

1447-2554 (On-line)

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DOI <https://doi.org/10.24199/j.mmv.2023.82.04>

## New records and one new species of Callichiridae (Crustacea, Axiidea) from the Indo-West Pacific, with keys to species of *Corallianassa*, *Lepidophthalmus* and *Neocallichirus*

(<https://zoobank.org/urn:lsid:zoobank.org:pub:5F38D3B8-2255-4559-8C5E-76FE24409F13>)

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### Abstract

Poore, G.C.B. (2023). New records and one new species of Callichiridae (Crustacea, Axiidea) from the Indo-West Pacific with keys to species of *Corallianassa*, *Lepidophthalmus* and *Neocallichirus*. *Memoirs of Museum Victoria* 82: 71–95.

Collections of Callichiridae from surveys of coral reefs and sandy shallow environments in the Indo-West Pacific, particularly Papua New Guinea and Australia, have been used to redescribe and differentiate poorly known species and/or extend the range of others. Keys are provided for identification of the Indo-West Pacific species of *Corallianassa* Manning, 1987 (six species) and *Lepidophthalmus* Holmes, 1904 (four species). The distribution of *Glypturus armatus* (A. Milne-Edwards, 1870) now includes Tonga, within its previously known geographic range. Supplementary descriptions and illustrations are provided for *Michaelcallianassa indica* Sakai, 2002, *Mocallichirus mocambiquensis* (Sakai, 2004) and *Mucrollichirus mucronatus* (Strahl, 1862). The 15 Indo-West Pacific and Australian species of the genus *Neocallichirus* Sakai, 1988 are diagnosed with a key for identification (*N. variabilis* (Edmondson, 1944) excepted). *N. nagoi* sp. nov. is described as a new species.

### Keywords

Crustacea, Axiidea, Callichiridae, *Corallianassa*, *Neocallichirus*, taxonomy, new species

### Introduction

Callichiridae Manning and Felder, 1991 is one of eight families of callianassoid Axiidea de Saint Laurent, 1979, most recently reviewed by Poore et al. (2019). Their classification 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 rediagnose known species and describe another revealed as new during the molecular study. This paper follows an earlier contribution on Eucalliidae (Poore, 2021).

Callichiridae comprise 17 genera, diagnosed by Poore et al. (2019), and 96 species listed by these authors. Another genus, *Articullichirus* Poore, Dworschak and Schnabel, 2022 and three species have been added since (Sepahvand et al., 2020; Hernáez et al., 2022; Poore et al., 2022). This contribution deals with seven of these genera from coral reefs and shallow environments in the Indo-West Pacific and Australia. *Karumballichirus* Poore, Dworschak, Robles, Mantelatto and Felder, 2019 is being dealt with separately. The species of each genus are reviewed. Keys to Indo-West Pacific and Australian species of *Corallianassa*, *Lepidophthalmus* and *Neocallichirus* are provided.

### Methods

Much of the material comes from the Muséum national d'Histoire naturelle, Paris (MNHN), including expeditions to Papua New Guinea, Madang Province (PAPUA NIUGINI stations), and New Ireland Province (KAVIENG 2014 stations), supplemented by the Indo-West Pacific collection of the Florida Museum of Natural History, University of Florida (UF). Specimens from Museums Victoria, Melbourne (NMV); the Australian Museum, Sydney (AM); Western Australian Museum, Perth (WAM); and Northern Territory Museum and Art Gallery, Darwin (NTMAG) were also examined. Material from the Museum für Tierkunde, Dresden (MTKD) is referred to but was not seen. Lists of material examined of common species are shortened to list localities, museums, sexes and size ranges; full details are available online from the museums specified. 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 of existing genera can be found in Poore et al. (2019) and in earlier references. Diagnoses of species of *Corallianassa* and *Neocallichirus* were generated from two

newly written DELTA databases (Dallwitz, 2018). Distribution are given in terms of Marine Ecoregions of the World (MEOW) realms or provinces (Spalding et al., 2007) with political terms in parentheses.

### Family Callichiridae Manning and Felder, 1991

#### *Corallianassa* Manning, 1987

**Remarks.** Komai et al. (2015) diagnosed *Corallianassa* in detail. These authors also reviewed the complicated taxonomic history of the 13 species that they recognised. Two, *Corallianassa articulata* (Rathbun, 1906), long regarded as different from the other species (Manning, 1987; Dworschak, 1992), and *C. collaroy* (Poore and Griffin, 1979) have been transferred to another genus, *Articullichirus* Poore, Dworschak and Schnabel, 2022 (Poore et al., 2022). Three widespread Indo-West Pacific species that had been confused have been described relatively recently in detail: *C. coutierei* (Nobili, 1904) by Sakai (1999) and Dworschak (2018); *C. borradailei* (De Man, 1928) by Komai et al. (2015); and *C. martensi* (Miers, 1884) by Dworschak (2014) and Komai et al. (2015). Each species was well supported on a molecular phylogram derived from mitochondrial genes, 16S rRNA and 12S rRNA, plus nuclear genes, histone H3 and 18S rRNA (Robles et al., 2019). Poore et al. (2023) diagnosed and revised the synonymy of four Hawaiian species of *Corallianassa*: *C. borradailei* (De Man, 1928); *C. lanceolata* (Edmondson, 1944); *C. martensi* (Miers, 1884); and *C. oahuensis* (Edmondson, 1944). As a consequence the number of species is now six from the Indo-West Pacific and four from the Americas and Atlantic.

#### Key to Indo-West Pacific species of *Corallianassa*

1. Major cheliped ischium lower margin with row of 4–10 oblique spines increasing in size distally; merus with 2–8 oblique spines or row of blunt tubercles ..... 2
- Major cheliped ischium lower margin with 1 or 2 small spines or obsolete teeth; merus with 2 small spines or row of denticles ..... 4

2. Major cheliped carpus and palm carinate, blade-like along entire upper margin. Minor cheliped palm about as long as wide, fingers longer than palm ..... *C. borradailei* (De Man, 1928)
- Major cheliped carpus and palm obscurely carinate along half of upper margin, with or without carina on distal quarter. Minor cheliped palm longer than wide, fingers about as long or shorter than palm ..... 3
3. Rostrum horizontal. Carapace anterolateral spines evenly tapered, slightly curved inwards. Major cheliped palm obscurely carinate along proximal two-thirds of upper margin ..... *C. coutierei* (Nobili, 1904)
- Rostrum upturned. Carapace anterolateral spines with mesial basal buttress. Major cheliped palm obscurely carinate along proximal half and distal quarter of upper margin ..... *C. oahuensis* (Edmondson, 1944)
4. Rostrum horizontal or almost so. Minor cheliped fingers 0.8–1.1 times as long as palm. Uropod endopod acutely rounded, flat; exopod posterior margin strongly concave ..... *C. martensi* (Miers, 1884)
- Rostrum upturned. Minor cheliped fingers 1.6 times as long as palm. Uropod endopod narrow, acute, upturned; exopod posterior margin slightly concave ..... 5
5. Uropod endopod 2.4 times as long as wide ..... *C. assimilis* (De Man, 1928)
- Uropod endopod 3 times as long as wide; apex attenuated. Hawaii only ..... *C. lanceolata* (Edmondson, 1944)

#### *Corallianassa assimilis* (De Man, 1928)

##### Figure 1

*Callianassa martensi*.—De Man, 1888: 482–483, pl. 21 fig. 1 (not *Callianassa martensi* [Miers, 1884]).

*Callianassa (Callichirus) assimilis* De Man, 1928a: 28, 93, 109  
*Glypturus assimilis*.—Sakai, 1999: 78, fig. 16a–f.—Sakai, 2005: 138–139.—Sakai, 2011: 433.

*Callianassa assimilis*.—Tudge et al., 2000: 143.

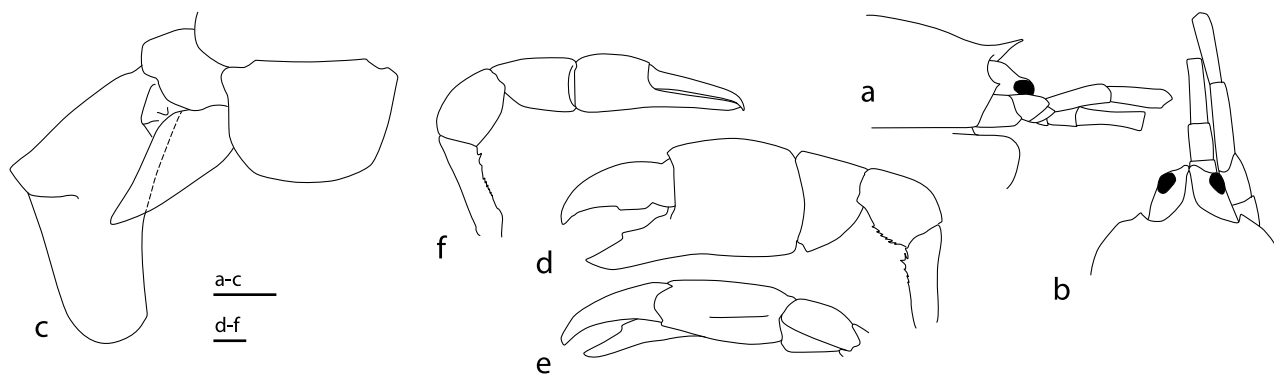


Figure 1. *Corallianassa assimilis* (De Man, 1928), Guam, UF 2961, ovigerous female, 8.1 mm: a, b, anterior carapace, rostrum, antennular peduncle, antennal peduncle; c, telson, left uropod; d, e, major cheliped (right, mesial and upper views); f, minor cheliped (left, mesial view). Scale bars = 1 mm.

*Corallianassa bayeri* Kensley, 2001: 328–332, figs 1, 2.—Sakai, 2011: 424 (type locality, Agat Bay, Guam).

*Corallianassa assimilis*.—Komai et al., 2015: 15 ff.

**Material examined.** USA, Mariana Is, Guam, Apra Harbor and Agat Bay, 13.5° N, 144.8° E, 1–12 m, UF 506, UF 538, UF 545, UF 1227, UF 1301, UF 1966, UF 2055, UF 2133, UF 2961, UF 3027 (17 females, 5 ovigerous; 4.1–8.1 mm).

**Diagnosis.** Rostrum upturned; carapace anterolateral spines triangular, short. Maxilliped 3 ischium-merus 2.5 times as long as wide; merus mesiodistal margin convex; propodus, free distal margin oblique. Major cheliped ischium lower margin with 2 small distal spines; merus lower margin with row of distally diminishing denticles; palm as long as wide, upper margin obscurely carinate along proximal half. Minor cheliped merus lower margin smooth; palm 1.3 times as long as wide, tapering; fingers longer than palm, straight. Uropodal endopod 2.4 times as long as wide; anterior margin convex over most of length; posterior margin convex; apex narrow, acute, upturned. Uropodal exopod posterior margin slightly concave; proximal article with blunt lobe overlapping endopod. Telson slightly tapering, 1.5 times as wide as long; posterior margin evenly convex; dorsal surface with about 6 pairs of fine setae separated by median gap on transverse ridge.

**Distribution.** Tropical Northwestern Pacific, Western Coral Triangle (Indonesia [type locality: Ambon], Guam).

**Remarks.** *Corallianassa assimilis* has a more acute uropodal endopod tip than *C. martensi* but less so than *C. lanceolata*. Moreover, the endopod has a strong middorsal ridge and an upturned distal tip. The species was described from Ambon, Indonesia, and its accepted synonym, *C. bayeri* Kensley, 2001, from Guam. Sakai (2011) treated the two as synonyms of “*Glypturus*” *assimilis* on one page but also as separate species in two genera. The most convincing of De Man’s (1928) features distinguishing *C. assimilis* and *C. martensi* is the shape of the minor cheliped. The palm of the minor cheliped is more barrel-shaped than in other species of the genus and its fingers are relatively longer (much longer than the palm).

#### ***Corallianassa coutierei* (Nobili, 1904)**

**Material examined.** Papua New Guinea, Madang and Kavieng areas, intertidal sandflats, MNHN IU-2013-7073\*, MNHN IU-2014-991, MNHN IU-2014-1089, MNHN IU-2014-2711\*, MNHN IU-2014-10010\* (3 males, 2 females, 3.0–5.5 mm).

**Diagnosis.** Rostrum horizontal; carapace anterolateral spines evenly tapered, slightly curved inwards. Maxilliped 3 ischium-merus twice as long as wide; merus tapering; propodus, free distal margin transverse. Major cheliped ischium lower margin with 4–6 oblique spines increasing in length distally; merus lower margin with row of blunt tubercles; palm as long as wide or slightly longer than wide, upper margin obscurely carinate along proximal two-thirds. Minor cheliped merus lower margin smooth; palm 1.5 times as long as wide, rectangular; fingers as long as palm, curved. Uropodal endopod twice as long as wide; anterior margin evenly convex; posterior margin convex; apex broadly rounded, flat. Uropodal exopod posterior margin almost straight; proximal article with sharp spine overlapping endopod

and smaller accessory proximal lobe. Telson tapering to about two-thirds basal width from basal lobes, 1.7 times as wide as long; posterior margin evenly slightly convex; dorsal surface with about 6 pairs of fine setae in row on transverse ridge.

**Distribution.** Western, Central and Eastern Indo-Pacific [type locality: Djibouti] (see Dworschak, 2018).

**Remarks.** Komai et al. (2015) and Dworschak (2018) reviewed the complicated history of this name and recognised the species as distinct from *C. borradailei*, with which it had been confused. All specimens from Papua New Guinea are small and lack the carinate chelipeds that characterise *C. borradailei*. *Corallianassa coutierei* is best diagnosed by the short obsolete carina along half the upper margin of the major cheliped palm and the denticles (not spines) on the lower margin of the major cheliped merus. Genetic diversity among individuals from Papua New Guinea and Philippines is low (Robles et al., 2020).

Sakai (1999) designated and illustrated Nobili’s (1904) specimen from Djibouti (MNHN Th75) as the lectotype. Other syntype specimens came from Périm and Aden. *Callianassa placida* De Man, 1905 is a well accepted synonym (Ngoc-Ho, 2005; Komai et al., 215) but records of *Callianassa* (*Callichirus*) *placida* from Clipperton I., northeastern Pacific (Chace, 1962), and from Isla Clarion, Mexico (Hernández-Aguilera et al., 1986) are referable to *Corallianassa xutha* Manning, 1988.

#### ***Glypturus* Stimpson, 1866**

**Remarks.** Komai et al. (2015) diagnosed *Glypturus* in detail, listing three species. For a fourth species, see Felder (2019).

#### ***Glypturus armatus* (A. Milne-Edwards, 1870)**

*Callianassa armata* A. Milne-Edwards, 1870: 90, 101, pl. 1.

*Glypturus armatus*.—Komai et al., 2015: 18–29, figs 1–7 (redescription, synonymy).—Dworschak, 2018: 21–22, figs 3, 4.—Poore et al., 2019: 136, 144, fig. 15k.—Robles et al., 2020.

**Material examined.** Australia, Northern Territory, Arafura Sea, 9.377° S, 134.215° E, 105 m (CSIRO cruise SS05/2005, stn 015BS004), AM P.74496 (female). USA, Marianas Is, Guam, burrows in seagrass, 0–1 m, UF (1 male). Papua New Guinea, Madang area, intertidal mudflats, MNHN (3 specimens, 6–12 mm). Kavieng, intertidal, MNHN (1 specimen). Tonga, Tongatapu, intertidal sandflat, NMV J6120 (2 males, 1 female, 11–18 mm). French Polynesia, Moorea, mudflats, 0–0.5 m, UF (4 specimens, 11–22 mm), MNHN (2 specimens).

**Size.** Cl. to 38.8 mm.

**Distribution.** Central and Eastern Indo-Pacific (Vietnam; Japan, Ryuku Is; Philippines; Mariana Is; Indonesia; Papua New Guinea; Australia, NT; Fiji [type locality]; Tonga; New Caledonia; French Polynesia); intertidal to 105 m.

**Remarks.** *Glypturus armatus* is a well-known species recently redescribed (Komai et al., 2015; Dworschak, 2018). These new records are within its known geographic range, but the species has not been previously recorded from Tonga or at depths greater than 30 m. Molecular data do not distinguish Papua New Guinea examples from representatives from the Philippines or from Tonga (Robles et al., 2020).

***Glypturus laurae* de Saint Laurent in Vaugelas and de Saint Laurent, 1984**

Figure 2

*Callichirus laurae* de Saint Laurent in de Vaugelas and de Saint Laurent, 1984: 147, pl. 1A–D.

*Glypturus laurae*.—Poore and Suchanek, 1988: 201, fig. 4c.—Dworschak, 1992: 209.—Tudge et al., 2000: 144.—Robles et al., 2009: 317.—Poore et al., 2019: 144.—Robles et al., 2020: figs 1, 4, 7, tables S1, S2.—Dworschak, 2022: 255–256.

*Glypturus armatus*.—Sakai, 2011: 432–433 (part).

**Material examined.** Saudi Arabia, Al Lith, 20.167155° N, 40.223307° E, near mangroves, 1–2 m, UF 37164 (female, 12 mm).

**Distribution.** Red Sea and Gulf of Aden; Sunda Shelf (Jordan [type locality: Aqaba]; Saudi Arabia; Singapore).

**Remarks.** The single small individual was identified more on the basis of its proximity to the type locality in the Red Sea than morphology. Contrary to Poore and Suchanek's (1988) assertion, the shape of the uropod seems not to be a reliable difference between the species now recognised (Komai et al., 2015). The uropodal exopod is more tapered in this specimen than in adults of 35 mm carapace length (fig. 2). Nor does it possess the tubercles on the distolateral face of the cheliped said by Komai et al. (2015) to differentiate it from *G. armatus* and seen on a topotypic specimen (NMV J11514). Molecular analysis found *G. laurae* and *G. armatus* to differ widely (Robles et al., 2020), contradicting Sakai's (2011) synonymy. Dworschak (2022) found the species in Singapore, far from its type locality.

***Lepidophthalmus* Holmes, 1904**

**Remarks.** Komai et al. (2018) diagnosed the genus and discussed its synonymy at length. Four species have been recorded from the Indo-West Pacific: *L. grandidieri* (Coutière, 1899); *L. madagassus* (Lenz and Richters, 1881); *L. rosae* (Nobili, 1904); and *L. tridentatus* (von Martens, 1868); three occur in these collections.

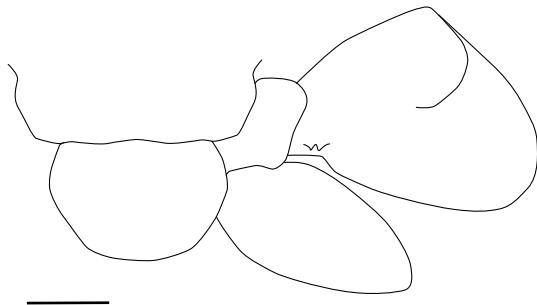


Figure 2. *Glypturus laurae* de Saint Laurent in Vaugelas and de Saint Laurent, 1984. Saudi Arabia, UF 37164, female, 12 mm: telson, right uropod. Scale bar = 1 mm.

**Key to the Indo-West Pacific species of *Lepidophthalmus***

1. Major cheliped carpus, propodus, dactylus upper margins without teeth ..... 2
- Major cheliped carpus, propodus, dactylus upper margins dentate ..... 3
2. Rostrum acute, simple ..... *L. rosae*
- Rostrum trifid, lateral spines shorter than medial spine ..... *L. tridentatus*
3. Major cheliped distal carpus, propodus, dactylus upper margin dentate. Rostrum trifid, lateral spines as long as medial spine ..... *L. grandidieri*
- Major cheliped dactylus swollen, upper and lower margins dentate; fixed finger with 2 dentate cutting edges. Rostrum acute, simple ..... *L. madagassus*

***Lepidophthalmus grandidieri* (Coutière, 1899)**

*Callianassa Grandidieri* Coutière, 1899: 285–287, figs 1–5.

*Callianassa (Callichirus) Grandidieri*.—Borradaile, 1903: 547.—De Man, 1928a: 28, 92, 110.

*Lepidophthalmus grandidieri*.—Sakai, 1999: 71.—Sakai, 2005: 151.—Poore et al., 2019: 144.—Sakai, 2011: 448–449.

**Diagnosis.** Major cheliped distal carpus, propodus, dactylus upper margin dentate. Rostrum trifid, lateral spines as long as medial spine. Cl. 8 mm.

**Distribution.** Western Indian Ocean (Madagascar, Mahanara R. estuary [known only from type locality]).

**Remarks.** *Lepidophthalmus grandidieri* has not been recorded since its description.

***Lepidophthalmus madagassus* (Lenz and Richters, 1881)**

Figure 3

*Callianassa madagassa* Lenz and Richters, 1881: 427, figs 20–23.

*Lepidophthalmus socotrensis* Sakai and Apel, 2002: 278–285, figs 3–7 (type locality, Socotra, Yemen).

*Podocallichirus madagassus*.—Sakai, 1999: 56–58, fig. 10.—Sakai, 2011: 467, fig. 66C, D (synonymy).—Sakai et al., 2014: 502–507, figs 5, 6 (redescription, synonymy).

*Lepidophthalmus madagassus*.—Poore et al., 2019: 144.—Robles et al., 2020: figs 1, 4, 7, tables S1, S2.

**Material examined.** Saudi Arabia. Farasan Is, Tiger Head I., karstic shore, 16.79097° N, 42.19865° E, UF 36969 (1). Thuwal, King Abdullah University of Science and Technology, silty sand flat, south beach, 22.29213° N, 39.09000° E, UF 37048\* + others (4 males, 6 females, 8.4–14 mm). Madagascar, Nosy Bé, MNHN Th409 (1), MNHN Th424 (male), MNHN Th426 (male), NMV J58224 (1).

**Diagnosis.** Major cheliped dactylus swollen, upper and lower margins dentate; fixed finger with 2 dentate cutting edges. Rostrum acute, simple. Cl. to 18.1 mm.

**Distribution.** Red Sea and Gulf of Aden, Western Indian Ocean (Saudi Arabia, Madagascar [type locality]).

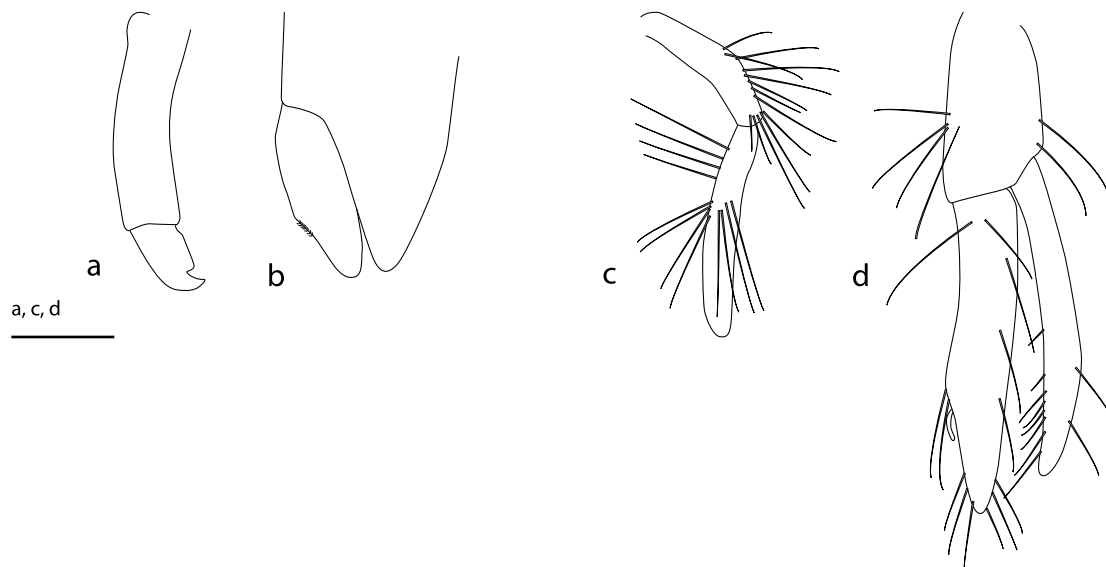


Figure 3. *Lepidophthalmus madagassus* (Lenz and Richters, 1881). Madagascar. MNHN Th426, male: a, pleopod 1; b, pleopod 2 endopod apex. UF 37101, female, 8.4 mm: c, pleopod 1; d, pleopod 2. Scale bar = 1 mm.

**Remarks.** Lenz and Richters (1881) illustrated the minor cheliped that, with its broad spinose dactylus, immediately distinguishes this species from other species of *Lepidophthalmus*, from all other callichirids and from members of related families. Sakai et al. (2014) synonymised *L. socotrensis* with *Podocallichirus madagassus* [sic]; the new material would seem to confirm this and any differences in the shapes of the uropod and telson are size-related. The species' range is extended into the Red Sea.

The male pleopod 1 has a short second article with a distal triangular apex (fig. 3a); pleopod 2 has an appendix masculina bearing a small field of hooks, all that remains of the appendix interna (fig. 3b) – not as complicated as in Sakai (1999: fig. 10). Female pleopods are typical of the genus (fig. 3c, d)—the appendix interna on pleopod 2 is placed about two-thirds along the mesial margin of the endopod.

#### *Lepidophthalmus rosae* (Nobili, 1904)

*Callianassa* (*Callichirus*) *rosae* Nobili, 1904: 237.—Nobili, 1906: 108–110, pl. 7 fig. 2.—De Man, 1928a: 29, 110.—Balss, 1933: 88–89, fig. 2.

*Lepidophthalmus rosae*.—Sakai, 1999: 71, fig. 14g–h.—Sakai, 2005: 151, figs 30–32.—Poore et al., 2019: 144.—Robles et al., 2020: figs 1, 4, 7, tables S1, S2.

*Callianassa rosae*.—Tudge et al., 2000: 143.

*Lepidophthalmoides rosae*.—Sakai, 2011: 444.—Sakai and Türkay, 2014: 179.

**Material examined.** **Australia**, Northern Territory, Darwin Harbour, Vestey's Beach, 12° 22' S, 130° 50' E, intertidal, NTMAG Cr016691 (2 males, 11, 14 mm; 3 females, 12–15 mm). Fannie Bay Beach, 12° 25' S, 130° 50' E, intertidal, NTMAG Cr016692 (2 males, 11, 13 mm; 3 ovigerous females, 13–14 mm), NTMAG Cr013046 (ovigerous female, 15 mm), NTMAG Cr013047 (3 males, 6–8 mm), NTMAG Cr016693 (male, 8 mm). Gove, sandy beach and reef, 12° 12' S, 136° 43' E, intertidal, NTMAG Cr009850 (5 males, 4–9 mm).

**Diagnosis.** Major cheliped carpus, propodus, dactylus upper margins without teeth. Rostrum acute, simple. Cl. to 16 mm.

**Distribution.** Western and Central Indo-Pacific (Red Sea [type locality]; Madagascar; Indonesia; Australia, NT; Philippines).

**Remarks.** *Lepidophthalmus rosae* is notable for the sharp curved proximal spine on the lower margin of the merus of the major cheliped, prominent in males, combined with the subrectangular telson with a bilobed posterior margin, broader than long, and lanceolate acute uropodal endopod. The species has been recorded from the type locality in the Red Sea to Indonesia (Balss, 1933; Sakai, 2005), Madagascar (Sakai, 1999) and the Philippines (Sakai, 2005). It is no surprise that it is common on beaches in northern Australia.

#### *Lepidophthalmus tridentatus* (von Martens, 1868)

*Callianassa tridentata* von Martens, 1868: 614–615.

*Lepidophthalmus tridentatus*.—Dworschak, 2007: 122–129, figs 2–39.—Komai et al., 2018: 10–23, figs 1–7 (redescription, synonymy).—Dworschak, 2018: 21 (synonymy, distribution).—Poore et al., 2019: 144.—Robles et al., 2020: 128, figs 1, 4, 7, tables S1, S2.

**Material examined.** **Samoa**, Tutuila I., Leone Bay, sand flat (stn BTUT-011), UF 2224 (male, 11.0 mm; female, 13.5 mm).

**Diagnosis.** Major cheliped carpus, propodus, dactylus upper margins without teeth. Rostrum trifold, lateral spines shorter than medial spine. Cl. to 18 mm.

**Distribution.** Western and Central Indo-Pacific (Sri Lanka; Indonesia [type locality: Java]; Papua New Guinea; Samoa; Philippines; Japan, Ryuku Is).

**Remarks.** *Lepidophthalmus tridentatus* is notable for the prominent triangular anterolateral carapace angles, the broadly convex posterior margin of the telson and the subrhomboidal

uropodal endopod. The species was described from Java, Indonesia, by von Martens (1868) and subsequently reported from Sri Lanka (Miers, 1884; Sakai, 1970, 1999), New Britain, Papua New Guinea (Sakai, 1970), Bali, Indonesia (Dworschak, 2018), Philippines (Dworschak, 2007) and Japan (Sakai, 2011; Dworschak, 2018; Komai et al., 2018). This is the first record from Samoa, and extends the range of the species well into the Central South Pacific. Sakai's (2011) "Diagnosis" mentioned only the male pleopods, neither diagnostic, and is in error. The male pleopod 1 is biarticulate with a simple short second article, not "chelate", and the male pleopod 2 is biramous with a weakly demarcated appendix masculina and small appendix interna on the endopod as typical of the genus (Dworschak, 2007: figs 37–39). Dworschak (2007) noted that his material from the Philippines, with a total length of 22–47 mm, was much smaller than previous records. The specimens from Samoa are within this range.

### *Michaelcallianassa* Sakai, 2002

*Michaelcallianassa* Sakai, 2002: 480–481.—Sakai, 2005: 156–157.—Sakai, 2011: 450.—Poore et al., 2019: 113.

**Remarks.** *Michaelcallianassa* is most easily recognised by the tapering telson with pairs of robust setae on the dorsal surface. Three species are known: *M. indica* Sakai, 2002 from the Persian Gulf (type locality), Bay of Bengal and the Andaman Sea (Sakai, 2002, 2005; Robles et al., 2020); *M. persica* Sepahvand, Momtazi and Tudge, 2020 from the Persian Gulf; and *M. sinica* Liu and Liu, 2009 from the South China Sea and

Singapore (Dworschak and Anker, 2022). Sepahvand et al. (2020) compared the three species in a table.

### *Michaelcallianassa indica* Sakai, 2002

#### Figure 4

*Michaelcallianassa indica* Sakai, 2002: 481–488, figs 11–14.—Sakai, 2005: 157–160, fig. 33.—Sakai, 2011: 450–451.—Robles et al., 2020: figs 1, 4, 7, tables S1, S2.—Padate et al., 2022: 198 (list).—Al-Kandari et al., 2020: 271, fig. 13.

**Material examined.** **Australia**, Arafura Sea, 10° 29.2' S, 134° 20.3' E, 57–59 m (R. Williams stn RW92–49), NTMAG Cr009817 (male, 5.6 mm).

**Supplementary description of male.** Carapace c. 0.3 times total length; with distinct linea thalassinica, with defined dorsal oval marked posteriorly by shallow transverse cervical groove extending anteroventrally to each side above linea thalassinica as shallow groove demarcating posterior half of dorsal oval; frontal margin continued ventrolaterally beyond anterolateral lobe as ridge towards linea thalassinica. Branchiostegite with oblique groove terminating at anterior end of rounded hepatic boss; anterior branchiostegal lobe articulating at junction of oblique ridge and linea thalassinica. Rostrum strongly convex in lateral view, narrowly triangular, reaching almost to cornea; anterolateral lobe flat, rounded in dorsal view, square in lateral view.

Antennular peduncle 0.55 times carapace length, article 3 1.8 times as long as article 2, with ventrolateral rows of long setae. Antennal peduncle just exceeding antennular peduncle; article 4 with 3 long dorsal setae; article 5 little longer than

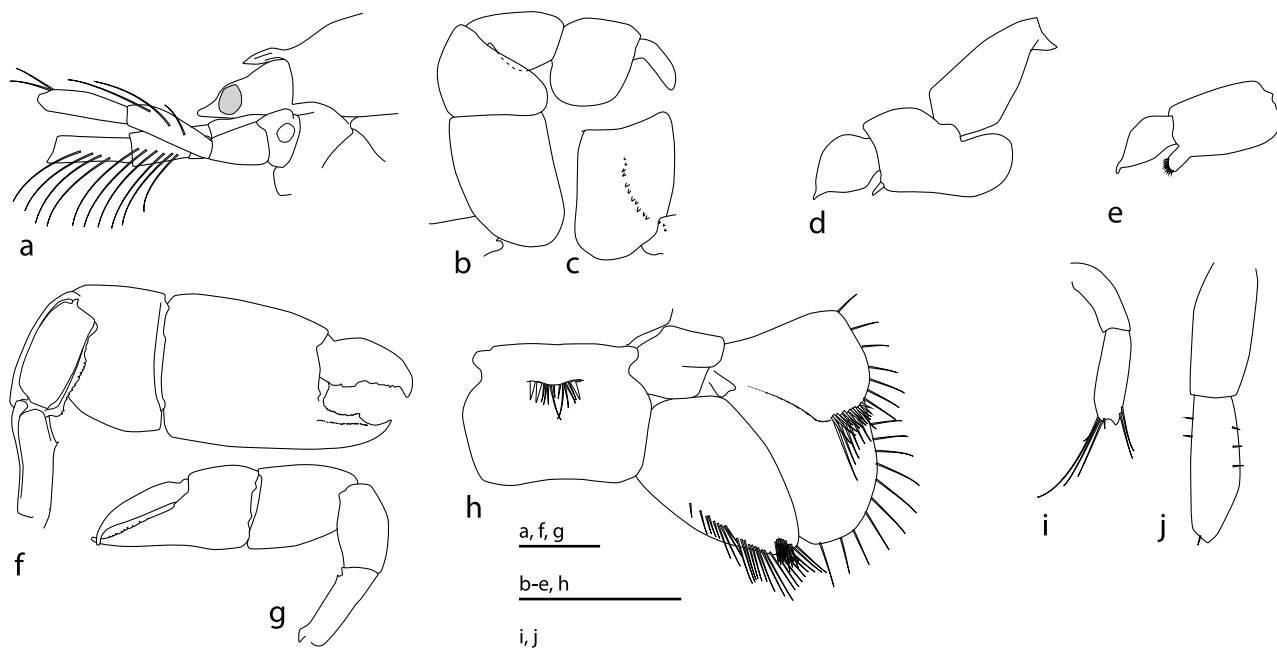


Figure 4. *Michaelcallianassa indica* Sakai, 2002. Australia, Arafura Sea, NTMAG Cr009817, male, 5.6 mm: a, front of carapace, eyestalks, antennular peduncle, antennal peduncle; b, c, right maxilliped 3, lateral, mesial basis and ischium; d, pereopod 3, carpus–dactylus; e, pereopod 4, propodus, dactylus; f, major cheliped (left, mesial); g, minor cheliped (right, mesial); h, telson, right uropod; i, j, pleopods 1, 2 (right, posterior view). Scale bars = 1 mm.

article 4; scaphocerite semicircular. Maxilliped 3 ischium 1.4 times as long as wide, proximally lobed, widest at midpoint, extensor margin slightly concave, flexor margin straight; merus subtriangular, 1.2 times as wide as long, flexor margin broadly rounded, distal margin oblique; carpus suboval, 1.6 times as long as wide, with lobe on flexor margin; propodus 1.1 times as wide as long, free distal margin slightly oblique, flexor margin almost semicircular; dactylus slightly arcuate, 0.7 times as long as propodus; crista dentata curved, of 3 small spines on basis, 11 uneven short sharp spines on proximal two-thirds of ischium.

Pereopods 1 (chelipeds) unequal, dissimilar. Major cheliped carpus–dactylus 1.5 times carapace length; ischium slender, lower (flexor) margin with 1 denticle just beyond midpoint; merus twice as long as wide, upper margin arcuate, lower margin with c. 12 denticles over proximal two-thirds, first 2 slightly more prominent; carpus 1.6 times as wide as long, lower proximal margin regularly curved; propodus upper margin twice as long as carpus, 1.1 times as long as greatest width, widest proximally, upper and lower margins of palm carinate, rolled mesially; palm distomesial margin with blunt tubercle at base of fixed finger; fixed finger one-third length of lower margin, twice as long as width at base, cutting edge lateral, with finely serrate concave blade over proximal half, smooth, concave beyond; dactylus 0.6 as long as upper margin of palm, cutting edge with blunt tooth in proximal half, irregularly toothed beyond, with acute hooked tip. Minor cheliped 1.2 times carapace length; palm 0.6 width of major; ischium narrow, with small tooth on flexor margin, as long as merus; merus 1.8 times as long as wide, margins curved, unarmed; carpus longer than merus, 1.2 times as long as wide, parallel-sided over distal half; palm upper margin 0.7 times as long as carpus, 0.8 times as long as wide, lower margin 1.6 times as long as carpus; fixed finger evenly tapering, more than half length of lower margin, cutting edge with 10 well-spaced denticles over distal half; dactylus 1.7 times as long as upper margin of palm, curved, cutting edge unarmed.

Pereopod 3 propodus with proximally directed rounded lobe of lower margin extending beyond lower margin of carpus, with spiniform seta on lower distal angle; dactylus broadly teardrop-shaped, 1.5 times as long as wide. Pereopod 4 propodus with distal thumb, its margin with c. 10 marginal sharp short setae.

Male pleopod 1 of 2 articles; article 2 longer than article 1, with distolateral triangular projection, with rounded distomesial lobe bearing long setae. Male pleopod 2 of 2 articles; article 2 longer than article 1, lateral margin convex, apex oblique; without appendix masculina. Pleopod 3 endopod with appendix interna embedded in mesial margin, with minute hooks.

Uropodal endopod 1.65 times as long as wide, anterior and posterior margins converging on rounded corner, posterior margin with subdistal cluster of dorsal setae, submarginal row of setae; exopod 1.8 times as wide as anterior margin, anterior margin almost straight, distal margin evenly curved, delimited each end by rounded angles, dorsal plate extending almost half width of exopod, bearing c. 30 spiniform setae on overlapping margin.

Telson 1.33 times wide as long, broadest at lateral lobes near midpoint, with strong lateral excision near anterior margin, tapering to rounded posterolateral corners, posterior margin weakly concave, posterolateral corners each bearing tuft of long

setae; dorsal surface with prominent transverse ridge, 2 pairs of spiniform setae and 5 pairs of fine setae posterior to ridge.

*Size.* Cl. 9.5 mm.

*Distribution.* Somali/Arabian, Bay of Bengal, Andaman, Sahul Shelf (Persian Gulf [type locality]; Kuwait; Iran; India; Australia, NT); 0–65 m.

*Remarks.* Sakai (2002) selected a large male, the only specimen from the Persian Gulf, as holotype of *M. indica* and listed many specimens from the Andaman Sea as paratypes. Sakai (2005) added more records from the south-eastern coast of India. Robles et al. (2020) recorded a second specimen from the Persian Gulf that contributed molecular data to their analysis. The small male figured here differs from those illustrated by Sakai (2002, 2005), which themselves vary. The rostrum is strongly convex (fig. 4a; similar to that of the holotype of *M. indica*, but a female from the Andaman Sea appears much flatter), the fixed finger of the major cheliped of the new male has a concave tooth occupying the proximal half (fig. 4f; resembling that of the Indian female; the tooth is much shorter in a paratype male and little shorter in a paratype female), the propodus of pereopod 3 (fig. 4d) is not as strongly lobed as figured by Sakai, and the maxilliped 3 is much wider and with a squarer propodus than previously figured (fig. 4b, c). The strong thumb on the propodus of pereopod 4 (fig. 4e) has not been noted previously. Male pleopods 1 and 2 are similar to those of *M. indica* (fig. 4i, j; labels E and F are reversed on Sakai's (2002) fig. 14). The armature of the cheliped merus, the shapes of the uropod and the telson of the newly found specimen (fig. 4h) are essentially identical to that previously figured.

#### ***Mocallichirus* Poore, Dworschak, Robles, Mantelatto and Felder, 2019**

*Mocallichirus* Poore et al., 2019: 113.—Robles et al., 2020: figs 1, 4, 7, tables S1, S2.

*Remarks.* The genus was erected as part of a molecular and morphological review, distinguishing its only species from the larger genus *Neocallichirus* Sakai, 1988 (Poore et al., 2019; Robles et al., 2020).

#### ***Mocallichirus mocambiquensis* (Sakai, 2004)**

Figure 5

*Callianassa mocambiquensis* Sakai, 2004: 585–592, figs 15–17.—Sakai, 2005: 93.

*Trypaea mocambiquensis*.—Sakai, 2011: 404.

*Mocallichirus mocambiquensis*.—Poore et al., 2019: 146.—Robles et al., 2020.

*Material examined.* Holotype. Mozambique Channel, 26–28 m, MNHN Th1452 (male [somewhat shrivelled], 3.3 mm). Paratypes. Collected with holotype, MNHN Th1453 (3 males, 3.0 mm).

**Madagascar.** Nosy Bé, across bay from CNRO complex, off Lokobe Reserve, 13.4139° S, 48.3056° E, 1–3 m, seagrass (stn MGNW-23), UF 14337\* (female, 4.2 mm). Nosy Bé, E of Hellville, at CNRO complex, 13.4069° S, 48.2917° E, 0–3 m (stn MGNW-26), UF 13903 (female, 4.5 mm); (stn MGNW-49), UF 13986 (male, 4.5 mm); (stn MGNW-26), UF 14462 (female, 4.5 mm). Nosy Bé, Plante stn NM2, MNHN IU-2016-8087 (male, 7.5 mm). Nosy Bé, Faubert, 10 m, MNHN IU-2016-8088 (male, 9.8 mm).

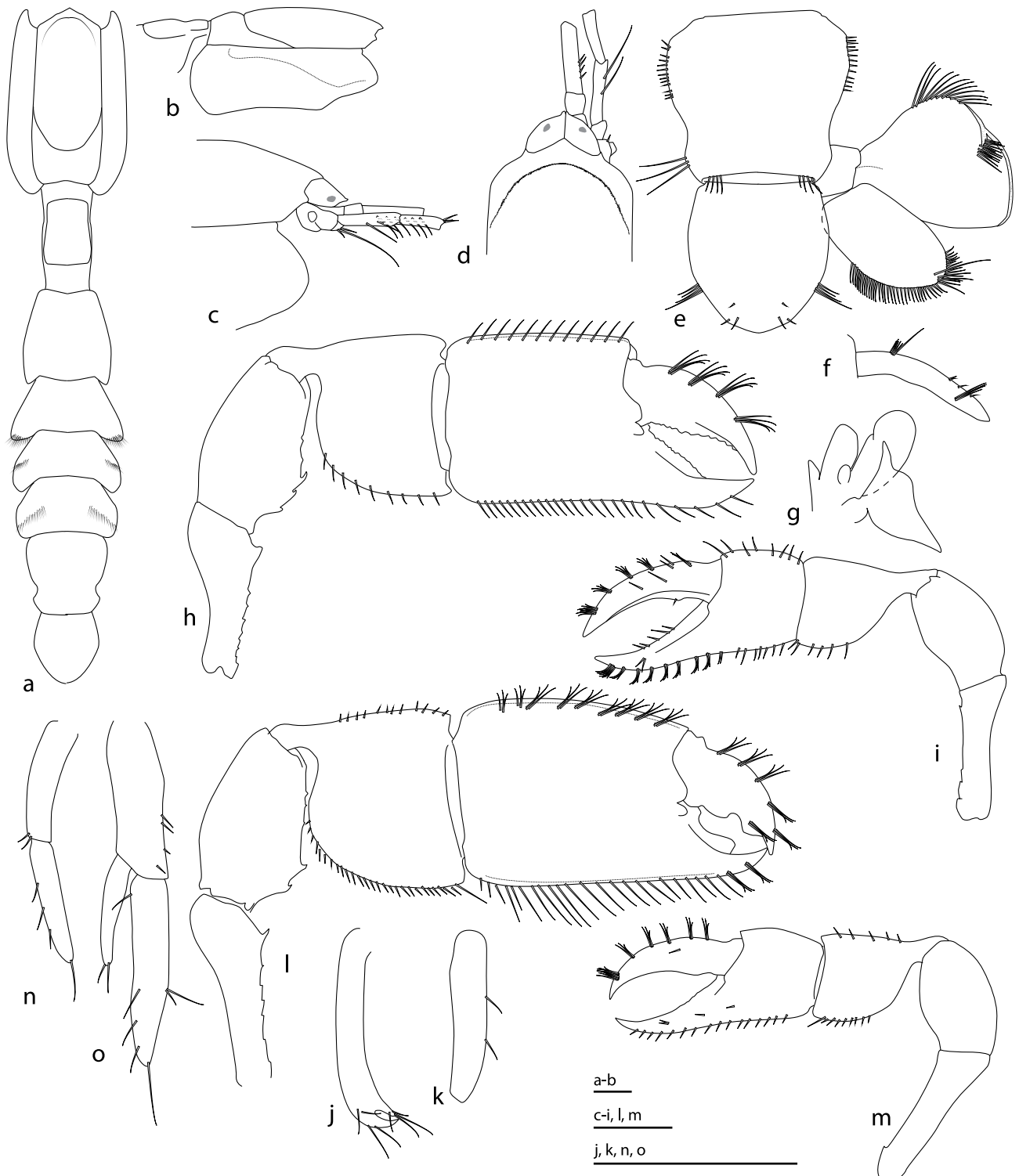


Figure 5. *Mocallichirus mocambiquensis* (Sakai, 2004). Madagascar. UF 13986, male, 4.5 mm: a, dorsal habitus; b, lateral carapace, pleonite 1; c, d, anterior carapace, eyestalks, antennular and antennal peduncles; e, pleonite 6, telson, right uropod; f, telson, left lateral view; g, maxilliped 1; h, major cheliped (left, mesial); i, minor cheliped (right, mesial); j, pleopod 1 (right), k, pleopod 2 (right, anterior view). UF 13903, female, 4.5 mm: l, major cheliped (left, mesial); m, minor cheliped (right, mesial). Scale bars = 1 mm.



*Supplementary description. Male.* Carapace quarter length of total; cervical groove at 0.8 length of carapace, well incised on dorsum; dorsal oval weak; cardiac pore present, without cardiac prominence. Rostrum broadly triangular, exceeding anterolateral lobes. Pleonite 1 with sclerified tergite not extending laterally, with shallow transverse groove; pleonite 2 1.3 times as long as pleonite 1 tergite; pleonites 3–5 expanded laterally with dense setose areas; pleonite 6 waisted posteriorly.

Eyestalk broader than long, basal height two-thirds length, lateral margin evenly convex, mesiodistal apex produced as acute lobe; cornea about 0.2 width, distolateral. Antennule 1.8 times basal width of both eyestalks, article 3 setose ventrolaterally. Antenna 2.1 times basal width of both eyestalks; scaphocerite absent. Maxilliped 1 with disc-like endopod, broad exopod, epipod with attenuated anterior lobe beyond lateral shoulder.

Major pereopod 1 (cheliped) ischium denticulate, distal tooth strongest; merus with 3 angled teeth over second quarter of lower margin; carpus waisted proximally; propodus upper margin carinate, 1.1 times as long as greatest width, with mesial edge produced and a tubercle at base of dactylus; fixed finger 0.6 times palm upper margin, cutting edge with denticulate lateral margin; dactylus as long as fixed finger, cutting edge with weakly crenellate lateral margin.

Minor pereopod 1 (cheliped) 0.7 times length of major; ischium weakly denticulate; merus lower margin smooth; carpus waisted proximally; propodus upper margin 0.85 times as long as greatest width, with mesial edge slightly produced at base of dactylus; fixed finger 1.3 times palm upper margin, cutting edge smooth; dactylus as long as fixed finger, cutting edge with weak tooth.

Pleopod 1 uniaarticulate, curved, with oblique curved apical notch. Pleopod 2 uniaarticulate, shorter than pleopod 1, tapering beyond greatest width at midpoint to oblique truncate apex, without appendices.

Uropod endopod 1.8 times as long as wide, with marginal setae, cluster of distal setae on upper face; exopod 1.5 times as wide as anterior margin, dorsal plate almost semicircular, well distinguished from distal margin, with few spiniform setae, posterodistal angle rounded.

Telson dorsally convex, 1.1 times as long as wide, lateral margins almost parallel over most of length, tapering over distal third to broadly rounded apex, with pair of clusters of distolateral setae but otherwise with few setae.

*Female.* Major pereopod 1 (cheliped) ischium as in male; merus with 2 angled teeth over second quarter of lower margin; carpus as in male; propodus upper margin carinate, 1.3 times as long as greatest width, with mesial edge produced and a tubercle at base of dactylus; fixed finger 0.3 times upper margin, cutting edge with strong step on lateral margin; dactylus as long as fixed finger, cutting edge with blunt basal tooth, notch, triangular tooth. Minor pereopod 1 essentially as in male.

Pleopod 1 with 2 articles, curved, article 2 with rounded apex. Pleopod 2 biramous; endopod 1.1 times length of peduncle, 5 times as long as wide, tapering to simple rounded apex, without appendix interna; exopod half as long as endopod.

*Size.* Cl. to 9.8 mm.

*Distribution.* Western Indian Ocean (Mozambique Channel [type locality], Madagascar); 1–28 m.

*Remarks.* Sakai (2011) included the species in *Trypaea*, a genus of Callianassidae s.s., in which he included more than 50 species. The epipod on maxilliped 1 (fig. 5g) and pleopods (fig. 5j, k, n, o) confirm its placement in Callichiridae, consistent with genetic affinities (Robles et al., 2020).

The species is immediately recognisable from the shape of the telson, appearing almost pentagonal, the lateral margins almost parallel over most of length and the posterior third tapering to a rounded obtuse apex, and convex in lateral view (fig. 4). Sakai's figure (2004, fig. 17E) of the telson of the somewhat shrivelled holotype is distorted and the chelipeds (Sakai, 2004: fig. 16A, B) are of a juvenile form. Sakai (2004) reported that the male holotype possessed a "two-segmented" pleopod 1 and lacked pleopod 2. A re-examination of the holotype revealed simple pleopods 1 and 2. Two of the three paratype males examined had no pleopods. All these are smaller (3.5 mm) than the male collected at Madagascar (4.5 mm), which has a 1-articled pleopod 1 with a distal notch (fig. 5j) and a simple pleopod 2 with a truncate apex (fig. 5k).

#### ***Mucrollichirus* Poore, Dworschak, Robles, Mantelatto and Felder, 2019**

*Mucrollichirus* Poore et al., 2019: 113–114.—Robles et al., 2020.

*Remarks.* The genus was erected as part of a molecular and morphological review, distinguishing its only species from its larger sister genus *Corallianassa* (Poore et al., 2019; Robles et al., 2020). The type species had been placed in *Neocallichirus* Sakai, 1988, from which it appears far removed genetically. *Mucrollichirus* is notable for the weakly lobed propodus on pereopod 3 (fig. 6f), the short telson (fig. 6a, d) and the somewhat swollen propodus of the major cheliped (fig. 6g, m).

#### ***Mucrollichirus mucronatus* (Strahl, 1862)**

Figure 6

*Callianassa mucronata* Strahl, 1862: 1056–1060.—De Man, 1888: 484–485, pl. 21 fig. 2 (record from Ambon).—Poore and Griffin, 1979: 273–275, figs 34, 35.

*Callianassa brevicaudata* A. Milne-Edwards, 1870: 91–92 (type locality, Zanzibar [Tanzania]).

*Neocallichirus mucronatus*.—Sakai, 1999: 105–107, fig. 26 (synonymy).—Sakai, 2011: 462–463 (full synonymy).—Sakai and Türkay, 2014: 185–187 (synonymy).—Dworschak, 2018: 31–36, figs 10, 11.

*Callianassa (Cheramus) novaeguineae* Thallwitz, 1891: 31–33, pl. 3 fig. 9 (type locality, Nordwest Neu-Guinea (Indonesia)).

*Callianassa novaeguineae*.—De Man, 1902: 757–758.

*Callianassa (Callichirus) mucronata*.—De Man, 1928a: 175–179, pl. 19, figs 30–30e (record from Ambon).

*Mucrollichirus mucronatus*.—Poore et al., 2019: 144.—Robles et al., 2020: figs 1, 4, 7, tables S1, S2.

*Material examined. Djibouti and Perim*, coll. Dr Jousseume, 1897, det. G. Nobili, AM P.5387 (2 females, 7.2, 8.6 mm). **Madagascar**, Nosy Bé, lagoon S of CNRO, muddy coral, 13.416° S, 48.29044° E, 23–25 m, UF 13925 (female, 8.5 mm). **Papua New Guinea** (PAPUA NIUGINI stns), Madang Province. Sek I., 0–2 m, 05° 04.8' S, 145° 48.9' E (stn

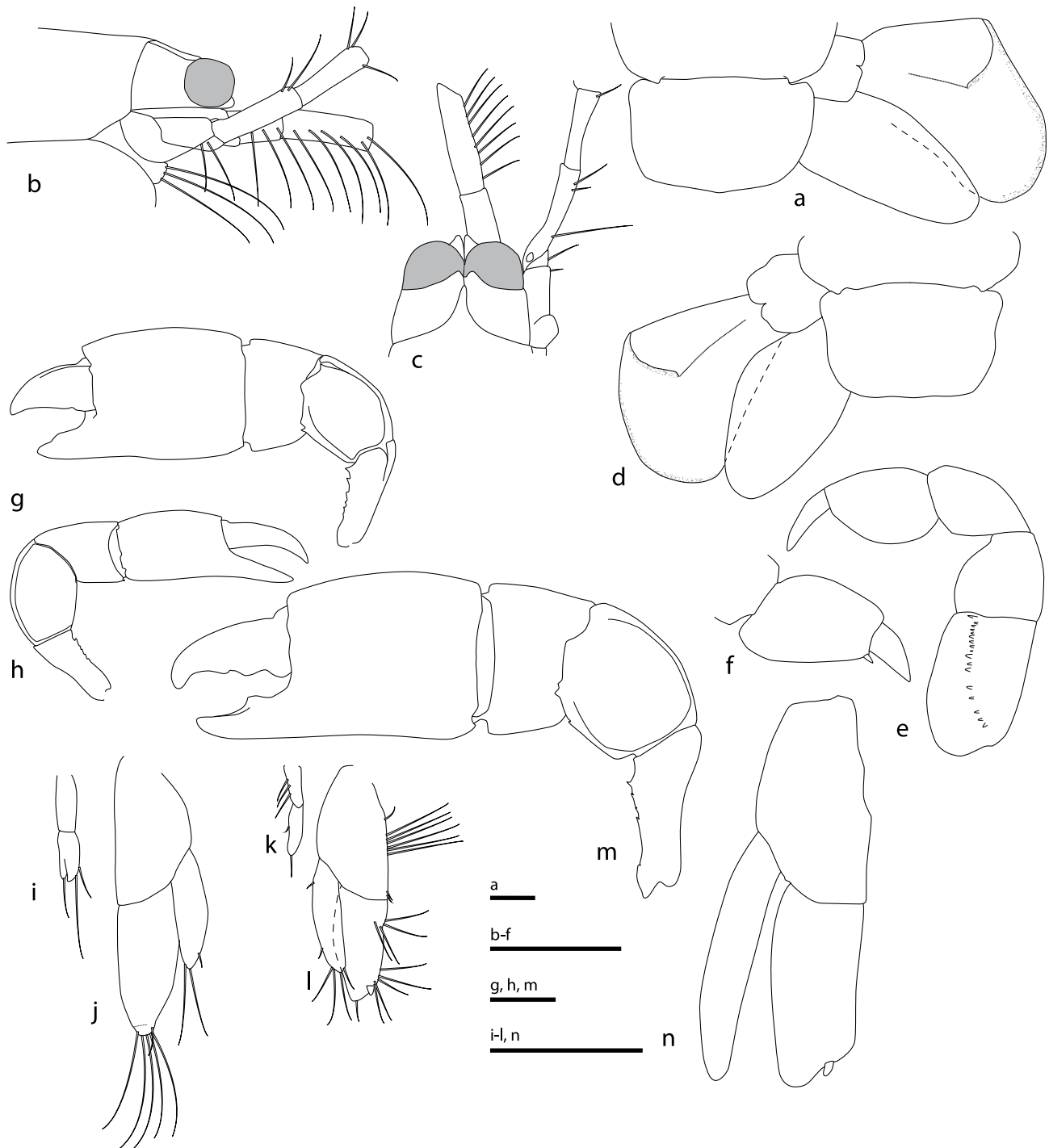


Figure 6. *Mucrollichirus mucronatus* (Strahl, 1862). Djibouti, AM P.5387, female, 8.6 mm: a, telson, uropod. Papua New Guinea, male, 2.5 mm, MNHN IU-2014-2777: b, c, anterior carapace, eyestalks, antennular peduncle, antennal peduncle; d, telson, uropod; e, maxilliped 3; f, pereopod 3 propodus, dactylus; g, major cheliped (right, mesial view); h, minor cheliped (left, mesial view); i, j, pleopods 1, 2. Papua New Guinea, MNHN IU-2014-1067, male, 4.0 mm: k, l, pleopods 1, 2. Papua New Guinea, MNHN IU-2014-459, female, 9.8 mm: m, major cheliped (right, mesial view); n, pleopod 2. Scale bars = 1 mm.

PR26) MNHN IU-2013-558 (female, 5.6 mm); Rempi area, E of Dumduman I., 2–13 m, 05° 01.18' S, 145° 48.0' E (stn PR63) MNHN IU-2013-7099 (ovigerous female, 3.0 mm). New Ireland. E side of Globig I., coral rubble with algae, sand, 3–5 m, 02° 38.8' S, 150° 44.2' E (stn KZ21), MNHN IU-2014-1067 (male, 4.0 mm); Cape Sueusat, coral drop off, 6–12 m, 02° 37' S, 150° 46.3' E (stn KZ06), MNHN IU-20142480\* (female, 5.0 mm); Kavieng Lagoon, Byron Channel, SE Patio I., rubble slope, 2–7 m, 02° 36.6' S, 150° 32.9' E (stn KB40), MNHN IU-2014-2576\* (female, 9.8 mm); NW side of Ral I., 19 m, 02° 36.4' S, 150° 42.4' E (stn KB62), MNHN IU-2014-2776\* (lost), MNHN IU-2014-2777\* (male, 2.5 mm). **Australia**, Qld, Rat I, AM P.2010 (male, 8.0 mm); Palm I., AM P.5194 (female, 10.1 mm). WA, S end of Ashmore Reef, 12° 16.7385' S, 122° 59.088' E, WAM C54241 (2 females).

*Size.* Cl. to 10.3 mm.

*Distribution.* Western and Central Indo-Pacific. The species has been widely reported from the Philippines (type locality: Luzon) (Dworschak, 1992, 2018), Indonesia (De Man, 1928a), Papua New Guinea, Maldives (Ortmann, 1894), north Queensland, Australia (Poore and Griffin, 1979), Djibouti and Madagascar (Sakai, 1999), and the Red Sea (Sakai et al., 2014). The identity of the specimens from Australia was confirmed as part of this study.

*Remarks.* Strahl (1862) reported on one female of *C. mucronata* of 13 lines (27.5 mm) without chelipeds from Luzon, Philippines, but supplemented his description with mention of a second smaller one of about 5 lines (10.6 mm). Tirmizi (1977) redescribed the larger one (ZMB 1128) as the holotype without noting the presence of a second specimen; this is an effective lectotype designation (ICZN Article 74.5). Sakai (1999) examined both specimens and alleged that Tirmizi's fig. 1B of the front of the carapace, eyestalks and antennules and antennae was of the smaller specimen. As argued by Dworschak (2018), this is improbable. The scale bars provided by Tirmizi (1977) and by Sakai (1999) indicate that the front of the carapace is about 4 mm wide. Tirmizi's fig. 1A of the dorsal habitus, fig. 1B of the front, and Sakai's fig. 26a of the front are all from the lectotype (called holotype by both authors). Sakai (1999: 44–46, fig. 8) described the smaller specimen (ZMB 27222) as *Callianassa gruneri* Sakai, 1999. The figure suggests that the fragments came from more than one species, and Poore et al. (2019) listed *C. gruneri* as incerta sedis.

The syntypes of *C. novaeguineae* were collected in “Nordwest Neu-Guinea” (now West Papua Province or Papua Province, Indonesia) and comprise a fairly well-preserved specimen of total length c. 40 mm and broken pieces of a smaller one. They were lodged in MTKD but were probably destroyed during World War II. De Man (1902) redescribed the entire syntype and suspected the species to be synonymous with *C. mucronata*. He later treated them as synonyms and redescribed and reillustrated material from Ambon, Indonesia (De Man, 1928a), specimens that he had previously identified as *C. mucronata* (De Man, 1888). Both names were included as synonyms and transferred to *Neocallichirus* by Sakai (1999) and later authors.

The male pleopods have not previously been illustrated, except for the tip of the endopod (Sakai, 1999: fig. 26i). Sakai (1999) described pleopod 1 as of two articles, the second one

“chelate”. In two small males from Papua New Guinea, pleopod 1 has two articles, the second article of one male with a deep apical longitudinal slit (fig. 6l, k). Pleopod 2 is biramous; an appendix interna is obvious in one small male (fig. 5j, l). The female pleopod 1 is of two articles (De Man, 1928a: pl. 19 fig. 30e; Tirmizi, 1977: fig. 3B; Dworschak, 2018: fig. 10c), typical of callichirids, not three as stated by Sakai (1999). The female pleopod 2 has a broad endopod with an obliquely truncate apex, with a small appendix interna (fig. 5n; see too Tirmizi, 1977: fig. 3C; Dworschak, 2018: fig. 10f, g).

Molecular data found no genetic divergence between Philippines and Papua New Guinea populations identifiable as *M. mucronatus* (Robles et al., 2020). Morphological differences are slight. De Man (1928a) noted that the posterior border of the uropodal endopod of his specimens from Ambon is regularly rounded (De Man, 1888: pl. 19 fig. 2a) while in the type of *C. mucronata* it appears obtusely angular in the middle. He believed that “this slight difference is no doubt individual”. Tirmizi's (1977: fig. 1C) and Sakai's (1999: fig. 26c) figures show this margin to be evenly curved, as in the new material from Papua New Guinea (fig. 5d). Another from Djibouti was found to have narrower uropodal rami than typical individuals (fig. 6a). Revival from synonymy of *Callianassa novaeguineae* cannot be justified.

#### *Neocallichirus* Sakai, 1988

*Remarks.* *Neocallichirus* is the largest of the 17 genera of Callichiridae (Poore et al., 2019). It comprises 33 nominal accepted species (DecaNet eds, 2023) of which about half occur in the Indo-West Pacific and 14 in the Caribbean and Atlantic. Sakai's (2011) key to species is now incomplete and includes species now in other genera; Hernáez et al. (2020) provided a key to seven Western Atlantic species. Species of *Neocallichirus* are recognised by the uropodal endopod with a straight or slightly convex anterior margin ending in a rounded angle, the posterior margin being more or less continuous with the posterior margin, a telson that tapers regularly to about half its width, and the antennal peduncle being longer than the antennular peduncle. Some of the nominal Indo-West Pacific species are incompletely described and problematic for one reason or another. Most were described from one or few specimens, or incomplete specimens, some possibly from juveniles. The types of some species have been illustrated more than once, e.g. *Neocallichirus moluccensis* (De Man, 1905) (De Man, 1928a; Kazmi and Kazmi, 1992; Sakai, 1999) but inconsistencies between figures such as these suggest that subtle differences between species are masked. Variation is appreciable for three species that have been collected in sufficient numbers (Dworschak, 2011a, 2011b, 2018) which, if accepted, would appear to allow other nominal species to be synonymised.

The diagnoses and key to 15 Indo-West Pacific species below rely on direct observations of seven species and published illustrations of the others. Some are difficult to distinguish in isolation. Five nominal species deserve comment and are not included in the key:

*Neocallichirus auchenorhynchus* Sakai, 2005 is based on a single very small female (cl. 4.4 mm) from an unknown locality. Sakai's (2005) description of the “frontal margin of carapace showing a neck-like form, with triangular rostrum and a pair of

anterolateral projections” (Sakai, 2005: fig. 37A) is hard to credit because the figure of the lateral view (Sakai, 2005: fig. 37B) does not show this and is typical of all callichirids. Lack of a type locality, small size, absence of the major cheliped and suspect illustrations argue for treating this name as species inquirenda.

*Neocallichirus kenyaensis* Sakai, 2015, is an unavailable name, without an explicit holotype, thereby failing ICZN Articles 16.4 and 72.3. The name was suggested for the female from Kenya identified by Dworschak (2011b) as *N. natalensis* (Barnard, 1947). The blade on the lower margin of the major cheliped is more developed on this 117-mm-long individual (Dworschak, 2011b, fig. 5E, F) than in the 100-mm-long holotype (Barnard, 1950: fig. 95g; Sakai, 2015: fig. 23c) but the dactylus is identical. A new name is not needed. *Callianassa natalensis* Barnard, 1947 was synonymised with *N. indicus* but Dworschak (2011b) showed it to be valid. *Neocallichirus indicus* is a synonym of *jousseaumei* Dworschak (2011b, 2018).

*Neocallichirus pola* Sakai and Türkay, 2014, type locality, Red Sea, seems indistinguishable from *N. mauritanus* (Miers, 1882) known only from Mauritius. If synonymous, the distribution of *N. mauritanus* would be extended (see below).

Poore et al. (2019) synonymised *Callichiropsis* Sakai, 2010 with *Neocallichirus*. Its only species *C. spiridonovi* Sakai, 2010 was included by these authors in *Neocallichirus*, but was based on two small damaged females with major chelipeds too difficult to characterise.

Dworschak (2011b) found no morphological difference between *Callianassa (Cheramus) variabilis* Edmondson, 1944 from Hawaii and *N. jousseaumei*, despite unpublished molecular studies that he cited showing a sufficient specific difference. The most recent molecular data, possibly using different genes, found almost no genetic difference between individuals of “*N. jousseaumei*” from Hawaii and Cocos (Keeling) Is relative to differences between individuals from Philippines, Papua New Guinea and Iran (Robles et al., 2020). While this uncertainty remains, *Neocallichirus variabilis* (Edmondson, 1944) is not included in the key to species below.

#### Key Indo-West Pacific and Australian species of *Neocallichirus*

1. Uropodal endopod 1.3 times as long as wide, posterior margin decidedly oblique, angle with anterior margin about 40° ..... 2
  - Uropodal endopod about as long as wide or wider than long, posterior margin moderately oblique or transverse, rounded angle between it and anterior margin ..... 3
2. Carapace anterolateral lobes acute. Maxilliped 3 propodus with slightly oblique concave transverse distal margin. Telson tapering from base to continuous rounded posterolateral margin. Major cheliped merus lower margin with straight dentate blade except over distal quarter ..... *N. vigilax*
  - Carapace anterolateral lobes rounded. Maxilliped 3 propodus disto-lower margin evenly rounded. Telson clearly tapering from greatest width at midpoint. Major cheliped merus lower margin with proximal tooth, square in male, triangular in female ..... *N. mauritanus*
3. Cornea reduced to small pigment spot ..... *N. darwinensis*
  - Cornea prominent, pigmented ..... 4
4. Eystalk distal lobe with truncate margin, usually with 1 or more denticles ..... 5
  - Eystalk distal lobe rounded or acute, not denticulate ..... 8
5. Major cheliped merus twice as long as wide, evenly convex, smooth; palm shorter than carpus; dactylus cutting edge with 2 obscure teeth. Minor cheliped subequal to major ..... *N. manningi*
  - Major cheliped merus 1.2–1.7 times as long as wide, with dentate blade; palm as long as or longer than carpus; dactylus cutting edge entire or with concave proximal rectangular tooth over most of length, distal triangular tooth. Minor cheliped narrower than major cheliped palm, palm shorter than carpus ..... 6
6. Major cheliped merus 1.2–1.5 times as long as wide, lower margin with asymmetrically curved blade, widest and denticulate over proximal half, more prominent in adult ..... *N. jousseaumei*
  - Major cheliped merus 1.5–1.7 times as long as wide, lower margin straight, dentate or denticulate ..... 7
7. Major cheliped merus with narrow straight dentate blade over proximal three-quarters; dactylus cutting edge entire. Minor cheliped palm about half as wide as major cheliped palm; palm longer than carpus. Maxilliped 3 propodus disto-lower margin evenly rounded. Telson tapering from subproximal width to continuous rounded posterolateral margin ..... *N. darvishi*
  - Major cheliped merus with wide rectangular dentate blade over proximal three quarters, margin straight or gently convex; dactylus cutting edge with molar-like tooth near midpoint, deep notch, concave blade over distal half. Minor cheliped palm about two-thirds as wide as major cheliped palm, shorter than carpus. Maxilliped 3 propodus transverse margin slightly oblique, concave. Telson clearly tapering from subproximal width to rounded corner between well-defined posterolateral margin and convex-straight posterior margin ..... *N. natalensis*
8. Major cheliped merus lower margin with asymmetrical dentate blade, prominent proximally, tapering distally ... 9
  - Major cheliped merus lower margin evenly convex or with straight dentate blade ..... 10
9. Major cheliped merus lower margin with asymmetrically curved blade, widest and dentate over proximal half, margin concave over distal third. Minor cheliped palm about half as wide as major cheliped palm, longer than carpus. Pereopod 3 propodus with proximally directed lobe of lower margin clearly protruding beyond lower margin of carpus. Female pleopod 2 appendix interna digitiform, subdistal, reaching or overlapping end of endopod ..... *N. calmani*

- Major cheliped merus lower margin with triangular blade tapering distally, more strongly dentate proximally. Minor cheliped palm about one-third as wide as major cheliped palm, shorter than carpus. Pereopod 3 propodus with proximally directed lobe of lower margin aligned with lower margin of carpus. Female pleopod 2 appendix interna digitiform, terminal ..... *N. frouini*
- 10. Eyestalk distal lobe elongate, longer than precorneal length, distally tapering, transparent ..... *N. vaugelasi*
- Eyestalk distal lobe shorter than precorneal length, distally acute, rounded or truncate ..... 11
- 11. Eyestalk distal lobe rounded, not differentiated from eyestalk proper. Antenna peduncle as long as antennule peduncle ..... *N. angelikae*
- Eyestalk distal lobe rounded, not differentiated from eyestalk proper. Antenna peduncle longer than antennule peduncle ..... 12
- 12. Major cheliped merus about 1.6 times as long as wide ..... 13
- Major cheliped merus at least twice as long as wide ..... 14
- 13. Maxilliped 3 propodus lower margin evenly rounded. Uropodal endopod posterior margin decidedly oblique, curving continuously to convex anterior margin. Telson tapering from base to continuous rounded posterolateral margin ..... *N. taiaro*
- Maxilliped 3 propodus distal margin transverse. Uropodal endopod posterior margin moderately oblique, angle with anterior margin about 30°. Telson clearly tapering from subproximal width to rounded corner between well-defined posterolateral margin and convex-straight posterior margin ..... *N. horneri*
- 14. Anterior lobe of eyestalk truncate, with sharp distolateral angle. Telson clearly tapering from subproximal width to rounded corner between well separated posterolateral and posterior margins ..... *N. moluccensis*
- Anterior lobe of eyestalk rounded, triangular. Telson scarcely tapering from subproximal width to rounded posterolateral-posterior margin ..... *N. nagoi* sp. nov.

### *Neocallichirus angelikae* Sakai, 2000

#### Figure 7

*Neocallichirus angelikae* Sakai, 2000: 92–97, figs 1–3.—Sakai, 2005: 176.—Sakai, 2011: 453.

*Material examined.* **Australia**, SA, Long Beach, Coffin Bay, 34.62° S, 135.45° E, NMV J59652 (3 males, 6 females, 14–20 mm).

*Diagnosis.* Carapace anterolateral lobe acute, small. Antenna peduncle as long as antennule peduncle. Eyestalk distal lobes rounded, not differentiated from eyestalk proper. Major cheliped merus lower margin with narrow straight dentate blade over proximal three-quarters; palm tuberculate on lateral and distal mesial faces in larger individuals; fixed finger cutting edge concave, denticulate over proximal half; dactylus cutting edge with notch at midpoint (male). Uropodal endopod posterior margin decidedly oblique, curving continuously to convex anterior margin. Telson clearly tapering from subproximal width to rounded corner between well-defined posterolateral margin and convex-straight posterior margin. Maximum cl. 20 mm.

*Distribution.* Southwestern Australian Shelf (Australia, SA [type locality: Ceduna]).

*Remarks.* Sakai (2000) based *N. angelikae* on a single small individual said to be a female. The pleopod 1 illustrated (Sakai, 2000, fig. 3G) is from a male; pleopod 2 (fig. 3H) shows two endopodal articles with a small appendix interna, an arrangement not seen elsewhere in the genus. Here, male and female pleopods 1 and 2 are figured from a collection of larger individuals collected near the type locality (fig. 7b–e). Pereopod 3 is illustrated for the first time (fig. 7a).

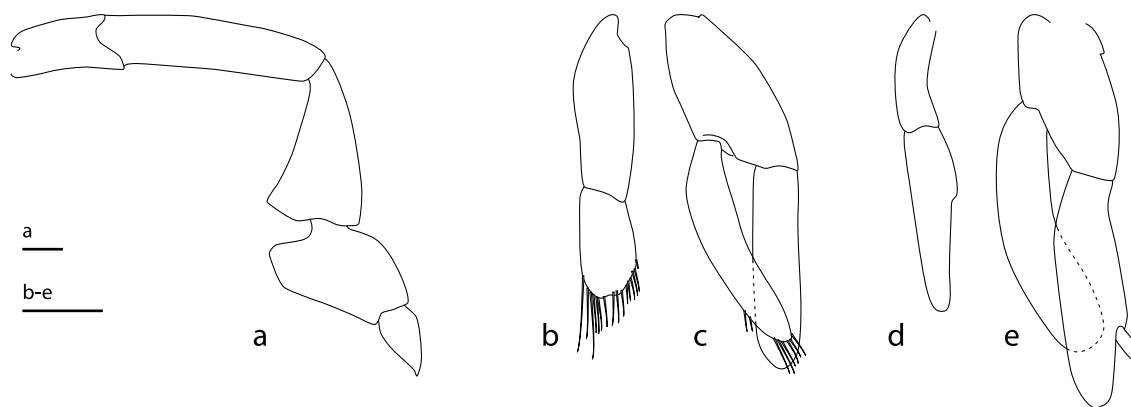


Figure 7. *Neocallichirus angelikae* Sakai, 2000. Australia, SA. NMV J59652, male, 14 mm: a, pereopod 3; b, c, pleopods 1, 2; female, 20 mm: d, e, pleopods 1, 2. Scale bars = 1 mm.

***Neocallichirus calmani* (Nobili, 1904)**

## Figure 8

*Callianassa* (*Cheramus*) *calmani* Nobili, 1904: 237.—Nobili, 1906: 104–15, pl. 5 fig. 2.

*Callichirus calmani*.—de Saint Laurent and Le Loeuff, 1979: 97.

*Callianassa calmani*.—Dworschak, 1992: 192, fig. 3.

*Neocallichirus calmani*.—Sakai, 1999: 96–98, fig. 22a–d.—Sakai, 2011: 455.—Dworschak, 2018: 27–31, figs 6–9 (redescription, synonymy).—Poore et al., 2019: 145.—Robles et al., 2020.

**Material examined.** **Jordan**, Al Aqaba, Red Sea, in front of Holiday Inn, NMV J55684 (ex MHNH) (male, 15.1 mm; female, 13.5 mm). **USA**, Mariana Is, Guam, Apra Harbour, tip of Glass Breakwater, 13.45473° N, 144.62547° E, reef slope in outer lagoon, UF 29713 (female, 7.5 mm), UF 29715 (female, 6.5 mm); W coast, near War in the Pacific Park, 13.5° N, 144.8° E, seagrass, UF 27333 (male, 8.2 mm), UF 29709 (male, 18.1 mm), UF 29711 (female, 14.1 mm), UF 29714 (male, 11.4 mm). **Australia**, Qld, Lizard I., Lumus beach, silty reef, soft and hard corals, UF 17052 (female, 5.76 mm), UF 17152 (female, 28.8 mm), UF 16888 (male, 11.7 mm), UF 17002 (female, 27.2 mm), UF 17003 (female, 25.6 mm); Lizard I., Watson's Bay, 14.664° S, 145.4513° E, UF 17241 (female, 27.6 mm). WA, Bernier I., beach S of Wedge Point, WAM C11999 (female, 21 mm). **Kiribati** (Gilbert Is), Arorae I., 2° 38' S, 176° 52' E, AM P.102701 (female, 16 mm). **French Polynesia**, Moorea, Papetoai, 17.49° S, 149.88498° W (stn BIZ-548), UF 29095\* (female, 7.7 mm). Shallow bay between Gump and Nihimaru, 17.4933° S, 149.8793° W (stn MIB171), UF16198 (female, 5.2), UF 16199 (male, 4.6 mm).

**Diagnosis.** Antenna peduncle exceeding antennule peduncle by half of article 5. Eyestalk distal lobes triangular, rounded, diverging. Major cheliped merus lower margin with asymmetrically curved blade, widest and dentate over proximal half, margin concave over distal third; gape with molar-like tooth in male; fixed finger cutting edge concave, denticulate over

proximal half, or smooth; dactylus cutting edge with tooth (often molar-like) one-third way along, separated by notch from distal blade (female), or with tooth (often molar-like) one-third way along, distal half smooth (male). Pereopod 3 propodus with proximally directed lobe of lower margin protruding beyond lower margin of carpus. Uropodal endopod posterior margin moderately oblique, angle with anterior margin about 30°. Telson tapering from base to continuous rounded posterolateral margin. Maximum cl. 28.8 mm.

**Type locality.** Obock, Djibouti.

**Distribution.** Western, Central and Eastern Indo-Pacific (Saudi Arabia, Red Sea, Madagascar, Indonesia, Philippines, Vietnam, Mariana Is, Kiribati, French Polynesia, NE Australia).

**Remarks.** Dworschak (2018) redescribed *Neocallichirus calmani* in detail. The species is distinguished from congeneric species by the asymmetrically curved blade on the major cheliped merus, widest and dentate over the proximal half, the molar-like tooth in the gape of the male cheliped, and the strong dorsal curvature of the telson.

On the basis of molecular data, Robles et al. (2020) found one of three individuals collected in French Polynesia to be sister to another identified as *N. calmani* from Iran, close to the type locality. This small female lacks ornamentation on the cheliped merus and has sharp teeth along the margins of the cheliped (fig. 8f). This record and another from Kiribati extend the geographic range of *N. calmani* from throughout the Indian Ocean into the eastern Indo-West Pacific. The only other species of *Neocallichirus* recorded from French Polynesia is *N. taiaro*. Individuals from Queensland, Australia, are about twice as long as all others but could not be distinguished otherwise.

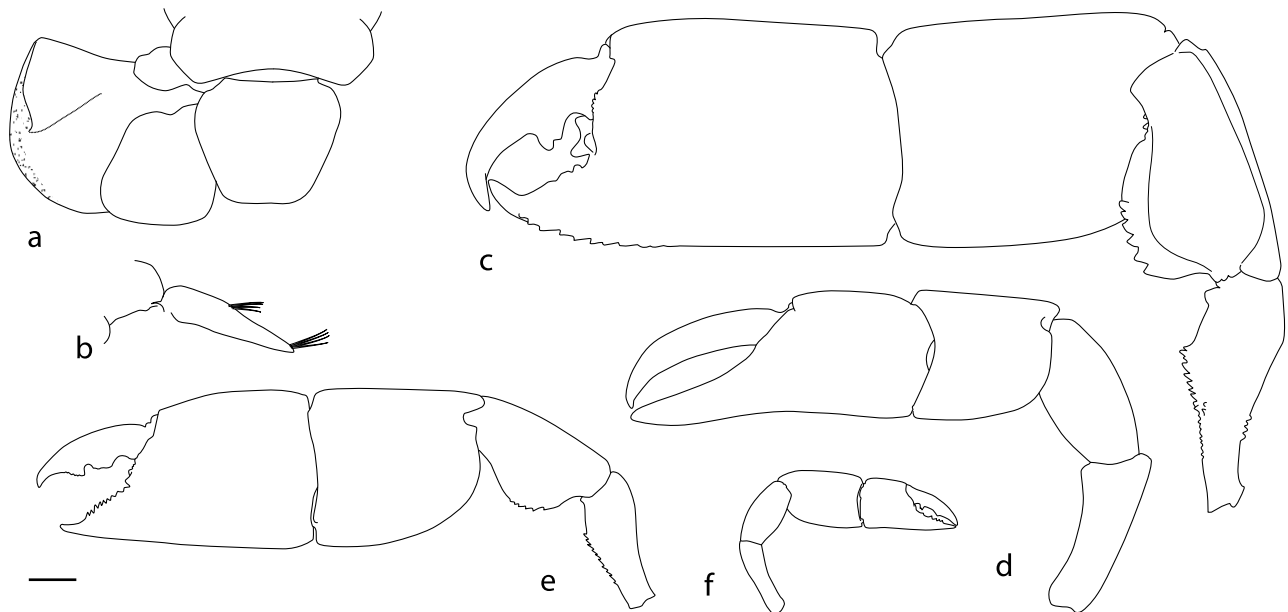


Figure 8. *Neocallichirus calmani* (Nobili, 1904). Jordan, Red Sea. NMV J55684, male, 15.1 mm: a, telson, uropod; b, telson, lateral view; c, major cheliped (right, mesial); d, minor cheliped (left, lateral); female, 13.5 mm: e, major cheliped (left, lateral). French Polynesia, UF 29095, female, 7.7 mm: f, major cheliped (left, mesial). Scale bar = 2 mm.

***Neocallichirus darvishi* Sepahvand, Komai, Momtazi and Shahabi, 2018**

*Neocallichirus darvishi* Sepahvand et al., 2018: 241–247, figs 1–4.

**Diagnosis.** Antenna peduncle exceeding antennule peduncle by one-third of article 5. Eyestalk distal lobes tapered, often truncate, with denticulate distal margin. Major cheliped merus lower margin with narrow straight dentate blade over proximal three-quarters; gape simple; fixed finger cutting edge smooth; dactylus cutting edge with molar-like tooth in proximal half, separated by deep notch from broad subtriangular tooth distally. Uropodal endopod posterior margin decidedly oblique, curving continuously to convex anterior margin. Telson tapering from base to continuous rounded posterolateral margin. Maximum cl. 8.2 mm.

**Distribution.** Somali/Arabian (known only from type locality: Persian Gulf, Iran).

**Remarks.** The species has not been recorded since its description.

***Neocallichirus darwinensis* Sakai, 1988**

Figure 9a, b

*Neocallichirus darwinensis* Sakai, 1988: 62–65, figs 5, 6.—Sakai, 2011: 455 (synonymy).

*Neocallichirus caechabitor* Sakai, 1988: 67–68, figs 9, 10.—Sakai, 1999: 96.—Davie, 2002: 461.—Sakai, 2011: 454–455 (type locality, Australia, NT, Darwin). **Syn. nov.**

**Material examined.** Australia, NT, Mindi Beach, NTMAG Cr000090 (holotype female, 24 mm).

**Diagnosis.** Antenna peduncle exceeding antennule peduncle by all of article 5. Cornea reduced to small pigmented area; eyestalk distal lobes truncate, with distolateral sharp corner. Uropodal endopod posterior margin moderately oblique, angle with anterior margin about 30°. Telson clearly tapering from subproximal width to rounded corner between well-defined

posterolateral margin and convex-straight posterior margin. Maximum cl. 24 mm.

**Distribution.** Sahul Shelf (Australia, NT [type locality: Darwin]).

**Remarks.** *Neocallichirus darwinensis* Sakai, 1988 was taken in the same region as *N. caechabitor* Sakai, 1988, and *N. horneri* Sakai, 1988, type species of the genus. The female holotype, the only specimen known, lacks the major cheliped, and is 2.7 times as long as the type and only specimen of *N. caechabitor* (24 mm vs 9 mm). Both specimens are unusual in having reduced cornea; they have almost identical maxilliped 3, pereopod 3 and telson. The minor cheliped of *N. caechabitor* is narrower than that of *N. darwinensis*, but this may be a sex-related difference. Sakai (1988) stated the holotype of *N. caechabitor* is an immature female but figured immature male pleopods 1 and 2. The minor cheliped of males is narrower than that of females in *N. grandimana* (Gibbes, 1850) (Felder and Manning, 1995; Ayón-Parente et al., 2014) and in *N. mericeae* (Manning and Felder, 1995), and is narrow in juveniles, e.g. *N. sulfureus* (Lemaitre and Felder, 1996). This may be true for all species of *Neocallichirus*, but both sexes and a wide size range have been illustrated for few species. *Neocallichirus caechabitor* is here synonymised with *N. darwinensis*.

*Neocallichirus darwinensis* is also twice as long as the types of *N. horneri*. *Neocallichirus horneri* has a fully developed cornea but some differences between the two species noted by Sakai (1988) may also be size-related. The antenna is relatively longer than the antennule in *N. darwinensis* than it is in *N. horneri*, and the propodus and dactylus of *N. darwinensis* are narrower than those of *N. horneri* (cf. fig. 9b, d). The uropodal endopod of *N. darwinensis* is almost semicircular, whereas that of *N. horneri* is fan-shaped (cf. fig. 9a, c). Some of these differences fall within the variability seen in other species of *Neocallichirus* (Dworschak, 2008, 2011a, 2011b, 2018) but without more specimens the synonymy of these species is uncertain. All species are known only from type specimens.

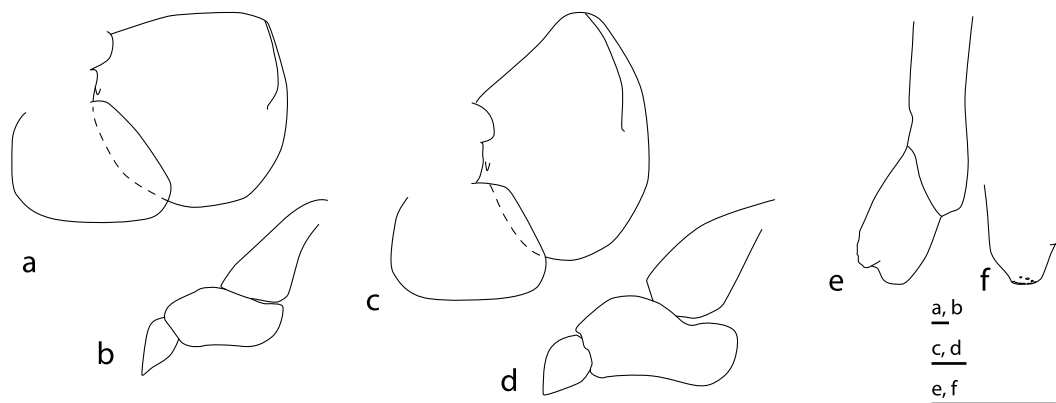


Figure 9. *Neocallichirus darwinensis* Sakai, 1988. Australia, NT, NTMAG Cr000090, holotype female, 24 mm: a, right uropod; b, pereopod 3, carpus–dactylus. *Neocallichirus horneri* Sakai, 1988, NTMAG Cr2048, paratype male, 14 mm: c, right uropod; d, pereopod 3, carpus–dactylus; e, pleopod 1; f, apex of pleopod 2. Scale bars = 1 mm.

***Neocallichirus frouini* Ngoc-Ho, 2005**

*Neocallichirus frouini* Ngoc-Ho, 2005: 74–77, fig. 14.

**Diagnosis.** Antenna peduncle exceeding antennule peduncle by half of article 5. Eyestalk distal lobes triangular, rounded, diverging. Major cheliped merus lower margin with triangular blade tapering distally, more strongly dentate proximally; gape with shallow notch; fixed finger cutting edge smooth; dactylus cutting edge with notch at midpoint (male). Uropodal endopod posterior margin moderately oblique, angle with anterior margin about 30°. Telson tapering from base to continuous rounded posterolateral margin. Maximum cl. 5.3 mm.

**Distribution.** Southeast Polynesia (known only from type locality: French Polynesia, Tahiti).

**Remarks.** The species has not been recorded since its description.

***Neocallichirus horneri* Sakai, 1988**

Figure 9c–f

*Neocallichirus horneri* Sakai, 1988: 65–66, figs 7, 8.—Sakai, 2011: 458 (synonymy).

**Material examined.** **Australia**, NT, Nightcliff, NTMAG Cr000846 (holotype female, 13 mm). West Shoal Bay, NTMAG Cr2048 (paratype male, 14 mm).

**Diagnosis.** Antenna peduncle exceeding antennule peduncle by one-third of article 5. Eyestalk distal lobes triangular, rounded, diverging. Major cheliped merus lower margin evenly convex, smooth (female); gape simple; fixed finger cutting edge denticulate over most of length; dactylus cutting edge with tooth (often molar-like) one-third way along, separated by notch from distal blade (female). Pereopod 3 propodus with proximally directed lobe of lower margin clearly protruding beyond lower margin of carpus. Uropodal endopod posterior margin moderately oblique, angle with anterior margin about 30°. Telson clearly tapering from subproximal width to rounded corner between well-defined posterolateral margin and convex-straight posterior margin. Maximum cl. 14 mm.

**Distribution.** Sahul Shelf (known only from type locality: Australia, NT, Darwin).

**Remarks.** Sakai's (1988) observations of the type specimens were confirmed by re-examination. The male paratype has a simply notched pleopod 1 apex and is a juvenile (fig. 9e; adults in this genus have a deeply notched apex), as is the female of similar size. Sakai (1988) likened the species to *N. indica* (now *N. jousseaumei*) noting the absence of denticles on the lobe of the eyestalk. These are absent in juveniles. The propodus of pereopod 3 does not align with the lower margin of the carpus as it does in *N. jousseaumei* (cf. fig. 9d with Dworschak, 2011b figures). Sakai (1988) did not compare *N. horneri* with *N. calmani*, a common and widespread Indo-West Pacific species with many similarities (see Dworschak, 2018). The propodus of maxilliped 3 is wider and more rectangular in *N. horneri*, but without adult chelipeds few further differences can be identified. The species is known only from types.

***Neocallichirus jousseaumei* (Nobili, 1904)**

*Callianassa (Cheramus) jousseaumei* Nobili, 1904: 236–237.

*Callianassa (Cheramus) indica* De Man, 1905: 605 (type locality, Indonesia, Bay of Kankmaralin, S coast of Kangean).

*Neocallichirus indicus*.—Sakai, 1999: 99, fig. 23a, b, d, e (lectotype, not fig. 23c).—Sakai, 2005: 178–179.—Sakai, 2011: 458.

*Neocallichirus jousseaumei*.—Sakai, 1999: 100–101, fig. 22e–g.—Sakai, 2011: 458–459 (synonymy).—Dworschak, 2011b: 2–9, figs 1–4, 6F–H (lectotype designation, redescription, synonymy).—Dworschak, 2014: 232–233, fig. 10b.—Dworschak, 2018: 25–27 (synonymy).—Poore et al., 2019: 145.—Robles et al., 2020.—Padate et al., 2022: 198 (list).

**Material examined.** **Saudi Arabia**, Red Sea, Al Lith, 20.167155° N, 40.223307° E (stn SAFA-039), UF 37166 (female, 7 mm). **Oman**, Muscat, UF 5439 (female, 6.5 mm). **Papua New Guinea**, Madang lagoon, 05° 11.5' S, 145° 49.5' E (stn PR58), MNHN IU-2013-7044 (male, 8.9 mm). Riwo, 05° 09' S, 145° 48.2' E, 1–2 m (stn PR235), MNHN IU-2013-7039\* (female, 9.3 mm); MNHN IU-2013-7122\* (male, 4.3 mm).

**Diagnosis.** Antenna peduncle exceeding antennule peduncle by half of article 5. Cornea prominent, hemispherical (sometimes with extracorneal pigment); eyestalk distal lobes tapered, often truncate, with denticulate distal margin. Major cheliped merus lower margin with asymmetrically curved blade, widest and denticulate over proximal half, more prominent in adult; gape with molar-like tooth in male; fixed finger cutting edge smooth, or with low proximal tubercles; dactylus cutting edge with molar-like tooth near midpoint, deep notch, concave blade over distal half, or entire. Uropodal endopod posterior margin almost transverse, angle with anterior margin squarish. Telson clearly tapering from subproximal width to rounded corner between well-defined posterolateral margin and convex-straight posterior margin. Maximum cl. 25.6 mm.

**Distribution.** Western and Central Indo-Pacific (Saudi Arabia; Oman; Yemen; Red Sea [type locality: Djibouti, Périm]; Persian Gulf; India; Australia, Cocos (Keeling) Is; Indonesia; Papua New Guinea; Japan, Ryuku Is; Thailand; Philippines).

**Remarks.** The species has a long and complicated synonymy, but its identity was well established by Dworschak (2011b), who described and illustrated several specimens, including type material from Djibouti. The species is notable for the denticulate lobe on the eyestalk, and the major cheliped merus with an almost evenly convex denticulate blade widest about one-third way along.

Sakai (1999, 2005, 2011) listed *N. indicus* as a valid species, but Dworschak (2011b, 2018) treated *C. (Cheramus) indica* De Man, 1905 as a junior synonym of *N. jousseaumei*. He recorded the species from the Red Sea, Persian Gulf, Indonesia, Philippines, Thailand and Cocos (Keeling) Is (Australia). He also recorded the species from French Polynesia as junior synonym *Callianassa taiaro* Ngoc-Ho, 1995, following Sakai's (1999) synonymy of this species with *N. indicus* (De Man, 1905). Padate et al. (2022) added India to the distribution.

Dworschak (2011b) argued that *Callianassa natalensis* Barnard, 1947, *C. manningi* Kazmi and Kazmi, 1992, and *C. variabilis* Edmondson, 1944, also synonymised with *N. indicus* by Sakai (1999), are valid species.



*Neocallichirus taiaro* Ngoc-Ho, 1995 has been treated as a synonym of *N. indicus* or *N. jousseaumei* (Sakai, 1999; Dworschak, 2011b) but the shape of the eyestalk, chelipeds, female pleopod 2, uropod and telson fall outside the variability of the latter. None of the specimens of *Neocallichirus* from French Polynesia seen during this study could be identified as *N. taiaro* or *N. jousseaumei*.

Molecular data does not distinguish Papua New Guinea and Philippines representatives (Robles et al., 2020). The juvenile male (MNHN IU-2013-7122) has swollen eyestalks terminating in a typical truncate lobe but lacks pleopod 1, and has a biramous but simple pleopod 2. The uropodal endopod is narrower than in typical *N. jousseaumei*. Molecular data suggest it is very close to this species (Robles et al., 2020), but is too small to characterise.

### *Neocallichirus manningi* Kazmi and Kazmi, 1992

*Neocallichirus manningi* Kazmi and Kazmi, 1992: 296, fig. 1.—Sakai, 2011: 460.—Sepahvand et al., 2018: 247–251, figs 5–7.

*Neocallichirus indicus*.—Sakai, 1999: 99.

**Diagnosis.** Antenna peduncle exceeding antennule peduncle by one-third of article 5. Eyestalk distal lobes tapered, often truncate, with denticulate distal margin. Major cheliped merus lower margin evenly convex, smooth (female); gape simple; fixed finger cutting edge denticulate over most of length; dactylus cutting edge with 2 obscure teeth (female). Uropodal endopod posterior margin decidedly oblique, curving continuously to convex anterior margin. Telson clearly tapering from subproximal width to rounded corner between well-defined posterolateral margin and convex-straight posterior margin. Maximum cl. 9 mm.

**Distribution.** Somali/Arabian (Gulf of Oman, Pakistan [type locality: Karachi]).

**Remarks.** The species has erroneously been synonymised with *N. indicus*, a synonym of *N. jousseaumei* (cf. Sakai, 1999; Sepahvand et al., 2018).

### *Neocallichirus mauritanus* (Miers, 1882)

*Callianassa mauritiana* Miers, 1882: 341–342.—Miers, 1884: 15, pl. 1 fig. 2.—Nobili, 1906: 106, figs 5, 6.—Kensley, 1975: 51–53, fig. 3. *Callianassa (Trypaea) mauritiana*.—Borradaile, 1903: 546 (list). *Callianassa (Cheramus) mauritiana*.—De Man, 1928a: 26, 99, 160. *Neocallichirus mauritanus*.—Sakai, 1999: 103, fig. 21.—Sakai, 2011: 461.

**Diagnosis.** Eyestalk distal lobes triangular, rounded, diverging. Major cheliped merus lower margin with distinct proximal prominent square dentate blade, denticulate over distal three-quarters (male), or with proximal prominent triangular dentate blade, denticulate over distal three-quarters (female); gape with deep notch below triangular tooth in male; fixed finger cutting edge smooth; dactylus cutting edge with proximal molar-like tooth, distal half dentate (male). Pereopod 3 propodus with proximally directed lobe of lower margin protruding slightly beyond lower margin of carpus. Uropodal endopod posterior margin decidedly oblique, angle with anterior margin about 40°. Telson clearly tapering from greatest width at midpoint. Maximum cl. 25 mm.

**Distribution.** Western Indian Ocean (known only from type locality: Mauritius).

**Remarks.** The types have been illustrated three times. No material was available for this study. Although the species has been said to occur in the Red Sea (Kensley, 1975; Sakai, 1999) the only hitherto published records are from Mauritius (Miers, 1882; Kensley, 1975). If *Neocallichirus pola* Sakai and Türkay, 2014 were treated as a junior synonym the distribution of *N. mauritiana* would in fact include the Red Sea. The telson in particular of the two species are indistinguishable.

### *Neocallichirus moluccensis* (De Man, 1905)

*Callianassa (Cheramus) moluccensis* (De Man, 1905: 606.—De Man, 1928a: 26, 93, 99, 159–160, pl. 16 fig. 25–25a, pl. 17 fig. 25b–c.

*Neocallichirus moluccensis*.—Kazmi and Kazmi, 1992: 298–299, fig. 2.—Sakai, 1999: 104, fig. 25.—Sakai, 2005: 181–182.—Sakai, 2011: 462.—Sakai and Türkay, 2014: 185, figs 9, 10.

**Diagnosis.** Antenna peduncle exceeding antennule peduncle by one-third of article 5. Eyestalk distal lobes truncate, with distolateral sharp corner. Uropodal endopod posterior margin convex-oblique, angle with anterior margin rounded. Telson clearly tapering from subproximal width to rounded corner between well-defined posterolateral margin and convex-straight posterior margin. Maximum cl. 16.5 mm.

**Distribution.** Eastern Coral Triangle (Indonesia [type locality: Ambon]).

**Remarks.** De Man (1928a), Kazmi and Kazmi (1992) and Sakai (1999) illustrated the holotype of *Neocallichirus moluccensis*, a male (cl. 16.5 mm) without chelipeds from Ambon, Indonesia. These figures are inconsistent, although the cornea appears to be prominent and the anterior lobe on the eyestalk is more or less truncate with a sharp lateral angle. The telson is wider than long, tapering to a narrow posterior margin; the uropodal endopod is about as long as wide and the uropodal exopod about 1.2 times as wide as the anterior margin. A female (cl. 10.3 mm) from Sulawesi is only the second individual illustrated (Sakai and Türkay, 2014), but the eyestalks are rounded, without the anterolateral angle, and the telson more rounded. No material was available for this study.

### *Neocallichirus nagoi* sp. nov.

<https://zoobank.org/urn:lsid:zoobank.org:act:5B5DF4DF-D589-45E6-8042-BAC8949A91F5>

Figures 10, 11

*Neocallichirus* PNG-1589.—Robles et al., 2020: figs 1, 4, 7.

**Material examined.** Holotype. **Papua New Guinea.** New Ireland, Nago I. wharf, 0–1 m, 02° 36.2' S, 150° 46.1' E, 6 Oct 2014 (KAVIENG 2014 stn KM03), MNHN IU-2014-10052 (male, 6.6 mm).

Paratypes, collected with holotype, MNHN IU-2014-10417\* (female, 6.2 mm); MNHN IU-2016-8148\* (male, 7.9 mm); MNHN IU-2016-8149\* (male, 5.5 mm); MNHN IU-2014-10418 (3 males, 5.2–6.0 mm); 3–12 m, sand (KAVIENG 2014 stn KR06), MNHN IU-2014-1157\* (male, 5.8 mm). NMV J62087 (3 males, 5.2–6.0 mm).

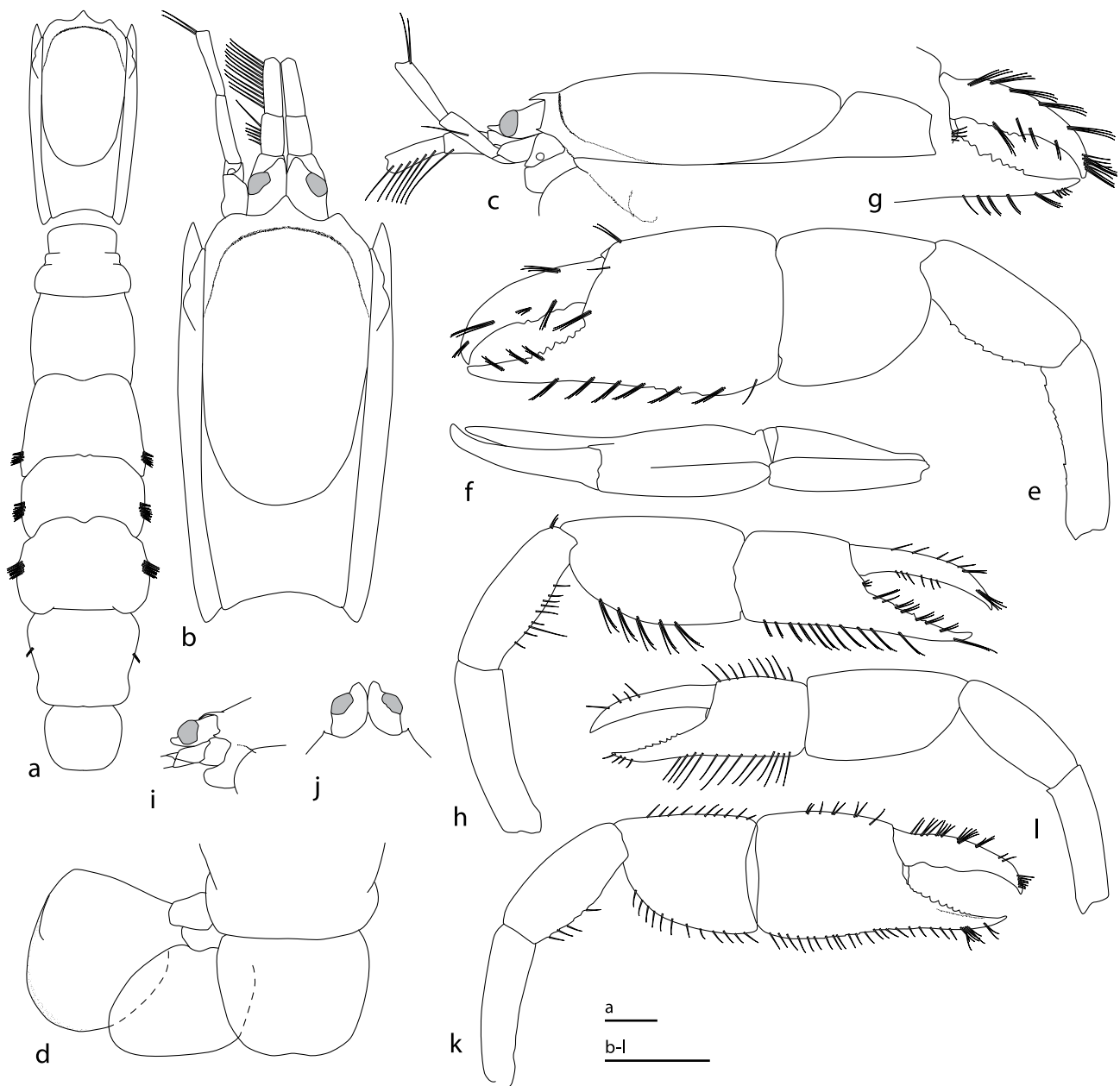


Figure 10. *Neocallichirus nagoi* sp. nov. Papua New Guinea. MNHN IU-2014-10052, holotype male, 6.6 mm: a, carapace, pleon, telson; b, c, carapace, eyestalks, antennular peduncle, antennal peduncle; d, telson, uropod; e, major cheliped (left, lateral); f, major cheliped, carpus–dactylus (upper view); g, major cheliped fingers (mesial); h, minor cheliped (right, lateral). MNHN IU-2014-10417, paratype female, 6.2 mm: i, j, eyestalks; k, major cheliped (left, mesial); l, minor cheliped (right, mesial).

**Diagnosis.** Antenna peduncle exceeding antennule peduncle by half of article 5. Eyestalk distal lobes triangular, rounded, diverging. Major cheliped merus lower margin evenly convex, denticulate; gape simple; fixed finger cutting edge concave, denticulate over proximal half; dactylus cutting edge entire. Uropodal endopod posterior margin convex-oblique, angle with anterior margin rounded. Telson scarcely tapering from subproximal width to broadly rounded posterolateral corner.

**Description.** Carapace c. 0.25 total length; with distinct linea thalassinica, with defined dorsal oval marked posteriorly by deep transverse cervical groove extending anteroventrally to each side above linea thalassinica as shallow groove demarcating posterior half of dorsal oval; frontal margin continued ventrolaterally beyond anterolateral lobe as soft ridge towards linea thalassinica. Branchiostegite with oblique ridge terminating at anterior end of prominent rounded hepatic boss;

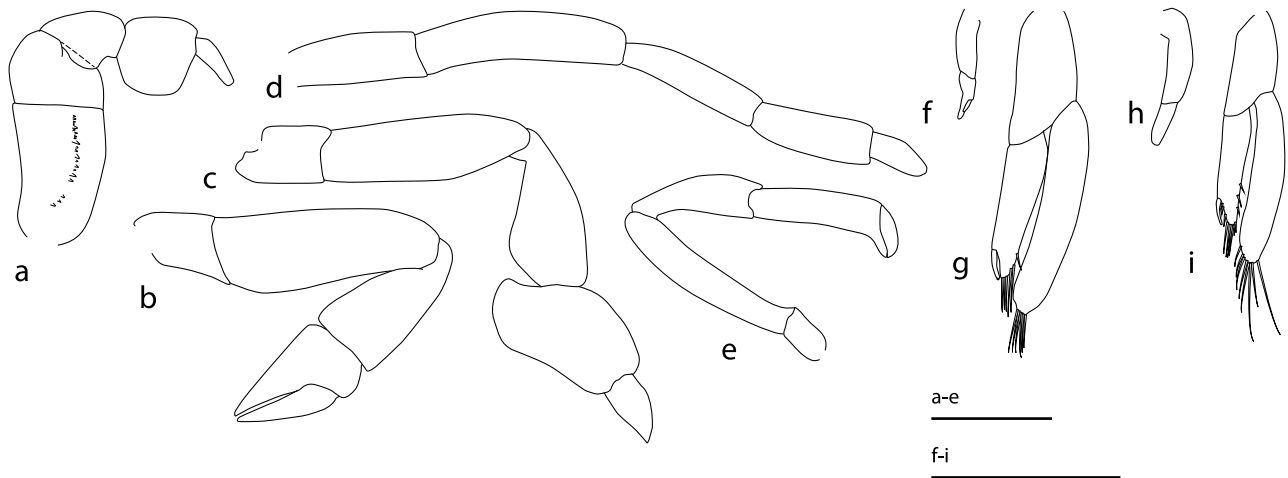


Figure 11. *Neocallichirus nagoi* sp. nov. Papua New Guinea. MNHN IU-2014-10052, holotype male, 6.6 mm: a, maxilliped 3; b–e, pereopods 2–5; f, g, pleopods 1, 2. MNHN IU-2014-10417, paratype female, 6.2 mm: h, i, pleopods 1, 2.

anterior branchiostegal lobe articulating at junction of oblique ridge and linea thalassinica. Rostrum slightly convex in lateral view, broadly triangular, reaching almost to cornea; anterolateral lobe flat, rounded in dorsal view, sometimes with small tubercle. Pleon with approximate ratio of pleonites 1–6 (along midline) 1 : 1 : 1 : 1.2 : 1.3; pleonites 3–5 with lateral tufts of setae; pleonite 6 with submarginal transverse grooves.

Eyestalk 1.5 times as long as wide, parallel-sided over proximal half, tapering beyond dorsally prominent hemispherical cornea, distal lobes flat, subtriangular, diverging distally, reaching end of antennal article 1. Antennular peduncle 0.4 times carapace length, article 3 1.5 times as long as article 2, with ventromesial and ventrolateral rows of long setae. Antennal peduncle exceeding antennular peduncle by half article 5, articles 4 and 5 subequal in length; scaphocerite semicircular. Maxilliped 3 setation typical of genus; ischium wider distally, extensor margin slightly concave, 1.5 times distal margin, flexor margin convex, crista dentata curved, of c. 22 uneven short sharp spines; merus subtriangular, slightly wider than long, flexor margin broadly rounded; carpus subtriangular, 1.5 times as long as wide, with lobe on flexor margin; propodus slightly wider than long, free distal margin slightly oblique; dactylus slightly arcuate, shorter than propodus.

Pereopods 1 (chelipeds) unequal, dissimilar, scarcely sexually dimorphic, relatively smaller in female. Major cheliped (male) carpus–dactylus 1.2 times carapace length; ischium slender, lower (flexor) margin with denticles over distal half; merus twice as long as wide, upper margin arcuate, lower margin curved, with c. 10 denticles over proximal two-thirds; carpus as long as wide, lower proximal margin regularly curved; propodus upper margin slightly longer than carpus, as long as greatest width, widest subproximally, upper margin carinate over proximal two-thirds, lower margin with submarginal mesial denticles extending on to base of fixed finger; palm distomesial margin with 2 tubercles at base of fixed finger; fixed finger 0.4 length of lower margin, twice as long as width at base, cutting edge with c. 9 triangular blunt

teeth over proximal two-thirds, smooth beyond; dactylus as long as upper margin of palm, cutting edge with irregular blade over proximal half, with acute hooked tip. Minor cheliped (male) barely shorter than major, palm 0.6 width of major palm; ischium narrow, unarmed, as long as merus; merus 3 times as long as wide, margins curved, unarmed; carpus almost as long as merus, 1.7 times as long as wide, widest near midpoint; palm upper margin half as long as carpus, 0.9 times as long as wide, lower margin 1.2 times as long as carpus; fixed finger evenly tapering, half length of lower margin, cutting edge with 5 well spaced denticles over middle third; dactylus 1.6 times as long as upper margin of palm, curved, cutting edge unarmed.

Major cheliped (female) carpus–dactylus 0.8 times carapace length; ischium slender, lower (flexor) margin with minute denticles; merus twice as long as wide, upper margin arcuate, lower margin curved, with c. 10 denticles over proximal two-thirds; carpus 1.2 times as long as wide, lower proximal margin regularly curved; propodus upper margin as long as carpus, little longer than greatest width, widest subproximally, upper margin of palm forming unserrated keel in proximal half, lower margin with submarginal mesial denticles extending on to base of fixed finger; palm distomesial margin unarmed; fixed finger 0.4 length of lower margin, twice as long as width at base, cutting edge with c. 9 triangular blunt teeth over proximal two-thirds, smooth beyond; dactylus as long as upper margin of palm, cutting edge with irregular blade over proximal half, with acute hooked tip. Minor cheliped (female) barely shorter than major, palm 0.6 width of major palm; ischium narrow, unarmed, as long as merus; merus 2.5 times as long as wide, margins curved, unarmed; carpus almost as long as merus, 1.7 times as long as wide, widest near midpoint; palm upper margin half as long as carpus, 1.1 times as long as wide, lower margin 0.8 times as long as carpus; fixed finger evenly tapering, half length of lower margin, cutting edge with 7 well-spaced denticles over middle third; dactylus 1.5 times as long as upper margin of palm, exceeding fixed finger, curved, cutting edge unarmed.

Pereopod 2 merus 3 times as long as wide; carpus 1.8 times as long as wide; chela almost as long as carpus, 1.6 times as long as wide; dactylus 0.7 of chela. Pereopod 3 merus 3 times as long as wide; carpus twice as long as wide; propodus with proximally directed lobe of lower margin aligned with lower margin of carpus, with subsquare proximal angle, with rounded margin leading to straight lower margin, upper margin convex; dactylus teardrop-shaped, 1.8 times as long as wide. Pereopod 4 linear, merus 4.5 times as long as wide; subchela poorly developed. Pereopod 5 fully chelate, fixed finger depressed.

Male pleopod 1 of 2 articles (in juveniles of 1 article or absent); article 2 0.7 time length of article 1, with lateral constriction at about midpoint, with linear appendix interna embedded in distal half of mesial margin, without hooks. Male pleopod 2 peduncle twice as long as wide; endopod slightly shorter than exopod, with subdistal appendix interna reaching end of endopod; without appendix masculina. Female pleopod 1 simple, of 2 articles; article 2 half length of article 1, simple. Female pleopod 2 essentially similar to male. Pleopods 3–5 with short, stubby appendix interna embedded into mesial margin of endopod.

Uropodal endopod as long as wide, anterior margin convex, with rounded corner to distal margin, distal and posterior margins continuous with slightly more exaggerated curvature between, dorsal surface with soft longitudinal carina; exopod 1.5 times as wide as anterior margin, anterior margin almost straight, distal and posterior margins evenly curved, dorsal plate ending submarginally, extending half width of exopod. Telson 1.35 times as wide as long, broadest at lateral lobes in anterior third, tapering at about 10°, posterior margin weakly sinuous, posterolateral corners broadly rounded, each bearing tuft of long setae; dorsal surface elevated anteromedially, with shallow median groove over posterior half.

*Size.* Cl. males 5.2–7.9 mm, female 6.2 mm.

*Etymology.* *Nagoi* is a contraction of Nago Island, the type locality, a noun in apposition.

*Distribution.* Eastern Coral Triangle (known only from type locality, Papua New Guinea).

*Remarks.* All specimens from this collection are similar in size; all except one is a male with open gonopores on the coxae of pereopod 5. The second article of the male pleopod 1 does not have two sharp curved apices typical of the genus, and that of the female is relatively short. These appear immature compared with those of most other species of *Neocallichirus*. The lower margin of the cheliped merus lacks a toothed blade, having instead a row of tubercles, a condition found in *N. darwinensis*, *N. horneri* and *N. moluccensis*. These species differ as follows. *Neocallichirus darwinensis* has reduced cornea, a more tapered telson, narrower minor cheliped and distally excavate propodus on maxilliped 3. *Neocallichirus horneri* has a more tapered telson, a more prominent lobe on the propodus of pereopod 3 and a shorter lower margin on the merus of maxilliped 3. The cornea of *N. moluccensis* is dorsally prominent as in the new species, but the distal eyestalk lobes are more truncate and the telson more tapered.

Robles et al. (2020) found *N. nagoi* (as *N. PNG-1589*) to be sister to a clade containing specimens of *N. calmani* from the

Philippines and French Polynesia, a species from which it differs in many ways.

### *Neocallichirus natalensis* (Barnard, 1947)

*Callianassa natalensis* Barnard, 1947: 379.—Barnard, 1950: 511, fig. 95f–h.—Kensley, 1974: 277.—Sakai, 1999: 100, fig. 23c (cheliped of holotype of *C. natalensis*).

*Neocallichirus natalensis*.—Dworschak, 2011b: 9–10, figs 5, 6I.

*Diagnosis.* Antenna peduncle exceeding antennule peduncle by half of article 5. Cornea prominent, hemispherical (sometimes with extracorneal pigment); eyestalk distal lobes tapered, often truncate, with denticulate distal margin. Major cheliped merus lower margin with deep rectangular denticulate blade over proximal three-quarters, margin straight or gently convex; gape with molar-like tooth in male; fixed finger cutting edge smooth; dactylus cutting edge with molar-like tooth near midpoint, deep notch, concave blade over distal half. Pereopod 3 propodus with proximally directed lobe of lower margin protruding slightly beyond lower margin of carpus. Uropodal endopod posterior margin almost transverse, angle with anterior margin squarish. Telson clearly tapering from subproximal width to rounded corner between well-defined posterolateral margin and convex-straight posterior margin. Maximum cl. 24.4 mm.

*Distribution.* Western Indian Ocean (South Africa [type locality: Natal]; Kenya).

*Remarks.* Sakai (1999) synonymised the species with *N. indicus*, but Dworschak (2011b) resurrected and reillustrated it.

### *Neocallichirus taiaro* Ngoc-Ho, 1995

*Neocallichirus taiaro* Ngoc-Ho 1995: 212–216, figs 1, 2.

*Diagnosis.* Antenna peduncle exceeding antennule peduncle by half of article 5. Eyestalk distal lobes triangular, rounded, diverging. Major cheliped merus lower margin evenly convex, denticulate; gape simple; fixed finger cutting edge smooth; dactylus cutting edge concave, with weak notch one-third way along. Uropodal endopod posterior margin decidedly oblique, curving continuously to convex anterior margin. Telson tapering from base to continuous rounded posterolateral margin. Maximum cl. 4 mm.

*Distribution.* Southeast Polynesia (French Polynesia [type locality: Tuamotu]).

*Remarks.* *Neocallichirus taiaro* Ngoc-Ho, 1995 has been treated as a synonym of *N. indicus* or *N. jousseaumei* (Sakai, 1999; Dworschak, 2011b) but the shape of the eyestalk, chelipeds, female pleopod 2, uropod and telson fall outside the variability of *N. jousseaumei*. None of the specimens of *Neocallichirus* from French Polynesia seen during this study could be identified as *N. taiaro* or *N. jousseaumei*.

### *Neocallichirus vaugelasi* Dworschak, 2011

*Callianassa jousseaumei*.—Dworschak, 1992: 198, figs 5a–d, 6a–c. *Neocallichirus vaugelasi* Dworschak, 2011b: 10–18, figs 7–10.

*Diagnosis.* Antenna peduncle exceeding antennule peduncle by half of article 5. Eyestalk distal lobes elongate, longer than

precorneal length, tapering, diverging, distally transparent. Major cheliped merus lower margin with convex dentate blade except over distal quarter; gape simple; fixed finger cutting edge denticulate over most of length; dactylus cutting edge with molar-like tooth in proximal half, separated by deep notch from broad subtriangular tooth distally. Uropodal endopod posterior margin moderately oblique, angle with anterior margin about 30°. Telson tapering from base to continuous rounded posterolateral margin. Maximum cl. 29.8 mm.

*Distribution.* Red Sea and Gulf of Aden (Jordan [type locality; Aqaba]).

*Remarks.* The species description was based on material reported by de Vaugelas (1984) and has been found only once since (Dworschak, 1992).

### *Neocallichirus vigilax* (De Man, 1916)

*Callianassa* (*Callichirus*) *vigilax* De Man, 1916: 57, pl. 1 figs 1–6.

*Neocallichirus denticulatus* Ngoc-Ho, 1994: 56, fig. 4.

*Neocallichirus vigilax*.—Sakai, 1999: 108.—Sakai, 2011: 464–465.—Dworschak, 2011a: 138–148, figs 1–79 (redescription, complete synonymy).—Dworschak, 2018: 25.—Poore et al., 2019: 141, 145, fig. 15j.—Robles et al., 2020: figs 1, 4, 7.

*Material examined.* *Neocallichirus denticulatus*. **Australia.** Qld, NE of Townsville, 18° 56' S, 146° 50' E, 24 m, NMV J22658 (holotype female, 6.7 mm), MNHN Th1246 (paratype female, 5.5 mm).

*Neocallichirus vigilax*. **Saudi Arabia.** Al Lith, 20.167155° N, 40.223307° E, UF 37165 (female, 12 mm); Farasan Banks, Marca I., 18.22055° N, 41.32438° E, UF 36640 (female, 12 mm); Thuwal, 22.29213° N, 39.09° E, UF 37092 (female, 7 mm). **USA,** Mariana Is, Guam, W coast, near Fish Eye Marine Park, UF 27327 (male); S coast, near Aga Point, UF 29710 (male). **Papua New Guinea.** Madang Province. Riwo, 05° 09' S, 145° 48.2' E, 1–2 m (stn PR235), MNHN IU-2013-7072\* (male, 7.4 mm); MNHN IU-2013-7043 (female, 7.2 mm); (stn PR195), MNHN IU-2013-7105\* (male, 5.2 mm). Madang lagoon, 05° 10.2' S, 145° 50.4' E, 1–3 m (stn PR243), (MNHN IU-2013-7129\* (male, 3.7 mm). New Ireland. NW corner of Little Nusa I., seagrass and sand, 0–1 m, 02° 34.9' S, 150° 46.8' E (stn KM13) MNHN IU-2014-10002\* (female, 12.3 mm); (stn KM11) MNHN IU-2014-2553\* (female, 13.0 mm); MNHN IU-2014-10004 (male, 6.7 mm); MNHN IU-2014-10009 (male, 7.2 mm). **French Polynesia.** Moorea, Haapiti, mangrove area, 17.55668° S, 149.8744° E, UF 15483 (juv., 4 mm), UF 15732 (male, 10.5 mm), Motu Tiatura 17.4891° S, 149.9121° E, UF 16478 (male, 3.3 mm); near Haapiti 17.55475° S, 149.87899° E, UF 29240 (female, 10.9 mm); Papetoai, 17.4911° S, 149.8844° E, UF 16281 (female, 9.5 mm), UF 16284 (female, 11 mm), UF 16293 (male, 5.5 mm), UF 23990 (female, 9.5 mm); between Papetoai and hotel, 17.4908° S, 149.8871° E, UF 16536 (male, 7 mm). **Australia.** Qld, Lizard I., Casuarina Beach, sand flat, 1 m, UF 17515 (male, 8 mm). Qld, Heron I., 23° 27' S, 151° 55' E, reef flat, NMV J40124\* (female); reef flat at Shark Bay, 23.45° S, 151.92° E, NMV J40125 (female, 13 mm, fixed in ethanol). Qld, Rib reef, shallow lagoon, 4 m, 18.47° S, 146.87° E, NMV J74247 (12 specimens), NMV J74248 (5 males and females, 6.8–14.0 mm). Qld, Myrmidon Reef, shallow lagoon, 8 m, 18.27° S, 147.38° E, NMV J74245 (ovigerous female, 12.3 mm), NMV J74246 (12).

*Diagnosis.* Carapace anterolateral lobe acute, prominent. Antenna peduncle exceeding antennule peduncle by half of article 5. Eyestalk distal lobes triangular, rounded, diverging, or truncate, with rounded distal margin, sometimes with dorsal ridge. Major cheliped merus lower margin with narrow straight

dentate blade over proximal three-quarters; palm tuberculate on lateral and distal mesial faces in larger individuals; gape simple; fixed finger cutting edge smooth; dactylus cutting edge obscurely tuberculate, with notch near midpoint. Uropodal endopod posterior margin decidedly oblique, angle with anterior margin about 40°. Telson tapering from base to continuous rounded posterolateral margin. Maximum cl. 24.4 mm.

*Distribution.* Western, Central and Eastern Indo-Pacific (Saudi Arabia, NE Australia, Indonesia [type locality: Ambon], Papua New Guinea, Philippines, Mariana Is, French Polynesia); shallow sand flats.

*Remarks.* The larger specimens agree well with the redescription of this species by Dworschak (2011a). It is notable for the slightly upturned anterolateral carapace spines and the concave anterior margin of the uropodal exopod. In the molecular phylogram based on nuclear and mitochondrial genes (Robles et al., 2020: fig. 4) eight individuals fell into three subclades: two from Madang, Papua New Guinea; two others also from Madang with a third from the Philippines; and two from Nusa I., Papua New Guinea, with a third from Queensland. Clades 2 and 3 are sister clades. No consistent morphological differences could be found between them, supporting the synonymy of *C. denticulatus* with *C. vigilax*.

### Acknowledgements

I thank Philippe Bouchet for his organisation of the Papouasie-Nouvelle-Guinée and Kavieng Lagoon biodiversity surveys (Principal Investigators: Philippe Bouchet, Jeff Kinch), part of the La Planète Revisitée expeditions organised jointly by Muséum national d'Histoire naturelle, Pro-Natura International and Institut de Recherche pour le Développement, with support from Papua New Guinea's National Fisheries Authority. The organisers acknowledge supporting funding from the Total Foundation, the Laboratoire d'Excellence Diversités Biologiques et Culturelles (LabEx BCDiv), the Laboratoire d'Excellence Diversités Biologiques et Culturelles (LabEx BCDiv, ANR-10-LABX-0003-BCDiv), the Programme Investissement d'Avenir (ANR-11-IDEX-0004-02), the Fonds Pacifique and CNRS Institut Ecologie et Environnement. The expedition was endorsed by the New Ireland Provincial Administration and operated under a memorandum of understanding with the University of Papua New Guinea. I am grateful to Laure Corbari, Paula Lefevre-Martin and Anouchka Krygelmans at MNHN and Zdeněk Ďuriš, University of Ostrava, Czech Republic, for help in making the collections available. I acknowledge all the divers who collected samples and the expeditioners who sorted them in the field.

I thank too Gustav Paulay and Amanda Bevis for the loan of collections from the Florida Museum of Natural History, University of Florida, and Robert Lasley Jr for checking on some. I am indebted to Darryl L. Felder and Rafael Robles, University of Louisiana at Lafayette, USA, Peter C. Dworschak, Naturhistorisches Museum, Vienna, Austria, and Fernando L. Mantelatto, University of São Paulo, Ribeirão Preto, São Paulo, Brazil for analyses and discussions leading to our new callianassoid classification and for financial support.

This study was supported by the National Taxonomy Research Grant Program (Grant numbers CN216-14 and CBG18-06) from the Australian Biological Resources Study and by the Alain Crosnier Fund at the MNHN in Paris.

## References

- Al-Kandari, M., Anker, A., Hussain, S., Sattari, Z., and De Grave, S. 2020. New records of decapod crustaceans from Kuwait (Malacostraca: Decapoda). *Zootaxa* 4803: 251–280. <https://doi.org/10.11646/zootaxa.4803.2.2>
- Ayón-Parente, M., Hendrickx, M.E., Ríos-Jara, E., and Salgado-Barragán, J. 2014. Records of mud shrimps (Crustacea: Decapoda: Axiidea and Gebiidae) from Pacific Mexico. *Journal of the Marine Biological Association of the United Kingdom* 94: 369–388. <https://doi.org/10.1017/S0025315413001495>
- Balss, H. 1933. Ueber einige systematisch interessante indopazifische Dekapoden. *Mitteilungen aus dem Zoologischen Museum in Berlin* 19: 85–98.
- Barnard, K.H. 1947. Description of new species of South African decapod Crustacea, with notes on synonymy and new records. *Annals and Magazine of Natural History (ser. 11)* 13: 361–392. <https://doi.org/10.1080/00222934608654562>
- Barnard, K.H. 1950. Descriptive catalogue of South African decapod Crustacea (crabs and shrimps). *Annals of the South African Museum* 38: 1–837. <https://biodiversitylibrary.org/page/40853502>
- Borradaile, L.A. 1903. On the classification of the Thalassinidea. *Annals and Magazine of Natural History (ser. 7)* 12: 534–551 + Addendum on p.638. <https://doi.org/10.1080/00222930308678891>
- Chace, F.A. 1962. The non-brachyuran decapod crustaceans of Clipperton Island. *Proceedings of the United States National Museum* 113: 605–635. <https://doi.org/10.5479/si.00963801.113-3466.605>
- Coutière, H. 1899. Note sur *Callianassa grandidieri* n. sp. (Voyage de M. Guillaume Grandidier à Madagascar). *Bulletin du Muséum National d'Histoire Naturelle, Paris* 5: 285–287. <https://www.biodiversitylibrary.org/page/42892574>
- Dallwitz, M.J. 2018. Overview of the DELTA system. <https://www.delta-intkey.com/www/overview.htm>
- Davie, P.J.F. 2002. *Crustacea: Malacostraca: Phyllocarida, Hoplocarida, Eucarida (Part 1)*. Vol. 19.3A. CSIRO Publishing: Melbourne. 551 pp.
- DecaNet eds. (2023). DecaNet. *Neocallichirus* Sakai, 1988. Accessed through: World Register of Marine Species at: <https://www.marinespecies.org/aphia.php?p=taxdetails&id=415685> on 26 Apr 2023
- Dworschak, P.C. 1992. The Thalassinidea in the Museum of Natural History, Vienna; with some remarks on the biology of the species. *Annalen des Naturhistorischen Museums in Wien, Serie B* 93: 189–238.
- Dworschak, P.C. 2007. First record of *Lepidophthalmus tridentatus* (von Martens, 1868) (Callianassidae) from the Philippines. *Annalen des Naturhistorischen Museums in Wien, Serie B* 108: 121–130.
- Dworschak, P.C. 2008. *Neocallichirus kemp* Sakai, 1999, a junior synonym of *Callianassa karumba* Poore and Griffin, 1979 (Decapoda: Callianassidae). *Raffles Bulletin of Zoology* 56: 75–84.
- Dworschak, P.C. 2011a. Redescription of *Callianassa vigilax* De Man, 1916, a subjective senior synonym of *Neocallichirus denticulatus* Ngoc-Ho, 1994 (Crustacea: Decapoda: Callianassidae). *Annalen des Naturhistorischen Museums in Wien, B* 112: 137–151.
- Dworschak, P.C. 2011b. Redescription of *Callianassa jousseaumei* Nobili, 1904, a junior subjective synonym of *Callianassa indica* de Man, 1905 with description of a new species of *Neocallichirus* (Decapoda: Axiidea: Callianassidae). *Zootaxa* 2746: 1–19. <https://doi.org/10.11646/zootaxa.2746.1.1>
- Dworschak, P.C. 2014. The Axiidea (Crustacea, Decapoda) of Cocos (Keeling) and Christmas Islands, with description of a new species of *Eucalliax* Manning and Felder, 1991. *Raffles Bulletin of Zoology Supplement* 30: 230–245.
- Dworschak, P.C. 2018. Axiidea of Panglao, the Philippines: families Callianideidae, Eucalliidae and Callichiridae, with a redescription of *Callianassacalmani* Nobili, 1904. *Annalen des Naturhistorischen Museums in Wien, B* 120: 15–40.
- Dworschak, P.C. 2022. On a collection of axiidean shrimp (Decapoda: Callianassidae, Callichiridae and Callianideidae) from the Gulf of Aqaba, Red Sea. *Annalen des Naturhistorischen Museums in Wien, Serie B* 124: 249–264.
- Dworschak, P.C., and Anker, A. 2022. Axiidea (Crustacea: Callianassidae, Callichiridae and Ctenochelidae) and Gebiidea (Upogebiidae) collected during the Comprehensive Marine Biodiversity Survey of Singapore. *Raffles Bulletin of Zoology* 70: 108–133. <https://doi.org/10.26107/RBZ-2022-0008>
- Edmondson, C.H. 1944. Callianassidae of the Central Pacific. *Bernice P. Bishop Museum Occasional Paper* 18: 35–61.
- Felder, D.L. 2019. Designation of a neotype for *Glypturus rabalaisae* Sakai, 2011, a ghost shrimp from continental shelf waters of the northern Gulf of Mexico (Crustacea: Decapoda: Callianassidae). *Zootaxa*: 194–200. <https://doi.org/10.11646/zootaxa.4679.1.12>
- Felder, D.L., and Manning, R.B. 1995. *Neocallichirus cacahuat*, a new species of ghost shrimp from the Atlantic coast of Florida, with reexamination of *N. grandimana* and *N. lemaitrei* (Crustacea: Decapoda: Callianassidae). *Proceedings of the Biological Society of Washington* 108: 477–490. <https://www.biodiversitylibrary.org/page/34572311>
- Gibbes, L.R. 1850. On the carcinological collections of the cabinets of natural history in the United States with an enumeration of the species contained therein, and description of new species. *Proceedings of the American Association for the Advancement of Science* 3rd meeting: 167–201.
- Hernández, P., Miranda, M.S., Rio, J.P.P., and Pinheiro, M.A.A. 2022. A new *Callichirus* ghost shrimp species from the south-western Atlantic, long confounded with *C. major* (Say, 1818) (Decapoda: Axiidea: Callichiridae). *Journal of Natural History* 56: 533–563. <https://doi.org/10.1080/00222933.2022.2067016>
- Hernández, P., Windsor, A.M., Paula, C.A., and Santana, W. 2020. A new species of the ghost shrimp genus *Neocallichirus* Sakai, 1988 (Decapoda: Axiidea: Callianassidae) from the southwestern Atlantic. *Marine Biology Research* 16: 50–60. <https://doi.org/10.1080/17451000.2019.1703003>
- Hernández-Aguilera, J.L., Salgado, L., and Henández, P.S. 1986. Crustáceos estomatópodos y decápodos de Isla Clarión. Fauna Carcinologica insula de Mexico, I. *Investigaciones Oceanográficas Biología* 3: 183–250.
- Kazmi, Q.B., and Kazmi, M.A. 1992. A new species of a callianassid shrimp, *Neocallichirus manningi*, with a note on the genus *Neocallichirus* Sakai 1988, not previously recorded from the Arabian Sea (Decapoda, Thalassinidea). *Crustaceana* 63: 296–300. <https://doi.org/10.1163/156854092X00442>
- Kensley, B. 1974. The genus *Callianassa* (Crustacea Decapoda, Thalassinidea) from the west coast of South Africa with a key to South African species. *Annals of the South African Museum* 62: 265–278. <https://biodiversitylibrary.org/page/40910523>
- Kensley, B. 1975. Records of mud-prawns (genus *Callianassa*) from South Africa and Mauritius (Crustacea, Decapoda, Thalassinidea). *Annals of the South African Museum* 69: 47–57. <http://biodiversitylibrary.org/page/41097139>

- Kensley, B. 2001. A new species of *Corallichirius* Manning, 1992 (Crustacea: Decapoda: Callianassidae) from Guam. *Bulletin of the Biological Society of Washington* 10: 328–333. <https://repository.si.edu/handle/10088/14811>
- Komai, T., Maenosono, T., and Osawa, M. 2015. Records of three species of callianassid ghost shrimp from the genera *Glypturus* Stimpson, 1866 and *Corallianassa* Manning, 1987 (Crustacea: Decapoda: Axiidea) from the Ryukyu Islands, Japan, with remarks on the taxonomic status of the two genera. *Fauna Ryukyuan* 27: 13–59.
- Komai, T., Osawa, M., Maenosono, T., Fujita, Y., and Naruse, T. 2018. Records of the callianassid ghost shrimp *Lepidophthalmus tridentatus* (von Martens, 1868) (Crustacea: Decapoda: Axiidea: Callianassidae) from the Ryukyu Islands, Japan. *Fauna Ryukyuan* 42: 9–27.
- Lemaitre, R., and Felder, D.L. 1996. A new species of ghost shrimp of the genus *Sergio* Manning and Lemaitre, 1994 (Crustacea: Decapoda: Callianassidae) from the Caribbean coast of Colombia. *Proceedings of the Biological Society of Washington* 109: 453–463. <https://www.biodiversitylibrary.org/page/34645060>
- Lenz, H., and Richters, F. 1881. Beitrag zur Crustaceenfauna von Madagascar. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 12: 421–428. <https://biodiversitylibrary.org/page/26181088>
- Liu, W., and Liu, J.-Y. 2009. *Michaelcallianassa sinica* sp. nov. (Crustacea, Decapoda, Thalassinidea, Callianassidae) from the South China Sea. *Zootaxa* 2294: 39–46. <https://doi.org/10.11646/zootaxa.2294.1.3>
- Man, J.G. de 1888. Bericht über die von Herrn Dr. J. Brock im indischen Archipel gesammelten Decapoden und Stomatopoden. *Archiv für Naturgeschichte* 53: 215–600, pls 217–222. <https://biodiversitylibrary.org/page/6379410>
- Man, J.G. de 1902. Die von Herrn Professor Kükenthal im Indischen Archipel gesammelten Dekapoden und Stomatopoden. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 25: 465–929. <http://biodiversitylibrary.org/page/25232702>
- Man, J.G. de 1905. Diagnoses of new species of macrurous decapod Crustacea from the “Siboga-Expedition”. *Tijdschrift der Nederlandsche Dierkundige Vereeniging* 9: 587–614. <http://biodiversitylibrary.org/page/9779712>
- Man, J.G. de 1916. Description of a new species of the genus *Callianassa* Leach and of a species of the genus *Alpheus* Fabr., both from the Indian archipelago. *Zoologische Mededelingen* 2: 57–61. <https://repository.naturalis.nl/pub/318824>
- Man, J.G. de 1928a. The Decapoda of the Siboga-Expedition. Part 7. The Thalassinidae and Callianassidae collected by the Siboga-Expedition with some remarks on the Laomedidae. *Siboga-Expédition* 39a6: 1–187.
- Man, J.G. de 1928b. A contribution to the knowledge of twenty-two species and three varieties of the genus *Callianassa* Leach. *Capita Zoologica* 2: 1–56.
- Manning, R.B. 1987. Notes on western Atlantic Callianassidae (Crustacea: Decapoda: Thalassinidea). *Proceedings of the Biological Society of Washington* 100: 386–401. <https://biodiversitylibrary.org/page/34570790>
- Manning, R.B. 1988. The status of *Callianassa hartmeyeri* Schmitt, 1935, with the description of *Corallianassa xutha* from the west coast of America (Crustacea, Decapoda, Thalassinidea). *Proceedings of the Biological Society of Washington* 101: 883–889. <https://www.biodiversitylibrary.org/page/34646580>
- Manning, R.B., and Felder, D.L. 1991. Revision of the American Callianassidae (Crustacea: Decapoda: Thalassinidea). *Proceedings of the Biological Society of Washington* 104: 764–792. <http://biodiversitylibrary.org/page/34809466>
- Manning, R.B., and Felder, D.L. 1995. Description of the ghost shrimp *Sergio merceae*, a new species from south Florida, with reexamination of *S. guassutunga* (Crustacea: Decapoda: Callianassidae). *Proceedings of the Biological Society of Washington* 108: 266–280. <https://www.biodiversitylibrary.org/page/34572096>
- Martens, E. von 1868. Über einige neue Crustaceen. *Monatsberichte der Königlich-Preussischen Akademie der Wissenschaften zu Berlin* 1868: 608–615. <https://biodiversitylibrary.org/page/35990130>
- Miers, E.J. 1882. On some crustaceans collected at the Mauritius. *Proceedings of the Zoological Society of London* 1882: 339–342. <https://biodiversitylibrary.org/page/30825651>
- Miers, E.J. 1884. On some crustaceans from Mauritius. *Proceedings of the Zoological Society of London* 1884: 10–17, pl. 11. <https://biodiversitylibrary.org/page/30826242>
- Milne-Edwards, A. 1870. Revision du genre *Callianassa* (Leach) et description de plusieurs espèces nouvelles de ce groupe. *Nouvelles Archives du Muséum d'Histoire Naturelle de Paris* 6: 75–102. <https://biodiversitylibrary.org/page/13957656>
- Ngoc-Ho, N. 1994. Some Callianassidae and Upogebidae from Australia with description of four new species (Crustacea: Decapoda: Thalassinidea). *Memoirs of the Museum of Victoria* 54: 51–78. <https://doi.org/10.24199/j.mmv.1994.54.02>
- Ngoc-Ho, N. 1995. Une espèce nouvelle de *Neocallichirus* aux îles Tuamotu, Polynésie française (Crustacea, Decapoda, Thalassinidea). *Bulletin du Muséum National d'Histoire Naturelle, Paris* 17: 211–218. <https://www.biodiversitylibrary.org/page/59172126>
- Ngoc-Ho, N. 2002. A new species of *Calliapagurops* de Saint Laurent from the Philippines with a discussion of the taxonomic position of the genus (Thalassinidea, Callianassidae). *Crustaceana* 75: 539–549.
- Ngoc-Ho, N. 2005. Thalassinidea (Crustacea, Decapoda) from French Polynesia. *Zoosystema* 27: 47–83. <http://sciencepress.mnhn.fr/sites/default/files/articles/pdf/z2005n1a4.pdf>
- Nobili, G. 1904. Diagnoses préliminaires de vingt-huit espèces nouvelles de Stomatopodes et Décapodes Macroures de la Mer Rouge. *Bulletin du Muséum National d'Histoire Naturelle, Paris* 10: 228–238. <https://biodiversitylibrary.org/page/5024281>
- Nobili, G. 1906. Faune carcinologique de la Mer Rouge. Décapodes et stomatopodes. *Annales des Sciences Naturelles, 9e série* 4: 1–347, pls 341–311. <http://www.biodiversitylibrary.org/item/41649>
- Ortmann, A.E. 1894. Crustaceen. In, Semon, R. (ed.), *Zoologische Forschungsreisen in Australien und dem malayischen Archipel. Denkschriften der Medicinisch-Naturwissenschaftlichen Gesellschaft zu Jena* 8: 3–80, pls 81–83. <https://biodiversitylibrary.org/page/39291795>
- Padate, V.P., Cubelio, S.S., and Takeda, M. 2022. Two axiidean ghost shrimps (Crustacea: Decapoda) from India, *Guyanacaris keralam* sp. nov. (Axiidae) and *Paragouretia galathea* (K. Sakai, 2017) (Ctenochelidae). *Zootaxa* 5093: 195–217. <https://doi.org/10.11646/zootaxa.5093.2.4>
- Poore, G.C.B. 2021. Indo-West Pacific and Australian species of Eucalliidae with descriptions of four new species (Crustacea, Axiidea). *Memoirs of Museum Victoria* 80: 1–41. <https://doi.org/10.24199/j.mmv.2021.80.01>
- Poore, G.C.B., and Griffin, D.J.G. 1979. The Thalassinidea (Crustacea: Decapoda) of Australia. *Records of the Australian Museum* 32: 217–321. <http://doi.org/10.3853/j.0067-1975.32.1979.457>
- Poore, G.C.B., and Suchanek, T.H. 1988. *Glypturus motupore*, a new callianassid shrimp (Crustacea: Decapoda) from Papua New Guinea with notes on its ecology. *Records of the Australian Museum* 40: 197–204. <https://doi.org/10.3853/j.0067-1975.40.1988.154>
- Poore, G.C.B., Dworschak, P.C., Robles, R., Mantelatto, F.L., and Felder, D.L. 2019. A new classification of Callianassidae and related families (Crustacea: Decapoda: Axiidea) derived from a molecular phylogeny with morphological support. *Memoirs of Museum Victoria* 78: 73–146. <https://doi.org/10.24199/j.mmv.2019.78.05>

- Poore, G.C.B., Dworschak, P.C., and Schnabel, K.E. 2022. *Articullichirus*, a new genus of ghost shrimp (Crustacea: Axiidea: Callichiridae) with one new species. *Memoirs of Museum Victoria* 81: 123–133. <https://doi.org/10.24199/j.mmv.2022.81.05>
- Poore, G.C.B., Longenecker, K., and Tudge, C.C. 2023. Reappraisal of Hawaiian species of *Corallianassa* Manning, 1987 (Crustacea: Axiidea: Callichiridae). *Zootaxa* 5249: 277–289. <https://doi.org/10.11646/zootaxa.5249.2.5>
- Rathbun, M.J. 1906. The Brachyura and Macrura of the Hawaiian Islands. *Bulletin of the United States Fish Commission* 23: 827–930, pls 821–824. <https://www.biodiversitylibrary.org/page/51691471>
- Robles, R., Tudge, C.C., Dworschak, P.D., Poore, G.C.B., and Felder, D.L. 2009. Molecular phylogeny of the Thalassinidea based on nuclear and mitochondrial genes. Pp. 309–326 in: Martin, J.W., Crandall, K.A., and Felder, D.L. (eds), *Crustacean Issues Vol. 18: Decapod Crustacean Phylogenetics*. CRC Press: Boca Raton. <http://doi.org/10.1201/9781420092592>
- Robles, R., Dworschak, P.C., Felder, D.L., Poore, G.C.B., and Mantelatto, F.L. 2020. A molecular phylogeny of Callianassidae and related families (Crustacea: Decapoda: Axiidea) with morphological support. *Invertebrate Systematics* 34: 113–132. <https://doi.org/10.1071/IS19021>
- Saint Laurent, M. de, and Le Loeuff, P. 1979. Campagnes de la *Calypso* au large des côtes Atlantiques Africaines (1956 et 1959) (suite). 22. Crustacés Décapodes Thalassinidea. I. Upogebiidae et Callianassidae. In: Forest, J. (ed.), *Résultats Scientifiques des Campagnes de la Calypso*. Fasc. 11 (22). *Annales de l'Institut Océanographique, Monaco et Paris* 55 suppl.: 29–101.
- Sakai, K. 1967. Three new species of Thalassinidea (Decapoda, Crustacea) from Japan. *Researches on Crustacea* 3: 39–51. [https://doi.org/10.18353/rcrustacea.3.0\\_39](https://doi.org/10.18353/rcrustacea.3.0_39)
- Sakai, K. 1970. Supplementary description of *Callianassa* (*Callichirus*) *tridentata* von Martens (Crustacea, Thalassinidea) Noona Dan papers No. 97. *Publications of the Seto Marine Biological Laboratory* 17: 393–401.
- Sakai, K. 1988. A new genus and five new species of Callianassidae (Crustacea: Decapoda: Thalassinidea) from northern Australia. *The Beagle, Occasional Papers of the Northern Territory Museum of Arts and Sciences* 5: 51–69. <https://biodiversitylibrary.org/page/55688670>
- Sakai, K. 1999. Synopsis of the family Callianassidae, with keys to subfamilies, genera and species, and the description of new taxa (Crustacea: Decapoda: Thalassinidea). *Zoologische Verhandlungen* 326: 1–152. <http://www.repository.naturalis.nl/record/219414>
- Sakai, K. 2000. A new species of *Neocallichirus*, *N. angelikae* from South Australia (Decapoda: Callianassidae). *Mitteilungen aus dem Hamburgischen Zoologischen Institut und Museum* 97: 91–98.
- Sakai, K. 2002. Callianassidae (Decapoda, Thalassinidea) in the Andaman Sea, Thailand. *Phuket Marine Biological Center Special Publication* 23: 461–532.
- Sakai, K. 2004. Dr. R. Plante's collection of the families Callianassidae and Gourretiidae (Decapoda, Thalassinidea) from Madagascar, with the description of two new genera and one new species of the Gourretiidae Sakai, 1999 (new status) and two new species of the Callianassidae Dana, 1852. *Crustaceana* 77: 553–601. <https://doi.org/10.1163/1568540041718019>
- Sakai, K. 2005. Callianassoidea of the world (Decapoda: Thalassinidea). *Crustaceana Monographs* 4: 1–285. <https://doi.org/10.1163/9789047416890>
- Sakai, K. 2010. Callianassoidea from the Gulf of Tonkin and the Red Sea, in the Zoological Museum of Moscow University (Decapoda, Thalassinidea). *Crustaceana* 83: 1431–1467. <https://doi.org/10.1163/001121610X538174>
- Sakai, K. 2011. Axiidea of the world and a reconsideration of the Callianassoidea (Decapoda, Thalassinidea, Callianassida). *Crustaceana Monographs* 13: 1–616.
- Sakai, K. 2015. A revised list of all ghost shrimps (Callianassidea and Thalassinidea) (Decapoda, Pleocyemata) from the Red Sea area, with a new genus, *Lepidophthalminus* gen. nov. and two new species in the genera *Gilvossius* and *Neocallichirus*. *Crustaceana* 88: 422–448. <https://doi.org/10.1163/15685403-00003420>
- Sakai, K., and Apel, M. 2002. Thalassinidea (Crustacea: Decapoda) from Socotra Archipelago, Yemen, with a new species of *Lepidophthalmus*. *Fauna of Arabia* 19: 273–288.
- Sakai, K., and Türkay, M. 2014. A review of the collections of the Infraorders Thalassinidea Latreille, 1831 and Callianassidea Dana, 1852 (Decapoda, Pleocyemata) lodged in three German museums, with revised keys to the genera and species. *Crustaceana* 87: 129–211. <https://doi.org/10.1163/15685403-00003281>
- Sakai, K., Al-Aidaros, A.M., Brösing, A., Spiridonov, V., Werding, B., and Türkay, M. 2014. A collection of Callianassidea Dana, 1852 (Decapoda, Pleocyemata) from the Saudi Arabian Red Sea coast with a check-list of all ghost shrimps (Thalassinidea and Callianassidea) known from the area. *Crustaceana* 87: 489–512. <https://doi.org/10.1163/15685403-00003297>
- Schmitt, W.L. 1935. Mud shrimps of the Atlantic coast of North America. *Smithsonian Miscellaneous Contributions* 93 (2): 1–21. <https://www.biodiversitylibrary.org/page/26492504>
- Sepahvand, V., Komai, T., Momtazi, F., and Shahabi, S. 2018. A new species of the ghost shrimp genus *Neocallichirus* Sakai, 1988 from Iran, and new record of *N. manningi* Kazmi and Kazmi, 1992 (Decapoda: Axiidea: Callianassidae). *Zootaxa* 4527: 239–254. <https://doi.org/10.11646/zootaxa.4527.2.5>
- Sepahvand, V., Momtazi, F., and Tudge, C. 2020. A new species of ghost shrimp of the genus *Michaelcallianassa* Sakai, 2002 (Crustacea: Decapoda: Axiidea: Callichiridae) from subtidal waters of the Persian Gulf, Iran. *Zootaxa* 4810: 383–388. <https://doi.org/10.11646/zootaxa.4810.2.12>
- Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N., Ferdana, Z.A., Finlayson, M., Halpern, B.S., Jorge, M.A., Lombana, A., and Lourie, S.A. 2007. Marine Ecoregions of the World: a bioregionalization of coastal and shelf areas. *Bioscience* 57: 573–584. <https://doi.org/10.1641/B570707>
- Stimpson, W. 1866. Descriptions of new genera and species of macrurous Crustacea from the coasts of North America. *Proceedings of the Chicago Academy of Science* 1: 46–48.
- Strahl, C. 1862. Über einige neue von Hrn. F. Jagor eingesandte Thalassinen und die systematische Stellung dieser Familie. *Monatsberichte der Königlichen Preussischen Akademie der Wissenschaften zu Berlin* 1861: 1055–1072. <https://biodiversitylibrary.org/page/38646928>
- Thallwitz, J. 1891. Decapoden-Studien, insbesondere basirt auf A. B. Meyer's Sammlungen im Ostindischen Archipel, nebst einer Aufzählung der Decapoden und Stomatopoden des Dresdener Museums. *Abhandlungen und Berichte aus dem königlichen Zoologischen und Anthropologisch-Ethnographischen Museum zu Dresden* 3(3): 1–55. <https://biodiversitylibrary.org/page/33470357>
- Tirmizi, N.M. 1977. A redescription of the holotype of *Callianassa mucronata* Strahl, 1861 (Decapoda, Thalassinidea). *Crustaceana* 32: 21–26. <https://doi.org/10.1163/156854077X00845>
- Tudge, C.C., Poore, G.C.B., and Lemaitre, R. 2000. Preliminary phylogenetic analysis of generic relationships within the Callianassidae and Ctenochelidae (Decapoda: Thalassinidea: Callianassoidea). *Journal of Crustacean Biology* 20 (Special Issue 2): 129–149. <https://doi.org/10.1163/1937240X-90000015>



- Vaugelas, J. de 1984. Preliminary observations on two types of callianassid (Crustacea, Thalassinidea) burrows. Gulf of Aquaba (Red Sea). Pp. 520–539 in: Saad, M.A.H. (ed.), *Proceedings of the Symposium on Coral Reef Environments of the Red Sea*. Abdulaziz University Press: Jeddah.
- Vaugelas, J. de, and de Saint Laurent, M. 1984. Premières données sur l'écologie de *Callichirus laurae* de Saint Laurent sp. nov. (Crustacea Decapoda Callianassidae: son action bioturbatrice sur les formations sédimentaires du golfe d'Aqaba (Mer Rouge). *Comptes rendus de l'Académie des Sciences (sér. 3)* 298: 147–152.