

A new species of *Periclimenaeus* (Crustacea: Decapoda: Palaemonidae) from Bohol (Philippines)

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Abstract. A new species of sponge-dwelling palaemonid shrimp of the genus *Periclimenaeus* is described from Tambolian Reef, Bohol, in the Philippines. The new species belongs to the group wherein the dactylus of the third pereiopod has a distal accessory tooth and the corpus has ventral denticles, but the unguis is non-dentate. Amongst this group, the new species is closest to *P. apomonosi*, *P. bidentatus*, *P. leptodactylus*, and *P. tuamotae*. It can be separated from these species by the combination of the following characters: well-developed dorsal rostral teeth; presence of a supraorbital tooth; presence of a pointed process on the inferior orbital margin; presence of the dorsal anteromedian lobe on the first tergite; presence of a minute acute median process on the distal margin of the telson; and presence of tubercles along the ventral border of the merus and ischium of the second pereiopods. This is the seventh species of *Periclimenaeus* reported from the Philippines.

Key words. Decapoda, Palaemonidae, new species, Philippines, *Periclimenaeus*, sponge-dwelling shrimp

INTRODUCTION

Periclimenaeus Borradaile, 1915, is one of the most diverse genera in the family Palaemonidae, with 85 species currently recognised (De Grave & Fransen, 2011; Bruce, 2013, 2014a, b, c, d; Ramos-Tafur & Lemaître, 2017; Park et al., 2019; Park & De Grave, 2021) and several more species awaiting formal description (Bruce, 1969, 1970). The genus is near-cosmopolitan in distribution and appears to be primarily associated with either Porifera or Ascidiacea, although for many species, their exact host association is unknown (Bruce, 2013).

Despite being located within the Coral Triangle, the marine palaemonid shrimp fauna of the Philippines remains poorly known, largely based on Bruce & Svoboda (1984), Bruce (1989), and Chace & Bruce (1993). Only six species of *Periclimenaeus* have been recorded before, to wit: *Periclimenaeus* aff. *colodactylus* Bruce, 1996; *P. jeancharcoti* Bruce, 1991a; *P. minutus* Holthuis, 1952; *P. pachydentatus* Bruce, 1969; *P. storchi* Bruce, 1989; and *P. tridentatus* (Miers, 1884) (see Chace & Bruce, 1993; Fransen, 2006; Bruce, 2013). Herein, we describe a new species of *Periclimenaeus* based on material collected from Tambolian Reef, Bohol, in the Philippines.

MATERIAL AND METHODS

Specimens were collected by SCUBA diving in depths of 20–22 m around Tambolian Reef, off northwestern Bohol (central Philippines), on an expedition jointly organised by the Korea Institute of Ocean Science & Technology (KIOST), the University of the Philippines Visayas (UPV), and Seoul National University (SNU) in 2018. Morphological characters were observed under stereo (Leica M205C and M125, Leica, Germany) and light microscopes (BX51, Olympus, Japan). Digital illustrations were done using a microscope-mounted digital camera (MC170, Leica, Germany), Helicon focus software (Helicon focus 7.5.6, Ukraine), and a drawing tablet (Wacom Intuos Pro PTH-660, China) with Adobe Illustrator software (Adobe Systems, USA), following Coleman (2006). Postorbital carapace length (in mm) was measured from the postorbital margin to the posterior dorsal margin of the carapace. Field collection numbers (fcn PB) were recorded for each specimen. Specimens examined are deposited in the Crustacean Collection of the National Museum of the Philippines, Manila (NMCR), and the Zoological Reference Collection (ZRC), Lee Kong Chian Natural History Museum, Singapore.

TAXONOMY

Family Palaemonidae Rafinesque, 1815

Genus *Periclimenaeus* Borradaile, 1915

Periclimenaeus alius, new species (Figs. 1–5)

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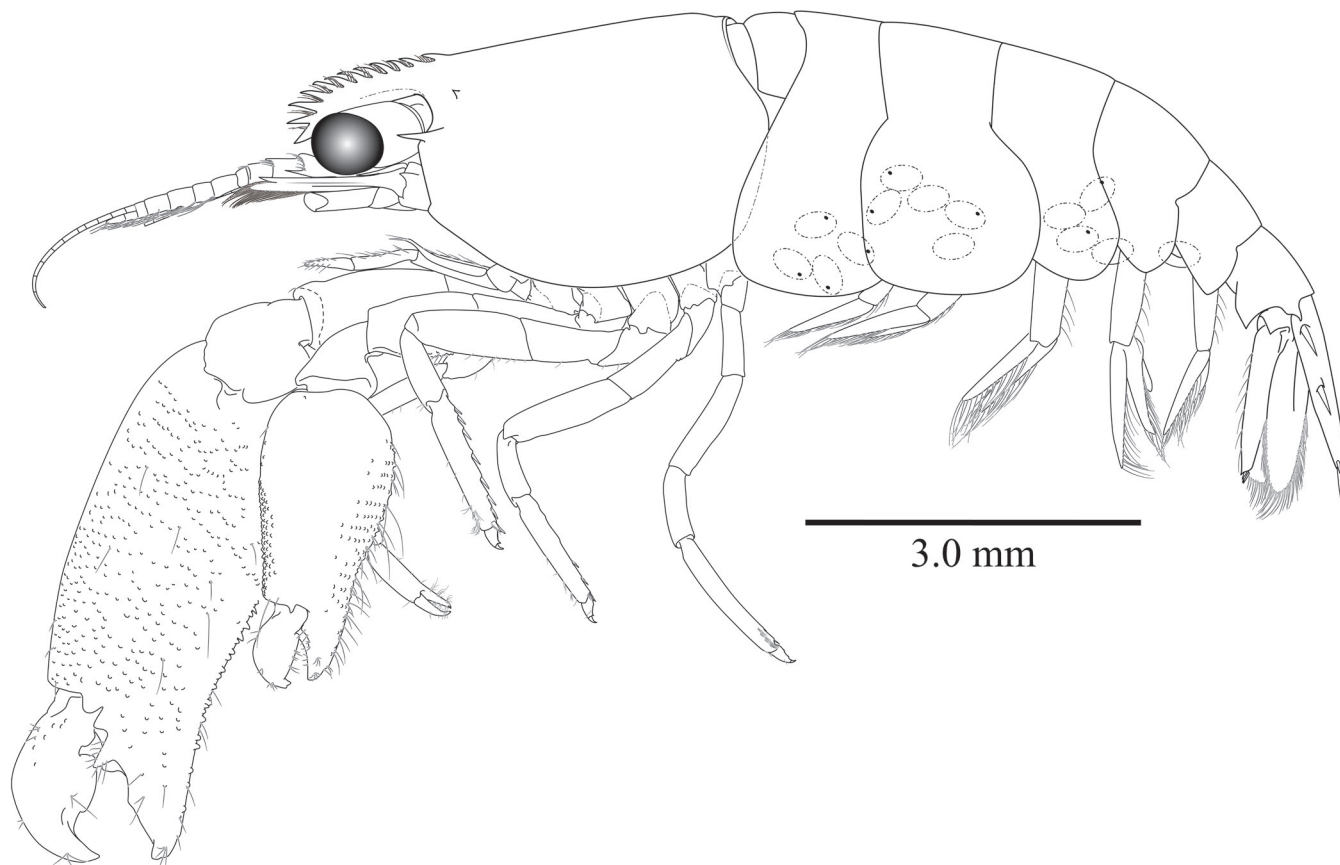


Fig. 1. *Periclimenaeus alius*, new species, Tambolian Reef, Bohol, Philippines. Holotype ovigerous female, pocl 2.7 mm, habitus (NMCR 50798).

Material examined. Holotype: ovigerous female (pocl 2.7 mm) (NMCR 50798), Tambolian Reef, Bohol, Philippines, 10°3'20.42"N, 123°56'58.28"E, 22 m in depth, from unidentified sponge, leg. D. Lee, 9 March 2018 (fcn PB19). Paratypes: 1 male (pocl 2.8 mm) (NMCR 50799), same data as holotype (fcn PB20); 2 males (pocl 2.9, 3.1 mm) (ZRC 2021.0382), same data as holotype (fcn PB18, 22).

Etymology. From the Latin adjective (nominative) 'alius', meaning 'another'; alluding to the description of yet one more species in the genus.

Description (based on female holotype). Medium-sized palaemonid shrimp, body subcylindrical (Fig. 1).

Rostrum (Fig. 2A) straight, trending downwards distally, about 0.45 of pocl, falling short of distal margin of antennular peduncle; furnished with 11 dorsal teeth, distally increasing in size, one of which placed post-orbitally, marginally more distant; without ventral teeth.

Carapace (Figs. 1, 2C) smooth, glabrous; supra-orbital tooth feebly developed (Fig. 2B, C); antennal tooth acute, well developed, reaching to distal margin of basicerite; inferior orbital angle with blunt pointed process (Fig. 2D); pterygostomial angle produced into a sub-angular lobe. Pleon (Fig. 1) smooth, first pleuron with distinct but poorly developed anteromedian dorsal lobe; first four pleura broadly rounded; fifth pleuron with posterolateral angle quadrate;

sixth pleuron about same length as fifth, about 0.5 of telson length, posterolateral margin acute, median lobe acute.

Telson (Figs. 1, 2I) about 0.6 of pocl, about 2.2 times longer than maximal width; with two pairs of dorsal cuspidate setae, subequal in size, inserted about 0.1 and 0.5 of telson length respectively; posterior margin (Fig. 2J) convex, with minute acute median process, with three pairs of spiniform setae, lateral pair short, about 0.4 of length of intermediate pair, intermediate pair longest, submedian pair about 0.9 of length of intermediate pair, setulose.

Eye (Figs. 1, 2E) with hemispherical cornea, cornea faceted, about 1.6 times as long as dorsal and lateral maximal diameter, nebenscape absent.

Antennule (Fig. 2F) with proximal article of peduncle bearing acute distolateral tooth, ventromesial tooth present; stylocerite sharply pointed, reaching to mid-length of proximal article; intermediate article short, about 0.4 of length of proximal article, subequal to distal article; upper flagellum biramous, proximal five divisions fused, short free ramus with two divisions, longer free ramus with 11 and 12 divisions; lower flagellum filiform.

Antennal basicerite (Fig. 2B, G, H) with pointed process distolaterally; carpocerite reaching about 0.6 of scaphocerite; scaphocerite ovoid, about 1.7 times as long as wide, distal lamella obtusely triangular, acute distolateral tooth situated

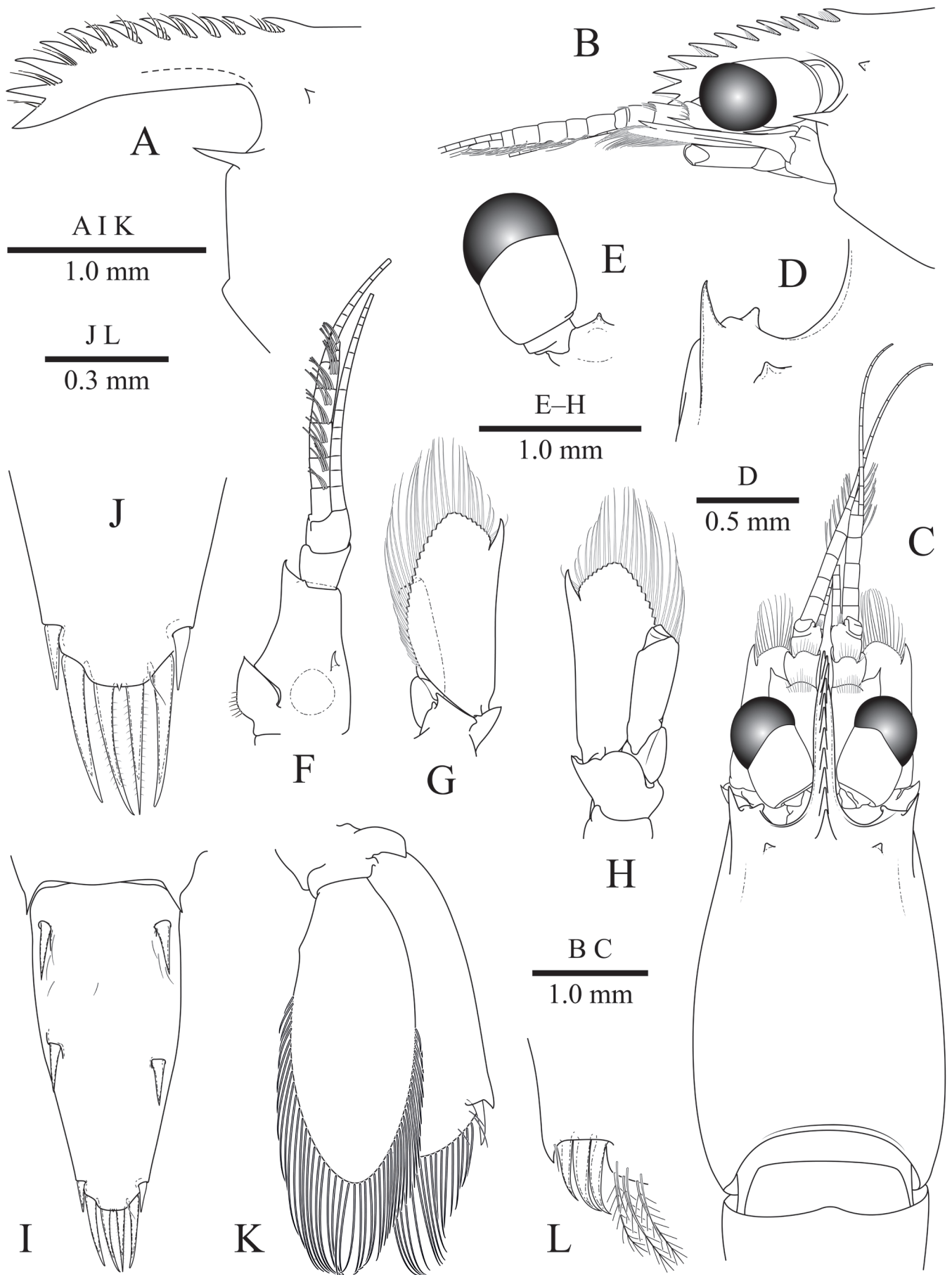


Fig. 2. *Periclimenaeus alius*, new species, Tambolian Reef, Bohol, Philippines. A, anterior carapace, lateral; B, anterior carapace and appendages, lateral; C, carapace and anterior pleonal tergite, dorsal; D, inferior orbital angle, dorsal; E, eye, dorsal; F, antennule, ventral; G, antenna, dorsal; H, same, ventral; I, telson, dorsal; J, tip of telson, dorsal; K, right uropod, dorsal; L, left uropodal exopod, distolateral angle, dorsal. A, D–L, holotype ovigerous female (pocl 2.7 mm) (NMCR 50798); B–C, paratype male (pocl 2.8 mm) (NMCR 50799).

at about 0.9 of scaphocerite length, reaching to end of distal lamella.

Mouthparts (Fig. 3A–F) as illustrated; typical for genus.

First pereopod (Fig. 4A) with coxa and basis without special features; ischium about 0.75 of merus length, unadorned; merus slightly longer than carpus, unadorned; carpus subequal to chela, unadorned; chela (Fig. 4B) stout, palm subcylindrical, smooth, fingers about 0.5 of palm length, tips of both pollex and dactylus simple; carpo-propodal brush well developed.

Second pereopods (Figs. 1, 4C, E) robust, dissimilar in shape, unequal in size.

Major second pereopod (Fig. 4C, D) with coxa and basis without special features; ischium about 0.6 of merus length, sparsely tuberculated on ventral margin; merus with conical tuberculation along ventral margin; carpus robust, about 0.8 of merus length, vase-shaped; chelae robust, about 1.85 times as long as poel; palm subcylindrical, densely tuberculated on both margins and surfaces; fingers mesially slightly curved, about 0.24 of total chela length, pollex subequal in length to dactylus, terminating in triangularly acute tip, cutting edge entire, proximal cutting edge with triangular process on mesial margin; dactylus about 0.6 times as deep as long, cutting edge entire, distally with hooked tip, well-developed fossa and molar system present.

Minor second pereopod (Fig. 4E) with coxa and basis without special features; ischium subequal to merus length, sparsely tuberculated on ventral margin; merus with fine tuberculation along ventral margin, marginally extending onto mesial and lateral surfaces, carpus short, about 0.65 times length of merus, vase-shaped; chela (Fig. 4E, F) robust, as long as poel, about 0.6 of major chela length, palm subcylindrical, pronounced tuberculation along ventral and dorsal margin, extending onto adjoining lateral and mesial surfaces, central aspect of mesial surface sparsely tuberculate; fingers about 0.3 of total chela length, pollex about 0.8 of dactylus, terminating in triangularly acute tip, cutting edge entire, dactylus about 0.5 times as deep as long, cutting edge entire, distally with hooked bidentate tip.

Third pereopod (Fig. 5A, B) relatively robust; coxa and basis without special features; ischium about 0.8 of merus length, unadorned; merus about 1.5 of carpus length, unadorned; carpus about 0.7 of propodus length, unadorned; propodus about six times as long as maximal depth, flexor margin armed with series of single, cuspidate setae, spaced at regular intervals across entire margin, distoventral angle with pair of spiniform setae; dactylus, short, about 0.2 of propodus length, unguis demarcated, simple, curved, about 0.4 of length of corpus; corpus with distinct, distal accessory tooth, flexor margin serrated. Fourth pereopod (Fig. 5C, D) generally similar to third pereopod in proportions; ornamentation of propodus with fewer spiniform setae. Fifth pereopod (Fig. 5E, F) slenderer than third or fourth, cleaning brush well developed.

Uropod (Fig. 2K) just overreaching distal margin of telson; exopod slightly shorter than endopod, lateral margin non-serrate, distolateral tooth well developed, adjacent spiniform seta strong (aberrant number on left uropod in holotype, Fig. 2L), overreaching tooth.

First pleopod of male (Fig. 3G), as illustrated; typical for genus.

Second pleopod of male (Fig. 3H) with endopod with long appendix masculina in relation to appendix interna, with five long setulose setae; appendix interna about 1.4 times longer than appendix masculina (Fig. 3I).

Morphological variation. The general morphology of both sexes is largely identical, although the major second chela is proportionally larger in male specimens, e.g., 2.2 times in male (poel 3.1 mm) vs. 1.85 times in the ovigerous female holotype (poel 2.7 mm). The largest male paratype (poel 3.1 mm) has a proportionally shorter rostrum and fewer teeth (7/0), but it is clear that the distal tip has been broken off.

Colour. Specimens preserved without colour notes or photo, no traces of colour.

Host. All specimens were obtained from an unidentified sponge.

Distribution. Currently only known from the type locality, Tambolian Reef, Bohol, the Philippines.

Remarks. A number of species groups have been proposed within the genus *Periclimenaeus* (e.g., *robustus* group cf. Bruce, 2005b; *rhodope* group cf. Bruce, 2006), although the majority of species have not been assigned to any groups. In the absence of a phylogeny of the genus, be it molecular or morphological, the systematic significance of these groupings and indeed the potential importance of the morphological characters on which they are based remain unclear. It therefore seems more logical to contrast the new species to other taxa within an identification framework, rather than speculating on what species could be phylogenetically closest. A clear framework for such a comparison was established by Bruce (2013), who drew attention to the utility of the third pereopod to quickly derive at a relatively small number of potential candidate species during identification within this morphologically heterogeneous genus. Using this scheme, the new species falls within his informal Group 3, by having the dactyli of the third pereopod with a distal accessory tooth, the corpus of which harbours ventral denticles (i.e., serrated), but with the unguis being non-dentate.

Nineteen Indo-West Pacific species are known to display this ornamentation: *P. apomonosi* Park & De Grave, 2021; *P. aurantiacus* Bruce, 2014d; *P. bidentatus* Bruce, 1969; *P. djiboutensis* Bruce, 1969; *P. garthi* Bruce, 1976; *P. hebedactylus* Bruce, 1970; *P. heronensis* Bruce, 2010; *P. leptodactylus* Fujino & Miyake, 1968; *P. lobiferus* Bruce, 1978; *P. matherae* Bruce, 2005a; *P. mortenseni* Bruce, 1994; *P. nufu* Đuriš, Horká & Hoc, 2009; *P. pachyspinosus* Marin,

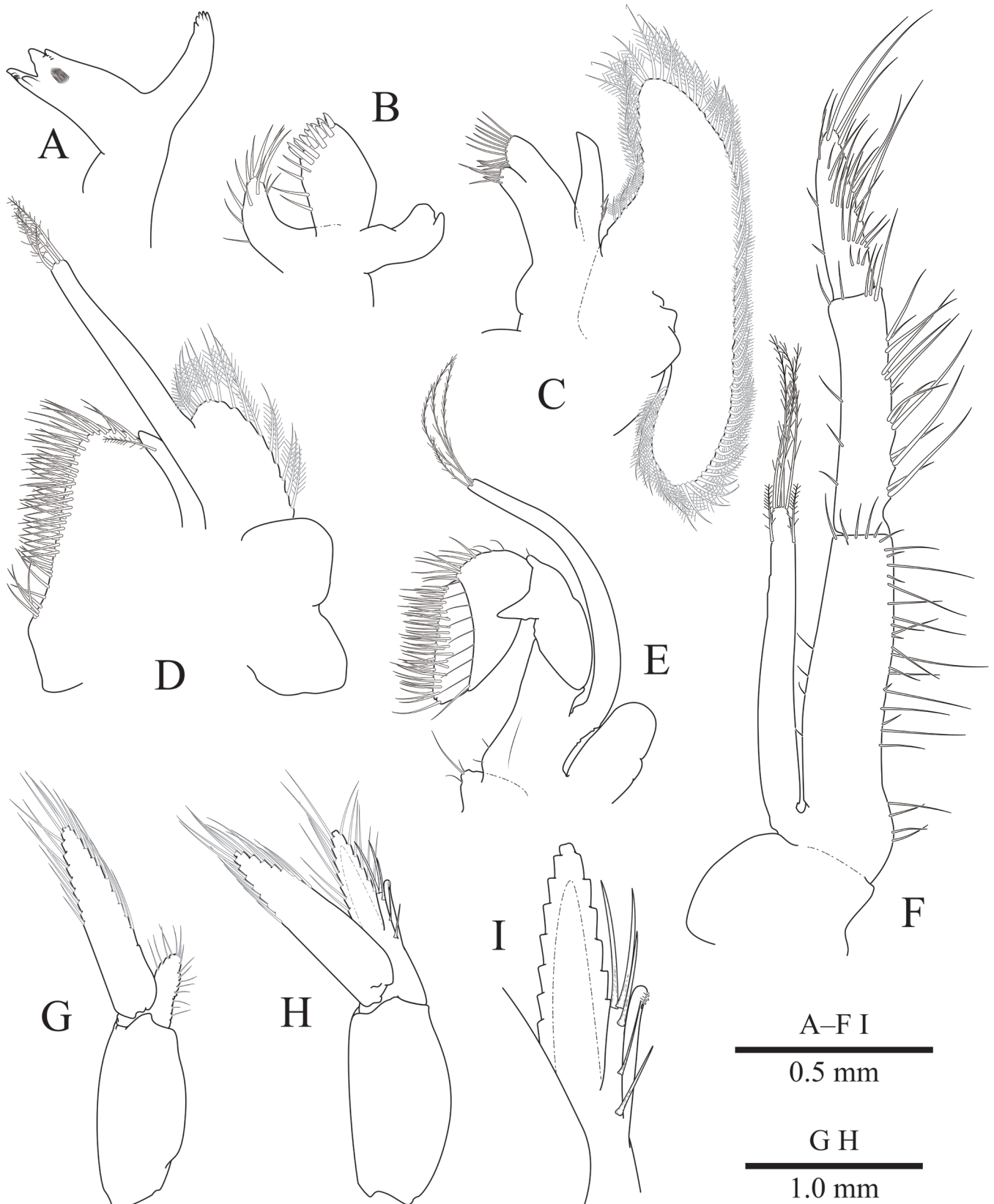


Fig. 3. *Periclimenaeus alius*, new species, Tambolian Reef, Bohol, Philippines. A, mandible; B, maxillula; C, maxilla; D, first maxilliped; E, second maxilliped; F, third maxilliped; G, first pleopod; H, second pleopod; I, same, detail of appendix masculina and appendix interna. A–F, holotype ovigerous female (pocl 2.7 mm) (NMCR 50798); G–I, paratype male (pocl 2.8 mm) (NMCR 50799).

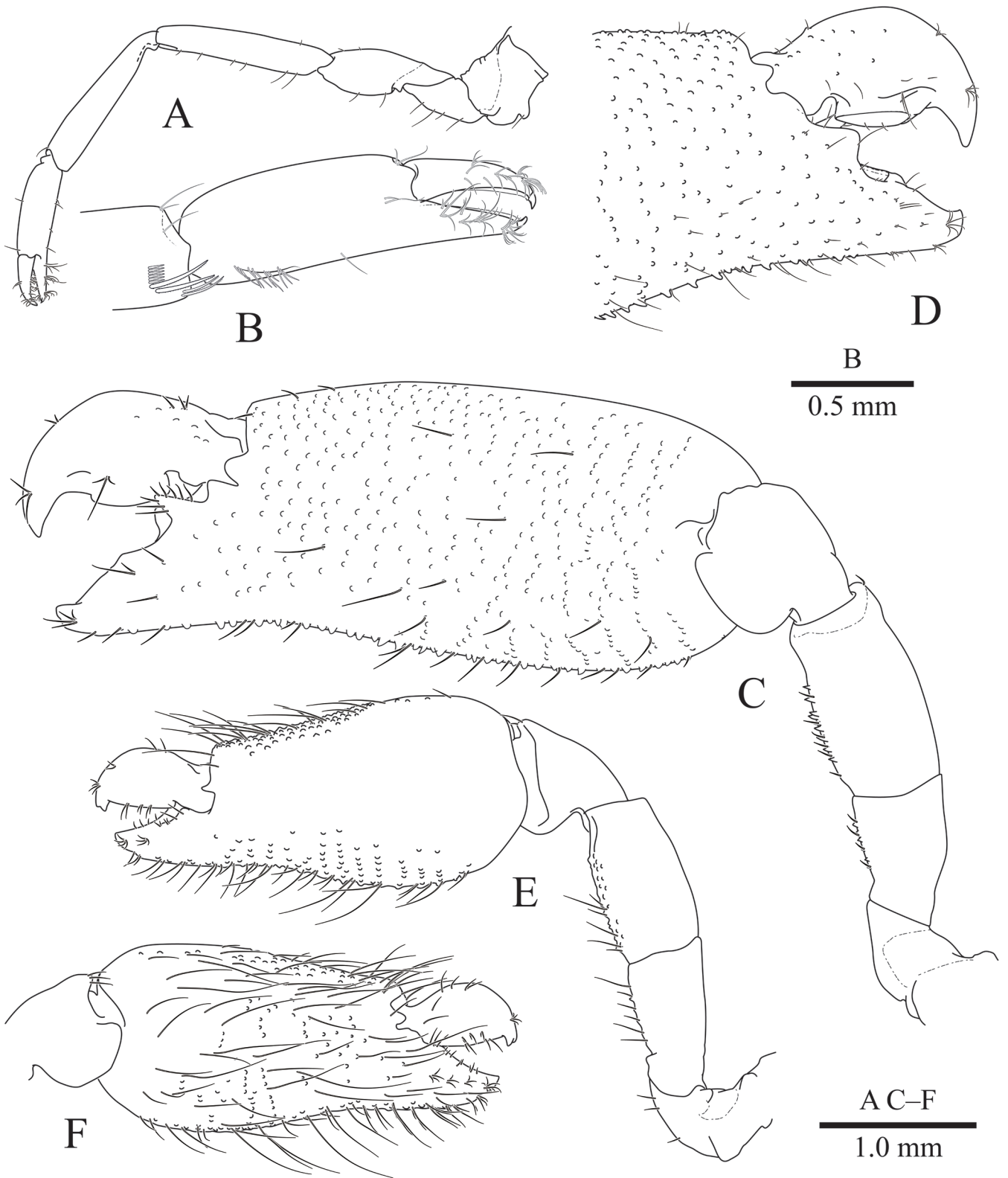


Fig. 4. *Periclimenaeus alius*, new species, Tambolian Reef, Bohol, Philippines. Holotype ovigerous female, pocl 2.7 mm (NMCR 50798). A, left first pereiopod, lateral; B, same, chela and distal carpus, mesial; C, right major second pereiopod, mesial; D, same, fingers, lateral; E, left minor second pereiopod, lateral; F, same, chela and distal carpus, mesial.

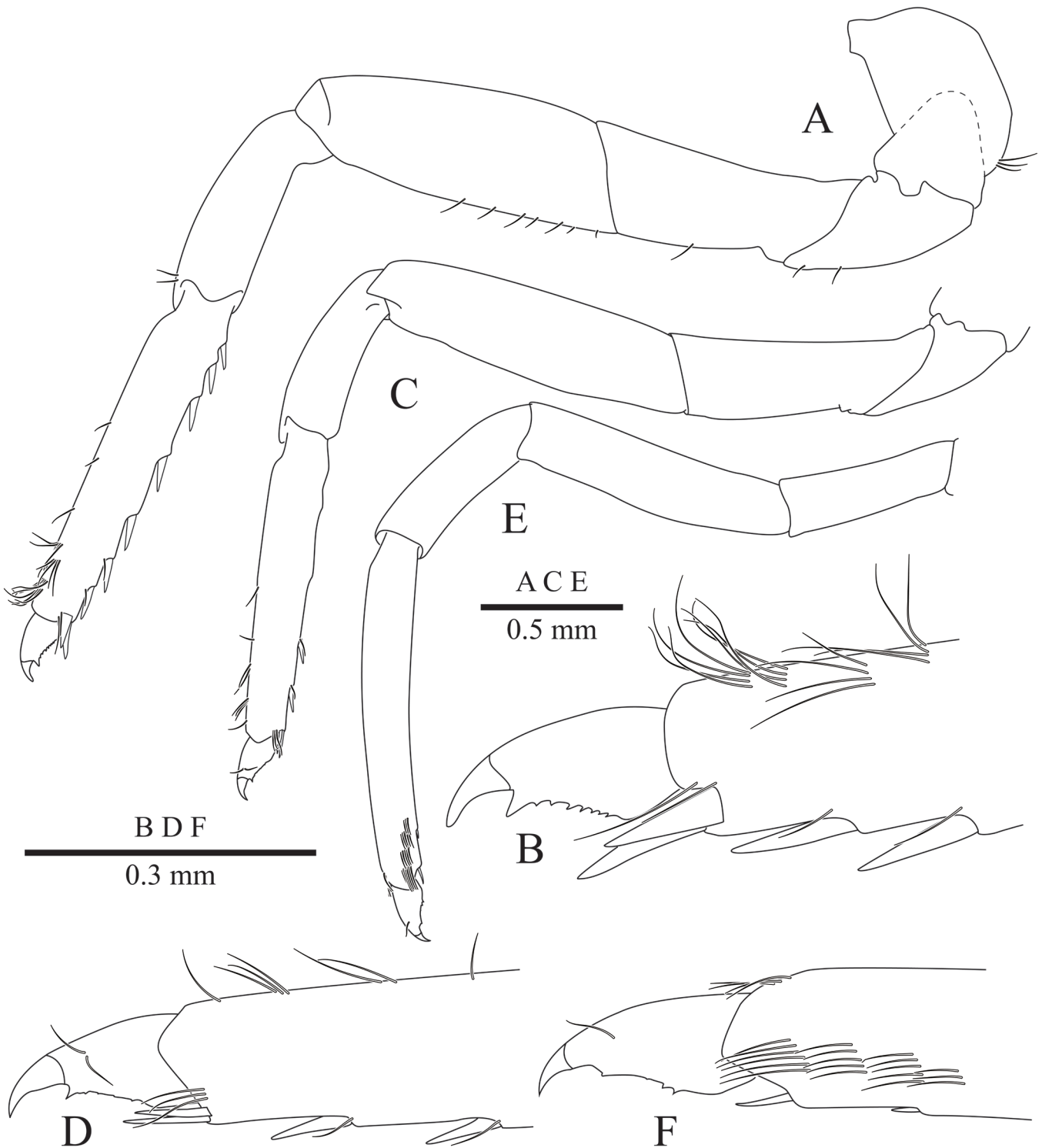


Fig. 5. *Periclimenaeus alius*, new species, Tambolian Reef, Bohol, Philippines. Holotype ovigerous female, pocl 2.7 mm (NMCR 50798). A, left third pereopod, lateral; B, same, dactylus and distal propodus, lateral; C, left fourth pereopod, lateral; D, same, dactylus and distal propodus, lateral; E, left fifth pereopod, lateral; F, same, dactylus and distal propodus, lateral.

2007; *P. pulitzerfinali* Bruce, 2011; *P. rastrifer* Bruce, 1980; *P. solitus* Bruce & Coombes, 1995; *P. spongicola* Holthuis, 1952; *P. tchesunovi* Đuriš, 1990; and *P. tuamotae* Bruce, 1969.

The new species harbours a distinct, although small, supra-orbital tooth, which serves to immediately distinguish it from the following species in this group in which such a tooth is absent: viz. *P. djiboutensis*, *P. garthi*, *P. heronensis*,

P. lobiferus, *P. pulitzerfinali*, and *P. spongicola* (Holthuis, 1952; Bruce, 1970, 1975, 1976, 1978, 2010, 2011; Franssen, 2006; Park & De Grave, 2021).

Of the remaining species, the new species can be easily differentiated from *P. solitus* by the number of dorsal rostral teeth (three vs. 11 in *P. alius*, see Bruce & Coombes, 1995); from *P. aurantiacus* by the same character (five teeth, see Bruce, 2014d); from *P. mortenseni* by the dactylus of the

second chela with a biunguiculate tip (vs. simple in *P. mortenseni*) as well as the presence of a poorly developed dorsal anteromedian lobe on the first tergite (absent in *P. mortenseni*, see Bruce, 1994); from *P. hebedactylus* by the position of the dorsal cuspidate setae on the telson (both pairs at about 0.2 of telson length in *P. hebedactylus* vs. proximal pair at about 0.1 and distal pair at 0.5 in new species) as well as the well-developed, dorsal anteromedian lobe on the first tergite (poorly developed in the new species, see Bruce, 2012); from *P. matherae* by the size and position of the antennal tooth in that species, entire cutting edge of the minor second chela (vs. serrated in *P. matherae*), as well as the differential shape of the dactylus of the third pereopod (see Bruce, 2005a); from *P. pachyspinosus*, *P. rastrifer*, and *P. tchesunovi* by the distally denticulate chelae of the first pereopod (vs. simple in *P. alius*, see Bruce, 1980; Āuriš, 1990; Marin, 2007); whilst the smooth, lateral margin of the uropodal exopod allows the new species to be easily distinguished from *P. nufu*, which has serrated margins (Āuriš et al., 2009).

Of the 19 species currently known from the Indo-Pacific region, which have the dactylus of the third pereopod armed with a distal accessory tooth, the corpus of which has ventral denticles but with the unguis being non-dentate; the new species thus appears morphologically similar to only four species, which may not necessarily form a phylogenetic clade, viz. *P. apomonosi*, *P. bidentatus*, *P. leptodactylus*, and *P. tuamotae*. These species share the following characteristics: 1) multidentate rostrum with more than six teeth; 2) the presence of a supraorbital tooth or tubercle; 3) the relative position of both pairs of dorsal cuspidate setae on the telson (near proximal margin and mid-length); 4) the non-denticulate cutting edges of the major and minor second chelae; 5) the presence of tubercles along the ventral border of the merus of the second pereopods; and 6) the presence of spiniform setae along the ventral margin of the third pereopods.

The recently described *P. apomonosi* from Korea (Park & De Grave, 2021) shares two further characters with the new species: the presence of a pointed process on the inferior orbital margin, and the presence of the dorsal anteromedian lobe on the first tergite. However, *P. apomonosi* is readily distinguished from the new species by the simple tip of the dactylus of the minor second chela (vs. bidentate in *P. alius*), as well as further differences, such as proportions of the eye (about 1.3 times as long as maximal diameter in *P. apomonosi* vs. about 1.6 times in *P. alius*), and the absence of a small acute median process of distal margin of the telson (present in *P. alius*).

Periclimenaeus bidentatus is currently known from Australia (Queensland, Northern Territory, Western Australia), East Africa, Papua New Guinea, and New Caledonia (Bruce, 2013). Based on the unillustrated type description (Bruce, 1970) as well as the illustrations in Bruce (1991b), this species shares the presence of the bidentate tip on the dactylus of the minor second chela (see fig. 18f in Bruce, 1991b). However, *P. bidentatus* clearly differs from *P. alius* as follows: 1) shape of the inferior orbital margin (feebly

developed and blunt in *P. bidentatus* vs. pointed process in new species); 2) length of distolateral of scaphocerite (far exceeding the distal lamella in *P. bidentatus* vs. reaching to end of distal lamella in *P. alius*); 3) the length of carpus of the first pereopod (about 1.5 times of chela in *P. bidentatus* vs. subequal to chela in *P. alius*); 4) the ornamentation of the fourth and fifth ambulatory propodi (absent in *P. bidentatus* vs. present in *P. alius*); and 5) the shape of the distal margin of the telson (median process absent in *P. bidentatus* vs. present, but minute, in *P. alius*).

Periclimenaeus leptodactylus has only been reported from the Ryukyu Islands and East Africa (Bruce, 2013). Based on the illustrated type description (Fujino & Miyake, 1968), this species is readily separated from the new species as follows: 1) the shape of the inferior orbital margin (slightly produced in *P. leptodactylus* vs. pointed in *P. alius*); 2) the shape of the outer margin of the antennal basicerite (unarmed in *P. leptodactylus* vs. with a pointed process in *P. alius*); 3) the length of the antennal carpus (long, reaching to end of the distal article of the antennule peduncle vs. short, reaching to proximal article in *P. alius*); 4) tip of the dactylus of the minor second chela simple (vs. bidentate in *P. alius*); and 5) the dactyl of the first pereopod with pectinations in about the distal half (vs. entire in *P. alius*). A minute process on the distal margin of the telson could have been overlooked in the type description of *P. leptodactylus*, but if truly absent, could serve as a further diagnostic difference.

Periclimenaeus tuamotae is currently known from the Tuamotu Archipelago (French Polynesia), East Africa, Sabah, and Australia (Northern Territory, Queensland) (Bruce, 2013), although the only description (lacking illustrations) is by Bruce (1969). Based on the type description, that species differs from *P. alius* as follows: 1) smaller number of dorsal rostral teeth (six vs. 11 in *P. alius*); 2) longer eye (extending beyond the tip of the rostrum vs. extending to about 0.8 of rostrum length in *P. alius*); 3) the shape of the inferior orbital margin (obsolescent vs. pointed in *P. alius*); 4) the distolateral tooth of the scaphocerite overreaching the distal margin of the lamella (vs. reaching to distal margin in *P. alius*); 5) the unarmed shape of the outer margin of the antennal basicerite (vs. pointed process in *P. alius*); 6) length of the carpus of the first pereopod (about 1.5 times of chela in *P. tuamotae* vs. subequal to chela in *P. alius*); and 7) the simple tip of the dactylus of the minor second chela (vs. bidentate tip in *P. alius*). A minute process on the distal margin of the telson could have been overlooked in the type description of *P. tuamotae*, but if truly absent, could serve as a further diagnostic difference.

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