point, Rapid Creek and Casuarina Beach (23434-40, 23482-99, 23529-30, 40299-301; NTR 2224-6); Fogg Dam, Humpty Doo (NTR 198); Beatrice Hill (NTM 1603-5); Tortilla Flats, ca 100 km SSE of Darwin (AM 38685); Marrakai (NTM 4599-4604, 5477);

Woolwonga Reserve (AM 38833-7, 38839); Boroalba Creek (AM 40009-10, 40138); Nourlangie Rock (AM 39993); Koongarra (AM 38822-3, 38830, 38832); Cannon Hill (AM 39881); Oenpelli (32255); Coomalie Creek (23759); 11 km N of Adelaide River (24002); 13 km S of Adelaide River (NTR 341); 26 km NE of Pine Creek (23204); Red Lily Lagoon, Daly River (34612-26); upper Roper River (NMV D5137-9, 5141 6); Dryfield Creek (NMV D5130-2, 5134-5), 'Northern Territory' (SAM 5367d).

Carlia triacantha

Leiopisma triacantha Mitchell, 1953, Rec. South Aust. Mus. 11: 88.
Adelaide River, Northern Territory (R.V. Southcott).

Diagnosis

A moderately large and robust *Carlia* with prefrontals usually forming a median suture and mid-dorsal scales irregular in alignment, usually tricarinate, and tending to be tricuspitate; further distinguishable from *C. gracilis* by its larger palpebral disc, larger and more circular ear aperture, and sharper and more numerous ear lobules.

Distribution

Western Australia north of lat. 23°S; including many continental islands from Sir Graham Moore south-west to Barrow. Greater part of the Northern Territory.



Fig. 2. Map of Western Australia and Northern Territory showing location of specimens of *Carlia triacantha*.

Description

Snout-vent length (mm): 21-52 (N=139, mean 39.4). Tail (%SVL): 121-244 (N=66, mean 181).

Prefrontals forming a median suture (90% of specimens), just touching (1%) or narrowly separated (9%). Supraciliaries 4-7, mostly 6 (N=120, mean 5.8). Ear aperture smaller than palpebral disc, usually circular, a lobule on anterior margin and several (up to 8) smaller, more acute lobules around remainder of aperture. Nuchals striate or weakly keeled, occasionally smooth. Midbody scale rows 28-36, mostly 32 (N=108, mean 32.3). Lamellae under fourth toe 21-30 (N=119, mean 25.0).

Head brown; back and tail greyish brown, thickly dotted with greyish black, dots more prominent on tail and tending to align. In breeding male head and face shining coppery green, back bluish grey, lower flanks anteriorly red.

Material

Kimberley Division (W.A.): Sir Graham Moore Island (44014, 44058-60); Kalumburu (27926-34, 40504, 43546, 44470, 44475-6, 44480-1, 44483-5, 44490-1, 44493); King Edward River (28197-202, 28207, 28225-7); South-west Osborne Island (44115, 44118); South-east Osborne Island (44119); Crystal Creek (43082-99); Mitchell Plateau (43240-3, 44270); Boongaree Island (44099); Bigge Island (41448, 41454); Coronation Islands (41417-8); St Andrew Island (44145); Augustus Island (41503); Heywood Islands (40454, 41375-6, 41378, 41381-4); Champagne Island (41436); 18 km E of Kuri Bay (40428); Uwins Island (44128-30); Koolan Island (27921, 45012-4); 11 km SE of Wyndham (23093); Parry Creek (44056); 37 km ESE of Wyndham (23100-2); Lake Argyle (42770, 42775-6, 42817-8, 42828-9, 44507-12, 44514-6, 44520-2); Inglis Gap (27925); Frazier Downs (27917, 27919).

North-west Division (W.A.): Barrow Island (45413, 45731); Hooley 34729).

Eastern Division (W.A.): Pollock Hills (45178).

Northern Territory: Gunn Point (NTR, 2 specimens); Darwin (32336-8; NMV D4680; NTR 288; QM J13690-1); 48 km S of Darwin (37149); Stapleton (NMV D1217); 33 km S of Adelaide River (23778, 37115); 5 km NW of Pine Creek (23219, 23783); Eva Valley (NTR 125); 20 km E of Katherine (NMV D10760); Balbirini (16° 41'S, 135° 30'E) (NTM 5621-2); Kintore Range (23° 21'S, 129° 23'E) (JSE 243, 256a-b); Mt Olga (JSE 83a-b).

Carlia amax sp. nov.

Holotype

R43350 in Western Australian Museum, collected on 22 February 1973 by Messrs L.A. Smith and R.E. Johnstone at Mitchell Plateau, Western Australia, in 14° 52'S, 125° 50'E.

Diagnosis

A small *Carlia* with mid-dorsal scales bicarinate, distinguishable from *C.j. johnstonei* by its much smaller ear aperture with fewer lobules, fewer rows of midbody scales (mostly 30-32 rather than mostly 34-38) and fewer supraciliaries (usually 6 rather than usually 7), and from *C.j. grandensis* by its much paler coloration.

Distribution

Far north of Western Australia south to lat. 16°30'S; also Heywood, Wood and Koolan Islands. Far north and north-east of the Northern Territory south to the watershed between the Gulf of Carpentaria and the Barkly Tableland; also Groote Eylandt, Maria Island and the Sir Edward Pellew Group.



Fig. 3. Map of part of Western Australia and Northern Territory showing location of specimens of *Carlia amax*.

Description

Snout-vent length (mm): 17-40 (N=111, mean 32.5). Length of tail (% SVL): 111-187 (N=47, mean 147).

Prefrontals narrowly separated or forming a median suture. Supraciliaries 6 (occasionally 5 or 7, rarely 8). Upper ciliaries partly hidden under brow. Ear aperture much smaller than palpebral disc, longer axis horizontal, usually a very small lobule on anterior margin, occasionally one or two minute lobules on other margins. Nuchals striate or weakly keeled. Mid-body scale rows 26-35, mostly 30-32 (N=83, mean 30.9), mid-dorsally bicuspidate with two strong mucronate keels, keels not well aligned longitudinally. Lamellae under fourth toe 19-28 (N=91, mean 22.7).

Dorsally and laterally dark brown, without pattern, except occasionally

for a fine greenish white line under eye and white edging to ear aperture. In breeding male head becoming coppery and back greyish.

Geographic variation

Kimberley specimens differ from Northern Territory specimens in the higher frequency of contiguous prefrontals (55 vs 16% of individuals) and in having fewer subdigital lamellae (mean 21.3 vs 23.0).

Remarks

This species is named after the Amax (Bauxite) Corporation, whose hospitality enabled my colleagues Lawrence A. Smith and Ronald E. Johnstone to spend six weeks on the Mitchell Plateau during the wet season of 1972-3.

Mitchell (1953: 85) included this species in *C. vivax* of Queensland. However, *C. vivax* differs from *C. amax* in having:

- (1) a ridged back (i.e. body tending to be triangular in section);
- (2) a tendency to form pale dorsolateral and midlateral stripes;
- (3) fewer supraciliaries (usually 5);
- (4) prefrontals more widely separated;
- (5) anterior ear lobule very large and obtuse;
- (6) more numerous lamellae under fourth toe (23-29, mean of 10 specimens 25.8).

Paratypes

Kimberley Division (W.A.): Kalumburu (44477); Port Warrender (45024); Mitchell Plateau (40472-4, 42523-5, 43194, 43196-7, 43348-9, 43351); Heywood Islands (40457); Kunmunya (40716); Wood Islands (44174-5); Koolan Island (45015); Wyndham (32359); Ninbing (27923-4); Ord Dam, Lake Argyle (44513).

Northern Territory: Mt Borradaile (NTM 4550-2); Oenpelli (37154-63); Cannon Hill (AM 39683-4, 39882); Koongarra (AM 38815-6, 38818-20, 38824, 38826-7, 38829, 38831, 39994-5); Muirella Park (NTM 5013); Deaf Adder Creek (AM 40253-4; NTM 5011, 5045); Darwin, including Stuart Park and Berrimah (23313-4, 23466-8; NTR 219; NMV D632, 1670, 2539, 2719, 5161; QM J2246); 27 km SE of Darwin (23696); Howard Springs (23625-6); Batchelor (37121-5); Coomalie Creek (23526-7, 23758); 13 km S of Adelaide River (NTR 336-7); 26 km NE of Pine Creek (23202-3); Pine Creek (23199-200); Katherine (19900, 21923, 21929, 23154-60); 32 km N of Larrimah (23799); Gorrie (AM 12837); Larrimah (24140-1, 24147); Maria Island (NTM 5738, 5742, 5747); Craggy Island, Sir Edward Pellew Group (40310); Bing Bong (SAM 13531a-b, 13536); Borroloola (NMV D5105, 5112); Nicholson River (17° 49'S, 137° 13'E) (NTM 3891); Springvale (NTM 3892).

Carlia johnstonei johnstonei subsp. nov.

Holotype

R43170 in Western Australian Museum, collected by Messrs L.A. Smith

and R.E. Johnstone on 28 January 1973 at Mitchell Plateau, Western Australia, in 14° 52'S, 125° 50'E.

Diagnosis

A small dark *Carlia* with mid-dorsal scales bicarinate, distinguishable from *C. amax* by its more numerous midbody scale rows (mostly 34-38 vs 30-32), more numerous supraciliaries (usually 7 vs 6), larger and more circular ear aperture margined with longer and more numerous lobules, and weaker but more regularly aligned dorsal keels.

Distribution

Sub-humid north-west coast of the Kimberley Division and adjacent plateaux; also several continental islands.



Fig. 4. Map of part of Western Australia and Northern Territory showing location of specimens of *Carlia rufilatus*, *Carlia gracilis*, *Carlia johnstonei johnstonei* and *Carlia johnstonei grandensis*.

Description

Snout-vent length (mm): 19-43 (N=100, mean 35.0). Tail (% SVL): 103-173 (N=36, mean 137).

Prefrontals separated (95% of specimens) or just touching (3%) or forming a median suture (2%). Supraciliaries usually 7, occasionally 6, rarely 8 (N=91, mean 6.9). Ear aperture usually a little smaller than palpebral disc, circular or vertically elliptical with one moderately large acute lobule anteriorly and 6-12 smaller acute lobules on other margins. Nuchals smooth or striate, occasionally weakly keeled. Midbody scale rows 32-40, mostly 34-38 (N=59, mean 35.4), mid-dorsally with moderately strong well-aligned keels. Lamellae under fourth toe 20-26 (N=75, mean 23.0).

Dorsally and laterally blackish brown; back and sides occasionally flecked

with pale brown and greyish white. Ventrally bluish grey; many scales of chin and throat edged with blackish brown or dark grey. Legs brown flecked with black. In breeding male head, neck and foreback black flecked with white; remainder of back dark chocolate brown flecked with white.

Remarks

This species is named after my assistant Ronald E. Johnstone, who collected much of the type series and many other *Carlia* in the Kimberley Division.

Paratypes

Kimberley Division (W.A.): Middle Osborne Island (40713-5, 41491-2); South-west Osborne Island (41500-2, 44112, 44116-7, 44124-5); South-east Osborne Island (44123); Surveyors Pool, Mitchell Plateau (43136); Amax Camp, Mitchell Plateau (43171, 43174, 43179, 43181, 43195, 43207, 43214-8, 43387, 43488, 44268-9); King Edward River (28224); Katers Island (41477-9); East Montalivet Island (41462); Bigge Island (41449-53); Boongaree Island (44098, 44100-2); Careening Bay (44005-6); Coronation Island (41414-6); Uwins Island (44131-2); Augustus Island (40439, 40445, 40481-2, 41273-8, 41305-16); Heywood Islands (40455-6, 41379-80, 41399-401); 18 km E of Kuri Bay (40418).

Carlia johnstonei grandensis subsp. nov.

Holotype

R13464a in Australian Museum, Sydney, collected on Groote Eylandt, Northern Territory.

Diagnosis

A small dark bicarinate *Carlia*; distinguishable from *C. j. johnstonei* by its fewer midbody scale rows, supraciliaries and ear lobules; and from *C. amax* by its much darker coloration, especially of throat and flanks.

Distribution

Groote Eylandt, off east coast of Northern Territory.

Description (based on holotype and single paratype)

Snout-vent length (mm): 39-42.

Prefrontals separated. Supraciliaries 6. Ear aperture considerably smaller than palpebral disc, longer axis horizontal, with a moderately large, very obtuse lobule on anterior margin. Nuchals striate. Midbody scale rows 30-32, mid-dorsally with two moderately strong keels, not well aligned longitudinally. Lamellae under fourth toe 23-25.

Dorsally dark olive flecked with black. Sides black flecked with greyish white. Scales of lips, chin and throat broadly edged with black; remaining ventral scales greyish white narrowly edged with pale brownish grey.

Remarks

In most respects other than coloration, *C. j. grandensis* is more like *C. amax* than *C. j. johnstonei*. In size and shape of ear aperture and lobule,

C. j. grandensis is most like *C. vivax* of Queensland.

The strange distribution of *C. johnstonei* (disjunct between North Kimberley and Groote Eylandt) is paralleled in the agamid lizard *Diporiphora bilineata margaretae*.

Paratype

Northern Territory: Groote Eylandt (AM 13464b).

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RECORDS
OF THE
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VOLUME 3

PART 3

1975

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ON A COLLECTION OF POLYCHAETA FROM INTERTIDAL AND SHALLOW REEFS NEAR PERTH, WESTERN AUSTRALIA

J.H. DAY*

[Received 18 April 1974. Accepted 22 January 1975. Published 30 June 1975]

INTRODUCTION

In March 1972, Mr L.M. Joll of the Western Australian Museum at Perth sent me 64 samples of Polychaeta. Most of them were collected around Rottneet Island, but a few were from Cape Naturaliste further south and one came from the Cocos Islands in the tropical Indian Ocean. The specimens were collected on rocks or seaweeds at low tide or a few metres below so that the epifauna of such habitats is well represented but the infauna of soft substrata is missing.

The whole collection included 40 species, of which three, namely *Lepidonotus (Thormora) jolli*, *Lepidonotus brunneus* and *Phyllodoce (Anaitides) australis*, are new. The genus *Lepidonotus* was represented by eight species. In order to identify them it was necessary to check the characters of all the 23 species which have been recorded from Australia in 18 publications. As an aid to future workers a table of their diagnostic characters and a summary of locality records has been provided. An attempt has also been made to add to the incomplete accounts of other species described by early workers.

Most of the species recorded here are Australian endemics while others are tropical or cosmopolitan and one, namely *Idanthyrsus armatus*, is subantarctic. The collection is thus a fairly good representation of a sub-tropical fauna in the overlap between the Damperian and Flindersian faunistic provinces.

I wish to thank Mr L.M. Joll and Dr B.R. Wilson for sending me this well-preserved collection and detailed station data. I am also grateful to Dr Patricia Hutchings of the Australian Museum for help with early references.

* Department of Zoology, University of Cape Town. Present address, Australian Museum, Sydney.

STATION DATA

- Station 1: 30 Jan. 1972; Amongst metamorphic rocks at low tide, Cape Naturaliste; moderate to strong wave action; (coll. L.M. Joll).
- Station 2: 16 Jan. 1972; At base of navigation beacon, Cockburn Sound; approximate depth 13 m; (coll. L.M. Joll).
- Station 3: 7 July 1971; Amongst seaweed on limestone reef platforms, North Point, Rottnest I.; depth about 0.5 m; (coll. L.M. Joll).
- Station 4: 30 June 1971; Amongst seaweed on limestone reef platforms, Green I. and North Point, Rottnest I.; depth about 0.5 m; (coll. L.M. Joll).
- Station 5: 14 June 1971; Amongst seaweed on limestone reef platform, Cottesloe, Perth; depth about 0.5 m; (coll. L.M. Joll).
- Station 6: 13 Feb. 1972; Amongst *Caulerpa* in shallow water, Woodman Pt. groyne, Cockburn Sound; (coll. H. Merrifield).
- Station 7: 13 Feb. 1972; Parmelia Bank, 1.6 km west of Woodman Pt. Cockburn Sound. Washings from *Pinna* shells with *Caulerpa*; depth 2-3 m; (coll. B.R. Wilson).
- Station 8: 13 Feb. 1972; Harding Rock, E. side Garden I., Cockburn Sound; from burrows in old coralline limestone; depth 5-7 m; (coll. B.R. Wilson).
- Station 9: 28 Oct. 1971; In shallow marine aquarium tank, Waterman Bay Marine Laboratory, Perth; (coll. L.M. Joll).
- Station 10: 3 April 1972; Dunsborough, S.W. Australia; on intertidal granite stones; found with an ophiuroid; (coll. B.R. Wilson).
- Station 11: Jan. 1972; Front Reef, Cocos I. Indian Ocean.

The number of specimens of each species is given in parenthesis against each of these numbered collecting stations in the systematic section, e.g. Sta. 5(3).

SYSTEMATIC SECTION

FAMILY POLYNOIDAE

Notes on Australian species of the genus *Lepidonotus*

Descriptions of the numerous species of *Lepidonotus* recorded from Australia are spread through many publications and it is hoped that the table of characters given below will save the time of future workers. A key would be ideal but several of the early descriptions are very incomplete, some of the records are probably based on misidentifications and some of the species may be synonyms. For these reasons the characters of the various species are tabulated in well defined groups and the workers responsible for

the records are listed. Records followed by an asterisk (*) are from this paper.

The genus Hermenia is distinguished from *Lepidonotus* by having the spinules on the blades of the neurosetae reduced to two stout spines; the neurosetae are thus really unidentate but appear tridentate. The elytra are small and covered with macrotubercles to the very margin.

The subgenus Thormora is distinguished from *Lepidonotus sensu stricto* by the possession of two types of notosetae, i.e. an outer palisade or normal serrated notosetae and a central group of long, very fine and completely smooth notosetae often referred to as *Thormora* setae. The two types of setae are so well marked that several workers have accorded *Thormora* the rank of full genus in spite of the fact that in all other respects it is similar to *Lepidonotus*. As shown in the description of *L. (Th.) jolli*, the *Thormora* setae may be restricted to a few feet or be present in all of them; for this reason *Thormora* is regarded as a subgenus. The distinctions between the several species of *Thormora* are summarised in the remarks under *L. (Th.) jolli*.

Lepidonotus sensu stricto. The very numerous species of this genus may be grouped according to two main characters namely the presence or absence of a fringe of soft papillae on the margins of the elytra and the possession of unidentate or bidentate neurosetae. Usually the four groups distinguished in this way are clear-cut but there are a few difficult species. The marginal papillae may be very small or they may arise near the margin but not actually from it; again the secondary tooth on the neurosetae is occasionally obsolescent.

Many other characters may be used as subdivisions of the four main groups. A few species have only one or two notosetae while the great majority have many. Most species have a subterminal swelling to the antennae and dorsal cirri but a few have not; some have a facial tubercle on the upper lip and some have the posterior part of the prostomium covered by a nuchal fold; probably all these characters are affected by the method of preservation to some degree. Many species have one or two dark bands on the antennae and dorsal cirri, others have dark bars on the dorsum while the elytra may be pale or characteristically marked or uniformly dark. These colour markings are very useful in fresh material but tend to fade on storage. Of all the characters, the most useful are the chitinous tubercles on the elytra but even these must be interpreted with caution. The surface of an elytron is chitinised to varying degrees. If the chitin is thick the tubercles retain their shape and ornamentation even in viscid mounting media and may be smooth, granular, thornlike or spinous like pine cones. However, if the chitin is thin, then transfer to a viscid mounting medium may cause shrinkage and even smooth tubercles become lumpy or develop ridges or starlike projections. It is as well to check the sculpture of the tubercles in the normal preservative before the elytron is transferred to the mounting medium.

SPECIES OF *HERMENIA* RECORDED FROM AUSTRALIA

Species	Diagnostic characters	Records
<i>Lepidonotus acantholepis</i> Grube = <i>Hermenia acantholepis</i> Grube 1875.	Neurosetae unidentate with only two spines; elytra with granular macro-tubercles to margin.	Abrolhos Islands W. Aust. (Fauvel 1922).

SPECIES OF *LEPIDONOTUS* RECORDED FROM AUSTRALIA

Species	Diagnostic characters	Records
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Group A: *Lepidonotus* (*Thormora*) with two types of notosetae.

<i>L. (Th.) jukesii</i> var. <i>rubra</i> Augener 1913 = <i>L. (Th.) jukesii</i> Baird 1865. <i>Thormora johnstoni</i> Monro 1931 (non kbg.) = <i>L. (Th.) jukesii</i> Baird.	<i>Thormora</i> setae with spear-shaped tips; tubercles bluntly conical, smooth.	? Australia (Baird 1865, Haswell 1883); Sharks Bay (Augener 1913); Cp. Jau- bert. N.W. Aust. (Augener 1922b); Qld. (Monro 1924, 1931); Sydney and Pt. Hacking (Augener 1927); Rottnest I. (x).
<i>L. (Th.) versicolor</i> Ehlers 1901.	<i>Thormora</i> setae with spear-shaped tips; larger tubercles granular.	Rottnest I., W. Aust. and New South Wales (Augener 1913). Referred to <i>L. (Th.) jukesii</i> by Augener 1927.
<i>L. (Th.) jolli</i> n. sp.	<i>Thormora</i> setae with plain tips; larger tubercles ovoid and spinous.	Cockburn Sound, Rottnest I., Perth, all W. Aust. (x).

Group B1: *Lepidonotus* with fringed margins to the elytra and unidentate neurosetae.

<i>L. aeololepis</i> Haswell 1883.	Elytra with polygonal 'figures' and dark blue spots; neurosetae with few rows of spinules.	Thursday I., (Haswell 1883)
<i>L. adspersus</i> Grube 1878.	Elytra mottled brown and covered with smooth conical microtubercles; no macro-tubercles.	Cape York, N. Aust. (Augener 1922c).
<i>L. bowerbankii</i> Baird 1865 (sensu Fauvel 1917).	Elytra marbled brown; a few smooth conical macro-tubercles best marked on posterior elytra; numerous thornlike and pedunculate microtubercles.	Australia (Baird 1865); Gulf of St Vincent (Fauvel 1917); Perth and Cockburn Sound (x).

<i>L. dictyolepis</i> Haswell 1883.	Elytra divided into polygonal areas, some brown others pale; numerous tubercles, the larger smoothly ovoid, the smaller often lobed.	Sydney (Haswell 1883, Augener 1927); Cockburn Sound (x).
<i>L. polychromus</i> Schmarda 1861.	Elytra marbled and covered with numerous round or conical microtubercles and a few larger ones.	Fremantle and Koombana Bay (Augener 1913); Tasmania (Monro 1939).
<i>L. yorkianus</i> Augener 1922.	Elytra with a dark central spot; surface covered with small to large smooth, ovoid tubercles.	Cape York, Queensland (Augener 1922c).

Group B2: *Lepidonotus* with fringed margins to the elytra and bidentate neurosetae.

<i>L. carinulatus</i> Grube 1870.	Elytra brown or grey; tubercles weakly chitinised, the larger pustulate, the smaller with blunt projections or carina.	Abrolhos Islands W. Aust. (Fauvel 1922); Perth and Cockburn Sound (x). Moreton Bay (Rullier 1965).
<i>L. furcillatus</i> Ehlers 1901.	Elytra with a central dark spot; numerous conical microtubercles; few noto-setae.	Shark Bay and Cockburn Sound (Augener 1913).
<i>L. jacksoni</i> Kinberg 1855.	Elytra brown with a white patch; tubercles numerous, large ones conical and granular, small ones starlike.	Sydney (Kinberg 1855, Haswell 1883, Augener 1922a); Tasmania (Benham 1915); off New South Wales (Augener 1927).
<i>L. torresiensis</i> Haswell 1883.	Elytra grey with a dark spot; tubercles few, prominent, either conical or clavate; neurosetae obscurely bidentate.	Thursday I., (Haswell 1883).

Group C1: *Lepidonotus* with smooth margins to the elytra and unidentate neurosetae.

<i>L. striatus</i> Kinberg 1855 = <i>Hyperhalosydna striata</i> Kinberg.	Holotype broken; complete worm with about 22 pairs of elytra having a girdle of microtubercles (see Augener 1922a).	Sydney (Kinberg 1855 Haswell 1883); Gt Barrier Reef (Monro 1924). New South Wales and Victoria (Augener 1927); Moreton Bay (Rullier 1965).
--------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------

<i>L. argus</i> Quatrefages 1865 = <i>L. (Th.) argus fide</i> Haswell.	Elytra pale with 1-2 dark central marks; macro- tubercles ovoid and sculp- tured like pine cones; mic- rotubercles either spiny or claviform.	Port Western (Western Port, Vic ?) (Quatrefages 1865); Sydney (Haswell 1883); Gulf of St Vincent (Fauvel 1917).
<i>L. brunneus</i> n. sp.	Elytra brown; no macro- tubercles; numerous smooth microtubercles; antennae uniformly taper- ed.	Cockburn Sound, (x).
<i>L. cristatus</i> Grube 1878.	Elytra with tumid bilobed crests; macrotubercles spi- nous; microtubercles stel- late; notosetae with blunt tips.	Torres Straits (McIntosh 1885); Abrolhos Islands (Fauvel 1922); King's Sound, W. Aust. (Monro 1928a).
<i>L. impatiens</i> (Sav.) var. <i>meridionalis</i> Augener 1913.	Elytra speckled brown; a few conical macrotubercles with 1-3 points and numerous microtubercles with 1-4 points; notosetae short with naked, pointed tips.	Koombana Bay (Augener 1913).
<i>L. oculatus</i> Baird 1865.	Elytra speckled and cover- ed with thorn-like micro- tubercles plus a few mush- room-shaped or flaskshap- ed forms; neurosetae stout with blunt tips.	Western Port (Baird 1865; Haswell 1883); Gulf of St Vincent and St Francis Is. (Fauvel 1917); Abrolhos I., W. Aust. (Fauvel 1922); Cp. Jaubert, N. Aust. (Augener 1922b); Pt. Phillip, S. Aust. (Monro 1928a).
<i>L. stephensoni</i> Monro 1931.	Anterior half of elytra with numerous hemispherical microtubercles, usually smooth, sometimes keeled; about 4 weakly serrated notosetae.	Low Isles Queensland (Monro 1931).
Group C2: <i>Lepidonotus</i> with smooth margins to elytra and bidentate neurosetae.		
<i>L. australis</i> Schmarda 1861 and <i>L. stellatus</i> Baird 1865 = <i>L. glaucus</i> Peters 1854.	Elytra grey to blue with divergent ridges from ely- trophore to posterior mar- gin bearing low carinate tubercles; a few coarsely serrated notosetae.	Australia (Baird 1865, Has- well 1883); Shark Bay and Albany (Augener 1913); Gulf of St Vincent (Fauvel 1917); Cp. Jaubert, N. Aust. (Augener 1922b).

<i>L. lissolepis</i> Haswell 1883.	Elytra slate brown with the pigment in lobed corpuscles; surface (?) smooth.	Port Stephens (Haswell 1883).
<i>L. melanogrammus</i> Haswell 1883.	Elytra with crescentric brown markings, the pigment cells being in polygonal groups; a small group of microtubercles on the anterior margin; only 1-2 short serrated notosetae.	Port Stephens (Haswell 1883); St Vincent Bay, S. Aust. (Fauvel 1917); Pt Jackson (Augener 1927); Dunsborough, S.W. Aust. (x).
<i>L. hedleyi</i> Benham 1915 = <i>L. purpureus</i> Potts 1910.	Elytra grey to purple with a scattering of clear ovoid microtubercles, sometimes lobed or carinate.	Kingston, S.A. (Benham 1915).
<i>L. simplicipes</i> Haswell 1883.	Elytra delicate 'with a band of very minute processes near the outer border'. Notosetae 'absent'.	Western Port (Haswell 1883).

Lepidonotus (Thormora) jolli sp. nov.

Fig. 1a-f

Type locality:

0.5 m on limestone reef, North Point, Rottneest I., Western Australia; lat. 31° 59' S; long. 115° 30' E.

Holotype

WAM 129-74.

Paratypes

WAM 79-72 (19 specimens); University of Cape Town (2 specimens).

Records

Sta. 2 (2), sta. 3 (5), sta. 4 (4), sta. 5 (1), sta. 6 (5), sta. 7 (10), sta. 8 (1).

Description

Holotype 17 mm long by 4 mm for 27 segments; paratypes 7 mm to 29 mm. Prostomium hexagonal (fig. 1d) with the anterior part grey; anterior pair of eyes larger and more lateral; no nuchal fold; median antenna twice prostomial length with a well marked subterminal swelling and terminal filament; lateral antennae shorter but otherwise similar to median. All three antennae terminal in origin with basal and subterminal dark bands. Palps with six ciliated ridges. Tentacular cirri similar to antennae but slightly longer and with 4-5 setae arising from the cirrophore.

Body oblong, generally pale but with median segmental spots where not covered by elytra. Elytra 12, covering body, broadly oval in outline, not fringed, mottled brown with a darker elevated area over the elythrochore. Elytra of paratypes pale to rust brown with the first pair often paler than the rest. Surface of all elytra covered with numerous tubercles of varying size, the largest more central, the smaller ones scattered over the whole surface. Individual large tubercles (fig. 1e) shaped like pine cones and often bent over; centre brown and surface covered with conical spinules. Small tubercles colourless, bluntly conical and covered with irregular spinules.

Parapodia (fig. 1f) of the usual shape with a small notopodium and a large neuropodium ending in equal presetal and postsetal lips. Dorsal cirrus mounted on a swollen cirrophore; cirrostyle with a dark band, a subterminal swelling and a terminal filament. Ventral cirri abruptly tapered before the terminal filament. Notosetae very numerous, usually including an outer palisade of shorter setae and an inner group of long, fine, smooth *Thormora* setae. *Thormora* setae present on all notopodia of small specimens, reduced in posterior notopodia of some larger specimens and restricted to a few anterior notopodia of one large specimen. Individual setae of outer palisade (fig. 1b) closely serrated apart from a fairly long naked tip. Individual *Thormora* setae (fig. 1a) one third the diameter of the serrated setae, completely smooth and uniformly tapered to the finely pointed tip, without any sign of a spear-shaped end. Neurosetae numerous, almost twice as stout as the serrated notosetae and all similar. Blades of individual neurosetae (fig. 1c) with about 12 rows of spinules and long unidentate tips; rows of spinules coarser distally, the terminal row including two spines.

Remarks

According to Hartman (1959, 1965) who ranks *Thormora* as a full genus, all the species listed below should be referred to *Thormora*. *L. (Th.) jukesii* Baird 1865 (the type species) from New Zealand and the Philippine Islands, *L. (Th.) johnstoni* Kinberg 1885 from Pacific Panama, *L. (Th.) notata* Hoagnad from Porto Rico, *L. (Th.) socialis* Kinberg 1855 from Eimeo I., Pacific and *L. (Th.) taeniatus* Ehlers 1887 from Florida. To this list must be added *L. (Th.) versicolor* Ehlers 1901 from Juan Fernandez I. listed by Seidler 1924 and the present species *L. (Th.) jolli*. *L. (Th.) jukesii* var. *rubra* Augener 1913 is clearly no more than a colour variety of the type species.

L. (Th.) jolli differs from all other species of the subgenus in having uniformly tapered tips to the *Thormora* setae instead of spear-shaped tips. Apart from this distinction it comes closest to *L. (Th.) versicolor* which Augener 1913 has also recorded from Rottneest I. off Fremantle. He does not describe the *Thormora* setae but Ehlers' figures of the type show them to be spear-shaped and the larger tubercles are shown as granular, not spinous. Apart from these two differences the two species appear to be identical and Augener reports that in *L. (Th.) versicolor* the number of



Fig. 1: *Lepidonotus (Thormora) jolli* a *Thormora* seta; b normal serrated notoseta; c neuroseta; d head and anterior segments; e side view of tubercles on elytron; f anterior view of foot. *Lepidonotus bowerbankii* g shorter notoseta; h long tapering notoseta; i neuroseta; j microtubercles on elytron; k posterior elytron; l microtubercles on elytron. *Lepidonotus dictyolepis* m posterior view of foot; n ornamentation on clytron; o elytron; p notoseta; q neuroseta.

Thormora setae varies from one specimen to another. *L. (Th.) notatus* is said to have smooth elytra and so does *L. (Th.) johnstoni* so the two may be conspecific. *L. (Th.) socialis* has a weak marginal fringe on the elytra and *L. (Th.) taeniatus* as redescribed by Seidler (1924) has elytra with strong thornlike tubercles and small rounded ones. It should also be remembered that large specimens of *L. (Th.) jolli* have the *Thormora setae* restricted to a few anterior feet; such a specimen could easily be mistaken for a species of *Lepidonotus sensu stricto*. Haswell (1883) referred *L. argus* to the subgenus *Thormora* and certainly the specimens of *L. argus* described by Fauvel (1917) are very close to *L. (Th.) jolli* apart from the absence of *Thormora setae*.

Lepidonotus (Thormora) jukesii Baird, 1865

Thormora jukesii: Baird, 1865: 199; Haswell: 1883: 277; Monro, 1924: 37.

Lepidonotus (Thormora) jukesii var. *rubra*: Augener, 1913: 107; Augener, 1922b: 11; Augener, 1927: 101.

Thormora johnstoni: Monro, 1931: 4.

Lepidonotus (Thormora) jukesii: Seidler, 1924: 88; Fauvel, 1953: 37, fig. 13 o-r; Day, 1967: 80, fig. 1.13.g-m.

Records

Sta. 3 (1).

Remarks

The single specimen is typical with black segmental marks on the dorsum, dark bands on the antennae and dorsal cirri and dark elytra with a pale area over the elythrochore. The tubercles on the elytra are smooth and bluntly conical and the *Thormora setae* have spear-shaped tips. As Augener (1927) has noted, his variety *rubra* differs only in having reddish brown elytra instead of dark ones, a colour variation which is common in many species of *Lepidonotus*.

Distribution

Indo-west-Pacific from the Red Sea to Japan and Mocambique to New Zealand. Australian records include Port Molle, Queensland, Low Isles, Cape Jaubert.

Lepidonotus bowerbankii Baird, 1865.

(Fig. 1 g-l)

Lepidonotus Bowerbankii: Baird, 1865: 185; Haswell, 1883: 284; Fauvel, 1917: 178, pl. 4, fig. 5-7, text-fig. 6 a-d.

Records

Sta. 5 (1), sta. 6 (2), sta. 7 (8).

Description

Body depressed, oblong to elongate-oval, up to 16 mm long for 25 setigers. Dorsum uniformly pale but elytra variably pigmented; some specimens with pale yellowish elytra, others speckled, others blotched with brown. A well-developed facial tubercle. Prostomium rectangular to hexagonal, sunken, and partly covered posteriorly by a nuchal fold. Eyes lateral with the two pairs rather close together, the anterior pair slightly larger. Median antenna twice prostomial length and only slightly longer than the laterals. All antennae, tentacular cirri and dorsal cirri tapered with only a slight indication of a subterminal swelling but no dark bands. Tentacular cirri longer than antennae and apparently lack setae on their cirrophores. Palps short, hardly longer than antennae with abruptly tapered tips.

Parapodia normally developed with rather small notopodia bearing numerous setae, stout bilabiate neuropodia and well-tapered ventral cirri. Dorsal cirri with rather long cirrophores but tips of cirrostyles seldom reaching ends of neurosetae. Elytra (fig. 1k) fairly large, imbricating and covering dorsum; external margins thickly fringed with soft papillae. Surface arched and pale over elytriphore and usually marked with a central dark spot but colour otherwise variable. Surface with a few macrotubercles and numerous microtubercles but none intermediate in size. Macrotubercles 2-12 in number, usually 4-5 and often larger on posterior elytra. Each macrotubercle (fig. 1l) quite smooth, conical and occasionally curved. Microtubercles (fig. 1j) over whole elytron surface; majority like small blunt thorns but some spherical and pedunculate like captive balloons and a few intermediates with a projecting tip to the sphere.

Notosetae numerous including a superior row of short coarse serrated forms with blunt tips (fig. 1g) and numerous longer forms (fig. 1h) closely serrated and tapering to fine tips. Neurosetae (fig. 1i) all stout with about eight rows of spinules preceding long, unidentate and slightly curved ends; no sign of a secondary tooth.

Remarks

Baird's original description of *L. bowerbankii* which is repeated by Haswell (1883) and Seidler (1924), is too brief to provide certain identification. Monro (1939) who examined Baird's type suggested that it is synonymous with *L. polychromus* Schmarda 1861 from New Zealand. Augener (1913) who examined Schmarda's type of *L. polychromus* and Knox (1956) who examined many specimens from New Zealand do not support Monro's suggestion. The present specimens agree in detail with the specimen identified by Fauvel (1917) as *L. bowerbankii* but, as Fauvel noted, Baird made no

mention of macrotubercles; this is not altogether surprising as the macrotubercles are only obvious on posterior elytra. At my request, Dr David George kindly checked Baird's type in the British Museum and found that macrotubercles are indeed present.

Distribution

Port Jackson, Gulf of St Vincent, W. Australia (Perth and Cockburn Sound).

Lepidonotus dictyolepis Haswell, 1883

(Fig. 1 m-l)

Lepidonotus dictyolepis Haswell 1883: 287, pl. 9, figs. 7, 8; Seidler, 1924: 25; Augener, 1927: 94, text fig. 3.

Records

Sta. 7 (2), sta. 8 (2).

Description

Body depressed and oblong, about 12 mm long for 25 setigers. Dorsum not pigmented but elytra speckled brown. A facial tubercle present. Prostomium hexagonal, anterior eyes lateral and larger than posterior pair. Median antenna twice prostomial length and slightly longer than laterals. Tentacular cirri longer than antennae but otherwise similar. All antennae, tentacular cirri and dorsal cirri simply tapered, there being no subterminal swelling or dark band. Parapodia (fig. 1m) normal with a fair sized notopodium and much larger neuropodium. Dorsal cirri mounted on rather long, somewhat swollen cirrophores with the tips of the cirrostyles barely reaching the tips of the neurosetae. Ventral cirri small. Elytra (fig. 1o) oval to reniform, overlapping in the median line; surface divided into polygonal areas which are larger centrally and smaller peripherally; external margin fringed with short stout papillae. Some polygonal areas chestnut brown, others paler and yet others colourless giving a speckled effect. Several large polygonal areas with smooth, bluntly conical tubercles (fig. 1n) and many small peripheral areas with smaller tubercles either conical or bilobed. All tubercles well chitinised and either colourless or brown. Notosetae (fig. 1p) numerous, slender and densely serrated to their finely tapered tips, the serrations resembling a series of overlapping cusps. Neurosetae (fig. 1q) very stout with only 4-5 rows of spinules which become coarser distally; naked tips slightly curved and unidentate.

Remarks

The beautiful elytra with their polygonal areas, blunt tubercles and stout marginal papillae are quite characteristic. Haswell states that the polygonal

areas are 'divided by narrow cuticular ribs' but this is an error possibly due to the method of preservation. Actually the polygonal areas are covered with thick cuticle and tend to be slightly swollen where not elevated to form tubercles and the divisions between them are slightly sunken. *L. dictyolepis* is allied to *L. aeololepis* Haswell; the main differences are that in the latter no tubercles were seen on the elytra which were marked with blue spots, also there were blue bands on the antennae and blue spots on the ventrum. *L. melanogrammus* Haswell also has the elytra divided into polygonal areas.

Distribution

An Australian endemic; from Sydney along the South Australian coast to South-West Australia.

Lepidonotus carinulatus Grube, 1870

(Fig. 2 a-f)

Polynoe (Lepidonotus) carinulatus: Grube, 1870: 488; 1878: 26, pl. 3, fig. 2.

Lepidonotus carinulatus: Fauvel, 1919: 330; Augener, 1922c: 8, text-fig. 3, 3a, 3b; Seidler, 1924: 72; Fauvel, 1953: 34.

Records

Sta. 5 (1), sta. 7 (3), sta. 8 (1).

Description

Body oblong, up to 16 mm for 25 setigers. A large facial tubercle. Prostomium hexagonal with a small nuchal fold; anterior pair of eyes lateral and larger than posterior pair; median antenna over twice the prostomial length with a subterminal swelling and two brown bands, one basally and one preceding the swelling. Lateral antennae similar but shorter; tentacular cirri similar but longer. Palps stout, abruptly tapered to slender tips. Dorsum not pigmented. Parapodia (fig. 2f) with a small notopodium bearing numerous fine notosetae; neuropodium stout with about 20 strong neurosetae; ventral cirri small and tapered. Dorsal cirri mounted on short swollen cirrophores; cirrostyles extending beyond ends of neurosetae and having a dark band preceding a subterminal swelling and filiform tip. Elytra, oval to reniform, (fig. 2c) arched over elytriphore, imbricating over back and completely covering body. External margin with a well-developed fringe: surface covered with low, weakly chitinised tubercles varying in size; larger ones more central but always mixed with numerous smaller ones. Largest tubercles (fig. 2e) smooth and hemispherical like well-raised blisters, smaller ones (fig. 2d) usually with ridges or short blunt projections; all ornamentation accentuated in viscid mounting media, the smaller tubercles becoming starlike and larger

ones often becoming irregular. Intensity of pigmentation of elytra variable; some specimens straw-yellow, some speckled, some rust-brown or dark grey, the pigment occasionally forming a network between the colourless tubercles. Notosetae (fig. 2a) mainly fine and closely serrated to their hair-like tips but a few peripheral ones short with blunt tips. Neurosetae (fig. 2b) stout and bidentate with 5-8 rows of spinules which become coarser distally; one or two inferior neurosetae unidentate.

Remarks

This well-known Indo-Pacific species has been redescribed in some detail because it has often been misidentified and confused with *L. jacksoni*. Augener (1922c) who re-examined Grube's types found that even Grube (1878) when identifying material from the Philippines has misidentified four out of five specimens. I agree with Augener that the specimen described and figured by Horst (1917) as *L. carinulatus* belongs to another species. The reason for the confusion is that the tubercles on the elytra are variable and their ornamentation is affected by the mounting medium. In addition Grube originally described the neurosetae as unidentate.

Distribution

Indo-west-Pacific from the Mediterranean to Madagascar and the Philippines to Australia; Australian records include Perth, Cockburn Sound, Houtman Abrolhos I.

Lepidonotus glaucus Peters, 1854

Polynoe glauca: Peters, 1854: 610.

Lepidonotus glaucus: Day, 1957: 60 with synonymy; Day 1967: 84, fig. 1.14. j-m.

Lepidonotus stellatus: Baird, 1865: 185; Haswell, 1883: 283; Augener, 1913: 98; Fauvel, 1917: 175, pl. 4 fig. 15-17; Augener, 1922b: 6.

Polynoe australis: Schmarda, 1861: 154 (*Homonym*).

Polynoe grisea: Quatrefages, 1865: 250.

Antinoe (?) *grisea*: Haswell, 1883: 288.

Records

Sta. 5 (1 juvenile), sta. 7 (1).

Remarks

As many workers have noted, this species is characterised by bidentate neurosetae and greyish blue elytra which lack a marginal fringe and have a

pair of divergent keels running back from the centre. The keels are beset with low carinate tubercles. This species has often been referred to as *L. stellatus* but Baird's name is predated by Peters' *Polynoe glauca*, the type of which I have examined.

Distribution

Indo-west-Pacific; Australian records include Shark Bay, Albany, Port Jackson, Gulf of St Vincent, Cape Jaubert; Perth and Cockburn Sound.

Lepidonotus brunneus sp. nov.

(Fig. 2 g-k)

Type locality:

Among *Caulerpa*, 0-1 m, Woodman Point, Cockburn Sound, Western Australia; lat. 32° 8' S; long. 115° 45' E.

Holotype

WAM 42-72.

Records

Sta. 6 (1).

Description

Body oblong, depressed, 9 mm long for 25 setigers; no pigmentation apart from the brown elytra. Prostomium (fig. 2h) roughly oblong, retracted back between the anterior pair of parapodia and partly covered by an occipital fold. A large pointed facial tubercle below the median antenna. Anterior pair of eyes larger and lateral in position; posterior pair smaller and partly covered by the occipital fold. All three antennae terminal in origin and smoothly tapered without a subterminal swelling; median twice prostomial length, laterals slightly shorter. Cirrophores of tentacular cirri close against sides of prostomium and without visible setae; cirrostyles similar to antennae but longer. Palps small, smooth and tapered (possibly regenerating). Parapodia (fig. 2i) with rather small notopodia and stout, obliquely truncate neuropodia. Dorsal cirri with rather long cirrophores and tapered cirrostyles similar to antennae and just reaching ends of neurosetae. Ventral cirri normally tapered. Elytron scars 12, but only one elytron still attached to setiger 5. Elytron (fig. 2g) almost oval with a straight anterior margin, brown on exposed part fading to colourless anteriorly where covered by preceding elytron. Margin not fringed. Surface with numerous small tubercles varying in size, all appearing as refringent spots against the brown background; individual tubercles (fig. 2g) hemispherical to bluntly conical, without spinules or granules. Notosetae (fig. 2j) numerous, fine and closely



Fig. 2: *Lepidonotus carinulatus* a notoseta; b neuroseta; c elytron; d microtubercles, e macrotubercles; f anterior view of foot. *Lepidonotus brunneus* g elytron with details of tubercles; h head and anterior segments; i posterior view of foot; j notoseta; k neuroseta. *Lepidonotus melanogrammus* l notoseta; m neuroseta; n elytron, o details of tubercles on anterior margin; p pigment pattern.

serrated to their hairlike tips. Neurosetae (fig. 2k) stout with 8-10 rows of spinules which become stronger distally and beyond the spinules a slightly curved unidentate tip.

Remarks

L. brunneus is similar in many respects to *L. lissolepis* Haswell 1883, *L. obscurus* Gravier 1901 and *L. purpureus* Potts 1910 but all three are said to have bidentate neurosetae. I hesitate to erect yet another species of *Lepidonotus* on the basis of a single specimen but none of the species described by Augener (1913), Fauvel (1917), Ilorst (1917) or Seidler (1924) has similar characters.

Lepidonotus melanogrammus Haswell, 1883

(Fig. 21n)

Lepidonotus melanogrammus: Haswell 1883: 284, pl. 8, fig. 13; Fauvel, 1917: 176, pl. 4 fig. 18-19; Seidler, 1924: 84, Augener, 1927: 97.

Records

Sta. 10 (1).

Remarks

This species is characterised by the possession of only one or two notosetae (fig. 2l), elytra without a marginal fringe (fig. 2n) and only a few microtubercles (fig. 2o) on the anterior margin. There are crescentic brown markings on the elytra with the pigment cells arranged in polygonal groups (fig. 2p). The neurosetae (fig. 2m) are bidentate in anterior feet but the tip is merely flanged in posterior feet.

Fauvel reported that there are no tubercles on the elytra but as there is only a small patch of microtubercles on the anterior margin this is not surprising. Two other very similar species were reported from Australia by Haswell (1883) namely *L. striatus* Kinberg and *L. simplicipes* Haswell. Both have only 1-2 notosetae, bidentate neurosetae and elytra without a marginal fringe. According to Augener (1922a) in his revision of Kinberg's types, the holotype of *L. striatus* is incomplete and the complete worm has 23 pairs of elytra and should be referred to the genus *Hyperhalosydna*. *L. simplicipes* is described by Haswell as having elytra 'with a band of very minute processes near the outer border.' The elytra are not figured but if the minute processes are microtubercles and not soft papillae *L. simplicipes* is indeed close to *L. melanogrammus*.

Distribution

Broughton I., Port Stephens and St. Francis I., Great Australian Bay.

Harmothoe praeclara Haswell, 1883

Antinoe praeclara: Haswell, 1883: 290, pl. 9 figs. 10-12.

(?) *Antinoe ascidiicola*: Haswell, 1883: 291, pl. 9 fig. 16.

Harmothoe waahli (non Kinberg): Augener, 1913: 112, pl. 2 fig. 9; Monro, 1938: 614.

Harmothoe praeclara: Augener, 1922a: 14, fig. 4, 4a, 4b; Augener 1927: 107.

Harmothoe terminocolata: Monro, 1924: 42, figs 5, 6.

Records

Sta. 6 (4), sta. 7 (6).

Diagnosis

Body up to 15 mm long with 37 setigers; greenish brown bars on dorsum and marks on antennae, cirrophores of dorsal cirri and notopodia. Prostomium with well-marked frontolateral peaks and anterior pair of eyes anteroventral. All appendages weakly papillose. Elytra large, delicate, deciduous and speckled brown; surface densely covered with cylindrical to bluntly conical microtubercles and, on the posterior half, with scattered soft papillae. Soft papillae more numerous near margin but actual margin with only a few short papillae. Notosetae numerous, as stout as neurosetae, well serrated up to the fairly long naked and bluntly pointed tip. Neurosetae bidentate with a weak secondary tooth. Anal cirri long; no caudal appendage.

Remarks

Haswell's description is incomplete and *H. praeclara* has been confused with *H. waahli* Kinberg by Augener (1913) and Monro (1938). Augener (1922a) when redescribing Kinberg's type of *H. waahli* corrected his earlier mistake, noting that *H. waahli* lacks soft papillae on the elytra. Monro's description of *H. terminocolata* is identical with the diagnosis given above. As judged by Haswell's very brief description of *Antinoe ascidiicola* it differs only in the occasional presence of pear-shaped vesicles near the posterior margins of the elytra. In this it is similar to the European *H. imbricata*.

Distribution

Shark Bay, Swan River estuary, Warnbro Sound, Port Jackson, Cockburn Sound.

Iphione muricata Savigny, 1818

Polynoe muricata: Savigny, 1818: 308, pl. 3, fig. 1.

Iphione muricata: Gravier, 1901: 226, pl. 9 figs. 129-135; Augener, 1922b: 5; Augener, 1922c: 6; Day, 1967: 43, fig. 1, 3 a-f.

Iphione fimbriata: Quatrefages, 1865: 271; Haswell, 1883: 277.

Records

Sta. 11 (1).

Distribution

Tropical Indo-west-Pacific; Australian records include Bowen and Torres Straits N.A.), Cape Jaubert (N.W.A.), Low Isles (Queensland).

Lepidasthenia michaelsoni Augener, 1913

Lepidasthenia michaelsoni: Augener, 1913: 109, pl. 2 figs. 15-16, text-fig. 4 a-c; Seidler, 1924: 159.

Lepidasthenia terrae-reginae: Monro 1931: 6, text-fig. 3 a-d.

Records

Sta. 7 (3).

Remarks

This species has been well described and figured by Augener. The diagnostic characters include the papillose margin of the nuchal fold, the large elytra with a central dark spot, the lack of notosetae, the presence of 1-4 fine superior notosetae which end in faintly knobbed unidentate tips, the numerous bidentate neurosetae below and the dark pigmentation on the dorsum. This varies from one specimen to another but always decreases in intensity posteriorly. When well developed the anterior dorsum is almost black with six longitudinal stripes almost merging with one another but interrupted every third or fourth segment by a pale segment, so that the whole worm has a series of broad cross bars. Further back the longitudinal streaks are broken to form a checker-board pattern and towards the tail this fades to a greenish brown. The pigment on the dorsum extends on to the elythrophones and dorsal cirrophores.

Monro maintains that *L. terrae-reginae* is distinguished by the absence of the fine superior neurosetae after the 30th. setiger and the smaller nuchal organ'. However, the fine neurosetae decrease with age and the nuchal fold is often distorted by preservation. *L. michaelsoni* is also close to a specimen described by Fauvel (1917) as *L. comma*, but according to Monro (1924), Fauvel's specimen is not *L. comma* Thomson but a new species which Monro names *L. phillippensis*. It differs from *L. michaelsoni* in the absence of a papillose nuchal fold, in the presence of denticles on the convex side of the apex of the neurosetae and in the decreased size of the posterior elytra.

Distribution

Cockburn Sound (W.A.), Low Isles (Queensland).

FAMILY AMPHINOMIDAE

Eurythoe complanata Pallas, 1766)

Aphrodite complanata: Pallas, 1766: 27.

Eurythoe complanata: Fauvel, 1953: 83, fig. 38 b-m; Day, 1967: 128, fig. 3. 2. a-h.

Records

Sta. 3 (36 juveniles).

Distribution

Circumtropical; in Australia it has been recorded as far south as Rottneest I. on the west coast and Low Isles on the east coast but probably extends much further south.

FAMILY PHYLLODOCIDAE

Eulalia magalaensis Kinberg, 1865.

Eulalia magalaensis: Kinberg, 1865: 241.

Eulalia magalaensis: Ehlers, 1901: 73, pl. 8 figs. 1-8.

Steggoa magalhaensis (sic): Bergström, 1914: 129, fig. 35.

Records

Sta. 6 (1).

Remarks

This species has been well described by both Ehlers and Bergström. The diagnostic features are the long, lancet-shaped dorsal cirri, the three separate and distinct tentacular segments and the tentacular formula: $1 + S_1^1 + S_N^1$.

Distribution

This is a new record for Australia. It is known from Chile, Kerguelen I., New Zealand and Antarctica.

Eulalia sp.

Records

Sta. 3 (1).

Remarks

The single specimen is 25 mm long and a uniform yellowish brown in alcohol. The prostomium is cordate with the median antenna arising well in advance of the eyes. The proboscis is missing. The first tentacular segment is fused to the head and not visible dorsally; the second and third are distinct and separate, the second having a median boss which fits into the concavity of the prostomium. The tentacular formula is $1 + S_1^1 + S_N^1$ with V2 flattened and the dorsal cirrus of segment 4 smaller than subsequent ones. The dorsal cirri are cordate with the apex pointed throughout. The setigerous lobe is blunt and the ventral cirri are pointed and equal to the setigerous lobes. The setae have serrated shaft-heads without any enlarged denticles and the blades are short, dagger-shaped and serrated.

These characters agree in general with those of *Eulalia (Eumida) sanguinea* but as the proboscis is missing positive identification is impossible. *E. (E.) sanguinea* has not been recorded from Australia but Augener (1913) records *E. (E.) strigata* Ehlers, the type locality of which is the Magellan area of South America. Neither Ehlers nor Augener describe the proboscis so that reference to the subgenus *Eumida* remains doubtful. Moreover Augener describes the specimens from Shark Bay and Cockburn Sound as having rusty brown dorsal cirri whereas those of Ehlers' type were not.

Phyllodoce (Anaitides) australis sp. nov.

(Fig. 3 a-c)

Type locality

Among seaweeds on limestone reef platform, Cottesloe, Perth, Western Australia; lat 32° S; long 115° 45' S.

Holotype

WAM 78-72; an ovigerous female, about 75 mm long, 1 mm wide with 250 segments; large reddish eggs visible through skin.

Paratypes

WAM 130-74, one adult and two juveniles.

Records

Sta. 4 (1), sta. 5 (1 + 2 juveniles).

Description

A very slender worm with a black collar on segments 4 and 5, three rows of faint spots on subsequent segments, dark dorsal cirri on segment 4, a brownish stain on subsequent ones and paired midventral dots on anterior segments. Adult paratype with only a single row of dorsal spots behind the black collar; juvenile paratype of 15 mm without a black collar.

Prostomium (fig. 3 a) cordate, longer than broad; eyes large, superior frontal antennae longer than the inferior pair; a very small occipital papilla in the posterior notch. Base of proboscis with six lateral rows of small papillae with about 10 papillae per row: distal part of proboscis with six lumpy ridges.

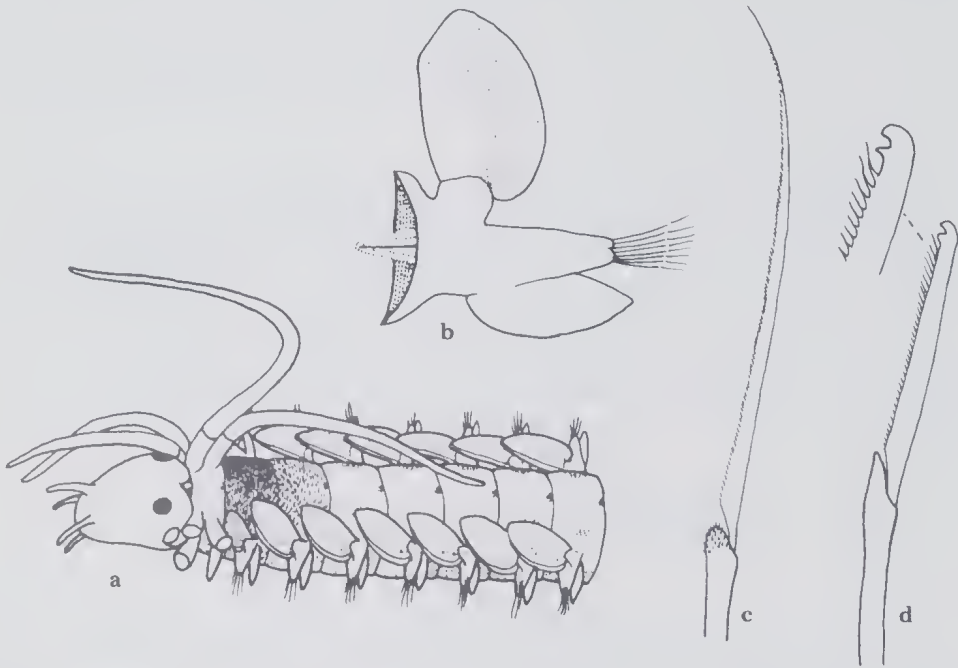


Fig. 3: *Phyllodoce (Anaitides) australis* (a) anterior end; (b) parapodium from mid-region; c seta. *Syllis* sp. B d superior seta.

All three tentacular segments fused dorsally and the first fused to the prostomium; four pairs of cylindrical tentacular cirri; no setae or setigerous lobe on any tentacular segment; tentacular formula: $1 + O_1^1 + O_N^1$. Tentacular cirrus 1 arising from side of head with a small papilla below. Tentacular cirrus D2 dorsal in origin and reaching back to setiger 6 (segment 9); V2 short with a minute papilla below: D3 lateral in origin and V3 a normal lamellar ventral cirrus but smaller than subsequent ones. Dorsal cirrus of segment 4 (setiger 1) dark coloured and smaller than subsequent ones.

Body very slender with segments well arched and three times broader than long. Parapodia long, slightly tapered and end in a pair of subequal blunt lobes. Dorsal cirri mounted on well-developed cirrophores; anterior ones symmetrically oval but later ones almost rhomboidal (fig. 3 b) and tinged with brown. Ventral cirri oval with the pointed apex longer than the

setigerous lobe. Setae (fig. 3 c), about 8 per foot with minutely denticulated shaft-heads and fairly long serrated blades.

Remarks

This species does not fit completely into any of the genera defined by Bergström (1914). The regular lateral rows of papillae at the base of the proboscis suggest *Anaitides* but the fusion of the tentacular segments does not agree. In this respect it is closer to *Paranaites* but this should have setae on the third tentacular segment. I regard the various genera defined by Bergström as subgenera and feel that this species fits best into *Anaitides*.

The dark collar on segments 4 and 5 is reminiscent of *Ph. longipes* but the latter has the superior lobe of the foot long and pointed whereas here the two lobes are subequal and blunt. The proboscis and tentacular formula agree with *Ph. (A.) madeirensis* but the fusion of the tentacular segments and the black collar are quite different. *Ph. (A.) duplex* McIntosh 1885 dredged off S. Australia is incompletely described but seems similar to *Ph. (A.) madeirensis*. Probably *Ph. (A.) australis* comes closest to *Ph. (A.) tenuissima* Grube which was recorded from Australia by Augener (1927). The extreme slenderness of the body, the papillae on the proboscis and the nature of the tentacular segments all agree but again the colour pattern is quite different.

A point of considerable interest is the nature of the small papillae below tentacular cirri 1 and V2. They are certainly not homologous with setigerous lobes and it is presumed that they are sensory; they are easily overlooked.

FAMILY SYLLIDAE

Syllis (Typosyllis) sp. A

Records

Sta. 3 (1).

Remarks

Body 6 mm long, colourless in alcohol apart from brown marks on prostomium and palps. Palps fused at origin; pharynx short with the dorsal tooth one fifth the way back; antennae and dorsal cirri slender, not tapered, distinctly jointed, those of middle segments alternately longer with about 20 joints and shorter with 15 joints. Setae with rather short bidentate blades with the secondary tooth well developed.

Many species of *Syllis* have been recorded from Australia particularly by Augener (1913), Fauvel (1917), Haswell (1920) and Augener (1927). The present specimen is closest to *S. hyalina* but more material is required for definite determination.

Syllis (Typosyllis) sp. B.
(Fig. 3 d)

Records

Sta. 6 (1).

Remarks

Body 8 mm long and colourless in alcohol apart from tinges of brown on the palps. Palps quite separate; prostomium with anterior ocular specks as well as two pairs of eyes. Pharynx with an anterior dorsal tooth and a lobe of the dorsal lip extending back into the mouth. Dorsal cirri of middle segments with 25-30 well marked joints. Falcigerous setae with strongly bidentate blades, the two teeth projecting at right angles to the axis of the blade; blades of 2-3 superior setae (fig. 3 d) longer than usual and having the last few spinules preceding the second tooth elongated.

This specimen has many resemblances to *S. variegata* but lacks the characteristic broken brown bars on the dorsum and the setae are different; they are closer to the setae of *S. augneri* Haswell and *S. bouvieri* Gravier. There are so many species allied to *S. variegata* that more material is required for positive identification.

Syllis (Typosyllis) cirropunctata Michel, 1909

Syllis cirropunctata: Michel, 1909: 318.

Syllis cirropunctata: Fauvel, 1923: 266, fig. 99 n-p; Day, 1967: 250, fig. 12.4 . k-l.

Records

Sta. 4 (1).

Remarks

This is a new record for Australia but the specimen is quite typical. The pigmentation is characteristic with black speckles on the antennae, dorsal cirri and between the parapodia both dorsally and ventrally. The dorsal cirri are stout, hardly tapered and have 35-45 close-set joints. The setae have short unidentate blades and the inferior ones have hooked blades without spinules on the cutting edge.

Distribution

Mediterranean, South Africa.

Opisthosyllis brunnea Langerhans, 1879

Opisthosyllis brunnea: Langerhans, 1879: 541.

Opisthosyllis brunnea: Augener, 1918: 274, text-fig. 25; Day, 1967: fig. 12.5. c-e.

Records

Sta. 4 (2 + 1 juvenile).

Remarks

The diagnostic features are: body stout, easily broken, up to 20 mm long. Surface smooth (no papillae) and pinkish brown: an occipital flap covering half the prostomium: pharynx thick-walled with a posterior dorsal tooth; dorsal cirri markedly tapered and alternate ones have 25 and 40 joints; strong falcigerous setae with short, hooked, unidentate blades.

This is a new record for Australia but the specimens are identical with South African material except that the dorsal cirri have more joints (25-40 vs. 20-28). In this respect they are closer to *O. australis* Augener (1913). The latter, however, has scattered papillae on the dorsum and parapodia and the anterior setae have bidentate blades.

Distribution

Madeira, tropical West Africa, South Africa, Mocambique.

FAMILY NEREIDAE

Nereis (Nereis) cockburnensis Augener, 1913

Nereis cockburnensis: Augener, 1913: 153, pl. 3 fig. 47, text-fig. 15 a-c; Hartman, 1954: 33, figs. 30-32.

Records

Sta. 1 (3).

Remarks

Diagnostic features include: Pharynx with group I = 0-3; V = 1-8; VI = 4-5 in a group; VII+VIII = three to five irregular rows. Anterior feet with two notopodial lobes and posterior feet with the superior notopodial lobe reduced to a long papilla at the base of the dorsal cirrus. Anterior notosetae included both spinigers and homogomph falcigers; posterior notopodial falcigers with 4-5 small teeth on the blade.

Distribution

Endemic to Australia; recorded from Shark Bay (W.A.) along S.A. to Broken Bay (N.S.W.).

Nereis (Neanthes) vaalii Kinberg, 1866

Neanthes vaalii: Kinberg, 1866: 171.

Nereis albanyensis: Augener, 1913: 149, pl. 2 fig. 6, text-fig. 14 a-c.

Nereis vaali: Augener, 1922c: 20.

Neanthes vaali: Augener, 1922a: 20, fig. 6-6b; Hartman, 1954: 27, fig. 22-25.

[Non] *Nereis (Neanthes) albanyensis*: Kott, 1951: 106.

Records

Sta. 1 (7), sta. 3 (5), sta. 7 (1 heteronereid).

Remarks

This common Australian species has no peculiar characters. The pharynx has group I = 1-2 in line; V = 3-4; VI = 3-5 in a group; VII + VIII = two to three irregular rows. There are touches of brown on the prostomium and paired dorsolateral marks on anterior segments. Anterior feet have two notopodial lobes and a longer dorsal cirrus; posterior feet are essentially similar. The notosetae are homogomph spinigers throughout and the neuropodial falcigers have short hooked blades. In the heteronereid phase the first seven dorsal cirri are thickened and natatory setae start on the 15th to 19th foot.

All the specimens recorded here were small, none over 20 mm but Augener (1913) records specimens from Albany up to 43 mm.

Distribution

An Australian endemic known from Fremantle (W.A.) Albany (S.W.A.) to Sydney (N.S.W.).

Platynereis dumerilii Audouin & Milne-Edwards, 1834

Nereis dumerilii: Audouin & Milne-Edwards, 1834: 196.

Platynereis dumerilii: Fauvel, 1923: 359, fig. 141 a-f; Augener, 1927: 138; Kott, 1951: 110; Day, 1967: 306, fig. 14.4. d-k.

Records

Sta. 4 (1 + 3 juveniles), sta. 5 (21), sta. 6 (1 juvenile).

Remarks

This is a well-known species but Hartman (1954) has recorded a new subspecies *P. dumerilii antipoda* from S. Australia, S.E. Australia and Tasmania so these specimens were examined with particular care. The new subspecies

differs in several minor characters. It has poorly marked paragnaths on group VI, several notopodial falcigers from the middle of the body onwards and there are differences in the parapodial lobes of the female heteronereid which start on setiger 26. *P. dumerilii* has normal paragnaths on group VI, only 2-3 notopodial falcigers from the middle of the body and in the heteronereid the feet change at setigers 22 or 23. No heteronereid was available among these specimens but in other respects they were typical *P. dumerilii* and agree with South African specimens. Augener (1927) noted the presence of 2-3 notopodial falcigers in specimens he reported from New South Wales and Victoria and Kott (1951) recorded numerous specimens from Rottneest Island and Point Peron.

Distribution

Cosmopolitan in temperate and tropical seas; in Australia from Rottneest I., Victoria and New South Wales.

Platynereis australis Schmarda, 1861

Platynereis australis: Benham, 1909: 238, pl. 9 fig. 1; Augener, 1913: 182; Day 1967: 305, fig. 14.4.m.

Platynereis magalhaensis: Fauvel, 1917, 208; Hartman, 1965.

Records

Sta. 5 (1 heteronereid ♂), sta. 6 (1).

Remarks

Both specimens lack notopodial falcigers in posterior feet and in the male heteronereid the first modified foot is the 16th. These characters are mentioned because the synonymy of *P. australis*, *P. magalhaensis* and even *P. dumerilii* is confused. There is no doubt that *P. magalhaensis* lacks notopodial falcigers in posterior feet for Hartman (1948) who re-examined Kinberg's type only found an occasional one in some feet. Most workers regard *P. magalhaensis* Kinberg (1865) as a synonym of *P. australis*, among others Benham (1909) Augener (1924) and Day (1953, 1967). Fauvel (1917) reported a specimen of *P. magalhaensis* from S. Australia and so did Hartman (1934); neither worker reported the presence or absence of notopodial falcigers. Knox (1951, 1960), who agrees with many other workers that *P. magalhaensis* is a synonym of *P. australis*, reports numerous specimens from New Zealand with notopodial falcigers in posterior feet; he also states that in the male heteronereid the modified feet start at setiger 16 and in the female at setiger 31 to 33.

P. australis and *P. magalhaensis* have a similar range in the southern oceans and in spite of some confusion I agree with many workers that they are synonymous.

Distribution

Subantarctic, S. Africa, New Zealand, west and south Australia.

FAMILY EUNICIDAE

Eunice antennata Savigny, 1820

Leodice antennata: Savigny, 1820: 50.

Eunice antennata: Augener, 1913: 270; Fauvel, 1917: 225; Fauvel, 1922: 495; Augener, 1922b: 30; Augener, 1927: 169; Monro, 1931: 21; Kott, 1951: 116; Kott, 1963: 13; Day, 1967: 384, fig. 17. 2.k-q.

Records

Sta. 3 (7 + 3 juveniles) sta. 4 (3 juveniles), sta. 5 (4 juveniles), sta. 9 (1).

Distribution

All warm and tropical seas; all around Australia.

Eunice afra Peters, 1854

Eunice afra: Peters, 1854: 611.

Eunice afra: Monro, 1931: 21; Day, 1967: 392, fig. 17.5.a-e.

Records

Sta. 4 (2 juveniles).

Remarks

There is some doubt about the identification of these juveniles as the branchiae, which start on setiger 23 and extend to the posterior end, are all single filaments. In adults of *E. afra* the gills have 3 to 8 filaments.

Distribution

Tropical Indo-west-Pacific; in Australia it has been recorded from Batt Reef and Low Isles.

Eunice afra paupera Grube, 1878

Eunice afra paupera: Day, 1967: 393.

Records

Sta. 1 (1).

Distribution

Indo-west-Pacific from Mocambique to the Philippine Islands; it has not been recorded from Australia.

Eunice tentaculata Quatrefages, 1865

Eunice tentaculata: Augener, 1913: 275; Fauvel, 1917: 209, text-fig. 17; ? Fauvel, 1922: 495; Day, 1967: 391, fig. 17. 4.s-v.

Records

Sta. 9 (1).

Distribution

Tropical Indian Ocean; west and south Australia, ? Tasmania.

Lysidice ninetta collaris Grube, 1870

Lysidice collaris: Augener, 1913: 286; Fauvel, 1917: 236; Fauvel, 1922: 496; Monro, 1931: 21; Kott, 1951: 123; Day, 1967: 402, fig. 17. 8.a-f.

Lysidice ninetta collaris: Day, 1973: 52.

Records

Sta. 3 (1 + 3 juveniles), sta. 4 (7).

Remarks

Small juveniles of about 30 mm have white bands across setigers 2 and 3; the band on setiger 3 disappears first and then that on setiger 2; specimens of over 40 mm have none. The eyes are always reniform and the antennae hardly reach the front margin of the head.

Augener (1913) recorded *L. brevicornis* Kinberg as well as *L. collaris* and maintained that the former differed by the shorter antennae. I agree with Fauvel that the length of the antennae is affected by preservation and the two are conspecific.

Distribution

Circumtropical; Australian records include W. Australia, S. Australia and Queensland.

Lumbrineris coccinea Renieri, 1894

Nereis coccinea: Renieri, 1804: 35 XIX.

Lumbrineris coccinea: Fauvel, 1923: 432, fig. 172 g-n; Day, 1967: 436, fig. 17. 16.i-m.

Lumbriconereis sphaerocephala Schmarda : Augener, 1913: 288; Augener, 1927: 188.

Lumbrineris sphaerocephala: Knox, 1960: 130.

Records

Sta. 8 (2).

Remarks

These specimens agree with Fauvel's description of European *L. coccinea* and are identical with South African specimens. Augener's descriptions of *L. sphaerocephala* from Australia are also similar as far as they go and the diagnostic characters given by Knox for New Zealand specimens agree perfectly.

Distribution

N. Atlantic, Mediterranean, South Africa, Indian Ocean; *L. sphaerocephala* has been reported from W. Australia, Victoria, New South Wales, New Zealand and the Solomon Islands.

Lumbrineris tetraura Schmarda, 1861

Lumbriconereis impatiens: Fauvel, 1923: 429, fig. 171 a-e.

Lumbrineris tetraura: Day, 1967, 439, fig. 17. 16.u-w.

Records

Sta. 9 (1).

Remarks

This is a new record for Australia but the specimen is typical.

Distribution

Mediterranean, temperate and tropical Atlantic and Indian Ocean.

Arabella mutans Chamberlin, 1919

Cenothrix mutans: Chamberlin, 1919: 330.

Arabella mutans: Day, 1967: 446, fig. 17. 18.f-h.

Records

Sta. 7 (1 juvenile).

Remarks

This is a new record for Australia but although small it has the characteristic asymmetrically winged acicular setae. The better known *A. iricolor* has

also been recorded from West Australia by Augener (1913) under the name *A. multidentata* Ehlers. Augener (1927) recorded another specimen from Port Jackson.

Distribution

Warm N. and S. Atlantic, tropical Indian Ocean, Solomon I., Easter I.

FAMILY ORBINIIDAE

Scoloplos (Scoloplos) cylindrifer Ehlers, 1905

Scoloplos cylindrifer: Ehlers, 1905: 45, pl. 6 figs. 16-19; Augener, 1914: 29, pl. 1 fig. 4.

Haploscoloplos cylindrifer: Monro, 1939: 124, fig. 13; Hartman, 1957: 270.

Scoloplos (Leodamas) dendrobranchus: Hartman, 1957: 291, pl. 33 figs. 1-3.

Records

Sta. 6 (4 + 4 juveniles).

Remarks

The published descriptions of *S. cylindrifer* and *S. dendrobranchus* differ only in the presence of a few small hooks in the thoracic neuropodia of *S. dendrobranchus* and their absence, according to Monro (1939), in *S. cylindrifer*. It was for this reason that he transferred the species to *Haploscoloplos*. At my request Dr David George of the British Museum has recently checked that neuropodial hooks are actually present on Monro's specimens. Augener (1914) makes no comment on the presence or absence of neuropodial hooks. Both species have very characteristic branched branchiae and both are confined to the Australian-New Zealand region; I believe them to be synonymous.

The specimens from station 6 include both juveniles and adults with a maximal length of 40 mm. Diagnostic characters include: Change from thorax to abdomen poorly marked at setiger 15; a single stout foot-papilla on the thoracic neuropodia; branchiae which start on setiger 18 or later, become bifid or trifid on posterior abdominal segments; no intermediate cirrus; no ventral cirri below abdominal neuropodia; notosetae as crenulate capillaries only there being no forked setae; thoracic neurosetae are mainly crenulate capillaries plus a small inferior group of slender, slightly curved and serrated hooks which may be absent from posterior thoracic feet.

In Day (1973) I revised the genera and subgenera of the Orbiniidae. *S. cylindrifer* with branchiae arising subsequent to the 10th setiger is thus transferred from *Scoloplos (Leodamas)* to *Scoloplos (Scoloplos)*.

Distribution

South Australia, Tasmania, New Zealand.

FAMILY SPIONIDAE

Polydora ? ciliata Johnston, 1838

Leucodore ciliatus: Johnston, 1838: 67.

(?) *Polydora ciliata*: Day, 1967: 469, fig. 18. 3. i-j.

Records

Sta. 7 (1).

Remarks

The single specimen is an anterior half and the characters on the posterior half are unknown.

Distribution

Atlantic, Mediterranean and Indo-west-Pacific, *P. ciliata* has been recorded from oysters at Newcastle (NSW) by Haswell (1885).

FAMILY CIRRATULIDAE

Cirriformia filigera Delle Chiaje, 1825

Lumbricus filigerus: Delle Chiaje, 1825: 178.

Audouinia filigera: Fauvel, 1927: 92, fig. 32 h-m; Fauvel, 1953: 331, fig. 173 h-l.

Cirriformia filigera: Day, 1967: 518, fig. 20.4 p-q.

Cirratulus (Timarete) ancylochaeta: Augener, 1914: 53 (partim).

Records

Sta. 6 (8), sta. 7 (2 juveniles).

Remarks

All the specimens are small, mostly broken and partly dried. The largest if complete would measure about 40 mm. The prostomium is broadly conical and lacks eyes, the numerous tentacular cirri form an arc over setigers 4-5 and the branchial filaments are stout and arise as far above the notosetae as the distance between the notosetae and neurosetae.

C. filigera has not been recorded from Australia before but the incomplete description of the many specimens recorded by Augener (1914) under the name *Cirratulus (Timarete) ancylochaeta* suggests that they included *C. filigera* as well as *C. ancylochaeta*; the latter name is a synonym of *C. tentaculata*. Thus he states that the tentacular filaments may arise on any two segments between setigers 4 and 7. He does not mention the shape of the prostomium, the thickness of the branchial filaments or the distance they arise above the notosetae. All these points help to distinguish *C. tentaculata* from *C. filigera*.

Distribution

Worldwide in tropical and subtropical seas.

Cirratulus chrysoderma Claparède, 1868

Cirratulus chrysoderma: Claparède, 1868: 261, pl. 23, fig. 4.

Cirratulus chrysoderma: Fauvel, 1927: 95; Day, 1967: 511, fig. 20. 3.a-d.

Records

Sta. 7 (25 + 2 juveniles).

Remarks

This is a new record for Australia but the specimens agree well with published descriptions. Fauvel noted 2-3 pairs of tentacular cirri but in South African and Australian specimens there may be as many as 8 cirri in distinct groups above setigers 4-7 or 5-8.

Distribution

Mediterranean, South Africa and Indo-west-Pacific.

FAMILY SABELLARIIDAE

Idanthysus armatus Kinberg, 1867

(Fig. 4a)

Idanthysus armatus: Kinberg, 1867: 349.

Pallasia sexungula: Ehlers, 1897: 125, pl. 8 figs. 194-202.

Pallasia armata: Ehlers, 1901: 267.

Idanthysus armatus: Johansson, 1927: 90; Monro, 1930: 177, fig. 73; Hartman, 1966: 73, pl. 24 figs. 2-5.

Records

Sta. 1 (8), sta. 2 (3), sta. 6 (1).

Remarks

It is with some hesitation that I refer these specimens to *I. armatus* and not to *I. pennatus* Peters. The latter has been recorded from Australia by Augener (1914), Fauvel (1917) and Augener (1922c and 1927) while the former is known only from the subantarctic. The small differences between the two species concern the outer paleae and the uncini. The outer paleae of *I. armatus* as figured by Ehlers, Monro and Hartman, have straight shafts with tapering spikes along the sides whereas the paleae of *I. pennatus* are curved with long, slender pinnules along the sides so that the whole palea resembles a feather or palm leaf. The uncini of *I. armatus* have a double row of 5-7 teeth while those of *I. pennatus* have a double row of 7-9.

The present specimens are all small like *I. armatus* with a maximum length of 16 mm. The outer paleae (fig. 4a) are straight or slightly curved and the lateral projections are tapered spikes which become longer than the width of the axis. The uncini have a double row of 6 teeth. It is obvious that the specimens are closer to the description of *I. armatus* but the distinction from *I. pennatus* is slight. Fauvel (1917) has suggested that *I. armatus* is a synonym of *I. pennatus* but all other workers regard them both as valid species. As noted the present specimens are small and they may be juveniles of *I. pennatus*. A larger size range of specimens is needed to settle the question.

Distribution

S. Chile, Magellan area, Falkland Is., S. Georgia.

FAMILY TEREPELLIDAE

Thelepus plagiostoma Schmarda, 1861

Thelepus plagiostoma: Augener, 1914: 95; 1922b: 48; Day, 1967: 729.
fig. 36.5.o.

Records

Sta. 6 (1 + 1 juvenile).

Remarks

Diagnostic characters typical.

Distribution

Indo-west-Pacific and southern oceans.

Nicolea venustula venustula Montagu, 1818

Terebella venustula: Montagu, 1818: 344, pl. 13, fig. 2.

Nicolea venustula venustula: Day, 1967: 735, fig. h-i.

Nicolea venustula: Day 1973a: 356, fig. 4 h-i.

Records

Sta. 7 (10).

Remarks

This is the first valid record of *Nicolea* from Australia. *Nicolea bilobata* Grube was recorded by Augener (1914) but this has lateral lobes on anterior segments and was referred to *Lanicides* by Hessle (1917). *Nicolea cetrata* Ehlers was recorded by Augener (1927) who said that *Nicolea quadrilobata* Augener (1918) was a synonym. This also has lateral lobes on anterior segments and elongated shafts to the first row of uncini. It was referred to *Pista* by Day (1967); it now becomes *Pista cetrata* Ehlers.

The specimens of *N. venustula* recorded here are typical. I have shown earlier (Day 1973a) that *N. gracilibranchis* Grube is a synonym of *N. venustula* and I agree with Monro (1930) that *N. chilensis* is probably another.

Distribution

Cosmopolitan.

FAMILY SERPULIDAE

Galeolaria caespitosa Lamarck, 1818

(Fig. 4 b-g)

Galeolaria caespitosa: Augener, 1914: 144, text fig. 18; Dew 1959: 35, fig. 11; Straughan, 1967: 236.

Records

Sta. 1 (3).

Description

Tube heavy, adnate and rugose with a flat median ridge which projects as a shelf over the mouth. Body dark, about 12 mm long. Branchial crown formed of two semicircles of about 15 blue radioles with 3-4 white bars. Opercular stalk (fig. 4c) median in origin, short, broad and having a pair of dorsal ridges and wide lateral flanges which terminate in triangular wings on either

side of the operculum. Operculum rounded in outline and formed of a number of separate calcareous ossicles supported by a membranous base with marginal rays (fig. 4b). Central ossicle with an oval base bearing a flattened tooth inclined forwards; inner circle of larger ossicles about 14 in number, petaloid in outline, the anterior 3-4 without projections, the 4-5 lateral ones with bladelike projections and the median posterior one again without projections. In larger opercula (fig. 4c) the projections of the lateral ossicles cover most of the basal plates and develop lateral serrations. An outer semicircle of minute ossicles develop on the marginal rays of the membranous base. Collar with paired lateral lobes and a median ventral lobe. Lateral lobes extend back as thoracic membranes to the end of the thorax and unite ventrally as an apron between thorax and abdomen. Thorax of 7 setigers. Collar setae small but similar to notosetae of setigers 2-7 which are all narrow winged capillaries (fig. 4d) with faint striations. Thoracic uncini (fig. 4e, f) with a single series of 7-9 teeth preceding an expanding and emarginate gouge whose thickened margins may simulate diverging prongs. Abdomen of about 75 segments of which the first 10 are achaetous. Abdominal uncini with 11-15 teeth; abdominal capillaries (fig. 4g) 2-3 per neuropodium, with serrated blades set at an angle to the shaft.

Remarks

Apart from the fact that *Galeolaria* has numerous separate ossicles on its operculum, it is very similar to *Pomatoceros*. There seem to be two valid species: *G. caespitosa* colonising rocks at mid-tide in Australia and Tasmania and *G. hystrix* Mörch at extreme low tide and below in Australia and New Zealand. This latter species lacks a large toothed central ossicle, but has very numerous small calcareous spines arranged in two or three concentric circles as shown by Dew (1959, fig. 128).

Serpula vermicularis Linnaeus, 1867

Serpula vermicularis: Augener, 1914: 133; Fauvel, 1927: 351, fig. 120; Dew, 1959: 21, fig. 3; Straughan, 1967: fig. 3a; Day, 1967: 809, fig. 38.5. a-h.

Records

Sta. 2 (1).

Remarks

The present specimen is typical but it should be noted that Straughan has recorded four more species from eastern Australia.

Distribution

Cosmopolitan.

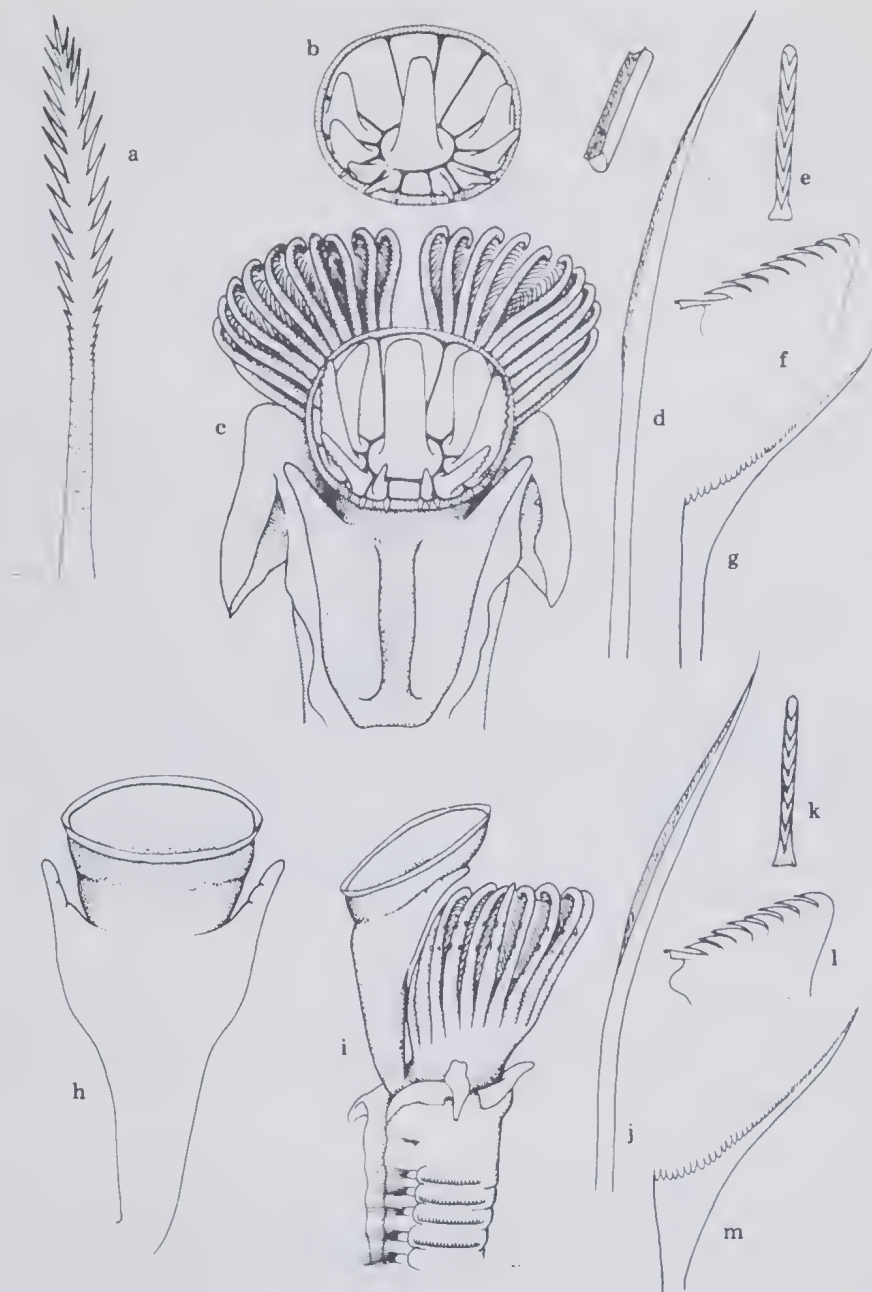


Fig. 4: *Idanthysus armatus* a outer palea. *Galeolaria caespitosa* b operculum of juvenile; c operculum and opercular stalk of adult; d thoracic capillary seta; e, f edge view and profile of thoracic uncinus; g abdominal capillary seta. *Pomatoceros caeruleus* h operculum and stalk; i lateral view of anterior end; j thoracic capillary seta; k, l edge view and profile of thoracic uncinus; m abdominal capillary seta.

Pomatoceros caeruleus Schmarda, 1861
(fig. 4 h-m)

Placostegus caeruleus: Schmarda, 1861: 29, pl. 21 fig. 178 (partim).

Pomatoceros caeruleus: Baird, 1864: 14.

Pomatoceros strigiceps: Ehlers, 1905: 67, pl. 9, fig. 11-19.

Pomatoceros caeruleus: Ehlers, 1907: 30.

Records

Sta. 7(4).

Description

Tube with a sharp median ridge. Body about 12 mm long and uniformly pale in spirit apart from a tinge of blue at the bases of the branchial lobes and 2-4 rows of blue dots on the sides of the radioles. Each branchial lobe with about 13 radioles united by a web for a third their length and ending in short tips. Opercular stalk (fig. 4h) derived from the left side and longer than the radioles, margins flattened and expanded distally forming a pair of triangular wings on either side of operculum. Wings slightly notched in larger specimens. Operculum circular in outline with a fleshy base; surface slightly concave and lightly calcified. Concavity of plate accentuated by a narrow chitinous rim. Collar (fig. 4i) low and trilobed with relatively large fillets between the ventral and paired lateral lobes. Lateral lobes continuous with broad thoracic membranes extending to end of thorax and uniting ventrally to form a short apron at junction of thorax and abdomen. Thorax of seven setigers. Collar setae as a small tuft of smooth-winged capillaries similar to other thoracic notosetae. Notosetae of setigers 2-7 (fig. 4j) all with smooth striated blades; no toothed setae. Thoracic uncini (fig. 4k, l) with a single row of 7-9 teeth preceding a broader emarginate gouge. Abdomen with about 60 setigers and about 4 achaetous segments at junction with thorax. Abdominal uncini with 9 teeth preceding the gouge. Abdominal capillaries (fig. 4m) short, only 2-3 per neuropodium, each with a tapering serrated blade set at an angle to the shaft.

Remarks

I am indebted to Dr H. Zibrowius who has seen many serpulids from both New Zealand and Australia for suggestions regarding the synonymy of this species. Our opinions differ and I am now doubtful whether *P. caeruleus* (Schmarda 1861) is a synonym of *Vermetus cariniferus* (Gray 1843). Gray's species was certainly a serpulid polychaete and not a Mollusc but its generic position is doubtful.

Schmarda's description of *Placostegus caeruleus* was very brief and referred to worms found both in New Zealand and at the Cape of Good Hope, South

Africa. As shown by Baird (1864) and Day (1955) the South African specimens lacked collar setae and were referred to *Pomatoleios kraussi* which is now well known through the warm and tropical waters of the Indo-Pacific. The New Zealand form of *Pomatoceros caeruleus* was first described in detail by Ehlers (1905) under the name of *Pomatoceros strigiceps* Mörch 1863 but in 1907 Ehlers stated that *P. strigiceps* was a synonym of *P. caeruleus*. In the same paper Ehlers also gave a brief account without illustrations of what he called *Spirobranchus* (?) *cariniferus* Gray. His specimens clearly belonged to the genus *Spirobranchus* for he says '... der Form der Borsten, zumal der besonders gestalteten Capillarborsten des ersten thorakalen Borstenbündels als zur Gattung *Spirobranchus* gehörend bezeichnet'. On the other hand the reference to *cariniferus* is, as he says, doubtful for the evidence is slender. He is doubtful of the tube and he says that the opercular plates of all his specimens were missing. Gray stated that *cariniferus* has a rounded horny plate without further details. *Spirobranchus* normally has horny projections arising from the opercular plate. On the evidence at present available I do not believe that Ehlers' *Spirobranchus* was Gray's *cariniferus* so that the generic position of *cariniferus* is open with the possibility that it may be a species of *Pomatoceros*, and possibly identical with *P. caeruleus* as both Hutton (1879) and Baird (1864) believed.

Ehler's (1905) account of the operculum of *P. strigiceps* (= *P. caeruleus*) and Ehler's (1907) account of the operculum of *P. caeruleus* are generally similar but not identical. In 1905 he describes and illustrates the operculum as a bluish calcareous plate encircled by a transparent rim; the plate itself has two small conical projections. In 1907 he states that the two conical projections may be missing and 'die Fläche is dann auch trichterförmig vertieft.' This description is not illustrated but it would agree with my fig. 4h.

The only other valid species of *Pomatoceros* recorded from Australia is *P. terraenovae* Benham 1927, of which the published type locality is South Trinidad in the tropical Atlantic. Dr Zibrowius in a personal letter informs me that he is strongly of the opinion that the locality labels were confused and that Benham's species is Australian. This appears very probable for Dew (1959) and Straughan (1967) between them have recorded it from Queensland, Victoria, Tasmania and South Australia but there is no record from the Atlantic. Again I am indebted to Dr Zibrowius for the information that *P. terraenovae* is a synonym of *P. taeniatus* Lamarck. It differs from *P. caeruleus* in having a convex instead of a slightly concave opercular plate and Dew (1959, fig. 13B) has illustrated a form of *P. taeniatus* with a small conical projection on the operculum.

Distribution (of *P. caeruleus*): New Zealand

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THE GENUS *CTENOTUS* (LACERTILIA, SCINCIDAE) IN THE KIMBERLEY AND NORTH-WEST DIVISIONS OF WESTERN AUSTRALIA

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ABSTRACT

The following 30 taxa are defined and keyed out: *C. pantherinus calx* Storr, *C. pantherinus ocellifer* (Boulenger), *C. pantherinus acripes* nov., *C. grandis* Storr, *C. robustus* Storr, *C. lesueurii* (Duméril & Bibron), *C. alleni* Storr, *C. inornatus* (Gray), *C. fallens* Storr, *C. severus* Storr, *C. helenae* Storr, *C. mastigura mastigura* nov., *C. mastigura burbidgei* nov., *C. youngsoni* nov., *C. mimetes* Storr, *C. uber uber* Storr, *C. militaris* nov., *C. leonhardii* (Sternfeld), *C. serventyi* nov., *C. decaneurus decaneurus* Storr, *C. decaneurus yampiensis* nov., *C. quattuordecimlineatus quattuordecimlineatus* (Sternfeld), *C. quattuordecimlineatus iapetus* nov., *C. quattuordecimlineatus atlas* Storr, *C. piankai piankai* Storr, *C. piankai duricola* nov., *C. colletti colletti* (Boulenger), *C. calurus* Storr, *C. schomburgkii* (Peters), *C. tantillus* nov.

INTRODUCTION

This is the fifth in a series of regional surveys of the genus *Ctenotus*. Previous papers covered the Eastern Division of Western Australia (Storr 1969), the Northern Territory (Storr 1970), South Australia (Storr 1971), and the South-west and Eucla Divisions of Western Australia (Storr 1974).

This paper is based on material in the Western Australian Museum (registered numbers without prefix) and a few specimens borrowed on earlier occasions from the National Museum of Victoria (numbers prefixed with NMV); Australian Museum, Sydney (AM); Museum of Comparative Zoology, Harvard (MCZ); Muséum National d'Histoire Naturelle (Paris); and Zoologisk Museum (Oslo). The number of specimens examined in each taxon were *C. pantherinus calx* (30), *C. p. ocellifer* (51), *C. p. acripes* (28), *C. grandis* (18), *C. robustus* (23), *C. lesueurii* (11), *C. alleni* (9), *C. inornatus* (450), *C. fallens* (282), *C. severus* (31), *C. helenae* (28), *C. m. mastigura* (3), *C. m. burbidgei* (21), *C. youngsoni* (2), *C. mimetes* (4), *C. u. uber* (13), *C. militaris* (18), *C. leonhardii* (43), *C. serventyi* (40), *C. d. decaneurus* (11), *C. d. yampiensis* (3), *C. q. quattuordecimlineatus* (8), *C. q. iapetus* (4), *C. q. atlas*

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(1), *C. p. piankai* (10), *C. p. duricola* (6), *C. c. colletti* (3), *C. calurus* (1), *C. schomburgkii* (6), *C. tantillus* (9).

In the descriptions, quantitative characters are usually expressed as ranges with means in brackets. The term 'palpebrals' here applies to the scales along the free edge of the upper eyelid. The term 'calli' (singular 'callus') refers to thickenings of the subdigital lamellae too broad to be called keels. 'Presuboculars' are the scales aligned with and immediately posterior to the loreals.

Users of the following key having difficulty in identifying specimens should consult my revisions for neighbouring regions. Certain species now known only from the Eastern Division (e.g. *C. ariadnae*) and Northern Territory (e.g. *C. tanamiensis*) could well extend to the present region.

KEY

1. Dorsal and lateral pattern consisting wholly or mainly of black-and-white ocelli; nasal with strong groove behind nostril — *pantherinus* group 2
 No ocelli; post-narial groove weak or absent 4
2. Subdigital lamellae narrowly callose *C. pantherinus calx*
 Subdigital lamellae finely keeled 3
3. Sole of foot smooth *C. pantherinus ocellifer*
 Sole of foot spiny *C. pantherinus acripes*
4. Dorsal and lateral pattern simple and full, i.e. consisting wholly or nearly wholly of alternating dark and pale longitudinal stripes, latter numbering 6 to 14 5
 Dorsal and lateral pattern complex (i.e. including pale blotches, spots, dots and dashes, and/or longitudinal stripes of varying width and colour) or reduced (resulting in wide strips or zones without pattern) 6
5. Subdigital lamellae obtusely keeled or narrowly callose; SVL up to 70 mm — *taeniolatus* group 22
 Subdigital lamellae sharply or finely keeled; SVL up to 50 mm — *colletti* group 28
6. First three of four supraoculars (or first two when only three supraoculars present) in contact with frontal; presuboculars 2 or 1 7

	First two of four supraoculars in contact with frontal; presuboculars 3 — <i>labillardieri</i> group	...	...						<i>C. youngsoni</i>
7.	Dorsal pattern simple, i.e. alternating dark and pale stripes of subequal width; lateral pattern consisting solely of pale dots that tend to align vertically; second loreal pentagonal with angular apex	...	...	...	...	...	...	...	<i>C. grandis</i>
	Dorsal pattern complex or reduced, i.e. longitudinal stripes of varying width and colour, or back mostly unpatterned; pale lateral dots (if any) aligned longitudinally; second loreal quadrilateral with flat or curving top	...	...	...	...	...	...	...	8
8.	Toes cylindrical or compressed; subdigital lamellae smooth or callose (usually widely); first supraocular much narrower than second (except when first and second fused into single scale much the widest of three)	...	...	...	...	...	...	...	9
	Toes compressed; subdigital lamellae keeled or narrowly callose; first supraocular not much narrower than second	...	...	...	...	...	...	...	10
9.	Toes not or only slightly compressed; subdigital lamellae smooth or widely callose; upper lateral zone bearing pale blotches or spots; head, body and tail stout to moderately slender; SVL up to 123 mm; occurring throughout the region — <i>lesueurii</i> group	...	...	...	...	...	...	...	11
	Toes strongly compressed; subdigital lamellae smooth or with wide to moderately narrow calli; upper lateral zone solid blackish or with small pale spots, especially anteriorly; head, body and tail slender; SVL up to 63 mm; occurring only in north-west Kimberley — <i>essingtonu</i> group	...	...	...	...	...	...	...	17
10.	Subdigital lamellae obtusely keeled or narrowly callose; SVL up to 79 mm — <i>leonhardii</i> group	...	...	...	...	...	...	...	18
	Subdigital lamellae finely keeled; SVL up to 51 mm — <i>schomburgkii</i> group	...	...	...	...	...	...	...	29
11.	Upper labials usually 8; suture between second and third supraoculars straight; dark vertebral								

- stripe (when present) usually much narrower than a paravertebral scale 12
- Upper labials usually 7; suture between second and third supraoculars undulating; dark vertebral stripe (when present) as wide or almost as wide as a paravertebral scale *C. robustus*
12. A pale dorsal line on nape between pale paravertebral and dorsolateral lines, continuing forward along outer edge of frontoparietal and frontal *C. lesueurii*
- At most only two pale lines on each side of nape (a paravertebral and a dorsolateral) 13
13. Lamellae under fourth toe 16-26, slightly or not compressed, smooth or widely callose; nuchals seldom more than 3 — *inornatus* sub-group 14
- Lamellae under fourth toe 27-34, moderately compressed, calli of medium width; nuchals usually more than 3 *C. alleni*
14. Well-defined, moderately wide black vertebral stripe with pale edge *C. fallens*
- Vertebral stripe narrow, faint or absent, and without pale edge (except in young *C. inornatus*) 15
15. Narrow but conspicuous white dorsolateral stripe 16
- Dorsolateral stripe normally faint or absent *C. helenae*
16. White dorsolateral stripe narrowly edged above with black and in contact below with dark upper lateral zone *C. inornatus*
- White dorsolateral stripe broadly edged above with black and separated from dark upper lateral zone by hiatus of ground colour *C. severus*
17. Supraoculars 3; vertebral stripe narrow but distinct *C. mastigura mastigura*
- Supraoculars 4; vertebral stripe faint or absent *C. mastigura burbidgei*
18. Some indication of dark vertebral stripe; upper lateral zone dark brown with 1-3 longitudinal series of whitish dots 19
- No pattern between narrow, unspotted black

- laterodorsal stripes; upper lateral zone consisting of alternating dark and pale squarish blotches *C. mimetes*
19. Vertebral stripe very narrow and not pale-edged; no white midlateral stripe 20
 Vertebral stripe moderately narrow and pale-edged; white midlateral stripe present 21
20. No dark dorsal line between dark vertebral stripe and dark laterodorsal stripe (which encloses a series of pale spots); nasals usually separated *C. uber uber*
 A dark dorsal line between vertebral stripe and unspotted laterodorsal stripe; nasals forming a median suture *C. militaris*
21. White midlateral stripe usually extending forward not quite as far as foreleg, occasionally to ear aperture but no further; prefrontals usually separated; midbody scale rows usually more than 26 *C. leonhardii*
 White midlateral stripe extending forward to lores; prefrontals usually in contact; midbody scales rows seldom more than 26 *C. serventyi*
22. No pale upper lateral line between pale dorsolateral and midlateral stripes 23
 One or two pale upper lateral lines 26
23. A pale dorsal line between pale paravertebral and dorsolateral lines 24
 No pale dorsal line between paravertebral and dorsolateral lines 25
24. Nasals in contact; midbody scale rows 24-26 *C. decaneurus decaneurus*
 Nasals separated; midbody scale rows 30-32 *C. decaneurus yampiensis*
25. Midbody scale rows 24-27; habitat sandy ... *C. plankai plankai*
 Midbody scale rows 28-31; habitat stony ... *C. plankai duricola*
26. A pale dorsal line between pale dorsolateral and paravertebral lines 27
 No pale dorsal line between pale dorsolateral and paravertebral lines ... *C. quattuordecimlineatus atlas*
27. One pale upper lateral line (between pale dorsolateral line and pale midlateral stripe)

- *C. quattuordecimlineatus iapetus*
 Two pale upper lateral lines
 *C. quattuordecimlineatus quattuordecimlineatus*
28. Back and sides brown with 12 pale stripes;
 tail pale brown; scales under foot uniformly
 small *C. colletti colletti*
 Back and sides black with 8 whitish stripes;
 tail blue or bluish grey; plantar scales opposite
 fourth toe enlarged and keeled *C. calurus*
29. Nasals separated; upper lateral zone consisting
 of alternating black and reddish vertically
 narrow bars *C. schomburgkii*
 Nasals in contact; upper lateral zone blackish,
 enclosing a series of small whitish spots *C. tantillus*

Ctenotus pantherinus calx

Ctenotus pantherinus calx Storr, 1970, J. Roy. Soc. W. Aust. 52: 99.
 Dunmarra, N.T. (A.J. Coventry & C. Tanner).

Diagnosis

A very large, stout *Ctenotus* whose colour pattern consists wholly of black-and-white ocelli, distinguishable from other subspecies of *C. pantherinus* by subdigital lamellae callose rather than finely keeled.

Distribution

East Kimberley. Extralimital in Northern Territory.

Description

Snout-vent length (mm): 45-110 (96.6). Length of appendages (% SVL): foreleg 24-30 (26.2), hindleg 34-46 (39.0), tail 178-208 (190).

Nasals forming a median suture. Prefrontals usually forming a median suture, occasionally narrowly separated. Supraoculars 4, first 3 in contact with frontal. Supraciliaries usually 7, occasionally 6 or 8 (7.0). Palpebrals 11-15 (12.4). Second loreal 0.9-1.6 (1.12) times as wide as high. Upper labials 8 (rarely 7 or 9). Ear lobules 4-9 (6.2), subacute, usually third or fourth largest. Nuchals 2-4 (2.8). Midbody scale rows 33-40 (36.6). Lamellae under fourth toe 19-23 (21.0), each bearing a narrow to wide callus.

Dorsally and dorsolaterally greenish brown, becoming paler and purplish grey ventrolaterally. Usually 10, occasionally 12, longitudinal series of ocelli, which on tail tend to coalesce into a white, dark-edged midlateral stripe. Subocular labials barred black and white. Lower surfaces, especially of tail, occasionally spotted with grey.

Material

Kimberley Division: 61 km SSE of Wyndham (25090-1); 37 km SE of Kununurra (23125); Lake Argyle (42745, 45569-94).

Ctenotus pantherinus ocellifer

Lygosoma ocelliferum [Boulenger], 1896, Ann. Mag. Nat. Hist. (6) 18: 342.
Roebuck Bay, W.A. (K. Dahl). For synonymy see Storr (1969: 99).

Diagnosis

A large stout *Ctenotus* whose colour pattern consists wholly of black-and-white ocelli, distinguishable from other subspecies of *C. pantherinus* by following combination of characters: finely keeled subdigital lamellae, smooth soles of feet, and lack of black vertebral stripe.

Distribution

Southern third of Kimberley Division, north to Derby (intergrading with *C. p. calx* in east); and northern half of North-west Division, south to the Gascoyne. Extralimital in Eastern and Eucla Divisions of Western Australia, Northern Territory and South Australia.

Description

Snout-vent length (mm): 34-102 (74.2). Length of appendages (% SVL): foreleg 22-33 (26.0), hindleg 32-49 (39.4), tail 141-200 (173).

Nasals forming a median suture. Prefrontals forming a median suture (just touching in one specimen). Supraoculars 4, first 3 in contact with frontal. Supraciliaries usually 7, occasionally 6 or 8. Palpebrals 9-15 (11.9). Second loreal 0.8-1.7 (1.12) times as wide as high. Upper labials 8 (rarely 7 or 9). Ear lobules 3-9 (5.4). Nuchals 1-4 (2.7). Midbody scale rows 32-38 (35.7). Lamellae under fourth toe 20-27 (23.7).

Remarks

Specimens from south-east Kimberley show some intergradation with *C. p. calx*; their nails are dark and the proximal plantars may be considerably enlarged.

Material

Kimberley Division: 83 km SW of Halls Creek (46030); Wolf Creek Meteorite Crater (46063); 26 km E of Bohemia Downs (23050); 56 km SSW of Christmas Creek (45981); 146 km E of McLarty Hills (46036-7); 56 km E of McLarty Hills (45980); Derby (23000); Frazier Downs (27842, 45794-5).

North-west Division: Wallal (1019-21, 45800); 50 km W of Wallal (45979); 52 km E of Port Hedland (46500-2); Mundabullangana (17065,

17293-7); Roebourne (29063); 60 km SE of Mallina (22935); 28 km NE of Bamboo Creek (13212); Braeside (14589); Mt Edgar (17286-90, 22785, 45763); Abydos (10805); Woodstock (17291); Chichester Range (31845); Millstream (20007); 96 km S of Onslow (29112); 28 km SE of Yanrey (17298); Yardie Creek (13272); Marrilla (5046); Winning Pool (17082); 30 km S of Ethel Creek (17292); 32 km NW of Mundiwindi (24008); Turee Creek (25138, 25140); Kumarina (23974-5).

Ctenotus pantherinus acripes subsp. nov.

Holotype

R27843 in Western Australian Museum, collected by W.H. Butler on 2 June 1964 on Barrow I., Western Australia, in 20°45'S, 115°25'E.

Diagnosis

A large stout *Ctenotus* whose colour pattern consists wholly or mainly of black-and-white ocelli, distinguishable from other subspecies of *C. pantherinus* by spiny soles of feet, more numerous midbody scale rows and extremely high keels of subdigital lamellae.

Distribution

Barrow I., Western Australia.

Description

Snout-vent length (mm): 42-94 (67.5). Length of appendages (% SVL): foreleg 24-30 (27.1), hindleg 33-43 (39.0), tail 134-180 (161).

Nasals forming a median suture. Prefrontals usually forming a short to moderately long median suture, occasionally separated very narrowly. Supraoculars 4, first 3 in contact with frontal. Supraciliaries usually 7, occasionally 8, rarely 6 (7.2). Palpebrals 9-14 (11.1). Second loreal 0.9-1.7 (1.17) times as wide as high. Upper labials usually 8, rarely 7 or 9 (8.0). Ear lobules 3-10 (6.1), usually subacute. Nuchals 2-4 (2.8). Midbody scale rows 36-40 (38.0). Lamellae under fourth toe 20-26 (22.9), each with an extremely high, fine keel. Plantar scales tubercular (i.e. conical with high sharp apex).

Back and sides dark olive brown, becoming paler and more purplish ventrolaterally, with 10-12 longitudinal rows of black-and-white ocelli and occasionally a black vertebral stripe. Nails dark brown or black.

Paratypes

North-west Division: Barrow Island (12894, 45415-38, 45674, 45735).

Ctenotus grandis

Ctenotus grandis Storr, 1969, J. Roy. Soc. W. Aust. 51: 100. 38 km ENE of Laverton, W.A. (E.R. & H.L. Pianka).

Diagnosis

A very large *Ctenotus*; back with 5-7 dark brown or black stripes on reddish brown ground (adults) or greenish white ground (juveniles); sides dark with pale dots tending to align vertically; second loreal high, pentagonal, with angular apex.

Distribution

Northern half of North-west Division, south nearly to the Tropic. Extralimital in Eastern Division of Western Australia and Northern Territory.

Description

Snout-vent length (mm): 34-117 (mean 90.0). Length of appendages (% SVL): foreleg 23-29 (25.6), hindleg 37-48 (41.1), tail 152-201 (183).

Nasals narrowly separated or forming a short median suture. Prefrontals usually forming a median suture, occasionally narrowly separated. Supraoculars 4, first 3 in contact with frontal. Supraciliaries 6-9 (8.0). Palpebrals 9-12 (11.0). Second loreal 0.8-1.8 (1.24) times as wide as high. Upper labials usually 8, occasionally 9 (8.1). Ear lobules 4-7 (5.8). Nuchals 2-5 (3.2). Midbody scale rows 34-38 (36.2) on Barrow Island, 32-35 (33.3) on mainland. Lamellae under fourth toe 19-27 (23.4), smooth or weakly callose.

Material

North-west Division: Mundabullangana (17293); Balmoral (28727); Tambrey (20006); Abydos (10804); Woodstock (13093, 13234, 27860-1, 28725); Meentheena (46166-7); North West Cape (28726, 31434); Yardie Creek (13210); Marrilla (5341); 23 km SW of Winning Pool (36103); Barrow Island (28455-6, 40028, 45361).

Ctenotus robustus

Ctenotus robustus Storr, 1970, J. Roy. Soc. W. Aust. 52: 100. 'Barrow Creek', N.T. (W.B. Spencer & F.J. Gillen).

Diagnosis

A very large member of the *lesueurii* group, usually with a very wide black vertebral stripe and 7 upper labials. Further distinguishable from *C. inornatus* by more numerous nuchals (usually 3 or 4 rather than 2 or 3) and third supraciliary usually not much smaller than second.

Distribution

Northern half of Kimberley Division, south to the King Leopold Range

and Lake Argyle. Extralimital in Northern Territory, South Australia and eastern Australia.

Description

Snout-vent length (mm): 39-123 (85.3). Length of appendages (% SVL): foreleg 22-31 (25.9), hindleg 38-47 (41.9), tail 148-223 (191).

Nasals in short contact or narrowly separated. Prefrontals usually in contact (usually short), occasionally separated very narrowly. Supraoculars 4, first 3 in contact with frontal. Supraciliaries 8-11, mostly 10 (9.6), fourth to penultimate much smaller than others and often hidden by strong brow. Palpebrals 10-13 (11.5). Second loreal 1.2-2.1 (1.65) times as wide as high. Upper labials usually 7, occasionally 8 (7.1). Ear lobules 2-5 (3.9), usually obtuse or subacute in juveniles and subadults, and truncate in adults. Nuchals 2-5 (3.4). Midbody scale rows 28-36 (29.8). Lamellae under fourth toe 17-23 (20.2), each with a wide callus (narrower in juveniles).

Dorsally and laterally brown. Broad black vertebral stripe, beginning narrowly on nape and ending on anterior quarter of tail, about as wide as a paravertebral scale, usually edged with white. White dorsolateral line from temples to distal quarter of tail. Upper lateral zone dark brown with one or two series of white dots or short dashes. Narrow white midlateral stripe from lores nearly to end of tail, sometimes broken on side of body into series of short dashes. Lower lateral zone brown, spotted with white.

Geographic variation

At Lake Argyle (but not elsewhere on the Ord) the colour pattern is not so well developed as described above. The vertebral stripe is not so dark or wide and is not or indistinctly pale-edged. The pale dorsolateral and mid-lateral stripes are not so distinct and are less extensive. The upper and lower lateral zones are with or without brownish white flecks.

Ord River specimens differ in their lower midbody scale count (28-30 *vs* 32-36 elsewhere) and high frequency of separated nasals (9 out 12 specimens *vs* one out of 8 elsewhere).

Material

Kimberley Division: Mitchell Plateau (43189-92); Prince Regent River Reserve, 15° 47'S, 125° 20'E (46899); 16 km ESE of Kuri Bay (40392); Moll Gorge (32285); Mt Bell (32266); Kimberley Research Station (22362); Lake Argyle (45552-7, 45560-6); Top Springs (29309).

Ctenotus lesueurii

Lygosoma lesueurii Duméril & Bibron, 1839, *Erpétologie générale* 5: 733. New Holland (F. Péron & C.A. LeSueur). For designation of lectotype, see Storr (1974: 88).

Tiliqua australis Gray, 1839, Ann. Nat. Hist. 2: 291. Australia. For designation of neotype, see Storr (1974: 88).

Diagnosis

A large, long-tailed, long-legged member of the *lesueurii* group, distinguishable from other members by bolder and more complex colour pattern, fewer midbody scale rows and more numerous subdigital lamellae. Further distinguishable from members of the *inornatus* subgroup (*C. fallens*, *severus*, *helenae* etc.) by more numerous nuchals (usually 4, vs seldom more than 3).

Distribution

Coasts and islands of the North-west Division south of the Tropic. Extralimital in South-west Division of Western Australia.

Description

Snout-vent length (mm): 38-93 (73.5). Length of appendages (% SVL): foreleg 24-35 (27.7), hindleg 40-59 (48.8), tail 219-267 (244).

Nasals separated, usually widely. Prefrontals in contact. Supraoculars 4, first 3 in contact with frontal. Supraciliaries usually 7, occasionally 8 (7.2). Palpebrals 10-13 (11.8). Second loreal 1.2-2.1 (1.66) times as wide as high. Upper labials usually 8, occasionally 9 (8.2). Ear lobules 4-6 (4.8), obtuse in juveniles, acute or subacute in adults, third usually largest. Nuchals 3-5 (4.1). Midbody scale rows 24-26 (24.4). Lamellae under fourth toe 23-28 (25.2), smooth or widely callose in adults, more compressed and narrowly callose in juveniles.

Ground colour of adults pale brown or brownish grey. Narrow to moderately wide black vertebral stripe from nape to base of tail, margined with white or brownish white (margins extending forward on to head, following outer edge of frontoparietals and frontal). Inner edge of black laterodorsal stripe margined with white. White dorsolateral line from temples to about middle of tail. Black upper lateral zone with two series of white dots or short dashes. White midlateral stripe fairly wide on tail, narrower on body, and breaking up behind foreleg into a series of dark-edged obliquely vertical bars extending forward to upper lip. Lower lateral zone blackish, dotted white (dots tending to clump into vertical bars). Limbs pale brown, longitudinally striped with dark brown.

Juveniles blackish brown marked with white as follows: on each side a paravertebral line and dorsolateral line (which may break up into a series of spots) and between them a dorsal line; a midlateral stripe, anteriorly breaking up into a series of spots; remainder of flanks with large spots, sometimes so close together ventrolaterally as to leave only a fine black reticulum.

Material

North-west Division: Carnarvon (NMV D1476); Carrarang (39020); Bernier Island (13205, 13207, 34088); Dorre Island (13201, 46525); Dirk Hartog

Island (45813, 45815); holotype (Paris 1892); paralectotype (Paris 1892a).

Ctenotus alleni

Ctenotus alleni Storr, 1974, J. Roy. Soc. W. Aust. 56: 89. 18 km N of Galena, W.A. (N.T. Allen).

Diagnosis

A member of the *lesueurii* group without vertebral stripe, distinguishable from *C. severus* by narrower black laterodorsal stripe and contact between white dorsolateral stripe and black of upper lateral zone; further distinguishable from *C. severus* (and other members of the *inornatus* sub-group) by more numerous nuchals and subdigital lamellae. Distinguishable from the superficially similar *C. mimetes* by wider subdigital lamellae and smaller pale upper lateral spots.

Distribution

Far south-west of North-west Division, north nearly to Shark Bay. Extralimital in South-west Division of Western Australia.

Description (based on all available specimens).

Snout-vent length (mm): 67-87 (76.2). Length of appendages (% SVL): foreleg 24-28 (25.1), hindleg 44-52 (48.0), tail 208-264 (248).

Nasals separated (usually narrowly). Prefrontals forming a median suture (usually short). Supraoculars 4, first 3 in contact with frontal, second wider than first and much wider than third. Supraciliaries 6-8 (7.0). Palpebrals 10-13 (11.7). Second loreal 1.3-1.9 (1.58) times as wide as high. Upper labials 8. Ear lobules 3-6 (5.0). Nuchals 3-5 (3.9). Midbody scale rows 24-28 (26.2). Lamellae under fourth toe 27-34 (28.9), slightly compressed and moderately widely callose.

Dorsally olive brown to reddish brown, with or without a dark median line on nape. Black laterodorsal stripe usually narrow. White dorsolateral stripe becoming pale brown as it extends forward to orbit and back on to tail. Black upper lateral zone marked with white and pale reddish brown; pale dots and short dashes usually arranged in 2-3 longitudinal rows but sometimes forming into a series of circular clusters. White midlateral stripe extending back nearly to end of tail and usually forward to lores. Lower lateral zone blackish brown with one or two series of white dots or short dashes. Limbs pale reddish brown, streaked with blackish brown.

Material

North-west Division: Hamelin Pool (47699).

South-west Division: 18 km N of Galena (33602); 32 km NE of Yuna (26499); 30 km SE of Yuna (47738-40); 29 km N of Tenindewa (47736-7).

Ctenotus inornatus

Hinulia inornata Gray, 1845, Catalogue of the lizards in the British Museum, p. 78. 'Swan River' [probably in error for Port Essington, Northern Territory].

Diagnosis

A member of the *lesueurii* group, *inornatus* sub-group, with conspicuous white dorsolateral line but other elements of pattern tending to disappear with age, especially dark vertebral stripe (which may be absent or reduced to a line on nape and fore-back). Further distinguishable from *robustus* by more numerous labials (usually 8 *vs* usually 7), fewer nuchals (usually 2 or 3 *vs* 3 or 4), and third supraciliary usually much smaller than second.

Distribution

Kimberley Division, excluding extreme south but including numerous continental islands from Sir Graham Moore south-west to Koolan. Extralimital in Northern Territory and Queensland.

Description

Snout-vent length (mm): 29-95 (70.0). Length of appendages (% SVL): foreleg 19-33 (24.4), hindleg 33-54 (42.0), tail 180-298 (231).

Nasals usually separated, occasionally in short contact. Prefrontals forming a median suture (occasionally just touching or very narrowly separated). Supraoculars normally 4, first 3 in contact with frontal, first much narrower than second and occasionally fused to it. Supraciliaries 7-11, mostly 8 or 9 (8.8), third (rarely fourth) to penultimate much smaller than others and often hidden by moderately strong brow. Palpebrals 9-14 (11.1). Second loreal 0.8-1.9 (1.24) times as wide as high. Upper labials 8 (rarely 7 or 9). Ear lobules 3-7 (5.2), usually obtuse in juveniles and subacute in adults. Nuchals usually 2 or 3, occasionally 4, rarely 1, mean 2.6. Midbody scale rows 26-35 (31.6). Lamellae under fourth toe 16-26 (20.9), slightly compressed and widely callose.

Head and back moderately dark brown or olive brown, becoming pale on distal half of tail. Blackish vertebral stripe variably but usually poorly developed, e.g. absent or represented by a line on nape and fore-back or a faint narrow stripe from nape to base of tail with little or no indication of pale edge. Narrow white dorsolateral stripe extending forward to or nearly to level of ear aperture and backward to base of tail (on which it becomes browner and wider), narrowly and indistinctly margined above with blackish. Indistinct whitish or pale grey midlateral stripe of variable width and discernibility, becoming wider, browner and dark-edged on tail. Remainder of sides brown, flecked or mottled with greyish white and blackish brown.

Material

Kimberley Division: Anjo Point (44072); Kalumburu (27829-41, 27857,

40496, 40502-3); King Edward River (28195-6, 28210-2); Crystal Creek, Port Warrender (43002-26, 43030-8, 43048-61); Surveyors Pool, Mitchell Plateau (43122, 43128, 43135, 43138); Amax Camp, Mitchell Plateau (41262, 43182-3, 43231-3, 43266, 43345); Careening Bay (44000-2); Prince Regent River Reserve (46695, 46785, 46799, 46801-8, 46820-1, 46846, 46857, 46897, 46902, 46927-8, 46938-9, 46951, 46960, 46968, 46970, 46975-6, 46978, 46999, 47002, 47011, 47013-4); Secure Bay (27824); Wotjulum, Yampi Sound (11210-2); Mt Hart (24069-70); Inglis Gap (27828); Manning Creek (32302-4, 45072); Forrest River Mission (AM 14204, 26970); Wyndham (32356); Parrys Creek (27826-7); Ninbing (27823); Kimberley Research Station (22354); 45 km SE of Kununurra (23129); Lake Argyle (12341, 42730, 42735-6, 42748, 42755, 42759, 42773, 42888-9, 45439-58, 45474-549); White Mountain, Ord River Station (37008-9); Mary River, 112 km SW of Halls Creek (AM 38672); Louisa Downs (46055); 25 km E of Bohemia Downs (23051); 56 km SSW of Christmas Creek (45982-3); 80 km SSW of Christmas Creek (45993); 25 km SE of Gogo (23040-2); St George Range (32137-40, 32309); Noonkanbah (13478); Mt Anderson (27821-2, 32090-2); Langey Crossing (23016-7); Lombadina (46412); 11 km E of Lombadina (46445); Coulomb Point (40271-2); Broome (14067, 14110, 28242, 31198); Injudinah Swamp (46494); Lagrange (27798-803, 45780-6); Frazier Downs (45991-2); Sir Graham Moore Is (44008-11, 44038-42, 44063-7); South-west Osborne I. (44113); Fenelon I. (40499-501); Katers I. (41471-2, 41481-6); Wollaston I. (41464-5); East Montalivet I. (41459-61); Bigge I. (41439-40); Maret Is (41458); Boongaree I. (44080-3, 44093-4); Coronation Is (40460-3, 41411-3, 41420); Uwins I. (44133); Augustus I. (40446, 41287-94, 41319, 41911); Heywood Is (40450, 41320-66, 41398, 41402-7); Byam Martin I. (44154-6); Champagny I. (41434, 41912); Wood Is (44166-8, 44176-9); Koolan I. (37766, 45052-3).

Ctenotus fallens

Ctenotus fallens Storr, 1974, J. Roy. Soc. W. Aust. 56: 88. 18 km SSE of Kalbarri, W.A. (L.A. Smith).

Diagnosis

A member of the *lesueurii* group, *inornatus* sub-group, with well-developed black vertebral stripe and white dorsolateral line, distinguishable from *C. lesueurii* by more numerous midbody scale rows, fewer nuchals and subdigital lamellae, and duller, less complex colour pattern, e.g. no white dorsal line between white paravertebral and dorsolateral lines.

Distribution

Extreme south-west of Kimberley Division; greater part of North-west Division, except southern interior south of the middle Gascoyne and upper

Ashburton (which is occupied by the closely related *C. severus*); also numerous islands from Depuch south to Dirk Hartog. Extralimital in South-west Division of Western Australia.

Description

Snout-vent length (mm): 32-101 (70.3). Length of appendages (% SVL): foreleg 20-31 (24.8), hindleg 33-52 (42.0); tail 177-268 (220).

Nasals usually separated (usually narrowly), occasionally in short contact. Prefrontals usually forming a median suture, rarely separated and then very narrowly. Supraoculars 4, first 3 in contact with frontal (one specimen with first fused to second). Supraciliaries usually 7 or 8, rarely 9, very rarely 6, mean 7.5, third or fourth to penultimate usually much smaller than others and sometimes hidden by moderately strong brow. Palpebrals 9-14 (10.9). Second loreal 0.8-2.2 (1.42) times as wide as high. Upper labials usually 8 (92% of specimens), rarely 9, very rarely 7, mean 8.0. Ear lobules 3-7 (4.9). Nuchals usually 2 or 3 (92% of specimens), rarely 4, very rarely 1 (except at Ningaloo, where all three specimens have only 1), mean 2.6. Midbody scale rows 26-36 (30.5). Lamellae under fourth toe 17-25 (21.5).

Dorsal ground colour olive green, brown or blackish. Moderately wide black vertebral stripe from nape to tail (on which it is paler), edged with white or brownish white, which in turn is usually narrowly edged with black. White dorsolateral line from nape to tail (on which it is suffused with brown), sometimes extending indistinctly forwards to supraoculars, margined above and below with black. Upper lateral zone bearing a series of pale blotches or large spots. White midlateral stripe from behind axilla to tail, edged above and below with black.

Geographic variation

The above colour description applies to northern specimens, south to Cape Range, Hamersley Range and the sources of the Oakover. At Ningaloo, Ullawarra and Mt Newman and south thereof, colour pattern is reduced: the vertebral stripe is narrower, and its white margin usually lacks a black edge; and the pale midlateral stripe is often narrow and indistinct. These somewhat sparse and scattered southern populations also differ in scutellation: (1) the first supraocular is not quite so narrow relative to the second; (2) because the second and third supraciliaries are seldom fused, it is the fourth (rather than the third) that is the anteriormost of the small supraciliaries; (3) the disparity between small and large supraciliaries is not so marked as in the north; (4) supraciliaries average fewer in number (despite the infrequency of fusion); (5) the second loreal is relatively wider; (6) ear lobules are fewer; and (7) nuchals are fewer.

Material

Kimberley Division: Anna Plains (27825); Mt Phire (27796-7).

North-west Division: Bulgamurgurdy Soak, 70 km SE of Wallal (36146);

52 km E of Port Hedland (46499); Port Hedland (24906); Mundabullangana (17170-3, 17177); 30 km SE of Mundabullangana (17077); Point Samson (14578); Balmoral (45788-9); Onslow (45790); Mt Herbert (17180-3, 20116, 20121-2); Tambrey (20114, 20119-20, 20123, 37707-8); Coolawanyah (20113, 20118); Hooley (34732); Wittenoom Gorge (29105, 37489); Yampire Gorge (17184-5, 37735); Dale Gorge (13129, 17186-7); Woodstock (13091-2, 13094, 13319, 17169); Shaw River (17167-8); Mt Edgar (17133-65); Meentheena (13209, 46179); Ragged Hills (13208); Ripon Hills (13244); Mosquito Creek (13243); Warrawoona (26693); Nullagine (37978); Cockeraga River (36558, 36746); Coondra Coondra (42287-9, 42296); Mt Newman (25177-8, 25194, 26531); 25 km SSE of Glenflorrie (25244); 44 km WNW of Ullawarra (25245-7); Kookhabinna Gorge, Barlee Range (25267); North-west Cape (17194, 22501-3); Exmouth (31410, 43821); Cape Range (16998, 25098); Yardie Creek (27807-9); 65 km S of Yardie Creek (27806); Ningaloo (16880-2); 15 km N of Cardabia (32599); Quobba Point (32588); gorge ca 30 km W of Mt Vernon (22819); Kumarina (23945-8, 23950-1, 25193); Carrarang (39023); 37 km E of Tamala (23876); Depuch I. (14555-6); Legendre I. (14333-5, 37324-6); Dolphin I. (14278, 14288, 37284-91); Angel I. (37257-61); Rosemary I. (37385-92, 40988); West Lewis I. (14503-4, 37336-8); Enderby I. (37348-54); Kendrew I. (41726-8); Hermite I. (37426-40); Lowendall I. (12887-8); Barrow I. (27811-3, 28457, 28669-71, 45383-411); South Double I. (27816-20, 45412), Sandy I. (27810); North Pascoe I. (42283); South Pascoe I. (45364-82); Thevenard I. (27814-5); South Murion I. (37242-4); Bernier I. (13203-4, 13206, 19983, 34095-6); Dorre I. (13200, 13202, 46524); Dirk Hartog I. (42358-61, 45812, 45814).

Ctenotus severus

Ctenotus severus Storr, 1969, J. Roy. Soc. W. Aust. 51: 101. Galena, W.A. (G.M. Storr).

Diagnosis

A member of the *lesueurii* group, *inornatus* sub-group, with vertebral stripe faint, short or absent; dark laterodorsal stripe very wide; and conspicuous white dorsolateral line separated from dark upper lateral zone by narrow hiatus of dorsal ground colour.

Distribution

Southern half (mainly interior) of North-west Division, north to Warroora, Landor, Belele and Lake Austin. Extralimital in South-west and Eastern Divisions of Western Australia.

Description

Snout-vent (mm): 44-90 (70.7). Length of appendages (% SVL): foreleg 19-27 (24.2), hindleg 34-47 (42.6), tail 196-248 (217).

Nasals usually separated (86% of specimens), occasionally just touching or forming a median suture. Prefrontals usually forming a median suture (88%), occasionally separated very narrowly. Supraoculars 4, first 3 in contact with frontal, first narrower than second (disparity not so marked as in *inornatus* and northern *fallens*). Supraciliaries usually 7, occasionally 8, rarely 6, mean 7.2, fourth to penultimate markedly to slightly smaller than others. Palpebrals 9-13 (10.7). Second loreal 1.2-2.3 (1.41) times as wide as high. Upper labials usually 8, occasionally 9, mean 8.2. Ear lobules 3-7 (4.9). Nuchals usually 3 (86% of specimens), occasionally 2 or 4, mean 3.0. Mid-body scale rows 28-32 (30.0). Lamellae under fourth toe 18-23 (20.8), smooth or widely callose.

Dorsal ground colour very variable, e.g. greyish, dark olive brown, dark reddish brown or bright pale brown. Obscure dark brown or blackish vertebral line, usually present only on neck (where very rarely it is narrowly white-edged). Broad dark brown or blackish laterodorsal stripe from occiput to base of tail. Narrower but more conspicuous white dorsolateral stripe from above and behind eye to base of tail, anteriorly and posteriorly suffused with brown. Obscure whitish midlateral stripe from ear to groin, above and below which ground colour is broken by pale dots or small spots of irregular shape and arrangement.

Material

North-west Division: Warroora (8214); Landor (2707); Errabiddy (46651-2); 26 km NW of Mileura (28345); Mileura (15773, 15803, 15807, 28340); Belele (7370); Meka (29270); 38 km S of Cue (17191-2); 30 km N of Mount Magnet (34679); Yalgoo (4948); 35 km SW of Yalgoo (17197-8); Gullewa (40848); Burnerbinmah (13970, 13973); Fields Find (17653, 25637, 30835-7); Warriedar (29753); 29 km N of Paynes Find (18549); Paynes Find (12530); Pindabunna (12531-2, 17193); 20 km E of Ninghan (34669).

Ctenotus helenae

Lygosoma lesueurii concolor Glauert, 1952, W. Aust. Nat. 3: 169. Marrilla, W.A. (R.A. Anderson). Not *Lygosoma (Rhodona) bipes* var. *concolor* Werner.

Ctenotus helenae Storr, 1969, J. Roy. Soc. W. Aust. 51: 100. 38 km ENE of Laverton, W.A. (E.R. & H.L. Pianka).

Diagnosis

A greenish member of the *lesueurii* group, *inornatus* sub-group, with little or no colour pattern.

Distribution

Far south of Kimberley Division; and greater part of North-west Division, south to lat. 27°S. Extralimital in Eastern Division of Western Australia, Northern Territory and South Australia.

Description

Snout-vent length (mm): 42-101 (72.9). Length of appendages (% SVL): foreleg 19-29 (24.0), hindleg 33-48 (40.6), tail 186-235 (212).

Nasals usually separated (83%), occasionally just touching or forming a median suture (especially on Pilbara plateau). Prefrontals usually forming a median suture (92%), rarely just touching or very narrowly separated. Supraoculars 4, first 3 in contact with frontal. Supraciliaries usually 7, occasionally 8, rarely 6, mean 7.1, fourth to penultimate smaller than others. Palpebrals 9-13 (10.8). Second loreal 1.0-2.2 (1.53) times as wide as high. Upper labials 8 (rarely 7 or 9). Ear lobules 4-7 (5.0). Nuchals 2 or 3 (2.6). Midbody scale rows 26-34 (29.7). Lamellae under fourth toe 17-25 (21.6).

Ground colour greenish brown or olive grey, sometimes completely without pattern but usually with longitudinally orientated whitish and (less frequently) blackish dotting of flanks. In south usually some indication of dark vertebral stripe; less frequently a trace of dark laterodorsal stripe and of pale dorsolateral and midlateral stripes.

Geographic variation

Generally pattern is more reduced in north than south. However, the specimens entirely without pattern come from the Pilbara plateau, a region notable for other peculiarities, e.g. high frequency of specimens with contiguous nasals and with high number of midbody scale rows (32-34).

Remarks

Earlier (Storr 1970: 101), before I had examined much western material, I synonymized *concolor* Glauert with *C. inornatus*. I had wrongly supposed that as it moved west and south from the north of the Northern Territory, *inornatus* lost elements of its pattern and gradually merged with *concolor*. On the contrary, pattern in *inornatus* strengthens as it moves west and south, i.e. towards the range of *fallens*. It is now clear that *fallens* (and *saxatilis* of Central Australia) are the southern representatives of *inornatus*. All three forms are primarily inhabitants of rocky or stony country, whereas *helenae* is primarily an inhabitant of sandy deserts. Moreover *inornatus*, *saxatilis* and northern *fallens* have similar supraciliaries, whereas in *helenae* they are like those of *severus* and southern *fallens*.

Material

Kimberley Division: 146 km E of McLarty Hills (46038); 26 km NE of McLarty Hills (46044-7); Anna Plains (45804).

North-west Division: Wallal (45803); 26 km SW of Mundabullangana (17250); Karratha (17251, 22934); Daniels Well (17252); Tambrey (20235); Marble Bar (11340); Mt Edgar (17248-9); Talawana (39131-4); 26 km NE of Billanooka (40169); Mt Newman (30936); Turee Creek (25139); Marrilla (5049); Winning Pool (36080); near Carnarvon (5340); Yinnietharra (40548); Kumarina (22703); Boolardy (5013).

Ctenotus youngsoni sp. nov.

Holotype

R42363 in Western Australian Museum collected by Dr A.A. Burbidge in September 1972 on Dirk Hartog Island, Western Australia, in 25° 50'S, 113° 05'E.

Diagnosis

A member of the *labillardieri* group with unbroken pale dorsolateral line; most like *lancelini* but with much darker coloration, spotted legs, little or no indication of pale midlateral stripe, and more numerous midbody scale rows.

Distribution

Dirk Hartog Island, off lower west coast of North-west Division.

Description (based on holotype and single paratype)

Snout-vent length (mm): 48, 51. Length of appendages (% SVL): foreleg 24, 28; hindleg 42, 45.

Nasals narrowly separated. Prefrontals narrowly separated. Supraoculars 4, first 2 in contact with frontal. Supraciliaries 7. Palpebrals 11, 10. Second loreal 1.5 and 1.4 times as wide as long. Upper labials 8. Ear lobules 3, subacute, second largest. Nuchals 3. Midbody scale rows 28, 30. Lamellae under fourth toe 23, 21.

Dorsal and lateral ground colour olive grey. Very broad ragged-edged blackish-brown laterodorsal stripe, obscurely spotted with ground colour, and extending back to proximal quarter of tail where it breaks up into a series of irregular spots. Pale olive dorsolateral line extending back to base of tail. Side of body spotted with blackish brown, spots tending to align vertically. Legs olive brown, spotted with blackish brown.

Remarks

Named after Mr W.K. Youngson of the Western Australian Fisheries and Fauna Department (and formerly of the Western Australian Museum), in appreciation of the many reptiles he has collected for the Western Australian Museum.

Paratype

North-west Division: Dirk Hartog Island (42362).

Ctenotus mastigura mastigura subsp. nov.

Holotype

R43210 in Western Australian Museum, collected by Messrs L.A. Smith and R.E. Johnstone on 15 February 1973 on the Mitchell Plateau, Western Australia, in 14°52'S, 125°50'E.

Diagnosis

A member of the *essingtonii* group with only three supraoculars, smooth subdigital lamellae, and well-defined vertebral stripe. Both subspecies of *C. mastigura* distinguishable from *C. essingtonii* of Northern Territory by more numerous ear lobules (first never largest) and more numerous midbody scale rows.

Distribution

Subhumid hinterland of Admiralty Gulf, north Kimberley.

Description

Snout-vent length (mm): 55-63. Length of appendages (% SVL): foreleg 23-29, hindleg 44-47, tail 240-303.

Nasals separated. Prefrontals forming a median suture. Supraoculars 3, first 2 in contact with frontal. Supraciliaries 8 or 9. Palpebrals 10. Second loreal 1.0-1.1 times as wide as high. Upper labials 7 or 8. Ear lobules 5-6, subacute. Nuchals 3. Midbody scale rows 29-32. Lamellae under fourth toe 21-23, compressed, smooth.

Dorsally dark iridescent olive-brown. Narrow pale-edged vertebral stripe. Narrow, but bold, white dorsolateral stripe, narrowly edged above and below with black. Upper lateral zone brownish grey. Whitish midlateral stripe, narrowly edged with dark brownish grey.

Remarks

An apparently related population occurs on the Arnhem Land Plateau; see Storr (1970: 104) for brief description of unique specimen (USNM 128758) from Oenpelli.

Paratypes

Kimberley Division: Mitchell Plateau (43244, 43344).

Ctenotus mastigura burbidgei subsp. nov.

Holotype

R41296 in Western Australian Museum collected by Dr A.A. Burbidge *et al.* on 12 May 1972 on Augustus Island, Western Australia, in 15°20'S, 124°35'E.

Diagnosis

A member of the *essingtonii* group with four supraoculars, callose lamellae, and vertebral stripe faint or absent.

Distribution

Subhumid mainland and islands of north-west Kimberley in vicinity of Kuri Bay, north to the lower Roe drainage.

Description

Snout-vent length (mm): 34-58 (50.0). Length of appendages (% SVL): foreleg 23-29 (26.2); hindleg 43-53 (47.7), tail 238-297 (265).

Nasals narrowly separated or in very short contact. Prefrontals usually in contact. Supraoculars 4, first 3 in contact with frontal. Supraciliaries 9 or 10 (9.5), third (occasionally fourth) to penultimate much smaller than others. Palpebrals 10-13 (10.9). Second loreal 1.0-1.5 (1.28) times as wide as high. Upper labials 8. Ear lobules 4-6 (5.0), obtuse or subacute, second or third usually largest (never first). Nuchals 2-6 (3.5). Midbody scale rows 27-34 (31.5). Lamellae under fourth toe 22-31 (24.5), compressed, each with a narrow or wide callus.

Dorsally yellowish brown, olive brown, or olive grey. Usually no trace of vertebral stripe. Narrow white dorsolateral stripe, narrowly edged above with black. Upper lateral zone greyish brown with or without a series of pale circular or squarish spots. Pale midlateral stripe narrow or indistinct.

Remarks

Named after Dr Andrew A. Burbidge of the Western Australian Fisheries and Fauna Department.

Paratypes

Kimberley Division: Prince Regent River Reserve (46583, 46696, 46698-705, 46852, 46867, 46966, 46988, 47009); 18 km E of Kuri Bay (40426); Augustus I. (40447, 41297-8); largest of Heywood Is (40451).

Ctenotus mimetes

Ctenotus mimetes Storr, 1969, J. Roy. Soc. W. Aust. 51: 103. 20 km E of Paynes Find, W.A. (D.A. Richards).

Diagnosis

A moderately large member of the *leonhardii* group; back brown and unpatterned between narrow, unspotted black laterodorsal stripes. Further distinguishable from *C. uber* and *C. leonhardii* by white midlateral stripe extending forward to lores and by upper lateral zone enclosing a series of large pale red squarish blotches rather than 1-3 series of whitish dots. Distinguishable from the superficially similar *C. severus* and *C. alleni* by toes

laterally compressed with subdigital lamellae narrowly callose or obtusely keeled.

Distribution

Southern interior of North-west Division north to the Ashburton. Extralimital in South-west Division.

Description

Snout-vent length (mm): 53-73 (63.7). Length of appendages (% SVL): foreleg 25-27 (25.8); hindleg 50-56 (52.6); tail 193-280 (234).

Nasals separated. Prefrontals forming a median suture or very narrowly separated. Supraoculars 4, first 3 in contact with frontal. Supraciliaries 5-8 (7.0). Palpebrals 11-13 (12.0). Second loreal 1.1-1.6 (1.32) times as wide as high. Upper labials 8. Ear lobules 3 or 4 (3.7). Nuchals 3 or 4 (3.5). Midbody scale rows 26-32 (28.5). Lamellae under fourth toe 23-28 (25.8).

Material

North-west Division: Wyloo (13211); 68 km SW of Youanmi (19119); 70 km NE of Paynes Find (ERP 10006); 20 km E of Paynes Find (17991).

Ctenotus uber uber

Ctenotus uber Storr, 1969, J. Roy. Soc. W. Aust. 51: 102. 35 km SE of Yalgoo, W.A. (P.J. Fuller).

Diagnosis

A member of the *leonhardii* group with white midlateral stripe completely absent and black laterodorsal stripe enclosing a series of pale spots. Further distinguishable from *C. leonhardii* by weak development of vertebral stripe and nasals usually separated rather than forming a median suture.

Distribution

Central and southern interiors of North-west Division north to the Fortescue. Extralimital in Eastern and Eucla Divisions of Western Australia.

Description

Snout-vent length (mm): 40-70 (57.2). Length of appendages (% SVL): foreleg 22-31 (26.6), hindleg 44-58 (50.5), tail 191-238 (211).

Nasals separated (just touching in one specimen). Prefrontals usually separated (83% of specimens), occasionally forming a short median suture. Supraoculars 4, first 3 in contact with frontal. Supraciliaries 7 or 8 (7.3). Palpebrals 9-14 (11.2). Second loreal 1.0-1.7 (1.34) times as wide as high. Upper labials usually 8, occasionally 9, mean 8.2. Ear lobules 4-9 (5.2). Nuchals usually 4, occasionally 2 or 3, mean 3.7. Midbody scale rows 30-34

(31.6). Lamellae under fourth toe 23-27 (24.7), each with a dark obtuse keel or narrow callus.

Dorsally brown or pale greenish brown. Dark vertebral stripe poorly developed (at best very narrow, unmarginated, and extending only to base of tail; at worst barely discernible or confined to nape). Blackish laterodorsal stripe enclosing a series of pale brown spots. White dorsolateral line sometimes broken into a series of short dashes. Blackish or dark reddish brown upper lateral zone enclosing 2 or 3 longitudinal series of white dots or short dashes, sharply separated from pale reddish brown lower lateral zone.

Material

North-west Division: Coolawanyah (13286); Koordarrie (30334); 18 km SW of Winning Pool (36112); Yinnietharra (40537-42); Jiggalong (13341, 25118); Gnows Nest, 35 km SE of Yalgoo (17654, 26349).

Ctenotus militaris sp. nov.

Holotype

R40779 in Western Australian Museum collected by Mr W.H. Butler on 19 September 1971 at Lake Argyle, Western Australia, in 16° 25'S, 128° 40'E.

Diagnosis

A moderately small member of the *leonhardii* group with 5 dark dorsal stripes and no white midlateral stripe; nasals in contact; prefrontals usually separated.

Distribution

East Kimberley, on or near the Ord.

Description

Snout-vent length (mm): 39-65 (50.8). Length of appendages (% SVL): foreleg 23-31 (26.7); hindleg 42-59 (50.4), tail 192-246 (217).

Nasals forming a median suture. Prefrontals separated (in very short contact in one specimen). Supraoculars normally 4 with 3 contacting frontal (5 with 4 in one specimen). Supraciliaries 6-8 (7.1). Second loreal 1.0-1.6 (1.23) times as wide as high. Upper labials 8 (7 in one specimen, 9 in another). Ear lobules 3-7 (5.1), subacute, obtuse or truncate. Nuchals 2-5 (3.6). Midbody scale rows 30-40 (only one specimen with more than 35; mean 32.4). Lamellae under fourth toe 20-25 (22.4), compressed, each with a brown obtuse keel.

Dorsally pale brown, darker and greyer on head. Narrow blackish or dark brown vertebral stripe from nape to base of tail. On each side two blackish

or dark brown dorsal lines, the outer (laterodorsal) margined below by white or pale brown dorsolateral line. Upper lateral zone reddish brown with 1-3 series of whitish dots or short dashes. Lower lateral zone pale greyish brown. Limbs pale brown longitudinally striped with dark brown.

Paratypes

Kimberley Division: Wyndham (13619); Lake Argyle (40767-8, 42681-8, 42747, 42834, 42893, 42901-2, 45558); Lissadell (11779).

Ctenotus leonhardii

Lygosoma (Hinulia) leonhardii Sternfeld, 1919, *Senckenbergiana* 1: 79. Hermannsburg, N.T. (M. von Leonhardi).

Diagnosis

A moderately large member of the *leonhardii* group with well-developed dark vertebral stripe, a dark laterodorsal stripe (usually unspotted) but no other dark dorsal stripe; white midlateral stripe not extending to lores; nasals usually contiguous; prefrontals usually separated.

Distribution

North-west Division between lat. 22° 30' and 27° 30'S. Extralimital in Eastern Division of Western Australia, Northern Territory and South Australia.

Description

Snout-vent length (mm): 29-76 (60.7). Length of appendages (% SVL): foreleg 21-34 (26.4), hindleg 44-58 (49.4), tail 173-235 (212).

Nasals usually forming a median suture (73% of specimens), occasionally separated or just touching. Prefrontals usually separated (86%), occasionally in short contact. Supraoculars normally 4 with 3 contacting frontal (5 with 4 in one specimen). Supraciliaries usually 7 (86%), occasionally 8, rarely 6, mean 7.1. Palpebrals 9-13 (10.3). Second loreal 1.0-1.8 (1.34) times as wide as high. Upper labials 8. Ear lobules 3-6 (4.6). Midbody scale rows 26-31 (28.2). Lamellae under fourth toe 21-29 (25.3), compressed, each with a narrow dark brown callus.

Dorsally brown to blackish brown. Narrow dark vertebral stripe, edged with pale brown. Dark laterodorsal stripe of variable width, rarely enclosing a series of white spots or short dashes, margined below by whitish dorsolateral stripe. Dark brown upper lateral zone enclosing 2-3 longitudinal series of pale dots. Whitish midlateral stripe moderately well developed posteriorly but often breaking up into a series of spots before reaching forward to level of arm, occasionally reaching forward to ear aperture.

Material

North-west Division: 26 km N of Minilya (36093, 36108-10, AM 38705); Booloogooroo (45796); 40 km N of Carnarvon (36086); Talawana (39135, 42227, 42242-6); Jiggalong (13340, 13354-7, 17282, 25119-20); Murramunda (40179); Mt Newman (25195, 26530, 30937); Turee Creek (25141); 37 km NW of Mt Vernon (25243); Kumarina (23949); 26 km NW of Mileura (28344); Mileura (15774-8, 15804-6); 15 km N of Meekatharra (17188); Nannine (17189-90); Big Bell (31496-7, 31509).

Ctenotus serventyi sp. nov.

Holotype

R46000 in Western Australian Museum, collected by Messrs L.A. Smith and R.E. Johnstone in April 1974 at Christmas Creek, Western Australia, in 18° 53'S, 124° 53'E.

Diagnosis

A very small member of the *leonhardii* group with 5 dark stripes on back and white midlateral stripe extending forward to lores; nasals and prefrontals usually contiguous.

Distribution

South of Kimberley Division, and north-west coastal plains and islands of North-west Division.

Description

Snout-vent length (mm): 31-57 (43.6). Length of appendages (% SVL): foreleg 23-33 (27.8), hindleg 39-53 (47.6), tail 201-254 (227).

Nasals contiguous (79% of specimens) or separated (usually narrowly). Prefrontals contiguous (75%) or narrowly separated. Supraoculars 4, first 3 in contact with frontal. Supraciliaries 6-9, usually 7, mean 7.1. Palpebrals 8-12 (9.8). Second loreal 0.9-1.6 (1.14) times as wide as high. Second pre-subocular small, often fused to first. Upper labials 8. Ear lobules 3-7 (4.6). Nuchals 1-5 (3.5). Midbody scale rows 24-28 (26.0). Lamellae under fourth toe 18-24 (21.2), compressed, each bearing a dark brown or black obtuse keel or narrow callus.

Dorsally pale brown, more reddish on head, more greenish or greyish on back, more buffy on tail. Narrow black vertebral stripe from nape to base of tail, edged with brownish white. Narrow dark dorsal stripe between vertebral and laterodorsal stripes, fading to pale brown with age. Narrow white dorso-lateral stripe from last supraocular to middle of tail or beyond. Upper lateral zone dark brown with 1 or 2 longitudinal series of brownish white dots or

short dashes. Narrow whitish midlateral stripe from lores to proximal quarter of tail. Narrow lower lateral zone pale brown. Limbs pale brown, longitudinally striped with dark brown. Under surface lustrous white (under tail occasionally suffused with pink).

Remarks

Named after Dr Dominic L. Serventy in recognition of his services to the natural history of Western Australia.

Paratypes

Kimberley Division: Christmas Creek HS (45995-9, 46001-22); presumably Derby (20331-2); Lagrange (46211).

North-west Division: Mundabullangana (17175-6, 17280); Cossack (17178-9); Legendre I. (14338, 14358); Rosemary I. (14530); Surf Point, Barrow I. (45414).

Ctenotus decaneurus decaneurus

Ctenotus decaneurus Storr, 1970, J. Roy. Soc. W. Aust. 52: 104. 34 km NW of Newry, N.T. (G.M. Storr & A.M. Douglas).

Diagnosis

A very small member of the *taeniolatus* group with 10 (8 when ventrolateral missing) whitish stripes and lines on a black or blackish-brown ground. Distinguishable from all subspecies of *C. quattuordecimlineatus* by separated prefrontals and absence of white upper lateral lines between white dorso-lateral and midlateral stripes.

Distribution

North and north-east Kimberley. Extralimital in Northern Territory.

Description (based on all material)

Snout-vent length (mm): 25-47 (37.5). Length of appendages (% SVL): foreleg 24-30 (27.1), hindleg 38-48 (43.0), tail 171-232 (196).

Nasals in short to moderately long contact. Prefrontals separated (in short contact in one specimen). Supraoculars 4, first 3 in contact with frontal. Supraciliaries 7 or 8 (7.6). Palpebrals 8-10 (9.1). Second loreal 1.2-1.9 (1.48) times as wide as high. Upper labials 7 or 8 (7.3). Ear lobules 3-6, obtuse, very small (except in Darwin area). Nuchals 2-5 (3.7). Midbody scale rows 24-26 (25.7). Lamellae under fourth toe 20-24 (21.5), each with a narrow to moderately wide dark callus.

On each side a brownish-white paravertebral line, a narrow dorsolateral stripe, and between them a dorsal line; white midlateral stripe, extending forward to lores after looping above ear aperture; and white ventrolateral stripe (occasionally indistinct or absent).

Geographic variation

The three specimens from the Darwin region differ from other specimens in having the uppermost ear lobule very much larger than others.

Material

Kimberley Division: Michell Plateau, 14°52'S, 125°30'E, (43152, 43162, 43188, 43247, 43526); Lake Argyle, at dam (45559). Northern Territory/Western Australia border in lat. 15°59'S (23130, 45595-6).

Northern Territory: Darwin area (AM 13005); Berrimah (NTR 233); Tapa Bay, Cox Peninsula (NTR 303).

Ctenotus decaneurus yampiensis subsp. nov.

Holotype

R11795 in Western Australian Museum, collected by Mr A.M. Douglas in 1955 at the former Wotjulum Mission Station, Western Australia, in 16°11'S, 123°37'E.

Diagnosis

A member of the *taeniolatus* group with 10 whitish lines and stripes on a black ground, distinguishable from *C. d. decaneurus* by its separated nasals and more numerous midbody scales; it also seems to be larger, with relatively longer appendages, and to have more palpebrals.

Distribution

Yampi Sound, west Kimberley.

Description

Snout-vent length (mm): 46-48. Length of appendages (% SVL): foreleg 25-27, hindleg 46-48, tail 205-241.

Nasals and prefrontals separated. Supraoculars 4, first 3 in contact with frontal. Supraciliaries 8. Palpebrals 10-12. Second loreal 1.1-1.2 times as wide as high. Upper labials 8. Ear lobules 4 or 5, subacute, second largest. Midbody scale rows 30 or 32. Lamellae under fourth toe 20 or 21, each with a wide dark callus.

Back and sides black; snout and tail pale brown. On each side a greenish-white paravertebral line and dorsolateral line and between them a greenish-white dorsal line; white midlateral stripe extending forward to lores after

looping over ear aperture; and white ventrolateral stripe. Legs pale brown, longitudinally striped with blackish brown.

Paratypes

Kimberley Division: Wotjulum (11796-7).

Ctenotus quattuordecimlineatus quattuordecimlineatus

Lygosoma (Hinulia) quattuordecimlineatum Sternfeld, 1919, *Senckenbergiana* 1: 80. Hermannsburg, N.T. (M. von Leonhardi).

Diagnosis

A large member of the *taeniolatus* group with 14 whitish lines and stripes on a blackish ground (on each side a paravertebral and dorsolateral line and between them a dorsal line; a midlateral and ventrolateral stripe and between them two upper lateral lines).

Distribution

Desert sand dunes of far south of Kimberley Division and of far north of North-west Division. Extralimital in Eastern Division of Western Australia, Northern Territory and South Australia.

Description

Snout-vent length (mm): 34-68 (46.5). Length of appendages (% SVL): foreleg 23-32 (28.0), hindleg 40-50 (46.4), tail 220-230 (225).

Nasals forming a median suture (very narrowly separated in one specimen). Prefrontals forming a median suture. Supraoculars 4, first 3 in contact with frontal. Supraciliaries usually 7, occasionally 6 or 8. Palpebrals 9-11 (10.2). Second loreal 1.2-1.8 (1.44) times as wide as high. Upper labials 8 (9 in one specimen). Ear lobules 3-7 (4.8). Midbody scale rows 26-29 (27.5). Lamellae under fourth toe 23-26 (24.3), compressed, each bearing a dark obtuse keel (juveniles) or moderately narrow callus (adults).

Material

Kimberley Division: 80 km SSW of Christmas Creek HS (46028); 146 km E of McLarty Hills (46033-5); 117 km W of McLarty Hills (45904); 37 km E of Mt Phire (46025).

North-west Division: Wallal (45801-2).

Ctenotus quattuordecimlineatus iapetus subsp. nov.

Holotype

R27887 in Western Australian Museum, collected by Mr W.H. Butler on 29 July 1963 at 13 km S of North West Cape, Western Australia, in 21°54'S, 114°08'E.

Diagnosis

A member of the *taeniolatus* group with 12 pale lines and stripes on a dark ground. Distinguishable from *C. q. quattuordecimlineatus* by one (rather than two) pale upper lateral stripes, and from *C. q. atlas* by presence of pale dorsal line between paravertebral and dorsolateral lines.

Distribution

Coastal plains of North-west Division from the Ashburton south nearly to the Tropic.

Description

Snout-vent length (mm): 39-59 (48.5). Length of appendages (% SVL): foreleg 25-31 (28.0), hindleg 45-53 (48.7), tail 214-240 (225).

Nasals forming a short median suture. Prefrontals forming a median suture. Supraoculars 4, first 3 in contact with frontal. Supraciliaries 7. Palpebrals 10-13 (11.5). Second loreal 1.2-1.9 (1.47) times as wide as high. Upper labials 8. Ear lobules 2-4 (3.0), acute in adults, obtuse in juveniles. Nuchals 2 or 3 (2.5). Midbody scale rows 25-27 (26.0). Lamellae under fourth toe 25-28 (26.2), each with a dark obtuse keel or narrow to moderately wide callus.

Back and sides black or blackish brown. On each side a white paravertebral and dorsolateral line and a dorsal line between them, a narrow upper lateral stripe, and a wide midlateral and ventrolateral stripe.

Remarks

In South Australia *C. atlas* and *C. quattuordecimlineatus* seem to intergrade in the Great Victoria Desert (Storr 1971: 10). Now we have a taxon that is intermediate between *atlas* and *quattuordecimlineatus*. All three forms are therefore treated here as subspecies of a single species, the oldest name for which is *C. quattuordecimlineatus*.

Paratypes

North-west Division: 26 km S of Urala (30324); 30 km E of Ningaloo (16883); 32 km N of Warroora (21776).

Ctenotus quattuordecimlineatus atlas

Ctenotus atlas Storr, 1969, J. Roy. Soc. W. Aust. 51: 105. 28 km S of Atley, W.A. (E.R. & H.L. Pianka).

Diagnosis

A large member of the *taeniolatus* group with 8 or 10 whitish lines and stripes on a blackish ground (on each side a paravertebral and dorsolateral

line, a narrow upper lateral stripe, a wide midlateral stripe, and usually a wide ventrolateral stripe.

Distribution

South-eastern quarter of North-west Division. Extralimital in Eastern and Eucla Divisions of Western Australia, South Australia and New South Wales.

Description

See Storr (1969: 105, 1971: 9).

Remarks

C. atlas and *C. quattuordecimlineatus* are now treated as conspecific for the reasons given under *C. q. iapetus* and despite their apparent sympatry at Queen Victoria Spring in the Eastern Division. Queen Victoria Spring is close to the south-western edge of the Great Victoria Desert and presumably also close to the boundary between the two taxa. Though three specimens of *quattuordecimlineatus* and one of *atlas* are labelled Queen Victoria Spring, I suspect that they were collected in different habitats some miles apart.

Material

North-west Division: 3 km SE of Turee Creek (25142).

Ctenotus piankai piankai

Ctenotus piankai Storr, 1969, J. Roy. Soc. W. Aust. 51: 106. 38 km ENE of Laverton, W.A. (E.R. & H.L. Pianka).

Diagnosis

A small member of the *taeniolatus* group with 6 (8 when ventrolateral present) whitish lines and stripes on a black or dark brown ground. Distinguishable from all subspecies of *C. decaneurus* by absence of dorsal line between paravertebral and dorsolateral lines, and from all subspecies of *C. quattuordecimlineatus* by absence of upper lateral stripe between dorso-lateral and midlateral stripe.

Distribution

Southern drier half of Kimberley Division, and far north of North-west Division. Extralimital in Eastern Division of Western Australia, Northern Territory and Queensland.

Description

Snout-vent length (mm): 29-59 (42.6). Length of appendages (% SVL): foreleg 23-32 (28.2), hindleg 39-52 (45.9), tail 205-260 (226).

Nasals forming a median suture. Prefrontals contiguous or separated. Supraoculars 4, first 3 in contact with frontal. Supraciliaries usually 7,

occasionally 6, mean 6.8. Palpebrals 8-12 (9.6). Second loreal 1.0-1.7 (1.28) times as wide as high. Upper labials 8 (7 in one specimen). Ear lobules 2-5 (3.6). Nuchals 2-4 (3.4). Midbody scale rows 24-27 (25.0). Lamellae under fourth toe 22-26 (24.4), each with a narrow to moderately wide callus.

Material

Kimberley Division: White Mountain, Ord River Station (27131); 10 km SW of Christmas Creek HS (45987-8); 30 km NW of McLarty Hills (45986); Frazier Downs (27884-5); Anna Plains (45805).

North-west Division: Wallal (45797-9).

Ctenotus piankai duricola subsp. nov.

Holotype

R17163 in Western Australian Museum, collected by G.M. Storr and B.T. Clay on 15 February 1961 at Mt Edgar, Western Australia, in 21°19'S, 120°02'E.

Diagnosis

A member of the *taeniolatus* group with 6 or 8 pale stripes, distinguishable from *C. p. piankai* by more numerous midbody scale rows and preference for hard, stony country rather than sandy country.

Distribution

Northern quarter of North-west Division, south to the Fortescue; also Barrow Island. A possibly different subspecies south of the Hammersley Range.

Description

Snout-vent length (mm): 35-60 (47.2). Length of appendages (% SVL): foreleg 23-28 (25.2), hindleg 40-48 (44.1), tail 173-180 (177).

Nasals in contact. Prefrontals narrowly separated or in short contact. Supraciliaries 6 or 7. Palpebrals 8-11. Second loreal 1.1-1.7 (1.42) times as wide as high. Upper labials 8. Ear lobules 3-7 (4.7), acute or subacute. Nuchals 2-5 (3.8). Midbody scale rows 28-31 (29.3). Lamellae under fourth toe 20-23 (21.2), each with a narrow to wide brown callus.

Back and sides reddish brown to blackish brown. On each side a narrow brownish-white paravertebral and dorsolateral stripe, and a slightly wider and whiter midlateral and ventrolateral stripe. Anterior sector of upper lateral zone bearing a series of whitish dots. Limbs pale reddish brown, foreleg spotted and hindleg striped with dark brown.

Remarks

Our single specimen from south of the Hamersley Range, *viz.* 31010 from Tom Price, is tentatively excluded from *C. p. duricola*. It has 9 upper labials and 27 subdigital lamellae and differs slightly in coloration: its ground colour is black; the whitish paravertebral and dorsolateral lines are markedly narrower than the midlateral stripe; the upper lateral zone does not enclose any pale dots; and there is no ventrolateral stripe.

Paratypes

North-west Division: Woodstock (12629); Mt Herbert (20117); Pindrina Waters, Tambrey (20115); Barrow Island (45362-3).

Ctenotus colletti colletti

Lygosoma colletti Boulenger, 1896, Ann. Mag. Nat. Hist. (6) 18: 234.
Roebuck Bay, W.A. (K. Dahl).

Diagnosis

A small brown-tailed member of the *colletti* group with 12 pale stripes on a dark ground. Further distinguishable from *C. calurus* by absence of enlarged plantars and of black markings under toes and tail.

Distribution

South-west coastal plains of Kimberley Division.

Description

Snout-vent length (mm): 33-42 (37.1). Length of appendages (% SVL): foreleg 24-27, hindleg 40-45, tail 162-213.

Nasals forming median suture. Prefrontals separated. Supraoculars 4, first 3 in contact with frontal. Supraciliaries 6. Palpebrals 9-10. Second loreal 1.3-1.6 times as wide as high. Upper labials 7. Ear lobules 2, first much the larger and very obtuse. Nuchals 3 or 4. Midbody scale rows 26-27. Lamellae under fourth toe 24-25, each with a fine weak keel.

Back and sides dark brown with following brownish white stripes on each side: a narrow paravertebral and moderately narrow dorsolateral and between them two narrow dorsal; a moderately wide midlateral and ventrolateral. Head pale brown marked with dark brown, including a median streak on frontal. Legs pale brown longitudinally striped with dark brown.

Material

Kimberley Division: holotype (Oslo); Lagrange (27883, 27886).

Ctenotus calurus

Ctenotus calurus Storr, 1969, J. Roy. Soc. W. Aust. 51: 107. 38 km ENE of Laverton, W.A. (E.R. & H.L. Pianka).

Diagnosis

A small blue-tailed member of the *colletti* group with 8 whitish stripes on a black ground (on each side a narrow paravertebral and dorsolateral and between them a narrow dorsal, and a moderately wide midlateral extending forward to snout). Further distinguishable from *C. colletti* by plantar scales opposite fourth toe enlarged and keeled and by black spots under toes and tail.

Distribution

Desert dunes south-east of Exmouth Gulf, North-west Division. Extralimital in Eastern Division of Western Australia and Northern Territory.

Description

See Storr (1969: 107).

Material

North-west Division: Marrilla (5342).

Ctenotus schomburgkii

Lygosoma schomburgkii Peters, 1863, Mber. Akad. Wiss. Berlin 1863: 231. Buchsfeld, S.A. (R. Schomburgk).

Hinulia muelleri Fischer, 1882, Arch. Naturgesch. 48 (1): 295. Nickol Bay, W.A. (F. von Mueller).

Lygosoma fischeri Boulenger, 1887, Cat. Liz. Brit. Mus. 3: 228. [Based on *Lygosoma muelleri* (Fischer) not *L. muelleri* (Schlegel).]

Diagnosis

A strongly patterned member of the *schomburgkii* group with nasals and prefrontals separated; back pale green with black vertebral stripe and latero-dorsal variegations; well-developed white dorsolateral and midlateral stripe; black upper lateral zone broken by a series of narrow reddish 'windows'.

Distribution

Greater part of North-west Division, north to Nickol Bay, Woodstock and the upper Oakover. Extralimital in Eastern, South-west and Eucla Divisions of Western Australia, Northern Territory, South Australia and New South Wales.

Description

Snout-vent length (mm): 25-49 (39.8). Length of appendages (% SVL): foreleg 22-28 (25.5), hindleg 40-54 (47.7), tail 165-197 (183).

Nasals separated. Prefrontals separated. Supraoculars 4, first 3 in contact with frontal. Supraciliaries usually 7, occasionally 6, mean 6.8. Palpebrals 8-11 (9.3). Second loreal 1.4-2.2 (1.72) times as wide as high. Upper labials usually 7, occasionally 8, mean 7.2. Ear lobules 2-3 (2.7), obtuse, first much the largest. Nuchals 3-5 (4.3). Midbody scale rows 24-30 (27.7). Lamellae under fourth toe 21-23 (21.7), each with a fine dark mucronate keel.

Coloration mainly of western type, as described by Storr (1969: 108), but the easternmost specimen (42241) has the back black with four greenish-white lines.

Material

North-west Division: Woodstock (17281); Talawana (42241); 34 km NNW of Ullawarra (25248); Meekatharra (MCZ 33274); Meka (29270); 13 km E of Wurarga (23325).

Ctenotus tantillus sp. nov.

Holotype

R45567 in Western Australian Museum collected by Messrs L.A. Smith and R.E. Johnstone on 10 January 1972 at Kununurra, Western Australia, in 15° 42'S, 128° 42'E.

Diagnosis

A member of the *schomburgkii* group, most like *C. pallescens* of Northern Territory and *C. schomburgkii* but distinguishable from both species by its contiguous nasals.

Distribution

Northern Kimberley south to about lat. 16° 30'S, including the Sir Graham Moore Islands.

Description

Snout-vent length (mm): 32-45 (37.2). Length of appendages (% SVL): foreleg 26-30 (27.9), hindleg 39-50 (44.5), tail 148-241 (194).

Nasals forming a short to moderately long median suture. Prefrontals separated. Supraoculars 4, with first 3 contacting frontal (5 with 4 in one specimen). Supraciliaries usually 7, occasionally 6, mean 6.9. Palpebrals 8-10 (9.2). Second loreal 1.0-1.7 (1.43) times as wide as high. Upper labials usually 7, occasionally 8, mean 7.1. Ear lobules 1-4 (2.5), obtuse,

first much the largest. Nuchals 2-5 (3.8). Midbody scale rows 26-30 (27.9). Lamellae under fourth toe 18-23 (20.4), compressed, finely keeled.

Back pale green with or without a dark vertebral and (on each side) dorsal and laterodorsal line. White dorsolateral line, sometimes broken into a series of short dashes. Upper lateral zone black or dark brown, enclosing a series of whitish dots or spots of variable distinctness. White midlateral stripe variable, e.g. it may be well-developed and extending to lores, faint, broken into a series of short dashes, or completely absent. Under surface glossy white.

Paratypes

Kimberley Division: Kununurra (45568); Cockatoo Spring, 37 km SE of Kununurra (23127); Grotto Creek, 35 km SSE of Wyndham (26790); Sir Graham Moore Is (44062); Anjo Point (44069-71); Manning Creek (32070).

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CEPHALOPHOLIS XANTHOPTERUS, A NEW SPECIES OF
SERRANID FISH FROM INDONESIA, MELANESIA AND THE
GREAT BARRIER REEF

GERALD R. ALLEN*

and

WALTER A. STARCK II †

[Received 6 January 1975. Accepted 7 May 1975. Published 30 June 1975]

ABSTRACT

Cephalopholis xanthopterus, a member of the family Serranidae, is described from eight specimens collected at Indonesia, New Britain, Solomon Islands, and on the northern Great Barrier Reef of Australia. It differs from other species of *Cephalopholis* primarily with regards to colour.

INTRODUCTION

During 1972 and 1973 the authors conducted ichthyological investigations aboard the research vessel 'El Torito' at various localities in Melanesia and on the Great Barrier Reef off Cairns, Queensland. Several collections of reef fishes were made with small spears and powdered rotenone. Among our material are five specimens of an undescribed serranid. Three additional specimens were collected by the senior author and J. Randall near Rabaul, New Britain during August 1973 and at Ambon and the Seribu Islands, Indonesia in February 1975. The species belongs to the subfamily Epinephelinae and genus *Cephalopholis* as defined by Katayama (1960). Type specimens have been deposited at the Australian Museum, Sydney (AM), the Bernice P. Bishop Museum, Honolulu (BPBM), and the Western Australian Museum, Perth (WAM).

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Cephalopholis xanthopterus n. sp.
(Fig. 1; Table 1)

Holotype

BPBM 15621, 93.5 mm SL, collected with dynamite at Alite Reef (approximately 8°52'S, 160°36'E), off Malaita, Solomon Islands in 15 metres by G. Allen, B. Goldman, J. Randall, and W. Starck II on 25 July 1973.

Paratypes

AM I.17498-001, 2 specimens, 74.2 and 92.9 mm SL, collected with dynamite at Kovuhika Island (approximately 8°59'S, 160°02'E), off northern end of Florida Island, Solomon Islands in 10-15 metres by G. Allen, B. Goldman, and J. Randall on 28 July 1973; AM I.17499-001, 92.9 mm SL, collected with rotenone near Tanavulu Point (approximately 9°02.5'S, 160°04'E), northern end of Florida Island, Solomon Islands in 10 metres by B. Goldman and J. Randall on 29 July 1973; AM I.17503-001, 52.0 mm SL, collected with rotenone at Blanche Bay (approximately 4°18'S, 152°11'E), about six nautical miles south of Rabaul, New Britain in six metres by G. Allen and J. Randall on 7 August 1973; AM I.16866-001, 75.3 mm SL, collected with rotenone at Opal Reef (16°15'S, 145°50'E), Great Barrier Reef, off Port Douglas, Queensland, Australia in 13 metres by G. Allen and W. Starck II on 26 November 1972; WAM P25244-008, 112.0 mm SL, collected with rotenone at Ambon Bay off Poka Village, Ambon, Molucca Islands, Indonesia in three to four metres by G. Allen and J. Randall on 6 February 1975; BPBM 18088, 91.0 mm SL, collected with spear at Pulau Putri, Seribu Islands, Java Sea in 1.5 metres by J. Randall on 15 February 1975.

Diagnosis

A species of *Cephalopholis* with the following combination of characters: dorsal rays IX,16 (last ray composite); anal rays III,8 to 9; pectoral rays 17; lateral-line pores 42 to 46; vertical scale rows from upper edge of gill opening to base of caudal fin about 90 to 95; body mostly dark brown; soft dorsal, anal, pelvic, and caudal fins mostly pale (bright yellow-orange in life).

Description

Dorsal rays IX,16 (last ray composite); anal rays III,9 (one paratype with III,8); pectoral rays 17 (mostly branched); pelvic rays I,5; branched caudal rays 15; lateral-line pores to caudal base 42 to 46; vertical scale rows from upper edge of gill opening to base of caudal fin about 90 to 95; scale rows above lateral-line to origin of dorsal fin 22 to 24; scale rows below lateral-line to anus 31 to 32; gill rakers (excluding rudiments) on first arch $1 + 1 + 8 = 10$ (range for paratypes 9 to 11 total rakers).

The range of proportional measurements for the paratypes are indicated in parentheses when differing from the holotype. Morphometric proportions

for the holotype and three paratypes are expressed as thousandths of the standard length in Table 1.

Greatest body depth 2.8 (2.8 to 2.9), greatest width 6.1 (5.2 to 6.1), head length 2.4 (2.3 to 2.5), snout to origin of dorsal fin 2.4 (2.4 to 2.5), snout to origin of anal fin 1.5 (1.4 to 1.5), snout to origin of pelvic fin 2.6 (2.5 to 2.8), all in standard length. Snout 4.5 (4.9 to 5.2), eye 5.5 (4.9 to 5.3), postorbital length of head 1.6 (1.6 to 1.7), least width of bony interorbital 9.6 (9.0 to 10.7), tip of snout to rear edge of maxillary 2.1 (2.0), least depth of caudal peduncle 3.2 (3.1 to 3.2), length of caudal peduncle 4.6 (4.3 to 4.6), length of dorsal fin base 0.7 (0.7 to 0.8), of anal fin base 2.1 (1.9 to

TABLE 1
MORPHOMETRIC PROPORTIONS (IN THOUSANDTHS OF THE
STANDARD LENGTH) OF SELECTED TYPES OF *CEPHALOPHOLIS XANTHOPTERUS*

CHARACTERS	Holotype BPBM 15621	Paratype AM I.17498-001	Paratype AM I.17498-001	Paratype AM I.16866-001
Standard length (mm)	93.5	92.9	74.2	75.3
Greatest body depth	357	354	350	361
Greatest body width	164	164	175	193
Head length	419	399	418	425
Snout length	84	76	85	86
Eye diameter	76	80	85	80
Postorbital length of head	258	255	259	252
Interorbital width	44	44	39	40
Least depth of caudal peduncle	136	135	131	132
Length of caudal peduncle	95	98	99	100
Snout to origin of dorsal fin	422	394	415	416
Snout to origin of anal fin	662	673	698	683
Snout to origin of pelvic fin	380	388	386	404
Length of dorsal fin base	572	566	532	529
Length of anal fin base	203	209	195	179
Length of pectoral fin	279	260	270	259
Length of pelvic fin	202	194	202	207
Length of 1st dorsal spine	61	57	62	70
Length of 2nd dorsal spine	106	102	115	113
Length of 3rd dorsal spine	128	123	135	121
Longest soft dorsal ray	187	170	177	166
Length of 1st anal spine	87	84	92	94
Length of 2nd anal spine	175	170	174	185
Length of 3rd anal spine	145	134	159	147
Longest soft anal ray	189	181	178	197
Length of caudal fin	227	231	222	234

2.4), of pectoral fin 1.5 (1.4 to 1.6), of pelvic fin 2.1 (1.8 to 2.1), of first dorsal spine 6.9 (6.0 to 7.0), of second dorsal spine 3.9 (3.6 to 4.1), of third dorsal spine 3.3 (3.1 to 3.5), of longest soft dorsal ray 2.2 (2.3 to 2.6), of first anal spine 4.8 (4.5 to 4.8), of second anal spine 2.4 (2.3 to 2.5), of third anal spine 2.9 (2.6 to 2.9), of longest soft anal ray 2.2 (2.1 to 2.3), of caudal fin 1.8 (1.7 to 1.9), all in head length.

Interorbital space flattened; anterior nostrils tubular; maxillary reaching level slightly posterior to eye; opercle armed with three spines, middle spine slightly closer to lower than upper spine; opercular flap rounded; preopercle margin broadly rounded; upper limb of preopercle finely serrate; scales on head and anterior body region cycloid, remainder of scales ctenoid; predorsal scale extending almost to tip of snout; teeth on dentary and on premaxillary in a villiform band, inner rows longest and depressible; pair of short, conical canines on each side of lower jaw near symphysis; single canine on each side at front of upper jaw; narrow V-shaped band of villiform teeth on vomer; narrow band of villiform teeth on palatine; caudal and pectoral fins rounded.

Colour of holotype in alcohol: head, body, and basal portion of dorsal and anal fins mostly dark brown; rear portion of caudal peduncle light tan; dorsal, anal, pelvic, and caudal fins yellowish-tan; distal margin of pelvic, dorsal, anal, and caudal fins slightly dusky; pectoral fins brown.

The 74.2 and 75.3 mm paratypes have the entire caudal peduncle and the portion of the body immediately adjacent to the soft dorsal and anal fins

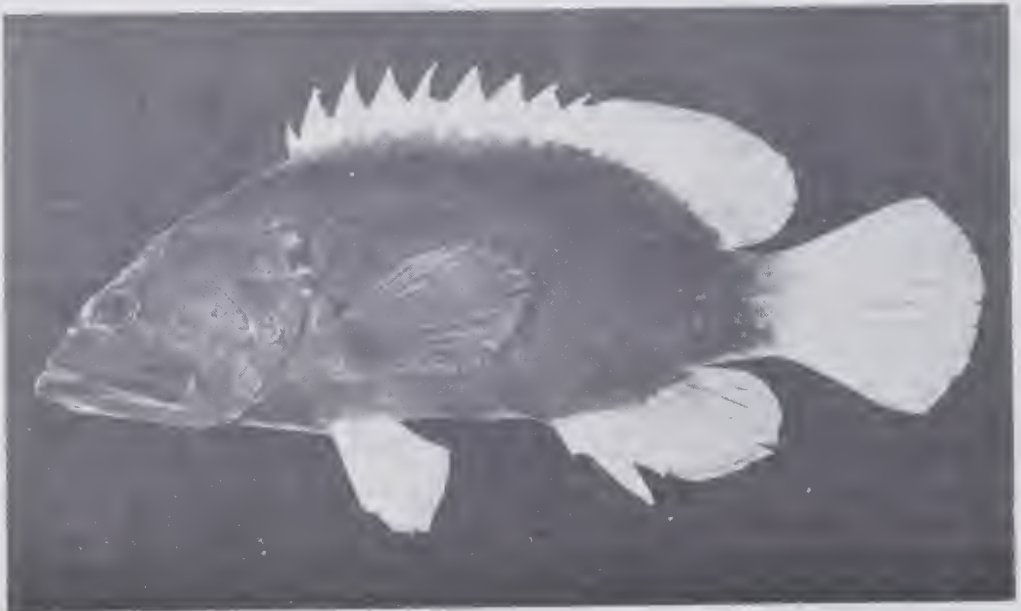


Fig. 1. *Cephalopholis xanthopterus*, holotype, 93.5 mm SL, Solomon Islands.

light tan to yellowish. The specimen from Pulau Putri, Indonesia has most of the spinous dorsal fin and basal half of the soft dorsal dark brown. In addition, the caudal peduncle and basal portions of the anal and caudal fins are brown. The pelvic fins are slightly dusky on the basal half and on the anterior edge.

Colour of holotype in life: head and body dark brown; posterior portion of caudal peduncle and all fins except pectorals yellow-orange; pectoral fins brown.

Remarks

The types were mostly collected from rich coral areas in 1.5 to 15 metres except the specimen from New Britain, which was taken from a World War II shipwreck situated in a silty bay at a depth of six metres. The species is either rare or is seldom seen because of its cryptic habits. The stomach of the specimen from the Great Barrier Reef contained the partly digested remains of a small fish.

The species differs from all other *Cephalopholis* primarily with regards to colour pattern. It is named *xanthopterus* in reference to the striking yellow-orange fins.

ACKNOWLEDGEMENTS

We thank the National Geographic Society, Washington, D.C., who provided funds for the 1973 Solomon Islands expedition. J.E. Randall provided the photograph of the holotype and assisted in collecting type specimens. B. Goldman also helped with collections in the Solomon Islands. Financial assistance for the 1975 trip to the Molucca Islands was provided by the Food and Agriculture Organization (FAO) of the United Nations.

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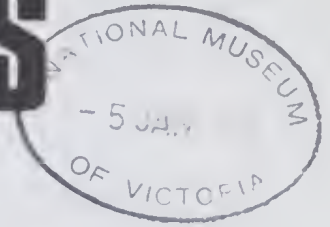
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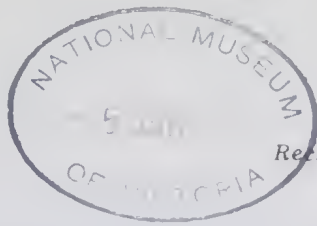
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Rev. West. Aust. Mus., 1975, 3 (4)

THE GENUS *HEMIERGIS* (LACERTILIA, SCINCIDAE) IN WESTERN AUSTRALIA

G.M. STORR*

[Received 23 April 1975. Accepted 7 May 1975. Published 31 December 1975.]

ABSTRACT

Four taxa are recognized: *H. initialis initialis* (Werner), *H. i. brookeri* nov., *H. peronii quadrilineata* (Duméril & Bibron) and *H. p. peronii* (Fitzinger); the last-named includes the tridactyl population of the extreme south-west corner.

INTRODUCTION

I agree with Copland (1946: 63) that Malcolm Smith (1937: 224) was wrong to merge *Hemiergus* in *Leiopisma*. However, I leave open the question whether *Saiphos* of south-eastern Australia is separable from *Hemiergus*; for the purposes of this paper I assume that it is a good genus.

This revision is based solely on material in the Western Australian Museum.

Genus *Hemiergus*

Hemiergus Wagler, 1830, 'Nat. syst. amphib.', p. 160. Type-species (by monotypy): *H. decresiensis* Wagler [= *H. decresiensis* (Fitzinger)].

Tetradactylus Gray, 1839, Ann. Nat. Hist. 2: 333. Type-species (by monotypy): *T. decresiensis* Gray [= *H. peronii* (Fitzinger)]. Not *Tetradactylus* Merrem, 1820.

Tridactylus Gray, *ibid.* Type-species (by monotypy): *T. decresiensis* Gray [= *H. peronii* (Fitzinger)]. Not *Tridactylus* Latreille, 1802.

Chelomeles Duméril & Bibron, 1839, 'Erpétologie générale' 5: 774. Type-species (by monotypy): *C. quadrilineatus* Duméril & Bibron [= *H. peronii quadrilineata* (Duméril & Bibron)].

*Curator of Birds and Reptiles, W.A. Museum

Diagnosis

Very small to moderately small, elongate, short-legged lygosomatine skinks with lower eyelid movable and bearing a transparent disc; digits 5+5, 4+4, 3+3 or 2+2, short, circular in section, with smooth lamellae; tail very fragile. Distinguishable from *Lerista* and *Leiopisma* by complete series of suboculars, absence of ear aperture and presence (in life) of bright yellow or reddish ventral pigments.

Distribution

Southern Australia from Jurien Bay (W.A.) to the New England Tableland (N.S.W.). Three species, including the extralimital *H. decresiensis*.

Description

Snout-vent length up to 79 mm. Nasals normally separated. Prefrontals usually narrowly separated (absent in *H. initialis brookeri*). Supraoculars 4, 2 in contact with frontal. Supraciliaries 5-7. Loreals 2. Upper labials normally 7. Temporals 3, uppermost larger than two subequal lower temporals. Mid-body scale rows 17-26.

Back golden to dark reddish brown, with or without an olive tinge, with 0-4 rows of dark dots or short dashes, the central ones sometimes coalescing to form a vertebral stripe. Head usually darker than back. Dark dorsolateral stripe often present. Lateral and ventral scales with or without dark spots or margins. Under-tail usually more heavily spotted than ventrals. Bright ventral pigments rapidly disappearing in alcohol.

Relationships

See Greer (1967: 7).

KEY

- | | | | | | | | | |
|-------------------------------------------|-----|-----|-----|-----|-----|-----|---------------------------------|---|
| 1. Fingers and toes 5; venter orange-red | ... | ... | ... | ... | ... | ... | ... | 2 |
| Fingers and toes 2, 3 or 4; venter yellow | ... | ... | ... | ... | ... | ... | ... | 3 |
| 2. Prefrontals present | ... | ... | ... | ... | ... | ... | <i>H. initialis initialis</i> | |
| Prefrontals absent | ... | ... | ... | ... | ... | ... | <i>H. initialis brookeri</i> | |
| 3. Fingers and toes 2 | ... | ... | ... | ... | ... | ... | <i>H. peronii quadrilineata</i> | |
| Fingers and toes 3 or 4 | ... | ... | ... | ... | ... | ... | <i>H. peronii peronii</i> | |

Hemiergis initialis initialis

Lygosoma (Hemiergis) initiale Werner, 1910, 'Fauna Südwest-Australiens' 2: 480. Lion Mill and Jarrahdale, W.A. (Michaelsen & Hartmeyer).

Diagnosis

A small short-tailed *Hemiergis* with 5 fingers, 5 toes, orange-red venter, and prefrontals.

Distribution

South-west of Western Australia: Darling Range, north nearly to the Avon, south nearly to Collie, and east to Boddington; and the south-east of the South-west Division, north to beyond Lake Varley, south nearly to the Gairdner River, west to Toolbrunup (*vide* Hobart Smith, 1939), and east to Ravensthorpe. Extralimital in western South Australia.

Description

Snout-vent length (mm): 20-47 (N 119, mean 37.1). Tail up to 136% of SVL.

Nasals separated. Prefrontals separated (usually narrowly), rarely touching. Suture between frontoparietals varying from absent (14% of specimens) to complete (49%); in most examples of latter, suture curving so that right frontoparietal smaller than left. Supraoculars 4, first 2 in contact with frontal. Supraciliaries 6 (rarely 5). Upper labials 7 (rarely 8). Nuchals mostly 0 or 1 (94% of specimens), occasionally 2, rarely 3 (N 76, mean 0.5). Mid-body scale-rows 20-22 (N 60, mean 20.5). Lamellae under longest toe: 7-10 (N 39, mean 8.2) in Darling Range; 8-11 (N 35, mean 9.6) in south-east of South-west Division.

Head dark grey. Back reddish brown to dark reddish brown with or without an olive tinge, usually with 2 or 4 longitudinal rows of faint to moderately conspicuous dark spots. Dark dorsolateral stripe usually discernible. Lateral scales greyish brown, with or without faint dark spots. Ventrals usually unspotted, occasionally dark-edged.

Geographic variation

Specimens come from three regions: (1) Darling Range, (2) south-east corner of South-west Division, and (3) far west coast of South Australia. The first two populations are separated by a gap of 170 km. They differ mainly in the number of subdigital lamellae.

Within the second population there is some regional variation: in all 22 specimens from between Ravensthorpe and the Gairdner River the suture between the frontoparietals is complete, compared to 7 out of 23 specimens from further north.

The third population is separated from the second by a gap of more than 1000 km, which is partly occupied by *H. initialis brookeri*. This population is represented by only one specimen; it is dorsally pale brown and has 8 lamellae under the longest toe and no nuchals.

Material

South-west Division (W.A.): Stoneville (27889); Mundaring Weir (14871-2, 19828, 24900-1, 26443, 26478, 34345); 10 km E of Kalamunda (22659, 37483); Gooseberry Hill (39068); Kalamunda (21231-4, 22854-5, 41772); Lesmurdie (18159, 18259); Bartons Mill (10274-5); Karragullen (18157-8, 40980); 8 km SE of Karragullen (18161-4); Churchmans Brook (18152); Wungong Brook (24914, 34582-6); 8 km E of Byford (18155-6); Gleneagle (23472-3); Jarrahdale (18154); Banksiadale (34259); Boddington (13633 *a-m*); Dwellingup (39972-3, 39980, 40126-9); Waroona (41243); Harris River, near Collie (46392); Holt Rock (34390); 8 km N of Ravensthorpe (30824-6); 24 km W of Ravensthorpe (44853-4); Lake Magenta Reserve (39895, 39910, 39922-3, 45305, 45311-3, 47336); 29 km E of Pingrup (39822-4); Cairlocup Reserve (41119-22); Chinocup Reserve (41090-8, 41103-4, 43481-2, 43491); 18 km S of Nyabing (29893); Fitzgerald River (36778-81, 36802-4, 36853-4, 36876-7, 36928, 36948, 36959); 25 km N of Bremer Bay (36187).

South Australia: 8 km W of Ceduna (24577).

Hemiergis initialis brookeri subsp. nov.

Holotype

R24677 in Western Australian Museum, collected on 9 October 1964 by G.M. Storr and A.M. Douglas at 40 km WSW of Caiguna, Western Australia, in 32°20'S, 125°00'E.

Diagnosis

Differing from *H. i. initialis* in its lack of prefrontals, more numerous nuchals, and lesser size.

Distribution

Far south-east of Western Australia: vicinity of Great Australian Bight from Mt Ragged east nearly to Eucla.

Description

Snout-vent length (mm): 21-38 (N 12, mean 33.1). Tail up to 119% of SVL.

Nasals separated. Prefrontals fused to frontonasal. Supraciliaries usually 6, 5 in one specimen. Upper labials 7. Suture between frontoparietals absent in 67% of specimens, and partly present in remainder but not extending forward more than one fifth of way to anterior corner of frontoparietal. Nuchals 2 or 3 (N 12, mean 2.5). Midbody scale rows 20-22 (N 11, mean 20.2). Lamellae under longest toe 8-10 (N 11, mean 8.5).

Head dark grey. Back pale to dark reddish brown, occasionally with an olive tinge, usually with two median lines of dark spots. Little or no development of dark dorsolateral stripe. Lateral scales usually without dark spots. Ventrals usually unspotted; anterior scales occasionally dark-edged.

Remarks

This skink is named after Mr Michael G. Brooker of the CSIRO Division of Wildlife Research. He collected some of the paratypes and many other reptiles in the Nullarbor region.

The strange location of *H. i. brookeri* between two segments of *H. i. initialis* implies varying rates of evolution in the four populations of *H. initialis*, slow in the three populations of the nominate subspecies and fast in *brookeri*. Perhaps ancestral *brookeri* was reduced to a very small population during some arid period, allowing the rapid acquisition of genetic peculiarities.

Material

Eucla Division (W.A.): Junana Rock, 9 km NW of Mt Ragged (36240); Pine Hill (36223-4); Mullendunya Tank (32°53'S, 124°35'E) (45355-6); Toolinna Rockhole (45349); 40 km WSW of Caiguna (24676); 8 km SE of Cocklebiddy (31887-9); 46 km W of Eucla (33439).

Hemiergis peronii quadrilineata

Chelomeles quadrilineatus Duméril & Bibron, 1839, 'Erpétologie générale' 5: 774. New Holland.

Diagnosis

A large long-tailed *Hemiergis* with yellow venter and two fingers and toes.

Distribution

Lower west coast and coastal plain of Western Australia from Jurien Bay south to Busselton, including Essex Rocks, Cervantes I., Green Islets, Rottne I., Garden I. and Penguin I.

Description

Snout-vent length (mm): 22-75 (N 182, mean 50.6). Tail up to 174% of SVL.

Nasals separated. Prefrontals separated (usually narrowly); rarely in very short contact. Supraoculars usually 4, with first 2 in contact with frontal; first 2 fused together in one specimen; 5 supraoculars in another specimen, with 3 in contact with frontal. Supraciliaries 6 (94% of specimens), 7 (5%) or 5 (1%). Upper labials 7 (very rarely 8). Nuchals mostly 3 or 4 (91% of

specimens), occasionally 2, rarely 0 or 1 (N 93, mean 3.1). Midbody scale rows 17-21, mostly 18 (N 87, mean 18.7). Lamellae under longer toe 6-11 (N 99, mean 9.0).

Back pale to dark reddish brown or golden brown or greyish brown, occasionally tinged with olive; usually with 2 median lines of dark spots that may coalesce to form a vertebral stripe. Dark laterodorsal stripe and lateral spotting variable in development. Venter unspotted.

Material

South-west Division (W.A.): Jurien Bay (37970); Essex Rocks (18122-7, 18130-9); Cervantes Islands (18128-9); Green Islets (18115-8, 19152); Wanneroo (31220, 31553-6, 34070-1); Upper Swan (18083-6); Noble Falls (13697); Guildford (21235-6); Mt Yokine (21274-5); Nollamara (34014); Tuart Hill (48170); Scarborough (48168-9); North Perth (4842); Mt Lawley (810); Perth (414, 428, 675, 1182, 2839, 4386, 4388-9, 7033, 8628); Leederville (947-8); Floreat Park (22853, 24887-8); Kings Park (18070-2); Crawley (18075-6); Nedlands (8317, 18074, 18087, 47786); Dalkeith (18077-80); Claremont (2252, 31468); Swanbourne (12819); Cottesloe (18081-2); Rottnest Island (2012-4, 2354-8, 2858-9, 3257-65, 3721-4, 4330, 11007-8, 12767, 15192-9, 18102-14, 18212, 25215-6); East Fremantle (26850); Willagee (34348); Melville Heights (31981); Applecross (21273, 22283); Mt Pleasant (25073); South Perth (4777); Como (2283-5, 41671); Bentley (40014); Garden Island (13025, 18100-1, 28472, 35042-8); Penguin Island (18088-99); Waikiki (40984); Wagerup (251); Yarloop (18140-2); Bunbury (48404); Busselton (34249, 42594).

Hemiergis peronii peronii

Seps peronii Fitzinger, 1826, 'Neue Classif. Rept.', p. 253. Kangaroo Island, S.A.

Chiamela Duvaucellii Gray, 1839, Ann. Nat. Hist. 2: 333. King George Sound, W.A.

Tetradactylus decresiensis Gray, *ibid.* Kangaroo Island, S.A. Not *Hemiergis decresiensis* (Fitzinger).

Hemiergis woodwardi Lucas & Frost, 1902, Proc. Roy. Soc. Vict. 15: 77. Western Australia.

Lygosoma (Hemiergis) quadridigitatum Werner, 1910, 'Fauna Südwest-Australiens' 2: 480. New name for *Seps peronii* Fitzinger.

Lygosoma peronii var. *tridactylum* Boulenger, 1915, Ann. Mag. Nat. Hist. (8) 16: 65. Yallingup, W.A. (R. Scharff).

Diagnosis

A large long-tailed *Hemiernis* with yellow venter and digits 3+3 or 4+4.

Distribution

Southern Western Australia from the lower west coast east nearly to the Nullarbor Plain and north to Busselton, nearly to Collie, Bridgetown, Rocky Gully, Stirling Range, Lake Grace, Lake Varley and the Fraser Range, including an islet in Hamelin Bay, Eclipse I., Coffin I., Bald I., and the Archipelago of the Recherche (Boxer I. and Termination I.). Extralimital in South Australia (Smyth, 1968).

Description

Snout-vent length (mm): 24-79 (N 448, mean 52.0). Tail up to 188% of SVL.

Nasals separated. Prefrontals separated (usually narrowly); occasionally touching. Supraoculars 4, first two in contact with frontal. Supraciliaries 6 or 7, very rarely 5 (N 225, mean 6.5). Upper labials 7 (very rarely 6 or 8). Nuchals 0-6, mostly 3 (N 267, mean 2.8). Midbody scale rows 18-22 (N 239, mean 19.6). Lamellae under longest toe 10-17 (N 231, mean 13.2).

Back pale to dark reddish brown or golden brown, yellowish brown or greyish brown, with or without an olive tinge; usually with two or more longitudinal rows of dark spots, the median pair sometimes coalescing to form a vertebral stripe. Blackish dorsolateral stripe from lores to tail variably developed. Lateral scales with or without blackish brown flecks. Ventrals with or without dark spots or edges.

Geographic variation

Specimens from the far west (see map) have only three digits; concomitant with this reduction are fewer subdigital lamellae, viz. 10-13 (N 37, mean 11.3), vs 10-17 (N 194, mean 13.5) in the tetradactyl populations. The tridactyl population also differs in having fewer supraciliaries, viz. 5-7 (16% of 38 specimens with 7), vs 6-7 (58% of 187 specimens with 7), and more numerous nuchals (2-6, N 39, mean 3.3; vs 0-5, N 228, mean 2.8). In digital characters and number of supraciliaries the tridactyl population shows some approach towards *H. p. quadrilineata*. However, in coloration, especially the heavily spotted venter, the tridactyl population is virtually identical with the tetradactyl population to its immediate east, i.e. the humid country between Nannup and the Fitzgerald River.

In the drier country to the northeast, i.e. from the Pingrup district to Hopetoun (and strangely also on Bald Island) the mid-dorsal spots may coalesce into a vertebral stripe and the ventral spotting is weaker or absent. Here, and east to the Fraser Range, lamellar counts are at their highest, averaging between 14 and 15, compared to 12-13 in the westernmost tetradactyl populations and 13-14 in South Australia.



Fig. 1. Map of southern Western Australia showing location of specimens of *Hemiergis i. initialis* and *H. i. brookeri*.

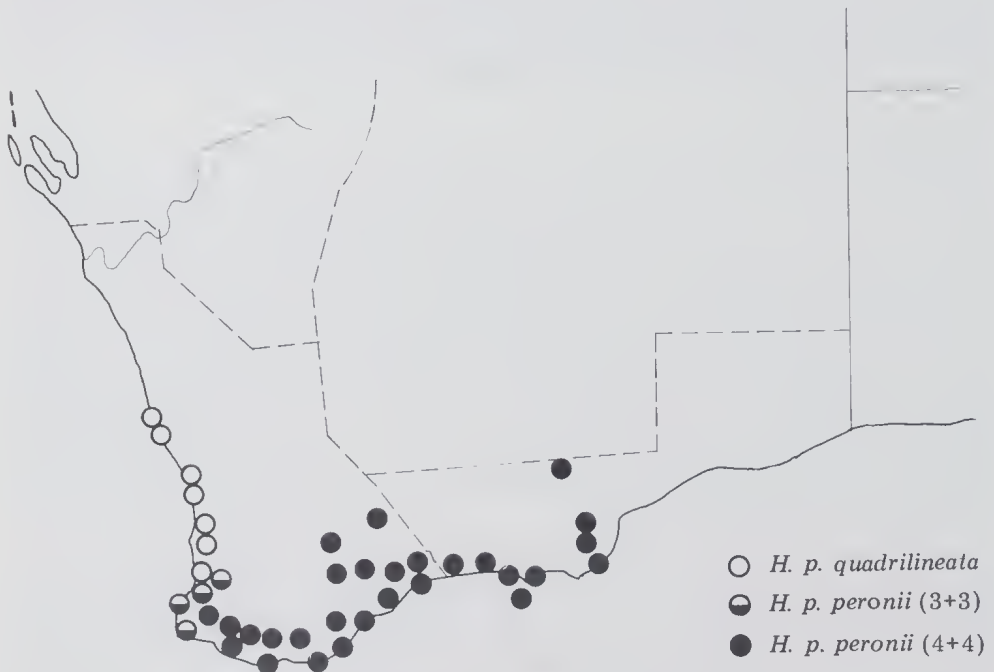


Fig. 2. Map of southern Western Australia showing location of specimens of *Hemiergis p. quadrilineata* and *H. p. peronii*.

At its eastern limit in Western Australia (i.e. east of Fraser Range) and in South Australia the dark dorsolateral stripe is nearly always absent.

The South Australian and Western Australian populations are widely separated (by the Nullarbor Plain). The South Australian specimens are large (SVL 36-79, N 54, mean 56.0; *vs* 25-69, N 311, mean 52.4 in Western Australian tetradactyl specimens, and 24-62, N 83, mean 49.1 in the tridactyl population). In South Australia supraciliary counts of 6 are much more frequent than 7, whereas in Western Australia 7 is more frequent than 6 except in the far west (i.e. in the tridactyl and adjacent tetradactyl populations). The dominant midbody scale count in South Australia is 18, compared to 20 in Western Australian populations except the far eastern. In the last character, as in coloration, the population from east of Fraser Range constitutes a morphological link between eastern and western segments of the subspecies.

Remarks

Though it is the most distinctive population of *H. p. peronii*, I hesitate to treat the tridactyl population as a subspecies. To do so would be tantamount to giving much weight to number of digits and none to coloration, and to implying that tetradactyl specimens from the Nannup district are more closely related to South Australian specimens than to neighbouring tridactyl specimens.

On the other hand I have little hesitation in recognising *H. p. quadrilineata*. At Busselton, where it meets the tridactyl population of *H. p. peronii*, there are marked differences in coloration. Moreover, there is so little evidence of recent gene-flow between them that I do not discount the possibility of *quadrilineata* being a full species.

Material

South-west Division (W.A.): Tridactyl specimens — 8 km SW of Collie (18066-9); Wellington Mill (8349); Donnybrook (18057); Brookhampton (9185); Kirup (18186); Busselton (11019, 47402-3); Dunsborough (12322-3, 18061-5); Yallingup (48298-9); Quindalup (19857); Jarrahwood (39124); Metricup (18060); Margaret River (18056); Calgardup (7726-31, 7953, 7955-9, 7963); Mammoth Cave (67, 12940, 47755-6) and 13 km S (25346); Bride Cave (47759); Devils Lair (39702); Nannup Cave (12425); Arumvale (30236); Alexandra Bridge (18058-9); Karridale (13444, 48405-10); Hamelin Bay (18055); Outer Island, Cosy Corner (21295-6); Kudardup (46246-9); Deepdene (12779); 8 km N of Augusta (37808-11); Carey Brook, Donnelly River (27894-903). Tetradactyl specimens — Nannup (45744-5); Bridgetown, including Carinya (155, 31679); Wilgarup (5595-7); Yanmah (5598, 5600-2); Manjimup, including Dinvale (5583-7, 5589-90, 8181, 8183, 19041-5, 41732-6); 12 km S of Manjimup (18151); Perup (5588); Perup River (18036-7); between upper reaches of Perup and Tone Rivers (42560-8);

Pemberton (5591-2, 5594); Meerup (47884); Yeagerup (47863, 47934-7); Dombakup (18150); Northcliffe (6572-3); Shannon River Dam (19820); Mt Chudalup (18153); East Broke Inlet (47973-8); Nornalup (11041-3); Rocky Gully (48174); Kent River (44669-72); 16 km N of Denmark (43827, 43841-7); Denmark, including Monkey Rock and Rudgyard Beach (297, 19851-2, 22474-81, 24948-51, 24974-9, 31066-7, 37965); Torbay (12820); 10 km W of Mt Barker (18148); Porongorup Range (8735, 21820-1); Chorkerup (4515); Albany (6790, 34263); Eclipse I. (6805, 11277, 45772); lower Kalgan River (18149); Two People Bay (36334, 36358-9, 37836); Coffin Island, Two People Bay (22752); Waychinicup River (29698); Cheyne Beach (18047-54, 18145, 29694-7); Bald Island (18143-4, 19965); Moir Pass (820); Mt Toolbrunup (21822); Bluff Knoll (18043-6); Bremer Bay (33405-7); Boondadup River (37195, 37212-3, 37216); middle and lower reaches of Fitzgerald River, including Twertup Creek (36806, 36812-6, 36831-4, 36874-5, 36926-7, 36984-9, 37721); West Mt Barren (36889); Middle Mt Barren (36904); Lake Grace (30202-4); Cairlocup Reserve (41123-31); 18 km E of Greenshield Soak (39924); 8 km W of Lake Magenta (21738-9); Lake Varley (27260-1); 27 km W of Ravensthorpe (44850-2); 18 km W of Ravensthorpe (18146); Ravensthorpe (4917, 30815); Hopetoun (6424, 11006, 18487) and 16 km E (31118).

Eucla Division (W.A.): Oldfield River (30146); Munglinup River (36234); Dalyup River (18007-35); Boxer Island (10117); Esperance (11370, 11372, 11783-4, 13371 *a-c*, 13677, 13678 *a-c*); Termination Island (10127); Frenchman Peak (41981); west end of Rossiter Bay (46263, 46270-1); Point Malcolm (14467); Israelite Bay (14177, 18040-2); Pine Hill (17599, 36225-6); Junana Rock (36241-4); Juranda Rock (18039); 13 km E of Fraser Range (30717-48); 18 km E of Fraser Range (30264, 30935).

South Australia: Fowlers Bay (24583-5); Ceduna (25554-61); Smoky Bay (24545-55); Port Kenny (27368); Venus Bay (27367); Elliston (27366); 28 km WNW of Port Lincoln (27361-4); Louth Bay (27356-8); Tumby Bay (27343-52); Port Neill (27319-23); Arno Bay (27318); Port Gawler (27284-8).

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A REVIEW OF THE POMACENTRID FISH GENUS *PARMA*, WITH DESCRIPTIONS OF TWO NEW SPECIES

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and

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ABSTRACT

The damselfish genus *Parma* (family Pomacentridae) is reviewed. The group contains eight species, including two which are described as new. *P. microlepis* and *P. unifasciatus* have overlapping distributions along the coast of New South Wales. *P. oligolepis* and *P. polylepis* are also found in New South Wales, but their range extends into Queensland. The latter species is also found at Lord Howe Island, Norfolk Island, and New Caledonia. *P. victoriae* occurs along the southern coast of Australia, including Tasmania. The known distribution of *P. mccullochi* extends from approximately Esperance, Western Australia to the Abrolhos Islands. *P. alboscapularis*, new species, is described from nine specimens collected at Lord Howe Island, North Island, New Zealand, and the Kermadec Islands. It is separable from other members of the genus by a combination of features which include scales on the inferior limb of the preopercle, a continuous exposed margin on the lower edge of the preorbital and suborbital bones, 25 to 32 tubed lateral-line scales, a convex snout profile, and 36 to 41 vertical scale rows. *P. occidentalis*, new species is described from 29 specimens collected off the west coast of Western Australia. It is distinguishable on the basis of a combination of characters which are similar to those given above for *P. alboscapularis* except it has 32 to 35 lateral-line scales, a distinctly concave snout profile, and 43 to 46 vertical scale rows.

INTRODUCTION

The genus *Parma* Günther (1862) contains eight species which are confined mainly to the Australian-New Zealand region. These fishes and the

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monotypic *Hypsypops* Gill (1861) from southern California and Mexico share the distinction of being the only pomacentrid genera which are mainly confined to temperate and subtropical latitudes. The family Pomacentridae constitutes one of the largest groups of coral reef fishes, containing approximately 250 species, most of which inhabit the Indo-W. Pacific region.

The genus has not been reviewed previously on a comprehensive basis. The most important works are those of Günther (1862), who described the genus, and Whitley (1929a). The former author recognized four species, *microlepis*, *squamipinnis* (a synonym of *microlepis*), *polylepis*, and *rubicunda* (now placed in *Hypsypops*). Whitley included five species of *Parma* in his review of the Australian 'Amphiprioniformes': *mccullochi*, *microlepis*, *oligolepis*, *unifasciatus*, and *viola*. The last named species is a junior synonym of *P. victoriae*, which Whitley placed in a separate genus, *Actinochromis* Bleeker (1877). In addition to the species treated by Whitley the present review includes Günther's *polylepis* and two new species, *P. occidentalis* from Western Australia and *P. alboscapularis* from Lord Howe Island, New Zealand, and the Kermadec Islands.

The members of the genus generally inhabit shallow rocky areas, although *P. occidentalis*, *P. microlepis* and *P. unifasciatus* are known to occur at depths of at least 35 metres. The diet consists primarily of algae.

Four of the species, *P. microlepis*, *P. oligolepis*, *P. polylepis*, and *P. unifasciatus*, have overlapping distributions in New South Wales. The south coast of Queensland is inhabited by *P. oligolepis* and *P. polylepis*. The latter species also occurs at Lord Howe Island with *P. alboscapularis*, which is the sole representative of the genus in New Zealand and the Kermadec Islands. *P. victoriae* is widespread across the south coast of Australia, including Tasmania. *P. occidentalis* inhabits the central west coast of Western Australia while *P. mccullochi* frequents the southwest corner from approximately the Abrolhos Islands to the Recherche Archipelago off Esperance, Western Australia. *P. victoriae*, *P. occidentalis*, and *P. mccullochi* are sympatric in the central west coast although the range of *victoriae* does not appear to extend much further north than Cape Naturaliste.

P. oligolepis, *P. polylepis*, *P. mccullochi* and *P. occidentalis* are sometimes found on coral reefs. The former species has been taken as far north as Green Island off Cairns. *P. polylepis* is not uncommon on the outer reef edge at One Tree Island in the Capricorn Group of the Great Barrier Reef. This species also occurs at New Caledonia, Norfolk Island, and Lord Howe Island, where it is extremely common.

METHODS OF COUNTING AND MEASURING

The methods of counting and measuring are the same as those described by Allen (1972), except the length of the dorsal and anal spines are

measured proximally from the base of the spine rather than the point at which the spine emerges from the scaly sheath. Measurements were made with needlepoint dial calipers to the nearest one-tenth millimetre. Standard length is abbreviated as SL. The fraction $\frac{1}{2}$ which appears in the dorsal and anal fin ray formulae refers to a bifurcate condition of the last ray.

The counts and proportions which appear in parentheses under the description section for each species apply to the paratypes when differing from the holotype. A summary of counts for the dorsal, anal, and pectoral fin rays, tubed lateral-line scales, and gill rakers on the first arch is presented in Tables 1 and 2.

Type specimens of *P. alboscapularis* and *P. occidentalis* have been deposited at the Australian Museum, Sydney (AM); Canterbury Museum, New Zealand (CM); CSIRO, Division of Fisheries and Oceanography, Cronulla, Australia (CSIRO); National Museum of New Zealand, Wellington (NMNZ); Queensland Museum, Brisbane (QM); and the Western Australian Museum, Perth (WAM).

TAXONOMY

GENUS *PARMA* GÜNTHER

Parma Gunther, 1862. Cat. Fish Brit. Mus., vol. 4, p. 57 (type species *Parma microlepis* by subsequent designation of Jordan, 1919).

Actinochromis Bleeker, 1877. Natuurk. Verh. Holl. Maatsch. Wetensch. (3) ii, 6, p. 6 (type species, *Glyphidodon victoriae* by original designation).

Diagnosis

Dorsal rays XIII, 16 to 21; anal rays II, $13\frac{1}{2}$ to $16\frac{1}{2}$; pectoral rays 19 to 22; tubed lateral-line scales 21 to 35; gill rakers 7 to $13 + 1 + 9$ to 12; teeth uniserial, close-set and slender, about 40 to 62 in each jaw; margin of pre-orbital, suborbital, and bones of opercular series entire; preorbital naked or scaled on posterior section; suborbital scaled.

Body depth 1.6 to 2.0, head length 3.0 to 4.3, both in standard length. Snout 2.3 to 3.4, eye 3.0 to 4.6, interorbital 2.3 to 3.6, depth of caudal peduncle 1.7 to 2.1, length of caudal peduncle 3.0 to 5.3, of pectoral fin 0.9 to 1.1, of pelvic fin 0.7 to 1.1, caudal concavity 1.4 to 3.4, all in head length.

Colour in alcohol generally brown, some species with one or more pale bars on sides. Juveniles usually pale (yellow in life) with pattern of dark stripes antero-dorsally and scattered spots on head and body (these markings bright blue in life). Juveniles also possess an ocellus on the dorsal fin.

Remarks

Parma is the largest pomacentrid genus of temperate Australia. Its salient features include a relatively large size at maturity, deep body, uniserial teeth, relatively small scales, and a benthic-dwelling mode (as opposed to the members of the genus *Chromis*, whose New Zealand and temperate Australian representatives are mid-water foragers). The members of this genus bear a close resemblance to the monotypic *Hypsypops rubicunda*, from southern California and the Pacific coast of Mexico. However, *Hypsypops* is characterized by 12 dorsal spines, slightly larger scales, and adults exhibit a prominent hump on the forehead and interorbital region. It is possible that *Parma* and *Hypsypops* have evolved from a common ancestral stock which was once widespread or their similarity may be the result of convergence due to environmental similarities.

KEY

- | | | | |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---|
| 1a. | Inferior limb of preopercle naked, vertical scale rows from upper edge of gill opening to base of caudal fin 30 to 38; tubed lateral-line scales 21 to 28 | ... .. | 2 |
| 1b. | Inferior limb of preopercle scaled; vertical scale rows from upper edge of gill opening to base of caudal fin 36 to 46; tubed lateral-line scales 25 to 35 | ... .. | 5 |
| 2a. | Preopercle largely naked, scales covering about ½ total area, arranged in 3-4 transverse rows below suborbital; snout profile convex; predorsal scales extending to about anterior margin of eye; preorbital naked; tubed lateral-line scales 21 to 22 (Victoria; Tasmania; South Australia; Western Australia) | victoriae | |
| 2b. | Preopercle mostly scaled, scales covering more than ½ total area, arranged in 6-7 transverse rows; snout profile concave or more or less straight; predorsal scales extending to level of posterior nostrils; preorbital scaled on posterior section; tubed lateral-line scales 22 to 28 | ... .. | 3 |
| 3a. | Lower margin of preorbital only slightly produced, not forming triangular projection; scale rows between lateral-line and first dorsal spine 5 to 6; upper corner of operculum | | |

- frequently with white patch (New South Wales) *microlepis*
- 3b. Lower margin of preorbital distinctly triangular; scale rows between lateral-line and first dorsal spine 4; upper corner of operculum without white patch 4
- 4a. Lower margin of preorbital with notch in front of triangular projection; soft dorsal rays usually 19 or 19½; surface of preorbital smooth without bony ridges; whitish bar on middle of sides absent (Queensland; New South Wales) *oligolepis*
- 4b. Lower margin of preorbital without notch in front of triangular projection; soft dorsal rays usually 17½; surface of preorbital with bony ridges, at least in adults; whitish bar on middle of sides (New South Wales) *unifasciatus*
- 5a. Lower margin of preorbital and suborbital discontinuous, separated by patch of scales (not apparent without magnification in specimens under about 90 mm SL); specimens in excess of about 100 mm SL with bony knobs above anterior corner of eye and at mid-interorbital, becoming more noticeable with increased size; specimens under about 125 mm SL with two pale bars on sides, frequently with large ocellus at soft dorsal junction (New South Wales; S. Queensland; Lord Howe Island; Norfolk Island; New Caledonia) *polylepis*
- 5b. Lower margin of preorbital and suborbital continuous, not separated by patch of scales; specimens of all sizes without bony knobs above eye and at mid-interorbital; specimens of all sizes without pale bars on sides, ocellus present in juveniles under about 50 mm SL 6
- 6a. Tubed lateral-line scales usually 32 to 35; occipital slightly arched; snout profile distinctly concave; predorsal scales extending to about anterior margin of eye; vertical scale rows from upper edge of gill opening to base of caudal fin 43 to 46; head and body usually light brown in preservative, frequently

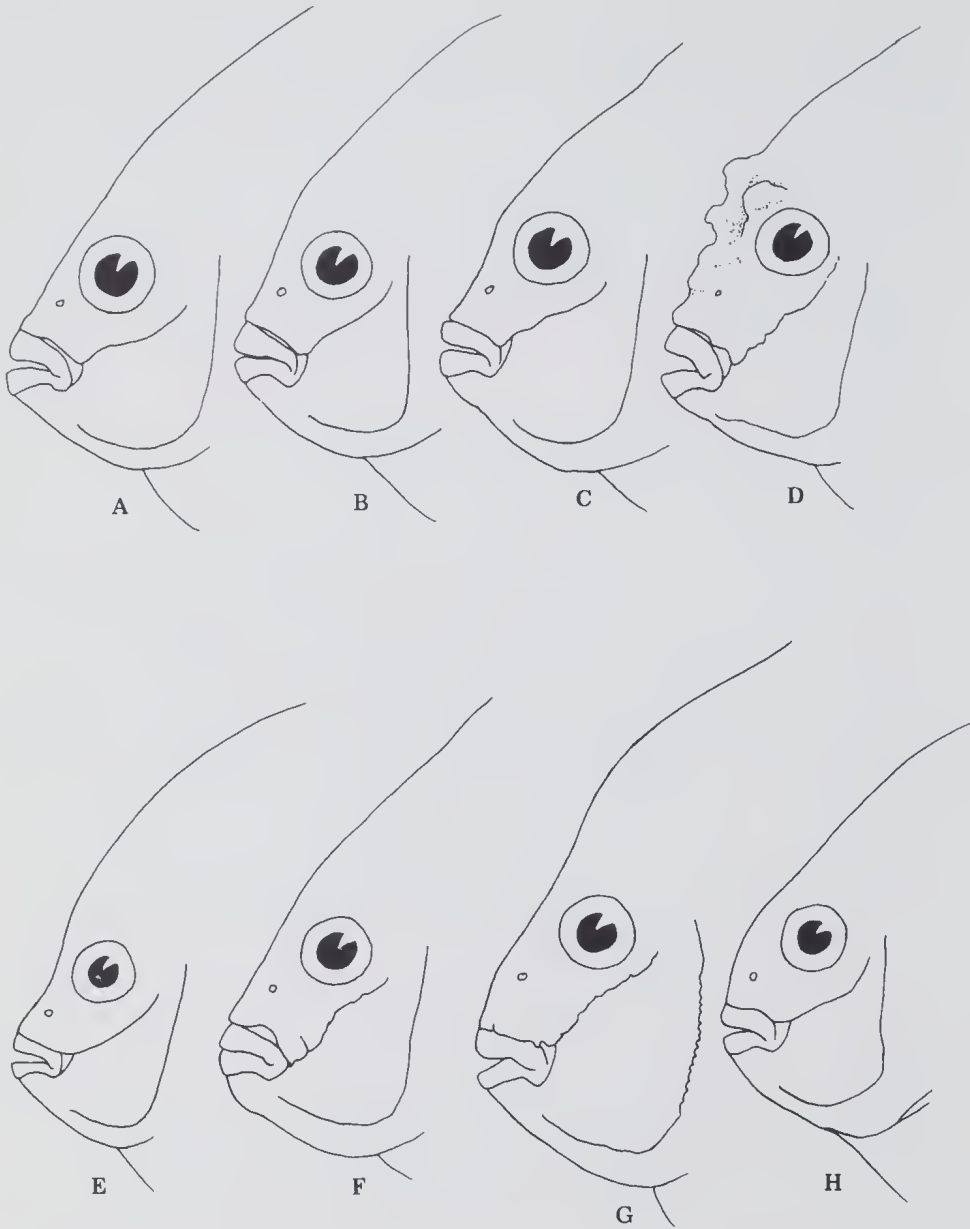


Fig. 1. Head profiles of various *Parma* (*P. mccullochi* not shown): (A) *microlepis*; (B) *unifasciatus*; (C) *polylepis*, juvenile to small adult; (D) *polylepis*, large adult; (E) *occidentalis*; (F) *oligolepis*; (G) *alboscapularis*; (H) *victoriae*.

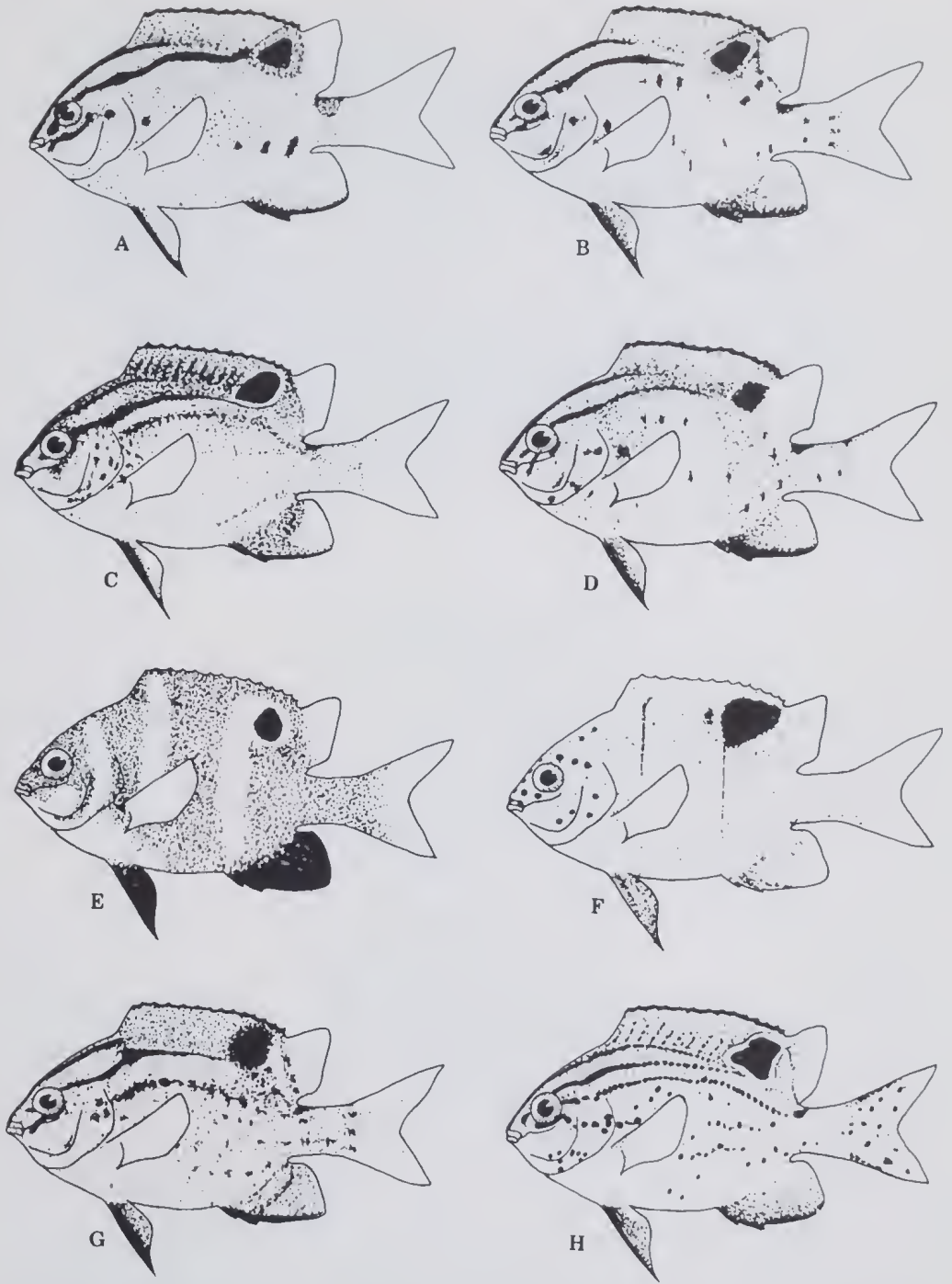


Fig. 2. Juvenile colour patterns of *Parma*: (A) *victoriae*; (B) *microlepis*; (C) *oligolepis*; (D) *unifasciatus*; (E) *polylepis*; (F) *occidentalis*; (G) *alboscapularis*; (H) *mccullochi*.

- with pair of faint dusky bars on sides (Western Australia) *occidentalis* n. sp.
- 6b. Tubed lateral-line scales 25 to 32; occipital not arched, confluent with contour of head profile; snout profile convex; predorsal scales extending to level of nostrils; vertical scale rows from upper edge of gill opening to base of caudal fin 36 to 41; head and body entirely dark brown in preservative 7
- 7a. Surface of preorbital with bony tubercles or ridges, at least in adults; pectoral rays usually 22, occasionally 21 (Lord Howe Island; New Zealand; Kermadec Islands) *alboscapularis* n. sp.
- 7b. Surface of preorbital without bony tubercles; pectoral rays usually 21, occasionally 20 (Western Australia) *mccullochi*

Parma victoriae

(Figs. 1H, 2A, 3 and 4; Tables 1, 2 and 3)

Glyphidodon victoriae Günther, 1863. Ann. Mag. Nat. Hist., vol. 11 (3), p. 115 (type locality, Victoria).

Heliastes lividus Klunzinger, 1872. Arch. Naturg. (Wiegmann), vol. 38, 1, p. 36 (type locality, Port Phillip, Victoria).

Parma viola Whitley, 1929a. Mem. Queensland Mus., vol. 9 (part 3), p. 231 (type locality, Tasmania).

Diagnosis

Dorsal rays XIII, 16½ to 17½; anal rays II, 15 to 16; pectoral rays 19 to 21; tubed lateral-line scales 21 to 22; gill rakers 9 to 11 + 1 + 10 or 11 (total 21 to 23); upper and lower jaw each with 44 to 50 teeth; body depth 1.8 to 1.9 in standard length; head length 3.0 to 3.3 in standard length; snout 3.0 to 3.4, eye 3.5 to 4.5, interorbital 2.6 to 2.9, depth of caudal peduncle 1.8 to 2.0, length of caudal peduncle 3.0 to 3.5, of pectoral fin 0.9 to 1.0, of pelvic fin 0.9 to 1.1, caudal concavity 1.7 to 2.2, all in head length.

Colour in alcohol: head and body mottled brown, lighter on breast, abdomen, and underside of head; snout and forehead dark brown and dark pigment usually present on middle section of upper lip; fins dark brown to blackish except pectorals dusky; dark wedge-shaped mark on upper portion of pectoral base. Two subadults, 64.5 and 75.8 mm SL, are light brown

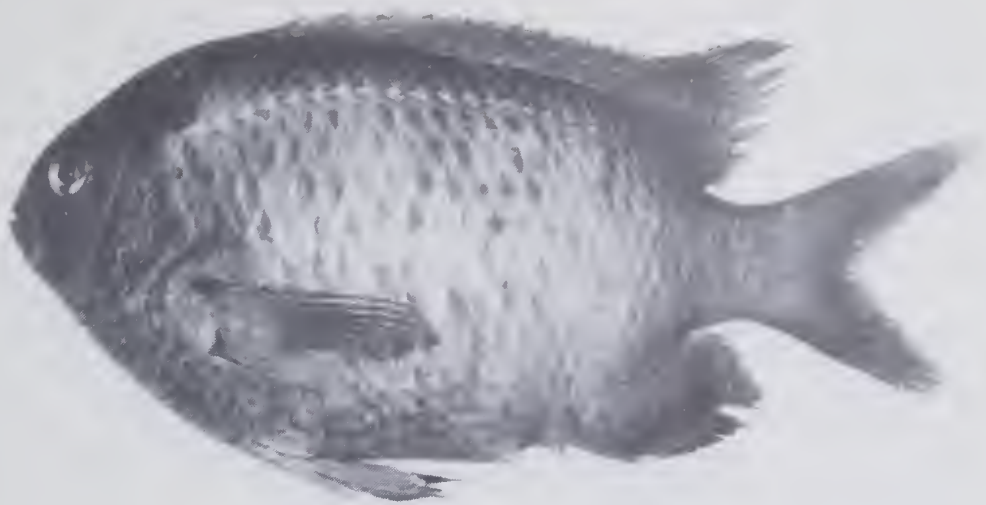


Fig. 3. *Parma victoriae*, 140 mm SL, Moana, South Australia.

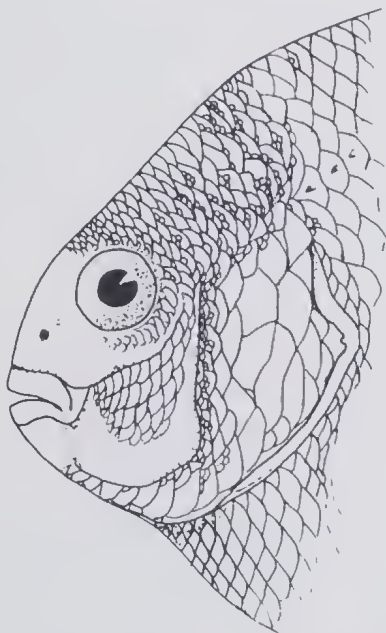


Fig. 4. Head of *Parma victoriae*.

grading to dark brown dorsally; fins dusky to dark brown, with posterior portion of soft dorsal, anal, and caudal more or less translucent, especially in smaller specimen; large pale-ringed black ocellus at base of dorsal fin

between 11th spine and first few soft rays, more prominent on smaller specimen.

Colour in life (based on a kodachrome transparency of a freshly collected specimen): body mostly yellowish-brown with irregular mottlings of darker brown; head and area above lateral-line dark brown; fins brown to dusky. The colours of a small juvenile (approximately 25 mm TL) taken from a colour transparency which was sent to us by Mr A.B. Whittenbury are as follows: head and body mostly yellow, although slightly brownish dorsally; three neon-blue lines on head and anterior portion of back, the first extending from snout tip to dorsal origin, the second from upper edge of eye to dorsal ocellus, the third from chin to posterior edge of preopercle; neon-blue spot about size of pupil on upper edge of caudal peduncle, just behind last dorsal ray and three smaller blue spots above anal fin base; dorsal fin yellowish-brown with large blue-edged black ocellus at soft dorsal junction; edge of spinous dorsal with narrow blue margin; remainder of fins yellow to translucent; except anteriormost pelvic ray darkened.

Remarks

The holotype is deposited at the British Museum (Natural History).

Material examined

Nine specimens, 64.5-178.5 mm SL.

Tasmania — AM I.6611 (holotype of *Parma viola*), 167.0 mm.

Victoria — AM I.16980-013, 2 specimens, 75.8 and 134.0 mm, Bell's Beach; AM I.16982-005, 64.5 mm, Bell's Beach.

South Australia — AM I.17608-002, 2 specimens, 124.0-138.2 mm, Moana Reef.

Western Australia — WAM P25128-001, 3 specimens, 162.5-178.5 mm, Geopraphe Bay.

Parma microlepis

(Figs. 1A, 2B, 5 and 6; Tables 1, 2 and 3)

Parma microlepis Günther, 1862. Cat. Fish Brit. Mus., vol. 4, p. 57 (type locality, Port Jackson, New South Wales).

Parma squamipinnis Günther, 1862. *Ibid.*, p. 58 (type locality, Australia).

Glyphidodon (Parma) australis Steindachner, 1867. Sitz. Akad. Wiss, Wien, vol. lvi, p. 328 (no locality given).



Fig. 5. *Parma microlepis*, adult (from Waite, 1905).

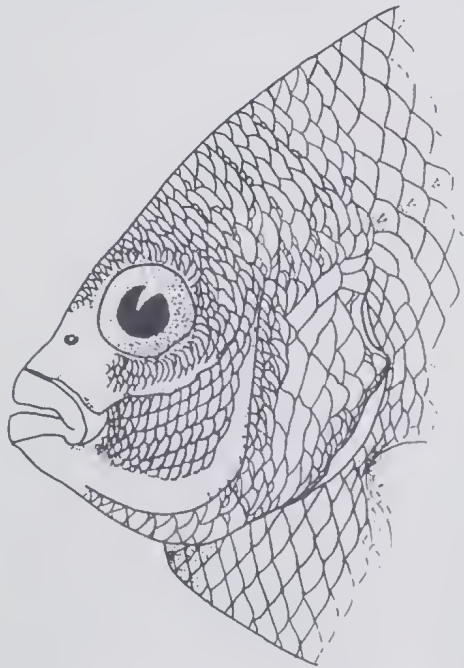


Fig. 6. Head of *Parma microlepis*.

Diagnosis

Dorsal rays XIII, 16 to 18½; anal rays II, 14½ to 16½; pectoral rays 20 to 21; tubed lateral-line scales 23 to 28; gill rakers 8 to 11 + 1 + 10 or 11 (total 19 to 23); upper and lower jaw each with 46 to 54 teeth; body depth 1.8 to 2.0, head length 3.0 to 3.2, both in standard length; snout 3.1 to 3.4, eye 3.4 to 4.1, interorbital 3.0 to 3.6, depth of caudal peduncle 2.0 to 2.1, length of caudal peduncle 3.7 to 4.8, of pectoral fin 1.0 to 1.1, of pelvic fin 0.9 to 1.0, caudal concavity 1.8 to 2.1, all in head length.

Colour in alcohol: head and body dark brown; frequently a darker band across snout connecting orbits and another across chin extending onto lower edge of preopercle; lips, preorbital, anterior suborbitals, and anterior portion of interopercle tan; large white blotch on upper edge of opercle margin; fins dark brown to blackish except pectorals dusky.

Juveniles between about 15-30 mm SL exhibit the following pattern: head and body mostly tan; three bluish stripes on head and anterior portion of back, the first extending from tip of snout to dorsal origin, the second from eye to dorsal ocellus, and the third from corner of mouth to about middle of opercle; small dark specks scattered on body and bluish saddle on dorsal edge of caudal peduncle behind last dorsal ray; spinous dorsal fin dusky with narrow black margin, soft dorsal pale; pale-rimmed black ocellus between 11th dorsal spine and 2nd soft ray; anal fin mostly pale with blackish anterior margin; caudal slightly dusky; pelvics dusky; pectorals pale.

Juveniles begin to turn brown between about 30-40 mm SL. The small dark specks on the sides are no longer apparent in specimens larger than about 55 mm SL. The prominent white spot or 'ear' mark on the opercle becomes readily apparent at about this same size. The dorsal ocellus is generally retained until a standard length of about 80-90 mm.

Remarks

Specimens from Sydney Harbour frequently lack the characteristic white 'ear' patch.

The holotype is deposited at the British Museum (Natural History).

Material examined

140 specimens, 17.0-138.8 mm SL.

New South Wales — AM IA.554-65, 12 specimens, 53.3-138.8 mm, Bondi Beach (plus 22 additional lots from the Sydney area [including Long Reef, Sydney Harbour, Maroubra, and Botany Bay] containing 71 specimens, 17.0-136.7 mm); AM IB.468, 36.0 mm, Clarence River; AM IB.2516, 114.0 mm, Byron Bay; AM I.11247, 104.0 mm, Baranju Head; AM I.15912-012, 13 specimens, 74.2-116.3 mm, Jervis Bay (plus 6 additional lots from this locality containing 26 specimens 46.0-104.5 mm); AM I.16467-002, 4 specimens, 34.0-39.0 mm, Minnie Waters; AM I.16468-001, 3 specimens, 35.0-37.0, Minnie Waters; AM I.16970-008, 22.0 mm, Nullica Bay; AM

I.17343-004, 3 specimens, 22.0-37.0 mm, Seal Rock (plus 2 additional lots from this locality containing 2 specimens, 30.0 and 49.0 mm); CSIRO C3475, 103.0 mm, Cronulla; CSIRO C3476, 97.3 mm, Cronulla.

Parma oligolepis

(Figs. 1F, 2C, 7 and 8; Tables 1, 2 and 3)

Parma oligolepis Whitley, 1929a. Mem. Queensland Mus., vol. 9 (part 3), p. 230 (type locality, Cape Moreton, Queensland).



Fig. 7. *Parma oligolepis*, 106 mm SL, Minnie Waters, New South Wales.

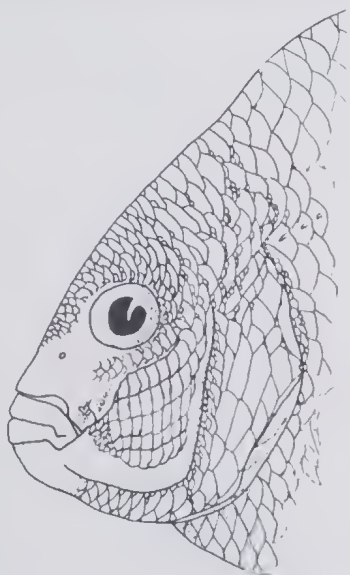


Fig. 8. Head of *Parma oligolepis*.

Diagnosis

Dorsal rays XIII,17 to 20; anal rays II,13½ to 15; pectoral rays 20 to 22; tubed lateral-line scales 22 to 24; gill rakers 9 to 12 + 1 + 11 or 12 (total 21 to 24); upper and lower jaw each with 48 to 56 teeth; body depth 1.6 to 1.9 in standard length; head length 3.0 to 3.3 in standard length; snout 2.7 to 3.0, eye 3.5 to 4.3, interorbital 2.4 to 3.1, depth of caudal peduncle 1.8 to 2.0, length of caudal peduncle 4.0 to 4.2, of pectoral fin 0.9 to 1.0, of pelvic fin 0.8 to 1.0, caudal concavity 1.8 to 2.2, all in head length.

Colour in alcohol: head and body entirely dark brown, except lighter on breast and underside of head; fins dark brown to blackish except more or less translucent on hindmost portion of soft dorsal, anal, and caudal fin; pectorals dusky with dark wedge-shaped mark on upper portion of fin base.

The colour pattern of four juvenile specimens 36.5-46.4 mm SL is as follows: head and body brown, darker dorsally; smaller specimens with pair of bluish lines on head and anterior portion of back, the first extending from snout tip to dorsal origin, the second from eye to dorsal ocellus (these marks still evident in 67.8 mm specimen from Byron Bay, New South Wales); 36.5 mm specimen with scattered dark specks on head, posterior portion of body, and caudal peduncle; 44.0 and 74.0 mm specimens with small blue dot on preorbital and pale line on suborbitals; spinous dorsal and basal 1/3 of soft dorsal brown, prominent pale-rimmed black ocellus between 11th dorsal spine and about first two soft rays; anal and pelvics darker than other fins except anal translucent posteriorly; pectorals pale; caudal dusky.

The live coloration of adults is unknown, but they are probably entirely dark brown. Juveniles are largely yellowish with a blue-rimmed black ocellus, blue lines on the head and upper back, and blue specks on the head and body. The margin of the spinous dorsal and anal fin is also blue.

Remarks

The holotype is deposited at the Queensland Museum.

Material examined

19 specimens, 30.0-160.2 mm SL.

Queensland — AM IA.3666 (paratype), 159.3 mm, Green Island, AM IA.3944-5, 2 specimens, 136.5-160.2 mm, Rat Island, Port Curtis; QMI.2536 (holotype), 156.0 mm, Cape Moreton.

New South Wales — AM IB.6838-39, 2 specimens, 44.0-105.0 mm, Minnie Waters; AM I.16466-005, 36.5 mm, Minnie Waters; AM I.16467-021, 4 specimens, 36.8-99.0 mm, Minnie Waters; AM I.16468-012, 4 specimens, 101.5-112.0 mm, Minnie Waters; AM I.17896-001, 2 specimens, 30.0-36.0 mm Long Bay; AM I.17915-001, 2 specimens, 62.8-74.0 mm, Byron Bay.

Parma unifasciatus

(Figs. 1B, 2D, 9 and 10; Tables 1, 2 and 3)

Pomacentrus unifasciatus Steindachner, 1867. Sitzb. Akad. Wiss. Wien.,
vol. lvi (1), p. 326 (no locality given).



Fig. 9. *Parma unifasciatus*, 118 mm SL, Long Reef, near Sydney.

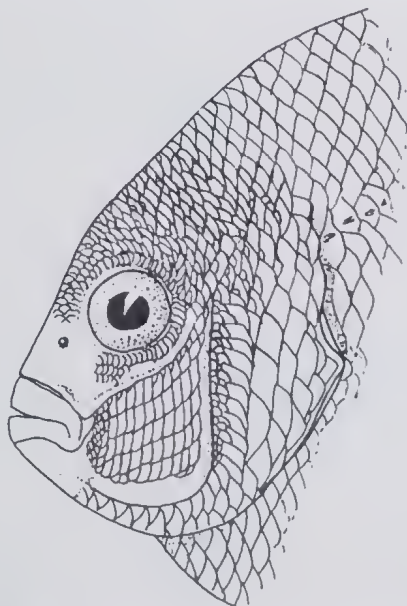


Fig. 10. Head of *Parma unifasciatus*.

Diagnosis

Dorsal rays XIII, 17 to 19; anal rays II, 14 to 15; pectoral rays 20 to 22; tubed lateral-line scales 22 to 27; gill rakers 9 to 11 + 1 + 10 to 12 (total 20 to 23); upper and lower jaw each with 40 to 46 teeth; body depth 1.7 to 1.9, head length 3.1 to 3.2, both in standard length; snout 2.7 to 2.9, eye 3.4 to 4.0, interorbital 2.8 to 3.0, depth of caudal peduncle 1.9 to 2.0, length of caudal peduncle 3.0 to 3.4, of pectoral fin 0.9 to 1.1, of pelvic fin 0.9 to 1.0, caudal concavity 1.8 to 2.3, all in head length.

Colour in alcohol: head and body mostly dark brown, breast and centre of scales slightly lighter; prominent pale band (3-4 scales wide) extending from base of 8th-10th dorsal spine to abdomen; fins dark brown, except pectorals dusky; lips tan. The coloration of four adults, 158.5-172.0 mm SL, obtained recently at the Sydney Market is slightly different than most of the specimens we examined. They are generally lighter brown with dusky scale margins. Live specimens from Byron Bay exhibit this same coloration. The posterior portion of the body and caudal peduncle are notably pallid. This region is separated from the pale mid-body bar by a darker brown area. The fins of these specimens are nearly blackish.

The colour pattern of two juvenile specimens 35.0 and 36.0 mm SL is as follows: body brown with broad tan area on middle of sides about 6-7 scales wide, extending from lateral-line to abdomen; breast, caudal peduncle and region adjacent to soft dorsal and anal fins tan; dark spot on upper edge of caudal peduncle adjacent to hindmost dorsal ray; several dark specks on caudal peduncle and posterior portion of body; larger dark spot behind upper edge of opercle; lower portion of head tan, upper part, including snout and forehead brown; pair of bluish lines on head and anterior portion of back, the first extending from snout tip to dorsal origin, the second passing through eye to dorsal ocellus, although indistinct and broken posteriorly; short bluish streak below antero-ventral corner of eye extending towards rictus; small bluish spot on side of snout, just in front of eye; opercle with 3-4 dark blotches; spinous dorsal dusky with narrow black margin, soft dorsal tan to translucent; large pale-rimmed black ocellus between 11th dorsal spine and about first two soft rays; anal and pelvic fins mostly tan except dusky on anterior margin; caudal and pectorals pale. The characteristic juvenile ocellus gradually fades with growth. It is generally absent in specimens over 80-90 mm SL, although we have examined one specimen, 52.5 mm, which does not have the ocellus and exhibits the adult pattern.

The colours of a freshly collected adult taken from a kodachrome transparency are as follows: head, body, and fins mostly dark brown; edge of opercle and outer 1/3 of pectorals pale brown; prominent pale brown band, about six scales wide, extending from base of 8th-10th dorsal spine to abdomen.

Remarks

This species is extremely common at Byron Bay, New South Wales, which is located near the Queensland border. The depth distribution ranges from three to at least 23 metres.

Material examined

Twenty six specimens, 31.9-172.0 mm SL.

New South Wales — AM IA.553, 138.8 mm, Bondi Beach; AM IA.4880, 120.0 mm, Port Jackson; AM IB.1356, 127.0 mm, Dee Why; AM IB.2341, 144.8 mm, Newcastle; AM IB.6837, 78.0 mm, Minnie Waters; AM IB.7349, 102.3 mm, Quarantine Beach, Sydney Harbour; AM I.6848, 142.0 mm, Maroubra; AM I.15575-006, 48.2 mm, Woolongong; AM I.15892-002, 2 specimens, 101.0-108.0 mm, Long Reef; AM I.16237-008, 108.5 mm, Long Reef, AM I.16466-009, 35.0 mm, Minnie Waters; AM I.16467-007, 4 specimens, 31.0-43.0 mm, Minnie Waters; AM I.16468-004, 2 specimens, 35.2-35.6 mm, Minnie Waters; AM I.17108-005, 3 specimens, 51.3-53.3 mm, Long Bay, AM I.17332-004, 114.7 mm, Long Reef; AM I.17903-001, 4 specimens, 158.5-172.0 mm, Sydney Market.

Parma polylepis

(Figs. 1C and D, 2E, 11 and 12; Tables, 1, 2 and 3)

Parma polylepis Günther, 1862. Cat. Fish Brit. Mus., vol. 4, p. 59 (type locality, Norfolk Island).

Diagnosis

Dorsal rays XIII, 16½ to 19; anal rays II, 13½ to 14½; pectoral rays 20 to 22; tubed lateral-line scales 26 to 33; gill rakers 7 to 11 + 1 + 9 to 11 (total 17 to 23); upper and lower jaw each with 44 to 48 teeth; body depth 1.6 to 1.7, head length 3.2 to 3.4, both in standard length; snout 2.5 to 2.7, eye 3.2 to 4.1, interorbital 2.3 to 2.8, depth of caudal peduncle 1.7 to 1.9, length of caudal peduncle 3.3 to 4.0, of pectoral fin 0.9, of pelvic fin 0.8 to 0.9, caudal concavity 1.8 to 2.3, all in head length.

Colour in alcohol: head and body dark brown, scale centres lighter especially on opercle and anterior half of body; upper limb of preopercle and opercle with dark brown outline; fins dark brown to blackish, except pectorals dusky with dark region at base especially prominent on upper and lowermost portion.

The colour pattern of juveniles between about 25-80 mm is as follows: two prominent pale bars on sides, each about six scales wide, the first extending from base of first 3-4 dorsal spines to just behind and below pectoral base, the second from base of 9th-11th dorsal spines to anal fin origin; caudal peduncle, breast, and lower half of head tannish; hind margin of preopercle and adjacent portion of opercle with dark brown streak,

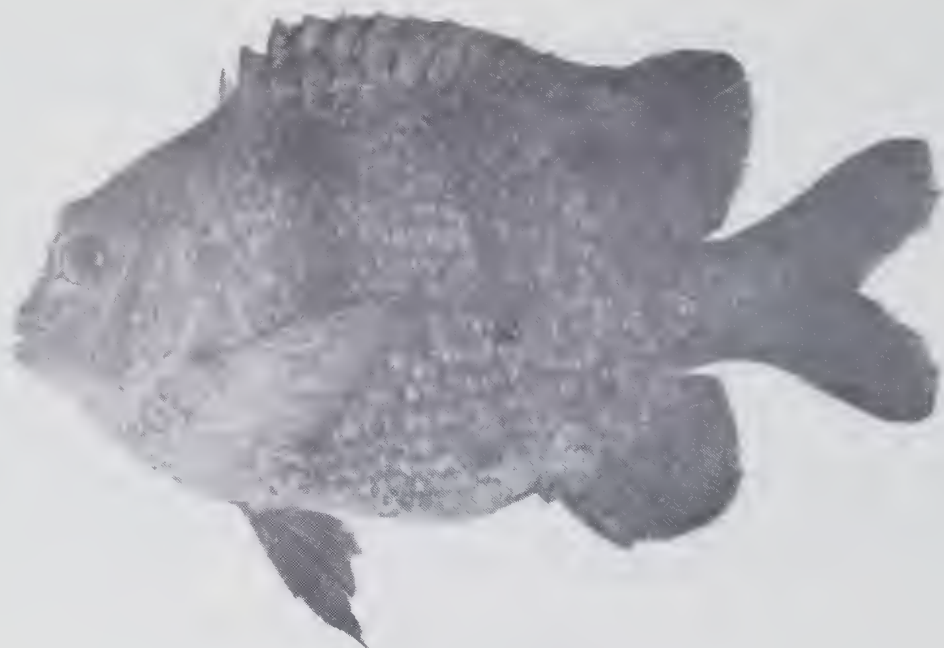


Fig. 11. *Parma polylepis*, 195 mm SL, Lord Howe Island.

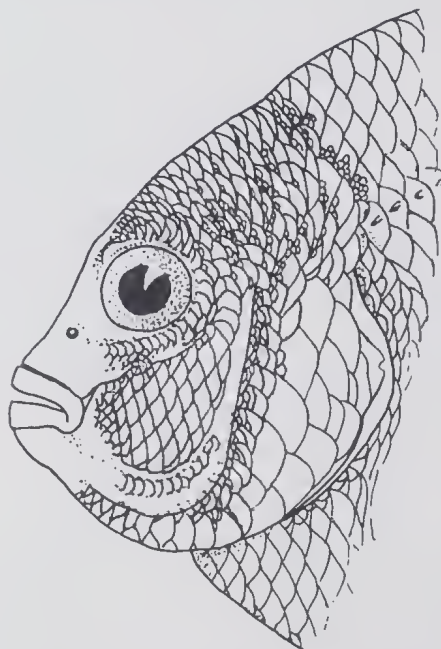


Fig. 12. Head of *Parma polylepis*.

similar mark on upper edge of opercle; indistinct pale band on nape, extending ventrally to lower edge of opercle; spinous dorsal fin brown to dusky, except where interrupted by extensions of pale bars on sides; soft dorsal dark brown on basal 1/3, translucent distally; pale-rimmed black ocellus between 10th dorsal spine and 2nd or 3rd soft ray; anal and pelvic fins mostly dark brown to blackish; caudal dusky to translucent; pectorals pale with dark spot on upper portion of fin base and frequently on lower corner also. The ocellus and pale bars gradually fade with growth. The ocellus generally disappears before a standard length of 100 mm is obtained and the bars are usually lost between about 110-140 mm SL. In subadults which still exhibit bars the ocellus is sometimes replaced by a whitish blotch.

The colour of live individuals is similar to preserved material except the bars are brighter (whitish), the fins of juveniles are frequently yellowish, and the black ocellus is rimmed with pale blue. In addition, adults observed at Lord Howe Island were usually yellowish on the upper portion of the head. Mature individuals taken at Byron Bay, northern New South Wales had a white band behind the head which disappears rapidly after death.

Remarks

The holotype is deposited at the British Museum (Natural History).

Material examined

Sixty five specimens, 31.8-170.5 mm SL.

New Caledonia — AM I.17465-001, 83.0 mm, Noumea.

Norfolk Island — AM I.1400-01, 2 specimens, 83.0-86.0 mm; AM I.5419, 131.0 mm; AM I.6006, 112.0 mm.

Lord Howe Island — AM I.10656-58, 3 specimens, 38.2-120.5 mm; AM I.17368-042, 36 specimens, 34.5-159.3 mm.

Queensland — AM I.15620-033, 5 specimens, 140.0-165.3 mm, One Tree Island, Capricorn Group (plus 8 additional lots from this locality containing 12 specimens, 67.0-164.5 mm).

New South Wales — AM IB.7520, 170.5 mm, Southwest Rocks (south of Forster); AM I.15646-003, 67.0 mm, Long Bay (Sydney); AM I.15892-004, 124.0 mm, Long Reef (Sydney); AM I.16250-016, 31.8 mm, Seal Rock.

Parma alboscapularis, new species

(Figs. 1G, 2G, 13 and 14; Tables 1, 2 3 and 5)

Parma microlepis Whitley, 1968. Aust. Zool. 15(1), p. 64.

Parma microlepis (non Günther) Doak, 1972. Fishes of the New Zealand Region, p. 58, plates 24-25.



Fig. 13. *Parma alboscapularis*, holotype, 212 mm SL, Lord Howe Island.

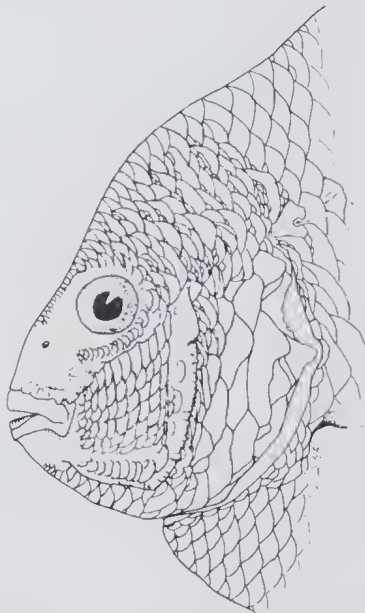


Fig. 14. Head of *Parma alboscapularis*.

Holotype

AM I.17361-008, 212.0 mm, collected with spear off Erskine Valley Stream, Lord Howe Island in 8 metres by W. Starck II on 6 February 1973.

Paratypes

Lord Howe Island: AM I.17360-023, 182.3 mm, collected with spear off Phillip Point, in 15-20 metres by G. Allen on 7 February 1973; AM I.17393-009, 200.0 mm, collected with spear off Phillip Point, in 8-10 metres by B. Russell on 8 February 1973; AM I.17411-010, 194.0 mm, collected with spear at Ball's Pyramid, in 10-15 metres by D. Hoese on 22 February 1973; New Zealand: NMNZ 3755, 2 specimens, 34.0 and 37.4 mm, collected at Mahia Peninsula, North Island, by A. Dobbins on 4 March 1964; NMNZ 4097, 80.8 mm, collected at Mayor Island in the Bay of Plenty, North Island, on 17 March 1965; NMNZ 5272, 84.8 mm, collected at the Poor Knights Islands, North Island, by C. Woudenburg on 5 November 1970; Kermadec: Island: CM 755, 158.0 mm, collected at Raoul Island, by J.H. Sorensen on 27 June 1944.

Description

Dorsal rays XIII,18 (XIII,18½ to 20); anal rays II,15 (II,14½ to 16½); pectoral rays 21 (21 to 22); pelvic rays I,5; branched caudal rays 13; gill rakers on first arch 9 + 1 + 10 (9 to 13 + 1 + 10 or 11, total 19 to 25); tubed lateral-line scales 25 (28 to 31); vertical scale rows from upper edge of gill opening to base of caudal fin 36 (39 to 41); horizontal scale rows from base of dorsal fin to terminal lateral-line scale (exclusive of dorsal base sheath scales) 3 to 4; from lateral-line to anal fin origin 15 (15 to 16); teeth elongate and narrow with conical to nearly pointed tips, about 54 to 60 in a single row in each jaw of adults.

Body ovate, laterally compressed, the greatest depth 1.6 (1.6 to 1.7) in the standard length. Head profile rounded, the head length contained 3.4 (3.1 to 3.4) times in the standard length; snout 2.3 (2.6 to 3.4), eye 4.6 (3.3 to 4.5); interorbital 2.3 (2.6 to 3.3), least depth of caudal peduncle 1.7 (1.7 to 1.9), length of caudal peduncle 3.4 (3.1 to 4.3), of pectoral fin 0.9 (0.9 to 1.0), of pelvic fin 0.9 (0.8 to 0.9), caudal concavity 1.4 (1.4 to 1.9), all in head length.

Pair of small nasal openings on each side of snout, the posterior set nearly inconspicuous; mouth oblique, terminally located; lateral-line gently arched 3 to 5 scale rows beneath dorsal fin, terminating below anterior section of soft dorsal fin; preorbital with bony ridges on anterior and posterior corner, a few scales posteriorly; suborbital scaly; snout, lips, chin, and isthmus naked; remainder of head and body scaled; scales finely ctenoid; predorsal scales extending to about level of nostrils; preopercle scale rows about 6-7 with 2-3 additional rows of scales (may be embedded) on inferior limb; small sheath

scales covering basal half of membranous portion of spinous dorsal fin and most of soft dorsal, anal, pectoral, and caudal fins; margin of preorbital and suborbital smooth or crenulate except where interrupted by bony ridges; margin of preopercle crenulate; margin of opercle smooth except large flattened spine at angle and one or more lesser projections on upper edge.

Origin of dorsal fin at level of third tubed lateral-line scale; spines of dorsal fin gradually increasing in length to about sixth or seventh spine, remaining spines gradually decreasing in length; length of first dorsal spine 4.2 (3.1 to 4.4), of sixth dorsal spine 2.0 (1.9 to 2.1), of last dorsal spine 2.6 (2.3 to 2.4), of longest soft dorsal ray 1.3 (1.1 to 1.3), of first anal spine 5.6 (4.3 to 5.0), of second anal spine 2.3 (1.9 to 2.2), of longest soft anal ray 1.5 (1.2 to 1.5), all in the head length; caudal fin forked with rounded lobes; pectoral fins pointed.

Colour of holotype in alcohol: head and body entirely dark brown, except light brown on breast and abdomen; fins dark brown to blackish.

The adult paratypes are similarly coloured. Two juvenile paratypes, 34.0 and 37.4 mm are generally light brown (darker above the lateral-line) and exhibit the following features: small, scattered dark specks on body, most prominent just below lateral-line and also above anal fin base; a pair of dark lines on head and anterior portion of back, the first from snout tip to dorsal origin, the second from eye to dorsal ocellus (broken and indistinct posteriorly); dark streak below eye extending across suborbital to level of rictus; dark spot on side of snout in front of eye; spinous dorsal dusky, soft dorsal translucent; large black spot between 10th dorsal spine and 2nd soft dorsal ray; anal fin mostly translucent except spinous portion dusky; pelvics dark brown; pectorals and caudal translucent.

The juvenile pattern gradually fades with growth into the somber colour of adults. The 80.0 mm paratype is dark brown on the dorsal half and lighter below with scattered dark spots on the head and sides. The fins are dark brown to blackish except the soft dorsal, caudal, and pectorals which are dusky. The 84.8 mm paratype is similar except it lacks the dark spots. Instead there is a dark streak across each scale giving the appearance of many longitudinal lines on the sides.

Colour in life: Doak (1972) provided excellent colour photographs of the adult and juvenile stages. Adults are entirely dark brown grading to black on the fins. Sometimes there is a white patch on the suprascapular region (see comments below under remarks). Juveniles are generally yellow-orange with many brilliant blue spots covering the head and body. Blue lines extend from the snout to the anterior part of the back and the spinous portions of the dorsal, anal, and pelvic fins have narrow blue margins. A prominent black ocellus is present at the soft dorsal junction.

Remarks

The bony ridges on the preopercle are not developed in the four smallest paratypes. In addition, these specimens have a smooth preopercular margin instead of the crenulate condition displayed by adults.

Doak (1972) reported that this species is common at certain localities off North Island, New Zealand. He further stated that spawning is generally restricted to the period between November and January. The eggs are attached to the algal carpet which covers the vertical surface of large boulders or rocky crevices. The male guards the nest during incubation and shows a marked increase in territorial behaviour during this period, which lasts less than 10 days. The diet consists mainly of algae.

Known only from Lord Howe Island, New Zealand, and the Kermadec Islands.

This species is named *alboscapularis* with reference to the white shoulder patch which is seen on live adults. The spot is 'turned' on or off according to behavioural 'moods'. It is generally flashed while driving intruders away from their territory and is particularly apparent in males during nest guarding activities.

Parma occidentalis, new species

(Figs. 1E, 2F, 15 and 16; Tables 1, 2 3 and 4)

Holotype

WAM P.10883, 106.9 mm, collected at Nancy Cove, Rottneest Island, Western Australia by A.R. Main and N. Milward on 24 January 1955.

Paratypes

(All specimens from Western Australia) — WAM P.10988, 42.2 mm, collected at the Blowholes, 70 km north of Carnarvon by E. Car in May, 1962; WAM P.13743, 97.0 mm, collected at Rat Island, Abrolhos Group by R. McKay in March, 1963; WAM P.10940, 96.0 mm, collected at Wallaby Island, Abrolhos Group by anonymous collector in May, 1959; WAM P.10877, 93.3 mm, collected at Rottneest Island by N. Milward in 1958; WAM P.10882, 110.0 mm, same data as holotype except collected by N. Milward on 24 November 1955; WAM P.24817, 2 specimens, 73.8 and 94.5 mm, collected at Armstrong Point, Rottneest Island by University W.A. Zoology class on 11 March 1964; CSIRO C.2684-91, 8 specimens, 74.1-113.6 mm, Rottneest Island; CSIRO A.1491-99, 9 specimens, 38.0-52.8 mm, Rottneest Island; CSIRO A.1508-11, 4 specimens, 46.4-74.0 mm, Rottneest Island.

Description

Dorsal rays XIII,18 (XIII,18½ to 21); anal rays II,16 (II,13½ to 15);



Fig. 15. *Parma occidentalis*, 106.9 mm SL, holotype, Rottneest Island.

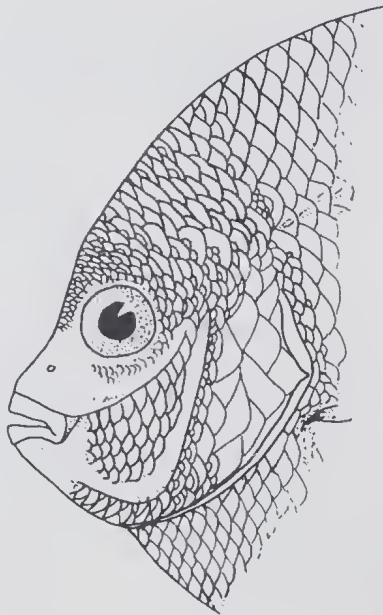


Fig. 16. Head of *Parma occidentalis*.

pectoral rays 21 (20 to 22); pelvic rays I,5; branched caudal rays 13; gill rakers on first arch 11 + 1 + 10 (9 to 11 + 1 + 9 to 10, total 19 to 22); tubed

lateral-line scales 34 (32 to 35); vertical scale rows from upper edge of gill opening to base of caudal fin 46 (43 to 46); horizontal scale rows from base of dorsal fin to terminal lateral-line scale (exclusive of dorsal base sheath scale) 4; from lateral-line to anal fin origin 19 (18 to 19); teeth elongate narrow, somewhat spatulate with rounded tips, about 46 to 50 in a single row in each jaw of adults.

Body ovate, laterally compressed, the greatest depth 1.7 (1.6 to 2.0) in standard length. Head profile slightly pointed, the head length contained 3.2 (3.0 to 3.4) in standard length; snout 2.9 (2.9 to 3.2), eye 3.2 (3.0 to 3.5), interorbital 3.1 (2.9 to 3.4), depth of caudal peduncle 1.9 (1.8 to 2.0), length of caudal peduncle 5.2 (3.5 to 5.3), of pectoral fin 1.0 (0.9 to 1.0), of pelvic fin 0.8 (0.7 to 0.9), caudal concavity 3.4 (2.0 to 3.1), all in head length.

Pair of small nasal openings on each side of snout, the posterior set nearly inconspicuous; mouth oblique, terminally located; lateral-line gently arched 4-6 scale rows beneath dorsal fin, terminating below anterior section of soft dorsal fin; suborbital and posterior section of preorbital scaly; snout, lips, chin, and isthmus naked; remainder of head and body scaled; scales finely ctenoid; predorsal scales extending to about front of orbits; preopercle scale rows about 6-7 with scattered scales on inferior limb; small sheath scales covering basal 2/3 of membranous portion of spinous dorsal fin and most of soft dorsal, anal, and caudal fins; margin of preorbital, suborbital, and bones of opercular series smooth except large flattened spine at angle of opercle.

Origin of dorsal fin at level of third tubed lateral-line scale; spines of dorsal fin gradually increasing in length to about sixth spine, remaining spines about equal in length; length of first dorsal spine 2.6 (2.7 to 3.0), of sixth dorsal spine 2.0 (1.8 to 2.2), of last dorsal spine 2.0 (1.9 to 2.5), of longest soft dorsal ray 1.5 (1.3 to 1.5), of first anal spine 4.5 (4.1 to 5.3), of second anal spine 1.7 (1.6 to 1.8), of longest soft anal ray 1.2 (1.1 to 1.3), all in head length; caudal fin forked with rounded lobes; pectoral fins pointed.

Colour of holotype in alcohol: uniform brown, darker on forehead and fins. Many paratypes with pair of faint dusky bands (about 2-3 scales wide) on sides, the first below dorsal spines 3 and 4, the second below dorsal spines 10 and 11, bands extending from dorsal base to lower portion of sides, barely detectable in some specimens. The following description of the juvenile pattern is based on 11 specimens, 38.0-56.0 mm SL: head and body mostly pale brown or tannish; head covered with numerous small dark spots, particularly apparent on snout and interorbital, and more conspicuous on smaller specimens; spinous dorsal tan to brown with narrow dark margin; irregular-shaped dark spot between about 12th dorsal spine and third soft ray (very faint in two specimens 47.5 and 52.0 mm and absent on a 46.0 mm specimen); soft dorsal brown, sometimes darker basally; pelvics and anal fin dark brown to dusky; pectorals pale; caudal brown at least on basal half; some specimens with posterior portion of soft dorsal and caudal fins more or less translucent.

Colour in life (from ektachrome transparencies provided by J. Butler): adults mostly greenish-brown, darker on fins; leading edge of pelvic and pectoral fins blue; iris blue. Adults which are almost entirely black are frequently encountered. The live colours of a 62.0 mm juvenile collected off Carnac Island (near Fremantle) Western Australia were as follows: head and body brown, golden brown on anterior two-thirds and darker brown posteriorly; head with many small blue dots, concentrated on suborbital, border of preopercle, interorbital, and nape: two narrow white bars on side below spinous dorsal fin extending from base of fin to lower portion of side; caudal peduncle with diffuse light grey bar; spinous dorsal fin golden brown with remnant of large blue ocellus posteriorly; soft dorsal, anal, and caudal fins dark brown; pelvic fins blackish.

Remarks

This species is sympatric with *P. mccullochi* along the south-western coast of Australia. It is easily distinguished from that species by the forehead profile (Fig. 1), different juvenile colour pattern (Fig. 2), and a higher lateral-line count.

This species is frequently encountered around islands off the metropolitan Perth area, including Rottnest, Carnac, and Garden Islands. At these localities it frequents rocky reefs generally at depths between two and six metres.

This species is named *occidentalis* in reference to its geographic distribution.

Parma mccullochi

(Figs. 2H, 17 and 18; Tables 1, 2 and 3)

Parma mccullochi Whitley, 1929a. Mem. Queensland Mus., vol. 9 (part 3), p. 228 (type locality, Rottnest Island, Western Australia).

Parma microlepis (non Günther) Waite, 1905 (in part, specimens from Houtman's Abrolhos). Rec. Aust. Mus., vol. 6, p. 69.

Diagnosis

Dorsal rays XIII, 18 to 19½; anal rays II, 14 to 15½; pectoral rays 20 to 21; tubed lateral-line scales 27 to 32; gill rakers 8 to 11 + 1 + 10 to 12; upper and lower jaw each with 52 to 62 teeth; body depth 1.7 to 1.9 in standard length; head length 3.1 to 3.4 in standard length; snout 2.7 to 3.0, eye 3.3 to 4.3, interorbital 2.6 to 3.0, depth of caudal peduncle 1.7 to 1.9, length of caudal peduncle 3.2 to 4.1, of pectoral fin 0.9 to 1.1, of pelvic fin 0.9 to 1.1, caudal concavity 1.5 to 1.7, all in head length.

Colour in alcohol: adults entirely dark brown, slightly lighter on breast and abdomen. Juveniles under about 40-50 mm SL display the following pattern: body mostly tan or light brown with dark stripes extending from

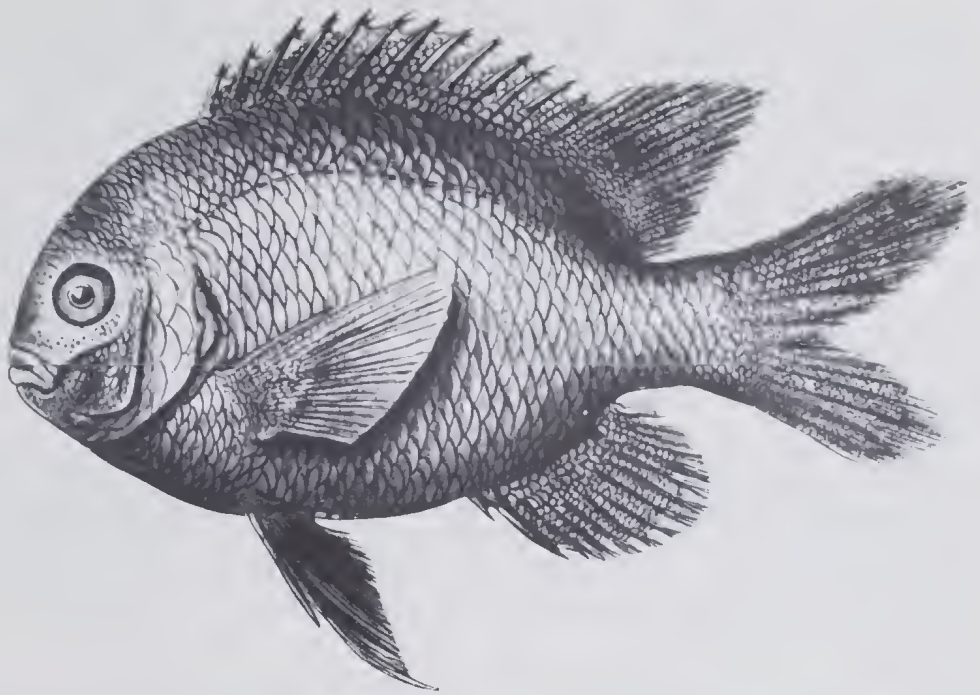


Fig. 17. *Parma mccullochi*, holotype, Rottneest Island, Western Australia (from Whitley, 1922b).

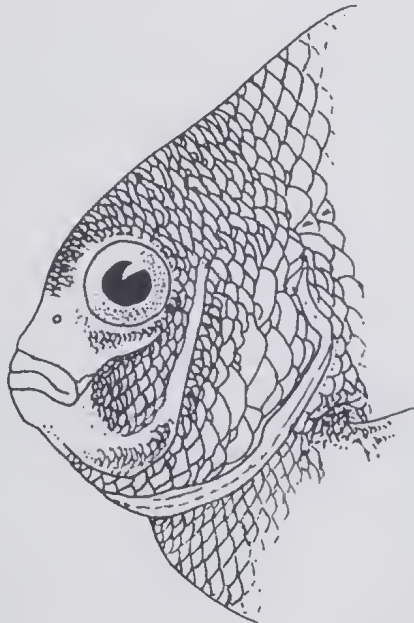


Fig. 18. Head of *Parma mccullochi*.

snout to dorsal origin and from upper edge of eye to below soft dorsal junction, two other lines interspersed between these stripes, but stopping short of head region; about 30-40 dark brown spots scattered on sides, about 5-6 similar spots on lower corner of opercle and broken dark line just below eye; pale-rimmed, black ocellus at soft dorsal junction; spinous dorsal brown basally, pale on distal portion with narrow dark margin; soft dorsal, anal, pelvic, and caudal fins tan to transparent. At a size of approximately 50-60 mm SL the transformation to the adult pattern is initiated. The general body colour gradually darkens and the spots, stripes, and ocellus begin to fade; 80 mm SL specimens are generally dark, although they clearly retain the juvenile pattern, except the dorsal ocellus may be absent or very faded. The last juvenile characters retained are the spots on the head and broken line below the eye. These features may persist until a size of about 110-120 mm SL.

Colour in life (from ektachrome transparencies provided by J. Butler): adults mostly dark greenish-brown; anterior part of head slightly yellowish; narrow blue margin on leading edge of pelvic, anal, and pectoral fins; iris orange. Small juveniles are mainly bright yellow with a pattern of blue spots and stripes, and a blue-ringed black ocellus on the dorsal fin.

Remarks

This species has generally been referred to as *Actinochromis victoriae* by Perth divers and aquarists. It is the common shallow water *Parma* of southern Western Australia. Off the Perth metropolitan area it is encountered in the vicinity of rocky reefs, particularly those surrounding offshore islands. It is particularly common at Rottnest Island, at depths from two to at least 25 metres.

The holotype is deposited at the Australian Museum.

Material examined

Twenty specimens, 22.2-192.7 mm SL.

Western Australia (from Rottnest Island unless indicated otherwise) — AM I.13144 (holotype), 109.5 mm; WAM P4096, 133.0 mm, Lancelin Island; WAM P4184, 192.7 mm, Lancelin Island; WAM P4733, 158.0 mm, Abrolhos Group; WAM P10783-91, 9 specimens, 22.2-142.0 mm; WAM P10857, 79.5 mm; WAM P22306, 162.3 mm, Burn's Beach, near Perth; WAM P24816, 3 specimens, 87.2-146.3 mm; WAM P24854, 44.0 mm, Albany; WAM P24856, 42.0 mm, Albany.

Table 1. Fin ray counts for species of *Parma*

species	soft dorsal rays							soft anal rays							pectoral rays								
	16	16½	17	17½	18	18½	19	19½	20	20½	21	13	13½	14	14½	15	15½	16	16½	19	20	21	22
<i>alboscupularis</i>					2	3	1	2	1					2	6			1				2	7
<i>miculochi</i>					1	10	4	2				4	8	6	2						1	19	
<i>microlepis</i>	1	1	2	10	4	2						3	2	12	2	1				4	16		
<i>occidentalis</i>					1	1	1	10	2	7	2	1	2	15	5	1				6	16	3	
<i>obigolepis</i>			2		2	2	4	4	1			1	1	9	4					6	8	1	
<i>polylepis</i>	1		2	2	13	2						1	1	18						1	14	5	
<i>unifasciatus</i>	1		2	10	1	6	1					5	13	3						4	14	3	
<i>victoriae</i>	1	3	3	2										6	2	1				1	7	1	

Table 2. Lateral line scale counts for species of *Parma*

species	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
<i>alboscupularis</i>				1			1	3		3	1				
<i>miculochi</i>							3	2	5	2	5	3			
<i>microlepis</i>			2	4	4	4	5	1							
<i>occidentalis</i>											1	1	9	8	2
<i>obigolepis</i>		3	6	4											
<i>polylepis</i>						3			5	4		2	1		
<i>unifasciatus</i>		1	1	3	9	6	1								
<i>victoriae</i>	7	2													

Table 3. Gill raker counts for species of *Parma*.

species	Upper Limb							Angle	Lower Limb				
	7	8	9	10	11	12	13		1	8	9	10	11	12
<i>alboscapularis</i>			3	3	1		1	8		1	1	6	
<i>mccullochi</i>	3	8	2					20		11	7	2	
<i>microlepis</i>	4	3	12	1				20		7	13		
<i>occidentalis</i>		6	16	2				24		20	4	1	
<i>oligolepis</i>		1	6	2	2			11				9	2
<i>polylepis</i>	2	2	5	8	3			20		7	10	3	
<i>unifasciatus</i>		2	10	6	1			19		3	13	3	
<i>victoriae</i>			3	5	1					3	6		

Table 4. Morphometric proportions of selected type specimens of *Parma occidentalis* n. sp. (expressed in thousandths of the standard length)

Character	Holotype	Paratype	Paratype	Paratype	Paratype	Paratype	Paratype
	WAM	WAM	WAM	WAM	WAM	WAM	WAM
Standard length (mm)	P10883	P24817	P24817	P24817	P10882	P10988	P10940
	106.9	94.5	73.8	110.0	42.2	96.0	
Body depth	578	534	539	610	507	589	
Body width	217	212	191	227	178	227	
Head length	316	301	318	331	332	332	

Table 4 (Contd)

Snout length	109	102	102	114	78	104
Eye diameter	99	101	104	100	140	98
Interorbital width	102	102	93	115	76	99
Least depth of caudal peduncle	165	164	163	182	159	172
Length of caudal peduncle	61	74	73	73	69	63
Snout to origin of dorsal fin	449	432	420	462	440	424
Snout to origin of anal fin	726	730	718	727	730	743
Snout to origin of pelvic fin	452	468	443	436	462	452
Length of dorsal fin base	664	650	653	709	626	677
Length of anal fin base	234	238	241	245	237	240
Length of pectoral fin	332	298	322	353	424	305
Length of pelvic fin	421	419	377	473	367	375
Length of pelvic spine	215	212	203	236	213	208
Length of 1st dorsal spine	120	106	108	121	111	125
Length of 6th dorsal spine	155	165	169	168	190	153
Length of last dorsal spine	159	159	171	165	173	135
Length of longest soft dorsal ray	217	238	221	261	225	245
Length of 1st anal spine	70	73	75	77	59	63
Length of 2nd anal spine	187	180	205	197	180	181
Length of longest anal ray	260	268	257	273	220	248
Length of longest caudal ray	290	307	325	348	313	289
Length of middle caudal ray	196	180	165	218	213	182
Caudal concavity*	94	127	160	130	100	106

* horizontal distance between longest and shortest caudal rays.

Table 5. Morphometric proportions of selected type specimens of *Parma alboscapulalis* n. sp. (expressed in thousandths of the standard length)

Character	Holotype AM I.17361-008	Paratype AM I.17411-010	Paratype AM I.17393-009	Paratype AM I.17360-023	Paratype NMNZ 4097	Paratype NMNZ 3755
Standard length (mm)	212.0	194.0	200.0	182.3	80.8	37.4
Body depth	625	585	575	601	582	487
Body width	235	245	230	225	223	195
Head length	290	294	293	302	322	361
Snout length	125	106	109	118	95	99
Eye diameter	63	69	67	67	99	134
Interorbital width	125	110	113	123	97	88
Least depth of caudal peduncle	172	165	168	170	171	139
Length of caudal peduncle	86	94	90	88	74	70
Snout to origin of dorsal fin	442	433	415	433	411	406
Snout to origin of anal fin	746	716	730	721	699	679
Snout to origin of pelvic fin	423	388	433	384	402	428
Length of dorsal fin base	652	624	633	686	644	588
Length of anal fin base	241	228	225	255	262	227
Length of pectoral fin	311	314	307	318	349	294
Length of pelvic fin	330	326	317	320	386	342
Length of pelvic spine	189	170	165	172	186	166
Length of 1st dorsal spine	68	67	70	73	105	80
Length of 6th dorsal spine	149	152	138	148	161	174
Length of last dorsal spine	112	124	125	123	136	107
Length of longest soft dorsal ray	226	245	238	241	297	209
Length of 1st anal spine	52	59	63	66	74	67
Length of 2nd anal spine	127	134	142	151	173	174
Length of longest anal ray	190	219	192	219	278	227
Length of longest caudal ray	319	322	313	326	359	320
Length of middle caudal ray	118	118	130	132	186	187
Caudal concavity*	201	205	183	195	173	134

*horizontal distance between longest and shortest caudal rays

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NOMENCLATURAL NOTES ON THE LAND SNAIL GENUS
BOTHRIBRYON PILSBRY, 1894 (PULMONATA: BULIMULIDAE),
WITH REDESCRIPTIONS OF THE TYPE AND TWO OTHER SPECIES

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and

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ABSTRACT

Corrected names and revised synonymies are presented for 3 species of *Bothriembryon*, including the type species *B. melo* (Quoy and Gaimard, 1832). Type specimens are designated, and diagnoses of the species and genus presented.

INTRODUCTION

Bothriembryon is a genus of Australian bulimulid land snails comprising not less than 30 living species, most of which are polymorphic and geographically variable. The type species, *Helix melo* Quoy and Gaimard, 1832, is one of the more variable of these and its identity has been a subject of some confusion for many years. Our studies have shown that *B. melo* is restricted to the Albany — Bremer Bay districts of southern Western Australia. Two other species that have been confused directly or indirectly with it inhabit the Shark Bay district on the central western coast, one of them ranging southward to the Lower Murchison district. For the smaller of these two species, we propose to use the name *B. costulatus* (Lamarck, 1822) and for the larger, the name *B. onslowi* (Cox, 1864). Other names that have been previously used in connection with these three species include *Helix* (*Cochlogena*) *costulata* Férussac, 1821, *Helix* (*Cochlogena*) *melones* Férussac, 1821, *Bulimus inflatus* Lamarck, 1822, *Bothriembryon castaneus* Pilsbry, 1900 and *Bothriembryon minor* Pilsbry, 1900.

Except where otherwise stated, all specimens referred to in this paper are in the collection of the Western Australian Museum.

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HISTORICAL SUMMARY

The nomenclatural problems that we seek here to clarify seem to have arisen from the disregard by some early collectors and taxonomists for locality data and from the mixing of specimens from different localities in the early collections. The initial confusion affecting the species *costulatus* and *melo* appears to have stemmed from labelling errors and the mixing of samples collected by M.F. Péron and C.A. Lesueur in 1801 while at Shark Bay ('la baie des Chiens-Marins') and in 1803 at King George Sound ('le port du Roi George'). The expedition, commanded by T.N. Baudin, visited the western part of Australia on two occasions, initially on the vessels 'Géographe' and 'Naturaliste' and subsequently on the 'Géographe' and 'Casuarina'. Péron prepared a narrative of the voyage (Péron, 1807) but did not live to finish it and it was left to L.C. de Freycinet, a senior officer of the expedition, to bring the work to completion (Whittell, 1954: 59). The extensive collections of Péron and Lesueur were brought to Paris and deposited in the Muséum National d'Histoire Naturelle, where they were later studied by Férussac, Lamarck and others. However, Lamarck acquired some of the shells of Péron and Lesueur for his personal collection. These, which include the type material of *Bulimus costulatus* Lamarck, are now in the Muséum d'Histoire Naturelle, Geneva.

In 1818, de Freycinet returned to Australia in command of the 'Uranie', accompanied by the naturalists J.R.C. Quoy and J.P. Gaimard. Collections were made by them at Shark Bay but these were lost by shipwreck at the Falkland Islands, with the exception, it seems, of a few specimens saved from the wreck by C. Gaudichaud, the ship's apothecary (Iredale, 1939). Gaudichaud's shells, which apparently included specimens of *Bothriembryon*, later passed into the hands of Férussac, but are now believed to be lost.

In 1826, Quoy and Gaimard returned to the western part of Australia, this time to King George Sound, on the 'Astrolabe', commanded by J. Dumont d'Urville. (Their visit preceded by only a few months the establishment of a permanent British settlement at Albany under Major E. Lockyer toward the close of that year.) The type material of *Helix melo* was collected on this occasion and was described, together with the other zoological results of the voyage, by Quoy and Gaimard (1832). Their collection is in the care of the Paris Museum.

The species *Bothriembryon onslowi* (Cox, 1864) was described from a shell collected on Dirk Hartogs Island by a Captain Onslow of the vessel 'Gazelle' and is now in the Cox Collection at the Australian Museum, Sydney. It enters this study as a result of having been confused with *B. costulatus* (Lamarck) by Iredale (1939).

Summaries of the early voyages mentioned above have been made by Alexander (1916) with regard to general Western Australian zoology and by Iredale (1939) concerning land snails.

We propose initially to discuss in turn eight nomina, their types and status and to follow these with consolidated redescrptions of the three bio-species which underly them.

THE NAMES, TYPES AND LOCALITIES

1. *Helix (Cochlogena) costulata* Férussac, 1821

Tableaux Systématiques des animaux mollusques. Limaçons, p. 58, January 1821; p. 54, June 1821. Localities given as: 'La Port du Roi George, dans la Nouvelle-Hollande, PERON; la baie des Chiens-Marins, GAUDICHO'.

As Iredale (1939) has pointed out, the name *costulata* Férussac is a *nomen nudum* but, because later workers quoted Férussac's localities, the identity of his specimens is of interest. In June 1965, one of us (B.R.W.) searched without success the collection of the Muséum National d'Histoire Naturelle, Paris, for the Shark Bay specimens attributed by Férussac to Gaudichaud and which were saved by him from the 'Uranie' wreck. We presume these specimens to be lost. There is, however, in that collection a sample of 8 shells which according to the label are types of '*Helix costulata* Fér'. The label bears the names of Péron and Lesueur as collectors and the locality 'Port du Roi George'. We consider this locality to be erroneous because 7 of the 8 shells belong to the smaller of the two species which occur in the Shark Bay district, i.e. *B. costulatus* (Lamarck). The largest of these shells is shown in Pl. III, fig. 5a, b. The eighth shell is a viviparid, probably not Australian, which seems to have been included in the sample in error. It is noted that the original Férussac catalogue lists only 7 specimens of '*H. (C.) costulata*'.

We are of the opinion that the 7 specimens comprising the type series of *H. (C.) costulata* Férussac in Paris represent part of the sample collected by Péron and Lesueur, not at King George Sound in 1803 but at Bernier and possibly other islands at Shark Bay in 1801. This conclusion is discussed more fully below.

2. *Bulimus inflatus* Lamarck, 1822

Histoire naturelle des animaux sans vertèbres 6 (2): 122. Locality given as 'dans la Nouvelle-Hollande'. Figured Delessert, 1841, *Recueil de coquilles décrites par Lamarck*, pl. 28, fig. 1 a, b.

Lamarck's description of *Bulimus inflatus* included the words 'Mon cabinet', indicating that there were specimens in his personal collection.

The five shells comprising this lot are now in the Muséum d'Histoire Naturelle at Geneva, the largest of them (26.0 mm in height) being that figured by Delessert and selected as the lectotype by Mermod (1951: 728,

PLATE I

Bothriembryon melo (Quoy and Gaimard)

Figs. 1a, 1b: Lectotype; Bald Head near Albany (morph a) Muséum National d'Histoire Naturelle, Paris.

Figs. 2a, 2b: Paralectotype, '*varietas castanea; vitta alba cincta*'; Bald Head near Albany (morph e) Muséum National d'Histoire Naturelle, Paris.

Figs. 3a, 3b: Lectotype of *Bothriembryon castaneus* Pilsbry; probably from Doubtful Island (morph e) Australian Museum C87458.

Figs. 4-6: All from Limestone Head near Albany.

Figs. 4a, 4b: Numerous intense brown stripes, with an obscure brown peripheral band (morph a) WAM 248-72.

Figs. 5a, 5b: Pallid, with few brown stripes and obscure multi-spiral white bands, probably the result of injury to the mantle edge (morph a) WAM 248-72.

Figs. 6a, 6b: Diffuse yellow-brown with few brown stripes (morph a) WAM 1533-70.

PLATE II

Bothriembryon melo (Quoy and Gaimard)

Figs. 1-4: All from Frenchman Bay, Albany.

Figs. 1a, 1b: Straw-yellow with chestnut subsutural band and umbilicus (morph b) WAM 1-72.

Figs. 2a, 2b: Brown striped and banded on a yellow-brown ground (morph a) WAM 1-72.

Figs. 3a, 3b: Same as Fig. 2 but with a white peripheral band (morph f) WAM 1-72.

Figs. 4a, 4b: Chestnut with a white peripheral band (morph e) WAM 236-72.

Figs. 5a, 5b. Breaksea Island. Diffuse straw-yellow with pale pink columella (morph d) WAM 246-72.

Figs. 6a, 6b: Waychinicup River Valley. Diffuse dark yellowish-brown (morph C) WAM 249-72.

PLATE III

Bothriembryon melo (Quoy and Gaimard)

Figs. 1a, 1b: Near Hunter River estuary, Bremer Bay. Brown with straw-yellow axial flames and dark brown umbilical patch (morph g) WAM 266-70.

Figs. 2a, 2b: Locality as for Fig. 1. Intense dark brown with thin axial yellow flames and light brown peripheral band (morph h) WAM 266-70.

Figs. 3a, 3b: Bremer Bay. Diffuse medium brown, without flames, with strong white peripheral band (morph e) WAM 238-72.

Bothriembryon costulatus (Lamarck)

Figs. 4a, 4b: Lectotype. Probably from Bernier Island, Shark Bay. Faded off-white with white flames. Muséum d'Histoire Naturelle, Geneva 1092/65.

Figs. 5a, 5b: Largest of the type series of *Helix* (*Cochlogena*) *costulata* Féussac. Probably from Bernier Island, Shark Bay. Faded, pale greyish-brown with white flames. Muséum National d'Histoire Naturelle, Paris.

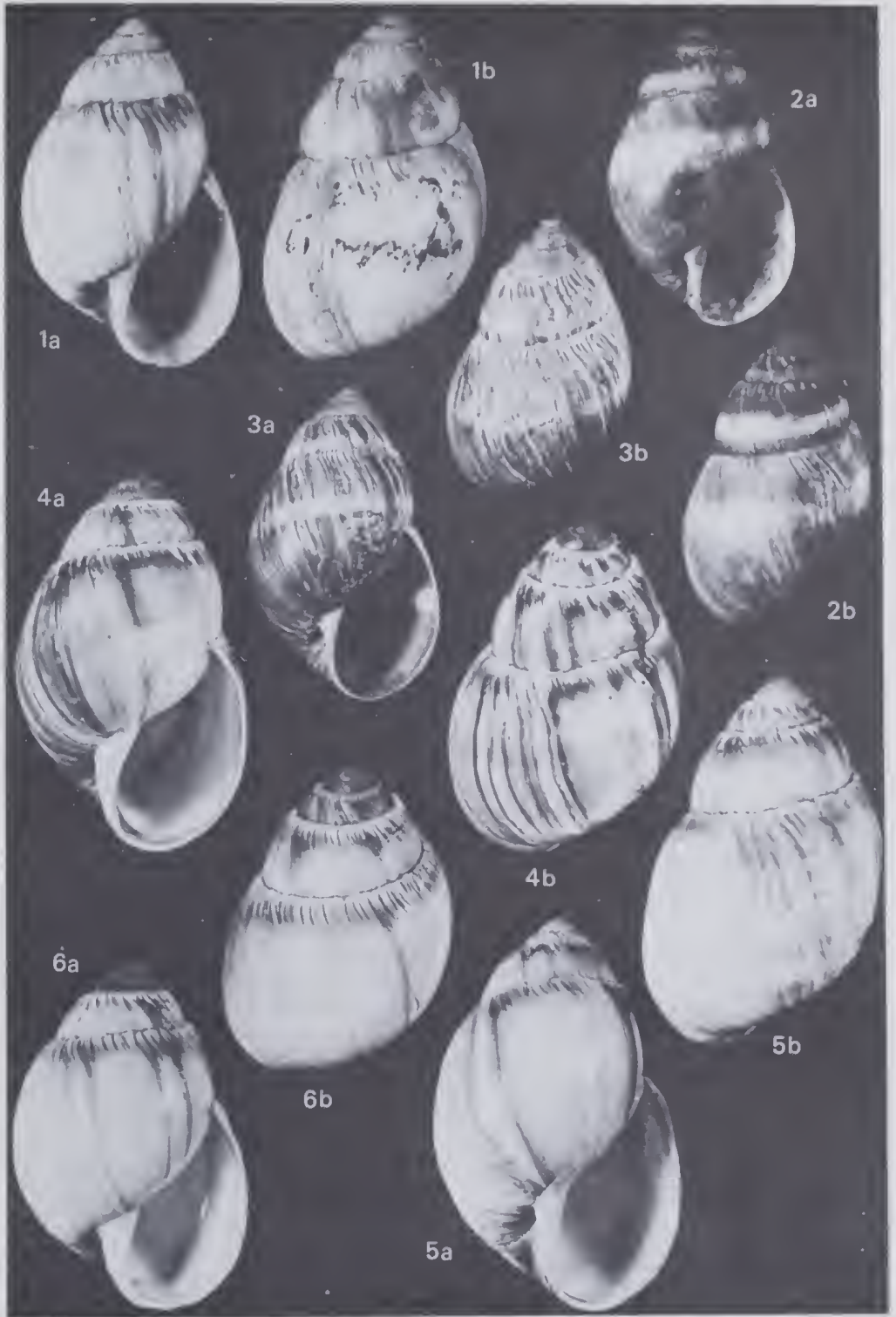
Figs. 6a, 6b: Types of *B. minor* Pilsbry. Locality unknown. Academy of Natural Sciences of Philadelphia 78504.

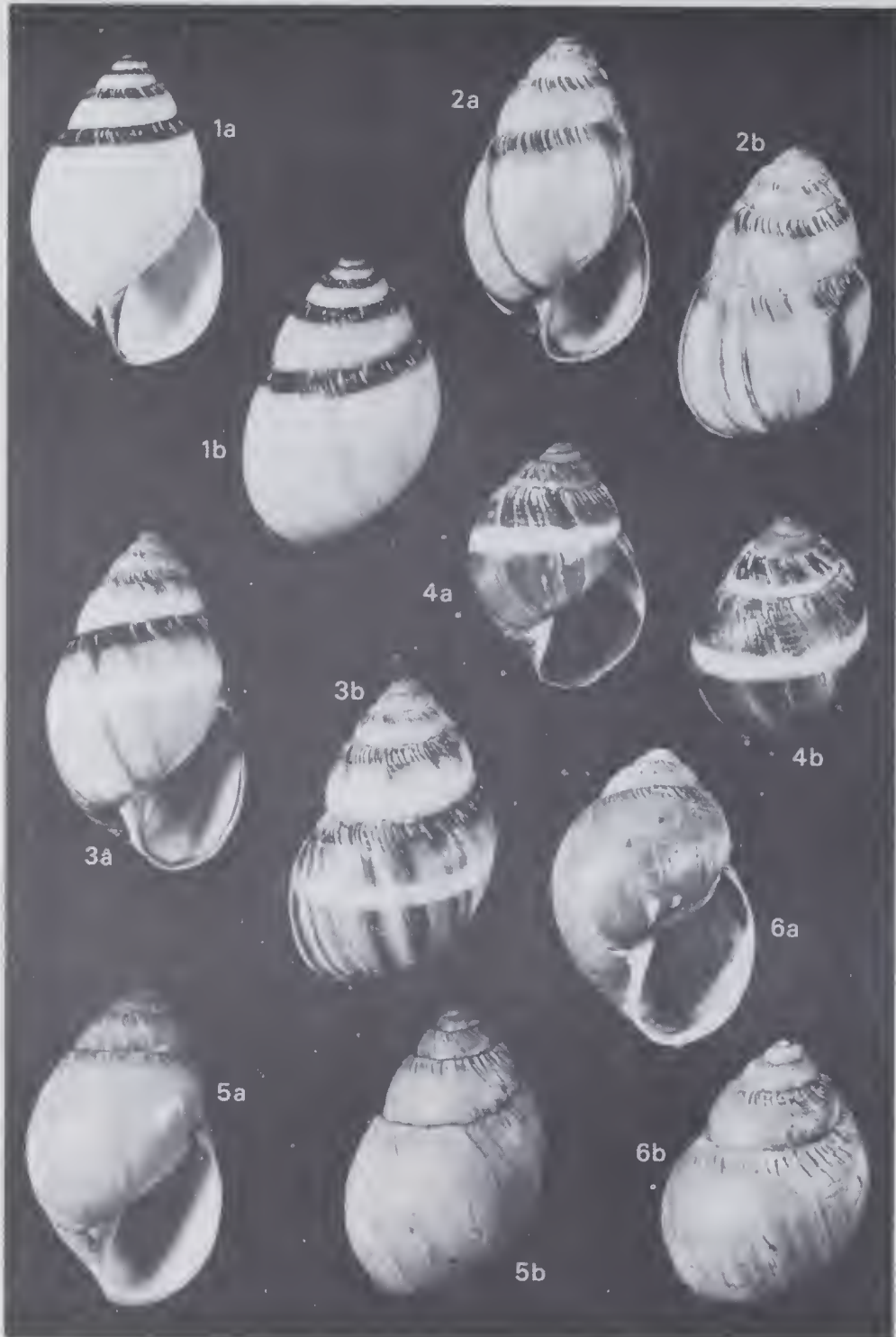
PLATE IV

Bothriembryon costulatus (Lamarck)

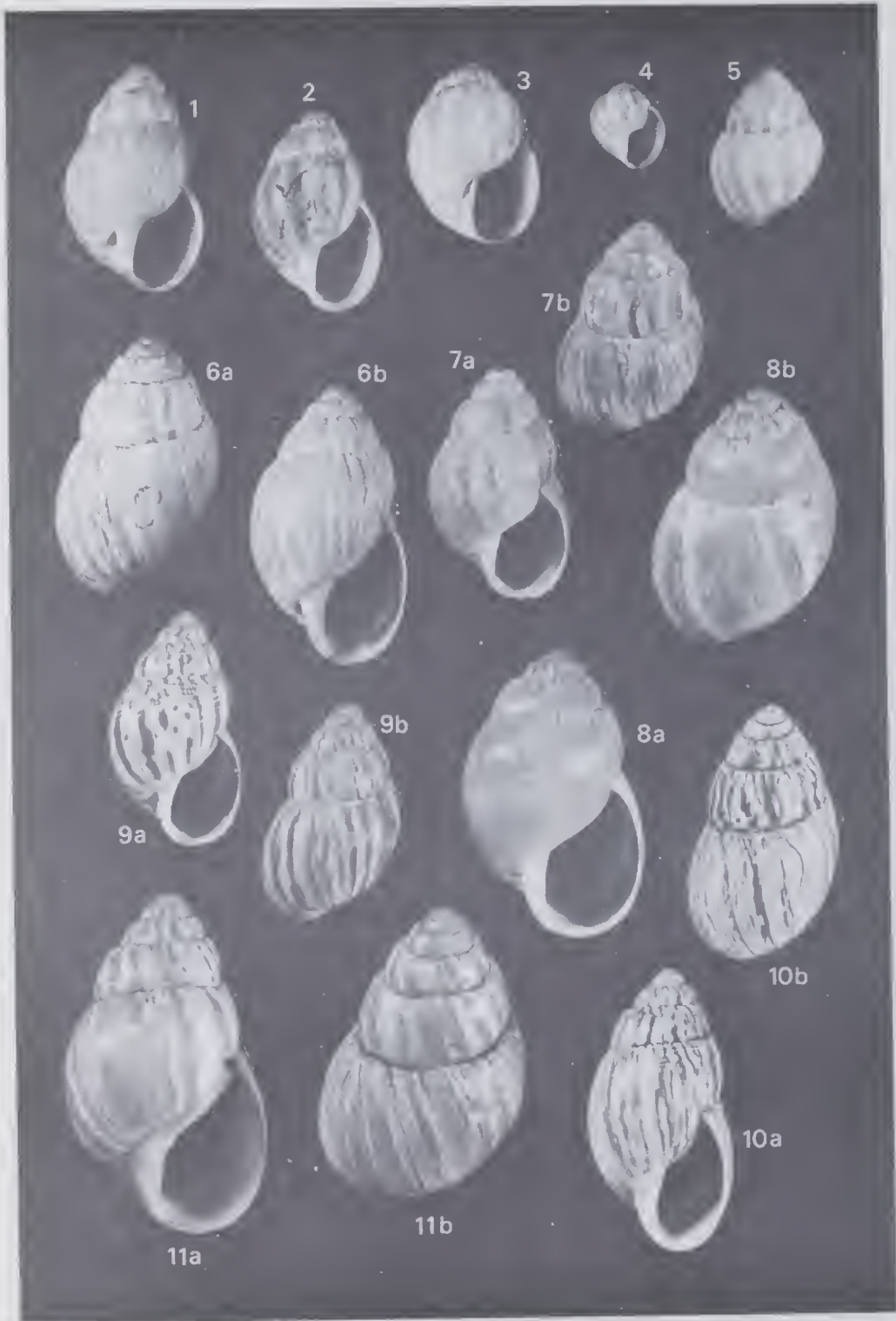
Figs. 1-5: Dirk Hartogs Island, Shark Bay. Coll. J.J. Walker, 13.xi.1890 (Smith, 1895: 95). Five faded shells glued to dark paper; apparently one shell missing. British Museum (Natural History) 91.11.21. 144-9.

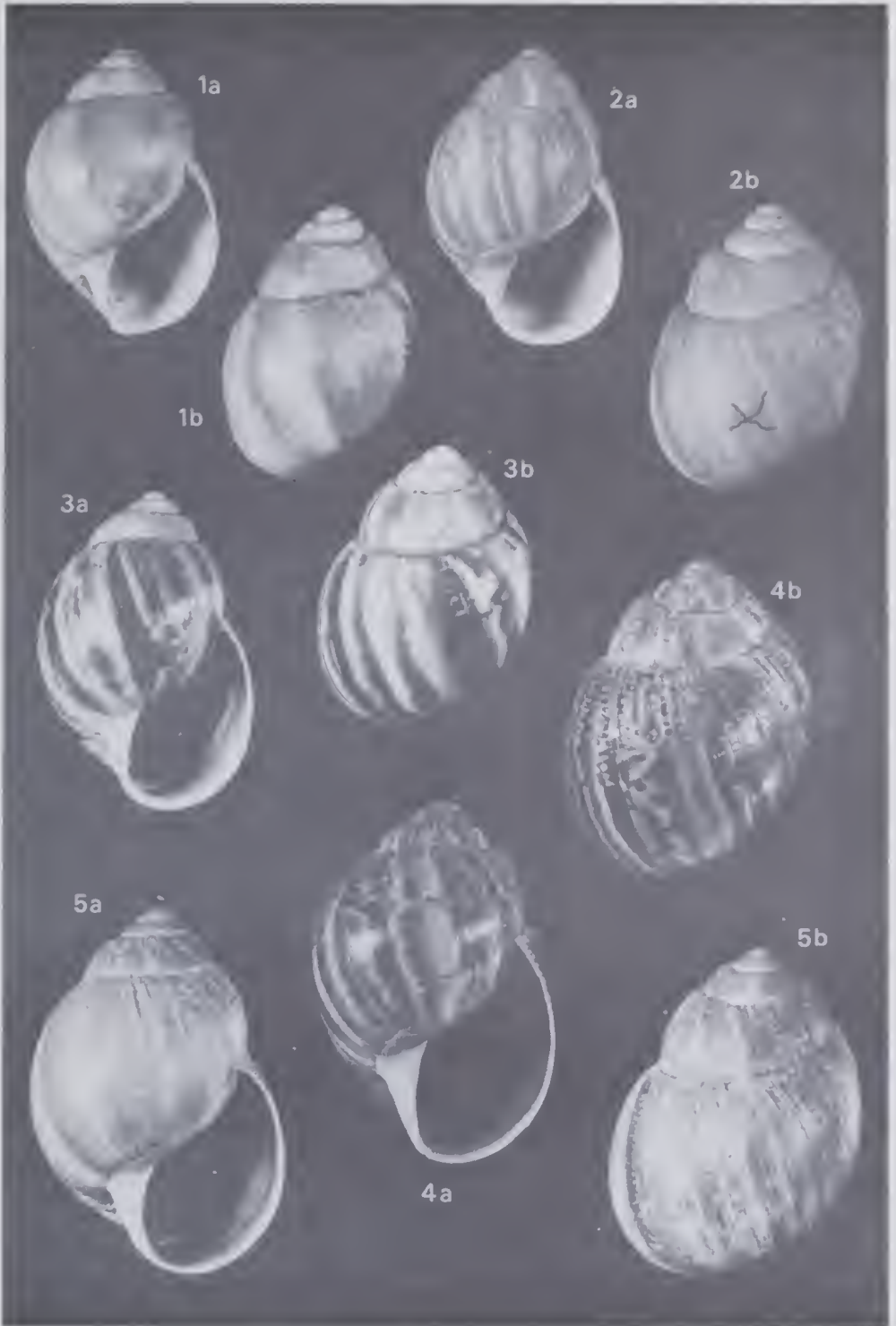
(Contd. on page 306)





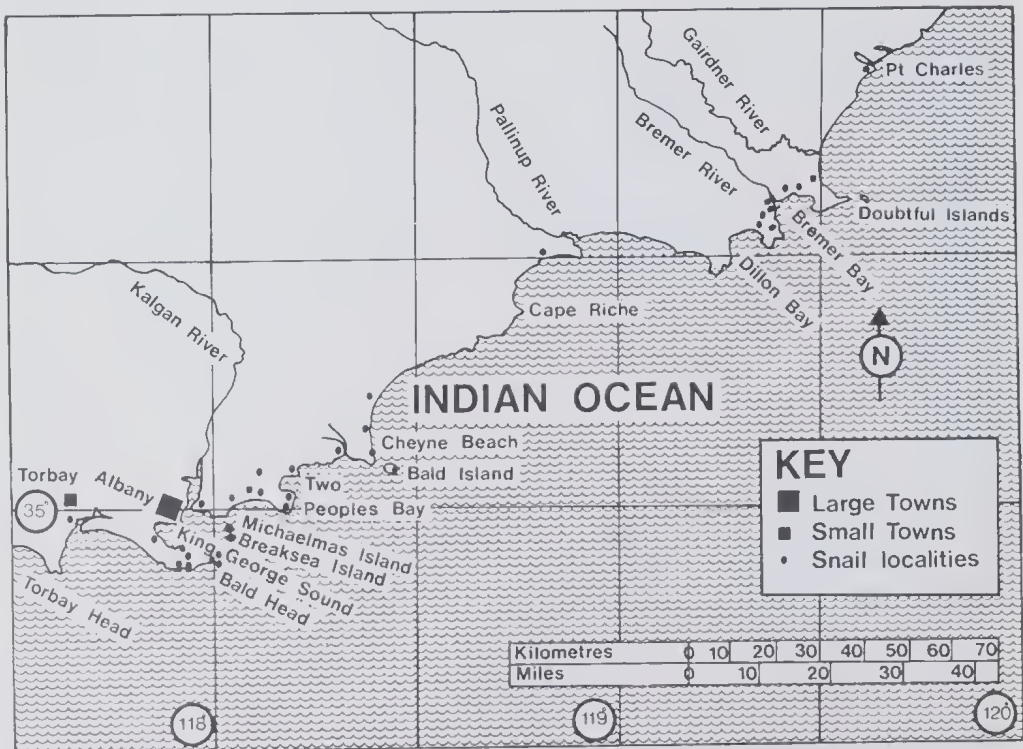








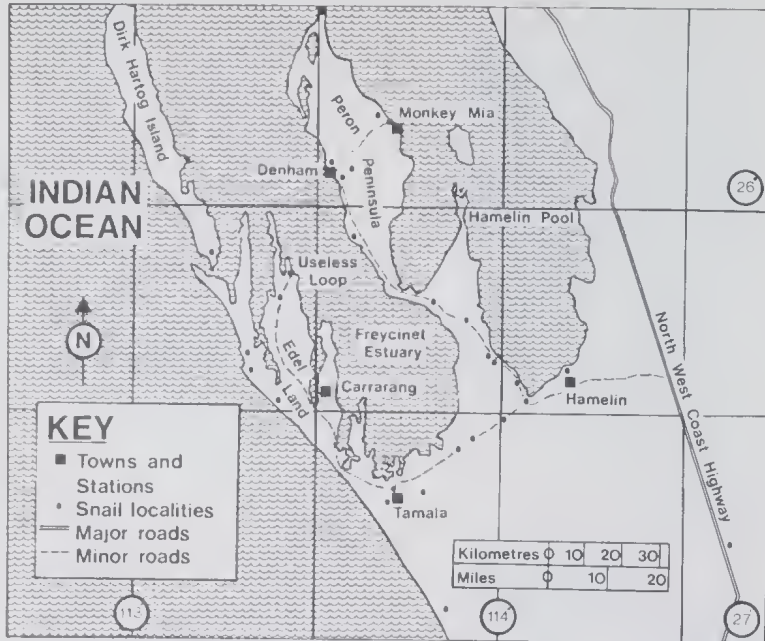
Map 1: Western Australia. Areas studied.



Map 2: Western Australia. Torbay to Pt Charles, showing localities for *Bothriembryon melo*.



Map 3: Western Australia. Kalbarri to Pt Cloates, showing localities for *Bothriembryon costulatus*.



Map 4: Western Australia, Shark Bay district. *Bothriembryon onslowi* localities.

(Plate IV Contd.)

Figs. 6a, 6b: False Entrance Well, Carrarang. Light brown with pale flames and white circumbilical band. WAM 1514-70.

Figs. 7a, 7b: Bernier Island, northern end near old hospital site. Light brown with white flames; slightly faded. WAM 342-73.

Figs. 8a, 8b: 13 miles from Carrarang homestead along road to Useless Loop, Shark Bay. Diffuse pale pinkish-brown with few white flames and white circumbilical area. WAM 109-68.

Figs. 9a, 9b: Dorre Island, Shark Bay. Medium brown with white flames and white circumbilical area; slightly faded. WAM 230-73.

Figs. 10a, 10b: Red Bluff, 5 miles south of Kalbarri (near southern end of range). Medium brown with white flames; slightly faded. WAM 475-48.

Figs. 11a, 11b: Bill Bay, 2 miles south of Pt Maud, Cardabia (near northern end of range). Pale waxen pinkish-brown with white flames. WAM 1524-70.

PLATE V

Bothriembryon onslowi (Cox)

Figs. 1a, 1b: Holotype. Dirk Hartogs Island, Shark Bay. Yellowish-brown with diffuse paler flames. Australian Museum C84882.

Figs. 2a, 2b: Dirk Hartogs Island, collected J.J. Walker (Smith, 1895: 95). The larger of two faded shells. British Museum (Natural History) 91.11.21. 202-4.

Figs. 3a, 3b: Monkey Mia, Peron Peninsula. Chestnut-brown with contrasting yellow flames. WAM 229-73.

Figs. 4a, 4b: False Entrance Well, Carrarang. Chestnut-brown with wavy yellow flames. WAM 1513-70.

Figs. 5a, 5b: 7 miles south of Useless Loop. Diffuse brown with obscure whitish flames. WAM 2232-69.

fig. 78). Like the 7 Paris shells in the type series of *costulata* Férussac, all 5 of the Geneva shells represent the smaller of the Shark Bay species of *Bothriembryon* (see Table 1) and in our view could well have originated from the same source. Lamarck did not identify the source of these specimens but it seems a reasonable assumption that this was Péron and Lesueur.

In his journal Péron (1807: 120) recorded that on June 29th, 1801 at Bernier Island, Shark Bay, 'Two species of land shells extremely numerous, but all dead, occupied great stretches of the interior of the island, one was a small species of *Helix*, the other belonged to the genus *Bulimus* of M. de Lamarck' (quoted in translation from Alexander, 1916: 96). Péron and his colleagues also went ashore on Dorre and Dirk Hartogs Islands and noted the general similarity of all three, but his references to modern land snails relate explicitly only to Bernier Island.

As far as we can determine from samples in the collection of the Western Australian Museum, only one species of *Bothriembryon* occurs today on Bernier and Dorre Islands. This is the smaller of the two Shark Bay species and is without doubt the '*Bulimus*' referred to by Péron. The small '*Helix*' appears to be the camaenid *Rhagada torulus* (Férussac, 1819), which occurs on Bernier, Dorre and Dirk Hartogs Islands and also on parts of the adjacent mainland.

It seems clear that Péron and Lesueur collected a sample of *Bothriembryon* shells while on Bernier Island. This sample, which may or may not have been supplemented with similar shells from Dorre and Dirk Hartogs Islands, we suggest was probably divided at some later time between Férussac and Lamarck. If so, the 7 Paris shells, i.e. the types of *costulata* Férussac, would then represent Férussac's share of this division, while the 5 at Geneva would be those secured by Lamarck, to become the types of *inflatus* Lamarck.

The view held by some later workers, for example, Hedley (1892, 1916) and Pilsbry (1900) that *inflatus* Lamarck was a species of the Albany district, may have arisen from a misinterpretation of Delessert's illustrations and perhaps also from reliance on the locality data for *costulata* Férussac, which we have shown above to be partly erroneous. However, Cox (1864, 1868) clearly distinguished between *inflatus* Lamarck, *melo* Quoy and Gaimard and his own new species, *onslowi*.

Iredale (1939) pointed out that the name *Bulimus inflatus* Lamarck, 1822 is a primary homonym of *Bulimus inflatus* Olivier, 1801.

3. *Helix costulata* Lamarck, 1822

Histoire naturelle des animaux sans vertébrés 6 (2): 122 (in synonymy).

Evidently Lamarck realized that the specimens which he proposed to name *inflatus* were conspecific with those called *costulata* by Férussac (without description) for he cited that name in the synonymy of *inflatus*.

Having shown that *inflatus* Lamarck is not an available name, Iredale (1939) employed *costulatus* as a name introduced in synonymy by Lamarck (see Article 11 (d) of the International Code of Zoological Nomenclature). Both names, *inflatus* Lamarck and *costulata* Lamarck, have the same type specimens, that is, the sample of 5 shells at Geneva.

Iredale (1939) deduced correctly that *inflatus* Lamarck and *costulata* Lamarck apply to 'the Shark Bay shell' but he did not take into account that there are two species of *Bothriembryon* living in that district and assigned these names to the wrong one, that is, the larger species, which we consider to be correctly named *onslowi* Cox. In his 1939 review of the genus, Iredale shows evidence of a change of mind on this question, for on p. 16 he cites *onslowi* as the type species of his subgenus *Hartogembryon* and later, on p. 26, lists *onslowi* in the synonymy of *costulatus*. This allocation seems to have been made without reference to both of the types and, like others before, Iredale may have been misled by Delessert's illustrations, which are not good likenesses of the specimen and species. Lamarck's type is an exceptionally large shell (see Pl. III, fig. 4a, b) and Delessert's illustrations are even larger. The shading is excessively dark and the anterior portion of the aperture is drawn inaccurately. In distinguishing between the two species *costulatus* and *onslowi*, Delessert's figures are at best ambiguous.

4. *Bulimus onslowi* Cox, 1864

Ann. Mag. nat. Hist. (3) 14: 185. Locality given as Dirk Hartogs Island, Shark Bay, Western Australia (Onslow); *Catalogue of specimens of the Australian land shells in the collections of James C. Cox, Sydney*, p. 24. Figured in Cox, 1868. *A monograph of Australian land shells*, Sydney, p. 74, pl. 13, fig. 13.

We follow Richardson (1971) in giving priority of publication of the name *onslowi* Cox to *The Annals and Magazine of Natural History*. We have examined Cox's type, which bears the Australian Museum registered number C 84882. It corresponds well with the written description, though the dimensions differ slightly from those given by Cox. The illustration is an unlikely reddish-brown whereas the type is yellow-brown and also a little less globose than the figure; the positions of the axial flames more or less correspond. The original label is missing but one, now fragmentary, added by Hedley bears the word 'type' (Mr P.H. Colman, personal communication, 18 January 1972). A further label in Iredale's hand is inscribed 'Not the figured specimen', evidently referring to the fact that another specimen (Western Australian Museum registered number 31-40) was used to illustrate the species in his revision of the genus (Iredale, 1930, pl. II, fig. 19).

The type of *B. onslowi* clearly is a member of the larger of the two Shark Bay species (Pl. V, fig. 1a, b) and is specifically distinct from the type of *Bulimus inflatus* (= *costulatus*) Lamarck.

Cox seems to have been the first to describe this species which, though common on Dirk Hartogs Island and elsewhere on the adjacent mainland, is not known to occur on Bernier (and Dorre) Island, the probable type locality of Lamarck's species.

5. *Bothriembryon onslowi* var. *minor* Pilsbry, 1900

Manual of conchology, (2) 13: 12, pl. 3, figs. 45, 46, 47. No locality stated.

After referring to specimens of '*Bulimus (Liparus)*' *onslowi* Cox, collected in 1890-91 by J.J. Walker at Dirk Hartogs Island, Smith (1895: 95) remarked that 'Five other examples are considerably smaller, averaging only 15 to 18 mm in length. They are a trifle less globose and more strongly granular just below the suture'. Smith's shells have been examined by us and are illustrated in Pl. IV, figs. 1-5 and Pl. V, fig. 2a, b. The two largest are *B. onslowi*; the other five, glued to cardboard, are *B. costulatus*. Pilsbry (1900: 12) quoted Smith's observation and referred to similar specimens in his own collection, for which he introduced the varietal name *minor*. Pilsbry described and figured his own two specimens and reproduced the earlier figure of Smith but omitted to state a locality for his own shells.

According to the catalogue of the Academy of Natural Sciences of Philadelphia, Pilsbry's specimens of *B. onslowi* var. *minor* were purchased from Messrs Sowerby and Fulton (Mrs M.C. Rulon, personal communication 17 January 1972) and may have been collected also by J.J. Walker, though there is no positive evidence of this. We have not directly examined Pilsbry's types but, from photographs kindly provided by Mrs Rulon (Pl. III, fig. 6a, b), we believe that they are conspecific with the type material of *costulata* Férussac and *inflatus* (= *costulatus*) Lamarck and specifically distinct from *onslowi* Cox.

It appears that Pilsbry did not recognize that his shells of '*onslowi* var. *minor*' were conspecific with *inflatus* (= *costulatus*) Lamarck because of his confusion of that species with *melo* Quoy and Gaimard. Then Iredale (1939), having decided mistakenly to apply the name *costulatus* Lamarck to the larger of the two Shark Bay species of *Bothriembryon*, raised Pilsbry's varietal name (*minor*) to full specific rank.

6. *Helix (Cochlogena) melones* Férussac, 1821

Tableaux Systématiques des animaux mollusques. Limaçons, p. 58, January 1821; p. 54, June 1821. Locality given as: 'La Nouvelle-Hollande'.

This name is a *nomen nudum* and was cited as such in the description of *Helix melo* by Quoy and Gaimard (1832). We do not know of the existence of any specimens which could be confidently regarded as Férussac's original

material but the possibility cannot be excluded that these may have been mixed with Quoy and Gaimard's type series of *H. melo*.

7. *Helix melo* Quoy and Gaimard, 1832

Voyage de découvertes de l'Astrolabe. Paris. Zoologie 2: 109-111, pl. 9, figs. 4-7 (plates in supplementary atlas). Locality given as: 'au port du Roi-Georges, principalement sur le sommet de Bald-Head' [Summit of Bald-Head, King George Sound].

Quoy and Gaimard evidently derived their name, *melo*, from Férussac's earlier, unavailable name, *melones*, and it seems probable that his specimens were known to them. We have examined a sample of shells from the collection of the Muséum National d'Histoire Naturelle, Paris, which is labelled '*Helix melones* Fér. Nouvelle Hollande. MM Quoy et Gaimard. 1829'. This sample comprises 11 shells, of which 10 are unquestionably from the Albany district, that is, King George Sound, the other being a Shark Bay shell conspecific with the types of *costulata* Férussac and *inflatus* (= *costulatus*) Lamarck. Within the aperture of the Shark Bay specimen is an adherent deposit of pinkish-brown, calcareous soil, identical with that in shells of the same species from Bernier Island in the collection of the Western Australian Museum. Soils of this nature do not accompany snail shells from the Albany district and, in our experience, do not occur there.

One of the 10 Albany shells bears the inscriptions in black ink '*inflatus* 19' and '*melones*' but when and by whom these were written is unknown. This shell is the closest of the 10 to Quoy and Gaimard's figures 4 and 5, particularly in the disposition of the axial stripes. However, the height of the figure is proportionately greater than that of the shell and the shading is much darker. (Notwithstanding these differences, we shall nominate this specimen below as the lectotype of *Helix melo* Quoy and Gaimard.)

Another specimen from the same sample is evidently the white-banded, brown shell (their '*varietas castanea; vitta alba cincta*'), illustrated by Quoy and Gaimard's figs. 6 and 7 and to which Pilsbry (1900: 5, fig. 11) referred when introducing his varietal name *castaneus*. As with the lectotype, the figures of this shell are shaded rather heavily but the proportions of shell and figures agree fairly well.

The type sample of *Helix melo* (excluding the single specimen of *B. costulatus*) compares closely with recently collected samples of that species in the collection of the Western Australian Museum from Bald Head and the adjacent Limestone Head, near Albany. However, the possibility cannot be ruled out that the 10 Paris shells may be a mixture of Quoy and Gaimard's specimens and those of Férussac, which were collected by Péron and Lesueur at King George Sound in 1803. The presence in the sample of one Shark Bay shell, which may well have been collected by Péron and Lesueur but almost

certainly not by Quoy and Gaimard, seems to strengthen the possibility that these represent a combination of Férussac's and Quoy and Gaimard's shells. If so, this would account for the apparent absence in Paris of Férussac's types of *melones*.

Other aspects of the immense confusion that has surrounded the identity of *H. melo* over the years following its model introduction have been discussed by Iredale (1939). The species is strongly polymorphic in shell characters and this has given rise to a number of varietal names, one of which was elevated to full specific rank by Iredale (1939) as *Bothriembryon castaneus* Pilsbry, 1900.

8. *Bothriembryon inflatus* var. *castaneus* Pilsbry, 1900

Manual of conchology, (2) 13: 5, pl. 1, figs. 11, 18. *Bothriembryon castaneus* Pilsbry, 1900. Iredale, 1939. *Rec. West. Aust. Mus.* 2: 19, pl. 2, fig. 2. Also published in *J. Proc. R. Soc. West. Aust.* 25: 19, pl. 2, fig. 2.

Pilsbry (1900) took his description of *Bothriembryon* 'inflatus var. *castaneus*' from a shell lent to him by Cox, the locality of which was said to be 'Recherche Archipelago'. Pilsbry's only other record for the variety was Quoy and Gaimard's banded, brown shell from King George Sound, previously discussed, and it is clear that he regarded it merely as one of several forms of a polymorphic species. The Cox-Pilsbry shell, now Australian Museum registered number C 87458, was selected as the type of *B. castaneus* Pilsbry by Iredale (1939: 19), adding that it was 'one of a series from Doubtful Island'. Iredale did not explain how he came by this locality and omitted to mention Pilsbry's earlier citation of the locality 'Recherche Archipelago'. We have examined this specimen and note that of the accompanying labels, only one, in Cox's hand, bears locality data and is inscribed (black-lead pencil) 'Reserch [sic] Archipelago W. Australia'. The shell bears the number 16 in black on the last whorl. There is nothing on the labels to indicate the source of Cox's shell. According to Richardson (1971), he did little personal collecting and relied mainly on exchange and purchase to establish his collection.

The collection of *Bothriembryon* shells from the Recherche Archipelago and coastal localities on the adjacent mainland in the Western Australian Museum comprises 30 lots totalling over 300 shells. We have compared this material with the type of *B. castaneus* and have found that there is no close resemblance between any of them and it. None of the Recherche-Esperance shells features a pale spiral band and we consider that none of them is conspecific with *melo*. On the available evidence we conclude that the Cox-Pilsbry locality, 'Recherche Archipelago', for the type of *castaneus* is probably incorrect.

The Australian Museum collection however, contains two lots of shells of *B. melo*, both labelled 'Doubtful Is., King George Sound, W. Aust. R. Helms Coll.'. Lot C 89370 comprises ten pale shells, all axially striped and with a dark, subsutural band and umbilical patch. Lot C 89373 comprises eight brown shells, each with a pale, spiral band. These lots we consider to probably represent the division, according to colour, of what was originally a single sample. We have no other comparative material from Doubtful Island but the shells in Helms' two lots are quite similar to specimens collected recently by one of us (G.W.K.) from the adjacent coast around Bremer Bay.

The type of *B. castaneus* is so similar as to be virtually indistinguishable from Helms' eight shells in lot C 89373 and could very well have been taken from there. According to Hedley (1915), Helms visited Western Australia twice, initially with the Elder Exploring Expedition in 1891-2 and subsequently in 1896-1900. The route of the Elder Expedition did not approach Doubtful Island and it seems more likely that Helms collected his specimens from there some time between 1896 and 1900. In all probability Cox obtained his single, banded shell from Helms during this period, in time for it to be passed on to Pilsbry. Conceivably, the locality discrepancy was acquired by the specimen in passage from Helms to Cox. It seems therefore that Iredale was correct concerning the type locality of *B. castaneus*.

Apart from the foregoing, the type of *B. castaneus* is typical of some of the more strongly coloured, brown, banded shells of *B. melo* that occur among populations of that species in the Bremer Bay district and we regard the name as a subjective junior synonym of *melo* Quoy and Gaimard.

REDESCRIPTIONS

Family Bulimulidae

Genus *Bothriembryon* Pilsbry, 1894

Liparus Martens (in Albers), 1860. *Die Heliceen*, second edition, p. 229
non Liparus Olivier, 1807 (Insecta), *nec Liparus* Albers 1850.

Bothriembryon Pilsbry, 1894. *The Nautilus* 8: 35-36.

Bothriembryon Pilsbry, 1900. *Manual of conchology*, (2). Pulmonata. 13:1.

Type species

By original designation, *Bulimus melo* (Quoy and Gaimard) = *Helix melo* Quoy and Gaimard.

Generic diagnosis

Bulimulid snails of small to large size, elevated, elongate-ovate to globose-conical, whorls convex, sutures impressed, finely crenulated; sculpture of

uneven, wrinkled, transverse growth striae, flexed and accentuated below the suture and usually bearing or crossed by spiral chords of variable strength, more prominent on the posterior third. Aperture oval, oblique, discontinuous, the margins joined by a thin parietal glaze; inductura finely granose; outer lip thin, slightly prosocline and sinuate; columella reflected, without folds; umbilicus small or closed. Protoconch of 1.5 to 2.5 whorls, terminally descending, with fine axial and/or reticulate sculpture, distinct from that of the teleoconch. The form of the protoconch distinguishes the genus from all other known land snails from the Australasian Region. Colours of the teleoconch comprise shades of yellow, brown, red, lilac and white, often in patterns of irregular axial flames and less frequently, spiral bands.

Anatomy

The jaw is arcuate and plaited, the median segment triangular or wedge-shaped; radula about as in *Bulimulus*; genital system simple, much as in *Bulimulus* (Pilsbry, 1900).

The anatomy of a specimen, referred to *B. inflatus* (Lamarck) on a determination by C. Hedley, was described in some detail by Pilsbry (1946). This may have been a specimen of *B. melo* but no locality is indicated and the identity of the specimen is uncertain. An earlier anatomical study of '*Bulimulus*' *melo* (Quoy and Gaimard) is by Semper (1870: 154, taf. XV, fig. 14, taf. XVII, fig. 13).

Geographic range

Western Australia, from the entire southern coast, northward to the Hamersley Range; southern South Australia from Eyre Peninsula westward and Kangaroo Island; Northern Territory at Palm Valley near Hermannsburg; Tasmania.

Stratigraphic range

? Miocene to Recent (Ludbrook, 1963; McMichael, 1968).

Remarks

In proposing the new name *Bothriembryon*, Pilsbry (1894) cited as type species *Bulimus melo* (Quoy and Gaimard) but in later studies (Pilsbry 1900, 1946) used the name *inflatus* Lamarck when referring to that species. In this, he seems to have been influenced by the views of Hedley (1892, 1895, 1916). Of the subgenera of Iredale (1933, 1939), the earlier group, *Tasmanembryon*, *Hartogembryon*, *Larapintembryon* and *Satagembryon* were based on observations by Pilsbry (1900) on interspecific differences in protoconch sculpture. The later group, *Dialembryon*, *Ponembryon*, *Telem-bryon* and *Celatembryon*, appear to be based on little more than size in the case of the first two, the others being undefined beyond citation of the respective type species, *B. kingii* (Gray) and *B. distinctus* Iredale.

Iredale (1939) himself expressed uncertainty and also some inconsistency in attempting to arrange the species of *Bothriembryon* into subgenera and it

is apparent that the question requires further study. This being beyond the scope of the present work, we shall confine ourselves to the observation that protoconch sculpture may need to be assessed in conjunction with other characters in determining subgeneric relationships.

Shell dimensions

In the present study, shell whorls have been counted under magnification by orientating the specimen so that the terminal lobe of the protoconch is directed toward the viewer, as in fig. 1. Whorls increase with each subsequent intersection by the suture of a line descending from the terminal lobe; tenths of whorls have been estimated. Shell height has been determined as the distance from the apical to the basal extremity. Maximum width represents the distance from the outer lip to the farthest edge of the last whorl, measured normal to the shell axis.

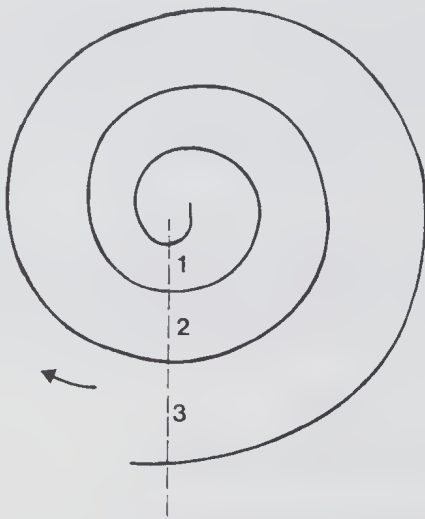


Fig. 1: Shell orientation for counting whorls, beginning with the protoconch. Arrow indicates direction of growth.

Bothriembryon melo (Quoy and Gaimard)

(Pl. I, II, III figs 1a, b, 2a, b, 3a, b. Map 2)

Helix melo Quoy and Gaimard, 1832. *Voyage de découvertes de l'Astrolabe*. Paris. Zoologie 2:109. Supplementary atlas, pl. 9, figs. 4-7.

Liparus inflatus var. *melo* (Quoy and Gaimard). Hedley, 1892. *Rec. Aust. Mus.* 2: 29.

Bothriembryon melo (Quoy and Gaimard). Pilsbry, 1894. *Nautilus* 8: 36.

Bothriembryon inflatus (Lamarck). Pilsbry, 1900. *Manual of conchology*. (2). Pulmonata. 13: 3-6, pl. 1, figs. 1-5 (part).

Bothriembryon inflatus (Lamarck). Hedley, 1916. *J. Proc. Roy. Soc. West. Aust.* 1: 216 (part).

Bothriembryon castaneus Pilsbry. Iredale, 1939. *Rec. West. Aust. Mus.* 2: 19, pl. 2, fig. 2; also published in *J. Proc. Roy. Soc. West. Aust.* 25: 19, pl. 2, fig. 2.

Type locality

Summit of Bald Head, King George Sound. Located on the extremity of the Flinders Peninsula, south of Albany across King George Sound, this site now lies within the Torndirrup National Park.

Type series

Muséum National d'Histoire Naturelle, Paris. Lectotype and 9 paralectotypes, here selected; unregistered.

Dimensions (mm)	(a)	(b)	(c)	(d)	(e)
Height of shell	25.2	22.3	22.3	30.7	27.0
Height of aperture	13.9	12.6	12.4	15.7	15.0
Maximum width	15.0	12.8	12.9	17.3	15.2
No. of whorls	5.4	5.2	5.2	5.8	5.4
Protoconch whorls	1.9	1.9	1.8	1.8	2.0

(a) Lectotype, from Bald Head near Albany.

(b) Paralectotype, also from Bald Head. Quoy and Gaimard's shell '*varietas castanea, vitta alba cincta*'.

(c) Holotype of *B. castaneus* Pilsbry, probably from Doubtful Island. Australian Museum C 87458.

(d) A large shell from Bald Head near Albany. Western Australian Museum 247-72 (part).

(e) A large shell from near the seaward part of the Hunter River estuary. Western Australian Museum 266-70 (part).

Diagnosis

A *Bothriembryon* of medium size, ovate-conical, with 5 whorls in a height of 21-23 mm and a height to width ratio of about 5 to 3. Sculpture of weak transverse growth striae, accentuated below and crenulating the suture; crossed by spiral chords, usually weak and confined to the posterior third, becoming obsolete on the last whorl; periostracum thin. Protoconch of 1.7 to 2.1 whorls, initially sculptured with fine, anastomose axial wrinkles passing into an irregular reticulate sculpture with a tendency to axial alignment; the last 0.1-0.2 whorl usually with fine, close anastomose, axial wrinkles; base of the protoconch very finely granose or almost smooth, polished; colour a light to medium brown, without axial flames. Teleoconch of one or more colours, shades of brown, yellow and white in combinations of diffuse, axial and/or spiral patterns; a white-flecked, chestnut, subsutural band and

a chestnut umbilical patch are commonly present; with or without axial flames.

Morphs

Some distinctive common colour morphs known to us are here listed. Intermediate-coloured shells also occur.

- (a) Off-white to yellowish-brown with a prominent, white-flecked, chestnut, subsutural band and brown axial stripes which converge into a brown, umbilical patch; columella pinkish-brown, lilac or white; usually without axial flames, but occasionally with obscure pale yellow flames. The lectotype is a weathered example of this form, which is common at Bald Head, Limestone Head, Frenchman Bay, Breaksea Island, Cheyne Beach and other localities near Albany; occasionally appears at Bremer Bay (Pl. I, figs. 1a, b, 4a, b, 6a, b, Pl. II, fig. 2a, b).
- (b) Pale yellow, with a chestnut-brown, subsutural band, strong to weak; without axial flames; umbilicus brown; columella shades of brown, pink or lilac. Occurs at Frenchman Bay near Albany (Pl. II, fig. 1a, b).
- (c) Diffuse olive brown, with or without a chestnut subsutural band and umbilical patch; without axial flames; columella pale brown. Occurs in the valley of the Waychinicup River, east of Albany (Pl. II, fig. 6a, b).
- (d) Straw-yellow, with or without weak brown axial streaks, subsutural band and umbilical patch; with or without obscure, pale, axial flames; columella whitish to brown. Occurs on Bald and Breaksea Islands, Two Peoples Bay and the vicinity of the Angove River pumping station (Pl. II, fig. 5a, b).
- (e) Diffuse chestnut to dark brown, usually with, but occasionally without, one or two peripheral bands, which may be visible on the spire; generally without axial flames but these are occasionally present [see (h)]. Present in both relatively slender and wide shells. Occurs at Bald Head, Limestone Head, Frenchman Bay, Nanarup, Two Peoples Bay and the Bremer Bay district. Corresponds to Quoy and Gaimard's white-banded brown shell from Bald Head. Similar shells from the Bremer Bay district more often feature yellow axial flames, being exemplified by the type of *B. castaneus* Pilsbry Pl. I, figs. 2a, b, 3a, b. Pl. II, fig. 4a, b, Pl. III, fig. 3a, b).
- (f) Similar to (a), but with 1 to 3 white peripheral bands. Occurs at Bald Head, Limestone Head, Frenchman Bay and other localities near Albany (Pl. I, fig. 5a, b, Pl. II, 3a, b).
- (g) Similar to (a), but darker, with more intense colours and yellowish axial flames. Occurs in the Bremer Bay district near Wellstead Estuary (Pl. III, fig. 1a, b).
- (h) Similar to (e), intense dark to tan brown with well-developed, thin yellow axial flames, with or without a pale, peripheral spiral band. Occurs on Bald Island and near the Hunter River estuary (Pl. III, fig. 2a, b).

Geographic range

Numerous localities, all near the coast from Tor Bay, west of Albany to Point Charles near Fitzgerald Inlet; also Michaelmas, Breaksea, Bald and Doubtful Islands (Map 2). Commonly on dunes with a cover of heath vegetation or *Agonis* thickets; occasionally found on heavier soils overlying gneissic rocks. Frequently sympatric with *B. kingii* (Gray).

The fossil collection of the Western Australian Museum contains specimens of *B. melo* collected in association with remains of the extinct marsupial *Zygomaturus trilobus* from lithified soils developed on Late Quaternary aeolian calcarenites near Bremer Bay (Merrilees, 1970). *B. melo* has also been collected from a similar fossil soil horizon at Limestone Head.

Bothriembryon costulatus (Lamarck)

(Pl. III, figs. 4a, b, 5a, b, 6a, b, Pl. IV. Map 3)

Bulimus inflatus Lamarck, 1822. *Histoire naturelle des animaux sans vertèbres* 6: 122. *Non Bulimus inflatus* Olivier, 1801.

Helix costulata Lamarck, 1822. *Histoire naturelle des animaux sans vertèbres* 6: 122. From synonymy.

Helix (Cochlogena) costulata Férussac, 1821. *Tableaux systematiques des animaux mollusques*. Limaçons, pp. 54, 58. *Nomen nudum*.

Bulimus inflatus Lamarck. Delessert, 1841. *Recueil de coquilles décrites par Lamarck*, pl. 28, fig. 1.

Bulimus (Liparus) onslowi Cox. Smith, 1895. *Proc. malac. Soc. Lond.* 1: 95 (part).

Bothriembryon onslowi var. *minor* Pilsbry, 1900. *Manual of conchology* (2). Pulmonata. 13: 12, pl. 3, figs. 45, 46, 47.

Bothriembryon minor Pilsbry. Iredale, 1939. *Rec. West. Aust. Mus.* 2: 27, pl. 2, fig. 20; also published in *J. Proc. Roy. Soc. West. Aust.* 25: 27, pl. 2, fig. 20.

Bulimus inflatus Lamarck. Mermod, 1951. *Revue suisse Zool.* 58: 728-729, fig. 78.

Type locality

New Holland = probably Bernier Island, Shark Bay, Western Australia.

Type series

Muséum d'Histoire Naturelle, Geneva. Lamarck Collection, lectotype and 4 paralectotypes; the former, number 1092/65.

The lectotype has been described and figured by Mermod (1951: 728-729, fig. 78). With 5.8 whorls in a height of 26.0 mm, it is exceptionally large for the species. The whole shell is worn and faded a dull off-white but

appears to have had originally a light brown ground colour with spaced, white axial flames; the protoconch shows no trace of axial flames. A quantity of loose, pink-brown sand has become dislodged from within the shell and has been retained with it.

Dimensions (mm)

Note: These are NOT the dimensions of the 'Type series'.

	(a)	(b)	(c)	(d)	(e)
Height of shell	26.0	21.9	14.5	22.1	19.9
Height of aperture	14.2	11.7	8.0	11.9	10.4
Maximum width	15.7	12.1	8.2	14.2	10.4
No. of whorls	5.8	5.5	5+	5.5	5.3
Protoconch whorls	2.2	1.9	—	2.2	2.1

- (a) Lectotype, probably from Bernier Island.
- (b) The largest of Férussac's 7 shells, probably also from Bernier Island.
- (c) The larger of the type series of *minor* Pilsbry (dimensions from text). Precise locality unknown.
- (d) A large shell from 16 miles south of Point Cloates (northern population).
- (e) From Red Bluff, 5 miles south of the mouth of the Murchison River (southern population).

Diagnosis

A *Bothriembryon* of medium size, ovate-conical to globose-conical, with 5 whorls in a height of 14-20 mm (see fig. 2) and a height to width ratio of about 3 to 2. Sculpture of weak, transverse growth striae bearing fine, granose, spiral chords on the posterior third; periostracum thin. Protoconch of 1.9 to 2.3 whorls bearing fine, close, wavy, axial wrinkles, occasionally becoming reticulate on the second whorl; colour brown, often darker than the teleoconch and with white, axial flames appearing at about 1.5 whorls. Teleoconch colours generally rather pallid, beige or medium brown, occasionally with pink or yellow tones, broken by white, irregular axial flames; sometimes a dull off-white or a diffuse pale-brown, without axial flames; columella white; often with a white circumbilical band, weakly or strongly defined; aperture coloured within like the exterior, but more intensely, the lip broadly edged in white. Axial flames persist in bleached, faded shells, such as the type.

Geographic range

Numerous localities, all near the coast, from 16 miles south of Point Cloates to Red Bluff, 5 miles south of Kalbarri; also Bernier, Dorre, Dirk Hartogs, Baudin and Salutation Islands in Shark Bay (Map 3). Associated

with heath, *Triodia* and *Acacia* vegetation on well-drained, pale to reddish-brown sandy soils and occasionally on limestone outcrops. Sympatric with *B. onslowi* throughout Edel Land, Péron Peninsula and Dirk Hartogs Island.

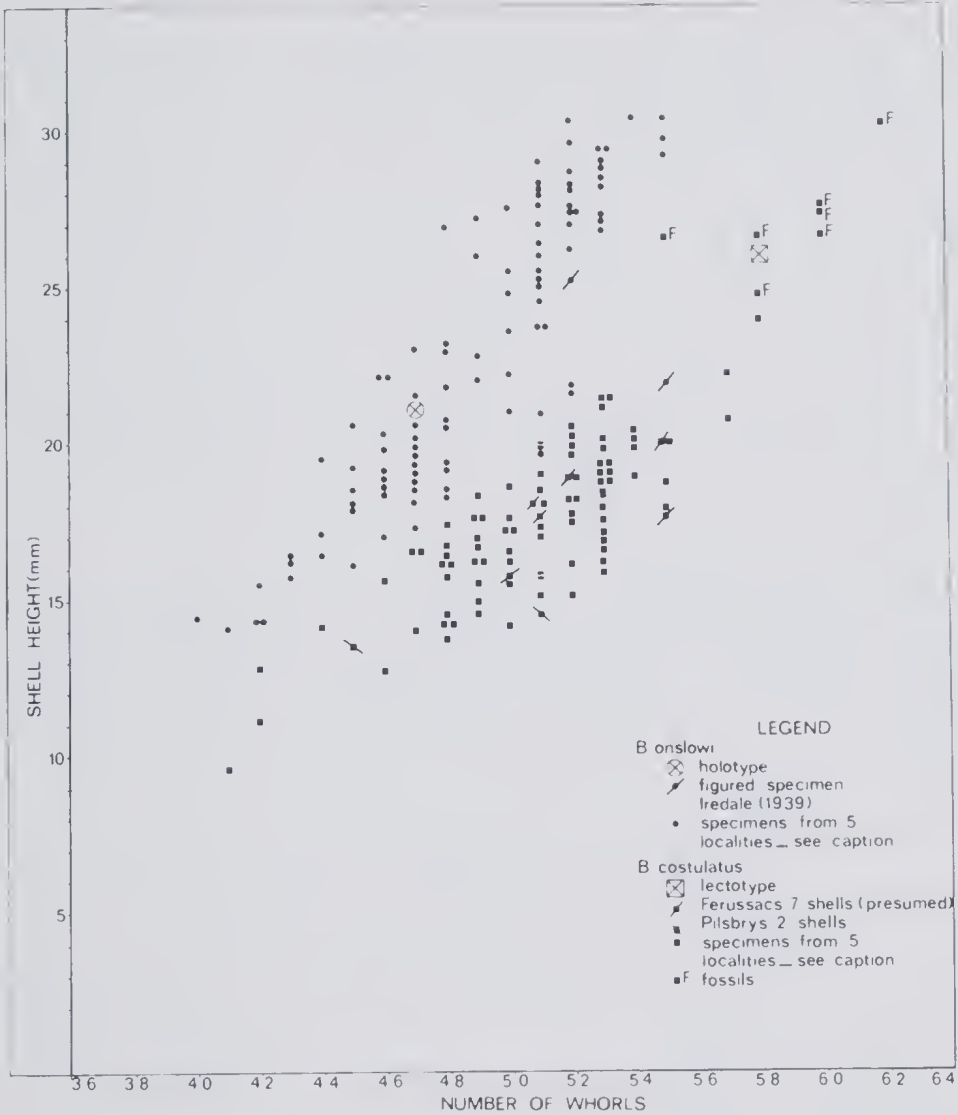


Fig. 2: Graph showing the relationship of shell height to number of whorls in *B. onslowi* and *B. costulatus*. Specimens of *onslowi* from Dirk Hartogs Island; Monkey Mia, Peron Peninsula; Carrarang-Tamala boundary near the western coast; 2 miles north of Billabong roadhouse, North West Coastal Highway, False Entrance Well, Carrarang. Specimens of *costulatus* from Bernier Island; Dirk Hartogs Island; 2 miles south of Pt Maud, Cardabia; False Entrance Well, Carrarang; vicinity of Zuytdorp wreck 40 miles (65 km) north of Kalbarri.

The fossil collection of the Western Australian Museum contains samples of *B. costulatus* from Bernier and Dorre Islands, Edel Land, Peron Peninsula, the vicinity of Tamala, Point Quobba and the site of the 'Zuytdorp' wreck some 65 km (40 miles) north of Kalbarri. These have been collected from both unlithified, modern soil profiles and from well lithified Pleistocene fossil soils (see Logan et al., 1970: 68). Shells of *B. costulatus* from these older deposits tend to be larger than modern shells, some even exceeding the type, which is the largest known modern specimen. In some localities, these large fossil specimens are associated with shells of what appear to be two extinct species of *Bothriembryon*, including that noted by Ride (1962: 24-25) on Dorre Island and probably by Péron (1807: 110-111) on Bernier Island. *B. onslowi* is not known to occur in the same deposits as these fossil species.

The volume of fossil evidence at present available is not enough for firm conclusions to be drawn but suggests that *B. costulatus* may have inhabited the district for longer than *B. onslowi*. The greater size of some of the Pleistocene shells of *costulatus* compared with modern specimens may point to adverse environmental changes since then. The apparent extinction of two species of *Bothriembryon* in the district since the Pleistocene seems to be consistent with such changes.

The affinities of *costulatus* appear to lie with a group of species, characterized by the presence of pale axial flames on the protoconch, located mainly in the south coast and lower south-west regions of the State. The group includes *B. brazieri* (Angas), *B. kingii* (Gray) and others; an undescribed species from Pt D'Entrecasteaux has similar protoconch sculpture to that of *costulatus*.

Bothriembryon onslowi (Cox)

(Pl. V. Map 4)

Bulimus onslowi Cox, 1864. *Ann. Mag. nat. Hist.* (3) 14: 185.

Bulimus onslowi Cox, 1864. *Catalogue of specimens of the Australian land shells in the collections of James C. Cox, Sydney.* J.A. Engel, p. 24.

Bulimus onslow Cox. Cox, 1868. *A monograph of Australian land shells.* Wm Maddock, Sydney. p. 74, pl. 13, fig. 13.

Bothriembryon costulatus (Lamarck, 1822). Iredale, 1939. *Rec. West. Aust. Mus.* 2: 26-27, pl. 2, fig. 19; also published in *J. Proc. Roy. Soc. West. Aust.* 25: 26-27, pl. 2 fig. 19.

Typelocality

Dirk Hartogs Island, Western Australia.

Type

Australian Museum, Sydney, number C 84882.

Dimensions (mm)	(a)	(b)	(c)	(d)	(e)
Height of shell	21.1	30.4	21.0	18.3	25.2
Height of aperture	13.3	18.2	13.2	10.8	15.9
Maximum width	14.1	18.5	13.8	12.1	16.1
No. of whorls	4.7	5.4	5.0	4.8	5.2
Protoconch whorls	1.7	2.0	1.9	1.8	1.9

(a) Holotype.

(b) A large shell from near the coast at the Carrarang-Tamala boundary. Western Australian Museum 225-73 (part).

(c) From Monkey Mia, Peron Peninsula. Western Australian Museum 226-73 (part).

(d) From beside North West Coastal Highway 47 km south of the Shark Bay turn-off. Western Australian Museum 224-73 (part).

(e) From Dirk Hartogs Island. Iredale's figured specimen. Western Australian Museum 31-40 (part).

Diagnosis

A *Bothriembryon* of medium size, ovate-conical, with 5.0 whorls in a height of 20-27 mm (see fig. 2) and a height to width ratio of about 3 to 2. Sculpture of weak, transverse, growth striae bearing fine granose spiral chords above the periphery; periostracum thin. Protoconch of 1.7 to 2.2 whorls, sculptured initially with obscure, irregular, axial wrinkles; after the first half whorl, becoming more or less reticulate, often with a marked axial alignment; the last 0.1-0.3 whorl with fine, close, axial wrinkles; colour light brown, paler than the teleoconch and without axial flames. Teleoconch colours generally rather intense, chestnut-brown, interrupted by irregular, off-white to yellow-brown axial flames; columella white. Aperture coloured within like the exterior but more diffuse, the lip narrowly edged in white. Axial flames persist in bleached, faded shells. In life, the axial flames may be greenish-yellow.

Geographic range

Dirk Hartogs Island, Edel Land, Péron Peninsula and adjacent areas near Shark Bay. Associated with well-drained sandy soils with heath and *Acacia* vegetation. Sympatric with *B. costulatus* throughout most of the known range.

The fossil collection of the Western Australian Museum contains samples of *B. onslowi* from what appear to be modern (i.e., post-Pleistocene) soil profiles in Edel Land, Péron Peninsula and the vicinity of Tamala. There is, in addition, a single shell, apparently of this species, from Useless Loop,

embedded in the calcrete of a weathered soil profile. These records all lie within the known modern range of the species and all associated species are extant. The stratigraphic range is possibly late Pleistocene to Recent.

The affinities of *onslowi* appear to lie with species such as *melo* and *bull*a (of the Perth district) in which the protoconch lacks axial flames. In protoconch sculpture, *onslowi* and *melo* are somewhat similar and their ratios of height to number of whorls are sometimes comparable.

Table 1. A comparison of usages of the names *inflatus* Lamarck (= *costulata* Lamarck), *melo* Quoy and Gaimard and *onslowi* Cox from various sources.

Lamarck, 1822	Quoy and Gaimard, 1832	Albers, 1860	Cox, 1864	Cox, 1868	Hedley, 1892	Pilsbry, 1894	Smith, 1895	Pilsbry, 1900	Hedley, 1916	Iredale, 1939	This paper
<i>inflatus</i> (preoccupied)		<i>inflatus</i>	<i>inflatus</i>	<i>inflatus</i>			<i>onslowi</i> (part)	<i>onslowi</i> var. <i>minor</i>		<i>minor</i>	<i>costulatus</i>
= <i>costulata</i> (in synonymy)							<i>melo</i> (part)	<i>inflatus</i> (part)	<i>inflatus</i> (part)	<i>melo</i>	<i>melo</i>
			<i>onslowi</i>	<i>onslowi</i>	<i>inflatus</i> var. <i>melo</i>	<i>melo</i>	<i>onslowi</i> (part)	<i>onslowi</i>	<i>onslowi</i>	<i>costulatus</i>	<i>onslowi</i>

Table 2. Comparison of diagnostic shell characters of *Bothriembryon melo*, *B. costulatus* and *B. onslowi*.

	<i>melo</i>	<i>costulatus</i>	<i>onslowi</i>
Maximum height.	About 30 mm.	Rarely greater than 23 mm (fossils may reach 27 mm).	About 30 mm; often greater than 23 mm.
Height to width ratio.	About 5 : 3.	About 3 : 2; tends to be a little more elevated than <i>onslowi</i> .	About 3 : 2.
Whorls to height.	5 whorls in 21-23 mm.	5 whorls in 14-20 mm.	5 whorls in 20-27 mm.
Teleoconch colours, fresh shells.	Variable patterns and shades of brown, yellow and white, spiral and/or axial; chestnut subsutural band and umbilical patch common.	Usually pallid; brown to off-white, occasionally with pink or yellow tones; diffuse or with axial flames; white spiral band often present on the base.	Intense brown with yellow-brown axial flames; spiral patterns absent; shells containing the live animal may show a greenish hue.
Protoconch colours.	Brown, without axial flames.	Brown, often darker than the teleoconch, and with white axial flames on the second whorl.	Brown, paler than the teleoconch, and without axial flames.
Protoconch whorls.	1.7-2.1 whorls.	1.9-2.3 whorls, generally more than in <i>onslowi</i> .	1.7-2.2 whorls, generally fewer than in <i>costulatus</i> .
Protoconch sculpture.	Initially with fine, anastomose axial wrinkles, passing into an irregular, reticulate sculpture with a tendency to axial alignment; the last 0.1-0.2 whorl usually with fine, close, anastomose axial wrinkles.	Fine, close, wavy, axial wrinkles throughout, occasionally becoming reticulate on the second whorl.	Initially with obscure, irregular, axial wrinkles; after the first half whorl, becoming more or less reticulate, often with a marked axial alignment; the last 0.1-0.3 whorl with fine close axial wrinkles.

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Professor A.R. Main, University of Western Australia, initially introduced us to this problem and subsequently gave us valuable advice. Dr W.D.L. Ride kindly advised us with regard to the International Code of Zoological Nomenclature.

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A NEW LARGE SPECIES OF *PSEUDOVERTAGUS*
(GASTROPODA, CERITHIIDAE) FROM
WESTERN AUSTRALIA

B. R. WILSON*

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INTRODUCTION

Cerithiids are generally gregarious and abundant within their habitat. It is a surprise therefore to discover a large and hitherto unknown species from the Western Australian coast near Perth. In February 1964 Mrs Gladys Hansen of Perth found a shell near Point Peron, Cockburn Sound, which she brought to me for identification. Provisionally I identified it as *Pseudovertagus clava* (Gmelin, 1791), but since then I have seen specimens of that species and I am now satisfied that Mrs Hansen's shell is new. I have seen only two other specimens, both shells occupied by hermit crabs taken from lobster pots in the Fremantle area and now in the collection of the late Mr Harry Baker of Fremantle. Although there is so little material and no live-taken specimen, the species is so distinctive that I have no hesitation in describing and naming it as follows.

Pseudovertagus peroni sp. nov.
(Pl. I, figs. 1-4)

Holotype

WAM 324-73, a shell without operculum collected by Mrs G. Hansen, February, 1964.

Type locality: Point Peron, Western Australia, 32° 16'S, 115° 42'E.

Description of the holotype

Large, solid, attenuate with almost straight sides. Protoconch broken off, teleoconch comprising 13 whorls, sutures sharply incised grooves, thin and shallow, with a prominent broad pre-sutural band comprising posterior 1/4 - 1/3 of spire whorls. On badly worn early spire whorls (1 to 6) pre-sutural band flat and smooth, on whorls 7 to 10 pre-sutural band cast into irregular low axial folds becoming broad, low but prominent axial ribs on the pre-sutural band of 3 remaining whorls. In front of pre-sutural band early spire whorls sculptured, first with 2 contiguous, nodulose spiral ribs, followed by

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6 narrow, rather flat spiral cords separated by finely incised spiral grooves, and finally by another spiral rib immediately behind suture of next whorl. On 10th, 11th and penultimate whorls central spiral cords quite flat and smooth and distinguishable only by thin lines representing positions of spiral grooves. Penultimate whorl bears a distinct and rather steeply sloping post-sutural ramp. Spiral sculpture more pronounced on body whorl with two weakly nodulose, contiguous spiral ribs in front of pre-sutural band, followed by 2 weaker, more widely separated spiral ribs, anterior one located on periphery, and 3 others around anterior slope of whorl. Weak growth lines prominent, crossing spiral sculpture on all whorls. Weak axial folds on body whorl, especially down anterior slope. A conspicuous axial swelling on left side of body whorl resembling a broad, poorly defined varix.

Outer lip flared, sharp-edged anteriorly, much thickened and reflected upwards posteriorly, with 6 indistinct denticles along inner edge. Anterior siphon canal high, rather straight but slightly posteriorly reflected at its tip. Posterior canal conspicuous, constricted at its base, leading back into a groove, bordered by tongue of callous which crosses suture and adheres to side of penultimate whorl as in strombids of genus *Rimella*, though much shorter than in that genus, Parietal and columellar walls thickly calloused, smooth except for prominent, angular parietal nodule bordering posterior canal. Prominently flared ramp or lip on columella behind anterior canal. No trace of umbilicus.

Shell exterior shiny, especially on ventral surface, ivory white with chestnut brown blotching between ribs and axial folds of pre-sutural band, and sharply defined chestnut brown spiral lines. Aperture and parietal — columellar callous glossy-white except for brown patch on parietal nodule and another on calloused left-hand edge of anterior siphon canal.

Length 13.49 cm, width 3.95 cm.

Remarks

The 2 specimens owned by the late Mr Harry Baker agree well with the description of the holotype though one is very battered and the other juvenile.

The nearest living relative of this species is probably *P. clava* (Gmelin, 1791) [Pl. II, figs.5-8] which is found in New Caledonia and the islands of French Polynesia. (Records of the species from the Galapagos Islands are probably erroneous; pers. comm. Dr Harald A. Rehder). I have examined a series of specimens of the latter species collected by Dr Rehder and myself at Oeno Atoll, Tuamotu Archipelago and Pitcairn Island. In that species the shell is stouter and more heavily nodulose; there are prominent axial ribs on the early whorls which are absent in the new species; the pre-sutural band is much less conspicuous; and the spiral ribs are stronger, especially on the anterior slope of the body whorl. In *P. clava* there is a prominent angular fasciole on the left side of the anterior siphon canal and a low plait on the posterior part of the columella deep within the aperture which are absent in *P. peroni*; there are pits representing both a true umbilicus and a false umbilicus, and a horizontally flared lip or ramp anteriorly behind the anterior siphon canal.



Plate I, figs. 1-4: *Pseudovertagus peroni* sp. nov. Holotype, WAM 324-73. Point Peron, Western Australia. (Figs. 1-3 one-third nat. size, fig. 4 two-third nat. size).



Plate II, figs. 5-8: *Pseudovertagus clava* (Gmelin, 1791). WAM 490-74. SW side Oeno Atoll, Tuamotu Arch., Pacific. (Figs. 5-7 one-third nat. size, fig. 8 two-third nat. size).



Plate III, figs. 9-12: *Pseudovertagus nobilis* (Reeve, 1866). WAM 322-73. Puerto Galera, Mindoro I., Philippines. (Figs. 9-11 one-third nat. size, fig. 12 two-third nat. size).

P. nobilis (Reeve, 1866) [Pl. III, figs. 9-12] of the Philippines and other parts of the Western Pacific is probably another relative but in that species the shell is quite long, attenuate and almost smooth except for strong spiral cords and axial striae on the earlier spire whorls. Spiral ribs are lacking except near the lip and on the anterior slope of the body whorl, and the anterior siphon canal is very high and straight. There is also a prominently flared, sharp-edged columellar lip just behind the anterior siphon canal in *P. nobilis* which is lacking in *P. peroni*.

The only other comparable species known to me is *P. sowerbyi* (Kiener, 1842) which also comes from the Philippines and northern Australia, but it is immediately distinguished by its conspicuous chestnut spots; it cannot be confused with the present species.

A number of medium and large fossil cerithiids occur in Tertiary and Quaternary sediments in southern Australia (Ludbrook, 1971) but none of them bear any close resemblance to *P. peroni*.

Salvat (1967) referred *clava* to *Pseudovertagus* Vignal, 1904, though noting the reflection or low columellar plait deep within the aperture, a character absent in *P. nobilis*, *P. sowerbyi* and *P. alueo* which are the other species he cites as congeners. This character is also absent in *P. peroni*. Although Salvat ranked *Pseudovertagus* as a subgenus of *Cerithium* s.s., Drs Joseph Houbricks and Harald Rehder advise me that it is better accorded full generic rank. I follow their opinion here.

The apparent rarity of *P. peroni* is anomalous for a cerithiid because species of this family are usually gregarious and abundant. I have delayed reporting on this species for several years in the hope that the habitat would be discovered and that a larger series would become available. Although the holotype was found in shallow water near the 'Turtle Factory' on the lee side of Point Peron, a popular, well-collected locality, I doubt whether the species actually lives there. Mr Baker's specimens from lobster pots suggest a deeper off-shore habitat and that Mrs Hansen's shell may have been discarded where she found it by one of the lobster fishermen who moor their boats at that spot. These fishermen lay their pots among the limestone ledges west of Point Peron, most commonly at depths of 40 to 80 metres, and it is my belief that one day divers will find this large cerithiid crawling in abundance in sand patches between the rocky ledges.

The new species, like the type locality, is named after Francois Péron, the distinguished French naturalist who visited the west coast of Australia aboard the ship *Geographe* in 1801.

ACKNOWLEDGEMENTS

Special thanks are due to Mrs Gladys Hansen who generously presented her shell to the W.A. Museum so that the species might be described, and the late Mr Harry Baker who lent his specimens for study. Dr Harald A. Rehder kindly read and modified the original manuscript and provided information on the distribution of *P. clava*. Mrs Shirley Slack-Smith helped in many ways to prepare the manuscript.

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THE GENUS *PROABLEPHARUS* (SCINCIDAE, LACERTILIA) IN WESTERN AUSTRALIA

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ABSTRACT

Two species, *P. tenuis* (Broom) (synonyms *broomensis* and *davisi*) and *P. reginae* are revised.

INTRODUCTION

Until recently all the Old World skinks with lower eyelid immovable and transparent had been brought together in a single genus *Ablepharus*. Fuhn (1969) has shown that such a genus was grossly polyphyletic. He divided the Australian ablepharic skinks into nine groups, one of which is the present genus.

At first sight the head scutellation of *P. tenuis* looks quite unlike that of *P. reginae*, but the differences are in fact quite trivial. It seems that the shield in *P. tenuis* corresponding to the first supraocular of *P. reginae* has fused with the first two supraciliaries.

All the specimens used in this revision are lodged in the Western Australian Museum, except for one (number prefixed with JSE) collected by the British Joint Services Expedition to Central Australia.

Proablepharus

Proablepharus Fuhn, 1969: 73. Type species: *Ablepharus tenuis* Broom and *A. reginae* Glauert.

Diagnosis

Very small, pentadactyl skinks with eye covered by spectacle and with interparietal free.

Description

Snout low and narrow. Body slender. Tail somewhat thick basally. Limbs short, usually failing to meet when adpressed. Ear aperture very small, without lobules.

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Nasals very widely separated. No supranasal or postnasal. Prefrontals very large but nearly always separated. Frontoparietals paired or wholly or partially fused. Loreals two, in horizontal series. Spectacle surrounded by granules which are hidden by brow in *tenuis* and in most mainland *reginae*. Upper temporal much larger than two subequal lower temporals. Upper labials normally 7; third-last subocular, very low and wide. Usually a pair of large oblique nuchals, sometimes separated in *reginae*. Supradigital scales in one series. Subdigital lamellae entire, smooth.

Dorsally and laterally olive, practically without pattern.

Distribution

Arid and northern semiarid and subhumid zones of Australia where ground cover dominated by spinifex (*Triodia* and *Plectrachne* spp.).

Proablepharus tenuis

Ablepharus tenuis Broom, 1896, Ann. Mag. Nat. Hist. (6) 18: 342. Muldiva, North Queensland (R. Broom).

Ablepharus broomensis Lönnberg & Andersson, 1913, K. svenska Vetensk. Akad. Handl. 52 (3): 11. Broome, Western Australia (E.G. Mjöberg).

Ablepharus davisii Copland, 1952, Proc. Linn. Soc. N.S. Wales 77: 121. Harding Range [16°18'S, 124°50'E], Western Australia (C. Davis).

Diagnosis

Supraoculars 3, only first in contact with frontal; supraciliaries 3 or 4, first much the largest.

Distribution

Far north of Western Australia, south to Broome and Lake Argyle. Extralimital in far north of Northern Territory and northern Queensland.

Description

Snout-vent length (mm): 24-32 (N 18, mean 28.3). Length of tail (% SVL): 126-150 (N 6, mean 140).

Prefrontals separated (usually very narrowly). Frontoparietals fused in 12 specimens, partly fused in 5 specimens (suture extending from rear for one-fifth to one-third of way to frontal), paired in one specimen. Supraciliaries normally 3; 4 in some specimens, where uppermost postocular could be construed as a supraciliary. Upper labials 7 except in one specimen with 8. Mid-body scale rows 22-26 (mostly 24, N 17, mean 24.0). Lamellae under fourth toe 17-22 (N 14, mean 18.8).

Back olive grey, olive green or olive brown, most scales with an anterior black or dark brown spot of variable size and shape. Head pale brown, finely flecked with blackish. Under surface whitish, except for dark grey under tail and brown under digits.



Map of Western Australia showing location of specimens of *Proablepharus tenuis* (including types of *broomensis* and *davisi*) and *P. reginae*.

Material

Kimberley Division: Crystal Creek, Admiralty Gulf (43045-6, 43102-7); Prince Regent River Reserve (46877); Lake Argyle (47315-24).

Proablepharus reginae

Ablepharus reginae Glauert, 1960, W. Aust. Nat. 7: 119. Queen Victoria Spring, Western Australia (W.H. Butler).

Diagnosis

Supraoculars 4, first two in contact with frontal; supraciliaries 4-7, all small.

Distribution

Arid zone of Western Australia between lats. 18° and 30°S, including Barrow Island. Extralimital in southwest of Northern Territory.

Description

Snout-vent length (mm): 21-41 (N 35, mean 32.2). Length of tail (% SVL): 129-224 (N 13, mean 165).

Prefrontals narrowly separated, except in one specimen where they just touch. Frontoparietals paired. Supraciliaries normally 5;4 in some specimens if last construed as a postocular; one specimen with 6 and 7. Upper labials 7 except in two specimens with 8. Midbody scale rows 24-28 (N 34, mean 26.4). Lamellae under fourth toe 21-26 (N 35, mean 23.3).

Back olive brown, most scales with an anterior black spot that tends in some specimens (especially from Barrow Island) to spread over much or whole of scale. Central and posterior head shields dark brown (black in most Barrow Island specimens). Snout and tail pale brown. Under surface whitish, except for dark brown under digits.

Geographic variation

Barrow Island specimens differ from mainland specimens in being smaller (mean SVL 30.3 *vs* 33.2) and darker and in having more subdigital lamellae (mean 23.6 *vs* 22.8). In most island specimens the upper periocular granules are not hidden by brow, whereas in most mainland specimens they are hidden.

Material

Kimberley Division: 45 km SE of Halls Creek (23063-6); 13 km E of Margaret River HS (46114); Louisa Downs (46062); 18 km E of Christmas Creek HS (46109).

North-west Division: 40 km E of Port Hedland (46504); Woodstock (27993); Barrow Island (28001-2, 29035-9, 47299-314).

Eastern Division: 32 km S of Neale Junction (34516); Queen Victoria Spring (13300 holotype, 18513).

Northern Territory: Kintore Range, 23°21'S, 129°23'E (JSE 247).

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