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Indo-West Pacific and Australian species of Eucalliidae with descriptions of four new species (Crustacea: Axiidea)

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Abstract

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Surveys of coral reefs and sandy shallow environments in the Indo-West Pacific and Australia have discovered 14 species of Eucalliidae, of which four are new. All species are diagnosed, and *Andamancalliax arafura* sp. nov., *Eucalliixiopsis dworschaki* sp. nov., *Eucalliixiopsis paradoxa* sp. nov. and *Eucalliixiopsis patio* sp. nov. are described as new. The collection is an opportunity to re-diagnose other species and provide colour photographs of some. *Calliixina xishaensis* Liu and Liang, 2016, is synonymised with *Calliixina novaebritanniae* (Borradaile, 1900).

Keywords

Crustacea, Axiidea Eucalliidae, taxonomy, new species

Introduction

Of eight families of callianassid-like Axiidea, Eucalliidae have the most complicated taxonomic history that was most recently reviewed by Poore et al. (2019). Their revision and the molecular phylogeny on which it was based (Robles et al. 2020) depended in part on extensive collections made in the Indo-West Pacific over the last couple of decades. These collections also made it possible to re-diagnose known species and describe others revealed as new during the molecular study.

Eucalliidae comprise seven genera, diagnosed by Poore et al. (2019), and 21 species listed by these authors. Six species are from the Atlantic or Mediterranean and two are deep-sea. This contribution deals only with those from coral reefs and shallow environments in the Indo-West Pacific and Australia. Fourteen species are covered here, of which four are described as new.

Methods

Much of the material comes from the Muséum nationale d'Histoire naturelle, Paris (MNHN), including expeditions to Papua New Guinea, Madang Province (PAPUA NIUGINI stations), and New Ireland Province (KAVIENG 2014 stations). Another sizable Indo-West Pacific collection has been accumulated by the Florida Museum of Natural History, University of Florida (UF). Specimens were also examined from Museums Victoria, Melbourne (NMV); the Australian Museum, Sydney (AM); Western Australian Museum, Perth (WAM); and Naturhistorisches Museum, Vienna (NHMW).

Unless otherwise stated, station prefixes and numbers belong to systems initiated by the museum holding the material.

Size is expressed as carapace length (cl.), including rostrum, in mm. Individuals marked with an asterisk (*) were sequenced and contributed to molecular analysis (Robles et al., 2020). Diagnoses have been prepared for all species and coded into a DELTA database (Dallwitz, 2010). This database was used to generate the diagnoses presented here; character states in italics diagnose each species in at least one respect from every other species. Colour photographs of fresh specimens were taken in the laboratory shortly after collection by Arthur Anker and Zdeněk Ďuriš. Photographs in figs 12 and 25 were taken using a Leica 205C microscope and the Leica Application Suite multifocus routine.

Eucalliidae Manning and Felder, 1991

Eucalliinae Manning and Felder, 1991: 781 (misspelling).

Eucalliicinae Sakai, 1999: 108–109.—Sakai, 2018: 734–738 (partim).

Eucalliidae.—Sakai, 2011: 491.—Sakai and Türkay, 2014: 190 (outdated key to genera).—Sakai, 2018: 734–738.—Poore et al., 2019: 122 (for complete synonymy).

Remarks. The family was diagnosed by Poore et al. (2019). It is recognised most easily by the truncate setose apex of the dactylus of maxilliped 3. Callianopsidae, which also share this feature, differ in that the uropodal exopod lacks a dorsal plate, indicated in eucalliids by a secondary dense row of stout setae diverging on the upper surface from the anterior margin.

Andamancalliax Sakai, 2011

Andamancalliax Sakai, 2011: 494–495.—Sakai, 2018: 738.—Poore et al., 2019: 126.

Remarks. The genus differs from other eucalliicids in the prominent sharp rostrum and the unequal dissimilar chelipeds, the minor one having elongate fingers. The crista dentata of the type species was not illustrated, but in the new species described here, it comprises few sharp long spines in lieu of a row of similar even teeth seen in other genera. Sakai (2011, 2018) stated that the maxilliped 3 lacks an exopod but in the newly discovered female of what appears to be a different species, a small exopod is present. The genus was diagnosed by Sakai (2011) as having the male pleopod 1 biarticulate, but this was changed by Sakai (2018) to pleopod 1 absent. I believe it is biarticulate, as in other eucalliicids, for the reasons given under remarks on the type species.

***Andamancalliax andamanica* (Sakai, 2002)**

Calliax andamanica Sakai, 2002: 463–467, figs 1, 2.—Sakai, 2005: 201.

Andamancalliax andamanica Sakai, 2011: 495.—Sakai, 2018: 738.

Distribution. Thailand, Andaman Sea. Shelf, 31–61 m.

Remarks. Sakai (2002) referred to the holotype of *Calliax andamanica* as female in the description and male in the figure legends. His figure 2B of the “female Plp 1” from the holotype, described as “uniramous, two-articled, distal article bilobed distally”, is most probably from an immature male (cf. fig. 16q of male pleopod 1 of *Eucalliixiopsis dworschaki* sp. nov.).

***Andamancalliax arafura* sp. nov.**

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Figures 2, 3

Material examined. Holotype. Australia, NT, Arafura Sea, 9.2055° S, 133.6483° E, 155–158 m, oozy mud (RV *Southern Surveyor* stn 032BS006), AM P.74526 (female, 3.7 mm, without major cheliped).

Description of holotype. Carapace smooth; gastric–abdominal regions together 4.3 times as long as width of these regions together; branchiostegite fully calcified; cervical groove at 0.62 carapace length, scarcely obvious on branchiostegite.

Rostrum acute, strongly tapering, two-thirds length of eyestalk. Anterolateral carapace lobe absent. Thoracic sternite 7 1.6 times as long as wide, with well-defined median sulcus over posterior half, smooth over medial half, weak lateral ridge anterior to coxal articulation crossing pit at quarter of width.

Pleonite 1 without anterior transverse groove, without sternal plates.

Eyestalk 1.8 times as long as greatest width, swollen laterally, tapering distally around cornea, with defined apical lobe; cornea wider than long. Antennular peduncle 1.8 times as long as width of both eyestalks; article 2 twice as long as wide; article 3 as long as article 2; article 3 with ventrolateral row of few setae, continued onto flagellum. Antennal peduncle 2.2 times as long as width of both eyestalks, overreaching antennule peduncle by most of article 5; scaphocerite ovoid, longer than wide; article 4

c. 5 times as long as wide; article 5 0.7 length of article 4. Maxilliped 3 basis with 4 mesial teeth along lower margin, ischium with strongly expanded proximo-lower lobe, tapering to two-thirds of its greatest proximal width; crista dentata of 3 short basal spines, plus 4 long sharp spines, first 2 recurved, last 2 overlapping merus; merus upper margin 1.5 times as long as greatest width; carpus–dactylus together reaching back to mid-ischium; dactylus as wide as long, with setose truncate apex; exopod third length of upper margin of ischium.

Major cheliped missing. Minor cheliped (right) ischium c. 2.8 times as long as distal width, lower margin with sharp subdistal spine; merus twice as long as broad, lower margin convex, unarmed; carpus 1.1 times as wide as upper length, margins carinate; propodus palm tapering, 0.9 times as wide as upper palm length, upper margin rounded, distomesial margin of palm oblique, distolateral margin of palm oblique, with triangular tooth at base of finger; fixed finger twice length of upper margin of palm, lateral cutting edge with proximal sharp oblique tooth, obtuse distal tooth; dactylus as long as fixed finger, 5 times as long as wide at base, cutting edge with obtuse rounded tooth at about two-thirds.

Pereopod 2 merus 2.2 times as long as maximum width; dactylus c. 5 times as long as upper margin of propodus. Pereopod 3 merus 2.3 times as long as maximum width; carpus 1.7 times as long as wide; propodus with lower margin concave, 1.3 times as long as mid-length; dactylus less than half as long as axial length of propodus. Pereopod 4 merus 3 times as long as maximum width; carpus 3 times as long as wide; propodus setose, with long distal spiniform seta among setose margin, as long as dactylus, with 2 long distal setae overlapping dactylus. Pereopod 5 chelate.

Pleopod 1 uniaarticulate, tapering. Pleopod 2 endopod 2.6 times as long as wide; appendix interna at midpoint of endopod, reaching two-thirds remaining length of endopod. Pleopod 3 with appendix interna embedded in endopod.

Uropodal endopod ovoid, anterior margin more convex than posterior margin, widest at midpoint, 1.7 times as long as wide, without facial setae; exopod ovate, greatest dimension 1.6 times anterior margin, anterior margin straight, curving into distal margin, sharper curve between distal and posterior margins, with row of blade-like setae on distal posterior margin; dorsal plate defined by weak longitudinal ridge, extending half of exopod width, distal plate margin with a dozen scattered spiniform setae of various sizes. Telson 1.6 times as wide as long, broadest over anterior half, lateral margin evenly curving to posterior margin; posterior margin convex, with posterolateral clusters of long setae; dorsal surface smooth.

Etymology. For the Arafura Sea (noun in apposition).

Distribution. Australia, Arafura Sea. Shelf, 151–158 m.

Remarks. The truncate setose dactylus of maxilliped 3, presence of a dorsal plate, spike-like rostrum and long fingers on the minor cheliped place the new species in *Andamancalliax*. The sole specimen differs from the illustrations of *A. andamanica* in the presence of a short exopod on maxilliped 3, a distal spine on the lower margin of the ischium of the minor cheliped, a tooth on the fixed finger of the minor cheliped, a



Figure 1. Live colour photographs: a, *Calliuxina bulimba*, Papua New Guinea, MNHN-IU-2013-7097; b, c, *C. kensleyi*, Saudi Arabia, UF 36699; d, e, *C. novaebritanniae*, Papua New Guinea, MNHN-IU-2013-7062; f, *Eucalliixiopsis dworschaki*, French Polynesia, UF 16286; g, *E. dworschaki*, Papua New Guinea, MNHN-IU-2013-7081; h, *E. inaequimana*, French Polynesia, UF 29162; i, *E. inaequimana*, French Polynesia, UF 29208. Photos a, d, e, g: Z. Đuriš; b, c, f, h, i, A. Anker. Various scales.

more oval uropodal endopod and a less pronounced dorsal plate on the uropodal exopod. The few sharp spines that constitute the crista dentata are unique within Eucalliicidae; the situation in *A. andamanica* was not reported. The dorsal plate of the uropodal exopod of *A. arafura* is less well developed than in *A. andamanica*, which was said to have the dorsal

surface carinate and the anterior half elevated.

***Calliuxina* Ngoc-Ho, 2003**

Calliuxina Ngoc-Ho, 2003: 493–494.—Sakai, 2011: 497 (part).—Poore et al., 2019: 126–127.

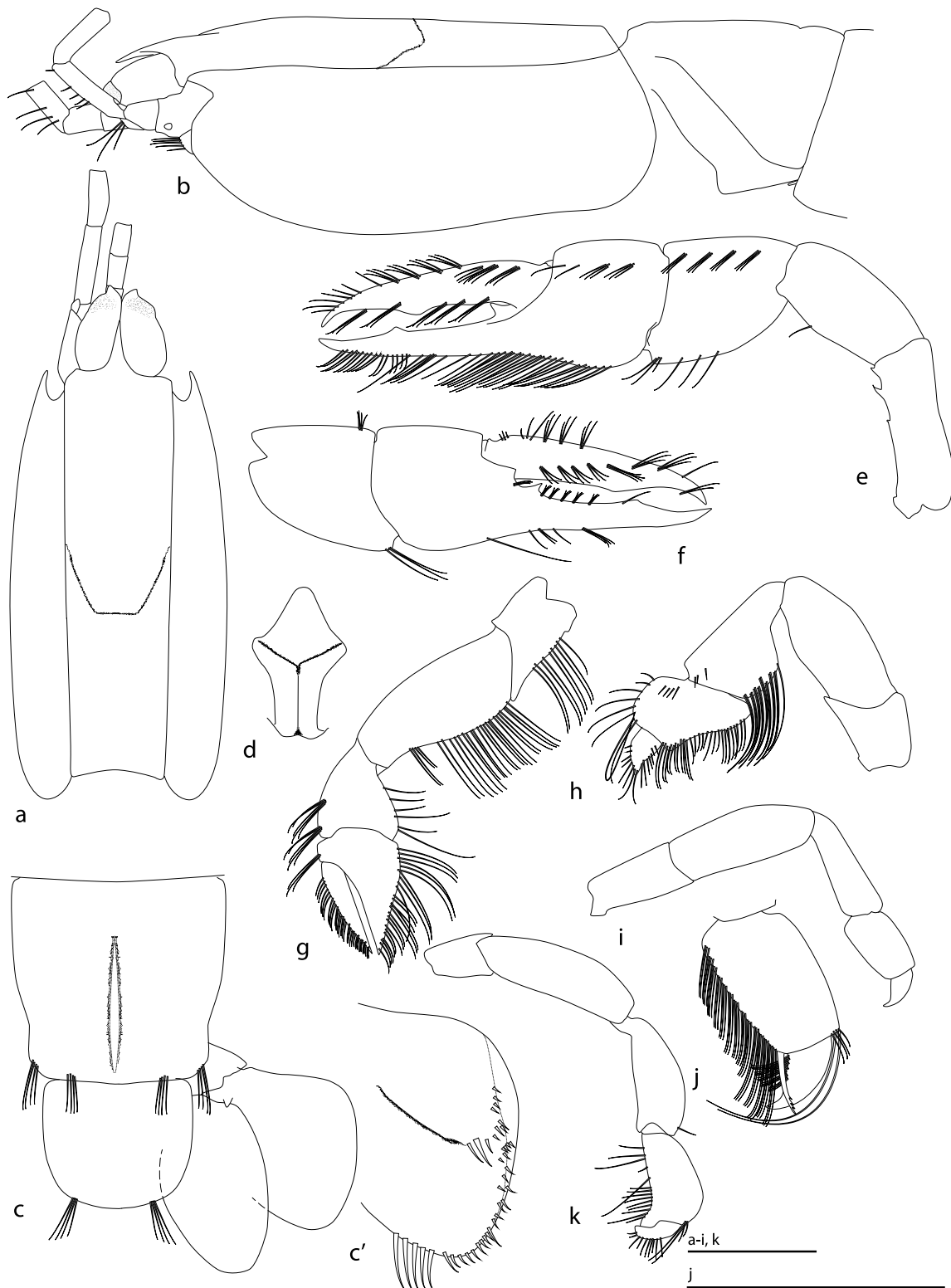


Figure 2. *Andamancalliax arafura* sp. nov. Holotype, Australia, NT, AM P.74526 (female, 3.7 mm): a, b, anterior carapace, eyestalks, antennule, antenna, pleonite 1, dorsal, lateral views; c, pleonite 6, telson, uropod (c', detail of uropod exopod spiniform setae); d, thoracic sternite 7; e, f, minor cheliped (right), mesial, lateral views; g, pereopod 2; h, pereopod 3; i, j, pereopod 4, with detail of propodus, dactylus; k, pereopod 5. Scale bars = 1 mm.

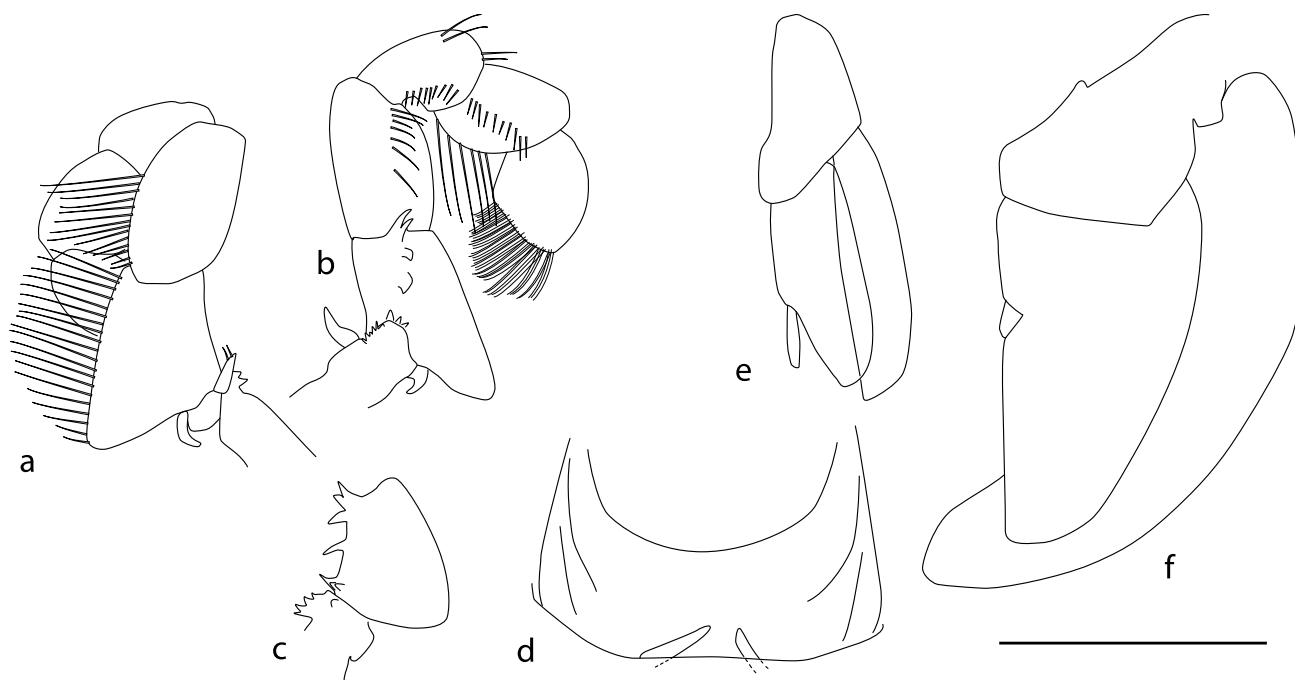


Figure 3. *Andamancalliax arafura* sp. nov. Holotype, Australia, NT, AM P.74526 (female, 3.7 mm): a, b, left maxilliped 3, lateral, mesial views; c, left maxilliped 3, basis, merus, posterior view; d, pleonal sternite 1, pleopod 1; e, f, pleopods 2, 3. Scale bar = 1 mm.

Remarks. *Calliaxina* differs from *Eucalliixiopsis* in lacking a transverse ridge on the telson, lacking differentiation between male and female major chelipeds, and always possessing an exopod on maxilliped 3, sometimes vestigial (Poore et al., 2019; Robles et al., 2020).

Calliaxina includes the type species, *C. punica* (de Saint Laurent and Manning, 1982) from the western Mediterranean plus four species from the Indo-West Pacific. Separation of the species is difficult because characters defining each have historically been incompletely documented. Juveniles of all species tend to have larger eyes, more acute rostrums and similar telsons, making differentiation on the basis of these characters impossible. Adult males of four species are known; juvenile males of one of these and of the fifth species have presumably immature pleopods 1 (see Poore et al. [2019] and discussions below under *C. bulimba* and *C. novaebritanniae*). Liu and Liang's (2016) key to species included one species here placed in *Eucalliixiopsis* and relied on the shape of the rostrum and telson, both size-dependent features.

Key to species of *Calliaxina*

- 1. Maxilliped 3 exopod vestigial 2
- Maxilliped 3 exopod reaching at least third way along ischium 3
- 2. Major cheliped propodus distomesial margin with setae aligned in 2 groups of c. 10 and c. 6 setae; minor cheliped

distomesial margin with setae aligned in 2 scarcely separate groups of c. 20 and c. 8 setae; cheliped merus lower margin with few denticles; Red Sea, Jordan, Saudi Arabia; Madagascar *C. kensleyi* (Dworschak, 2005)

- Major and minor chelipeds propodi distomesial margins with setae aligned in 2 groups of c. 9 setae each; cheliped merus lower margin with 2 or 3 proximal truncated curved teeth and diminishing denticles more distally; Papua New Guinea, SE Australia *C. bulimba* (Poore and Griffin, 1979)
- 3. Maxilliped 3 exopod overlapping merus (except in juveniles) 4
- Maxilliped 3 exopod reaching half-way along ischium; male pleopod 1 article 2 3 times as long as wide; Japan, East China Sea *C. sakaii* (de Saint Laurent, 1979)
- 4. Antennule peduncle reaching base of antenna peduncle article 5; male pleopod 1 with broad subapical notch, prominent appendix interna, triangular apex; Mediterranean *C. punica* (de Saint Laurent and Manning, 1982)
- Antennule peduncle reaching midpoint of antenna peduncle article 5; pleopod 1 article 2 with narrow apical notch, short appendix interna, apex prominently curved; Papua New Guinea, Indonesia, NE Australia, Philippines, South China Sea, French Polynesia *C. novaebritanniae* (Borradaile, 1900)

***Calliixina bulimba* (Poore and Griffin, 1979)**

Figures 1a, 4, 5, 12a, h

Callianassa bulimba Poore and Griffin, 1979: 257, fig. 21.

Calliax bulimba.—de Saint Laurent and Manning, 1982: 222.—Sakai, 1999: 119, fig. 32a–c.—Sakai, 2005: 202.

Calliixina bulimba.—Sakai, 2011: 499.—Poore et al., 2019: 127, 146, fig. 19g, h.

Eucalliix bulimba.—Dworschak, 2005: fig. 5c, d.

Eucalliix kensleyi.—Sakai, 2017: 1122–1124 (partim), fig. 2D.

Material examined. Australia. Qld, Britomart Reef front, 18° 17' S, 146° 38' E (NMV stn AIMS 57), NMV J12184 (female, 8.7 mm). Rib Reef, 18.48° S, 146.86° E, October 1985, shallow lagoon, 8 m, (M. Riddle stn R/10/1), NMV J71676 (male, 4.6 mm).

Papua New Guinea. Madang Province, lagoon, PAPUA NIUGINI stations: 05° 10.2' S, 145° 50.4' E, 1–3 m (stn PR243), MNHN-IU-2013-7097* (male, 4.5 mm); 05° 10.3' S, 145° 48.5' E, 1–18 m (stn PR213), MNHN-IU-2013-7124 (female, 3.5 mm).

Diagnosis. Sternite 7 with transverse groove visible only laterally, anteromedial lobe rounded. Antennule peduncle reaching to midpoint of antenna peduncle article 5. Maxilliped 3 exopod vestigial, about twice as long as wide. Major cheliped merus, lower margin with 2 or 3 proximal truncate teeth; propodus distomesial margin with setae aligned in 2 similar groups of c. 9 setae each. *Male pleopod 1 article 1 linear, with distal setae; article 2 short, oblique (juvenile form).*

Colour. Exoskeleton translucent white (fig. 1a).

Distribution. Indonesia, Ambon; Papua New Guinea, Madang and New Ireland provinces; Australia, Qld (type locality). Coral reef lagoon, 1–18 m.

Remarks. Poore and Griffin's (1979) simple figures are supplemented here by illustrations of a newly discovered male and female from Australia. The telson is widest proximally, the anterior margins each side of the rostrum are concave, and the distomesial margins of the propodi of the chelipeds bear two widely separate small groups of c. 9 setae each. As is typical of callianassid-like families, the rostrum of small individuals is more acute than in adults and the cornea more swollen. Separation of the anterior and posterior sections of thoracic sternite 7 is weak, with only a slight inclination laterally terminating in a sublateral pit; the posterolateral margin carries groups of c. 6, 7 and 9 long setae (fig. 12h). As figured by Dworschak (2005), pleonite 1 lacks obvious ventral plates but bears two short rows of three or four long setae anterior to the pleopods.

The 4.5-mm male from Papua New Guinea has a pleopod 1 with long distal setae on article 1 and a short simple oblique article 2 (fig. 5d). This is consistent with Poore and Griffin's (1979: fig. 21g) and Dworschak's (2005: fig. 5c, d) illustrations of the much larger holotype (cl. 10 mm) and resembles those of *Eucalliixiopsis inaequimana* (see Dworschak, 2014: fig. 4j–l), *E. madagassa* (see Ngoc-Ho, 2014: fig. 2S, as *C. thomassini*) and *E. patio* sp. nov. Pleopod 1 of the 4.6-mm male from Australia differs in having a bilobed article 2 with a longitudinal crease and a separate appendix interna (fig. 5b). As argued by

Poore et al. (2019), this would appear to be an intermediate form tending towards the more typical eucalliixid male pleopod (e.g., fig. 7h, j). Undeveloped male pleopods 1 are also seen in small juveniles of *C. novaebritanniae* (see below).

The small specimens from Papua New Guinea can be distinguished from the holotype in having an apparently broader uropodal endopod (1.25 times as long as wide vs 1.4 times). They did not possess the fine granular lateral surface in the gape of the cheliped illustrated by Poore and Griffin (1979). Sakai (1999: fig. 32) showed the cobblestone pattern on the lower branchiostegite to be a little more extensive in the holotype from Queensland than on the new material from Papua New Guinea.

This is one of two species with a rudimentary exopod on maxilliped 3, overlooked by Poore and Griffin (1979) but noted on the holotype by Sakai (1999). The exopod bears a few short setae. The other is *C. kensleyi* (Dworschak, 2005); the two were differentiated by Dworschak (2005) but see further comments under *C. kensleyi* below.

Sakai (2017) listed and figured an ovigerous female from Ambon, Indonesia, as *Eucalliix kensleyi* but on biogeographical grounds this is certainly *C. bulimba*.

***Calliixina kensleyi* (Dworschak, 2005)**

Figures 1b, c, 6, 7, 12b, c, i

Eucalliix kensleyi Dworschak, 2005: 205, figs 1–4, 5a, b.—Sakai, 2017: 1122–1124 (partim), fig. 2A–C, E–G.

Calliixina kensleyi.—Poore et al., 2019: 125, 127, 146, fig. 19i.

Material examined. Saudi Arabia, Farasan Banks, Marka Island, sandy cay, 18.22055° N, 41.32438° E (stn SAFA-010), UF 36699 (male, 5.9 mm).

Madagascar, Tuléar (now Toliara), Thomassin stn 648, MNHN-IU-2014-10476 (female, 7.8 mm); Thomassin stn 650, MNHN-IU-2016-8086 (female, 6.6 mm). Nosy Bé, MNHN-IU-2016-8084 (male, 7.4 mm).

Diagnosis. Sternite 7 with transverse groove visible only laterally, anteromedial lobe rounded. Antennule peduncle reaching to midpoint of antenna peduncle article 5. *Maxilliped 3 exopod vestigial, about twice as long as wide.* Major cheliped merus, lower margin with 2 or 3 proximal truncate teeth; propodus distomesial margin with setae aligned in 2 groups of c. 10 and c. 6 setae. Male pleopod 1 article 2 about 2.5 times as long as wide; appendix interna obsolete.

Colour. Exoskeleton mostly translucent white, gastric region, epistome, upper parts of chelipeds pink (fig. 1b, c).

Distribution. Red Sea (Jordan, Saudi Arabia); western Indian Ocean (Madagascar). Intertidal, shallow sediments.

Remarks. *Calliixina kensleyi* shares a vestigial maxilliped 3 exopod with *C. bulimba*. The two species were compared by Dworschak (2005) but the differences he listed are subtle and deserve reinterpretation and addition. The more pronounced rostrum of *C. kensleyi* is subtly so, but juveniles appear to have sharper rostrum in both species. The telson of *C. kensleyi* was

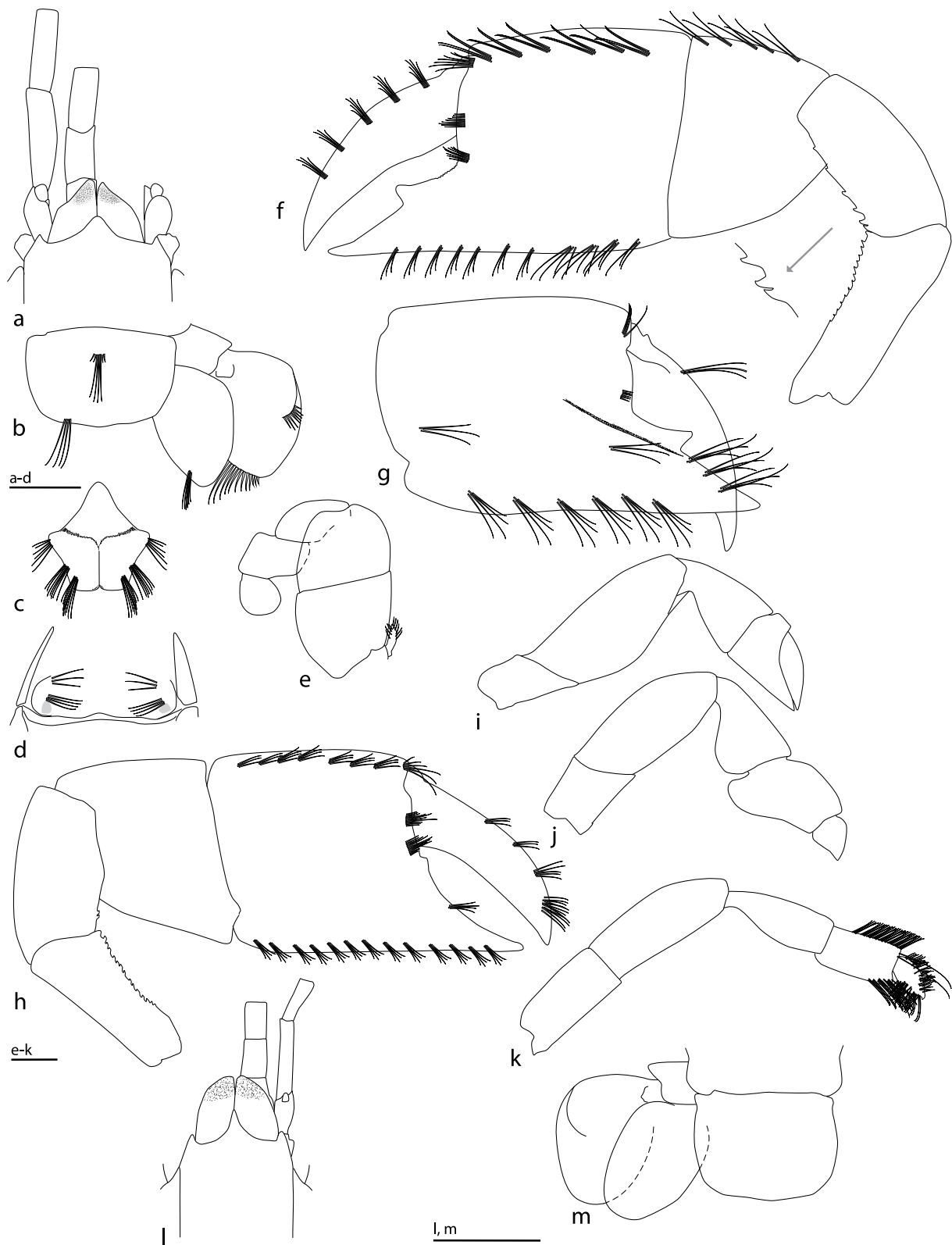


Figure 4. *Calliaxina bulimba*. Australia, Qld, NMV J12184 (female, 8.7 mm): a, anterior carapace, eyestalks, antennule, antenna; b, telson, uropod; c, thoracic sternite 7; d, pleonal sternite 1; e, maxilliped 3; f, g, major cheliped (right), mesial, lateral views; h, minor cheliped (left), mesial view; uropod. Scale bars = 1 mm.

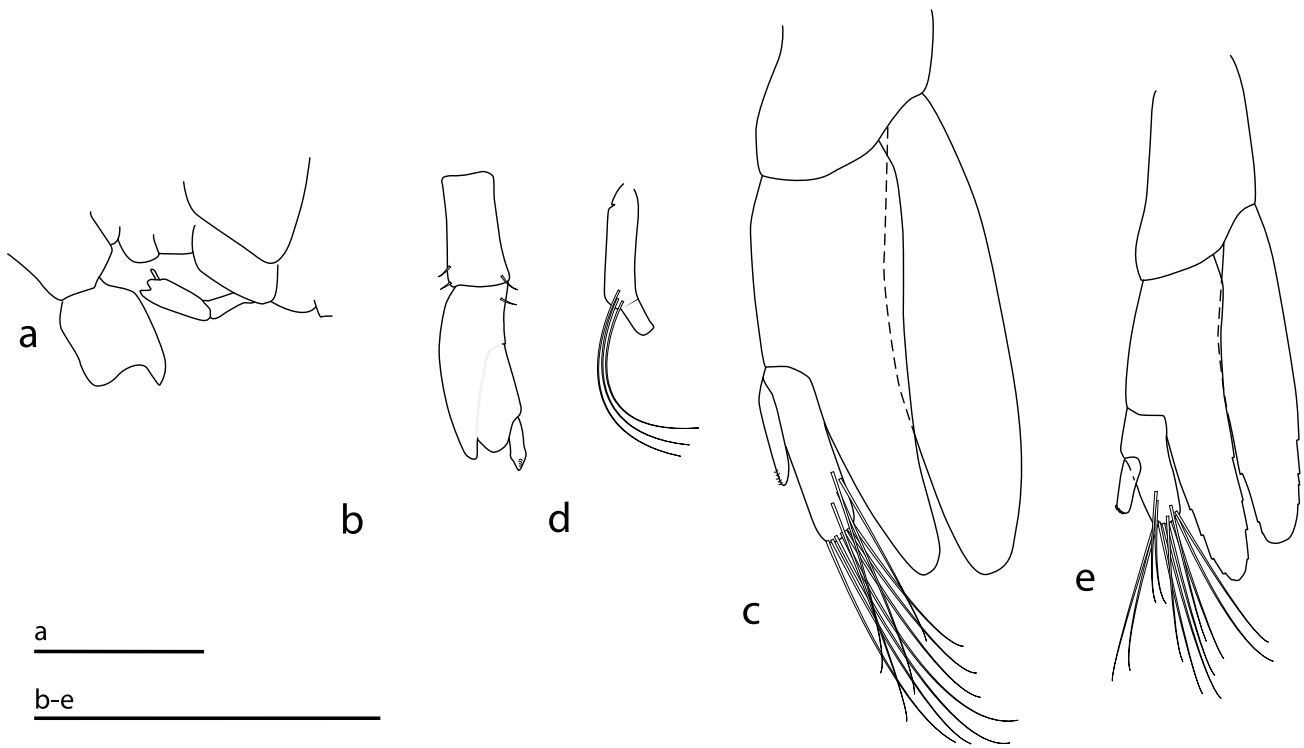


Figure 5. *Calliaxina bulimba*. Australia, Qld, NMV J71676 (male, 4.6 mm): a, left coxa 5, pleonite 1, pleopod 1 in situ, lateral view; b, c, pleopods 1, 2. Papua New Guinea, MNHN-IU-2013-7097 (male, cl. 4.5 mm): d, e, pleopods 1, 2. Scale bars = 1 mm.

said to be widest at its midpoint, whereas that of *C. bulimba* is widest anteriorly; this difference is less obvious in smaller specimens. The uropodal exopod is oval in *C. kensleyi*, more tapering in *C. bulimba*, but again less clear in smaller specimens. In both species, the major cheliped (the slightly wider one) has a tooth on the fixed finger, whereas the minor cheliped does not, with the apparent exception of the paratype of *C. kensleyi*.

Despite their obvious morphological similarity, *Calliaxina kensleyi* and *C. bulimba* were not the two most phylogenetically related of the four species in Robles et al.'s (2020) study. *Calliaxina kensleyi* was sister species to *C. novaebritanniae*, and these two more related to *C. sakaii*, which if true suggests that the vestigial maxilliped 3 exopod has evolved twice. Ovoid plates are visible on the sternite of pleonite 1 (fig. 6c) but absent in *E. bulimba* (fig. 4d).

Dworschak (2005) did not describe the dentition of the lower margin of the merus of the chelipeds of *C. kensleyi*; in the new material there are few proximal denticles (fig. 6e, f). All specimens of *C. bulimba* possess two or three proximal truncated curved teeth and diminishing denticles more distally (fig. 4f). The distomesial face of the propodus of the chelipeds has two rows of submarginal setae in both species. On the

major cheliped of *C. kensleyi*, these setae align in two separate groups of c. 10 and c. 6 setae (figs 6d, 12c); on the minor cheliped, the setae align in two scarcely separate groups of c. 20 and c. 8 setae (fig. 6f; Dworschak, 2005: fig. 3a, c). On both chelipeds of *C. bulimba*, distomesial setae align in two widely separate groups of c. 9 setae each (fig. 4h). The distolateral propodus of the chelipeds is granulated in a concavity at the base of the fingers in some individuals of both species but is absent on others, especially smaller specimens.

The two males identified here as *C. kensleyi* possess a male pleopod 1 typical of several species of *Calliaxina* and *Eucalliaxiopsis*: *C. novaebritanniae*, *C. paradoxa*, *C. punica*, *C. sakaii*, *Eucalliaxiopsis jonesi* (Heard, 1989), *E. mcilhennyi* (Felder and Manning, 1994) and *E. panglaoensis* (all with a broad article 2, appendix interna and curved apex; see fig. 7h, j and earlier papers (Dworschak, 2006, 2014; Felder and Manning, 1994; Heard, 1989; de Saint Laurent and Manning, 1982;). As noted above, the male pleopod 1 of *C. bulimba* differs from all of these, its second article lacking an appendix interna and distal curved apex. The appendix masculina on pleopod 2 of *C. kensleyi* is narrower than that of *C. bulimba*.

Sakai (2017) included *C. kensleyi* in *Eucalliax* although

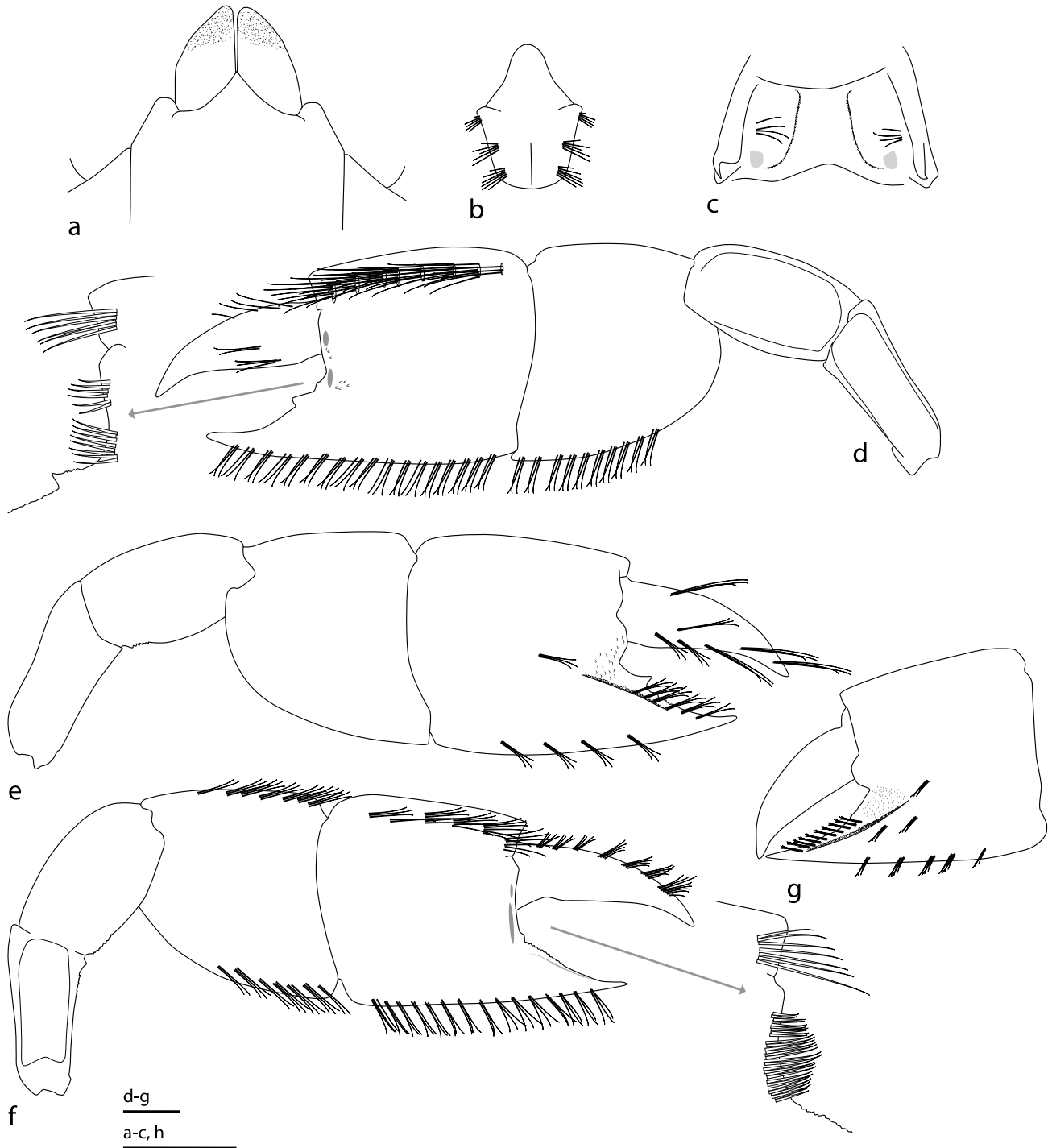


Figure 6. *Calliaxina kensleyi*. Madagascar, MNHN-IU-2014-10476 (female): a, anterior carapace, eyestalks; b, thoracic sternite 7; c, pleonal sternite 1 (anterior uppermost); d, e, major cheliped (right), mesial, lateral views, with detail of mesial setae on propodus; f, g, minor cheliped (left), mesial, lateral views, with detail of mesial setae on propodus. Scale bars = 1 mm.

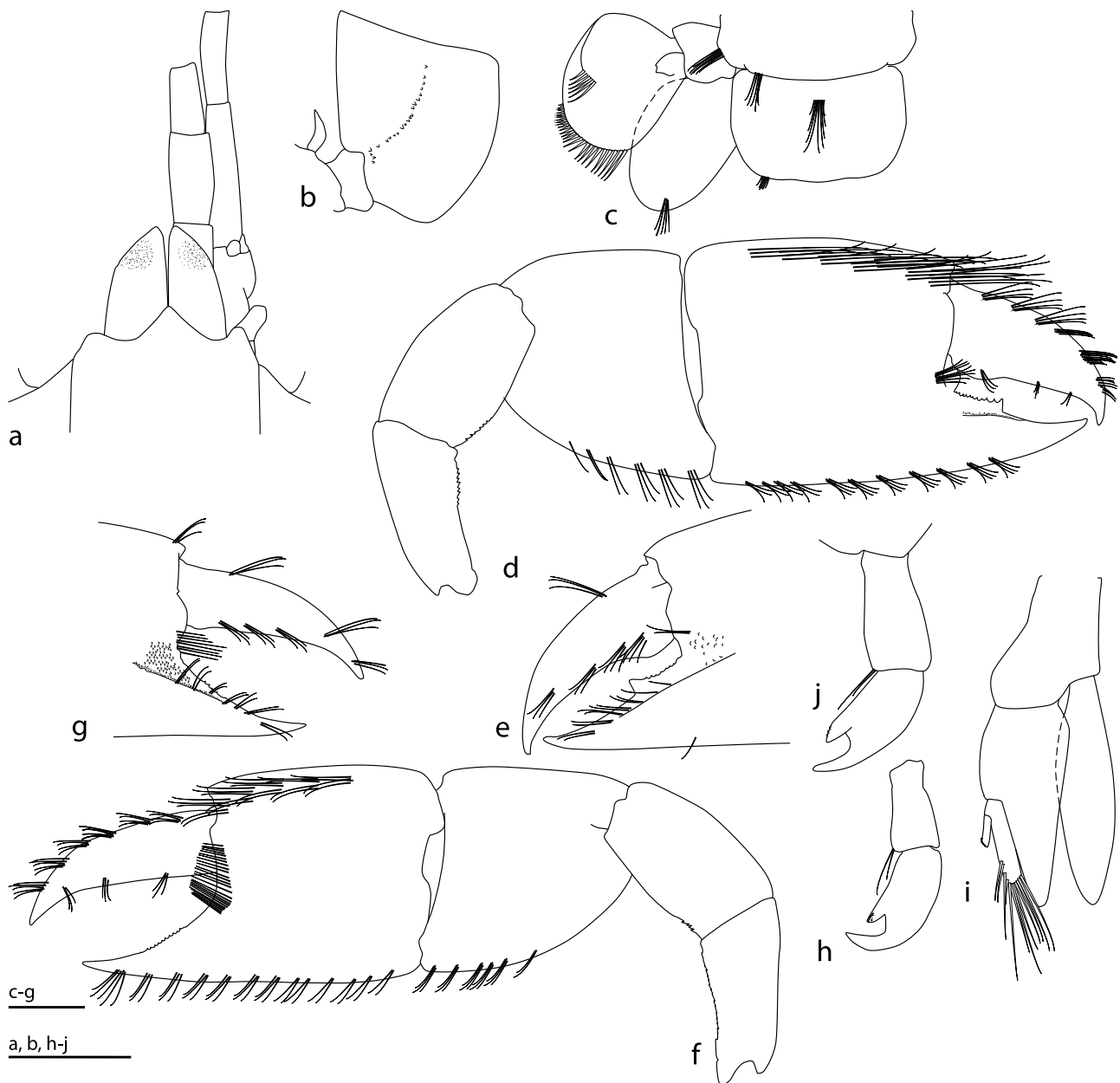


Figure 7. *Calliaxina kensleyi*. Saudi Arabia, UF 36699 (male): a, anterior carapace, eyestalks, antennule, antenna; b, maxilliped 3, exopod, basis, ischium; c, telson, uropod; d, major cheliped (left), mesial view; e, major cheliped fingers (left), lateral view; f, minor cheliped (right), mesial view; g, minor cheliped fingers (right), lateral view; h, i, pleopods 1, 2. Madagascar, MNHN-IU-2014-8084 (male): j, pleopod 1. Scale bars = 1 mm.

the species has all the features of *Calliaxina*, however diagnosed. His figure 2A–C, E–G of material from the Red Sea resembles the types from the nearby type locality, Aqaba. His figure 2D of the cheliped of a female from Ambon has a curiously triangular carpus. The location suggests *C. bulimba*, a species he did not mention. He referred to *E. kensleyi* as being from Aqaba and Moreton Bay (*Calliaxina bulimba* is from Moreton Bay, Qld) but listed the type locality as Alona

Beach, the Philippines (the type locality of *E. panglaoensis* Dworschak, 2006). The species was not listed by Sakai (2011).

Calliaxina novaebritanniae (Borradaile, 1900)

Figures 1d, e, 8–10, 12d, e, j

Callianassa novae-britanniae Borradaile, 1900: 419, pl. 39 figs 14a–d.

Callianassa (Callichirus) novae-britanniae.—Borradaile, 1903:

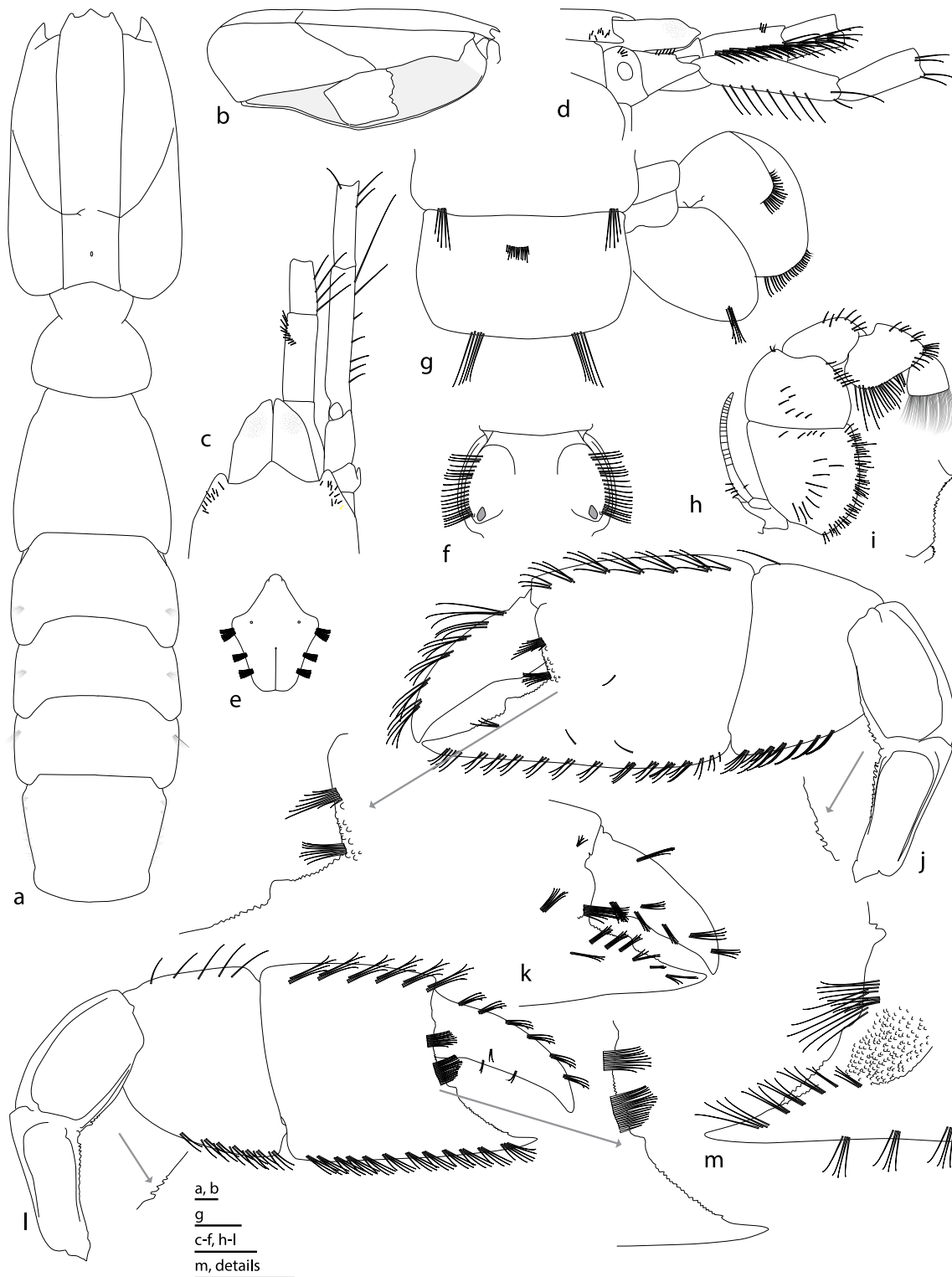


Figure 8. *Calliuxina novaebritanniae*. Australia, NMV J71677 (female, 11.5 mm): a, carapace, pleon, dorsal; b, carapace, lateral; c, d, anterior carapace, eyestalks, antennule, antenna, dorsal and lateral views; e, thoracic sternite 7; f, pleonal sternite 1; g, telson, uropod; h, maxilliped 3; i, maxilliped 3, crista dentata, basis, ischium; j, major cheliped (right), mesial with detail of merus margin, distal propodus; k, major cheliped (right), distal propodus, dactylus, lateral; l, minor cheliped (left), mesial view, with detail of merus margin, distal propodus; m, minor cheliped (left), fixed finger, lateral. Scale bars = 1 mm.

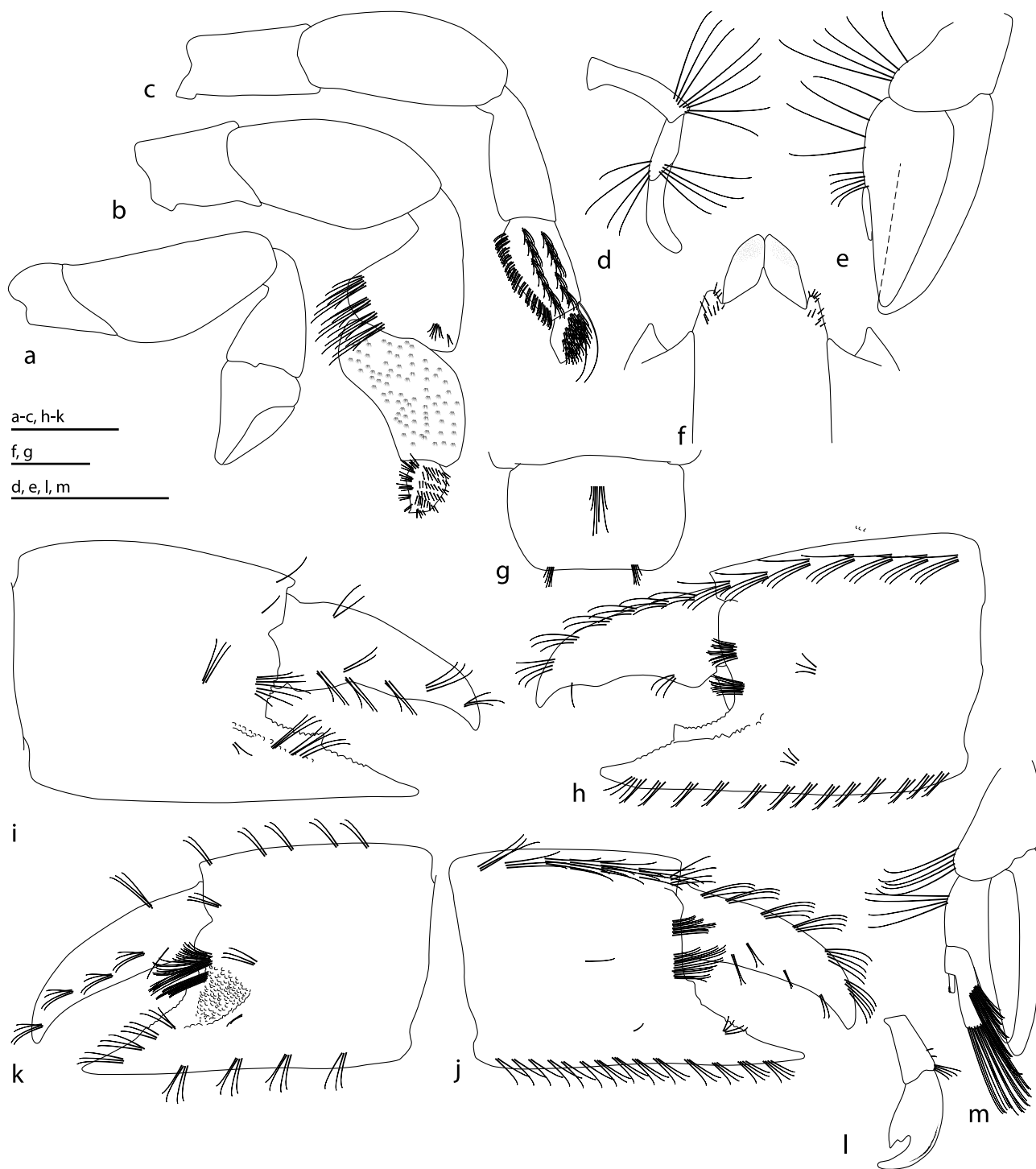


Figure 9. *Calliaxina novaebritanniae*. Australia, NMV J71677 (female, 11.5 mm): a–c, pereopods 2–4; d, e, pleopods 1, 2. NMV J71678 (male, 8.7 mm): f, anterior carapace, eyestalks; g, telson; h, i, major cheliped (right), propodus, dactylus, mesial and lateral; j, k, minor cheliped (left), propodus, dactylus, mesial and lateral; l, m, pleopods 1, 2. Scale bars = 1 mm.

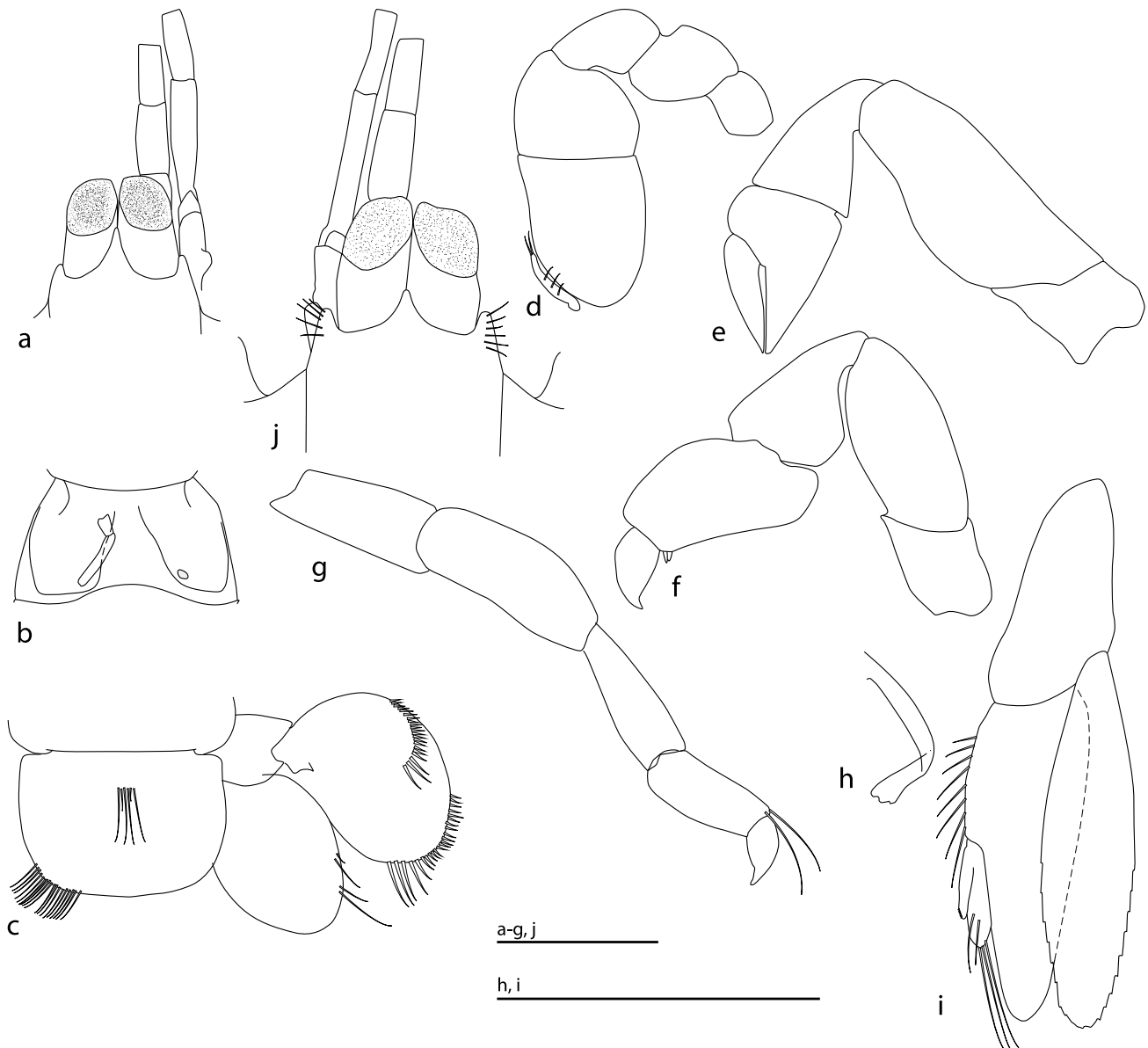


Figure 10. *Calliixina novaebritanniae*. Papua New Guinea, MNHN-IU-2014-8837 (male, 4.0 mm): a, anterior carapace, eyestalks, antennule, antenna; b, pleonal sternite 1, right pleopod 1 (anterior uppermost); c, telson, uropod; d, maxilliped 3; e–g, pereopods 2–4; h, i, pleopods 1, 2. French Polynesia, UF 23954 (female, 5.1 mm): j, anterior carapace, eyestalks, antennule, antenna. Scale bars = 1 mm.

547.—Borradaile, 1904: 753.—De Man, 1928a: 48.—De Man, 1928b: 29, 92, 93, 114 (part).

Calliix novaebritanniae.—de Saint Laurent and Manning, 1982: 211–224, figs 1c, 2b, 6c.—Sakai, 2005: 202.

Paraglypturus novaebritanniae.—Sakai, 1999: 123, fig. 32d–f.

Calliixina novaebritanniae.—Ngoc-Ho, 2003: 493.—Sakai, 2011: 500–501.—Dworschak, 2018: 17–19, fig. 1b, c (synonymy, notes).—Poore et al., 2019: 126, 127, 146.—Robles et al., 2020.

Calliixina xishaensis Liu and Liang, 2016: 83–87, figs 1, 2. **Syn. nov.**

not *Callianassa (Callichirus) novaebritanniae*.—Sakai, 1966: 161–

171 (record from Japan = *C. sakaii* [de Saint Laurent, 1979]).

not *Callianassa (Callichirus) novaebritanniae* var.—De Man, 1928b: fig. 20 (= *C. punica* [de Saint Laurent and Manning, 1982] fide de Saint Laurent and Manning [1982]).

Material examined. Papua New Guinea. Madang Province, lagoon, 05° 10.2' S, 145° 50.4' E, 1–3 m (PAPUA NIUGINI stn PR243), MNHN-IU-2013-7062* (ovigerous female, cl. 8.8 mm). New Ireland Province, Nago Island, 02° 36.3' S, 150° 46.2' E, 3–12 m (KAVIENG 2014 stn KR06), MNHN-IU-2014-8837* (male, 4.0 mm); MNHN-IU-2013-7941* (female, c. 4.0 mm).

French Polynesia, Moorea Island, NW motus, in channel between

islands and beach, 17.488393° S, 149.91342° W (stn BIZ-148), UF 23954 (female, 5.1 mm)

Australia, Qld, Great Barrier Reef. Myrmidon Reef, 18.27° S, 147.38° E, October 1985: lagoon with "*Callianassa*" mounds, 8 m, (M. Riddle stn M/10/1), NMV J71677 (female, 11.6 mm); NMV J71678 (male, 8.7 mm); NMV J71669 (2 males, 8.4 mm; 6 ovigerous females, 6.9–10.3 mm; 1 female, 9.4 mm). Myrmidon Reef, 18.27° S, 147.38° E, October 1985: shallow lagoon, 4 m, (M. Riddle stn M/10/2), NMV J71670 (2 males, 11.1 mm; 3 ovigerous females, 10.4 mm); outer reef flat, 2 m, (M. Riddle stn M/10/3), NMV J71673 (3 males). Rib Reef, 18.48° S, 146.86° E, October 1985: reef flat, 4 m, (M. Riddle stn R/10/2), NMV J71671 (4 males; 16 females). reef flat, 8 m, (M. Riddle stn R/10/1), NMV J71675 (6 males, smallest 5.5 mm; 4 females). Lizard Island, 50 m W of Loomis beach, 14.6816° S, 145.4515° E, (stn AUST-ST-036), UF 16947 (ovigerous female, 9.0 mm). Lord Howe Island, Old Settlement Beach, 31.5° S, 159.1° E (stn LHI 2017 059), AM P.100430 (2 males, 11.9 mm, 14.6 mm).

Diagnosis. Sternite 7 with transverse groove visible only laterally, anteromedial lobe rounded. Antennule peduncle reaching to midpoint of antenna peduncle article 5. *Maxilliped 3 exopod reaching third to half-way along ischium (juveniles only) or reaching to mid-merus.* Major cheliped merus, lower margin with 2 or 3 proximal truncate teeth; propodus distomesial margin with setae aligned in 2 similar groups of c. 9 setae each. *Male pleopod 1 article 2 twice as long as wide; appendix interna prominent.*

Description of female. Carapace scattered with small shallow depressions; gastric–abdominal regions together 4.6 times as long as wide; branchiostegite calcified over dorsal half, separate from wide ventral uncalcified anterior region and narrower triangular uncalcified posterior section, the two separated from each other by squarish calcified plate; posteroventral area without small calcified plates; cervical groove at 0.57 carapace length, scarcely obvious on branchiostegite; cardiac sulcus at 0.73 carapace length, not meeting mid-dorsally, extending obliquely anteroventrally to lower limit of calcified branchiostegite.

Thoracic sternite 7 1.35 times as long as wide, with well-defined median sulcus over posterior third, smooth over medial half, lateral ridge anterior to coxal articulation ending in pit at quarter of width, with 3 posterolateral clusters of long setae.

Rostrum broadly triangular, length about 0.25 width of eyestalks. Anterolateral carapace lobe half as long as rostrum, with rounded apex, dorsal anterolateral margin oblique in dorsal view as far back as anterodorsal angle of branchiostegite, with c. 10 submarginal dorsal setae. Pleonites 1–6 lengths relative to cl: 0.42 : 0.47 : 0.30 : 0.30 : 0.32 : 0.47; pleonite 1 with strong dorsal transverse groove, with pair of oval sternal plates supporting pleopods, each with lateral row of c. 20 setae; pleonites 3–5 with lateral tufts of setae; pleonite 6 with 8 lateral rows of setae.

Eyestalk 1.85 times as long as wide at base, tapering slightly to cornea, then more rapidly to subacute apices, sometimes with minute mesiodorsal tubercle; cornea round, slightly domed, 0.6 width of maximum eyestalk width. Antennular peduncle 2.5 times as long as width of both eyestalks; article 2 3 times as long as wide; article 3 0.6 length of article 2; articles 2 and 3 with ventrolateral row of long setae, continued onto flagellum. Antennal peduncle 3.2 times as long as width of both eyestalks, overreaching antennule peduncle by all of article 5;

scaphocerite ovoid, longer than wide; article 4 c. 7 times as long as wide; article 5 half as long as article 4. Maxilliped 3 exopod reaching to midpoint of merus; ischium with convex mesial margin, expanding from narrow proximomesial corner; ischium–merus 1.8 times as long as greatest width; crista dentata of c. 25 even denticles on basis and ischium; carpus–dactylus together as long as ischium–merus.

Chelipeds subequal, major 1.1 length of minor. Major cheliped ischium c. 2.2 times as long as distal width, lower margin with truncate denticles becoming more distinct distally; merus 2.6 times as long as broad, lower margin with 4–5 truncate proximal denticles, diminishing distally; carpus 1.5 times as wide as upper length, margins carinate; propodus greatest width in middle of palm, as wide as upper palm length, distomesial margin of palm with 2 submarginal groups each of c. 8 setae plus nearby granules, distolateral margin of palm with submarginal group of c. 10 setae between fingers; fixed finger half as long as upper margin of palm, cutting edge with microdenticles over proximal half, blunt triangular tooth third way along; dactylus as long as fixed finger, twice as long as wide at base, cutting edge concave over proximal half; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers.

Minor cheliped ischium c. 2.3 times as long as distal width, lower margin with truncate denticles becoming more distinct distally; merus 1.7 times as long as broad, lower margin with 4–5 truncate proximal denticles, diminishing distally; carpus 1.5 times as wide as upper length, margins carinate; propodus palm more evenly wide than major, 1.1 times as wide as upper palm length, distomesial margin of palm with 2 submarginal groups of c. 10 and c. 12 setae, distolateral margin of palm with submarginal group of c. 10 setae, plus 2 smaller groups further from margin between fingers; fixed finger 0.4 times as long as upper margin of palm, mesial cutting edge with microdenticles, blunt proximal tooth, lateral cutting edge microdenticulate defining edge of lateral concavity at base of fixed finger, filled with granules; dactylus overreaching fixed finger, 3 times as long as wide at base, cutting edge curved; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers.

Pereopod 2 merus 2.2 times as long as maximum width; dactylus c. 3 times as long as upper margin of propodus. Pereopod 3 merus twice as long as maximum width; carpus as long as wide; propodus with strongly concave lower margin, twice as long as mid-length; dactylus 2.5 times axial length of propodus. Pereopod 4 merus 2.3 times as long as maximum width; carpus 2.5 times as long as wide; propodus typically setose, with 2 long distal setae overlapping dactylus.

Pleopod 1 article 1 without distal projection beyond article 2; article 2 longer than article 1. Pleopod 2 endopod 2.5 times as long as wide; appendix interna about quarter length of endopod.

Uropodal endopod ovoid, anterior margin more convex than posterior margin, widest about third way along, 1.5 times as long as wide, with subdistal facial group of c. 8 long setae; exopod 2.4 times as wide as long (length measured from peduncle to anterior point of dorsal plate), distal and posterior margins typically setose, with c. 20 blade-like setae near end of posterior margin; dorsal plate extending almost over half of

exopod width, posterior margin with spiniform setae. Telson 1.7 times as wide as long, broadest at mid-length, posterolateral corner more sharply rounded than lateral and posterior margins; posterior margin convex, with lateral lines of long setae; dorsal surface with median row of long setae at anterior quarter.

Adult male. As in female except as follows. Major cheliped propodus, distomesial margin of palm with 2 submarginal groups each of c. 8 setae, fixed finger with proximal mesial and lateral granulate ridges; dactylus cutting edge with basal blunt tooth.

Minor cheliped propodus, distomesial margin of palm with 2 submarginal groups of c. 12 and c. 15 setae, distolateral margin of palm with submarginal groups of c. 30 and c. 15 setae; lateral concavity at base of fixed finger, filled with numerous granules.

Pleopod 1 article 1 twice as long as greatest width; article 2 2.3 times as long as wide, appendix interna acute, without hooks, subdistal lobe small, distal curved lobe acute, occupying about third of whole. Pleopod 2 endopod 2.3 times as long as wide; appendix masculina attached at c. 0.4 of length, 3.5 times as long as distal width, distal margin convex-truncate reaching 0.9 length of endopod, with c. 20 facial setae near midpoint, c. 15 subdistal setae; appendix interna rod-like, with hooks, about fifth length of appendix interna.

Variation. Branchiostegite always divided by oblique longitudinal edge between calcified dorsal region and variously uncalcified ventral region, always with midventral rectangular plate, sometimes with posteroventral tessellated pattern (Sakai, 1999: fig. 32e), sometimes more or less calcified, often not calcified. Rostrum more acute in smaller specimens (figs 3a, j). Cornea larger in smaller specimens (fig. 3j). Maxilliped 3 exopod reaching mid-ischium in some small specimens. Minor cheliped propodus fixed finger proximal concavity variously granulate.

Colour. Exoskeleton mostly translucent white, middle of branchiostegites pink (fig. 1d, e).

Distribution. Papua New Guinea, Madang, New Britain (type locality) and New Ireland provinces; Indonesia, Sulawesi, Bali; Australia, N Qld; Philippines, Palawan; French Polynesia. Lagoon sediments, to 12 m.

Remarks. *Calliixina novaebritanniae* is unique in the Indo-West Pacific in having the exopod of maxilliped 3 reaching to the middle of the merus in adults. Small genetic differences were found between the pair from Nago Island (New Britain), one from Madang, one from Palawan, Philippines (NHMW 25366), and one from Indonesia (NHMW 25783) (Robles et al., 2020). Nago Island and Madang, Papua New Guinea, are not far distant, west and east respectively, from the type locality. Morphological differences between them, the female from French Polynesia and the large collection from the Great Barrier Reef, Australia, are small. The telson and uropod of adults are the same, all have a sulcus on the carapace. The maxillipedal 3 exopod reaches to mid-merus except in two small specimens where it is shorter than in adults, a phenomenon noted by Liu and Liang (2016) in *C. xishaensis*. The rostrum is sharper and the eyestalks more rounded in smaller specimens. Article 2 of pleopod 1 of the holotype has two similar distal lobes on its inner margin (one the appendix interna) and an apex strongly curving mesially (de

Saint Laurent and Manning, 1982: fig. 6). The appendix interna and second subdistal lobe are less developed in all the Australian males in this collection (fig. 9l). A juvenile male from Papua New Guinea has a simple pleopod 1 with three obsolete distal lobes (fig. 10h), indicating that this limb metamorphoses with maturity. The male pleopod 2 has a broad appendix masculina, with distal and subdistal clusters of long setae, and appendix interna midway on the endopod (fig. 10i).

Calliixina novaebritanniae co-occurs in one sample from the Great Barrier Reef with individuals of *C. bulimba* from which it is difficult to distinguish at first glance. However, the exopod of maxilliped 3 reaches to the middle of the merus in most *C. novaebritanniae* but is vestigial in all *C. bulimba*. The eyestalks of *C. novaebritanniae* are narrower than in *C. bulimba* (almost twice as long as wide vs 0.8 times as long as wide in adults), the antennal peduncles are narrower (antennular peduncle article 2 3.5 times as long as wide vs twice; antennal 1peduncle article 4 6 times as long as wide vs 3 times). The telson of *C. novaebritanniae* is widest at its midpoint whereas in *C. bulimba* it tapers from the base, although the taper is less obvious in juveniles. Pereopods of *C. novaebritanniae* are relatively broader than in *C. bulimba* (meri of pereopods 2 and 3, 2.5 and 2.0 times as long as wide vs 2.2 and 2.4 times). The rostrum is more acute in larger *C. novaebritanniae* than in similarly sized *C. bulimba* but is more acute in small specimens of both species.

Borradaile (1900) based his description on a single male of total length 37 mm from New Britain (Papua New Guinea). The holotype was illustrated by Borradaile (1900), de Saint Laurent and Manning (1982) and Sakai (1999). Notwithstanding the species' long and complicated synonymy, the material listed here and that from the Philippines and Indonesia (Dworschak, 2018) are the first reported since. De Man (1928a) described and illustrated a specimen he identified as a variety of *C. novaebritanniae*; this was described as *Calliix* (now *Calliixina*) *punica* by de Saint Laurent and Manning (1982), type locality, Salamambo, Gulf of Tunis. De Man (1928b) identified material from the Maldives as *C. novaebritanniae*; this was identified by Sakai (1999) as *Calliix* (now *Eucalliixiopsis*) *aequimana* (Baker, 1907) but is almost certainly *E. inaequimana* (Dworschak, 2014).

In as far as can be decided from descriptions, *C. novaebritanniae* is indistinguishable from *C. xishaensis* Liu and Liang, 2016. The latter was described from two females from the South China Sea, not far from Palawan, Philippines. A specimen from this locality (NHMW 25366) was found to be genetically similar to those from Papua New Guinea (the type locality) and Indonesia, suggesting that the species has a wide distribution. *Calliixina xishaensis* is here synonymised with *C. novaebritanniae*. *Calliixina sakaii* is close by in Japan but is morphologically and genetically quite remote (see below and Robles et al., 2020).

Sakai's (1999) designation of the holotype as a lectotype was unnecessary.

***Calliixina sakaii* de Saint Laurent in de Saint Laurent and Le Loeuff, 1979**

Figures 11, 12f, g

Callianassa (*Callichirus*) *novaebritanniae*.—Sakai, 1966: 161–168, figs 1–4.

Calliix sakaii de Saint Laurent in de Saint Laurent and Le Loeuff, 1979: 95.—de Saint Laurent and Manning, 1982: 212, 222–223, figs 1g, 2c.—Sakai, 1987: 305–306.—Sakai, 2005: 203.

Paraglypturus sakaii.—Sakai, 1999: 124, fig. 33d, e.

Calliixina sakaii.—Ngoc-Ho, 2003: 489, 493, 496, fig. 20J.—Sakai, 2011: 502.—Sakai, 2018: 739.

Material examined. Japan, Tomioka, MNHN Th312 (holotype male, 10 mm), MNHN Th313 (female), NMV J59763 (male, 6.7 mm; female, 7.0 mm; ex ULLZ-8894*).

Diagnosis. Sternite 7 with complete transverse V-shaped groove, anteromedial lobe acute. Antennule peduncle reaching to base of antenna peduncle article 5. Maxilliped 3 exopod reaching third to half-way along ischium. Major cheliped merus, lower margin with several proximal teeth; propodus distomesial margin with setae aligned in 4 groups of 10, 5, 7 and 4 setae. Male pleopod 1 article 2 3 times as long as wide; appendix interna prominent.

Remarks. Differences between *C. sakaii* and the more widespread *C. novaebritanniae* were confirmed by re-examination of the holotype and more recently collected material. The male pleopod 1 has a bilobed proximal lobe and pleonal sternite 1 has a pair of oval plates supporting the pleopods, both similar to *C. novaebritanniae*. *Calliixina sakaii* differs from *C. novaebritanniae* in the exopod of maxilliped 3 reaching half the length of the ischium (vs overlapping the merus), a more acute rostrum, fully calcified branchiostegites (vs weakly chitinised over the lower half), having a deep sharp transverse groove on thoracic sternite 7 (vs an obsolete ridge) and the posterior margin of the telson concave (convex). The distomesial margin of the propodus of the major cheliped has four groups of 4–10 submarginal setae, two groups on the minor cheliped (vs two groups on both chelipeds). A lateral concavity at the base of the fixed finger is defined by a lower ridge on both chelipeds.

The species was described briefly in footnote number 14 by M. de Saint Laurent alone in de Saint Laurent and Le Loeuff (1979).

***Eucalliixiopsis* Sakai, 2011**

Eucalliixiopsis Sakai, 2011: 503–504.—Poore et al., 2019: 127–128 (synonymy).

Remarks. *Eucalliixiopsis* differs from *Calliixina* in having a strong ridge across the telson, lacking an exopod on maxilliped 3 (with one exception), the appendix masculina overlapping the endopod of pleopod 2, and in the major cheliped of the male usually being more robust, the palm longer and wider, than that of the female. In *Calliixina*, the telsonic ridge is absent or obsolete, maxilliped 3 always possesses an exopod, the appendix masculina does not reach the apex of the endopod of pleopod 2, and chelipeds of males and females are not differentiated from each other nor scarcely from the minor chelipeds. In as much as

can be deduced from published illustrations, the lower margin of the merus of the chelipeds is smooth or with small tubercles at its midpoint in *Eucalliixiopsis*, whereas this margin bears small proximal truncate teeth in *Calliixina*. The post-rostral dorsal area of some species of *Eucalliixiopsis* (*E. aequimana*, *E. madagassa*) has a broad median longitudinal ridge, seen also in *Eucalliix quadracuta* (Biffar, 1970).

Eucalliixiopsis includes seven species from the Indo-West Pacific, of which three are newly described here, plus three species from the Western Atlantic: *E. ceareaensis* (Rodrigues and Manning, 1992) from Brazil, *E. jonesi* from the Bahamas and *E. mcilhennyi* from Florida, USA. The species identified as *E. HWI* from Hawaii by Robles et al. (2020), which is genetically quite separate from six other species, was not available for study.

Eucalliixiopsis panglaoensis, *E. dworschaki* and *E. paradoxa*, the last two being new species described here, differ from the others. All possess a transverse telson ridge beset with a row of short spiniform setae, a distally excavate uropodal endopod, a cheliped carpus with two distal spines on the upper margin, two mesiodistal lobes near the apex of the lower lateral margin plus a submarginal distal ridge on the mesial face. The carpus is similar to that of *Eucalliix quadracuta*, sole member of its genus. The first two of this group were found to be sister taxa by Robles et al. (2020) but the others were not monophyletic.

Calliixiopsis Sakai and Türkay, 2014, was synonymised with *Calliixina* by Poore and Dworschak (2017). *Bakercalliix* Sakai, 2018, *Hardcalliix* Sakai, 2018, and *Manningcalliix* Sakai, 2018, were all differentiated from *Eucalliix*, *Calliixina* and from each other largely on the basis of the male pleopod 1 but also on the relative sizes of the appendices interna and masculina of pleopod 2. All were synonymised with *Eucalliixiopsis* by Poore et al. (2019), who argued that similar forms of the male pleopod 1 are found in *Eucalliixiopsis* and *Calliixina* and that some of the forms used as generic characters by Sakai (2018) are characteristic of juveniles.

Key to Indo-West Pacific species of *Eucalliixiopsis*

1. Telson with row of spiniform setae on transverse ridge; cheliped carpus with 2 short grooves perpendicular to distolateral margin near lower apex; uropodal endopod with apical concavity 2
- Telson without spiniform setae on transverse ridge; cheliped carpus distolateral margin smooth; uropodal endopod ovate 4
2. Cheliped carpus upper margin with proximal hook and subproximal submesial pit; cheliped propodus lateral face with longitudinal ridge extending from near carpus to base of finger; uropodal endopod with 8 short setae between apical clusters; widespread in Indo-West Pacific *E. dworschaki* sp. nov.
- Cheliped carpus upper margin smooth; cheliped propodus lateral face with longitudinal ridge extending proximally slightly from base of finger; uropodal endopod with 10–11 short setae between apical clusters 3

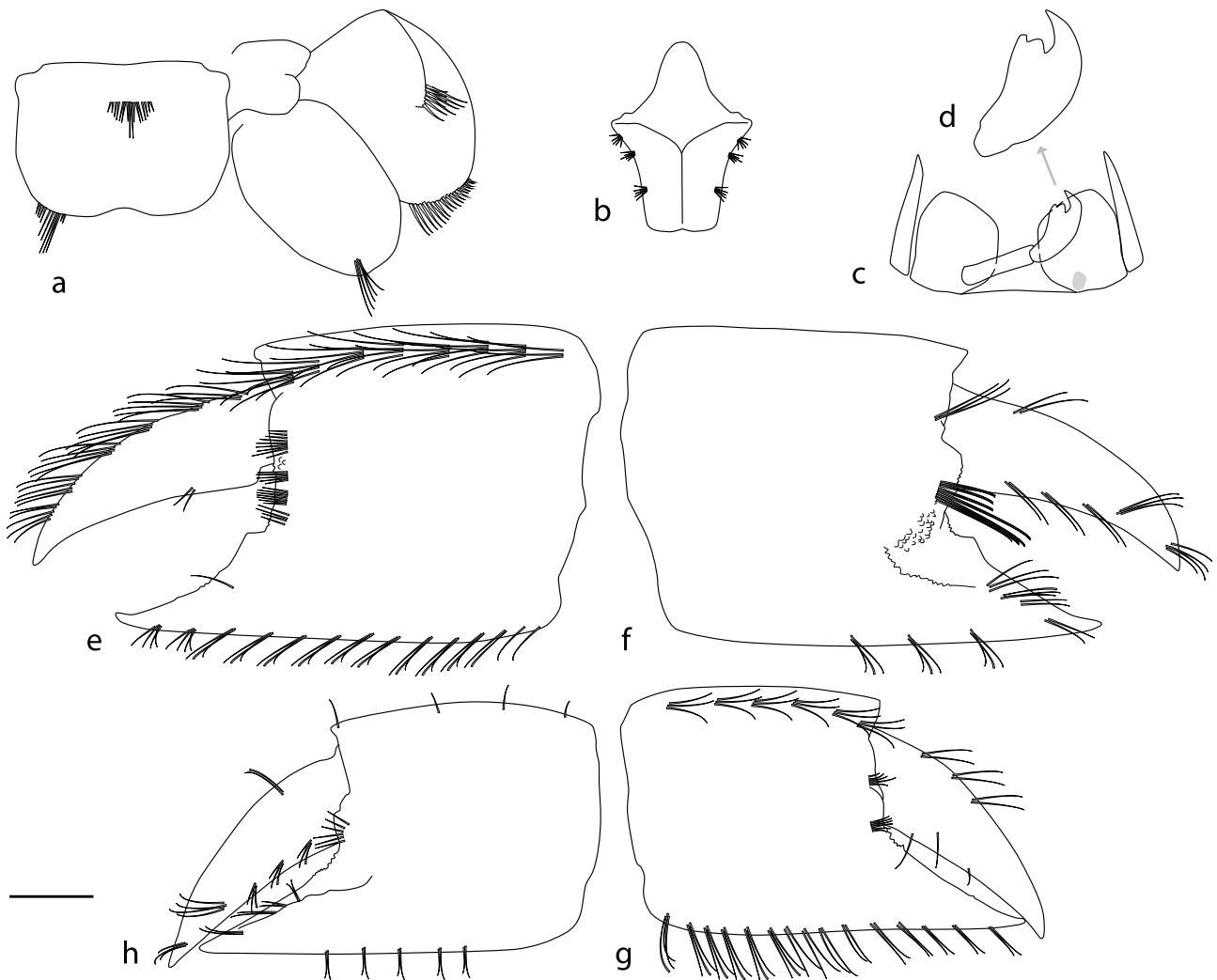


Figure 11. *Calliaxina sakaii*. Japan, NMV J59763 (male, 6.7 mm): a, telson, uropod; b, thoracic sternite 7; c, pleonal sternite 1 (anterior uppermost); d, pleopod 1; e, f, major cheliped propodus, dactylus (right), mesial, lateral views; g, h, minor cheliped propodus, dactylus (left), mesial, lateral views. Scale bars = 1 mm.

- | | |
|---|---|
| <p>3. Chelipeds asymmetrical in male, major cheliped propodus longer than wide and longer than in female; distolateral lobe above lower margin of cheliped carpus with acute apex, ridged, oblique; Philippines, Japan
 <i>E. panglaoensis</i> (Dworschak, 2006)</p> <p>– Chelipeds similar in both sexes, major cheliped palm little longer than wide; distolateral lobe above lower margin of cheliped carpus with rounded apex, longitudinally grooved, perpendicular; NE Australia
 <i>E. paradoxa</i> sp. nov.</p> <p>4. Maxilliped 3 with exopod; cheliped merus lower margin with 2 denticles at midpoint, fixed finger with row of equally spaced setae along lateral ridge; telson with rounded posterior margin; female pleopod 2 with free extension beyond rami; Madagascar
 <i>E. madagassa</i> (Sakai and Türkay, 2014)</p> | <p>– Maxilliped 3 without exopod; cheliped merus lower margin smooth, fixed finger with clusters of setae along lateral ridge; telson with truncate or excavate posterior margin; female pleopod 2 without extension beyond rami 5</p> <p>5. Cheliped propodus upper mesial face with row of clusters of setae without associated transverse ridges; major cheliped of male upper margin as long as wide, similar to female; male pleopod 1 article 1 without distal setae, article 2 parallel-sided, apically rounded, with marginal setae, without appendix interna; S Australia
 <i>E. aequimana</i> (Baker, 1907)</p> <p>– Cheliped propodus upper mesial face with row of short transverse ridges associated with clusters of setae; major cheliped of male upper margin longer than wide, dissimilar to female; male pleopod 1 not as above 6</p> |
|---|---|

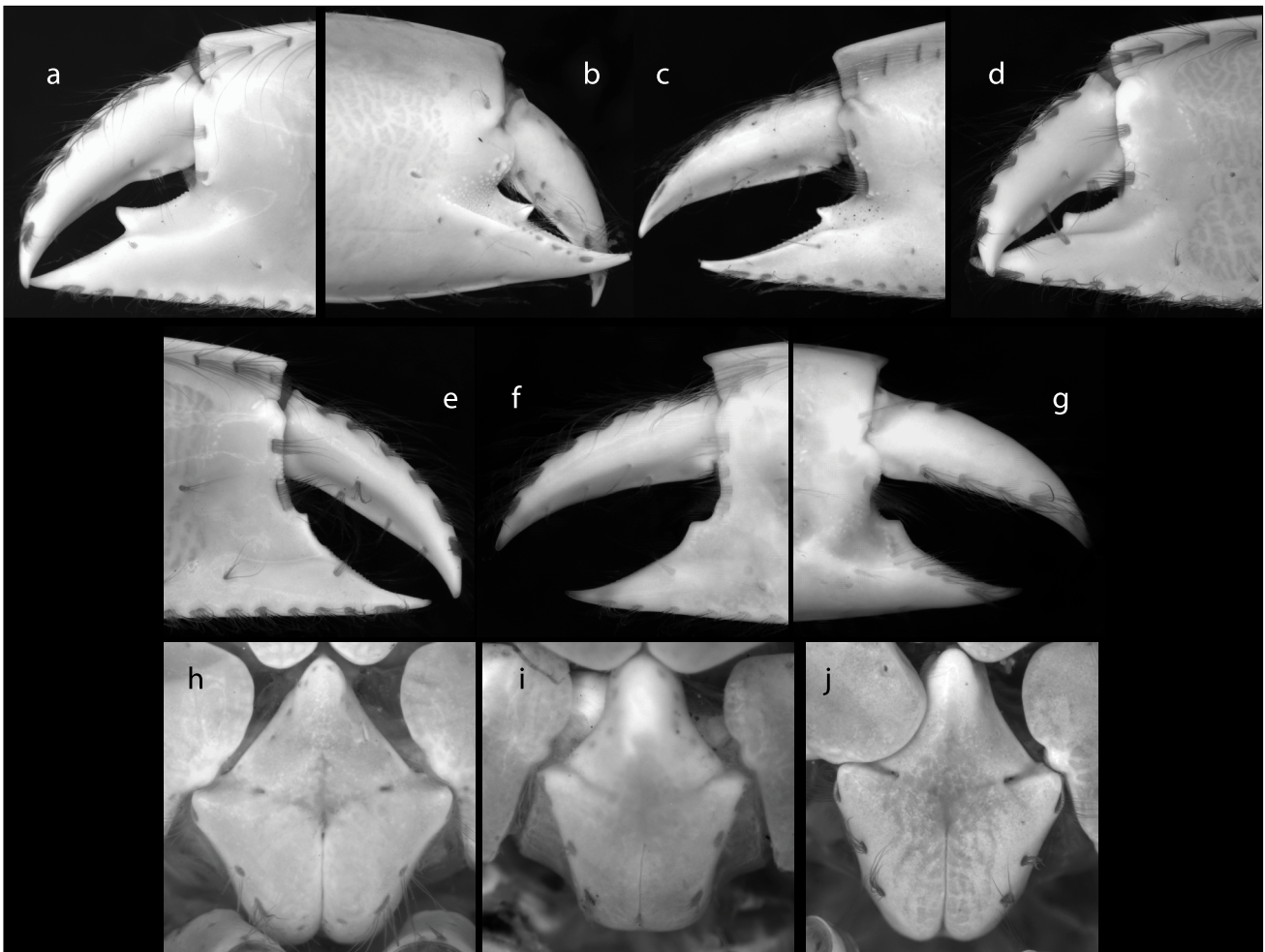


Figure 12. *Calliaxina* spp. *C. bulimba*: a, major cheliped, mesial. *C. kensleyi*: b, c, major cheliped lateral, mesial. *C. novaebritanniae*: d, major cheliped, mesial; e, minor cheliped, mesial. *C. sakaii*: f, g, minor cheliped mesial, lateral. Thoracic sterna: h, *C. bulimba*; i, *C. kensleyi*; j, *C. novaebritanniae*. Various scales.

6. Antenna peduncle 3 times as long as base of both eyes, most of article 5 exceeding antennule; telsonic ridge sharply elevated, with median notch; uropodal endopod 1.8 times as long as wide; female pleopod 2 without appendix interna; widespread in Indo-West Pacific *E. inaequimana* (Dworschak, 2014)
- Antenna peduncle 2.4 times as long as base of both eyes, half of article 5 exceeding antennule; telsonic ridge slightly elevated, complete; uropodal endopod 1.5 times as long as wide; female pleopod 2 with appendix interna; Papua New Guinea *E. patio* sp. nov.

***Eucalliaxiopsis aequimana* (Baker, 1907)**

Figures 13, 14, 25a, b

Callianassa aequimana Baker, 1907: 182–185, pl. 24 figs 1–8.—Hale, 1927: 87, fig. 83.—Poore and Griffin, 1979: 245, figs 12, 13.
Callianassa (Callichirus) aequimana.—De Man, 1928b: 28, 93, 114.

Calliax aequimana.—de Saint Laurent and Manning, 1982: 222.—Sakai, 1988: 53, 61.—Sakai, 1999: 118–119 (not fig. 31).—Tudge et al., 2000: 145.—Davie, 2002: 459.—Sakai, 2005: 202.

Eucalliax aequimanus.—Poore, 2004: 184, fig. 50e, f.

Calliaxina aequimana.—Sakai, 2011: 498–499.

Eucalliax aequimana.—Dworschak, 2014: 236, 244, figs 8, 9h, i.

Bakercalliax aequimana.—Sakai, 2018: 738.

Material examined. Australia. NSW, Balmoral Beach, 33.8° S, 151.3° E, AM P.3636 (male, 20 mm).

Victoria. San Remo, NW from rock outcrop 1.1 km E of Back Beach Rd (MRG transect 4), 38.53° S, 145.38° E, NMV J59759 (female, 9.6 mm). San Remo, channel bank end, 38.5233° S, 145.363° E, NMV J59762 (female, 6.6 mm). Port Phillip Bay, Geelong arm, 3 m, (NMV stn PPBES 953), 38.155° S, 144.545° E, NMV J16782 (4 females, 3.4–4.7 mm).

Tasmania. Waterhouse Island, 3–5 m, 40° 48' S, 147° 38.7' E (Moverley stn 52), NMV J71685 (juv., 2.9 mm). Georges Bay, Steiglitz Beach, 3–4 m, 41° 19.3' S, 148° 19.1' E (Moverley stn 42) NMV J71686 (juv., 2.9 mm).

South Australia. Port MacDonnell, 38.05° S, 140.7° E, NMV

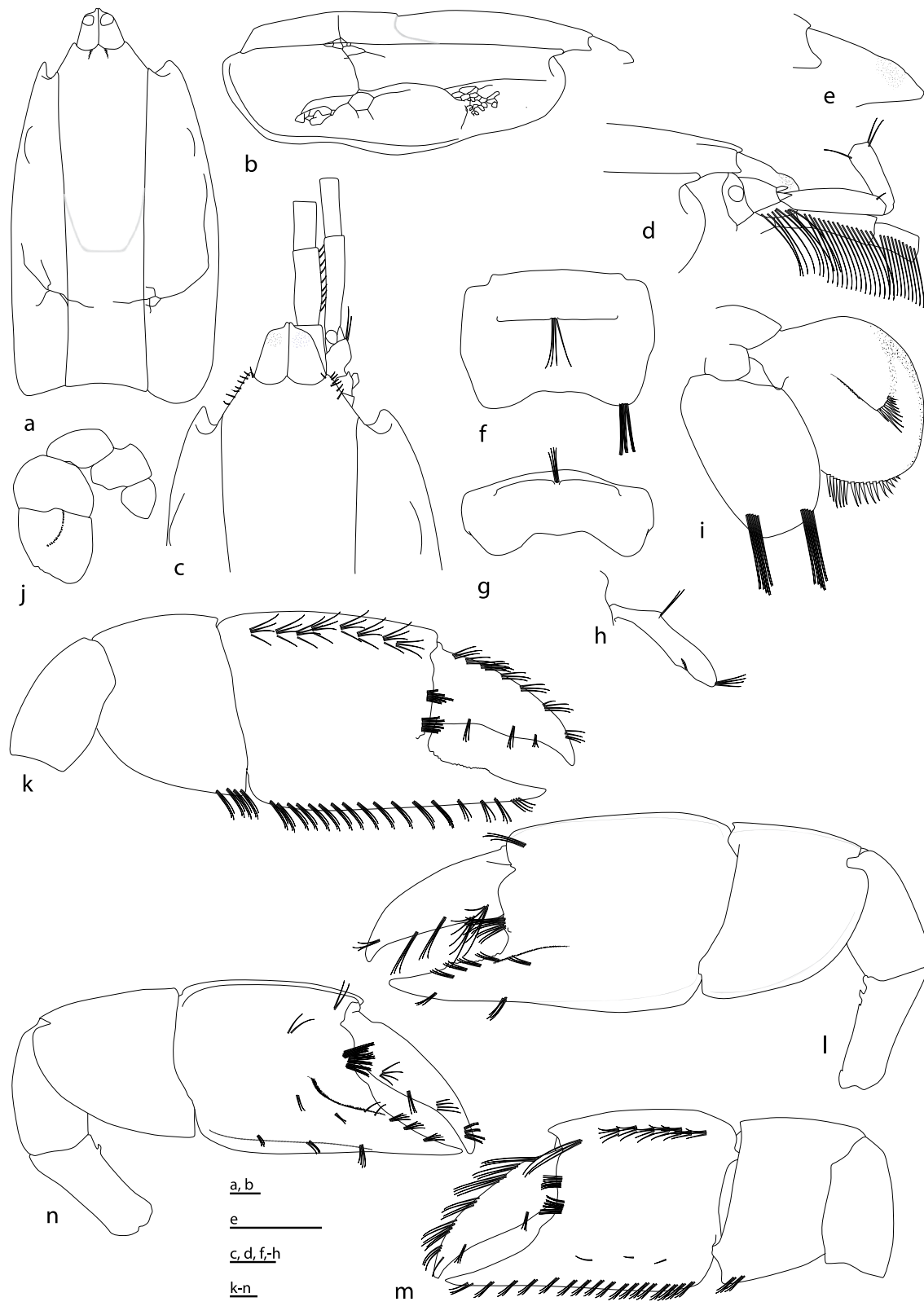


Figure 13. *Eucalliixiopsis aequimana*. Australia, NMV J71687 (male, 11.0 mm): a, carapace, dorsal view; b, carapace, lateral view; c, d, anterior carapace, eyestalks, antennule, antenna, dorsal and lateral views; e, eyestalk, lateral view; f–h, telson, dorsal, postero-oblique, lateral views; i, right uropod; j, maxilliped 3; k, l, major cheliped (left), mesial and lateral views; m, n, minor cheliped (right), mesial and lateral views. Scale bars = 1 mm.

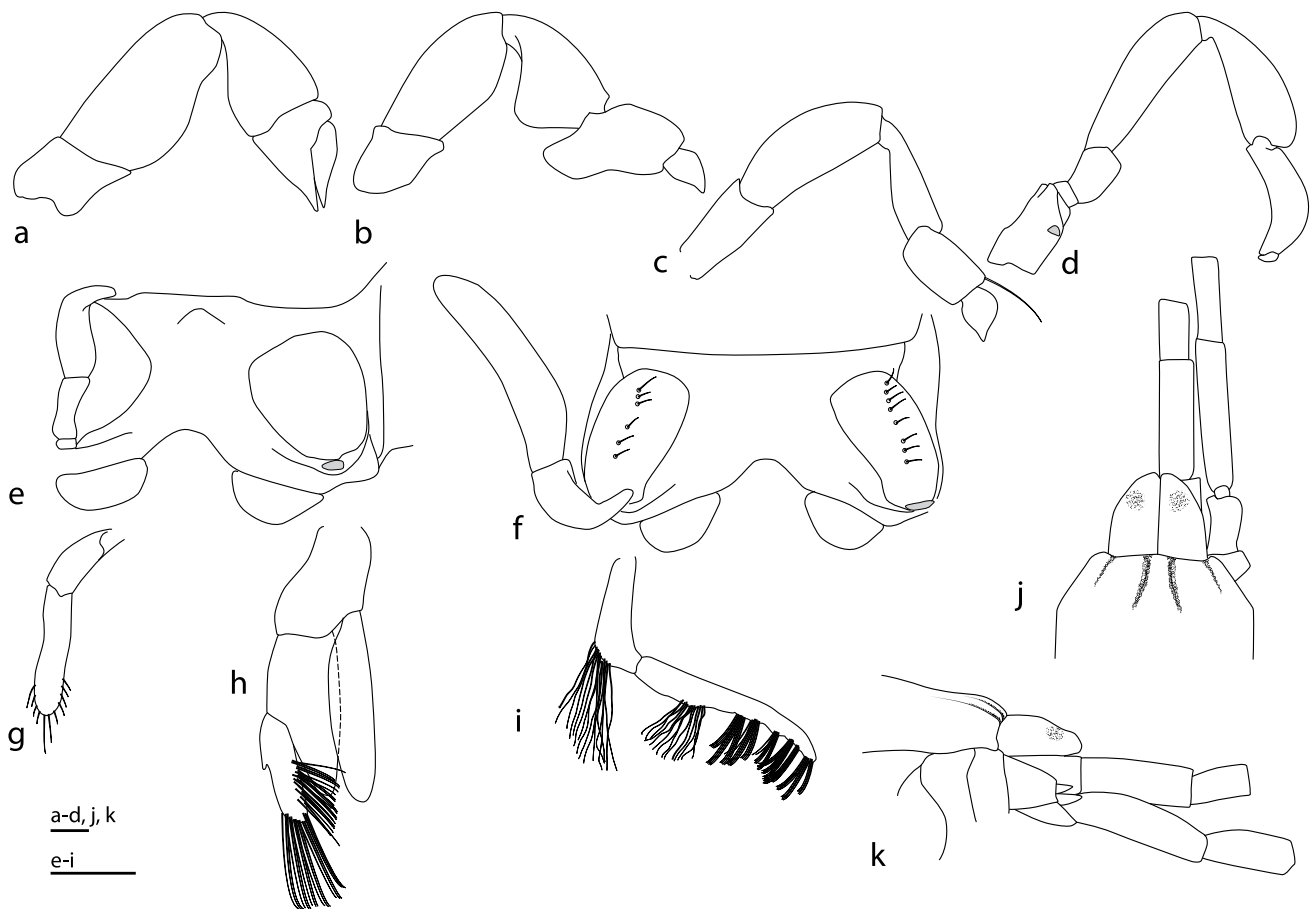


Figure 14. *Eucallixiopsis aequimana*. Australia, NMV J71687 (male, 11.0 mm): a, b, d, pereopods 2, 3, 5; e, pleonal sternite 1, right pleopod 1 (anterior uppermost); g, h, left pleopods 1, 2, posterior views. NMV J759651 (female, 11.2 mm): c, pereopod 4; f, pleonal sternite 1, right pleopod 1; i, left pleopod 1, mesial view; j, k, anterior carapace, antennule, antenna, lateral and dorsal views. Scale bars = 1 mm.

J16783 (male, 12.8 mm). Dutton Bay, eastern shore, 34.0489° S, 136.415° E, NMV J71688 (male, 12.2 mm; 3 females, 8.9–11.9 mm), NMV J59651* (female, 11.2 mm). NMV J71687 (male, 11.0 mm).

Western Australia. Houtmans Abrolhos, WAM C9113 (male, 14.8 mm). Dalkeith, Swan River, WAM C1410 (male, 16.2 mm). Colpoy Point, Garden Island, 32° 12' S, 115° 40' E, WAM C11975 (female, 14.4 mm). Rockingham, Point Peron, Cockburn Sound, 32° 11' S, 115° 43' E, WAM C11973 (male, 12.9 mm). Fremantle Harbour, 32° 03' S, 115° 44' E, WAM C12030 (male, 20.3 mm). Mandurah, 32° 32' S, 115° 43' E, WAM C11978 (female, 15.8 mm). Bunbury, 33° 20' S, 115° 38' E, WAM C11990 (female, 10.1 mm). Harbour Board, Bunbury, WAM C5056 (female, 21.3 mm). Koombana Beach, Bunbury, 33° 20' S, 115° 38' E, WAM C12029 (male, 14.9 mm). Leschenault Estuary, Bunbury, 33° 20' S, 115° 38' E, WAM C11986 (male, 11.2 mm). Peel Inlet, 32° 36' S, 115° 43' E, WAM C11968 (male, 8.9 mm; female, 17.6 mm). Albany, 32° 00' S, 117° 52' E, WAM C11994 (female, 13.0 mm). Albany, WAM C6792 (female, 15.9 mm). Cheyne Beach, WAM C11987 (female, 19.8 mm). King George Sound, MNHN Th578 (female).

Diagnosis. Pleonite 1 with pleopods attached to pair of sternal plates. Eyestalk about twice as long as wide. *Antennule peduncle reaching to base of antenna peduncle article 5*. Maxilliped 3

exopod absent. Cheliped carpi distolateral margin square at lower angle, propodi lateral face with oblique longitudinal ridge extending from beyond mid-length of palm on to base of finger, upper mesial face with row of clusters of long setae. *Male pleopod 1 article 1 without distal setae, article 2 parallel-sided, apically rounded, with marginal setae, without appendix interna*. Female pleopod 2, appendix interna present. Uropod endopod ovate. Telson without transverse row of spiniform setae.

Description of male. Carapace smooth, with pair of shallow longitudinal groove posterior to rostrum; gastric–abdominal regions together 4.3 times as long as wide; branchiostegite calcified, with tessellated pattern of sulci; cervical groove at 0.6 carapace length, scarcely obvious on branchiostegite; cardiac sulcus at 0.76 carapace length, not meeting mid-dorsally, extending transversely across half of branchiostegite, with complex branches dorsally.

Rostrum blunt or obsolete. Anterolateral carapace lobe longer than rostrum, with rounded apex, anteriorly directed, with numerous submarginal dorsal setae.

Thoracic sternite 7 1.15 times as long as wide, with well-

defined median sulcus over posterior half, lateral groove anterior to coxal articulation poorly defined, oblique, not meeting medially, with 3 posterolateral clusters of long setae. Pleonal sternite 1 with pair of swollen well marked areas anterior to ridge bearing pleopods; without setae. Pleonite 6 lateral margin smooth.

Eyestalks 1.6 times as long as wide at base, tapering around cornea, acute apical tubercle sometimes present; cornea subcircular. Antennular peduncle 2.5 times as long as width of both eyestalks; article 2 2.5 times as long as wide; article 3 0.6 times as long as article 2; articles 2 and 3 with ventrolateral row of long setae, continued onto flagellum. Antennal peduncle 3 times as long as width of both eyestalks, overreaching antennule peduncle by third of article 5; scaphocerite wider than long, subcircular; article 4 c. 5 times as long as wide; article 5 0.6 length of article 4. Maxilliped 3 ischium with slightly convex mesial margin, expanding from narrow proximomesial corner; ischium–merus upper margin 1.5 times as long as greatest width; crista dentata of c. 25 small teeth; carpus–dactylus together almost as long as ischium–merus.

Chelipeds subequal, propodus of major cheliped about 1.2 times that of minor, of similar widths, major dactylus stouter than that of minor. Major cheliped ischium twice as long as distal width, lower margin with short distal tooth; merus 1.8 times as long as broad, lower margin barely convex, unarmed; carpus 1.4 times as wide as upper length, upper margin carinate, distomesial and distolateral margins simple; propodus greatest width proximally, upper palm length 1.1 width, distomesial margin of palm with 2 submarginal groups each of c. 10 setae plus small submarginal bicuspid tooth, distolateral margin of palm with submarginal group of c. 10 setae between fingers plus small submarginal tooth; fixed finger half as long as upper margin of palm, cutting edge with microdenticles over proximal half, obsolete tooth at midpoint, with obsolete lateral ridge extending on to palm; dactylus overreaching fixed finger, 2.2 times as long as width at base, cutting edge sinuous; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers.

Minor cheliped ischium twice as long as distal width, lower margin with distal tooth; merus twice as long as broad, lower margin barely convex, unarmed; carpus 1.2 times as wide as upper length, upper margin carinate, distomesial and distolateral margins simple; propodus palm as wide as upper palm length, upper margin carinate, with blunt distal tooth, distomesial margin of palm with 2 submarginal groups of c. 10 and c. 12 setae, distolateral margin of palm with 2 submarginal groups of c. 8 and 10 setae; fixed finger half as long as upper margin of palm, cutting edge smooth, lateral concavity at base of fixed finger sharply defined by ridge on distal palm; dactylus barely overreaching fixed finger, 3.8 times as long as wide at base, cutting edge sinuous; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers.

Pereopod 2 merus twice as long as maximum width; dactylus 3 times as long as upper margin of propodus. Pereopod 3 merus twice as long as maximum width; carpus 1.6 times as long as wide; propodus with lower margin concave, 1.6 times as long overall as mid-length; dactylus half axial length of propodus. Pereopod 4 merus length 2.7 times

maximum width; carpus 2.7 times as long as wide; propodus 1.5 times as long as wide, typically setose, with 1 long distal seta overlapping dactylus.

Pleopod 1 article 1 without distal setae; article 2 parallel-sided, apically rounded, 1.8 times as long as article 1, 4 times as long as wide, apex with c. 10 marginal setae, without appendix interna. Pleopod 2 endopod 2.4 times as long as wide; appendix masculina overreaching endopod by about fifth its length, setose along posterior face and distally; lobe-like appendix interna near midpoint of appendix masculina. Pleopod 3 with appendix interna submerged in endopod margin.

Uropodal endopod anterior margin convex, posterior margin almost straight, widest about third way along, 1.7 times as long as wide, apex broadly rounded, with 2 groups of long setae at ends of anterior and posterior margins; exopod ovate, all margins continuous, greatest dimension 1.3 times greatest width, with row of blade-like distal setae on distal margin; dorsal plate extending beyond half of exopod width, distal margin with spiniform setae. Telson 1.5 times as wide as long, broadest at midpoint, posterolateral corner rounded; posterior margin deeply excavate, with posterolateral cluster of long setae plus short spiniform seta; dorsal surface with sharp transverse ridge at anterior third, notched and with few long setae at midpoint.

Female. Essentially as male except: pleonal sternite 1 with pair of oval plates supporting pleopods, each with longitudinal row of 6–8 single setae emerging from pore. Pleopod 1 peduncle curved, with dense group of plumose setae; article 2 twice as long as article 1.

Distribution. Australia, NSW (as far north as 33° S), Tas., Vic., SA, WA (as far north as 25° S). Intertidal to subtidal sediments.

Remarks. *Eucalliixiopsis aequimana* is recognised by the subequal chelipeds that are not sexually dimorphic. In a sample of 14 large specimens, the ratio between the upper propodus margins of major and minor chelipeds ranged from 1.1 to 1.3, with insignificant difference between males and females. The species is notable for the simple setose article 2 of the male pleopod 1, longer than article 1, lacking an appendix interna and acute apex.

The collection from Western Australia includes specimens with carapace lengths ranging 8.9–20.3 mm, most are larger than any from South Australia or Victoria, maximum cl. 12.8 mm. They differ most obviously in the near absence of a prominent rostrum (fig. 13j).

Sakai's (2005) synonymy includes references to other species from places outside southern Australia.

Eucalliixiopsis dworschaki sp. nov.

<http://zoobank.org/urn:lsid:zoobank.org:act:E8BF2226-256F-4EF7-9DEB-DFD6955BB744>

Figures 1f, g, 15–17, 25c–f

Eucalliix panglaoensis.—Dworschak, 2006: 356 (partim), fig. 5.—Kneer et al., 2013: 265.—Dworschak, 2018: 17 (partim; not fig. 1 = *E. panglaoensis*).

Calliixina panglaoensis.—Sakai and Türkay, 2014: 191–192, fig. 12.

Eucalliixiopsis aff. *panglaoensis.*—Robles et al., 2020.



Figure 15. *Eucallixiopsis dworschaki* sp. nov. Holotype, MNHN-IU-2014-10003 (male, 8.9 mm): a, b, carapace, pleonite 1, dorsal and lateral views; c, d, anterior carapace, eyestalks, antennule, antenna, dorsal and lateral views; e, thoracic sternite 7; f, pleonite 1, sternite (anterior uppermost); g, pleonite 6, right lateral margin, oblique view; h, i, maxilliped 3; j, maxilliped 3, crista dentata; k, left uropod; l, m, telson, dorsal and lateral views. Scale bars = 1 mm.

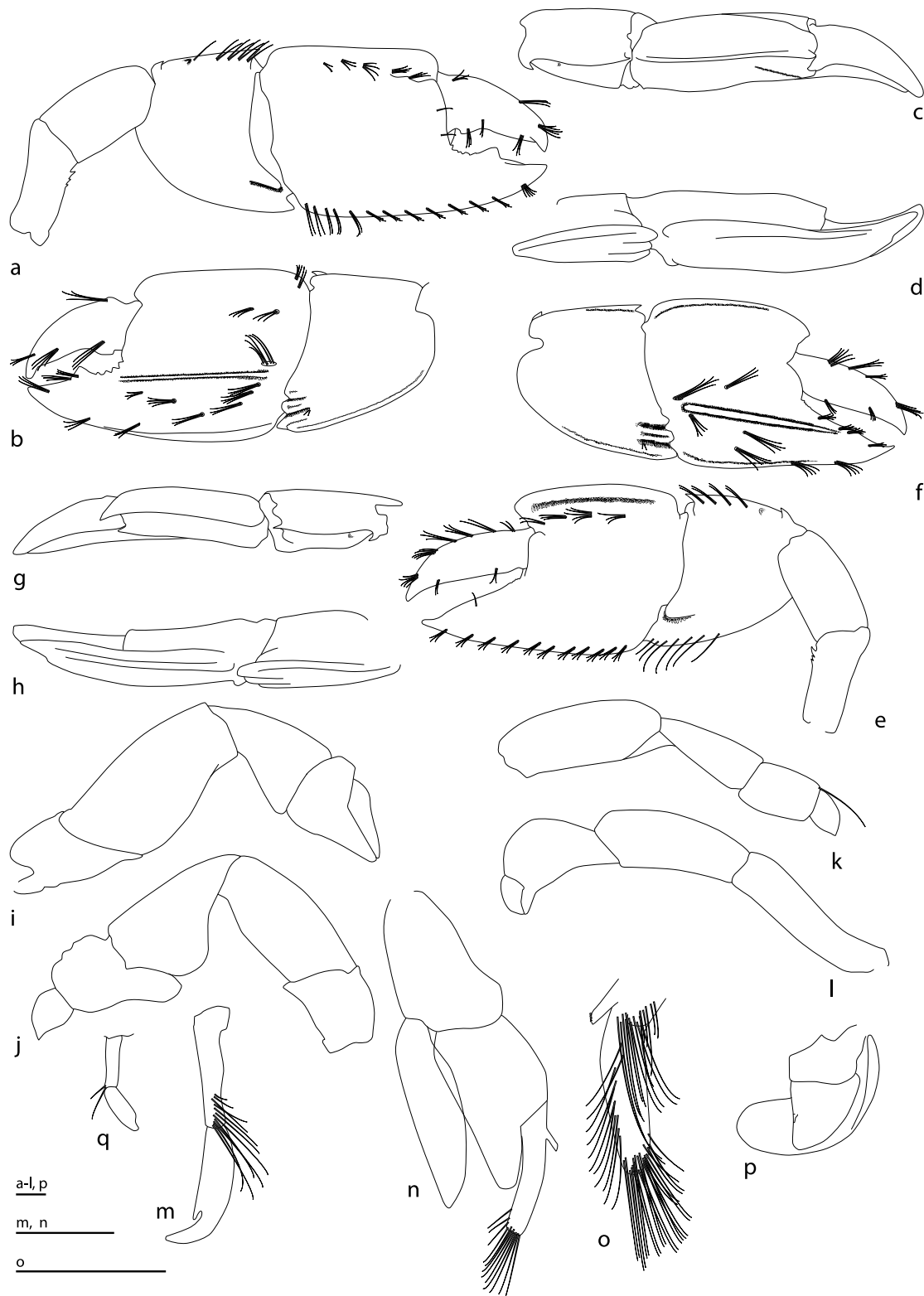


Figure 16. *Eucalliixiopsis dworschaki* sp. nov. Holotype, MNHN-IU-2014-10003 (male, 8.9 mm): a, b, major cheliped (left), mesial and lateral views; c, d, major cheliped (left), carpus, propodus, dactylus, upper and lower views; e, f, minor cheliped (right), mesial and lateral views; g, h, minor cheliped (right), carpus, propodus, dactylus, upper and lower views; i-l, pereopods 2-5; m, right pleopod 1, mesial view; n, right pleopod 2, anterior view; o, appendices masculina, interna, posterior view; p, right pleopod 3, posterior view. UF 28877 (male, 6.0 mm): q, pleopod 1. Scale bars = 1 mm.

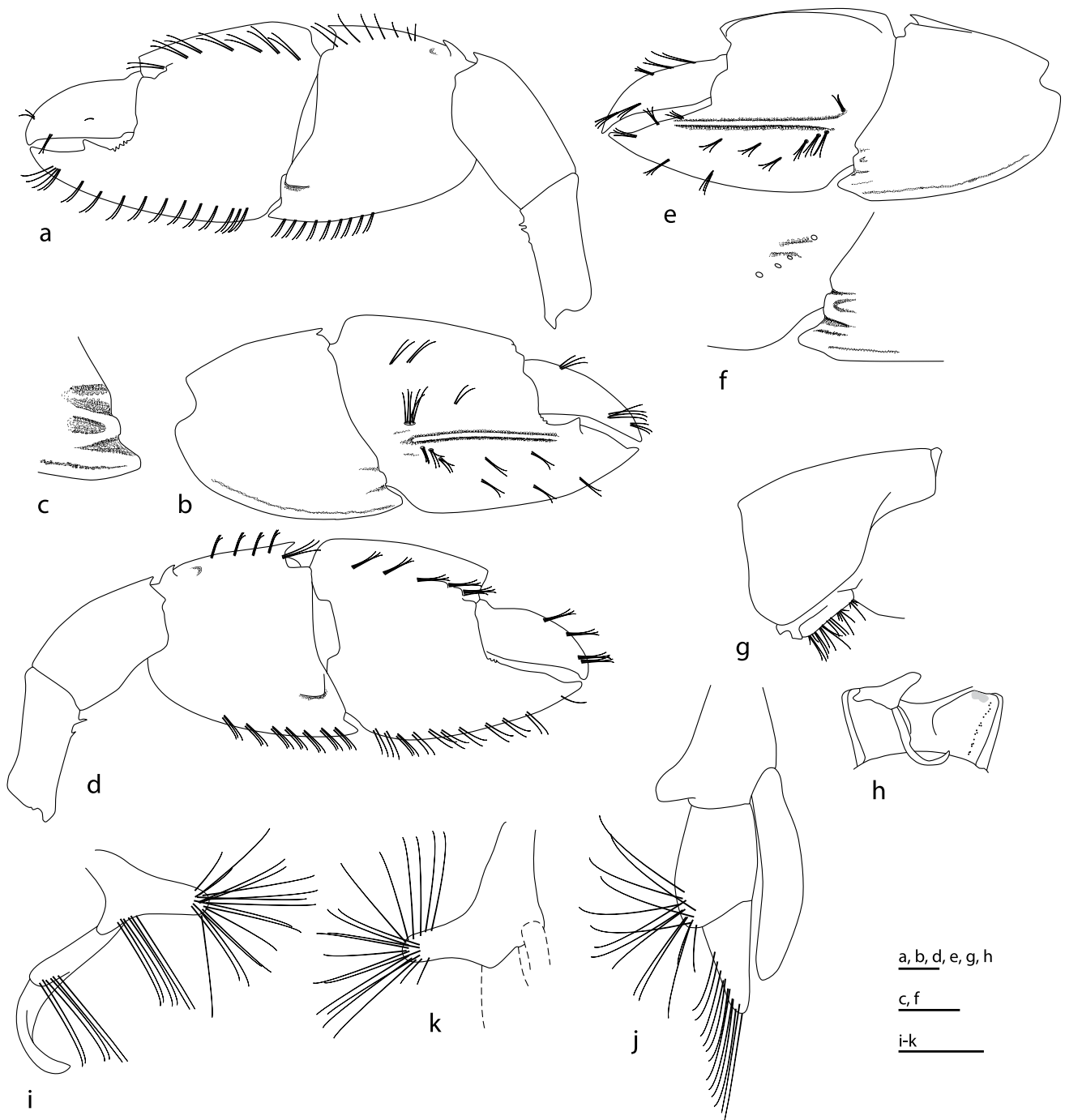


Figure 17. *Eucalliaxiopsis dworschaki* sp. nov. Paratype, MNHN-IU-2017-1351 (female, 8.2 mm): a, b, major cheliped (right), mesial and lateral views; c, carpus, lower distolateral margin, detail; d, e, minor cheliped (left), mesial and lateral views; f, carpus, lower distolateral margin, detail; g, pleonite 1; h, pleonal sternite 1, left pleopod 1 in situ (anterior uppermost); i, left pleopod 1, anterior view; j, k, left pleopod 2, posterior view, lateral view of peduncle. Scale bars = 1 mm.

Material examined. Holotype. Papua New Guinea, New Ireland, NW corner of Little Nusa Island, sand, 0–1 m, 02° 34.9' S, 150° 46.8' E (KAVIENG 2014 stn KM13), MNHN-IU-2014-10003* (male, 8.9 mm).

Paratypes. Papua New Guinea. Collected with holotype, MNHN-IU-2017-1351 (female, 8.2 mm). Madang Province, Riwo, mangrove, 05° 09' S, 145° 48.2' E, 1–2 m (PAPUA NIUGINI stn PR235), MNHN-IU-2013-7081 (female, 7.3 mm).

French Polynesia, Moorea, Papetoai, near 17.49° S, 149.88° W: stn BIZ-463, UF 28782* (female, 8.4 mm); stn BIZ-493, UF 28930 (female, 4.4 mm); stn BIZ-539, UF 28878* (male, 7.9 mm), UF 28877* (male, 6.0 mm); stn MIB-208, UF 16416 (female, 6.7 mm); stn MIB-195, UF 16286 (male, 8.8 mm); stn MIB-227, UF 16531 (male, 5.4 mm). Off Nihimaru River estuary, 17.533° S, 149.9045° W, stn MIB-098, UF 15946 (male, 2.9 mm).

Other material. Australia, Qld, Great Barrier Reef, Myrmidon Reef, 18.27° S, 147.38° E, October 1986: lagoon with “*Callianassa*” mounds, 4 m, (M. Riddle stn M/10/2), NMV J71681 (male, 8.4 mm); 8 m, (M. Riddle stn M/10), NMV J71682 (female, 9.2 mm).

Marianas Island, W coast of Guam, near Fisheye Marine Park, seagrass bed, 0.2–0.5 m (stn AA05), UF GUOK 10-0378, (male, 3.7 mm).

Madagascar, Toliara (as Tuléar), Thomassin stn 678, MNHN-IU-2016-8083 (female, 8.9 mm).

Diagnosis. Pleonite 1 with pleopods attached to pair of sternal plates. Eystalk about twice as long as wide. Antennule peduncle reaching to midpoint of antenna peduncle article 5. Maxilliped 3 exopod absent. *Cheliped carpi distolateral margin with 3 rounded lobes near lower margin separated by submarginal grooves parallel to lower margin, second lobe with slight median depression*, propodi lateral face with horizontal longitudinal ridge extending from near carpus to base of finger, upper mesial face with row of clusters of long setae. Male pleopod 1 article 1 linear, with distal setae; article 2 blade-like with subapical medial notch. Female pleopod 2, appendix interna absent. Uropod endopod ovate with excavate apex. Telson with row of spiniform setae on ridge.

Description of holotype male. Carapace length 8.9 mm, smooth; gastric–abdominal regions together 4.7 times as long as wide; branchiostegite fully calcified; cervical groove at 0.60 carapace length, scarcely obvious on branchiostegite; cardiac sulcus at 0.77 carapace length, not meeting mid-dorsally, extending transversely across third of branchiostegite.

Rostrum acute, tapering to narrow tip, length about 0.4 width of eystalks. Anterolateral carapace lobe almost as long as rostrum, with rounded apex, anteriorly directed, with numerous submarginal dorsal setae.

Thoracic sternite 7 1.2 times as long as wide, with well-defined median sulcus over posterior half, lateral groove anterior to coxal articulation well defined, oblique, meeting medially, with 3 posterolateral clusters of long setae. Pleonal sternite 1 with pair of swollen relatively unchitinised areas anterior to ridge bearing pleopods; without setae. Pleonite 6 with small lateral blunt hook-like process at midpoint.

Eystalks twice as long as wide at base, tapering to cornea and acute apical tubercle; cornea subcircular. Antennular peduncle 3 times as long as width of both eystalks; article 2 3.5 times as long as wide; article 3 half as long as article 2; articles 2 and 3 with ventrolateral row of long setae, continued onto flagellum. Antennal peduncle 3.4 times as long as width

of both eystalks, overreaching antennule peduncle by most of article 5; scaphocerite wider than long, with acute apex; article 4 c. 5 times as long as wide; article 5 0.65 length of article 4. Maxilliped 3 ischium with slightly convex mesial margin, expanding from narrow proximomesial corner; ischium–merus upper margin 1.6 times as long as greatest width; crista dentata of 12 spines, the most proximal reflexed; carpus–dactylus together almost as long as ischium–merus.

Chelipeds unequal, of similar lengths, propodi of similar widths, major dactylus stouter than that of minor. Major cheliped (left in holotype) ischium twice as long as distal width, lower margin with short spines becoming more distinct distally; merus 1.8 times as long as broad, lower margin mostly straight, unarmed; carpus 1.4 times as wide as upper length, upper margin carinate, with proximal hooked tooth, subproximal mesial pit, distal tooth, distomesial margin with prominent lobe near lower margin, distomesial face with lower submarginal ridge, distolateral margin with rounded notch near upper margin, with 3 rounded lobes near lower margin separated by submarginal grooves parallel to lower margin, second lobe with slight median depression, 2 short setae in lower groove; propodus greatest width in middle of palm, upper palm length equal to greatest width, upper margin carinate, with rounded lobe projecting over dactylus, lower margin carinate, strongly curved mesially, mesial face with short distal uneven setose ridge below upper margin, distomesial margin of palm almost straight, lateral face of palm with prominent ridge running from tubercle near proximal margin on to finger, oblique row of tubercles at proximal end of ridge, each perforated for cluster of setae; fixed finger half length of upper margin of palm, cutting edge with denticles over proximal half, blunt triangular tooth at about midpoint; dactylus as long as fixed finger, twice as long as wide at base, cutting edge with blunt molar, with deflected tip; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers.

Minor cheliped (right in holotype) ischium twice as long as distal width, lower margin with distal spine; merus 1.7 times as long as broad, lower margin mostly straight, unarmed; carpus 1.4 times as wide as upper length, upper margin carinate, with proximal hooked tooth, subproximal mesial pit, distal tooth, distomesial face with lower submarginal ridge, distolateral margin with notch near upper margin, with 3 lobes near lower margin separated by perpendicular submarginal grooves, middle lobe apex rounded, with shallow median groove, 3 short setae in lower groove; propodus greatest width in middle of palm, upper palm length equal to greatest width, as wide distally as proximally, upper margin carinate, overhanging mesial face, with rounded lobe projecting over dactylus, lower margin carinate, strongly curved mesially, distomesial margin of palm almost straight, lateral face of palm with prominent ridge running from tubercle near proximal margin on to finger, oblique row of tubercles at proximal end of ridge, each perforated for cluster of setae; fixed finger 0.7 length of upper margin of palm, width at base half width of palm, cutting edge smooth; dactylus as long as fixed finger, 3.5 times as long as wide at base, cutting edge straight; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers.

Pereopod 2 merus twice as long as maximum width; dactylus c. 2.5 times as long as upper margin of propodus. Pereopod 3 merus 2.2 times as long as maximum width; carpus 1.8 times as long as wide; propodus with lower margin concave, 1.5 times as long overall as mid-length; dactylus 0.7 times length of axial length of propodus. Pereopod 4 merus length 2.7 times maximum width; carpus 2.7 times as long as wide; propodus 1.5 times as long as wide, typically setose, with 1 long distal seta overlapping dactylus.

Pleopod 1 article 1 distally setose; article 2 as long as article 1, 4 times as long as wide, with apex curved over subdistal notch, appendix interna freely produced, unarmed. Pleopod 2 endopod 2.1 times as long as wide; appendix masculina overreaching endopod by about half its length, setose along posterior face and distally; appendix interna near base of appendix masculina with 5 small hooks. Pleopod 3 with appendix interna submerged in endopod margin.

Uropodal endopod anterior margin convex, posterior margin convex, widest about third way along, 1.4 times as long as wide, apex excavate, with rows of long setae at ends of anterior and posterior margins, with 11 short setae between in excavation, with subdistal group of facial setae; exopod ovate, anterior margin straight, distal and posterior margins continuous, greatest dimension 2.3 times anterior margin, with row of blade-like distal setae on distal margin, c. 6 not overlapping with densely setose distal margin; dorsal plate extending almost half of exopod width, distal margin with spiniform setae. Telson 1.8 times as wide as long, broadest at midpoint, posterolateral corner squarish; posterior margin sinuous, lateral regions most prominent, with posterolateral cluster of long setae plus 2 short spiniform setae; dorsal surface with sharp transverse ridge at anterior third, with 30 short spiniform setae, few long setae at midpoint.

Female. Essentially as male except: major cheliped palm more tapering than in male, widest proximally. Pleonal sternite 1 with pair of oval plates supporting pleopods, each with longitudinal row of c. 20 setae in clusters of 4 or 5. Pleopod 1 peduncle with mesial setose lobe longer than base. Pleopod 2 peduncle with similar lobe directed mesially.

Colour. Exoskeleton mostly translucent white, upper parts of chelipeds pink (fig. 1f, g).

Etymology. For Peter C. Dworschak, good friend and colleague, and in recognition of his career devoted to the biology of “thalassinideans”.

Distribution. Madagascar, Philippines, Mariana Islands, Papua New Guinea, Indonesia, French Polynesia. Intertidal to 8 m.

Remarks. *Eucallixiopsis dworschaki* is similar to *E. panglaoensis* and *E. paradoxa* (see remarks under *Eucallixiopsis* above). *Eucallixiopsis dworschaki* differs from both species in possession of a proximal hooked spine and subproximal-mesial pit on the upper margin of the carpus of both chelipeds (figs 16g, 25d, e) and a lateral ridge extending almost the entire length of the propodus of both chelipeds (figs 16b, 25b). The palm of the major cheliped of the male is a little longer than wide, while it is 1.25 times as long as wide in

E. panglaoensis. The telson is relatively shorter (length: width ratio 1.8 vs 1.6) and with a more sinuous posterior margin, and the uropodal endopod is broader (length: width ratio 1.4 vs 1.6). Dworschak (2006; pers. comm. 29 September 2019) reported a small spine on the merus of maxilliped 3 of the allotype of *E. panglaoensis*, and of seven from Sulawesi, here reidentified as *E. dworschaki*. None of the material examined for this study, nor Dworschak’s two individuals from Bali, possess this spine. *Eucallixiopsis paradoxa* is compared below.

Dworschak (2006: 356, fig. 5) remarked on and illustrated two females from Panglao that differed from typical *E. panglaoensis*. He noted the hook and pit on the upper margin of the cheliped carpus and the longitudinal ridge on the propodus, characters used here to differentiate *E. dworschaki*. The genetic difference from *E. panglaoensis* from the type locality in the Philippines (Robles et al., 2020) and consistent morphology of *E. dworschaki* over a wide geographic range in the Indo-West Pacific support recognition of two species. Dworschak (2018) listed material of *E. panglaoensis* from Sulawesi and Bali, Indonesia. He has now confirmed (pers. comm. 30 October 2018) that this collection of five males and four females also belongs to *E. dworschaki*. The two species occur sympatrically at Panglao and a single individual of *E. dworschaki* was recorded from Guam, not far from the Philippines. A large sample of ghost shrimps from the Great Barrier Reef, a sample that included specimens of *Corallianassa* sp. (Callichiridae) and *Thomassinia aimsae* Poore, 1997 (Callianideidae), was dominated by *E. paradoxa* but also included one specimen of *E. dworschaki*.

There is no genetic difference between the individual from Papua New Guinea and the three sequenced from French Polynesia.

Sakai and Türkay (2014) illustrated a single somewhat distorted individual from Papua New Guinea that was identified as *Callixina panglaoensis*. On the basis of its recorded locality, the specimen is probably *E. dworschaki*.

Eucallixiopsis inaequimana Dworschak, 2014

Figures 1h, i, 18, 25h

Callianassa aequimana.—Poore and Griffin, 1979: 245 (partim from Qld).

Callix aequimana.—Sakai, 1999: 118–119 (partim from Maldives), fig. 31.

Eucalliix inaequimana Dworschak, 2014: 236–244, figs 3–7, 9f, g, 10e, f.—Dworschak, 2018: 17.

Eucallixiopsis inaequimana.—Poore et al., 2019: 125, 127, fig. 19o, p.—Robles et al., 2020.

Material examined. Papua New Guinea, New Ireland, NW corner of Little Nusa Island, seagrass, 0–1 m, 02° 34.9' S, 150° 46.4' E (KAVIENG 2014 stn KM11), MNHN-IU-2013-10006* (female, 5.8 mm), MNHN-IU-2013-10008* (male, 7.2 mm).

Australia. Qld. Great Barrier Reef, Myrmidon Reef, 18.27° S, 147.38° E, October 1986, 4 m (M. Riddle stn M/10/2), NMV J71689 (2 males, 7.1 mm; 5 females, 5.3–8.3 mm); 2 m (M. Riddle stn M/10/3), NMV J71690 (female, 5.6 mm). Norwest Islet, Capricorn Group, 23.3° S, 151.7° E, AM P.10356 (male, 8.1 mm)

Mariana Islands, Guam, W coast, near Fish Eye Marine Park,

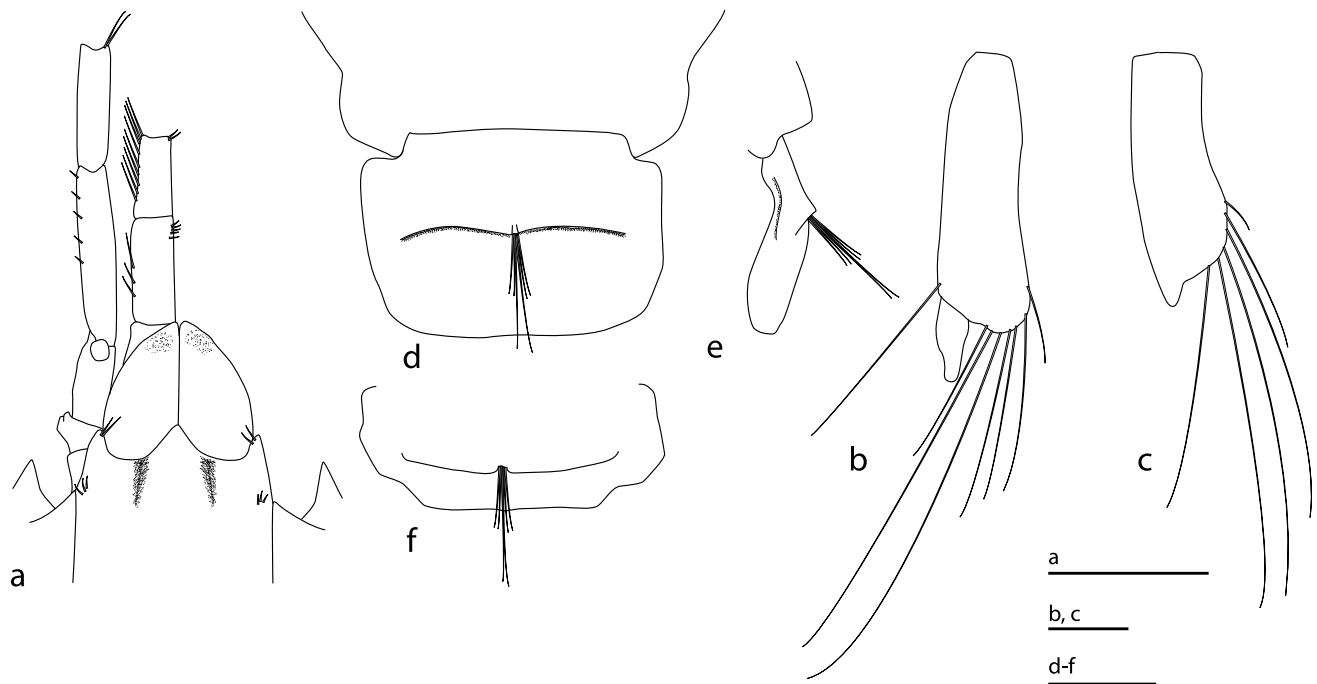


Figure 18. *Eucalliixiopsis inaequimana*. French Polynesia, UF 16512 (male, 5.0 mm): a, anterior carapace, eyestalks, antennule, antenna; b, pleopod 1. French Polynesia, UF 28903 (male, 5.4 mm): c, pleopod 1. Papua New Guinea, MNHN-IU-2014-10008 (male, 7.2 mm): d–f, telson, dorsal, lateral and anterodorsal views. Scale bars a, d–f = 1 mm; scale bars b, c = 0.1 mm.

sand/rubble flat, 0.2–0.5 m, 13.471° N, 144.704° E (stn AA05), UF 27330 (female, 3.5 mm).

French Polynesia. Moorea Island, Motu Tiahura/Fareone channel, 17.4888° S, 149.9134° W (stn MIB-225), UF 16512 (male, 5.0 mm). Papetoai, 17.4898° S, 149.884° W, (stn BIZ-463), UF 16479 (female, 3.9 mm), UF 28784* (male, 5.1 mm); stn BIZ-493 UF 28903 (male, 5.4 mm), UF 28929 (female, 5.1 mm). S of Nihimaru, 17.535° S, 149.904° W (stn BIZ-616), UF 29162 (ovigerous female, 6.6 mm). Off Opunohu public beach, 17.49143° S, 149.85138° W (stn BIZ-636), UF 29208 (male, 6.0 mm). Off Nihimaru river estuary, 17.533° S, 149.9045° W (stn MIB-098), UF 15915 (male, 5.0 mm), UF 15945 (female, 4.0 mm). Gump reef, in front of waterfront bungalows, 17.4902° S, 149.826° W (stn MIB-224), UF 16498 (ovigerous female, 6.2 mm). Between Papetoai and Hotel, 17.4908° S, 149.8871° W (MIB-227), UF 16535 (male, 2.9 mm), UF 16542 (female, 4.6 mm; male, 4.1 mm).

Diagnosis. Pleonite 1 without pair of sternal plates. *Eyestalk about twice as long as wide*. Antennule peduncle reaching to base of antenna peduncle article 5. Maxilliped 3 exopod absent. Cheliped carpi distolateral margin square at lower angle, propodi lateral face without longitudinal ridge, *upper mesial face with row of short transverse ridges associated with more distal clusters of setae*. Male pleopod 1 article 1 linear, with distal setae; article 2 short, oblique, or of single article with narrower distal lobe. Female pleopod 2, appendix interna absent. Uropod endopod ovate. Telson without transverse row of spiniform setae.

Colour. Exoskeleton mostly translucent white, gastric region, distal propodus of chelipeds with few pink chromatophores (fig. 1h, i).

Distribution. Australia, Cocos (Keeling) Island (type locality), Qld, Great Barrier Reef; Papua New Guinea, New Ireland; Indonesia, Sulawesi; Philippines, Panglao; French Polynesia. Intertidal to 4 m.

Remarks. Dworschak (2014) distinguished this species, as *Eucalliix inaequimana*, on several features including inequality of the chelipeds in both sexes from *E. aequimana*. Usually, only males of *Eucalliixiopsis* have a significantly larger major cheliped although not all descriptions are clear on this point. The same is true of *E. patio* (described and compared below) and both species differ from *E. aequimana* in the ways listed by Dworschak (2014).

Robles et al.'s (2020) phylogram detected no genetic difference between two individuals from the type locality, two from Papua New Guinea and one from French Polynesia. Dworschak (2014) recorded the maximum carapace length as 9.1 mm; the largest in this collection were a male of 7.2 mm and ovigerous female of 6.2 mm. His illustrations and description were comprehensive, and many specific details appear on the new material, such as the transverse ridges on the mesial faces of the chelipeds and distal tubercles on the cheliped propodus. A broad postrostral obsolete median ridge defined by shallow longitudinal grooves is typical of the new material (fig. 18a) but was not mentioned by Dworschak (2014). The feature appears to be more conspicuous in some individuals than others (Dworschak, pers. comm. 29 September 2019). The male pleopod 1 is manifest in two forms – a long article and shorter second article (fig. 18b; as

figured by Dworschak) – and a form where these appear fused (fig. 18c).

Poore and Griffin's (1979) specimen of *Callianassa aequimana* from Queensland was reidentified as *E. inaequimana*. Sakai's (1999) record of *Calliax aequimana* from the Maldives is almost certainly referable to *E. inaequimana*. Sakai (2018) omitted *E. inaequimana* from his revision of Eucalliicinae.

***Eucalliaxiopsis madagassa* (Sakai and Türkay, 2014)**

Figure 19

Calliaxiopsis madagassa Sakai and Türkay, 2014: 193, fig. 13.

Calliaxina thomassini Ngoc-Ho, 2014: 549, fig. 2.

Calliaxina madagassa.—Poore and Dworschak, 2017: 120, fig. 1.

Material examined. Madagascar. Nosy Bé, W of Hell-Ville, 13.41562° S, 48.24648° E (stn MGNW-50), UF 14090 (ovigerous female, 5.8 mm). Toliara (as Tuléar), Thomassin stn 676, MNHN-IU-2016-8085 (ovigerous female, 5.8 mm).

Diagnosis. Eyestalk about twice as long as wide. Antennule peduncle reaching to midpoint of antenna peduncle article 5. Maxilliped 3 exopod present. Cheliped carpi distolateral margin square at lower angle, propodi lateral face without longitudinal ridge, upper mesial face with row of clusters of long setae. Male pleopod 1 article 1 without distal setae, article 2 parallel-sided, apically rounded, with marginal setae, without appendix interna. Female pleopod 2, appendix interna absent. Uropod endopod ovate. Telson without transverse row of spiniform setae.

Distribution. Madagascar.

Remarks. Poore and Dworschak (2017) discussed the synonymy and priority of the species names before *Calliaxina* was divided into two by Poore et al. (2019). The species is widespread in Madagascar (Ngoc-Ho, 2014) and is recognised by rounded posterolateral corners and convex posterior margin of the telson, the continuous dense row of setae on the lateral margin of the fixed finger of the minor cheliped, and the presence (usually) of two or three tubercles at the midpoint of the lower margin of the cheliped merus. The ovigerous female differs from that of the male figured by Ngoc-Ho (2014) in having a slightly narrower uropodal exopod and in having the chelipeds subequal – they are unequal in males of most species of this genus.

***Eucalliaxiopsis panglaoensis* (Dworschak, 2006)**

Figure 25g

Eucalliax panglaoensis Dworschak, 2006: 349–358, figs 1–4, 6, 7 (not fig. 5 = *E. dworschaki* sp. nov.).—Osawa and Fujita, 2016: 40–41, fig. 3c.—Dworschak, 2018: 17, fig. 1 (partim).

Calliaxina panglaoensis.—Sakai, 2011: 501.

Eucalliaxiopsis panglaoensis.—Poore et al., 2019: 125, 127, 146, fig. 19m.—Robles et al., 2020.

Material examined. Paratypes. Philippines, Panglao Island, 09° 38.3' S, 123° 49.6' E, MNHN Th1503 (female, 7.1 mm), MNHN Th1504 (male, 4.3 mm).

Diagnosis. Pleonite 1 with pleopods attached to pair of sternal plates. Eyestalk about twice as long as wide. Antennule peduncle

reaching to midpoint of antenna peduncle article 5. Maxilliped 3 exopod absent. *Cheliped carpi distolateral margin with 3 acute teeth near lower margin separated by wide grooves parallel to lower margin, second tooth with acute ridge*, propodi lateral face without longitudinal ridge, upper mesial face with row of clusters of long setae. Male pleopod 1 article 1 linear, with distal setae; article 2 blade-like with subapical medial notch. Female pleopod 2, appendix interna absent. Uropod endopod ovate with excavate apex. Telson with row of spiniform setae on ridge.

Distribution. Philippines, Panglao; Japan, Ryukus, Miyako Group. Sandy beaches, intertidal to 4 m.

Remarks. *Eucalliaxiopsis panglaoensis* differs from *E. paradoxa* and *E. dworschaki* (see remarks under *Eucalliaxiopsis* above and these two species) in armature of the cheliped. The marginal teeth at the lower distal angle of the carpus are more widely spaced, and the second more sharply ridged than in the other two. The longitudinal lateral ridge on the propodus is shorter than in *E. dworschaki* but more prominent than in *E. paradoxa* (fig. 25g; Dworschak, 2006).

The record of this species, rather than *E. dworschaki*, from Japan is based on the illustration of the cheliped with a short lateral propodal ridge (Osawa and Fujita, 2016: fig. 3c).

***Eucalliaxiopsis paradoxa* sp. nov.**

<http://zoobank.org/urn:lsid:zoobank.org:act:2EEAC4EC-C3EA-4D17-9102-4090CA6DF02E>

Figures 20, 21, 25h, i

Material examined. Holotype. Australia, Qld, Great Barrier Reef, Rib Reef, 18.48° S, 146.86° E, October 1985, shallow lagoon, 4 m, (M. Riddle stn R/10/2), NMV J71683 (male, 9.4 mm).

Paratypes. Collected with holotype. NMV J71679 (ovigerous female, 9.4 mm), NMV J71684 (3 females, 9.8–10.9 mm). Australia, Qld, Great Barrier Reef, Myrmidon Reef, 18.27° S, 147.38° E, October 1985, lagoon with “*Callianassa*” mounds, 8 m, (M. Riddle stn M/10/1), NMV J71680 (7 males, 3.9–10.3 mm; 7 females, 4.4–10.4 mm).

Diagnosis. Pleonite 1 with pleopods attached to pair of sternal plates. Eyestalk about twice as long as wide. Antennule peduncle reaching to midpoint of antenna peduncle article 5. Maxilliped 3 exopod absent. *Cheliped carpi distolateral margin with 3 acute teeth near lower margin separated by submarginal oblique grooves, second tooth with prominent rounded ridge*, propodi lateral face with short horizontal longitudinal ridge extending from beyond mid-length of palm to base of finger, upper mesial face with row of clusters of long setae. Male pleopod 1 article 1 linear, with distal setae; article 2 blade-like with subapical medial notch. Female pleopod 2, appendix interna absent. Uropod endopod ovate with excavate apex. Telson with row of spiniform setae on ridge.

Description of holotype male. Carapace length 9.4 mm, smooth; gastric–abdominal regions together 4.7 times as long as wide; branchiostegite fully calcified; cervical groove at 0.63 carapace length, scarcely obvious on branchiostegite; cardiac sulcus at 0.8 carapace length, not meeting mid-dorsally, extending transversely across quarter of branchiostegite.

Rostrum acute, tapering evenly over most of length, length 0.5 width of eyestalks. Anterolateral carapace lobe 0.6 length

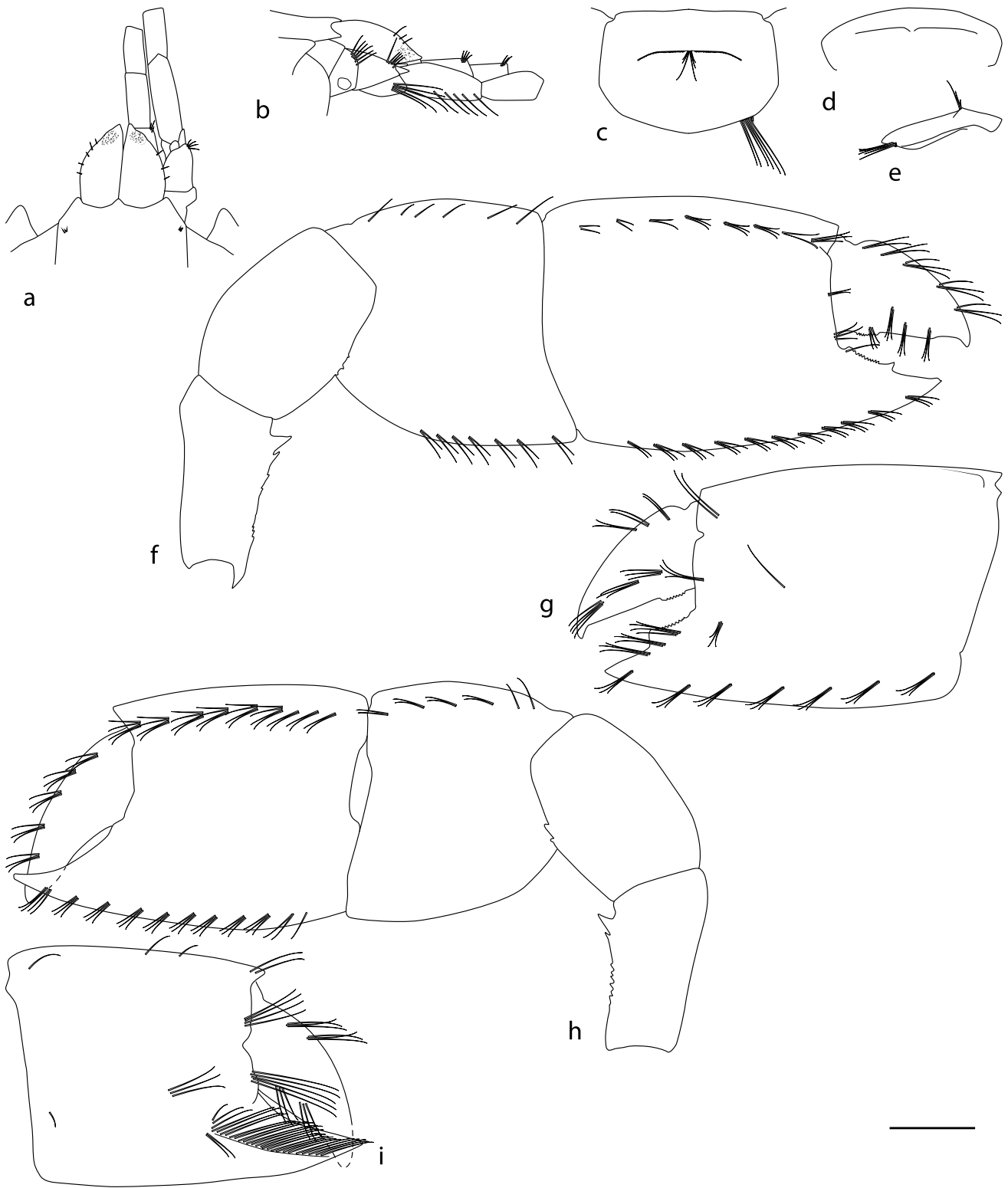


Figure 19. *Eucalliixiopsis madagassa*. Madagascar, UF 14090 (ovigerous female, 5.8 mm): a, b, anterior carapace, eyestalks, antennule, antenna, dorsal and lateral views; c–e, telson, dorsal, posterior and lateral views; f, major (left) cheliped, mesial view; g, major (left) cheliped, propodus, dactylus, lateral view; h, minor (right) cheliped, mesial view; i, minor (right) cheliped, propodus, dactylus, lateral view. Scale bars = 1 mm.

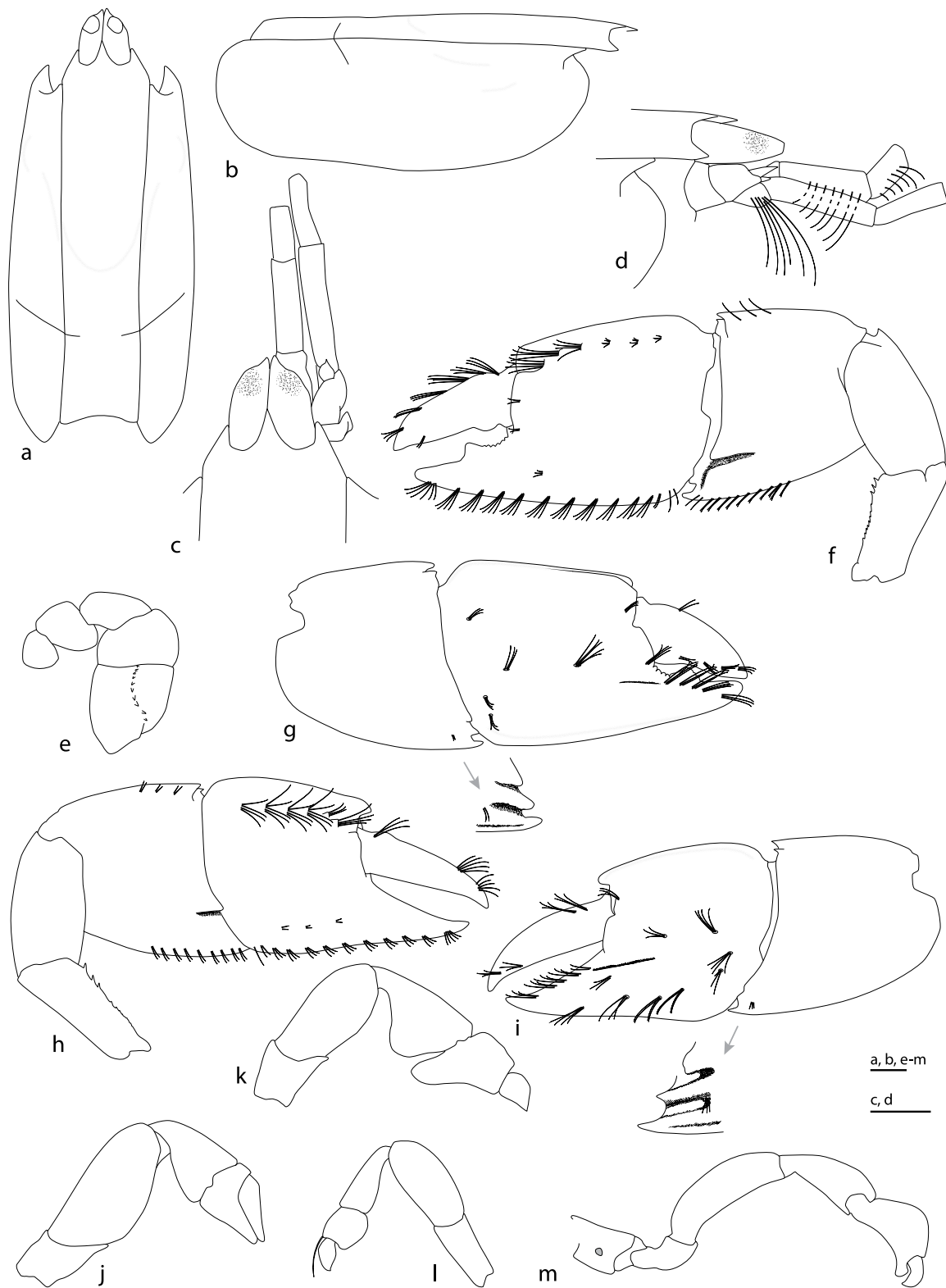


Figure 20. *Eucallixiopsis paradoxa* sp. nov. Holotype, NMV J71683 (male, 9.4 mm): a, b, carapace, dorsal and lateral views; c, d, anterior carapace, eyestalks, antennule, antenna, dorsal and lateral views; e, maxilliped 3; f, g, major cheliped (left), mesial and lateral views, with detail of distolateral corner of carpus; h, i, minor cheliped (right), mesial and lateral views, with detail of distolateral corner of carpus; j, k, m, pereopods 2, 3, 5. Paratype, NMV J71680 (female, 9.3 mm): l, pereopod 4. Scale bars = 1 mm.

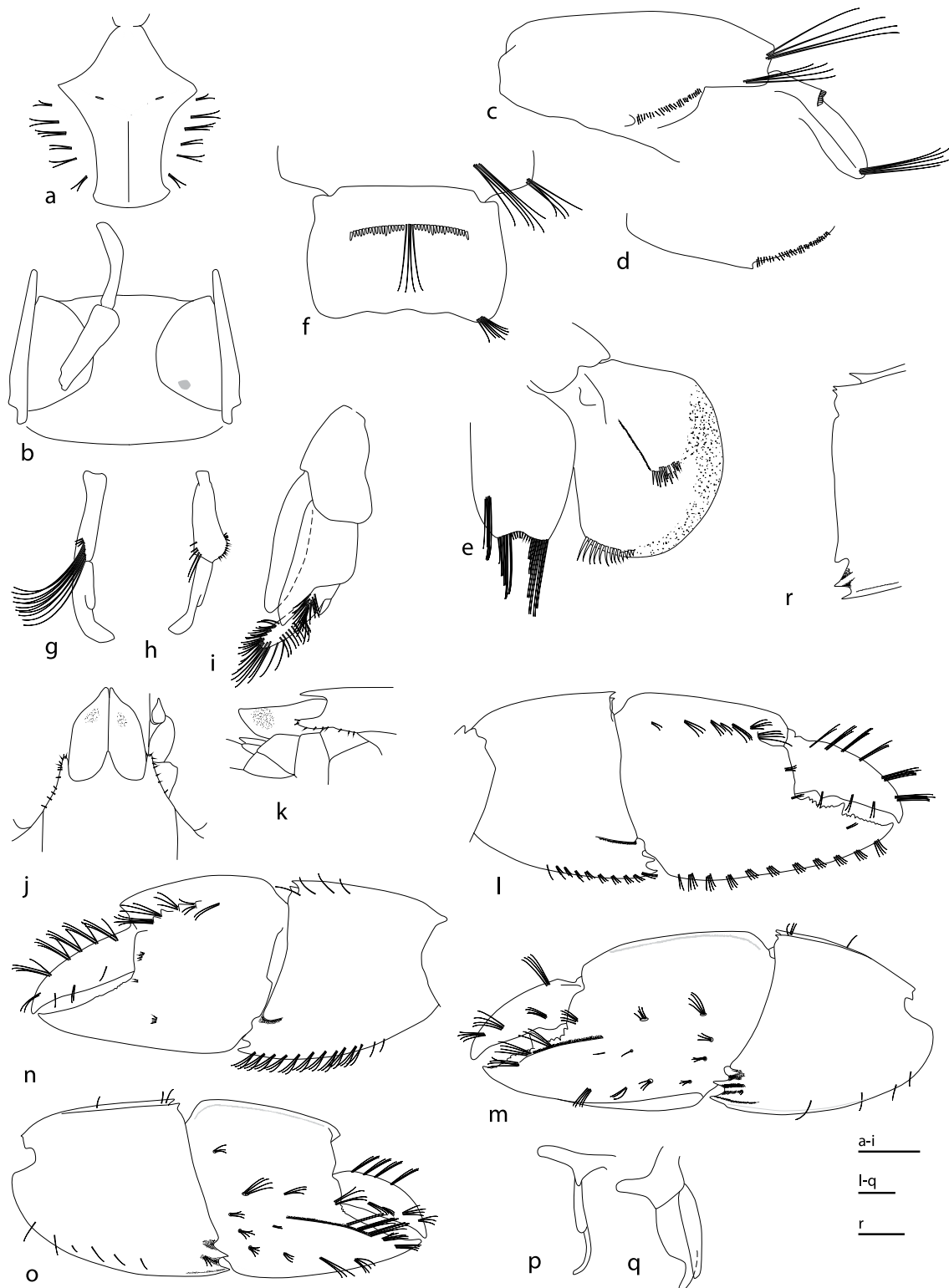


Figure 21. *Eucalliixiopsis paradoxa* sp. nov. Holotype, NMV J71683 (male, 9.4 mm): a, thoracic sternite 7; b, pleonite 1 sternite, right pleopod 1 (anterior uppermost); c, pleonite 6, telson, lateral view; d, pleonite 6, left lateral oblique view; e, right uropod; f, telson; g, h, pleopod 1, mesial and posterior views; i, pleopod 2, posterior view. Paratype, NMV J71679 (ovigerous female, 9.4 mm): j, k, anterior carapace, eyestalks, antenna, dorsal and lateral views; l, m, major cheliped (left), mesial and lateral views; n, o, minor cheliped (right), mesial and lateral views; p, q, pleopods 1, 2. Paratype, NMV J71684 (female, 10.4 mm): r, minor cheliped carpus, distolateral margin. Scale bars = 1 mm.

rostrum, with rounded apex, anteriorly directed, with numerous submarginal dorsal setae.

Thoracic sternite 7 1.3 times as long as wide, with well-defined median sulcus over posterior half, lateral groove anterior to coxal articulation shallow, oblique, meeting medially, with 7 posterolateral clusters of 2 or 3 long setae. Pleonal sternite 1 with pair of swollen relatively unchitinised areas anterior to ridge bearing pleopods. Pleonite 6 with small lateral blunt hook-like process at midpoint.

Eyestalk 2.2 times as long as wide at base, tapering to cornea and acute apical lobe; cornea subcircular; apical lobe extended dorsally. Antennular peduncle 3 times as long as width of both eyestalks; article 2 3.5 times as long as wide; article 3 half as long as article 2; articles 2 and 3 with ventrolateral row of long setae, continued onto flagellum. Antennal peduncle 3.4 times as long as width of both eyestalks, overreaching antennule peduncle by half of article 5; scaphocerite wider than long, with acute apex; article 4 c. 5 times as long as wide; article 5 0.6 length of article 4. Maxilliped 3 ischium with slightly convex mesial margin, expanding from narrow proximomesial corner; ischium–merus upper margin 1.7 times as long as greatest width; crista dentata of 12 spines, the most proximal reflexed; carpus–dactylus together almost as long as ischium–merus.

Chelipeds unequal, major propodus 1.2 times as long as that of minor, both of similar widths, major dactylus stouter than that of minor. Major cheliped (right in holotype) ischium twice as long as distal width, lower margin with short spines becoming more distinct distally; merus twice as long as broad, lower margin mostly straight, unarmed, upper margin with distal tooth; carpus 1.2 times as wide as upper length, upper margin carinate, unarmed except for distal tooth, distomesial margin with prominent lobe near lower margin, distolateral margin with acute tooth near upper margin, with 3 acute teeth near lower margin separated by submarginal oblique grooves, second tooth with prominent rounded ridge, 3 short setae in lower groove; propodus widest proximally, tapering, upper palm length barely exceeding greatest width, upper margin straight, carinate, with rounded lobe not projecting over dactylus, lower margin carinate, strongly curved mesially, mesial face with short distal uneven setose ridge below upper margin, distomesial margin of palm almost straight, lateral face of palm with short horizontal ridge, about fifth length of palm, extending on to finger, 4 rimmed tubercles near proximal margin, 1 at midpoint of palm, 1 near lower margin, each perforated for cluster of setae; fixed finger half length of upper margin of palm, cutting edge with denticles over proximal half, blunt triangular tooth near midpoint; dactylus as long as fixed finger, twice as long as wide at base, cutting edge with blunt proximal molar, with straight tip; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers.

Minor cheliped (left in holotype) ischium twice as long as distal width, lower margin with distal spines; merus twice as long as broad, lower margin mostly straight, unarmed; carpus 1.2 times as wide as upper length, upper margin carinate, unarmed except for distal tooth, distomesial face with lower

submarginal ridge, distolateral margin with acute tooth near upper margin, with 3 teeth near lower margin separated by submarginal oblique grooves, second tooth acute with prominent rounded ridge, 2 short setae in lower groove; propodus greatest width proximally, tapering, upper palm length equal to greatest width, palm tapering, upper margin carinate, overhanging mesial face, with rounded lobe projecting over dactylus, lower margin carinate, strongly curved mesially, mesial face with 4 blunt teeth at associated with upper row of clusters of setae, distomesial margin of palm almost straight, lateral face of palm with prominent ridge running from two-thirds length of palm to middle of finger, 5 rimmed tubercles near proximal margin of which 1 near midpoint of palm is more distal, each perforated for cluster of setae; fixed finger 0.7 length of upper margin of palm, width at base half width of palm, cutting edge smooth; dactylus as long as fixed finger, 3.2 times as long as wide at base, cutting edge straight; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers.

Pereopod 2 merus twice as long as maximum width; dactylus c. 3 times as long as upper margin of propodus. Pereopod 3 merus twice as long as maximum width; carpus 1.8 times as long as wide; propodus with lower margin concave, twice as long overall as mid-length; dactylus 0.7 times length of axial length of propodus. Pereopod 4 merus length 2.2 times maximum width; carpus 2.5 times as long as wide; propodus as long as wide, typically setose, with 1 long distal seta overlapping dactylus.

Pleopod 1 article 1 distally setose; article 2 as long as article 1, 4 times as long as wide, with apex curved, appendix interna lobe-like, not produced, unarmed. Pleopod 2 endopod twice as long as wide; appendix masculina overreaching endopod by about third its length, triangular in cross-section, setose along posterior face and distally; appendix interna near base of appendix masculina without hooks.

Uropodal endopod anterior margin convex, posterior margin convex, widest about third way along, 1.4 times as long as wide, apex excavate, with rows of long setae at ends of anterior and posterior margins, with 8 short setae between in excavation, with subdistal group of facial setae; exopod ovate, anterior margin straight, distal and posterior margins continuous, greatest dimension 2.2 times anterior margin, with row of blade-like distal setae on distal margin, c. 6 not overlapping with densely setose distal margin; dorsal plate extending almost half of exopod width, distal margin with spiniform setae. Telson 1.6 times as wide as long, broadest at midpoint, posterolateral corner rounded; posterior margin sinuous, lateral regions most prominent, with posterolateral cluster of long setae plus 2 short spiniform setae; dorsal surface with sharp transverse ridge at anterior third, with 36 short spiniform setae, few long setae at midpoint

Female. Essentially as male except: major cheliped palm tapering, upper length 0.9 greatest width, upper margin convex, depressed distally, lateral ridge longer than in male, fixed finger broader than in male, crenellate proximal and distal to tooth. Pleonal sternite 1 with pair of oval plates supporting pleopods, each with longitudinal row of setae. Pleopod 1 peduncle with

mesial setose lobe longer than base. Pleopod 2 peduncle with similar mesial setose lobe; endopod without appendix interna.

Etymology. *Paradoxa* (Latin), reflecting the subtle differences from *E. panglaoensis* and co-occurring *E. dworschaki*, and a tribute to the collector's name, Martin Riddle.

Distribution. Australia, Qld, central Great Barrier Reef (18° S). Subtidal coral reef lagoons.

Remarks. *Eucalliixiopsis paradoxa* shares several features with *E. panglaoensis* and *E. dworschaki* (see remarks under *Eucalliixiopsis* above). The new species differs from these two in having eight short setae in the uropodal endopod excavation (fig. 21e; 11 in the other species), a short longitudinal ridge at the base of the finger on the lateral face of the chelipeds, the propodus of the male cheliped tapering (more rectangular in the others), and the middle distolateral cheliped carpal tooth being oblique and sharply ridged (figs 20g, i, 21m, o, r, 25h). In *E. dworschaki*, the ridge on the palm extends almost its entire length, and the middle carpal lobe is perpendicular and with a median groove. Besides having fewer short setae at the end of the uropodal endopod, *Eucalliixiopsis paradoxa* differs from *E. panglaoensis* in the upper margin of the male major cheliped palm being as long as wide (vs 1.3 times as long as palm width), the palm of the female major cheliped being relatively longer (1.1 vs 0.9 times as long as greatest width), the uropodal endopod being more tapered (more oval in *E. panglaoensis*) and the sinuous posterior margin of the telson (vs straight).

***Eucalliixiopsis patio* sp. nov.**

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Figures 22–24

Eucalliixiopsis PNG-1153C.— Robles et al., 2020.

Material examined. Holotype. Papua New Guinea, New Ireland Province, Patio Island, 02° 36.2' S, 150° 31.6' E, 6–8 m, coral rubble (KAVIENG 2014 stn KB38), MNHN-IU-2014-2536* (female, cl. 4.6 mm).

Paratype. Collected with holotype (MNHN-IU-2014-2539 (male, cl. 4.3 mm, with male and female bopyrid isopods under left branchiostegite).

Diagnosis. Pleonite 1 without pair of sternal plates. Eyestalk 1.5 times as long as wide. Antennule peduncle reaching to midpoint of antenna peduncle article 5. Maxilliped 3 exopod absent. Cheliped carpi distolateral margin square at lower angle, propodi lateral face without longitudinal ridge, upper mesial face with row of short transverse ridges associated with more distal clusters of setae. Male pleopod 1 of single article with narrower distal lobe. Female pleopod 2, appendix interna present. Uropod endopod ovate. Telson without transverse row of spiniform setae.

Description of holotype female. Carapace length 4.6 mm, smooth; gastric–abdominal regions together 4.2 times as long as wide; branchiostegite fully calcified; cervical groove at 0.67 carapace length, scarcely obvious on branchiostegite; cardiac sulcus at 0.83 carapace length, not meeting mid-dorsally, extending transversely across two-thirds of branchiostegite.

Rostrum broadly rounded-triangular, length about 0.2 width of eyestalks. Anterolateral carapace lobe as long as rostrum, with rounded apex, depressed anteriorly, with c. 5 submarginal dorsal setae. Pleonites 1–6 lengths relative to cl: 0.46 : 0.67 : 0.45 : 0.33 : 0.41 : 0.51; pleonite 1 with strong dorsal transverse groove, without pair of sternal plates; pleonites 3–5 with lateral tufts of setae; pleonite 6 with 8 lateral rows of setae.

Thoracic sternite 7 1.2 times as long as wide, with well-defined median sulcus over posterior half, smooth over medial half, lateral ridge anterior to coxal articulation crossing pit at quarter of width, meeting medially, with 3 posterolateral clusters of long setae.

Eyestalk 1.7 times as long as wide at base, swollen laterally, tapering to cornea and acute apical tubercle; cornea wider than long, depressed anteriorly. Antennular peduncle twice as long as width of both eyestalks; article 2 twice as long as wide; article 3 as long as article 2; articles 2 and 3 with ventrolateral row of long setae, continued onto flagellum. Antennal peduncle 2.4 times as long as width of both eyestalks, overreaching antennule peduncle by half of article 5; scaphocerite ovoid, longer than wide; article 4 c. 5 times as long as wide; article 5 0.8 length of article 4. Maxilliped 3 ischium with slightly convex mesial margin, expanding from narrow proximomesial corner; ischium–merus upper margin twice as long as greatest width; crista dentata of 6 spines, the 2 most proximal largest; carpus–dactylus together almost as long as ischium–merus.

Chelipeds unequal, major carpus–propodus upper margin 1.1 length of minor, propodus 1.2 times as wide as minor. Major cheliped (left in holotype) ischium twice as long as distal width, lower margin with needle-like spines becoming more distinct distally; merus 1.7 times as long as broad, lower margin convex, unarmed; carpus 1.2 times as wide as upper length, margins carinate; propodus greatest width in middle of palm, upper palm length 1.15 times greatest width, distomesial margin of palm with submarginal group of 2 setae, small tubercle, distolateral margin of palm with submarginal group of c. 6 setae between fingers; fixed finger 0.4 length of upper margin of palm, cutting edge with microdenticles over proximal half, blunt triangular tooth at about midpoint; dactylus as long as fixed finger, twice as long as wide at base, cutting edge with deflected tip; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers; 3 short transverse ridges associated with setae on submesial upper margin.

Minor cheliped (right in holotype) ischium c. 2.3 times as long as distal width, lower margin with needle-like spines becoming more distinct distally; merus 1.7 times as long as broad, lower margin convex, unarmed; carpus 1.2 times as wide as upper length, margins carinate; propodus palm more tapering than major, 0.95 times as wide as upper palm length, distomesial margin of palm with submarginal group of 4–12 setae, distolateral margin of palm with submarginal group of c. 4 setae; fixed finger half length of upper margin of palm, mesial cutting edge straight, smooth, cutting edge straight, fixed finger with smooth lateral ridge defining edge of lateral concavity at base of fixed finger, without granules; dactylus as long as fixed finger, 3 times as long as wide at base, cutting edge straight; submarginal tufts of long setae on upper and lower mesial

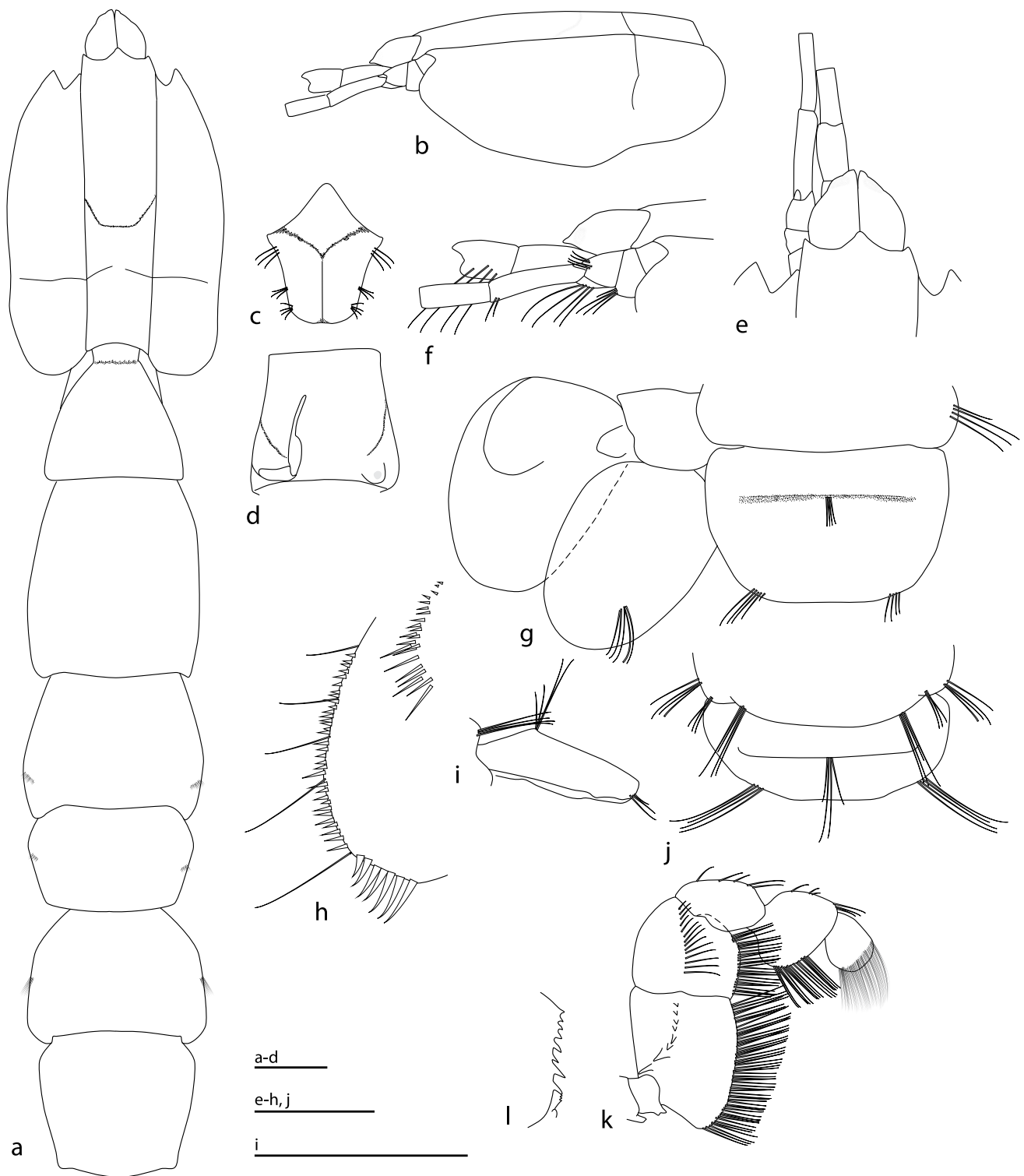


Figure 22. *Eucalliaxiopsis patio* sp. nov. Holotype, MNHN-IU-2013-2536 (female, 4.1 mm): a, habitus, dorsal; b, carapace, lateral view; c, thoracic sternite 7; d, pleonitel sternite, right pleopod 1; e, f, anterior carapace, eyestalks, antennule, antenna, dorsal and lateral views; g, pleonite 6, telson, uropod; h, uropod exopod, margin, dorsal plate; i, j, telson, lateral and dorso-anterior views; k, maxilliped 3; l, maxilliped 3, crista dentata, basis, ischium. Scale bars = 1 mm.

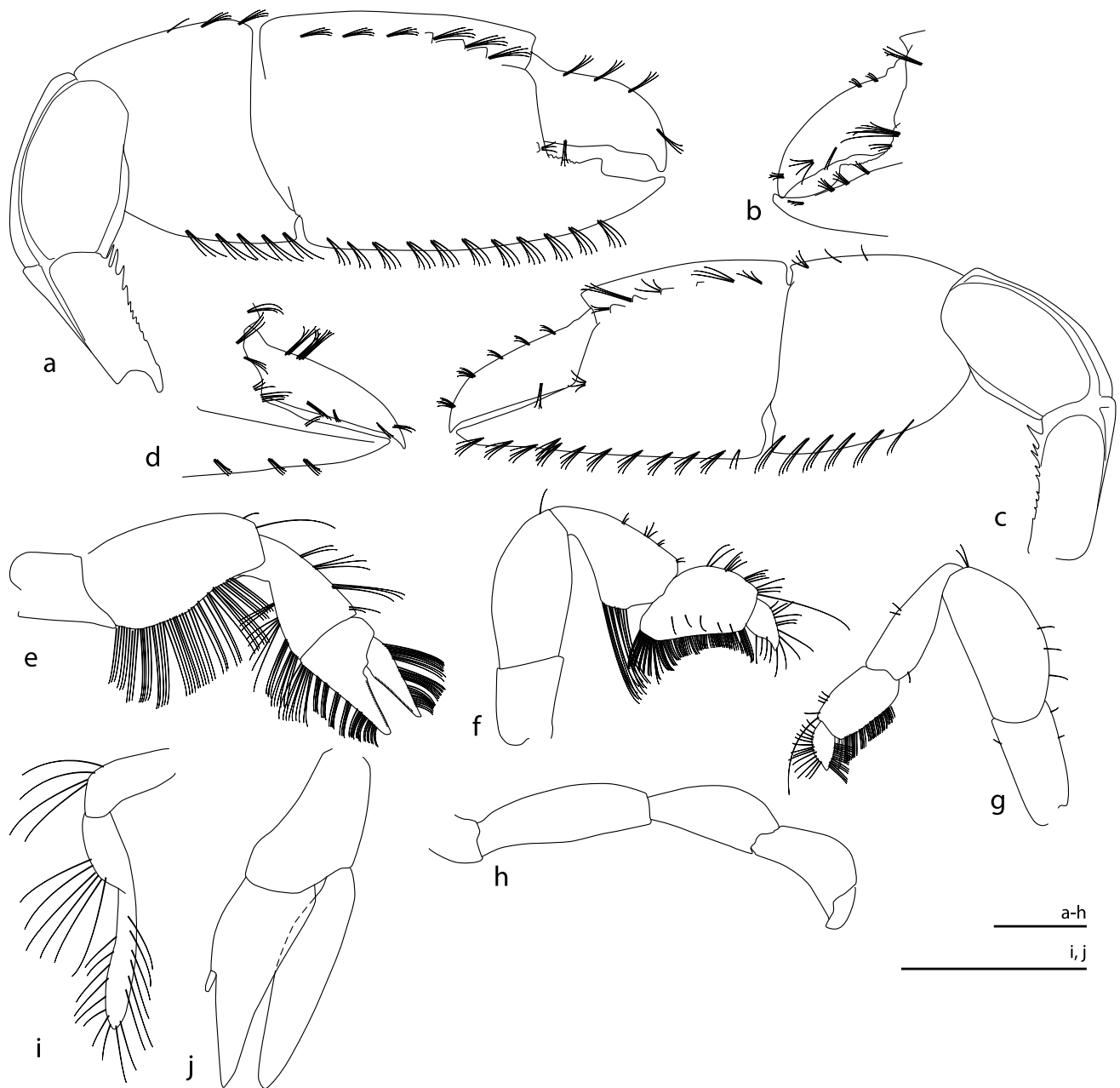


Figure 23. *Eucalliixiopsis patio* sp. nov. Holotype, MNHN-IU-2013-2536 (female, 4.1 mm): a, major cheliped (left), mesial; b, major cheliped (left), distal propodus, dactylus, lateral; c, minor cheliped (right), mesial view; d, minor cheliped (right), distal propodus, dactylus, lateral; e–h, pereopods 2–5; i, j, pleopods 1, 2. Scale bars = 1 mm.

margins of carpus and propodus, opposing mesial margins of fingers; 2 short transverse ridges associated with setae on submesial upper margin, more prominent distally.

Pereopod 2 merus 1.8 times as long as maximum width; dactylus c. 3 times as long as upper margin of propodus. Pereopod 3 merus 2.2 times as long as maximum width; carpus 1.8 times as long as wide; propodus with lower margin almost straight, 1.8 times as long as mid-length; dactylus half

as long as axial length of propodus. Pereopod 4 merus twice as long as maximum width; carpus 3 times as long as wide; propodus typically setose, with distal spiniform setae among setose margin, with 2 long distal setae overlapping dactylus.

Pleopod 1 article 1 without distal projection beyond article 2; article 2 longer than article 1. Pleopod 2 endopod 3 times as long as wide; appendix interna at midpoint of endopod.

Uropodal endopod ovoid, anterior margin more convex

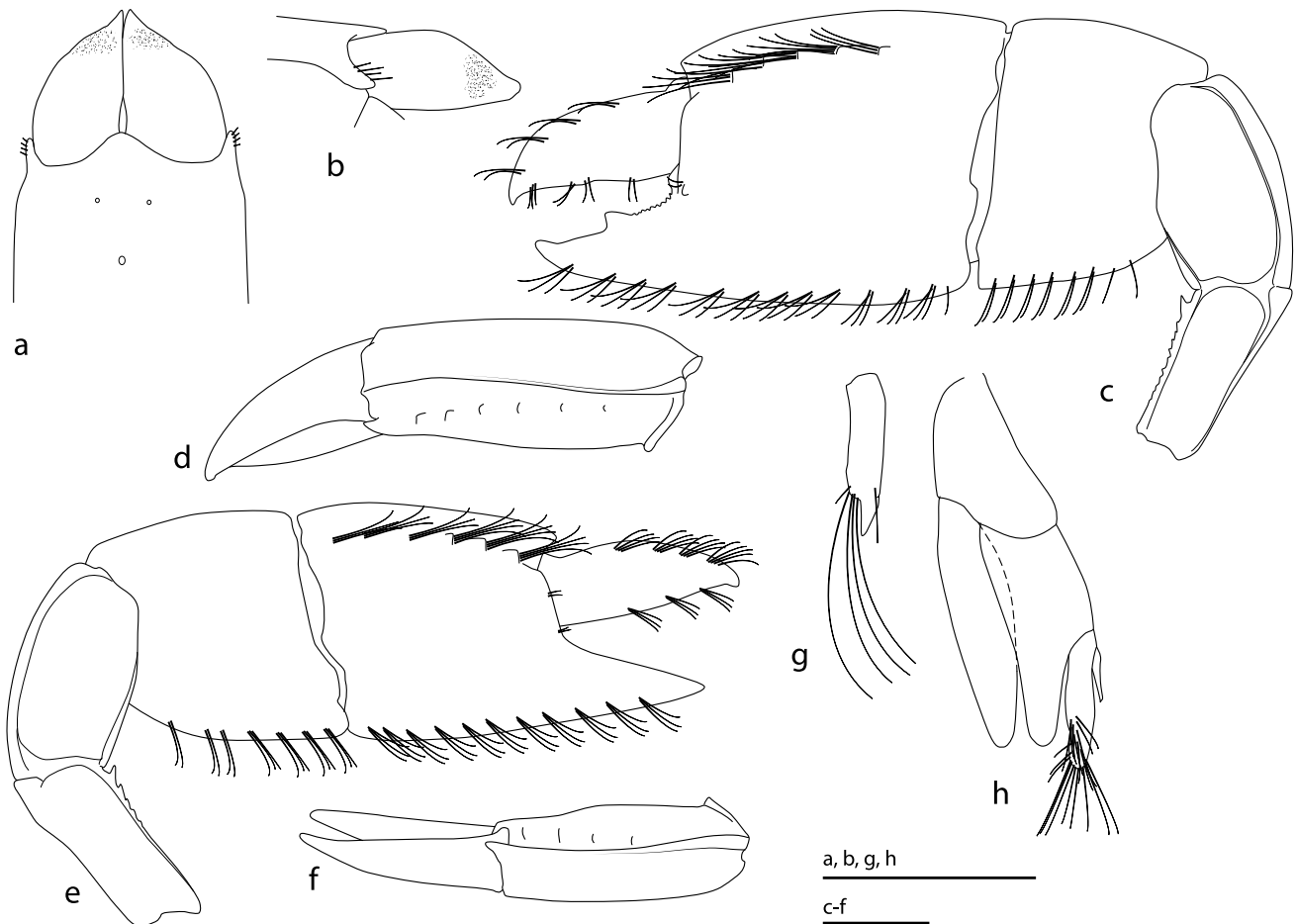


Figure 24. *Eucallixiopsis patio* sp. nov. Paratype, MNHN-IU-2013-2539 (male, 4.6 mm): a, b, anterior carapace, dorsal and lateral views; c, major cheliped (right), mesial; d, major cheliped (right), propodus, dactylus, upper; e, minor cheliped (left), mesial view; f, minor cheliped (left), propodus, dactylus, upper; g, h, pleopods 1, 2. Scale bars = 1 mm.

than posterior margin, widest about third way along, 1.5 times as long as wide, with subdistal group of facial setae; exopod ovate, anterior margin straight, distal and posterior margins continuous, greatest dimension 2.2 times anterior margin, with row of blade-like distal setae on distal margin, c. 6 not overlapping with densely setose distal margin; dorsal plate extending almost half of exopod width, distal margin with spiniform setae. Telson 1.6 times as wide as long, broadest over anterior half, posterolateral corner evenly rounded to posterior margin; posterior margin barely convex, with posterolateral clusters of long setae; dorsal surface with obscure rounded transverse ridge at anterior third, without median notch.

Paratype male. Carapace length 4.3 mm. Eyestalks 1.5 times as long as wide at base, swollen laterally, tapering to cornea and acute apical tubercle; cornea wider than long, depressed anteriorly. Postrostral dorsal area with pair of shallow pits.

Chelipeds unequal, major carpus-propodus upper margin 1.1 length of minor, propodus 1.3 times as wide as minor. Major cheliped (right) ischium twice as long as distal width,

lower margin with denticles, 1 distal spine; merus 1.7 times as long as broad, lower margin convex, unarmed; carpus 1.4 times as wide as upper length, margins carinate; propodus greatest width in middle of palm, upper palm length 1.15 times greatest width, distomesial margin of palm with submarginal group of 2 setae plus tubercle; fixed finger 0.35 length of upper margin of palm, cutting edge with microdenticles over proximal half, blunt triangular tooth near midpoint; dactylus as long as fixed finger, twice as long as wide at base, cutting edge irregular, with deflected tip; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers; 4 short transverse ridges associated with setae on submesial upper margin.

Minor cheliped (left) ischium c. 2.3 times as long as distal width, lower margin with denticles, 1 distal spine; merus 1.8 times as long as broad, lower margin convex, unarmed; carpus 1.1 times as wide as upper length, margins carinate; propodus palm more tapering than major, 0.95 times as wide as upper palm length, distomesial margin of palm with 2 submarginal

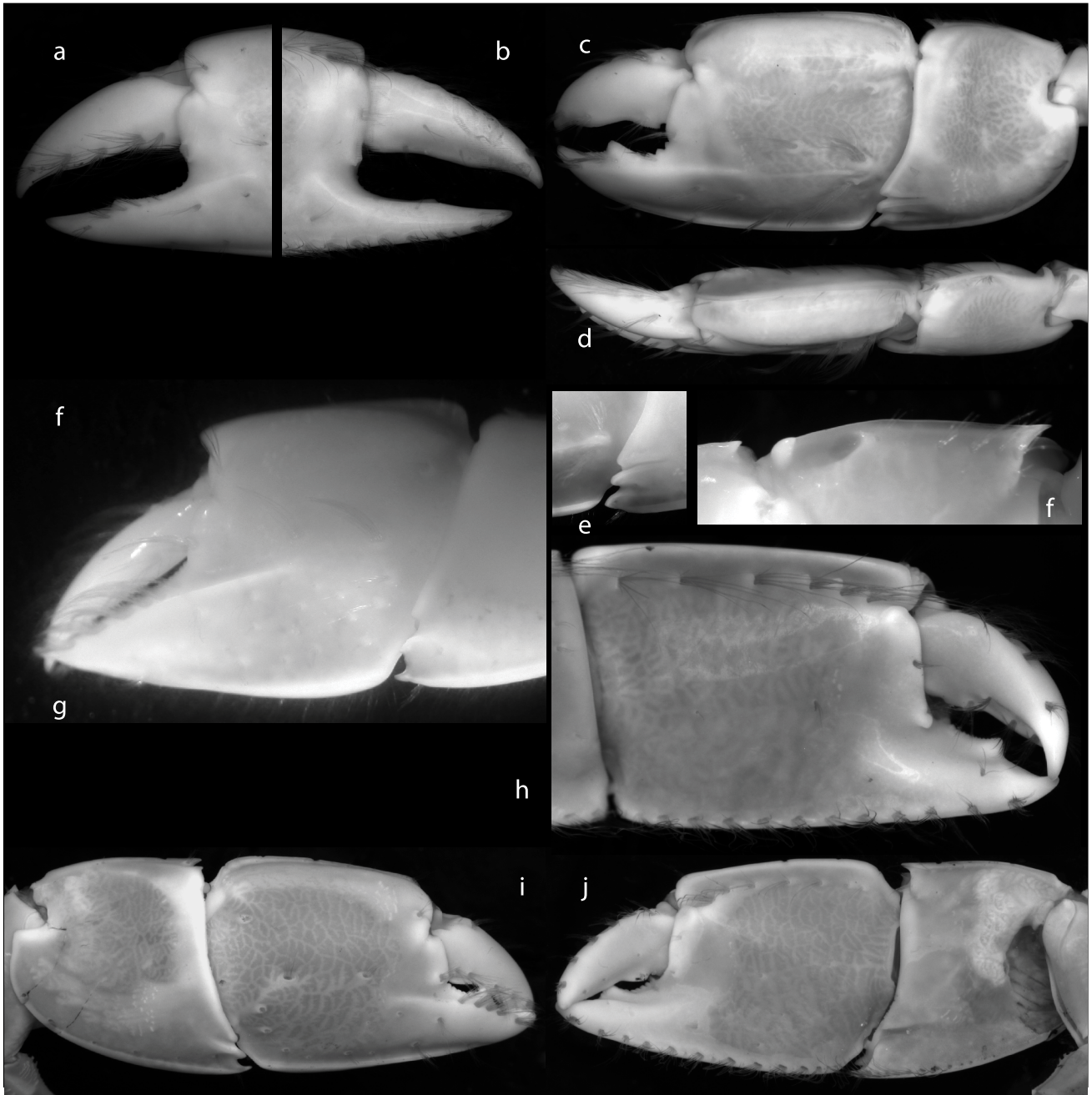


Figure 25. *Eucalliixiopsis* spp. *E. aequimana*: a, b, major cheliped, mesial. *E. dworschaki*, Papua New Guinea, MNHN-IU-2013-10003: c, d, major cheliped lateral, upper margin. *E. dworschaki*, Philippines, NHMW 20923: e, f, major cheliped carpus lower lateral angle, upper margin. *E. panglaoensis*, NHMW 20922: g, minor cheliped, lateral. *E. inaequimana*: h, major cheliped, mesial. *E. paradoxa*: h, i, major cheliped lateral, mesial. Photos e–g: P.C. Dworschak. Various scales.

groups of 2–3 setae; fixed finger 0.4 length of upper margin of palm, mesial cutting edge straight, smooth; dactylus as long as fixed finger, 2.8 times as long as wide at base, cutting edge straight; submarginal tufts of long setae on upper and lower mesial margins of carpus and propodus, opposing mesial margins of fingers; 3 short transverse ridges associated with setae on submesial upper margin, more prominent distally.

Pleopod 1 articles indistinguishable; article 1 with 1 short, 4 long distal setae; article 2 a short triangle, half as wide as article 1. Pleopod 2 endopod 2.7 times as long as wide; appendix masculina attached at mid-length, 5 times as long as width, distal margin rounded, exceeding endopod by fifth of its length, with c. 9 facial setae near midpoint, c. 14 subdistal setae; appendix interna rod-like, about 0.4 length of appendix interna.

Etymology. From Patio Island, Papua New Guinea, the type locality (noun in apposition).

Distribution. Papua New Guinea. Coral rubble, 6–8 m.

Remarks. The holotype was sister taxon to five individuals of *E. inaequimana* on the phylogenetic tree of Robles et al. (2020). Both species have submarginal mesial transverse ridges on the cheliped propodi from which tufts of long setae emerge; in other species of *Eucallixiopsis* the same tufts are not supported in this way. The male pleopod 1 of both species has a simple second article, free or fused, a form seen too in *E. madagassa* (see Poore and Dworschak, 2017: fig. 1C, D), *Eucalliix quadracuta* and *Calliixina bulimba* (see above). The typical article 2 of species of *Eucallixiopsis* is flattened with a distal oblique notch. *Eucallixiopsis patio* differs from *E. inaequimana* in shorter, more swollen eyestalks (1.5 vs 1.8 times as long as wide), slightly shorter rostrum (quarter vs fifth length of eyestalk), shorter antenna peduncle (2.4 vs 3.0 times as long as base of both eyes), more compact antennular and antennal peduncular articles, the telsonic ridge being only slightly elevated and complete (vs clearly elevated, with median notch), and a broader uropodal endopod (1.5 vs 1.8 times as long as wide). The appendix interna on the female pleopod 2 is present while it is absent in *E. inaequimana*. It is possible that this difference may be related to the female's small size; Dworschak (2006) noted that the smallest female of *E. panglaoensis* possessed an appendix interna while larger ones did not. Two individuals were collected from the type locality, with carapace lengths of 4.3 and 4.6 mm. The largest known specimen of *E. inaequimana* has a carapace length of 9.1 mm.

Identification of these specimens using Sakai's (2011) key to species of *Calliixina* leads to *C. aequimana*, a southern Australian species. This species, now *Eucallixiopsis aequimana*, lacks mesial ridges on the chelipeds and has a female-like male pleopod 1.

***Pseudocalliix* Sakai, 2011**

Pseudocalliix Sakai, 2011: 505–506.—Sakai, 2018: 744.—Poore et al., 2019: 128, 146, figs 18a, k, 19e, r.

Remarks. The type and only species was placed in Eucalliicinae, now Eucalliicidae, as a species of *Calliix*, by Sakai (2005). Sakai (2011) erected the new genus *Pseudocalliix* for it in the

same subfamily. No molecular sequences were available to Robles et al. (2020) to challenge this placement that has good morphological support (Poore et al., 2019). The genus shares with the three species of *Calliix* the characteristic short fixed finger on the minor cheliped.

***Pseudocalliix tooradin* (Poore and Griffin, 1979)**

Figure 26

Callianassa tooradin Poore and Griffin, 1979: 275–277, fig. 36.

Calliix tooradin.—Sakai, 1988: 61.—Davie, 2002: 459.—Sakai, 2005: 204.

Paraglypturus tooradin.—Sakai, 1999: 124, fig. 33a–c.—Poore, 2004: 184, fig. 50h, i.

Pseudocalliix tooradin.—Sakai, 2011: 506.

Material examined. Australia, Vic., Western Port, Crib Point, 38° 20.23' S, 145° 13.38' E, 5 m (CPBS stn 11N), NMV J301 (holotype female, 5.2 mm), NMV J302 (2 paratype females); 38° 21.17' S, 145° 13.15' E, 2 m (CPBS stn 000), NMV J303 (paratype male, 6.5 mm). San Remo, channel edge, E. of No. 7 beacon, 38° 32' S, 145° 23' E (MRG Transect 1), NMV J59760 (male, 5.1 mm); N from 200 m E of Back Beach Rd to channel edge, 38° 32' S, 145° 23' E (MRG transect 2), NMV J59761 (2 males, 4.2, 6.0 mm). Swan Bay, Edwards Point, 38° 13.3' S, 144° 41.4' E, 2 m, NMV J16722 (juvenile, 1.5 mm).

Distribution. Australia, Vic., entrances of Western Port and Port Phillip Bay. Subtidal, c. 2 m.

Remarks. Poore and Griffin (1979) provided only a short description and simple figures. Here, the antennae, chelipeds, terminal articles of pereopods 3 and 4, male pleopods, telson and uropod are figured. The species is notable for the setose thoracic sternite 7 and ventroposterior surface of the coxa–ischium of pereopod 5, a feature diagnostic for the genus (fig. 26b). The antenna bears a free scaphocerite, longer than broad, with a rounded apex (fig. 26a). The exopod of maxilliped 3 typically reaches the middle of the merus but is shorter on smaller individuals. While the fixed finger of the minor cheliped is shorter than the dactylus in most individuals it is almost as long in one male. The propodus of pereopod 3 is suboval, little longer along its upper margin than its greatest width, and densely setose on its lateral face. The propodus of pereopod 4 is elongate-oval, 1.5 times as long along its upper margin than its greatest width, with a distal long spiniform setae on the lower margin, and densely setose on its lateral face. The male pleopod 1, overlooked by Poore and Griffin (1979), has a shorter second article with an apical notch (fig. 26g). The peduncle of the male pleopod 2 is longer than broad; the appendix interna is short and lacks hooks; no appendix masculina is present (fig. 26h). The appendix interna on the endopod of pleopod 3 is triangular, longer than broad, emerging by about half its length (fig. 26j). The uropodal endopod is oval, 1.8 times as long as wide, with marginal setae; the exopod is 1.6 times as long as wide, with short spiniform setae along its apical margin, with a well-defined dorsal plate with c. 6 short spiniform setae and many longer setae (fig. 26f). A dorsal oval, cardiac prominence and cardiac sulcus are all absent; all known material is in NMV (cf. contradictory statements and figures in Sakai, 1999, and Sakai, 2011).

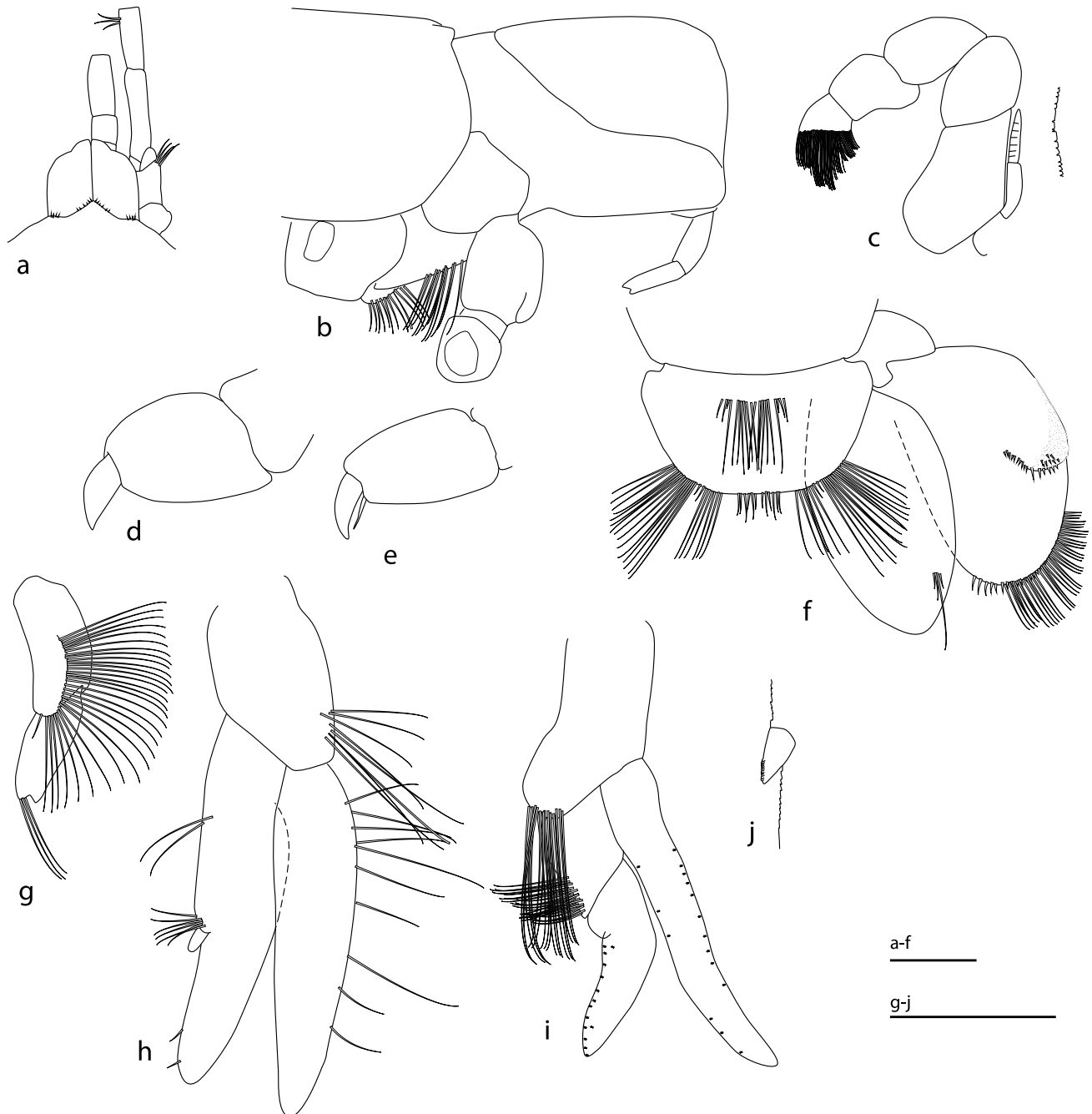


Figure 26. *Pseudocalliax tooradin* Poore and Griffin, 1979. Australia, Vic., Western Port, NMV J303 (paratype male, 6.5 mm): a, anterior carapace, eyestalks, antennule, antenna; b, posterior carapace, pleonite 1, coxa 4, thoracic sternite 7, coxa-basis 5, pleopod 1; c, maxilliped 3, with crista dentata; d, e, propodus, dactylus, pereopods 3, 4; f, telson, uropod; g, pleopod 1; h, pleopod 2; j, appendix interna, pleopod 3. NMV J301 (holotype female, 5.2 mm): i, pleopod 2. Scale bars = 1 mm.

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