

Australian Axiidae (Crustacea: Decapoda: Axiidea)

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Abstract

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Three new genera and nine new species of Axiidae are described from shelf and continental margins of Australia: *Acanthaxius garawa* sp. nov., *Acanthaxius gathaagudu* sp. nov., *Acanthaxius ningaloo* sp. nov., *Australocaris pinjarup* gen. and sp. nov., *Calastacus myalup* sp. nov., *Eiconaxius mallacoota* sp. nov., *Pilbaraxius kariyarra* gen. and sp. nov., *Platyaxius bardi* sp. nov.; *Michelaxiopsis* gen. nov. is erected for *Axiopsis australiensis* De Man, 1925 and *Michelaxiopsis nauo* sp. nov. New records of Indo-West Pacific species for Australia are: *Acanthaxius clevai* Ngoc-Ho, 2006, *Allaxius clypeatus* (De Man, 1888), *Axiopsis serratifrons* A. Milne-Edwards, 1873, *Axiopsis tsushimaensis* Sakai, 1992, *Bowieraxius keiensis* Sakai, 1992 and *Planaxius brevifrons* Komai and Tachikawa, 2008. New distributional records are given for species previously recorded from Australia: *Calaxius acutirostris* Sakai and de Saint Laurent, 1989, *Dorphanaxius kermadecensis* (Chilton, 1911), and *Paraxiopsis pumilus* (Sakai, 1994). Ten genera are rediagnosed. Undescribed species of *Axius*, *Axiopsis* and *Ambiaxius* are mentioned. Photomicrographs of maxillae 1 and 2 and maxillipeds 1 and 2 of 11 species are appended. We could find very little of taxonomic value at the genus or species level in these appendages and question the value of illustrating them in future. A key is provided for the identification of all 30 Australian species.

Keywords

Crustacea; Decapoda; Axiidea; Thalassinidea; Axiidae; *Acanthaxius*; *Allaxius*; *Ambiaxius*; *Australocaris*; *Axiopsis*; *Bowieraxius*; *Calastacus*; *Calaxius*; *Dorphanaxius*; *Eiconaxius*; *Michelaxiopsis*; *Oxyrhynchaxius*; *Pilbaraxius*; *Paraxiopsis*; *Planaxius*; *Platyaxius*; *Scytoleptus*; taxonomy; new genus; new species

Introduction

The Axiidae, a family of burrowing lobsters, have traditionally been placed in the decapod infraorder Thalassinidea (e.g., Poore, 1994) but more recent molecular and morphological evidence suggests that Thalassinidea is not a monophyletic taxon. Instead, this family falls within a smaller group, Axiidea de Saint Laurent, 1973 (Robles et al., 2009).

The Australian axiid fauna comprises 18 recognised species (Davie, 2002; Poore, 2008). Here we diagnose three new genera, add nine new species, record six Indo-West Pacific species for the first time from Australia, reidentify or synonymise material of three species and provide additional records for three species previously recorded from Australia. The taxonomy of some other known species is reassessed and updated and in the process it was necessary to redescribe some species and rediagnose ten other genera. We take the opportunity to list and provide a key to all 30 known Australian Axiidae and comment on biogeography.

Photomicrographs of maxillae 1 and 2 and maxillipeds 1 and 2 of 11 species were prepared using a Leica DM5000B microscope and Leica DC500 camera after clearing in lactic acid and staining with chlorazol black. Between 15 and 25 images were taken in different planes and merged using Automontage[®] software. Mandibles were also dissected and

examined stereoscopically. We could find very little of taxonomic value at the genus or species level in these appendages and do not present descriptions in words. The only exceptional morphology is the absence in *Acanthaxius clevai* Ngoc-Ho, 2006 of a posterior long seta on the epipod of maxilla 2 (scaphognathite). Mouthparts of axiids have been illustrated with or without the complex of setae that ornament them by many authors. The level of detail has varied considerably probably largely because of the difficulty of rendering such complex setose structures as line drawings. For this reason comparison between species has been rarely attempted and species have never been differentiated using these characters. In spite of the detail made possible by our photographic tools, we are still unable to discover useful characters. In our view, our own and earlier efforts have not been informative and we question the value of illustrating them in future.

Much of the new material arose from recent sampling (cruises SS10-2005 and SS05-2007) by CSIRO Marine and Atmospheric Research (CMAR) and Museum Victoria along the Western Australian continental margin (Poore et al., 2008). This collection is supplemented by material from the Northern Territory, tropical Queensland, the south-eastern Australian slope, and South Australia.

Material is deposited in the Australian Museum, Sydney (AM), Museum Victoria, Melbourne (NMV), South Australian Museum, Adelaide (SAM), Museum and Art Gallery of the Northern Territory, Darwin (NTM) and Natural History Museum, London (BMNH). Measurements are of carapace length including rostrum (cl.) and total length (tl.). Most illustrations were made by the second author and prepared for publication using Adobe Illustrator and many of the recommendations of Coleman (2003).

Family **Axiidae** Huxley, 1879

Restricted synonymy.

Axiidae Huxley, 1879: 785.—Sakai and de Saint Laurent, 1989: 4–5.—Poore, 1994: 96.

Calocarididae Ortmann, 1891: 47.—Kensley, 1989: 960.—Poore, 1994: 98

Eiconaxiidae Sakai and Ohta, 2005: 69.

Diagnosis. Carapace more or less laterally compressed, moderately to well calcified; cervical groove distinct at least dorsally; linea thalassinica absent; posterior margin of carapace with lateral lobes interacting with abdominal somite 1. Rostrum present, acute. Pleuron of abdominal somite 1 more or less produced. Eyestalks cylindrical. Antenna 1 with article 3 about as long as article 2. Antenna 2 with scale-like or well produced scaphocerite. Maxilla 2 scaphognathite with a posterior whip (rarely without). Pereopods 1 chelate, equal or unequal; pereopod 2 chelate; pereopod 3 simple; pereopod 4 simple or subchelate; pereopod 5 chelate. Pleopod 1 present or absent. Pleopod 2 similar in dimensions to pleopods 3–5, biramous; pleopods 3–5 endopodal rami elongated, not laterally expanded, with or without appendix interna. Uropodal rami lamellate, endopod more or less oval.

Remarks. Axiid lobsters are recognised by the combination of a prominent rostrum ending in an acute tip, similar laminar rami on pleopods 2–5, and oval uropodal endopod. They may be confused with Strahlaxiidae which have a rostrum with an apical notch and a triangular uropodal endopod. The family Calocarididae was revived and defined by Kensley (1989) and included in the key to thalassinidean families by Poore (1994). Poore's key to genera included six genera and Poore (2008) listed two more. Kensley (1989) recognised the family on its being hermaphroditic, having unpigmented eyes and highly modified pleopod 2; in his view, axiids are gonochoristic (that is, the sexes are separate with gonopores on either coxae 3 [female] or coxae 5 [male] and pleopods 1 and 2 usually sexually dimorphic). In Kensley's cladogram (1989: fig. 1) four calocaridid genera form a clade separated from a paraphyletic clade of three representative "axiid" genera. Tsang et al.'s (2008) molecular analysis of relationships between two calocaridid species (*Calastacus crosnieri* and *Paracalocaris sagamiensis*) and three axiids found the calocaridids were sister taxa and the axiids paraphyletic. Robles et al. (2009) used eight species in another molecular study and found that another calocarid, *Calocaris caribbaeus*, was embedded within the seven species of Axiidae. In their analysis the species labelled as belonging to the calocaridid genus, *Calaxiopsis*, is here reidentified as an axiid, *Pilbaraxius kariyarra* sp. nov. Cladistic

support for the family is currently weak in spite of its strong morphological unity. The problem lies more with the apparent parphyly of Axiidae than with Calocarididae itself. Similarly, Sakai and Ohta (2005) isolated *Eiconaxius* in its own family, Eiconaxiidae, on the basis of rounded spinose dactyli on pereopods 3–5. This supposed unique feature defines the genus while nothing except its absence defines remaining axiids. However, this characteristic is shown in part in another genus (see discussion of *Platyaxius* below), weakening support for this family. We prefer to synonymise Calocarididae and Eiconaxiidae with Axiidae.

We note a structure hitherto unreported in many of the new species described below. Attached to the anterolateral margin of sternite 8, at the base of the socket of pereopod 5, is an articulating flap, oval-semicircular in shape with a setose margin (e.g. figs. 7d, e). In other species the structure is reduced to a setose ridge. Its homology is unclear but it appears to be a sternal sclerite that may act as a valve at the posterior of the branchial cavity.

Key to Australian species of Axiidae

This key is designed to be as practical as possible and concentrates on characters most easily determined from what can sometimes be fragmentary specimens. It does not reflect relationship nor necessarily use generic characters.

1. Pleopod 2 endopod with dominating terminal appendix masculina and digitiform appendix interna; pleopods 3–5 rami extremely thin; eyes without pigment; usually hermaphroditic (with gonopores on both coxae 3 and 5, pleopods 1 and 2 not sexually dimorphic) 2
 - Pleopods 2–5 endopods laminar, similar; pleopod 2 with appendices masculina and interna (if present in male) linear and attached mesially; eyes usually pigmented; gonochoristic (sexes separate, gonopores on either coxae 3 [female] or coxae 5 [male]; pleopods 1 and 2 sexually dimorphic) 3
2. Rostrum directed upwards, about half length of postorbital carapace length; pleopod 2 article 2 elongate-triangular, mesially curved *Ambiaxius franklinae* Sakai, 1994
 - Rostrum directed anteriorly, about quarter length of postorbital carapace length; pleopod 2 article 2 linear, 2-segmented *Calastacus myalup* sp. nov.
3. Uropodal exopod without transverse suture; telson tapering to rounded apex 4
 - Uropodal exopod with transverse suture; telson more or less rectangular, apex truncate or rounded 8
4. Rostrum significantly depressed below level of gastric region of carapace; gastric region almost vertical anteriorly *Scytoleptus serripes* Gerstaecker, 1856
 - Rostrum level with or slightly below gastric region of carapace; gastric region horizontal or gently sloped 5

5. Rostrum depressed between smooth marginal rim; median gastric carina smooth; submedian gastric carinae absent 6
 – Rostrum scarcely depressed between dentate marginal rim; median gastric carina dentate; submedian gastric carinae present, usually toothed 7
6. Telson 1.1 times as long as wide; uropodal endopod with oblique apex *Eiconaxius kimbla* Kensley, 1996
 – Telson 1.5 times as long as wide; uropodal endopod with rounded apex *Eiconaxius mallacoota* sp. nov.
7. Rostrum longer than eyestalks; scaphocerite strongly curved; lateral gastric carina with supraocular spine plus 1 spine *Platyaxius bardi* sp. nov.
 – Rostrum shorter than eyestalks; scaphocerite straight; lateral gastric carina unarmed *Platyaxius brevirostris* Sakai, 1994
8. Pleopods 2–5 without appendix interna 9
 – Pleopods 2–5 each with appendix interna 12
9. Scaphocerite slender, reaching more than half length of antennal article 4; rostrum with 4 or 5 lateral spines along length; lateral gastric carina unarmed; submedian gastric carina with 3 or 4 spines *Bouvieraxius keiensis* Sakai, 1992
 – Scaphocerite plate-like, triangular or bifurcate, barely overlapping base of antennal article 4; rostrum with 1 or 2 lateral spines near base; lateral gastric carina unarmed or with 2 teeth; submedian gastric carina unarmed or with 6–8 spines 10
10. Submedian gastric carina with 5–8 spines *Paraxiopsis austrinus* (Sakai, 1994)
 – Submedian gastric carina absent or unarmed 11
11. Lateral gastric carina with 1 or 2 spines posterior to supraocular spine; submedian gastric carina ending anteriorly as definite tooth *Paraxiopsis brocki* (De Man, 1888)
 – Lateral gastric carina unarmed posterior to supraocular spine; submedian gastric carina weak, not well defined *Paraxiopsis pumilus* (Sakai, 1994)
12. Uropodal exopod with 5 prominent lateral spines, second article oval, longer than wide; uropodal endopod with broad shoulder proximally *Allaxius clypeatus* (De Man, 1888)
 – Uropodal exopod with small lateral spines or unarmed, second article short, much wider than long; uropodal endopod evenly expanding 13
13. Eyestalks longer than spike-like rostrum *Oxyrhynchaxius manningi* Lin, Kensley and Chan, 2000
 – Eyestalks shorter than rostrum or if longer, rostrum broadly triangular 14
14. Cheliped dactyli with row of at least 2 erect spines on upper margin (as well as on propodus upper margin) 15
 – Cheliped dactyli without erect spines on upper margin (propodus upper margin may have erect spines) 18
15. Carapace densely spinose 16
 – Carapace smooth 17
16. Eyestalks longer than rostrum; major cheliped propodus with tubercles and blunt spines laterally, gross tubercles mesially *Acanthaxius garawa* sp. nov.
 – Eyestalks shorter than rostrum; major cheliped propodus with sharp spines laterally, small tubercles and few spines mesially *Acanthaxius ningaloo* sp. nov.
17. Lateral gastric carina with 1 prominent tooth posterior to supraocular spine; major cheliped dactylus with 2 erect spines on upper margin; telson significantly longer than wide *Acanthaxius clevai* Ngoc-Ho, 2006
 – Lateral gastric carina with 2 prominent teeth posterior to supraocular spine; major cheliped dactylus with 5 erect spines on upper margin; telson as wide as long *Acanthaxius gathaagudu* sp. nov.
18. Chelipeds densely setose, setae completely obscuring tuberculation; rostrum extremely narrow, with about 6 small lateral teeth *Acanthaxius polychaetes* Sakai, 1994
 – Chelipeds sparsely setose, ornamentation visible through setae; rostrum broadly triangular or with fewer than 6 lateral teeth if narrow 19
19. Rostrum strongly depressed below median gastric carina; gastric carinae with only supraocular spines and minute anterior median tooth above steeply sloping anterior ridge *Dorphanaxius kermadecensis* (Chilton, 1911)
 – Rostrum level with or slightly below median gastric carina; gastric carinae more or less dentate or spinose 20
20. Abdominal pleura 2–5 acutely produced ventrally to sharp point 21
 – Abdominal pleura 2–5 rounded ventrally 22
21. Carapace tuberculate; rostrum with 1 pair of lateral spines; chelipeds without spines on upper margin of carpus and propodus; uropodal endopod apically rounded, without spines *Pilbaraxius kariyarra* gen. and sp. nov.
 – Carapace smooth; rostrum with 2 or more pairs of lateral spines; chelipeds with strong curved spines on upper margin of carpus and propodus; uropodal endopod apically truncate, with 2 distal spines *Calaxius acutirostris* Sakai and de Saint Laurent, 1989
22. Rostrum a triangular projection well separated from gastric region, with 10 spines each side; without supraocular spines; cheliped dactyli massive, with convex upper margin *Spongiaxius brucei* (Sakai, 1986)

- Rostrum triangular, not well separated from gastric region, variously dentate; with supraocular spines clearly or weakly differentiated; cheliped dactyli tapering 23
- 23. Scaphocerite longer than antennal peduncle, with 3 spines on lower margin and 1 spine on mesial margin; eyes unpigmented
..... *Australocaris pinjarup* gen. and sp. nov.
- Scaphocerite shorter than antennal peduncle, unarmed, minutely bifurcate or with basiomesial spine; eyes pigmented 24
- 24. Lateral gastric carina unarmed posterior to supraocular spine; submedian gastric carina unarmed or absent 25
- Submedian and usually lateral gastric carinae denticulate posterior to supraocular spine 26
- 25. Median gastric carina with 2 teeth anteriorly; submedian gastric carina a simple ridge; cheliped merus upper margin unarmed *Axius werribee* (Poore and Griffin, 1979)
- Median gastric carina unarmed; submedian gastric carina absent; cheliped merus upper margin with 2 small teeth
..... *Planaxius brevifrons* Komai and Tachikawa, 2008
- 26. Lateral gastric carina unarmed; submedian gastric carina a hair-pin shaped double ridge of small beads; median gastric carina with few spines and/or beads 27
- Lateral gastric carina with several teeth; submedian gastric carina of numerous teeth; median gastric carina with several teeth 28
- 27. Carapace smooth; telson without lateral teeth; inner row of tubercles of submedian gastric carina with wide hiatus
..... *Michelaxiopsis australiensis* (De Man, 1925)
- Carapace covered with numerous short stiff setae; telson with 3 lateral teeth; inner row of tubercles of submedian gastric carina continuous
..... *Michelaxiopsis nauo* gen. and sp. nov.
- 28. Gastric region with numerous tubercles between median and submedian rows of denticles; cheliped merus without tooth on upper margin
..... *Axiopsis serratifrons* (A. Milne-Edwards, 1873)
- Gastric region with single or duplicated submedian rows of denticles; cheliped merus with subdistal tooth on upper margin 29
- 29. Gastric region with duplicated submedian rows of denticles; larger cheliped propodus tuberculate over distal half of lateral face *Axiopsis tsushimaensis* Sakai, 1992
- Gastric region with single submedian row of denticles; larger cheliped propodus smooth over lateral face
..... *Axiopsis consobrina* De Man, 1905

***Acanthaxius* Sakai and de Saint Laurent, 1989**

Acanthaxius Sakai and de Saint Laurent, 1989: 66 (diagnosis, list of species).—Kensley, 1996d: 70–71 (diagnosis, list of species).

Type species. Axiopsis (Axiopsis) pilocheira Sakai, 1987 by original designation.

Diagnosis. Carapace generally smooth or spinose; cervical groove visible laterally over half distance to anterolateral margin. Rostrum spine-like, narrow, laterally obscurely denticulate, about as long as eyestalks, not depressed below level of carapace, continuous with definite lateral carinae; supraocular spines prominent (or not); lateral carina spinose; submedian carina present, spinose; median carina a spinose ridge; postcervical carina absent. Abdominal somite 1 pleuron acute; pleuron 2 broad, anteriorly rounded, posteriorly rounded; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea pigmented. Antenna, scaphocerite short, curved; distal spine on antenna article 2 anteromesially angled and acute. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs absent; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 asymmetrical, with propodus cylindrical; carpus-dactylus upper margins prominently spinose (or not). Pereopods 3–5 propodi with transverse rows of robust setae; dactyli tapering, with longitudinal row of robust setae. Pleopods 3–5, appendix interna present. Pleopod 1 of male absent (or present). Pleopod 2 of male with appendix masculina. Uropodal exopod with transverse suture. Telson with lateral fixed spines and posterolateral robust setae; apex truncate-rounded.

Remarks. *Acanthaxius* is a genus of 13 nominal species, from the Pacific Ocean and Caribbean Sea. Kensley (1996d) stated that “the definition of this genus contains some uncertainties” and was supported in this by Ngoc-Ho (2006). Most of its members are unambiguously recognised by the combination of spinose rostrum, supraocular spine, spine-bearing median, submedian and lateral gastric carinae on the gastric region of the carapace, narrow chelipeds (pereopods 1) with prominently spinose upper margin and elongate fingers, absence of pleurobranchs, absence of the male pleopod 1, and anteromesially angled acute distal spine on antenna article 2.

Some species, including the type species, are known only from females and the absence of the male pleopod 1 would appear to have been assumed by the authors of the genus from the condition in *A. miyazakiensis* Yokoya, 1933 that they redescribed from abundant material. The male pleopod 1 is absent also in species described subsequently, *A. formosa* Kensley and Chan, 1998, *A. grandis* Kensley and Chan, 1998, *A. gadaletae* Ngoc-Ho, 2006, *A. clevai* Ngoc-Ho, 2006 and one of the new species described here.

Two species, *Calocaris (Calastacus) hirsutimana* Boesch and Smalley, 1972 and *Axiopsis (Axiopsis) caespitosa* Squires, 1979, both referred to *Acanthaxius* by Sakai and de Saint Laurent (1989), and *A. polychaetes* Sakai, 1994 do possess a male pleopod 1 and also differ from typical *Acanthaxius* in absence of a prominent supraocular spine, more compact propodus on the major cheliped with few lateral spines, and a prominent lateral spine on the telson. *Acanthaxius spinulicauda* (Rathbun, 1902) is also less spinose than the type species. These species may well deserve another genus whose exceptions are given in parentheses in the diagnosis above.

Acanthaxius clevai Ngoc-Ho, 2006

Figures 1–3, 37

Acanthaxius clevai Ngoc-Ho, 2006: 59–62, figs. 1, 2, 3A–C).

Material examined. WA, off Mermaid Reef, 17°11.83'S, 119°34.81'E–17°12.37'S, 119°35.00'E (stn SS05-2007 079), 435–438 m, 18 Jun 2007, NMV J55706 (female, cl. 28.8 mm, tl. 64 mm). WA, off Point Leveque, 14°58.22'S, 121°38.56'E–14°57.76'S, 121°38.26'E (stn SS05-2007 143), 232–228 m, 02 Jun 2007, NMV J55705 (juvenile male, cl. 8.3 mm, tl. 20 mm).

Diagnosis. Carapace generally smooth, with scattered setae and small tubercles dorsally. Rostrum 0.4 times length of fronto-cervical groove, acute, with 2 lateral spines anterior to supraocular spine, continuous with definite lateral gastric carinae (connecting by diverging curved ridges). Supraocular spines prominent. Lateral gastric carina with 1 spine, diverging anteriorly. Submedian gastric carina with 4 spines (last small, flattened). Median gastric carina with 3 spines. Abdominal pleuron 1 ventrally acute; pleura 2–5 posteroventrally rounded; pleuron 6 of male with small spine on anteroventral margin.

Antennal article 1 with 1 spine on lower distal margin; article 2 distal spine slender, directed inwards, reaching distally to middle of antennal article 4; scaphocerite slender, straight, reaching distally almost to end of article 4; article 3 with 1 spine on mesial lower margin. Maxilliped 3 ischium with 2 spines on lower margin; merus with 3 spines on lower margin.

Pereopods 1 well differentiated, of similar length, propodus of major cheliped more swollen than minor cheliped. Major pereopod 1 merus upper margin convex, with 2 spines, lower margin with 4 spines, lateral face spinose distally, mesial face spinose distally; carpus upper margin with 4 midline spines and 1 spine on each side, lower margin with 3 spines, mesial face tuberculate, with 1 spine; propodus upper margin with 3 midline spines and 2 spines each side, lower margin with 7 spines in lateral row and 3 spines in mesial row, lateral face tuberculate, with 5 scattered spines, mesial face tuberculate, with 4 scattered spines; fixed finger 1.2 times length of upper palm, cutting edge with large rounded teeth; dactylus upper margin with 2 erect spines, 1 submarginal spines on each side, tuberculate, cutting edge with large rounded teeth.

Minor pereopod 1 merus, carpus as in larger cheliped; propodus as in larger cheliped except narrower, lower margin with 7–9 spines in lateral row and 3 spines in mesial row; fixed finger 1.7 times length of upper palm, cutting edge straight with numerous small sharp teeth; dactylus armature as in major pereopod.

Telson rectangular, approximately parallel-sided, 1.3 times as long as wide, lateral margin with 3 spines, distal margin convex with posteromedian spine, posterolateral angle with 2 robust setae; dorsal face with 2 spines in each oblique row. Uropodal endopod 1.4 times as long as wide, with 1 lateral spine, longitudinal ridge with 4 spines (including marginal). Uropodal exopod 1.6 times as long as wide, with 7 lateral spines, 2 longitudinal ribs (outer rib with 4 spines), posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 10 spines.

Distribution. Solomon Islands; WA, North-West continental margin, 15°–17°S, 119°–122°E, 228–438 m depth.

Remarks. The new material, a female and juvenile male from north-western Australia, are barely distinguishable from Ngoc-Ho's (2006) figures and description of a similarly-sized male specimen from the Solomon Islands. We illustrate them fully and present a short diagnosis. The species is recognisable by the pattern of spination on the rostrum and carapace (two lateral rostral spines, median gastric carina with four spines, submedian with five spines including the supraorbital, and a single spine on the curved lateral gastric carina). The complex patterns of spination on the major and minor chelipeds are also virtually identical to those of the holotype. N. Ngoc-Ho illustrated the minor cheliped of a female paratype (MNHN Th1492) for us and we detect no significant differences from our male. Slight differences in proportions (the chelipeds of the Australian adult female are slightly more slender than in the male holotype) can be attributed to sexual dimorphism. We identify the small male (about one-third as long as the adult) as the same species in spite of substantial differences in the chelipeds. The chelipeds of the small juvenile male are more elongate than those of the adult female and with more prominent spination (cf. figs. 1i–l with 3c, d). The upper margin of the dactylus possesses three spines while the Australian female and male holotype have only two. The juvenile male possesses spinules on the anteroventral corners of abdominal pleura 3–6, not present in the adult female nor in the male holotype.

Ngoc-Ho (2006) described a second similar species, *Acanthaxius gadaletae*, from the Solomon Islands and New Caledonia, based on type material about half the size of specimens of *A. clevai*. The species, apparently adult males and females, differs from *A. clevai* only in better defined gastric carinae, maxilliped 3 basis with a spine, more stout pereopod 1 with four propodal and dactylar spines on the upper margins, and abdominal pleura 3–5 slightly angled posteriorly. The cheliped spination alone (more spines than in adult and juveniles of *A. clevai*) is sufficient to differentiate *A. gadaletae*. The maxilliped 3 basis of the type of *A. clevai* was said to lack a distal spine and to differentiate the species from *A. gadaletae*; both of the Australian specimens possess a strong spine but we don't consider this difference alone diagnostic. This small species possesses spinules on the anteroventral corners of abdominal pleura 3–6 as in the small Australian male.

Acanthaxius gadaletae differs from the type species, *A. pilocheira* (Sakai, 1987) most obviously in not having a spinose carapace and in having one, not two, spines on each lateral gastric carina.

Both specimens of *A. clevai* from WA lack a long straight seta on the posterior lobe of the scaphognathite (maxilla 2 epipod; fig. 37) as was reported for this species and the similar *A. gadaletae* (Ngoc-Ho, 2006). The seta is typical of Axiidae and is found in all other species of *Acanthaxius* (Squires, 1979; Sakai, 1987; Sakai and de Saint Laurent, 1989; own observations of four species). Only *A. hirsutimana* is unknown.

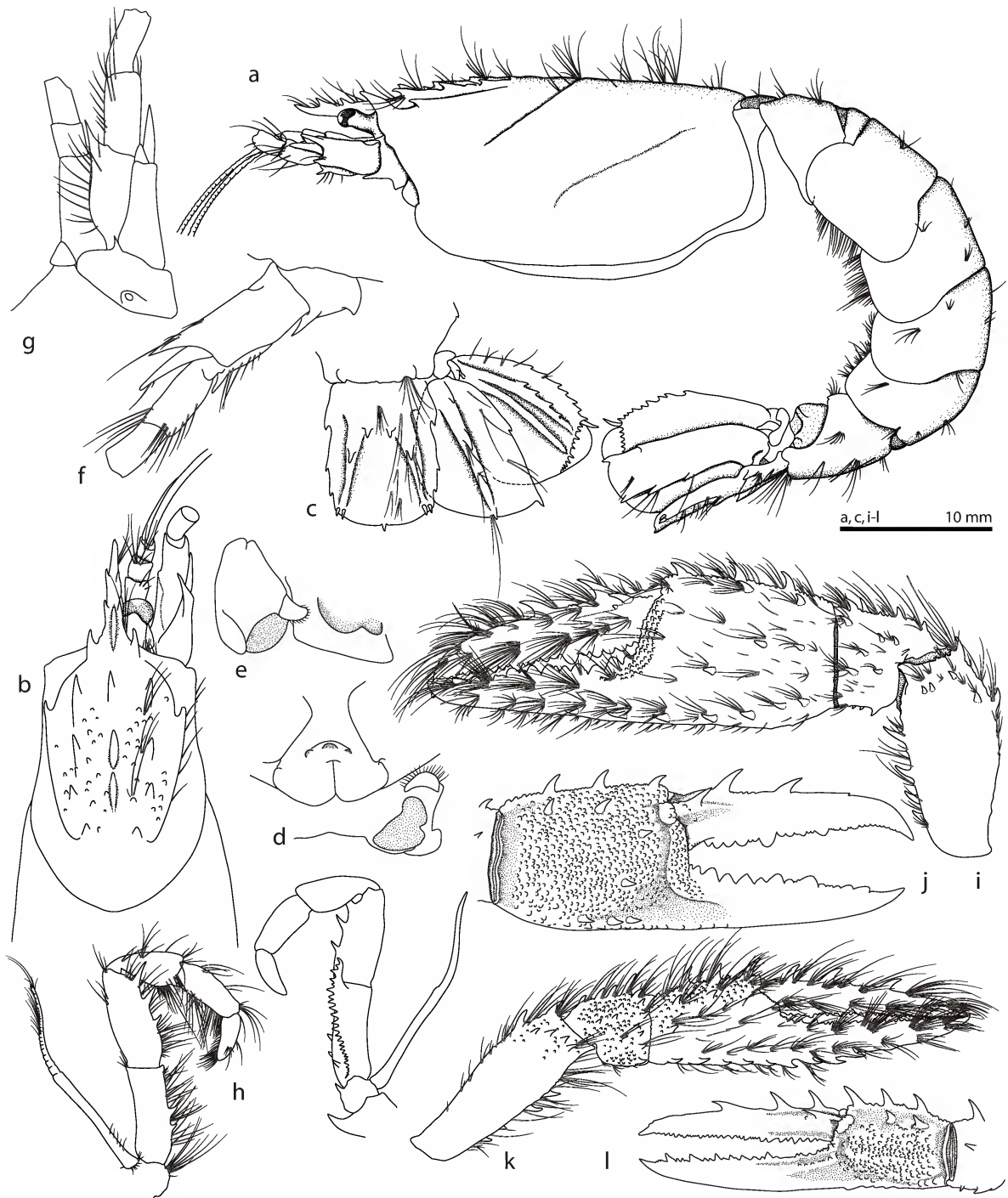


Figure 1. *Acanthaxius clevai* Ngoc-Ho, 2006. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and right uropod. d, sternites 7 and 8. e, right sternite 8 (lateral). f, left antenna peduncle. g, epistome, left antennule and antenna (ventral). h, maxilliped 3 (anterior and posterior views); i, major pereopod 1 (left, lateral). j, same (propodus–dactylus, without setae, mesial). k, minor pereopod 1 (right, lateral). l, same (carpus–dactylus, without setae, mesial). All figures from NMV J55706.



Figure 2. *Acanthaxius clevai* Ngoc-Ho, 2006. a–d, pereopods 2–5 (right except d, with detail of dactylus of pereopod 3). e, f, female pleopods 1, 2. All figures from NMV J55706.

***Acanthaxius garawa* sp. nov.**

Figures 4, 5

Material examined. Holotype. Qld, Gulf of Carpentaria, 12°10.5'S, 139°56.7'E (stn SS05-1991 040, A.J. Bruce), 59 m, 25 Nov 1991, NTM Cr008808 (male, cl. 9.9 mm, tl. 28 mm).

Paratype. Qld, Gulf of Carpentaria, 11°25.2'S, 139°25.2'E (stn SS05-1991 054, A.J. Bruce), 49 m, 28 Nov 1991, NTM Cr009067 (male, cl. 10.0 mm, tl. 28 mm).

Description of male holotype. Carapace heavily spinulose. Rostrum 0.2 times length of front-to-cervical, acute, with 4 lateral spines anterior to supraocular spine, weakly continuous with lateral gastric carinae. Supraocular spines moderately

prominent. Lateral gastric carina with 10 spines. Submedian gastric carina duplicated, external row with 10–12 spines, internal with 10–12 spines. Median gastric carina with about 20 spines. Sternite 7 (pereopod 4) deeply divided in midline over posterior two-thirds and with sharp oblique lateral ridge. Sternite 8 (pereopod 5) with setose semicircular flap on anterior face at base of leg. Abdominal pleuron 1, 1.4 times as deep as middorsal length, ventrally obtuse; pleuron 2 broad, lateral length as long as dorsal length, anteroventrally rounded; pleura 3–5 becoming more ventrally quadrate, each with small anteroventral tooth; pleuron 6 rounded, with small anteroventral tooth; pleura 1–5 without lateral crease, slightly flared laterally.

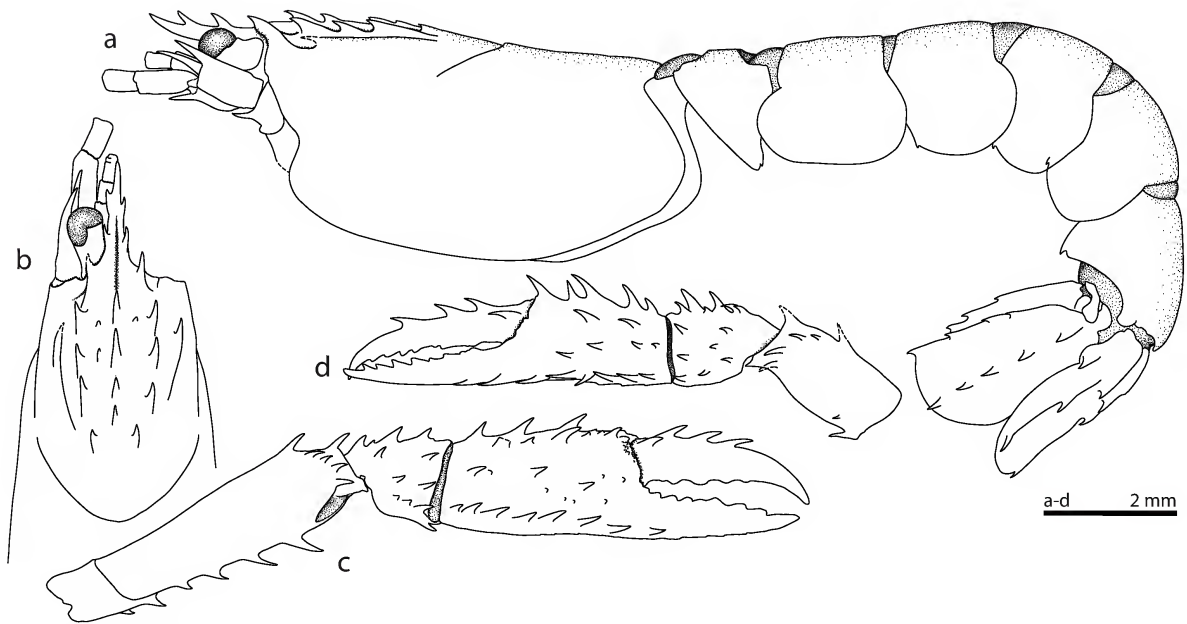


Figure 3. *Acanthaxius clevai* Ngoc-Ho, 2006. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, major pereopod 1 (left, lateral). d, minor pereopod 1 (right, lateral). All figures from NMV J55705, without setae.

Eyestalk, 1.6 length of rostrum; cornea weakly pigmented. Antennular peduncle reaching to middle of antennal article 5. Antennal article 1 with 1 spine and 3 spinules on distoventral margin; article 2 distal spine slender, directed slightly inwards, reaching distally to middle of antennal article 4; scaphocerite slightly curved, reaching distally to just beyond midpoint of article 4; article 3 with with 4 spines on mesial lower margin; article 4 about two-thirds length of article 2 (excluding distal spine), with distoventral spine; article 5 about half length of article 4. Maxilliped 3 basis with 1 spine; ischium with 2 spines on lower margin; crista dentata with ~24 teeth; merus with 3 spines; carpus with 1 spine.

Pereopods 1 asymmetrical, propodus of major more swollen, 1.15 times as long as minor. Major pereopod 1 (left) coxa lower margin with 2 spines; basis lower margin without spine; ischium lower margin with 3 spines; merus upper margin convex, with 4 spines, lower margin with 10 spines, lateral face spinose distally near upper margin, mesial face rugose distally; carpus upper margin with 6 spines, lower margin with 3 spines laterally, 1 spine mesially, lateral face tubercular, mesial face with 3 spines plus others smaller; propodus upper margin with row of 7 spines, lower margin with 12 spines in lateral row and obsolete mesial row, lateral face covered with dome-like tubercles, mesial face covered with larger distinct tubercles, with 1 spine near gape; fixed finger 1.2 times length of upper palm, cutting edge straight, with c. 20 irregular rounded teeth; dactylus upper margin with 8 spines, lateral face with row of blunt spines, mesial face with

row of 6 spines and denticles, cutting edge as in fixed finger; both fingers bearing setae.

Minor pereopod 1 coxa, ischium as in larger cheliped; merus upper margin with 5 spines, lower margin with 7 spines; carpus upper margin with 6 spines, lower margin with 4 spines laterally, 1 spine mesially, lateral face weakly spinose, mesial face with 3 spines; propodus upper margin with 5 spines, lower margin with 7 spines in lateral row and 7 spines in mesial row, lateral face weakly tuberculate, mesial face grossly tuberculate, with 2 spines near gape; fixed finger 2.5 times length of upper palm, cutting edge with c. 40 irregular teeth; dactylus upper margin with 6 spines, lateral face with proximal row of 5 spines, mesial face with row of 4 denticles, cutting edge as in fixed finger; both fingers setose as in major pereopod.

Pereopod 2 ischium lower margin with 1 distal spine; merus lower margin with 4 spines; carpus about as long as chela; propodus upper margin 0.8 length of dactylus. Pereopod 3 merus lower margin with 5 strong spines; carpus with 1 spine; propodus 1.9 times as long as dactylus, with 7 marginal robust setae (some duplicated). Pereopod 4 missing. Pereopod 5 propodus 2.5 times as long as dactylus, subchelate, with short fixed finger; dactylus with broad blade on cutting edge.

Pleopods 2–5 appendix interna one quarter length of endopod; appendix masculina just exceeding appendix interna.

Telson about as long as broad, lateral margin with proximal tooth, distal margin broadly convex, with posteromedian spine, posterolateral angle with 1 minute tooth and 2 robust setae; dorsal face with 2 spines in each oblique row. Uropodal

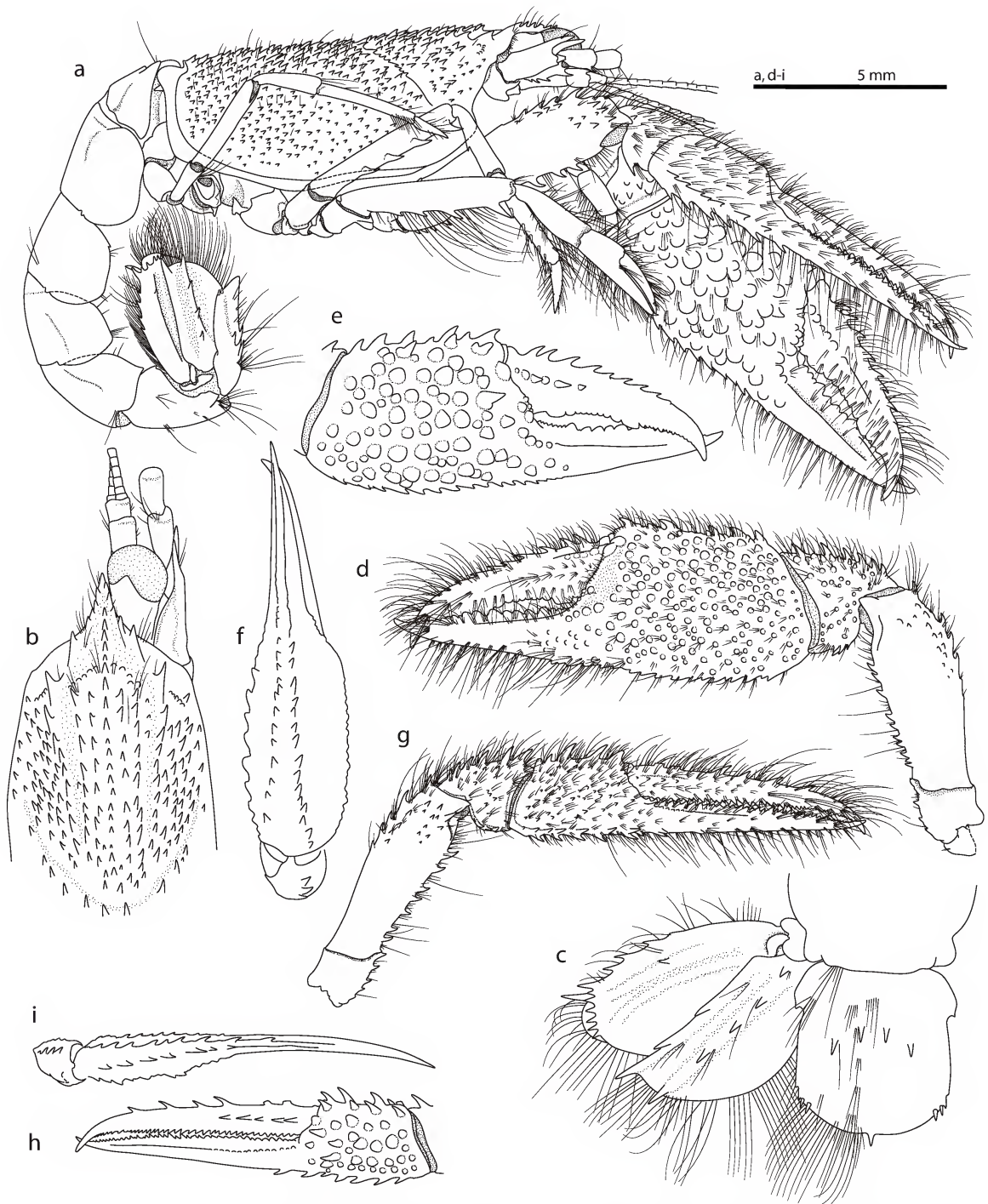


Figure 4. *Acanthaxius garawa* sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and left uropod. d, major pereopod 1 (left, lateral). e, same (propodus–dactylus, without setae, mesial). f, same (carpus–propodus, without setae, lower). g, minor pereopod 1 (right, lateral). h, same (propodus–dactylus, without setae, mesial). i, same (carpus–propodus, without setae, lower). All figures from holotype.

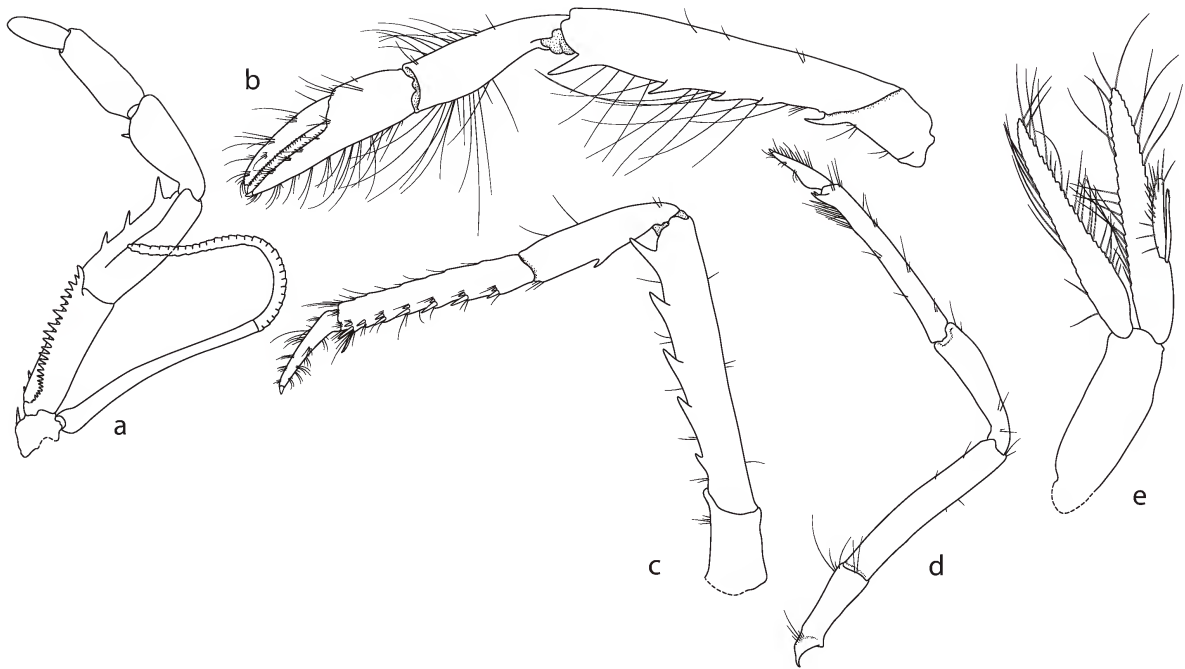


Figure 5. *Acanthaxius garawa* sp. nov. a, maxilliped 3 (without setae). b, male pleopod 2. c, pereopod 2 (right). d, pereopod 3 (right). e, pereopod 5 (right). All figures from holotype.

endopod 2.0 times as long as wide, with 2 lateral and 1 distolateral spines, longitudinal ridge with 5 spines (including marginal). Uropodal exopod 1.8 times as long as wide, with 4 lateral spines, 2 longitudinal ribs (outer rib with 1 spine), posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 6 spines.

Etymology. Garawa is an Australian Aboriginal language which was spoken in the Gulf of Carpentaria region close to the Northern Territory-Queensland border.

Distribution. Qld, Gulf of Carpentaria, 12°S, 140°E, 49–59 m depth (known only from the type locality).

Remarks. With its spinose carapace, *Acanthaxius garawa* is closest to *A. ningaloo* sp. nov. described below. It differs in having tubercles rather than sharp spines on lateral and mesial faces of the chelipeds and the rostrum being shorter than the eyes. The tubercles on the mesial face of the major cheliped are strikingly prominent. See the *Remarks* following *A. ningaloo* for differences from other similar Indo-West Pacific species.

***Acanthaxius gathaagudu* sp. nov.**

Figures 6–8

Material examined. Holotype. WA, Shark Bay, 25°55.40'S, 112°14.35'E–25°56.17'S, 112°14.46'E (stn SS10-2005 113), 404–407 m, 06 Dec 2005, NMV J53448 (female, cl. 36 mm, tl. 85 mm).

Paratype. WA, off Mermaid Reef, 17°01.09'S, 119°35.46'E–17°01.81'S, 119°35.00'E (stn SS05-2007 080), 451–440 m, 18 Jun 2007, NMV J55704 (male, cl. 22 mm, tl. 55 mm).

Description of female holotype. Carapace smooth, with few setae. Rostrum (broken in holotype, 0.4 times length of fronto-cervical groove in paratype), acute, with 3–4 lateral spines anterior to supraocular spine, weakly continuous with lateral gastric carinae. Supraocular spines prominent. Lateral gastric carina with 2 spines. Submedian gastric carina with 4 spines. Median gastric carina with 3 anterior spines, 1 tubercle, 1 posterior spine. Sternite 7 (pereopod 4) deeply divided in midline over posterior two-thirds and with sharp oblique lateral ridge. Sternite 8 (pereopod 5) with setose semicircular flap on anterior face at base of leg. Abdominal pleuron 1 twice as deep as middorsal length, ventrally acute; pleuron 2 broad, lateral length 1.2 times dorsal length, anteroventrally rounded; pleura 3–5 becoming more ventrally quadrate; pleuron 6 rounded; pleura 1–5 without lateral crease, slightly flared laterally.

Eyestalk (broken in holotype, 0.5 length of rostrum in paratype); cornea pigmented. Antennular peduncle reaching to proximal part of antennal article 5. Antennal article 1 with 1 spine on distoventral margin; article 2 distal spine slender, directed slightly inwards, reaching distally to middle of antennal article 4; scaphocerite slightly curved, reaching distally to just beyond midpoint of article 4; article 3 with broad mesiodistal spine on lower margin; article 4 about two-

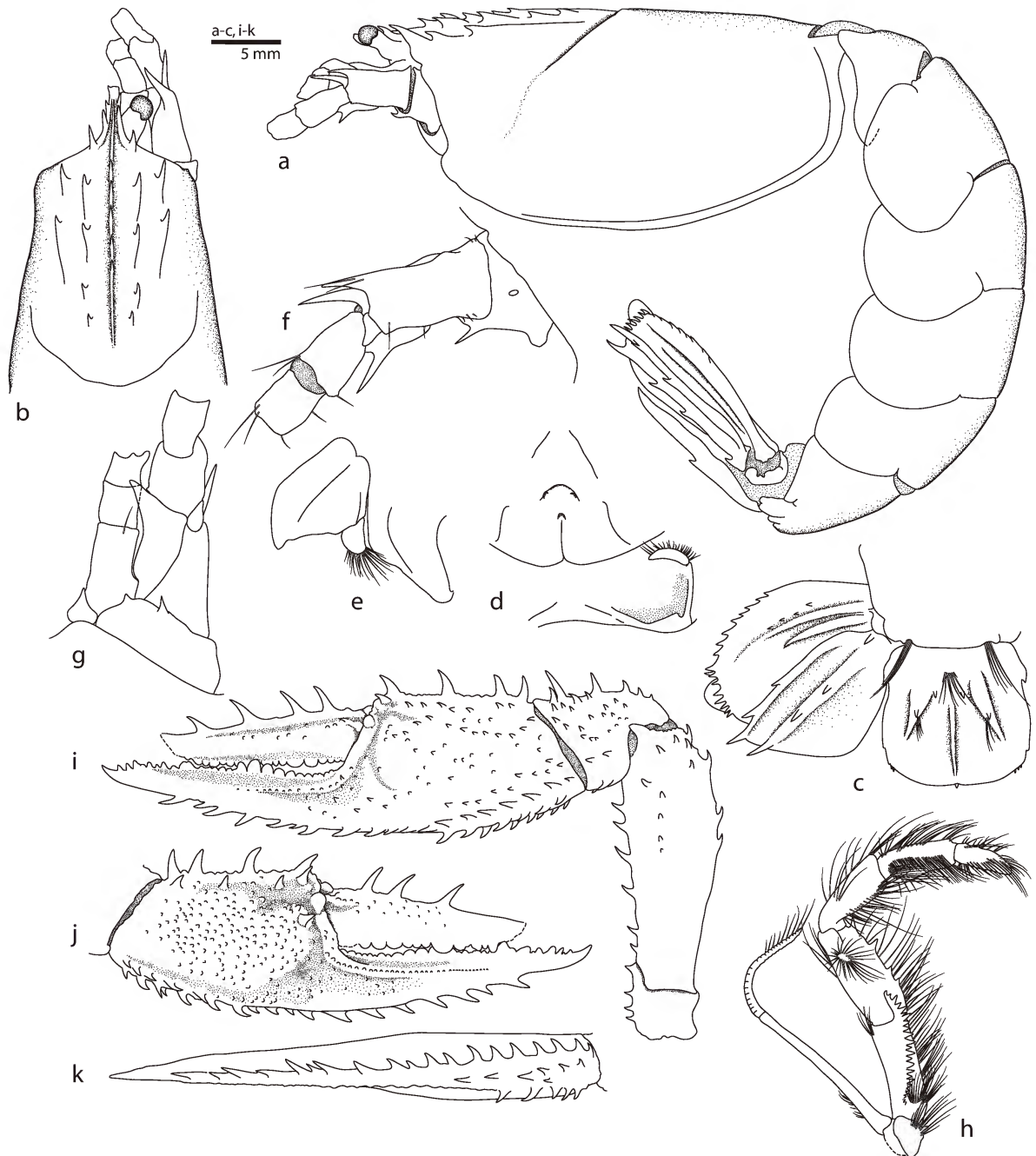


Figure 6. *Acanthaxius gathaagudu* sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and left uropod. d, sternites 7 and 8. e, left sternite 8 (lateral). f, left antenna peduncle (lateral). g, epistome, left antennule and antenna (ventral). h, maxilliped 3. i, major pereopod 1 (left, without setae, lateral). j, same (propodus, dactylus, without setae), mesial. k, same (propodus, without setae, lower). All figures from holotype.

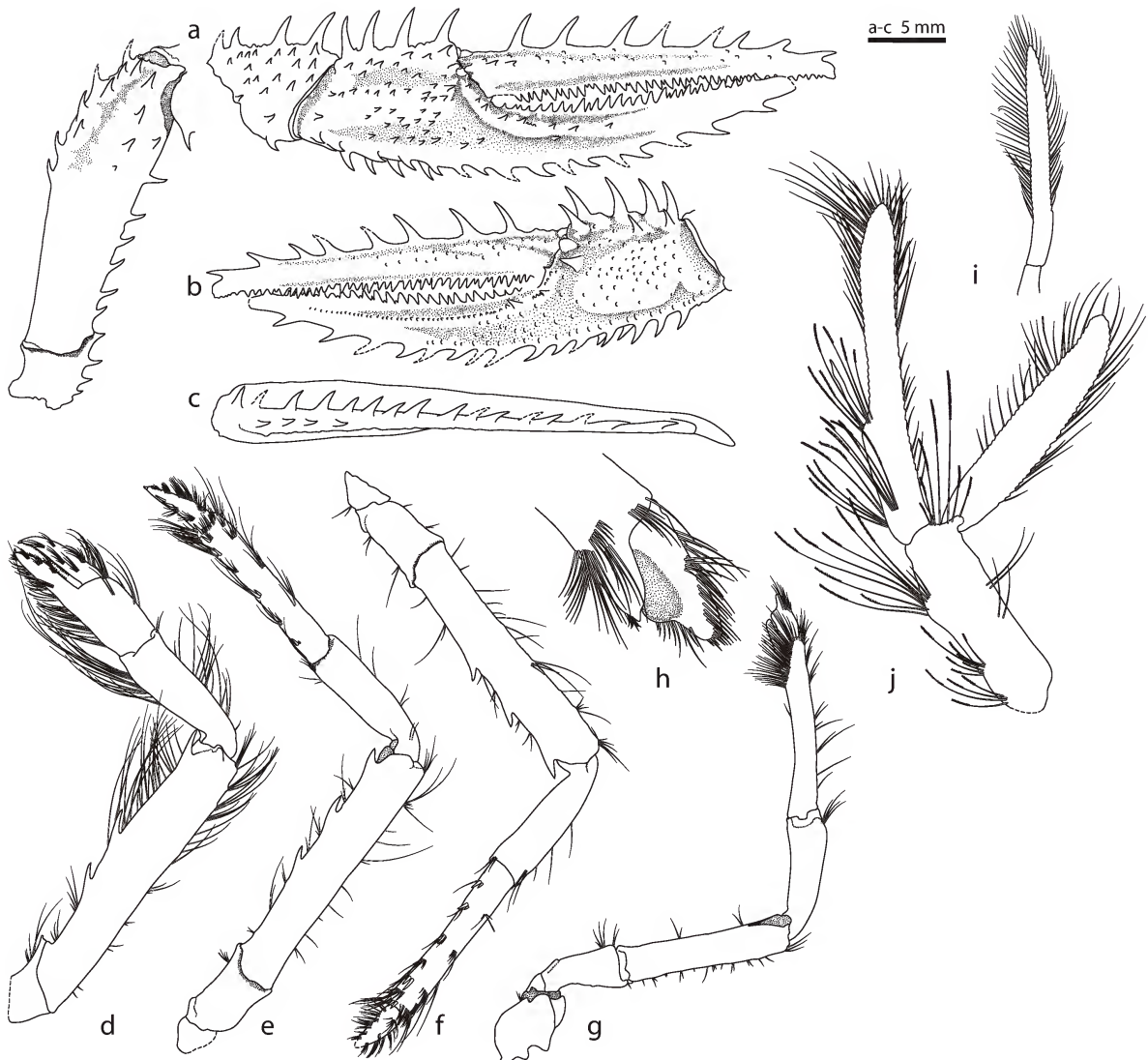


Figure 7. *Acanthaxius gathaagudu* sp. nov. a, minor pereopod 1 (right, without setae, lateral). b, same (propodus, dactylus, without setae, mesial). c, same (propodus, lower). d-g, pereopods 2-5 (left except f). h, pereopod 5 fingers. i, j, female pleopods 1, 2. All figures from holotype.

thirds length of article 2 (excluding distal spine); article 5 about half length of article 4. Maxilliped 3 basis with 1 spine; ischium crista dentata with 15-20 teeth; merus with 4 spines; carpus unarmed.

Pereopods 1 scarcely differentiated, of similar length, propodus of major more swollen. Major pereopod 1 (right) coxa lower margin with 1 spine; basis lower margin without spine; ischium lower margin with 4 spines; merus upper margin convex, with 4 spines, lower margin with 7 spines, lateral face spinose distally, mesial face smooth; carpus upper

margin with 5 spines, lower margin spinulose, lateral face spinose, mesial face with 1 spine; propodus upper margin with 1 row of 4 spines, lower margin with 18 spines in lateral row, 5 spines in proximal mesial row and 7 smaller intermediate spines, lateral face spinose, mesial face tuberculate, with 5 spines concentrated near gape; fixed finger 1.5 times as long as upper palm, cutting edge straight with c. 25 irregular rounded teeth; dactylus upper margin with (est. 5) spines, lateral face with 1 small spine, mesial face unarmed, cutting edge as in fixed finger; both fingers bearing setae.

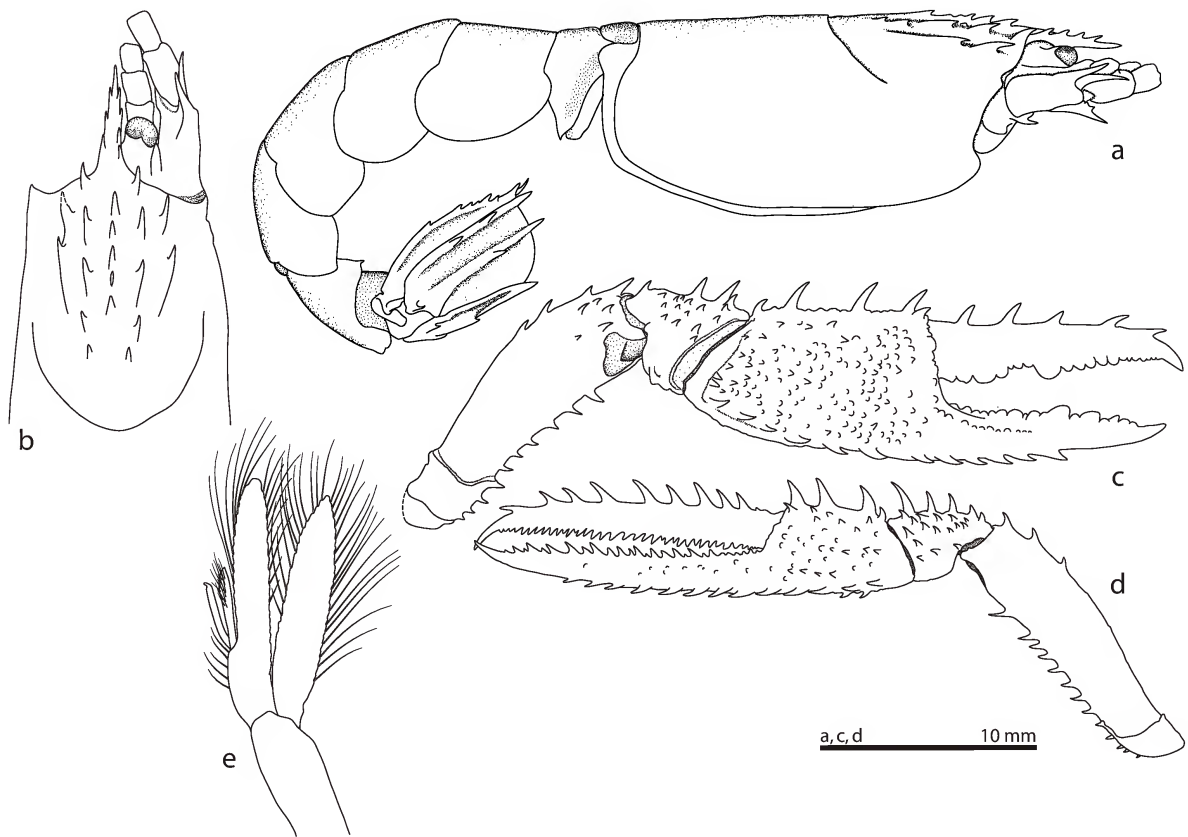


Figure 8. *Acanthaxius gathaagudu* sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, major pereopod (right, lateral, without setae). d, minor pereopod (left, lateral, without setae). e, male pleopod 2. All figures from paratype, NMV J55704.

Minor pereopod 1 coxa, ischium and merus as in larger cheliped; carpus upper margin with 3 spines, lower margin with 2 spines, lateral face spinose, mesial face with 1 spine; propodus upper margin with 1 row of 4 spines, lower margin with 16 spines in lateral row and 4 spines in mesial row, lateral face spinose, mesial face tuberculate, with 2 spines near gape; fixed finger 2.8 times length of upper palm, cutting edge with c. 20 oblique sharp teeth; dactylus upper margin with 8 spines, lateral face with obsolete spine, mesial face unarmed, cutting edge as in fixed finger; both fingers setose as in major pereopod.

Pereopod 2 ischium lower margin with 1 distal spine; merus lower margin with 3 spines; carpus slightly shorter than chela; propodus upper margin 0.8 length of dactylus. Pereopod 3 merus lower margin with 3 spines; propodus 2.2 times as long as dactylus, with 7 marginal robust setae (some duplicated). Pereopod 4 merus lower margin with 3 spines; propodus 2.7 times as long as dactylus, with 6 marginal robust setae (some duplicated). Pereopod 5 propodus 4 times as long as dactylus, subchelate, with short fixed finger; dactylus with broad blade on cutting edge.

Pleopods 2–5 appendix interna one quarter length of endopod.

Telson about as long as broad, lateral margin with 2 spines, distal margin broadly convex, with posteromedian spine, posterolateral angle with 1 minute tooth and 2 robust setae; dorsal face with 2 spines in each oblique row. Uropodal endopod 1.6 times as long as wide, with 3 lateral spines, longitudinal ridge with 3 spines (including marginal). Uropodal exopod 1.7 times as long as wide, with 9 lateral spines, 2 longitudinal ribs (outer rib with 4 spines), posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 7 spines.

Male paratype. Essentially indistinguishable from female except for: maxilliped 3 merus with 3 spines, carpus with 1 spine; details of spination of chelipeds; more slender minor cheliped; pleuron 1 having a small ventral spine, a slightly more rectangular pleuron 5 and a small spine on pleuron 6. Pleopod 2 with appendix masculina about half length of distal endopod; appendix interna slightly shorter.

Etymology. Gathaagudu is the name for Shark Bay in the local Malgana language.

Distribution. WA, North West Shelf to Shark Bay, 17°–26°S, 112°–119°E, 400–450 m depth.

Remarks. Comparison of the figures of the holotype (figs. 6, 7) and paratype (fig. 8) illustrates variability in spination of the carapace, maxillipeds and chelipeds. *Acanthaxius gathaagudu* is most similar to two other species of *Acanthaxius* with two spines on the lateral gastric carina. The most significant difference between them is in the number of spines on the upper margin of the dactylus of the major cheliped, five (in both sexes) in the new species, 11 in *A. grandis* and 8–10 in *A. pilocheira*. The number of dactylar spines on the minor cheliped are similar in the three species, 8–9 in *A. gathaagudu*, 10–11 in the other two species. In *A. gathaagudu* the minor cheliped of the male is slightly more slender than in the female so any comparisons must be made between individuals of the same sex. The holotype of *A. grandis* from Taiwan is a female of carapace length 33.5 mm whose chelipeds were figured by Kensley and Chan (1998: fig. 4). The figured holotype of *A. pilocheira* is also a female of a similar size. The female major and minor chelipeds of *A. gathaagudu* are narrower (depth: dorsal length of propodus 0.85) and with more prominent marginal spines than in *A. grandis* (depth : dorsal length of propodus 1.25) whereas *A. pilocheira* is intermediate between them. *Acanthaxius gathaagudu* has narrower uropodal rami than the other species and, like *A. pilocheira*, has 8–9 marginal spines on the uropodal exopod compared to only five in *A. grandis*. Kensley and Chan (1998) remarked on the abdominal pleura, especially pleuron 5, which is posteriorly rectangular in *A. grandis*, rather than rounded as in *A. pilocheira*. We suspect that this may be a sexual difference—their figures of a paratype may be of a male whereas those of *A. pilocheira* are of female. The male of *A. gathaagudu* has a slightly more rectangular pleuron 5 than the female and a small spine on pleuron 6, absent in the female (cf. figs. 6a, 8a).

***Acanthaxius ningaloo* sp. nov.**

Figures 9, 10, 38

Material examined. Holotype. WA, off Ningaloo North, 21°59.10'S, 113°49.12'E–21°59.47'S, 113°49.08'E (stn SS10-2005 153), 165 m, 11 Dec 2005, NMV J53446 (female, cl. 22.2 mm, tl. 56.7 mm).

Paratype. Collected with holotype, NMV J53447 (male, cl. 16 mm, complete but fragmented).

Description of female holotype. Carapace heavily spinulose. Rostrum 0.4 times length of front-to-cervical groove, acute, with 3–4 lateral spines anterior to supraocular spine, continuous with definite lateral gastric carinae. Supraocular spines prominent. Lateral gastric carina with 9 spines. Submedian gastric carina duplicated, external row with 7–10 spines, internal with 12–13 spines. Median gastric carina with 21 spines. Sternite 7 (pereopod 4) deeply divided in midline over posterior two-thirds and with sharp oblique lateral ridge. Sternite 8 (pereopod 5) with setose semicircular flap on anterior face at base of leg. Abdominal pleuron 1 twice as deep as middorsal length, ventrally acute; pleuron 2 broad, lateral length 1.2 times dorsal length, anteroventrally rounded; pleura 3–5 becoming more ventrally acute; pleuron 6 with small spine on ventral margin; pleura 1–5 with lateral crease.

Eyestalk 0.8 length of rostrum; cornea weakly pigmented. Antennular peduncle reaching to proximal part of antennal article 5. Antennal article 1 with 1 spine and 2 spinules on lower distal margin; article 2 distal spine slender, directed slightly inwards, reaching distally to middle of antennal article 4; scaphocerite slender, straight, reaching distally almost to end of article 4; article 3 with 4 spines on mesial lower margin; article 4 about half length of article 2 (excluding distal spine), with distoventral spine; article 5 about two-thirds length of article 4. Maxilliped 3 basis with 1 spine; ischium with 2 spines on lower margin; crista dentata with 16 teeth; merus with 3 spines on lower margin; carpus unarmed.

Pereopods 1 scarcely differentiated, of similar length, propodus of major more swollen. Major pereopod 1 (right) coxa lower margin with 2 spines; basis lower margin with 1 spine; ischium lower margin with 4 spines; merus upper margin convex, with 4 spines, lower margin with 9 spines, lateral face spinose distally, mesial face spinose distally; carpus upper margin with 6 spines, lower margin with 4 spines laterally, 1 spine mesially, lateral face spinose, mesial face with 1 spine; propodus upper margin with 2 rows each of 4 spines, lower margin with 21 spines in lateral row and 8 spines in mesial row, lateral face spinose, mesial face tuberculate, with 8 spines concentrated near gape; fixed finger twice length of upper palm, cutting edge straight, with c. 20 irregular rounded teeth; dactylus upper margin with 9 spines, lateral face with proximal row of 5 submarginal spines, mesial face with proximal spine and row of denticles, cutting edge as in fixed finger; both fingers bearing setae.

Minor pereopod 1 coxa, ischium and merus as in larger cheliped; carpus upper margin with 4 spines, lower margin with 1 spine, lateral face spinose, mesial face with 1 spine; propodus upper margin with 2 rows each of 4 spines, lower margin with 23 spines in lateral row and 5 spines in mesial row, lateral face spinose, mesial face tuberculate, with 6 spines concentrated near gape; fixed finger 2.5 times length of upper palm, cutting edge with c. 30 oblique sharp teeth; dactylus upper margin with 10 spines, lateral face with proximal row of 5 submarginal spines, mesial face with row of denticles, cutting edge as in fixed finger; both fingers setose as in major pereopod.

Pereopod 2 ischium lower margin with 1 distal spine; merus lower margin with 3 spines; carpus slightly shorter than chela; propodus upper margin 0.8 length of dactylus. Pereopod 3 merus lower margin with 3 spines; propodus 2.8 times as long as dactylus, with 6 marginal robust setae (some duplicated). Pereopod 4 merus lower margin with 4 spines; propodus 2.6 times as long as dactylus, with 7 marginal robust setae (some duplicated). Pereopod 5 propodus 2.9 times as long as dactylus, subchelate, with short fixed finger; dactylus with broad blade on cutting edge.

Pleopods 2–5 appendix interna one third length of endopod.

Telson about as long as broad, lateral margin with 1 spine, distal margin convex with posteromedian spine, posterolateral angle with 1 or 2 minute teeth and 2 robust setae; dorsal face with 2 spines in each oblique row. Uropodal endopod 1.6 times as long as wide, with 3 lateral spines, longitudinal ridge with 3 spines (including marginal). Uropodal exopod 1.6 times as

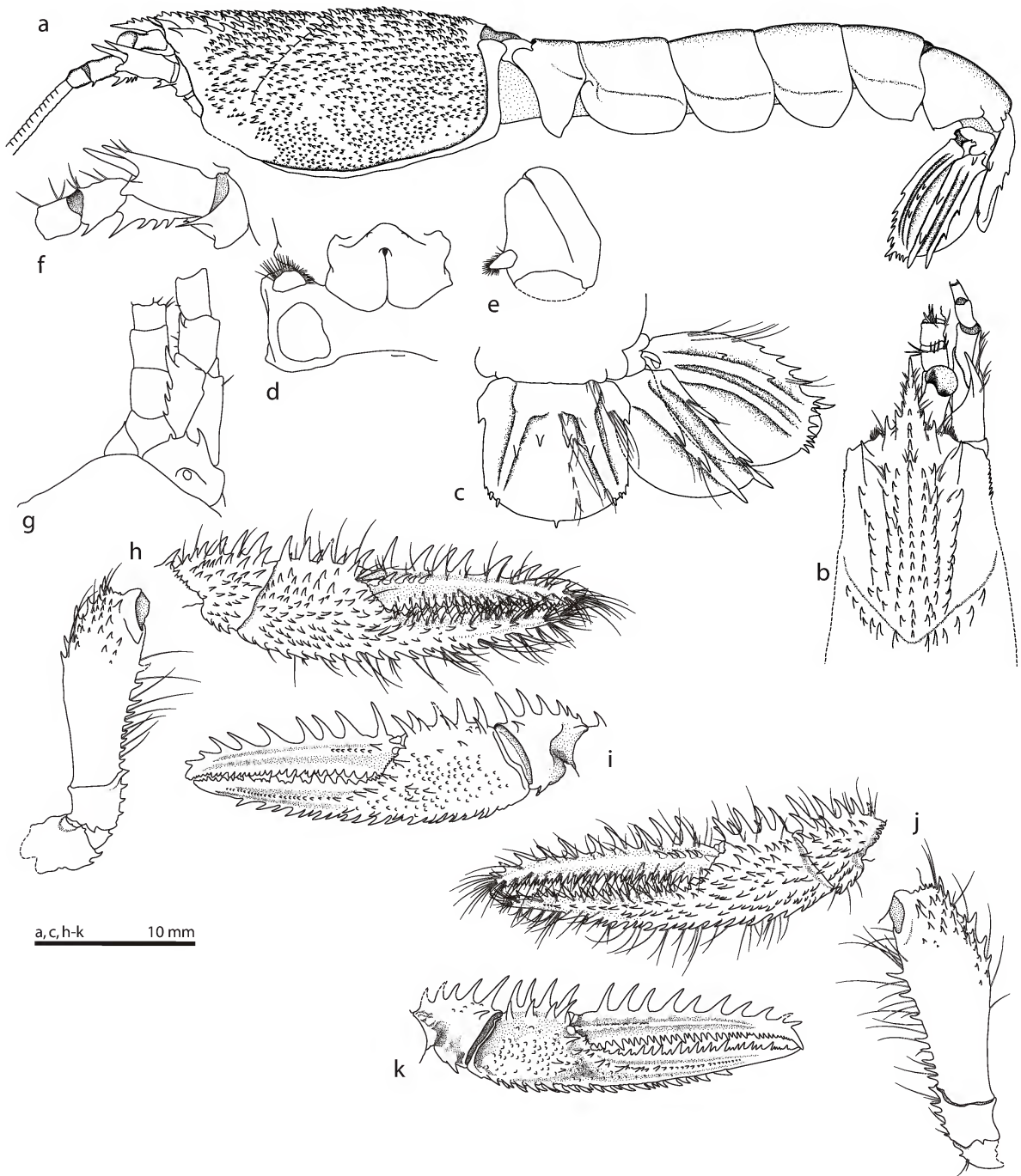


Figure 9. *Acanthaxius ningaloo* sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and right uropod. d, sternites 7 and 8. e, left sternite 8 (lateral). f, left antenna peduncle (lateral). g, epistome, left antennule and antenna (ventral). h, female major pereopod 1 (right, dislocated, lateral). i, same (carpus-dactylus, without setae, mesial). j, female minor pereopod 1 (left, dislocated, without setae, lateral). k, same (carpus-dactylus, without setae, mesial). All figures from holotype.

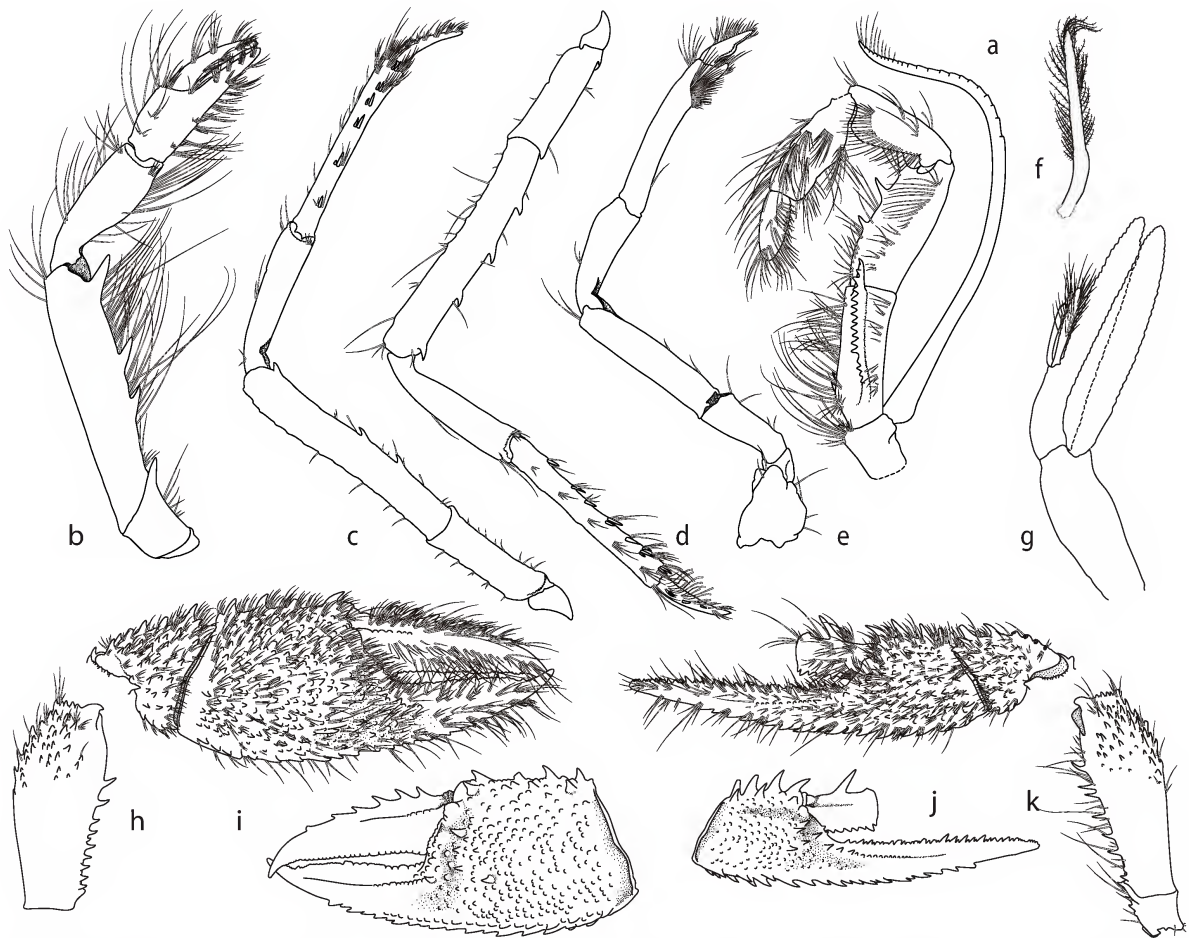


Figure 10. *Acanthaxius ningaloo* sp. nov. a, maxilliped 3. b–e, pereopods 2–5 (right except d). f, female pleopod 1. g, male pleopod 2 (rami without setae). h, male major pereopod 1 (right, dislocated, lateral). i, same (propodus–dactylus, without setae, mesial). j, male minor pereopod 1 (left, dislocated, without setae, lateral). k, same (propodus–dactylus [broken], without setae, mesial). Figs a–f from holotype; figs. g–k from paratype NMV J53447.

long as wide, with 4 lateral spines, 2 longitudinal ribs (outer rib with 2 spines), posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 7 spines.

Male. Carapace spination and abdomen indistinguishable from female. Pereopods 1 grossly differentiated, of similar length, propodus of major considerably more swollen than minor. Major pereopod 1 (right) coxa lower margin with 2 small spines; basis lower margin with 1 spine; ischium lower margin with 5 spines; merus upper margin convex, with 4 spines, lower margin with 10 spines, lateral face spinose distally, mesial face spinose distally; carpus upper margin with 6 spines, lower margin with 3 spines laterally, 1 spine mesially, lateral face spinose and densely setose in upper half, mesial face with 1 spine; propodus upper margin with 2 rows

each of 4 spines (mesial row obsolete), lower margin with 19 spines in lateral row and 14 spines in mesial row, diminishing, lateral face spinose and densely setose in upper half, mesial face tuberculate, with 8 spines concentrated near gape; fixed finger as long as upper palm, cutting edge straight, with c. 20 irregular rounded teeth; dactylus upper margin with 6 spines, lateral face with proximal row of 5 small submarginal spines, densely setose, mesial face with proximal spine and row of denticles, cutting edge as in fixed finger.

Minor pereopod 1 coxa, ischium and merus as in larger cheliped; carpus upper margin with 4 spines, lower margin with 3 lateral spines, 1 mesial spine, lateral face spinose and setose, mesial face with 1 spine; propodus upper margin with 2 rows of 4 lateral and 3 small mesial spines, lower margin

with 20 spines in lateral row and 5 spines in mesial row, lateral face spinose and setose, mesial face tuberculate, with 6 spines concentrated near gape; fixed finger 4 times length of upper palm, cutting edge with c. 30 oblique sharp teeth; dactylus upper margin with spinose (broken).

Pleopod 2 with appendix masculina about third length of endopod, attached one-third along; appendix interna slightly shorter than appendix masculina.

Etymology. Ningaloo, the name of a major WA fringing reef, is from the local Gnulli language.

Distribution. WA, off Ningaloo North, 22°S, 114°E, 165 m depth (known only from the type locality).

Remarks. *Acanthaxius ningaloo* is most similar to *A. polyacantha* (Miyake and Sakai, 1967) described from the East China Sea, also recorded from the Solomon Islands by Ngoc-Ho (2006), and to *A. formosa* from off Taiwan (Kensley and Chan, 1998). The type specimen is a female of similar size to the holotype of the other three species; the Solomon Islands specimen is much smaller. All species share a carapace covered with spinules and duplicated submedian gastric carinae. *Acanthaxius ningaloo* has a longer rostrum with four (as in *A. formosa*, rather than two as in *A. polyacantha*) pairs of lateral spines, antenna article 3 with four spines (rather than one as in the other two species), relatively shorter telson, more pronounced spines along the margin of the cervical groove and more definite spines on the postcervical carapace. The spines along the margins of the fingers of the chelipeds are apparently longer and more erect. Further, *A. formosa* lacks denticles anterolateral to the cervical groove. *Acanthaxius miyazakiensis*, reported from Japan, Philippines and New Caledonia (Sakai and de Saint Laurent, 1989), is similar to all three but has a more elongate minor first cheliped and fewer carapace spinules.

Acanthaxius ningaloo has strongly sexually dimorphic chelipeds, the major one of the male being more setose, more swollen than the minor, and with shorter marginal spines than the female. In no species described to date has both sexes been illustrated. Most figures are of females but the male of *A. grandis*, a species with a similar cheliped but smooth carapace, would appear to be of the grossly swollen form (Kensley and Chan, 1998).

Acanthaxius polychaetes Sakai, 1994

Acanthaxius polychaetes Sakai, 1994: 193–198, figs. 11–13.—Davie, 2002: 450.

Distribution. Qld, continental slope, 260 m depth.

Remarks. *Acanthaxius polychaetes* is remarkable for the absence of spines on the upper margins of the carpus-dactylus and abundance of long setae on the chelipeds obscuring any ornamentation. Like American species of this genus and unlike the Indo-West Pacific species, the male possesses a pleopod 1. The distal spine on article 2 of the antenna is, however, characteristically anteromesially directed.

Allaxius Sakai and de Saint Laurent, 1989

Allaxius Sakai and de Saint Laurent, 1989: 73–74.

Remarks. *Allaxius*, with five species from the Indian Ocean, Indonesia and Papua New Guinea, is recognised by the uropodal exopod being spined laterally with its second article at least as long as wide and usually longer than wide, and the uropodal endopod having broadly shoulders proximolaterally. The rostrum is short, about the same length as the eyestalks, with short lateral teeth.

Allaxius clypeatus (De Man, 1888)

Axius clypeatus De Man, 1888: 470, pl. 20 fig. 2.

Axiopsis (Axiopsis) clypeata.—De Man, 1925b: 70.

Allaxius clypeatus.—Sakai and de Saint Laurent, 1989: 73–74.

Material examined. Qld, Yonge Reef, Lizard Island (14°38'S, 145°38'E), 8 Nov 1975, AM P25014 (male, cl. 4.5 mm).

Remarks. *Allaxius clypeatus* is known from reefs in Indonesia and is here reported from Lizard Island, northern Great Barrier Reef. The rostrum is narrow and as long as the eyestalks, with two pairs of lateral teeth. The median gastric carina has a blunt tooth anteriorly and a broad triangular plate posteriorly. The submedian carina comprises two blunt teeth and the lateral gastric carina just one tooth. The tapering telson has four lateral spines and a minute posterolateral one. The uropodal exopod has three spines in a longitudinal ridge, four lateral spines, three small spines along the transverse suture and a larger mesiodistal spine. A long moveable spine lies lateral to the oval second article of the exopod. The uropodal endopod has a strong lateral shoulder, four spines in a longitudinal ridge, and one lateral and two distolateral spines.

Ambiaxius Sakai and de Saint Laurent, 1989

Ambiaxius Sakai and de Saint Laurent, 1989: 54.—Poore, 1994: 99 (key).—Sakai and Ohta, 2005: 82.

Callistocaris Kensley, 1989: 961 (objective synonym: same type species).

Diagnosis. Carapace smooth; cervical groove visible laterally over most of distance to anterolateral margin. Rostrum triangular or spine-like, dentate or not, longer than eyestalks, depressed below level of carapace, continuous with lateral carinae; supraocular spines prominent; lateral carina weak; submedian carina absent; median carina smooth; postcervical carina absent. Abdominal somite 1 pleuron triangular; pleuron 2 posteriorly rectangular; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea unpigmented. Antenna, scaphocerite short. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs absent above pereopods 2–4; podobranchs and arthrobranchs present; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 asymmetrical, with propodus cylindrical; propodus with spine on upper margin. Pereopods 3–5 propodi with transverse rows of robust setae; dactyli 3 and 4 elongate, with scattered robust setae; dactylus 5 elongate. Pleopods 3–5, appendix interna present. Hermaphroditic. Pleopod 1 article 1 flattened; article 2 subtriangular, one-third length of first, folded obliquely, posterior part distally lobed, anterior part smaller, narrower, with distal margin oblique, with short appendix interna. Pleopod 2 endopod article 2 elongate-triangular, as long as article 1, mesial margin concave, with

basal thumb-like appendix interna, appendix masculina with a row of strong spines followed by a short apical setose appendage. Uropodal exopod with transverse suture. Telson without lateral teeth, without posterolateral robust setae; apex deeply rounded and continuous with lateral margins.

Remarks. Species of *Ambiaxius* are recognised by the prominent supraocular spines, unarmed and obsolete or absent gastric carina, being hermaphroditic, triangular short second article on pleopod 1, and pleopod 2 endopod elongate-triangular, with concave mesial margin and short setose end. The genus is closest to *Calastacus* Faxon, 1893 (see below). Sakai and Ohta (2005) distinguished their new genus *Briancaris* from *Ambiaxius* on the shape of the rostrum, the former having a broad triangular toothed rostrum while the latter has a styliform rostrum that is barely toothed if at all. These differences are slight and otherwise the two genera, each of three species, have virtually identical pleopods.

Ambiaxius franklinae, from the Coral Sea, is the only Australian species known so far. A specimen of another species, too incomplete to describe, is recorded below.

Ambiaxius franklinae Sakai, 1994

Ambiaxius franklinae Sakai, 1994: 177–180, figs. 1, 2.—Davie, 2002: 451.

Distribution. WA, continental slope, 1300 m depth

Remarks. The species is distinguished from others in the genus and from all other Australian axiids in the possession of a narrow styliform upturned rostrum.

Ambiaxius sp.

Material examined. WA, off Cape Leveque, 14°36.89'S, 121°19.65'E–14°36.25'S, 121°20.74'E (stn SS05-2007 147), 700–698 m, 02 Jun 2007, NMV J54313 (hermaphrodite, cl. 10 mm, tl. 31 mm).

Remarks. The single individual lacks chelipeds and has a neat U-shaped excision at the anterior of the gastric region where the rostrum and supraocular spines, typical of species of *Ambiaxius*, might attach. Pleopods 1 and 2 are typical of the genus. *Ambiaxius franklinae*, from the Coral Sea, has similar maxilliped 3, pleopods 1 and 2, fused triangular eyestalks, and telson and uropods, but has a shorter scaphocerite, quite linear in this specimen.

Australocaris gen. nov.

Type species. *Australocaris pinjarup* sp. nov., here designated.

Diagnosis. Carapace smooth; with weakly defined short cervical groove. Rostrum styliform, elongate, laterally denticulate, 3 times as long as eyestalks, level with carapace, continuous with definite lateral gastric carinae; supraocular spines (spine at anterior end of lateral gastric carina and base of rostrum) prominent; lateral gastric carina unarmed except for anterior supraocular spine; submedian gastric carina present, obsolete; median gastric carina as weak ridge; postcervical carina absent. Abdominal somite 1 pleuron produced; pleuron 2 broad, anteriorly rounded, ventrally flat, posteriorly rounded; pleura 3–5 posteriorly rounded. Eyestalk cylindrical,

articulating; cornea unpigmented. Antenna, scaphocerite extending beyond antennal peduncle, with basal mesial spine and spines on lower margin. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs absent above pereopods 2–4; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 symmetrical, with propodus laterally flattened, broad, carinate on upper and lower margins; carpus-dactylus upper and lower margins with strong spines. Pleopods 3–5, appendix interna present. Pleopod 1 of male minute. Pleopod 2 of male without appendix masculina. Uropodal exopod with transverse suture.

Etymology. A combination derived from Australia and *karis* (Greek), a shrimp (feminine).

Remarks. It is unfortunate that the only individual of the type species is a male of uncertain development. It has a pair of simple pleopods 1 and lacks an appendix masculina on pleopod 2. These limbs may develop at a later instar. Nevertheless, the unique form of the rostrum and associated gastric carinae, the long spinose scaphocerite, and the form of the chelipeds distinguish the species from all other axiids and a new genus is justified. Poore's (1994) key leads this species to *Calocarides* Wollebaek, 1908 (uropodal exopod with suture, epipods present, appendix interna present, pleurobranchs absent, scaphocerite well developed, carapace smooth, eyestalks not more than half length of rostrum, eyes weakly pigmented). Differences are in the absence of the male pleopod 1 (minute in the new genus but not considered of generic importance—see discussion of *Paraxiopsis* below) and presence of the appendix masculina (absent in the new species). *Calocarides* was reviewed by Kensley (1996c). The gastric carinae of all its 11 species are more or less armed; apart from the supraocular spine and rostral dentition, gastric carinae in the new species are obsolete and unarmed. The first pereopods of species of *Calocarides* are asymmetrical, narrow, cylindrical and linear with teeth concentrated on the upper margins of the propodus and dactylus while in the new species the chelipeds are symmetrical, broad, flattened, with strong spines on the upper and lower margins of the carpus-dactylus. These chelipeds set the new species apart from all other axiid genera. Genera without an appendix masculina are *Axiorygma* Kensley and Simmons, 1988, *Bouvieraxius* Sakai and de Saint Laurent, 1989 (some species), *Parascytoleptus* Sakai and de Saint Laurent, 1989, and *Paraxius* Bate, 1888 but the new genus bears little resemblance to these genera. All except *Bouvieraxius* are monotypic.

The spinose scaphocerite is unique to axiids but similar spination is seen in the unrelated *Neaxius acanthus* Milne-Edwards, 1878 (Strahlaxiidae).

Australocaris pinjarup sp. nov.

Figures 11, 12, 39

Material examined. Holotype. WA, off Bunbury, 33°00.35'S, 114°34.12'E–32°59.37'S, 114°34.55'E (stn SS10-2005 067), 423–397 m, 29 Nov 2005, NMV J53443 (male, cl. 10.1 mm, tl. 27 mm, damaged).

Description of holotype. Carapace smooth except for slight rugosity at base rostrum, with few setae on gastric region and

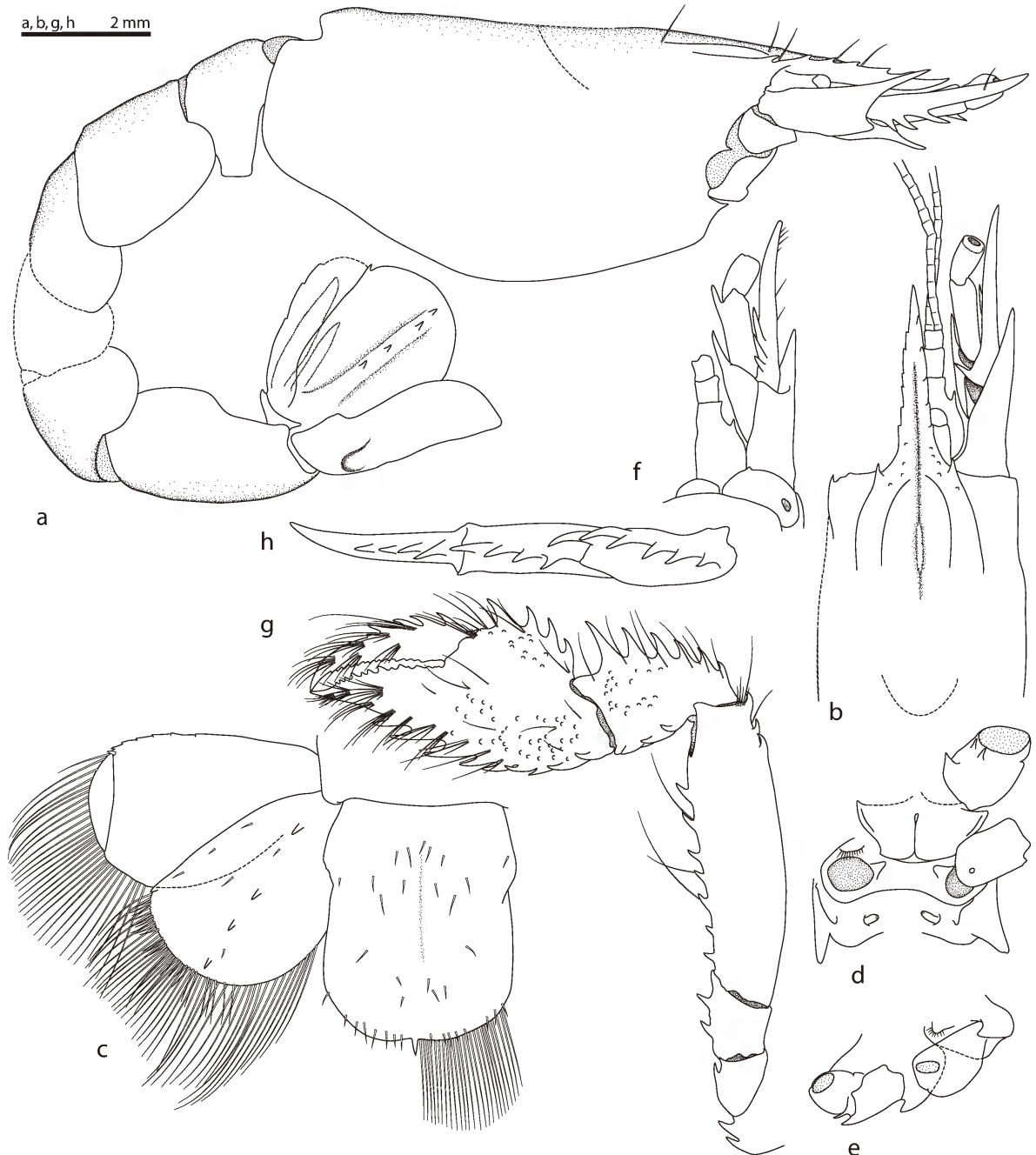


Figure 11. *Australocaris pinjarup* gen. and sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna and antennae. c, telson and right uropod. d, sternites 7 and 8, abdominal somite 1 and pleopods 1 (ventral). e, pereopod 4–5 coxa (left, lateral). f, epistome, left antennule and antenna (ventral). g, pereopod 1 (left, lateral). h, same (carpus–dactylus, without setae, upper). All figures from holotype.

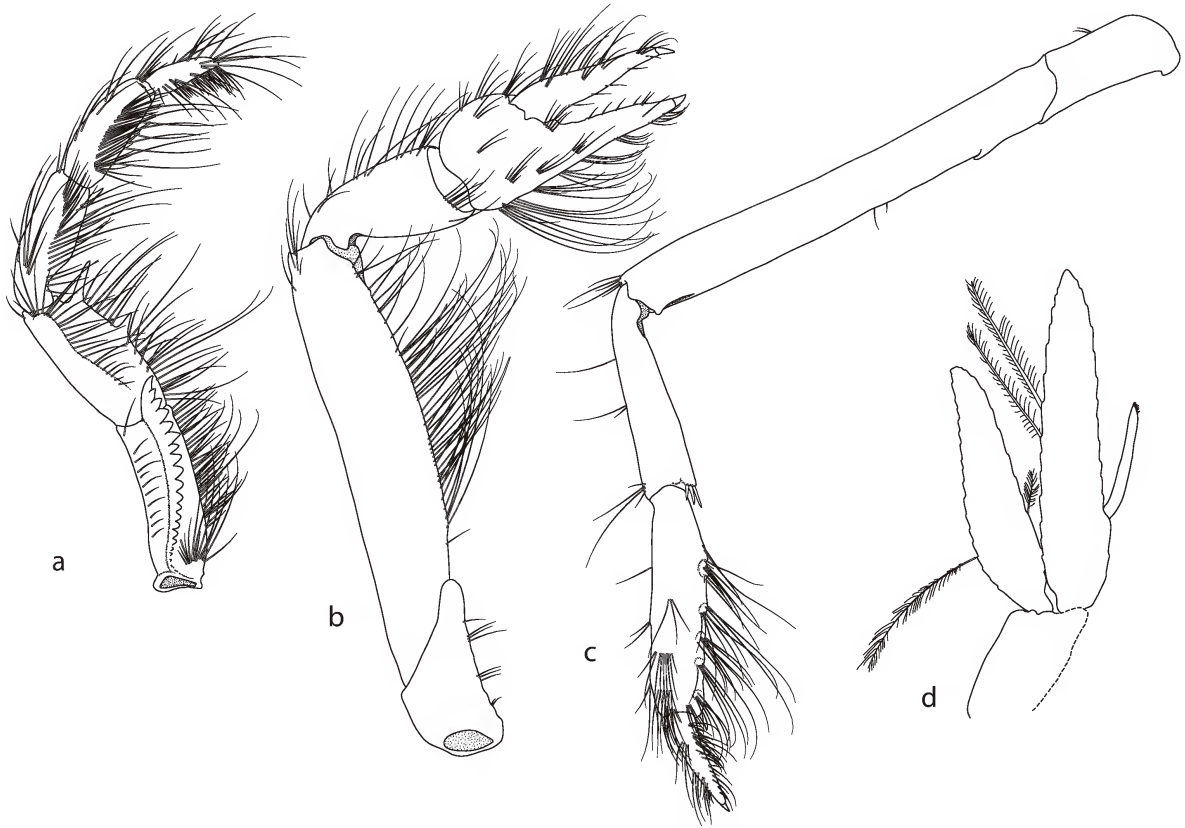


Figure 12. *Australocaris pinjarup* gen. and sp. nov. a, maxilliped 3. b, c, pereopods 2 (right), 3 or 4 (left). e, pleopod 2. All figures from holotype.

rostrum. Rostrum 0.75 times length of front-to-cervical groove, narrow, with 5–6 short oblique lateral spines anterior to supraocular spine, continuous with lateral gastric carinae. Supraocular spines prominent. Lateral gastric carina unarmed. Submedian gastric carina obsolete, curved mesially between supraocular spines. Median gastric carina sharp on rostrum, unarmed. Sternite 7 (pereopod 4) deeply divided in midline over posterior two-thirds and with sharp oblique lateral ridge. Sternite 8 (pereopod 5) with setose ridge on anterior face at base of leg. Abdominal somite 1 pleuron ventrally truncate; pleuron 2 asymmetrical, posteriorly rounded; pleura 3–5 rounded; pleura 6 rounded.

Eyestalk, 0.3 length of rostrum; cornea unpigmented. Antennular peduncle reaching to midpoint of antennal article 4; article 1 swollen proximally, with small lateral spinule. Antennal article 1 unarmed; article 2 distal spine slender, directed slightly upwards, reaching distally to middle of antennal article 4; scaphocerite reaching distally beyond distal margin of article 5, with 3 strong spines on lower margin, 1 spine on mesial margin; article 3 with sharp mesiodistal spine on lower margin; article 4

about as long as article 2 (excluding distal spine), with mesial distal spine (left side only); article 5 about half length of article 4. Maxilliped 3 coxa and basis lower margin each with distal spine; ischium unarmed; crista dentata of about 20 teeth; merus with 2 spines; carpus with 1 spine.

Pereopods 1 symmetrical, flattened, carinate; coxa lower margin with 2 spines; basis lower margin with 1 spine; ischium lower margin with 2 spines; merus upper margin barely convex, with 3 distal spines, lower margin with 7 spines, lateral face smooth, mesial face smooth; carpus upper margin with 6 spines, lower margin with 3 spines laterally, mesial face smooth; propodus upper margin with 1 row of 4 spines, lower margin convex, with 9 spines, lateral face tuberculate, mesial face smooth; fixed finger 1.2 times as long as upper palm, cutting edge convex, with c. 15 irregular triangular teeth; dactylus upper margin with 4 spines along proximal half, lateral face smooth, mesial face smooth, cutting edge denticulate; both fingers bearing setae.

Pereopod 2 ischium lower margin unarmed; merus lower margin unarmed; carpus 0.7 length of chela; propodus upper margin 0.5 length of dactylus. Pereopod 3 or 4 merus lower

margin with 1 spine; propodus 2.3 times as long as dactylus, with oblique rows of simple setae but without robust setae except for one distally. Pereopod 5 missing.

Pleopod 1 minute, cylindrical. Pleopod 2 without appendix masculina; appendix interna third length of endopod.

Telson 1.2 times as long as wide, widest proximally, then approximately parallel-sided, lateral margin unarmed, distal margin truncate-convex, with posteromedian spine, posterolateral angle rounded, unarmed; dorsal face without oblique ridges or spines. Uropodal endopod 1.5 times as long as wide, without lateral spines, longitudinal ridge with 4 spines (none marginal). Uropodal exopod 1.6 times as long as wide, with 6 obscure lateral spines, no longitudinal ribs, posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture unarmed.

Etymology. Pinjarup is the name of the Australian Aboriginal people inhabiting the coast close to the type locality (noun in apposition).

Distribution. WA, off Bunbury, 33°S, 114°E, c. 400 m depth (known only from type locality).

Remarks. The type specimen is in poor condition but sufficient features can be ascertained to enable the species to be described as a new genus and species. The single article of the male pleopod 1 is enigmatic and may not reflect the adult state.

Axiopsis Borradaile, 1903

Axiopsis Borradaile, 1903: 538.—Sakai and de Saint Laurent, 1989: 76.—Komai et al., 2002: 29–30.

Type species. *Axiopsis affinis* De Man, 1888.

Diagnosis. Carapace smooth; cervical groove visible laterally almost to anterolateral margin. Rostrum triangular, broad, laterally denticulate, longer than eyestalks, not depressed below level of carapace, continuous with definite lateral carinae; supraocular spines not differentiated from other spines; lateral carina spinose; submedian carina present, spinose; median carina a spinose ridge; postcervical carina absent. Abdominal somite 1 pleuron acute; pleuron 2 broad, anteriorly rounded, posteriorly rounded; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea pigmented. Antenna, scaphocerite long, acute. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs absent; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 asymmetrical, with propodus cylindrical; carpus-dactylus upper margins smooth. Pereopods 3–5 propodi with transverse rows of robust setae; dactyli tapering, with longitudinal row of robust setae. Pleopods 3–5, appendix interna present. Pleopod 1 of male absent. Pleopod 2 of male with appendix masculina. Uropodal exopod with transverse suture. Telson with lateral fixed spines and posterolateral robust setae; apex truncate-rounded.

Remarks. *Axiopsis* is defined by the absence of a male pleopod 1, a triangular rostrum with marginal teeth running uninterrupted on to lateral gastric carinae, similar even denticles along the lateral, submedian and median gastric carinae, absence of pleurobranchs and the presence of the appendix masculina on the male pleopod 2 and appendices internae (Komai et al.,

2002). We rediagnose *Axiopsis* here so as to differentiate it from the new genus, *Michelaxiopsis* gen. nov., below.

Axiopsis tsushimaensis Sakai, 1992 differs from others in that the submedian gastric carinae are each duplicated but in *A. serratifrons* (Milne-Edwards, 1873) irregular intermediate tubercles occupy the space between median and submedian gastric carinae.

Axiopsis consobrina De Man, 1905

Axiopsis consobrina De Man, 1905: 595–596.—Sakai and de Saint Laurent, 1989: 77–78.—Sakai, 1994: 198–201, fig. 14.—Davie, 2002: 451.

Axiopsis (Axiopsis) consobrina.—De Man, 1925b: 69, 80–84, pl. 6 figs. 13–13c.—Ngoc-Ho, 2005: 55–57, fig. 4.

Distribution. Indo-West Pacific, WA, North West Shelf.

Remarks. *Axiopsis consobrina* possesses a distal spine on the upper margin of the merus of the major cheliped; the lateral face of the propodus is tuberculate only distally. The gastric submedian gastric carina is a single row of teeth without surrounding tubercles. Poore and Griffin's (1979) Queensland record of this species is of *A. serratifrons*. Sakai (1994) recorded *A. consobrina* from the North West Shelf.

Axiopsis serratifrons (A. Milne-Edwards, 1873)

Limited synonymy. *Axia* [sic.] *serratifrons* A. Milne-Edwards, 1873: 263, pl. 13.

Axiopsis (Axiopsis) serratifrons.—De Man, 1925b: 68, 72–80, pl. 6 figs. 12–12i.

Axiopsis serratifrons.—Sakai and de Saint Laurent, 1989: 76–77.—Ngoc-Ho, 2005: 53, fig. 3.—Komai and Tachikawa, 2008: 20–22, fig. 1 (synonyms).

?*Axiopsis (Axiopsis) consobrina*.—Poore and Griffin, 1979: 230–232, fig. 4.

Distribution. Indo-West Pacific, Caribbean, Brazil; Qld, Gulf of Carpentaria.

Remarks. Milne-Edwards (1873) reported his species from Upolu, Samoa (specimen now in Zoological Museum, Hamburg) and Hawaii (specimen now in Muséum national d'Histoire naturelle, Paris), the latter being assumed by some to be the type locality (Kensley, 1981; Sakai and de Saint Laurent, 1989). De Man (1925b) described the “cotype” from Upolu and illustrated marked tuberculation on the lateral face of the propodus of the cheliped. Ngoc-Ho (2005) redescribed what she called the “holotype” from Hawaii with this face being smooth. It is possible that more than one species is involved which is significant because the species has been reported many times and has at least two synonyms (Kensley, 1981; Sakai and de Saint Laurent, 1989; Komai and Tachikawa, 2008). No lectotype has been selected and Ngoc-Ho's use of “holotype” does not constitute lectotype designation (ICZN 74.7).

The Australian record of *A. consobrina* (Poore and Griffin, 1979) is another species (M. de Saint Laurent, pers. comm., 1990), potentially *A. serratifrons*. The material has not been re-examined for this study. Until the identity (or identities) of this widespread species is decided, *A. serratifrons* is best

distinguished from other Australian species of *Axiopsis* by the absence of a spine on the upper margin of the merus and the numerous tubercles that ornament the space between the denticulate median and submedian gastric carinae.

Axiopsis tsushimaensis Sakai, 1992

Figures 13, 40

Axiopsis tsushimaensis Sakai, 1992: 173–175, figs. 14, 15.—Sakai, 1994: 198.—Komai et al., 2002: 19–30, figs. 1–3.

Material examined. WA, off Bald Island, 35°11.26'S, 118°38.42'E–35°11.15'S, 118°39.00'E (stn SS10-2005 035), 157–157 m, 24 Nov 2005, NMV J55437 (male, cl. 6.8 mm, tl. 19 mm). WA, Jurien Bay, 29°48.25'S, 114°25.52'E–29°48.33'S, 114°25.55'E (stn SS10-2005 083), 113–114 m, 02 Dec 2005, NMV J55444 (juvenile, cl. 3.0 mm).

Diagnosis. Carapace generally smooth except in gastric region. Rostrum 0.4 times length of front-to-cervical groove, broadly acute, with 4–5 lateral spines anterior to supraocular spine, continuous with definite lateral gastric carinae. Supraocular spines not differentiated from others in row. Lateral gastric carina with 9–10 low spines. Submedian gastric carina duplicated, each row of 6–8 low spines. Median gastric carina with 9–10 low spines.

Antennal article 2 distal spine slender, directed slightly upwards, reaching distally to quarter of antennal article 4; scaphocerite reaching distally to end of article 4, simple; article 3 with sharp mesiodistal spine on lower margin.

Pereopods 1 significantly differentiated. Major pereopod 1 ischium lower margin with 5 denticles and 1 spine; merus upper margin convex, with 1 spine, lower margin with 7 spines, last longest, and sublateral proximal row of denticles, lateral face smooth, mesial face smooth; carpus upper margin unarmed, lower margin unarmed; propodus upper margin with ridge of 11 low blunt teeth, lower margin with ridge of 11 low blunt teeth, lateral face with low tubercles concentrated near margins on distal two-thirds (absent proximally and from fixed finger), mesial face with low tubercles concentrated near margins on distal two-thirds (absent proximally and from fixed finger); fixed finger 0.5 length of upper palm, cutting edge with irregular rounded teeth, largest at midpoint; dactylus upper margin tuberculate, lateral face tuberculate proximally, mesial face tuberculate proximally, cutting edge with major tooth at midpoint and notch proximally; both fingers bearing setae.

Minor pereopod 1 coxa, ischium, merus and carpus as in major cheliped but narrower; propodus upper margin with sharp ridge, lower margin ridge of 11 low blunt teeth, lateral face mostly smooth, mesial face with few tubercles; fixed finger as long as upper palm, cutting edge with c. 25 short sharp teeth; dactylus upper margin unarmed, lateral face smooth, mesial face with few denticles, cutting edge obscurely denticulate.

Telson 1.1 times as long as wide, lateral margin with 3 spines, distal margin convex, with posteromedian spine, posterolateral angle with 4 robust setae well separated; dorsal face with 2 spines in each oblique row. Uropodal endopod 1.5 times as long as wide, with 2 lateral spines, longitudinal ridge with 5 spines (including marginal). Uropodal exopod 1.4 times

as long as wide, with 6 lateral spines, 2 longitudinal ribs unarmed, posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 10 spines.

Male. Pleopod 2 appendix interna 0.3 length of endopod; appendix interna 0.7 length of appendix interna.

Distribution. Tsushima Strait (Korea Strait), southern Japan; Sulu Sea, Philippines; WA, south-western coast; 34°N–35°S, 114°–130°E, 102–157 m depth.

Remarks. Sakai (1992) based his description of *Axiopsis tsushimaensis* on a juvenile female (tl. 18 mm) without a larger cheliped. Komai et al.'s (2002) detailed description and illustrations were likewise based on a small female. We illustrate for the first time an adult male and show in particular the strongly dimorphic chelipeds and pleopod 2. We could not detect differences in the carapace armature, abdomen, tail fan or antennae between our material and the type. The species is similar to *A. consobrina* De Man, 1905 in having a spine on the upper margin of the merus of the chelipeds and the proximal lateral surface of the larger cheliped smooth. *Axiopsis tsushimaensis* differs principally in having a double (rather than single) gastric submedian gastric carina and scaphocerite without a basal mesial spine (obvious to De Man, 1925b). While *A. consobrina* was described from slightly larger specimens (tl. 21, 29.5 mm), these differences would not appear to be size related as evidenced by our examination of a size range of the similar *A. serratifrons* (Milne-Edwards, 1873) in NTM collections (Cr0009886, Cr010271).

Axiopsis sp. aff. *serratifrons* (A. Milne-Edwards, 1873)

Material examined. Vic., eastern Bass Strait, 11.7 km W of Pt Ricardo (37°49.53'S, 148°30.08'E), 27 m (stn MSL-EG), NMV J31777 (female, tl. 28 mm)

Remarks. The single female without pereopods has four spines on the rostrum, 13 teeth on the lateral gastric carina, numerous setae in the submedian region, some in longitudinal rows, and 15 teeth on the median gastric carina. A description awaits the discovery of more complete specimens.

Axius Leach, 1815

Axius Leach, 1815: 343.—Sakai and de Saint Laurent, 1989: 26.—Ngoc-Ho, 2003: 447.

Remarks. *Axius* was diagnosed most recently by Ngoc-Ho (2003). Three species are known, the type species, *A. stirrhynchus* Leach, 1815, from the eastern North Atlantic (Ngoc-Ho, 2003) and two from the western North Atlantic, *A. serratus* Stimpson, 1852, and *A. armatus* Smith, 1881 (Kensley, 2001). Species of *Axius* are recognised by having a triangular, laterally armed rostrum, undifferentiated supraocular spine, unarmed submedian gastric carina anteriorly flexed towards the midline, uropodal exopod with a transverse suture, pleurobranchs present above pereopods 2–4 and sometimes 5, male pleopod 1 present, and pleopods 2–5 with an appendix interna. We confirmed Ngoc-Ho's (2003) observation that the male pleopod 1 of *A. stirrhynchus* is simple but with an obsolete suture between two articles and a ridge that hints at an obsolete appendix interna (fig. 14a). Kensley reported

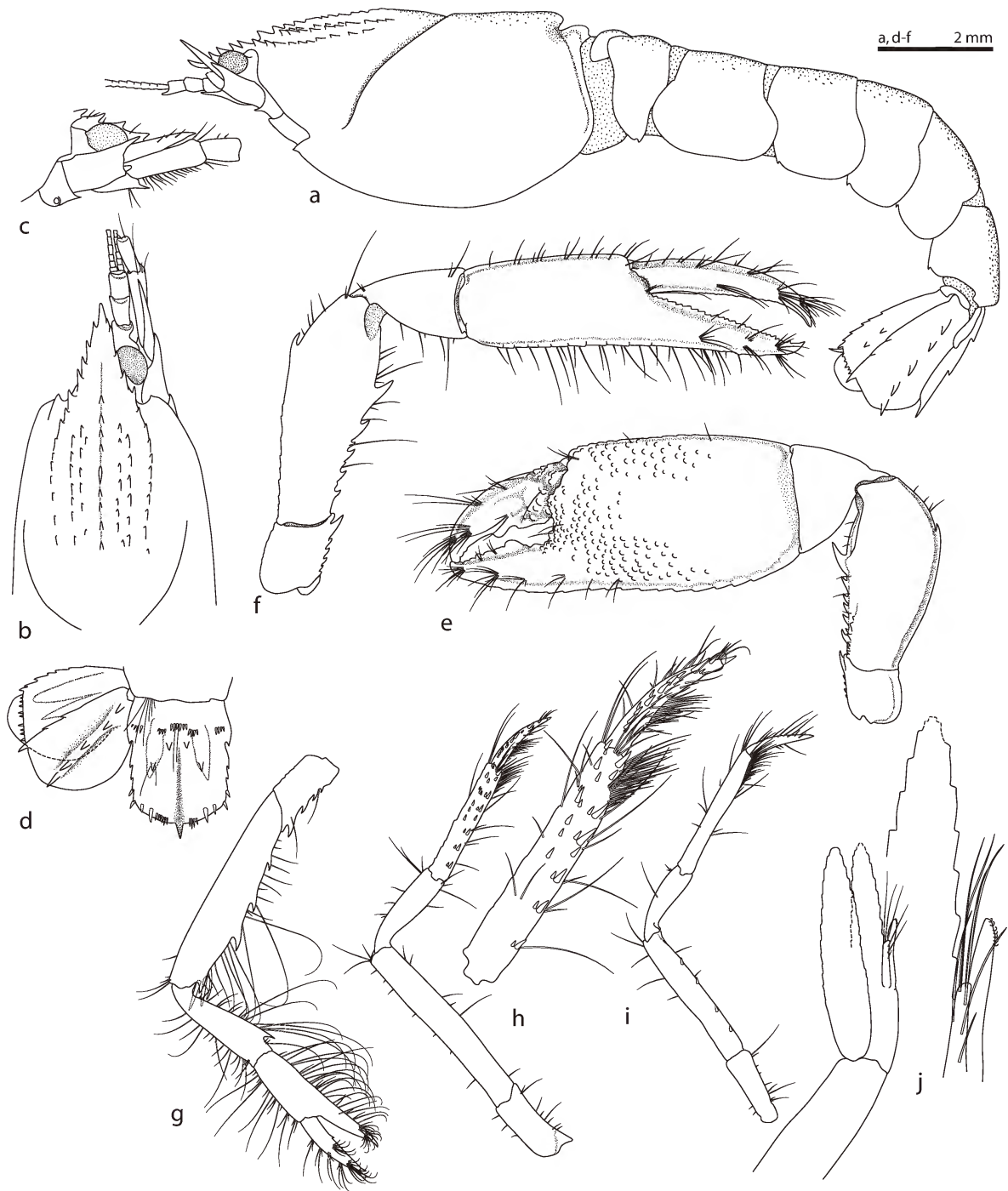


Figure 13. *Axiopsis tsushimaensis* Sakai, 1992. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, right antenna peduncle (lateral). d, telson and left uropod. e, major pereopod 1 (left). f, minor pereopod 1 (right). g, h, i, pereopods 2, 4, 5 (left except g, with detail of pereopod 4). j, male pleopod 2, with detail of appendices interna and masculina. All figures from NMV J55437.

for *A. serratus* the “pleopod 1 in both sexes consisting of single slender setose ramus.” We include *Axiopsis* (*Axiopsis*) *werribee* Poore and Griffin, 1979 (and possibly another species, see below) in this genus, the only ones outside the North Atlantic.

Sakai and de Saint Laurent (1989) listed *Axiopsis australiensis* as a member of *Axius* but this species lacks a male pleopod 1 and appendix masculina and possesses more complex gastric armature. It is here redescribed in a new genus, *Michelaxiopsis* gen. nov.

Axius werribee (Poore and Griffin, 1979)

Figure 14b

Axiopsis (*Axiopsis*) *werribee* Poore and Griffin, 1979: 232–235, figs. 5, 6.—Gowlett-Holmes, 2008: 217 (colour photo).

Calocarides werribee.—Sakai and de Saint Laurent, 1989: 84.—Sakai, 1994: 175, 201.—Davie, 2002: 452.

Axiopsis werribee Poore, 2004: 174, figs. 45c, d, 46b, pl. 11h.

Distribution. Tas., Vic. SA, 2–25 m depth.

Remarks. *Axius werribee* has five gastric carinae unornamented except for two teeth on the median gastric carina at the base of the rostrum. The triangular rostrum has five pairs of lateral teeth from which the supraocular tooth is not differentiated. Poore and Griffin (1979) misinterpreted the pleopods. Reexamination of type material in Museum Victoria has revealed that the male pleopod is present, two-articled, with the second article triangular and bearing a thumb-like appendix interna (Poore and Griffin, 1979: fig. 6h). The male pleopod 2 has both appendices interna and masculina. These characters together place the species clearly in *Axius* rather than *Axiopsis* or *Calocarides*. Both have spinose lateral carinae and lack pleurobranches. The presence of this species in SA relies on Gowlett-Holmes (2008).

Of the three species of *Axius*, *A. werribee* most closely resembles *A. armatus* redescribed by Kensley (2001). These two species alone share two teeth on the median gastric carina and two pairs of spines dorsally on the telson and lack a pleurobranch over pereopod 5. The chelipeds of *A. werribee* lack a meral spine (present in *A. armatus*) and are more compact. The male pleopod 1 (fig. 14b) is more complex than in *A. stirhynchus* (fig. 14a; see too Ngoc-Ho, 2003: fig. 2E); that of *A. armatus* is unknown and of *A. serratus* slender and setose (Kensley, 2001).

Axius sp. aff. *werribee* (Poore and Griffin, 1979)

Material examined. NSW, 44 km E of Nowra (34°55.47'S–34°56.04'S, 151°08.04'E–151°07.52'E), 429 m, (stn SLOPE 56), G.C.B. Poore on RV *Franklin*, 22 Oct 1988, NMV J16793 (juvenile male, cl. 4.0 mm; juvenile, cl. 2.9 mm)

Remarks. These two specimens from the continental slope lack all pereopods except one pereopod 3 on the smaller one. The rostrum and gastric carinae are exactly as in *Axius werribee* but article 4 and the scaphocerite of the antenna are significantly more elongate than in the subtidal species. They were compared with similarly sized individuals of *A. werribee* from Port Phillip Bay in NMV collections whose antenna is as described for the larger adults. The larger specimen has visible male gonopores but lacks pleopod 1 and appendix masculina as do



Figure 14. Male pleopods 1. a, *Axius stirhynchus* Leach, 1815 (France, NMV J34093). b, *Axius werribee* (Poore and Griffin, 1979) (holotype, NMV J280).

small males of *A. werribee*. The more elongate antenna and the ecological separation (slope depths vs subtidal) suggest a second Australian species of *Axius* similar to *A. werribee* (and to *A. armatus*). A description awaits the discovery of adults.

Bouvieraxius Sakai and de Saint Laurent, 1989

Bouvieraxius Sakai and de Saint Laurent, 1989: 45.—Sakai, 1992: 165–166.—Poore, 2008: 161–162.

Posthonocaris Kensley, 1989: 964.

Type species. *Axius longipes* Bouvier, 1905, by original designation.

Diagnosis. Carapace smooth; cervical groove visible laterally over almost half distance to anterolateral margin. Rostrum

triangular, acute, laterally denticulate, longer than eyestalks, not depressed below level of carapace, continuous with definite lateral carinae; supraocular spines barely differentiated from other spines; lateral carina smooth; submedian carina present, spinose; median carina smooth; postcervical carina absent. Abdominal somite 1 pleuron acute; pleuron 2 broad, anteriorly rounded, posteriorly rounded; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea pigmented. Antenna, scaphocerite long, acute. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs present over pereopods 2–4; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 subequal, with propodus cylindrical; carpus-dactylus upper margins smooth, with distal tooth on propodus. Pereopods 3–5 propodi with transverse rows of robust setae; dactyli tapering, with longitudinal row of robust setae. Pleopods 3–5, appendix interna absent. Pleopod 1 of male present, of 3 articles, second lobed and with field of hooks (appendix interna remnant). Pleopod 2 of male with appendix masculina elongate and with appendix interna. Uropodal exopod with transverse suture. Telson with lateral fixed spines and posterolateral robust setae; apex truncate-rounded.

Remarks. The genus has been discussed but not recently redefined. It is defined by the combination of uropodal exopod with a transverse suture, three pairs of pleurobranchs, toothed triangular rostrum, male pleopods 1 and 2 present and, importantly, pleopods 3–5 without an appendix interna (not 'with' as in the key of Poore, 2008).

***Bouvieraxius keiensis* Sakai, 1992**

Bouvieraxius keiensis Sakai, 1992: 166–168, figs. 8, 9.

Bouvieraxius rudis.—Sakai, 1994: 177 (not *Axius rudis* Rathbun, 1906).

Bouvieraxius michelae Poore, 2008: 162–164, fig. 1. (**syn. nov.**)

Figures 15, 16, 41

Material examined. WA, off Kalbarri, 27°48.48'S, 113°18.40'E–27°49.06'S, 113°18.43'E (stn SS10-2005 102), 96–98 m, 05 Dec 2005, NMV J55441 (male, cl. 9.8 mm; female, cl. 10.0 mm). Off Zuytdorp, 27°03.06'S, 113°13.19'E–27°02.56'S, 113°06.00'E (stn SS10-2005 104), 97 m, 05 Dec 2005, NMV J53445 (damaged carapace with chelipeds, abdomen missing). Off Shark Bay, 25°54.27'S, 112°49.23'E–25°54.26'S, 112°49.44'E (stn SS10-2005 035), 100 m, 06 Dec 2005, NMV J53444 (2 ovigerous females, cl. 10.0 mm; male with bopyrid parasite, cl. 8.3 mm). S of Shark Bay, (SS10-2005 stn not recorded), NMV J55471 (male, cl. 10.8 mm). Off Barrow I., 21°02.15'S, 114°53.28'E–21°01.99'S, 114°53.14'E (stn SS05-2007 008), 90–100 m, 10 Jun 2007, NMV J55709 (damaged male, cl. 6.0 mm). North West Shelf, 19°50.0'S 115°34.0'E, 80 m, NTM Cr000886 (ovigerous female, cl. 8.0 mm, tl. 23.5 mm, determined as *Bouvieraxius rudis* by Sakai, 1994).

Diagnosis. Carapace smooth. Rostrum 0.3 times length of fronto-cervical groove, narrowly triangular, with 3 (sometimes fourth obsolete) lateral spines anterior to supraocular spine, continuous with definite lateral gastric carinae. Supraocular spines similar in size to other rostrum spines. Lateral gastric carina unarmed behind supraocular spine. Submedian gastric carina with 3 or 4 spines. Median gastric carina unarmed. Abdominal pleura 3–6 each with small anteroventral tooth in male only (female pleura rounded).

Eyestalk 0.5 length of rostrum; cornea pigmented. Antennular peduncle reaching to proximal part of antennal article 5. Antennal article 1 with 1 spine and 2 spinules on lower distal margin; article 2 distal spine slender, directed distally, reaching distally to one third of antennal article 4; scaphocerite slender, straight, reaching distally to 0.7 length of article 4; article 3 with 1 or 2 spines on mesial lower margin; article 4 about half length of article 2 (excluding distal spine), without spine, article 5 about two-thirds length of article 4. Maxilliped 3 basis with 1 spine; ischium with 3 spines on lower margin; crista dentata with 18 teeth; merus with 4 spines on lower margin; carpus with 1 spine on lower margin.

Pereopods 1 unequal, of similar length, propodus of major cheliped more swollen than in minor. Major pereopod 1 coxa lower margin with 1 spine; basis lower margin with 1 spine; ischium lower margin with 2–4 spines; merus upper margin convex, with 2 or 3 spines, lower margin with 5–9 spines, lateral face smooth, mesial face smooth; carpus smooth and unarmed; propodus upper margin with 1 row of c. 27 blunt truncate teeth, lower margin with obsolete scale-like teeth, lateral face tuberculate, especially distally near upper and lower margins, mesial face tuberculate, especially near upper margin; fixed finger 1.4–1.6 length of upper palm, cutting edge weakly toothed; dactylus upper margin smooth—weakly tuberculate, lateral face smooth, mesial face smooth, cutting edge irregularly toothed.

Minor pereopod 1 spination and tuberculation as in larger cheliped (numbers of spines on merus show same range of values but pair often asymmetrical); propodus less swollen, slightly narrower, fixed finger as long as upper palm.

Male pleopod 1 article 2 with distal lobe bearing hooks proximally, mesial lobe reaching halfway along article 3. Male pleopod 2 appendix masculina about as long as endopod, extending beyond endopod by half its length. Pleopods 2–5 appendix interna one third length of endopod.

Telson 1.3 times as long as broad, lateral margin with 3 spines, distal margin convex with posteromedian spine, posterolateral angle with 1 robust seta; dorsal face with 2 spines in each oblique row. Uropodal endopod 1.3 times as long as wide, with 2 lateral spines, longitudinal ridge with 5 spines (including marginal). Uropodal exopod 1.4 times as long as wide, with 1 or 2 lateral spines, 2 longitudinal ribs (ribs with 7 scattered denticles), posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 16–20 spinules.

Distribution. Indonesia (Kei Island), 245 m; Timor Sea, 18 m; Mauritius, 73 m; WA, North West Shelf to Shark Bay, 20°–27°S, 113°–115°E, 80–100 m depth.

Remarks. *Bouvieraxius keiensis* was described from material from Kei Island, Indonesia (type locality) and Mauritius. The new material from the region of Shark Bay, central WA, totals nine specimens that vary in the number of lateral spines on the rostrum anterior to the supraocular spine (two or three, the last often obsolete), teeth on the submedian gastric carina (usually four, three in two individuals, five on one side in one individual), spines on the merus of the cheliped (two or three on the upper margin, 6–9 on the lower margin, usually asymmetrical), and extent of tuberculation on the propodus of the cheliped (from one third to two thirds of the lateral surface). Sakai's (1994)



Figure 15. *Bouvieraxius keiensis* Sakai, 1992. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and left uropod. d, epistome, left antennule and antenna (ventral). e, major pereopod 1 (right). f, minor pereopod 1 (left). g, maxilliped 3. h, i, male pleopods 1, 2. j, k, female pleopods 1, 2. l, left pleura of abdominal somites 3-6. Figs a-e, j, k from NMV J55441 female; figs. h, i, l from male, NMV J55441.



Figure 16. *Bouvieraxius keiensis* Sakai, 1992. a–d, pereopods 2–5 (right except d). All figures from female, NMV J55441.

illustrations (taken from three individuals) show two lateral spines on the rostrum, four teeth on the submedian gastric carina, four upper and five lower spines on the merus of the cheliped, and extensive tuberculation on the propodus of the cheliped. While the spination of the cheliped meri of the holotype falls outside the range of the Australian material we can see no other differences; otherwise, the tail fan and male pleopods seem identical. We illustrate an ovigerous female of a size similar to Sakai's specimens; both show the inequality in the female chelipeds that is mirrored in males.

Bouvieraxius michelae was described on the basis of a small male (cl. 4.2 mm) from the Timor Sea. The holotype lacks chelipeds. Dorsal spination is essentially the same as in the figures of *B. keiensis*; its more elongate telson could be attributed to its small size. The male pleopod 1 of *B. michelae* lacks a mesial lobe overlapping an apical third article, apparently less developed than that figured for the new material (cf. fig. 15h with Poore, 2008: fig. 1). The pleopod 2 of the small male of *B. michelae* has a shorter and less setose appendix masculina and rami than those of the larger specimen figured here but male pleopods 1 and 2 of both specimens are consistent with those figured for *B. keiensis* (Sakai, 1992: fig. 9). We conclude that *B. michelae* is a junior synonym of *B. keiensis*.

Sakai (1994) identified a small female from the North West Shelf, WA, as the Hawaiian species, *Bouvieraxius rudis* (Rathbun, 1906). We examined his specimen (NTM Cr000886) and noted three teeth on the submedian gastric carina as reported for *B. rudis* (the types of *B. keiensis* have four). Two males (J55471, J55709) from our new collections also have

only three pairs of submedian teeth but are otherwise identical. Sakai noted that the rostrum has three rostral spines (including the supraocular) while *B. rudis* has two (Rathbun said "three or four" and Sakai and de Saint Laurent illustrated two or three). The cheliped merus of the NTM specimen has 2+6 spines, different from the types of both species but within the range of our new Australian material. Sakai (1994) differentiated *B. keiensis* from *B. rudis* on the number of teeth on the submedian gastric carina (4 or 5 vs 3) and the number of mesiodistal spinules on article 1 of the antenna (2 vs 4 or 5 in *B. rudis* from New Caledonia). The identity of the New Caledonian specimens (Sakai and de Saint Laurent, 1989) is uncertain (M. de Saint Laurent, pers. comm., 1990). The mesiodistal angle of article 1 of the antenna in our material varied from barely angular to two or three spinules.

The synonymy or otherwise of *B. rudis* and *B. keiensis* remains uncertain and until this is resolved we prefer to use the name associated with a species from the region.

Calastacus Faxon, 1893

Calastacus Faxon, 1893: 194. —Schmitt, 1921: 112. —de Saint Laurent, 1972: 353. —Sakai and de Saint Laurent, 1989: 59. —Kensley, 1989: 961. —Kensley, 1996: 158, 159.

Calocaris (*Calastacus*). —Alcock, 1901: 191. —Borradaile, 1903: 539. —De Man, 1925b: 115.

Type species. *Calaxius stilirostris* Faxon, 1893, by monotypy.

Diagnosis. Carapace smooth; cervical groove visible laterally over most of distance to anterolateral margin. Rostrum spine-

like, laterally weakly dentate, longer than eyestalks, depressed below level of carapace, continuous with lateral carinae; supraocular spines prominent; lateral carina weak; submedian carina absent; median carina smooth; postcervical carina absent. Abdominal somite 1 pleuron triangular; pleuron 2 posteriorly rectangular; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea unpigmented. Antenna, scaphocerite short. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs absent above pereopods 2–4; podobranchs rudimentary on maxilliped 3–pereopod 3, arthrobranchs present; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 asymmetrical, with propodus cylindrical; propodus with spine on upper margin. Pereopods 3–5 propodi with transverse rows of robust setae; dactyli 3 and 4 elongate; dactylus 5 elongate. Pleopods 3–5, appendix interna present. Hermaphroditic. Pleopod 1 article 1 flattened; article 2 subtriangular, two-thirds length of first, folded longitudinally, posterior part distally lobed, anterior part larger, broader, with short appendix interna. Pleopod 2 endopod article 2 elongate, twice length of article 1, mesial margin straight, with basal digitiform appendix interna, appendix masculina divided into 2 equal parts bearing rows of strong setae. Uropodal exopod with transverse suture. Telson without lateral teeth, without posterolateral robust setae; apex deeply rounded and continuous with lateral margins.

Remarks. *Calastacus* is a genus of six species, *C. stilirostris* Faxon, 1893 from the central eastern Pacific, *C. laevis* de Saint Laurent, 1972 from the eastern Atlantic and Mediterranean, *C. colpos* Kensley, 1996 and *C. mexicanus* Kensley, 1996 from the Gulf of Mexico (Kensley, 1996e), *C. crosnieri* Kensley and Chan, 1998 and *C. inflatus* Komai, Lin and Chan, 2009 from the north-western Pacific. The genus was diagnosed by de Saint Laurent (1972) whose concept has been followed by later authors. The genus differs from *Ambiaxius* only in the characteristic pleopods 1 and 2. Pleopod 1 is more elongate than in *Ambiaxius* and pleopod 2 has a long second segment on the endopod. A seventh species, first from the Indian Ocean, is described below.

Calastacus myalup sp. nov.

Figures 17, 42

Material examined. Holotype. WA, off Bunbury, 33°00.35'S, 114°34.12'E–32°59.37'S, 114°34.55'E (stn SS10-2005 067), 423–397 m, 29 Nov 2005, NMV J53460 (hermaphrodite, cl. 8.0 mm, tl. 19 mm; carapace damaged, pereopods 1 missing, 1 egg case on pleopod 3).

Paratype. Collected with holotype, NMV J58382 (hermaphrodite, cl. 8.0 mm, tl. 19 mm; most pereopods missing).

Description of hermaphrodite holotype. Carapace smooth except for slight rugosity between supraocular spines. Rostrum 0.5 times length of front-to-cervical groove, acute, unarmed anterior to supraocular spine, not continuous with lateral gastric carinae. Supraocular spines prominent. Lateral gastric carina absent. Submedian gastric carina absent. Median gastric carina unarmed. Abdominal pleuron 1 twice as deep as middorsal length, short, ventrally rounded; pleuron 2 broad, lateral length 1.3 times dorsal length, anteroventrally rounded; pleura 3–5 rounded; pleura 6 rounded.

Eyestalk 0.4 length of rostrum; cornea unpigmented. Antennular peduncle reaching two-thirds along antennal article 4. Antennal article 1 with 1 sharp spine and spinule on lower distal margin; article 2 distal spine slender, directed slightly inwards, reaching distally to middle of antennal article 4; scaphocerite slender, directed slightly upwards, reaching distally to middle of antennal article 4; article 3 with sharp distal spine on lower margin; article 4 little longer than article 2 (excluding distal spine); article 5 about half length of article 4. Maxilliped 3 basis unarmed; ischium unarmed on lower margin; crista dentata with 20 teeth; merus with 2 long spines on lower margin; carpus unarmed.

Pereopods 1 coxa with 1 spine; basis unarmed; remainder missing.

Pereopod 2 ischium unarmed; merus unarmed; carpus 0.7 length of chela. Pereopod 3 merus unarmed; propodus 3 times as long as dactylus, with oblique rows of simple setae but without robust setae. Pereopod 4 unarmed; propodus 3 times as long as dactylus, with oblique rows of simple setae distally but without robust setae. Pereopod 5 unarmed; propodus with oblique rows of simple setae distally but without robust setae, with short rounded fixed finger; dactylus broken.

Pleopod 1 article 2 0.8 length of article 1, leaf-like, concave posteromesially, hooks representing the appendix interna on a blunt lobe on broad triangular anterior fold, lateral fold almost semicircular, the pair together forming a broad open tube joined anteriorly by the hooks. Pleopod 2 endopod of 2 articles (third weakly differentiated), all articles more or less in line with peduncle, with thumb-like appendix interna at base of article 2, setae of appendix masculina not well differentiated from more distal setae (as in other species); exopod half length of endopod.

Telson 1.6 times as long as wide, widest proximally, then approximately parallel-sided, lateral margin unarmed, distal margin semicircular without posteromedian spine, posterolateral region rounded; dorsal face without spines on obsolete oblique row. Uropodal endopod 2.0 times as long as wide, without lateral spines, longitudinal ridge unarmed. Uropodal exopod 2.0 times as long as wide, without lateral spines, 2 obsolete longitudinal ribs unarmed, posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 11 robust setae of varying lengths.

Etymology. Myalup is a settlement on the coast close to the type locality (noun in apposition).

Distribution. WA, south-western coast, 400 m depth.

Remarks. The new species differs from *C. crosnieri* and *C. inflatus*, the two West Pacific species, in having narrower uropods.

Calaxius Sakai and de Saint Laurent, 1989

Calaxius Sakai and de Saint Laurent, 1989: 84 (diagnosis, list of species).—Sakai, 1994: 192 (diagnosis).—Clark et al., 2007: 64 (diagnosis).

Manaxius Kensley, 2003: 367–368.

Type species. *Calaxius acutirostris* Sakai and de Saint Laurent, 1989, by original designation.



Figure 17. *Calastacus myalup* sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and right uropod. d, maxilliped 3. e-h, pereopods 2-4 (right except e). i, j, right and left pleopod 1 (right from anterolateral view, left from mesial view). k, pleopod 2. All figures from holotype.

Diagnosis. Carapace smooth or tuberculate; cervical groove visible laterally over third distance to anterolateral margin. Rostrum acutely triangular, with 2 or 3 pairs of lateral spines, longer than eyestalks, not depressed below level of carapace, continuous with definite lateral carinae; supraocular spines prominent; lateral carina with at least 1 spine; submedian carina present, with 1 or few spines; median carina a weak ridge, with 1 or few spines; postcervical carina absent. Abdominal somite 1 pleuron acute; pleuron 2 acute or rounded, pleura 3–5 acute, sometimes with anteroventral tooth, or rounded. Eyestalk cylindrical, articulating; cornea pigmented. Antenna, scaphocerite long. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranches present above pereopods 2–4; podobranchs and arthrobranches well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 slightly asymmetrical, with propodus flattened; carpus-propodus upper margin with strong curved spines (rarely obsolete), densely covered with long setae. Pereopods 3–5 propodi with transverse rows of robust setae; dactyli tapering, with longitudinal row of robust setae. Pleopods 3–5, appendix interna present. Pleopod 1 of male absent. Pleopod 2 of male with appendix masculina. Uropodal endopod with lateral and distolateral spines; exopod with transverse suture. Telson with lateral fixed spines and posterolateral robust setae; apex rounded.

Remarks. Sakai and de Saint Laurent (1989) listed eight species. Subsequently, six species have been described, including one originally in the synonymised genus *Manaxius* Kensley, 2003 (Clark et al., 2007). While Clark et al.'s (2007) diagnosis serves to enable species to be recognised, it should be added that pleopods 3–5 each possess an appendix interna. Most species can be recognised by the long rostrum, pattern of gastric spines and chelipeds with long spines and dense mat of long setae. The chelipeds of *Calaxius euophthalmus* (De Man, 1905) would appear to lack strong spines and setae. Here, we redescribe the type species from Australian material and erect a new genus, *Pilbaraxius*, for a similar axiid with affinities to *Calaxius* (see below).

***Calaxius acutirostris* Sakai and de Saint Laurent, 1989**

Figures 18–20, 43

Calaxius acutirostris Sakai and de Saint Laurent, 1989: 86–92, fig. 25 (probably not figs. 23, 24).—Sakai, 192–193, fig. 10.

Material examined. WA, off Zuytdorp, 27°08.01'S, 112°45.04'E–27°08.48'S, 112°45.43'E (stn SS10–2005 105), 414–405 m, 05 Dec 2005, NMV J53450 (female, cl. 20 mm, tl. 48 mm). WA, north-west slope, 16°45.3S, 119°46.4'E, 502–504 m, NTM Cr004234 (male, cl. 22.2, tl. 56.0). Qld, off Mackay, 22°55.1'S, 153°00.5'E, 338–325 m, NTM Cr007158 (male, cl. 26.5, tl. 65.0).

Description of female NMV J53450. Carapace smooth (with scattered setae). Rostrum 0.5 times length of front-to-cervical groove, acute, with 2 lateral spines anterior to supraocular spine, continuous with definite lateral gastric carinae. Supraocular spines prominent. Lateral gastric carina with 1 prominent spine posterior to supraocular spine. Submedian gastric carina with 2 spines. Median gastric carina present as a ridge with 3 small spines. Faint postcervical carina present,

becoming stronger posteriorly. Sternite 7 (pereopod 4) deeply divided in midline over posterior two-thirds and with sharp oblique lateral ridge. Sternite 8 (pereopod 5) with setose semicircular flap on anterior face at base of leg. Abdominal pleuron 1 2.5 times as deep as middorsal length, ventrally acute; pleura 2–5 broad, lateral length 1.3 times dorsal length, tapering posteroventrally to a point, pleura 4 and 5 with small anteroventral tooth; pleuron 6 rounded.

Eyestalk 0.3 length of rostrum; cornea pigmented. Antennular peduncle reaching to end of antennal article 4. Antennal article 1 with 2 spines on lower distal margin; article 2 distal spine slender, reaching distally to middle of antennal article 4; scaphocerite slender, straight, reaching distally 0.8 length of article 4; article 3 with 1 spine on mesial lower margin; article 4 about 1.3 length of article 2 (excluding distal spine), article 5 about two-thirds length of article 4. Maxilliped 3 basis with 1 spine; ischium with 2 spines on lower margin; crista dentata with 18 teeth; merus with 3 spines on lower margin; carpus unarmed.

Pereopods 1 scarcely differentiated, of similar length, major slightly more swollen than minor, merus of major slightly broader. Major pereopod 1 (right) coxa lower margin with 1 spine; basis lower margin with 1 spine; ischium lower margin with 1 spine; merus upper margin convex, with 2 spines, lower margin with 3 spines, lateral face with 1 distal spine, mesial face smooth; carpus upper margin with 3 spines, lower margin with 2 spines laterally, lateral face smooth, mesial face smooth; propodus upper margin with 4 spines (2 in midline, 1 on each side), lower margin with 8 spines in lateral row, lateral face with row of 4 spines, mesial face with 1 spine and few tubercles near lower margin; fixed finger 1.5 times upper palm, cutting edge with 5 sharp spine-like teeth; dactylus unarmed, cutting edge denticulate; distal articles bearing clusters of stiff setae.

Minor pereopod 1 coxa, ischium, merus and carpus as in larger cheliped; propodus as in larger cheliped except mesial face with 2 spines and few tubercles near lower margin; fixed finger 1.8 times length of upper palm, cutting edge with uneven blunt teeth; dactylus unarmed, cutting edge denticulate; distal articles bearing clusters of stiff setae.

Pereopod 2 ischium lower margin unarmed; merus lower margin with 3 spines; carpus slightly shorter than chela; propodus upper margin 0.8 length of dactylus. Pereopod 3 merus lower margin with 2 spines; propodus 2.7 times as long as dactylus, with 4 marginal robust setal rows. Pereopod 4 merus lower margin with 1 spine; propodus 2.8 times as long as dactylus, with 3 marginal robust setal rows. Pereopod 5 propodus 5 times as long as dactylus, subchelate, with short fixed finger; dactylus twisted.

Pleopod 1 article 2, 3 times article 1. Pleopods 2–5 appendix interna 0.3 length of endopod.

Telson 1.3 times as long as broad, lateral margin with 1 robust seta on proximal lobe, distal margin convex without posteromedian spine, posterolateral angle with 2 robust setae; dorsal face with 2 small spines in each oblique row. Uropodal endopod 1.6 times as long as wide, with 1 distolateral spine, longitudinal ridge with 2 spines (including marginal). Uropodal exopod 1.7 times as long as wide, with 2 obsolete lateral spines, 2 longitudinal ribs unarmed, posterolateral angle with minute

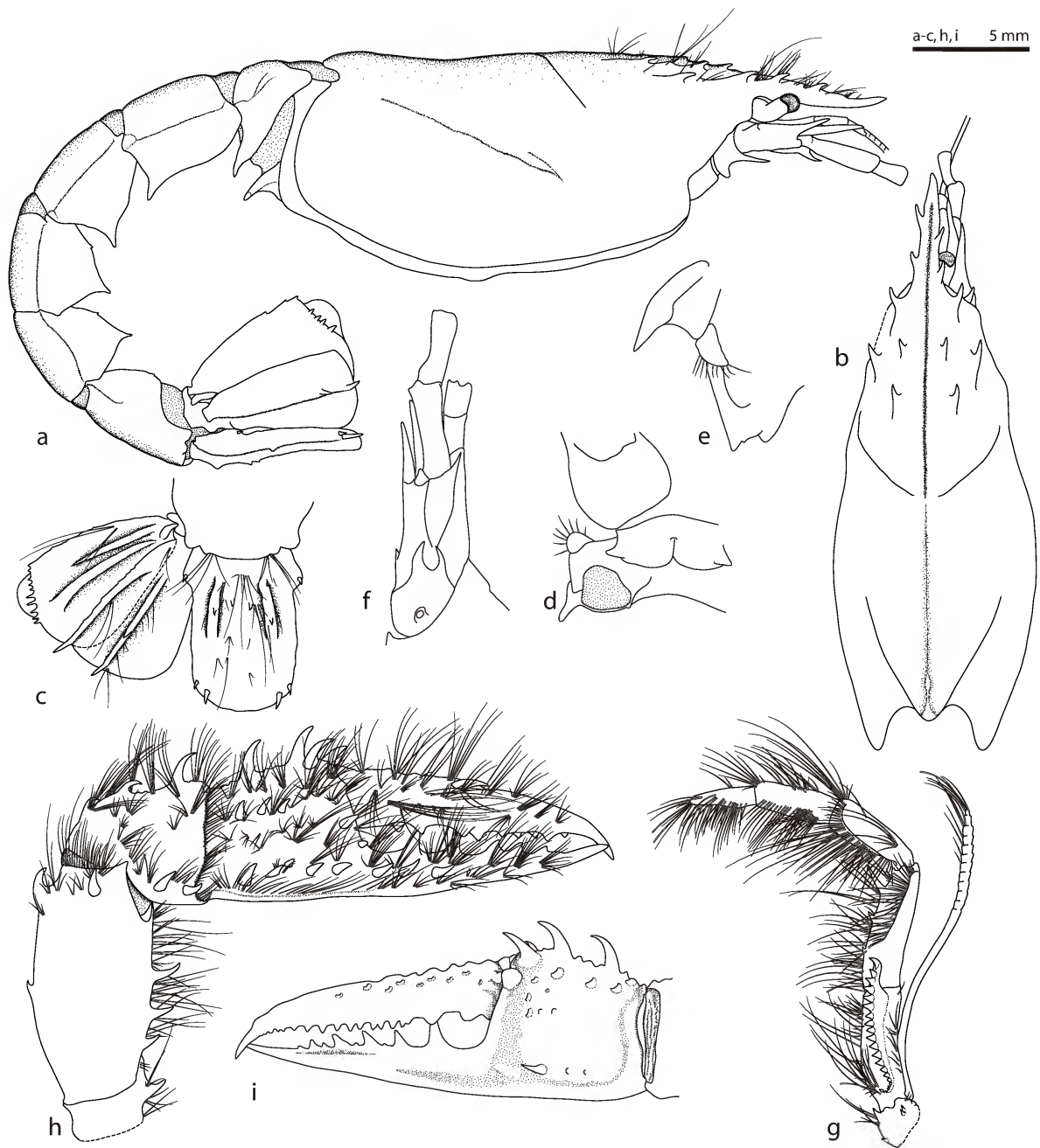


Figure 18. *Calaxius acutirostris* Sakai and de Saint Laurent, 1989. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and left uropod. d, sternites 7 and 8. e, right sternites 7 and 8 (lateral). f, epistome, left antennule and antenna (ventral). g, maxilliped 3. h, major pereopod 1 (right, lateral). i, same (propodus–dactylus, without setae, mesial). All figures from NMV J53540.

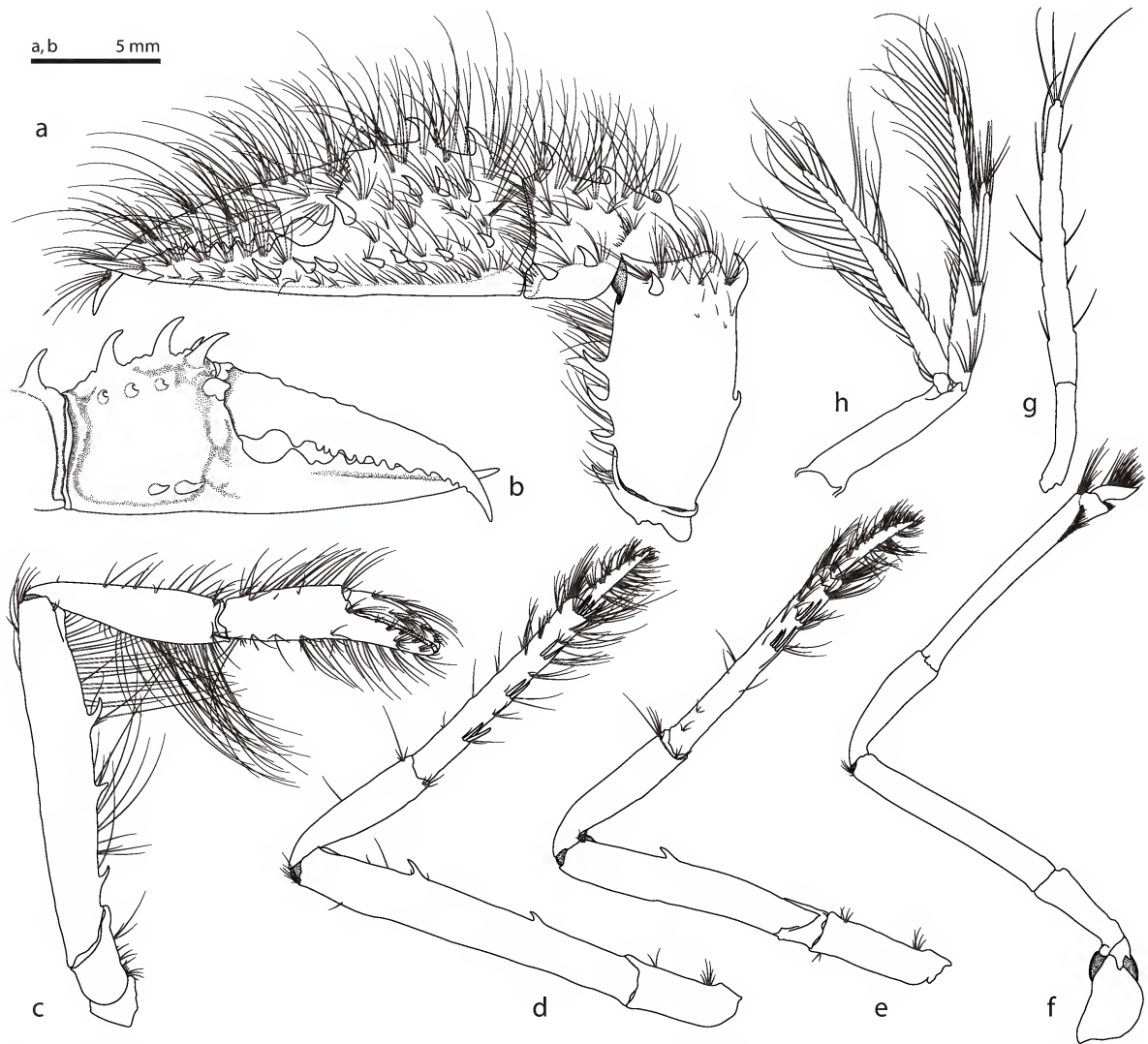


Figure 19. *Calaxius acutirostris* Sakai and de Saint Laurent, 1989. a, minor pereopod 1 (left, lateral). b, same (carpus-dactylus, without setae, mesial). c-f, pereopods 2-5 (right). g, female pleopod 1. h, male pleopod 2. Figs a-g from NMV J53540, fig. h from NTM Cr007158.

fixed spine (robust seta probably lost); transverse suture with 6-10 uneven spines.

Description of male NTM Cr007158. Essentially as female except: rostrum with 3 and 4 lateral spines anterior to supraocular; major cheliped more swollen, propodus mesial face more obviously tuberculate; pleopod 1 absent; pleopod 2 with appendices interna and masculina of similar lengths, each about third length of endopod; telson lateral margin with fixed spine (in place of robust seta) on proximal lobe and robust seta at midpoint; uropodal exopod posterolateral angle with minute fixed spine and robust seta.

Distribution. Madagascar (type locality); Australia, central and northern WA, central Qld, to 27°S, 325-505 m depth.

Remarks. De Saint Laurent (pers. comm., 1990) informed GCBP that, in her view, only figure 25 of *C. acutirostris* in the original description (Sakai and de Saint Laurent, 1989) refers to this species whose holotype is from Madagascar; the other figures and part of the description refer to another species from the Philippines. This would appear to differ only in the degree of spination of the chelipeds. Sakai (1994: 192, fig. 10) recorded *Calaxius acutirostris* from off Queensland and Western Australia, and illustrated and

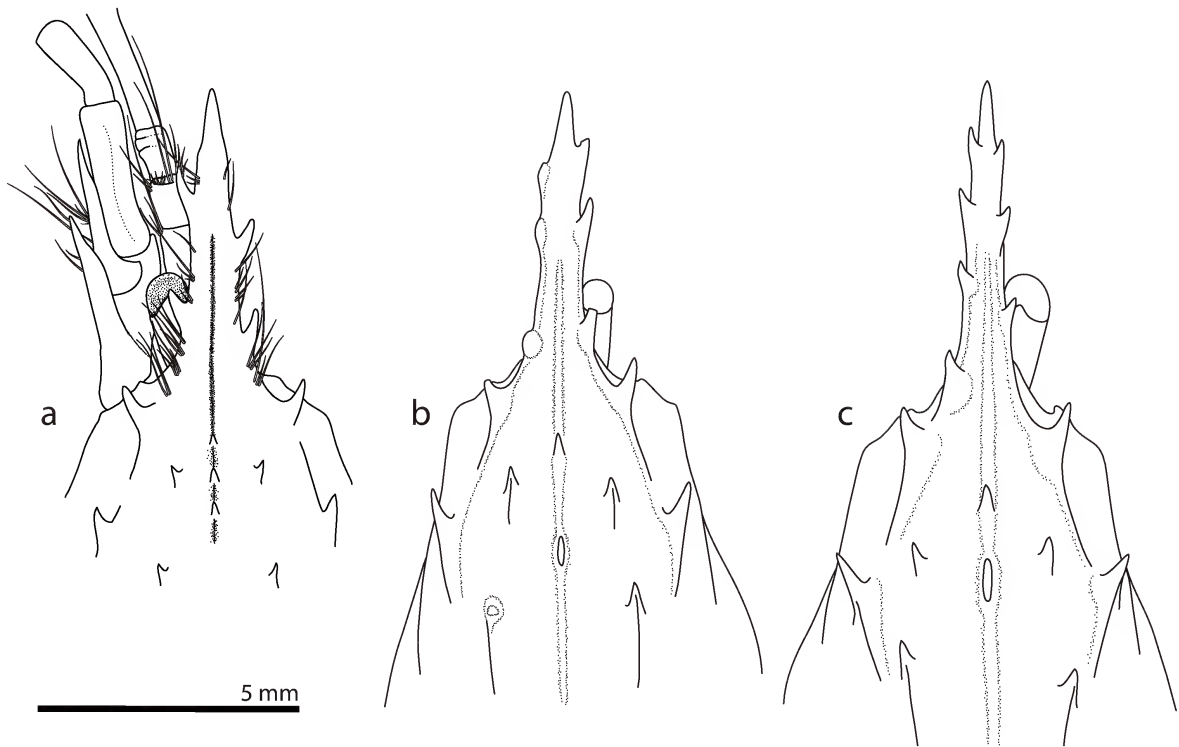


Figure 20. *Calaxius acutirostris* Sakai and de Saint Laurent, 1989. Detail of rostrum (and left antennae) of three specimens. a, female, cl. 20 mm, NMV J53540. b, male, cl. 22.2 mm, NTM Cr004234. c, male, cl. 26.5 mm, NTM Cr007158.

described maxilla 2 and maxillipeds 1–3. We examined his material and found it, like our own, more resembled figure 25 of the type specimen than figure 24 of the Philippines specimen. We figure dorsal views of all Australian specimens to illustrate the elongation of the rostrum with increased size (fig. 20).

The original diagnosis and description were extensive and covered all limbs (Sakai and de Saint Laurent, 1989) but apart from pereopod 1 no limbs were illustrated. Because of the confusion about which species was referred to, we provide figures and another description based on the Australian material. We note differences in the number of rostral spines (between individuals and between left and right sides)—two to four spines possible, in degree of spination and tuberculation of chelipeds, and in armature of the telson.

Calaxius acutirostris, is similar to *C. euophthalma* (De Man, 1905), *C. manningi* Kensley et al., 2000 and *C. tungi* Zhong, 2000 in the possession of two well defined spines on each lateral and sublateral gastric carina. All possess two to four asymmetrical spines on each lateral margin of the rostrum. *Calaxius acutirostris* and *C. manningi* also have a similar spination pattern on the chelipeds while *C. tungi* has fewer and weaker spines. *Calaxius euophthalma* lacks prominent cheliped

spines. Also belonging to this group of Indo-West Pacific species with two or three asymmetrical rostral spines are *C. mimasensis* (Sakai, 1967) and *C. sibogae* (De Man, 1925b) but these species have less spinose chelipeds than *C. acutirostris*.

Dorphanaxius Sakai and de Saint Laurent, 1989

Dorphanaxius Sakai and de Saint Laurent, 1989: 33–34.—Poore, 2004: 175.

Type species. *Axiopsis (Paraxiopsis) appendiculis* Poore and Griffin, 1979 by original designation.

Diagnosis. Carapace smooth; cervical groove visible laterally over half distance to anterolateral margin. Rostrum triangular, broad, laterally obscurely denticulate, about as long as eyestalks, depressed below level of carapace, continuous with definite lateral carinae; supraocular spines prominent; lateral carina unarmed; submedian carina present, with blunt anterior tooth; median carina a weak ridge, with one blunt tubercle; postcervical carina absent. Abdominal somite 1 pleuron rounded; pleuron 2 broad, anteriorly rounded, ventrally flat, posteriorly rounded; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea pigmented. Antenna, scaphocerite short,

curved. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs present above pereopods 2–4; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 slightly asymmetrical, with propodus cylindrical; carpus-dactylus upper and lower margins unarmed. Pereopods 3–5 propodi with transverse rows of robust setae; dactyli tapering, with longitudinal row or robust setae. Pleopods 3–5, appendix interna present. Pleopod 1 of male absent. Pleopod 2 of male with appendix masculina. Uropodal exopod with transverse suture. Telson with lateral fixed spines and posterolateral robust setae; apex rounded.

Remarks. Sakai and de Saint Laurent (1989) likened their new genus to *Scytoleptus* Gerstaecker, 1856, the two sharing a depressed rostrum, broad foliaceous epipods on pereopods 1–4, and sexually dimorphic pleopods 2–5. The epipods of these two genera seem not different from those of many other axiids and pleopods are scarcely sexually dimorphic (cf. figs. 23g, h). According to their account, *Scytoleptus* has a shorter cervical groove than *Dorphinaxius*. They erroneously differentiated the two genera on pleurobranchs above pereopods 2–4 (present in both genera). Here, we rediagnose the genus and confirm the taxonomy of the type and only species.

Dorphinaxius kermadecensis (Chilton, 1911)

Figures 21–23

Iconaxiopsis kermadecensis Chilton, 1911: 550–551, figs. 1, 2.

Axius (*Eiconaxius*) *kermadecensis*.—De Man, 1925b: 4, 10, 15.

Axiopsis (*Paraxiopsis*) *appendiculis* Poore and Griffin, 1979: 224–226, fig. 1.

Eiconaxius kermadecensis.—Sakai and de Saint Laurent, 1989: 23.

Dorphinaxius appendiculis.—Sakai and de Saint Laurent, 1989: 34.—Sakai, 1994: 200.

Dorphinaxius kermadecensis.—Davie, 2002: 452.—Poore, 2004: 175, figs. 45e, f, 46c.

Material examined. *Iconaxiopsis kermadecensis* Chilton, 1911. Syntypes. New Zealand, Kermadec Islands, Meyer I. and Coral Bay, rock pools at Sunday I. [= Raoul I.] (29°16'S, 177°55'W), Captain Bollons, BMNH 1912.5.25.44–46 (fragments of 5 chelipeds, 1 body with only abdominal segments identifiable, 1 body with anterior carapace, 1 right uropod; annotated "Cotypes Pres. Prof. Chilton. The specimens came back from Godstowe very macerated—only fragments left. I. G[jordan] v/46.").

Axiopsis (*Paraxiopsis*) *appendiculis* Poore and Griffin, 1979. Holotype. Australia, NSW, Shellharbour, under stones between tide marks, G. McAndrew, 1926. AM P9359 (ovigerous female, cl. 14 mm). Paratypes. Australia, central NSW: Grafton, Collaroy, Port Jackson and Shellharbour (29°47.0'S–34°35'S, 151°12'E–153°18'E), AM, 12 of 19 paratype lots (6 males, cl. 10–19 mm; 14 females, 6 ovigerous, cl. 6.5–21 mm).

Other material. Australia, Norfolk I., Emily Bay, Point Hunter (29°03.8'S, 167°57.3'E), 0–0.25 m, H. Larsen, 18 Apr 1984, NTM Cr001666 (juvenile, cl. 4.0 mm).

Description. Carapace smooth except for slight rugosity at base rostrum, with few setae on gastric region and rostrum. Rostrum 0.25 times length of front-to-cervical groove, broadly triangular, without or with 2 or 3 lateral tubercles anterior to supraocular spine, depressed below level of median carina, anteriorly

directed or directed slightly upwards, continuous with lateral carinae. Supraocular spines prominent, broadly triangular. Lateral carina unarmed. Submedian carina smooth, with 1 anterior blunt tooth. Median carina obsolete, with single tooth, sloping down at 20–40°. Abdominal somite 1 pleuron ventrally rounded; pleuron 2 asymmetrical, posteriorly rounded; pleura 3–5 rounded; pleura 6 rounded.

Eyestalk, 0.5 length of rostrum; cornea pigmented. Antennular peduncle reaching to midpoint of antennal article 4; article 1 with mesial and distal spinule. Antennal article 1 unarmed; article 2 stylocerite obsolete; scaphocerite one third length of article 4, curved downwards; article 4, 1.5 times length of article 2; article 5 about half length of article 4. Maxilliped 3 coxa and basis lower margin each with distal spine; ischium unarmed; crista dentata of about 17 teeth; merus with 3 spines; carpus with 1 spine.

Pereopods 1 asymmetrical, robust, not sexually dimorphic. Major cheliped coxa to ischium unarmed; merus upper margin strongly convex, unarmed, lower margin with 1 small spine; carpus unarmed; propodus unarmed; fixed finger 0.5 times as long as upper palm, cutting edge with 1 triangular tooth; dactylus distally curved, cutting edge unevenly toothed.

Minor cheliped similar to major, propodus narrower, fixed finger 0.6 times as long as upper palm, cutting edge with 2 blunt teeth.

Pereopod 2 ischium lower margin unarmed; merus lower margin unarmed; carpus slightly shorter than chela; propodus upper margin 1.1 times length of dactylus. Pereopod 3 merus unarmed; propodus 2.0 times as long as dactylus, with 5 transverse rows each of 3–9 robust setae; dactylus tapering, with 8 large robust setae plus longitudinal row of 7 smaller robust setae on inner face, plus unguis. Pereopod 4 propodus 2.4 times as long as dactylus, distally densely setose, with 5 transverse rows each of 3–10 robust setae; dactylus tapering, with 11 large robust setae plus longitudinal row of 7 smaller robust setae on inner face, plus unguis. Pereopod 5 propodus 2.5 times as long as dactylus, weakly subchelate, distally densely setose, with distal transverse row of 7 robust setae; dactylus spoon-shaped, with 2 robust setae mesially, plus unguis.

Pleopods 2–5 each with appendix interna 0.2 length of endopod. Pleopod 1 of male absent. Pleopod 2 of male appendix masculina 1.1 times as long as appendix interna. Pleopod 1 of female a single narrow article.

Telson 1.2 times as long as wide, widest proximally, then tapering, lateral margin with 4 teeth and 2 robust setae, distal margin convex between distolateral spines and robust setae, without posteromedian spine; dorsal face with oblique ridges bearing 2 spines. Uropodal endopod 1.7 times as long as wide, with 3 or 4 lateral spines, longitudinal ridge with 2–4 spines (last submarginal). Uropodal exopod 1.5 times as long as wide, with 3 or 4 lateral spines, longitudinal rib with 3 or 4 spines, posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture 3–5 spines, two most medial strongest, adjacent and diverging.

Distribution. New Zealand: Kermadec Is; Australia: Norfolk I., central NSW. Intertidal to 8 m depth.

Remarks. Chilton (1911) based his new species on "several specimens," the largest with a carapace length of 17 mm and

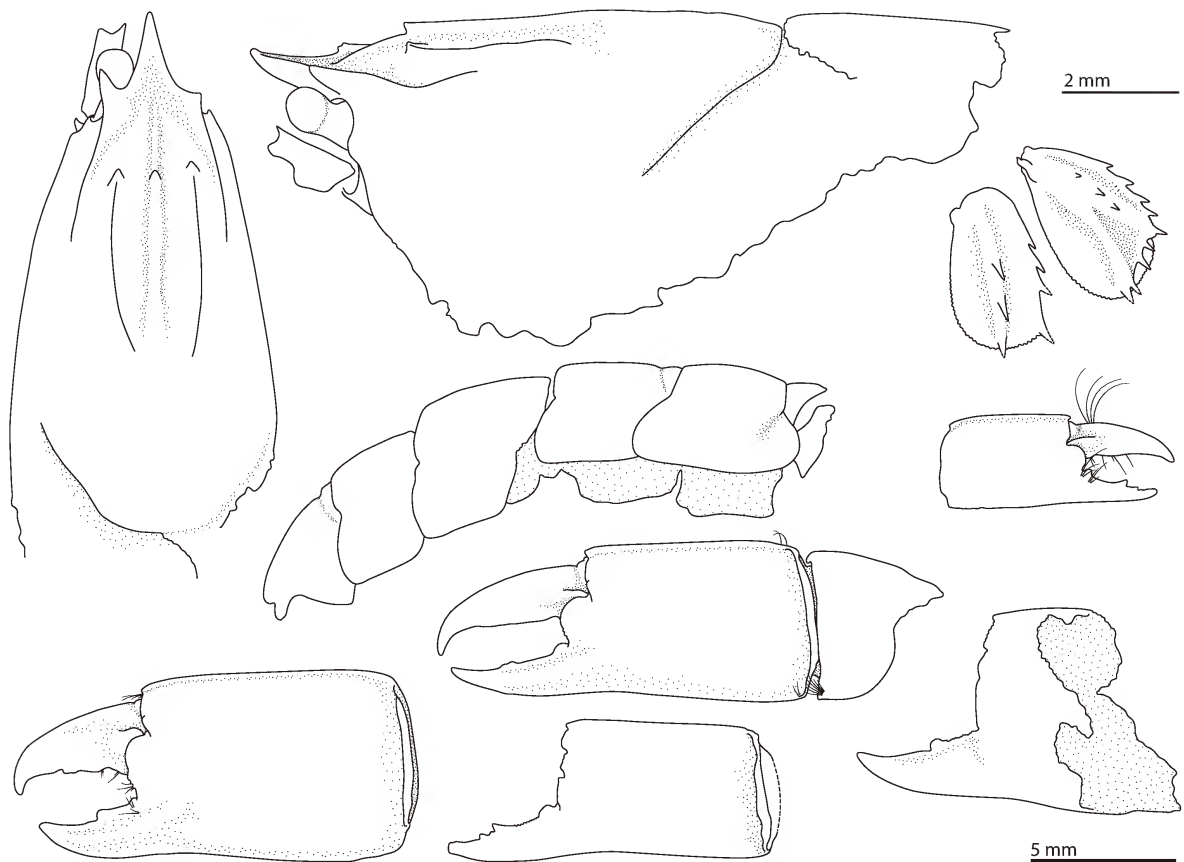


Figure 21. *Dorphinaxius kermadecensis* (Chilton, 1911). Fragments of 5 chelipeds, abdominal segments, anterior carapace, rami of right uropod. All from syntypes of *Iconaxiopsis kermadecensis* Chilton, 1911. BMNH 1912.5.25.44–46. Top scale bar refers to carapace, abdomen and uropod; bottom scale bar refers to chelipeds.

abdomen to end of telson, 29 mm. The “cotypes” at the BMNH are the remains of only three specimens; no material could be found at the Canterbury Museum, Christchurch, New Zealand, where Chilton placed other species, nor at the National Museum of New Zealand (Te Papa). His description was brief, mentioning only the rostrum, the gastric region of the carapace and the chelipeds; he illustrated only the left and right chelipeds of one individual. He likened the species to “*Iconaxiopsis andamanensis* Alcock, 1901 now placed in *Eiconaxius* Bate, 1888.

In his key, De Man (1925b) correctly assumed that the species possessed pleurobranchs and placed it in the subgenus *Axius* (*Eiconaxius*). Sakai and de Saint Laurent (1989) failed to report the pleurobranchs above pereopods 3–4 of the species they called *D. appendiculis* in spite of having examined material and noting their presence in the generic diagnosis.

The synonymy of *I. kermadecensis* and *A. appendiculis* was first proposed by Davie (2002) on the advice of the late Brian Kensley but we are unaware of how he reached this

conclusion. We have carefully examined what remains of the types of *I. kermadecensis* and compared them with types of *A. appendiculis*, both reillustrated here. We can detect no differences and agree with Kensley. The attitude of the rostrum varies remarkably (cf. figs. 22a, g), as does the number of lateral spines on the uropodal rami. A submedian tubercle sits between those on the median and lateral gastric carinae on some specimens, for example, on three of six individuals in one sample. The difference is not of taxonomic significance.

Although the species occurs at the Kermadec Islands north of New Zealand, at Norfolk Island in the Tasman Sea, and in the Sydney region, Australia, it has not been recorded from the main islands of New Zealand (S. Ah Yong, R. Webber, pers. comm.).

Eiconaxius Bate, 1880

Eiconaxius Bate, 1888: 40.—Sakai and de Saint Laurent, 1989: 15–16.—Sakai and Ohta, 2005: 69–70 (list of species).

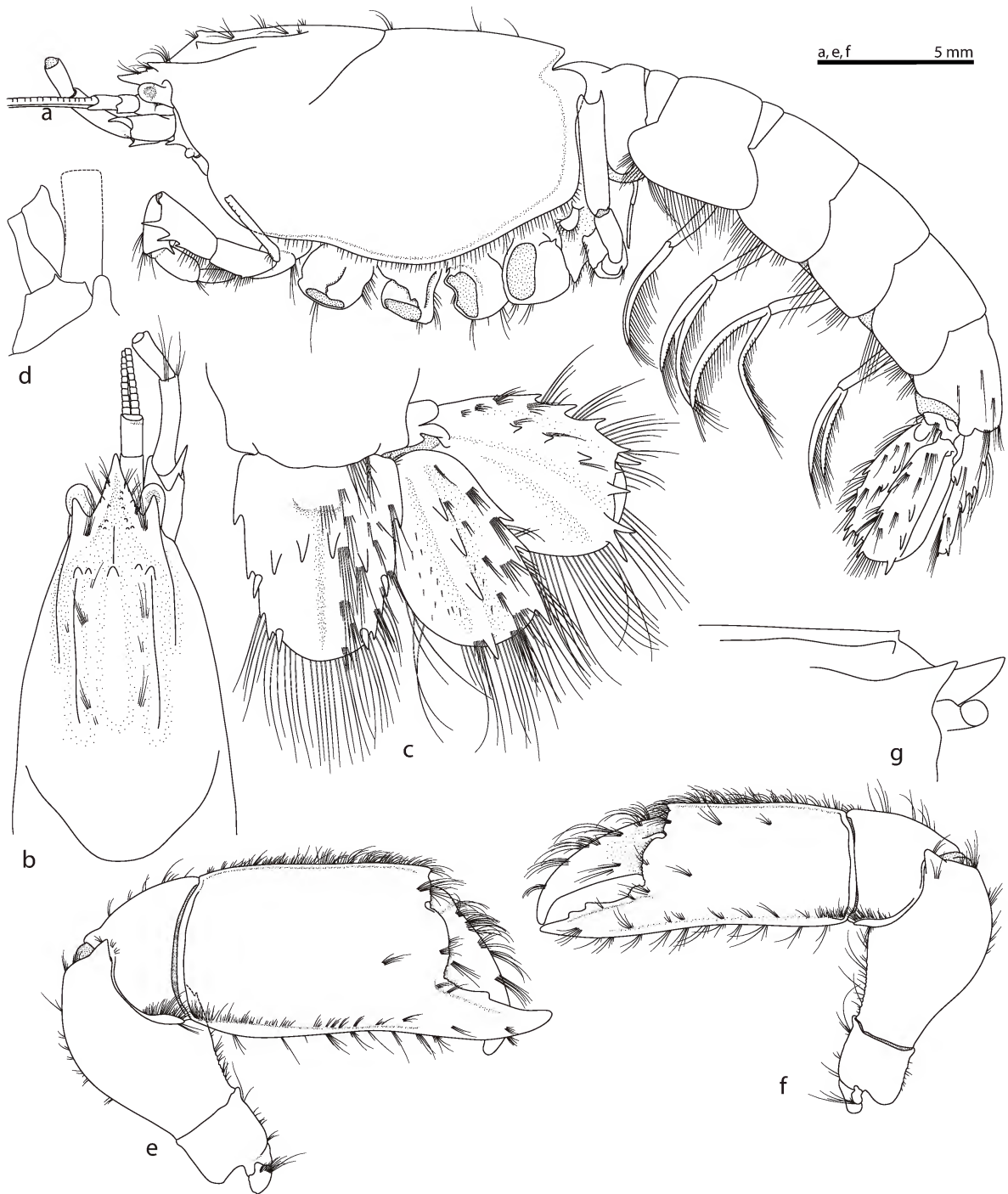


Figure 22. *Dorphinaxius kermadecensis* (Chilton, 1911). a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and right uropod. d, epistome, bases of right antennule and antenna (ventral). e, major pereopod 1 (right, lateral). f, minor pereopod 1 (left). g, lateral anterior carapace and rostrum. a–f from holotype of *Axiopsis* (*Paraxiopsis*) *appendiculus* Poore and Griffin, 1979 (AM P9359, ovigerous female, cl. 14 mm); g from female, cl. 21 mm (AM P1511).



Figure 23. *Dorphanaxius kermadecensis* (Chilton, 1911). a, maxilliped 3. b–e, pereopods 2–5. f, g, female pleopods 1, 2. h, male pleopod 2. a–g from holotype of *Axiopsis* (*Paraxiopsis*) *appendiculis* Poore and Griffin, 1979 (AM P9359, ovigerous female, cl. 14 mm). h from male, cl. 19 mm (AM P18557).

Iconaxiopsis Alcock, 1901: 193–195.—Borradaile, 1903: 537.—Balss, 1925: 210 (type species: *Eiconaxius kermadeci laccadivensis* Alcock and Anderson, 1894, subsequent designation by Borradaile, 1903.

Axius (*Eiconaxius*).—Borradaile, 1903: 537–538.—De Man, 1925b: 8–9 (synonymy of *Iconaxiopsis*), 14.

Type species. *Eiconaxius acutifrons* Bate, 1888, subsequent designation by Borradaile, 1903.

Diagnosis. Carapace smooth; cervical groove weak to inconspicuous. Rostrum triangular, broad, laterally smooth or obscurely denticulate, longer than eyestalks, depressed below level of carapace, continuous with definite lateral carinae; supraocular spines absent; lateral carina unarmed; submedian carina present, converging anteriorly and joining median carina; median carina a weak ridge on rostrum only, armed or not; postcervical carina absent. Abdominal somite 1 pleuron rounded; pleuron 2 posteriorly acute; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea pigmented or not. Antenna, scaphocerite blade-like. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs present above pereopods 2–4; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 asymmetrical, with propodus cylindrical; carpus-dactylus upper and lower margins smooth or toothed, propodus at least with distal tooth on upper margin. Pereopods 3–5 propodi with transverse rows of robust setae; dactyli spatulate, with row of robust setae along oblique margin. Pleopods 3–5, appendix interna present. Pleopod 1 of male absent. Pleopod 2 of male with appendix interna and appendix masculina. Uropodal exopod without transverse suture. Telson with lateral teeth, without posterolateral robust setae; apex rounded or truncate.

Remarks. *Eiconaxius* is a well-characterised genus of 25 similar species from deep waters in the Indo-Pacific, Caribbean and Gulf of Mexico. Sakai and Ohta (2005) erected a family, Eiconaxiidae, for the genus defining it mainly using typical generic characters. They believed the family “is conspicuously different from all other genera of the family Axiidae” citing the chelate pereopod 2, rounded dactyli with robust marginal setae on pereopods 3–5, indistinct cervical groove and absence of the male pleopod 1. Chelate pereopods 2 are found in all axiideans. A similar “rounded” or spatulate dactylus is found on pereopod 5 of *Platyaxius* Sakai, 1994 (see below) but not on pereopods 3 and 4. *Platyaxius* also has an oval telson and uropodal rami, the exopod without a transverse suture, similar to those of species of *Eiconaxius*. In the telson and uropod (but not the male pleopod 1) these two genera are similar to *Scytoleptus* Gerstaecker, 1856. Several axiid genera lack a male pleopod 1. Many genera lack a pleopod 1 and have an indistinct cervical groove. These similarities suggest a more complex relationship between the genera than proposed by Sakai and Ohta (2005) and we include the genus in Axiidae for now.

The median carina has been described as bifurcating posteriorly in species of *Eiconaxius*. We interpret the bifurcation as the two submedian gastric carinae converging anteriorly on the median carina and look to axiid genera such as *Axiopsis* Borradaile, 1903 for homology (see for example Ngoc-Ho, 2005).

Eiconaxius kimbla Kensley, 1996

Eiconaxius kimbla Kensley, 1996b: 481–483, fig. 8.—Davie, 2002: 453.

Distribution. Qld, c. 150 m depth.

Remarks. In this species the rostral rim is unarmed and uropodal rami are obliquely truncated. No material was examined.

Eiconaxius mallacoota sp. nov.

Figure 24

Material examined. Holotype. Australia, Victoria, S of Point Hicks (38°19.36'S, 149°24.18'E–38°19.00'S, 149°27.18'E, 930–951 m (stn SLOPE 33), M.F. Gomon et al. on RV *Franklin*, WHOI epibenthic sled, 23 Jul 1986, NMV J15061 (male, cl. 5.7 mm, tl. 15.0 mm).

Paratypes. Collected with holotype, NMV J53161 (male, cl. 4.1 mm, tl. 11.0 mm); NMV J53162 (male, cl. 6.2 mm, tl. 16.8 mm). S of Point Hicks (38°21.90'S, 149°20.00'E, 1000 m (stn SLOPE 32), G.C.B. Poore et al. on RV *Franklin*, WHOI epibenthic sled, 23 Jul 1986, NMV J15060 (juvenile, cl. 2.0 mm, abdomen damaged).

Description of male holotype. Carapace smooth. Rostrum 0.25 times length of front-to-posterior margin of carapace, concave dorsally, parallel-sided over eyes, then tapering to acute tip, with 10 marginal lateral tubercles on oblique margins, depressed below level of median carina, anteriorly directed, continuous with lateral carinae. Supraocular spines absent. Lateral carina unarmed. Submedian carina smooth, together semicircular and converging on median carina. Median carina obsolete, on base of rostrum only. Abdominal somite 1 pleuron ventrally rounded-truncate; pleuron 2 oblique angled, posteroventrally acutely produced; pleura 3–4 posteroventrally acutely produced, pleuron 5 less so, all with anteroventral tooth; pleura 6 subacute; abdominal somite 6 dorsal posterior margin with pair of lateral teeth at base of telson, with (3 uneven) denticles along dorsal posterior margin.

Eyestalk 0.5 length of rostrum; cornea unpigmented. Antennular peduncle reaching to end of antennal article 4; article 1 unarmed. Antennal article 1 unarmed; article 2 stylocerite a vertical blade, reaching to midpoint of article 5; scaphocerite a vertical blade, reaching beyond end of article 5; article 3 lower margin with mesial tooth; article 4 as long as article 2; article 5 about half length of article 4. Maxilliped 3 coxa–ischium unarmed; crista dentata of about 15 similar teeth; merus and carpus unarmed.

Pereopods 1 asymmetrical, robust. Major cheliped coxa with 1 spinule; basis unarmed; ischium lower margin with few irregular teeth; merus upper margin strongly convex, with 2 small teeth, lower margin with 6 small teeth; carpus lower margin with 1 distal tooth; propodus greatest depth equal to upper margin length; upper margin with distal tooth, lower margin with 5 small teeth on lateral submarginal ridge; fixed finger 0.7 times as long as upper palm, cutting edge with irregular teeth in shallow proximal concavity, irregular tooth distally; dactylus distally curved, cutting edge smooth.

Minor cheliped more slender than major; coxa with 1 spinule; basis unarmed; ischium lower margin with few

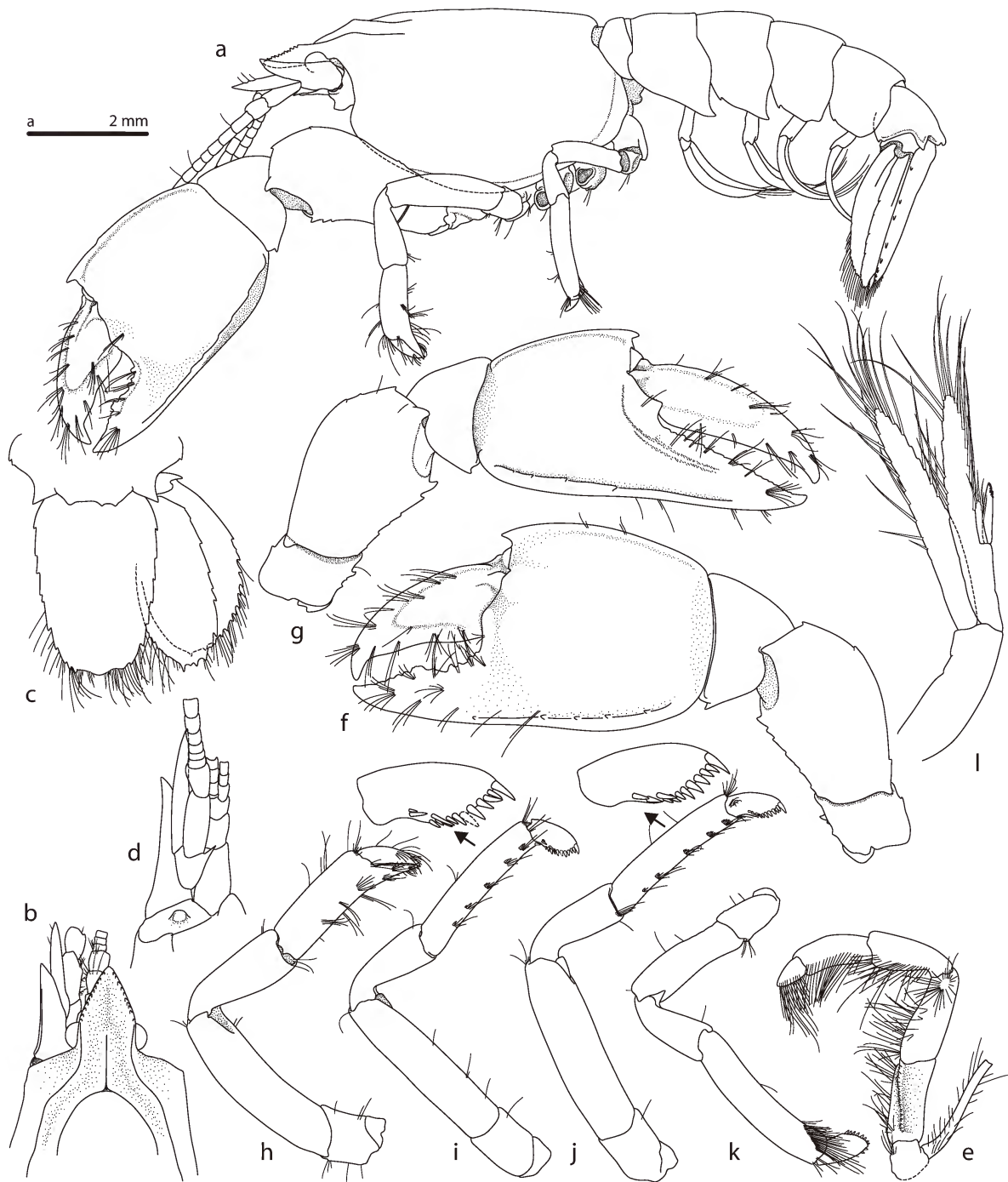


Figure 24. *Eiconaxius mallacoota* sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and right uropod. d, epistome, right antennule and antenna (ventral). e, maxilliped 3. f, major pereopod 1 (left, lateral). g, minor pereopod 1 (right). h–k, pereopods 2–5 (with details of dactyli of pereopods 3 and 4). l, male pleopod 2. All figures from holotype.

irregular teeth; merus upper margin strongly convex, with 2 small teeth, lower margin with 5 small teeth; carpus lower margin with 1 distal tooth; propodus greatest depth 1.1 times upper margin length; upper margin with distal tooth, lower margin with 4 small teeth on lateral submarginal ridge; fixed finger 1.2 times as long as upper palm, with lateral ridge parallel to cutting edge, cutting edge straight, with irregular teeth; dactylus tapering, cutting edge smooth.

Pereopod 2 ischium lower margin unarmed; merus lower margin unarmed; carpus slightly shorter than chela; propodus upper margin 3 times as long as dactylus. Pereopod 3 merus unarmed; propodus 2.5 times as long as dactylus, with 6 rows of robust setae, of 1 or 2 setae; dactylus spatulate, with 13 robust setae along oblique margin, plus unguis. Pereopod 4 virtually identical to pereopod 3; propodus 2.5 times as long as dactylus, with 6 rows of robust setae, of 1–3 setae; dactylus spatulate, with 11 robust setae along oblique margin, plus unguis. Pereopod 5 propodus 2.8 times as long as dactylus, simple, distally densely setose, without robust setae; dactylus spatulate, with 8 robust setae along oblique margin, plus unguis.

Pleopods 2–5 each with appendix interna 0.25 length of endopod. Pleopod 2 of male appendix masculina 0.7 times as long as appendix interna.

Telson 1.5 times as long as wide, widest proximally, then tapering more steeply distally, lateral margin with 8–10 small teeth, distal margin a shallow obtuse angle between weak distolateral teeth, without posteromedian spine; dorsal face with obsolete longitudinal ridges. Uropodal endopod 2.35 times as long as wide, oval, with 12 small irregular lateral teeth, last tooth distal, without longitudinal ridge. Uropodal exopod 1.6 times as long as wide, oval with 14–20 small irregular lateral teeth over distal two-thirds, last tooth distal, without longitudinal rib.

Variation. Paratype male, cl. 6.2 mm, NMV J53162. Abdominal somite 6 posterodorsal margin with pair of lateral teeth and 2 pairs of submedian denticles. Telson with 7 small lateral teeth.

Paratype male, cl. 4.1 mm, NMV J53161. Rostrum with 5 sharp lateral teeth. Abdominal somite 6 posterodorsal margin with pair of lateral teeth, 1 pair of submedian denticles, 1 median tooth. Minor cheliped merus upper margin with 3 teeth, lower margin with 2 teeth; propodus upper margin with 2 teeth; dactylus upper margin with 1 tooth. Telson with 7 small lateral teeth.

Paratype juvenile, cl. 2.0 mm, NMV J15060. Major cheliped merus upper margin with 2 teeth, lower margin with 2 teeth; propodus upper margin with 2 teeth, lower margin with 4 teeth (all more prominent than in larger specimens). Minor cheliped merus upper margin with 1 tooth, lower margin with 1 tooth; propodus upper margin with 4 teeth, lower margin with 3 teeth; dactylus upper margin unarmed.

Etymology. Mallacoota, a township and estuary not far from the type locality (noun in apposition).

Distribution. Australia, off eastern Vic., 930–1000 m depth.

Remarks. The new species is represented by three males and one juvenile. The males vary only slightly but the juvenile has more prominent spination on the chelipeds than the others.

Eiconaxius mallacoota is similar to *E. kermadeci* (Bate, 1888) from a depth of 1100 m at the Kermadec Islands, north of New Zealand. The latter was redescribed by Sakai and de Saint Laurent (1989: 16–18, fig. 5) and a lectotype designated. The acute rostrum and gastric region of *E. kermadeci* are similarly weakly ornamented but the rostrum is shorter, not reaching to article 3 of the antennule, and less acutely tapering. The telson and uropodal rami of *E. kermadeci* are relatively broader than in the new species and the fixed finger of the larger cheliped is basally strongly toothed and gaping. At 37 mm long (according to Bate, or 23 mm according to Sakai and de Saint Laurent) *E. kermadeci* is larger than the new species but few specimens are available for either species.

Another similar species is *E. parvus* (Bate, 1888), known from a single 12 mm long ovigerous female (holotype, not lectotype as stated by Sakai and de Saint Laurent) taken at 950 m also near the Kermadec Islands. Bate's short description and simple drawing do not allow a comparison but Paul Clark (Natural History Museum, London) kindly figured the holotype for us (fig. 25). The rostrum of *E. parvus* is not so clearly tapered as in *E. mallacoota*, the telson is relatively broader and the chelipeds slightly more elongate.

A third similar species is *E. demani* Sakai, 1992 from Indonesia and the Arafura Sea (just outside Australia's EEZ) but its rostrum is apically rounded rather than acute. The only other Australian species is *E. kimbla* Kensley, 1996b, which differs from the new species in having an irregularly ornamented tapering rostrum, shorter telson, asymmetrical uropodal rami, and more massive elongate chelae with short fingers.

Michelaxiopsis gen. nov.

Type species. *Axiopsis (Axiopsis) australiensis* De Man, 1925, herein designated.

Diagnosis. Carapace and abdomen smooth or covered with numerous stiff setae; cervical groove visible laterally over most of distance to anterolateral margin. Rostrum triangular, broad, laterally denticulate, longer than eyestalks, slightly depressed below level of carapace, continuous with definite lateral carinae; supraocular spines barely differentiated from other spines; lateral carina beaded; submedian carina present, beaded, duplicated as hair-pin shape; median carina toothed and beaded; postcervical carina absent. Abdominal somite 1 pleuron acute; pleuron 2 broad, anteriorly rounded, posteriorly rounded; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea pigmented. Antenna, scaphocerite long, acute. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs present above pereopod 2–4; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 asymmetrical (in male), with propodus cylindrical; carpus-dactylus upper margins smooth. Pereopods 3–4 propodi with transverse rows of robust setae; dactyli tapering, with longitudinal row of robust setae. Pleopods 3–5, appendix interna present. Pleopod 1 of male absent. Pleopod 2 of male without appendix masculina. Uropodal exopod with transverse suture. Telson with lateral fixed spines and posterolateral robust setae; apex truncate-rounded.

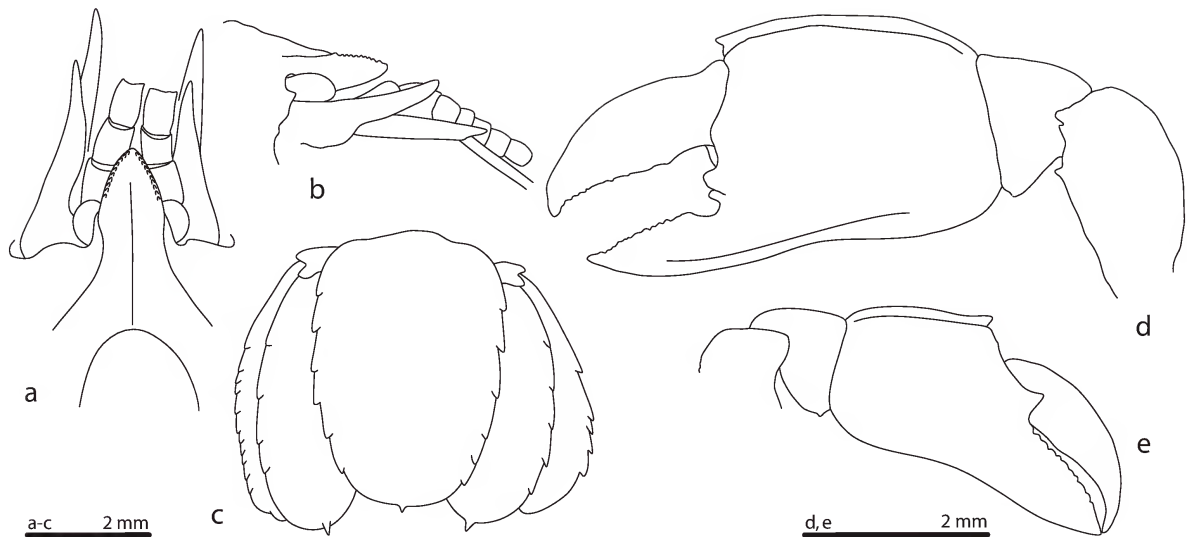


Figure 25. *Eiconaxius parvus* (Bate, 1888). a, b, dorsal and lateral views of anterior carapace, peduncles of antennule and antenna. c, telson and right uropod. d, major cheliped (left). e, minor cheliped (right). All figures prepared for publication by DJC from pencil drawings of the holotype by Paul Clark.

Etymology. This species is dedicated to the late Michèle de Saint Laurent (1926–2003) who in 1990 alerted the first author to the probability that the type species belonged to a new genus.

Remarks. Although superficially similar to species of *Axiopsis*, the type species and the second described below differ in two important characters. Pleurobranchs are present and well developed over pereopods 2–4 (absent and probable apomorphy in *Axiopsis*) and the male pleopod 2 lacks an appendix masculina (present and probable plesiomorphy in *Axiopsis*).

Michelaxiopsis australiensis (De Man, 1925) comb. nov.

Figure 26

Axiopsis (Axiopsis) australiensis De Man, 1925a: 127–132, fig. 4.—De Man, 1925b: 69.—Poore and Griffin, 1979: 226–228, fig. 2.

Axiopsis australiensis.—Poore, 2004: 174, figs. 45a, b, 46a.

Axiopsis australiensis.—Sakai and de Saint Laurent, 1989: 26, 29.—Sakai, 1992: 165, fig. 7.—Davie, 2002: 451.—Sakai, 1994: 200.

Material examined. NSW, Long Reef, W end of reef (33°44'S, 151°19'E), I. Bennett, Apr 1964, AM P24699 (2 ovigerous females, cl. 20.0, 24.7 mm). Port Jackson, Watsons Bay (33°50.8'S, 151°16.8'E), McIntosh and Whitelegge, Mar 1908, AM P15036 (1 male, cl. 11.7 mm; 2 females, cl. 13.6, 15.0 mm).

Vic., Shoreham (38°26'S, 145°03'E), AM P1757 (2 juvenile males, cl. 7.2, 8.5 mm).

Diagnosis. Carapace smooth, with scattered long setae. Rostrum 0.25 times length of front-to-cervical groove, broadly acute, rugose dorsobasally, with 5 lateral spines anterior to supraocular spine, continuous with definite lateral gastric carinae. Supraocular spines barely differentiated from others

in row. Lateral gastric carina with 3 or 4 obscure low beads fading posteriorly. Submedian gastric carina duplicated, outer row of 12–15 tubercles curving inwards at anterior end, beading fading posteriorly, inner row of 3–5 tubercles anteriorly, 3–4 posteriorly and clear hiatus between. Median gastric carina with 18–22 tubercles, scarcely taller anteriorly, fading posteriorly.

Antennule article 1 with sharp stylocerite. Antennal article 2 distal spine slender, directed anteriorly, reaching distally to quarter of antennal article 4; scaphocerite reaching two-thirds length of article 4, simple; article 3 with short mesiodistal spine on lower margin.

Major pereopod 1 ischium lower margin with 1 spine; merus upper margin convex, unarmed, lower margin with 5 spines, last longest, lateral face smooth, mesial face smooth; carpus upper margin unarmed, lower margin unarmed; propodus upper margin tuberculate, lower margin smooth, lateral face with squamous tubercles concentrated on distal two-thirds along lower margin, few along upper margin, mesial face with squamous tubercles concentrated on distal two-thirds along lower margin, few along upper margin; fixed finger 0.8 length of upper palm, cutting edge with 1 blunt tooth and 1 triangular tooth; dactylus upper margin smooth, lateral face smooth, mesial face smooth, cutting edge with blunt tooth at midpoint and notch proximally, with subapical robust setae prominent.

Minor pereopod 1 of similar length and ornamentation as major cheliped but narrower.

Telson 1.2 times as long as wide, lateral margin unarmed (rarely 1 spine), distal margin convex, with posteromedian

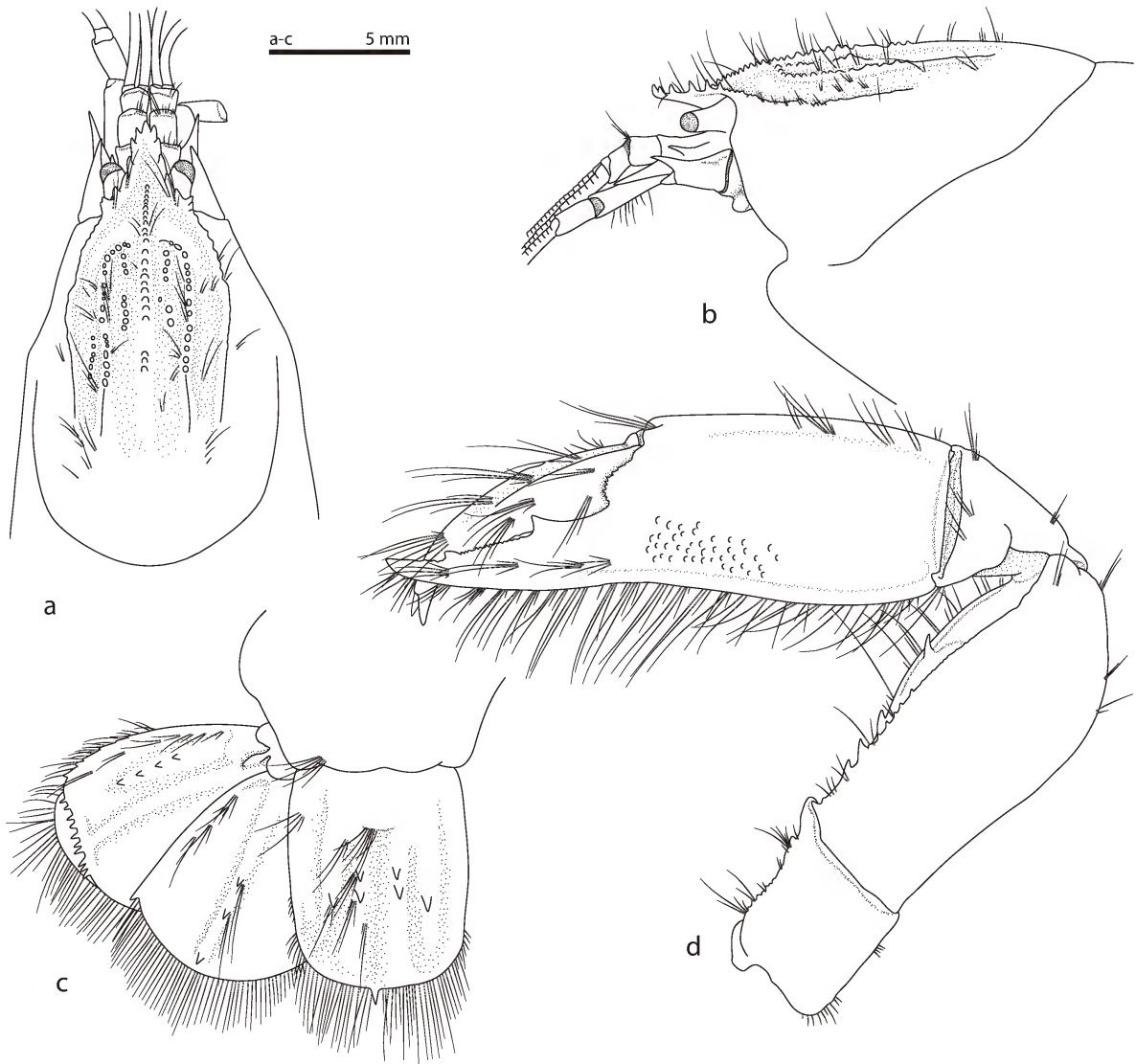


Figure 26. *Michelaxiopsis australiensis* (De Man, 1925). a, b, lateral and dorsal view of anterior carapace, peduncles of antennule and antenna. c, telson and left uropod. d, cheliped (left). All figures from female (AM P24699).

spine, posterolateral angle with inconspicuous robust setae; dorsal face with 2 spines in each oblique row. Uropodal endopod 1.2 times as long as wide, with or without lateral spine and 1 distolateral spine, longitudinal ridge with 4–5 spines. Uropodal exopod 1.3 times as long as wide, with 5–6 lateral spines, 2 longitudinal ribs with 3–4 on outer rib, posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 6–10 spines.

Distribution. NSW, Vic., intertidal-subtidal.

Remarks. *Michelaxiopsis australiensis* is differentiated from *M. nauo* by the absence of short stiff setae on the carapace and abdomen. The submedian gastric carina is duplicated, the outer row of tubercles continuous and the inner one of three anterior and three or four posterior tubercles separated by a distinct hiatus. The median gastric carina is composed largely of bead-like tubercles, the anteriormost ones only slightly more elevated than posterior ones. The lateral margin of the telson is usually smooth, and only rarely with a small tooth. The absence of the

male pleopod 1 and gastric ornamentation exclude this species from *Axius* to which it has been assigned. Poore and Griffin (1979) listed numerous specimens from central NSW, a few of which were re-examined for this study.

The two small specimens from Victoria are in poor condition. They differ from the others in that the gastric carinae are almost smooth, with only vestiges of the beads or tubercles of larger specimens. The hiatus in the inner submedian row is quite evident.

***Michelaxiopsis nauo* sp. nov.**

Figures 27, 28

Material examined. Holotype. SA, Sir Joseph Banks Group: Roxby I. (34°35'S, 136°19'E), 6 m, in burrow under rocks, N. Holmes, 9 Jan 1988, SAM C6811 (ovigerous female, cl. 24.5 mm).

Paratypes. SA, Reevesby I. (34°31'S, 136°16'E), offshore from Northwest Point, 3 m, under rocks, W. Zeidler, 13 Jan 1984, SAM C6812 (male, 9.0 mm); Marum I., North Point (34°30'S, 136°15'E), 5–6 m, under rocks, K. Gowlett, 22 Jan 1985, SAM C6813 (male, 14.5 mm); between Reevesby and Partney Is., opposite Nicholas Bay, 6 m, under dead *Pinna* shells, K. Gowlett and N. Holmes, 23 Jan 1985, NMV J59765 (female, cl. 11.0 mm).

Description of female holotype. Carapace covered with short stiff setae, often in small bunches, and scattered longer setae. Rostrum 0.25 times length of front-to-cervical groove, broadly acute, with 4 lateral spines anterior to supraocular spine, continuous with definite lateral gastric carinae. Supraocular spines barely differentiated from others in row. Lateral gastric carina with obscure low beads fading posteriorly. Submedian gastric carina duplicated in form of a hair-pin, of 20–25 beads in each row, fading posteriorly. Median gastric carina with about 5 erect spines near base of rostrum and about 15 beads fading posteriorly. Abdominal somite 1 pleuron ventrally rounded; pleuron 2 rounded anteriorly and posteriorly; pleura 3–4 posteroventrally rounded, pleuron 5 less so; pleuron 6 rounded.

Eyestalk, 0.5 length of rostrum; cornea pigmented. Antennular peduncle reaching almost to end of antennal article 4; article 1 with sharp stylocerite. Antennal article 2 distal spine slender, directed anteriorly, reaching distally to quarter of antennal article 4; scaphocerite reaching two-thirds length of article 4, simple; article 3 with sharp mesiodistal spine on lower margin. Maxilliped 3 coxa–ischium unarmed; crista dentata of about 20 similar teeth; merus with 4 spines, largest distal; carpus with 1 spine.

Pereopods 1 symmetrical; ischium lower margin with 1 spine; merus upper margin convex, unarmed, lower margin with 6 spines; propodus upper margin tuberculate, lower margin smooth, lateral face with squamous tubercles concentrated on distal two-thirds (absent proximally and from fixed finger), mesial face with squamous tubercles concentrated on distal two-thirds (absent proximally and from fixed finger); fixed finger 0.7 length of upper palm, cutting edge with 1 blunt bicuspid tooth; dactylus upper margin smooth, lateral face smooth, mesial face smooth, cutting edge with blunt tooth at midpoint and notch proximally.

Pereopod 2 ischium lower margin unarmed; merus lower margin unarmed; carpus slightly longer than chela; propodus

upper margin 1.2 times as long as dactylus. Pereopod 3 merus lower margin unarmed; propodus 2.5 times as long as dactylus, with 7 transverse rows of 2 or 3 robust setae; dactylus with 2 longitudinal rows of robust setae. Pereopod 4 merus unarmed; propodus 2.1 times as long as dactylus, with 8 transverse rows of 1–4 robust setae; dactylus with 2 longitudinal rows of robust setae. Pereopod 5 propodus 2.2 times as long as dactylus, subchelate, with short fixed finger; dactylus with row of 6 robust setae.

Pleopod 1 a simple, setose article. Pleopods 2–5 each with appendix interna 0.25 length of endopod.

Telson 1.2 times as long as wide, lateral margin with 3 spines, distal margin convex, with posteromedian spine, posterolateral angle with 2 robust setae; dorsal face with 2 spines in each oblique row. Uropodal endopod 1.5 times as long as wide, with 1 lateral spine and 1 distolateral spine, longitudinal ridge with 4–6 spines. Uropodal exopod 1.3 times as long as wide, with 4 lateral spines, 2 longitudinal ribs with 6 and 2 spines, posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 7–11 spines.

Male. Pereopods 1 significantly differentiated. Major pereopod 1 ischium lower margin with 1 spine; merus upper margin convex, with 2 spines, lower margin with 5 spines, last longest, lateral face smooth, mesial face smooth; carpus upper margin unarmed, lower margin unarmed; propodus upper margin tuberculate, lower margin smooth, lateral face with squamous tubercles concentrated on distal two-thirds (absent proximally and from fixed finger), mesial face with squamous tubercles concentrated on distal two-thirds (absent proximally and from fixed finger); fixed finger 0.6 length of upper palm, cutting edge with 1 blunt bicuspid tooth and 1 triangular tooth; dactylus upper margin smooth, lateral face smooth, mesial face smooth, cutting edge with blunt tooth at midpoint and notch proximally.

Minor pereopod 1 of similar length and ornamentation as major cheliped but narrower (85% of width) and merus upper margin unarmed.

Etymology. The species is named for the Nauo people of the southern part of the Eyre Peninsula, South Australia, close to the Sir Joseph Banks Group of islands (noun in apposition).

Distribution. SA, Sir Joseph Banks Group of islands; 5–6 m depth.

Remarks. *Michelaxiopsis nauo*, from South Australia, differs from *M. australiensis*, from NSW and Victoria, most obviously in having a setose carapace and abdomen. The submedian gastric carina is duplicated, both rows of tubercles continuous and fading posteriorly. The anterior-most tubercles of the median gastric carina are decidedly more elevated than posterior ones. The lateral margin of the telson always has three teeth, absent in *M. australiensis*.

***Oxyrynchaxius* Parisi, 1917**

Remarks. *Oxyrynchaxius* is characterised by elongate eyestalks, longer than the spike-like rostrum and a carapace covered with spinules (Lin et al., 2000). The Australian species is only the second known.

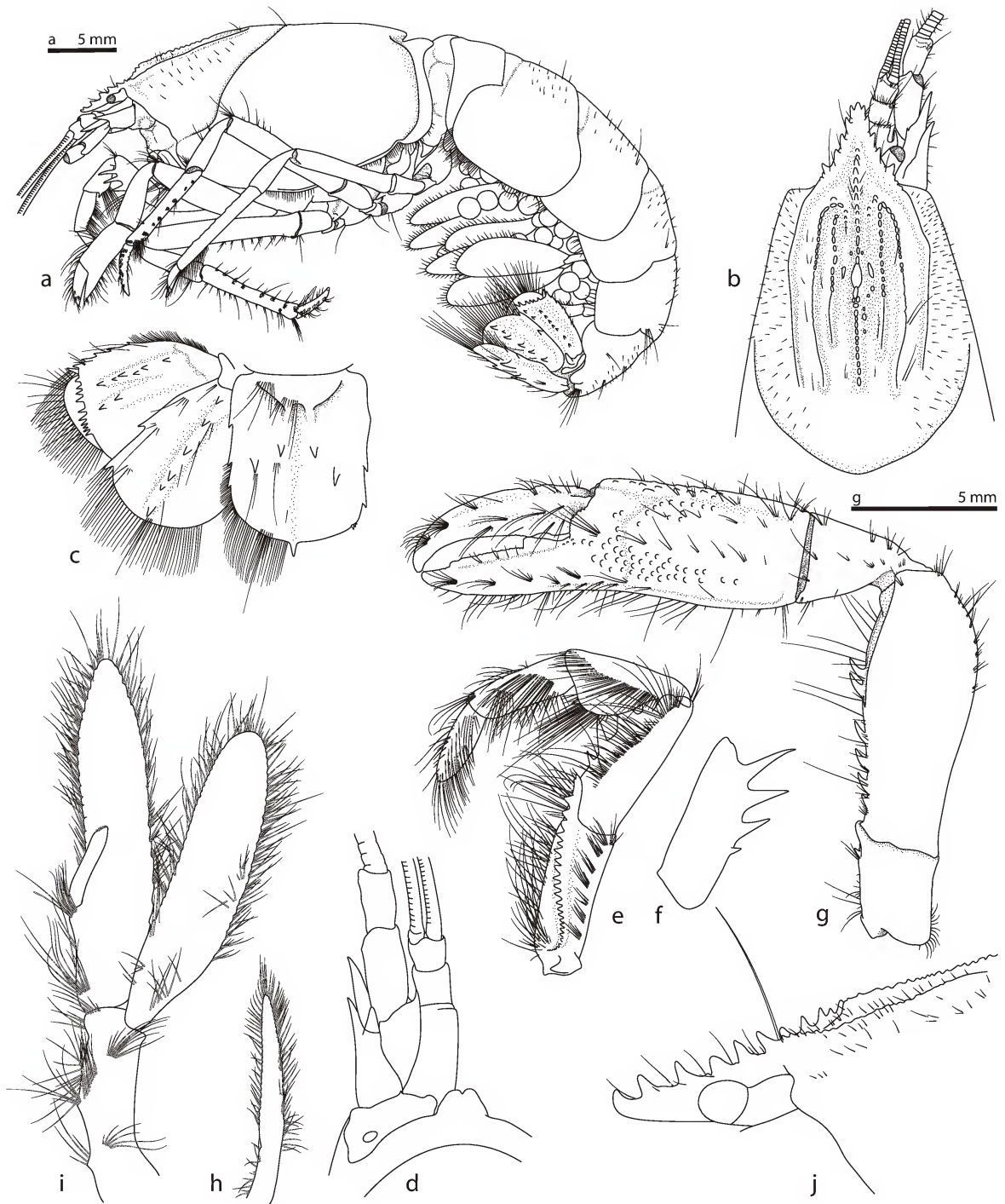


Figure 27. *Michelaxiopsis nauo* sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and left uropod. d, epistome, right antennule and antenna (ventral). e, f, maxilliped 3. g, pereopod 1 (left, lateral). h, i, female pleopods 1, 2. j, lateral anterior carapace and rostrum. a–i from holotype; j from paratype male (SAM C6813).

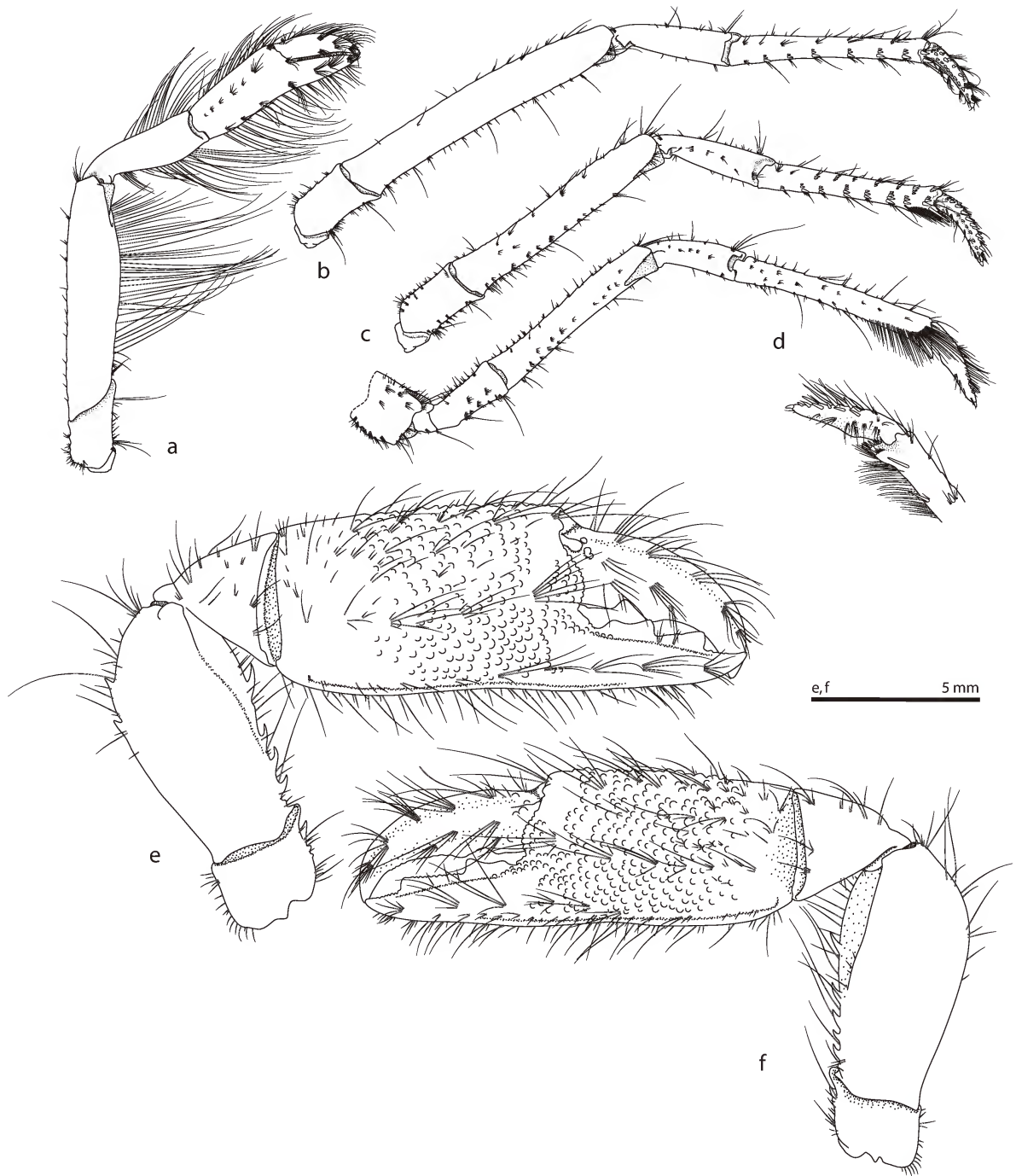


Figure 28. *Michelaxiopsis nauo* sp. nov. a–d, pereopods 2–f (with detail of dactylus of pereopod 5). e, major pereopod 1 (right, lateral). f, minor pereopod 1 (right, lateral). a–d from holotype; e, f from paratype male (SAM C6813).

***Oxyrhynchaxius manningi* Lin, Kensley and Chan, 2000**

Oxyrhynchaxius manningi Lin et al., 2000: 203–205, figs. 3, 4.—Davie, 2002: 453.

Distribution. WA, North West Shelf, 134 m depth.

Remarks. The generic characters immediately identify the species in Australia.

***Paraxiopsis* De Man, 1905**

Axiopsis (*Paraxiopsis*) De Man, 1905: 597.

Paraxiopsis.—Kensley, 1996a: 709–712.

Eutrichocheles.—Sakai and de Saint Laurent, 1989: 51 (part).

Diagnosis. Carapace and abdomen smooth or covered with numerous stiff setae; cervical groove visible laterally over half distance to anterolateral margin. Rostrum triangular, broad, laterally denticulate or unarmed, longer than eyestalks, slightly depressed below level of carapace, continuous with definite lateral carinae; supraocular spines barely differentiated from other spines; lateral carina spinose or smooth; submedian carina present, dentate or smooth; median carina smooth; postcervical carina absent. Abdominal somite 1 pleuron acute; pleuron 2 broad, anteriorly rounded, posteriorly rounded; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea pigmented. Antenna, scaphocerite short, acute or asymmetrically bifid. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs absent; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 asymmetrical, with propodus cylindrical; carpus-dactylus upper margins smooth. Pereopods 3–4 propodi with transverse rows of robust setae; dactyli tapering, with longitudinal row of robust setae. Pleopods 3–5, appendix interna absent. Pleopod 1 of male absent or minute article. Pleopod 2 of male without appendix interna, with appendix masculina. Uropodal exopod with transverse suture. Telson without lateral fixed spines and with posterolateral robust setae; apex rounded.

Remarks. The subgenus *Paraxiopsis* De Man, 1905 was synonymised with *Eutrichocheles* Wood-Mason, 1876 by Sakai and de Saint Laurent (1989) but later resurrected at full genus status (Kensley, 1996a). Kensley (2003) brought the number of species to fourteen. The two genera share several features, male pleopod 1 lacking or reduced, absence of appendix interna on pleopods 2–5, and similar gastric carinae. Kensley (1996a) listed several characteristics distinguishing *Paraxiopsis* from *Eutrichocheles*, notably the absence of a postcervical carina, absence of a gape and tubercle on fingers of the cheliped, presence of a spine and absence of a notch on the telson, and small size (maximum cl. 8 mm). His differentiation was accepted with minor discrepancies by Ngoc-Ho et al. (2005) who redescribed *E. modestus* Wood-Mason, 1876, type species of *Eutrichocheles*. Kensley (1996a) diagnosed *Paraxiopsis* as lacking male pleopod 1 but one male of *P. pumilus* displays minute digitiform male pleopods 1 (see fig. 30e) as in species of *Eutrichocheles* (Ngoc-Ho et al., 2005). The female pleopod 1 is typically a uniramous appendage but in *P. pauleyi* Kensley, 1996a, *P. majuro* Kensley, 1996a, *P. austrinus* (fig. 29b) and *P. pumilus* pleopod 1 is a minute conical articulating projection similar to that seen in some males.

Kensley (1996a) noted the presence of an appendix masculina on the male pleopod 2 (in spite of few species of the genus actually being documented) and this is confirmed for *P. pumilus* below.

***Paraxiopsis austrinus* (Sakai, 1994)**

Figure 29

Eutrichocheles austrinus Sakai, 1994: 185, figs. 6, 7.

Paraxiopsis austrinus.—Kensley, 2003: 373

Material examined. NT, Bullocky Point, Darwin, 12°26'S, 130°50'E, low water rocky outcrops with muddy pools, A.J. Bruce, 3 Dec 1982 (stn AJB-10), NTM Cr003173 (2 females, cl. 8.3 mm, 6.8 mm; juvenile, cl. 3.4 mm). NT, Shell Island, Darwin, 12°30'S, 130°45'E, reef pools, D. Sachs, 18 Mar 1988 (stn AJB-38), NTM Cr006384 (female, cl. 10 mm).

Distribution. NT, Darwin region, 12°S, 130°E, low intertidal.

Remarks. Kensley (2003) differentiated this species from nine other species of *Paraxiopsis*. It is recognisable by the presence of a tomentum of long and short setae over much of the body and limbs. The rostrum has three close-set spines on the lateral margins running towards three more on the lateral gastric carina. The submedian gastric carinae each has usually six spines but in the female illustrated here there are eight on one side only. Sakai based his species on two females only. One of the females in the new collection, with gonopores on coxae 3, has a minute pair of pleopods 1 while the others do not.

***Paraxiopsis brocki* (De Man, 1888)**

Restricted synonymy.

Axius Brocki De Man, 1888: 475, pl. 20 fig. 3.

Axiopsis (*Paraxiopsis*) *brocki*.—De Man, 1925b: 101, pl. 8 figs. 19–19f.—Poore and Griffin, 1979: 228, fig. 3.—Tirmizi, 1983: 88, fig. 3.—Morgan, 1990: 6, 63.

Eutrichocheles brocki.—Sakai and de Saint Laurent, 1989: 52, fig. 4B.—Ngoc-Ho, 1998: 365, fig. 1.

Paraxiopsis brocki.—Kensley, 1996a: 712, figs. 1, 2.—Poore, 2004: 176, figs. 45g, h, 46d.—Ngoc-Ho et al., 2005: 200.

Material examined. WA, near Mermaid Reef, 17°46.10'S, 120°43.15'E–17°45.95'S, 120°42.94'E (stn SS05-2007 097), 97–109 m, 20 Jun 2007, NMV J155708 (ovigerous female lacking most pereopods, cl. 6 mm).

Distribution. Indo-West Pacific from Japan and Hawaii in north, Tuamotu in east, through Indonesia, to southwestern Australia, and to Kenya; to 100 m depth.

Remarks. *Paraxiopsis brocki* has been redescribed and illustrated several times recently. It has been recorded from WA and NT in Australia by Poore and Griffin (1979) and Morgan (1990). The new specimen has prominent rostral spines like that figured by Poore and Griffin (1979), more prominent than on the specimen from Tuamotu figured by Ngoc-Ho (1998). The female has prominent uniramous first pleopods.

***Paraxiopsis pumilus* (Sakai, 1994)**

Figures 30, 31, 44

Eutrichocheles pumilus Sakai, 1994: 188–192, figs. 8, 9.

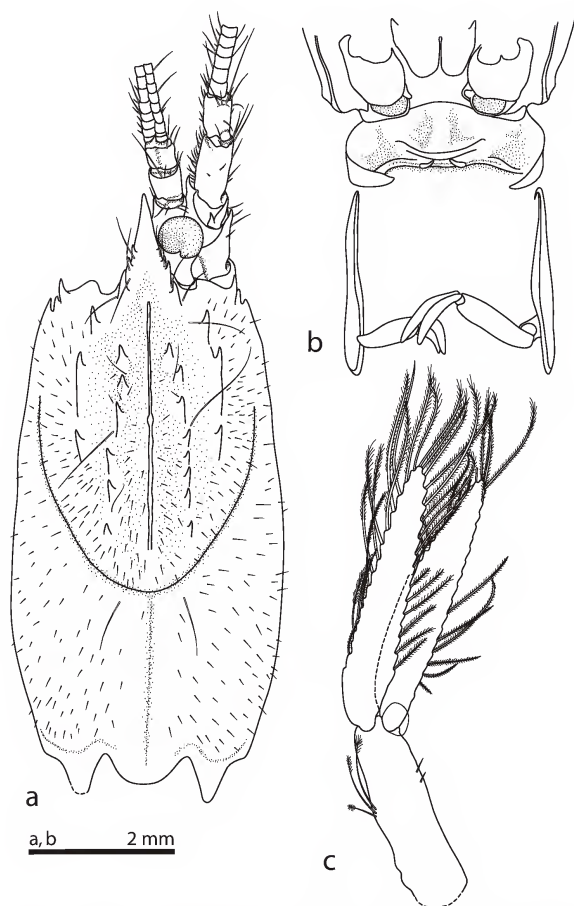


Figure 29. *Paraxiopsis austrinus* (Sakai, 1994). a, dorsal view of carapace, peduncles of antennule and antenna. b, thoracic sternites 7 and 8, abdominal sternites 1 and 2 showing pleopods 1, 2. c, pleopod 2. All figures from female, cl. 8.3 mm, NTM Cr003173.

Paraxiopsis pumilus.—Kensley, 2003: 373

*Paraxiopsis diana*e Poore, 2008: 165–168: fig. 2. (**syn. nov.**)

Material examined. WA, off Barrow I., 20°59.05'S, 114°54.25'E–20°59.40'S, 114°54.32'E (stn SS10-2005 170), 101–100 m, 13 Dec 2005, NMV J53449 (male, cl. 8.3 mm, tl. 21.5 mm). WA, Bonaparte Archipelago, Port George IV (15°23.474'S, 124°37.793'E), 10–16 m, 8 Oct 2007, J. James (stn P23), NMV J59647 (4 juvenile females, cl. 4.8–6.0 mm; female, cl. 7.3 mm)

NT. W side of Barrow Bay, Port Essington (11°22.0'S, 132°12.0'E), low water, J.R.Hanley, 18 Sep 1985 (stn CPV8), NTM Cr013204 (1 female), NTM Cr013205 (1 female). Arafura Sea, 09°36.63'S, 134°10.95'E–09°36.59'S, 134°10.87'E (stn SS05-2005 BS014), 95 m, 25 May 2005, AM P74506 (1 juvenile).

Distribution. NT, Cobourg Peninsula, Arafura Sea; WA, Barrow Island—Dampier Archipelago, c. 9°–21°S, 115°–132°E, 6–100 m depth.

Remarks. The species is distinguished from other species of *Paraxiopsis* by the possession (in adults) of two pairs of spines at the base of the tapering rostrum and none on the submedian gastric carina (Kensley, 2003). Poore (2008) compared his new species, *Paraxiopsis diana*e, with several descriptions of the similar species, *P. brocki* De Man, 1888, and concluded that probably more than one species over a wide geographical range had been referred to the latter name. He did not compare it with *P. pumilus* (Sakai, 1994), described as a species of *Eutrichocheles*, from the Northern Territory and north-western WA. For this paper, topotypic material was compared with the WA material. Sakai figured the tail fan, gastric region and rostrum of two individuals of *P. pumilus*. The number of lateral spines on the rostrum differed between these two and between individuals in the new collections from WA and NT. On small individuals lateral spines are absent, in others there is one spine on one or both sides, in addition to the supraocular spine (fig. 31). The two individuals of *P. diana*e fall within this range of variability and the species must be synonymised with *P. pumilus*.

Most species of *Paraxiopsis* and *Eutrichocheles* possess a bifid scaphocerite and illustrations of type material of both *Paraxiopsis pumilus* and *P. diana*e show this. Some specimens possess a simple comma-shaped scaphocerite on both antennae, a difference we do not consider of specific importance (cf. figs. 30b, 31g, h). *Paraxiopsis johnstoni* Edmondson, 1925 from Hawaii was also illustrated with a simple scaphocerite but has a different carapace.

Type material of the two nominal Australian species was collected at 6–40 depth; the new specimen is from 100 m depth but at a similar latitude.

Pilbaraxius gen. nov.

Type species. *Pilbaraxius kariyarra* sp. nov., herein designated.

Diagnosis. Carapace smooth or tuberculate; cervical groove visible laterally over third distance to anterolateral margin. Rostrum acutely triangular, with pair of lateral spines, longer than eyestalks, not depressed below level of carapace, continuous with definite lateral carinae; supraocular spines prominent; lateral carina with 1 spine; submedian carina present, with 1 spine; median carina a weak ridge, unarmed; postcervical carina absent. Abdominal somite 1 pleuron acute; pleuron 2 acute, pleura 3–5 acute, with anteroventral tooth. Eyestalk cylindrical, articulating; cornea weakly pigmented. Antenna, scaphocerite long. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs present above pereopods 2–4; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 slightly asymmetrical, with propodus flattened; carpus-propodus upper margin unarmed, sparsely setose. Pereopods 3–5 propodi with transverse rows of robust setae; dactyli tapering, with longitudinal row of robust setae. Pleopods 3–5, appendix interna present. Pleopod 1 of male absent. Pleopod 2 of male without appendix masculina. Uropodal endopod without lateral and distolateral spines; exopod with transverse suture. Telson with lateral fixed spines and posterolateral robust setae; apex rounded.

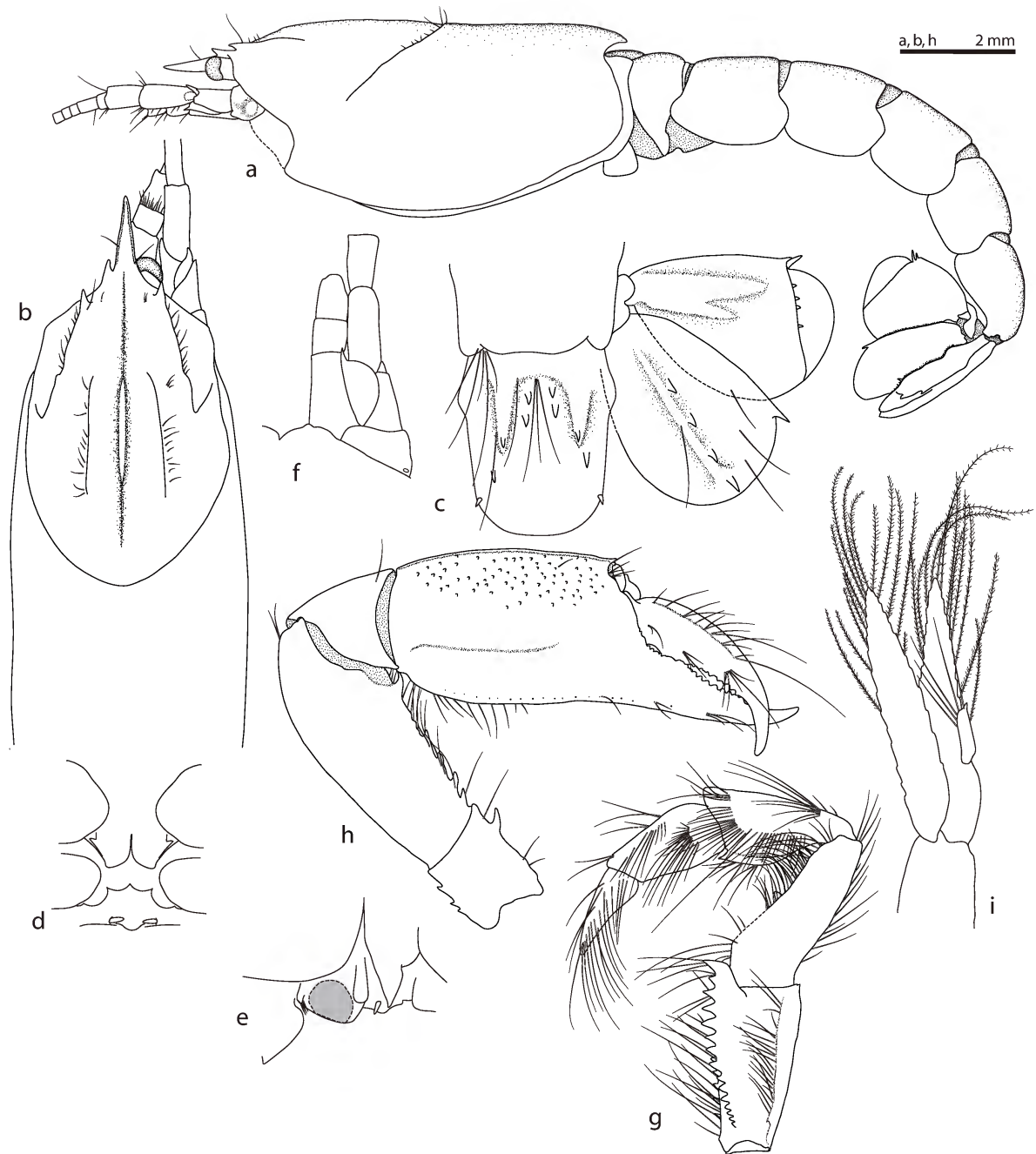


Figure 30. *Paraxiopsis pumilus* (Sakai, 1994). a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and right uropod. d, thoracic sternites 7 and 8, abdominal somite 1 with pleopods 1. e, left thoracic sternites 7 and 8, abdominal somite 1 with pleopod 1 (lateral). f, epistome, left antennule and antenna (ventral). g, maxilliped 3. h, major pereopod 1 (right, lateral). i, male pleopod 2. All figures from male, cl. 8.3 mm, NMV J53449.

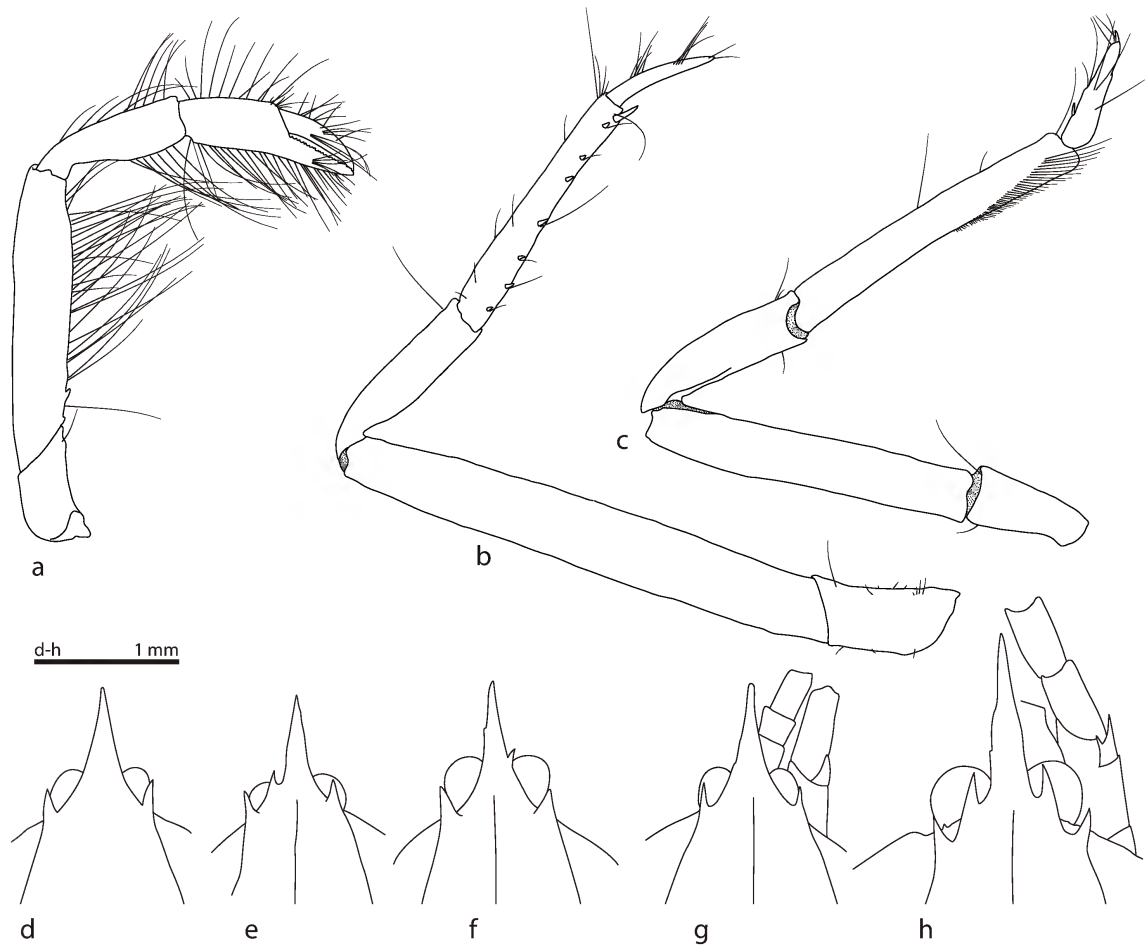


Figure 31. *Paraxiopsis pumilus* (Sakai, 1994). a–c, pereopods 2–4. d–h, anterior carapace, peduncles of antennule and antenna and rostrum of five individuals, cl. 4.8, 4.8, 5.2, 6.0, 7.3 mm. Figs a–c from male, cl. 8.3 mm, NMV J53449; figs. d–e from male, 7.3 mm, NMV J59647.

Etymology. Pilbara is the name of the region of North-western Australia close to the type locality of the type species.

Remarks. The problematic generic placement of the type species highlights issues with the family Axiidae. The spinose rostrum, diverging palm and long fingers on the chelipeds and abdominal pleura with prominent ventral spination closely resemble those of *Calaxiopsis serrata* Sakai and de Saint Laurent, 1989, a species belong to the “calocaridid” group. The new species differs from all in this group in possessing pleurobranches and lacking the modified pleopods 1 and 2. The new species also resembles species of *Calaxius* but these usually have highly setose chelipeds and rows of prominent spines on the upper margin of the chelipeds (as in *C. acutirostris* redescribed above). Neither of these conditions characterises the new species. In addition, the uropodal endopod is apically rounded and lacking lateral and distolateral spines typical of

Calaxius and many other axiid genera. Further, pleopod 2 lacks an appendix masculina, a state seen in few axiids. In summary, a new genus seems warranted.

***Pilbaraxius kariyarra* sp. nov.**

Calaxiopsis sp.—Robles et al., 2009: 314, 316 (molecular phylogeny, GenBank numbers).

Figures 32, 33, 45

Material examined. Holotype. WA, off Port Hedland, 18°34.19'S, 117°27.86'E–18°34.06'S, 117°28.63'E (stn SS05-2007 052), 405–401 m, 14 Jun 2007, NMV J55576 (male, cl. 6.8, tl. 15.7 mm).

Description of male holotype. Carapace covered in small tubercles. Rostrum 0.4 times length of front-to-cervical groove, acute, elongate, with 1 long lateral spine anterior to

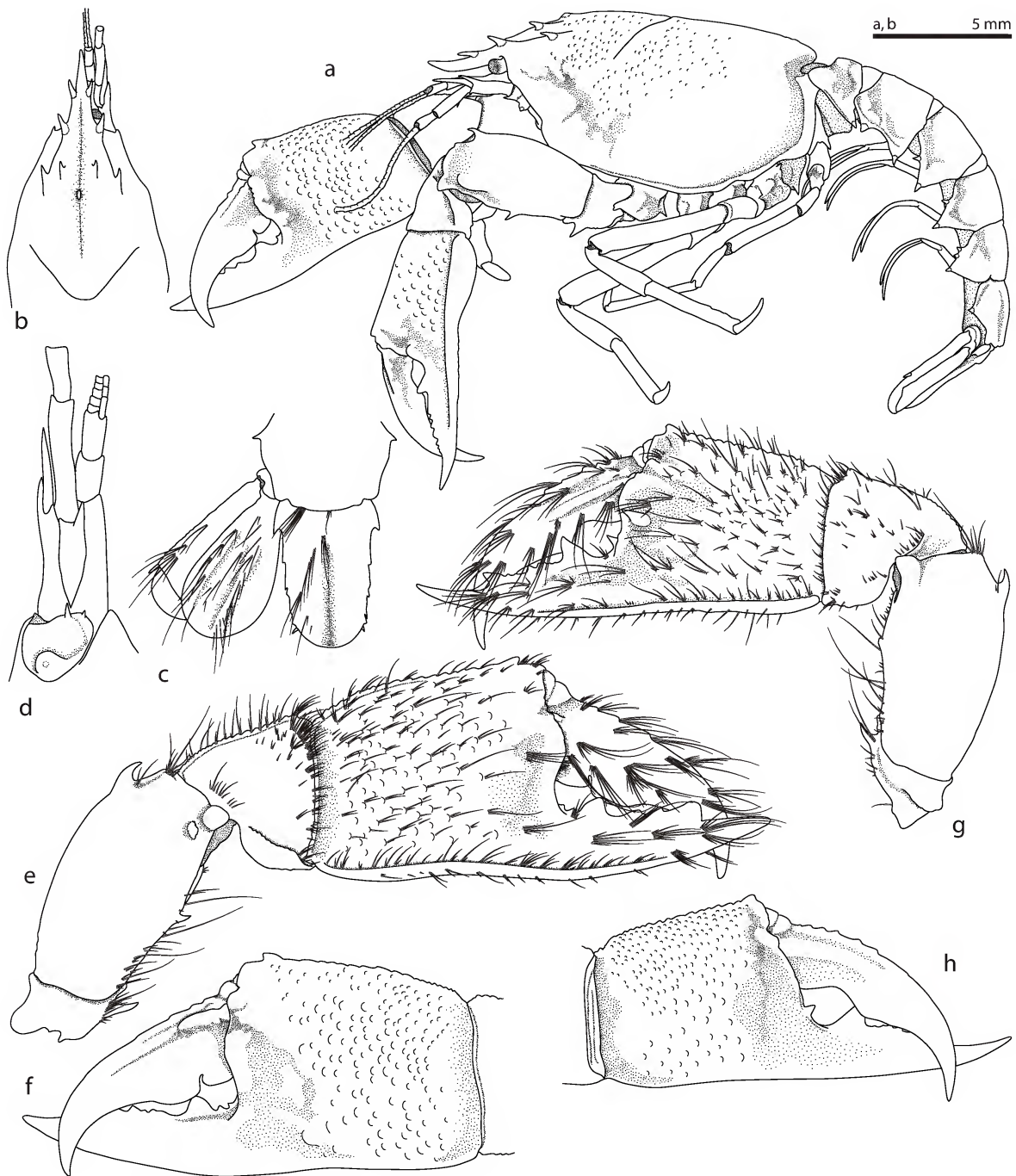


Figure 32. *Pilbaraxius kariyarra* sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and left uropod. d, epistome, left antennule and antenna (ventral). e, major pereopod 1 (right, lateral). f, same (propodus-dactylus, mesial, setae not shown). g, minor pereopod 1 (left, lateral). h, same (propodus-dactylus, mesial, setae not shown). All figures from holotype.

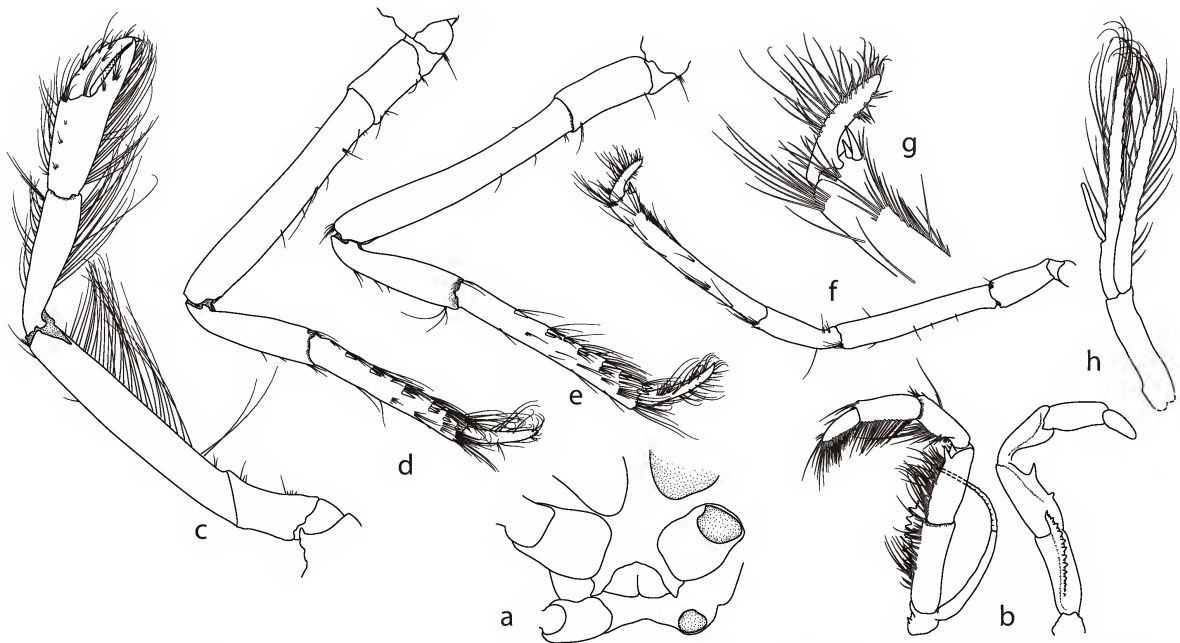


Figure 33. *Pilbaraxius kariyarra* sp. nov. a, thoracic sternites 7 and 8. b, maxilliped 3. c–f, pereopods 2–5 (c, f right; d, e left). g, pereopod 5 distal propodus and dactylus. h, female pleopod 2. All figures from holotype.

supraocular spine, continuous with definite lateral gastric carinae. Supraocular spines prominent. Lateral gastric carina with 1 spine. Submedian gastric carina with 1 spine. Median gastric carina present as a ridge extending anteriorly onto rostrum, with 1 tubercle located midway between rostrum and cervical groove. Postcervical carina on carapace absent. Sternite 7 (pereopod 4) deeply divided in midline over posterior two-thirds and with oblique lateral ridge ending in sharp spine. Sternite 8 (pereopod 5) with setose semicircular flap on anterior face at base of leg. Abdominal pleuron 1, 2.6 times as deep as middorsal length, with small ventral spine; pleuron 2 asymmetrical, lateral length 1.3 times dorsal length, concave ventrally, with 2 distinct ventral spines; pleura 3 and 4 tapering to a ventral spine, with another spine located anteroventrally; pleuron 5 tapering to a ventral spine, with another 2 spines located anteroventrally; pleuron 6 with 1 ventral spine.

Eye stalk 0.25 length of rostrum; cornea weakly pigmented. Antennular peduncle reaching to end of article 4 of antenna. Antennal article 1 with 2 small spines on distal margin; article 2 distal spine straight, approximately half length of article 2; scaphocerite simple, straight, reaching distally almost to end of article 4; article 3 with 1 spine on lower margin; article 4 about as long as article 2 (excluding distal spine); article 5 about half as long as article 4. Maxilliped 3 basis with 1 spine; crista dentata with 15 teeth; merus with 2 spines on lower margin (1 large, 1 small); carpus unarmed.

Pereopods 1 differentiated, propodus of major cheliped longer and more swollen than minor. Major pereopod 1 (right) coxa lower margin with 1 spine; basis lower margin unarmed; ischium lower margin with 1 spine; merus upper margin convex, with 1 hooked spine, lower margin with 1 spine and obsolete tubercle laterally, lateral face with broad tubercle distally, mesial face smooth; carpus upper margin tuberculate, lower margin unarmed, lateral face tuberculate, mesial face smooth; propodus upper margin with 1 distal spine, lower margin with low lateral carina, lateral face tuberculate, mesial face smooth; fixed finger 1.2 times length of upper palm, cutting edge with 4 large irregular rounded teeth; dactylus upper margin smooth, lateral face smooth, mesial face smooth, cutting edge with narrow proximal notch.

Minor pereopod 1 coxa, ischium, merus and carpus as in larger cheliped; propodus similar except mesial face with spine near gape; fixed finger about as long as upper palm, cutting edge with 2 large triangular teeth and smaller intermediate denticles; dactylus cutting edge excavate proximally.

Pereopod 2 unarmed; carpus slightly shorter than chela; propodus upper margin as long as dactylus. Pereopod 3 unarmed; propodus 2.2 times as long as dactylus, with 6 marginal robust setae (some duplicated). Pereopod 4 unarmed; propodus 2.2 times as long as dactylus, with 7 marginal robust setae (some duplicated). Pereopod 5 propodus 3.9 times as long as dactylus, subchelate, with short fixed finger bearing 5 distinct robust setae; dactylus slightly flattened.

Pleurobranches present above pereopods 2–4; arthrobranches on maxilliped 2 (rudimentary) to pereopod 4; epipods with well developed podobranchs (with up to 10 gill filaments) on maxilliped 2 to pereopod 3

Pleopod 1 absent. Pleopod 2 appendix masculina absent; appendix interna slender, about quarter length of endopod.

Telson 1.3 times as long as broad, lateral margin with 4 spines, distal margin convex without posteromedian spine, posterolateral angle with 1 robust seta; dorsal face without spines on each oblique row. Uropodal endopod 1.9 times as long as wide, without lateral spines, longitudinal ridge unarmed. Uropodal exopod 1.9 times as long as wide, without lateral spines, longitudinal ribs unarmed, posterolateral angle with 1 robust seta; transverse suture unarmed.

Etymology. Kariyarra is the name of the Australian Aboriginal people inhabiting the coast close to the type locality (noun in apposition).

Distribution. WA, off Port Hedland, 18°S, 118°E, c. 400 m depth (known only from type locality).

Remarks. See the discussion for the genus *Pilbaraxius*. Unfortunately, the species was placed in a molecular analysis as *Calaxiopsis* sp. by Robles et al. (2009).

***Planaxius* Komai and Tachikawa, 2008**

Planaxius Komai and Tachikawa, 2008: 22–24.

Remarks. *Planaxius* is recognised by the combination of the absence of submedian gastric carinae, uropodal exopod with a transverse suture, pereopodal epipods present, three pairs of pleurobranches, toothed triangular rostrum, male pleopods 1 and 2 present and pleopods 3–5 with an appendix interna. It is the absence of submedian gastric carinae and presence of appendices internae that distinguishes the genus from *Bouvieraxius* whose species have five gastric carinae and lack appendices internae (Komai and Tachikawa, 2008). These authors described the type and only species as lacking a median gastric carina. The single individual from Australia referred to this species below has a definite median gastric carina at the base of the rostrum extending as far back as the lateral gastric carinae.

***Planaxius brevifrons* Komai and Tachikawa, 2008**

Planaxius brevifrons Komai and Tachikawa, 2008: 24–29, figs. 2–6.

Figures 34, 46

Material examined. WA, off Jurien Bay, 29°48.33'S, 114°25.52'E–29°48.33'S, 114°25.55'E (stn SS10-2005 083), 113–114 m, 02 Dec 2005, NMV J55445 (male, cl. 3.3 mm, tl. 9.5 mm, without pereopods 3–5).

Description of male. Carapace smooth, cervical groove short. Rostrum 0.3 times length of front-to-cervical groove, triangular, with 2 or 3 short oblique lateral spines anterior to supraocular spine, continuous with definite lateral gastric carinae. Supraocular spines prominent. Lateral gastric carina unarmed. Submedian gastric carina absent. Median gastric carina low, sharp, unarmed. Branchiostegal angle produced, lobe-like, with 2 minute marginal teeth. Sternite 8 (pereopod 5) with

setal ridge on anterior face at base of leg. Abdominal pleuron 1, 3 times as deep as middorsal length, ventrally acute; pleuron 2 broad, lateral length 1.8 times dorsal length, anteroventrally rounded; pleura 3–5 becoming more posteroventrally square, each with anteroventral tooth; pleuron 6 with small tooth on ventral margin.

Eyestalk 0.5 length of rostrum; cornea pigmented. Antennular peduncle reaching to proximal part of antennal article 5. Antennal article 1 with 2 spinules on lower distal margin; article 2 distal spine slender, directed slightly inwards, reaching distally one third of antennal article 4; scaphocerite slender, straight, reaching distally two-thirds of article 4; article 3 with 1 spine on mesial lower margin; article 4 about 1.3 times length of article 2 (excluding distal spine), article 5 about one-third length of article 4. Maxilliped 3 basis with 1 spine; ischium with 3 spines on lower margin; crista dentata with 13 teeth; merus with 4 spines on lower margin; carpus with 1 spine.

Pereopods 1 asymmetrical, propodus of major longer, more swollen. Major pereopod 1 (right) coxa lower margin with 1 spine; basis lower margin unarmed; ischium lower margin with 3 spines; merus upper margin convex, with 2 spines, lower margin with 6 spines, lateral face smooth, mesial face smooth; carpus unarmed, smooth; propodus upper margin carinate, with small distal spine, lower margin smooth, lateral face smooth, mesial face smooth; fixed finger half length of upper palm, cutting edge unevenly denticulate; dactylus smooth, cutting edge as in fixed finger.

Minor pereopod 1 coxa as in larger cheliped; ischium lower margin with 1 spine; merus upper margin convex, with 2 spines, lower margin with 6 spines, lateral face smooth, mesial face smooth; carpus unarmed, smooth; propodus upper margin carinate, with small distal spine, lower margin smooth, lateral face smooth, mesial face smooth; fixed finger as long as upper palm, cutting edge unevenly denticulate; dactylus smooth, cutting edge scarcely denticulate.

Pereopod 2 ischium lower margin unarmed; merus lower margin unarmed; carpus as long as chela; propodus upper margin 0.8 length of dactylus. Pereopods 3–5 missing.

Pleopod 1 of 2 fused articles; article 2 blade-like, apex unevenly bilobed, appendix interna represented by few hooks. Pleopod 2 with appendix masculina as long as remaining endpod; appendix interna third length of endpod, 0.6 length of appendix masculina. Pleopods 2–5 appendix interna one third length of endpod.

Telson 1.5 times as long as wide, lateral margin with 3 spines, distal margin convex without posteromedian spine, posterolateral angle with 2 robust setae, one much larger; dorsal face with 2 small spines in each oblique row. Uropodal endopod 1.8 times as long as wide, with 1 lateral spine, longitudinal ridge with 4 spines (including marginal). Uropodal exopod 1.6 times as long as wide, with 4 lateral spines, 2 longitudinal ribs (outer rib with 2 spines), posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture with 4 spines.

Distribution. Japan, Kii Peninsula, Ogasawara Is, 47–100 m; WA, south-western coast, 114 m depth.

Remarks. The single male is virtually indistinguishable from slightly larger specimens reported from Japan by Komai and

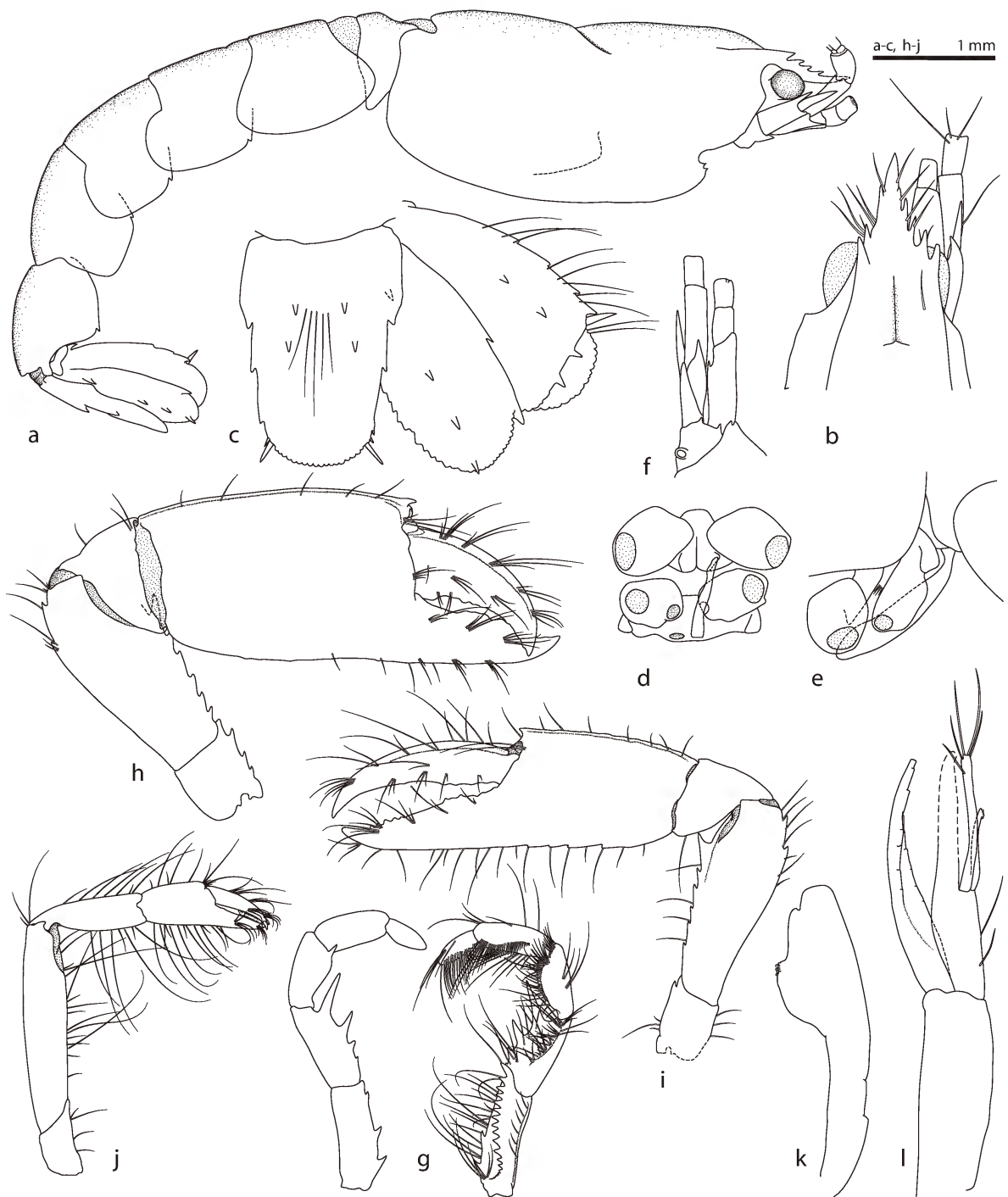


Figure 34. *Planaxius brevifrons* Komai and Tachikawa, 2008. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, telson and right uropod. d, sternites 7 and 8, pleonite 1 with left pleopod 1 in situ. e, sternites 7 and 8, pleonite 1 with left pleopod 1 in situ (lateral). f, epistome, right antennule and antenna (ventral). g, maxilliped 3. h, major pereopod 1 (right, lateral). i, minor pereopod 1 (left). j, pereopod 2. k, l, male pleopods 1, 2. All figures from NMV J55445.

Tachikawa (2008). Dr Komai kindly re-examined the type material at our request and confirmed the presence of a median gastric carina, more clear and sharp in the paratypes than in the illustrated holotype, as in the WA specimen. While the ischium of maxilliped 3 of the Australian specimen has blunt teeth along the lower margin some of the Japanese specimens have one or two minute spinules obscured by stiff setae. Dr Komai confirmed that the two minute teeth on the anterior branchiostegal lobe of the Australian specimen are absent in the Japanese material. The uropodal endopod of the holotype lacks the lateral and distolateral spines seen in the Australian specimen. While we have only one specimen, none of these differences argues strongly for a separate species but the record is a considerable range extension.

Platyaxius Sakai, 1994

Platyaxius Sakai, 1994: 180–181.

Diagnosis. Carapace smooth, with scattered long setae; cervical groove visible laterally over half or more of distance to anterolateral margin. Rostrum triangular, broad, laterally weakly dentate, as long as or slightly longer than eyestalks, slightly depressed below level of carapace, continuous with definite lateral carinae; supraocular spines absent; lateral carina weakly dentate or unarmed; submedian carina dentate; median carina, dentate; postcervical carina absent. Abdominal somite 1 pleuron triangular; pleuron 2 posteriorly rectangular; pleura 3–5 posteriorly rounded. Eyestalk cylindrical, articulating; cornea pigmented. Antenna, scaphocerite short. Maxilliped 3 exopod not clearly bent at base of flagellum. Pleurobranchs absent above pereopods 2–4; podobranchs and arthrobranchs well developed; epipods present on maxilliped 2 to pereopod 4. Pereopods 1 asymmetrical, with propodus cylindrical; carpus-dactylus upper and lower margins smooth, propodus with obsolete distal tooth on upper margin. Pereopods 3–5 propodi with transverse rows of robust setae; dactyli 3 and 4 triangular, with scattered robust setae; dactylus 5 spatulate, with row of robust setae along oblique margin. Pleopods 3–5, appendix interna present. Pleopod 1 of male absent. Pleopod 2 of male with appendix interna and appendix masculina. Uropodal exopod without transverse suture. Telson with lateral teeth, with posterolateral robust setae; apex deeply rounded and continuous with lateral margins.

Remarks. The type species, *Platyaxius brevirostris* Sakai, 1994 from the Australian North West Shelf, is recognised by the absence of a suture on the uropodal exopod, absence of the male pleopod 1 and lateral teeth on the rostrum. Sakai compared his new genus to species of *Eiconaxius* Bate, 1888 (see Sakai, 1992 for descriptions of five species) and the two genera share similar uropods, pleopods, swollen chelipeds and a rounded telson, differing largely in the dentition of the rostrum. The dactyli of pereopods 3–5 of species of *Eiconaxius* are spatulate, non-tapering and with a row of robust setae on the oblique distal margin. See, for example, *E. farreae* Ortmann, 1891 figured by Sakai and Ohta (2005) and *E. mallacoota* sp. nov. (fig. 24). The same unusual form is seen only on pereopod 5 of the new species described here; dactyli of pereopods 3 and 4

are tapering with several facial robust setae. Sakai (1994) illustrated only pereopod 3 of *P. brevirostris* and did not mention pleurobranchs in his diagnosis. The new species described below differs from all species of *Eiconaxius* in lacking pleurobranchs above pereopods 2–4.

Axius odororhynchus De Man, 1905 was included in *Spongiaxius* by Sakai and de Saint Laurent (1989) but is better placed in *Platyaxius*. It too has denticulate rostrum margins, swollen chelipeds and non-tapering dactylus only on pereopod 5 (De Man, 1925b: pl. 1 figs. 11, m).

Sakai and Ohta (2005) removed *Eiconaxius* from Axiidae and placed it in its own family, Eiconaxiidae, on the basis of ‘P3–5 dactyli ... rounded in shape ... and their ventral margins spinulate ...’ and other features that are shared with one or more other axiid genera. *Eiconaxius* and *Platyaxius* are clearly related but whether or not they belong in a clade separate from another containing all other axiids remains to be investigated.

Platyaxius bardi sp. nov.

Figures 35, 36, 47

Material examined. Holotype. WA, near Mermaid Reef, 17°29.23'S, 120°27.64'E–17°29.72'S, 120°28.07'E (stn SS05-2007 091), 187–184 m, 20 Jun 2007, NMV J55707 (male, cl. 5.9 mm, tl. 17.2 mm).

Paratypes. WA, North-west Shelf, between Port Hedland and Dampier, 18°36'S, 118°02'E–18°39'S, 118°04'E (stn NWA-24), 184 m, 06 Jun 1983, NMV J15420 (2 ovigerous females, cl. 5.7 mm).

Description of male holotype. Carapace smooth. Rostrum 0.3 times length of front-to-cervical groove, narrowly triangular, with 4 weak lateral spines anterior to supraocular spine, continuous with definite lateral gastric carinae. Supraocular spines similar size to other rostrum spines. Lateral gastric carina with 2 prominent spines in addition to supraocular spine. Submedian gastric carina with 4 spines. Median gastric carina with 6 spines. Sternite 7 (pereopod 4) deeply divided in midline over posterior two-thirds and with sharp oblique lateral ridge. Sternite 8 (pereopod 5) with setose semicircular flap on anterior face at base of leg. Abdominal pleuron 1, 2.6 times as deep as middorsal length, ventrally acute; pleuron 2 asymmetrical, lateral length 1.2 times dorsal length, posteroventrally quadrate; pleura 3–5 posteroventrally angled, each with small anteroventral spine; pleuron 6 with small spine on ventral margin.

Eyestalk 0.8 length of rostrum; cornea pigmented. Antennular peduncle reaching to distal part of antennal article 4. Antennal article 1 with 2 spinules on lower distal margin; article 2 distal spine well developed, reaching to proximal part of antennal article 5; scaphocerite strongly curved downwards, reaching distally almost to end of article 4; article 3 with spine on lower margin; article 4 approximately as long as article 2 (excluding distal spine); article 5 about two-thirds length of article 4. Maxilliped 3 basis with 1 spine; ischium with 1 spine on lower margin; crista dentata with numerous small, even teeth; merus with 3 spines on lower margin; carpus unarmed.

Pereopods 1 differentiated, propodus of major cheliped longer and more swollen than minor. Major pereopod 1 (left) coxa lower margin with 1 spine; basis lower margin unarmed;

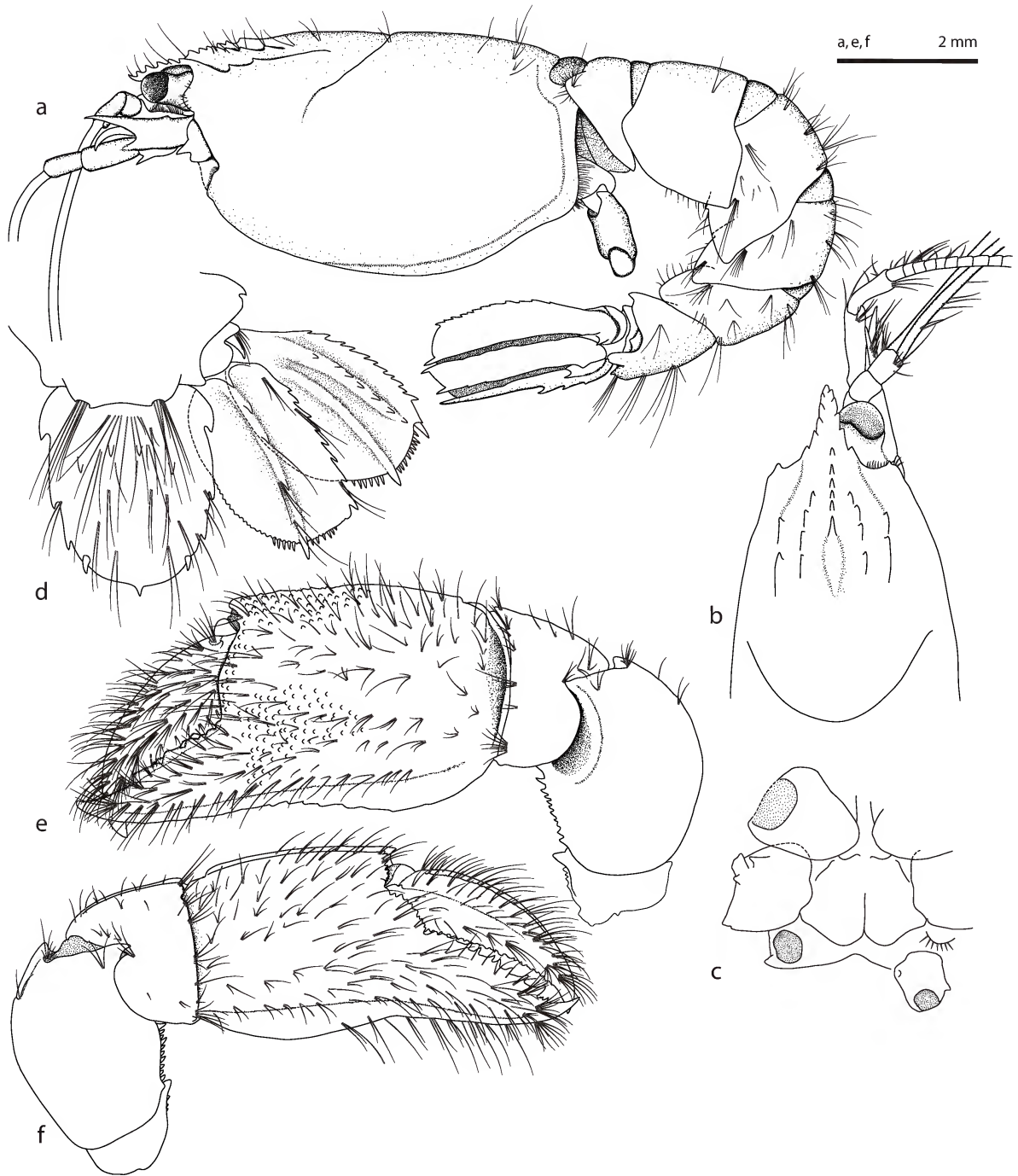


Figure 35. *Platyaxius bardi* sp. nov. a, lateral view. b, dorsal view of carapace, peduncles of antennule and antenna. c, thoracic sternites 6–8. d, telson and right uropod. e, major pereopod 1 (left, lateral). f, minor pereopod 1 (right, lateral). All figures from holotype.

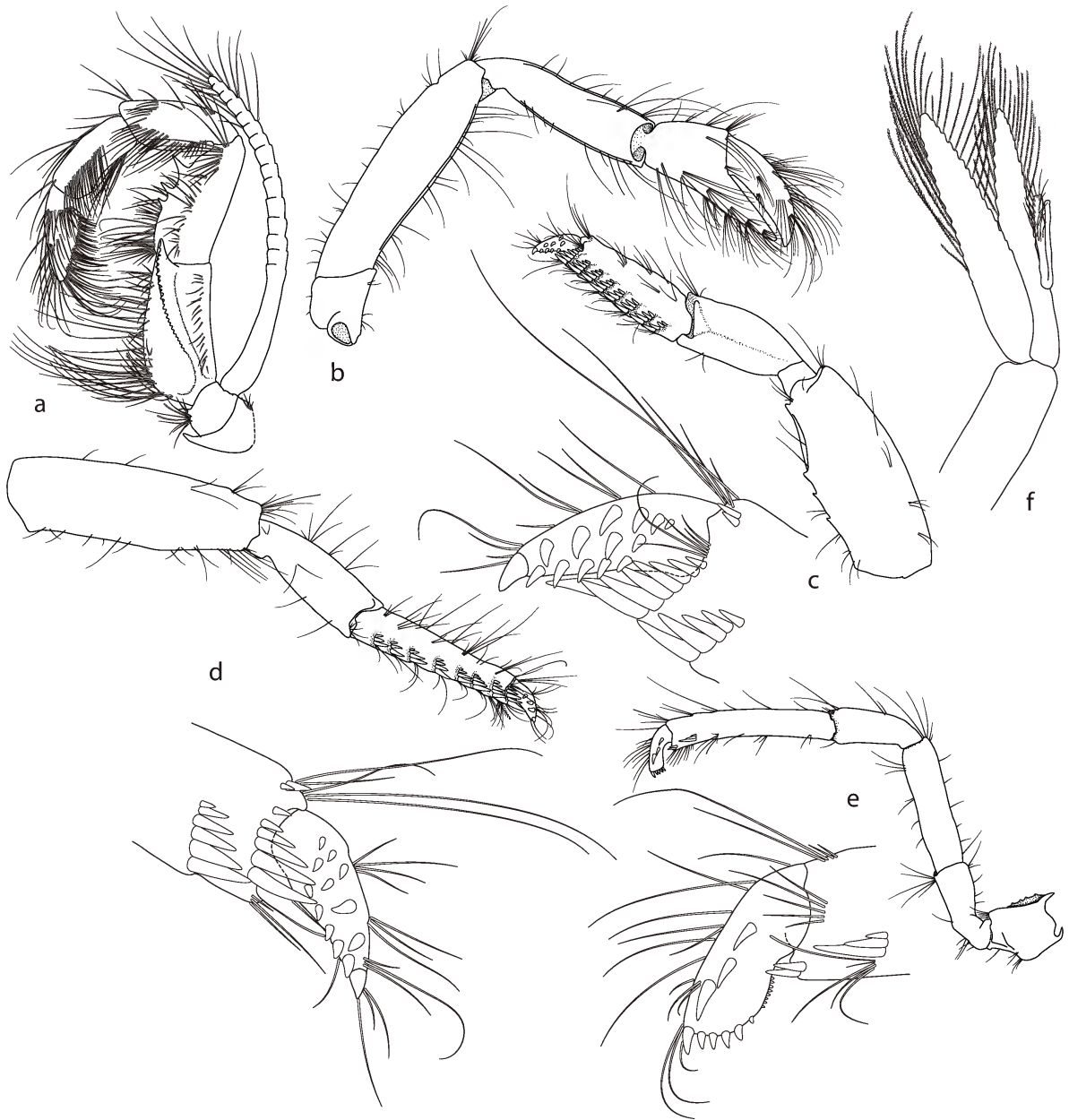


Figure 36. *Platyaxius bardi* sp. nov. a, maxilliped 3. b–e, pereopods 2–5 (b, e right; c, d left; each with details of dactylus). f, male pleopod 2. All figures from holotype.

ischium lower margin with 4 small spines and 1 larger; merus upper margin strongly convex, unarmed, lower margin with 10 teeth, lateral face smooth, mesial face smooth; carpus upper margin carinate, lower margin unarmed, lateral face smooth, mesial face smooth; propodus upper margin carinate, with blunt distal tooth, lower margin with weak lateral carina, better defined on finger, lateral face tuberculate over upper and lower distal third, mesial face tuberculate near base of finger; fixed finger 0.6 length of upper palm, cutting edge straight; dactylus margins and faces smooth, cutting edge with few blunt teeth.

Minor pereopod 1 coxa, ischium, merus and carpus as in larger cheliped, narrower; propodus upper margin carinate, with blunt distal tooth, lower margin with weak lateral carina, better defined on finger, lateral face with few tubercles, mesial face with few tubercles near base of finger; fixed finger as long as upper palm, cutting edge with regularly spaced sharp teeth; dactylus margins and faces smooth, cutting edge denticulate.

Pereopod 2 ischium lower margin unarmed; merus lower margin unarmed; carpus slightly longer than chela; propodus upper margin 0.4 length of dactylus. Pereopod 3 merus lower margin with 3 weak spines; propodus 2.9 times as long as dactylus, with 8 transverse rows each of 4–7 robust setae; dactylus with 13 robust setae on inner face plus unguis. Pereopod 4 propodus 4.1 times as long as dactylus, with 8 transverse rows each of 3–8 robust setae; dactylus with 12 robust setae on inner face plus unguis. Pereopod 5 propodus 3.5 times as long as dactylus, weakly subchelate, distally with 2 transverse rows each of 2 or 3 robust setae; dactylus with 6 robust setae on distal margin, 3 robust setae on inner face.

Pleopods 2–5 appendix interna one third length of endopod. Pleopod 2 appendix masculina as long as appendix interna.

Telson ovate, slightly tapering posteriorly, 1.1 times as long as wide, lateral margin with 3 spines, distal margin convex with posteromedian spine, posterolateral curve with 1 robust seta; dorsal face with 2 spines in each oblique row. Uropodal endopod 1.7 times as long as wide, with 7 lateral spines, longitudinal ridge with 4 spines (including marginal). Uropodal exopod 1.6 times as long as wide, with 11 lateral spines, 2 longitudinal ribs (inner rib ending in marginal spine, outer rib with 7 spines), posterolateral angle with 1 fixed spine and 1 robust seta; transverse suture absent.

Female (2 paratypes). As male except: rostrum with 4–6 lateral spines anterior to supraocular spine; lateral gastric carina with 2 or 3 prominent spines in addition to supraocular spine; submedian gastric carina with 4 or 5 spines; median gastric carina with 5–7 spines; pleura 3–5 posteroventrally angled, each with small anteroventral spine (as male); pleuron 6 with small spine on ventral margin; major and minor chelipeds fixed finger and dactylus with lateral ridge; pleopod 1 uniramous, article 2, 3 times length of article 1; ovigerous with at least 6 eggs.

Etymology. Bardi is the name of the Aboriginal Australian people inhabiting Cape Leveque close to the type locality (noun in apposition).

Distribution. WA, continental slope of North-west Shelf, 17°–19°S, 118°–120°E, 180–184 m depth.

Remarks. The three individuals of *Platyaxius bardi* vary in the numbers and size of spines/teeth on the rostrum and gastric carinae. The species differs from *P. brevisrostris* and *P. odontorhynchus* (from Indonesia) in the more pronounced dentition on the rostrum and gastric carina (obsolete in the other two). The rostrum exceeds the eyestalks in the new species (does not in the other two species) and uropodal rami are broader. The scaphocerite of *P. bardi* is strongly curved while it is straight in the other two species. *Platyaxius bardi* and *P. brevisrostris* have both been taken from similar limited latitudes and depths on the north-western Australian shelf. *Platyaxius bardi* has teeth on the lateral gastric carina while *P. brevisrostris* does not.

Platyaxius brevisrostris Sakai, 1994

Platyaxius brevisrostris Sakai, 1994: 181–185, figs. 4, 5.—Davie, 2002: 454.

Distribution. WA, North West Shelf, 141 m depth.

Remarks. See comments under *P. bardi* above.

Scytoleptus Gerstaecker, 1856

Remarks. The steep margin of the median gastric carina, falling almost vertically to the short rostrum, and with three small teeth, immediately differentiate the genus and its only species.

Scytoleptus serripes Gerstaecker, 1856

Scytoleptus serripes Gerstaecker, 1856: 158, pl. 6 figs. 1–4. De Man, 1925b: 49, pl 4 figs. 9–9h.—Poore and Griffin, 1979: 243–245, fig. 11.—Sakai and de Saint Laurent, 1989: 37–39, fig. 9.—Sakai, 1994: 200.—Davie, 2002: 454.

Distribution. Indo-West Pacific, NT, WA, northern and central coast, to 36 m depth

Remarks. *Scytoleptus serripes* is recognised by the characteristic median gastric carina that defines the genus.

Spongiaxius Sakai and de Saint Laurent, 1989

Spongiaxius Sakai and de Saint Laurent, 1989: 41.—Sakai and Ohta, 2005: 88–89.

Sakaiocaris Kensley, 1989: 964 (objective synonym: same type species).

Remarks. The rostrum with its margin of erect spines, separated by a constriction from the carapace, serves to recognise species of *Spongiaxius*.

Spongiaxius brucei (Sakai, 1986)

Axiopsis brucei Sakai, 1986: 12–20, figs. 1–6.

Spongiaxius brucei.—Sakai and de Saint Laurent, 1989: 44–45.—Davie, 2002: 454.—Sakai and Ohta, 2005: 89–90, fig. 11.—Poore, 2008: 168.

Sakaiocaris brucei.—Kensley, 1989: 964–965.

Distribution. WA, slope of North West Shelf, Sulu Sea, 450–690 m depth.

Remarks. *Spongiaxius brucei* is a large species with erect spines on the five gastric carinae, the carinae themselves

separated by a constriction from the elevated rostrum surrounded by about 20 erect spines. The massive dactylus of the major cheliped is also distinctive. Unlike most axiids from deep water, numerous specimens have been taken, including more than those already reported in NTM collections.

Biogeographical commentary

In earlier reviews, Poore and Griffin (1979) recognised only six species of Axiidae and Sakai (1994) thirteen (plus species now placed in Strahlaxiidae). Now, 30 are known with others probable. Eleven of these have also been reported from elsewhere in the Indo-West Pacific, some as far away as Japan or Madagascar (Table 1). These include both shallow-water, shelf and deep-water species whose distribution in WA range as far south as 35°S. This generalisation is subject to the proviso that identifications of Australian specimens as species known from elsewhere depend on subjective judgements of morphological similarity between material at hand and published descriptions. Poore (2008) has already tabulated differences between six published descriptions of the seemingly widespread *Paraxiopsis brocki*. A further 12 species are now known only from tropical Australia, most from WA (Table 1). Nine are known only from the type locality. It is reasonable to assume that some of these could subsequently be found north of Australia. Nine species are found in southern temperate Australia south of 30°S (Table 1). Two of these are Indo-West Pacific species and another occurs also in New Zealand. Of the southern species six could be treated as endemic. Three are shallow-water species from south-eastern Australia reported from narrow geographic ranges. The other three are species from the continental slope taken only once. The distribution of these is unknown until these burrowing cryptic animals from deep water can be reliably sampled. Three genera, monotypic *Australocaris* and *Dorphinaxius*, and *Michelaxiopsis* with two species, are confined to southern Australia-New Zealand. Most others are widespread in the Indo-West Pacific. *Axius* and *Calastacus*, with species in the North Atlantic and southern Australia appear to have anomalous global distributions.

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Table 1. Distributions of Australian Axiidae. Species are divided into three groups: (1) those distributed elsewhere in the Indo-West Pacific; (2) those known only from northern tropical and subtropical Australia; and (3) those known from southern temperate Australia.

Taxa grouped by distribution and ranked by depth range	Depth range (m)	Australian distribution: state and southern (Indo-West Pacific and subtropical species) or northern (temperate species) latitudinal limit
Indo-West Pacific		
<i>Allaxius clypeatus</i>	0	Qld, 15°S
<i>Axiopsis serratifrons</i>	0–30	Qld, 15°S
<i>Scytoleptus serripes</i>	0–36	NT, WA, 22°S
<i>Paraxiopsis brocki</i>	0–100	WA, 32°S
<i>Bowieraxius keiensis</i>	18–245	WA, 27°S
<i>Planaxius brevifrons</i>	47–114	WA, 30°S
<i>Axiopsis consobrina</i>	75–113	WA, 19°S
<i>Axiopsis tsushimaensis</i>	102–157	WA, 35°S
<i>Acanthaxius clevai</i>	228–438	WA, 17°S
<i>Calaxius acutirostris</i>	325–505	Qld, 27°S
<i>Spongiaxius brucei</i>	450–690	WA, 17°S
Tropical and subtropical Australia only		
<i>Paraxiopsis austrinus</i>	0	NT, 12°S
<i>Paraxiopsis pumilus</i>	6–100	NT, WA, 9°–21°S
<i>Acanthaxius gawara</i>	49–59	Qld, 12°S
<i>Oxyrhynchaxius manningi</i>	134	WA, 19°S
<i>Platyaxius brevirostris</i>	141	WA, 19°S
<i>Eiconaxius kimbla</i>	150	Qld, 27°S
<i>Acanthaxius ningaloo</i>	165	WA, 22°S
<i>Platyaxius bardi</i>	180	WA, 19°S
<i>Acanthaxius polychaetes</i>	260	Qld, 18°S
<i>Pilbaraxius kariyarra</i>	400	WA, 18°S
<i>Acanthaxius gathaagudu</i>	400–450	WA, 17–26°S
<i>Ambiatus franklinae</i>	1300	WA, 17°S
Temperate only		
<i>Dorphanaxius kermadecensis</i>	0–8	New Zealand, NSW, 32–34°S
<i>Michelaxiopsis australiensis</i>	0–5	Central NSW, Vic., 29–38°S
<i>Michelaxiopsis nauo</i>	5–6	SA, 34°S
<i>Axius werribee</i>	2–25	Tas., Vic. SA, 35°S
<i>Australocaris pinjarup</i>	400	WA, 33°S
<i>Calastacus myalup</i>	400	WA, 33°S
<i>Eiconaxius mallacoota</i>	930–1000	Vic., 38°S

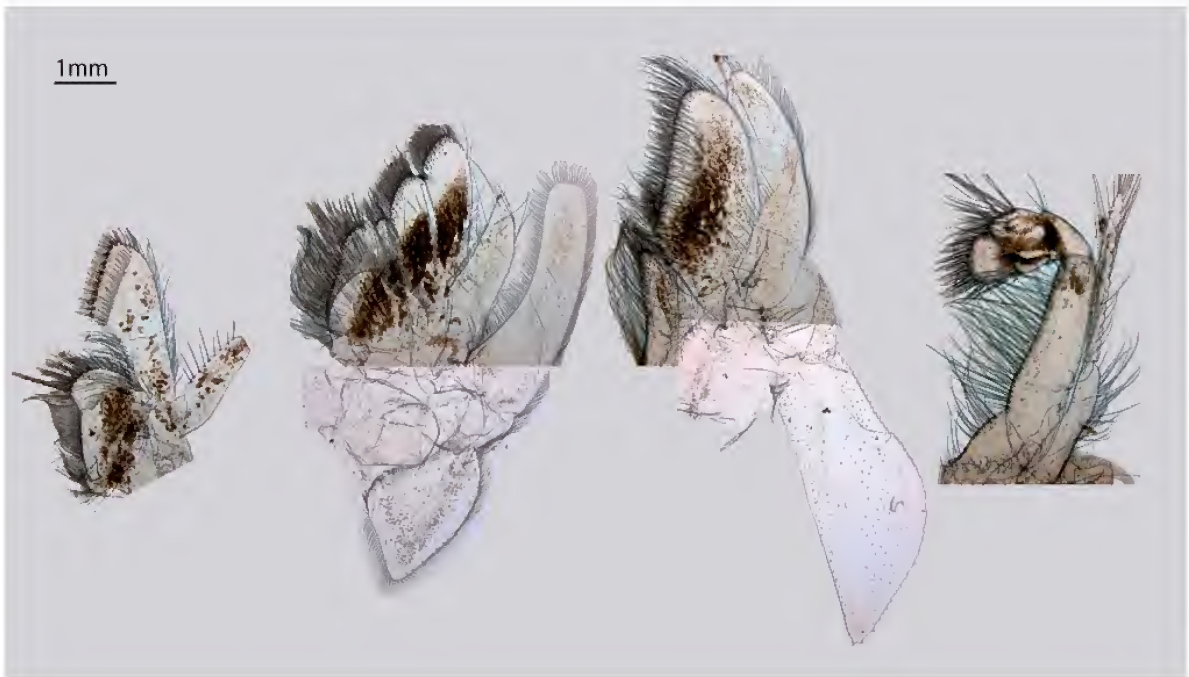


Figure 37. *Acanthaxius clevai* Ngoc-Ho, 2006. Photomicrographs of (left to right) maxilla 1, maxilla 2, maxilliped 1, maxilliped 2.



Figure 38. *Acanthaxius ningaloo* sp. nov. Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta missing), maxilliped 1, maxilliped 2.



Figure 39. *Australocaris pinjarup* gen. and sp. nov. Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta truncated), maxilliped 1, maxilliped 2.

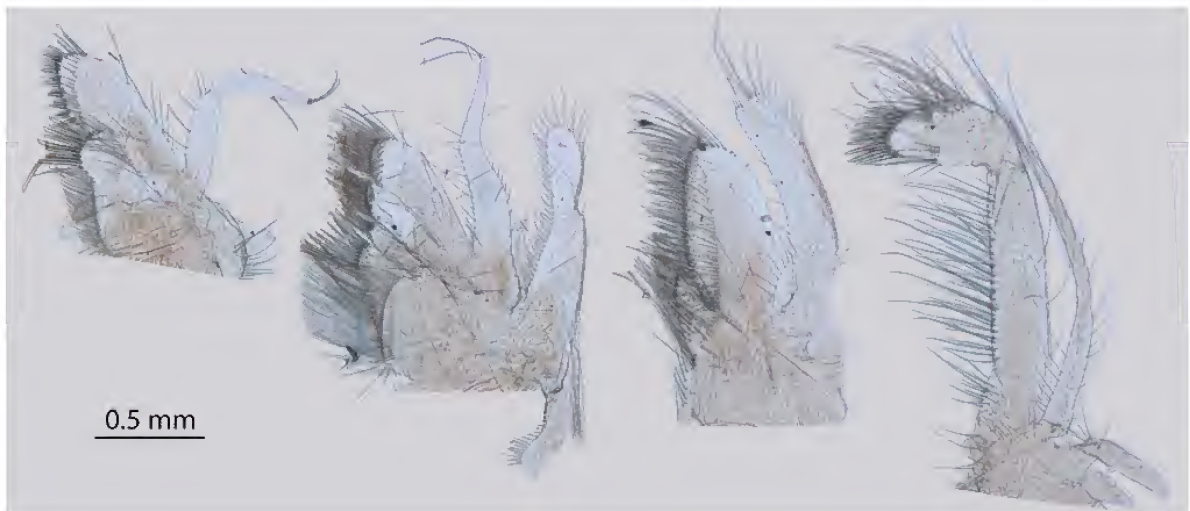


Figure 40. *Axiopsis tsushimaensis* Sakai, 1992. Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta truncated), maxilliped 1, maxilliped 2.

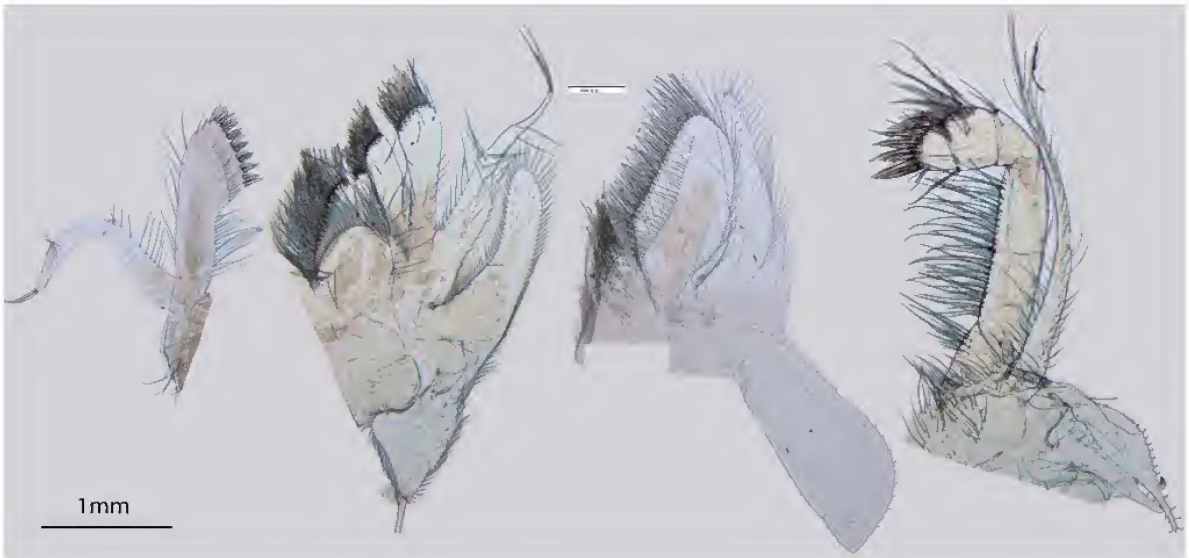


Figure 41. *Bouvieraxius keiensis* Sakai, 1992. Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta truncated), maxilliped 1, maxilliped 2.

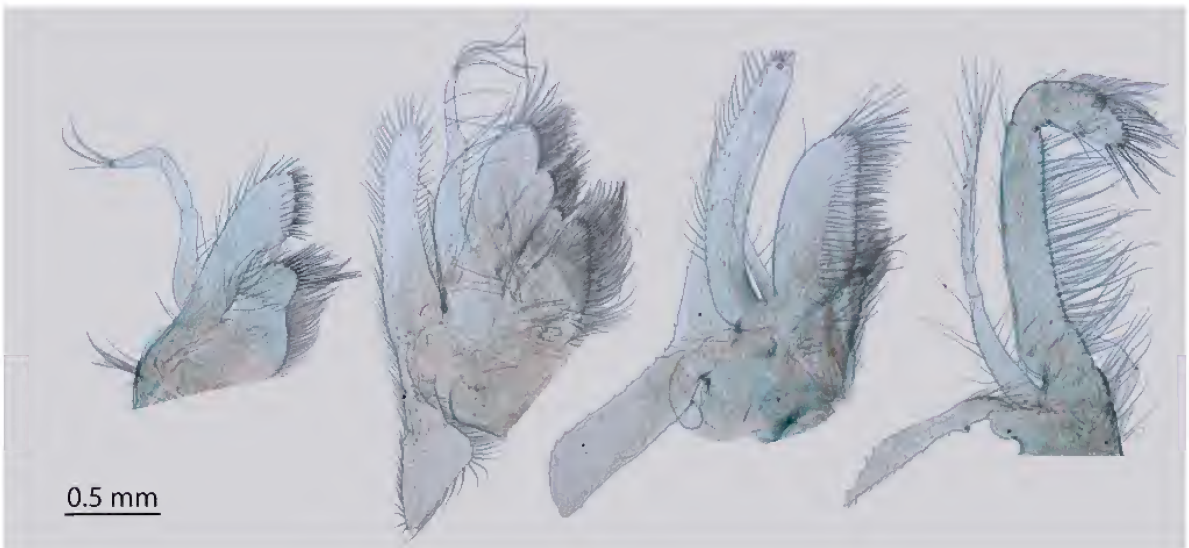


Figure 42. *Calastacus myalup* sp. nov. Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta missing), maxilliped 1, maxilliped 2.



Figure 43. *Calaxius acutirostris* Sakai and de Saint Laurent, 1989. Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta truncated), maxilliped 1, maxilliped 2.

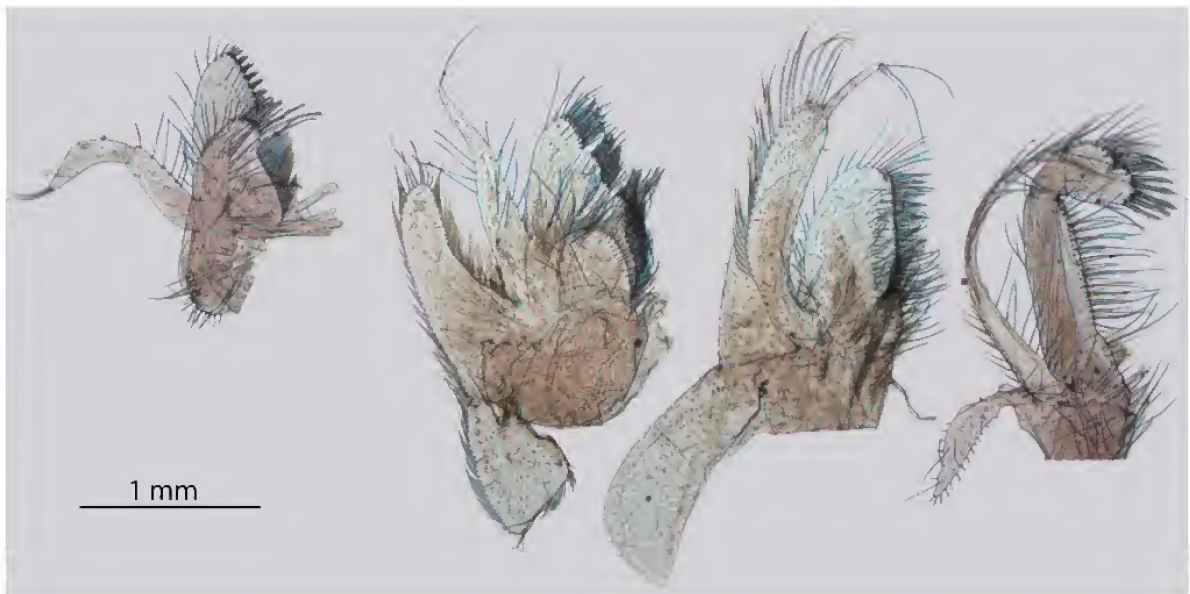


Figure 44. *Paraxiopsis pumilus* (Sakai, 1994). Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta truncated), maxilliped 1, maxilliped 2.



Figure 45. *Pilbaraxius kariyarra* sp. nov. Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta truncated), maxilliped 1, maxilliped 2.

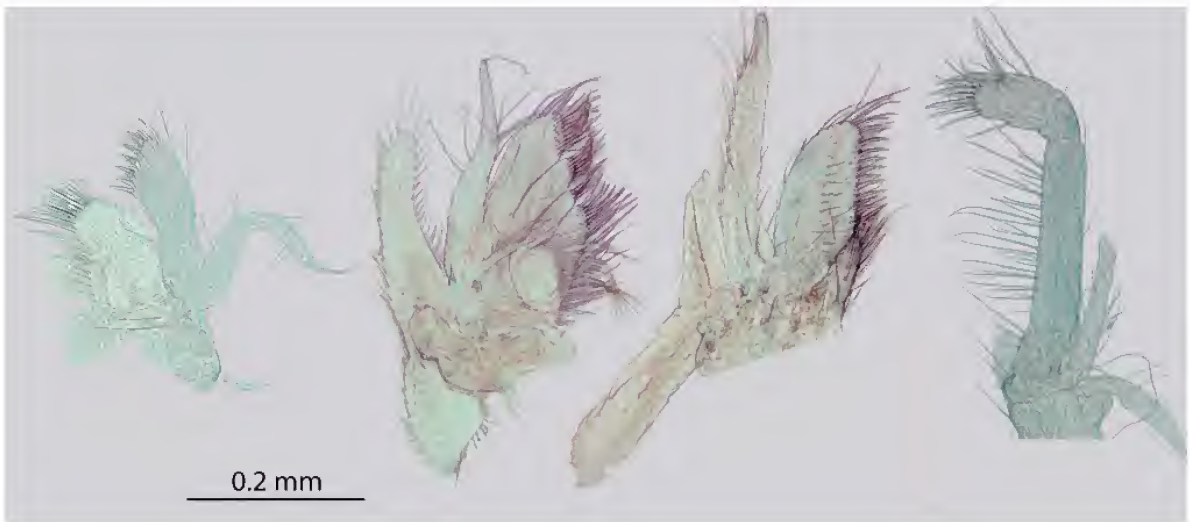


Figure 46. *Planaxius brevifrons* Komai and Tachikawa, 2008. Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta truncated), maxilliped 1, maxilliped 2.

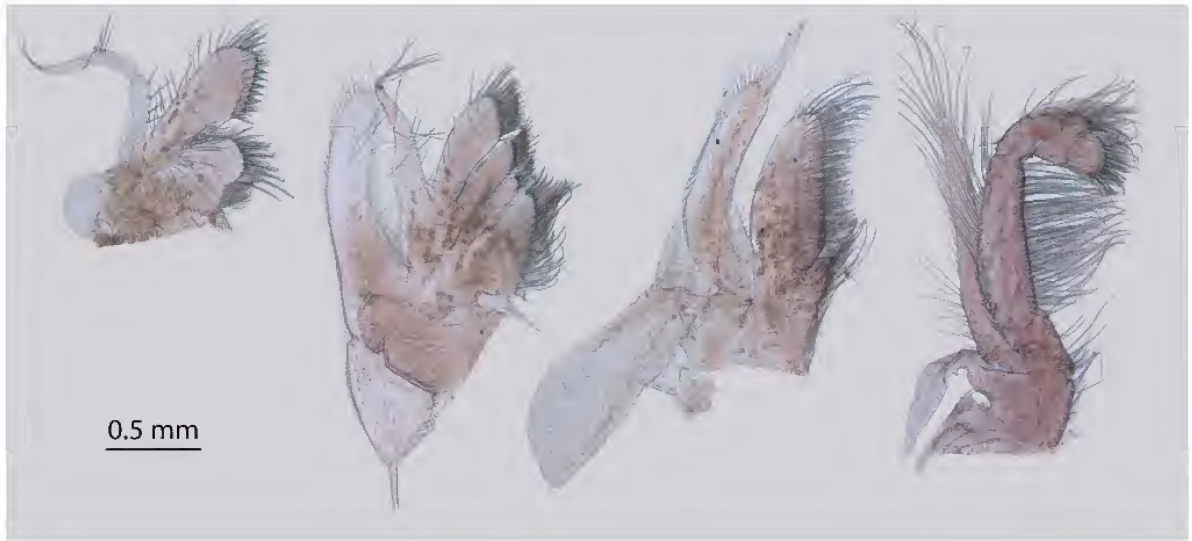


Figure 47. *Platyaxius bardi* sp. nov. Photomicrographs of (left to right) maxilla 1, maxilla 2 (posterior epipod seta missing), maxilliped 1, maxilliped 2.