The BEAGLE, Records of the Museums and Art Galleries of the Northern Territory

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ABSTRACTED IN ZOOLOGICAL RECORD AND BIOSIS

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Cover: A snapping of shrimps described or illustrated by Sandy Bruce: upper left: Bresilia plumifera; upper right: Hymenocera picta, first zoal stage; middle left: Thor spinipes; middle right: Typton nanus; bottom: Periclimenes orontes.
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Sandy Bruce, in the Crustacea laboratory of the Northern Territory Museum, Darwin.
EDITORIAL

The Beagle owes its very existence to Dr Sandy Bruce. He joined the Northern Territory Museum of Arts and Sciences, Darwin, as Curator of Crustacea in 1981, became Deputy Director (Research) in 1987, and retired on the 25th February 1994, to continue work as a Curator Emeritus and Research Associate. It was Sandy who organised publication of the very first Beagle in February 1983. It was then named The Beagle, Occasional Papers of the Northern Territory Museum of Arts and Sciences and subsequently appeared as a series of separates until September 1985. Of course, the first Beagle paper was about a new species of shrimp.

Sandy believed that the Museum could not fulfill its function as a research institution without publishing its own academic journal, and actively encouraged not only staff, but everyone who borrowed specimens (especially crustacea) from the collections, to publish the results of their research in the Museum’s journal (and continues to do so). Although Sandy apparently loves pontoniine shrimps above most other life forms, his extensive knowledge and network of colleagues (accumulated through his employment in places such as Zanzibar, Hong Kong, Heron Island, Kenya as well as Darwin) brought prestige and a wealth of contacts to a small new museum in a rather isolated part of northern Australia.

He rarely got wet, however, on collecting expeditions, having seemingly ensured that the museum employed curators with SCUBA-diving ability who would bring him rare and wonderful crustacea, especially small commensal shrimps.

Now that Sandy has retired, it is expected that he will finally have enough time to produce his pontoniine treatise and many other publications. He has left behind a well-established museum journal which will continue to improve in stature. It is our pleasure to dedicate this volume to Sandy Bruce and we wish him all the very best for the future.

Helen K. Larson
Editor, Scientific Publications

LIST OF PUBLICATIONS BY A.J. BRUCE, SINCE 1981

1981

1 Notes on some Indo-Pacific Pontoniinae, XXXVII. Additional information on Dasella herdmaniae (Lebour) (Decapoda, Natantia). Crustaceana 40(1): 50-56.
4 Some pontoniine shrimps from the Solomon Islands. Micronesica 16(2): 261-269.
9 Pontoniine shrimps from Viti Levu, Fijian Islands. Micronesica 17(1-2): 77-95.

1982

10 Notes on some Indo-Pacific Pontoniinae, XXXIX. Isopontonia platychelos gen. nov., sp. nov., from the Chesterfield Islands, New Caledonia (Decapoda, Caridea). Crustaceana. 42(1): 54-64.
12 Notes on some Indo-Pacific Pontoniinae, XL. The rediscovery of Periclimenes Iljuensis Borradale, 1898 (Decapoda, Pontoniinae) and the establishment of its systematic position. Crustaceana 42(2): 158-173.


1983


29 Observations upon some pontoniine shrimps from Aqaba, Jordan. *Zoologische Verhandelingen (Leiden)* **205**: 1-44. (A. Svoboda, junior author).


1984


1985

39 Caridean shrimps from Lord Howe Island. The Beagle, Occasional Papers of the Northern Territory Museum of Arts and Sciences 1(14): 123-130.

1986

46 Manningia raymondi sp. nov., a new eurysquillid stomatopod from the Northern Territory, Australia. The Beagle, Occasional Papers of the Northern Territory Museum of Arts and Sciences 2(1): 17-21.
52 Shrimps that live on tropical echinodermcs. Underwater 17: 92-94.

1987

56 Three new species of commensal shrimps from Port Essington, Arnhem Land, Northern Australia (Crustacea: Decapoda: Palaemonidae). The Beagle, Occasional Papers of the Northern Territory Museum of Arts and Sciences 3(1): 143-166.
57 Metaphryxus intutus Bruce (Crustacea: Isopoda), a bopyrid parasite new to the Australian fauna. The Beagle, Occasional Papers of the Northern Territory Museum of Arts and Sciences 3(1): 213.
60 Typton namus sp. nov., a new commensal shrimp (Crustacea: Decapoda: Palaemonidae) from the Australian North-West Shelf. The Beagle, Records of the Northern Territory Museum of Arts and Sciences 4: 49-56.
61 Records of three palaemonid shrimps new to the Australian fauna. The Beagle, Records of the Northern Territory Museum of Arts and Sciences 4: 57-60.

1988

73 Two new palaemonid shrimps (Crustacea:Decapoda) from the Australian Northwest Shelf. *Journal of Natural History* 22: 1263-1276.

1989

77 A new palaemonid shrimp from the *Zostera*-beds of Moreton Bay, Queensland, Australia (Decapoda:Palaemonidae). *The Beagle, Records of the Northern Territory Museum of Arts and Sciences* 5: 105-114.
83 Notes on some Indo-Pacific Pontoniinae, XLV. *Conchodytes maculatus* sp. nov., a new bivalve associate from the Australian Northwest Shelf. *Crustacea* 56(2): 182-192.

1990

84 A further occurrence of the palaemonid shrimp *Chacella kerstitchi* (Wicksten) in Mexican waters (Crustacea, Caridea). *Crustacea* 56(2): 219-221.


98 Two deep-sea shrimps new to the Australian fauna, *Psathyrocaris hawaiiensis* Rathbun (Pasiphaeidae) and *Bresilia antpodaram*, sp. nov. (Bresiliidae), with remarks on *Encantada spinoculata* Wieksten (Bresiliidae). *Invertebrate Taxonomy* 4: 847-866.


101 *Leontocaris amplectipes* sp. nov. (Hippolytidae), a new deep-water shrimp from southern Australia. *Memoirs of the Museum of Victoria* 51: 121-130.

1991


1992


1993


114 On the occurrence of the semi-terrestrial shrimps *Merguiola oligodon* (De Man, 1888) and *M. rhizophorae* (Rathbun, 1900) (Decapoda: Hippiolytidae) in Africa. *Tropical Zoology* 16: 179-185.


1994


A RE-EXAMINATION OF *Palaemonetes sinensis* (Sollaud, 1911) (CRUSTACEA; DECAPODA; Palaemonidae).

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**ABSTRACT**

The aberrant species of *Palaemonetes, P. sinensis* (Sollaud, 1911) is re-examined. Its unusual mouthparts are described and illustrated in further detail. Its position in the genus *Palaemonetes* Heller, 1869, is confirmed. The distribution of some species of *Palaemonetes* is discussed.

**KEYWORDS:** *Palaemonetes sinensis* (Sollaud, 1911), Crustacea, Decapoda, Palaemonidae, systematic position confirmed.

**INTRODUCTION**

The genus *Palaemonetes*, characteristic of coastal brackish and estuarine waters and fresh waters, is of widespread distribution, but with only *P. africanus* Balss, 1916, in sub-Saharan Africa and *P. sinensis* (Sollaud, 1911) in Asia. Gurney (1938) remarked that the study of caridean mouthparts was much neglected, an observation that is still valid. On account of its unusual mouthparts, the species *P. sinensis* was initially considered sufficiently different to be placed in a new genus, *Allocaris* Sollaud, 1911. In view of its isolated geographical distribution, its systematic position was considered worth re-investigation, and specimens for this purpose were kindly provided by Prof. J.C. Liu, from the collections of the Institute of Oceanology, Qingdao, the People’s Republic of China. CL refers to the postorbital carapace length and NTM to the Northern Territory Museum, Darwin.

**SYSTEMATICS**

*Palaemonidae* Rafinesque, 1815  
*Palaemoninae* Rafinesque, 1815  

*Palaemonetes sinensis* (Sollaud, 1911)  
(Figs 1-3)

**Restricted synonymy**

*Allocaris sinensis*, Sollaud, 1911: 50-52, figs 1-2. *Palaemonetes varians* var. loci sinensis Pesta, 1913: 26, fig.11.


*Palaemonetes (Allocaris) sinensis* Sollaud, 1923: 589.

**Material examined.** 6 spms (four males, two females, largest male, CL 6.6 mm), Qingdao, north China, coll. 30 August 1957, NTM Cr.010142.

**Description.** The specimens agree well with the previously published descriptions. Some mouthparts were briefly described by Sollaud, who illustrated only the first maxilliped. Further detail was provided by Holthuis, who provided figures of the mandible and first and second maxillae.

**Mandible** (left) without palp; molar process stout, with several blunt teeth, occlusal surface obliquely divided into dorsal and ventral parts by deep groove; incisor process robust, with four acute teeth distally, ventral edge thickened, dorsal, edge sharply carinate.

**Maxillula** with palp deeply bilobed, upper lobe slender, non-setose, lower lobe stouter, with small ventral tubercle with minute simple terminal spine; upper lacinia curved, feebly tapering, obliquely truncate distally with about 13 short, acute simple spines, dorsal margin with numerous short setulose setae distally, four simple spines proximally; lower lacinia swollen, with numerous setulose setae distally, extending along dorsal margin.
A.J. Bruce


Maxilla with short curved tapering palp, with several short, plumose setae proximolaterally; basal endite well developed, with two lobes, upper lobe slightly longer, more slender than lower, with short simple setae distally, four longer simple setae proximodorsally, lower lacinia with setulose setae distally and ventrally; coxal endite obsolete, medial margin feebly con-
Palaemonetes sinensis, a re-examination

vex; scaphocerite about 2.7 times longer than wide, posterior lobe 1.5 times longer than width, anterior lobe 1.4 times longer than wide, distally narrow, medial margin with deep subrectangular emargination.

First maxilliped with short, slender tapering palp with short preterminal plumose seta; basal endite expanded, forming large rounded sub-oval medial lobe with numerous long, slender, simple marginal setae, separated by deep angular notch from coxal endite; coxal endite feebly bilobed, distal lobe dorsally concave, medial margin convex, fringed with long, coarsely setulose setae, proximal lobe thickened, non-setose; exopod well developed with slender flagellum with numerous long, plumose setae.
**Fig. 3.** *Paiaemonetes sinensis* (Sollaud), male, CL 5.4 mm, Qingdao, China. A, right anterior branchiae. B, thoracic sternites, ventral oblique. C, right posterior branchiae, dorsal aspect, second maxilliped podobranch, third maxilliped arthrobranchs and first pereiopod pleurobranch (left to right).

distally, caridean lobe large, broadly expanded laterally; epipod small, sub-oval.

Second maxilliped with normal endopod, dactylar segment with medial margin straight, with numerous short strong denticulate spines; propodal segment with distomedial angle rounded, with numerous long simple spines or spiniform setae; exopod with slender flagellum with numerous plumose setae distally, central third with narrow laminar expansion laterally; coxa with low ventromedial lobe with six slender simple setae distally; with small simple epipod laterally, bearing well developed podobranch.

Third maxilliped with endopod extending to distal end of carpocerite, ischiomerus completely fused to basis, combined segment bowed ventrally, about seven times longer than central width, subuniform, medial margin sparsely fringed with simple setae, with group of stouter spiniform setae distomedially, lateral borders sparsely setose, without spines, penultimate segment 6.0 times longer than width, 0.6 of antepenultimate segment length, medial margin with sparse spiniform setae, with several stouter serrulate spines distomedially, terminal segment 0.7 of penultimate segment length, 6.0 times longer than proximal width, tapering distally, with 10 transverse rows of serrulate spines medially, with stout distal spine; exopod well developed, with slender flagellum with numerous plumose setae distally; coxa without ventromedial lobe, with small oval epipod laterally; with large outer arthrobranch and small inner arthrobranch with three pairs of lamellae.

Paragnaths with well developed irregular alae; corpus broad, with shallow anterior medial depression margined by feeble carinae laterally.

Third thoracic sternite with low unarmed transverse ridge; fourth with slender acute median process anteriorly, with transverse ridge with small acute submedian teeth posteriorly; fifth with posterior transverse ridge with acute teeth laterally; sixth-seventh sternites unarmed; eighth with stout acute anteroverted median tooth in male only.

Male first pleopod with endopod about 0.5 of exopod length, 3.4 times longer than proximal width, slightly expanded distally, curved medially, without accessory lobule, distal margins with short plumose setae, about 27, medial mar-
gin proximally with eight long setulose spines, with two short simple spines at 0.5 of medial margin length.

Male second pleopod with endopod bearing appendices at about 0.33 of medial border length; appendix masculina about 0.36 of endopod length. 6.5 times longer than distal width, slightly swollen distally with one simple lateral terminal spine about 0.33 of corpus length, with two similar shorter spines medially, two distomedially; appendix interna reaching to about 0.6 of appendix masculina length, with few distal cincliniuli only.

Other minor morphological features are; the ventral margin of the rostrum bears a double row of plumose setae; the ventromedial border of the proximal segment of the antennular peduncle bears a strong acute tooth, the fingers of the first pereiopods have sharp entire lateral cutting edges and lack acute hooked tips; the dactyl of the third ambulatory pereiopod is about 0.33 of the propod length, six times longer than the proximal depth, compressed, feebly curved ventrally, ventral margin sharply carinate, with five small groups of spiniform setae dorsally; propod with single distoventral spine only; first and second abdominal sternites with acute median processes, fifth with low longitudinal median carina and the anterior dorsal surface of the telson lacks a median transverse row of short setae.

**Systematic Position.** The species described by Sollaud is correctly placed in the genus *Palaemonetes*, as first proposed by Pesta (1913), who considered Sollaud’s species to be only a variety of *P. varians*. This latter assessment was emphatically refuted by Kemp (1918), who considered *P. sinensis* a valid species of *Palaemonetes* closely related to *P. varians* (Leach) although he considered the first maxilliped to be rather aberrant for this genus. In *P. varians* (Fig. 4b, from the Netherlands) this appendage is typical of the majority of palaemonid shrimps, and is not dissimilar to that of *P. sinensis*, particularly if examined in an unflattened attitude. The basal endite is broad and suboval, clearly separated from the coxal endite by a deep angular notch, medially fringed with numerous slender simple setae; the coxal endite is feebly bilobed, the distal lobe laminar, medially fringed with long, coarsely setulose setae, the proximal lobe is thickened and devoid of setae medially. The basal and distal coxal endites are deeply concave dorsally. The epipod is distinctly bilobed, with the proximal lobe larger than the distal. In *P. sinensis* the expanded basal endite serves to occlude the space proximal to the lobes of the basal endite of the maxilla, which is effectively sealed also by the long coarsely setulose setae of the coxal endite, which abut against those of the opposite side. The mechanism appears approximately similar in *P. varians*. The maxillae are essentially similar in the two species, but in *P. varians* the emargination on the anteromedial margin of the scaphocerite is much less marked and the proximal dorsal border of the distal basal endite lacks a row of short simple setae. The maxillulae are also similar but in *P. varians* the palp bears three short simple setae with swollen bases on the outer side of the lower lobe. The distal margin of the upper lacinia bears about 15 finely serrulate spines distally. The paragnaths in *P. varians* are noticeably different from *P. sinensis*: the alae are broader, very feebly bilobed and rather pointed laterally: the corpus is shorter and broader, with a small transversely oval anteromedian fossa, surrounded by a raised rim. The anterodorsal surface of the telson lacks a transverse row of setae in *Palaemonetes varians*, in contrast to *P. sinensis*, and some other palaemonid shrimps, such as *Palaemon affinis* Milne-Edwards (Yaldwyn 1954: figs 2-16), *Palaemonetes australis*, *P. atrinubes*, *Palaemon serenus* and *Macrobrachium intermedium* (Bray 1976). The thoracic sternites in *P. varians* are basically similar to those of *P. sinensis*, but the anterior median process on the fourth thoracic sternite is much smaller, and the eighth thoracic segment lacks a median ventral tooth in both sexes.

**DISCUSSION**

The genus *Palaemonetes* Heller is at present represented by 31 species. These are found predominantly in American fresh waters. The following species occur outside the American region:

- *P. africanus* Balss, 1916, Nigeria.
- *P. antennarius* (H. Milne-Edwards, 1837), Italy, the Balkans and Syria.
- *P. atrinubes* Bray, 1976, west and north Australia, New Caledonia.
- *P. australis* Dakin, 1915, west and north Australia.
- *P. mesogenitor* Sollaud, 1912, Tunisia, Algeria.
- *P. mesopotamica* Pesta, 1913, Syria, Turkey.
- *P. sinensis* (Sollaud, 1911), eastern China, southeastern Siberia.
P. varians (Leach, 1814), western Baltic and North Sea coasts to western Morocco, Algeria, Tunisia.
P. zariqueyi (Sollaud, 1939), Mediterranean Spain.

The Old World distribution of the genus *Palaemonetes* is difficult to explain, partly due to the sparse and widely scattered nature of the available record. Of the nine species, five are of north west European, Mediterranean and north west African distribution. These all occupy primarily coastal habitats, with the exception of *P. mesopotamica*, which presumably has a freshwater preference, in the River Khabur and the River Kemer. The distribution of the remaining species, *P. africanus* in West Africa, *P. australis* and *P. atrinubes* in western and northern Australia and New Caledonia, and *P. sinensis* in south eastern China and Siberia, suggests that they are relict populations. *Palaemonetes atrinubes* has not been previously reported from New Caledonia. Specimens of this species from New Caledonia, with a Milne-Edwardsian label, without a more precise locality, were examined in the collections of the Muséum National d'Histoire Naturelle, Paris, through the kindness of Prof. J. Forest.

The mouthparts of *P. sinensis* are quite different to those of *Convieriella tonkinensis* Sollaud (1914), found in Vietnam and southern China, at one time also placed in the genus *Palaemonetes*, and are completely without the basket-like arrangement of long setae on the maxilla and first maxilliped as found in that species (Bruce 1989).

It may also be noted that the posterior margin of the third abdominal tergite in both *P. sinensis* and *P. varians* is entire and without minute denticulations. These have been reported re-

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Fig. 4. *Palaemonetes varians* (Leach), male, CL 6.3 mm, Vesterputten, Netherlands. A, maxillula. B, same, palp. C, maxilla. D, first maxilliped (unflattened). E, paragnaths.
cently in several palaemonid genera (Duris and Bruce, in press) and are at present of unknown distribution in the Palaemonidae. Bray (1976) drew attention to a small transverse row of short setae on the anterior dorsal surface of the telson in both *Palaemon serenus* and *Macrobrachium intermedium*, but which were lacking in both *P. australis* and *P. atrinubes*. These are also lacking in *P. sinensis*. The appendix masculina in *P. sinensis* is essentially similar to those of the North American species reported upon by Fleming (1969), in which it is short with relatively few simple spines distally.

ACKNOWLEDGEMENTS

I am most grateful to Dr C.H.J.M. Fransen, Nationaal Natuurhistorisch Museum, Leiden, for the donation of specimens of *Palaemonetes varians* for comparative purposes.

REFERENCES


Accepted 15 June 1993
CENTROPAGES ACUTUS, A NEW CALANOID COPEPOD FROM THE FLY RIVER ESTUARY, PAPUA NEW GUINEA.

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ABSTRACT

A new species of calanoid copepod, Centropages acutus, from the Fly River delta, Papua New Guinea, is described. The new species is unique in having the head produced antero-dorsally into a strong point, in having a large process bearing two spines on the third urosome segment of the female, and in having a large process on the first segment of the antennule in both sexes.

KEYWORDS: Crustacea, Copepoda, Centropagidae, Centropages acutus, new species, Papua New Guinea.

INTRODUCTION

McKinnon and Kimmerer (1988) summarised the current status of the genus Centropages Krøyer, and listed ten species occurring in waters adjacent to Australia. During sampling of the zooplankton of the Fly River delta, Papua New Guinea (Robertson et al. 1993), we found a new species of the genus which we describe below.

We took plankton samples using a plankton pump with 105μm mesh, with the inlet 2.0m below the surface; station numbers are those of Robertson et al. (1993). Samples were preserved in dilute formalin and animals subsequently placed in lactic acid and drawn using an Olympus BH-2 microscope fitted with Nomarski optics, and camera lucida. We dissected the animals in lactic acid and mounted them in polyvinyl lactophenol on microslides. Armament formulae are presented from basis to most distal segment, and for swimming legs as outer margin first; roman numerals indicate spines, arabic numerals setae. Type material is deposited in the Northern Territory Museum, Darwin (NTM).

SYSTEMATICS

Family Centropagidae Krøyer, 1849
Centropages acutus sp. nov.
(Figs 1-3)

Type material. HOLOTYPE - NTM Cr.008801, female, 1.47 mm (on slide), Fly River delta Station 7, (8° 28.8'S, 143° 42.6'E), 2 August 1989; ALLOTYPE - NTM Cr.008802, male, 1.40 mm (on slide), from type locality; PARATYPES - 14 males, NTM Cr.008803; 14 females, NTM Cr.008804.

Diagnosis. Centropages acutus sp. nov. is unique among species of Centropages in having the head produced antero-dorsally into a strong point, and in having a large process bearing two spines on the third urosome segment of the female. The antennule is unusual in having a postero-ventrally directed process from the first segment in both sexes. Female antennules consist of 22 segments, two segments having been lost between segments 11 and 17, in contrast to the usual 24-segmented condition found in the genus. The male left antennule is also 22-segmented, but the right antennule is 21-segmented, due to fusion of segments 19 and 20. In other respects C. acutus sp. nov. resembles Centropages typicus Krøyer, 1849 (see Lawson and Grice, 1970).

Description of female. Total length 1.47 mm (range 1.42-1.56). Body (Fig. 1a,b) comprises cephalosome and five thoracic segments. Head sharply pointed in dorsal view, in lateral view apex dorsal, tapering away ventrally into strong rostrum. Fifth thoracic segment drawn posteriorly into sharp recurved points. Urosome (Fig. 1c,d) 3-segmented. Genital complex with two postero-lateral spines, extending posteriorly as far as anterior margin of urosome segment 3. Urosome segment 2 with two small lappet-like processes on ventral surface, one on either side
Fig. 1. *Centropages acutus* sp. nov., female holotype: a, habitus, dorsal; b, lateral; c, urosome, ventral; d, urosome, lateral; e, right antennule.
New Centropages from Papua New Guinea

Fig. 1. Centropages acutus sp. nov., female holotype: a, leg 1, anterior; b, leg 2, anterior; c, leg 3, anterior; d, leg 4, anterior; e, leg 5, anterior.

Fig. 2. Centropages acutus sp. nov., female holotype: a, leg 1, anterior; b, leg 2, anterior; c, leg 3, anterior; d, leg 4, anterior; e, leg 5, anterior.
Fig. 3. *Centropages acutus* sp. nov., b-f, female holotype: a, maxilliped; male allotype: b, habitus, dorsal; c, right antennule; d, right antennule, segments 17-20; e, left leg 5, anterior; f, right leg 5, anterior.
of mid-line. Urosome segment 3 with large asymmetrical process on ventro-posterior surface, biased toward right-hand side, bearing two strong spines, one directed posteriorly, the other postero-laterally, toward right hand side. Caudal ramus asymmetrical, with right-hand ramus slightly wider than the left, and with lateral seta inserted at about mid-length; lateral seta of left-hand ramus inserted at about 0.8 length from base.

Antennules (Fig. 1e) symmetrical, 22-segmented, with large pointed posteriorly directed process on postero-lateral margin of segment 1. Segment 10 has robust thorn on the outer distal margin. Antennae and mouthparts similar in form to those of other species of Centropages. Antenna comprises coxa with 1 seta, basis with 2 setae, 2-segmented endopod with 2,4 setae and 7-segmented exopod with 1,3,1,1,1,4 setae. Mandible palp coxa with 4 setae, endopod 2-segmented with 4,9 setae, exopod 4-segmented with 1,1,1,3 setae. Maxillula praecoxal arthrite with 15 spiniform setae, coxal endite with 3, coxal epipodite with 9. Basal endite with 4 setae, exite with 1, fused basis and endopod segments with 9. Single distinct endopod segment with 5 setae, exopod with 9. Maxilla 2-segmented, syncoxa with 4 endites bearing 5,3,3,3 setae respectively. Fused basis and endopod segments forming two lobes bearing 3,8 setae. Maxilliped (Fig. 3a) 7-segmented, basis elongate, length of outer side 5.6 times maximum width. Maxilliped syncoxa with 10 setae, fused basis and first endopod segment with 5, second - sixth endopod segments with 2,3,2,3,4 respectively.

Rami of all legs 3-segmented (Fig. 2a-c). Swimming legs with armament formulae as follows:

<table>
<thead>
<tr>
<th>Leg</th>
<th>Coxa</th>
<th>Basis</th>
<th>Exopod</th>
<th>Endopod</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg 1</td>
<td>O-I</td>
<td>0-1</td>
<td>1-1,1-1,1-1,1-4</td>
<td>0-1, 0-2, 1-2-3</td>
</tr>
<tr>
<td>Leg 2</td>
<td>O-I</td>
<td>0-0</td>
<td>1-1,1-1,1-1,1-5</td>
<td>0-1, 0-2, 2-2-4</td>
</tr>
<tr>
<td>Leg 3</td>
<td>O-I</td>
<td>0-0</td>
<td>1-1,1-1,1-1,1-5</td>
<td>0-1, 0-2, 2-2-4</td>
</tr>
<tr>
<td>Leg 4</td>
<td>O-I</td>
<td>0-0</td>
<td>1-1,1-1,1-1,1-5</td>
<td>0-1, 0-1, 2-2-3</td>
</tr>
<tr>
<td>Leg 5</td>
<td>O-0</td>
<td>0-0</td>
<td>1-0,1-0,1-1-4</td>
<td>0-1, 0-1, 2-2-2</td>
</tr>
</tbody>
</table>

Female leg 5 (Fig. 2e) exopod segment 1 with pronounced excavation on inner proximal margin, segment 2 with typical centropagid ensiform process produced from inner margin. Process denticulate along distal half.

Description of male. Total length 1.40 mm (range 1.34-1.40). Body (Fig. 3b) similar to female, but with urosome 4-segmented. Left antennule 22-segmented. Right antennule 21-segmented resulting from the fusion of segments 19 and 20, geniculate between segments 18 and 19 (Fig. 3c,d). Segments 17,18 with row of spinules along anterior margin (Fig. 3d), segment 19 with complex row of spinules on proximal two-thirds, terminating in spine lying along margin of segment.

Legs 1-4 similar to those of female. Legs 5 much modified, but with similar endopods to those of female. Right exopod 3-segmented (Fig. 3e), first segment carrying strong spine on outer distal margin, second segment with long thick curved process on inner proximal margin. Terminal segment modified into single curved process, with spine a short distance along inner face of process, and strong short spine on outer margin at about one third length. Left exopod (Fig. 3f) 2-segmented, first segment carrying single outer spine, second two outer spines and terminal spine with adjacent inner terminal thorn.

Etymology. From acutus, Latin, acute, sharp-pointed, referring to the distinctive shape of the head in dorsal view.

Remarks. Centropages acutus was collected at stations D1, D6, D7 and D9 (see Robertson et al. 1993, for details of station locations), in the northern section of the delta. The water was typically highly turbid (Secchi depth 0.2 m) and low in salinity (15.2 ppt). With only one exception, C. acutus was captured on the high tide, and reached a peak in density of 376 m⁻³ at D7 on 2 August, 1989.

ACKNOWLEDGEMENTS

We wish to thank the crew of the R.V. The Harry Messel for assistance during the cruises, and Ok Tedi Mining Ltd. for their support in sampling in the Fly River delta.

REFERENCES


Accepted 10 February 1993
**ALPHEUS FENNERI** sp. nov. AND **A. WILLIAMSI** sp. nov.,
TWO NEW INDO-WEST PACIFIC ALPHEID SHRIMPS OF
THE *BREVIROSTRIS* SPECIES GROUP.

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**ABSTRACT**

Two new shrimps of the "brevirostris" group of the genus *Alpheus* are described and illustrated. *Alpheus fenneri* sp. nov. was collected from 6 m depth, off Sulawesi, Indonesia, and *A. williamsi* sp. nov. from 18-24 m depth, in the Beagle Gulf, Timor Sea, the former species living in association with the goby *Amblyeleotris fontanesii*. *Alpheus fenneri* sp. nov. is most closely related to another goby-associated species, *A. bellulus* Miya and Miyake, and *A. williamsi* sp. nov. is most closely related to the apparently free-living species *A. pubescens* De Man. A key for the provisional identification of the Indo-West Pacific species of the "brevirostris" group is provided.

**KEYWORDS:** *Alpheus fenneri*, sp. nov., Sulawesi, Indonesia, *A. williamsi* sp. nov., Timor sea, spp. nov., Crustacea, Decapoda, Alpheidae, "brevirostris" group, key to Indo-West Pacific species, goby association.

**INTRODUCTION**

The species of the "brevirostris" species group of the shrimp genus *Alpheus* Fabricius, 1798, are of special interest as several species are commonly involved in associations with gobies. *Alpheus* species often feature in underwater photographs in the popular natural history press. Unfortunately, these photographs are usually only accompanied by the identification of "*Alpheus* sp." A wide variety of gobid genera may be involved in these associations, including *Amblyeleotris*, *Cryptocentroides*, *Cryptocentrus*, *Stonogobiops* and *Vanderhorstia*. The fishes are usually associated with a heterosexual pair of shrimps, which are frequently the possessors of well developed distinctive colour patterns. Although frequently observed and photographed, the shrimps are generally difficult to capture. Those species that have been described have often not had their colour patterns recorded, particularly those described earlier, so that their identification from photographs is generally difficult or impossible. At the present time, the number of *Alpheus* colour patterns that have been illustrated in association with gobies greatly exceeds the number of species that have been positively identified as goby associates. Much further work will be necessary to clarify the details of these associations and the degree of specificity of the shrimp colour patterns. The diversity of these colour patterns and their constancy suggests that they may be species specific and diagnostic. The associations between gobies and *Alpheus* species have been reviewed by Karplus (1987). Most of the reports of associations with gobies have come from relatively shallow water depths, through the use of scuba diving apparatus and it is at the moment unknown if these associations also occur in the deep-water species. The problems of alpheid shrimp colour patterns are discussed in Banner and Banner (1981).

Fortunately, in the case of the present specimens, collected by Dr J.E. Randall, of the Bishop Museum, Honolulu, and R. Williams, of the Northern Territory Museum, the freshly caught shrimps were photographed. In the case of Dr Randall’s specimens, which were collected by hand, the identity of the associated fishes was
also established, and the distinctive colour pattern immediately suggested an unusual species. Mr Williams' specimen was trawl caught and any association thereby obscured. Further examination indicated that these specimens could not be referred to any of the species so far described and they are now here described as new.

SYSTEMATICS

ALPHEIDAE Rafinesque, 1815

Alpheus Fabricius, 1789

Diagnosis of “brevirostris” group (modified from Banner and Banner, 1982; Chace, 1988).

Orbital hoods often prominent, generally unarmed, major chela with palm always compressed, subquadrangular in section, often with surfaces delimited by distinct angles; with or without transverse groove (“saddle”) proximal to dactylar hinge; minor chela sometimes balaeniceps or sub-balaeniceps in adult males; third pereiopod with dactyl always simple or subspatulate, merus usually distoventrally unarmed.

Alpheus fenneri sp. nov.

(Figs 1-2, 5 )

Type Material. HOLOTYPE - 1 ovig. female, 1 male ALLOTYPE, Manado, Sulawesi, Indonesia, off Nusantara Diving Centre, 6 m, mud, 30 October 1991, NTM Cr. 008777. PARATYPE - 1 juv. male, same data as previous, USNM 264747.

The single male specimen is designated allotype and the female as holotype; both deposited in the Northern Territory Museum, Darwin (NTM). The paratype juvenile specimen is placed in the National Museum of Natural History, Washington (USNM).

Diagnosis. (“brevirostris” group). Body not unusually compressed or setose; rostrum slender, reaching anteriorly to about 0.6 of length of proximal segment of antennular peduncle, bluntly carinate in the midline posteriorly to slightly beyond bases of orbital hoods, base not abruptly delimited from adrostral grooves; carapace without median tooth or tubercle on gastric region or paired acute teeth overhanging posterior ends of adrostral grooves, anterior margin transverse medial to orbital hoods, curving gradually into rostral margin, unarmed, region not markedly depressed, orbital hoods unarmed, non-carinate, adrostral grooves comparatively shallow; telson with two pairs of small dorsal spines, posterior margin with two pairs of small spines laterally, with about 27 small spinules along posterior margin; second segment of antennular peduncle about 2.25 times longer than wide; basicerite with small lateral tooth, not reaching to level of tip of stylocerite; scaphocerite with lateral margin feebly concave near midlength, sublinear distally, distolateral tooth small, subequal to distal margin of lamella; third maxilliped with distal segment about 2.80 times length of penultimate segment, both with dense masses of very long fine simple setae; first pereiopod with palm of major chela oval in section, about 3.50 times longer than wide, dactyl straight in longitudinal plane, not double ended, molar process much reduced, defined only by proximal angle, palm without teeth on either side of dactylar articulation, sculpture limited to obsolete transverse groove proximal to adhesive plaque; merus with small acute distal tooth on ventral medial margin; minor chela about 3.8 times longer than wide, dactyl not broadened, simple in female, sub-balaeniceps in adult male, about 2.2 times as long as palm; merus with small acute distoventral tooth medi ally; second pereiopod with proximal article of carpus subequal to length of second segment; third pereiopod with dactyl subspatulate, propod with sparse series of small spines along proximal ventral margin, with pair of small distoventral spines, merus unarmed, ischium with small articulated spine; endopod of uropod with about 30 small spinules along posterior margin dorsolaterally, posterior margin of exopod without spinules.

Measurements(mm). Allotype male: total body length (approx.) 55.5; carapace and rostrum 19.5, major chela 19.0, minor chela 19.0, third pereiopod propod 7.5. Holotype female: total body length (approx.) 60.0, carapace and rostrum 23.0, major chela 20.5, minor chela 19.5, third pereiopod propod 8.5, length of ovum 0.5. Juvenile male, carapace and rostrum 13.0.

Colouation. General body colouration uniform orange brown; antennal peduncles, first pereiopods and caudal fan similar; antennal flagella purplish; tips of fingers of first pereiopods white; second to fifth pereiopods pinkish, dactyls of ambulatory pereiopods white; posterior margins of uropods pale purplish.
Fig. 1. *Alpheus feneri* sp. nov., holotype female, Sulawesi. A, anterior carapace and antennal peduncles, lateral; B, same, dorsal; C, scaphocerite; D, first pereiopod, major chela, ventral; E, same, merus; F, minor chela, ventral; G, same, merus; H, second pereiopod; I, third pereiopod; J, same, propod and dactyl; K, same, dactyl, dorsal; L, caudal fan; M, telson, posterior margin; N, uropod, posterior margin of endopod.
Fish Associate. *Amblyeleotris fontanesii* (Bleeker) [Gobiidae].

**Etymology.** The species is named in honour of Dr Fenner A. Chace, jr, in recognition of his extensive contributions to the knowledge of alpheid shrimps over many years, and particularly, for his recent study of the alpheid shrimps of the *Albatross* Philippine Expedition.

**Systematic Position.** *Alpheusfenneri* is most closely related to *Alpheus bellulus* Miya and Miyake, 1969, with which it shares the following major features:

Rostral carina extending posterior to level of orbital hoods, higher than orbital hoods, not reaching to mid-length of carapace; orbital hoods without acute teeth; palm of major chela with transverse groove proximal to dactylar hinge; dorsal face of palm granular; minor chela of male sub-balaeniceps, fingers up to 1.3 times palm length; minor chela of female normal; third pereiopod with dactyl subspatulate.

*Alpheusfenneri* differs from *A. bellulus* in the following features:

Rostral tip more acute in *A. fenneri*, not reaching nearly to the anterior margin of the proximal segment of the antennular peduncle, with the carina distinctly less elevated, with the anteromedial margin of the orbital hoods forming a deep concavity with the tip of the rostrum in dorsal view; scaphocerite with lateral border
New shrimps of the *Alpheus brevirostris* group

almost straight, with distolateral tooth not largely exceeding the anterior margin of the lamella; the third maxilliped has the penultimate segment bearing a very dense ventromedial tuft of very long fine setae that exceed the tip of the terminal segment; major chela with palm about 2.0 times longer than deep in female and male (about 1.6 and 1.4 in *A. bellulus*), dactyl about 2.8 times longer than deep in female and male (2.0 and 2.2 in *A. bellulus*), about 0.6 of the palm length in both sexes (about 0.50 and 0.55 in *A. bellulus*), with the distodorsal transverse groove very feebly developed in both sexes (quite distinct in *A. bellulus*); minor chela with palm about 1.75 times longer than deep in female, 1.9 times in male (1.3 times in female, 1.1 in male in *A. bellulus*), fingers about 1.3 times palm length in female, subequal in male (1.1 times in both sexes in *A. bellulus*).

**Remarks.** The closely related species, *Alpheus bellulus* is also a known goby associate, being found with a partner closely related to that of *A. fenneri, Amblyeleotris japonicus* Takagaki (Miya and Miyaki, 1969). It may also be noted that in the juvenile male specimen the minor chela has simple, non-balaeniceps dactyl, as in the female.

*Alpheus williamsi* sp. nov. (Figs 3, 5)

**Type Material.** HOLOTYPE - female, NTM Cr.009495, F.V. *Clipper Bird*, stn RW 92-4, north of Charles Point, Northern Territory, Australia, 12°17.18'S, 130°40.06'N, 18-24m, trawl, soft corals and sponges, 2 September 1992, NTM Cr.009495.

**Diagnosis.** ("brevirostris" group). Body not unusually compressed, densely pubescent; rostrum slender, reaching anteriorly to distal margin of proximal segment of antennular peduncle, compressed, postrostral carina distinct to about middle of carapace length, base of rostrum not abruptly delimited from adrostral grooves; carapace without median tooth or tubercle on gastric region, with small median pit, without paired acute teeth overhanging posterior ends of adrostral grooves, anterior margin transverse medial to orbital hoods, curving gradually into rostral margin, unarmed, region not noticeably depressed, orbital hoods glabrous, projecting anteriorly, unarmed, non-carinate, adrostral grooves comparatively deep, glabrous; telson with two pairs of small dorsal spines, posterior margin with two pairs of small lateral spines, about 26 dorsal marginal spinules; second segment of antennular peduncle about 3.2 times longer than wide; basipecerite with acute lateral tooth, not reaching to level of tip of stylocerite; scaphocerite with lateral margin strongly concave, distolateral tooth robust, distinctly exceeding margin of lamella; first pereiopod with palm of major chela oval in section, about 3.5 times longer than wide, dactyl straight in longitudinal plane, not double ended, molar process much reduced, defined only by proximal angle, palm without teeth on either side of dactylar articulation, sculpture limited to distinct transverse groove proximal to adhesive plaque, longitudinal ventral carina setose, dorsal surface rough, setose; merus with small acute distal tooth on ventral medial margin, with several small acute spines; minor chela about 5.0 times longer than wide, dactyl not broadened, simple in female (male unknown), about 1.5 times as long as palm; merus with small acute distoventral tooth medially, with small ventral spines; second pereiopod with proximal segment of carpus about 1.7 times length of second segment; third pereiopod with dactyl feebly subspatulate, about 0.35 of propod length, propod with single row of five stout spines ventrally, with pair of distoventral spines; merus unarmed; ischium with small articulated spine; endopod of uropod with about 50 small posterolateral marginal spinules, rather long, slender laterally, exopod without spinules.

**Measurements (mm).** Total body length (approx.) 52.5, carapace and rostrum 19.5, major chela 25.5, minor chela 16.75, length of ovum 1.05.

**Colouration.** Ground colour of body pale yellow-buff, with patches of pale orange-red over rostrum, anterior margin of carapace, gastric region, cardiac region, middle parts of antennal peduncles and scaphocerite; abdomen with articular surface of first tergite deep reddish-brown, rest yellowish-white, anterior and posterior margins spotted and blotched with reddish-brown, most marked on the posterior of each segment, pleura more heavily mottled with reddish-brown; caudal fan mottled with pale red-brown; dorsum of major chela with palm whitish, with proximal, central and distal bands of red-brown, with scattered small red-brown spots, fingers proximally maroon, distally white; minor chela similar, with proximal and distal bands of maroon, fingers largely red-brown, with small white patches, tips white; ambulatory pereiopods whitish, merus with proximal and distal dull reddish bands, carpus with white central band, propod and dactyl white.
Fig. 3. *Alpheus williamsi* sp. nov., holotype female, Arafura Sea. A, anterior carapace and antennal peduncles, lateral; B, same, dorsal; C, scaphocerite; D, third maxilliped; E, first pereiopod, major chela, ventral; F, same, merus; G, same, minor chela; H, second pereiopod; I, third pereiopod; J, same, propod and dactyl; K, same, distal propod and dactyl, lateral; L, same, dactyl, dorsal; M, caudal fan; N, telson, posterior margin.

**Etymology.** The species is named in honour of Mr Rex Williams, the collector of this and many other interesting specimens.

**Systematic position.** *Alpheus williamsi* is most closely related to *A. pubescens* De Man, 1908, the only other species of the genus. *Alpheus*
New shrimps of the *Alpheus brevirostris* group

*brevirostris* group with a densely pubescent carapace. However, in *A. williamsi* the abdomen is also densely pubescent, a feature that is not present in any other species of the *brevirostris* group. In *A. williamsi* the slender acute rostrum reaches clearly to the level of the anterior end of the proximal segment of the antennular peduncle, in contrast to the broader rostrum of *A. pubescens*, which only reaches to the middle of that segment. The postrostral carina in *A. williamsi* is very distinct, but only feebly discernible in *A. pubescens*. In addition, *A. pubescens* is a small species, about 17-20 mm long (De Man, 1911), while *A. williamsi* is a large species with the total body length over 50 mm.

**Remarks.** *Alpheus pubescens* is a common species in the intertidal pools of Darwin Harbour (Bruce 1988) and numerous specimens were available for comparison with *A. williamsi*. The largest ovigerous female specimen had a total body length of 23 mm. Although also a member of the "*brevirostris*" group, there is as yet no indication of any association of this species with fishes.

**DISCUSSION**

The species of the *Alpheus brevirostris* group are of special interest in view of their frequent associations with gobies, but many of the species remain very poorly known and a considerable number appear to be of rather dubious taxonomic status. Some 32 species can be referred to this group at the present time. The last key to the species of this group was provided by De Man

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![Images of shrimps and anatomical parts](https://example.com/fig4.png)

**Fig. 4.** *Alpheus pubescens* De Man, Darwin Harbour, male, carapace length 8.0 mm. A, third maxilliped; B, first pereiopod, major chela, dorsal; C, same, lateral; D, minor chela; E, third pereiopod; F, same, dactyl, lateral; G, same, dorsal.
(1911), and many species have been subsequently described. An attempt is made here to provide a key for the identification of the Indo-West Pacific species, based on the information available in the literature on morphological characters. Many of the species descriptions are insufficiently complete for detailed comparative studies and a satisfactory solution to the problems of species identification for these shrimps will not be possible until many of the type specimens have been redescribed in detail. The study of mated pairs appears to be particularly essential, in view of the differences in the sexes, and the study of specimens without both of the first pair of pereiopods is probably best avoided. Many of the species appear to have highly specific colour patterns in life, so that it may ultimately be possible to produce a field guide based on colouration alone.

Professor J.Y. Liu has kindly advised me that the type material of *Alpheus homochirius* and *A. heterocarpus*, both described by Yu (1935, as *Crangon*) are not in the collections of the Institute of Zoology, Beijing, to which the collections of the Fan Memorial Institute of Biology have been transferred, and are no longer extant. Professor Liu considers that the former species was based on an abnormal specimen of *A. brevirostris* De Haan, and it is therefore omitted from the following key. No further specimens have been reported in Chinese waters since the original description. *Alpheus heterocarpus* is very closely related to *A. distinguendus* De Man (Liu: pers. comm.). Dr Yasuhiko Miya has indicated (2 March 1993; pers. comm.) that he concurs with the views of Professor Liu and that the condition of the aberrant major first pereiopod described for *A. homochirius* occurs commonly in Japanese specimens of *A. brevirostris* and that the distinguishing proportional differences of *A. heterocarpus* fall within the range of variation of *A. distinguendus*. It is therefore also omitted from the following key. Recently Miya (1990) has provided the preliminary results of a study of some species of the *brevirostris* group that further clarifies the relationships of some of the species of this group. *Alpheus distinguendus* De Man, 1909, is considered to be a synonym of *A. digitalis* De Haan, 1844, and *A. dispar* Randall, 1840, is a synonym of *A. brevirostris* (Olivier, 1811). Similarly, *A. brevirostris angustodigitus* De Man, 1911, is also placed in synonymy with *A. brevirostris* (Olivier, 1811). Professor Miya's comments (1993; pers. comm.) are as follows:

...D.M. Banner and A. H. Banner (1982; 173) suspected that *A. distinguendus* having the major chela without any transverse groove would be a junior synonym of *A. brevirostris* (Olivier, 1811) having a major chela with a transverse groove, when the transverse groove would be proved to be variable in a population and to be meaningless in the specific diagnosis. In the same page (173), however, they stated that "But none of the specimens available in the collections [of *A. distinguendus*] had the transverse groove or even approached it."

I cannot accept their hypothesis on the basis of my long research of *A. digitalis* in Japanese waters and the present study on the types of both species [Plate 2 A-B] and the material from Australia and East Asian countries. I have found some male specimens which are referable to *A. brevirostris* among the Australian specimens identified as *A. distinguendus* and others by the Banners (my résumé, 1990). Few female specimens of *A. brevirostris* have been examined among Singaporean and Malaysian collections. I agree with them on *Alpheus brevirostris angustodigitus* De Man, 1911 which may be assigned to Olivier's species.

...Chace (1988) put *A. digitalis* and *A. distinguendus* into a synonymy of *Alpheus dispar* Randall, 1840 on the acceptance of the above Banner's hypothesis. When I examined the holotype of *A. dispar* in the collection of the Academy of Natural Sciences of Philadelphia (ANSP CA246), I knew that Dr Chace, too, examined this dry material which was represented only by the major and minor chelae (Slide 4) [Fig. 6D] and few pieces of little fragments. As shown in Slide 4 [Fig. 6D], the major chela is provided with a distinct transverse groove and appears completely different from the major chela having no transverse groove in *A. digitalis* (Slides 2 & 3) [Fig. 6B-C].

I cannot agree about Chace's statement and, on the contrary, I am inclined to assign the chelae of the holotype of *A. dispar* to those of *A. brevirostris*. Judging from the material examined of both species, *A. brevirostris* and *A. digitalis*, they are respectively good species and their distributions may overlap each other from tropical (?) Australia, Irian Jaya, Kalimantan, Brunei (Dr S. Choy's material), Malaysia, Singapore and Philippines...

Yaldwyn (1956) redescribed the species [*A. novaezelandiae* Miers, 1876] in the *Insignis* subgroup of the *Crinitus* group, but, in a personal communication (September 23, 1969), kindly told me his correction: "Examination of fresh material in N.Z. shows that *A.
New shrimps of the *Alpheus brevirostris* group

*Alpheus brevirostris* group as the large chela has a longitudinal ridge on the outer surface and a transverse groove on the upper margin.

It is hoped that the following key will be of some assistance to those wishing to identify specimens, but the results should be regarded as provisional and the specimens should be critically compared with the original and subsequent descriptions, keeping in mind the probability that there are certainly many species yet to be described. It is also quite probable that some of the specimens already recorded in the literature may prove to be distinct species, for example, the specimen from Torres Strait (stn. BAU 27) referred to *A. pubescens* by Banner and Banner (1982). The species referred to in Karplus (1987) under the names of *Alpheus ochrostriatus*, *A. purpurilenticularis* and *A. rubromaculatus* have not been taken into consideration as their descriptions are not yet available and it is not certain that they are members of the *brevirostris* group.

### A KEY TO THE INDO-WEST PACIFIC SPECIES OF THE *ALPHEUS BREVIROSTRIS* SPECIES GROUP

1. a. Orbital teeth present, pterygostomial margin triangular .............. *A. miyakei* Miya
   b. Orbital teeth absent, pterygostomial margin rounded .................. 2

2. a. Without transverse groove proximal to dactylar articulation of major chela .... 3
   b. With slight to pronounced transverse groove proximal to dactylar articulation .... 17

3. a. Major chela over 6.0 times longer than broad .................................. 4
   b. Major chela at most 4.5 times longer than broad .............................. 8

4. a. Telson 2.6 times longer than proximal width, strongly constricted at half length, posterior margin strongly produced, about 0.15 of telson length; lateral margins of scaphocerite strongly concave; (major chela unknown) .............. *A. notabilis* Stebbing
   b. Scaphocerite with lateral margin sublinear; telson not as above .................. 5

5. a. Postrostral carina well developed, extending at least to middle of carapace ........ 6
   b. Postrostral carina not extending posteriorly to orbital hoods .................. 7

6. a. Postrostral carina interrupted posterior to orbital hoods by acute median tooth .....  .......... *A. acutocarinatus* De Man
   b. Postrostral carina without acute median tooth; (minor chela unknown) ...............  .......... *A. explorator* Boone

7. a. Major chela oval in section, without palmar ridges or carinae; merus with strong preterminal dorsal tooth ............................. *A. macroskeles* Acock and Anderson
   b. Major chela with palm subrectangular in section, with strong longitudinal ridges; merus without preterminal dorsal tooth .... *A. nonalter* Kensley

8. a. Carapace pustulose or papillose, especially on anterior region ................... 9
   b. Carapace smooth .................................. 10

9. a. Major chela very strongly compressed, feebly papillose .................................. *A. leptochelae* Banner and Banner
   b. Major chela less strongly compressed, densely pustulose ............................ *A. stephensi* Banner and Smalley

10. a. Body very strongly compressed; exopod of uropod with large lateral flap lateral to diaeresis .................................................................  ................... *A. compressus* Banner and Banner
    b. Body not strongly compressed, subcircular in section ................................ 11

11. a. Rostral carina reaching at most to anterior third of carapace .......................... 12
    b. Rostral carina reaching almost to, or to slightly beyond, middle of carapace .... 14

12. a. Dactyl of minor chela simple (not *balaeniceps*) in both sexes; fingers of minor chela not crossing at tips, nearly 1.5 times as long as palm ...........................................  .................. *A. quasarapacida* Chace
    b. Dactyl of male minor chela *balaeniceps*, (dactyl of female unknown); fingers of minor chela crossing at tips, subequal to palm length ........................................... 13

13. a. Dorsal margin of major chela rounded (without any depression proximal to dactylar articulation); minor chela about 6-9 times as long as broad; fingers a little shorter than palm; merus and ischium of first pereiopods armed with long acicular spines along ventromedial border ........................................... *A. pustulosus* Banner and Banner
    b. Dorsal margin of major chela with slight depression proximal to dactylar articulation; minor chela slightly more than 4 times as long as broad; fingers 1.2 times longer than palm; merus and ischium of first pereiopod unarmed, without acicular spines  .......... *A. arenicolus* Banner and Banner
14 a. Rostral carina with small obtuse median tubercle slightly posterior to orbital hoods; dactyls of ambulatory pereiopods slender; dactyl of male minor chela balaeniceps, of female slender, tapering; lateral margin of scaphocerite strongly concave .....

................. A. sibogae De Man

b. Rostral carina unarmed, without median tubercle; dactyls of ambulatory pereiopods spatulate; dactyl of minor chela of both sexes not balaeniceps; lateral margin of scaphocerite almost straight; (A. lepidus De Man is placed here with some doubt, as the minor chela is unknown). 15

15 a. Major chela with longitudinal ridge on lateral margin; fingers of male minor chela spoon-shaped, deeply excavate medially, approaching 3.0 times palm length, palm about as long as wide; fingers of female minor chela compressed, not medially excavate, approaching twice palm length, palm about 1.5 times as long as wide ... 16

................. A. digitalis De Haan

b. Major chela rounded, without ridges on lateral margin (in A. rapacida fingers of minor chela of both sexes compressed, not medially excavate); fingers of male minor chela 1.5-2.0 times palm length, palm about 1.5-2.0 times as long as broad .....

16 a. Postrostral carina narrow, sharp, extending posteriorly beyond middle of carapace; carpus of second pereiopod with second article 10 times longer than wide, 2.6 times longer than first article ...............

................. A. lepidus De Man

b. Postrostral carina obtuse posterior to orbital hoods, extending almost to middle of carapace; carpus of second pereiopod with second article 6.0 times longer than wide, 1.5 times longer than first article ...............

................. A. rapacida De Man

17 a. Carapace with light pubescence ..... 18

b. Carapace glabrous .................. 19

18 a. Abdomen glabrous ..................... 19

b. Abdomen pubescent .................. 19

19 a. Dactyl of third pereiopod simple, conical .................. 20

b. Dactyl of third pereiopod subspatulate or spatulate .................. 22

20 a. Anterior margins of orbital hoods gently rounded, lacking eaves; palm of major chela compressed in cross section ...............

................. A. savuensis De Man

b. Anterior margins of orbital hoods projecting as narrow eaves, palm of major chela more or less circular in cross section .. 21

21 a. Orbitrostral groove gently V-shaped, merging mediually with postrostral carina, and laterally with broadly inflated orbital hood; merus of third and fourth pereiopods armed with small distoventral tooth ....

................. A. miersi Coutière

b. Orbitrostral groove shallow, broad, flat, demarcated mediually by postrostral carina, laterally by narrowly inflated orbital hood; merus of third and fourth pereiopods unarmed .......... A. novaezelandiae Miers

22 a. Major chela with oblique transverse groove proximal to dactylar articulation; dactylus falcate ...............

................. A. cythereus Bannier and Banner

b. Major chela with groove proximal to dactylar articulation distinctly transverse in orientation; dactylus non-falcate .......... 23

23 a. Rostral carina reaching to middle of carapace ..... A. mortensis Bannier and Banner

b. Rostral carina reaching to most anterior third of carapace ...............

24 a. Dactyl of minor chela simple (not balaeniceps) in both sexes ...............

b. Dactyl of minor chela balaeniceps in male, simple in female ...............

25 a. Dactyl of minor chela more than twice as long as palm in both sexes; scaphocerite slender, with distal margin of lamella subtriangular ...............

b. Dactyl of minor chela less than 1.5 times as long as palm in both sexes; scaphocerite broad, distal margin of lamella rounded ..

................. A. brevirostris (Olivier)

b. Fingers of minor chela compressed, not mediually spoon-shaped, in both sexes ....

................. A. brevicristatus De Haan

27 a. Lateral margin of scaphocerite weakly concave; fingers of minor chela more or less gaping in both sexes; major chela with flat dorsal area, flanked by medial and lateral longitudinal ridges .... A. rapax Fabricius

b. Lateral margin of scaphocerite concave near midlength, distally convex; fingers of minor chela closing (not gaping) in both sexes; major chela dorsally rounded, without flat area flanked by ridges ...............

................. A. macellarius Chace
New shrimps of the *Alpheus* brevirostris group

Fig. 5. A (top left), *Alpheus fenneri* sp. nov., holotype and paratype, Menado, Sulawesi (photo. J.E. Randall); B (top right), *Alpheus bellulus* Miya and Miyake, female, Shirahama, Japan (photo. Y. Miya); C (bottom left), *Alpheus williamsi* sp. nov., ovigerous female holotype, off Charles Point, Northern Territory (photo. A.J. Bruce); D (bottom right), *Alpheus pubescens* De Man, ovigerous female, Darwin Harbour, Northern Territory (photo. A.J. Bruce).
Fig. 6. A (topleft), Alpheus brevicristatus De Haan, lectotype, Japan (photo. Y. Miya); B (topright), Alpheus distinguendus De Man, paralectotypes (=A. digitalis De Haan) (photo. Y. Miya); C (bottom left), Alpheus digitalis De Haan, holotype, Japan (photo. Y. Miya); D (bottom right), Alpheus dispar Randall, holotype, Manila, Philippines, chelae of first pereiopods (photo. Y. Miya).
28a. Carpus of second pereiopod with second article more than twice as long as first ...

28b. Carpus of second pereiopod with first and second articles subequal ...

29a. Rostrum blunt, equilaterally triangular, rostral carina elevated ...

29b. Carpus of second pereiopod with first and second articles subequal ...

30a. Rostral carina higher than orbital hood; penultimate segment of third maxilliped with very dense ventrolateral tuft of very long fine setae exceeding tip of terminal segment; major chela with feeble transverse groove proximal to dactylar articulation ...

30b. Rostral carina concealed by orbital hoods laterally; penultimate segment of third maxilliped with tuft of short setae scarcely reaching to tip of terminal segment; major chela with distinct transverse distal palmar groove ...

ACKNOWLEDGEMENTS

I am most grateful to Dr F.A. Chace for his helpful comments with regard to *A. macellarius* and *A. fenneri* and other brevirostris-related species, and Professor Y. Miya for his detailed advice, particularly his most useful remarks on the key and the colour slides used for figures 5 and 6. Without his expertise the preparation of the key would not have been possible. The approval of the Natural History Museum, Leiden, and the Philadelphia Academy of Natural Sciences, to publish these photographs is also greatly appreciated. Particular thanks is also due to the collectors of the specimens described, Rex Williams and Dr Jack Randall, who also provided the colour photograph of *Alpheus fenneri*.

REFERENCES


Randall, J.W. 1840. Catalogue of the Crustacea brought by Thomas Nuttall and J.K. Townsend, from the west coast of North America and the
Sandwich Islands, with descriptions of such species as are apparently new, among which are included several species of different localities, previously existing in the collections of the Academy. Journal of the Academy of Natural Sciences of Philadelphia 8: 106-147.


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A NEW SPECIES OF HINGE-BEAK SHRIMP FROM THE WESTERN PACIFIC (CRUSTACEA, DECAPODA, RHYNCHOCINETIDAE).

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ABSTRACT

A new rhynchocinetid shrimp, *Rhynchocinetes brucei*, sp. nov. is described and illustrated. It is most closely related to *R. rugulosus* Stimpson from Australia, but can be distinguished from the latter species by having a shorter stylocerite, an indistinct lobe on the outer margin of the second pleopod in the male and by its live color. The new species occurs in the Philippines, Hong Kong and on the Great Barrier Reef.

Keywords: Crustacea, Decapoda, Rhynchocinetidae, *Rhynchocinetes*, new species, West Pacific.

INTRODUCTION

The shrimps of the genus *Rhynchocinetes* H. Milne Edwards, 1837, form a very distinct group of caridean shrimps on account of the presence of a movable rostrum which is articulated with the carapace and the presence of numerous transverse striae over the whole body surface. During recent taxonomic studies on hinge-beak shrimps, it has been noted that the color pattern is one of the most important diagnostic characters for identification of these shrimps (Nomura and Hayashi 1992; Okuno and Takeda 1992a, b). One of these shrimps, *Rhynchocinetes rugulosus* Stimpson, 1860, is a well known species, being distinguished from its congeners by the presence of an arthrobranch on the third pereiopod and a single lobe at the outer margin of the endopod of the first pleopod in the male (Gordon 1936; Hale 1941). In life, the dorsal surface of the third abdominal segment is ornamented with a beautiful red and white meshwork (Healy and Yaldwyn 1970; Coleman 1987). In the specimens from Hong Kong identified by Bruce (1986) as *R. rugulosus*, however, there is a large median spot on the dorsal surface of the same segment.

Through the kindness of Dr A.J. Bruce of the Northern Territory Museum, I have been able to examine many specimens of several species of rhynchocinetid shrimps which are deposited in the collection of the Northern Territory Museum, Darwin. Among these materials are some specimens of *R. rugulosus* and related species from some widely separated localities, viz. Hong Kong, Heron and Lizard Islands on the Great Barrier Reef. As the result of direct comparison, it became clear that the specimens from Hong Kong and the Great Barrier Reef differ from *R. rugulosus* from Sydney and its vicinity, not only in life-coloration but also in some morphological characters. The former specimens are described below as a new species under the name of *Rhynchocinetes brucei* sp. nov.

The measurements follow those of Okuno and Takeda (1992a). The abbreviations are as follows: NTM - the Northern Territory Museum, Darwin, Australia; NSMT - the National Science Museum, Tokyo, Japan; cl - carapace length.

SYSTEMATICS

*Rhynchocinetes brucei* sp. nov.
(Figs 1-3, 4a-b, Plate 1)

*Rhynchocinetes rugulosus* Bruce, 1986: 612. Type Material. HOLOTYPE - male (10.0 mm cl), Long Ke Wan, Hong Kong, 8 m depth, 27 April 1980, coll. diver, NTM Cr.003618.
PARATYPES - 1 male (9.3 mm cl), Lizard Island, Queensland, coll. H.K. Larson, NTM Cr.000678; 1 male, 1 ovig. female (5.7 and 7.5 mm cl), Heron Island, Queensland, 12 m depth, 6 February 1986, coll. A.J. Bruce, NTM Cr.003617; 2 males (11.5 and 14.5 mm cl), Long Ke Wan, Hong Kong, 8 m depth, 27 April 1980, coll. diver, NTM Cr.003618 (B, C); 1 male (12.3 mm cl), Stn. T/13, Mirs Bay, Hong Kong (22° 31.5' N, 114° 19.9' E), 18 m depth, 5 April 1986, coll. P. Shin, NTM Cr.003806; 1 ovig. fe male (10.3 mm cl), Peng Chau, Mirs Bay, Hong Kong, 15 April 1986, NTM Cr.003951; 1 male (10.8 mm cl), Gau Tau, Mirs Bay, Hong Kong, 16-20 m depth, 18 April 1986, coll. divers, NTM Cr.004002.

Additional Material. Four specimens - 1 juv. (2.9 mm cl), Lizard Island, Queensland, 19 September 1981, coll. H.K. Larson, NTM Cr.000168; 1 male (6.3 mm cl), Lizard Island, Queensland, coll. H.K. Larson, NTM Cr.009606; 1 male (15.4 mm cl), Stn. PH. HK-4, Kai Kun Tan, Hong Kong, 4-6 m depth, 5 April 1986, coll. P. Hutchings, NTM Cr.003812; 1 male (6.4 mm cl), Philippines, coll. aquarium trader, NSMT-Cr 1529.

Description. Body subcylindrical, rather robust, without lateral ridge. Carapace with many fine transverse striae; depth 0.5 - 0.6 times length of carapace; anterior width 0.6 - 0.7 times length of carapace. Two acute teeth on dorsal carina behind rostral articulation; orbital spine strong, on level of upper orbital margin; antenial spine longer than orbital spine, strongly pointed, exceeding anterior margin of carapace; pterygostomial angle bluntly pointed, directed anteriorly.

Rostrum distinctly articulated with carapace, laterally compressed and curved obliquely upward along its distal half; length 1.1 - 1.3 times length of carapace; upper margin with two acute large spines on proximal half, second tooth at 0.5 of rostral margin, tip of rostral upper margin with four to six teeth smaller than proximal teeth; lower margin with 12 - 15 acute teeth, decreasing in size distally.

Abdomen marked with fine striae similar to those of carapace; third segment weakly humped posterodorsally, length 0.5 - 0.8 times as long as carapace; pleurae of first three segments rounded; fifth segment with acute posterolateral angle, directed backward; sixth segment 0.4 - 0.5 times longer than carapace, with sharply pointed spine directed backward obliquely just in front of base of uropod. Telson about 0.6 times longer than carapace, with three pairs of posterior spines present, lateral spines very small, shorter than dorsal spines, intermediate pairs of spines long and robust. Submedian spines slender, slightly longer than lateral spines.

Antennular peduncle reaching to median part of rostrum; distal margin of proximal segment with sharply pointed lateral spine, reaching to distal margin of next segment; stylar legs well developed, strongly acute distally, usually shorter than distal spine of proximal segment, rarely reaching to apex of distal spine; statocyst longi-
New hinge-beak shrimp from the western Pacific

**Fig. 2.** *Rhynchocinetes brucei* sp. nov., paratype male (11.5 mm cl, NTM Cr.003618B). A, carapace and rostrum; B, antennular peduncle; C, antennal scale; D, telson; E, uropod. Scales: A= 5 mm, B-E = 2 mm.

tudinally oblong; intermediate and distal segments short, together are equal to two thirds of length of proximal segment, length of distal segment almost equal to that of intermediate segment.

Antennal scale well developed, not reaching to rostral apex, 0.8 - 0.9 times as long as carapace; broad proximally, narrower distally, maximum width 0.2 times longer than its length; distolateral spine strongly acute, extending beyond tip of lamella; basiscerite with acutely pointed anteriorly directed lateral tooth.

Mouthparts generally similar to those of congers. Mandible robust, with three-segmented palp; distal segment of palp with dense setae at outer margin, larger and stouter than penultimate segment; molar process stout, with five slits at distal end; incisor process stout, with 11 sharp distal teeth. Maxillula with sharply pointed palp; proximal endite broader than distal endite with dense setae at inner margins. Maxilla with simple palp, proximal third broad, distal two-thirds slender; distal endite bilobed, distal lobe rounder and broader than proximal, with dense setae at outer margin of endite; proximal endite strongly convex, with dense setae at inner margin, which are longer than those of distal endite;
Plate 1. *Rhynchocinetes brucei* sp. nov., non-type specimen, Philippines (6.4 mm cl, NSMT-Cr 1529), dorsal view.
scaphognathite large, anterior lobe broad and rounded, posterior lobe posteriorly elongated, sub-triangular, with dense long setae at distal end.

All maxillipeds with both epipod and exopod. First maxilliped with rather slender endopod, with dense setae at inner margin; proximal endite broad and rounded, inner margin densely fringed with setae; exopod well developed, with long setae distally; epipod bilobed. Second maxilliped of normal form; dactylus slender, with dense setae, propodus with distomedial angle convex, with dense long setae at outer margin; carpus with acute distolateral tooth; ischiomerus as long as basis, with sparse setae at distal end of outer margin; exopod well developed, with numerous setae distally; inner margin of coxa straight; epipod with small podobranch. In female and young male, third maxilliped rather slender, usually extending slightly beyond rostral apex, rarely failing to reach rostral apex; distal segment 2.3 - 2.7 times as long as penultimate segment, tip armed with five to eight dark horned spines; ischiomerus with sparse setae; in large male, third maxilliped more robust than those of female and young male, surface glabrous, extending well beyond rostral apex by proximal two-thirds of penultimate segment, single dark horned spine situated at apex; with two small arthrobranchs and acute spine directed forward at distal margin of ischiomerus.

The branchial formula is shown in Table 1.

First pereiopod robust, more or less compressed, usually reaching to median part of rostrum; distal end of upper margin of merus and carpus each with strong acute tooth; chela 0.4 - 0.7 times as long as carapace, 1.5 - 2.2 times as long as carpus; in large male, more robust than in female and young male, chela 0.9 - 1.1 times longer than carapace, 2.9 - 3.2 times longer than carpus, broad distally, strongly curved movable finger opposing fixed finger; with well developed arthrobranch.

Second pereiopod more slender than first pereiopod; surface of palm entire, base of movable and fixed fingers sparsely fringed with setae, length of chela 0.3 - 0.4 times as long as carapace, 0.6 - 0.7 times as long as carpus; carpus 0.5 - 0.6 times as long as carapace; in female and young male, reaching to proximal two-thirds of rostrum, longer than first pereiopod; in large male, extending to rostral apex, shorter than first pereiopod; articular membrane with arthrobranch, smaller than that of first pereiopod.

Last three pereiopods moderately slender, similar to each other; ischium of each pereiopod armed with single blunt spine at lower margin, or unarmed; carpus of each pereiopod with two rather acute spines at outer surface, 0.3 - 0.4 times as long as carapace; dactylus of each pereiopod with strong acute horned claw at its apex, three small acute spines posterior to terminal claw. Third pereiopod usually reaching to rostral apex, but in large male, extending beyond rostral apex by proximal two-thirds of penultimate segment, tip armed with five to eight equidistant spines at distal part of outer surface, 0.7 - 0.9 times longer than carapace, 2.0 - 2.4 times longer than carpus, 1.1 - 1.3 times longer than propodus; propodus armed with five to eight equidistant spines at distal part of outer surface, 0.6 - 0.7 times as long as carapace; dactylus 5.3 - 8.0% of merus. Fourth pereiopod usually reaching to proximal two thirds of rostrum; merus with three spines (rarely four) similar to those of third pereiopod, 0.7 - 0.8 times as long as carapace, 1.9 - 2.3 times as long as carpus, 1.1 - 1.3 times as long as propodus; propodus armed with spinules and setae like those of third pereiopod, 0.5 - 0.7 times longer as carapace, dactylus 5.7 - 8.6% of merus. Fifth pereiopod reaching to middle of rostral length; merus with two to four (usually three) small equidistant spines at lower part of outer surface, shorter than those of third and fourth pereiopods, 0.6 - 0.7 times longer than carapace, 1.7 - 2.0 times longer than carpus, 0.9 - 1.1 times longer than propodus; propodus similar to those of two anterior pereiopods, 0.6 - 0.7 times longer than carapace; dactylus 5.9 - 10.0% of merus.

Table 1. Branchial formula of Rhynchocinetes brucei sp.-nov.

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<th>Maxillipeds</th>
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Fig. 3. *Rhynchocietes brucei* sp. nov., paratype male (A-K, 11.5 mm cl, NTM Cr.003618B; L, 14.5 mm cl, NTM Cr.003618C). A, mandible; B, maxillula; C, maxilla; D, first maxilliped; E, second maxilliped; F, third maxilliped; G, first pereiopod; H, second pereiopod; I, third pereiopod; J, dactylus of third pereiopod; K, male second pleopod; L, tip of third maxilliped of large male. Scales: A-E, K-L = 2 mm, F-I = 5 mm, J = 1 mm.
Endopod of male first pleopod distinctly broader than exopod of same pleopod, outer margin with dense setae at proximal half, with very small lobe at proximal two thirds of length; appendix interna situated at proximal four fifths of inner margin, apex with dense very small setae; distal part of endopod as broad as proximal part, weakly pointed distally.

Endopod of male second pleopod with appendices masculina and interna; appendix masculina with sparse setae at outer margin and more dense setae at its apex, as long as appendix interna.

Exopod of uropod rounded distally, with articulated acute spine and non-articulated small tooth at distal third of outer margin; distal end of endopod slightly rounded, fringed with dense setae on outer margin.

Coloration. Ground color of whole body rather hyaline, pale pinkish, with pattern of complicated red bands covering whole body; small white spots between red bands at lateral and dorsal surfaces of carapace. Third abdominal segment with large dark reddish median spot on dorsal surface. Rostrum with longitudinal red bands on lateral surface, rostral apex white. All segments of pereiopods mottled with red and white, except for blackish terminal claws. Tail fan semi-translucent, with reddish band along each outer margin.

Etymology. Rhynchocinetes brucei is named in honour of Dr. A.J. Bruce who kindly sent me on loan several specimens of rhynchocinetid shrimps deposited in the Northern Territory Museum.

Systematic Position. Rhynchocinetes brucei resembles R. rugulosus in the presence of a single lobe on the outer margin of the endopod of the first pleopod in the male and the number of gills in the branchial formula. The present new species is, however, distinguished from R. rugulosus by the following differences.

1) In R. brucei, the stylocerite is usually shorter than the distolateral spine of the proximal segment of the antennular peduncle and fails to reach the distal margin of the next segment. In R. rugulosus, the stylocerite extends beyond the distolateral spine of the proximal segment and reaches to the middle part of the distal segment, except in very small specimens that are less than 3.3 mm cl. The antennular peduncle of R. rugulosus has been figured by McCulloch (1909).

2) The endopod of the first pleopod in the male of R. brucei is equally broad from the proximal to the distal part with a bluntly pointed distal end, and an indistinct small lobe is situated on the outer margin, whereas the width of the same endopod of R. rugulosus is...
narrower distally and the outer margin has a distinct large lobe. It was possible to establish that the differences are not due to sexual dimorphism in the process of male growth, through the results of my examination of small (5.7 mm cl) to large (15.4 mm cl) series of *R. brucei* and by comparison with the detailed description of the endopod of *R. rugulosus* given by Hale (1941).

3) In life, *R. brucei* has a large dark median spot on the dorsal surface of the third abdominal segment, while *R. rugulosus* lacks such a median spot on the same segment, which is ornamented only with a red and white meshwork (Healy and Yaldwyn 1970; Coleman 1987).

There is an obvious similarity in color, having a large dark median spot on the third abdominal segment between *R. conspiciocellus* Okuno and Takeda, 1992a, and the present new species. The former differs, however, from the latter by lacking an arthrobranch on the third pereiopod and lacking a lobe on the outer margin of the endopod of the first pleopod in the male.

**DISCUSSION**

The shrimps of the genus *Rynchocinetes* are divided in two distinct species groups (Kemp 1925; Gordon 1936). One (*R. typus* species-group) is characterized by having a strong acute supraorbital spine and two teeth on the median carina of the carapace behind the distinct rostral articulation, the other (*R. rigens* species-group) by the absence of a supraorbital spine and having three teeth on the median carina behind the indistinct rostral articulation. The present new species is referred to the *R. typus* species-group.

*Rynchocinetes brucei* is known from the Philippines, Hong Kong and the Great Barrier Reef in the tropical West Pacific. The range of this species may be, however, extended by further revisional studies of rhynchocinetid shrimps, as it is conceivable that some earlier scientists may have recorded the species under other names (e.g. *R. typus* or *R. rugulosus*).

According to Stimpson (1860), the type locality of *R. rugulosus* is “In portu Jacksoniensi Australiae”, so the name of *R. rugulosus* is valid for the species occurring around Sydney and its neighbouring waters, the distinguishing characters of which are compared above with those of the present new species.

There are some records of hinge-beak shrimp from Hawaiian waters under the name of *R. rugulosus* (Rathbun 1906; Edmondson 1925; Edmondson 1952; Hiatt 1948). However, the Hawaiian specimens disagree with *R. rugulosus* and *R. brucei* in morphology and in the live color, based on my observation of a single rhynchocinetid specimen from Hawaii. I hope that additional Hawaiian specimens will be compared directly with specimens of *R. rugulosus* and *R. brucei*, to establish with certainty the systematic position of the Hawaiian species.

The species of the Australian *R. typus* species-group may be identified from the following key.

The Australian *Rhynchocinetes typus* species-group.

1 a. Third pereiopod with arthrobranch ...... 2
b. Third pereiopod without arthrobranch .... 4

2 a. Equidistant three teeth on proximal to median parts of rostral upper margin; outer margin of endopod of male first pleopod without lobe; third abdominal segment strongly humped posterodorsally ............... .................................. *R. durbanensis* Gordon
b. Two teeth on proximal to median parts of rostral upper margin; outer margin of endopod of male first pleopod with distinct lobe; third abdominal segment weakly humped posterodorsally ............... 3

3 a. Stylocerite reaches beyond tip of distolateral spine of antennular proximal segment; dorsal surface of third abdominal segment ornamented only with a red and white meshwork .............. *R. rugulosus* Stimpson
b. Stylocerite less than or equal to tip of distolateral spine of antennular proximal segment; dorsal surface of third abdominal segment with distinct dark median spot .............................................................. *R. brucei* sp. nov.

4 a. Second pereiopod with arthrobranch .... 5
b. Second pereiopod without ar throbranch .. ........................................ *R. balssi* Gordon

5 a. Stylocerite reaches beyond tip of distolateral spine of antennular proximal segment; outer margin of endopod of male first pleopod without lobe ........................................ *R. australis* Hale
b. Stylocerite does not extend to tip of distolateral spine of antennular proximal segment; outer margin of endopod of male first pleopod with distinct lobe .............................................................. *R. kuiteri* Tiefenbacher
ACKNOWLEDGMENTS

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REFERENCES


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LEANDER PLUMOSUS SP. NOV., A NEW PALAEMONINE SHRIMP (CRUSTACEA: PALAEMONIDAE) FROM THE MALDIVE ISLANDS.

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ABSTRACT

A new palaemonid shrimp, *Leander plumosus* sp. nov., is described and illustrated on the basis of specimens collected in the Maldives Islands, but the species was first noticed on the island of Bali, Indonesia. The species is remarkable in the conspicuous development of plumose setae on the rostrum, body and antennal peduncles. A sensory mechanism on the third maxilliped is described. A key to the identification of the four known species of the genus *Leander* Desmarest is provided.


INTRODUCTION

The author received for identification some photographs of Balinese shrimps taken in 1990 by Roger Steene. Amongst these were some striking pictures of a beautifully coloured shrimp that appeared to belong to the Palaemonidae, but which could not be identified as any known genus or species. Unfortunately, no specimens were collected. A copy of the photograph was published in Indonesia in the hope that specimens might be obtained (Bruce 1990) and subsequently in Australia by Steene (1990). Copies of the photograph were also circulated amongst collectors. The photograph was recognised by Helmut Debelius, as being of a species occurring in the Maldives Islands. Through his good offices, Herwarth Voigtmann, of Maayafushi, Ari Moroll, subsequently provided a single specimen, which on examination proved to belong to the genus *Leander* Desmarest and represented an undescribed species. In some *Leander* species, the rostra of male and female are morphologically different. On request, Mr Voigtmann then provided a second specimen of the complementary sex. It is of rare occurrence for specimens of new species to be supplied on demand, although the holotype of *P. hurii* was separated by an even greater distance from the paratypes, collected some two years later.

Carapace refers to the postorbital carapace length. The specimens are deposited in the collections of the Northern Territory Museum (NTM), Darwin.

SYSTEMATICS

**Palaemonidae Rafinesque, 1815**

**Palaemoninae Rafinesque, 1815**

*Leander* E. Desmarest, 1849

**Type species:** *Leander tenuicornis* (Say, 1818).

**Diagnosis** (from Chace and Bruce, 1993). Rostrum without elevated basal crest; carapace with submarginal branchiostegal spine, without hepatic or branchiostegal suture; fourth thoracic sternite without slender median process; mandible with palp; ambulatory pereopods with dactyls simple; endopod of male first pleopod with appendix interna.

*Leander plumosus* sp. nov.

(Figs 1-5, 6AB, Plate 2)

Unidentified palaemonid shrimp - Bruce, 1990: 62-63, fig. 2; Steene, 1990: 285, colour fig.
Plate 2. *Leander plumosus* sp. nov. A, specimen from Maldives Islands, photograph Herwarth Voightmann; B, C, specimen from Bali, Indonesia, photographs by Roger Steene.
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**Type Material.** HOLOTYPE - undissected ovigerous female, Ari Atoll, Maldives Islands, coll. Herwarth Voigtmann, 1991, NTM Cr.008567A; PARATYPE - dissected male, NTM Cr.008567B, same data as for holotype.

**Description.** Small sized, slenderly built palaemonid shrimps, each lacking one second pereopod (Fig. 1).

Carapace smooth, glabrous. Rostrum very slender, elongate, slightly up-curved, extending well beyond scaphocerite, about 2.5 times carapace length in male (Fig. 2B), 1.75 times in female (Fig. 2A); dorsal carina feebly developed with acute teeth throughout length, 11 in male, 12 in female. First two teeth situated on carapace, anterior tooth distinctly posterior to level of orbit, posterior tooth in epigastric position, remaining nine teeth rather irregularly distributed in male, more widely spaced proximally, 10 teeth regularly spaced in female, slightly decreasing in size distally in both. Teeth with small median rows of short plumose setae anteriorly to each tooth, with scattered longer erect submedian plumose setae. Ventral carina feebly developed, with nine acute teeth in male, similar, subequal, decreasing in size slightly distally, uniformly distributed over distal two-thirds, distal tooth smaller, close to tip. Twelve teeth present in female, extended over distal four-fifths, proximal four teeth smaller, more closely spaced, distal teeth larger, increasing in size slightly distally, distal tooth remote from tip. Ventral rostral margin with dense submedian row of coarsely plumose setae from orbital notch to rostral tip, setae short proximally, increasing in length distally, projecting ventrolaterally, densely pigmented, completely obscuring ventral rostral teeth. Supraorbital and hepatic spines absent, inferior orbital angle (Fig. 2D) produced, bluntly rounded, without medial flange. Antennal spine acute, marginal, far exceeding inferior orbital angle. Branchiostegal spine acute, subequal to antennal spine, remote from branchiostegals margin; without branchiostegal groove. Anterior angle of branchiostegite broadly obtuse, ventral margin scotose.

Abdomen smooth (Fig. 2F), with short longitudinal rows of short coarsely plumose setae scattered on tergites of second to fourth segments. Third segment slightly posterodorsally produced, fifth segment about 0.7 of sixth segment length, sixth segment 1.5 times longer than deep, posterolateral angle acutely produced, posteroventral angle produced, dorsally blunt, with small acute ventral tooth, ventral margin with row of short coarsely plumose setae. Pleura of first three segments broadly rounded, enlarged in female, ventral margins scotose, central portion of row with longer, coarsely plumose setae in female only. Fourth segment with pleuron posteriorly produced, rounded, setose, without coarsely plumose setae. Fifth segment with pleuron posteriorly produced, acutely pointed.
posteroventrally, ventral margin setose, with coarsely plumose setae posteriorly, present in male and female. Telson (Fig. 2K) slender, about 1.35 times sixth segment length, 3.0 times longer than anterior width, tapering posteriorly, lateral margins straight, convergent posteriorly.
Posterior margin (Fig. 5N) 0.4 of anterior width, biconcave, with long acute median process, dorsally with transverse row of plumose setae proximally, two pairs of similar, subequal spines at 0.43 and 0.7 of telson length. Posterior margin with lateral spines similar to dorsal spines, medial spines long, robust, 3.5 times lateral spine length, 0.3 of telson length, with submedian pair of setulose setae, 0.38 of medial spine length, arising ventral to apical process.

Eye (Fig. 2G) well developed, with large globular cornae with dorsal accessory pigment spot, much wider than stalk, oblique, stalk subcylindrical, slightly compressed, about 1.4 times longer than wide.

Antennular peduncle (Fig. 2L) reaching to about 0.35 of rostral length. Proximal segment about 2.4 times longer than wide, medial margin with long plumose setae, with minute ventromedial tooth. Lateral margin, lateral margin straight, anterolateral margin (Fig. 5A) strongly acutely produced, slightly exceeding distal margin of intermediate segment, medial margin feebly sinuous, with coarsely plumose submarginal setae ventrally, continuous with row of similar setae along lateral margin. Stylocerite well developed, slender, acute, reaching to about 0.8 of segment length, proximal lateral margin swollen, périphery ringed with short finely plumose setae with swollen pore-bearing basal process (Fig. 5B). Statocyst normally developed, with subcircular statolith. Distal dorsolateral region of segment with numerous, scattered, coarsely plumose setae. Intermediate segment about 0.33 of proximal segment length, 1.5 times longer than wide, subcylindrical, medial margin strongly setose. Distal segment about 1.1 times intermediate segment length, subcylindrical, 2.0 times longer than wide. Upper flagellum (Fig. 2H) slender, biramous, rami fused for five proximal segments only, shorter free ramus about 4.0 times longer than fused portion, with about 19 groups of aesthetascs, lower ramus much longer than shorter ramus, filiform. Lower flagellum (Fig. 2H) slender, about 0.4 of longer upper ramus length.

Antenna (Fig. 2J) with stout basicerite with strong acute lateral tooth. Ischiocerite and merocerite normal; carcerite short, subcylindrical, about 2.5 times longer than wide, reaching to about 0.15 of scaphocerite length. Scaphocerite long, slender, reaching to about 0.8 of rostral length, lateral margin feebly concave, with strong acute distolateral tooth, lamella narrow, medial margin subparallel to lateral margin, 9.0 times longer than central width, distal lamella bluntly angular, distinctly exceeding tip of distolateral tooth, margins densely fringed with long coarsely setulose setae.

Ophthalmic somite without bec ocellaire, with small median pigment spot. Epistome with low rounded posteriorly convergent longitudinal ridges. Labrum (Fig. 2E) acutely produced ventromedially, with laminar median lamella anteriorly. First and second thoracic sternites fused (?), forming transverse ridge with median notch; third with transverse ridge; fourth with short stout, transversely compressed blunted median process. Fifth with rounded transverse lateral ridges; sixth and seventh unarmed; eighth with short stout anteriorly flattened median process (male only).

Mandible (right) (Figs 3A, 5C) robust. Palp (Fig. 5F) slender, three-segmented, distal segment slender, subcylindrical, longer than combined length of proximal segments, with several slender simple setae distally. Molar process (Fig. 5D) stout, with four blunt teeth distally, without setal brushes. Incisor process (Fig. 5E) short, broad, with three large acute teeth distally, outer tooth larger than inner teeth, medial margin sharp.

Maxillula (Fig. 3B) with bilobed palp (Fig. 5G), upper lobe larger than lower, lower lobe curved, without distal setae. Upper lacinia (Fig. 5H) slender, curved, distally truncate, with about nine stout simple teeth distally, with sparse simple setae. Lower lacinia short, tapering, with numerous serrulate setae disimponentally.

Maxilla (Fig. 3C) with simple, slender, tapering palp, with numerous short plumose setae along lateral margin. Basal endite slender, deeply bilobed, upper lobe longer than lower, each with about 13 and 11 slender, simple distal setae respectively, upper lobe with setae along dorsal and ventral margins. Coxal endite obsolete, margin weakly convex. Scaphognathite about 2.5 times longer than broad, posterior lobe well developed, 1.4 times longer than broad; anterior lobe 1.4 times longer than broad, distally narrow, medial margin deeply concave distally, convex proximally.

First maxilliped (Fig. 3D) with slender, tapering palp, with single long plumose pre-terminal seta. Basal endite broad, medial margin densely fringed with slender, finely serrulate setae, with submarginal medial dorsal row of similar setae. Coxal endite separated from basal endite by deep notch, distinctly bilobed, distal lobe with numerous, long, finely serrulate setae, proximal
lobe with fewer, shorter setae. Exopod well developed, flagellum broad, with numerous plumose setae distally, caridean lobe narrow. Epipod large, triangular, deeply bilobed, triangular, distal lobe larger than oval proximal lobe.

Second maxilliped (Fig. 3E) with endopod robust. Dactylar segment about four times longer than wide, with about eight long simple spines distoventrally, medial margin densely fringed with shorter, more slender, biserrate spines. Propodal segment distomedially expanded, margin rounded with numerous stout spines, ventromedial margin with row of short, simple spines, with several longer, stouter spines distally. Carpal segment normal, distal dorsomedial angle acute; ischiomerus normal. Basis robust, medi-
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Fig. 4. *Leander plumeus* sp. nov., male, paratype: A, first pereopod; B, same, chela and distal carpus; C, same, ischium, basis and coxa, lateral; D, right second pereopod; E, same, chela; F, same, fingers; G, third pereopod; H, same, propod and dactyl; I, same, distal propod and dactyl; J, first pleopod; K, same, endopod; L, second pleopod; M, same, appendix masculina, appendix interna.

Figures 4A-4M. 1.0 mm. A, D, F, G, H, L, M. 0.5 mm. E, J, K, L, M. 0.2 mm. I, M.

Third maxilliped (Fig. 3F) with endopod extending distally to exceed carpocerite by 0.5 of terminal segment. Ischiomerus completely fused to basis, combined segment about 3.4 times longer than distal width, expanded and twisted.
distomedially (Fig. 5l), distolateral margin with six small stout spines, few short setae, medial margin with numerous long, slender, simple, rigid spiniform setae situated on raised bases, highly mobile, with shorter, more slender setae proximally. Penultimate segment slender, about 5.75 times longer than proximal width, subequal to ischiomeral portion of proximal segment, with numerous long slender mobile spiniform setae medially and laterally, with distally convex curved row of 18 minute, short, acute, non-articulated (?) spinules ventrolaterally at proximal end (Figs 5J-K, 6A-B), immediately adjacent to joint margin. Terminal segment about 0.6 of penultimate segment length, slightly curved, tapering distally, about 6.5 times longer than proximal width, densely spinose, with about 11 transverse groups of serrulate setae medially, scattered small groups laterally, distally unarmed in male (Fig. 5L) (terminal spines broken?), with short stout unarmored terminal spine in female. Exopod well developed, with broad flagellum, reaching to about 0.75 of antepenultimate segment length with numerous plumose setae distally. Coxa short, stout, about 1.75 times wider than long, broadly produced medially, feebly setose, with oval lateral plate, with smaller upper and larger lower arthrobranchs.

Paragnaths (Fig. 3G-I) well developed with large rounded alae, with small lateral lobe, corpus with posterolateral tubercles, with median eminence surrounded by low ridge.

First peraeopods (Fig. 4A) slender, exceeding antennular peduncle by about length of chela and distal fourth of carpus, carpocerite by carpus and chela, reaching to about 0.75 of scaphocerite length. Chela (Fig. 4B) with palm subcylindrical, slightly swollen, compressed, 2.4 times longer than central depth, with about nine transverse groups of short stout unarmed terminal spine medially, feebly setose, with oval lateral plate, with small ventral process and lobe, both with spiniform setae.

Second peraeopods (Fig. 4D) slender, only one preserved in each specimen, exceeding scaphocerite by half length of fingers, reaching to tip of rostrum. Chelae (Fig. 4E) about 0.66 of carapace length in male, similar in female, palm subcylindrical, smooth, slightly compressed, feebly swollen centrally, about 3.0 times longer than central depth, fingers (Fig. 4F) slender, similar, 1.4 times palm length. Dactylus about 9.0 times longer than proximal width, compressed, with acute hooked tip, cutting edge proximally blunt, with single small acute tooth at 0.25 of length, distal lamina entire. Fixed finger similar, with single small acute tooth slightly proximal to level of dactylar tooth. Carpus about 1.1 times chela length, about 8.0 times distal width, tapered proximally, unarmed. Merus subcylindrical, about 0.75 of carpal length, 10.5 times longer than central width, uniform, unarmed. Ischium about 1.1 times meral length, 9.0 times longer than distal width, slightly expanded distally. Basis and coxa without special features.

Ambulatory peraeopods (Fig. 4G) slender. Third peraeopod exceeding carpocerite by carpus, propod and dactyl, reaching to about 0.75 of scaphocerite length. Fifth peraeopod extending to end of scaphocerite; third peraeopod dactyl (Fig. 4l) robust, about 0.16 of propod length. Unguis stout, feebly demarcated, acute, unarmed, feebly curved, about 2.7 times longer than proximal width, 0.33 of corpus length. Corpus slightly compressed, ventral margin sharp, sublinear, unarmed, dorsal margin convex with pair of short simple spiniform setae at about 0.8 of length. Propod (Fig. 4H) slender, 0.85 of carapace length, about 20.0 times longer than distal width, subuniform, slightly expanded distally, with short simple distoventral spines, five smaller similar spines along ventral border, two to three small spines on distodorsal border, two small spines on dorsal margin, distal and dorsal spines slender, with central third minutely serrulate ventrally. Carpus about 0.5 of propod length, 12.0 times longer than distal width, subuniform, with distodorsal lobe, unarmed. Merus about 0.9 of propod length, 16.5 times longer than central width, subcylindrical, unarmed. Ischium subequal to carpal length, 11.0 times longer than central width, slightly tapered proximally, expanded distally, unarmed. Basis and coxa without special features. Fourth and fifth peraeopods similar, fourth peraeopod propod about 0.87, fifth 0.95 of carapace length.
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Fig. 5. *L. plumosus* sp. nov., male, paratype. A, antennule, distolateral angle of proximal peduncular segment; B, same, dorsal seta; C, mandible, molar and incisor processes and palp; D, same, molar process; E, same, incisor process; F, same, palp; G, maxillula, palp; H, same, distal upper lacinia; I, third maxilliped endopod, distal penultimate segment, dorsal; J, same, carpopodal joint, ventral, with possible sensory mechanism; K, same, enlarged; L, same, tip of terminal segment; M, uropod, distolateral angle of exopod; N, telson, posterior marginal spines.

fifth without transverse rows of serrulate setae distolaterally.

Male first pleopod (Fig. 4J) with basipodite about 3.5 times longer than broad, non-setose. Endopod (Fig. 4K) about 0.75 of basipodite length, 3.7 times longer than central width, subuniform, distally rounded, proximal half of medial margin with eight simple spinules, with
three short robust densely plumose setae proximally; distal and lateral margin with numerous short feebly plumose setae, proximal third of lateral margin glabrous; with well developed appendix interna at about 0.5 of medial margin length, exceeding distal margin of endopod. Exopod about 1.4 times basipodite length, slender, about 8.0 times proximal width. Second pleopod (Fig. 4L) with basipodite 1.2 times first pleopod basipodite length, 4.7 times longer than wide, glabrous. Endopod subequal to basipodite length, 6.5 times longer than proximal width, with appendices (Fig. 4M) at about 0.4 of medial margin length. Appendix masculina with corpus subcylindrical, slightly swollen, 5.5 times longer than central width, 0.25 of endopod length, with ventrolateral row of long simple spines, with two similar terminal spines, subequal to corpus length. Appendix interna not exceeding appendix masculina.

Uropod (Fig. 2L) with protopodite posterolaterally acute, medially fringed with setae. Exopod distinctly exceeding posterior end of telson, reaching to posterior end of medial telson spines, about 2.5 times longer than wide, greatest width at 0.6 of length, diaeresis distinct, broadly rounded distally, lateral margin straight, with acute posterolateral tooth (Fig. 5M) with larger mobile spine medially, with submarginal row of short plumose setae ventrally. Endopod about 0.9 of exopod length, 3.3 times longer than wide, greatest width at about 0.3 of length.

Ova numerous and small.

Measurements (mm). Holotype female, carapace length, 6.0; carapace and rostrum, 17.8; total body length (approx.) 34.5; second pereopod chela, 4.6; length of ovum, ca. 0.5. Paratype male, carapace length, 5.3; carapace and rostrum, 18.6; total body length (approx.), 34.0; second pereopod chela, 2.4.

Colouration (from transparencies). Orange-red, darkest dorsally, paler along lateral aspects of body; rostrum, antennal peduncles, scaphocerite, and dorsal surfaces of second to sixth abdominal segments densely covered with short stout, densely red, coarsely plumose setae, similarly coloured setae on uropods and in short rows on central parts of ventral margins of first to third pleura in female, posteroventrally on fifth and sixth segments; rostrum with dorsal carina, including teeth, yellowish white, with reddish spots between teeth, dorsal carapace with thin creamy submedian stria, branchiostegite with thin line of white, margined with red, extending from near antennal spine to posterior ventral margin; abdomen with dorsal surface of first to fourth segments heavily mottled with red and white spots, thin oblique white line crossing first three segments, angulated on third, extending to posterolateral angle of sixth segment, similar white line, margined with orange red, crossing pleura submarginally, posteroventral regions of fourth and fifth pleura mottled red and white; caudal fan similarly mottled; scaphocerite heavily mottled with orange-red and white, tending to form transverse bars, densely fringed with deep red, coarsely plumose setae; third maxilliped with similar orange-red mottlings; pereopods bluish-purple, fingers of second pereopod white distally, ambulatory pereopods and pleopods transparent.

Habitat. The Indonesian specimen was photographed on a coral reef, at a depth of 7 m (Plate 2). The species is apparently solitary and not associated with any other marine animals.

Systematic position. Leander plumosus appears to be not closely related to most of the other species of the genus but may be considered more closely related to L. tenuicornis (Say) on account of the similarities of the anterolateral margins of the proximal segment of the antennular peduncle (in both species this being acutely produced to about the level of the distal dorsal margin of the intermediate peduncular segment). The differences in the form of the rostrum and scaphocerite readily separate L. plumosus from L. tenuicornis. Leander plumosus lacks the sexual dimorphism of the rostrum found in L. tenuicornis, in which the rostrum is only about 1.6 times the carapace length in males, 1.1 in females, with a deep blade instead of a shallow lamina in the female only. Leander plumosus shares with L. kempi Holthuis the long, coarsely plumose setae that obscure the ventral rostral teeth and are scattered over the dorsal carapace and abdomens in both species. Again, the two species may be readily separated by the form, length and dentition of the rostrum and shape of the scaphocerite. In L. kempi, the rostrum is straight, with 12-14 dorsal teeth and five to seven ventral teeth, only slightly exceeding the scaphocerite, which is only about 4.0 times longer than wide, with the lateral margin convex.

DISCUSSION

The definition of the genus Leander provided by Holthuis (1950) refers to the double rows of setae along the ventral margin of the rostrum.
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These setae are particularly well developed in *L. plumosus* (described above), and almost completely obscure the ventral rostral teeth. These submarginal rows are usually of decreasing length distally on the rostral lamina, but in *L. plumosus* they increase in length distally, except at the very extreme tip, and diverge strongly laterally. The setae are particularly densely pigmented and have a shaft diameter of about 0.08 mm and length of 1.5 mm, with setules
throughout the length, uniformly about 47 to the 0.01 mm length, length about 0.175 mm. The homologous setae of *L. tenuicornis* (ovigerous female, carapace length 6.3 mm) have a shaft diameter of about 0.06 mm, length of 0.9 mm, with about 30 setules to the 0.01 mm length, length 0.9 mm. The dorsal rostral lamina also bears numerous similar isolated short plumose setae, that have not been reported in the other species of the genus. Similar plumose body setae do not appear to have been reported in *L. tenuicornis* and *L. paulensis* (Ortmann) (Holthuis, 1950, 1952; Manning 1961; Ramos-Porto 1986), but are known to occur in *L. kempi*. They do not appear to have been reported in other palaemonid shrimps but occur more commonly in the Hippolytidae (e.g. *Hippolyte ventricosa* H.M. Edwards), where their presence and absence has caused some taxonomic confusion. Similar problems could also occur in *Leander*, as it can be seen that the specimen photographed in Bali is markedly more densely plumose than the Maldivian specimens. In the Maldivian specimens, the male is also distinctly less strongly plumose than the female and many of the plumose setae have lost their setules, presumably through age and abrasion, so that they appear as rigid setae. Possibly some specimens will be found that lack these characteristic setae, but these will be readily identifiable on the basis of other morphological characters.

The ambulatory pereopods are provided dorsally with small spines rather than setae, with the central part of the ventral surface minutely serrate, and presenting a rather characteristic appearance. Similar spines also occur in the same position in *L. tenuicornis* (Bruce 1991). The minute spinulate sensory mechanism on the penultimate segment of the third maxilliped endopod, is also present in *L. kempi* (Fransen, pers. comm.) and also in *L. tenuicornis* (Fig. 6 C-F). Similar sensillae at the distal side of the carpo-propodal joint of the second maxilliped of *Panulirus argus* Latreille are illustrated by Laverack and Barrientos (1985: fig. 4B), who note that these are mechano-receptors and occur in various macruran decapods. They present a slightly different appearance when viewed by optical microscopy, appearing to have a series of short radially arranged ridges behind the spines, which are possibly internal chitinous thickenings, as they are not visible on the external surface under SEM examination.

It may also be noted that *L. plumosus* has the fourth thoracic sternite provided with a distinct median process. A similar process is present in *L. tenuicornis* and this feature is probably a character of the genus *Leander*.

A revision and resurrection of the genus *Urocaridella* Borradaile is in progress (Chace and Bruce, in press), and it is likely that the genus *Leander* Desmarest will contain only four species, one near circumtropical (*L. tenuicornis*), two Indo-West Pacific species (*L. kempi*, *L. plumosus*) and one western Atlantic species (*L. paulensis*). These species may be distinguished by the following key:

### A key to the species of *Leander* Desmarest, 1849 (sensu Chace and Bruce, 1993)

1 a. Carpus of second pereopod distinctly shorter than chela; rostrum less length than 1.5 times carapace ......................... 2
   b. Carpus of second pereopod distinctly longer than chela; rostrum and scaphocerite elongate, greatly exceeding carapace length (2.5 times, male; 1.75 times, female), R. 2+9-10/9-12 .......... *L. plumosus* sp. nov.

2 a. Anterior margin of proximal segment of antennular peduncle convex, with acute tooth laterally, reaching to about middle of intermediate peduncular segment; second pereopod with palm of chela not swollen; fingers not longer than palm; fourth pleura posterioventrally rounded ...................... 3
   b. Anterior margin of proximal segment of antennular peduncle concave, with acute tooth laterally, exceeding dorsal anterior margin of intermediate segment; chela of second pereopod with palm swollen, fingers longer than palm; fourth and fifth abdominal pleura acute posteroventrally; R. 2+6-12/5-12 .......... *L. tenuicornis* Say

3 a. Fifth abdominal pleuron posterioventrally rounded; R. 2+10-12/5-7 .......... *L. tenuicornis* (Say)
   b. Fifth abdominal pleuron posterioventrally acute; R. 3+8-11/5-7 .......... *L. paulensis* (Ortmann)

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REFERENCES


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SOME AUSTRALIAN STYLODACTYLLAE (CRUSTACEA: DECAPODA), WITH DESCRIPTIONS OF TWO NEW SPECIES.

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ABSTRACT

Nine species of Stylodactyllae are reported here from the north-west Australian continental shelf, as well as from the east of the continent (off the Great Barrier Reef). Eight species, including two new species, Stylodactyllus brucei sp. nov. (also collected from Wallis Island) and S. bathyalis sp. nov., represent new records for the area. This brings to eleven the number of species of this family now known from Australian waters.

KEYWORDS: Crustacea, Decapoda, Stylodactyllae, new species, Australia, Wallis Island.

INTRODUCTION

As a result of the increase in deep-water research in the last few years in Australia, Dr. A.J. Bruce sent me numerous specimens of the decapod family Stylodactyllae for study. These were collected mainly on the north-west continental shelf during expeditions undertaken between 1983 and 1988 by the CSIRO research vessel Soela and the fishing vessel Territory, and some collected off the Great Barrier Reef. This new material allowed me to complete the recent revision of the Indo-west Pacific Stylodactyllae (Cleva 1990), in which one new genus and nine new species were described.

Nine species have been identified from the recent material received. As far as I know, only one of them, Stylodactyllus multidentatus Kubo, 1942, was previously known from Australia, from off New South Wales (Kensley, Tranter and Griffin 1987: 293). On the other hand, the other two species mentioned by these authors, Stylodactyllus libratus Chace, 1983, and Parastylodactyllus sp. (= Parastylodactyllus tranterae Cleva, 1990), are absent from these new collections.

Two new species, Stylodactyllus brucei sp. nov., remarkable for its large size, and S. bathyalis sp. nov., from 3502-3515 m depth, the greatest depth the family has been reported, are described and illustrated. The relationships of S. brucei sp. nov. with S. major Hayashi and Miyake, 1968, and S. profundus Cleva, 1990, are discussed. It should also be noted that Neostylodactyllus investigatoris (Kemp, 1925), is recorded here for the third time.

The other six species, Stylodactyllus multidentatus Kubo, 1942, S. licinus Chace, 1983, Neostylodactyllus amarynnis (de Man, 1902), Parastylodactyllus bimaxillaris (Bate, 1888), P. semblatae Cleva, 1990, and Stylodactylloides crosnieri Cleva, 1990, were the subjects of a detailed study in Cleva (1990), consequently, an annotated list is given here, inviting the reader to refer to my paper for further details.

Abbreviations: MNHN (Museum National d'Histoire Naturelle, Paris), NTM (Northern Territory Museum, Darwin), QM (Queensland Museum, Brisbane).

SYSTEMATICS

Genus Stylodactyllus A.Milne Edwards, 1881

Stylodactyllus A.Milne Edwards, 1881: 11; - Bate 1888: 850; - Hayashi and Miyake 1968: 585; - Figueira 1971: 2, 3 (key); - Chace 1983: 3 (key), 8; - Cleva 1990: 82.
**Stylodactylus brucei** sp. nov.  
(Fig.1A, C-F)

**Type Material.** HOLOTYPE - male, 37 mm, south-west Pacific, Wallis Island, st.CP 638, 13°37'S 179°56'E, 820-840 m, 30 May 1992, MUSORSTOM 7 expedition, MNHNa.12121.  
PARATYPES - 3 males, 38-39 mm, 1 female (ovig.), 41.5 mm, North West Shelf, st. S9, 13°06'S 122°18'E, FV Territory Pearl, 900-1000 m, 25 January 1988, B. Wallner coll., NTM Cr.007060; 1 male, 34.5 mm, same station as previous, NTM Cr.007195.  
**Other material.** 2 females (1 ovig.), 39-40 mm, same station as previous, NTM Cr.006874; 3 females (ovig.), 40.5-41.5 mm, same station as previous, NTM Cr.007195.

**Description.** The 10 Australian specimens unfortunately have most of their thoracic appendages missing. Luckily, the recent French expedition MUSORSTOM 7, in the south-west Pacific, collected a specimen from Wallis Island, which has retained most of these appendages (only the first and third left pereiopods are missing); as a consequence, this specimen has been designated as the holotype.

In two specimens only, the male paratype 34.5 mm, NTM Cr.007195, and the male paratype 39 mm, NTM Cr.007060, is the rostrum complete (its tip, however, is broken in the latter); it carries 30 dorsal spines (five on the carapace proper), the size of which decrease from the base to the apex, and 33 ventral spines on the former specimen, and 29 dorsal spines (six on the carapace) and 26 ventral spines on the latter (Fig.1A). The ratio rostrum/carapace lengths are respectively 1.9 and 1.5.

Supraorbital spine absent, antennal and branchiostegal spines present, rather short.

Posteroventral edge of third abdominal segment with two to four teeth.

Posteroventral margin of fourth segment rounded, margin of fifth ending in sharp point (Fig.1C).

Telson 1.7 to 1.9 times longer than sixth abdominal segment, ending in long sharp point; dorsal surface with two rows of longitudinal dorsal spines disposed along two distinct carinae, spines variable in numbers; excepting the most distal pair (usually included with two pairs of long terminal spines more ventrally situated), on the nine specimens with an undamaged telson, 4-6, 5-6, 6-6, 7-7, 7-7, 7-8, 7-8, 8-8, and 7-9 spines are present (Fig.1E).

Eye with well pigmented cornea, slightly wider than ocular peduncle; no secondary cornea.

Antennal peduncle nearly reaching extremity of antennal scale; second segment 1.6 (male) to 1.8 (female) times longer than first (measured dorsally); stylocerite ending in sharp point, slightly exceeding extremity of first article of antennal peduncle (Fig.1F).

Antennal scale about four times longer than wide, lateral margin unarmed (Fig.1D).

The following description is of the holotype.

Third maxilliped extending past tip of antennal scale by little more than length of distal segment.

First pereiopod extending past tip of antennal scale by length of chela.

Second pereiopod extending past tip of antennal scale by length of about three-quarters of chela.

Third right pereiopod (most of the left appendage missing) is broken toward middle of merus; remaining part of appendage preserved with the specimen seems to fit with the attached part; merus with three strong lateroventral spines, without dorsodistal spine; propodus three times as long as carpus and 10 times as long as dactyl; dactyl short and strong, with three ventral spinules, measuring about 3.2 mm.

Fourth right pereiopod (left appendage incomplete) overreaching tip of antennal scale by length of dactyl and about three-quarters of propodus; ischium and merus not fused (suture line clearly visible); merus with row of five strong lateroventral spines (eight on the left leg); ischio-merus 4.1 times as long as carpus; propodus 3.1 times as long as carpus and about 12 times as long as dactyl; dactyl short and strong, measuring about 3 mm.

Fifth left pereiopod (right appendage incomplete) extends past tip of antennal scale by length of dactyl and about three-quarters of propodus; ischium and merus not fused; merus with four strong lateroventral spines (five on the right leg) and minute dorsodistal spine remaining on the right leg; ischio-merus about 3.2 times as long as carpus; propodus 3.1 times as long as carpus and about 15 times as long as dactyl; dactyl short and strong, with 11 ventral spinules, measuring about 3 mm.

Variation. The spinulation of the merus of the last three pairs of pereiopods shows some variation; on the few legs still present in the specimens and in place on the body, nine spines are present on the fourth pereiopod, and 11 on the fifth for the female NTM Cr.006874.
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Measurements (mm). Males with complete rostrum, carapace lengths 34.5 and 39, total lengths from tip of rostrum to extremity of telson, respectively 210 and 220. Carapace length of the largest specimens, 41.5.

Eggs. Unusually large in size; in one ovigerous female paratype, 78 eggs still in place, measuring 5.5 to 6.5 mm in length by 4 to 4.5 mm in width. On the other ovigerous females, eggs still in place less numerous.

Fig. 1. Stylodactylus brucei sp. nov.: A, C, male paratype 39 mm (NTM Cr.007060); D-F: other male paratype 39 mm, same station; A, anterior part of cephalothorax; C, fourth and fifth abdominal somites; D, antennal scale; E, telson; F, antennula. B. Stylodactylus major Hayashi and Miyake, holotype, anterior part of carapace. Scalebar = 10 mm.
Colouration. Two Australian specimens (male and female NTM Cr.007195) and the Wallis Island specimen (holotype) have been photographed. The body is entirely red, more or less uniform, with no characteristic pattern visible.

Etymology. It is a pleasure for me to dedicate this species to Dr A.J. Bruce, who entrusted the specimens to me for study, and who reviewed and translated the manuscript.

Systematic position. Stylodactylus brucei shows a close relationship to S. major Hayashi and Miyake, 1968. Dr Hayashi kindly sent me the holotype of S. major (female, carapace length 28 mm, Zoological Laboratory, Faculty of Agriculture, Kyushu University no. 11129), and a comparison of the two species indicated marked differences, enabling separation by the following characters:

A - Number, aspect and disposition of rostral spines. There are 29-30 dorsal spines and 26-33 ventral spines in S. brucei versus 51 and 30 in S. major; the proximal dorsal spines of the former are visibly longer than the others, which is not the case in the latter species, where this difference of size is less marked (Fig. 1A-B). The distal part of the rostrum of S. brucei is unarmed dorsally, in contrast to S. major.

B - The posteroventral margin of the fourth abdominal somite of S. brucei is rounded (Fig. 1C), and pointed in S. major.

C - The last three pairs of pereiopods of S. brucei have fewer spines on the merus and the proportions between the articles of these legs are very different from those of S. major.

D - Stylodactylus brucei is also of a larger size than S. major and was collected at a significantly greater depth (820 to 1000 m, compared to 122-124 m).

The shape of the posteroventral margin of the pleura of the fourth and fifth abdominal somites (rounded in fourth and pointed in fifth) brings S. brucei closer to S. profundus Cleva, 1990, which was previously the only species of the genus with this character (Cleva 1990: 83, 87). Stylodactylus profundus may be distinguished from the new species by the following characters.

A - The rostral spines are smaller and homogenous in size, and more than 46 dorsal spines are present.

B - The rostrum is less curved.

C - The ratio of rostrum/carapace lengths is smaller: 1.2 versus 1.5 to 1.9.

D - The supraorbital spine is present but very small.

E - The telson has five pairs of dorsal spines.

F - The proportions of the articles of the last three pairs of pereiopods are very different.

G - It is much smaller in size.

Distribution. Northwest Australia, 900-1000m; south-west Pacific, Wallis Island, 820-840m.

Stylodactylus bathyalis sp. nov. (Fig. 2A-E)

Material examined. HOLOTYPE - male, 127 mm, St. 17.1, CIDARIS III, FRV Franklin, Coral Sea, Bligh Canyon, 12°23'S 146°08'E, 3515-3502 m, 16 February 1992, coll. M. Pichon, A. Birtles and P. Arnold, QM W. 13594.

Description. Carapace pubescent. Cervical and hepatic grooves well marked. Upper part of branchial region marked by well developed carina. Supraorbital spine absent, antennal and branchiostegal spines present (Fig. 2A).

Rostrum distinctly curved upward, more than 1.7 times longer than the carapace, lacking distal end; proximal portion with 31 dorsal spines, including 10 smaller more regularly placed spines situated on the dorsal margin of carapace proper, anterior to the level of the posterior margin of orbit (post-rostral spines); 21 ventral spines, longer than dorsal spines, most proximal spine situated at level of proximal third of second segment of antennular peduncle (Fig. 2A).

Third to fifth abdominal segments with feecile dorsal carina; with spine at middle of ventral margin of third and fourth pleura, spine slightly more posteriorly on fifth pleuron (Fig. 2B). Sixth segment about 1.7 times longer than fifth. Telson with acutely pointed posterior margin, about 1.7 times longer than sixth segment, about 5.0 times longer than maximum width, dorsal surface with two rows of 10 and 11 small spines along crests of longitudinal carinae (Fig. 2C).

Eyes very small, with cornea reduced, unpigmented, less wide than ocular peduncle. Antennular peduncle exceeding scaphocerite. Scaphocerite reaching to 0.8 of length of second segment of peduncle; first article with distally acute stylocerite, its tip reaching middle of segment length; second segment about same size as proximal; third segment much shorter than lengths of proximal segments, about 0.25 of length (Fig. 2D). Scaphocerite about 4.5 times longer than wide, with very small spines proximolaterally, with larger mobile, distolateral spine, not exceeding anterior border of lamella.
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Fig. 2 Stylodactylus bathyalis sp. nov., male holotype, QM.W.13594. A, cephalothorax; B, abdomen and telson; C, telson; D, left antennula; E, first pleopod. Scalebar = 5 mm.
Mandible with well developed palp, with two segments. Second maxillipeds with distoventral segment longer than distodorsal segment. Third maxilliped exceeding tip of scaphocerite by terminal segment and distal third of penultimate segment.

First pereiopods with only right pereiopod preserved, detached, and probably exceeding scaphocerite by chela and about distal third of carpus.

Second pereiopods both preserved, right pereiopod still attached, exceeding scaphocerite by chela and about 0.2 of carpus.

Third to fifth pereiopods missing or very incomplete, third pereiopod represented only by part of left ischiomerus still attached, indicating that distal end of this segment greatly exceeds scaphocerite, with series of strong lateral spines (six on remaining part); fourth pereiopod with part of left ischiomerus only, attached, with which may be associated one detached fragment (distal ischiomerus, carpus and part of propod), ischiurn and merus separated by distinct suture, end of segment distinctly exceeding scaphocerite, with total of 14 mobile lateral spines, in two rows, with three medial spines, one distodorsal spine. Also present one detached pereiopod, incomplete, lacking part of propod and dactyl, apparently from left side, probably the left fifth pereiopod; ischium and merus separated by distinct suture, merus distinctly smaller than in third and fourth pereiopods, exceeding scaphocerite, with 11 lateral spines, two medial spines, one distodorsal spine.

Anterior abdominal sternites without strong median spines.

First pleopod with endopod very well developed (Fig. 2E).

**Measurements.** Total body length 127 mm; postorbital carapace length 23.5 mm.

**Colouration.** Live colour unknown.

**Etymology.** The term “bathyalis” indicates the deep-sea habitat of this new species.

**Distribution.** North-east Australia, Coral Sea, 3502-3515 m.

**Remarks.** On account of the characteristics of its minute and unpigmented eyes, and last three pairs of legs which, though unfortunately incomplete, appear to be thin and very long, this new species of the genus *Stylodactylus* can not be confused with any other species. The depth of capture, which exceeds by far that previously known for the genus (1618-1740 m for *Stylodactylus profundus* Cleva, 1990, described from New Caledonia) accounts, without doubt, for its peculiarities.

*Stylodactylus licinus* Chace, 1983

*Stylodactylus licinus* Chace, 1983: 14, fig.6. - Hayashi in Baba, Hayashi and Toriyama 1986: 93, fig. 52 (colour photograph); - Cleva 1990: 87, fig.3a-j, 18f, g - Hayashi 1991: 41.

*Stylodactylus tokarensis* Zarenkov, 1968: 58 (pro parte), fig. 2 (third pereiopod) and fig. 3 (other drawings of fig. 2 are of *Stylodactylus tokarensis* Zarenkov, 1968).


**Material examined.** 1 female, 17 mm, North West Shelf, FRV *Soela*, st. 91, 18° 36.1'S 117°16.6'E, 472 m, 16 August 1983, T. Davis coll., NTMCr.000543. I female (ovig.), 16 mm, FRV *Soela*, st. 16, 18°37.45'E 117°02.4'E, 504-508 m, 31 January 1984, T.Ward coll., NTM Cr.004222. 1 male, 12 mm, 1 female (ovig.), 11 mm, FRV *Soela*, st. 51, 18°06.8'S 118°06.0'E, 448 m, 2 February 1984, A.J. Bruce coll., NTM Cr.001186. 1 female (ovig.), 13 mm, FRV*Soela*, st. 0184-33, 17°30.5'S 118°41.9'E, 505 m, 3 February 1984, T. Ward coll., NTM Cr.006877. 1 male, 9.5 mm, FRV *Soela*, st. 57, 17°13.1'S 118°28.9'E, 504-506 m, 3 February 1984, A.J. Bruce coll., NTM Cr.000707. 1 male, 8.5 mm, 1 female (ovig.), 12.5 mm, FRV *Soela*, st. 67, 16°18.1'S 120°18.7'E, 496-500 m, 5 February 1984, A.J. Bruce coll., NTM Cr.001184. 2 males, 14.0-14.5 mm, FRV *Soela*, st. 0184-85, 14°52.0'S 121°40.8'E, 452-456 m, 5 February 1984, T. Ward coll., NTM Cr.004221. 1 male, 13 mm, 1 female (ovig.), 13 mm, FRV *Soela*, st. 67, 16°18.1'S 120°18.7'E, 496-500 m, 5 February 1984, A.J. Bruce coll., NTM Cr.001184. 2 males, 14.0-14.5 mm, FRV *Soela*, st. 0184-85, 14°52.9'S 121°40.8'E, 470-540 m, 25 January 1988, B. Wallner coll., NTM Cr.007058. 1 female (ovig.), 16 mm, 1 female (ovig.), 16 mm, 2 females (ovig.) 12.5-13 mm, FRV *Territory Pearl*, st. 59, 13°26.3'S 122°21.4'E, 470-540 m, 25 January 1988, B. Wallner coll., NTM Cr.007059 and Cr.006873. 1 female (ovig.), 14 mm, off Great Barrier Reef, FRV *Soela*, st. 0683-36, 19°55.8'S 150°31.1'E, 879-886 m, 24 November 1985, NTM Cr.006883.
The individual variation noted in the six males and 11 females here identified as *S. licinus* complete and expand that already observed from the material from the Philippines and New Caledonia area (Cleva 1990: 88, 95). The variations concern mostly the relative length of the rostrum and the rostral formula. In the female NTM Cr.000543, the largest specimen known, the rostrum/carapace ratio does not reach 1.4; the rostrum of the male NTM Cr.001184 has 33 dorsal spines and only 12 ventral, the lowest numbers observed so far for this species.

**Distribution.** *Stylodactylus licinus* is known from the Philippines (550-970 m), New Caledonia (780 m), the Chesterfield Islands (650-970 m) and Fiji (494 m). Hayashi (1986) reported it from Japan (Tosa Bay, 432 m), and more recently (1991) from off Kagoshima, southern Kyushu, at 808-826 m. It is recorded here for the first time from Australia, where it was collected between 222 and 1000 m, minimal and maximal depths for the species, indicating a wide bathymetric distribution.

**Stylodactylus multidentatus multidentatus**

*Kubo, 1942*

**Stylodactylus multidentatus** Kubo, 1942: 34, fig. 4, 5; - Hayashi and Miyake 1968: 586, fig. 1; Miyake 1982: 26, pl. 9, fig. 5 (colour photograph); - Chace 1983: 11 (key), 20, fig. 8a-0; - Chan and Yu in Baba, Hayashi and Toriyama 1986: 93, fig. 53 (colour photograph); - Kinsley, Tranter and Griffin 1987: 293.

**Stylodactylus multidentatus multidentatus** - Cleva 1990: 100, fig. 7, 8h-m.

**Stylodactylus discissipes** - Balss 1933: 84 (nec Bate, 1888).

**Stylodactylus bimaxillaris** - Miyake 1982: pl. 9, fig. 4 (nec Bate, 1888).

**Stylodactylus brevidactylus** - Cleva 1990: 106, fig. 8a-g.

**Material examined.** 5 females (ovig.), 18-20 mm, North West Shelf, FRV *Soela*, st. 35, 19°19.2'S 115°41.6'E, 348-352 m, 29 January 1984, A. J. Bruce coll., NTM Cr.001183. 2 males, 16.5-19.0 mm, FRV *Soela*, st. 0184-20, 18°55.0'S 117°05.5'E, 296 m, 31 January 1984, T. Ward coll., NTM Cr.006879. 1 male, 19 mm; 4 females, 14.0-18.5 mm, FRV *Soela*, st. 45, 18°55.0'S 117°05.5'E, 298-294 m, 31 January 1984, T. Davis coll., NTM Cr.000711. 15 males, 12.5-18.5 mm; 14 females (9 ovig.), 13-18 mm, FRV *Soela*, st. 0184-29, 18°10.15'S 118°14.4'E, 302 m, 2 February 1984, T. Ward coll., NTM Cr.006875. 1 female (ovig.), 15 mm, FRV *Soela*, st. 0184-66, 14°28.9'S 122°01.8'E, 300 m, 12 February 1984, T. Ward coll., NTM Cr.006882. 1 female (ovig.), 15 mm, FRV *Soela*, st. 0184-74, 14°15.5'S 122°36.3'E, 302 m, 14 February 1984, T. Ward coll., NTM Cr.006880. 2 females (1 ovig.), 11.0-14.5 mm, off Great Barrier Reef, FRV *Soela*, st. 0685-03, 22°34.8'S 153°38.7'E, 314-319 m, 16 November 1985, NTM Cr.006886. 1 female, 19 mm, FRV *Soela*, st. 0685-12, 22°55.1'S 153°00.5'E, 338-325 m, 18 November 1985, NTM Cr.006881. 2 females, 15-16 (ovig.) mm, FRV *Soela*, st. 0685-16, 22°10.55'S 153°30.3'E, 344-325 m, 19 November 1985, NTM Cr.006876. 3 males, 17.5-18.5 mm; 1 female (ovig.), 20 mm, FRV *Soela*, st. 0685-19, 21°32.25'S 152°58.3'E, 237-247 m, 20 November 1985, NTM Cr.006878. 1 female (ovig.), 12 mm, FRV *Soela*, st. 0685-21, 21°27.8'S 153°28.3'E, 412-403 m, 21 November 1985, NTM Cr.006882. 2 females, 10.5-12.5 mm, FRV *Soela*, st. 0685-24, 20°46.4'S 152°35.5'E, 350-362 m, 22 November 1985, NTM Cr.006887. 3 females (1 ovig.), 18.0-19.5 mm, Timor Sea, 9°46'S 129°54'E, 298 m, 22 September 1987, NT Fisheries coll., NTM Cr.006135. 3 females (ovig.), 19.0-21.5 mm, Arafura Sea, 9°46'S 130°00'E, 244-300 m, November-December 1987, T. Bradley coll., NTM Cr.006223. 1 male, 18 mm; 1 female (ovig.), 18.5 mm, FRV *Territory Pearl*, st. A2, 9°49'S 130°07'E, 260-280 m, 16 January 1988, B. Wallner coll., NTM Cr.007057.

Sixty-three specimens (22 males and 41 females, 29 ovigerous) are here identified as *Stylodactylus multidentatus* Kubo, 1942. This species, widely distributed throughout the Indo-Pacific, seems to exhibit geographical variation, as established for the Malagasian populations, elevated to the sub-species *Stylodactylus multidentatus robustus* Cleva, 1990. This could be investigated more thoroughly for the populations of New Caledonia (Cleva 1990: 105 and 104).

On the other hand, after considering the variability recently observed in 45 specimens of *S. multidentatus multidentatus* Cleva, collected from the Moluccas in 1991 during the French-Indonesian KARUBAR expedition, I have decided to synonymise *Stylodactylus brevidactylus* Cleva, 1990, with *S. multidentatus multidentatus*.

The Australian specimens seem to belong to the nominal sub-species; the individual variations observed closely resemble those noted in...
the Philippine material from the MUSORSTOM expeditions (Cleva 1990: 101). It is worth noting that the rostrum/carapace ratio varies between 1 and 1.25, just a bit more than in the Philippines specimens.

**Distribution.** Common in a wide area of the Indo-West Pacific (Cleva 1990: 105), this species has also been reported from eastern Australia (New South Wales: Kensley, Tranter and Griffin 1987: 293), where it was collected at 356 m. These new collections occurred between 237 and 412 m.

**Genus Neostylodactylus** Hayashi and Miyake, 1968


Two species of the genus *Neostylodactylus*, *N. amarynthis* (de Man, 1902), and *N. investigatoris* (Kemp, 1925), were identified in the Australian material. The large number of specimens in the first species (11 males and 29 females) makes it possible to confirm the sexual dimorphism of the branchial formula, reported initially by Chace (1983: 6): absence in the females, unlike the males, of arthrobranchs on pereiopods 1 to 4. Nevertheless, two females out of 29 (2.5 and 3 mm, NTM Cr.007196) possess well developed arthrobranchs on pereiopods 1 to 4, on both sides.

These observations reveal some exceptions to this surprising dimorphism, which has also been reported in *N. affinis* Hayashi and Miyake, 1968 (Cleva 1990: 111).

The new data obtained from this additional material leads me to modify the key for the identification of the species of the genus proposed in the revision of the family (Cleva 1990: 112).

**Key to species of the genus Neostylodactylus**

1a. Rostrum with two or more ventral spines; abdominal pleura with one or more marginal denticles, at least on fourth and fifth somites .............................. 2

b. Rostrum unarmed ventrally; pleura of first five abdominal somites without marginal denticles .................................................. 3

2a. Pleura of all abdominal somites with marginal denticles; sixth abdominal somite with one strong lateroventral spine situated in the centre; telson usually with five pairs of dorsal spines; lateral spinules of antennal scale well developed; endopodite of uropods with well developed proximolateral lobe .......... *N. amarynthis* (de Man, 1902)

b. Pleura of first two abdominal somites without marginal denticles; sixth abdominal somite without spine in centre; spinules of antennal scale minute; endopodite of uropods without well developed proximolateral lobe .......... *N. affinis* Hayashi and Miyake, 1968

3a. Telson with three pairs of dorsal spines; eye provided with secondary cornea ("ocellus"); dactyls of last three pairs of pereiopods slender, those of third between 2.2 and 2.8 times shorter than propodus ........................ N. investigatoris* (Kemp, 1925)

b. Telson with five pairs of dorsal spines; eye without secondary cornea; dactyls of third to fifth pereiopods short and robust, those of third about 4.5 times shorter than the propodus .......... *N. sibogae* (de Man, 1918)

**Neostylodactylus amarynthis** (de Man, 1902) (Fig. 3)

*Stylodactylus* sp. (*amarynthis*) de Man, 1902: 897, pl. 27, fig. 64a-b.

*Stylodactylus Amarnthis* - De Man 1920: 32, pl. 5, fig. 9a-h.

*Stylodactylus amarynthis* - Kemp 1925: 258; - Holthuis 1955: fig. 12.

*Neostylodactylus amarynthis* - Hayashi and Miyake 1968: 603, fig. 6; - Chace 1983: 4, fig. 1-3; - Cleva 1990: 112.

**Material examined.** 5 males, 2.5-3.0 mm, North West Shelf, FRV *Soela*, st. 0183-B04, 19°05.1'S 118°53.4'E, 83 m, 15 February 1983, T. Ward coll., NTM Cr.006889. 5 females (3 ovig.), 2-3 mm, same data, NTM Cr.006890, 2 females, 1.5 mm, FRV *Soela*, st. 0283-B06, 19°04.5'S 118°47.3'E, 83 m, 27 April 1983, NTM Cr.006893. 7 females, 1.5-2.5 mm, same data, NTM Cr.006894, 1 male, 3 mm, FRV *Soela*, st. 0283-B06, 19°04.5'S 118°47.8'E, 82 m, 28 April 1983, NTM Cr.006892. 2 males, 2-3 mm; 7 females, 1.5-2.5 mm, FRV *Soela*, st. 0283-B10, 19°05.0'S 118°57.2'E, 83 m, 28 April 1983, NTM Cr.006895. 1 female, 3 mm, FRV *Soela*, st. 0483-B02, 19°56.3'S 117°53.9'E, 44 m, 26 August 1983, NTM Cr.006898. 3 males, 1.8-2.5 mm; 7 females (1 ovig.), 1.5-3.0 mm, FRV *Soela*, st. 0583-D04, 19°29.6'S 118°52.2'E, 36-38 m, 25 October 1983, NTM Cr.007196.
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The rostrum carries 9-24 dorsal spines (including postrostral spines) and 2-7 ventral spines; the lowest numbers refer to the smallest specimens.

Of the 35 specimens with an intact telson, 24 bear five pairs of dorsal spines, four others four pairs, two others five and four spines, two others four and three, and three others 3-5, 5-7, and 3-3 spines. Among the 11 specimens showing an unusual number of spines, eight have a carapace length less than 2 mm.

The presence of two fixed spines on the distolateral extremity of the exopodite of the uropods is not constant; most often, only one is present (the more external one), the second one then being absent or barely noticeable. This can be observed especially in small specimens (carapace length equal to or less than 2 mm), which would seem to show that the second fixed spine develops with the growth of the animal. The same applies to the suture line between the ischium and merus of the fifth pereiopods, which is rarely clearly visible.

The sexual dimorphism also affects the shape of the abdominal pleura, as evidenced in Figures 3A and 3B. This dimorphism is, however, less marked in small or very small specimens.

Distribution. Reunion, Andaman Islands, Indonesia, Philippines and Japan, between 9 and more than 120 m (Cleva 1990: 113); this species now known from north-west Australia, where it was collected between 36-38 and 83 m.

**Neostylodactylus investigatoris** (Kemp, 1925)

*Sstylodactylus investigatoris* Kemp, 1925: 260, figs 1-2.


Material examined. 1 female, 2 mm, North West Shelf, FRV *Soela*, st. 0183-B04, 19°05.1'S 118°53.4'E, 83 m, 15 February 1983, T. Ward coll., NTM Cr.010908. 1 female (ovig.), 2 mm, FRV *Soela*, st. 2, 19°04.3'S 119°01.1'E, 84 m, 19 April 1983, A.J. Bruce coll., NTM Cr.000432. 1 female, 1.5 mm, FRV *Soela*, st. 0283-B06, 19°04.5'S 118°47.3'E, 83 m, 27 April 1983, T. Ward coll., NTM Cr.010909.

The three specimens examined are in bad condition, two are totally lacking their five pairs of pereiopods, and the third, relatively intact, has been visibly dessicated. But the identification of the latter does not pose any problems, as it corresponds well to the description and the drawings of Kemp, and A. J. Bruce had previously identified it as belonging to this species before me. The rostrum of this specimen (NTM Cr.000432) carries 14 dorsal spines, four of them postrostral (12 dorsal spines in the holotype, 19 in the specimen studied by Hayashi and Miyake), the telson has three pairs of dorsal spines, the dactyls of the last three pairs of pereiopods are slender, those of the third being about 2.5 times and less than 3 times shorter than the propodus.

The telson of the other two specimens also has three pairs of dorsal spines, the rostrum of the largest bears 17 dorsal spines (four of which postrostral), and that of the smallest has a broken tip.

A secondary cornea, small but well marked, can be seen on these three specimens, as Hayashi and Miyake pointed out as being characteristic (1968: 609), on the dorsal face of the peduncle, just behind the main cornea, this last being well developed and well pigmented. It looks as if the ocular peduncle is without the plumose setae present in *N. amarynthis* and *N. affinis* (this is tentative, considering the bad state of the specimens examined); this feature seems to apply also to *N. sibogae* (de Man 1918).

Distribution. Mergui Archipelago, 73 m; Straits of Korea, 110 m; north-west Australia, 83 m.
Genus *Parastylodactylus* Figueira, 1971


*Parastylodactylus bimaxillaris* (Bate, 1888)

*Stylodactylus bimaxillaris* Bate, 1888: 855, pl. 138, fig. 3; - Calman 1939: 188; - Hayashi and Miyake 1968: 599, fig. 5; - Miyake 1982: 25 (nec pl. 9, fig. 4 = *Stylodactylus multidentatus* Kubo, 1942).

*Parastylodactylus bimaxillaris* - Chace 1983: 8, fig. 4; - Chan and Yu 1985: 289, pl. I A-D (colour photographs); - Cleva 1990: 114, 115, fig. 11a, 12a.


Nec *Stylodactylus bimaxillaris* - Miyake 1982, pl. 9, fig. 4 (= *Stylodactylus multidentatus* Kubo, 1942).

Material examined. 1 female (ovig.), 8 mm, North West Shelf, FRV *Soela*, st. 0184-69, 14°19.4'S 129°53.4'E, 450 m, 13 February 1984, NTM Cr.006411. 2 females (ovig.), 8-9 mm, FRV *Soela*, st. 0184-110, 16°55.7'S 119°53.1'E, 434 m, 22 February 1984, T. Ward coll., NTM Cr.006885.

These three specimens conform well to earlier descriptions. It should be noted, however, that on the single specimen with an intact rostrum, there are 17 dorsal rostral spines (six on the carapace) and four ventral spines; the first number seems to be the smallest so far noted in this species.

Distribution. Known from many areas of the Indo-West Pacific, between 106 and 500 m (Cleva 1990: 118), *Parastylodactylus bimaxillaris* had never before been recorded from Australia.

*Parastylodactylus semblatae* Cleva, 1990

*Parastylodactylus semblatae* Cleva, 1990: 122, fig. 12e, 14, 18e.


Material examined. 1 female (ovig.), 6 mm, st. 43-2, off Great Barrier Reef, 17°34.58'S 146°53.21'E, 458-500 m, 15 May 1986, Cidarisis 1 (Ref. 353) expedition, NTM Cr.010910.

This specimen, with broken rostrum and telson, has been assigned to this species recently described from New Caledonia and Chesterfield Islands. Nonetheless, some caution is called for, because of the state of the specimen and also because the merus of the fourth pereiopods carries two or three lateroventral spines, unlike all other specimens examined for the original description, which had only a single spine at the level of this segment; this character was integrated in the key for the identification of the species of the genus *Parastylodactylus* (Cleva 1990: 115).

Distribution. New Caledonia and Chesterfield Islands (260-630 m), north-east Australia (458-500 m). Hayashi (1991) has recently reported it from Japan (one female from East China Sea, 255 m; one male and two ovigerous females from Taiwan) but his material differs from the original description in:

- the upper margin of the rostrum has a smaller number of spines.
- the ischio-merus of the third walking leg lacks a strong posterior proximal spine.
- the articulation is distinct between the ischium and merus of the fourth walking leg.

These differences, and the figure given by the author, lead me to consider that some confusion has been made with *P. bimaxillaris* (Bate).

Genus *Stylodactyloides* Cleva, 1990

*Stylodactyloides Cleva, 1990: 129.*

*Stylodactyloides crosnieri* Cleva, 1990

*Stylodactyloides crosnieri* Cleva, 1990: 129, figs. 17, 18d-e.

Material examined. 1 female, 9 mm, off Great Barrier Reef, Coral Sea, FRV *Soela*, st. 33, 19°55.7'S 151°44.35'E, 357 m, 23 November 1985, A.J. Bruce coll., NTM Cr.004985.

The very particular characters that were used to define *Stylodactyloides crosnieri* and, as a consequence, the new genus *Stylodactyloides*, enabled me to identify this specimen easily. The stylocerite is short and its extremity is widely rounded, the distal lobe of the carpus of the last three pairs of pereiopods carries a spine, the mandibular palp consists of a single article, and the antennal scale is long and narrow, with its margins sub-parallel.

The rostral formula of this specimen, 43 dorsal spines (eight on the carapace) and 18 ventral ones, and the ratio of rostrum/carapace lengths (1.9), fit in with the variations noticed in the original description (Cleva 1990: 131). The
Some Australian Stylodactylidae

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I would like to thank them here very sincerely.

REFERENCES


Man, J.G. DE. 1902. Die von Herrn Professor Kükenthal im Indischen Archipel gesammelten


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A NEW GENUS OF DEEP-SEA MAJID CRAB: **GRIFFINIA** GEN. NOV.  
(CRUSTACEA, DECAPODA, BRACHYURA).

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New Caledonia.

ABSTRACT

A new record from north-western Australia permits the description of the first male of *Griffinia lappacea* (Rathbun, 1918) comb. nov. The morphological features and the shape of the first pleopod merit the creation of a new genus for this deep sea species: *Griffinia* gen. nov. This new genus includes two other Pacific species, *G. gilloloensis* (Rathbun, 1916) and *G. polita* (Griffin and Tranter, 1986).


INTRODUCTION

In 1990, I found among the deep-sea material preserved in the Northern Territory Museum, three specimens of majid crabs from north-western Australia belonging to *Antilibinia lappacea* Rathbun, 1918. This species is very rare and not well known. Rathbun (1918) described it from a single female specimen from the Great Australian Bight. Barnard (1950), commenting on the South African species *Antilibinia smithii* MacLeay, 1838, remarks that *lappacea* "does not seem ... to fit well into this genus".

In their preliminary work, listing the very rich material collected by the MUSORSTOM I cruise in the Philippine Islands (Forest, 1981), Serène and Vadon (1981) mentioned one female specimen of a "*Pisidarum* sp". These authors considered it to be an unknown species belonging to a new genus. The name *Pisidarum* means only "genus belonging to Pisidae" (D. Guinot in litt.).

Griffin and Tranter (1986) found another female specimen from Kai Islands (Indonesia) and remarked that it looked very similar to the *Pisidarum* sp. of Serène and Vadon. In the remarks about the affinities of their new species *A. polita*, Griffin and Tranter noted that "a new genus may be required for the western Pacific species".

After having examined the holotype and the first known male of *Antilibinia lappacea*, I think that the specimen from north-western Australia and the holotype belong to the same species (which does not belong to the genus *Antilibinia*). The holotype of *A. gilloloensis* Rathbun, 1916, and a male specimen of *A. smithii* MacLeay, 1838, from South Africa, were also examined. Therefore, it is necessary to separate the Pacific species (*A. lappacea*, *A. gilloloensis*, *A. polita*) from the type species *A. smithii*, and create for them a new genus, *Griffinia* gen. nov.

Abbreviations: AM = Australian Museum, Sydney; MNHN = Muséum national d’Histoire naturelle, Paris; NTM = Museums and Art Galleries of the Northern Territory; SAMA = South African Museum, Capetown; USNM = National Museum of Natural History, Washington. Measurements are in mm; the lengths are without rostrum.

Super-family Majoidea Samouelle, 1819  
Family Majidae Samouelle, 1819  
Sub-family Epialtinae MacLeay, 1838  
*Griffinia* gen. nov.

*Antilibinia* - Rathbun 1918: 12; Hale 1927: 133; Griffin 1966: 267; Griffin and Tranter 1986: 70 (pro-part: only *A. lappacea*).
Fig. 1. *Griffinia gilloloensis* (Rathbun, 1916) comb. nov., male holotype 13.1 x 10 mm (USNM 48205). A, dorsal view; B, dorsal view of carapace.
North-western Australian deep-sea majid crabs

ne Antilibinia MacLeay, 1838: 56; Krauss 1843: 49; Stebbing 1910: 287; Stebbing 1918: 49; Rathbun 1916: 537; Barnard 1950: 36; Sakai 1965: 43; Sakai 1976: 201.

Diagnosis. A small species, less than 20 mm. Carapace pyriform, surface smooth, covered by long, thin, spaced hairs; without spines or tubercles. Rostrum composed of two divergent spines. Orbit very open, defined by strong, acute, preocular spine joining a very narrow supraocular cleft ending in small, blunt, postocular spine. Basal antennal article longer than broad. Lateral border of the carapace with granules. One hepatic tooth, well developed in G. lappacea. Border of the pterygostomian area serrulate. Cheliped merus, carpus and propodus carinate in the male. Short ambulatory legs, cylindrical in cross-section. Abdomen with seven segments in male and six in female (fifth and sixth fused), first pleopod of male thin and straight, distally battened with an apical opening.

Etymology. Dedicated to Dr. D. J. G. Griffin, who recognized that the genus Antilibinia was heterogeneous.

Type species. Griffinia lappacea (Rathbun, 1918).

Griffinia gilloloensis (Rathbun, 1916)  
(comb. nov.)  
(Figs 1A-B, 2A)

Antilibinia gilloloensis Rathbun, 1916: 537; Rathbun 1918: 13; Sakai 1965: 43, fig. 2; Sakai 1976: 201, fig. 109; Griffin and Tranter 1986: 70.

Material Examined. 1 male holotype 13.1 x 10 mm (USNM 48205), Philippines, between Jolo and Makyam Islands, RV Albatross, st. 5624, 0°12'15"N - 127°29'30"E, 535 m, 29 November 1909 (M. J. Rathbun det. Antilibinia foloensis).

Remarks. Griffinia gilloloensis has a short, round shell with long, dispersed setae. The rostral spines are very short, the supraocular spines are short and there is an hepatic tubercle. The pereopods have setae.

The carapace is shorter in G. gilloloensis than in G. lappacea; the rostral spines and supraocular spines are shorter too. In G. gilloloensis there is only an hepatic tubercle but there is a very long, blade-like sub-hepatic spine in G. lappacea.

Rathbun (1916) described this species without any illustrations and placed it in the genus Antilibinia without discussion. The only previously published figure is in Sakai's (1965, 1976) work on Japanese specimens.

Distribution. Philippines and Japan.

Griffinia lappacea (Rathbun, 1918)  
(comb. nov.)  
(Figs 3A-D, 4B-C)

Material Examined. AUSTRALIA: Great Australian Bight, S of Eucla, 32°S 129°60'E, 366-548 m, 5 April 1913, RV Endeavour, ovigerous holotype, 12.8 x 9 mm, AM E.3659; north-western Australia, CSIRO cruise 0184, FRV Soela, Stn 44, 16°18.1'S 120°18.7'E, 496-500 m, 5

Fig. 2. Male first sexual pleopod. A, Griffinia gilloloensis; B, C, Antilibinia smithii.
February 1984, 1 male, 12 x 9.4 mm, NTM Cr.000931; FRV Soela, Stn 61, 14°40.7'S 121°26.7'E, 503 m, 12 February 1984, 2 ovigerous females, 13.6 x 9.5 mm, 12.6 x 9.3 mm, NTM Cr.008505. INDONESIA, East Tanimbar Islands: Karubar cruise, st. CP 38, 7°38'4''S 132°29'22''E, 620-670 m, 28 October 1991, 1 ovigerous female, 13.2 x 9.2 mm, MNHN B 22508; Karubar cruise, st. CP 39, 7°45'43''S 132°28'22''E, 466-500 m, 3 ovigerous females, 13.5 x 9.7 mm, 12.3 x 8.6 mm, 13 x 9.5 mm, MNHN B22506.

Fig. 3. Griffinia lappacea (Rathbun, 1918) comb. nov., male 12 x 9.4 mm. A, dorsal view; B, lateral view; C, general view; D, first pleopod, apical part.
Description. The following description, based on the 12 x 9.4 mm male, is the complement to Rathbun's 1918 description of the female holotype. A small species (<20 mm), carapace pyriform, regularly rounded and without spines, area non-delimited, entirely covered by very long setae, straight and widely dispersed. Bifid rostrum, with two long sharp spines divergent into a V, setae present.

Orbit widely open with small eyes borne on short peduncles. One very strong preocular spine, slightly curved, pointing upward; small blunt post-ocular tooth very close to ocular peduncle. Sub-hepatic area surrounded by very long, flattened, curved blade-like spine, directed forward and upward (Figs 3B, 4C). Anterior border of branchial zone underlined by several large granules. Basal antennal article wide, with flat ventral side. Epistome longer than wide. Superior border of buccal cavity with three fissures, the median fissure deeper than others. Third maxilliped without spines, merus edge serrulate. Chelipeds of male strong, with an inflated propodus, carinate at its superior edge; carpus with high foliate carina; merus also carinate, carina higher proximally and distally.

Ambulatory legs long and slender; first ambulatory legs longer than chelipeds; legs diminishing in size from first to fourth pair; articles sub-cylindrical. Merus from second to fifth percopod with bump on distal superior edge, spiniform on second. Dactyli long and sharp.

Male abdomen composed of seven segments (abdomen of adult female with six segments, five and six fused). Male pleopods straight, slender, with flattened extremity, sharp tip and sub-apical opening (Fig. 3D).

Distribution. South and north-western Australia, Philippines, Indonesia (Kai Islands).

Griffinia polita (Griffin and Tranter, 1986) comb. nov.

Antilibinia smithii MacLeay, 1838 (Figs 2B-C, 4A)

Antilibinia smithii MacLeay, 1838: 57, pl. 2; - Krauss 1843: 49, pl. 3; Stebbing 1893: 117; Stebbing 1910: 287; Stebbing 1918: 49; Rathbun 1916: 537; Rathbun 1918: 13; Barnard 1950: 38, fig. 7c-d; Griffin 1966: 267; Sakai 1976: 201; Griffin and Tranter 1986: 70.

Material Examined. South Africa, Coffee Bay, 31°59'4"S 29°9'4"E, "Caught on rocks just above deep pool at low tide", R. E. Stobbs coll., 5 November 1972, 1 male 55.7 x 52.4 mm, SAMA 13381.

Remarks. Large species. Shell rounded and flattened. Very short rostral spines. Strong, curved antero-lateral spines. Two strong spines on postero-lateral border, one cardiac and one branchial area of the shell well delimited. Gastric area and anterior part of branchial area tuberculate. Chelipeds without carinae. Ambulatory legs short with strong articles. First male pleopod long and straight, tip with two points (Fig. 2B-C).

DISCUSSION

The genus Antilibinia was described by MacLeay (1838) based on a large species (72 x 67 mm), A. smithii, from shallow waters of South Africa. Rathbun (1916, 1918) placed the genus Antilibinia in the sub-family Acanthonychinae. The genus contained three species: A. smithii MacLeay, 1838, A. gilloloensis Rathbun, 1916 and A. lappacea Rathbun, 1918. Barnard (1950) put this genus in the family Acanthonychidae and pointed out that the deep-water species of South Australia, A. lappacea, seems misplaced in the genus.

According to Garth (1958), the genus Antilibinia is clearly in the sub-family Acanthonychinae. However, Serène and Vadon (1981) thought that their specimen of "Pisidarum" belongs to the sub-family Pisinae. But, curiously, we can read in the same text "Pisidarumsp. est un specimen ne correspondant à aucun des genres de Pisidae, voire de Majoidea. décrit à ce jour".
Griffin (1966) placed Antilibinia in the subfamily Acanthonychinae, characterized by an "eye stalk short, little moveable and either concealed by a preorbital spine or sunk in sides of rostrum". In 1986, Griffin and Tranter put this genus in the sub-family Epialtinae characterized by "a sunken orbit and short, often immobile, eyestalks and many species have a prominent beaked rostrum"; they also pointed out the diversity in male pleopods of this group. The Epialtinae was by then recognised as the correct name for what had been referred to previously as the Acanthonychinae.

Griffin and Tranter (1986) described another species in the genus Antilibinia, A. polita, and proposed to create a new genus for the Pacific species.
The new genus *Griffinia* differs from *Antilibinia* by the following characters:

- *Griffinia* is composed of small species, but the single species of *Antilibinia* is large;
- a subpyriform carapace without a marked area present in *Griffinia*, subcircular with well defined zones in *Antilibinia*;
- carapace compressed, with two strong branchial and antero-lateral spines in *Antilibinia*; in *Griffinia* the carapace is not compressed and has only one lateral spine in the hepatic area;
- female abdomen with seven segments in *Antilibinia* and only six in *Griffinia*;
- long, thin ambulatory legs, articles of chelipeds carinate in *Griffinia*, in *Antilibinia* the ambulatory legs are thick and relatively short, and the cheliped of the male is stout with rounded edges;
- chelipeds shorter than the first ambulatory legs in *Griffinia*; longer in *Antilibinia*;
- first male pleopod with one apical spine in *Griffinia* and with two terminal spines in *Antilibinia*.

Finally, all *Griffinia* species are from deep waters and *Antilibinia* is from shallow water. The morphological differences between *Antilibinia smithii* and the *Griffinia* species (*G. giloloensis*, *G. lappacea*, *G. polita*) are very significant.

In their extensive work on the Majidae of the Siboga-Expedition, Griffin and Tranter (1986) described a fourth species in the genus *Antilibinia*, *A. polita*, with a female holotype and a male juvenile paratype (6.5 mm). These authors recognised that the genus is heterogeneous. They remark that *A. polita* has characters in common with *Huenia De Haan, 1839*, and only six in *Griffinia*:

- the anterior male pleopod is of *Pugettia*, *Sakai (1965, 1976) said "As in the *Silloloensis*, *Latreille, 1825*. Similar to that of *Antilibinia, A. polita*, the male of *A. smithii* has a first pleopod in common with *Huenia* De Haan, 1839, and only six in *Griffinia*.

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B. Richer de Forges

Biological Laboratory, Imperial Household, Tokyo;
Samouelle, G., 1819. *The entomologist's useful compendium; or an introduction to the knowledge of British insects, etc.* London.

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MAYANG: THE TRADITIONAL FISHING VESSEL OF JAVA.

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ABSTRACT

A survey is provided of the various regional types of the traditional Javanese fishing vessel, generally called the mayang. Ten distinct types are described in detail, these are the kolek, the compleng, the seroto, the sopek, the jegongan, the Jepara sopek, the konteng, the ijon ijon, the eder and the jangraja. Some types show influence from the boat building traditions of peninsular Malaysia and other areas. The mayang building tradition is regarded as a distinct element within the overall boat building tradition of mainland Southeast Asia and Western Indonesia and separate from the boat building traditions of Eastern Indonesia.

KEYWORDS: Javanese fishing vessel, boat building, mayang, Southeast Asia, Indonesia, maritime archaeology.

INTRODUCTION

Colourful and exotic-looking traditional fishing craft can be found crowded together in the harbours and creeks, and on sheltered beaches, all along the densely populated north coast of Java. The details of the construction and also the colourful paintwork of these vessels vary regionally, but they have been recognised as constituting a distinct family of traditional craft within the overall context of Indonesian and Southeast Asian maritime traditions. The obvious characteristics of the Javanese vessels belonging to that family are: a broad, shallow draughted hull with no fixed deck, typically about 10 to 12 metres in length; a large projecting prow, and a similar stern finial, with recurved profiles (Fig. 1); and the use of bulkheads rather than frames to strengthen the hull. This family of vessels has been classified as mayang. Properly, the term mayang only applies to those vessels equipped with a payang (seine net) but the term has been usefully extended to include all similar vessels in the Javanese tradition. Van Kampen (1909) made use of the term in his survey of the Javanese fishing industry and his usage has been followed by Horridge (1981), Hawkins (1982) and Burningham (1989). Horridge (1981: 47) characterised the “mayang type” as “flat-bot-
argue that the Javanese *mayang* building tradition is fundamentally different from the boat building traditions of Eastern Indonesia (those of Macknight’s groups three and four) but it is more closely related to the traditions of Sumatra and especially Malaysia. The basis of this relationship is McGrail’s (1985: 291-292) argument that, in the classification of traditional watercraft types, analysis of structural differences should be preferred over consideration of raw materials used, or the form or shape of the craft, because “Emphasis on structural differences may reveal culturally-determined principles.” McGrail (1985) proposed a scheme of classification that divided shell-built boats into seven categories (and skeleton-built boats into a parallel seven categories) according to the use of three main techniques by which boatbuilders convert their raw materials into a boat. On the basis of that system, the planked boats of Eastern Indonesia (where planks are carved to shape but not bent to shape) belong to McGrail’s classification C4, while the *mayang* and the vessels of Sumatra-Malaysia belong to C7 because the planks are cut and then bent into shape.

This paper provides a description of all the various types of *mayang* that can be found along the north coast of Java and defines more precisely the *mayang* as a distinct family of watercraft through a detailed description of the *mayang* building tradition. Ten distinct types of *mayang* are described:

1. the *kolek*, originally from Central Java but now found mainly in West Java, a type which exhibits *mayang* design virtually unaltered by other boat building traditions;
2. the *compreng*, from the Cirebon region of West Java, which shows some Malay influence in its construction;
3. the *sopek*, from West Java, which is a relatively plain modernised version of the *mayang*;
4. the *seroto* from the Indramayu region of West Java, which shows Malay design with only a few features of the *mayang*;
5. the *jegongan*, also from the Indramayu region, which combines the *mayang* hull form with some of the construction features of the planked-up dugout canoes of the Bajau “Sea Gypsy” people;
6. the *sopek* from the Jepara region of Central Java, here designated the “Jepara sopek” to distinguish it from the West Java *sopek*;
7. the *konteng*, an East Java version of the *kolek* which shows some influence from the traditions of Madura and Eastern Indonesia;
8. the *ijon ijon*, a smaller *mayang* built alongside the *konteng* in the Lamongan region of East Java;
9. the *jangraja*, built by Madurese boatbuilders in the eastern part of East Java;
10. the *eder*, built only in Madura.

Measured midsections for all the boat types are illustrated. It will be shown that the first of the chines in Burningham’s (1989) proposed
Mayang

three chine hull form is often absent or scarcely perceptible in the midsection, though it does appear towards the bow and stern in most cases. The four strake construction proposed by Bumingtiam was qualified with the observation that "frequently [mayang are] built with a greater number [than four]... strakes because of the difficulty in acquiring suitably wide planks. Even so, the builders... consider the vessels to have four strakes" (1989: 195). An example was given of a plank naming system which nominated only four strakes but was applied to a vessel with a greater number of strakes. In this paper plank naming systems for all the mayang are provided. It will be seen that some nominate five strakes, but we argue that this is a recent adaptation.

The various systems of naming the planks, which are employed by the traditional boat builders in different places along the north coast of Java, reflect the fact that in the mayang building tradition, the planking at the ends of the hull's is always regarded as structurally distinct from the planking of the midbody. The names which are here ascribed to the various types of mayang, are, in most cases, the names used by the builders of the vessels. These names are here applied consistently for the sake of classification. But such classification is, in a sense, arbitrary: most mayang types are known by a variety of different names in different areas, by fishermen, by builders and by people less directly involved with the fishing industry. Several local names are derived from the names for types of nets, for instance pukat, bondet, kerakat and jaring, in the same way that fishing vessels are classified as trawlers, seiners, longliners, etc. Other names, such as jukung, and possibly kolek, appear originally to have meant no more than "fishing boat".

The various types of mayang are described below in an order which approximately corresponds to their distribution from west to east along the north coast of Java. There is, however, considerable overlap in the distribution of the types, particularly in West Java.

Where the principal dimensions of a hull are listed, the convention of listing length overall x extreme beam x moulded depth, in that order, is followed. Length overall is the horizontal length of the entire hull including stem and sternpost but excluding any projecting spars or steering gear. Moulded depth is the vertical distance between the top of the keel and the rail: it has nothing to do with the draught, or depth of water in which the vessel will float.

All the mayang are normally built of the same materials. Planking and frames are normally teak (Tectona grandis), dowels and treenails are kayu pung (Dichrosichys cinerea) and the luting between the planks and timbers of the bulkheads is the bark of the paperbark tree (Melaleuca sp.) called gelam or gelang in Indonesia.

The data presented here were mainly collected by Stenross on two visits to Java in 1989 and 1990. Buminghiam was in Java in early 1989 and briefly in West Java in early 1991. Following a visit to Madura by Buminghiam in March-April 1994, the section describing a Madurese type of mayang called the eder was added. Both authors visited as many boat building sites as possible and several sites have been visited independently by both authors - inevitably resulting in the collection of some contradictory data. Where possible, experienced builders were interviewed and data was checked with other experienced craftsmen. The Javanese technical terms and plank naming terminologies listed below were confirmed in this way, but, as with the naming of...
Fig. 3. Kolek.

Fig. 4. Bow of a *kolek*.
perahu types, few terms are completely uniformly applied even within one village. Some of the boat builders in East Java acknowledged Madurese descent. In West Java, virtually every builder spoken to acknowledged being Javanese rather than Sundanese.

Data from Malaysia, particularly Terengganu, was collected by Bumingham on visits to Malaysia in 1979 and 1991. Comparison with the traditional craft of Thailand and Vietnam, made here, relies almost entirely on the literature rather than first-hand experience. Particularly useful is the large catalogue of photographs in the so-called “Blue Books” prepared by the USA Defence Department (RACIC 1967).

**KOLEK**

Kolek are a type of mayang found mainly in West Java, but some are found in Central Java, and formerly they were built there. Kolek are the most widely distributed type; they are also the largest mayang and one of the most numerous. The large fleets of kolek that operate in the highly populous areas of West Java are all motorised and their fishing techniques have been modernised as a result of government programs designed to increase the efficiency of the fishery. The koleks are likely to be replaced by more modern and utilitarian types of vessel in the near future.

The name kolek, and cognate names such as golek, golek-an, kole-kole, kora-kora, etc, are used over a wide area of Indonesia and neighbouring states to name a range of small and larger craft. Apart from the particular type of mayang described in this section, there are various types of small craft in Java which are referred to as kolek. For instance, the kolek Pulau Seribu from the islands off Jakarta are small, narrow beamed craft with a very small version of the distinctive prow (linggi) carried by the kolek. Some other vessels that can be called kolek in Java have no linggi and they are usually crudely built. These vessels are not mayang according to the definition used in this paper because they do not have the typical mayang midsection and hull form.

**Recognition.** The kolek, like most mayang types, is most easily identified by its decorative prow structure called the linggi. The linggi of the kolek is a large projection of the stem above the bow (Fig. 4). There is a smaller, similarly shaped linggi in the stern. The profile of the aft linggi is somewhat flattened and is embellished.

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Fig. 5. Stem of a kolek showing the rudder held in place against the projecting mangga mangga.
with a piece of carving, called the ampolok, on its aft edge (Fig. 5).

There is some variation in the styling of the linggi of kolek. Some kolek have a smaller linggi with a more trapezoidal profile. Three styles of kolek linggi with their typical decorative paint patterns are shown in Figure 6. The trapezoidal style has almost disappeared but a few examples remain in Central Java (Fig. 7).

Size. Kolek are usually beamy, shallow-bodied vessels: they are of a design suitable for handling large payang nets. A typical example measured 12.2 m length overall (11.4 m length between the tops of the rabbets on the stem and stempost) x 3.64 m beam x 1.03 m depth from the top of the keel to the rail. In profile, the linggi measured 1.70 m at its greatest width and extended 1.90 m above the top of the bow.

Some kolek of similar relative proportions measure 15 m length overall; these are the largest mayang. Very small versions, about 7 m long, were also built in the past. These were known as jukung, a common, general name for small, planked craft in West and Central Java.

Rig. The traditional rig, shown in Figure 8, is rarely seen now. It is a single, broad, tilted, rectangular sail with the yard and boom somewhat longer than the hull of the vessel. The mast is stepped at one third of the hull's length from the bow. It is stepped through a large thwart, against the aft side of a bulkhead with its heel set into a large floor timber. The yard is made of two or three pieces of bamboo, which are lashed together.
Fig. 8. The rig of a *kolek*.

Fig. 9. The midsection of a *kolek* with the strake names.
with numerous frappings or seizings at about 100 mm intervals to give the required strength and stiffness. The boom is a more flexible, single bamboo. Horridge (1981: pl. L) shows an excellent photograph of a kolek under sail.

The smaller kolek-styled jukung carried a two masted spritsail rig similar to that shown in Figure 34.

Use. The primary use of the kolek is for fishing with the payang net. The nets are usually large (and nearly as expensive as the boat), take up much room on board and require a large crew to handle them, especially since winches are not used traditionally; a typical crew is fifteen men. The kolek is scaled to handle the largest size of payang net while still being reasonable easily propelled with oars during calms and while shooting the net. The relatively low freeboard facilitates handling of the net.

Distribution. Kolek are found today mainly in two places: Jakarta Bay (especially Kali Baru) and Eretan, a small town west of Indramayu, West Java. There is no traditional boat building at Kali Baru, Jakarta. Most of the kolek which are operated from there were built at Eretan, but some are said to have been built in Central Java, especially at Pemalang. Until recently, a few kolek were ordered from boat builders at Gebang, near Cirebon in West Java, although it is not the traditional mayang for that area. The Cirebon builders called these kolek “kedokan”, a term that probably refers to the sheer strake called the kedok or gedok by the boat builders of Cirebon, and some other areas. As shown below, the sheer strake of the kolek is very different from the sheer strake of the ma-yang normally constructed in the Cirebon area.

In both Kali Baru and Eretan, kolek remain the predominant traditional type and they are very numerous. However, it seems that few were built in the last five years. Although many of these beautiful vessels are carefully maintained by proud owners, mayang do not have a particularly long working life, due in part due to certain aspects of their construction and in part to the rigours of the wet tropical climate. It seems unlikely that the remaining kolek fleets will last more than another ten years unless there is a revival of kolek building.

Recent history. Today the kolek appears to be a West Java mayang type but that was not originally the case. Van Kampen (1909: pl.3) illustrates kolek and calls them “Majangs van Tegal”; Tegal is in Central Java. A number of boat builders, interviewed in various places, stated that the kolek originated from Batang, near Pekalongan, in Central Java, about 70 kilometres further east than Tegal. We do not know...
of the construction of any large mayang in Central Java during recent years and doubt that any has taken place.

There is reason to believe that construction of the kolek style has only recently been introduced to Eretan in West Java. The traditional mayang of the Eretan area appears to be the jegongan (see below) which is a distinctly different type of mayang. There are several examples of similar transposition of boat building tradition on the Java coast. Van Kampen (1909:10) noted that the Rembang area in Central Java was the foremost area for Javanese boat building and that the Rembang builders built mayang for sale to the areas of Banten, Cirebon, Pekalongan, Semarang, Surabaya, Pasuruan, Besuki and Madura - in other words, virtually the whole north coast of Java. They built kolek for use in Central Java but they would build any other style on request, even the jangraja (see below) of East Java. Other places in Central Java where mayang were built for sale to distant areas were Juwana, Jepara and Batang. Today there is little or no mayang building anywhere in Central Java, apart from the small soper (see below) built around Jepara and Juwana. In the Rembang area there appears to be no boat building. Types which were formerly built by the renowned builders of Rembang are now built in other parts of Java.

The kolek builders at Eretan employ a set of boat building terms which differ from those used in the neighbouring West Java boat building centres around Indramayu and Cirebon. The Eretan boat building terms seem to have come from Central Java. Some old people at Eretan say that when they were young, there were close links between Eretan and the town of Batang in Central Java. This is curious since the two places are quite a distance apart and there are a number of boat building centres and places of much greater economic importance between them.

Today there is no traditional boat building in Batang, Central Java, and it is apparently several years since any traditional boat building took place there. However, in 1990 Stenross visited a respected, retired mayang builder in Kelurahan Karangasem to the west of Batang. A man of over forty years experience as a boat builder, he said that Batang had been the major centre of mayang building. Mayang had been built regularly to fulfill orders from places including Pekalongan, Pemalang and Tegal in Central Java and Eretan, Kali Baru and Muara Angke in West Java. Mostly these were kolek but a type called condong were ordered by the fisherman of Muara.

Fig. 11. Section through planking showing edge dowelling and locking pins.

Ciasem. From his description, these seem to have been the same as the condong or bingkoeng illustrated in Van Kampen (1909: fig. 7, pl. 17) rather than the condong illustrated in Burningham (1989: fig. 16) which was probably a kind of hybrid condong/jegongan. None of these condong exist today.

Names for the strakes used in the construction of kolek were obtained from this builder (his wife and his son were also familiar with all the terms) and these proved to be the same as the terms used by the kolek builders at Eretan. Stenross was told, at Batang, that about twenty years ago, a local man named Siong who built kolek, married a woman from Eretan; he moved to Eretan and introduced the building of kolek.

Construction. Keel, stem and sternpost. The keel (lunas) is a straight timber of more or less square cross section. The stem and sternpost (solor) meet the keel at a definite angle rather than curving into the keel through the forefoot and heel. Both the stem and sternpost rabbets are gently curved. The stem is more upright than the sternpost - this is a typical feature of mayang. The term solor is only applied to the stem and sternpost proper, the upper decorative part of the prow and the sternpost is the linggi. The linggi of a kolek is made up from a number of planks edge dowelled together and dowelled to the solor. The carving on the sternpost, the amplok, is usually part of the sternpost, not an addition.

While the solor are rabbetted to receive the hood ends of the planking, the linggi are not in any way attached to the planking. The large bow linggi is therefore rather poorly supported. It gets some support from having its lower edge notched into a short thwart (polangan) in the bow, as shown in Figure 12. Linggi are frequently damaged and broken off in crowded harbours.

Midsection. The kolek midsection has almost no deadrise and shows two distinct chines. Figure 10 is a measured midsection of a typical kolek; it has only 30 mm of rise from the keel to the first chine. Originally this midsection would have been formed from four strakes, as shown by the strake nomenclature in Figure 9. Today it is
usually necessary to use more than four strakes to form the hull of a large *kolek*. The use of six strakes is typical, but the four strake terminology is retained. Builders at Eretan also use this terminology when building a more modern type of fishing boat with a similar hull form. In the tra-
ditional strake terminology the first two strakes, pengampit and karon, form the bottom of the hull (dasar). Frequently the karon is made up of two or three strakes. The telon, which is the bilge strake, is nowadays usually two strakes but formerly very wide planks were employed: Burningham (1989: 206) notes a plank of 720 mm width used on another type of mayang. The topside strake, maludan, is relatively narrow and is usually a single strake in modern construction. The maludan is capped by a heavy rail timber, the golak, which is usually about 200 mm deep and is finished flush with the maludan on the outside.

Planking. Javanese mayang are built with fairly long planks by comparison with many other Indonesian craft. Whereas most of the craft of Eastern Indonesia are built from fairly short baulks of dense timber which are carved to shape, the Javanese builders use sawn planks which they bend to the desired shape, using heat to make the timber pliable. The planks are usually bent in matched opposing pairs to achieve symmetry in the construction of the two sides of the hull. Figure 10 shows two planks being twisted to shape.

The garboard strake (pengampit) is fastened to the keel with edge dowels of about 10 mm diameter at 100 mm intervals. The planks are edge dowelled to each other in the same way. The edge dowelling is locked with small locking dowels called paku dindian (Fig. 11). Planks of the largest available size are used in the midbody: butts or scarfs in the planking never occur near the midsection. The midbody planks of the lower strakes terminate with fairly long straight scarfs. In the upper planking the scarfs are shorter, really just slanting butts. In all cases the scarf or butt slopes downwards towards the nearer end of the vessel. These scarfs or butts are called serangan. The use of these scarfs and the term serangan (sometimes sirungan or serongan in other areas) is common to all types of mayang.

The strake names noted above apply only in the midbody: forward and aft of the serangan the planks of the pengampit strake are called serang pengampit, the planks of the karon strake are serang karon and the telon strake ends with planks called serang kembang (rising planks).

The sheer strake (maludan) is tapered out with no serangan and no serang planks. As with the linggi and solor the same terms are used both in the bow and the stern; the Indonesian words depan (forward) and belakang (aft), or their Javanese equivalent, are used to differentiate where necessary. Figure 12 shows typical plank patterns for both bow and stern of a kolek.

Bulkheads. There are twelve bulkheads. All except those right in the bow and stern are topped by thwarts. The thwarts are fitted about 450 mm below the rail. Underneath the thwarts the bulkheads are made of heavy planks laid horizontally and edge dowelled together. Above the thwarts the planking and rail are strengthened by short top pieces. These top pieces are fitted with the grain running horizontally—parallel to the grain of the timbers in the bulkhead. There is a temporary decking of loose planks laid fore and aft between the thwarts and this is the standard arrangement for all mayang types.

Rudder mounting system. The tall spar crutch (sanggaan) and the post (sumbi) which supports the upper end of the rudder are both stepped through a pair of thwarts (daporan) which are positioned one above the other. Figure 13 shows this arrangement in a side view: it can be seen that the upper thwart is heavier, measuring about 400 mm x 90 mm in section. Both thwarts project outboard, the upper one projects slightly further and often has a chock on the forward edge to brace it and fair it into the golak (rail). Although the daporan thwarts project outboard, the rudder does not rest against the aft edge of the projection as it does in many other types of traditional Indonesian craft (and also those of Malaysia and Thailand). Instead the rudder is lashed against the aft edge of a short stout stick (mangga mangga) which projects diagonally across the rail. The inboard end of the stick is jammed
between the two daporan and forward of the sumbi. The rudder is used on the leeside when the vessel is under sail and must be shifted around the stern when changing tack. Under power, the usual convention is to carry the rudder on the starboard side; the payang nets are usually shot from the port side of the hull.

The golak or rail terminates just forward of the daporan. It is extended aft by a much heavier timber called the katir. The upper daporan is notched flush into the katir and secured to it with large dowels: further aft another short thwart is let into the katir in the same way, but it does not project outboard. There is a similar thwart in the bow. These thwarts are important structural members, tying the two sides of the hull together at the ends.

**COMPRENG**

The compreng is a West Javanese mayang which is fairly similar in appearance to the kolek although there are many differences in construction. The compreng must be of considerable economic importance in West Java: it is probably the most numerous of all mayang.

**Recognition.** As with the kolek, it is the large bow linggi that is the most conspicuous feature. The profile of the bow is quite similar to that of the kolek, but the smaller linggi in the stern comes to a point rather than being flattened like that of the kolek (Fig. 14).

Although the bow profile is much the same as that of the kolek, in the detail of the construction there is considerable difference. The upper part of the rabbet on the stem rakes back inboard (Fig. 15). The topside strake, instead of tapering
Fig. 16. Above, *comprenge* rigged with short sprits; below, *comprenge* rigged with longer sprits and square headed sails.
out under the rail as it does in the *kolek*, is carried through to end in the rabbet (i.e. rebate) which is cut in the *linggi* (prow), not in the *solor* (stem). The *linggi* of the *compreng* is faired into the topside planking and for this reason it is much thicker on its inboard face than that of the *kolek*.

**Size.** The *compreng* is generally a smaller boat than the *kolek*, although the largest are fully 12 m in length. A typical boat measured 9.74 m l.o.a. x 2.63 m beam x 0.8 m depth of hull. Most are of about this size.

**Rig.** The normal rig is a two or three masted spritsail rig in a schooner configuration. All three masts are easily unstepped and furling is achieved by unshipping the sprit, unstepping the mast and simply rolling the sail around the mast. The *mizzen* is only carried when going to windward in light conditions. The foremast is usually unstepped before entering confined water. The shape of the spritsails, varies from nearly triangular to nearly square (Fig. 16). Horridge (1981: pl. 24) shows a *compreng* carrying a rather scruffy example of the rig with nearly triangular sails and a relatively small mainsail. A neater version of the rig, with the *mizzen* mast unstepped, and carried by a *perahu jegongan*, appears below as Figure 34.

The sails are called *layar padok* (foresail), *layar agong* (mainsail), and *layar kapel* (mizzen). Each mast is stepped through a thwart with its heel in a longitudinal mast step. This longitudinal step allows the rake of the mast to be adjusted to optimise performance in varying wind strength and different points of sail.

**Use.** *Compreng* have been used for various fishing techniques. Today they are mainly used for inshore prawn and shrimp fishing with fine mesh nets. The boats usually sail out with the land breeze before dawn and return during the day. The majority are not large enough to handle a modern *payang* net.

**Distribution.** The *compreng* is very common along the north coast of West Java. From Banten to Indramayu they are usually called *lembon*. Around Cirebon, where the greatest concentration exists, they are called *compreng*. Probably the biggest fleet can be seen at Gebang, about 10 km east of Cirebon. In the late afternoon the river at Gebang is jammed solid with *compreng*. There is a bridge over the upper part of the harbour and the boats which moor upstream of this bridge all have their forward *linggi* cut down a little to allow them to fit under the bridge. These modified boats are known as *caplo-"
Mayang

They can also be found in some other ports.

Compreng seem to be a re-

van kampen

mention of the compreng or djoekoeng Pi Cirebon, but an illustration (1909: fig 8c). These vessels were known by a number of names, especially dermayuan, indicating origins in Indramayu, and also jegong. They were mainly associated with the population of Malay (Johor) origin settled in the Krawang and Indramayu areas. The gemplo (Fig. 18) is usually constructed of solid blocks of timber morticed together, but some are planked structures, particularly on the older boats at Karang Song near Indramayu.

The stern construction is different from that of the bow. There is no true sternpost. Instead a sternpost is built up from horizontally laycerc blocks of timber morticed together. This is how the stem and sternpost of the original canoe compreng were built up, and the construction is still used today on the built up dugout canoes of Central Java called jukung. A rabbet is cut in this built up sternpost of the modern compreng, but a rabbet is not part of the construction of jukung. The sternpost rabbet of the compreng is curved.
The sheer strake and gemplo structure of the upper part of the stern is essentially the same as that in the bow, although the profile of the gemplo is different.

Midsection. The midsection of a typical compreng shows double chines and a slight rounding up to the first chine in the bilge. The measured midsection in Figure 19 shows three named strakes in the bottom of the hull and a total of five actual strakes and five named strakes. Sometimes a greater number of actual strakes is required when sufficiently wide planks are not available. The significance of this five strake system is discussed below under the heading “Plank naming systems”.

Planking. As in the kolek and all other mayang, the longest planks are used in the midbody of the vessel, and the special terms given to the strakes through the midbody do not apply beyond the serangan scarfs towards the ends of the hull. The plank pattern and the positioning of the serangan is not as precise as on the kolek; the plank pattern can be varied somewhat according to lengths of the planks available. Figure 20 illustrates a typical plank pattern with the names of the planks. It will be seen that the sheer strake, made up of the gedok and two tekol, has very little taper towards the ends of the boat. This is unusual in mayang construction. There are other unusual features in the plank pattern of the compreng.

While the kolek plank pattern is more or less the same forward as it is in the stern, the plank pattern in the stern of the compreng is quite different from that at the bow. In the stern all the strakes except the garboard strake and the sheer strake (and sometimes the second strake) are tapered out before reaching the sternpost.

The arrangement of the serangan can be seen in Figure 20. The scarfs all slope downwards towards the nearer end of the vessel. Forward, the scarfs are staggered in much the same way as they are on the kolek, but in the stern the scarfs in all the strakes except the sheer strake are roughly in line. This is a very unusual arrangement in any system of boat building and would appear to be a structural weakness. It is not a chance arrangement, but rather reflects the method and order in which the planks are assembled. Figure 21 shows a compreng in an early stage of construction. The bottom strakes of the midbody, pengampit, karon and telon, are all in place, and each has its serang extension fitted in the bow. At this stage no planks have been fitted in the stern. The reason for this is that the serang karon, serang telon and serang cantel will be tapered out in a smooth line below the sheer strake. Because the builder is working by eye (there are no patterns for cutting the shapes of the planks) the planks can only be tapered to this line when the mid-body cantel strake is in place.

![Fig. 19. Midsection of a compreng with strake names.](image-url)
Fig. 20. Plank pattern of the bow and stem with plank names.
The early stages of construction of a *compreng*: although the bow is already planked up, the planking of the afterbody has not commenced.
The method of fastening the planks in the ends is noteworthy. The hood ends are secured to the stem or sternpost by four treenails which pass right through the stem or sternpost and through the plank on the opposite side of the bow or stern. These treenails are slightly tapered, two are driven in from each side. This is similar to the construction of many traditional craft on the east coast of Malaysia where vessels are built without a stem or sternpost and the planks simply meet in the ends: their stem and sternpost, which are largely decorative, are fitted after the planking is complete. The ends of the sheer strake of the *compreng* are not through fastened in this way, because where they are fastened, the *jempol* is too thick to allow effective use of such a method.

Many builders of *mayang* now use steel rod to replace some of the treenails and edge dowelling in the construction. The Cirebon *compreng* builders have resisted this practice and regard it as undesirable, perhaps because steel pins used for edge dowelling the planks together rust and expand, and would probably split planks as thin as those of a *compreng*.

**Planking.** The plank pattern of the *compreng* is different from that of other *mayang*, but it is much the same as that of the *perahu* called *sopek*, which are built by Sundanese boatbuilders around Labuan on the Java shore of Sunda Strait. Those *sopek* are not *mayang* according to the definition employed here: they are round bilged and their builders name six strakes in the construction.

**Bulkheads.** In a standard sized *compreng* there are 13 bulkheads which are fitted into the hull after the *cantel* (bilge strake) has been fitted. They are assembled outside the boat by edge dowelling planks together (Fig. 22), and they are then trimmed to fit precisely into the hull. No other framing is used. The treenails which fasten the upper planking are driven into the end grain of the bulkhead planks. This is not a particularly strong arrangement, but is apparently adequate. The bulkheads are evenly spaced, except for the three aft bulkheads which are closer together to support the spar crutch and the rudder mounting. The aftermost bulkhead, and the one right in the bow, are constructed of thicker timber; they are each a single plank with its grain running vertically to provide better fastening in these critical parts of the hull (Fig. 23). These two bulkheads are called *gading cempod* while the rest are simply called *gading*. These names, or similar names are usually applied to frames rather than bulkheads. For instance the frames in

![Fig. 22. Building a bulkhead.](image-url)
the bow and stem of perahu jegongan are called gading cempit, and at Kuala Terengganu in Malaysia they are called kecaping.

Rudder support system. The spar crutch and the rudder support post are stepped through a large thwart (daporan) at the level of the rail. The daporan projects slightly outboard like the daporan of the kolek, but in the compreng it is usually a single thwart rather than two, one above the other. Some large compreng do have double daporan; the builders say that it simply a question of size, with a larger boat requiring the strength of the double thwart structure. However, jegongan, some of which are as large as the biggest compreng, always have only a single daporan thwart structure.

The use of double thwarts in the daporan structure is probably connected with traditional use of the payang net in conjunction with the tilted rectangular sail set from a stout single mast, and a strut connecting the mast to the spar crutch, which is stepped through the daporan. Mayang which are equipped with large payang nets are more likely to have the single masted rig and a double thwart daporan structure than mayang equipped for other methods of fishing. This is because at times during fishing operations the large net is hung from the strut, called the andang, which is fitted between the mast and the top of the spar crutch (sanggan) in the stern so that it can be dried and can be arranged and repaired. With the entire weight of the wet net supported by the andang there must be considerable lateral load transmitted to the spar crutch and then to the daporan, particularly if the vessel is rolling. Mayang such as jegongan, which usually carry sprit sail rig on light and easily unstopped masts cannot have a strong andang fitted between the mast and the spar crutch, but jegongan are not normally equipped with payang nets so there is no requirement for a strong andang and spar crutch and the double daporan is not required to step the spar crutch.

The daporan of the compreng is closer to the stern than that of the kolek. The rudder is lashed against a short projecting stick in the same way as in the kolek. The rail (golak) is interrupted by the daporan but there is no heavy timber extending the rail aft of the daporan. Outside the rail, aft of the daporan, carved boards are sometimes fitted: these are called serang manis or kuping kuping.

SOPEK

Sopek, like kolek, is a name that has been applied to a range of different vessels. The name here is applied to a type of vessel with a modified traditional mayang midsection and hull form, but with a straight stem and sternpost and lacking the large decorative prow of traditional mayang.

Recognition. Sopek are easily recognised by their straight stem and sternpost, which are cut off just above the sheer (Figs 24 and 25). In spite of their relatively plain construction and design, traditional decorative features are present in the carved rudder support post (sumbi) and the carved boards in the stem (kuping kuping).

Size. Most sopek are in the same size range as the compreng. A typical example measured 9.80 m l.o.a. x 2.36 m x 0.83 m. The largest are about 12 m in length.

Rig. The smaller sopek use the same two or three masted spritsail rig as the compreng, while larger versions can carry the tilted rectangular sail rig of the kolek. In fact, most sopek are fitted with a long-shaft outboard motor and carry only a small auxiliary rig. In many cases, large motorised mayang which are equipped with payang nets only retain the stout mast of the tilted
rectangular rig because the strut (andang) which runs between the mast and the spar crutch in the stern, is used for hanging and drying the large net.

**Use.** Most sopek are employed along with the similar sized compreng in the inshore prawn and shrimp fishery. Larger examples work with payang nets or with longlines.

**Distribution.** Sopek are found in fishing fleets from Banten in the very west of Java all the way to Semarang in Central Java. East of Semarang the name sopek is used for a different type of mayang which is described below.

**Recent history.** The sopek is a recent, "rationalized" version of the traditional mayang design. The majority of sopek are today built around Cirebon, but, according to builders at Gebang, the design originated in Pemalang, Central Java. Possibly it is a kind of standardised West Javanese version of the Central Java sopek described below. It is now displacing the compreng and other traditional types in West Java and may eventually replace them altogether. There are two obvious reasons for this. The sopek must be slightly cheaper and easier to build with its simplified ends. For a standard sized vessel built at Gebang in 1990, builders were quoting 2.5 million rupiah for a compreng and 2.0 million rupiah for a sopek. (In 1990, one million rupiah was equivalent to approximately A$ 700).

Perhaps more importantly, a sopek is expected to have a longer working life than a compreng. Relative figures of approximately ten years and seven years were given at Gebang. This seems to be because the sopek can be built with narrower planks producing a more rounded section with less angle at the chines so the seams at the chines are under less stress and, protruding less, they might be less prone to damage. Also the scarfs are better staggered in the plank pattern. This is described below.

**Construction.** *Keel, stem, and sternpost.* The keel is straight and meets the stem and sternpost at a distinct angle. Typically the stem rakes forward at about 20° from the perpendicular, while the sternpost rakes aft about 35°, but there is considerable variation and many sopek have considerably more rake to the stem and sternpost. There is a rabbet cut in the stem and in the sternpost, but there is no apron in the bow or stern.

**Midsection.** Older sopek have a similar midsection to mayang such as the compreng or kolek. Larger sopek are still built with this form, however, most standard size sopek built in the Cirebon area now have a modified midsection which appears to be designed to overcome some of the structural problems of the compreng. The measured midsection in Figure 26 shows the same broad, slightly rounded bottom as the compreng. This example shows almost no deadrise which is the modern trend for both sopek and compreng. The cantel or bilge strake is divided into two narrower strakes with a chine between them. The sheer strake (gedok) is narrower. The section is more rounded especially above the first chine. The chine names in Figure 26 are those used in the Cirebon area. Sopek builders in other areas use other sets of terms derived from their own traditional terminology.

![Fig. 26. Midsection of a sopek with strake names.](image-url)
Mayang

Planking. There are considerable differences between the planking of a *compreng* and a *sopek*, apart from the extra chine in the midsection. Forward, all the strakes run through to the rabbet on the stem. In the stern, the three strakes from the bottom of the hull are run through to the sternpost but the lower *canel* is tapered out and so is the *gedok* or sheer strake (Fig. 27). In the bow the *tekol* - the forward plank of the sheer strake - is flared outwards and the rabbet on the stem is angled forward to accommodate this. In effect, this is the stylistic opposite of the inward angled rabbet for the *tekol* of the *compreng*. As with the *compreng*, four trenails are driven right through each pair of planks in the ends, two from each side (Fig. 28).

Bulkheads. A typical Cirebon built *sopek* has eleven bulkheads. This is, in fact, the same as for the *compreng* except that the *gading cempod* in the bow and stern are absent.

Rudder support. As for the *compreng*.

Other. A short foredeck provides both structural strength to the bow and uses the extra space in the bow (in comparison with a *compreng*) to advantage.

SEROTO

The typical *seroto* is not really a *mayang* according to the definition given in the introduction. Seroto are, however, of similar size and

![Fig. 27](image-url). The plank pattern of the bow and stern with plank names.
function to *mayang* such as *compreng* and they are certainly a related design. Some small *seroto* do have a true *mayang* hull form.

**Recognition.** A graceful, fine ended craft with straight stem and sternpost which project well above the rail. The projecting parts of the stem and sternpost are built up on their inboard edges and have distinctive carved decoration (Fig. 29).

**Size.** The largest *seroto* are about 10 m l.o.a. x 3 m x 1 m. No precise measurements were taken. A number of derelict *seroto* of this size could be seen on river banks west of Cirebon, and a number of smaller *seroto* are still in use.

**Rig.** Two or three masted rig, as for the *compreng*. Smaller *seroto* usually do not have motors.

**Distribution.** Most are found in creeks around Indramayu and Krawang. A few operate from Cirebon and from Muara Angke, Jakarta. They are not very common today.

**Use.** The main employment of the larger *seroto*, if any still work, is in the longline fishery, particularly fishing for shark. Boats so employed are fitted with a stout timber windlass on the port side, just forward of the mainmast. Smaller *seroto* work along with *compreng* in the shrimp and prawn fishery.

Recent history. The *seroto* is a design that originated with the Malay population of the eastern Krawang and Indramayu district. Van Kampen (1909: 35) records that this type was usually called *djohoran* (i.e. of Johor, Malaysia). They were also called *trondalan* at Krawang and *soto* at Cirebon; the latter name is still used in the area of Indramayu. There was apparently a version built without stem called *soto depangan* recorded at Tegal (Van Kampen 1909: 35); this was possibly a *Bajau* ("Sea Nomad") *sope* from the Karimunjawa Islands to the north. The Malay population of the Krawang-Indramayu region were maritime people, and some of them, at least, were probably from the islands lying off the coast of Johor which were inhabited by several groups of "Sea Nomad" people (Sopher 1965). The *seroto* and the *jegongan* (described below) both originated in the Krawang-Indramayu region and both have considerable affinity with the vessels of the Bajau who are the largest and most widely spread group of the "Sea Nomads".

In hull form, the *seroto* is unlike a typical *mayang* but similar to many of the fishing boats and small cargo carriers of the east coast of Malaysia. They have less beam than a *mayang*.

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*Fig. 28. The bow of a *sopek* under construction showing the treenails which fasten the hood ends of the planks.*
Fig. 29. The bow of a *seroto*. The rounded hull form is very obvious.

Fig. 30. The stern of a *doret*, a rare hybrid type with the hull form of a *seroto*.
and a much more rounded bilge: the turn of the bilge starts almost at the keel and continues virtually to the rail. However, the seroto does have some of the construction features of a mayang, particularly the compreng from the neighboring Cirebon district. Some small seroto in the Cirebon district have been built with the construction and hull form of the compreng but they are finished with seroto style prow and stern. They are really just a stylistic variant of the compreng.

There appear to be no seroto of recent construction. It seems that the type is no longer built and will soon cease to exist. The larger seroto probably required ballast to sail whereas a mayang is never ballasted. Also a seroto in sailing trim would draw considerably more water than a mayang of comparable size. With their fine ends they would probably have been quite swift sailors but with the introduction of motors that capability is no longer an advantage.

Construction. Keel, stem, and sternpost. The keel is straight and meets the stem and the sternpost at a distinct angle. The stem rakes forward only about ten degrees from the perpendicular while the sternpost rakes aft about 25°. The high prow piece is built from the projecting stem, and a plank sweeping up from the rail on either side which is faired on to the aft face of the stem. There is a capping piece on the top of this structure. The projection at the stem is constructed on the sternpost in the same way as that at the bow is constructed on the stem. There is a rabbet on the stem and on the sternpost.

Figure 30 shows the stem of a derelict vessel called a doret: it had a similar hull form to a seroto including straight stem and sternpost but the decorative structure on the stem and sternpost is quite different. Formerly this decorative structure was found on mayang called kolek poekat (pukat in modern Indonesian orthography is a type of net) from Bantam, West Java (Van Kampen 1909: fig. 1).

Midsection. A measured midsection has not been obtained but Figure 29 gives a good idea of the shape. There are no chines, instead the section curves gently through a very slack bilge. There is much less beam relative to depth in the midsection.

Planking. The forward plank pattern of a disused seroto is shown in Figure 31. There are long planks which run through the midsection of the hull but the strakes finish with strange, irregular pieces in the bow. Possibly this was a repair; alternatively it is a scruffy adaptation to the use of sawn timbers in a design that formerly had bow and stern pieces carved to shape like the sope and lepa of the Bajau. The shape of the bow is achieved by a gradually curving in from the midsection of the long midbody planks, rather than curving in more abruptly with serang planks as it is on a mayang. This produces a very long, sharp entry.

In the stern the plank pattern is rather like that of the compreng but adapted for the use of several more strakes than the usual five strakes of the compreng (Fig. 32). The strakes which run through the turn of the bilge are tapered out under the topside strakes in the same way that the karon, telon and cantel strakes taper out under the sheer strake in the compreng. The stem is considerably fuller than the bow. (Neither the plank pattern in the stern, nor the relative fullness in the stern, appear to be features of any traditional Malay boats, as far as one can tell from the literature.)

Bulkheads. A large seroto that was surveyed had 15 frames; most of these were bulkheads, but some were conventional sawn frames. Bulkheads are not a feature of Malay boats.

Rudder support system. The rudder support post and spar crutch are stepped through a single daporan thwart. In some cases the thwart is strengthened by a beam on its forward edge (Figure 32). The rudder rotates in the cleft formed where a diagonally extended stick crosses the rail. This is similar to the arrangement on the vessels described above except that the stick is fixed in place and cannot be unshipped. For this reason there is a stick fitted on each side of the stern. Having these permanent projecting structures in the stern precludes the use of payang (seine nets) because the net would foul on the projection while being shot.

The rudder of any mayang, and also the seroto, can be unshipped from the rudder support post and used as a sweep or steering oar, pivoting
The jegongan differs from all other mayang types in both the shape and the construction of its ends. Apart from being an attractive and distinctive vessel, it is interesting because of the similarity of its ends to those of the lepa and sope of the bahasa sama speaking Bajau or Bajo people. The Bajau have spread over much of island Southeast Asia, but they are not now distinguishable as a separate ethnic group in the population along the coast of Java. Sope and lepa are discussed in detail in Burningham (1993).

Recognition. The jegongan is easily recognised even at a distance by the vertical ends and the high prow and stern finials (Fig. 33). Closer inspection reveals that they are built entirely without a stem or stem post. Most jegongan are only partially painted with a bold decorative design bearing the boat's name while other parts of the planking are left as bare timber. This can be seen in the text figures illustrating the jegongan (Figs 33, 34).

Size. Lengths range from about 5 m to 11 m. A large example measured 11.35 m x 4.26 m x 1.47 m. Though not as long as the largest kolek, a large jegongan is a vessel of similar or greater
register tonnage because of its greater beam and moulded depth. Smaller jegongan usually have less capacious lines with less moulded depth relative to length. Both large and small jegongan are fairly common in the area in which the type is popular, and in this respect they differ from other types of mayang, because examples of other mayang types are mostly of one standardised size for their type.

Rig. Two or three masted spritsail rig, similar to that of the compreng (Fig. 34). Most jegongan today are motorised, especially the larger examples. In this case they usually have a small tilted rectangular sail or a triangular boomed lateen sail as auxiliary sail power. This rig is carried on a permanently stepped mast rather than the light easily unstepped mast of the sprit rig, and it allows the fitting of an andang between the mast and the spar crutch in the stern. Some jegongan, used for payang fishing, may have carried a large tilted rectangular sail, like the kolek, in the past.

Distribution. Jegongan are mostly found on the coast from Jakarta, eastwards through Krawang to Indramayu. The larger ones are concentrated in the major fishing ports of Muara Angke (West Jakarta) and Eretan. They are almost unknown at Cirebon in spite of the proximity to Indramayu. All jegongan are apparently built in the Kandang Huar district just to the west of Indramayu. The main building centre for the larger jegongan is the village of Parean, a little to the east of Eretan.

Use. The smaller boats are used for a variety of fishing methods, but the larger jegongan are used mainly in the longline fishery, for which they are the favorite vessel. The offshore longline fishery demands fairly long voyages, ten days at sea being typical, and it is carried on throughout the year with no interruption by the northwest monsoon except when conditions are extremely stormy. To obtain the necessary sea keeping qualities, jegongan are built with greater moulded depth to give greater freeboard than...
other mayang types. This makes them less suitable for handling large payang nets.

The jegongan travel considerable distances to fish off the coast of Sumatra and far out into the Java Sea. Frequently a ten day voyage will involve only four days of fishing and six days of sailing to and from the fishing grounds. They carry large quantities of ice to preserve the catch. Jegongan from Muara Angke, Jakarta, fish along the south coast of Sumatra, setting 600 hooks in about 50 metres of water.

Recent history. Van Kampen (1909:35) mentions a type called jegong from Krawang but at Indramayu, when a bow profile similar to the jegongan and built without a stem were common (Van Kampen 1909: fig. 35a, pl. 7), but they were smaller than a modern jegongan and did not have the construction or form of a mayang in their midsection. They appear to have been very similar to the perahu sope of the Bajau, both in construction and hull form. Since the sope is such a distinctive type, it is reasonable to suppose that they were a closely related type of vessel.

Along with a variety of other small craft, these small jegongan-like vessels were generally known as jukung at Indramayu. There was a type distinguished as jukung jegong but Van Kampen does not indicate its design. Regarding the naming of these various small craft without the curved stem of the mayang, Van Kampen (1909: 34) offered the comment that “In the naming of these craft, there prevails even greater confusion, if that were possible, than among the mayang” (our translation).

Today the term jegong is used to mean plank or strake in the plank naming terminology of the Indramayu area. Perhaps the name jegongan indicates a plankened boat rather than a built up dugout which is what the original jegongan-like boats seem to have been. There is an example of a jegongan-like boat on display in the Museum Bajari, Jakarta. It has a stem, but the stem is merely an external addition to the hull and has no structural function. Two interesting features of this vessel are that it is built up from a small dugout base, and that the serang - the forward planks - of the lowest strake are not formed from sawn planks but rather they are carved bowl shaped pieces, fashioned from thick baulks of timber (as a non-nautical term, jegong means bowl-shaped in Javanese). These two construction features are the essential characteristics of the sope.

The modern jegongan is built entirely from sawn timber and it has a midsection and hull form that are characteristic of the mayang. The stemless construction, the standardised structural design which is of high quality, and the characteristic traditional decoration, all tend to suggest that the jegongan is a long established traditional vessel. In reality, it seems to be a recently developed hybrid of two distinct traditions: the Javanese mayang and the Bajau sope. The literature is not adequate to indicate when it originated, but the absence of the jegongan type from a 1944 British Defence Department catalogue of fishing and trading craft of Indonesia (Naval Intelligence Division 1944) might well be significant since the modern jegongan is a notable seagoing vessel of the region.

Construction. Keel and ends. The keel is straight; there is no stem or stem post. The ends of the strakes are simply fastened to each other. When the plank shell is complete, an apron timber is fitted; it is called the topeng topeng.

The high finial at each end is called the ceruk. The ceruk is built from two shaped baulks of timber notched into the rail, port and starboard, and a third piece of timber which is fitted in the middle to fill the inboard part of the structure. However if the port and starboard baulks are sufficiently thick, then no filler piece is used. The structure is not capped.

Midsection. The midsection of a typical Parean jegongan is less angular - the chines are less distinct - than most other types of mayang. Jegongan built in other places tend to have more distinct chines. Chines are not a feature of the sope type. The terms used to name the planks vary according to the background of the builder. Some builders use terms similar to those used by kolek builders, others use compreng terms. The terms shown in Figure 35 were supplied by the head builder at a small yard in the kampung of Parean Girang. This man said he was sixty five years of age and that he had been building jegongan for all of his working life. At the time he was interviewed by Stenross, he was supervising the construction of four, full sized, craft. The measured midsection shown in Figure 35 is taken from one of the vessels shown under construction. The bottom is gently curved. The strakes which form the bottom are not individually named: they are all called jegong and can be designated by number. The outermost of the
The planking pattern of the jegongan is notable for lacking the peculiarities that distinguish most other types of mayang. Plank patterns vary somewhat in pragmatic response to the size and lengths of plank available. The plank pattern in Figure 37 shows all the scarfs between the midbody and the end planks rather too close to each other for optimum structural strength (in technical terms, there is not adequate shift of the butts); this probably reflects use of a standard plank length for all the planks and a desire to achieve minimum wastage of tim-

**Fig. 35.** Midsection of a jegongan with the strake names.

**Fig. 36.** Midsection of a jegongan with a different shape and different strake names.
ber. The plank pattern is the same in the bow as in the stern (Fig. 37). The scarfs in the planking were called *sambung laras* at Parean, a term that was not encountered elsewhere.

In the construction of a *jegongan*, each strake is completed before the next one is commenced. This might seem like a statement of the obvious, but it is, in fact, different from the assembly sequence of other *mayang*.

**Bulkheads.** A typical full size *jegongan* has ten bulkheads and two frames, one at each end of the hull. The bulkheads are constructed differently from those of the *kolek*, or the *compreng*, in that their construction incorporates proper sawn frames and it is the top pieces of these frames which project above the thwarts and strengthen the upper part of the plank shell.

**Rudder support system.** This is slightly different from the arrangements described above. The post which supports the top of the rudder stock (*sumbi*) is stepped through a single *daporan* thwart. This thwart is further aft than in other *mayang*. The rudder does not pivot in a cleft formed at the intersection of the projecting stick and the rail. Instead it is lashed into a notch on the aft edge of the *daporan* thwart. This arrangement is similar to that used on some *perahu* from Madura and especially those from the islands lying east of Madura. It is a combination of the system of rudder mounting found on the traditional craft of the Sulawesi tradition and also many Bajau craft, with the Javanese system; a system which allows the head of the rudder stock to be taken off the mounting post so that the rudder can be used as a sweep for manoeuvring and in shallow water.

**JEPARA **

The name Jepara *sopek* is used here to distinguish these vessels from the distinctly different *sopek* of West Java described above. They are mainly built and used along the coast of the large promontory of land between Semarang and Rembang. The largest town, on this somewhat isolated coast, is Jepara.

**Recognition.** Like the West Java *sopek*, this type is a relatively plain design lacking any remarkable decorative structures that can be easily distinguished at a distance. Furthermore, there is considerable stylistic variation in features such as the rake of the stem and stern post, and the projection of the prow finial. This variation is found when comparing *sopek* from different villages and especially *sopek* of different sizes. Nevertheless, a number of features distinguish the Jepara *sopek* as a distinct type of *mayang*.

The stem and stern post are nearly straight and the rabbet on the stem and on the stern post is very nearly straight, or actually straight, in many cases. There is no structurally separate *linggi* but the top of the stem forms a sharp projection and the upper part of the stem is decorated with a characteristic spiral design (Fig. 38). There is a second prow finial immediately abaft the stem, formed by the upswept conjunction of the port and starboard rails where they meet at the bow (Fig. 38). Though it serves no structural function, it is related in structure, as well as form, to the prow finial of the stemless *jegongan* and the Bajau *sope*. Similar finials are found on some *perahu* of East Java, Madura and the islands east of Madura. Most of these types have a similarly structured finial in the stem, just forward of the stern post. On the Jepara *sopek*, the stern finial is either absent or it is formed from a single block of timber simply held in place by dowels (Fig. 40). On the Madurese *perahu golekan* the forward finial is styled so that its bipartite structure is evident, while the finial in the stern has a filler

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Fig. 37: Plank pattern of the bow (above) and the stern (below) of a *jegongan*.
piece between the two projections of the rail; thus it appears to be a single block in the way that the stern finial of the sopek actually is a single block.

Another distinctive feature of these craft, is the spar crutch, formed by an extension of the top piece of a frame, on one or other side of the vessel and positioned well forward. Similar spar crutches are a standard feature of most traditional Malaysian fishing craft and many of the boats used by the Bajau in different parts of Southeast Asia.

The smaller Jepara sopek tend to have very fine lines with relatively little beam and considerable rake to the stem and stern post. The larger sopek, particularly those from Juwana on the eastern side of the Jepara promontory, are sturdy looking, capacious vessels with considerable beam and relatively upright stem and stern posts.

Size. The smallest sopek are no more than 4 m in length; with little beam and moulded depth they are not much more than canoes. The most common size is approximately 9 m x 2.8 m x 1.08 m; the largest are nearly 12 m in length and have similar relative proportions.

Rig. The most common rig was the two-masted sprit rig, but today, very few sopek are operated without a long shaft motor and the majority of

Fig. 38. Jepara sopek.

Fig. 39. Internal view of the bow of a Jepara sopek.
the motorised sopek carry one or two lete sails set on very short masts like the small Madurese lisalis. This rig is illustrated in Horridge (1986: pl. 14). The sprit sails formerly carried by many Jepara sopek were of very square headed shape, with a rather short foot and leach.

Use. The various sizes of sopek are used for a variety of different fishing techniques including payang net fishing in the case of the larger vessels. Quite a number appear to serve as tenders to the many large stationary fish trapping platforms that are built in the shallow bight between Jepara and Semarang.

Distribution. These sopek are common everywhere between Semarang and Juwana. There are many of them at Jepara and some are built there. Two major building centres are Wedong, near Demak in the west, and Juwana in the east.

Recent history. This is another type of mayang which has not previously appeared in the literature, apart from a brief and imperfect description in Bumingham (1989: 204). In styling and in some detail it shows affinities with the traditional craft which seem to have originated from the islands to the east of Madura. However, the men who build and operate the sopek in the area of Jepara speak Javanese and consider themselves to be of Javanese descent. Possibly the design has its origins with the mixed population of the off-lying Karimunjawa Islands.

Construction. Keel, stem and sternpost. The keel is straight. In some small craft it is broad and shallow, and is a median plank rather than a structural keel. The stem and sternpost meet the keel at a distinct angle. Both are slightly curved and the rabbet on the stem and on the stern post is also slightly curved. The sternpost is more raked than the stem. There is a complete apron in the bow and the stern. The bow apron reaches from the keel up into the rail finial. The stern apron finishes below the rail. The apron is always carefully fitted, whereas the apron of the jegongan (the only other type which normally has an apron) is rather roughly fitted.

Midsection. In many of the larger sopek, the shape of the midsection is relatively deeper and fuller than that found in most other mayang types. The chines are often less distinct because there are always more than two chines in the midsection; it is a multi-chined form, and in some cases almost a round bilged form. Figure 41 shows a typical example of a large sopek. The smallest sopek have only four strakes, in which case there are three chines.

Not all builders of sopek have a complete set of strake terminology. The terminology shown in Figure 41 is a mixture of simple enumeration and traditional Javanese terminology used by builders of kolek. The top plank is called the golak, a name usually applied to a rail or cap-

Fig. 40. The stem of a Jepara sopek.
ping piece. Although this golak is only the same thickness as the planking, it is, in fact, fitted as a rail or washstrake on top of the planking (Fig. 42).

Planking. The pengampit, or garboard strake, is ideally a single plank from bow to stem. If this is not possible, it is joined in the middle to keep the join away from the area where the plank is twisting from the horizontal flat bottom of the midsection, to the vertical, in the ends. The other strakes which run through the lower part of the hull have their joins towards the ends of the hull, which is typical of mayang construction. The joins are staggered to avoid creating lines of weakness in the plank shell. The strake terms apply to the long planks which run through the midbody while the planks in the ends are the serang.

As with the jegongan, each strake is completed before the next one is commenced, and the plank pattern in the bow is the same as in the stern. In the lower strakes, there is little tapering of the planks, so these strakes sweep up high on to the stem and sternpost. For this reason only the lower strakes reach the ends of the hull. The upper strakes run out under the rail (golak) towards the bow and stem. The top strake, the maludan, is quite short and has no serang extensions. This is the same kind of upper plank pattern as in the kolek and other related types.

Fig. 41. Midsection of a Jepara sopek with strake names.

Fig. 42. Sketch showing a typical Jepara sopek plank pattern.
Mayang

Large Jepara sopek are often built with good quality teak planking of more than 30mm thickness. Most of them are very carefully constructed with very tight seams and very precise smooth lines in the run of the planking. The standard of workmanship in the area is arguably the highest in all of Java and Madura, and the Jepara sopek are said to be the most durable of mayang. The Jepara area is also noted for the excellence of the local furniture makers and wood carvers who utilise the teak available from local plantations.

Bulkheads and frames. These vessels are not heavily framed but presumably they are quite strong enough, thanks to the excellence of their shell construction. A typical 9m boat will have eight or nine sawn frames. Some of these in the midbody will be filled in as bulkheads but they are essentially constructed with frames rather than bulkheads. A frame in the bow is extended above the rail to form a bitt or bollard and, as noted above, it can be used as a spar crutch. Usually this extended frame is on the port side.

Rudder mounting system. The daporan thwart, which projects well outboard is located right in the stern. The rudder pivots against the aft edge of the thwart, as in the jegongan and some craft originating from east of Madura. Few, if any, Jepara sopek are fitted with a rudder support post: the rudder usually has a tiller but it is used as a sweep rather than a rudder. Many of the traditional fishing craft of the Malay Peninsula are steered in this way. It is not certain whether sopek were originally steered in this way; it is possible that in the past, before the advent of auxiliary motors, sopek would have had a rudder support as a standard fitting. However, a photograph at the Jepara Tourist Information Office (Dinas Parawisata) shows a number of sopek racing under sail and they are steered with the rudders used as sweeps.

KONTENG

The konteng is one of the most numerous and economically important of the mayang types. It has been described and illustrated, in some detail, in Burningham (1989: 206-8, figs 1-6). Many features of the construction indicate a close relationship of the konteng to the kolek.

Recognition. The konteng is a conspicuous and easily identified craft. At a distance it can be distinguished by the very high pointed stem. The stern also has a distinctive profile. Most konteng have extraordinarily vivid paintwork. The bright and ornate paintwork is applied in the yards where the konteng are built; most yards use the same design, but some have their own
distinctive variation of the design. Figure 43 shows a typical example. Just abaft the projecting stem there is a ladder (pantok). This is carried on many konteng, but not all: in some cases the uprights of the ladder are elaborately carved.

Size. Nearly all konteng are of the same standardised size. A typical new boat measured 12.2 m x 3.71 m x 1.4 m. This is a little larger, and relatively a little deeper than Terima Kasih, the example illustrated in Bumingham (1989) which was built during the 1970s. A few konteng are built a little larger and with noticeably greater moulded depth. These vessels are intended to be used for longer voyages. Smaller konteng are also built occasionally.

Rig. The konteng carry a large quadrilateral sail. Because the sails are now cut with the luff very short and angled aft (Fig. 44) they often appear to carry a triangular sail when seen from a distance. The rig illustrated in Figure 44 is somewhat different from the rig illustrated previously in Bumingham (1989: fig. 5). The inaccuracies in the earlier illustration were the result of measuring the spars but not having the space to fully unfurl and set the sail of the vessel, which was then in storage.

The upper spar has a very distinctive shape with a strong downward curve at the aft end. It is a very heavy spar made up of several large lengths of teak laminated together with hundreds of seizings or frappings of monofilament fishing line. The aft end of the spar, where it is curved, is thin and flexible; it twists to spill wind from the leach of the sail in gusty conditions. There is usually a long decorative "horsetail" made from strips of old inner tube or cassette tape hanging from the aft tip of the spar. Often, ribbons of gathered, brightly coloured cloth are flown from the leach of the sail and from the backstay. The sail can be furled by rolling it up on the lower spar and leaving the heavy upper spar at the mast head. In port, the upper spar is usually lowered. The full rig is still much used although many konteng now have an auxiliary long shaft engine which can be used to propel the vessel or to power a winch.

Use. Konteng are used mainly for fishing with payang nets. Others are used for longlining. Around Jepara and the Karimunjawa Islands quite a number of konteng are equipped for fish trapping with large horizontal nets set from long booms extended from the port side of the hull. Occasionally large konteng are converted to work as inter-island cargo carriers, particularly at Sedayu Lawas in East Java. Some konteng from Sedayu Lawas have been built up to more than

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Fig. 44. Konteng rig.
Fig. 45. A konteng hull (above) and a cemplok (below) built up from a konteng.
twice their original moulded depth, given a large
deckhouse and a two masted lete rig. These built
up vessels are usually called cemplok or
cemplong (Fig. 45).

Distribution. All konteng are built in the
twinned villages of Blimbing and Brondong,
in the isolated Kabupaten of Lamongan, which
is east of Tuban in East Java. The fishing harbour
at Brondong-Blimbing is one of the largest and
most colourful in all of Indonesia. Konteng from
these villages are sold to owners from many other
places in Java, especially Jepara. They can some-
times be seen among the kolek fleet at Jakarta,
but they are not normally found in the Madura
Strait area, or in the fishing villages on the north
coast of Madura.

Recent history. The names konting, koenting
and koentingan are mentioned in Van Kampen
(1909: 28-31) as types of mayang but no de-
scription is offered except that the koentingan
was a very small vessel for line fishing. Nothing
that looks much like a modern konteng is illus-
trated in Van Kampen (1909). However,
Macknight (1977: 6) shows an excellent photo-
graph of a mayang “from probably around the
turn of century ... off the coast of North Java”.
This mayang has a kolek style stem and sternpost
but has the unmistakable rig, plus certain char-
acteristic decorative features, and the powerful
lines of the Brondong-Blimbing built konteng.
However, there is no way of knowing whether
the vessel in the photograph was, in fact, built at
Brondong-Blimbing. The Lamongan area is not
mentioned as a boat building area by Van
Kampen (1909). Possibly the vessel in the pho-
tograph was a mayang built at Rembang, which
is not far to the west of Lamongan, and was, at
the time, the foremost centre of mayang build-
ing. Although the exact location at which the
vessel in the photograph was constructed is a
matter for conjecture, it is reasonable to con-
clude that the vessel, which shows considerable
similarity to the modern konteng, was an exam-
ple of a type of kolek-like mayang built in the
Tuban-Rembang area. The modern konteng
seems to have developed from that mayang with
a new profile to the stem and stern, but retaining
the distinctive rig and overall look. The tall
pointed stem and the inboard curve of the
sternpost both resemble the styling of certain
types of Madurese perahu which are also re-
cently evolved styles.

In recent years, fewer and fewer konteng have
been built. The boat builders of Brondong-
Blimbing have, increasingly, been building
larger motor driven fishing craft of more mod-
ern design. These vessels, like the konteng, are
very well built, and although they are not of a
traditional design they are rakish, handsome craft
by comparison with most other modern fishing
vessels built in Indonesia.

Construction. Keel, stem and sternpost. The
keel is straight and usually is of considerably
greater width and depth than the keel of most
other mayang. The stem, which is slightly curved
and less raked than in most other mayang meets
the keel at a distinct angle forming a sharp fore-
foot. The stem projects high above the bow,
tapering to a point. The broadened part of the stem,
just above rail is not supported or attached to the
hull: this is a structure that it has in common
with the kolek.

The sternpost is very curved, it does not meet
the keel at a sharp angle but gradually curves up
from the keel and the upper part hooks back
inboard. There is no rabbet on either the stem or
sternpost. The ends of the planking are edge
dowelled onto the bevelled inside edges of the
stem and lower part of the sternpost, as shown
in Burningham (1989: 207). In the stern the
upper strake is not edge dowelled to the sternpost.
Also the plank that extends the strake to the
sternpost is not a sawn plank that has been bent
into shape, rather it is carved to shape from a
block of timber (Fig. 46). In this respect, and in
that the sternpost curves gradually into the keel,
the construction of the stern of the konteng has
affinities with the boat building tradition of
Eastern Indonesia, a tradition that is significantly
different from that of Java.

Midsection. There is some variation in the
midsection form of konteng but, in general, the
konteng with its considerable beam has a more
powerful midsection than most mayang. The
measured midsection shown in Figure 47 has
three named planks in the bottom before the first
distinct ehine. In fact, the names jang'ru and
jang'lu simply mean plank two and plank three.
Formerly konteng were built with only two
planks in the bottom; this is the case with the
vessel Terima Kasih which is illustrated in
Burningham (1989) and is now on display at the
Museum and Art Gallery of the Northern Terri-
itory, Darwin. Where only two planks are used to
form the bottom, the plank naming system shown
in Figure 47 would obviously be inappropriate
since the bilge plank is named plank four. It
seems that the boat builders of Brondong-
Blimbing do not have a strict traditional plank
naming system.
Fig. 46. The stem of a *konteng* undergoing repair. The specially shaped planks which finish the sheer strake and the not yet shaped *golak gemi* on the starboard quarter have been fitted.

Fig. 47. Midsection of a *konteng* with the strake names.
Above the heavy rail timber (golak) there is a distinct wash strake, slightly set in from the rail. This is another feature that is common to various types of perahu from Madura and off-lying islands to the east.

**Planking.** Although the strakes in the midsection are enumerated rather than described by special terms, the planks which continue the strakes forward and aft of the serangan scarfs are distinguished as serang (Fig. 48). In the bow,
the lower strakes are scarcely tapered so their serang extensions sweep high up the stem. The serang of the bilge strake runs so high that it reaches the under side of the rail about 1.5 m from the stem; it is called the serang paratan and corresponds to the serang kembang of the kolek. The topside strake does not reach the stem and has no serang. However, right in the bow, the topside strake reappears in the form of two carved pieces (port and starboard) that sweep upward as they converge immediately abaft the stem. This is rather like the bow finial of the jegongan or the second finial, abaft the stem in some cases it is tapered almost to a point where it reaches the under side of the rail about 1.5 m from the stem. Another timber is edge dowelled onto the outboard edge of the golak gemi and the rudder rotates in a notch cut in the outboard edge of this timber. The upper daporan thwart is notched into the golak gemi and the lower thwart helps to support the projecting golak gemi. The name gemi, or kemi, can be used to mean the stern of a vessel and it also means "splice" or "join together".

**IJON IJON**

The ijon ijon, sometimes called just ijon, or jong, is a sister vessel to the konteng. Like the konteng, ijon ijon are built in the twinned villages of Brondong and Blimbing, in Kabupaten Lamongan, East Java. The two types, not surprisingly, share a number of construction features but have significant differences. In broad terms, it may be said that the konteng is closely related to the kolec while the ijon ijon is closer to the Jepara sopek, in both structure and hull form.

**Recognition.** The ijon ijon is easily distinguished by the narrow projection of the stern and sternpost (linggi) above the sheer at each end (Fig. 50). The linggi are not as large as those of most other mayang types and they are relatively simple in shape with squared ends. The bow linggi is a little taller, and a little less raked than the one at the stern. There is a second distinctive finial immediately inboard of the linggi at each end. This finial is similar to the one in the bow of the Jepara sopek and is also found on a number of perahu types from the region of Madura. At Brondong-Blimbing it is called the topengan. The same name is used along the north coast of Madura while the name pakes is used on the islands east of Madura where the feature seems to have originated. As with the konteng, the painwork of ijon ijon is often extravagantly decorative.

**Size.** The ijon ijon, like the konteng, is very standardised in size. It is a smaller vessel than the konteng. A new ijon ijon, measured in 1990, had dimensions of 9.9 m x 3.73 m x 1.21 m. These dimensions are slightly larger, particularly in the beam, than was typical for older examples.

**Rig.** The ijon ijon does not carry the same rig as the konteng. While the konteng carries a single quadrilateral sail, the ijon ijon carries two
masts and two triangular lete sails in a configuration similar to that found on many small Madurese craft (Fig. 51). The smaller foresail is not always carried today on vessels that have auxiliary engines. The mainyard is much lighter than that of the konteng: it is a single length of bamboo, sometimes reinforced by lathes of split bamboo. The mainmast is stepped in the same way as in the konteng.

Use. Ijon ijon are used extensively for fishing with payang nets as well as other techniques of fishing. Ijon ijon based in Kabupaten Lamongan are operated over quite a wide area and frequently sell their catch in other ports such as Jepara in Central Java. They return to their home port only after several weeks, in some cases.

Distribution. The greatest number of ijon ijon can be found at Brondong and Blimbing where they are built. There are also large numbers of ijon ijon owned at Rembang, Central Java, where they are, apparently, called konting (Hawkins 1982: 104-5). They are also found on the north coast of Madura, in the villages of Pasean, Ambunten and Pasong Songan. Painted in the relatively subdued Madurese style, they blend in well with the locally built boats which are similar in appearance.

Recent history. Very little is known of the origins of the ijon ijon. Nothing much like it is illustrated by Van Kampen (1909). It combines
features of a *mayang* with design apparently derived from certain Madurese vessels, but these Madurese vessels also seem to be recently developed.

**Construction. Keel, stem and sternpost.** The straight keel on recently built *ijon ijon* is a fairly heavy timber. On some of the older vessels it is noticeably lighter and tends to be slightly wider than its depth. A newly laid keel, in 1990, measured 225 mm x 125 mm. The stem is more raked than that of the *konteng* or most other types of *mayang*. The sternpost is even more raked, but the finials of the stem and sternpost are fairly upright and are nearly vertical on some older boats. Both the stem and sternpost are curved. There is no rabbet on the stem or sternpost, the inner faces are bevelled to take the butt ends of the planks. A short apron timber is fitted in the bow and the stern, and secures the ends of the upper strake and fills the finials formed by the upswept ends of the rail in the bow and stern (Fig. 52).

**Midsection.** The *ijon ijon* has more beam relative to its length than any other type of *mayang*. The measured midsection shown in Figure 53 has as much beam, and is almost as deep, as that of a *konteng* nearly three metres greater in length. The planks are named or enumerated in the same way as those of the *konteng* up to the *maludan*. Above this is an extra strake called *lampih* and then a narrow, constant depth rail plank called *gedok*, which is like the *golak* of the Jepara *sopek*. There is no heavy rail timber. Instead a plank is fitted horizontally, on the inside of the *gedok*, just below the line of the sheer. This horizontal timber, the *tenkam*, is about 200 mm x 45 mm, and sits on top of the frame ends. *Tenkam* is the Madurese term for a similar struc-
Fig. 52. Stem of a nearly completed ijon ijon showing the sternpost and the stern finial.

ture in which the timber usually slopes outwards rather than lying completely horizontal as it does on the ijon ijon.

Planking. The plank pattern of the lower strakes is very similar to that of the konteng (Fig. 54). Forward, the serang extensions of the lower strakes are not tapered so they run out high on the stem. Aft, more taper is used. In the bilge and the topside planking, none of the seams run cleanly through to the stem or sternpost. The ijon ijon does not have strakes running from one end to the other. The planking in the ends, although connected, is discontinuous to the midbody planking. The plank patterns for the ends is,

Fig. 53. Midsection of an ijon ijon showing the strake names.
nevertheless, fairly standardised: a typical arrangement is illustrated in Figure 54.

**Bulkheads.** Ten bulkheads are fitted in a standard ijon ijon. The bulkheads and related structure of a nearly completed ijon ijon are illustrated in Figure 55. Three longitudinal timbers, one on each side, and one on the centreline, are secured in place beneath the thwarts. These add strength to the structure of the hull and also support the removable decking planks which lie flush with the thwarts. All mayang are fitted with a similar structure but in the ijon ijon it is heavier and more obviously of structural significance.

**Rudder support structure.** The rudder support structure is identical to that of the konteng.

**JANGRAJA**

This is a form of mayang from the eastern part of East Java. It is a distinctive type with numerous distinguishing features that are not found on any other mayang, but there are strong similarities in the plank structure to the general kolek/conteng design.

**Recognition.** Very easily distinguished by the extremely high prow structure, as shown in Figure 56. Jangraja are often lavishly decorated with flags, pennants, and intricate ornaments made of copper wire and beads. They also have very distinctive paintwork patterns (Fig. 57). There is nearly always a snake motif, said to have magical powers, decorating the prow structure: it is called pe'kopek in bahasa Madura or penjampi in Indonesian.

**Size.** These vessels are very standardised in size. A typical example measured 12 m x 3.13 m x 0.85 m. Unlike other types of mayang, there appear to be no smaller versions of this type at all. Though long and fairly beamy, they have relatively little moulded depth.

**Rig.** Today the jangraja carry a single lete (Indonesian lateen) sail. This type of sail has long been in use in the area, it is shown in an 1856 watercolour sketch of Madura Strait by Thomas Baines (reproduced Braddon 1986: 112). Although side mounted motors have been widely used for some years now, most jangraja still carry a large sail and use the sail in preference to the motor when conditions are favourable. The up-
Fig. 55. An ijon ijon under construction showing the internal structure.

The spar of the jangraja rig is more or less straight, and is made of bamboo.

Use. These vessels are used almost exclusively for fishing with large payang nets, which helps to account for their uniformity of size. Unlike the konteng of Brondong-Blimbing, the jangraja make only short fishing trips. They usually leave port late in the night, with the help of the land breeze, and return the following afternoon, often with a sea breeze which comes up against the prevailing southeast trade winds during the afternoon.

Distribution. Jangraja are found from a little west of Probolinggo (about 80 km east of Surabaya) almost to the eastern extremity of the north coast of Java. The major concentrations are at the village of Pesisir, near Besuki, and the harbour of Panarukan, a little further to the east. Formerly a few were found along the south coast of Madura, especially at Camplong and

Fig. 56. Jangraja.
Bandaran, but there appeared to be none left in 1990.

**Recent history.** These vessels are usually called *perahu payang*, or *mayang* by the fishermen who operate them. In South Madura they are called *gelatik* or *gelatik*, but this term is not used at all in the area of Besuki on the mainland.

All *jangraja* are built by men from the area of Nguling, a little to the west of Probolinggo and it is the builders who employ the term *jangraja*. *Jang* means plank, and *raja* literally means king or ruler, but can mean big or important. Whether the name means big planked boat, boat with big planks, or refers to the large prow structure which is built from large planks, is not clear.

Many of the builders and operators of *jangraja* are of Madurese descent, as indeed is a large part of the population of the Javanese shore of the Madura Strait. The design of the *jangraja*, however, has more in common with the Javanese *mayang* than it does with the traditional craft of Madura.

As noted above, Thomas Baines sketched *mayang* fishing in Madura Strait in the middle of the last century. The vessels he drew carried the triangular *lete* rig, rather than the quadrilateral sail, which is a strong indication that the vessels were locally owned. Baines was a very accurate observer of sailing vessels. The *mayang* that he drew in Madura Strait setting *payang* nets appear to be the same size as the typical large modern *mayang*. They do not have the styling of the *jangraja* but have the prow style and decoration very much like that of the *mayang* from Bantam, West Java illustrated by Van Kampen (1909; fig. 1, pl. 4). This style is more closely related to *hekolek*. The vessels that Baines drew have fairly high freeboard, whereas the *jangraja* have particularly low freeboard. In this respect Baines’ vessels look more like the *mayang* of Brondong-Blimbing.

If the *jangraja* was not the *mayang* of Madura Strait when Baines was there, it certainly existed at the beginning of this century. Van Kampen (1909: pl. 5) shows a photograph of a fine *jangraja*, apparently identical to many that are in use now.

**Construction. Keel and ends.** The keel is straight, more or less square in section and not very substantial for the size of the vessel. The

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![Fig. 57. The decorated linggi of a jangraja.](image)
Fig. 58. The keel and linggi erected at the start of construction. The linggi, which symbolises a phallus has been wrapped with a white cloth, presumably for the sake of modesty. The linggi of konteng are usually wrapped when in harbour.
huge stem/prow and sternpost are constructed from large planks, about 90 mm thick, edge dowelled together. As with the konteng, the ends of the planks simply butt on to the stem and the sternpost - there is no rabbet. It can be seen that the lower part of the stem, in Figure 58, shows considerable curvature and rake but the inner face of the stem, where the planking abuts (the equivalent of the rabbet) is straighter and more upright, as it is in most mayang types.

As with the kolek and the konteng, the upper part of the stem is clear of the hull and unsupported. The stem is tied to the hull by a stout wire bridle which is passed through two holes in the stem near its outer edge just above the waterline: these wires lead diagonally up on each side of the hull to pass through the heavy rail. The two ends are joined and the bridle is set up taut by twisting it.

It is common to see the projecting prow made of planks with natural holes in the timber (Figs 56, 58). The holes are left unfilled. Probably these natural holes in the stem are thought to confer good luck, as they are by the traditional boat builders and sailors of South Sulawesi (Macknight and Mukhlis 1975: 278). There is a good deal of superstition involved in the decoration of these vessels.

Midsection. The midsection form is considerably shallower than for other types of mayang. The double chine is clearly defined and the bottom is gentle curved (Fig. 59). There are no separate terms for the strakes of the bottom. All of the bottom planking in the midbody is collectively referred to as the pengampit. This is unusual because pengampit and cognate terms are very widely used in Indonesia and Malaysia to mean specifically the first strake (the garboard strake) rather than the lower planking. In a large modern jangraja there are usually three strakes in the bottom. The bilge strake is called the akong, which is usually made up of two strakes in modern practice. The topside strake is the ko’ong. The terms akong and ko’ong apply for the full length of the strakes, right to the ends of the hull. No serang (or milong in the local terminology) are recognised for these strakes.

The rail, called the lete, is flush with the planking on the outside. It is a heavy timber, typically about 120 mm deep x 180 mm. Outside this there is a wale called the telep. No other mayang type is built with a wale but several Madurese types of perahu have one or more wale.

Planking. The early stages of construction of a jangraja are illustrated in Figure 60. There are three planks fitted in place either side of the keel, in the midbody of the vessel. This comprises the pengampit which appears an almost flat platform. Not a single plank has been added to either end at this stage. The end planks of the pengampit strakes are referred to by the builders of jangraja as milong or melong: this is the equivalent of the term serang used by other mayang builders (Fig. 61). Looking at the plank pattern of a completed hull, it will be seen that there is little taper in the planks which extend the lower strakes into the bow and stern, and therefore they run up high on the stem and sternpost. As a result, the bilge strake (akong) reaches the sheer in the bow and the stern, while the the topside strake tapers out under the rail.

![Fig. 59. The midsection of a jangraja with the strake names.](image)
before it reaches the ends. This is similar to the planking pattern of the *kolek* and several other *mayang*.

The hull is finished with the fitting of the wale (*telep*) around the outside of the rail. The function of the wale seems to be more aesthetic than structural. It is a feature of several types of Madurese *perahu* and other smaller vessels built in the same area as the *jangraja*. The wale is usually painted with diagonal stripes, as in Figure 56. The whole vessel is usually painted with complicated geometric patterns which distract the eye from the run of the seams in the planking. The planks are carefully and closely fitted together, so the seams and plank structure of the painted vessels are very difficult to discern.

The *jangraja* has particularly low freeboard, and a very flat sheer by comparison with other *mayang*. If the *jangraja* is compared with most of the Madurese designs that are found in the same area it appears even more flat sheered. Perhaps the builders, who were familiar with the Madurese tradition, exaggerated the relatively low freeboard and flat sheer of the *mayang* when adopting the design and structure of that type. The low freeboard is convenient for handling the nets, and for rowing if no engine is used, which was the case until recently. *Jangraja* operate in the fairly sheltered waters of Madura Strait and make relatively short voyages so they do not need the seakeeping qualities of the *konteng* or *jegongan*. Madura Strait is, however, more than thirty nautical miles wide and can become quite rough.

Bulkheads and frames. A *jangraja* normally has eleven bulkheads plus a floor timber which serves as the step for the spar crutch and rudder support post in the stern. The bulkhead structure is similar to that found in the *konteng* but it is usually less neatly executed.

Rudder support system. This is a version of the normal *mayang* system with a single rudder support post rather than the bifid rudder support post, or twin posts, found on most Madurese vessels. Along with the spar crutch, the rudder support post is stepped through a wide thwart (*panggalan* or *bangkal* in bahasa Madura) with its heel fitted into a notch in a floor timber below the thwart. The rudder support thwart differs from that of other *mayang* in that it lies completely below the rail rather than being notched flush into it, and extends outboard only very slightly. The projecting ends are not clearly discernible. Aft of the rudder support thwart, the rail is extended by a heavier timber, rather like that in the *kolek* and the *konteng*. 

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Fig. 60. The early stages of construction when only the midbody planking is assembled.
The means of securing the rudder in place is somewhat different from that of other mayang. The rudder is lashed against a projecting, crooked timber called the sengkir (Figs 61, 62). The sengkir itself is firmly secured by lashings and is not normally unshipped in port.

Only one sengkir is fitted, on the starboard side. There are reasons to suppose that in the past, before engines were used, a sengkir would have been fitted on both sides since the rudder has to be carried on the port (lee) side when the vessel is under sail on starboard tack. Larger trading vessels from the same area, called perahukacik, carried port and starboard sengkir. However, local informants were quite adamant that jangraja never carried a port sengkir: the nets
are shot from the port side and they would have fouled on a projecting sengkir. In order to sail with the rudder on the port quarter a temporary arrangement was rigged, presumably something like the mangga mangga of the kolek.

EDER

Eder are small fishing vessels built only on the mid-south coast of Madura. In style they are related to the larger jangraja built by Madurese people across Madura Strait on the north coast of Java. Eder are not typical mayang in all respects, like the jangraja they have some Madurese elements in their design, but they have a distinctly chined midsection, and builders at Camplong, Madura, were quite emphatic that there are only four strakes in the structure, for which they had a complete set of names.

Recognition. The large bow linggi of the eder is distinctive and very strongly recurved (Fig. 63). The paintwork on a typical eder is ornate and attractive. There is a second bow finial formed at the confluence of the port and starboard rail in the bow, similar to that of the Jepara sopek and the ijon ijon, but strongly recurved in parallel with the linggi. The chines are clearly evident in the midsection, but they do not rise much before fairing out towards the ends of the hull, so they are less obvious at a distance. The rail, or wale, is a light timber fixed to the outside of the hull, and there is usually a half-bamboo lashed to the outside of the wale as a rubbing-strip.

Size. Eder are a small type of mayang; generally 7-9 m in length and not particularly deep or beamy. An eder measured at Camplong was 7.410 x 2.095 x 0.700 m.

Rig. There is a single, short mast, on which a boomed lateen, or lete sail is set. The heel of the upper spar is held in the bow, when the sail is set, by one of a number of short strops. These strops are spliced to fore-and-aft timbers (jagalan) which are either fitted to the inside of the planking in both sides of the bow, or fitted as a central fore-and-aft timber in the bow at deck level. There are a number of strops - up to five per side - at different positions in the bow. If port and starboard jagalan are fitted, the heel of the spar is held by a strop on the lee side, and strops must be shifted and changed when changing tack. In light winds the strop nearest the mast is used to set the sail peaked up high; as the wind strength increases, strops further forward in the bow are utilised, in order to set the sail with its peak lower and to move the spar’s point of attachment to the...
mast closer to the middle of the upper spar. The spars are generally rather light. There is a sheet on the boom and a vang to control the spar. The same rig is used on a variety of Madurese small craft which cannot be classified as mayang.

Use. Eder are too small to be equipped with a large, modern, payang net. In the area where eder are based, payang nets are carried by the larger jangraja which are usually called jabar on the south coast of Madura. Some eder are equipped with smaller seine nets that can be called krakad. Others use fine mesh nets to catch prawns and small fish attracted by kerosene pressure lanterns. They do not fish far offshore, nor do they remain at sea for long. When conditions are right, they sail in the late afternoon, fish through the night and return during the first half of the morning. In 1994 the majority of eder were fitted with a small long-shaft motors, but they retain a full-size sailing rig, and use the sail whenever there is wind.

Distribution. Eder are only found in any number in a small and distinctly limited area in the Kabupaten of Sampang, Madura. They are numerous at Camplong and at Tanjung Mendereng, Tambakan, a few kilometres to the east, but they are hardly found to the west of Camplong, and to the east they are not seen much beyond the border of the neighbouring Kabupaten Pamekasan. A few eder can be found on the Java side of Madura Strait, and it may be that at certain times of the year, the fleet from the Camplong area operate further afield, as fishing fleets from the north coast of Madura do.

Recent History. Vessels that can be classified as mayang are not found on the north coast of Madura and have very limited distribution on the south coast, which suggests that the eder, and other types of mayang, are relatively recently introduced or adopted in Madura. To the east of the Camplong area, similar sized fishing vessels are round-bilged perahu of the lete type (eg. Burningham 1989: fig 29), or an older type built without frames or bulkheads, the sakangan, which has not yet been recorded in the literature. To the west there are small craft of another lete type with some mayang affinities (eg. Burningham 1989: fig 7), and a very different type, built without frames of bulkheads, the lis alis (Horridge 1981:32-34, plate 10). The construction of the eder combines some features of these Madurese types with a mayang midsection. A builder of eder interviewed at Tanjung Mendereng in April 1994 was constructing a round-bilged lete or pakesan and he stated that it was a stronger or more durable type (lebih tahan) than the eder. Eder tend to be less heavily constructed and perhaps they are preferred at Camplong because they can be efficiently propelled by their rather light rig, but if the trend to motorisation and the use of larger motors continues, the eder are likely to be replaced by lete.

Construction. Keel, stem and sternpost. The keel is usually shallow and wide, almost a median plank. It is usually straight throughout its length, but at the ends it is extended by up curving pieces called dapang or dapangan. This is a Madurese characteristic. Above the dapan-gan, the large Bowlinggi is built up from timbers edge-dowelled together with little regular pattern, but in general the same type of construction as the linggi of a jangraja is employed. The stem rabbet rakes sharply forward in its lower part following the curve of the dapangan. It curves
sharply and then recurves aft in its upper part. In the stern the rabbet rises a little more quickly and turns through less of a curve to finish more or less vertical. All other types of mayang (except the stemless jegongan) have their sternpost more raked than the stem. The stern dapangan, and linggi is in some cases a grown piece of timber, as in the konteng, rather than a number of pieces edge-dowelled together.

**Midsection.** The garboard (pengapet) and second nominal strake (pe'lempang) form a gently rounded bottom with little deadrise and with the pe'lempang rising quite perceptibly (Fig. 64). The bilge strake is wide and gives a typically mayang midsection. The topside strake is moderately deep, particularly when compared to that of the jangraja. The naming of the upper strakes - terkoan and ko'ong - is similar to that employed by builders of jangraja.

**Planking.** The plank pattern (Fig. 65) is essentially like that of lete and other Madurese types. The garboards are either full length planks or they are scarfed near midships. All strakes can run the full length of the hull and none of them need have a scarf near the bow or stern. The concept of bow and stem extensions to midship planking is known in some places on the south coast of Madura and the term pemalong is used for these planks, but eder are not considered to have distinct pemalong planks in their structure.

**Bulkheads and frames.** A mixture of bulkheads and frames are fitted; most bulkheads are built up from floors or full frames rather than horizontally aligned planks edge-dowelled together. In the ends of the hull there are often solid bulkheads sawn from large single planks vertically aligned. The bulkhead built on the floor that is the mast step, is built up higher than the level of the decking and the other bulkheads. The thwart that sits on top of it, and through which the mast steps, is let through the hull planking and projects very slightly. There is another projecting thwart at the same height towards the stern. Some Madurese vessels are built without frames or bulkheads and derive their structural rigidity from having a large number of thwarts fitted. Because these thwarts cannot be fastened to frames (there are none), either directly or by way of a beam shelf, they are let through the planking and fastened to it by the internal edge-dowelling that also fastens the planking together. The two projecting thwarts of an eder obviously reflect this tradition of construction.

**Rudder Support System.** The rudder is lashed against the aft face of a large projecting thwart which sits right in the stern. This thwart, along with the heavier beam which is immediately forward of it, is not called the dapuran as the corresponding and similar structure is on most Javanese and Madurese vessels, instead it is called the bangkalan. Bangkalan is also the name of the western district of Madura. The rudder mounting post which steps through the heavy beam which is the forward component of the bangkalan is called the tajuk, a name which can mean 'horn', and is usually applied, in a nautical context, to the top timbers in the framing of a perahu. There are sometimes short fairings on the rail aft of the bangkalan which the rudder bears against, like the serang manis of a
Fig. 65. Bow and stem profiles of an eder.
compreng; they are called pekepe. The terminology collected from builders at Camplong and Tanjung Mendereng was significantly different from the terminologies used by builders of different types of perahu in neighbouring parts of Madura, but had very few cognates with any Javanese mayang builder’s terminology.

PLANK NAMING SYSTEMS

The various plank nomenclatures used by mayang builders in different parts of Java provide information about the builders’ conception of the construction and also clues as to the development and relationship of the various types of mayang.

The evidence of the plank naming systems suggests that the builders regard the plank shell of the hull, not as a series of strakes running from one end of the hull to the other, but as consisting of the midbody planking and the structurally distinct bow and stern planks, called serang. The word serang means “attack” in Indonesian while berserang means “to increase”. As a boat building term referring to the bow and stern, it appears to derive from the idea of the bow and stern being “additions” or “extensions” to the midbody. The noun serangan is used to name the scarfs or butts joining (and adding) the serang to the long midbody planks. The term serang is used by traditional boat builders on the east coast of Malaysia to name the apron timbers that are fitted between the converging bow and stern planking, and also to name the whole bow and stern structures of which the aprons are part. The Javanese term can be understood in the same way: referring to the whole structure of converging planking in the bow and stern.

The concept of special bow and stern planking is by no means unique to mayang builders. For example, specially shaped bow and stern planks are named tungku tungkulu in South Sulawesi (Horridge 1979: 17). They are called salureh by the Bajau of Eastern Indonesia, and tujjah in the Sulu Sea region. At Bonerate, an important boat building centre where the Bhinongko dialect of Butonese is spoken, these planks are called sarempa.

The various names for the mayang midbody strakes, which are given in the text above, are tabulated in Figure 66. Some of the sets of terms are simple enumeration and have been disregarded for this reason. Some others should probably be disregarded since they are descriptive names (most likely, these were supplied as polite response to silly questions asked by one or other of the authors). Two systems are listed for the compreng: the first is the one described in the text, and the second is one displayed in the Museum Bahari, Jakarta. There are also two systems listed for the jegongan: the first is a system collected at Eretan in 1989 and noted in Burningham (1989: 200), the second is described in the text. The plank naming system employed by the Madurese speaking builders of the jangraja is clearly differentiated. No system is listed for the West Java sopek because it is the system used by builders of the compreng and is listed for the compreng.

It can be seen that some terms are fixed or common, some are variable, and some can be regarded as anomalous. The two ends of the various systems are fixed: the first strake is always the pengampit or pengapel, (the exception, dasar, means “base” in Indonesian, and may be regarded simply as a description). The term golak is always used to name the rail. Karon is also fixed as both a second named strake and part of the bottom planking.

Menteng cementeng is the fourth named strake and part of the topsides in both the jegongan systems. It does not appear elsewhere in mayang building but it is used by some Madurese boat builders and means belly or paunch.

Cantelisa is a fourth named strake and is the bilge strake. However the bilge strake is the third strake in most other systems. The term is only used by builders of compreng but is consistently applied by a large number of compreng builders.

Sender is a third strake and the turn of the bilge, but it only appears once. Everything else is variable or anomalous.

Maludan is always in the topsides but it can be the fourth or fifth named strake.

Telon is an interesting variable. It is always a third named strake, and ought to be, since the name means third. But it shifts from the turn of the bilge to the bottom planking and occupies an indeterminate position in the rather different section of the Jepara sopek.

Gedok is always in the topsides but shifts from the fifth topside/sheer strake to the rail and then up to the wash strake.

The strake naming systems of the kolek and the jegongan can be regarded as “classical” four strake systems. There are three systems with five named strakes listed. Two of them are for the compreng and one for the Jepara sopek. In the
Mayang

In the Jepara sopek case the system is partly simple enumeration - *talon, k'ampat* means third, fourth - and the midsection is, in any case, atypical. Smaller Jepara sopek, in fact, often have a four strake structure, so a five strake naming system could not be applied to them (the same is true of the *ijon ijon* and *konteng* terminologies which are largely enumeration). The two *compreng* strake naming systems appear to be adaptations of a four strake system. The fifth strake is named *gedok* or *golak*, names that are elsewhere used for the rail and for a washstrake, pieces that are not part of the plank shell proper.

**DISCUSSION**

The *mayang* is clearly a type of vessel of some antiquity. Vessels that are recognisable as *mayang* were drawn by western travellers in Southeast Asia as early as the 16th century: the earliest example is a 1598 engraving in *D'Eerst Boeck* (reproduced in Manguin 1980: 217). There are several sketches by Sidney Parkinson who accompanied Cook on HMS *Endeavour* (reproduced in Joppien and Smith 1985: 232) which show *mayang* in more detail.

These early representations (and a greater number of 19th century representations) are recognisable as *mayang*, primarily on the basis of the recurved bow and stern profile (Fig. 67). This type of recurved profile is still the most obvious distinguishing feature of the bow and stern of *kolek* and *jangraja*, the bow of the *compreng* and the stern of the *konteng*. Other details such as the single masted, tilted rectangular sail rig, the spar crutch in the stern, the *andang* and the single quarter rudder reinforce the identification of these early representations as *mayang*, but it is the recurved profile that is crucial. It is a style that is virtually unique to the Javanese *mayang*. The only other examples in Southeast Asia are found in neighbouring areas of Sumatra.

The non-Chinese, traditional planked craft of the South China Sea region (Malaysia, Borneo, Thailand and Vietnam) are broadly similar to the

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**Fig. 66.** Various strake naming systems tabulated and arranged for comparison and analysis.
mayang. They are built using heat to bend planks and they have moderately sharp, double-ended hulls, often with some hollow in the forefoot and heel. None of them share the recurved ends of the mayang. The Malay payang has a number of details in common with the mayang and its intended function is the same, as the name implies. Its bow and stern profile are stylistically typical of east coast Malay vessels but quite unlike those of the mayang (Fig. 68a). The rua chalom from Thailand (Fig. 68b) is of a different and widely spread style, and it is also quite unlike the mayang, with the exception of the anomalous jegongan.

While the early representations of mayang are distinguished from other regional craft by the recurved stem, a purely stylistic element of the mayang design, there are a number of structural features and elements of the hull form of the modern mayang, that, taken together, distinguish the mayang from all other craft. These features can be summarised:

1. A long straight keel which meets the stem and the sternpost at a distinct angle;
2. Bulkheads as part of the framing;
3. A chined hull form with an almost flat bottom and double chines in the midsection;
4. A plank pattern in which long planks are fitted in the midbody so that no joins in the planking occur near midships. The planks and the strakes are as wide as possible with a total of only four strakes being the standard structure. The lower two strakes comprise the base (dasar) or bottom of the hull. The other two strakes form the turn of the bilge and the topsides. It is this structure which produces the double chined midsection. The planks at the ends of the lower strakes are not (much) tapered, particularly in the bow, so the upper strakes have to be tapered out before they reach the stem and, in some cases, the sternpost.

Some traditional planked boats of the South China Sea region have a straight keel which meets the stem and sternpost at a distinct angle, but most traditional craft of the region, including the payang, have some rocker (convex curvature) to the keel. Traditional vessels of Thailand and Vietnam do not have a projecting keel, rather they have a stout median plank which often retains the form of an opened out dugout canoe. It usually has some rocker.

The use of bulkheads is standard in the boat building tradition of China, but the mayang builders’ use of bulkheads rather than frames seems to be a unique example of this construction outside the Chinese tradition. The use of the bulkheads in mayang is somewhat different from the normal use in Chinese boat building. In the mayang the bulkheads are fitted into the completed plank shell whereas in Chinese boat building the bulkheads are erected as formers on top of the bottom planking before the rest of the planking is fitted. This comparison is only true in respect of what can be considered the north Chinese tradition. Recent discoveries of wrecks and related research by maritime archaeology in Southeast Asia indicate that there was, in the past, a south Chinese tradition of building sharp bottomed ships, by shell construction with bulkheads inserted into the shell (Green 1983). There were also non-Chinese Southeast Asian vessels of related design and vessels that appear to have been “hybrids” incorporating features regarded as Chinese and others regarded as Southeast Asian (Manguin 1980). Green (1990) has summarised the evidence from the various significant wreck-sites of the region: it is not yet clear what were the origins of the South Chinese tradition, or its relationship to non-Chinese Southeast Asian ship building; also it is not certain what were the reasons for its disappearance though the so-called “Ming ban” on the construction of ocean going vessels must have played a part. Returning to comparison with the surviving north Chinese tradition: in virtually all Chinese vessels, the bulkheads are augmented by frames - often the frames are more numerous than the bulkheads. Worcester (1971) provides plans and construction details of a great variety of Chinese tradi-
Mayang

The plank pattern of the mayang is significantly different from that of traditional South China Sea planked boats although the practice of using heat to bend planks, often in matched opposing pairs, is a common feature. In Malay and Thai boats, as characterised by the payang and the rua chalom, the strakes run smoothly into the ends of the hull. The sheer strake is always carried right to the stem and sternpost. If stealers (strakes which do not run the full length of the hull) are used in Malay or Thai boats, they are used in the turn of the bilge, as they are in the jegongan. This is a more common type of plank pattern and is found, for example, in Mediterranean and Arab boat building traditions.

The use of four distinct and broad strakes, producing a chined hull form is apparently unique to the mayang, at least in Southeast Asia. But while the chined section of the mayang is unique, there are other examples of strake naming systems which name four strakes. At Kuala Terengganu, Malaysia, the planks are named lepang apit, papan timbal, perut ikan and biji kaya, and above these there can be a rail plank called papan tarik and a washstrake called lepa (lepah, lepang and papan all mean plank). If there are more than four strakes, the extra strakes are all called papan timbal. The Bajau of Semporna, Sabah, name four strakes, including a washstrake, in the construction of a lipa lipa canoe. The names are pangahapit, gipis, kapi kapi and koyang koyang.

Turning from the structural distinction of the mayang, the ornamentation of the various mayang is also distinctive. Most have bright and complicated designs in their paintwork. No other Indonesian traditional craft have such paintwork but the kolek of Kelantan Malaysia and neighbouring southern Thailand have similarly extravagant painted decoration.

The massive ornamental prow piece (linggi) of most mayang is another distinctive feature. The kolek with the recurved profile of the linggi seems to be an “original” form of mayang which has changed very little since examples were photographed at the beginning of this century. Several other mayang types show influence from other traditions of boat building, particularly Malaysian tradition and that of the various Sea Nomad people. The konteng is very similar to the kolek in structure but it has a high, pointed prow (linggi) which is probably a recent addition. The tall pointed prow pieces of several mayang types are probably all recently developed and even the kolek has a taller and more pointed linggi than formerly.
N. Bumingham and K. Stenross

Bumingham (1989: 217) speculated that the archaic mayang might have been built without a true stem or stempost, and that, in this and certain other related aspects of their structure, they were related to other archaic traditional designs of the Indian Ocean region. This possibility is not discounted, but the stemless structure of the jegongan appears to be a recently incorporated design from another boatbuilding tradition. The same is true of the non-structural stempost of the compreng.

If the mayang design has long incorporated a stem and stempost, it is more likely that the stem without a rabbet, as on the konteng, is the original design, rather than the rabbeted stem of the modern kolek. Traditional Malaysian craft are built with no rabbet on the stem, indeed some designs are planked up before the external stem is added.

Some features of the various mayang types represent recent influence on the original design from boat builders of other traditions, especially boat builders of Malaysian origin. In a broader sense, the mayang belongs to a boatbuilding tradition that also encompasses the boatbuilding of peninsular Malaysia, Borneo, Thailand and some parts of Vietnam. Within this broader tradition the mayang is a very distinct type. Further detailed study of the structure and construction of traditional boats from other parts of the region is necessary to determine what are the widespread and characteristic features of the region’s boatbuilding tradition. This course of research is needed to reconstruct the probable development and design of the archaic watercraft of the region which will be an important key for interpreting wrecks discovered by the burgeoning maritime archaeology of the region.

REFERENCES


Naval Intelligence Division. 1944. Fishing and trading craft of the Netherlands East Indies, New Guinea and the Solomon Islands. Admiralty restricted publication: London.


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A REDESCRIPTION OF ANTHOMASTUS AGILIS TIXIER-DURIVAULT WITH A GENERIC PLACEMENT IN SINULARIA (COELENTERATA: OCTOCORALLIA), AND SOME REMARKS ON SINULARIA RAMOSA TIXIER-DURIVAULT.

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ABSTRACT

The holotype of Anthomastus agilis (family Alcyoniidae) does not have siphonozooids nor the characteristic spiculation of Anthomastus, as originally reported. The specimen is redescribed and transferred to the genus Sinularia. Some additional information and sclerite drawings are given for Sinularia ramosa.

KEYWORDS: Coelenterata, Anthozoa, Alcyonacea, Octocorallia, Alcyoniidae, Anthomastus, Sinularia, soft corals, new combination, taxonomy, New Caledonia.

INTRODUCTION

During the course of researching the identity of an unusual dimorphic soft coral from Darwin, northern Australia, I had cause to examine the holotype of Anthomastus agilis which had been described by Tixier-Durivault (1970a: 186-187). Apart from lacking the characteristically large autozoids of Anthomastus, it also became obvious that the spiculation was quite atypical of that genus. A far too cursory look at the proposed siphonozooids that were reported by Tixier-Durivault led to my erroneous “pers. comm.” to Dr Gary Williams (1992: 1, 23) that the material represented a new genus. A subsequent examination, regrettably too late to prevent publication, revealed that the siphonozooids recorded by Tixier-Durivault were actually inflated caecae of the subsurface canal system. Ironically, Tixier-Durivault (1951: 11) had previously pointed out that other authors had made similar mistakes. The holotype has the characteristic spiculation of a Sinularia and is herein transferred to that genus as an undescribed species. The somewhat unusual growth form is perhaps attributable to its apparent juvenility when preserved, and the inflated nature of the specimen, and possibly also its most recent habitat, which was the Noumea Aquarium run by its founder M. René Catala.

It appears that Utinomi and Imahara (1976: 211) failed to take into account the difference in the respective sizes of the internal sclerites when they proposed that A. agilis was a probable synonym of A. phalloides Benham, 1928. The sclerites of A. agilis were described as up to 2.2 mm in length and those of A. phalloides only up to 0.25 mm. Williams (1992: 19) recently transferred A. phalloides to the genus Minabea.

Fig. 1. Sinularia agilis, holotype. 1.5 times natural size.
Mme d'Hondt's 1992 paper (published in 1993) was only received subsequent to submitting the manuscript for this paper. Several electron micrographs of surface sclerites of *Anthomastus agilis* are illustrated in Figure 1 of that publication and should be viewed in conjunction with the present description.

![Fig. 2. *Sinularia agilis*, holotype, sclerites from the surface of the lobes.](image)
The generic placement of *Anthomastus agilis*

Fig. 3. *Sinularia agilis*, holotype, sclerites from the surface of the lobes.

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Fig. 4. *Sinularia agilis*, holotype, sclerites from the surface of the base.
SYSTEMATICS

Family Alcyoniidae Lamouroux
Genus *Sinularia* May, 1898

*Sinularia agilis* (Tixier-Durivault, 1970a)
new comb.
(Figs 1-5)


Description. The holotype (Fig. 1) is a single lobe, about 40 mm in length and 11 mm at its greatest upper diameter, with a small flattened lobe, 15 x 6 mm, that protrudes from one side. The colony seems to have been preserved in a relatively inflated state and is soft and compressible.

The polyp apertures are about 0.5 mm across and are present over both the large and small lobes down to within approximately 15 mm of the base of the specimen. While some of the polyps have their contracted, but unfolded, tentacles protruding, most are retracted until they are flush with the lobe surface. The inflated caecae of the subsurface canal system appear as clear patches between the white heads of the club-shaped surface sclerites, and are present right down to the base of the specimen. Tixier-Durivault’s illustration (1970a: fig. 10E) is misleading in its uniform representation of the shape of the patches which actually vary from small and more-or-less circular, to larger irregular and often elongate structures. Microscopical examination of small tissue fragments in both

Fig. 5. *Sinularia agilis*, holotype: A, sclerites from the interior of the lobes; B, sclerites from the interior of the base; C, detail of sclerite warting.
plan and sectional views revealed no apertures or mesenterial structures in the caecae, only aggregates of cells which are probably zooxanthellae.

The surface of the large lobe contains club shaped sclerites (Figs 2, 3) with irregularly and complexly warted heads. They vary from 0.07-0.30 mm in length with most <0.28 mm long. There are also a few curved spindles, about 0.25 mm long, with simple processes, but they are quite rare.

The interior of the large lobe contains long, pointed, narrow spindles up to 2.2 mm long (Fig. 5A). Some of the smaller forms are branched. The complex warts are high and spiny (Fig. 5C).

The surface of the base contains clubs and a few irregular forms (Fig. 4). They are 0.09 - 0.22 mm long, with most <0.17 mm. The handles of the clubs are thicker than those in the lobe surface.

The interior of the base contains large, robust spindles, up to 2.5 mm long, many of which are terminally bifurcated (Fig. 5B). The complex warts are the same as those on the sclerites in the lobe interior, but they are far more densely placed.

Remarks. While comparing *Sinularia agilis* to other species of *Sinularia*, I was able to examine sclerite samples of the holotype of *S. ramosa* Tixier-Durivault, 1945. There is some similarity in the general shape of the sclerites

![Fig. 6. Sinularia ramosa, holotype: A, polyp sclerites; B, sclerites from the surface of the lobes.](image-url)
between this species and *S. agilis*, and it is not inconceivable that *S. agilis* could have a similar mature colony form. The style of the sclerite warping is different, but perhaps it is within the bounds of intraspecific variation. Unfortunately, the latter is a subject on which little is known for the majority of octocorals, and nothing is known with respect to *S. ramosa*. Tixier-Durivault did report other occurrences of the species, from New Caledonia (1970a:293) and Vietnam (1970b:205), but regrettably none of the 12 specimens were described. The author, characteristicly, just repeated her earlier original diagnostic text word for word, including the sclerite dimensions.

The holotype of *S. ramosa* was redescribed by Verseveldt (1980:112-113), but two important facts were overlooked. First, the polyps are armed with at least four to five pairs of rod-like and club-like sclerites (Fig. 6A) arranged *en chevron*. They are 0.09-0.17 mm long. Second, the surface of the lobes contains numerous, narrow, often curved, pointed spindles (Fig. 6B) that are ornamented with simple prominences. It is also worth noting that the majority of surface clubs are only 0.09-0.12 mm long. This is not obvious from the text, but it is why this species is included in Verseveldt's key under group III. This size is considerably smaller than for *S. agilis* which is here considered a distinct species.

ACKNOWLEDGEMENTS

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REFERENCES


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HYLID FROGS FROM THE MID-MIOCENE CAMFIELD BEDS OF NORTHERN AUSTRALIA.

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ABSTRACT

Three new anuran species representing hylids of the genera Australobatrachus Tyler and Litoria Tschudi are reported from the Tertiary Camfield Beds at Camfield Station in the north-west of the Northern Territory. The material comprises 10 fragmentary ilia and a sacral vertebra, and constitute the second Tertiary record of frogs for northern Australia, and the first for the Northern Territory.

KEYWORDS: Anura, Hylidae, new species, Miocene, Camfield Beds, Australia, Australobatrachus, Litoria.

INTRODUCTION

Knowledge of the Tertiary frog fauna of northern Australia has been confined to material recovered from the rich Oligo-Miocene deposits at Riversleigh Station in north-west Queensland. To date, representatives of six hylid and leptodactyloid genera have been reported from sites there: Litoria Tschudi, Crinia Tschudi, Kyarranus Moore, Lechriodus Günther, Limnodynastes Fitzinger and Philoria Parker (Tyler, 1989, 1990, 1991a, 1991b, 1991c, in press).

Here I report material from a Tertiary locality in the Northern Territory - the mid-Miocene Camfield Beds on Camfield Station, located on the Buchanan Highway. The material also represents the first record of fossil frogs from the Northern Territory.

MATERIAL AND METHODS

The specimens reported here are all deposited in the palaeontological collections of the Northern Territory Museum, Darwin. Descriptive terminology of ilia follows Tyler (1976). Scanning electron microscopy involved the use of a Cambridge 5250 housed in the CSIRO Division of Soils, Glen Osmond, South Australia.

SYSTEMATICS

Order ANURA Rafinesque
Family Hylidae Gray
Australobatrachus Tyler
Australobatrachus undulatus sp. nov. (Fig. 1)

HOLOTYPE-NTMP936, unrecorded quarry, Bullock Creek Locality, Camfield Station, Northern Territory (17° 00' S; 131° 30' E), Bullock Creek Local Fauna, mid-Miocene. Proximal portion of a right ilium.

PARATYPES - The proximal portions of two right ilia: NTM P8697-33, from 'Dromomithid Mountain' and P87114-8 from 'Top Site', both from the Bullock Creek Locality.

Description of holotype. In the holotype (Fig. 1), the dorsal acetabular expansion, dorsal prominence and protuberance and pre-acetabular zone are complete. The only diagnostic portion of the ilium lacking in this specimen is the ventral acetabular expansion, and the ventral rim to the acetabular fossa.

The dorsal acetabular expansion is low and on a level with the dorsal face of the ilial shaft. The dorsal prominence is large but only weakly raised and the dorsal protuberance scarcely elevated from it. The preacetabular zone is evenly curved and broad. The ilial shaft bears a broad
and shallow, longitudinal groove. Total length of specimen 6.5 mm.

Comparison with other species. The type species *A. ilius* Tyler is readily distinguished by the sharp definition of the lateral groove which is narrow, rather than the greater wave-like form across the lateral surface of the entire shaft in *A. undulatus*.

Etymology. Derived from *undulatus* (L.) meaning wave and referring to the wave-like surface of the ilial shaft.

Comment. Previously, *Australobatrachus* has been known from the Tertiary of South Australia, principally from the Oligocene (Lindsay 1987) in the Ditjimanka and Ngama Local Faunas at Lake Palankarinna (Tyler 1976, 1982, 1986).

**Litoria Tschudi**

* Litoria conicula* sp. nov. (Fig. 2)

HOLOTYPE - NTM P933. Unrecorded quarry, Bullock Creek Locality, Camfield Station, Northern Territory (17° 07' S; 131° 31' E), Bullock Creek Local Fauna, mid-Miocene. A right ilium.

Description of holotype. The dorsal acetabular expansion is slightly developed. The dorsal prominence is conspicuous but small and conical; the dorsal protuberance is not distinguishable. The ilial shaft is gently curved and bears a slight lateral depression on the proximal half. The pre-acetabular zone is moderate and gently curved and the acetabulum very large. Length of ilium 12.4 mm.

Comparison with other species. The small conical dorsal prominence is unlike any extant species, and the single extinct Tertiary species *L. magna* Tyler, which is also distinguished from *L. conicula* by possession of a right-angled flange upon the summit of the medial surface of the ilial shaft.

Etymology. From *coniculus* (L.), a cone, referring to the conical form of the dorsal prominence.

Comment. Although this species is known solely from the holotype, its fine condition, distinctive characters and the low frequency of occurrence of material from Bullock Creek justify the description of the species.

**Litoria curvata** sp. nov. (Fig. 3)

HOLOTYPE - NTM P938. Unrecorded quarry, Bullock Creek Locality, Camfield Station, Northern Territory (17° 07' S; 131° 31' E), Bullock Creek Local Fauna, mid-Miocene. Proximal two-thirds of a left ilium.

PARATYPES - Four ilia: NTM P934, P935, P937, P8697-32. Unrecorded quarries except P8697-32 ("Site X"). Locality data as for holotype. There is minimal variability in this series. The ventral acetabular expansion is missing in all specimens.

Description of holotype. The dorsal acetabular expansion is slightly inclined and the dorsal prominence and dorsal protuberance inclined laterally. The ilial shaft is almost straight. The ventral acetabular expansion is broad and evenly curved, forming a quadrant with the inferior surface of the ilial shaft. The acetabular fossa is large and extends superiorly above the level of the inferior margin of the ilial shaft.

Etymology. From *curvus* (L.), bent, alluding to the curvature of the pre-acetabular zone of the ilium of the species.

**DISCUSSION**

Camfield Station represents the fourth locality in Australia at which Tertiary frogs have been reported. Three species and two genera are included in the small sample and, at a generic level, there is a similarity to the material obtained from the Etadunna Formation at Lake Palankarinna, north of Lake Eyre, South Australia (Table 1).

<table>
<thead>
<tr>
<th>Genus</th>
<th>Lake Palankarinna SA</th>
<th>Lake Yanda Station SA</th>
<th>Riverleigh Station Qld</th>
<th>Camfield Station NT</th>
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<tr>
<td>Australobatrachus</td>
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<tr>
<td>Crinia</td>
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<td>Philoria</td>
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</table>
Miocene hylid frogs

Fig. 1. (Upper) Holotype of *Australobatrachus undulatus* sp. nov. (NTM P936).
Fig. 2. (Centre) Holotype of *Litoria conicula* sp. nov. (NTM P933).
Fig. 3. (Lower) Holotype of *Litoria curvata* sp. nov. (NTM P938).
The presence of crocodiles, fish and turtles amongst the vertebrates in the Bullock Creek Local Fauna (Murray and Megirian 1992) signifies a reasonably substantial body of persistent water. The frog species included do not contribute to any further understanding of the palaeoenvironment because it is uncertain whether the species are terrestrial or aquatic. All that can be stated is that the ilia lack fossorial adaptations. Although the sample is small, the seasonal aridity interpretation as a palaeoclimatic scenario (Murray and Megirian 1992) would be expected to be accompanied by a fossorial element in the frog fauna. The Camfield Beds were considered to be mid-Miocene by Woodburne et al. (1985).

Murray and Megirian (1992) state that the 'Dromornithid Mountain' and 'Top Site' quarries are in conglomeratic limestone, probably representing stream channels, and that more material has been produced from such sites than from those considered to be lacustrine deposits (e.g. 'Site X').

ACKNOWLEDGEMENTS

I am indebted to Dirk Megirian (Northern Territory Museum) who drew my attention to the existence of frogs in the Bullock Creek Local Fauna, permitted me to search for additional material amongst the collection at Darwin and provided constructive criticism of an early draft of the manuscript. The studies were funded by the Australian Research Council. Stuart McClure prepared the scanning electron micrographs and Simon Bryars assisted the project.

REFERENCES


INTRODUCTION

Amongst crocodilians, the Sebecosuchia (Simpson), Hisisosuchidae Young and Chow and the Eusuchian Pristichampsinae Kuhn are remarkable for having serrated, laterally-compressed teeth. Langston (1973: 291) introduced the vernacular term ‘ziphodont’ (Greek: sword-toothed) to describe the condition of the teeth as an alternative to the more cumbersome descriptive ‘dinosaur-toothed’. Most crocodilians have conical, unserrated teeth.

The South American Sebecus icaeoorhinus Simpson, 1937, and North American and European species of Pristichampsus (Gervais) are amongst the most complete, and best known ziphodont crocodilians (e.g. Colbert 1946; Langston 1956, 1975; Kuhn 1938; and Berg 1966). The synonymy of pristichampsines is reviewed or discussed by Berg (1966), Langston (1956, 1975) and Steel (1973). Here I follow the summary of Steel (1973). In addition to their unusual teeth, these two genera evolved convergently a distinctive morphological complex that is widely accepted as being indicative, at least in part, of a terrestrial mode of life. In his synthesis of the Crocodylia, Steel (1973: 50) lists those features of the Sebecus cranium that may have suited it to life on land, though a contrasting interpretation was published by Langston (1965: 135) who suggested, by analogy with Paleosuchus Gray (see also Steel 1973:86), that Sebecus “may also have frequented high energy water courses”. Kuhn (1938:324) discusses features of P. rollini (Gray) (=Weigeltisuchus geiseltalensis Kuhn 1938) that suggest a terrestrial habitus.

Whatever their habits in life, Sebecus and Pristichampsus species are generally considered to represent a convergently-evolved crocodilian ecomorph (e.g. Buffetaut 1989: 33, Langston 1973) having deep, narrow snouts, laterally-facing orbits and similar quadrate morphology (Langston 1973: fig.4). In Sebecus, the external nares also open laterally, while P. rollini has hoof-like ungual phalanges, and a probably round rather than laterally-compressed tail (Kuhn 1938). Viewed laterally, pristichampsines have a relatively flat dorsal snout surface. However, in Sebecus it is arched, both conditions contrasting with the dorsally-concave profile typical of essentially aquatic crocodilians.

The fundamental difference between the Eusuchian pristichampsines and the
Sebecosuchia, however, lies with the position of the internal nares (choanae), rather than with any differences in their adaptive complexes for supposed life on land. In Sebecosuchians, the internal nares are large and relatively more anterior in position, bounded by both the palatines and pterygoids, while in Eusuchians they are proportionally smaller and occupy a posterior position entirely within the pterygoids.

The presence of ziphodont crocodilians in Australia was reported by Hecht and Archer (1977), who identified two types of laterally-

Fig. 1. Partial Quinkana timara sp. nov. holotype, NTM P895-19, composed of the right maxilla and premaxilla, in: A, dorsal; B, ventral; C, lateral; D, medial; E, anterior; and F, posterior views. In the line drawings, sutural surfaces are shown in stipple and in the medial view the narial passage is hatched. Abbreviations: a.w.fpt, anterior wall of the pterygoid fossa; e.n., external nares; fsp, palatal fenestra; i.f., incisive foramen; im.x., intermaxillary suture; ipx, interprenaxillary suture; l.m., lateral maxillary chamber;
New ziphodont crocodile

compressed teeth from Quaternary sediments, and described two maxillary fragments representing two distinct species. They suggested that both the Sebecosuchia and Pristichampsinae might be represented in the Australian fossil record. Earlier in the same year, Molnar (1977) provided an initial description of an almost complete, though edentulous, snout of an apparently ziphodont crocodilian of Pleistocene age from Tea Tree Cave, Queensland, which was eventually designated the holotype of *Quinkana fortirostrum* Molnar, 1981. Molnar (1981) con-
D. Megirian eluded that *Q. fortirostrum* was possibly also a terrestrial crocodile, though differing from other ziphodonts in having a relatively broad snout.

The new Bullock Creek species is placed in *Quinkana* because it shares with *Quinkana fortirostrum* a distinctive ziphodont dentition, and a pattern of antorbital excrescences on the dorsal surface of the rostrum that appears to be unique to this genus. In snout proportions, the new ziphodont from Bullock Creek is more similar to species of *Pristichampsus* than it is to *Quinkana fortirostrum*, but whether these and other similarities are convergently evolved or indicative of close relationship cannot yet be resolved.

Detailed comparisons between the known Australian fossil crocodilians are outside the scope of this paper. However, such studies will be required to develop comprehensive differential diagnoses, and to more satisfactorily resolve the systematics of Australian fossil Eusuchians. Four extinct crocodilian genera are currently recognised from Australia. The extinct Australian forms are species of *Quinkana*, *Pallimnarchus pollens* de Vis; *Harpacochampsa camfieldensis* Megirian, Murray and Willis 1991; *Barudarrowi* Willis, Murray and Megirian 1990; and *Australosuchus clarkae* Willis and Molnar 1991.

Institutional prefixes to catalogue numbers are abbreviated as follows: AM, Australian Museum, Sydney; FMNH, Field Museum of Natural History, Chicago; Me, Hessisches Landesmuseum Darmstadt, Germany; NTM, Northern Territory Museum, Darwin; QM, Queensland Museum, Brisbane; UCMP, University of California Museum of Palaeontology.

**SYSTEMATICS**

Eusuchia Huxley
Crocodylia Gmelin
Crocodylidae Cuvier
*Quinkana* Molnar, 1981

**Type species and type locality.** *Quinkana fortirostrum* Molnar, 1981; holotype AM F57844; Tea Tree Cave, Queensland.

**Revised generic definition (after Molnar 1981: 809).** Eusuchian crocodylid with the following combination of characters: rostrum proportionally deep; anterior margins of palatal fenestrae coincident with the anterior walls of the pterygoid fossae; two distinctive eminences present on lacrimal and one on prefrontal, anterior and dorsal to the orbit margin; antorbital shelf above the nasolacrimal foramen, adjacent to base of prefrontal eminence; jugal proportionally deep; shallow sub-orbital jugal sulcus (inferred for *Q. fortirostrum*) confluent with lateral concavity of the posterior maxilla; palatal portion of maxillary-premaxillary suture broadly U-shaped with convexity directed posteriorly; palatal bulges coincide with sub-narial extensions of the 'lateral chambers' of the maxillae; maxillary alveoli elongate with long axes typically inclined to the lateral snout margin; narial aperture wider than long.

*Quinkana timara* sp. nov.
(Figs 1-5, 8-9)

**Type material examined.** From the Bullock Creek Locality, Camfield Station, Northern Territory (Latitude 17° 7'S, Longitude 131° 31'E): HOLOTYPE - from the 'Blast Site', NTM P895-19, two fragments, one composed of the right premaxilla and maxilla, maxilla incomplete posteriorly, and the other composed of the left lacrimal, prefrontal and partial jugal. The two fragments were collected in the same mass of limestone, and on the basis of juxtaposition, preservation and relative sizes are thought to represent one individual. Extracted using acetic acid. PARATYPES - from the 'Blast Site', NTM P895-12, edentulous left dentary fragment retaining four complete and two incomplete alveoli; NTM P894-6, anterior part of a left dentary with eight alveoli and one tooth in situ: from an unrecorded Bullock Creek Locality quarry, NTM P8691-3, left posterior maxillary fragment from alongside the palatal fenestra, retaining three serrated, laterally-compressed teeth and partial alveoli for two other teeth.

**Referred specimens.** From 'Dromornithid Mountain' (Bullock Creek Locality), NTM P8697-2, jugal: from the 'Blast Site', NTM P87105-6, NTM P87103-8, all from the 'Blast Site', NTM P87105-23 and NTM P87105-43, isolated ziphodont crowns: from unrecorded Bullock Creek Locality sites, NTM P8696-24, NTM P869-23 and NTM P87105-43, isolated ziphodont crowns.

**Comparative material.** *Quinkana fortirostrum* holotype, AM F57844; Tea Tree Cave, Queensland; *Barudarrowi*, holotype NTM P8695-8, and referred specimens NTM P87105-6, NTM P87103-8, all from the 'Blast Site', Bullock Creek Locality; neontological *Crocodylusporosus*, NTM P926, Darwin Croco-
Fig. 2. Partial *Quirkana timara* sp. nov. holotype, NTM P895-19, composed of the left lacrimal, prefrontal and partial jugal in: A, dorsal; B, lateral; C, medial; D, ventral; and E, posterior views. Sutural surfaces are shown in stipple. Abbreviations: aos, antorbital shelf; le, lacrimal excresences; mjs, maxillo-jugal suture; mls, maxillo-lacrimal suture; nlf, nasolacrimal foramen; nld, naso-lacrimal duct; o, orbit; pe, prefrontal excrescence; pfs, prefrontal-frontal suture; vsj, ventral sculptured area of the jugal.
D. Megirian

dile Farm, 40km, Stuart Highway.

Age. The *Quinkana timara* sp. nov. material described here is part of the Bullock Creek Local Fauna from the Camfield Beds. The age of the fauna is estimated from the relative stage-of-evolution of marsupial components of the Bullock Creek Local Fauna, according to methods outlined in Woodburne *et al.* (1985). The Bullock Creek Local Fauna is considered younger than the Kutjarapuru Local Fauna (Wipajiri Formation) of South Australia, older than the Alcoota Local Fauna (Waiete Formation) of central Australia, and mid to late Miocene in age (Woodburne *et al.* 1985, Rich 1991).

Diagnosis. Differs from the other known species, *Q. fortirostrum*, in having a narrower snout, proportionally larger antorbital shelf, slightly greater degree of festooning, and on the basis of alveolar morphology, probably more size-differentiation in the teeth. In ventral view, the maxillo-jugal suture is transversely broad, lying anterior to a triangular sculptured area. Ventrolateral margin of the dentary ramus developed into a low crest.

Description. The *Quinkana timara* holotype, composed of an entire premaxilla and virtually complete maxilla from the left hand side (Fig. 1), and a fragment composed of right lacrimal, prefrontal and partial jugal (Fig. 2), has been restored to show the shape of the complete rostrum (Figs 3, 4), with snout proportions given in Table 1.

In restored dorsal aspect, the external narial aperture of *Q. timara* is large, and positioned close to the anterior margin of the premaxillae. The widest dimension of the narial aperture lies towards the front of the opening. In dorsal view, the aperture has a bi-lobed appearance: posteriorly, the nasals, which probably projected a short distance into the aperture, were buttressed laterally by a short anterior projection of the premaxillae, while anteriorly the premaxillae have a short, delicate posterior projection at the mid-line. An internarial septum is absent. In lateral view, the external narial aperture is deeply notched, indicating that the nostrils opened somewhat laterally.

The holotype premaxilla was breached dorsally, within the narial vestibule, by the tip of the first dentary tooth. The narial aperture is bounded posteriorly by a distinct, but very low and gently-rounded, rim. The incisive foramen is relatively small and rounded-triangular to cardioid in outline, with the apex pointing anteriorly.

Notable features of the *Q. timara* maxilla, in dorsal view, include the absence of lateral undulations (lateral festooning of Langston 1975:295), presence of a pre-orbital crest (continued from the lacrimal as described below), presence of a very weakly defined crest over the first maxillary tooth, and a notch (‘crocodylid notch’) for the fourth dentary tooth at the maxillo-premaxillary suture. The preorbital crest defines the transition in the posterior half of the rostrum from the planar dorsal surface to the steeply inclined, slightly convex, lateral maxillary face (Figs 1F, 3B). The maxillary convexity is probably confluent with a sub-orbital jugal sulcus (described below).

While no nasals have been found yet for *Q. timara*, their structure may be deduced from a restoration (Fig. 3B). Their combined outline is parallel-sided where bounded by the maxillae, tapering anteriorly between the premaxillae to contribute to the posterior margin of the narial aperture, and tapering posteriorly between lacrimals and prefrontals. In the absence of a frontal bone, the position of the naso-frontal contact is uncertain.

The *Q. timara* holotype had five premaxillary teeth, as evidenced by the alveoli, but the total number of maxillary teeth cannot be precisely determined. The maxilla retains eight complete or partial alveoli, while maxillary alveoli cight to 12 are interpreted to be present on the paratype NTM P8691-3 (Fig. 5). Most alveoli are laterally compressed, though the degree of compression varies somewhat along the tooth row (Fig. 1B) being generally more pronounced in the posterior teeth. One complete and five broken teeth are retained in the holotype (NTM P895-19) while three complete examples are present in the paratype (NTM P8691-3). The first maxillary

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**Table 1. Snout proportions of *Quinkana timara* sp. nov. compared to selected ziphodonts (after Molnar 1981; Table 1).**

<table>
<thead>
<tr>
<th>Taxon</th>
<th>H/L</th>
<th>H/W index of snout depth</th>
<th>W/L index of snout width</th>
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<td>1.37</td>
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<td>0.51</td>
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<tr>
<td><em>Quinkana timara</em></td>
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<td>0.61</td>
<td>0.41</td>
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<tr>
<td><em>Quinkana fortirostrum</em></td>
<td>0.36</td>
<td>0.51</td>
<td>0.70</td>
</tr>
</tbody>
</table>
Fig. 3. Comparison of the skull shape of: A, *Pristichampsus vorax* (after Langston 1975: figs 1 and 2); B, a restoration of *Quinkana timara* sp. nov., based on the best fit of the two NTM P895-19 fragments and P8691-3; jugal P8697-2 was not incorporated because it comes from a larger individual and is too robust (probably an ontogenetic allometric effect) to match the P895-19 individual; and C, *Q. fortirostrum* holotype AM P57844; the lateral view is a reversal of the more complete left hand side. Some of the sutures in *Q. timara* sp. nov. are uncertain, and are based on *Q. fortirostrum*. Scale bars are all 50mm. The three skulls are scaled so that the distance between the anterior orbit margin and the posterior margin of the external nares is constant.
tooth of the Bullock Creek holotype has a distinct posterior curvature in lateral view, such that the leading edge of the tooth is longer than the trailing edge, while the more posterior teeth were evidently proportionally shorter (dorsoventral dimension) and longer (anterior-posterior dimension) (Table 2). A selection of isolated teeth showing these characteristics from the Bullock Creek Local Fauna are portrayed in Figure 6. In all Bullock Creek examples, the carinae are very finely and evenly serrated, averaging seven to ten serrations per millimetre. The dentary teeth occupied reception (occlusal) pits lying medial and intermediate to the maxillary teeth when the jaws were closed, in an 'overbite' configuration.

It is apparent from the alveoli of *Quinkana* and, in some cases from the *in situ* teeth, that the long (anteroposterior dimension) axes of the teeth were generally inclined to the lateral snout margins (Figs 1B, 5A). The alveoli lie within an alveolar process projecting ventrally below the level of the palate, which thus appears vaulted in cross-section (Fig. 3). Palatal morphology is distinctive. Anteriorly, from the incisive foramen,
**New ziphodont crocodile**

Fig. 5. *Quinkana timara* sp. nov. maxillary fragment NTM P8691-3 in: A, ventral; B, left lateral; C, dorsal; D, medial; and E, posterior views. Sutural surfaces are shown in stipple. Abbreviations: ec, ectopterygoid; imc, intra-maxillary chamber; mes, maxillo-ectopterygoid suture; mjs, maxillo-jugal suture; mx, maxilla; mx8-mx12, maxillary tooth (or its alveolus), numbered from the anterior end.

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across the palatal maxillo-premaxillary suture and posteriorly to about the level of the third maxillary tooth, the palate is domed in transverse section. Posteriorly, from the level of the third maxillary tooth to the palatal fenestra, the parasagittal region bulges so that in transverse section, the roof of the palate is markedly peaked at the midline (Fig. 3).

Within the snout, the partition separating the narial passage from the maxillary sinuses is incomplete due to breakage, exposing the supra-alveolar 'niche' and 'lateral chamber' (terminology of Molnar 1981) (Fig. 1D). Molnar's 'narrow chamber between the niche and alveolar part of the maxillary wall' (for which the alternative term 'intramaxillary chamber' is proposed) is possibly exposed at the broken anterior end of the paratype NTM P8691-3 (Fig. 5E). In the holotype, the medial part of the lateral chamber separates the narial passage from the palate in the region delimited by the palatal bulges described above.

The palatines are not preserved with the *Q. timara* holotype, though a small segment of the maxillo-palatine suture is preserved on the medial margin of the pterygoid fossa. The unsutured, preserved portion of the maxillary palate indicates that the anterior palatal processes of the palatines did not project anteriorly far, if at all, beyond the anterior margins of the palatal fenestrae, but their shape cannot be determined.

Although the *Q. timara* holotype right jugal is incomplete posteriorly, it preserves a shallow sub-orbital sulcus that was almost certainly confluent with a lateral concavity such as that preserved on the left maxilla of the holotype. The jugal projects forward beyond the level of the anterior margin of the orbit (Fig. 2B), in the typical Eusuchian fashion. Ventrally, the *Q. timara* jugal has a deeply-sculptured, triangular area adjacent to the transversely-broad maxillo-jugal suture.

Further details are provided by the more complete, isolated jugal NTM P8697-2 (Fig. 7). This specimen represents a larger individual than the holotype, and is shown in Figure 7 in orientations that correspond approximately to the holotype. The ascending process of the postorbital bar, lying in the characteristically Eusuchian subdermal position, is relatively more vertical than in crocodiles with relatively flattened skulls, suggesting that the skull table probably projected somewhat over the temporal arcade. The upturned dorsal margin at the jugal-quadratojugal suture suggests a short anteroposterior dimension for the infratemporal fenestra relative to that

### Table 2. Morphometrics of *Quinkana timara* sp. nov. teeth, compared with Pleistocene ziphodont crowns from Croydon, Queensland (after Molnar 1981: Table 2), and *Pristichampsus* spp. examples. *Pristichampsus vorax* data from Langston (1975); UCMP, *rollinatii* data from Langston (1956); Messel (Me) *P. rollinatii* data from Berg (1966). Various authors have given measurements with differing accuracy. Few of the *Q. timara* specimens recorded here have a full five millimetre length of serrations preserved, and in these instances the frequency of serrations is recalculated per 5 mm. For consistency, the spacing of serrations reported in the literature for *Pristichampsus* species have been recalculated to serrations per 5 mm, and rounded off to the nearest whole number. Bracketed figures are estimates; pmx2 and pmx5 = second and fifth premaxillary tooth; mx1 - mx11 = first to eleventh maxillary tooth; d7 = seventh dentary tooth, numbered from the front; ?pmx = not known from where in the tooth row these specimens came.

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<th>WIDTH</th>
<th>HEIGHT</th>
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of the orbit. The extent of the jugal-ectopterygoid suture indicates that there was no posteriorly-directed process of the ectopterygoid along the medial margin of the jugal.

In the *Q. timara* holotype, the lacrimal and prefrontal are fused to the extent that precise interpretation of their contact is difficult. The interpreted suture appears to pass obliquely between three, just distinguishable, pre-orbital eminences (Fig. 2A).

Dentary fragment NTM P895-16 (Fig. 9), from the mid-region of the dentary ramus, retains four complete and two partial alveoli. The alveoli are of relatively uniform size, laterally compressed, with their long axes slightly inclined to the lateral margin of the dentary, and are medial to small indentations that accomodate the upper dentition.

The other dentary fragment, NTM P894-6 (Fig. 9), includes the symphysial region. All alveoli are elongated to some degree, with the fourth dentary alveolus markedly so. Dimensions of the *in situ* tooth are given in Table 2. The dorsal surface lateral to the symphysis is narrow and long, while the symphysis extends posteriorly to the level of the sixth dentary tooth. The splenial is not present, but judging from the sutural trace, terminated anteriorly just short of the symphysis. At about the level of the sixth tooth, the ventrolateral margin of the dentary ramus is expanded into a low crest, increasing in size posteriorly.

**Comparative remarks.** The comparisons presented here are limited to comparative material at hand and descriptions in the literature. Attention is focussed primarily on ziphodont Eusuchians, namely species of *Pristichampsus* and *Quinkana fortirostrum*, and on selected aspects of other Australian fossil genera and *Crocodylus porosus*.

**Snout form.** Snout proportions of *Q. timara* are distinctive, and readily distinguish the form from other Australian fossil taxa. Snout proportions of *Q. timara, Q. fortirostrum, P. vorax* and the Sebecosuchian *S. icaeorhinus* are compared in Table I using the method of Molnar (1981) which was devised to accomodate the state of preservation of *Q. fortirostrum*. The *P. rollinai* specimens described by Kuhn (1938) and Berg (1966) are crushed and distorted, and the illustrations do not lend themselves to calculations of snout proportions. Snout proportions of *P. rollinai* appear to be comparable to *P. vorax*, as noted by Langston (1975:308-309).

In snout width, *Q. timara* most closely resembles *P. vorax*. The snout is not as narrow as that of *S. icaeorhinus*, while *Q. fortirostrum* is unique amongst the ziphodonts under consideration in having a broad snout. *Quinkana timara*’s snout is somewhat deeper in comparison to that of *P. vorax* and *Q. fortirostrum*, but not as deep as that of *S. icaeorhinus*. Its ratio of rostrum height to length is very similar to that of *P. vorax*, and significantly less than the ratios of *S. icaeorhinus* and *Q. fortirostrum* which are similar to each other.

**Features of the premaxillae.** The narial aperture of *Q. timara*, like that of *Q. fortirostrum*, is somewhat trapezoidal and wider than it is long, contrasting with the ovoid outline and longer than wide dimensions in *Pristichampsus* species. In both *Quinkana* species, and both *Pristichampsus* species, the dorsal surfaces of the premaxillae are breached within the narial vestibule by the first dentary teeth. In both *Quinkana* species and in *P. vorax*, the narial aperture opens slightly forward and laterally, giving the anterior rostrum a downturned profile in lateral view (Fig. 3). *Quinkana timara* is similar to *Q. fortirostrum* in having no paranasal roofing of the narial vestibule by the premaxilla.
Fig. 7. *Quinkana timara* sp. nov. referred jugal NTM P8697-2 in A, lateral; B, medial; C, ventral; D, dorsal; and E, posterior views, compared with the Pleistocene Chinchilla *Quinkana* sp. jugal QM F1152 in F, medial and G, lateral views (reversed figs after Molnar 1981: figs 11, 12). Sutural surfaces are stippled. Abbreviations: ejs, ectopterygoid-jugal suture; fit, infratemporal fenestra; mps, maxillo-jugal suture; po.b, postorbital bar; pojs, postorbital-jugal suture; qjs, quadratojugal-jugal suture; sul.so, suborbital jugal sulcus; vsj, ventral sculptured area of the jugal.

The cardioid or rounded-triangular incisive foramen of *Q. timara* appears to be similarly-shaped, but perhaps proportionally narrower, to that of *Q. fortirostrum*, at least to the extent that a comparison is possible with the incompletely preserved one of the *Q. fortirostrum* holotype. The incisive foramen (=premaxillary foramen of Langston 1975) of *P. vorax* is oval, centred more posteriorly within the narial aperture (Fig. 3), and as noted by Langston (1975:300) "seems to be exceptionally large for a narrow-snouted crocodilian". That of *P. rollinati* is depicted in a schematic illustration by Berg (1966: Abb.6) as being small, but of uncertain outline.

*Quinkana timara* has a subdued rim bounding the external nares about their posterior margin. In *Q. fortirostrum* the homologous structure shows an exaggerated development that is probably indicative of an aged individual. Langston (1975:300) notes that in *P. vorax* "the narial rims are not raised above the level of the adjacent skull bones", though his illustrations of FMNH PR399 suggests a close structural similarity to *Q. timara*, in which a subdued rim is present.
Dentition. Quinkana timara had at least 12 maxillary teeth. As restored in Figure 3B, the Q. timara maxilla has ample room for a thirteenth maxillary alveolus. The Q. fortirostrum holotype has 12 alveoli preserved on the left maxilla, which is also incomplete posteriorly. Molnar (1977) considered there to be insufficient room for additional teeth posterior to the twelfth because of the marked narrowing of the maxilla. However, in this region the maxilla was lapped by the ectopterygoid, as evidenced by the trace of the maxillo-ectopterygoid suture. In many Eusuchians, for example P. vorax (Fig. 3A), the ectopterygoid, separated from the medial walls of the most posterior alveoli by only a thin lamina of maxillary bone, compensates for the narrowing of the maxilla. Thus, Q. fortirostrum may have had more than twelve maxillary teeth. By comparison, P. rollinati had 13 maxillary teeth (Berg 1966), while P. vorax had 16 or 17 (Langston 1975). Both Quinkana species and Pristichampsus vorax have alveoli for five pre-

Fig. 9, Quinkana timara sp. nov. paratype dentary fragment NTMP894-6 in A, dorsal; B, medial and C, lateral views. Abbreviations: dc, dentary crest; ds, dentary symphysis; dss, dentary-splenial suture; d1 - d7, dentary tooth or its alveolus, numbered from the anteriorend.
maxillary teeth, and *P. rollinati* is restored as having five (Berg 1966: Abb. 6a).

The apparent variation in tooth size, reflected in alveolar dimensions, along the tooth row in *Q. timara* appears to be somewhat greater than in *Q. fortirostrum*, and more closely resembles variation in *P. vorax* and *P. rollinati*. *Quinkana fortirostrum* shows the least development of festooning, with *P. vorax* and *Q. timara* showing relatively more (Fig. 3). The snout of *P. rollinati* is described by Berg (1966:69) as being vertically festooned: "Der unterrand dieser cranialen Schnauzenwände ist ‘festioniert’", but to what degree is not expressed. Kuhn (1938: 322) indicates that it is reasonably well developed "...die Festonierung (ist) noch ziemlich stark aus-gesprägt...".

In both *Quinkana* species, the maxillary alveoli (and in the case of *Q. timara*, the *in situ* teeth) typically have their long (antero-posterior) axes inclined to the lateral margin of the maxilla. However, this condition may not be obvious in some views because of parallax effects. For example, it is most obvious in *Q. fortirostrum* from a slightly ventrolateral perspective (Fig. 10) rather than a strictly ventral aspect (compare with Molnar 1981: fig. 3). Figures 1B and 5A most clearly illustrate the condition in *Q. timara*. Berg (1966:72) records seven to nine serrations per millimetre in Messel (Germany) specimens of *P. rollinati* (Table 2).

**Shape of the palate.** *Quinkana timara*, *Q. fortirostrum* and *P. vorax* all have, in transverse sections (Fig. 3), a domed anterior palate, and a peaked profile between parasagittal bulges posteriorly. The alveoli are housed in alveolar processes which project ventrally below the level of the palate. The condition in *P. rollinati* cannot be ascertained from the available literature. *Quinkana timara* teeth average seven to ten serrations per millimetre on the carinae, which is approximately twice as many as recorded by Molnar (1981: table 2) for Pliocene *Quinkana* sp. teeth from Croydon, Queensland (Table 2).

Langston (1975; 308) records six serrations per millimetre on a *P. vorax* tooth. Berg (1966:72) records seven to nine serrations per millimetre in *P. rollinati* (Table 2).

**Internal structure of the rostrum, extent of the palatine, and pterygoid fossa morphology.** These three aspects of morphology are treated together

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Fig. 10. A slightly right-lateral, ventral view of the *Quinkana fortirostrum* holotype AM F57844, that best shows the inclination of the alveoli to the right (upper in photograph) margin of the snout.
here because they may be part of a single complex. The sutural relationship of the palatines to the maxillae are of some interest as possible systematic indicators. Willis et al. (1990), as part of a preliminary assessment of the systematic position of the mid-Tertiary crocodylian Baru darrowi, hypothesised that the lack of, or marked reduction of, the anterior palatine process might represent a shared derived characteristic state of a natural group of crocodylians containing extinct Australian genera, including Quinkana. Additional cleaning of the B. darrowi holotype has revealed that the the maxillo-palatine sutures depicted in Willis et al. (1990: fig. 1) represent a fracture, rather than sutures. The morphology of the maxillo-palatine sutures of Q. fortrostrum and B. darrowi are both illustrated in Figure 11, and contrasted with the living estuarine crocodile, Crocodylus porosus. A detailed description of this region in Q. fortrostrum is provided by Molnar (1981), and only selected aspects are repeated here.

The internal structure of the Q. timara holotype corresponds closely with that described by Molnar (1981) for the Pleistocene Texas Caves Quinkana sp. QMF 7898, and is consistent with what can be seen within the snout of the Q. fortrostrum holotype. Both Q. timara and Q. fortrostrum have the "lateral chamber" of Molnar (1981), which is also present in other crocodylians (e.g. Crocodylus spp., Molnar 1981, and Fig. 11). In Crocodylus porosus the lateral chambers do not extend between the palate and narial passage, but do in juvenile Baru, where they become reduced or disappear in growth. Their more extensive development in Quinkana and Baru is almost certainly related to the depth of the skull.

In palatal view, the palatal fenestrae of C. porosus extend anteriorly to the level of the ninth maxillary tooth. The combined anterior palatine processes appears as a large, lobate structure projecting forward to the level of the seventh maxillary tooth. Anteriorly, the palatine bone is flat, flaring laterally and lapping the maxilla so that it forms part of the anteromedial margin of the palatal fenestra. The anterior edge of the palatal fenestra is sharp because the pterygoid fossa continues forward above the palate, terminating at a medial projection of the lateral maxillary wall (Fig. 11).

In Q. fortrostrum, both the palatal fenestrae and the anterior extremities of the palatines extend to the level of the seventh maxillary tooth in palatal view. The maxillo-palatine suture follows a posteriorly-open, broad V-shaped trace between the anteromedial margins of the palatal fenestrae. The indications are that Q. timara also had a short palatine process, with the anterior margin of the palatal fenestra aligned with the eighth maxillary tooth. In Q. fortrostrum (and Q. timara), the pterygoid fossa does not continue forward above the bony palate, but terminates at "a high, posteriorly concave partition dorsally bound(ing) the anterior margin of the palatal fenestra" (Molnar 1981: 807). Molnar conceptualised the wall as representing a medially complete version of the projection of the lateral maxillary wall in Crocodylus, as described above. The Q. fortrostrum holotype (AM F57844) is sufficiently complete to show that the palatines participate in this wall medially, so the condition, relative to Crocodylus, might more realistically be thought of as a dorsal folding (along a curved axis) of part of the palatal and maxillary palate.

The holotype Baru darrowi specimen NTM P8695-8, a mature adult, is similar to Q. fortrostrum in having the pterygoid fossa walled anteriorly and part of the palate folded dorsally, but the maxillo-palatine suture and lateral chamber morphology are not identical (Fig 11). The anterior palatine process is quite large and lobate, terminating anteriorly slightly forward of the palatal fenestrae, and is reminiscent of Asiatosuchus and Osteolaemus. The lateral chamber of Baru extends posteriorly alongside the narial passage to well behind the anterior margin of the palatal fenestra, and appears to open through a small foramen into the medial wall of the pterygoid fossa. A post-hatching Barus specimen (NTM P87105-6) appears to have an unfolded palate (Fig. 11), with a lateral chamber terminating at, and opening through, a proportionally large foramen in the anterior wall of the pterygoid fossa. A slightly larger individual (NTM P87103-8) has similar lateral chamber morphology, but shows signs of incipient palatal folding (Fig. 11).

In the skull of Crocodylus porosus sectioned for illustration in Figure 11, the lateral chamber is confluent with the narial passage, though the opening of the lateral chamber lies outside the direct line of the narial passage as extrapolated anteriorly from the lateral margins of the vomers. Vomer morphology of Baru is unknown. The "two thin, nearly vertical flanges, which together form a narrow trough along the floor of the snout cavity" of Q. fortrostrum (Molnar 1981: 807)
are in sutural contact with the maxilla, and represent the anterior parts of the vomers (Fig. 11), and are not part of the maxilla as described by Molnar (1981). The anterior extent of the vomers cannot be determined in the \( Q. \) \textit{fortirostrum} holotype because they are still partly embedded in matrix, while the relationship of the narial passage to the lateral chambers of \( Q. \) \textit{fortirostrum} cannot be determined because of the lack of preservation of the vomers posteriorly.

Iordansky (1973: fig. 14) labels the opening of the lateral chamber in \textit{Crocodylus} sp. as “an accessory air cavity of the narial passage”, but it would be interesting to dissect a fresh specimen to determine whether the narial passage is isolated from the lateral chamber by soft tissue, and whether the lateral chamber is connected to the pterygoid fossa, rather than the narial passage, as suggested by the morphology of \textit{Baru}. Excluding the lateral chamber, ramifications of the narial passage in the form of accessory chambers are present in \textit{Crocodylus}, but absent in \textit{Quinkana} and \textit{Baru} (Fig. 11).

The palatal view of \( P. \) \textit{vorax} (Fig. 3A; after Langston 1975: fig. 1b) shows the anterior palatine processes projecting slightly beyond the anterior edge of the palatal fenestrae, but the morphology of its pterygoid fossae and internal structure are undescribed. Berg (1966) portrays a palatine process projecting beyond the palatine fenestrae in \( P. \) \textit{rollinii}, but his use of dashed lines suggests some uncertainty in the interpretation. Pterygoid fossa morphology and internal structure is not described for \( P. \) \textit{rollinii}.

In Eusuchians, the combined palatines typically project anteriorly as a lobate structure on the palate, often beyond the anterior margins of the palatal fenestrae. Amongst living Eusuchians, \textit{Osteolaemus tetrasper} Cope and \textit{Tomistoma schlegelli} (Muller) have the palatines terminating anteriorly at about the level of the anterior margin of the palatal fenestrae. However, these taxa differ in that the anterior palatinal processes of \textit{Osteolaemus}, though lying entirely between the palatal fenestrae, appears lobate in palatal view, while the maxillo-palatine sutures of \textit{Tomistoma} basically taper forward, meeting as a posteriorly-open, broad V, though in this species the maxillo-palatine relationship is complicated by palatal exposure of the vomers (=pre-vomers of Mook 1921; see Mook 1921: 145, fig. 2 and Iordansky 1973: fig 3 for variability in \textit{T. schlegelli}). However, palatal features in longirostrine forms may be determined by skull conformation so that comparison of maxillo-palatine sutures between brevirostrine and longirostrine forms may be problematic.

Willis \textit{et al.} (1990) considered the possibility that the palatal trace of the maxillo-palatine sutures might simply relate to the relative size of the palatal fenestrae. It is well known that long, narrow-nosed crocodilians tend to have small palatal fenestrae, while short, broad-nosed forms typically have larger ones (e.g. Iordansky 1973). Willis \textit{et al.} (1990) observed that while \textit{Osteolaemus} has large palatal fenestrae, it also has large, lobate anterior palatine processes similar to those present in alligatorids and \textit{Crocodylus}, though not projecting beyond the palatal fenestra, and that therefore the two structures seem to be independent character states.

The maxillo-palatine suture of \textit{Baru darrowi} was interpreted by Willis \textit{et al.} (1990) to resemble \textit{Quinkana fortirostrum} and the North American Eocene species \textit{Brachyuranaochamps}a \textit{eversolei} Zangerl, 1944. With further preparation (Fig. 11), \textit{Baru} appears to more closely resemble \textit{Asiatiusuchus germanicus} (Berg 1966) and \textit{Osteolaemus}; i.e., with the palatines projecting to about the level of the anterior margins of the palatal fenestrae (as remarked upon by Berg 1966: 55), but having a lobate structure. Willis and Molnar (1991) depict the maxillo-palatine suture of \textit{Australosuchus clarkae} resembling that of \textit{Quinkana fortirostrum}, but it is not clear how the shape was determined from the described material.

\textbf{Jugal morphology.} The jugal of \( Q. \) \textit{timara} is similar to Queensland \textit{Quinkana} sp. material in having a ventral sculptured area. Molnar (1981: 815) likens the ventral sculptured area in his \textit{Quinkana} sp. material to the condition in \textit{Alligator mississippiensis} (Daudin), but gives no indication of its shape. In \( Q. \) \textit{timara} specimens, the ventral maxillo-jugal suture is quite broad. No ventral sculptured area such as that present in \( Q. \) \textit{timara} is present in the other two named fossil taxa from Bullock Creek, \textit{B. darrowi} and \textit{H. camfieldensis}. The \textit{B. darrowi} and \textit{H. camfieldensis} holotypes have short, less transversely oriented jugal-maxillo contacts in ventral view (Willis \textit{et al.} 1990, Megirian \textit{et al.} 1991). The jugal of \textit{H. camfieldensis} is gracile alongside the infratemporal fenestra and has a robust postorbital bar. The sub-orbital suture in \( Q. \) \textit{timara} is more weakly developed than in \textit{B. darrowi}, and there is no prominent lateral jugal ridge as described in Willis \textit{et al.} (1990: fig 1A). As mentioned in the description of \( Q. \) \textit{timara}, the paratype jugal is from a larger individual than
Fig. 11. A comparison of palatine-maxillary relationships and internal structure of the mid-palatal region of the rostrum in: A, *Crocodylus porosus*; B, *Quinkana fortirostrum* (schematic); and C, *Bantu darbowi* (schematic). INSET: a crocodylid skull in ventral view showing the region of the skull being compared. Vomer morphology is unknown for *Bantu*, while the palatal maxillo-palatine sutural contacts of *Bantu* and *Quinkana* are restorations prepared from plasticine impressions. Sutural surfaces are shown in stipple, and sectioned or broken surfaces are hatched. Abbreviations: ac, accessory chamber of the nasal passage; aos, antorbital shelf; a.w.fpt, anterior wall of the pterygoid fossa; ?dR.V, ?duct for Ramus maxillaris nervi trigemini; fsp, palatal fenestra, l.c., lateral chamber, le, lacrimal eminence; mes, maxillo-ectopterygoid suture; mps, maxillo-palatine suture; mx, maxilla; mx5, fifth maxillary alveolus; nif, nasolacrimal foramen; n.p., nasal passage; pal, palatine; pe, preorbital eminence; snlc, sub-narial portion of the lateral chamber; v, vomer.
the holotype, and is more robust, and probably proportionally deeper. However, the two jugals seem to fall within the range of allometric variability expressed in NTM *C. porosus* samples. Langston (1975) records two suborbital sulci in *P. vorax*, but his illustrations convey no specific detail about ventral jugal morphology.

Molnar (1977, 1981) was mistaken in describing the jugal of *Q. fortirostrum* as not projecting beyond the orbit. The maxillo-jugal suture is
clearly visible in the Texas Caves cranium, both externally and internally (Fig. 3C), and its anterior projection beyond the orbit is typically Eusuchian, and resembles Q. timara and P. vorax in its extent. Although the jugal posterior to the anterior orbit margin is not known for Q. fortirostrum, it was clearly deep dorsoventrally, and the presence of a probably shallow sub-orbital sulcus is indicated by the portion of the jugal preserved.

One possibly significant difference in Q. timara when compared to the Pliocene Chinchilla Quinkana sp. jugal is the relatively smaller extent of jugal-ectopterygoid sutural contact (compare Fig. 8B and F). In P. vorax, the posterior ramus of the jugal, where it bounds the infratemporal fenestra, is deflected ventrally (Fig. 3A), contrasting with the unflexed arrangement in Q. timara.

Structure of the preorbital, post-premaxillary surface of the rostrum. Quinkana fortirostrum exhibits dramatic development of excrescences and ridges on the dorsal surface of the rostrum (Molnar 1977, 1981), including the expression of the nasal rim on the premaxilla described above. The lacrimal bears two distinct knobs and the prefrontal bears a single knob, the maxilla has a prominent ridge or crest at the transition from the dorsal to the lateral surfaces of the snout, a crest lies over the first maxillary tooth, and the nasals are greatly thickened. Homologous structures can be distinguished in Q. timara on the lacrimal, prefrontal and maxilla, though their expression is much more subtle. The nasals cannot be compared because they are not known for Q. timara. The exaggerated development of these structures in Q. fortirostrum may be related to age.

Another structure shared by the two species of Quinkana is a distinct antorbital shelf, of unknown function, lying directly above the nasolacrimal duct, and laterally adjacent to the base of the prefrontal eminence. The shelf in Q. timara is proportionally larger than that of Q. fortirostrum. The two species of Quinkana are structurally identical about the orbit, only differing in the degree of expression of lacrimal and prefrontal excresences, and the antorbital shelf.

Apart from a preorbital maxillary crest, none of the structures present in Quinkana are specifically mentioned by Langston (1975) for P. vorax. I can recognise no specific reference to the development of structures on the dorsal surface of P. rollini in Berg (1966) or Kuhn (1938).

Discussion and concluding remarks. Quinkana fortirostrum and Quinkana timara sp. nov. share a distinctive ziphodont dentition and pattern of development of excrescences on the dorsal surface of the rostrum, justifying the assignment of the new Bullock Creek form to the genus Quinkana, and distinguishing these species from other described Australian fossil taxa. The literature on Pristichampsus species makes no mention of such characters, nor are they apparent in illustrations.

In terms of trophic specialisation and skull conformation, Quinkana timara is most similar to species of Pristichampsus, sharing a suite of characters that have been interpreted as advantageous for a terrestrial mode of life. Quinkana fortirostrum differs notably from these ziphodont ecomorphs in having a relatively broader snout (Molnar 1977, 1981). Whether these features support an interpretation of close relationship, or are yet another example of convergent evolution in crocodylomorphs, is unclear.

When dealing with fragmentary material from a number of quarries known to contain several poorly-understood species, there is always the possibility that individual specimens are misidentified. At the time B. darrowi was described, there was little idea of the diversity of crocodilian taxa at the type locality (Bullock Creek), or in other northern Australian Miocene limestone deposits (e.g. Willis 1992). I now suspect that part of a cranial table (NTM P87103-11) designated a paratype of B. darrowi in Willis et al. (1990), and used in its restoration, represents Q. timara. The fragment is too small to represent the Q. timara holotype individual.

Willis et al. (1990: 535) noted that features of the incompletely preserved NTM P87103-11 quadrate ...are more reminiscent of Pristichampsus than Crocodylus*. I reserve a re-evaluation of NTM P87103-11 until it is possible to differentiate the skull table of Q. timara sp. nov. from that of B. darrowi and other possible Baru species (Archer et al. 1991: 69, Willis 1992).

The systematic position of Quinkana within the Eusuchia cannot at this time be satisfactorily resolved using cladistic methods. Benton and Clark (1988) presented a phylogenetic analysis of the Archosaurus, establishing the Eusuchia as a monophyletic group of crocodilians. More recent work has focussed on more firmly establishing outgroups to the Eusuchia as a step towards more satisfactorily resolving relationships within the group (Norell and Clark 1990, Clark and
Norell 1992). Clark and Norell (1992) diagnose the Eusuchia by the following synapomorphies: 1, posterior intrapterygoid position of the choana; 2, procoelous trunk vertebrae; 3, procoelous cervical vertebrae; 4, strongly convex condyles on the biconvex first caudal vertebra and 5, dorsal osteoderms lacking a smooth, raised area on their anterior dorsal surface. The Crocodylia are defined as a crown group comprising the living Eusuchians and the descendents of their closest common ancestor, though no entirely satisfactory diagnosis has been put forward. Norell (1989) provides a phylogenetic analysis of the living Crocodylia, in which he recognises three natural groups, referred to informally as 'crocodylids', 'alligatorids' and 'gavialids', which are comparable to the concept of the Alligatorinae, Crocodylinae and Gavialidae sensu Källin (1955), for example. However, these studies do not provide a suitable basis for evaluating the position of Quinkana within the Eusuchia, or the relationship of Australian fossil genera to each other. At the higher taxonomic level, the scheme is heavily dependent on post-cranial characters, which are not known for Quinkana, while more generally, insufficient cranial characters of systematic significance are known or adequately documented for the Eusuchia. Additional limitations result from incomplete representation of the taxa of interest, precluding direct comparison. Thus, at this stage it is only possible to consider whether the form has 'enough' of the 'key' characters that distinguish some of the recognised groupings.

Molnar (1981) provided a character state assessment of Quinkana fortirostrum using a method based on the system of Hecht (1976) and Hecht and Edwards (1976). He established polarities of 18 cranial characters (not all of them considered by him to be useful in determining relationship) largely by 'commonality of the state' amongst 34 crocodilian genera, and was successful in resolving Q. fortirostrum as a ziphodont crocodylid. Molnar (1977) initially suggested Quinkana fortirostrum might also belong to the Pristichampsinae Kuhn, 1968, but later designated it sub-family incertae sedis (Molnar 1981: table 4).

Willis et al. (1990) recognised in Baru, Pallimnarchus and Quinkana a suite of characters that distinguished these forms from extant crocodylids (e.g. Crocodylus), and noted that they shared similarities with certain Paleogene taxa from North America and Europe. Willis and Molnar (1991) recognise similar features in Australosuchus. Molnar (1981) suggested that a reduced anterior process of the palatine might be a derived condition in Eusuchians. Willis et al. (1990) went so far as to suggest that this character state might be a synapomorphy of a clade within the Crocodylidae. The more detailed comparison presented here of the palatal region of Quinkana fortirostrum, Crocodylus porosus and Baru darrowi indicates that additional studies, incorporating a greater range of taxa, are needed. While there are certainly some similarities between Baru and Quinkana, it is not clear that their respective palatal morphologies are homologous.

Detailed comparative studies are also needed to determine whether Quinkana, Baru, Pallimnarchus and Australosuchus have shared, derived character states diagnosing a clade (Willis et al. 1990). The structural similarities between Quinkana timara and Pristichampsus species suggest that a pristichampsine designation for Quinkana cannot be ruled out.

Etymology. In the mythology of the Yalanji people of Cape York, as retold by Trezise and Roughsey (1982), the Timara are thin Quinkins (spirits). The allusion is to the narrower snout of Q. timara relative to Q. fortirostrum.

NOTE ADDED IN PROOF

In the interval between the preparation of this manuscript and its appearance in print, several developments have occurred. Two additional Australian fossil taxa have been described, namely Kambara murgonensis Willis, Molnar and Scanlon, 1993, and Trilophosuchus rackhami Willis, 1993a. Additional crocodilian research in progress during the period 1990 to 1993 is reviewed in Willis (1993b).

Willis et al. (1993a) expanded the Willis et al. (1990) concept of a monophyletic radiation of extinct Australian crocodiles (which includes Quinkana) to encompass the New Caledonian form, Mekosuchus inexpectatus Balouet and Buffet, and formally designated the clade the Mekosuchinae. Within this concept of the Mekosuchinae, Kambara, a morphologically generalised crocodile, is the most plesiomorphic representative. Trilophosuchus is not mentioned in Willis et al. (1993), but is portrayed in a dendrogram in Willis (1993a) as being the plesiomorphic sister taxon to the genera included in the Mekosuchinae. Trilophosuchus
ACKNOWLEDGEMENTS

I am much obliged to Peter Murray for recognizing critical parts of the holotype in the spoil heap at Bullock Creek, within minutes of our arrival, and for the reconstruction of the animal presented as Figure 4. Bob Jones of the Australian Museum generously placed the Q. fortirostrum holotype at my disposal, which Jeff Larson and Gary Single carried to and from Darwin. Palaeontological work at Bullock Creek was sponsored through a National Estate Program Grant (Northern Territory) awarded to Peter Murray.

My thanks to Helen Larson, and Drs M. Hecht (Queens College, City University of New York) and M. Norell (American Museum of Natural History) for useful suggestions on how to improve the manuscript.

REFERENCES


Mook, C.C. 1921. Skull characters of Recent Crocodilia, with notes on the affinities of the


Accepted 9 December, 1992
A NEW SPECIES OF PASIPHAEA SAVIGNY (CRUSTACEA: CARIDEA:
PASIPHAEIDAE) FROM NORTH-WESTERN AUSTRALIAN WATERS.

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Ohno-cho, Hirosima 739-04, Japan.

ABSTRACT

A new species of *Pasiphaea* Savigny is described, based on material collected from
north-western Australian waters. This species is characterized by having the dorsal
margin of the carapace bluntly carinate, the abdomen carinate dorsally at least on the
second to sixth somites and the telson tip weakly emarginate distally. These features
are associated with a consistently larger number of meral spines on the first and second
pereopods when compared with related species.

KEYWORDS: Crustacea, Caridea, Pasiphaeidae, *Pasiphaea levicarinata* n. sp., north-west Australia.

INTRODUCTION

Shrimps of the genus *Pasiphaea* Savigny, 1816, in Australian waters have been studied by
Hanamura (1987; 1989) and Kensley *et al.* (1987), resulting in the recognition of six spe-
cies in the Australian *Pasiphaea* fauna.

Dr A.J. Bruce and several members of the
CSIRO Fisheries Division have continued to
make available samples of shrimps obtained
during surveys of the Australian deep water
fauna. In recent collections of deep-sea shrimps
examined were more than 30 specimens belong-
ing to *Pasiphaea*. Those from north-western
Australian proved to belong to an undescribed
species. This new species is characterized by
having a blunt carina on the dorsal margin of the
carapace, a distinct dorsal carina on the second
to fifth abdominal somites as well as a blunt
carina on the anterior portion of the sixth somite,
the telson very weakly emarginate at the poste-
rior end, and the meri of the first and second
pereopods armed with a comparatively larger
number of spines than in related species.

The type specimens, including the holotype,
are housed in the Northern Territory Museum of
Arts and Sciences (NTM) except for some para-
types that are deposited in the National
Science Museum, Tokyo (NSMT).

SYSTEMATICS

Family Pasiphaeidae
Genus *Pasiphaea* Savigny
*Pasiphaea levicarinata* n. sp.
(Figs 1-2)

*Pasiphaea sinensis*: Hanamura, 1987: 15, fig.
2 (not Hayashi and Miyake, 1971).

*Pasiphaea* species 1 Wadley and Evans, 1991:
14, 2 figs on p. 14.

Type material. HOLOTYPE - Ovig. female,
cl 32.0 mm, 4 December 1991, 18° 30'S 117°
23'E, 0135-0615 hrs, demersal trawl, depth 530
m, FV Striker, coll. R. Jackson (NTMCr010906).
PARATYPES - 6 ovig. females, cl 27.5-32.6
mm, same data as holotype (NTM Cr 010907);
3 males, cl 33.5-38.8 mm, 25 January 1988, Sta.
S9, 13° 06'S 122° 18E, trawl, depth 900-1000
m, FV Territory Pearl, coll. B. Wallner (NTM
Cr 007210); 1 male, cl 36.0 mm, data same as
preceding (NTM Cr 007211); 1 male, cl 32.1
mm, 3 ovig. females, cl 31.3-32.2 mm, data
same as holotype (NSMT-Cr 11336).

Additional material. 1 female, cl 31.9 mm.
8° 38'S 132° 00'E, depth 525-540 m, FV Ocean
Pearl, coll. M. Saehse (NTM Cr 006844); 2
males, cl 36.0 and 38.1 mm, 25 January 1988,
Description. Rostrum (Fig. 1a) rather stout, semi-triangular, extending obliquely upward, with sharp terminal spine reaching fully or just falling short of anterodorsal end of carapace, anterior margin slightly convex.

Carapace (Fig. 1b) remarkably compressed laterally along anterior five-sevenths of dorsal margin, forming blunt or very weak carina on that portion, while distinctly rounded posteriorly; anterior half of dorsal margin noticeably concave in lateral aspect. Suprabranchial ridge rather marked. Branchiostegal spine marginal, extending anteriorly beyond anterolateral margin of carapace. Branchiostegal sinus rather deep, and nearly right-angled.

Abdomen (Fig. 1c) with first somite very weakly carinate dorsally or rounded, second to fifth somites sharply carinate, sixth somite carinate on anterior two-thirds, while posterior portion is flattened dorsally. Sixth somite 1.29-1.44 (average 1.37) times as long as fifth. No postmedian spine on any somite. Telson (Fig. 1g,h) 0.92-1.08 (average 0.96) times as long as sixth somite, weakly sulcate dorsally, although this groove is obscure at distal third; posterior end very shallowly emarginate, and armed with about 11-13 termini spines, largest of which is lateral pair (distalmost spines of telson more or less damaged).

Eye (Fig. 1d) with cornea well pigmented, wider than eyestalk.

First antenna (Fig. 1e) with third segment of peduncle bearing sharp spine at distal end of ventrolateral margin, second segment shortest, nearly half as long as first segment. Stylocerite twisted, ending in sharp spine, and barely reaching or falling short of distolateral end of first segment.

Second antenna (Fig. 1f) with antennal scale, 0.45-0.52 (average 0.49) times as long as carapace, and 3.40-3.85 (average 3.57) times as long as wide, outer margin convex, distolateral spine rather long, reaching well beyond distal end of lamella. Basicepitated with sharp spine at distoventral end.

Mouthparts as figured (Figs 2a-f). Third maxilliped barely reaching or extending slightly beyond end of antennal scale, distal segment 1.65-1.76 (average 1.70) times as long as penultimate segment.

First pereopod (Fig. 2g,h) extending beyond antennal scale by length of whole to three-fourths of finger length, fingers 0.70-0.89 (average 0.82) times as long as palmar length, ventromesial margin of palm with four to six minute spines, basis unarmed on ventral margin except for terminal tooth, ischium unarmed, merus armed ventrally with 5-15 (commonly 8-12 in greater than 80% of specimens) spines, and dorsal portion slightly expanded distally, bearing 9-12 small spines. Second pereopod (Fig. 2i, j) extending beyond antennal scale by two-thirds to four-fifths of finger length, fingers 1.03-1.33 (average 1.22) times as long as palmar length, ventromesial margin of palm with three to seven minute spines, basis unarmed ventrally except for terminal tooth, ischium unarmed, merus armed ventrally with 19-30 (commonly 24-28 in greater than 70%) spines and 3-10 small spines on dorsal margin, especially on distal third. Third pereopod (Fig. 2k) slender, reaching proximal end of propodus of second pereopod, carpus about one-tenth as long as distal two segments combined. Fourth pereopod (Fig. 2l) distinctly shorter than fifth pereopod, reaching to or slightly exceeding end of ischium of second pereopod. Fifth pereopod (Fig. 2m) extending slightly beyond mid-length of merus of second pereopod.

Exopod of third pleopod 0.32-0.36 (average 0.33) times as long as earapace.

Appendix masculina (Fig. 2n) about two-thirds as long as appendix interna.

Branchial formula same as known for the genus.

Size. Smallest ovigerous female is cl 26.3 mm, and largest specimen is cl 38.8 mm (male).

Egg size. Non-eyed eggs 1.60-1.80 x 1.30-1.35 mm.

Colour. Body is basically white (probably semi-transparent), and reddish spots are scattered over nearly the whole of the body, concentrated especially along the ventrolateral margin of the body and dorsal margin from the second abdominal somite to end of the telson, while the lateral portion of the abdomen is less pigmented due to sparse distribution of red patches. The appendages are also well pigmented (see Wadley and Evans 1991).

Distribution. Only known from north-western Australian waters, and with a vertical range of 500 to 1000 m.

Y. Hanamura
Sta. S8, 13° 17'S 122° 21'E, trawl, depth 600-740 m, FV Territory Pearl, coll. B. Wallner (NTM Cr 007212); 1 male, cl 28.8 mm, 5 females, cl 26.0-34.0 mm, 7 ovig. females, cl 26.3-36.2 mm, data same as for holotype.
Fig. 1. *Pasiphaea levicarinata* sp. nov. a-c, holotype, ovig. female cl 32.0 mm and d-h, paratype, ovig. female, cl 31.8 mm. a, anterior part of body; b, carapace; c, abdomen; d, eye; e, 1st antenna; f, 2nd antenna; g, telson; h, same, distal end enlarged.
Fig. 2. *Pasiphaea levicarinata* sp. nov. a-m, paratype ovig. female, cl 31.8 mm, n, paratype, male, cl 36.0 mm. a, mandible; b, 1st maxilla; c, 2nd maxilla; d, 1st maxilliped; e, 2nd maxilliped; f, 3rd maxilliped; g, 1st pereopod; h, same, distal portion; i, 2nd pereopod; j, same, distal portion; k, 3rd pereopod; l, 4th pereopod; m, 5th pereopod; n, appendix masculina and appendix interna.
Table 1. Diagnostic characters and differentiation of seven related species of *Pasiphaea*

<table>
<thead>
<tr>
<th>Species</th>
<th>Carapace</th>
<th>Abdomen</th>
<th>1st pereopod</th>
<th>2nd pereopod</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. affinis</em></td>
<td>dorsal margin nearly straight in lateral aspect,</td>
<td>2nd to 5th somites bluntly carinate</td>
<td>&lt; 5 (3) meral spines</td>
<td>6-10 (6) meral spines</td>
<td>Rathbun 1902, 1904;</td>
</tr>
<tr>
<td></td>
<td>not sinuous on anterior portion; rostrum</td>
<td>dorsally; telson distinctly grooved</td>
<td>[number of spines of holotype</td>
<td></td>
<td>Burukovsky &amp; Romensky 1987;</td>
</tr>
<tr>
<td></td>
<td>triangular-shaped, directed obliquely upward,</td>
<td>distally, 2/5 times as deep as distal</td>
<td>female in parentheses]</td>
<td></td>
<td>Chace, pers. comm.</td>
</tr>
<tr>
<td></td>
<td>tip not directed forward, distal extremity</td>
<td>wide, bearing about 28 spines distally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>barely reaching end of carapace</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><em>P. magna</em></td>
<td>dorsal margin descending on anterior 2/3; rostrum</td>
<td>2nd to 6th somites carinate dorsally;</td>
<td>4 or 5 meral spines</td>
<td>12 or 13 meral spines</td>
<td>Faxon 1893, 1895; Mendez</td>
</tr>
<tr>
<td></td>
<td>directed forward well beyond distal end of</td>
<td>telson very weakly sinuous distally,</td>
<td></td>
<td></td>
<td>1981</td>
</tr>
<tr>
<td></td>
<td>carapace, fully reaching corners of eye</td>
<td>bearing 12 spines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. nishiei</em></td>
<td>dorsal margin weakly sinuous on anterior half in</td>
<td>2nd to 4th somites carinate dorsally;</td>
<td>unarmed on merus</td>
<td>1 meral spine</td>
<td>Iwasaki 1990</td>
</tr>
<tr>
<td></td>
<td>lateral aspect; rostrum nearly triangular-shaped,</td>
<td>telson truncated distally, bearing 8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>directed obliquely upward, tip slightly turned</td>
<td>spines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>anteriorly, distal extremity reaching anterior end</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>of carapace</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><em>P. princeps</em></td>
<td>dorsal margin descending on anterior 2/5; rostrum</td>
<td>2nd to 6th somites carinate dorsally;</td>
<td>unarmed on merus</td>
<td>5 meral spines</td>
<td>Smith 1884; Iwasaki 1990</td>
</tr>
<tr>
<td></td>
<td>directed forward or slightly upturned distally,</td>
<td>telson deeply grooved distally, about</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>distal extremity extending beyond end of carapace,</td>
<td>as deep as distal width, bearing about</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>but not reaching to corners of eye</td>
<td>20 spines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. propinaqua</em></td>
<td>dorsal margin nearly straight or faintly sinuous</td>
<td>2nd to 4th somites bluntly carinate</td>
<td>no data available</td>
<td>no data available</td>
<td>de Man 1916, 1920</td>
</tr>
<tr>
<td></td>
<td>on anterior half in lateral aspect; rostrum</td>
<td>dorsally; telson distinctly produced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>forming obtuse and low carination, distal</td>
<td>posteri orly as round lobe, bearing 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>extremity falling far short of distal end of</td>
<td>spines</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>carapace; branchiostegal sinus indistinct</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><em>P. westindica</em></td>
<td>dorsal margin weakly sinuous on anterior half;</td>
<td>2nd to 6th somites bluntly carinate;</td>
<td>3 meral spines</td>
<td>7 or 8 meral spines</td>
<td>Tchesunov 1984</td>
</tr>
<tr>
<td></td>
<td>rostrum subtriangular-shaped, directed obliquely</td>
<td>telson weakly grooved distally,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>upward, tip turning anteriorly, distal extremity</td>
<td>bearing about 10 spines</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>reaching to or slightly extending beyond anterior</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>end of carapace</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. levicarinata</em></td>
<td>dorsal margin weakly sinuous on anterior half;</td>
<td>2nd to 5th somites distinctly carinate</td>
<td>5-15 (8; &gt;80%) meral spines</td>
<td>19-30 (24-28; &gt;70%) meral spines</td>
<td>present work</td>
</tr>
<tr>
<td></td>
<td>rostrum subtriangular-shaped, slightly directed</td>
<td>dorsally, and 6th bluntly carinate on</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>upward, tip turning anteriorly, distal extremity</td>
<td>anterior 2/3; telson weakly sinuous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>barely reaching anterior end of carapace</td>
<td>distally, bearing about 11-13 spines</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Remarks. Among some 45 species of the genus Pasiphaea, P. levicarinata n.sp. resembles the following six species in having the carapace without a sharp carina along the dorsal margin and some somites of the abdomen noticeably carinate dorsally: P. affinis Rathbun, 1902; P. magna Faxon, 1893; P. nishiei Iwasaki, 1990; P. princeps Smith, 1884; P. propinqua de Man, 1916; and P. westindica Tchesunov, 1984. 

Pasiphaea levicarinata can be distinguished from these species by the features set out in Table 1. The new species is immediately distinguishable from P. propinqua by having a well developed rostrum and a deep branchiostegal sinus. The meri of the first and second pereopods in P. levicarinata are provided with larger number of spines, which are well beyond the ranges known for P. affinis, P. magna, P. nishiei, P. princeps, and P. westindica.

On the other hand, Pasiphaea merriami Schmitt, 1931, may occasionally have carinae on some of the abdominal somites (Schmitt 1931; Tchesunov 1984). But the spines on the meri of the first and second pereopods of this species are considerably fewer than those of P. levicarinata. In this regard, there remains little known about the identity of P. nishiei. The merial spine count in P. merriani is the same as that of P. nishiei. In addition, these two species exhibit a close similarity in rostral shape, carination on the lateral face of the carapace as well as no carina on its dorsal margin, and even the truncated telson tip. Such close resemblance in morphology has brought suspicion that P. nishiei may represent a form of the variable species P. merriami. Close analyses and comparison of the two species based on rather extensive materials may be needed.

In my earlier paper (Hanamura 1987), I recorded P. sinensis Hayashi and Miyake, 1971, based on a single female from the north-west Australian continental shelf. Examination of abundant material recently received from the same area has convinced me that the RV Soela specimen reported in 1987 should be referred to P. levicarinata. The general form, and fingers to palm ratios of the first two chelae of that specimen are within the range of those of P. levicarinata. Confusion might derive from the presence of a slight carination on the dorsal margin of the carapace, and the meral spine numbers on the first two pereopods which overlap extensively between the two species. According to the original authors (Hayashi and Miyake 1971), P. sinensis has the carapace distinctly carinate dorsally throughout its length, and the telson is deeply notched distally in contrast to being weakly sinuous in the new species.

Pasiphaea species 1 recorded by Wadley and Evans (1991) from western Australian waters is actually identical to P. levicarinata.

Etymology. The compound Latin word “levicarinata” refers to an obtuse or very weak carination on the dorsal margin of the carapace.

ACKNOWLEDGEMENTS

I am grateful to Dr A.J. Bruce of the Northern Territory Museum of Arts and Sciences, Darwin, and Mr D. Evans of the CSIRO Division of Fisheries at North Beach, WA, for making available interesting shrimp specimens for this work. The latter also provided a fine colour picture, Dr F.A. Chace, Jr., of the Smithsonian Institution, Washington, D.C., provided valuable data on the morphology of P. affinis. Dr R.N. Burukovsky of the Atlanticro, Kaliningrad, has kindly given me information on Pasiphaea taxonomy. I also thank Dr F.A. Chace, Jr., and Dr K. Hayashi of Shimonosemi University of Fisheries, Shimonosemi, for reviewing the manuscript. Thanks are due to two anonymous referees of this journal for improving this paper.

REFERENCES


Faxon, W. 1895. The stalk-eyed Crustacea: Reports on an exploration off the west coasts of Mexico, central and south America, and off the Galapagos Island, in charge of Alexander Agassiz, by the
New *Pasiphaea* from NW Australia


Wadley, V. and Evans, D. 1991. Crustaceans from the deepwater trawl fisheries of Western Australia. *CSIRO Division of Fisheries, North Beach, Australia* 1-44.

Accepted 22 October 1992
ELEVEN SPECIES OF AUSTRALIAN AXIIDAE (CRUSTACEA: DECAPODA: THALASSINIDEA) WITH DESCRIPTIONS OF ONE NEW GENUS AND FIVE NEW SPECIES.

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ABSTRACT
Eleven species of the decapod crustacean family Axiidae: Neaxius glyptocercus, Bouvieraxius rudis, Ambiaxius frankliniae sp. nov., Scytoleptus serripes, Platyaxius brevirostris gen. and sp. nov., Eutrichocheles brocki, E. austrinus sp. nov., E. pumilus sp. nov., Calaxius acuirostris, Acanthaxius polychaeae sp. nov., and Axiopsis consobrina are reported and described from northern Australia. The lectotype of Axiopsis consobrina is selected to separate the species from A. tsushimaensis.

Keywords: Crustacea, Decapoda, Thalassinidea, Axiidae, Neaxius, Bouvieraxius, Ambiaxius, Scytoleptus, Platyaxius, Eutrichocheles, Calaxius, Acanthaxius, Axiopsis, new taxa, northern Australia; Axiopsis consobrina lectotype.

INTRODUCTION
Specimens of the family Axiidae represented in the Northern Territory Museum’s collections were examined. Among the eleven species found, one new genus, Platyaxius gen. nov., and five new species, Platyaxius brevirostris, Eutrichocheles australiensis, E. pumilus, Ambiaxius frankliniae, and Acanthaxius polychaeae spp. nov., are described below, and two known species, Bouvieraxius rudis (Rathbun) and Calaxius acuirostris Sakai and de Saint Laurent, are newly recorded for Australia.

Up to now, eleven known species were recorded from Australian waters: Dorphinaxius appendiculis (Poore and Griffin), Eutrichocheles brocki (De Man), Axius australiensis (De Man), Axiopsis consobrina (De Man), Calocarides werribee (Poore and Griffin), Neaxius acanthus (A. Milne Edwards), Neaxius glyptocercus (von Martens), Strahlaxius plectrorhynchus (Strahl), Strahlaxius waroona (Poore and Griffin), Scytoleptus serripes Gerstaecker, and Spongaxius brucei (Sakai).

Among De Man’s type specimens of Axiopsis consobrina, two species, A. consobrina and A. tsushimaensis, were found to be included; therefore the lectotype of A. consobrina is designated below.

SYSTEMATICS

Family Axiidae Huxley
Remarks. The family Calocarididae Ortmann, 1891, was resurrected and rediagnosed by Kensley (1989: 960). However, it is very difficult to separate the Calocarididae from the Axiidae on morphological features other than pleopods 1-2. On the other hand, the subfamily Coralaxiinae Sakai and de Saint Laurent, 1989, was based on the type species of Coralaxius abelei Kensley, 1981. Coralaxius abelei is simi-
lar to a fossil species, *Schlueteria tetracheles* Frisch and Kafka, 1887, in the form of the chelipeds and the rounded chela of pereopod 2, and is distinct from the *Axiiidae* in the shape of the rostrum, the scaphocerite of antenna 2, the exopod of maxillipeds 2-3, the biunguiculate dactyls of pereopods 3-5, the absence of epipods on pereopods 1-5, and the flagellum of the exopod of maxilliped 3 bending at an acute angle from its proximal segment. In the *Axiiidae* as well as the *Calocarididae*, the simple dactyls of pereopods 3-5, the presence of epipods 1-5, the flagellum of the exopod of maxilliped 3 connected with its proximal segment in a straight line, are distinct characteristics of the morphology (Sakai and de Saint Laurent 1989: 10). As a result, the family *Calocarididae* cannot be placed at the same level of the family *Axiiidae*, as it is more reasonable to separate *Coralaxius* into the subfamily *Coralaxiinae*, apart from the genera of *Axinae*, so as to maintain the taxon *Thalassinidea*.

Species of the family *Axiiidae* are found from the littoral to the abyssal regions (down to 1788 m depth), and from the tropics to subarctic regions. Fourteen genera of the family *Axiiidae* are known from Australian waters: *Axius*, *Neaxius*, *Strahlaxius*, *Spongiaxius*, *Bouvieraxius*, *Ambiaxius*, *Dorfinaxius*, *Scytoleptus*, *Platyaxius* gen. nov., *Eutrichiocheles*, *Galaxis*, *Acanthaxius*, *Calocarides*, and *Axiopsis*.

**Genus Neaxius** Borradaile

*Neaxius* s. str. Borradaile, 1903: 537.

**Definition.** Dorsomedian region of carapace extending forward almost at same level with rostrum; anterolateral margin with teeth. Rostrum bifurcate at tip, continuous laterally with lateral carina of carapace. Telson usually wider than long, with one or more strong transverse ridges on dorsal surface. Eye subglobose, cornea pigmented. Antennal segment 2 with an elongate distodorsal tooth, scaphocerite of moderate size. Pereopod 1 unequal. Propod of pereopod 3 without transverse rows of spines laterally. Pleurobranchs present. Pleopod 1 in male absent, and in female, pleopod 1 biarticulate, consisting of proximal segment and distal multiarticulated segment. Pleopods 2-5 in both sexes broad, with appendices internae, and pleopod 2 in male without appendix masculina. Uropodal exopod without transverse suture.

**Type species.** *Axia acanthus* A. Milne Edwards, 1878, designated by Borradaile, 1903: 537.

**Remarks.** In the generic definition given by Sakai and de Saint Laurent (1989: 29), it was stated that pleopod 1 in females is a single leaf. However, it bears a proximal segment, so the definition is here revised to state: "...pleopod 1 in females biarticulate..." in this paper, in addition to other characters such as the dorsomedian region of the carapace and antennal segment 2.

*Neaxius acanthus* A. Milne Edwards and *N. glyptocercus* are known from Australian waters.

**Neaxius glyptocercus** (von Martens)

*Axius(Neaxius) glyptocercus* - De Man, 1925: 50, fig. 1; De Man, 1925b: 13; Poore and Griffin, 1979: 236, fig. 8.

**Material.** NTM Cr.00068, one female, TL 25.5, CL 9.0, sand-flat pools under stone, Bullocky Point, Darwin, NT, 12°26.2'S 130°49.9'E, 2 October 1981, coll. J.N.A. Hooper.

**Type locality.** Cape York, Australia.

**Distribution.** Darwin, Northern Territory, to Moreton Bay, Queensland, Australia.

**Genus Bouvieraxius** Sakai and de Saint Laurent


**Definition.** Gonochoristic, but with hermaphroditic forms. Dorsomedian region of carapace slightly convex anteriorly, posterior to rostrum. Rostrum narrowly triangular, continuous laterally with lateral carina of carapace. Telson longer than wide. Eye subglobose, cornea pigmented. Antennal segment 2 with a prominent distodorsal tooth; scaphognathite also prominent. Pereopod 1 subequal. Pereopod 3 with propod bearing transverse rows of spines laterally, Genital pores on coxae of pereopods 3 and 5. Pereopod 1 in male two-segmented, distal segment spatulate; pleopod 2 slender, with articulated endopod bearing appendix interna and appendix masculina at about midlength, appendix masculina elongate, reaching beyond endopod and exopod; pleopods 3-5 without appendices.
Northern Australian Axidae

Internae. Pleopod 1 in female slender, biarticulate, distal segment multiarticulate; pleopods 2-5 without appendices internae. Uropodal exopod with transverse suture.

Type species. *Axius longipes* Bouvier, 1905, original designation by Sakai and de Saint Laurent, 1989: 45.

Remarks. *Posthonocaris* Kensley, 1989, was reviewed by Sakai (1992; 169). It is confirmed here that in *B. rudis* (Rathbun, 1906) and *B. keiensis* Sakai, 1992, the anterolateral margin of carapace has a spine, although in the definition of *Bouvieraxius* 1 neglected to note the presence of the spine (Sakai 1992).

*Bouvieraxius rudis* (Rathbun, 1906)

*Axius rudis* Rathbun, 1906: 894, fig. 51; Balss, 1925: 209.

*Axioptis* (*Axioptis*) *rudis* - De Man, 1925b: 70.


Material. NTM Cr.000886, one ovig. fe¬male, TL 23.5, CL 8.0, 19°50.0'S 115°34.0'E, 80 m, 19 September 1982, coll. NT Fisheries Dept.

Remarks. In the present ovigerous specimen the first pleopod shows a uniramous, biarticulate appendage, the distal segment is multiarticulated, the second pleopod has no appendix interna, and the genital pores are present on the coxae of pereopods 3 and 5. The rostrum has three lateral teeth, of which the distal one is small, while the proximal two are sharp. In the female type specimen (USNM 30535) the rostrum has only two sharp lateral teeth (Sakai and de Saint Laurent 1989; 46, fig. 12).

Type locality. South coast of Molokai Is., Hawaii, 92-212 fms (168-388 m).

Distribution. Hawaii, 73-426 m depth; New Caledonia; Western Australia; Malagasy Republic.

Genus *Ambiaxius* Sakai and de Saint Laurent

*Ambiaxius* Sakai and de Saint Laurent, 1989: 54.


Definition. Hermaphroditic. Dorsomedian region of carapace with anterior convexity posterior to rostrum; anterolateral margin unarmured.


Type species. *Calocaris alcocki* McArdle, 1900, designated by Sakai and de Saint Laurent, 1989: 54.

Remarks. *Ambiaxius* Sakai and de Saint Laurent, and *Callistocaris* Kensley were established on the same type species, *Calocaris alcocki* (McArdle, 1900), but the latter genus is a junior synonym of the former.

The definition of the genus *Ambiaxius* given by Sakai and de Saint Laurent (1989: 54) is here revised with respect to characters of pereopods 1 and appendices internae of pleopods 3-5 to read "Pereopod 1 slightly asymmetrical, and pleopods 3-5 without appendices internae". McArdle (1900: 477) already stated "The chelipeds are long and slightly asymmetrical", and Barnard (1950: 503) noted that "...none of the pleopods carry an appendix interna."

*Ambiaxius franklinae* sp. nov. represents the first record of the genus *Ambiaxius* for Australian waters.

*Ambiaxius franklinae* sp. nov.

(Figs 1-2)

Material. HOLOTYPE - QM WI 3237, fe¬male, TL 41.5, CL including rostrum 16.5, R 6.0, 17°19.76'S 147°28.05'E, 1310-1357 m, 11 May 1986, coll. FRV Franklin, St. 27-2, beam trawl.

Description. Carapace smooth (Fig. 1). Dorsomedian region depressed anteriorly; median and submedian carinae smooth; lateral carina smooth, with an acute tooth anteriorly. Rostrum (Fig. 2A, B) styliform, largely upturned with acute apex, with small tooth laterally at mid-length on right side, but unarmured on
left. Cervical groove located about at mid-length of carapace, extending laterally to near anteroventral corner. Posterior thoracic region smooth on dorsal surface, punctate on branchial region. Abdomen smooth, relative lengths of abdominal somites 1-6 and telson 1: 1.2; 1.2; 1.2; 1.5 and 2.0. Pleuron 1 short, deflected posteroventrally; pleura 2-5 produced anteroposteriorly, and rounded on ventral margins. Telson (Fig. 2C) 1.8 times as long as broad, with median transverse tuft of setae at anterior fourth of length, and posterior to tuft, sulcate medially on dorsal surface; lateral margins unarmed, slightly expanded in proximal fourth length; posterior margin broadly rounded, without median tooth.

Eye triangular, carinate dorsolaterally, and devoid of pigment and corneal facets. Antennular peduncle reaching to proximal third of antennal segment 4, segment 1 about as long as segments 2 and 3 combined, produced proximally on lateral margin, and with small tooth. Antennal segment 2 with a minutely pointed distodorsal tooth, scaphocerite small, apically pointed on right (Fig. 1), but missing on left side (Fig. 2B); segment 3 triangular, acute at distal apex; segment 4 elongate, 2.2 times as long as segment 2; segment 5 short, a quarter length of segment 4, almost reaching to rostral tip. Maxilliped 2 with epipod, but devoid of podobranch. Maxilliped 3 pediform; coxa with medial tooth; basis unarmed; ischium 3.5 times as long as broad, with crista dentata; merus slightly shorter than ischium, with a medial subterminal tooth; carpus three-quarters the length of merus; propod three-quarters the length of carpus, subequal to dactyl. Exopod composed of proximal stem and segmented flagellum, reaching to near distal end of merus. Epipods with rudimentary podobranchs, and foliaceous arthrobranchs (Fig. 2D).

Pereopods 1 missing. Coxa with postmedial tubercle. Pereopod 2 chelate. Coxa with small posterior tooth; ischium with subterminal ventral tooth; merus long, unarmed; carpus 0.4 times length of merus; chela 1.6 times length of carpus. Pereopod 3 missing. Coxa unarmed. Pereopod 4 simple. Coxa and ischium unarmed; merus long, unarmed; carpus 0.4 of merus; propod more than half length of carpus; dactyl about 0.33 of propod. Pereopod 5 simple. Ischium unarmed; merus long; carpus 0.55 of merus; propod subequal to meral length; dactyl 0.7 of propod. Epipods with rudimentary podobranch on maxilliped 3 and pereopods 1-3 present; pair of foliaceous arthrobranchs on maxilliped 3 and pereopods 1-4 (Fig. 2D) present.

Branchial formula as follows:

<table>
<thead>
<tr>
<th>Maxillipeds</th>
<th>Pereopods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

Epipods
- - - 1 1 1 1 1 1 -
Podobranchs
- - r r r r - -
Arthrobranchs
- - 2 2 2 2 - -
Pleurobranchs
- - - - - - - -

Pleopod 1 (Fig. 2E) biarticulate; proximal segment flattened, and distal segment consisting of two lobes fused longitudinally with one another; medial lobe triangular distally, and with medial patch of hooks proximally, and lateral lobe rounded distally. Pleopod 2 bifurcate; endopod consisting of protopod and foot-shaped appendix masculina (Fig. 2F), edged with double rows of spines on medial margin, and with small appendix interna proximally;
Northern Australian Axiidae

Exopod slender. Pleopods 3-5 (Fig. 2G) slender, consisting of articulated exopod and endopod, and without appendices internae.

Uropodal exopod elongate, twice as long as broad, lateral margin with a small tooth subterminally; distinct transverse suture present. Uropodal endopod also elongate, 2.2 times as long as broad, slightly exceeding telson, lateral margin with small tooth at distal end on right side, but unarmed on left.

**Etymology.** The species name is derived from the FRV Franklin, which collected this interesting specimen from deep waters in the Coral Sea.

**Remarks.** The present species is very similar to *A. alcocki* (McArdle, 1900). However, it is distinguished by the following features: the rostrum is longer than in *A. alcocki*, about half the length of the carapace, reaching to the end of the antennal peduncle, and the posterior thoracic region is without a median carina. The type specimen of *A. alcocki*, 53.5 mm in total length, from off Sri Lanka, 992 m depth, was reported by McArdle (1900: 476) as “length of rostrum 3 mm, carapace to base of rostrum 16.5 mm”, that is, the rostrum is about a third of the length of the carapace, and in the figure (Alcock and McArdle 1901: pl. 50, fig. 4) the rostrum reaches only to the proximal part of antennal segment 4. Later, Stebbing (1915: 59, 1917: PI 91) described his specimen from NE Cape Natal, 805 m depth, 33

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**Fig. 2. Ambiaxius franklinae** sp. nov.: female, holotype, QM WI 3237: A, dorsomedian region of carapace, dorsal aspect; B, dorsomedian region, lateral aspect; C, abdominal somite 6 and tail-fan, dorsal aspect; D, gills and epipods on maxilliped 2 to pereopod 4; E, pleopod 1, lateral aspect; F, appendix masculina attached to appendix interna in pleopod 2, lateral aspect; G, pleopod 3 with egg-thread, lateral aspect. Scale in 1 mm divisions.
mm in total length, as having a rostrum that reaches to the distal part of antennal segment 4.

**Distribution.** North-West Shelf, Australia.

**Genus Scytoleptus Gerstaecker**


**Definition.** Dorsomedian region of carapace bordered by submedian carina on each side; median and submedian carinae ending short of front of carapace in a strong tooth, arched steeply to rostrum; anterolateral margin of carapace unarmed. Rostrum short. Telson longer than wide, arched dorsally. Eye subglobose, cornea pigmented. Antennal segment 2 with reduced distodorsal tooth, scaphocerite short. Pereopods 1 unequal. Pereopod 3 with propod bearing transverse rows of spines laterally. Pleurobranchs present. Pleopod 1 in male biarticulate, consisting of two segments, and in female, a proximal segment and a multiarticulate flagellum. Pleopods 2-5 in both male and female (Fig. 3C-D) biramous, with appendices internae, but without appendix masculina in male. Uropods arched on surface; exopod without transverse suture.

**Type species.** *Scytoleptus serripes* Gerstaecker, 1856, by monotypy.

**Remarks.** The generic definition is revised here by some additional characters. Pleopod 1 in males was defined as a slender leaf by Sakai and de Saint Laurent (1989: 36), however, it should be described as a biarticulate segment consisting of two segments. The status of the dorsomedian region of the carapace, and antennal segment 2 are added to the present definition.

**Scytoleptus serripes Gerstaecker**

(Fig. 3)

*Scytoleptus serripes* Gerstaecker, 1856: 158, pl. 6, figs 1-4; - De Man, 1925b: 49, pl. 4, figs 9-9h; - Poore and Griffin, 1979: 243, fig. 11. - Sakai and de Saint Laurent, 1989: 37.

**Material.** NTM Cr.000802, one male, TL 28.7, CL 9.5, *Bopyrina* sp. attached in left gill-chamber (K. Sakai det.). NTM Cr.000802, one female, TL 38.0, CL 14.0, Lee Point, Darwin, NT, shore reef flat, 7 April 1975, coll. A.J. Dartnall. NTM Cr.000919, one male, TL 19.0, CL 8.0, Lee Point, Darwin, NT, 13 December 1981, coll. J.N.A. Hooper. NTM Cr.000839, one male, TL 13.0, CL 4.5, Table Head, Port Essington, NT, 11°13.5'S 132°10.5'E, 3 May 1982, coll. A.J. Bruce. NTM Cr.000780, one male, TL 11.0, CL 4.0, gastric region broken, St. No. CP 162, Caiman Creek, Port Essington, NT, 11°10.5'S 132°03.8'E, rubble, 4 m, 17 May 1983, coll. N.L. Bruce.

**Remarks.** The present Australian specimens agree with Gerstaecker's female type specimen, probably from Port Natal, but differ from De Man's male specimens (De Man 1925b: 49, pl. 4, fig. 9e-f) from off Seba, Savu, Indonesia. In De Man's male the pleopodal protopod is broadly oval, the endopod with an appendix interna (= stylamblys) and an appendix masculina (De Man 1925b: 50, pl. 4, fig. 9e), while in the present male (Fig. 3C) and female (Fig. 3D) pleopod 2 has an elongate protopod, the endopod with an appendix interna, but no appendix masculina.

**Type locality.** Probably Port Natal, South Africa.

**Distribution.** South Africa; Malagasy Republic (= Madagascar); Aldabra Is.; Mozambique; Zanzibar Is.; Mauritius; Indonesia; Luzon, Philippines; northern and western Australia.

**Platyaxius gen. nov.**

**Definition.** Dorsomedian region of carapace slightly convex anteriorly, with flat dorsal plat-
form bearing lateral, submedian and median carinae; anterolateral margin unarmed. Rostrum triangular, notched dorsally, spinulate laterally, and continuous laterally with lateral carina of carapace. Cervical groove distinct dorsally, but absent laterally. Abdominal pleura rounded ventrally. Telson longer than wide; posterior margin rounded, without median tooth. Eye subglobose, cornea pigmented. Antennal segment 2 with prominent distodorsal tooth, scaphocerite also prominent. Pereopods 1 subequal, with broadened merus. Pereopod 3 with propod bearing transverse rows of spines on ventrolateral surface, dactyl short, with longitudinal rows of spines on lateral and ventral surfaces. Pleopod 1 in male absent, and in female biarticulate, distal segment multiarticulate. Pleopods 2-5 in both male and female with free appendices internae, and pleopod 2 in male with appendix masculina. Uropodal exopod without transverse suture.

**Typespecies.** *Platyaxius brevirostris* sp. nov., by present designation: gender, masculine.  

**Etymology.** The generic name is derived from the Greek, “platus”, meaning flat, and the genus name *Axius*, because the type species *Platyaxius brevirostris* sp. nov., is characterised by the flat dorsomedian region of the carapace.

**Remarks.** The type species, *Platyaxius brevirostris* sp. nov., is closely related to *Eiconaxius parvus* Bate, 1888. De Man’s specimens of *Eiconaxius parvus* from Kai Island, 560 m depth, are different from Bate’s female type from off the Kermadec Islands at 952 m depth. In De Man’s *Eiconaxius parvus* the broadened merus of pereopod 1 is serrate on the ventral margin (De Man 1925b: 43, pl. 3, fig. 7c) as in *Platyaxius brevirostris*, however, in Bate’s female type of *Eiconaxius parvus* it is smooth (Bate 1888: 45, pl. 5, fig. 4). *Platyaxius brevirostris* is also similar to *Eiconaxius sibogae* in morphological features of the uropodal endopod. 

In *Platyaxius brevirostris* and *Eiconaxius sibogae* the uropodal endopod shows a serrate projection at the posterolateral angle (De Man 1925b: 35, pl. 2, fig. 4c). However, *Eiconaxius parvus* and *Eiconaxius sibogae* are fundamentally different from *Platyaxius brevirostris*, because in species of *Eiconaxius* the rostrum is distinctly smooth on the lateral margin, and its tip is subacute (De Man 1925b: 16); the dorsomedian region of the carapace is marked by the median carina which may branch into two carinae posteriorly, and without submedian carina; the cervical groove is inconspicuous; the dactyli of the pereopods are roundedly curved, while in *Platyaxius brevirostris* the rostrum is triangular, with three to four lateral teeth, and with an obtuse tooth apically; the dorsomedian region of carapace is flat, being marked by the median, submedian and lateral carinae; the cervical groove is clearly defined; and the dactyli of pereopods are short and incurved.

**Platyaxius brevirostris** sp. nov. 
(Figs 4-5)

**Type material.** HOLOTYPE - NTM Cr.000784a, one male, TL 18.0, CL 5.5, 18°33.4’S 118°35.4’E, 141 m, 15 April 1983, coll. FRV *Soela*, trawl. PARATYPE - NTM Cr.000784b, one female, TL 18.0, CL 5.5, same data as holotype.

**Diagnosis.** Dorsomedian region of carapace with median carina bearing thick protuberance at anterior quarter of length. Rostrum triangular, with three to four obtuse lateral teeth. Cervical groove distinct dorsally, but inconspicuous anterolaterally. Maxilliped 3 with three medial meral teeth. Pereopods 1 subequal; merus broad, serrate on ventral margin. Telson longer than wide; posterior margin oval, without median tooth. Uropodal endopod extended posterolaterally to form serrate semicircular projection.

**Description of male holotype.** Carapace (Fig. 4A) smooth. Dorsomedian region of carapace with flat platform; lateral carina unarmed, extending to posterior third of length; submedian carina also unarmed, incurved anteriorly, extending backward to posterior third of length; median carina armed with six denticles, extending from base of rostrum to broadened protuberance at anterior fourth of length; anterolateral margin unarmed. Rostrum (Fig. 4B-C) triangular with an obtuse tooth apically, three to four obtuse teeth laterally, continuous laterally with lateral carina of carapace. Cervical groove distinct dorsally, but absent anterolaterally. Posterior thoracic region without median dorsal carina. Abdomen sparsely setose, relative lengths of somites 1-6 and telson 1; 2; 2; 2; 2 and 3.5. Pleuron 1 narrow, deflexed posteroventrally; pleuron 2 unarmed, broadly rounded on ventral margin; pleura 3-5 rounded, each provided with denticle on anteroventral angle; pleuron 6 triangular, with an apical tooth ventrally. Telson (Fig. 4G) setose dorsally, 1.3 times as long as wide, lateral margins expanded with proximal tooth in proximal third, and with a fixed poste...
Fig. 4. *Platyxius brevirostris* sp. nov.: A, whole body, lateral aspect; B, dorsomedian region, dorsal aspect; C, dorsomedian region, lateral aspect; D, dorsomedian region, dorsal aspect; E, antennal peduncle, lateral aspect; F, pleopod 2 in male, posterior aspect; G, tail-fan, dorsal aspect. A-C, E-G, male, holotype, NTMCr.000784a; D, female, paratype, NTMCr.000784b. Scale in 1 mm divisions.
Northern Australian Axiiidae

Fig. 5. *Platyaxis brevirostris* sp. nov.: A, maxilliped 3, lateral aspect; B, pereopod 1, lateral aspect; C, distal part of chela in larger pereopod 1, lateral aspect; D, pereopod 1, lateral aspect; E, distal part of chela in pereopod 1 in female, lateral aspect; F, carpus and chela in pereopod 2, lateral aspect; G, carpus, propod and dactyl in pereopod 3, lateral aspect. A-D, F-G, male, holotype, NTM Cr.000784a; E, female, paratype, NTM Cr.000784b. Scale in 1 mm divisions.
armed; merus about three times as long as broad, posteromedial margin; basis and ischium unarmed; coxa flat medially, smoothly carinate on ventral margin; dactyl slightly longer than palm, cutted edge of fixed finger with seven well-spaced carinate dorsally and ventrolaterally; cutting edge. Pereopod 3 with coxa bearing distal tooth armed; chela (Fig. 5F) subequal to carpus, forming edge with row of small granules. Pereopod 3 subequal to pereopod 3 in shape; coxa with two ventral teeth, one at middle length, one at distal end; basis and ischium unarmed; merus 0.7 of length of merus; propod subequal to carpus, with seven transverse rows of one to two transparent spines on ventral surface; dactyl short, with row of four lateral and five ventral spines, terminating in transparent spine at tip. Pereopod 3 similar to pereopod 3 in shape; coxa with two ventral teeth, one at middle length, one at distal end; basis and ischium unarmed; merus 0.7 of length of merus; propod subequal to carpus, with seven transverse rows of one to two transparent spines on ventral surface; dactyl short, with row of spines on lateral surface and another on ventral margin, ending in transparent spine at tip. Pereopod 5 with coxa, basis and ischium unarmed; merus 1.8 times length of ischium; carpus 0.8 of length of merus; propod 1.4 times length of carpus; dactyl 0.3 of length of propod.

Pleopod 1 absent in male. Pleopod 2 biramous, endopod and exopod narrow, leafy; endopod with free appendices masculinae and internae (Fig. 4F), both slender, similar in shape. Pleopods 3-5 similar to pleopod 2 in shape, endopods with appendices internae. Uropodal exopod truncate distally, lateral margin with 13 lateral teeth, and movable tooth at distolateral angle; dorsal surface with two longitudinal carinae, with six teeth on lateral longitudinal carinae; smooth on median carina, terminated by a distal marginal tooth. Uropodal endopod longer than telson, with four interspaced median teeth, nine lateral teeth, serrate semicircular distolateral projection, and posterior margin straight with an articulating distomedial tooth.

Paratype. Female very similar to male. Dorsoependean region of carapace with submedian carina (Fig. 4D) discontinuous in two or three places. Right, larger pereopod 1 with fingers (Fig. 5E) irregularly denticulate on cutting edge. Plocopod 1 uniramous, biarticulate, consisting of proximal segment and multiarticulate flagellum. Plocopods 2-5 biramous, endopods with appendices internae. Etymology. The specific name is derived from the Latin "brevis", short, and "rostrum", snout, referring to the short triangular rostrum, which is characteristic of this species.

Remarks. Platyaxius brevirostris sp. nov. is similar to species of Eiconaxius in the characters of the prominent scaphocerite, the broadened merus of the first pereopods, and the tail.
fan. However, it differs from Eiconaxius, because in Platyaxius brevirostris the rostrum is triangular, the submedian carina of carapace is present, the cervical groove is present, the propodi of pereopods 3-4 are armed with transverse rows of spines laterally, and the dactyli of the pereopods are short.

**Distribution.** North-West shelf, Western Australia.

**Genus Eutrichocheles** Wood-Mason

*Eutrichocheles* Wood-Mason, 1876: 264.


**Definition.** Dorsomedian region of carapace convex anteriorly, dorsal platform with lateral, submedian, and median carinae; anterolateral margin usually armed with a tooth. Rostrum triangular, pointed at tip, continuous laterally with lateral carina of carapace. Telson subquadrangular, with pair of oblique carinae on dorsal surface. Eye subglobose or cylindrical, cornea pigmented. Antennal segment 2 with short distodorsal tooth, scaphocerite also short, bifurcate distally. Pereopods 1 subequal. Pereopod 3 with propod bearing transverse rows of spines laterally. No pleurobranchs. Uropodal exopod with transverse suture.

**Type species.** Cancer modestus Herbst, 1890, designated by Wood Mason, 1876: 264.

**Remarks.** Two new species, *Eutrichocheles australinus* sp. nov. and *E. pumilus* sp. nov. are added as members of the genus *Eutrichocheles*.

With regard to the characters of the pleopods, the genus *Eutrichocheles* was defined by Sakai and de Saint Laurent (1989: 51) as “Pleopod 1 in males absent, and in females of basal segment and multiarticulate flagellum. Pleopod 2 in males is provided with an appendix interna, but without an appendix masculina, and pleopods 3-5 with appendices internae; pleopods 2-5 in females with appendices internae”. However, the present specimens of *E. brocki*, *E. australinus* sp. nov. and *E. pumilus* sp. nov. vary from previously described forms as follows. Pleopod 1 in the male is absent in *E. pumilus*, and it is unknown in *E. australinus* sp. nov.; pleopod 1 in the female is absent in *E. australinus* sp. nov. and *E. brocki*, while it is uniramous and biarticulate in *E. pumilus*. Pleopod 2 in the male has an appendix masculina, but no appendix interna in *E. pumilus*, and it is unknown in *E. australinus* sp. nov. and *E. brocki*. Pleopod 2 in the female lacks appendix interna in *E. australinus* sp. nov., *E. pumilus* and *E. brocki*.

**Pleopods 3-5 in the male lack appendices internae in *E. pumilus*, however they are unknown in *E. australinus* sp. nov. and *E. brocki*; pleopods 3-5 in the female lack appendices internae in *E. australinus* sp. nov., *E. pumilus* and *E. brocki*.

The status of the pleopods in the type species, *E. modestus*, was not mentioned by Herbst (1794: 173). Wood-Mason (1876: 264) and Chopra (1933: 277), however, in the two males of *E. biserratus* from Malacca and Singapore (De Man 1925a: 138) and the female of *E. brocki* from Ambon and the Siboga-St. 131 (De Man 1925b: 102, 109), pleopods 2-5 are devoid of the appendices internae, but with the appendix masculina.

Poore and Griffin (1979: 228, Fig. 3) described *E. brocki* as the female having pleopods 1 uniramous, consisting of a proximal segment and a multiarticulate flagellum, and the male having a single small ovate segment with a minute terminal hook. The characteristics of the pleopods in *Eutrichocheles* should be revised.

**Eutrichocheles brocki** (De Man, 1888)

Axius Brocki De Man, 1888: 475, pl. 20, fig. 3.

Axioxis (Paraxiopsis) Brocki - De Man, 1925b: 71, 101, pi. 8, fig. 19f.

Axioxis (Paraxiopsis) brocki - Poore and Griffin, 1979: 228, fig. 3; Sakai, 1987: 304.

*Eutrichocheles brocki* - Sakai and de Saint Laurent, 1989: 52.


**Type locality.** Ambon, Indonesia.

**Distribution.** Reefs, to 83 m deep. Northern and western Australia; Timor Sea; Indonesia; Borneo (De Man 1925b); Okinawa, Japan (Sakai 1987).

**Eutrichocheles australinus** sp. nov.

(Figs 6-7)


**Diagnosis.** Dorsomedian region of carapace bordered by lateral carina with two to three teeth, submedian carina with row of five teeth, and median carina with middle protuberance.
Rostrum triangular, acuminate at tip, with three lateral teeth proximally. Posterior thoracic region with median carina in posterior 0.7 of carapace. Scaphocerite double-spinulate distally. Maxilliped 3 with ischium bearing three medial teeth, and merus with seven medial teeth. Pereopod 1 subequal. Pleopod 1 in female absent, pleopods 2-5 without appendices internae.

**Description of female holotype.** Carapace (Fig. 6) sparsely setose. Dorso median region of carapace convex posterior to rostrum; lateral carina with three distinct teeth, the posterior most small, set apart from penultimate tooth; submedian row not carinate but with five interspaced teeth; median carina smooth, with central protuberance, extending backward to cervical groove; anterolateral margin with sharp denticle. Ros trum (Fig. 7A) triangular, acuminate, with two to three lateral teeth proximally, continuous laterally with lateral carina of carapace. Cervical groove distinct. Posterior thoracic region with median carina in posterior 0.7 times length of carapace. Thoracic sternite attached to pereopod 4 (Fig. 7B) with transverse carina, median slit deep. Relative lengths of abdominal somites 1-6 1.3; 1.3; 1.4; 1.7 and 2.0. Pleuron 1 (Fig. 6) narrow, unarmed ventrally; pleuron 2 broadened, rounded anteriorly; pleura 3-5 truncate posteriorly, each with denticle at anteroventral angle; pleuron 6 triangular with apical denticle. Telson (Fig. 7C) 1.2 times as long as broad, with three to four medial teeth in paired diagonal lines; lateral margins expanded with tooth at proximal 0.4 of length, and posterior to it, two teeth at 0.7 and 0.8 of length, a movable tooth at posterolateral angle, posterior margin rounded, with median tooth.

Eye cylindrical, shorter than rostrum; cornea pigmented. Antennular peduncle shorter than distal end of penultimate segment; segment 1 longer than segments 2 and 3 combined; segments 2 and 3 short, subequal. Antennal segment 1 (Fig. 7D) with two teeth distoventrally; segment 2 with short distodorsal tooth, scaphocerite bifurcate distally; segment 3 with distoventral tooth on left side, unarmed on right; segment 4 longer than segment 2, and shorter than segment 5. Maxilliped 3 with coxa bearing sharp distal tooth on posteromedial margin; basis with small distal tooth on medial surface; ischium with three medial teeth (Fig. 7E), crista dentata with nine triangular teeth; merus with seven medial teeth, gradually increasing distally in size; carpus shorter than merus, with large distomedial tooth; propod as long as carpus and longer than dactyl.

Pereopod 1 slender, subequal. Coxa with two small distal teeth on medial margin, and one sharp tooth proximally on posteromedial carina. Left pereopod 1 with ischium (Fig. 7F) bearing three ventral teeth; merus about three times as long as broad, with four distinct ventral and two dorsal teeth; carpus 0.4 of length of merus, unarmed; chela about four times as long as carpus, palm more than twice as long as broad, and with distodorsal tooth, chela serrate on
cutting edges, fingers missing at tips. Right pereopod 1 (Fig. 7G) more slender than left one, chela serrate on cutting edge, fixed finger incurved distally, and dactyl broken at tip. Pereopod 2 with coxa bearing a distal tooth on both anteromedial and posteromedial margins; ischiium with four to five ventral teeth; merus with three triangular ventral teeth, and unarmed.

Fig. 7. *Eutrichocheles australis* sp. nov. f, holotype, NTM Cr.000842: A, dorsomedian region, dorsal surface; B, thoracic sternites 3-4, ventral aspect; C, tail-fan, dorsal aspect; D, antennal peduncle, lateral aspect; E, maxilliped 3, lateral aspect; F, larger pereopod 1, lateral aspect; G, smaller pereopod 1, lateral aspect; H, pleopod 2, anterior aspect. Scale in 1 mm divisions.
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Dorsally; carpus half times as long as merus, unarmed; chela 1.3 times as long as carpus, dactyl shorter than palm, unarmed on cutting edge, and fixed finger evenly serrate on cutting edge. Pereopod 3 simple, coxa with distal tooth on anteromedial margin; genital pore present on medial surface; basis and ischium unarmed; merus elongate, with distinct distoventral tooth; carpus 0.4 of length of merus, unarmed; propod 1.5 times as long as carpus, with nine transverse rows of transparent spines on ventrolateral surface, third and fourth proximal rows represented by single spine, other rows with two spines; dactyl half times as long as propod, with two lateral, and seven well-spaced ventral spines, and strong transparent spine at tip. Pereopod 4 simple, coxa with distal teeth on anteromedial margin; ischium and merus unarmed; carpus about 0.4 of length of merus, unarmed; propod twice as long as carpus, with eight lateral teeth along midline, and with nine transverse rows consisting of one to three transparent spines on ventrolateral surface; dactyl about half times as long as propod, with six lateral, and seven interspaced ventral spines, and distinct transparent spine at tip. Pereopod 5 with coxa, basis and ischium unarmed; merus 2.5 times as long as ischium; carpus 0.7 of length of merus; propod 1.8 times length of carpus, setose distally on lateral surface, and with nine transverse rows of transparent spines ventrally; dactyl 0.3 of length of propod.

Pleopod 1 absent. Pleopods 2-5 (Fig. 7H) without appendices internae. Uropodal exopod rounded on distal margin, and an articulated tooth at distolateral angle; dorsal surface with two longitudinal carinae; medial carina smooth, and lateral carina with two teeth posteriorly; transverse denticulate suture present. Uropodal endopod subequal to telson, with three lateral teeth including distal one at distolateral angle; dorsal surface carinate with row of five teeth medially. 

Etymology. The species name *austrinus* means "from the south", referring to Australia where the species was found. 

Remarks. In the female paratype, antennal segment 3 has a disoventral tooth on both sides, however the female holotype shows individual variation, as the tooth is found only on the left side.

This species closely resembles *E. brocki* (De Man, 1888) in the shape of the rostrum, the antennular and antennal peduncles, and the tailfan, but differs in that the submedian carina on the dorsomedian region of carapace bears a row of five teeth; the merus of maxilliped 3 has seven medial teeth, while in *E. brocki* the submedian carina on the dorsomedian region is unarmed; and the merus of maxilliped 3 has only two medial teeth. 

**Eutrichocheles pumilus** sp. nov. (Figs 8-9)

Material. **HOLOTYPE** - one female, NTM Cr.004557, TL 17.0, CL 6.0, Port Essington, Cobourg Peninsula, NT, St. CPV/8, 11°21.5'S 132°13'E, 18 September 1985, coll. J.R. Hanley. NTM Cr.000792, one male, TL 11.5, CL 4.2 including rostrum, 27 m, in sponge, coll. H.K. Larson, R.V. Anson, Stn. HL 81-29, trawl, NTM CL 001762, one male, damaged, TL 21.5, Cr.7.5 including rostrum, 19° 30.7'S 118° 49.1'E, 39-40 m, 26 June 1983, coll. A.J. Bruce.

**Diagnosis.** Dorsomedian region of carapace convex anteriorly; lateral carina with two strong teeth anteriorly, briefly extending backward to anterior third of length; submedian carina slightly developed or absent; median carina running from base of rostrum to anterior quarter of length, with tubercle at midlength. Rostrum triangular, sulcate dorsally, acuminate at tip. Telson longer than wide, without median tooth on posterior margin. Maxilliped 3 with merus bearing 13-14 medial teeth, increasing in size distally. Pereopod 1 subequal. Pleopod 1 in male absent, in female uniramous. Pleopods 2-5 in male and female without appendices internae, but in male with appendices masculinae.

**Description of female holotype.** Carapace naked. Dorsomedian region of carapace convex posterior to rostrum anteriorly; lateral carina distinct in anterior third of length, bearing one to two sharp teeth anteriorly, one tooth on left side, and two on right; submedian carinae slightly raised; median carina extending over anterior quarter of length, with tubercle at midlength; anterolateral margin with tooth. Rostrum (Fig. 8D) triangular, sulcate dorsally, acuminate at tip, with small lateral tooth at midlength, continuous laterally with lateral carina of carapace. Cervical groove distinct at posterior 0.6 of length of carapace. Posterior thoracic region slightly convex along middorsal line. Relative lengths of abdominal somites 1-6 and telson 1; 1.3; 1.3; 1.3; 1.3; 1.3; 1.5 and 2.0. Pleuron 1 narrow, deflexed posteroventrally, with apical tooth; pleura 2-6
convex ventrally, unarmed. Telson (Fig. 8F) longer than wide, with medial transverse line of setae at proximal 0.3 times length, and, posterior to this line of setae, largely sulcate medially, with three teeth on paired diagonal line; lateral margins expanded without proximal tooth at proximal 0.3 of length, and posterior to it with tooth at proximal 0.4 of length on left side, and 0.6 of length on right side, and other two transverse teeth at posterolateral angle; posterior margin convex, without median tooth.

Eye subglobose, reaching to proximal 0.3 times length of rostrum; cornea brown in alcohol. Antennular peduncle reaching slightly be-
Fig. 9. *Eutrichocheles pumilus* sp. nov.: A-B, maxillipeds 3, lateral aspect; C-F, pereopod 1, lateral aspect; G, pleopod 2 in female, anterior aspect; H, pleopod 2 in male, anterior aspect: A, E-F, young male, NTM Cr.000792; B, H, male, NTM Cr.007162; C-D, G, female, holotype, NTM Cr.004557. Scale in 1 mm divisions.

Beyond antennal segment 4, segment 1 expanded proximally on lateral margin; segments 2 and 3 short, subequal. Antennal segment 1 unarmed; segment 2 with short distodorsal tooth; scaphocerite short, bifurcate distally with small medial tooth; segment 3 with short distal tooth; segment 4 subequal to segment 2, and 0.7 of length of segment 5. Maxilliped 3 with coxa bearing sharp distal tooth on posteromedial margin; epipod with podobranch but without gill-branches; basis with distal medial tooth; ischium with five medial teeth, crista dentata with 15-16 teeth; merus (Fig. 9B) subequal to ischium, with 13-14 medial teeth increasing in size distally, four distal teeth prominent; carpus with distomedial tooth; propod longer than dactyl; exopod longer than merus, consisting of proximal segment and jointed flagellum.
Pereopod 1 subequal. Coxa carinate in proximal half on posteromedial margin, and with tooth at its distal angle, and distal to it deflected to two poorly defined carinae, posterior carina with blunt tubercle, but anterior one unarmed; basis unarmed; ischium with subterminal tooth on both dorsal and ventral margins. Right larger pereopod 1 with merus (Fig. 9C) about 2.5 times as long as broad, with four teeth on ventral margin, unarmed on dorsal margin; carpus 0.4 of length of merus, unarmed; chela 3.5 times length of carpus, 2.3 times as long as broad; palm 1.3 times as long as broad; fixed finger with low triangular cusp proximally on serrate cutting edge; dactyl narrow, less than palm in length, serrate on cutting edge, tip incurved distally. Left, smaller pereopod 1 with ischium (Fig. 9D) slightly more slender than that of right side, with six ventral teeth; carpus and chela similar to those on right, but more slender. Pereopod 2 missing, coxa with distal tooth on posterior margin, basis unarmed. Pereopod 3 present on right side, missing on left side. Coxa, basis and ischium unarmed; merus slender, reaching to middle of merus of pereopod 1; carpus less than half length of merus, unarmed; propod 1.2 times length of carpus, with five well spaced teeth with setae on ventrolateral margin, and distinct tooth at distoventral angle; dactyl 0.4 of length of propod. Pereopod 4 present on left side, missing on right side. Coxa, basis, ischium and merus unarmed; carpus half length of merus, unarmed; propod 1.2 times length as long as carpus, with tuft of setae on lateral surface; dactyl about half length of propod. Pleopod 1 two-segmented, setose distally. Pleopods 2-5 biramous, without appendices internae. Uropod with protopod unarmed (Fig. 8F). Uropodal exopod rounded on distal margin, with fixed distolateral tooth at distal angle, beside it a movable tooth, and six teeth on transverse suture. Uropodal endopod oval distally; with lateral tooth medially and distally, and five to six teeth on median carina.

Description of young male. This specimen differs from the larger female type specimen in following characters.

Dorsomedical region of carapace with two sharp teeth on lateral carina anteriorly (Fig. 8B), unarmed on anterolateral margin (Fig. 8C). Antennular peduncle reaching to near distal end of antennal peduncle. Telson (Fig. 8E) longer than wide, with pair of three teeth medially; lateral margins expanded with tooth in proximal 0.4 of length, posterior to it with tooth at distal 0.3 of length on left side, tooth at distal 0.4 of length on right side, and one movable tooth at posterolateral angle.

Pereopod 1 subequal. Right larger pereopod 1 with ischium (Fig. 9E) with tooth on ventral and dorsal margins; merus 3.8 times as long as broad, with four ventral teeth; carpus about 0.3 of length of merus; chela 2.8 times length of carpus, about four times as long as broad; palm 2.2 times as long as broad; fixed finger less than palm in length, serrate on cutting edge, and slightly incurved distally; dactyl serrate on cutting edge, broken at tip. Left smaller pereopod 1 with ischium (Fig. 9F) bearing tooth on both ventral and dorsal margins; merus 4.2 times as long as broad, with five ventral teeth; carpus 0.33 of length of merus, slightly longer than that on right side; chela 2.8 times as long as carpus, about four times as long as broad; palm 2.2 times as long as broad; dactyl about 0.8 of length of palm; fingers serrate on cutting edges. Pleopod 1 absent. Pleopod 2 with appendix masculina bearing apical setae, but without appendix interna. Pleopods 3-5 without appendices internae.

Etymology. The species name is derived from the Latin "pumilus", small, referring to the small size of the animal.

Remarks. The female specimen is designated as the holotype; one of two males is young, and the other larger male is damaged, lacking pereopod 1. In the female holotype, the antennal tooth on the anterolateral margin of the carapace is present, and the submedian carina of the carapace is weakly developed, but in the other male specimens the antennal tooth and the submedian carina are absent.

The young male differs from the larger male and female in that the telson and the uropod are more slender, and the medial meral teeth of maxilliped 3 are reduced in number (Fig. 9A). This species is similar to E. brocki in the shape of the rostrum, antennule, antenna, and the telson. However, it differs distinctly from E. brocki, because in E. pumilus the submedian...
carina on the dorsomedian region of the carapace is weak or absent; maxilliped 3 has 13-14 medial meral teeth, and the telson lacks a posteromedian tooth. In *E. brocki* the submedian carina is conspicuous; maxilliped 3 is armed with two medial meral teeth; and the telson has a posteromedian tooth.

Genus *Calaxius* Sakai and de Saint Laurent

*Calaxius* Sakai and de Saint Laurent, 1989: 84.


**Type species.** *Calaxius acutirostris* Sakai and de Saint Laurent, 1989, by original designation.

**Remarks.** The type species of the genus *Calaxius, C. acutirostris*, is the first record from the Australian waters.

*Calaxius acutirostris* Sakai and de Saint Laurent (Fig.10)

*Calaxius acutirostris* Sakai and de Saint Laurent, 1989: 86, figs 23-25.

**Material.** NTM Cr.0007158, one male, TL 65.0, CL 26.5 including rostrum, 22°55.1'S 155°00.5'E, 338-325 m, 18 September 1985, coll. A.J. Bruce, FRV *Soela*, St. 12. NTM Cr.004234, one male, TL 56.0, CL 22.2, 16°45.3'S 119°46.4'E, 502-504 m, 5 February 1984, coll. A.J. Bruce, FRV *Soela*, St. 0184.66, trawl.

**Diagnosis.** Scaphognathite of maxilla 2 (Fig. 10A) bearing elongate posterior seta. Maxilliped 1 (Fig. 10B) with endopod biarticulate, exopod with distal setose process. Maxilliped 2 (Fig. 10C) with unbranched arthrobranch, podobranch with rudimentary epipod. Maxilliped 3 (Fig. 10D) with ischium bearing two medial teeth, merus with two medial teeth.

Remarks. The male specimens from north-eastern Australia described above agree with the type specimens from the Malagasy Republic in morphological features. This species is recorded for the first time in Australian waters.

**Type locality.** Malagasy Republic.

**Distribution.** 219-400 m deep. Malagasy Republic; north-eastern Australia; Philippines.

Genus *Acanthaxius* Sakai and de Saint Laurent


**Definition.** Gonochoristic. Rostrum narrowly triangular, pointed at tip, discontinuous laterally with lateral carina of carapace. Dorsomedian region of carapace confluent with rostrum or slightly convex posterior to rostrum; with or without antennal tooth on anterolateral margin. Abdominal pleura 2-5 rounded ventrally. Telson subsquare, or clearly longer than wide. Eye cylindrical, and with double corneae. Antennal segment 2 with distinct distodorsal tooth, and scaphocerite also well developed, with or without medial tooth proximally. Pereopod 1 unequal, fingers of small cheliped slender, strikingly longer than palm. Pereopod 3 with propod bearing transverse rows of spines on ventrolateral surface. No pleurobranch. Pereopod 1 in male absent or biarticulate, and in female biarticulate, distal segment multiarticulate. Pleopods 2-5 in both male and female with appendices internae, and pleopod 2 in male with appendix masculina. Uropodal exopod with transverse suture.


**Remarks.** The antennal tooth on the anterolateral margin of carapace is added to the definition of the genus *Acanthaxius;* the type species, *Acanthaxius pilocheira* (Sakai, 1987), *A. polyacanthus* (Miyake and Sakai, 1967), and *A. amakusana* (Miyake and Sakai, 1967) have no antennal tooth. However, it is present in *A. polychaetes* sp. nov., *A. hirsutimanus* (Boesch and Smalley, 1972) and *A. caespitosa* (Squires, 1979).

The character of pleopod 1 in the male is variable; in *A. pilocheira,* and *A. miyazakienisis* pleopod 1 is absent in the male, and in *A. polychaetes* and *A. hirsutimanus it is biarticulate rod.

The species of *Acanthaxius, A. polychaetes* sp. nov. is first recorded from Australian waters.

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Fig. 10. Calaxius acutirostris Sakai and de Saint Laurent, male, NTM Cr.007158: A, maxilla 2, lateral aspect; B, maxilliped 1, medial aspect; C, maxilliped 2, lateral aspect; D, maxilliped 3, lateral aspect. Scale in 1 mm divisions.

Acanthaxius polychaetes sp. nov.  
(Figs 11-13)

Type Material. HOLOTYPE - one male, NTM Cr.007156, TL 76, CL 30 including rostrum, R 4.2, 17°57.5'S 147°03.5'E, 259-260 m, 19 January 1986, coll. FRV Soela.

Diagnosis. Body setose. Posterior thoracic region with distinct median carina. Eye cylindrical, with double cornea. Scahpognathite distinct, directed laterally beyond distodorsal tooth of antennal segment 2, and with small medial tooth proximally. Pereopod 1 asymmetric, chelae slanting, covered with thick setae on lateral surface; palm of larger pereopod 1 unarmed on dorsal margin, that of smaller pereopod 1 with three teeth. Pleopod 1 in male biarticulate, unknown in female.

Description of male holotype. Carapace (Fig. 11A) large, with many setose tubercles. Dorsomedian region of carapace slightly humped towards rostrum, lateral carinae with six interspaced teeth on right carina, and five on left; submedian carinae with six interspaced teeth on right carina, five on left; median carina with four teeth in anterior half, thick protuberance at midlength, six teeth in posterior half, extending from rostral base to near cervical groove; and anterolateral margin with small antennal tooth. Rostrum (Fig. 11B-F) narrowly triangular, sulcate dorsally, with seven lateral teeth on right side, six on left, discontinuous laterally with lateral margin of carapace. Cervical groove distinct at middle of carapace. Posterior thoracic region with median tuberculous carina, and low triangular cusp near posterior margin. Thoracic sternite 4 (Fig. 12A) with transverse intermediate line anteriorly; median slit distinct, with central pit. Abdomen setose, relative lengths of abdominal somites 1-6 and telson 1; 1.2; 1.1; 1.3; 1.3 and 1.7. Pleuron 1 narrow, deflexed posterolaterally with apical tooth, transverse lateral carina between pleuron and tergum present in posterior half; pleuron 2 convex antero-posteriorly, truncate on ventral margin, sloping down posteriorly; pleura 3-5 rounded ventrally, each with denticle at anteroventral angle. Telson (Fig. 12B) about 1.5 times as long as wide, setose, with two pairs of medial teeth; lateral margins expanded with tooth at proximal 0.4 of length, and posterior to it, two teeth on right side, four on left, without movable tooth at
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posterolateral angle; posterior margin rounded with median tooth.

Eye cylindrical, with double-cornea, reaching to midlength of rostrum. Antennular pedun-}
cle nearly reaching to distal end of antennal segment, segment 1 about 1.7 times length of segments 2 and 3 combined, expanded laterally on proximal 0.7, with denticle; long setae present

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Fig. 11. *Acanthaxius polychaetes* sp. nov., male, holotype, NTMCr.007156: A, whole body, lateral aspect; B, carapace, dorsal aspect; C, dorsomedian region, dorsal aspect; D, anterior part of carapace, dorsal aspect; E, carapace, lateral aspect; F, dorsomedian region, lateral aspect; G, antennule and antenna, ventral aspect. Scale in 1 mm divisions.
Northern Australian Axiidae

Fig. 12. Acanthaxius polychaetes sp. nov., male, holotype, NTM Cr.007156: A, 3rd and 4th thoracic stemites, ventral aspect; B, sixth abdominal somite and tail-fan; C, maxilla 2, lateral aspect; D, maxilliped 1, medial aspect; E, maxilliped 2, lateral aspect; F, maxilliped 3, lateral aspect; G, crista dentata of ischium in maxilliped 3, medial aspect. Scale in 1 mm divisions.

on ventral margin; segment 3 longer than segment 2. Antennal segment 1 short, broader than long, flattened and setose on ventral surface, with sharp median tooth on distoventral margin, denticulate in its medial half (Fig. 11G); segment 2 with long, sharp distodorsal tooth; scaphocerite directed laterally beyond distodorsal tooth of segment 2, with small medial tooth proximally (Fig. 11C, D); segment 3 ending in distoventral tooth, fringed with thick setae on ventral margin; segment 4 subequal to segment 2 including its distodorsal tooth, 1.8 times as long as segment 5. Maxilla 2 (Fig. 12C) with endopod deflexed at tip, with four slender distal setae; scaphognathite with single elongate posterior seta. Maxilliped 1 (Fig. 12D) with endopod biarticulate; exopod with slender, four-segmented process tipped with plumose setae. Maxilliped 2 (Fig. 12E) with epipod carrying podobranch. Maxilliped 3 with coxa bearing a sharp distal tooth on posteromedial margin; basis with strong tooth, and thick setae on medial surface; ischium (Fig. 12F) with three medial teeth, crista dentata (Fig. 12G) strongly serrate, exceeding ischium distally; merus subequal to ischium, with three teeth on medial
margin; carpus with subterminal tooth on median margin; propod subequal to carpus, 1.5 times length of dactyl; podobranch with epipod.

Pereopod 1 asymmetric; coxa carinate with sharp proximal tooth on posteromedial margin, and distal to it deflected in distal half to two marginal carinae, medial carina terminated by sharp tooth; basis carinate with sharp tooth on posteromedial margin; ischium with one to three ventral teeth, one on right side, and three on left side, the distal tooth sharp, other teeth small in size.

Left, larger pereopod 1 with merus 1.8 times as long as broad, dorsal margin carinate with four teeth in distal half, ventral surface setose, with six stout teeth medially, and carinate laterally, with tubercles, and lateral surface with sharp tooth just ventral to distal articulation; carpus (Fig. 13A) 0.66 of length of merus, lateral surface roughly tuberculate on dorsal half of distal margin, medial surface with row of fine tubercles on distal margin; chela 2.2 times as long as broad, slanting on lateral surface, lateral surface smooth with few denticles in proximal half, and thickly setose in distal half, dorsal margin unarmed, ventral surface carinate laterally, with six interspaced teeth; fixed finger incurved apically, cutting edge with thick tooth at proximal part, and series of teeth in distal three-quarters length (Fig. 13B); dactyl slightly shorter than palm, lateral surface with thick carina medially, cutting edge with row of three stout teeth in proximal half, robust tooth at midlength, largely concave with row of rounded teeth on distal half, tip strongly incurved.

Right, smaller pereopod 1 with merus more slender than in larger pereopod, twice as long as broad, dorsal margin carinate with two teeth in distal part, ventral surface setose, with five stout teeth medially, carinate, with row of small tubercles laterally, and lateral surface with sharp tooth just ventral to distal articulation; carpus (Fig. 13C) narrower than that of larger pereopod 1, lateral surface roughly tuberculate on distal margin, medial surface finely tuberculate on distal margin, and small distodorsal tooth on dorsal margin; chela 3.5 times as long as broad, lateral surface thickly setose in most part, denticulate in its ventroproximal part; palm 1.4 times as long as broad, dorsal margin with three small teeth, ventral margin carinate with row of denticles in proximal part, and four teeth in middle part; medial surface less setose than on lateral surface, and roughly tuberculate; fixed finger slender, covered by thick setae, with row of teeth on cutting margin, and strongly incurved at tip; dactyl (Fig. 13D) slender, longer than palm, appears regularly serrate by small pointed teeth on cutting edge, carinate in midline on medial surface, and strongly incurved at tip.

Pereopod 2 with coxa having short carina with sharp proximal tooth on posteromedial margin, and distal to it, deflected into two weak carinae, medial carina with two small teeth distally; basis with subterminal ventral tooth; ischiium with five ventral teeth; merus elongate, with four ventral teeth, lateral surface with tooth just ventral to distal articulation; carpus 0.6 of length of merus, unarmed; chela 1.2 times as long as carpus; dactyl subequal to palm. Pereopod 3 with coxa carinate on proximal half, with sharp tooth on posteromedial margin, and distal to it, deflected to distal half; basis unarmed; ischium with few ventral teeth; merus with subterminal ventral tooth; carpus 0.4 of length of merus; propod (Fig. 13E) 1.3 times as long as carpus, with row of ten transparent spines ventrolaterally, with sharp distoventral spine. Pereopod 4 with coxa carinate proximally, with sharp proximal tooth on posterior margin, three small distal teeth on distomedial margin; basis and ischium unarmed; merus with small subterminal ventral tooth; carpus 0.4 of length of merus; propod (Fig. 13F) 1.8 times as long as carpus, with bands of setae on ventrolateral margin. Dactyl about 0.33 of length of propod. Pereopod 5 with coxa unarmed, bearing genital pore on medial surface; basis, ischium and merus unarmed; carpus third length of merus; propod 3.2 times as long as carpus, protruded distolaterally with series of transparent teeth on cutting edge (Fig. 13G); dactyl 0.3 of length of propod, bearing proximal protuberance with row of transverse denticles on cutting edge.

Pleopod 1 in male (Fig. 13H) rod-like, biarticulate, distal segment 0.6 of length of proximal segment. Pleopod 2 slender, foliaceous (Fig. 13I); endopod with free appendix interna and appendix masculina. Pleopods 3-5 also slender, endo-pod with free appendices internae.

Uropod with protopod unarmed. Uropodal exopod about 1.3 times as long as broad, slightly convex with five to six teeth laterally, movable tooth at distolateral angle, and row of teeth on transverse suture. Uropodal endopod about as long as exopod or telson, with two to three teeth on lateral margin, and four to five teeth on median rib.
Etymology. The species name, "polychaetes", is derived from the Greek, "poly" meaning many, and "chaete" meaning setae, which are found on the surface of the body and the first pereopod.

Remarks. This species is most similar to *A. hirsutimana* Boesch and Smalley, 1972, from off British Guiana in the northern Gulf of Mexico, in the shape of the scaphocerite, the tail-fan, the presence of the dorsomedian carina in the posterior thoracic region, the antennal tooth on the anterolateral margin of the carapace, the appendix interna and appendix masculina in males, and the unequal first pereopods. However, this species is distinguished from *A. hirsutimana* and other species of *Acanthaxius* in that the lateral surface of pereopod 1 are densely and finely setose, the palm of the larger pereopod 1 is unarmed on the dorsal margin, but that of the smaller pereopod 1 has three teeth.
Genus *Axiopsis* Borradaile


**Definition.** Rostrum triangular, pointed at tip. Dorso-median region of carapace slightly convex anteriorly, bordered by lateral carina of carapace on each side. Abdominal pleura 2-5 rounded ventrally. Telson subsquare or oblong. Eye subglobose, cornea pigmented. Antennal segment 2 with prominent distodorsal tooth, scaphocerite also prominent, usually with medial tooth proximally. Pereopod 1 unequal, fingers of smaller cheliped shorter than palm. Pereopod 3 with propod bearing transverse rows of spines laterally. No pleurobranch. Pleopod 1 in male absent, and in female with two segments, distal segment multiarticulate. Pleopods 2-5 in both male and female with appendices internae, pleopod 2 in male with appendix masculina. Uropodal exopod with transverse suture.

**Type species.** *Axius affinis* De Man, 1888, designated by Borradaile, 1903: 538.

**Remarks.** The generic definition is here revised with additional characters such as the status of the dorso-median region, antennal segment 2, abdominal pleura 2-5, the propod of pereopod 3, pleopods 2-5, and the relative length on the fingers and palm of the smaller cheliped.

**Axius consobrina** De Man (Fig. 14)

*Axiopsis (Axius) consobrina* - De Man, 1925b: 80 (part), pl. 6 fig. 13-13c.  
*nec. Axiopsis (Axius) consobrina* - Poore and Griffin, 1979: 230, fig. 4; - Tirmizi, 1983: fig. 4 (not *A. consobrina*).

**Material.** LECTOTYPE - one male, ITZA, TL 34.0 (TL 29.5 measured by De Man, 1925b: 81), Siboga-St. 305. ITZA, one female, TL 32.0 (TL 28.0 measured by De Man, as cited above), Siboga-St. 204. NTM Cr.000817, one male, TL 17.5, CL 5.3, North-West Shelf, WA, 19°04.4'S 118°47.3'E, 82 m, 28 April 1983, coll. A.J. Bruce, FRV *Soela*, trawl. NTM Cr.007157, two females, TL 11.0, CL 4.0; TL 8.0, CL 2.6, North-West Shelf, WA, 83 m, 27 April 1983, coll. FRV *Soela*, trawl.

**Diagnosis of male lectotype.** Dorso-median region of carapace with lateral carina with eight to nine teeth, submedian carina with eight teeth, median carina with 15 teeth, and intermediate regions between carinae unarmed; anterolateral margin of carapace with small antennal tooth (Fig. 14B), but unarmed on pterygostomial region. Rostrum (Fig. 14A) triangular, acuminate, with five lateral teeth, continuous laterally with lateral carina of carapace. Pleuron 1 rounded at ventral angle; pleura 3-5 with small tooth on anterior margin, and pleuron 6 without an apical tooth ventrally.

Antennal segment 2 with distodorsal tooth reaching midlength of segment 4, scaphocerite extending to near distal margin of segment 4, bearing strong proximal tooth on medial margin. Maxilliped 3 with ischium bearing two distinct medial teeth; merus with five medial teeth, distally increasing in size; carpus with distomedial tooth. Pereopod 1 (Fig. 14C-D) unequal; fingers of larger cheliped distinctly shorter than palm, these of smaller cheliped about as long as palm.

Pleopod 1 absent. Pleopod 2 in male with appendices masculinae and internae. Pleopods 3-5 with appendices internae.

**Remarks.** Three type specimens designated as *Axiopsis consobrina* by De Man (1905: 595, 1925b: 80) were re-examined. It was observed that they included two species, *A. consobrina* and *A. tsushitnaensis* Sakai, 1992. The young specimen from north of Sulu Island, 275 m, belongs to *A. tsushitnaensis* Sakai, 1992, due to the absence of the proximal tooth on the medial margin of scaphognathite. The other two specimens, one female from the northern entrance of Butung-Strait, Sulawesi, 75-95 m, and one male from Solor Strait, 113 m, are confirmed as *A. consobrina*, and therefore the latter male specimen is here designated as the lectotype of *Axiopsis consobrina* to separate the other species, *A. tsushitnaensis*. *Axiopsis consobrina* is evidently distinguishable from *A. tsushitnaensis* by the presence of the sharp proximal tooth on the medial margin of the scaphocerite, and the dorso-median region of the carapace lacks teeth on the intermediate regions of the longitudinal carinae, while in *A. tsushitnaensis* the proximal tooth on the medial margin of the scaphocerite is absent, and the dorso-median region of the
carapace has some teeth on the intermediate region of the longitudinal carinae.

De Man (1925b: 84) mentioned that the young specimen differed from the other two by the characters of the gastric region, however, the teeth on the longitudinal carinae of the gastric region are variable as shown in the Table 1. In the description of *A. consobrina*, the status of the proximal tooth on the medial margin of the scaphocerite and the median tooth on the posterior margin of the telson was overlooked.

Tirmizi (1983: 91) described a female specimen from Bali, Indonesia, as *A. consobrina*, which differs from the lectotype because the gastric region has scattered denticles between the median and submedian carinae, although the scaphocerite of antenna 2 has a small basal medial tooth.

The presence or absence of the antennal tooth on the anterolateral margin of the carapace, the tooth on the pterygostomian region, the proximal tooth on the medial margin of the scaphocerite, and the number of teeth on the lateral, submedian, and median carinae are inconsistent in *A. consobrina*.

Poore and Griffin (1979:230) described *A. consobrina* from the Gulf of Carpentaria, Queensland. I was not able to access their specimens, however, they apparently differ from the lectotype.

**Table 1.** Variation of characters in *Axiopsis consobrina*. St. Spec. No. = S, station number of Siboga Expedition; n, catalogue number of specimen belonging to NTM; antenn. tooth = antennal tooth; pterygost. tooth = pterygostomial tooth; (*) measurements taken by De Man, 1925.

<table>
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<th>St. Spec. No.</th>
<th>S305</th>
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<th>N817</th>
<th>N7157</th>
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<td>$\varnothing$</td>
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<tr>
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<td>32.0</td>
<td>17.5</td>
<td>11.0</td>
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<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pterygost. tooth</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rostrum</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
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<td>3-5</td>
<td>6</td>
<td>4-5</td>
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<tr>
<td>Longitud. carinae</td>
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<td>8-9</td>
<td>6</td>
<td>5-8</td>
<td>9-12</td>
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<tr>
<td>Lateral teeth</td>
<td>7-8</td>
<td>7</td>
<td>6-8</td>
<td>7-9</td>
<td>7-8</td>
</tr>
<tr>
<td>Submed. teeth</td>
<td>13</td>
<td>16</td>
<td>12</td>
<td>10</td>
<td>9</td>
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</table>
and the specimens examined in this study. In Poore and Griffin's specimens the eye peduncle is slender, the median carina of the carapace is a double row of teeth in part of the posterior third, and the distodorsal tooth of antennal segment 2 is nearly as long as segment 4.

**Type locality.** Solor Strait, Indonesia, 113 m.

**Distribution.** 75-113 m deep. Indonesia; Queensland, Australia; Japan.

**KEY TO THE AUSTRALIAN AXIIDAE**

1 a. Pereopod 3 with broad propod, without transverse rows of spines laterally .... 2
   
1 b. Pereopod 3 with slender propod, with transverse rows of spines laterally .... 6

2 a. Uropodal exopod with transverse suture
   
2 b. Uropodal exopod without transverse suture
   
   3 a. Rostrum bifurcate anteriorly; uropodal exopod spinose laterally; pleurobranchs present (Neaxius) 4
   
   3 b. Rostrum triangular; uropodal exopod smooth laterally; pleurobranchs absent (Strahlaxius) 5

4 a. Cervical groove spinous laterally; antennal segment 2 with one medial and two to five lateral teeth proximally ...
   
   4 b. Cervical groove smooth; antennal segment 2 unarmed (Neaxius glyptocercus)

5 a. Rostrum spinous laterally; uropodal exopod U-shaped, widest at midpoint
   
   5 b. Rostrum usually with reduced lateral spinulation; uropodal exopod subtriangular, widest distally
   
   6 a. Hermaphroditic; pleopod 1 biarticulate; distal segment spatulate or bilobed; pleopod 2 with appendix masculina ...
   
   6 b. Gonochoristic; pleopod 1 in male biarticulate, distal segment simple, or absent; pleopod 2 with or without appendix masculina

7 a. Pereopod 2 with chela setose laterally; abdominal pleura 2-4 acute ventrally
   
   7 b. Pereopod 2 with chela not setose laterally; abdominal pleura 2-4 rounded ventrally

8 a. Cornea pigmented; rostrum triangular; antennal segment 2 with prominent distodorsal tooth, prominent scaphocerite also present .......... *Bouvieraxius rudis*
8 b. Corneal pigment absent; rostrum elongate; antennal segment 2 with reduced distodorsal tooth, scaphocerite also reduced .... *Ambiaxius frankliniae* sp. nov.

9 a. Dorsomedian region of carapace convex, dropping steeply posterior to rostrum; rostrum short ...................................... 10
9 b. Dorsomedian region of carapace weakly convex posterior to rostrum, or at same level with rostrum; rostrum well developed ............................................. 11

10 a. Pereopod 1 subequal; scaphocerite with curved tooth; telson with movable distolateral tooth; uropodal exopod with transverse suture; pleurobranchs absent .......... *Dorphinaxius appendiculatis*
10 b. Pereopod 1 strikingly unequal; scaphocerite reduced; telson without movable distolateral tooth; uropodal exopod without transverse suture; pleurobranchs present .......... *Scyloleptus serripes*

11 a. Uropodal exopod without transverse suture; pereopod 1 with broad merus; pereopod 2 with chela setose laterally . *Platayxius brevirrostris* gen. and sp. nov.
11 b. Uropodal exopod with transverse suture; pereopod 1 with slender merus; pereopod 2 with chela not setose laterally .... 12

12 a. Scaphocerite short, bifurcate distally ...
   
   12 b. Scaphocerite elongate, simple or with medial tooth proximally

13 a. Telson without posteromedian tooth; submedian carina of carapace obscure or absent
   
   13 b. Telson with posteromedian tooth; submedian carina of carapace present ... 14

14 a. Submedian carina of carapace smooth.
   
   14 b. Submedian carina of carapace spinulate . *Eutrichocheles brocki*

15 a. Abdominal pleura acute ventrally; pleurobranchs present
   
   15 b. Abdominal pleura rounded ventrally; pleurobranchs absent

16 a. Pereopod 1 with chela setose laterally; eye with double cornea
   
   16 b. Pereopod 1 with chela not setose; eye with single cornea
ACKNOWLEDGEMENTS

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REFERENCES


Miyake, S. and Sakai, K. 1967. Two new species of Axiidae (Thalassinidea, Crustacea) from the
East China Sea. *Journal of the Faculty of Agriculture, Kyushu University* 14(2): 303-309.


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BOOK REVIEW

ENCYCLOPEDIA OF AUSTRALIAN ANIMALS. REPTILES.

Harald Ehmann

1992
Collins Angus and Robertson Publishers,
25-31 Ryde Road,
Pymble, N.S.W. 2073, Australia.
495 pp. Hardcover. $49.95

Produced by the Australian Museum's National Photographic Index of Australian Wildlife, Harald Ehmann's Encyclopedia of Australian Animals. Reptiles is a large (230mm x 310mm) and attractively presented volume. Bound with hard covers and protected by a glossy, illustrated dust sheet, this book is one of four which comprise the series Encyclopedia of Australian Animals.

The foremost attraction of this work is the 719 colour photographs of Australian reptiles. Most species are represented by these generally excellent photographs, with only a few hard to obtain taxa being portrayed by line drawings or not illustrated at all. The text is concisely written and contains informative data, much of which are the author's original observations. Format and methodology are explained in an introductory section, which is followed by the species accounts. Here, the text is set out in an hierarchical arrangement, giving brief details on orders, families and genera where they precede the more comprehensive information on each relevant taxon. Information given includes remarks on nomenclature, natural history, habitat, size, distribution, abundance and status. Accompanying each specific account is an identifying illustration and a small map of Australia, showing the taxon's geographic distribution as a shaded area. In the remarks on natural history, some detail is given on habitat, diet, reproduction, unusual habits and, in some instances, identifying features of morphology and colour pattern.

Species' distributions, abundances and survival status are scored as being one or more various categories, the indices of which are shown and explained in the introductory section. Distributions are scored as being one of six categories of area, which range between less than 10,000 square kilometres and more than 1,000,000 square kilometres. Abundance and survival status are allocated to all Australian reptiles for the first time in a popular work, and though potentially important components of the text, these are based on very subjective parameters.

Species abundance is categorised in terms of the time required to locate individuals, with the six categories ranging between very rare (more than 100 hours) and abundant (less than one hour). In this approach, the time required to locate the first individual of a species is deemed to be "in appropriate places at appropriate season and time of day". However, other important parameters, such as skill of collector and familiarity with the species and its particular habitat, are not taken into account. The use of this subjective parameter, which suggests that the collector must know the precise habitat of the species before searching for it, leaves many species abundances open to question. For example, the Frilled Lizard, Chlamydosaurus kingii, though uncommon in the south-eastern limits of its range, is one of the most common agamids in the extensive savannas of the tropical Northern Territory, but it is stated to have a sparse abundance. Alternatively, the Broad-headed Snake, Hoplocephalus bungaroides, which has "... a very restricted distribution, entirely within the wider Sydney geological basin... " and "may be endangered", is given an abundance of sparse to common.
Survival status is ranked by a combination of "...past and present distribution and abundance, and those environmental and human factors that are currently acting to its detriment or benefit." Seven categories, ranging between presumed extinct and secure, are used to score survival status. The problem with this particular approach is that many of the species placed in the vulnerable and possibly endangered categories, have been placed there on the basis of the author's views of a minor percentage of their total population. Examples of this are: the Southern Death Adder, Acanthophis antarcticus, said to be vulnerable due to habitat disturbance and the introduction of the toxic cane toad. With a distribution of "more than 1 million km^2", much of which is outside the range of the cane toad, surely the application of the above criteria to this species alone is an anomaly when it could be equally applied to many others (eg. Pseudechis spp. and Pseudonaja spp.). Similarly, the Eastern Bandy-bandy, Vernicella annulata, another widely distributed species, is said to be vulnerable because of land clearing and the possible reduction in populations of its principal prey (Ramphophis spp.) due to the use of pesticides affecting that animal's insect prey. Again, these are unsubstantiated factors which could affect almost any species.

Also for the first time in a publication covering all Australian reptiles, a common name is provided for each species. Where no name previously existed, these were created by the author, using as a basis "...morphology, appearance, behaviour, ecology or distribution." His naming system involves the use of a generic common name for major genera, some of which (eg. Lashtail and Slider) show imagination and are distinctive. However, I do perceive problems with many of these names. In particular, direct translations of the scientific name may have been more appropriate in numerous cases. For example, in the case of Sphenomorphus douglasii the name Orange-sided Bar-lipped Skink is clumsy and hard to remember in comparison to the relatively simple Douglas' Skink. Similarly, why call Morethia butleri the Woodland Morethia Skink in preference to Butler's Morethia. Other cumbersome examples are overly lengthy (eg. Simoselaps varro, the Northeastern Plain-nosed Burrowing Snake) or confusing as, for example, Greater Robust Fine-lined Slider (Lerista allanae) and Lesser Robust Fine-lined Slider (Lerista karlschmidtii); Brown-sided Bar-lipped Skink (Sphenomorphus brongersmai) and Brown-tailed Bar-lipped Skink (Sphenomorphus fuscicaudis). Occasionally even the generic common names used are too similar, for example Worm-lizard and Worm-skink; plus, Sheen-skink and Shinning-skink. It is also odd that "Slider", his generic common name for the scincid genus Lerista, is also applied to a single pygopodid species, Pletholax gracilis or the Slender Slider. Worth noting is that in some of his common names the author does resort to using the genus name (ic.Calypitois and Ctenotus), and also uses specific epithets in cases where they have been prvious use.

Scientific nomenclature of Australian reptiles is in a especially dynamic stage, with binomials varying widely between publications. Harald Ehmann does not indicate his source of nomenclature, but appears to have adopted a composite approach. I have no argument with such an approach, however, some of his decisions appear to be arbitrary and really need to be justified. For instance, he has raised many subspecies to species rank for the first time without justifying his actions. Examples include Pygopus schraderi, Lophognathus centralis, Simoselaps woodjonesi, Aipysurus pooleorum and Hydrophis ocellatus. I personally find it frustrating that, with only a single page of recommended further reading and no specific references, the interested reader is given no means of pursuing and verifying the author's actions in regard to scientific nomenclature.

Other problems with this book are not always readily apparent, even though some are quite serious. The most critical of these is the misidentification of some illustrated taxa. Lack of identification keys and detailed species diagnoses, the volume relies on its illustrations to distinguish and identify species, thus a mislabeled photograph is totally misleading. Misidentifications that I am aware of are: page 9, the photo of Eremochelys imbricata is of a specimen of Chelonia mydas; page 53, the photo of Gehyra pamela is of a specimen of G. nana; page 167, the photo of Carlia amax is of a specimen of C. rufilatus; page 202, the photo of Ctenotus hilli is of a specimen from the C. essingtonii species complex; page 221, the photo of Ctenotus tanamensis is of a specimen of C. geeri; page 239, the photo of Egerinia richardi is of a specimen of E. arnhemensis (= E. frerei); page 325,
the photo of *Sphenomorphus arnhemensis* is of a specimen of *S. darwinensi*; page 461, the photo of *Aipysurus daboii* is of a specimen of *A. eydouxii*. In addition to these misidentifications, the photos of *Ctenotus robustus* (page 214) and *C. schomburgkii* (page 216) have been transposed and thus are located beside the wrong species name and account.

Concomitant with these misidentifications is another significant problem resulting from the book’s format: the lack of location data for each specimen illustrated. For example, the supposed *Egernia richardi*, illustrated on page 239, was photographed thousands of kilometres (Nourlangie Rock, Northern Territory, S. Swanson, pers. comm.) away from that species’ geographic distribution of southern parts of South Australia and Western Australia. Therefore, some problems may have been eliminated during proof-reading if locality data had accompanied each species’ photograph. The omission of these data is particularly lax as the book’s producer, the National Photographic Index of Australian Wildlife, has the locality data of each photograph on file. These data would also have been helpful in those cases where different variants of a species are described, but the variant illustrated is not stated (e.g. *Egernia cunninghami*, *Morelia spilota* and *Pseudonaja nuchalis*).

Individual problems do occur in the written text. For instance, misidentification of certain taxa means that some information given is incorrect. An example of this occurs on page 53 where *Gehyra pamela* is said to occur “… in extensive granite crevices near the Edith River, north of Katherine”. This species is only known from the sandstone escarpment on the western edge of the Arnhem Land Plateau and does not occur on granite or near the middle reaches of the Edith River.

Other minor typographical faults do intrude to some extent. In the classification section of the introduction, the example used (the Fresh-water Crocodile), is given the specific epithet *porosus* instead of the correct *johnstoni*. Also, a quick perusal of the scientific names index revealed some missing names, though the species are listed in the common names index. Examples are *Diplodactylus stenodactylus*, *Calyptris lepidorostrum* and *Carlia tetradactyla*. An inconsistency also appears in the spelling of *Laticauda laticaudata* (page 480) and *L. laticauda* (page 492) (*L. laticaudata* is correct).

As a final point, in the introductory section the author states “… the text is based on a comprehensive survey of the literature of Australian reptiles to mid-1989, …” (page 3). Why, therefore, are the following species not included: *Diplodactylus immaculatus* Storr, 1988; *D. jeanae* Storr, 1988; *D. keenally* Storr, 1988; *Ctenotus angusticeps* Storr, 1988; *Hydrophis ornatus* (Gray, 1842); and, *H. vorisi* Kharin, 1984? If, in the latter two cases, the author has synonymised these with other species, it would assist the reader if such an action was mentioned in the text.

In summary, this volume is aesthetically pleasing with photographs and information on the natural history of all known Australian reptiles. Its appeal, however, is limited by problems such as the misidentification of many of the specimens illustrated; the lack of locality data for all specimens illustrated; the lack of specific references; many clumsy common names; and, occasional factual errors. Overall, the book is fair value for money, however, it does not live up to its encyclopedic title and I can not recommend it over other similar works on the market. I must admit to being disappointed that a volume of such potential has failed to fulfil my expectations.

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**REFERENCES**


BOOK REVIEW

MY KIND OF PEOPLE: ACHIEVEMENT, IDENTITY AND ABORIGINALITY.

Wayne Coolwell

1993
University of Queensland Press.
St Lucia.
154 pages

In 154 pages (24 of pictures) you could hardly expect to get in-depth biographies of 12 singularly successful people, but Wayne Coolwell comes pretty close to giving us just this in his *My Kind of People*. In fact, he gives insight into the lives and achievements of 13 young Aboriginal people if we realise that the book itself is quite an achievement. An achievement on a number of levels, not the least of which is the sheer amount of travel which Coolwell undertook to track down his subjects. They are scattered from Phuket to Perth, Melbourne to Milan, Cape York to New York. It is not free, of course, from the somewhat uncritical enthusiasm redolent of prize-giving night, and this is probably its chief fault. But there is much that is praiseworthy and for those who might still cling to stereotypical images of "unproductive Aborigines" this book will lay to rest many misconceptions. To be sure, in the account of Archie Roach's life as alcoholic, to winner of various awards including the ARIA award for indigenous album of the year in 1990, there is a recognition that many Australian Aborigines are, after more than 200 years, still suffering from the devastation of the dominant culture. But the overall impression gained is one of pride in Aboriginality and hope for a more just future. Foregrounded is the disarming honesty of many of those whom Coolwell interviews.

Aboriginality, though, has not been an easy mantle for many of the book's singers, educationists, sportspeople and others to take upon themselves. "I'm an Aborigine. Whew. I've said it. But it was so difficult to actually say those three words". So says visual artist Gordon Bennett, winner of the Moet and Chandon award for the most outstanding young Australian artist of 1991, whom Coolwell visited in France. Not just Aboriginal artist, note. Bennett is understandably proud of this. So in this and in many other ways, a certain ambivalent complexity of identity and political direction for the future is evident. Noel Pearson, history graduate and land rights activist, sees all Aboriginal pursuits as being bound up with his "people's political struggle". Television personality Stan Grant is not so sure as to just what the struggle is about anymore.

Underlying what drives many of these high achievers, though, is a determination to do something for their own people. Ironically perhaps, rarely does this desire take the form of actually working with other Aborigines. Overwhelmingly, it is seen in terms of opportunities to bring Aboriginality up-front, proud and confident both in terms of what it means to these young people personally and what it can mean to the broader community of Aborigines and other Australians alike. As Ernie Dingo puts it, "I take my Aboriginality with me all the time". And he does not just mean colour, for there are many shades of black represented here, and indeed shades of language (for Shirley Nirrpurrandydj, school principal of Gapuwiyak in Arnhem Land, English is only one of a number of languages). But given this, and perhaps even because of it, Coolwell has put his finger on a certain unifying, underlying, at times illusory Aboriginal essence which informs the book.
Despite some stylistic inconsistencies (Dr Sandra Eades, for example, virtually writes her own chapter) this book is warmly recommended reading if you want to gain an insight into what the Aboriginal future of Australia is increasingly likely to be.

John Burke is the 1993 winner of the David Unaipon Award. His novel *Bridge of Triangles* will be published by Queensland University Press in September. He is currently a lecturer at Northern Territory University.

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GUIDE TO AUTHORS

Authors are advised to follow the layout and style in the most recent issue of The Beagle.

Three copies of typewritten manuscripts should be submitted. Manuscripts should be in English, double-spaced throughout and have a margin of at least 4cm on the left-hand side. Text should be on one side of good quality A4 bond paper. If available, a computer file of the manuscript (on 5½" or 3½" MS/IBM DOS floppy disk) should be submitted together with the printed version. Where appropriate, articles should conform to the sequence: Title, Abstract, Keywords, Introduction, Materials and Methods, Text, Discussion, Acknowledgements, References.

The Title should be concise and informative. An abridged title (not exceeding 50 letter spaces) should be included for use as a running head.

The Abstract should not exceed 150 words, and should state concisely the scope of the work and give the principal findings.

Keywords, to facilitate information retrieval, of up to 15 in number should be chosen to outline the main subjects covered.

The Introduction, including a review of literature, should not exceed what is necessary to indicate the reason for the work and the essential background. Abbreviations used throughout the text may be explained at the end of the introductory material, or placed separately in the Materials and Methods section.

Footnotes are to be avoided, wherever possible, except in papers dealing with historical subjects.

The International System of units should be used.

In the descriptive text numbers from one to nine should be spelt out and figures used for numbers over nine. For associated groups, figures should be used consistently, e.g. 5 to 10, not five to 10.

Systematic papers must conform with the International Code of Zoological Nomenclature and, wherever possible, with their recommendations.

Synonymies should be given in the short form (taxon author, date: page) and the full reference cited at the end of the paper. Full citations of taxa used in the text (i.e. taxon author, date) must also be included in the references, whereas the short citation (i.e. taxon author) need not be included. Subsequent citations of taxa given in synonymies should be separated from bibliographical details by a dash (-).

TABLES

Tables should be numbered with arabic numerals and accompanied by a title. Horizontal rules are inserted only above and below column headings and at the foot of the table. Footnotes on tables should be kept to a minimum and be reserved for specific items in columns. All other explanatory material should be incorporated with the title.

ILLUSTRATIONS

Line drawings, maps, graphs and photographs are generally regarded as “figures” and are to be numbered consecutively for interspersion through the text. Drawings must be on drafting film or good quality board with appropriate lettering inserted. Black and white photographs must be sharp, of high contrast on glossy paper, and mounted on flexible board. The author’s name, title of paper and figure number must be indicated on the reverse side of all illustrations. Captions or legends should be typed together on pages at the end of the text.

Colour illustrations may be accepted for larger papers, such as substantial revisions, and only where colour contributes significantly to the descriptive or scientific merit of the paper.

CITATIONS AND REFERENCES

Citations of sources within the body of the text should include the author, year of publication and page reference (where appropriate), e.g. Roth (1896); (Roth 1896); (Roth 1896, 1898); (Roth 1896; Smith 1915). Note that commas are not used to separate bibliographical citations (e.g. Roth 1896), whereas they should be included for taxonomic citations; for the original citation (e.g. Dasyurus Geoffroy, 1796), but not for subsequent citations (e.g. Dasyurus Gould 1842).

References should be arranged alphabetically and chronologically at the end of the paper. Titles of all references must be given in full and wherever possible citations given in BIOSIS format. Where an author has published more than one work referred to in the same year, the references should be appended with the letter (a), (b), etc. The following examples show the style to be followed:


Roth, H.L. 1896. The natives of Sarawak and British North Borneo. 2 volumes. Truslove and Hanson: London [Textual reference: Roth 1896 (II):22-26].

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