THE RAFFLES BULLETIN OF ZOOLOGY 2009 Supplement No. **20**: 233–246
Date of Publication: 31 Jul.2009

THE CYMONOMIDAE OF THE PHILIPPINES (CRUSTACEA: DECAPODA: BRACHYURA), WITH DESCRIPTIONS OF FOUR NEW SPECIES

Shane T. Ahyong
Marine Biodiversity and Biosecurity, National Institute of Water and Atmospheric Research, Private Bag 14901, Kilbirnie, Wellington, New Zealand
Email: s.ahyong@niwa.co.nz

Peter K. L. Ng
Tropical Marine Science Institute and Raffles Museum of Biodiversity Research, National University of Singapore, Kent Ridge, Singapore 119260, Republic of Singapore
Email: peterng@nus.edu.sg

***ABSTRACT*. –** The deep-sea crabs of the family Cymonomidae collected by the PANGLAO 2004, PANGLAO 2005 and AURORA expeditions are reported. Five species of *Cymonomus* A. Milne-Edwards, 1880, are reported of which four are new to science: *C. diogenes*, *C. deforgesi*, *C. gracilipes*, and *C. mariveneae*. *Cymonomus hakuhoae* Takeda & Moosa, 1991, previously known only from a single damaged specimen from Indonesia, was rediscovered in the Philippines, and is redescribed here based on specimens of both sexes. This increases the number of cymonomids known from the Indo-West Pacific from 16 to 20. Members of *Cymonomus* have abdominal somite 6 and the telson fused without trace of a suture separating them; this is the primary character that distinguishes *Cymonomus* from members of *Cymonomoides* Tavares, 1993, in which the two are separated by a visible suture. The specimens and species on hand suggest that this character may not be reliable. Our observations of *Cymonomus diogenes*, new species, and a very similar species, *Cymonomoides delli* (Griffin & Brown, 1976), from Australia, indicate that both are best placed in *Cymonomus* sensu stricto and that other putative species of *Cymonomoides* require restudy. Sexual dimorphism is confirmed in lengths of the second and third pereopods in the three species of *Cymonomus* for which both sexes were collected in addition to *C. kapala* from Australia. Cymonomids are rarely collected and usually known only from few specimens and often a single sex (generally female). Further sampling will probably show sexual dimorphism in ambulatory leg length to be a general pattern in the family.

***KEY WORDS.* –** Crustacea, Decapoda, Brachyura, Cymonomidae, *Cymonomus*, *Cymonomoides*, Philippines, taxonomy.

INTRODUCTION

The rise in deepwater sampling from various Indo-West Pacific localities over the past three decades has seen a marked increase in the rate of discovery of new brachyuran species. Among these, are new species of the apparently rare members of the Cymonomidae. Ng et al. (2008) recognized four genera and 32 species worldwide, of which 15 species are from the Indo-West Pacific. Since then, *Cymonomus clarki* Ahyong, 2008, has been described from New Zealand. Here, we report on five species of *Cymonomus* collected by three recent surveys in the Philippines: PANGLAO 2004, PANGLAO 2005 and AURORA expeditions to the Philippines. The family has not previously been reported from the Philippines. Four of these species are new to science.

Carapace length (cl) includes the rostrum. Postrostral carapace length (pcl) excludes the rostrum. Carapace width (cw) is the greatest width. The abbreviations G1 and G2 are used for the male pleopods 1 and 2, respectively. P2–P5 refer to pereopods 2–5 (ambulatory legs 1–4), respectively. Studied specimens are deposited in the Raffles Museum of Biodiversity Research, National University of Singapore (ZRC), Crustacean Collection of the National Museum of the Philippines, Manila (NMCR), National Institute of Water and Atmospheric Research, Wellington (NIWA), National Science Museum, Tokyo (NSMT) and Australian Museum, Sydney (AM).

CYMONOMIDAE BOUVIER, 1898

Cymonomus deforgesi, new species
(Figs. 1, 7A, B)

Material examined. – Holotype: NMCR, male (cl 6.2 mm, pcl 5.4 mm, cw 5.7 mm), station CP 2681, east of Dingalan Bay, Luzon, 15°00.93 N 123°12.33 E, 1160–1184 m, coll. AURORA 2007, 23 May 2007. Others: ZRC, 1 juvenile male (cl 3.1 mm, pcl 2.7 mm, cw 2.8 mm), station CP 2384, Bohol/Sulu sea margin, off Aligbay Island, 8°46.2'N 123°16.1'E, 624–647 m, coll. PANGLAO 2005, 29 May 2005.

Description of holotype. – Carapace quadrate, almost square, lateral margins almost parallel; regions weakly indicated; with slender anteriorly directed anterolateral spine and similar anterolaterally directed spine on lateral margin behind anterolateral spine; lower pterygostomian region swollen; anterior and anterolateral surfaces with long, fine setae, other surfaces with sparse, short fine setae. Dorsal and lateral surfaces entirely covered with minute granules, with granules becoming larger and more elongate anterolaterally. Fronto-orbital margin (excluding rostrum and lateral projections) advanced beyond anterolateral margins; exceeding half anterior carapace width; lateral frontal projections slender, elongate, situated below plane of rostrum, laterally spinulate, with acute apices, slightly shorter than rostrum. Rostrum slightly longer than half-length of eyestalks; slender, tapering to acute apex, minutely granular laterally and dorsally. Eyestalks distinctly divergent, flattened, granular and prominently spinulate, fused to carapace below rostral base; reaching anteriorly almost to end of antennular peduncle article 1; cornea apparently vestigial, not pigmented. Epistome with blunt tubercle mesial to base of antennules, a small spine mesial to base of antenna, and small cluster of elongate granules at base of rostrum.

Antennular peduncle longer than cl; article 1 granular laterally or minutely spinular; article 2 minutely granular; article 3 smooth. Basal antennal article fused to epistome; articles 2–5 irregularly granular or spinular.

Maxilliped 3 ischiobasis subquadrate, sparsely granular, with longitudinal sublateral groove; ischium and basis demarcated by faint groove. Merus slightly shorter than ischiobasis, about 2.5 times longer than wide; tapering distally to rounded apex; surface sparsely granular or spinulate; margins spinulate. Propodus and carpus sparsely spinulate. Dactylus conical, unarmed. Exopod sparsely granular, not exceeding merus of endopod.

Chelipeds (P1) equal in size and ornamentation, setose. Merus finely granular. Carpus finely granular, dorsal margin with 3 spines. Palm surfaces with fine granules and few scattered acute granules, flexor and extensor margins spinulate. Dactylus slightly longer than upper palm length; with proximal dorsal spines and granules; with faint longitudinal carina on outer surface, occlusal surfaces of dactylus and pollex crenulate, without gape when closed.

P2 and P3 long, slender, sparsely setose; all segments except for dactylus finely granular; propodus and carpus with spinular extensor margins; merus with spinular extensor and flexor margins. P3 longest, merus longer than cl (1.36 times pcl). Dactyli broadly curved, smooth, with longitudinal rib. P3 dactylus as long as combined length of propodus and carpus.

P4 and P5 granular, minutely spinulate, sparsely setose; shorter than merus of P3; dactyli markedly shorter than propodi, falcate, with corneous apex and 4 or 5 obliquely inclined, corneous spines on flexor margin. P5 merus, when folded against carapace, reaching midlength of carapace.

Male abdomen with margins and surface finely granular or minutely spinulate; pleotelson rounded, length about 1/3 width.

G1 3-segmented; distal article cannulate, forming copulatory tube, with moderately long distal setae. G2 with segments fused; distomesial margin slightly hollowed, apex acute.

Etymology. – Named in honour of Bertrand Richer de Forges, for his tireless efforts during the PANGLAO and AURORA expeditions.

Remarks. – *Cymonomus deforgesi*, new species, most closely resembles *C. soelae* Ahyong & Brown, 2003, from southeastern Australia in the combination of divergent eyestalks, rostrum that is about half the length of the eystalks, and well developed lateral frontal processes that are about as long as the rostrum. The new species, however, differs from *C. soelae* most notably in proportionately longer antennules, which are longer than the carapace and rostrum combined (rather than distinctly shorter than the carapace) and in having spinulous P2 and P3 (rather than being granulate only). A juvenile male is also tentatively identified as *C. deforgesi* (Fig. 7B); it resembles the holotype in all important respects, but the spinulous ornamentation of the P2 and P3 is, at most, feebly developed.

Distrubution. – Presently known only from the type locality.

Cymonomus diogenes, new species
(Figs. 2, 7C, D)

Cymonomoides sp. — Ahyong et al., 2007: 583, Tab. 1.
Cymonomoides aff. *delli*. — Ng et al., 2008: 32, Fig. 3.

Material examined. – Holotype: NMCR (ex ZRC 2006.126), ovigerous female (cl 7.8 mm, pcl 7.2 mm, cw 8.2 mm), station CP 2358-JL21, Bohol/Sulu sea margin, 8°52.1'N 123°37.1'E, 569–583 m, coll. PANGLAO 2005, 26 May 2005. Paratypes: ZRC, 1 male (cl 8.4 mm, pcl 7.6 mm, cw 8.2 mm), station CP 2336-JL15, Bohol Sea, off Balicasag Island, 9°32.3'N 123°39.3'E, 757–760 m, coll. PANGLAO 2005, 22 May 2005; ZRC, 1 ovigerous female (cl 9.7 mm, pcl 8.8 mm, cw 10.0 mm), station CP 2397, Bohol Sea Maribojoc Bay, 9°34.9'N 123°41.7'E, 642–669 m, coll. PANGLAO 2005, 31 May 2005; NIWA 49258, 1 ovigerous female (cl 9.7 mm,

pcl 8.8 mm, cw 9.9. mm), station CP 2398, Bohol Sea, off Balicasag Island, 9°32.6'N 123°40.5'E, 713–731 m, coll. PANGLAO 2005, 31 May 2005.

***Description*. –** Carapace quadrate, almost square, lateral margins gently divergent posteriorly; regions weakly indicated; with 1–3 small anteriorly directed anterolateral spines in addition to other surface ornamentation; lower pterygostomian region swollen; surfaces sparsely setose. Dorsal and lateral surfaces entirely covered with minute granules, with granules becoming larger and more elongate anterolaterally. Fronto-orbital margin (excluding rostrum and lateral projections) advanced slightly beyond anterolateral margins; exceeding half anterior carapace width (about 0.6 times); lateral frontal projections slender, pointed, situated below plane of rostrum, laterally spinulate or granulate, about as long as rostrum. Rostrum small, about half-length of eyestalks; triangular, apex acute, minutely granular laterally and dorsally. Eyestalks distinctly divergent, flattened, stout, width at midlength exceeding 1/3 length, fused to carapace below rostral base; reaching anteriorly almost to end of antennal peduncle article 1; granular and minutely spinulate; cornea apparently vestigial, not pigmented. Epistome with blunt tubercle mesial to base of antennules, small spine

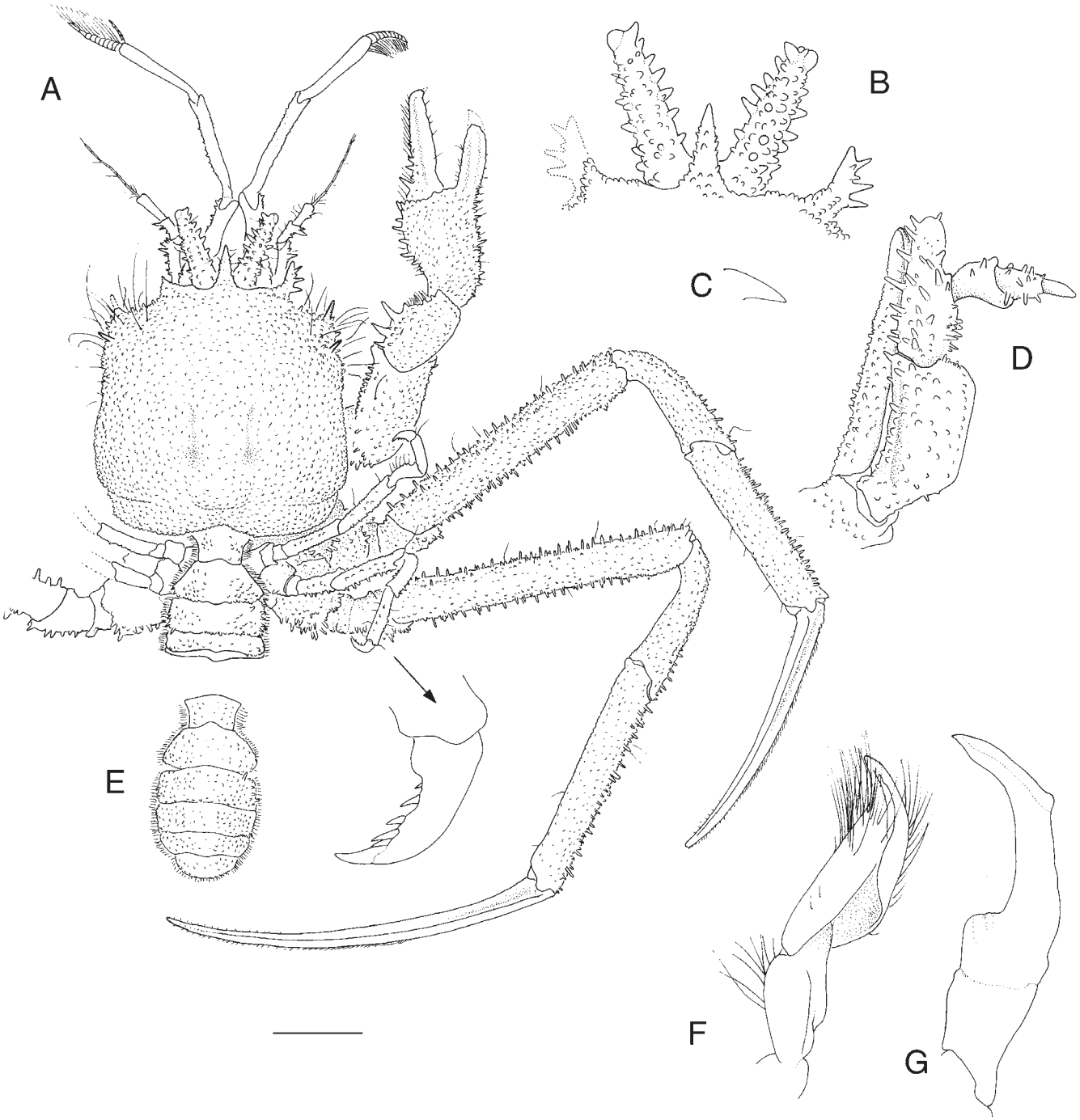

Fig. 1. *Cymonomus deforgesi*, new species, male holotype (cl 6.2 mm, pcl 5.4 mm, cw 5.7 mm) (NMCR). A, dorsal habitus. B, anterior carapace. C, basal antennal spine, right ventral view. D, right maxilliped 3. E, abdomen. F, right G1, abdominal view. G, right G2, abdominal view. Scale bars: A, E = 2.0 mm; B, D = 1.0 mm, C, F, G = 0.5 mm.

mesial to base of antenna, and pointed tubercle flanked by small granules at base of rostrum.

Antennular peduncle about 3/4 times pcl; articles 1 and 2 minutely granular; article 3 smooth. Basal antennal article fused to epistome; articles 2 and 3 irregularly granular or spinular; article 5 smooth.

Maxilliped 3 ischiobasis subquadrate, sparsely granular, with longitudinal sublateral groove; ischium and basis demarcated by faint groove. Merus slightly shorter than ischiobasis, 2.0 times longer than wide; tapering distally to rounded apex; surface sparsely granular or spinulate; margins spinulate. Dactylus, propodus and carpus coarsely spinulate. Exopod sparsely granular, not exceeding merus of endopod.

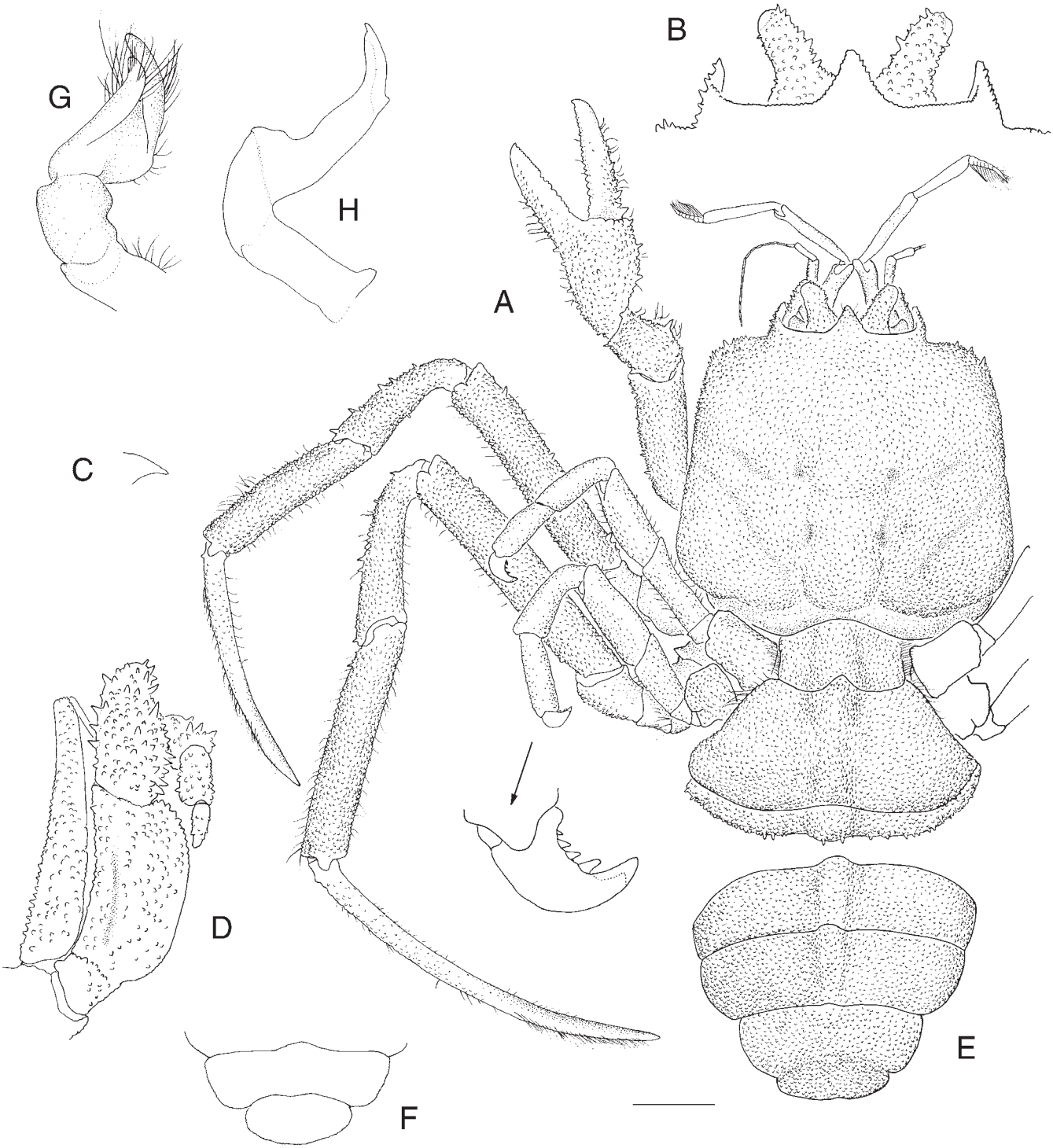

Fig. 2. *Cymonomus diogenes*, new species. A–E, ovigerous female holotype (cl 7.8 mm, pcl 7.2 mm, cw 8.2 mm) (NMCR). F–H, male paratype (cl 8.4 mm, pcl 7.6 mm, cw 8.2 mm) (ZRC). A, dorsal habitus. B, anterior carapace. C, basal antennal spine, right ventral view. D, right maxilliped 3. E, posterior abdomen, female. F, posterior abdomen, male. G, right G1, abdominal view. H, right G2, abdominal view. Scale bars: A, E, F = 2.0 mm; B, D = 1.0 mm, C = 0.5 mm; G, H = 0.8 mm.

Chelipeds (P1) equal in size and ornamentation, sparsely setose. Merus finely granular, with occasional longer spinules. Carpus finely granular, dorsal margin with 1–3 spines. Palm surfaces with fine granules and few scattered acute granules, flexor and extensor margins irregularly spinulate. Dactylus longer than upper palm length; proximal dorsal 2/3 with spines and granules; with faint longitudinal carina on outer surface, occlusal surfaces of dactylus and pollex crenulate, without gape when closed.

P2 and P3 long, slender, sparsely setose; all segments finely granular; propodus, carpus and merus with serrated granules and scattered spinules on extensor margins. P3 longest; male merus distinctly longer than cl (1.25 times pcl); female merus length ranging from as long as pcl to slightly shorter than cl (1.00–1.05 times pcl). Dactyli broadly curved, finely granular, without longitudinal rib, though slightly compressed in distal 0.4; sparsely setose, densest on extensor margin. P3 dactylus about as long as combined length of propodus and carpus.

P4 and P5 minutely spinulate, sparsely setose; longer than merus of P3; dactyli markedly shorter than propodi, falcate, with corneous apex and 4 or 5 obliquely inclined, corneous spines on flexor margin. P5 merus, when folded against carapace, reaching slightly beyond anterior midlength of carapace.

Male abdomen with margins and surface finely granular or minutely spinulate; telson immovably fused to abdominal somite 6 forming pleotelson, but suture well-defined, length about 1/3 width; apex broadly rounded.

Female abdomen with similar ornamentation to male; telson immovably fused to abdominal somite 6 to form pleotelson, suture absent, but demarcation indicated only laterally by marginal notch; apex broadly rounded or gently emarginate.

Male pleopod 1 with 3 segment; distal article cannulate, forming copulatory tube, with moderately long distal setae. Male pleopod 2 with articles fused, L-shaped; distomesial margin slightly hollowed, apex acute.

Egg diameter 1.0–1.1 mm.

***Etymology*. –** The species is named after the Greek cynic Diogenes, alluding to our doubts that the presence or absence of an abdominal suture is a useful generic character. The name is used as a noun in apposition.

***Remarks*. –** Tavares (1993) established a new genus, *Cymonomoides* (type species *Cymonomus guinotae* Tavares, 1991), for species previously classified in *Cymonomus* that have the sixth abdominal somite and telson separated by a visible suture. In *Cymonomus* sensu stricto, the telson and abdominal somite 6 are indistinguishably fused into a pleotelson in both sexes. The discovery of *C. diogenes*, new species, however, raises important questions about the validity and/or definition of *Cymonomoides*. In male *C. diogenes*, abdominal somite 6 and the telson are immovably fused, but clearly demarcated by a suture. In female *C. diogenes*, no suture is visible. If the absence or presence of a suture between abdominal somite 6 and the telson is the only criterion to separate the two genera, then the male and female *C. diogenes* would be referred to different genera, *Cymonomoides* and *Cymonomus*, respectively. Moreover, re-examination of the female holotype of *Cymonomoides delli* (Griffin & Brown, 1976) (AM P19379), a species very similar to *C. diogenes*, revealed that the telson and abdominal somite 6 are also immovable, though clearly demarcated, as in male *C. diogenes*. Male *Cymonomoides delli* are not presently known. Thus, there is no common pattern of somite differentiation between the sexes in *C. diogenes* and *Cymonomoides delli*, except that abdominal somite 6 and the telson form a pleotelson, irrespective of the presence or absence of a demarcation. That both *C. diogenes* and *Cymonomoides delli* have a pleotelson indicates that both are best placed in *Cymonomus* sensu stricto, rather than *Cymonomoides*. As such, we depart from Tavares (1993) in transferring *Cymonomus delli* to *Cymonomoides* Tavares, 1993, but instead keep it in *Cymonomus* A. Milne-Edwards, 1880, sensu stricto, as Griffin & Brown (1976) originally intended.

Ng & Chia (1994) highlighted a similar problem in members of the subfamily Antrocarcininae Ng & Chia, 1994 (Xanthidae), in which the sutures separating male abdominal somites 3 to 5 are clearly visible, even though the somites are functionally immobile and therefore must be regarded as fused. Similar observations have been made in various geryonids, progeryonids, xanthids and camptandriids (see Ng & Manning, 1998; Ng & Guinot, 1999; Tan & Ng, 1999; Ng & Chan, 2000; Manuel-Santos & Ng, 2007). For the Cymonomidae, the nature of the differentiation between the telson and abdominal somite 6 will need to be studied in more detail for the Atlantic species of *Cymonomoides*. The female holotype of *Cymonomoides guinotae* Tavares, 1991 (type species), however, was kindly examined for us by Danièle Guinot (pers. com., March 2009); it proved to have a pleotelson in which the telson and abdominal somite 6 are demarcated by a suture. Clearly, the concept of *Cymonomoides*, if the genus is valid, requires substantial revision.

Cymonomus diogenes closely resembles *C. andamanicus* Alcock, 1905, from the Andaman Sea, and *Cymonomus delli*, from southeastern Australia, sharing the short, equilaterally triangular rostrum, short, stout, divergent eyestalks, and the posteriorly divergent lateral carapace margins. *Cymonomus diogenes* differs from *C. delli* in having a proportionally wider fronto-orbital margin, which is wider than half the anterior carapace width (half anterior carapace width in *C. delli*); the P3 merus is as long as or longer than the postrostral carapace length, but shorter in *C. delli*; the P4 merus is distinctly shorter than half the P3 merus length (half in *C. delli*); and the telson is indistinguishably fused to abdominal somite 6 in females (males with a marked suture) in contrast to a marked suture in female *C. delli* (male *C. delli* not known).

The poorly known *Cymonomus andamanicus* Alcock, 1905, from the Andaman Sea, also closely resembles *C. diogenes* and *C. delli*. Separate unpublished studies by the authors indicate that the specimens of "*C. andamanicus*" reported from Taiwan (Ho et al., 2004; Ahyong et al., 2009) and Japan (Sakai, 1976) actually represent different species. At present, *C. andamanicus* is known reliably only from Alcock's holotype (male, cl 8.5 mm, cw 8.0 mm, 11°26'30"N 92°53'45"E, 378 fathoms [692 m]). According to the excellent figures of the male holotype of *C. andamanicus* by Alcock (1905) and Alcock & MacGilchrist (1907: Pl. LXXIX, 2, 2a, 2b), *C. diogenes* differs chiefly in its proportionately longer legs. The male P3 merus of *C. andamanicus* is shorter than the carapace length, rather than distinctly longer in *C. diogenes*. Unfortunately, Alcock (1905) did not mention abdominal segmentation of the male holotype, but it is likely to be similar to *C. delli* or *C. diogenes* in view of the substantial similarities in other features.

Sexual dimorphism in the lengths of P2 and P3, as measured by the meral lengths, is now confirmed in at least some cymonomids. In *C. diogenes*, *C. hakuhoae* and *C. marivenae* reported below, the P2 and P3 are proportionally longer in males than in females (as measured by merus lengths). In female *C. diogenes*, the P3 merus is equal to or longer than postrostral carapace length but shorter than carapace length. The P3 merus of male *C. diogenes* is distinctly longer than overall carapace length. Although sexual dimorphism in pereopod length occurs in many decapods, the material at hand confirms that it also occurs in at least some species of Cymonomidae. As such, sexual dimorphism should be carefully considered during identification and diagnosis of cymonomid species. Unfortunately at present, many cymonomid species are known only from females.

***Distribution*. –** Presently known only from the Bohol and Sulu seas, Philippines; 569–760 m.

Cymonomus gracilipes, new species
(Fig. 3)

***Material examined*. –** Holotype: NMCR, ovigerous female (cl 6.1 mm, pcl 5.8 mm, cw 6.0 mm), station CP 2341-JL16, Bohol Sea, off Pamilacan Island, 9°24.5'N 123°49.7'E, 544–712 m, coll. PANGLAO 2005, 23 May 2005.

***Description*. –** Carapace quadrate, almost square, lateral margins broadly convex; regions weakly indicated; with anteriorly directed anterolateral spine flanked by smaller spines; lower pterygostomian region swollen; anterior and anterolateral surfaces with long, fine setae, other surfaces with sparse, short fine setae. Dorsal and lateral surfaces entirely covered with minute granules, with granules becoming larger and more elongate anterolaterally. Fronto-orbital margin (excluding rostrum and lateral projections) advanced beyond anterolateral margins; exceeding half anterior carapace width; lateral frontal projections slender, elongate, situated below plane of rostrum, laterally spinulate, with acute apices, about twice length of rostrum. Rostrum short, triangular, apex acute, minutely granular laterally and dorsally. Eyestalks slightly divergent, flattened, fused to carapace below rostral base; granular; cornea unknown (broken in holotype). Epistome smooth except for blunt tubercle mesial to base of antennules, small spine mesial to base of antenna and small cluster of blunt granules at base of rostrum.

Antennular peduncle longer than cl; article 1 granular laterally or minutely spinular; articles 2 and 3 smooth. Basal antennal article fused to epistome; articles 2–4 irregularly granular or spinular; article 5 smooth.

Maxilliped 3 ischiobasis subquadrate, sparsely granular, with longitudinal sublateral groove; ischium and basis demarcated by faint groove. Merus slightly shorter than ischiobasis, about 3.5 times longer than wide; tapering distally to rounded apex; surface sparsely granular or spinulate; margins spinulate. Propodus and carpus sparsely spinulate or granular Dactylus conical, unarmed. Exopod sparsely granular, not exceeding merus of endopod.

Chelipeds (P1) sparsely setose. Merus carpus and palm finely granular, without spines. Dactylus about 1.5 times upper palm length; with proximal dorsal granules; with faint longitudinal carina on outer surface; occlusal surfaces of dactylus and pollex crenulate, without gape when closed.

P2 and P3 long, slender, sparsely setose; segments finely granular (P2 dactylus unknown; P3 dactylus and propodus unknown). P3 longest, merus longer than carapace and rostrum length combined (1.14 times pcl).

P4 granular, minutely spinulate, longer than P3 merus; dactylus markedly shorter than propodus, falcate, with corneous apex and 4 obliquely inclined, corneous spines on flexor margin. P5 ischium sparsely granulate; other segments unknown.

Female abdomen with margins and surface finely granular or minutely spinulate; pleotelson pentagonal, apex bluntly angular; half as long as wide.

Egg diameter: 1.1 mm.

***Etymology*. –** The species is named *gracilipes* for its proportionally longer ambulatory legs in comparison to those of the very similar species, *C. hakuhoae*.

***Remarks*. –** Unfortunately, the single known specimen is damaged, although it is sufficiently intact to characterise as a new species. *Cymonomus gracilipes*, new species, is closest to *C. hakuhoae* in the slightly divergent ocular peduncles, short, triangular rostrum that is about half the length of the lateral frontal processes and slender distal half of the maxilliped 3 merus in which the palp inserts at about the midlength. *Cymonomus gracilipes* differs from *C. hakuhoae* in having proportionally longer P2 and P3 meri (longer than postrostral carapace and carapace lengths respectively) and the relatively more slender antennular peduncle. The holotype of *C. gracilipes* carried 15 eggs of 1.1 mm diameter.

***Distribution*. –** Presently known only from the Bohol Sea off Pamilacan Island; 544–712 m.

Cymonomus hakuhoae Takeda & Moosa, 1990
(Figs. 4, 5, 7E, F)

Cymonomus hakuhoae Takeda & Moosa, 1990: 59–61, fig. 3 [type locality: Flores Sea, Indonesia]. — Ng et al., 2008: 32.

***Material examined*. –** Holotype: NSMT Cr10529, female (cl 5.0 mm, cw 4.9 mm), Flores Sea, 5°55.4–54.5'S 119°29.5'E, 558–593 m, KH-85-1 stn B-2, coll. *Hakuho Maru*, 12 Feb.1985. Others: ZRC, 1 male (cl 4.2 mm, pcl 3.9 mm, cw 4.0 mm), station CP 2384, Bohol/Sulu sea margin off Aligbay Island, 8°46.2'N 123°16.1'E, 624–647 m, coll. PANGLAO 2005, 29 May 2005; ZRC, 1 female (cl 5.7 mm, pcl 5.2 mm, cw 5.5 mm), station CC 2700, east of Dingalan Bay, Luzon, 14°47.22'N 123°08.5'E, 500–527 m, coll. AURORA 2007, 27 May 2007.

***Description*. –** Carapace quadrate, almost square, lateral margins broadly convex; regions weakly indicated; with anteriorly directed anterolateral spine flanked by smaller spines; lower pterygostomian region swollen; anterior and anterolateral surfaces with long, fine setae, other surfaces with sparse, short fine setae. Dorsal and lateral surfaces entirely covered with minute granules, with granules becoming larger and more spiniform anterolaterally. Fronto-orbital margin (excluding rostrum and lateral projections) advanced

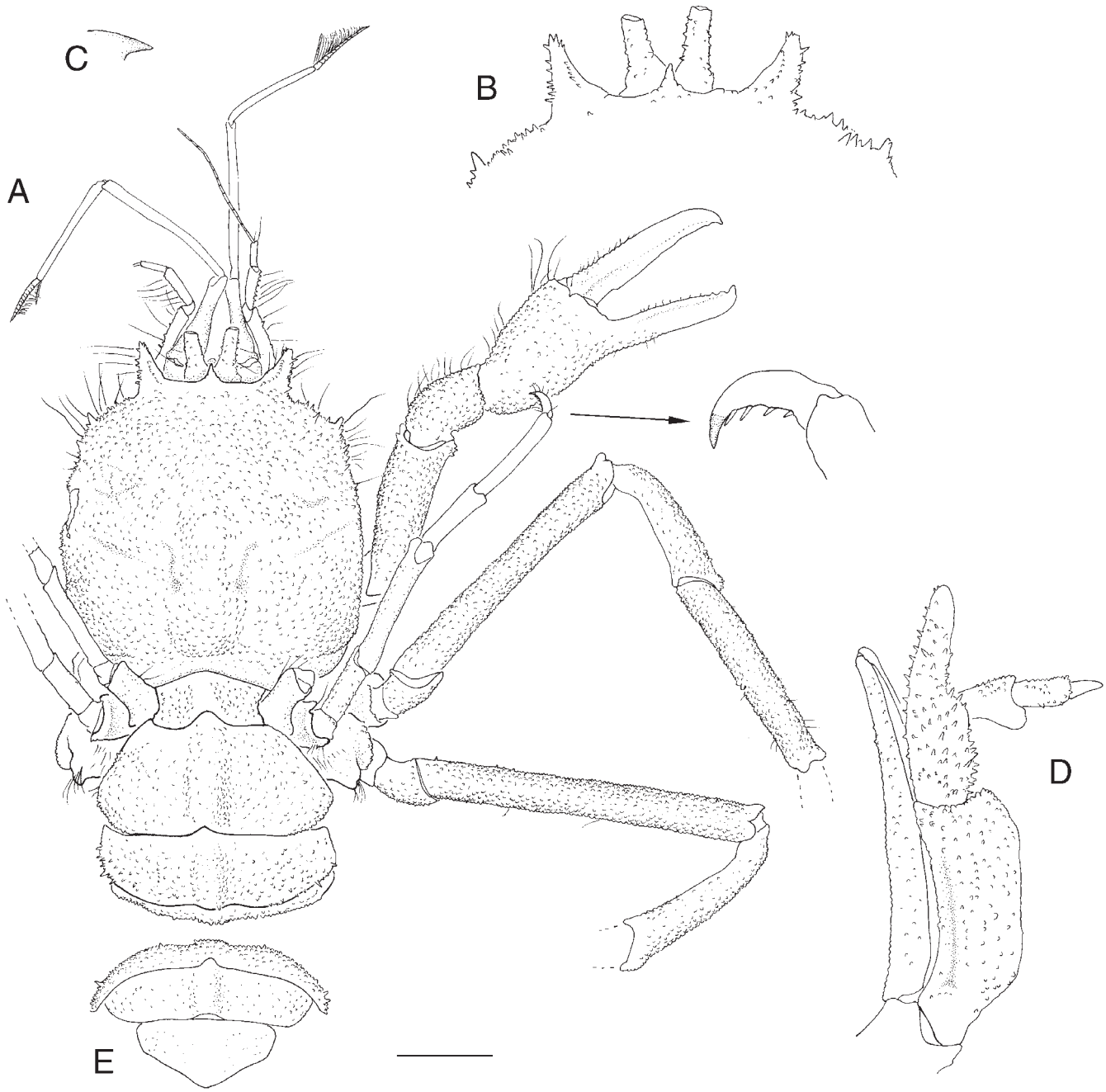

Fig. 3. *Cymonomus gracilipes*, new species, ovigerous female holotype (cl 6.1 mm, pcl 5.8 mm, cw 6.0 mm) (NMCR). A, dorsal habitus. B, anterior carapace. C, basal antennal spine, right ventral view. D, right maxilliped 3. E, posterior abdomen. Scale bars: A, E = 2.0 mm; B = 1.25 mm, C = 0.5 mm; D = 1.0 mm.

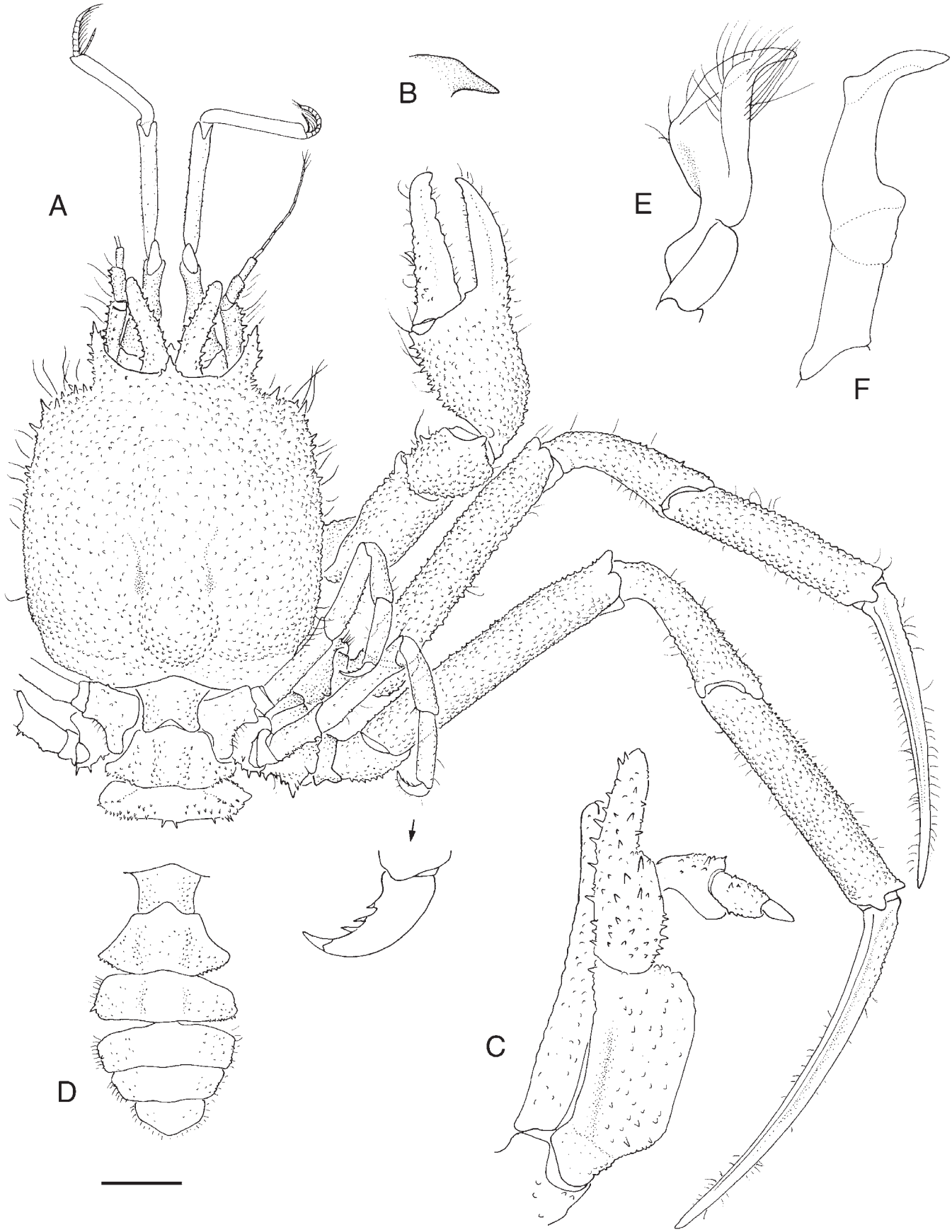

Fig. 4. *Cymonomus hakuhoae* Takeda & Moosa, 1990, male (cl 4.2 mm, pcl 3.9 mm, cw 4.0 mm) (ZRC). A, dorsal habitus. B, basal antennal spine, right ventral view. C, right maxilliped 3. D, abdomen. E, left G1, abdominal view. F, left G2, abdominal view. Scale bars: A, D = 1.0 mm; B = 0.2 mm, C = 0.5 mm; E, F = 0.4 mm.

slightly beyond anterolateral margins; exceeding half anterior carapace width; lateral frontal projections slender, elongate, situated below plane of rostrum, laterally spinulate, with acute apices, about twice length of rostrum. Rostrum short, triangular, apex acute, minutely granular laterally and dorsally. Eyestalks slightly divergent, flattened, fused to carapace below rostral base; granular; reaching anteriorly almost to apex of basal antennular peduncle segment. Epistome smooth except for blunt tubercle mesial to base of antennules, small spine mesial to base of antenna, and small cluster of blunt granules at base of rostrum.

Antennular peduncle as long as cl; articles 1 and 2 granular; article 3 smooth. Basal antennal article fused to epistome; articles 2–4 irregularly granular or spinular; article 5 smooth.

Maxilliped 3 ischiobasis subquadrate, sparsely granular, with longitudinal sublateral groove; ischium and basis demarcated by faint groove. Merus slightly shorter than ischiobasis, about 3.0 times longer than wide; tapering distally to rounded apex; surface sparsely granular or spinulate; margins spinulate. Propodus and carpus sparsely spinulate or granular Dactylus

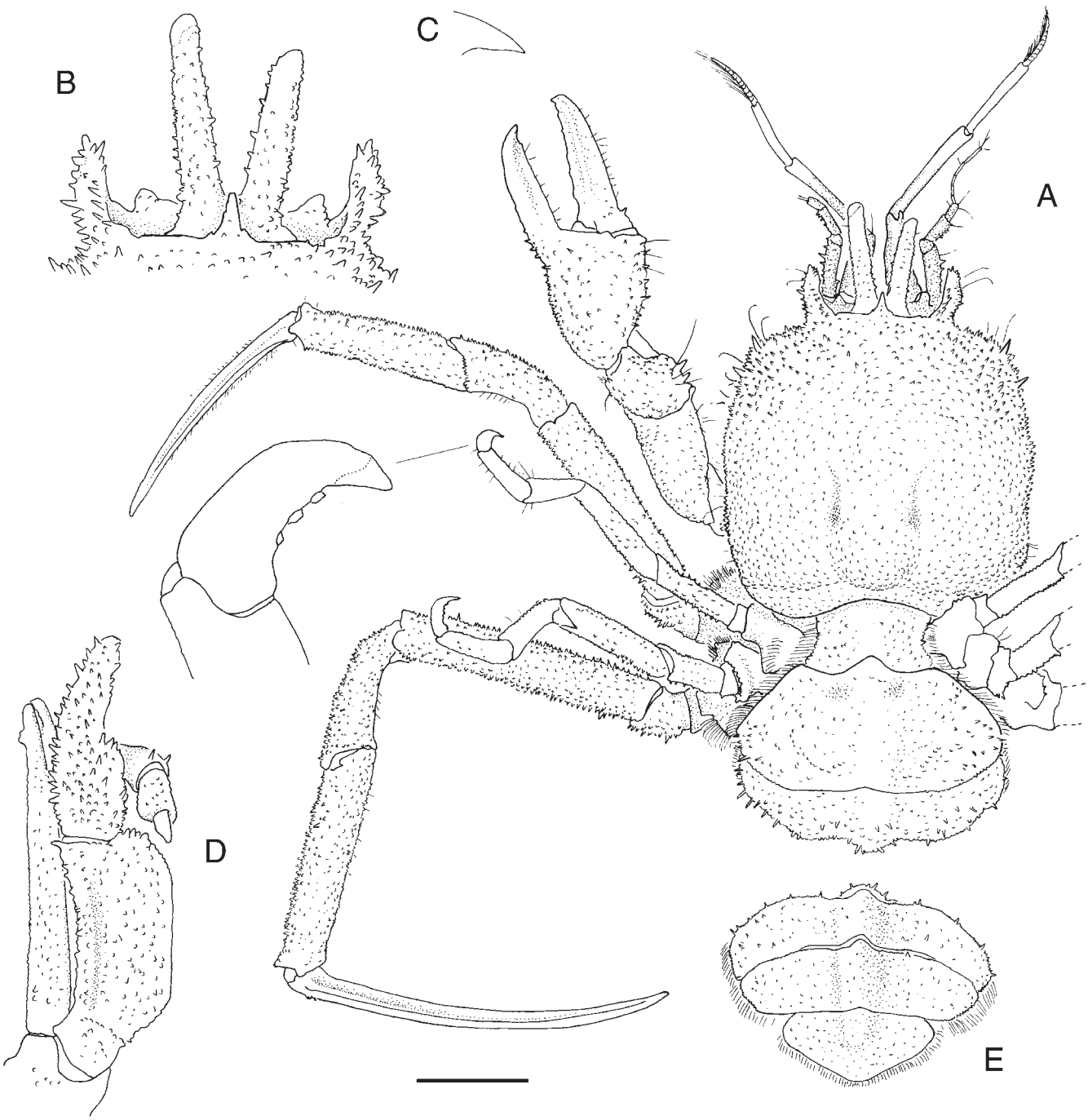

Fig. 5. *Cymonomus hakuhoae* Takeda & Moosa, 1990, female (cl 5.7 mm, pcl 5.2 mm, cw 5.5 mm) (ZRC). A, dorsal habitus. B, anterior carapace. C, basal antennal spine, right ventral view. D, right maxilliped 3. E, posterior abdomen. Scale bars: A, E = 2.0 mm; B, D = 1.0 mm, C = 0.5 mm.

conical, unarmed. Exopod sparsely granular, not exceeding merus of endopod.

Chelipeds (P1) sparsely setose. Merus carpus and palm finely granular. Carpus and palm with extensor and flexor spines. Dactylus about 1.5 times upper palm length; with proximal dorsal granules or spinules; with faint longitudinal carina on outer surface; occlusal surfaces of dactylus and pollex crenulate, without gape when closed.

P2 and P3 long, slender, sparsely setose; all segments except for dactylus finely granular; propodus and carpus with minutely spinular extensor margins; merus with minutely spinular extensor and flexor margins.

P3 longest; male merus slightly shorter than cl (1.03 times pcl); female merus shorter than cl (0.94 times pcl). Dactyli broadly curved, proximal extensor margin minutely granulate or spinulate; with longitudinal rib. P3 dactylus slightly shorter than combined length of propodus and carpus (male) or slightly longer (female).

P4 and P5 granular, minutely spinulate, sparsely setose; longer than merus of P3; dactyli markedly shorter than propodi, falcate, with corneous apex and 3 or 4 obliquely inclined, corneous spines on flexor margin. P5 merus, when folded against carapace, reaching midlength of carapace.

Male abdomen with margins and surface finely granular or minutely spinulate; pleotelson pentagonal, apex bluntly rounded, half as long as wide.

G1 3-segmented; distal article cannulate, forming copulatory tube, with moderately long distal setae. G2 with articles fused; distomesial margin slightly hollowed, apex acute.

Female abdomen with margins and surface finely granular or minutely spinulate; pleotelson subpentagonal, lateral margins straight to rounded, apex bluntly rounded; half as long as wide.

Egg diameter 0.8 mm.

***Remarks*. –** *Cymonomus hakuhoae* was described from a single damaged female, lacking both the P3 and P4. The two Philippine specimens of *C. hakuhoae* are the first complete specimens and first additional records of the species since the original description, so the species is redescribed and refigured here. The original account of *C. hakuhoae* incorrectly figured the holotype with parallel rather than divergent eyestalks. In fact, the female holotype, re-examined here, agrees with the Philippine female in all respects. The male differs from both females in having proportionally longer ambulatory legs as measured by the length of the P3 merus, and in having slightly more divergent eyestalks.

***Distribution*. –** Flores Sea (Takeda & Moosa, 1990) and now from the Philippines; 500–647 m.

Cymonomus mariveneae, new species
(Figs. 6, 7G, H)

Cymonomus, new species. — Ng et al., 2008: 32, fig. 4.

***Material examined*. –** Holotype: NMCR, male (cl 2.7 mm, pcl 2.3 mm, cw 2.4 mm), station T34, Bohol Sea, between Libaong and Pamilacan Island, sand substrate with echinoderms, 09°31.3'N 123°51.4'E, 145–163 m, coll. PANGLAO 2004, 3 Jul.2004. Paratype: ZRC, 1 female (cl 2.4 mm, pcl 2.0 mm, cw 2.4 mm), station T34, Bohol Sea, between Libaong and Pamilacan Island, 09°31.3'N 123°51.4'E, 145–163 m, sand with echinoderms, coll. PANGLAO 2004, 3 Jul.2004.

***Description*. –** Carapace quadrate, almost square, lateral margins subparallel; regions weakly indicated; lower pterygostomian region swollen; anterior and anterolateral surfaces with few long, fine setae, other surfaces almost glabrous. Anterolateral and posterolateral surfaces covered with rounded or globular tubercles and granules, and club-shaped or stalked tubercles in anterolateral regions; tubercles largest anterolaterally, becoming smaller posterolaterally. Central carapace surface smooth. Fronto-orbital margin (excluding rostrum and lateral projections) advanced slightly beyond anterolateral margins; exceeding half anterior carapace width; lateral frontal projections slender, elongate, situated below plane of rostrum, covered with club-shaped or stalked tubercles, slightly shorter than rostrum. Rostrum slender, apex acute, granular laterally and dorsally; reaching anteriorly beyond distal ¾ bit not apices of eyestalks. Eyestalks strongly divergent, flattened, fused to carapace below rostral base; spinose; reaching anteriorly beyond midlength of basal antennular peduncle segment. Epistome smooth except for small cluster of granules at base of rostrum and small blunt, rounded lobe mesial to base of antenna.

Antennular peduncle longer than pcl but shorter than cl; articles smooth. Basal antennal article fused to epistome; articles 2–4 with globose tubercles; article 5 smooth.

Maxilliped 3 ischiobasis subquadrate, sparsely granular, with globose tubercles; ischiobasal demarcation not evident. Merus slightly shorter than ischiobasis, about 3.0 times longer than wide; tapering distally to rounded apex; surface and margins covered with globose and club-shaped tubercles. Dactylus, propodus and carpus sparsely spinulate or granular. Exopod with globose and club-shaped tubercles, not exceeding merus of endopod.

Chelipeds (P1) sparsely setose; all segments with with globose and club-shaped tubercles. Dactylus slightly longer than upper palm length; with proximal dorsal granules or spinules in addition to globose tubercles; occlusal surfaces of dactylus and pollex with scattered spinules, with distinct gape when closed.

P2 and P3 long, slender, sparsely setose; all segments except for dactylus covered with globose club-shaped tubercles. P3 longest, merus shorter than carapace; 0.89 times pcl (male), 0.83 times pcl (female). Dactyli broadly curved, extensor margin minutely granulate or spinulate; without longitudinal

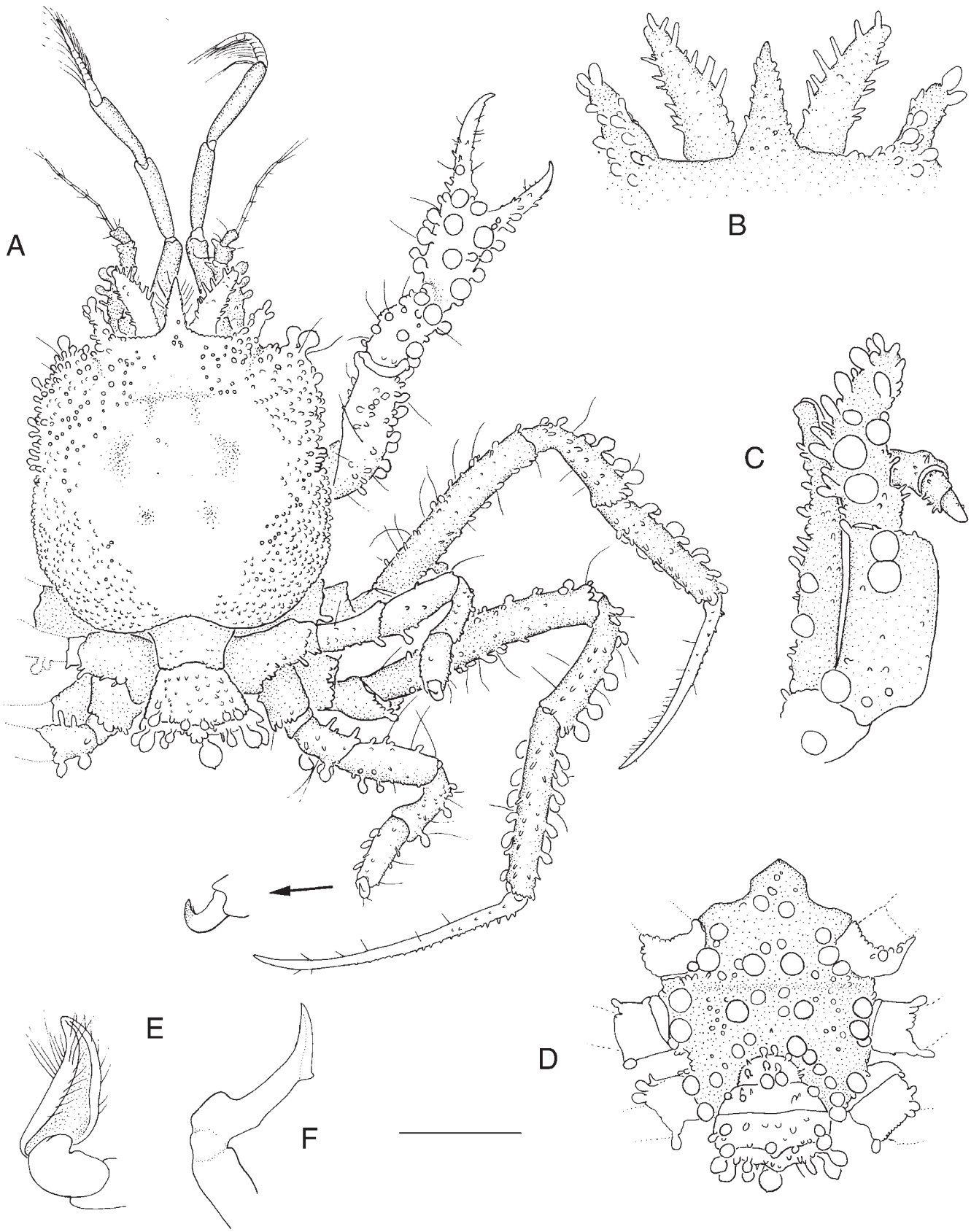

Fig. 6. *Cymonomus mariveneae*, new species, male holotype (cl 2.7 mm, pcl 2.3 mm, cw 2.4 mm) (NMCR). A, dorsal habitus. B, anterior carapace. C, right maxilliped 3. D, sternum and abdomen, ventral view. E, right G1, abdominal view. F, right G2, abdominal view. Scale bars: A, D = 1.0 mm; B, C, E, F = 0.5 mm.

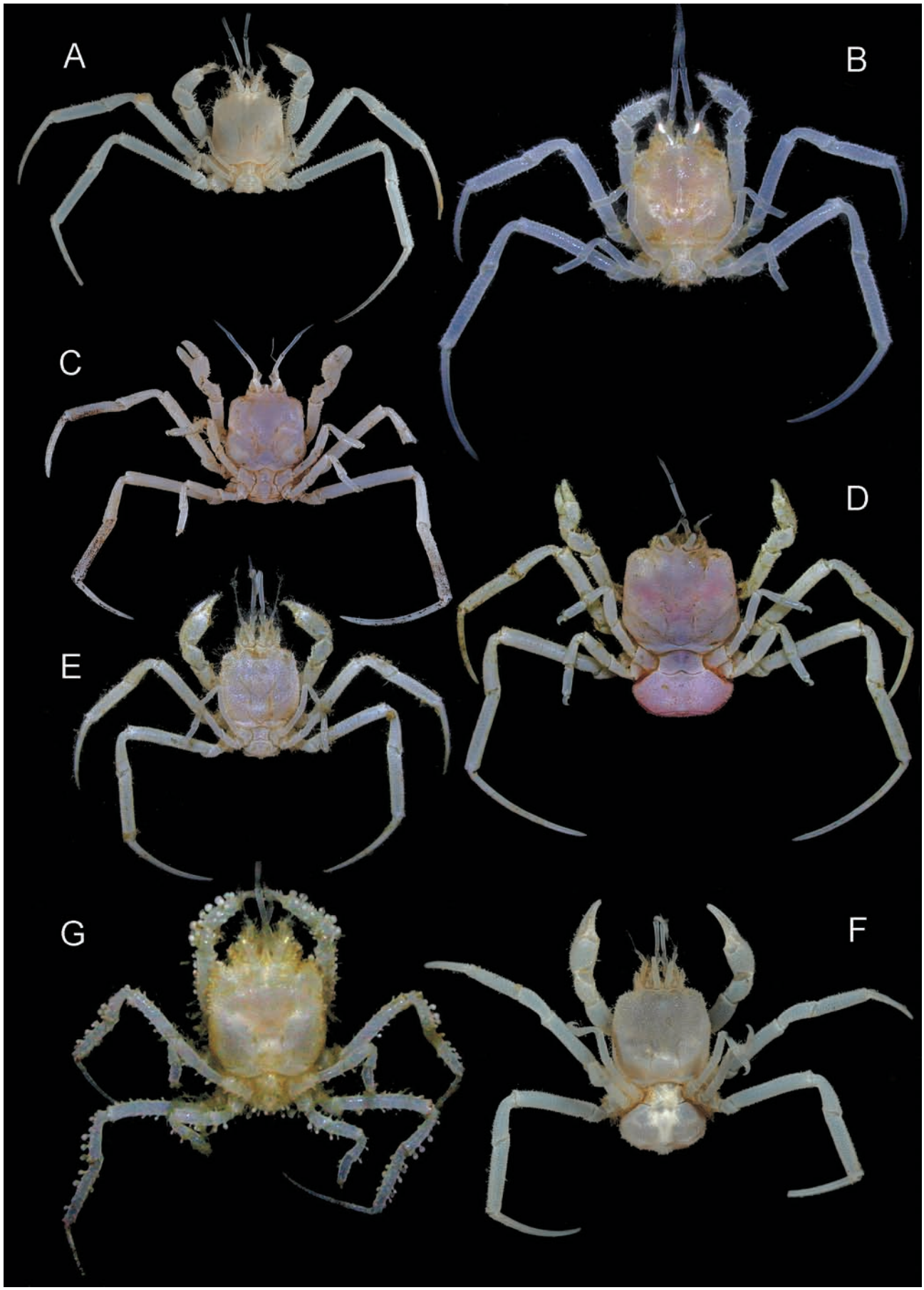

Fig. 7. Colours in life. A, B, *Cymonomus deforgesi*, new species, male holotype (NMCR) and juvenile male (ZRC), respectively. C, D, *Cymonomus diogenes*, new species, male paratype, PANGLAO 2005 stn CP2336 (ZRC) and female paratype, PANGLAO 2005 stn CP2397 (ZRC), respectively. E, F, *Cymonomus hakuhoae* Takeda & Moosa, 1990, male (ZRC) and female (ZRC), respectively. G, *Cymonomus mariveneae*, new species, male holotype (NMCR).

rib; with scattered spinules on other surfaces. P3 dactylus slightly shorter than combined length of propodus and carpus in both sexes.

P4 and P5 with globose and club-shaped tubercles, and minute spinules, sparsely setose; longer than merus of P3; dactyli markedly shorter than propodi, falcate, flexor margin with 1 spine adjacent to corneous apex. P5 merus, when folded against carapace, reaching almost to midlength of carapace.

Abdomen of both sexes covered with globose and club-shaped tubercles, and scattered spinules. Male and female pleotelson rounded.

G1 3-segmented; distal article cannulate, forming copulatory tube, with moderately long distal setae. G2 with articles fused; distomesial margin slightly hollowed, apex acute.

***Etymology*. –** The species is named after Marivene Manuel-Santos, crustacean curator at the NMCR, for her kind help with the expedition.

***Remarks*. –** *Cymonomus mariveneae*, new species, is the fourth species in the genus to bear the prominent petaloid and pedunculate globular tubercles on the body and pereopods. Other similarly ornamented species are *C. curvirostris* Sakai, 1965 (from Japan), *C. kapala* Ahyong & Brown, 2003 (from eastern Australia) and *C. trifurcus* Stebbing, 1920 (from South Africa). These species form a discrete group within the genus, united not only by possessing globular tubercles on the body and limbs, but also by their diminutive size with adults smaller than 3.5 mm in carapace length. *Cymonomus trifurcus* is unique in this group by its rostrum being longer rather than shorter than the eyestalks. *Cymonomus kapala* is unique in bearing a large hemispherical boss laterally on each branchial margin. *Cymonomus mariveneae* is easily distinguished from *C. curvirostris* by its virtually smooth central area of the carapace and the clear demarcation between the ocular peduncles and carapace margin. In *C. curvirostris*, the carapace surface is uniformly covered with rounded tubercles and the ocular peduncles are indistinguishably fused with the frontal margin of the carapace.

As with *C. diogenes* and *C. hakuhoae*, *C. mariveneae* exhibits sexual dimorphism in the length of the ambulatory legs, though the differences are more slight. The P3 merus in male *C. mariveneae* is 0.89 times the pcl, versus 0.83 times in the female. A similar pattern of sexual dimorphism is present also in *C. kapala*, in which the male P3 merus is 1.05 times the pcl versus 0.86–0.90 times in females. Sexual dimorphism in ambulatory leg length will probably prove to be a general pattern in cymonomids.

***Distribution*. –** Presently known only from the Bohol Sea, in the vicinity of Libaong and Pamilacan islands, Philippines; 145–163 m.

ACKNOWLEDGMENTS

The material was collected in three expeditions and cruises (PANGLAO 2004, PANGLAO 2005 and AURORA 2007) which were organized by the Muséum national d'Histoire naturelle (MNHN, Paris); University of San Carlos (USC, Cebu); National Museum of the Philippines (NMCR, Manila); Philippines Bureau of Fisheries Research (BFAR, Manila); Raffles Museum of Biodiversity Research, National University of Singapore (RMBR); and National Taiwan Ocean University (NTOU, Keelung). Thanks are due to Philippe Bouchet and Bertrand Richer de Forges (MNHN), Danilo Largo and Lawrence Liao (USC), M. Ludivina (BFAR), Marivene Manuel-Santos (NMCR), Tan Swee Hee, Tohru Naruse, Tan Siong Kiat and Joelle Lai (RMBR), Chan Tin Yam and Lin Chia-Wei (NTOU), and Helen Stoddart and Stephen Keable (AM) for their kind help in various aspects of this study. The second author is grateful to Philippe Bouchet for making all the complex arrangements necessary for the expeditions and inviting him to participate. We thank the captain and crew of the Philippine fisheries research vessel R.V. *DA-BFAR* for their kind help. The expeditions were supported by grants from the Total Foundation, French Ministry of Foreign Affairs, MNHN, RMBR and NTOU. The first author gratefully acknowledges the support of the NIWA Capability Fund, New Zealand Foundation for Research Science and Technology, and fellowships from the Raffles Museum of Biodiversity Research, National University of Singapore. We also thank Hironori Komatsu (NSMT) for the loan of specimens and S. H. Tan (RMBR) for assistance with literature.

LITERATURE CITED

Ahyong, S. T., 2008. Deepwater crabs from seamounts and chemosynthetic habitats off eastern New Zealand (Crustacea: Decapoda: Brachyura). *Zootaxa*, **1708**: 1–72.

Ahyong, S. T. & D. E. Brown, 2003. New species of *Cymonomus* from southeastern Australia (Brachyura, Cymonomidae) with a key to the Indo-West Pacific species. *Crustaceana*, **75**: 1363–1374.

Ahyong, S. T., J. C. Y. Lai, D. Sharkey, D. J. Colgan & P. K. L. Ng, 2007. Phylogenetics of the brachyuran crabs (Crustacea: Decapoda) part 1: the status of Podotremata based on small subunit nuclear ribosomal RNA. *Molecular Phylogenetics and Evolution*, **45**: 576–586.

Ahyong, S. T., T. Naruse, S. H. Tan & P. K. L. Ng, 2009. Part II. Infraorder Brachyura: Sections Dromiacea, Raninoida, Cyclodorippoida. *In*: T.-Y. Chan, P. K. L. Ng, S. T. Ahyong, & S. H. Tan (eds.), Crustacean Fauna of Taiwan: Brachyuran Crabs, Volume 1 – Carcinology in Taiwan and Dromiacea, Raninoida, Cyclodorippoida. National Taiwan Ocean University, Keelung. Pp. 27–198.

Alcock, A., 1905. Natural history notes from the R.I.M.S. Ship 'Investigator', Capt. T.H. Heming, R.N. commanding. Series III, No. 9. On a new species of the dorippoid genus *Cymonomus* from the Andaman Sea, considered with reference to the distribution of the Dorippidae; with some remarks on the allied genus *Cymonomops*. *Annals and Magazine of Natural History*, series 7, **15**: 565–577.

Alcock, A. & A. C. MacGilchrist, 1907. *Illustrations of the Zoology of the Royal Indian Marine Survey Ship 'Investigator', under the command of Captain T. H. Heming, R. N. (Retired). Crustacea (Malacostraca)* — Pt. XII, pls. LXXVII–LXXIX. Crustacea (Stomatopoda) — Pt. I., pls. I–II. Published under the authority of Captain G. H. Hewett, R.N., Director of the Royal Indian Marine. Calcutta: Office of the Superintendent of Government Printing, India. (See Clark & Crosnier, 1992, for dates).

Bouvier, E.-L., 1898. Observations on the crabs of the family Dorippidae. *Annals and Magazine of Natural History*, (7)**1**: 103–105.

Clark, P. F. & A. Crosnier, 1992. Illustrations of the Zoology of the R.I.M.S. *Investigator*: authors, dates, issues, plates and titles. *Archives of Natural History*, **19**(3): 365–374.

Griffin, D. J. G. & D. E. Brown, 1976. Deepwater decapod Crustacea from eastern Australia: brachyuran crabs. *Records of the Australian Museum*, **30**: 248–271.

Ho, P.-H., P. K. L. Ng, T.-Y. Chan & D.-A. Lee, 2004. New records of 31 species of brachyuran crabs from the joint Taiwan-France expeditions, "TAIWAN 2000" and "TAIWAN 2001", off deep waters in Taiwan. *Crustaceana*, **77**: 641–668.

Manuel-Santos, M. R. & P. K. L. Ng, 2007. On the genus *Ladomedaeus* Stevcic, 2005, from the Philippines and Japan, and the status of the Ladomedaeidae Stevcic, 2005 (Decapoda: Brachyura: Xanthoidea). *Raffles Bulletin of Zoology*, Supplement **16**: 177–185.

Milne-Edwards, A., 1880. Études préliminaires sur les crustacés, 1ere partie, *in* Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico, and in the Caribbean Sea, 1877, '78, '79, by the U.S. Coast Survey Steamer "Blake," Lieut.-Commander C. D. Sigsbee, U.S.N., and Commander J. R. Bartlett, U.S.N., commanding, VIII. *Bulletin of the Museum of Comparative Zoology at Harvard College*, **8**: 1–68, Pls. 1, 2.

Ng, P. K. L. & T.-Y. Chan, 2000. Note on *Mathildella serrata* (Sakai, 1974) (Crustacea: Decapoda: Brachyura: Goneplacidae) from deep waters in Taiwan. *National Taiwan Museum Special Publication Series*, Taipei, **10**: 149–153.

Ng, P. K. L. & D. G. B. Chia, 1994. The genus *Glyptocarcinus* Takeda, 1973, with descriptions of a new subfamily, two new genera and two new species from New Caledonia (Crustacea: Decapoda: Brachyura: Xanthidae). *Raffles Bulletin of Zoology*, **42**(3): 701–730.

Ng, P. K. L. & D. Guinot, 1999. On a new species of deep-water crab of the genus *Progeryon* (Decapoda, Brachyura, Geryonidae) from Hawaii. *Crustaceana*, **72**(7): 685–692.

Ng, P. K. L. & R. B. Manning, 1998. A new deep-water crab from Belau, Micronesia, with a key to the Pacific species of *Chaceon* (Crustacea: Decapoda: Brachyura: Geryonidae). *Proceedings of the Biological Society of Washington*, **111**(2): 389–397.

Ng, P. K. L., D. Guinot & P. J. F. Davie, 2008. Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *Raffles Bulletin of Zoology*, Supplement **17**: 1–286.

Sakai, T. 1965. *The Crabs of Sagami Bay, collected by His Majesty the Emperor of Japan*. Maruzen, Tokyo. Pp. i–xvi, 1–206, 1–92, 1–32, Figs. 1–27, Pls. 1–100.

Sakai, T., 1976. *Crabs of Japan and the Adjacent Seas*. Kodansha, Tokyo. Pp. 1–773, 1–461, 1–16, maps 3, text-figs. 1–379, Pls. 1–25.

Stebbing, T. R. R., 1920. South African Crustacea (Part X of S.A. Crustacea, for the Marine Investigations in South Africa). *Annals of the South African Museum*, **17**: 16–272.

Takeda, M. & M. K. Moosa, 1990. A small collection of deep-sea crabs from the Florès Sea. *Indo-Malayan Zoology*, **6**: 53–71.

Tan, C. G. S. & P. K. L. Ng, 1999. A revision of the genus *Camptandrium* Stimpson, 1858 (Crustacea: Decapoda: Brachyura: Camptandriidae). *Raffles Bulletin of Zoology*, **47**(1): 193–219.

Tavares, M., 1991. Espèces nouvelles de Cyclodorippoidea Ortmann et remarques sur les genres *Tymolus* Stimpson et *Cyclodorippe* A. Milne Edwards (Crustacea, Decapoda, Brachyura). *Bulletin du Muséum national d'Histoire naturelle, Paris*, Series 4, **12A**: 623–648.

Tavares, M. S., 1993. Description préliminaire de quatre nouveaux genres et trois nouvelles espèces de Cyclodorippoidea Américains (Crustacea, Decapoda Brachyura). *Vie et Milieu*, **43**: 137–144.