

On Three Species of Reef-dwelling Pilumnid Crabs from Taiwan, with Notes on *Heteropilumnus* De Man, 1895 (Crustacea: Brachyura)

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(Received 24 October 2017; Accepted 24 February 2018; Published 27 March 2018; Communicated by Benny K.K. Chan)

Citation: Ng PKL, Lin CW, Ho PH. 2018. On three species of reef-dwelling pilumnid crabs from Taiwan, with notes on *Heteropilumnus* De Man, 1895 (Crustacea: Brachyura). Zool Stud 57:12. doi:10.6620/ZS.2018.57-12.

Peter K.L. Ng, Chia-Wei Lin, and Ping-Ho Ho (2018) Three species of reef-dwelling pilumnid crabs are recorded for the first time from Taiwan: *Heteropilumnus decharmoyi* (Bouvier, 1915), *Heteropilumnus satriai* Yeo, Rahayu and Ng, 2004, and *Viaderiana sentus* Ng, Dai and Yang, 1997. *Heteropilumnus decharmoyi* was previously assigned to *Pseudolitochira* Ward, 1942, but its carapace and epistomal characters indicate that the species should be referred to as *Heteropilumnus* De Man, 1895, instead. *Heteropilumnus satriai* and *Viaderiana sentus* were described from the South China Sea and both are now recorded from Taiwan. *Heteropilumnus satriai* is redescribed and refigured because the type specimen was a male that had been parasitised by a rhizocephalan and had anomalous features.

Key words: Pilumnidae, Pilumnoidea, *Heteropilumnus*, Crustacea, Brachyura, Taiwan.

BACKGROUND

The pilumnoid crab fauna of Taiwan is currently represented by three known families, 23 genera and 37 species (Ng et al. 2001 2017; Ng and Huang 2002 2003; Hsueh and Ng 2008; Hsueh et al. 2009a b; Chen and Lo 2014; Ng and Lin 2015). Recent collections from shallow reefs in Taiwan have obtained three small species of pilumnids: *Heteropilumnus decharmoyi* (Bouvier, 1915), *H. satriai* Yeo, Rahayu and Ng, 2004, and *Viaderiana sentus* Ng, Dai and Yang, 1997, all of which are new records for the island. The taxonomy of *Heteropilumnus* De Man, 1895, is discussed in this study and *Pseudolitochira decharmoyi* is here reassigned to *Heteropilumnus*.

MATERIALS AND METHODS

Specimens examined are deposited in the National Museum of Marine Biology - Crustacea Decapoda (NMMBCD), National Museum of Marine Biology and Aquarium, Taiwan; National Museum of Natural Science, Taichung (NMNST), Taiwan; Muzium Zoologicum Bogoriense (MZB), Cibinong, Java, Indonesia; and Zoological Reference Collection (ZRC) of the Lee Kong Chian Natural History Museum, National University of Singapore. The abbreviations G1 and G2 are used for the male first and second gonopods, respectively. The measurements (in millimetres) are of the maximum carapace width and length, respectively.

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RESULTS

SYSTEMATICS

Pilumnidae Samouelle, 1819

Subfamily Pilumninae Samouelle, 1819

Genus *Heteropilumnus* De Man, 1895

Type species: Heteropilumnus stormi De Man, 1895, by original designation.

Remarks: Heteropilumnus De Man, 1895, currently contains 19 species from the Indo-West Pacific, but the genus is heterogeneous and almost certainly polyphyletic. Ng (1987: 96) noted that the “definition of the genus remains vague, being characterised by its quadrilateral carapace, usually entire or indistinctly cut anterolateral margin, and the presence of a fringe of long hairs lining the frontal and anterolateral margins.” Some species have been transferred to *Viaderiana* Ward, 1942, *Pseudolitochira* Ward, 1942, and *Cryptocoeloma* Miers, 1884 (see Ng 1987 1989; Ng and Tan 1988), but a revision of *Heteropilumnus* is still necessary.

With regards to *Pseudolitochira*, Ward (1942) established the genus for *Carcinoplax integra* Miers, 1884, described from a female from Seychelles measuring 5.0 × 4.0 mm. In his introduction to the decapods known from Mauritius and adjacent areas, Ward (1942: 52) also listed *Litocheira decharmoyi* Bouvier, 1915, as belonging to *Pseudolitochira*, but without any explanation. Ward (1942: 101) distinguished *Pseudolitochira* from *Heteropilumnus* because the former’s front is relatively broad; the regions on its dorsal carapace surface are not discernible (regions are distinct in *Heteropilumnus*); its anterolateral margin is entire or almost so (vs. with well-developed teeth in *Heteropilumnus*), and its carapace and pereopods have relatively fewer setae (vs. more densely setose in *Heteropilumnus*). Ward (1942) did not examine the type of *P. integra* but noted he had two female specimens from Chagos Islands with carapaces measuring 11 and 15 mm in width. He also apparently did not examine material of *P. decharmoyi*, relying only on the paper by Bouvier (1915) who described the species from Mauritius.

The problem with *Pseudolitochira* is that not all the characters stated by Ward (1942) for the type species, *Carcinoplax integra*, also apply to *P. decharmoyi*. Before comparisons proceed, it is important to note that the illustrations of *C. integra* by Miers (1884: pl. 8 fig. C) are not accurate when compared to photographs of the

type female provided to us by Paul Clark (Natural History Museum, London). Miers (1884: pl. 8 fig. C) depicted the exopod of the third maxilliped as short, reaching only to just after the edge of the ischium; but the photographs reveal that it is actually longer, reaching to just before the distal edge of the merus. The anterolateral margin was described and figured as entire and while no teeth or lobes are discernible, the photograph shows that it is lined with small granules. The outer surface of the chela was not described and while Miers’ figure of it (1884: pl. 8 fig. c’) shows it to be smooth, the photograph reveals that it is actually covered with numerous distinct rounded granules. The taxonomy of this species is now being investigated by Paul Clark and the first author.

The type of *Pseudolitochira integra* nevertheless differs markedly from *P. decharmoyi* because the former has a carapace that is distinctly transversely subovate (cf. Miers 1884: pl. 8 fig. C) (vs. subquadrate in *P. decharmoyi*, Fig. 2A); the regions on its dorsal carapace surface are barely indicated (cf. Miers 1884: pl. 8 fig. C) (regions are distinct in *P. decharmoyi*, Fig. 2A); its front is proportionately much wider such that the anterolateral margin is short (cf. Miers 1884: pl. 8 fig. C) (vs. proportionately narrower front with wider anterolateral margins in *P. decharmoyi*, Fig. 2A-D); its anterolateral margin is entire or almost so (cf. Miers 1884: pl. 8 fig. C) (vs. anterolateral margin cut into low teeth in *P. decharmoyi*, Fig. 2A-D); the posterior margin of its epistome is almost entire, with median lobe triangular and completely confluent with the lateral parts (cf. Miers 1884: pl. 8 fig. c) (the posterior margin of the epistome is distinctly cut into three parts, with the median lobe separated from the lateral parts by a deep fissure in *P. decharmoyi*, Fig. 2E); and the ambulatory legs are proportionately more slender and longer (cf. Miers 1884: pl. 8 fig. C) (vs. legs relatively short and stout in *P. decharmoyi*, Fig. 2A).

The carapace shape, areolation on the carapace and - especially - the structure of the posterior margin of the epistome indicates that *Carcinoplax integra* Miers, 1884, is not congeneric with *Litocheira decharmoyi* Bouvier, 1915, as supposed by Ward (1942). As such, *Pseudolitochira* Ward, 1942, is here restricted for the type species *Carcinoplax integra* Miers, 1884. The carapace and epistomal characters of *L. decharmoyi* are more compatible with *Heteropilumnus*, and this study agrees with Balss (1933) and Serène (1968) that it should be assigned there instead.

***Heteropilumnus decharmoyi* (Bouvier, 1915)**
(Figs. 1A-C, 2-4)

Litochira de Charmoyi Bouvier, 1915: 298, text-fig. 35, pl. 5 fig. 8, pl. 6 fig. 9.

Litocheira de charmoyi - Tesch 1918: 165.

Heteropilumnus de charmoyi - Balss 1933: 44.

Pseudolitochira de charmoyi - Ward 1942: 52.

Heteropilumnus decharmoyi - Serène 1968: 85.

Pseudolitochira decharmoyi - Ng 1987: 79; Ng et al. 2008: 144; Maenosono 2016: 39, figs. 1-3.

Material examined: Taiwan: 1 male (16.8 × 12.7 mm) (NMNST), intertidal area, under rock in sand substrate, Lutao (= Green Island), Taiwan, coll. H.-D. Huang and H.-T. Hong, 30 March 2008; 1 male (13.3 × 9.3 mm) (NMMBCD4084), 1 female (8.6 × 5.9 mm) (ZRC 2017.1042), under rocks, muddy substrate, northeastern cape, Taiwan, by SCUBA, coll. C.-W. Lin, 18 July 2014. Vanuatu: 1 male (14.5 × 10.3 mm) (ZRC 2017.189), station VM53, intertidal reefs with soft and hard bottoms, east of Luganville Second Channel, 15°31'S 167°11.9'E, Vanuatu, coll. Expédition SANTO 2006, 6 October 2006.

Colour: The colour is striking and agrees very well with what was described by Bouvier (1915) and Maenosono (2016). The red colour on the branchial, cardiac and intestinal regions varies slightly in coverage and intensity of colour. In the male from Vanuatu, these areas are brighter red and covers more of the carapace (Fig. 1C) compared to the Taiwanese ones (Figs. 1A, B).

Remarks: Maenosono (2016: 44) suggested that *Heteropilumnus splendidus* (De Man, 1929), may be a synonym of *H. decharmoyi*. De Man (1929: 10, pl. 1 fig. 3-3c, pl. 2 fig. 3d-f) described the species from two males (10.0 × 7.3 mm, 9.0 × 6.5 mm) and a female (9.4 × 6.5 mm) from Pulau Berhala in the Straits of Malacca and the general appearance and colour notes suggests that the two taxa are close. However, there are several differences that argue against synonymising the two species at this stage: in *H. splendidus*, the dorsal surface of the carapace is distinctly flatter in frontal view (cf. De Man 1929: pl. 1 fig. 3c) (vs. gently convex and higher dorsal surface of carapace in *H. decharmoyi*, Fig. 2E); the anterolateral margin is not distinctly cut into any low teeth or lobes (cf. De Man, 1929: pl. 1 fig. 3, 3a) (vs. margin forming low teeth in *H. decharmoyi*, Fig. 2A-D); and the male pleon is differently structured, with somite 3 proportionately less wide and the telson more semicircular in shape (cf. De Man 1929: pl. 2 fig. 3d) (vs. somite 3

distinctly wider with the telson more elongate in *H. decharmoyi*, Fig. 3B).

Heteropilumnus decharmoyi is also superficially similar to *H. satriai* in external morphology and colour in life, and both species occur together in Taiwan. *H. decharmoyi*; however, can easily be separated because its long setae lining the carapace and pereopods are stiff and translucent (Figs. 1A-C, 2A) (vs. setae are more flexible and opaque in *H. satriai*, Figs. 1D-F, 6A, C); the posterolateral margins are less convergent towards the posterior carapace margin, giving the carapace a more rectangular appearance (Figs. 2A-D) (vs. posterolateral margins sharply converging towards posterior carapace margin, with the carapace appearing more hexagonal in *H. satriai*, Figs. 5A, B, 6A-D); the ambulatory meri is proportionately shorter and stouter (Figs. 3E-G) (vs. meri are proportionately longer and more slender in *H. satriai*, Figs. 5G, 6E, F); the median lobe of the posterior epistomal margin is approximately level with the lateral margins (Fig. 2E) (vs. the median lobe protrudes anteriorly of the lateral margins in *H. satriai*, Figs. 5C, 7A, 8A); the ischium of the third maxilliped is relatively short (Fig. 2F) (vs. ischium is proportionately longer in *H. satriai*, Figs. 5D, 7B, 8B); the adult male chelae are not swollen, but relatively slender (Figs. 3C, D) (vs. adult male chelae distinctly inflated and stout in *H. satriai*, Figs. 5E, 7E, 8E, F); the male pleon is relatively wider (Fig. 3B) (vs. male pleon relatively narrower in *H. satriai*, Figs. 7D, 8D); and the G1 is distinctly more sinuous, with the distal part relatively short and bent at around 45° from the horizontal (Figs. 4A-C) (vs. G1 relatively less sinuous with the distal part long and bent at almost 90° to the horizontal in *H. satriai*, Figs. 9A-C, E-G).

Distribution and ecology: The species was described from Mauritius (Bouvier 1915) but has been reported from Japan (Maenosono 2016), and now from Taiwan and Vanuatu.

***Heteropilumnus satriai* Yeo, Rahayu and Ng, 2004**
(Figs. 1D-F, 5-9)

Heteropilumnus satriai Yeo, Rahayu and Ng, 2004: 80, fig. 1; Ng et al. 2008: 140.

Material examined: Holotype - male (19.3 × 13 mm) (MZB Cru 1668), station EA-D 11, rocky islet southeast of Pulau Laut, Natuna Island, Indonesia, coll. Anambas Expedition, 16 March 2002. Others - 1 male (11.1 × 8.2 mm) (NMMBCD4085), under rock with sandy substrate,

Hojie, Kentin, 21°57.432'N 120°42.631'E, southern Taiwan, by SCUBA, coll. C.-W. Lin, 8 July 2013; 1 male (18.3 × 13.0 mm) (ZRC 2017.1043), under rock with sand substrate, Houbihu, Kentin, Taiwan, by SCUBA, coll. C.-W. Lin, 8 June 2016; 2 females (16.1 × 11.9 mm, 6.8 × 5.4 mm), Lutao (= Green Island), southern Taiwan, by SCUBA, coll. C.-W. Lin, 24 June 2017; 1 female (11.4 × 8.2 mm) (NMMBCD4086), under large rock, sand substrate, Lutao (= Green Island), southern Taiwan, by

SCUBA, coll. C.-W. Lin, 16 August 2017.

Colour: The colour and patterning in *H. satriai* in life is similar to that of *H. decharmoyi* except that the red patches on the ambulatory legs are relatively smaller and more uneven (Figs. 1D, E). There is some variation in this species, from having the red colour cover most of the carapace (Fig. 1D) to only covering less than half the surface (Fig. 1E), to the carapace and pereopods being mostly yellowish-white with only small patches of



Fig. 1. Colour in life. A, *Heteropilumnus decharmoyi* (Bouvier, 1915), male (16.8 × 12.7 mm) (NMNST); B, *H. decharmoyi* (Bouvier, 1915), male (13.3 × 9.3 mm) (NMMBCD4084); C, *H. satriai* Yeo, Rahayu and Ng, 2004, male (18.3 × 13.0 mm) (ZRC 2017.1043); D, *H. satriai* Yeo, Rahayu and Ng, 2004, female (16.1 × 11.9 mm) (NMMBCD4086); E, *H. satriai* Yeo, Rahayu and Ng, 2004, male (11.1 × 8.2 mm) (NMMBCD4085); F, *H. satriai* Yeo, Rahayu and Ng, 2004, male (6.8 × 5.4 mm) (NMMBCD4086).

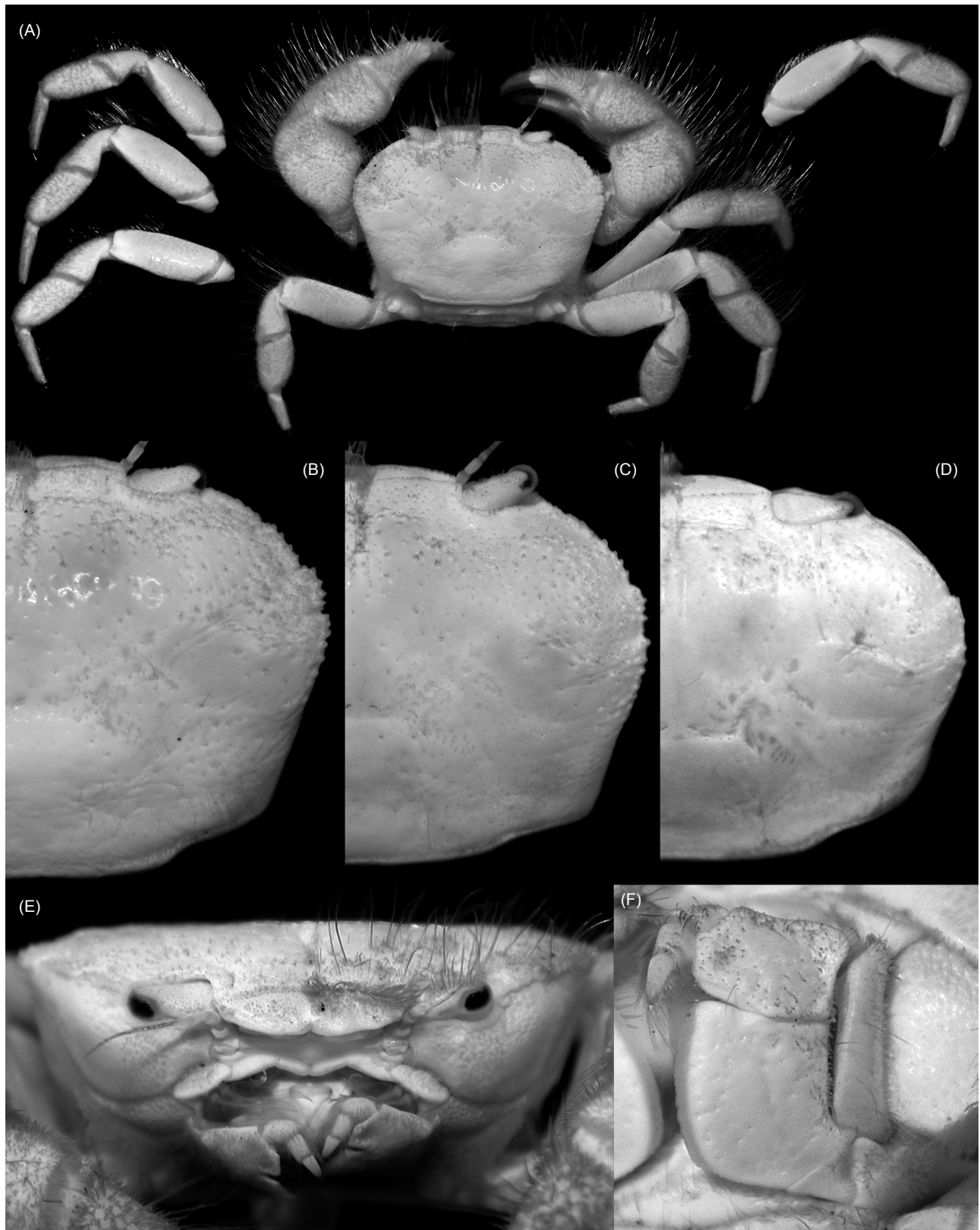


Fig. 2. *Heteropilumnus decharmoyi* (Bouvier, 1915). A, B, E, F, male (16.8 × 12.7 mm) (NMNST); C, male (13.3 × 9.3 mm) (NMMBCD4084); D, female (8.6 × 5.9 mm) (ZRC 2017.1042). A, overall view; B-D, right side of carapace (denuded); E, frontal view of cephalothorax (right side denuded); F, left third maxilliped (denuded).

orange in small specimens (Fig. 1F).

Remarks: This species was described from one male, which was parasitized by a rhizocephalan and collected from the Indonesian Natuna Islands in the South China Sea (Yeo et

al. 2004). No colour notes were available at the time. The specimens from Taiwan now allow us a better understanding of its colour, morphological characters and variation.

The teeth on the anterolateral margin

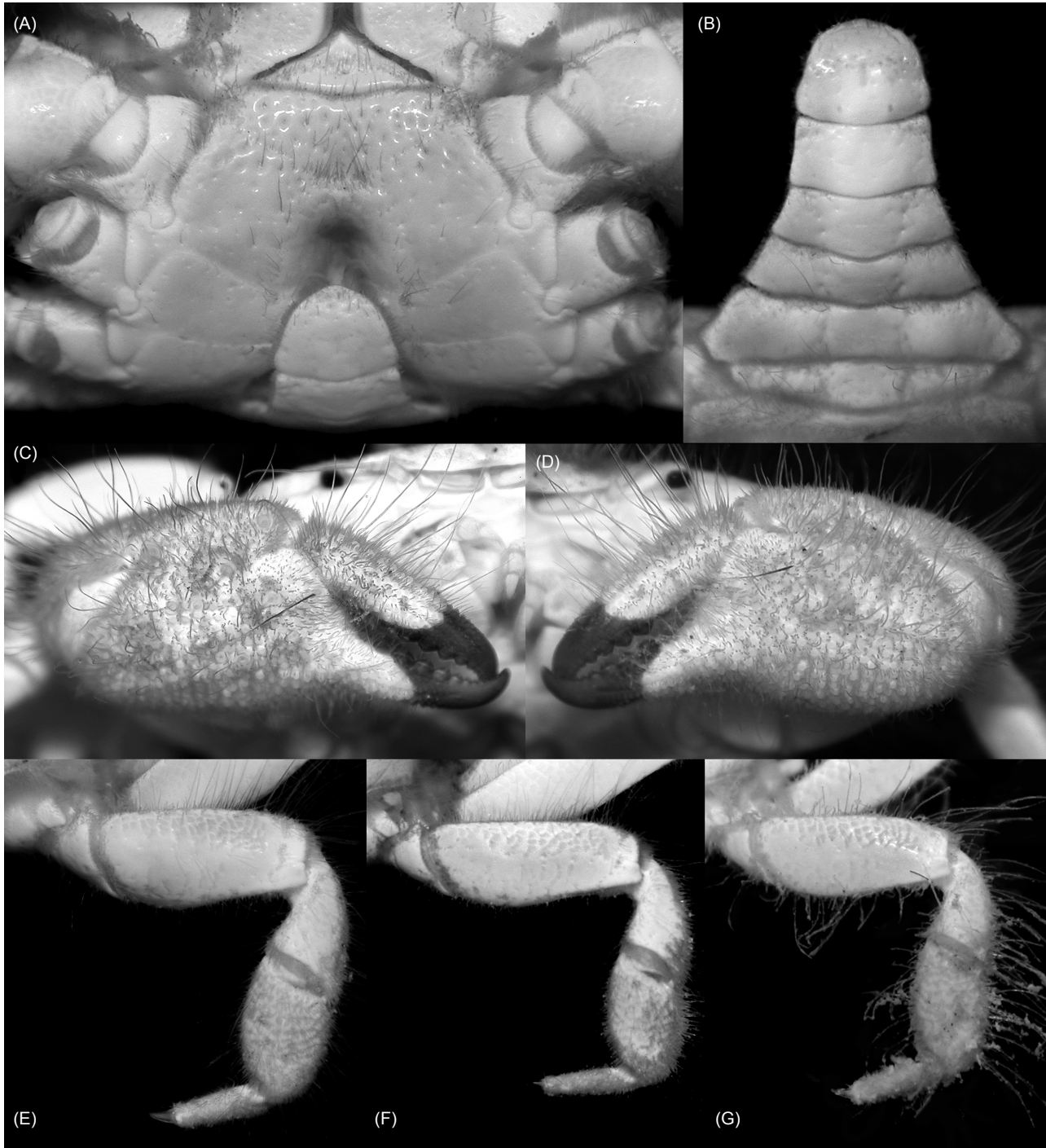


Fig. 3. *Heteropilumnus decharmoyi* (Bouvier, 1915). A, B, C-E, male (16.8 × 12.7 mm) (NMNST); F, male (13.3 × 9.3 mm) (NMMBCD4084); G, female (8.6 × 5.9 mm) (ZRC 2017.1042). A, anterior thoracic sternum and pleon; B, pleon; C, outer view of right chela; D, outer view of left chela; E-G, right fourth ambulatory leg.

of smaller specimens (e.g., 11.1 × 8.2 mm, NMMBCD4085) are less well defined, with the lobes relatively lower (Fig. 6B). In larger specimens (e.g., holotype male and male 18.3 × 13.0 mm, ZRC 2017.1043); the teeth are better defined and separated by more distinct clefts (Figs. 5B, 6D). The male pleon of the holotype male is atypical as the specimen was infected with a rhizocephalan (Fig. 6F). The pleon of the uninfected males is more triangular, with the telson semicircular in shape (Figs. 7C, D, 8C, D). The G1 of the present material varies slightly with size. In the larger male (18.3 × 13.0 mm, ZRC 2017.1043), the distal elongated part of the G1 is gently curved to relatively straight (Figs. 9A-C) whereas in the smaller male (11.1 × 8.2 mm, NMMBCD4085), it is gently sinuous with the tip gently curved upwards (Figs. 9E-G). The form of the G1 of the smaller male agrees very well with that figured by Yeo et al. (2004: fig. 1e, f) for the holotype.

The differences between *H. satriai* and *H. decharmoyi* have been discussed under the latter species. *Heteropilumnus satriai* is also similar to *H. granulimanus* Ward, 1933, described from one male measuring 12.0 × 9.0 mm from the Capricorn

Group of islands in Queensland, Australia. In *H. granulimanus*; however, the frontal margin is more truncate with the two lobes separated by a narrow fissure (Ward 1933: pl. 2 fig. 3) (vs. the two frontal lobes separated by a distinct V-shaped cleft in *H. satriai*, Figs. 5B, 6B, D); the granules on the outer surface of the chela are more rounded, densely packed and arranged in rows (Ward 1933: pl. 2 fig. 4) (vs. the granules are rounded to conical and distributed evenly on surface in *H. satriai*, Figs. 5E, 7E); and the male telson is relatively wider (Ward 1933: pl. 2 fig. 4) (vs. less wide in in *H. satriai*, Figs. 7C, D).

Distribution: The species was described from the Natunas Islands in Indonesia, in the South China Sea (Yeo et al. 2004), and is now recorded from Taiwan.

***Viaderiana sentus* Ng, Dai and Yang, 1997**
(Figs. 10-13)

Viaderiana sentus Ng, Dai and Yang, 1997: 156, fig. 6; Ng et al. 2008: 143.

Material examined: 1 male (8.4 × 6.5 mm) (NMMBCD4087), under coral rubble, in coral reef,

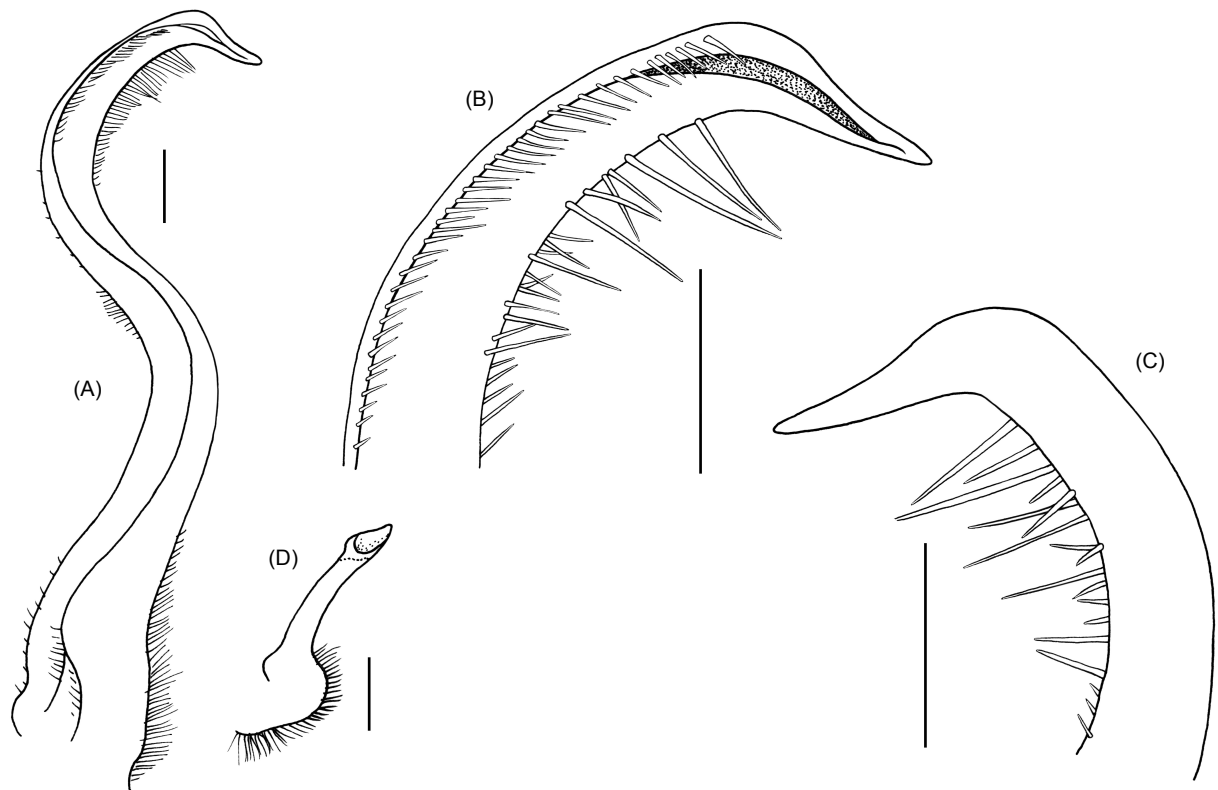


Fig. 4. *Heteropilumnus decharmoyi* (Bouvier, 1915), gonopods, male (16.8 × 12.7 mm) (NMNST). A, left G1 (ventral view); B, distal part of left G1 (ventral view); C, distal part of left G1 (dorsal view); D, left G2. Scale bars = 0.5 mm.

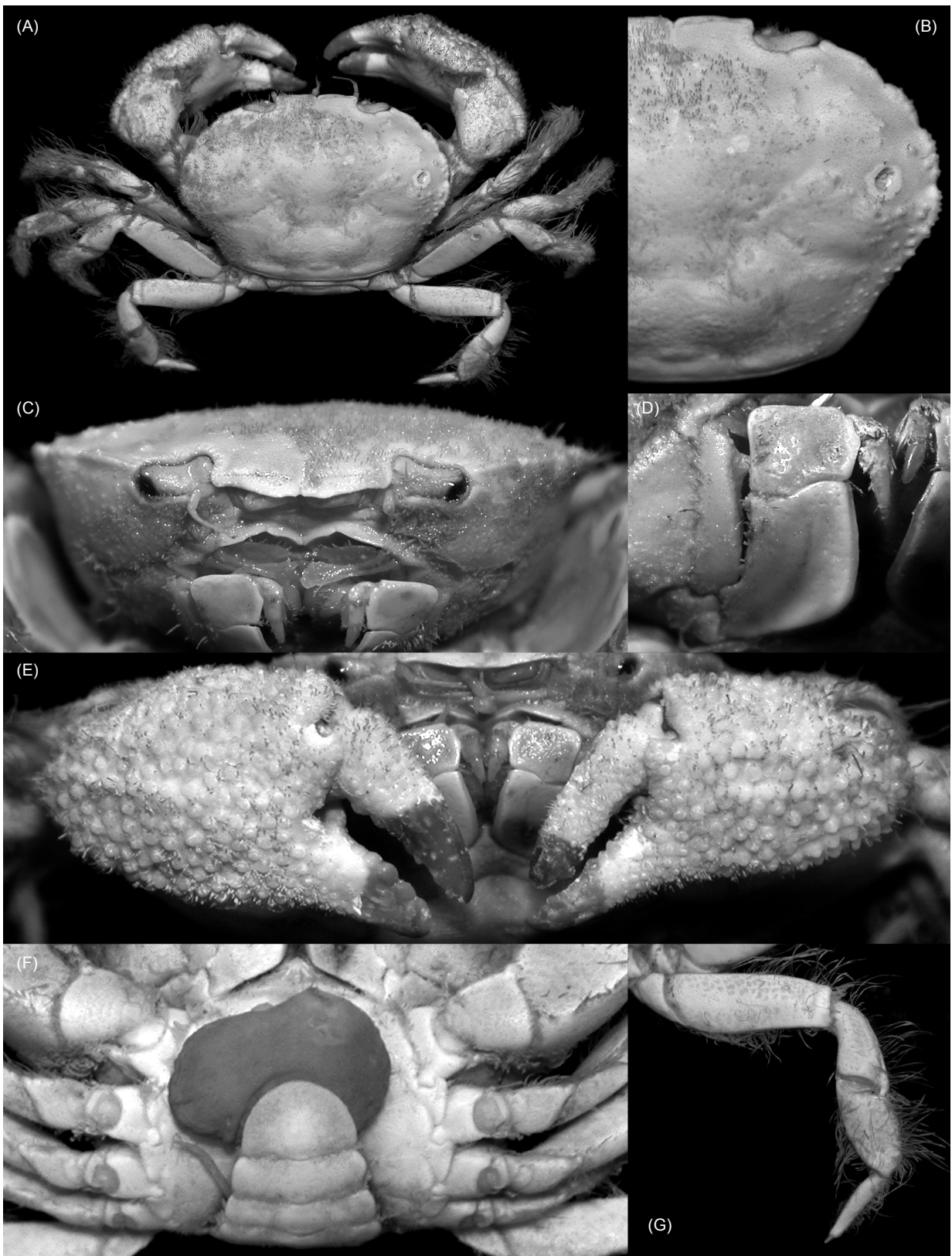


Fig. 5. *Heteropilumnus satriai* Yeo, Rahayu and Ng, 2004, male (19.3 × 13 mm) (MZB Cru 1668), Indonesia. A, overall view; B, right side of carapace (denuded); C, frontal view of cephalothorax (right side denuded); D, right third maxilliped (denuded); E, outer view of chelae; F, anterior thoracic sternum and pleon; G, right fourth ambulatory leg.

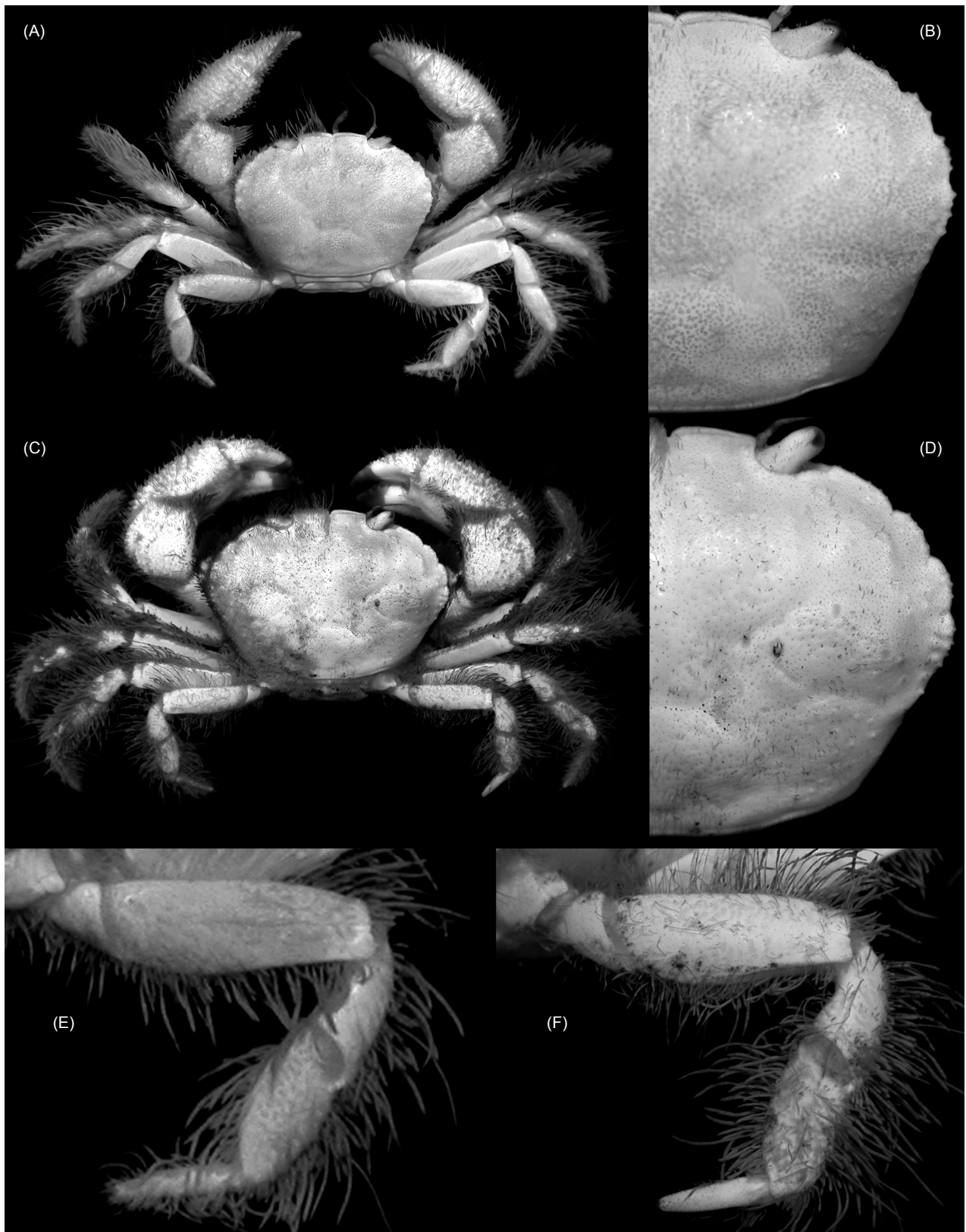


Fig. 6. *Heteropilumnus satriai* Yeo, Rahayu and Ng, 2004. A, B, E, male (11.1 × 8.2 mm) (NMMBCD4085); C, D, F, male (18.3 × 13.0 mm) (ZRC 2017.1043). A, C, overall view; B, D, right side of carapace (denuded); E, F, right fourth ambulatory leg.

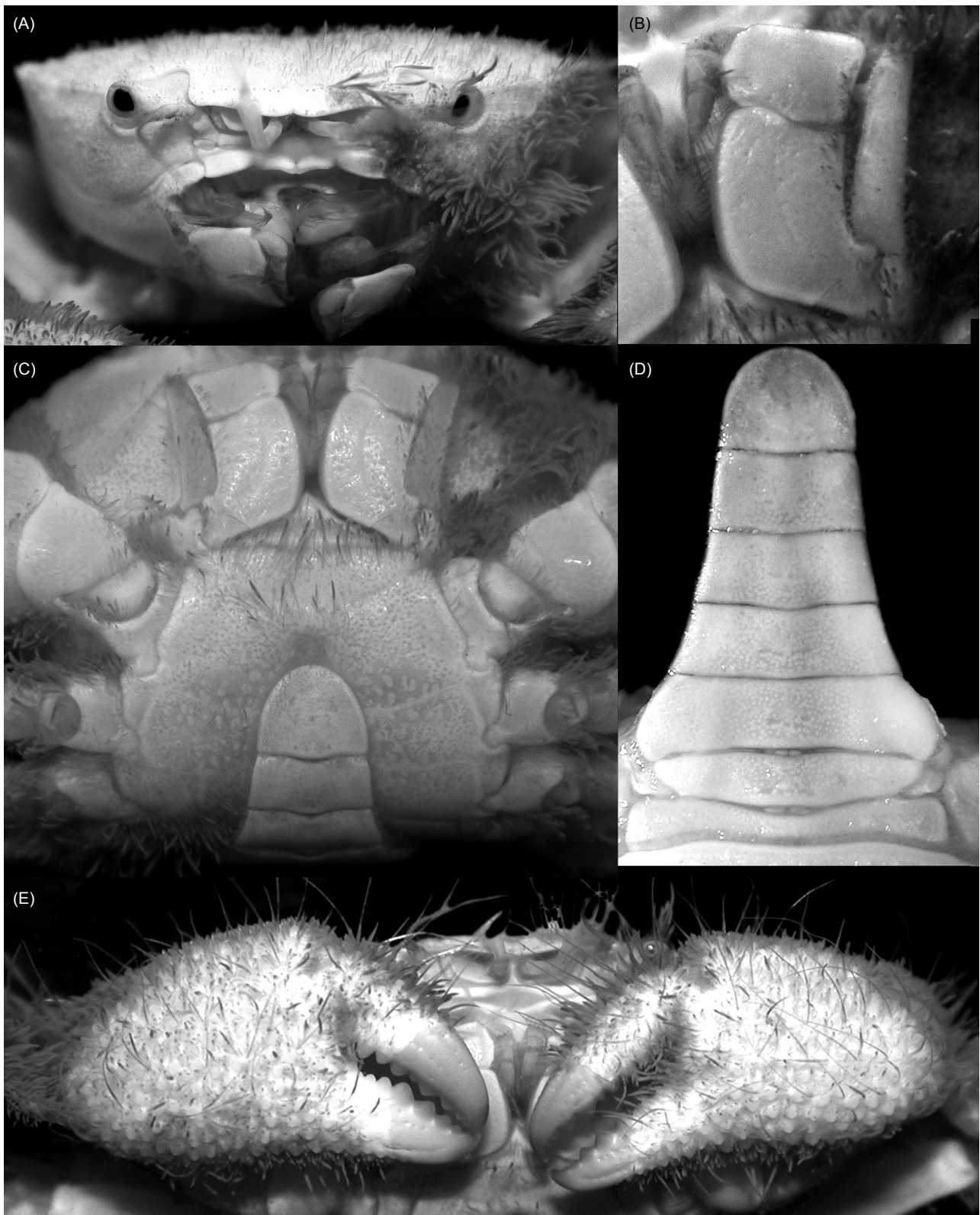


Fig. 7. *Heteropilumnus satriai* Yeo, Rahayu and Ng, 2004, male (11.1 × 8.2 mm) (NMMBCD4085). A, frontal view of cephalothorax (right side denuded); B, left third maxilliped (denuded); C, anterior thoracic sternum and pleon; D, pleon; E, outer view of chelae.

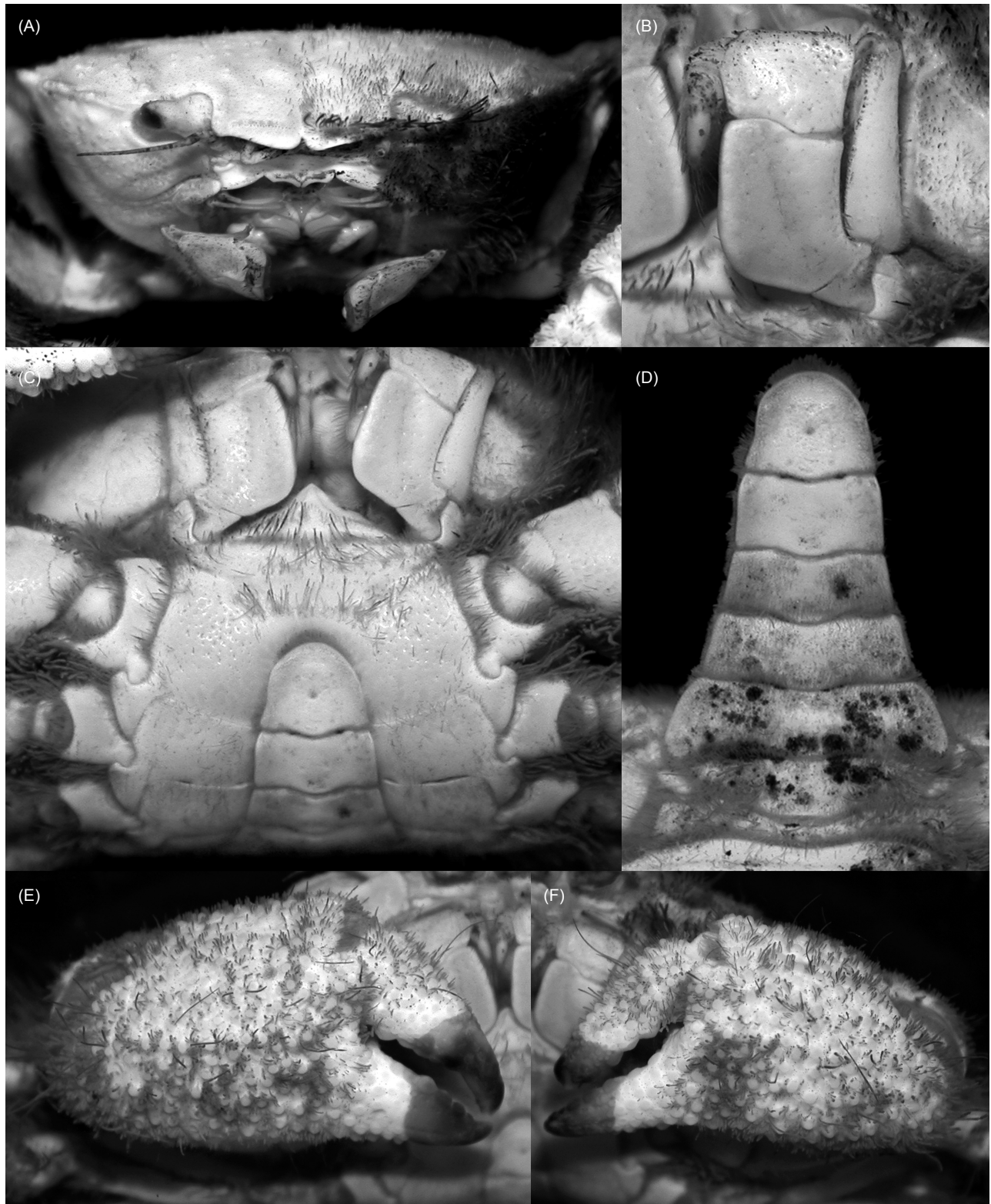


Fig. 8. *Heteropilumnus satriai* Yeo, Rahayu and Ng, 2004, male (18.3 × 13.0 mm) (ZRC 2017.1043). A, frontal view of cephalothorax (right side denuded); B, left third maxilliped (denuded); C, anterior thoracic sternum and pleon; D, pleon; E, outer view of pleon.

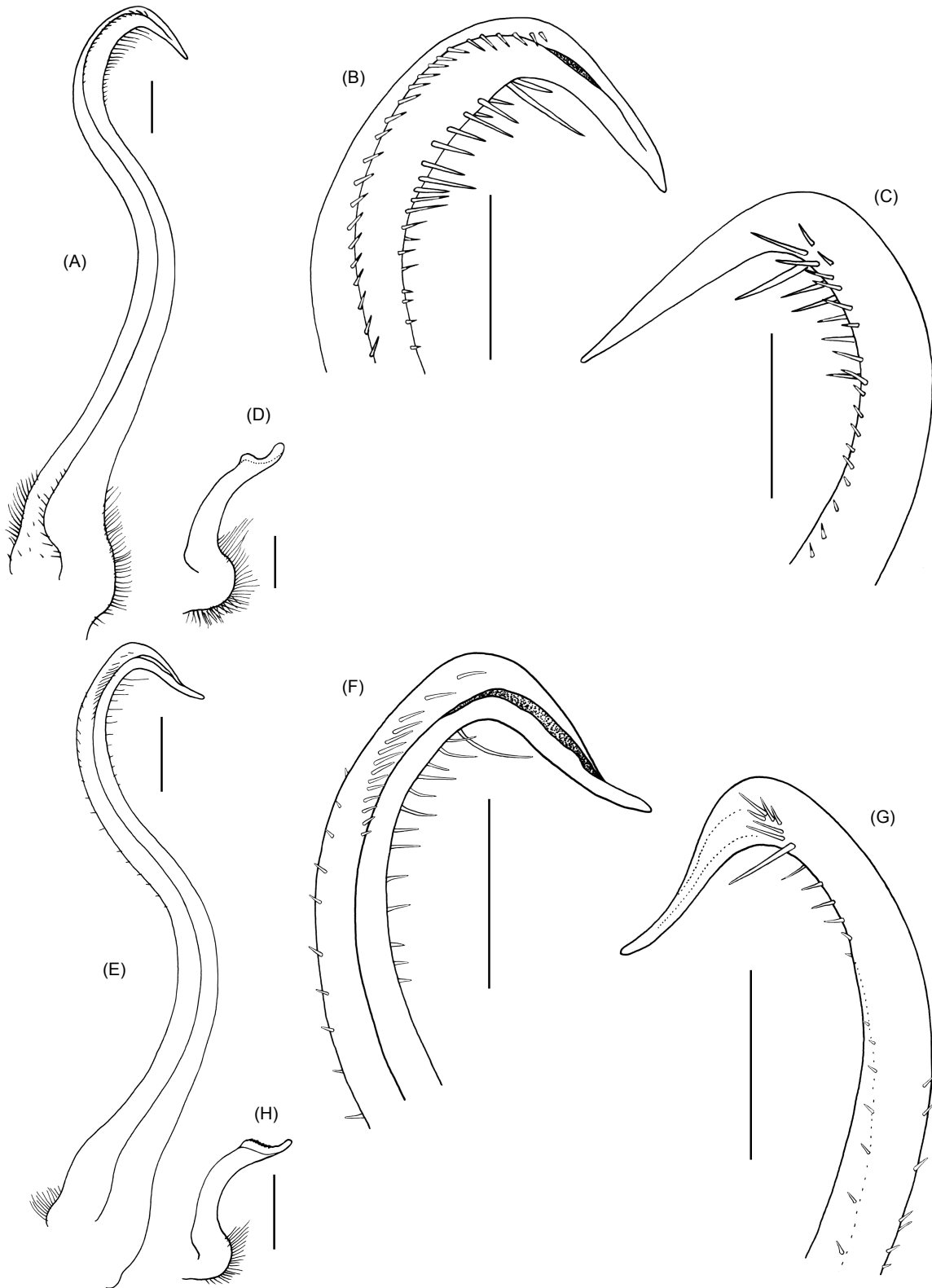


Fig. 9. *Heteropilumnus satriai* Yeo, Rahayu and Ng, 2004, gonopods. A-D, male (18.3 × 13.0 mm) (ZRC 2017.1043); E-H, male (11.1 × 8.2 mm) (NMMBCD4085). A, E, left G1 (ventral view); B, F, distal part of left G1 (ventral view); C, G, distal part of left G1 (dorsal view); D, H, left G2. Scale bars = 0.5 mm.

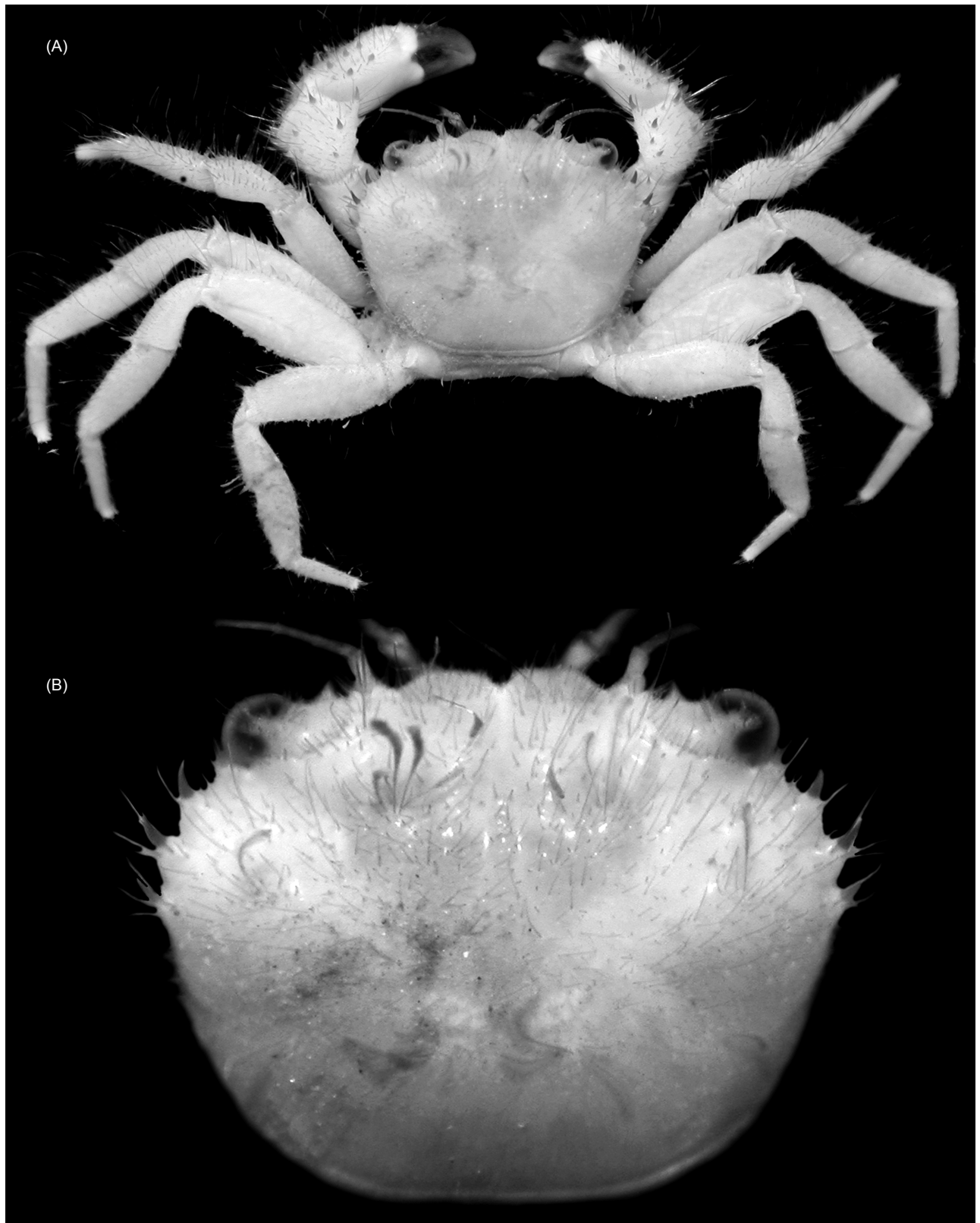


Fig. 10. *Viaderiana sentus* Ng, Dai and Yang, 1997, male (8.4 × 6.5 mm) (NMMBCD4087). A, overall view; B, dorsal view of carapace.

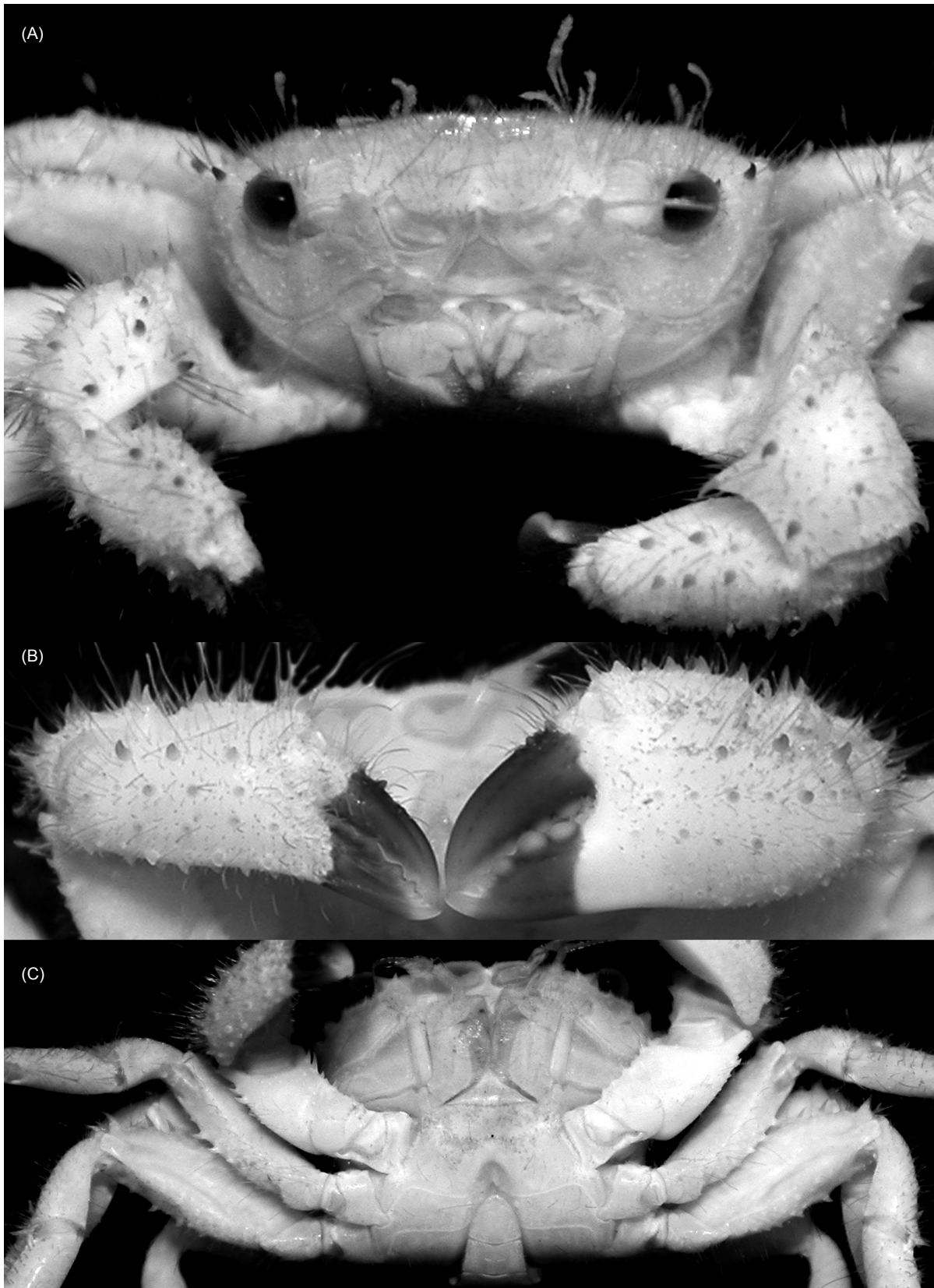


Fig. 11. *Viaderiana sentus* Ng, Dai and Yang, 1997, male (8.4 × 6.5 mm) (NMMBCD4087). A, frontal view of cephalothorax; B, outer view of chelae; C, ventral view of cephalothorax.

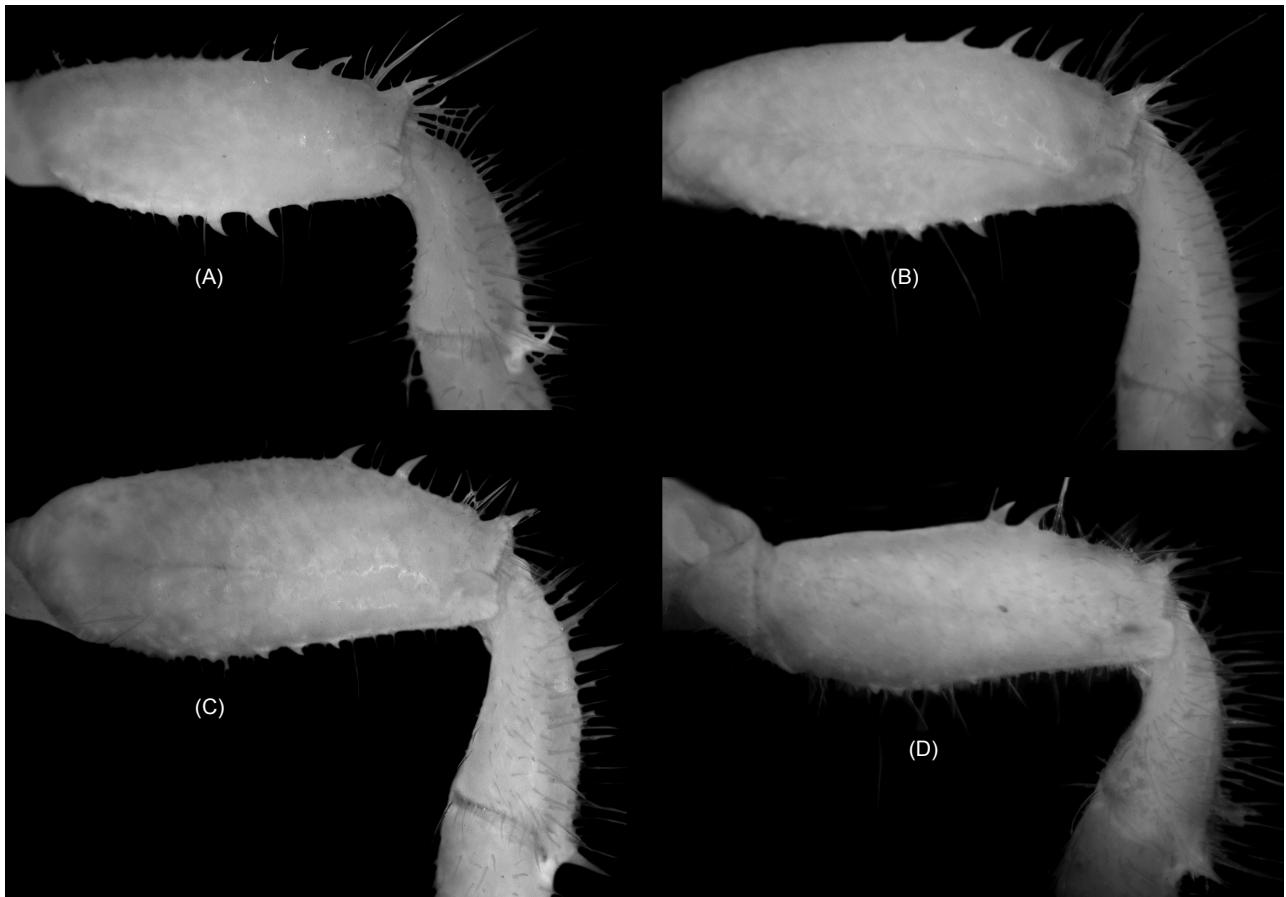


Fig. 12. *Viaderiana sentus* Ng, Dai and Yang, 1997, male (8.4 × 6.5 mm) (NMMBCD4087). A-D, right ambulatory meri, first to fourth legs, respectively.

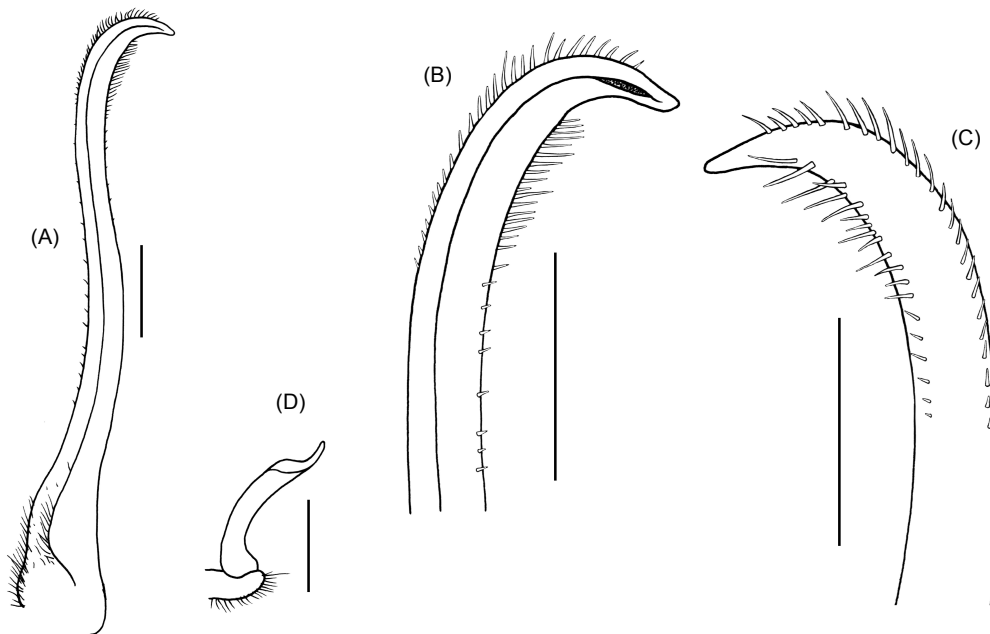


Fig. 13. *Viaderiana sentus* Ng, Dai and Yang, 1997, male (8.4 × 6.5 mm) (NMMBCD4087), gonopods. A, left G1 (ventral view); B, distal part of left G1 (ventral view); C, distal part of left G1 (dorsal view); D, left G2. Scale bars = 0.5 mm.

Hojie, Kentin, 21°57.432'N 120°42.631'E, southern Taiwan, by SCUBA, coll. C.-W. Lin, 8 July 2013.

Remarks: This species was described from one male 8.0 × 6.1 mm collected from the South China Sea. This is only the second record of the species and the first from Taiwan. The present specimen agrees well with the descriptions and figures in Ng et al. (1997), except that the distal part of the G1 is slightly longer (Figs. 3A-C).

In life, the species is a uniform reddish-brown on all its dorsal surface, with the setae yellowish-brown. The fingers of chela are pigmented light brown with the tips white.

Distribution: The species was described from the Nansha Islands in the South China Sea (Ng et al. 1997) and now from southern Taiwan.

DISCUSSION

Ng et al. (2001) recorded 24 species of pilumnoid crabs (as a family) from Taiwan (including Dongsha, Matsu and Kinmen). Of these, 14 can be regarded as reef or rocky shore species, with the rest from shallow water muddy habitats or deep water. In the subsequent years, 13 more species have been added, of which nine are also from soft substrates or deep water (Ng and Huang 2002; Ng and Ho 2003; Li et al. 2008; Hsueh and Ng 2008; Ng et al. 2017). Only four of these new records inhabit shallow reefs and intertidal rocky habitats: *Pilumnus trispinosus* (Sakai, 1965), *Glabropilumnus laevimanus* (Dana, 1852), *Cryptopilumnus taiwanensis* Hsueh, Huang and Ng, 2009, and *Zehntneriana serrata* Ng and Lin, 2015 (Hsueh et al. 2009a b; Ng and Lin 2015).

Although the shorelines of Taiwan have been relatively well surveyed over the years, many pilumnoids have been missed because of their cryptic habits and small size (some are less than a centimetre in carapace width). This is especially the case in poorly sampled habitats like under reef rubble and inside live and dead scleractinian corals. The new genus and species *Cryptopilumnus taiwanensis*, for example, is actually commonly found inside intertidal rocks but was not discovered until these rocks were broken up to sample the fauna living (Hsueh et al. 2009a). For taxa living under rubble or large reef formations in subtidal areas, the use of SCUBA at night has proved important, especially since many brachyurans have nocturnal habits. Recent efforts using SCUBA by the corresponding author have in fact uncovered numerous interesting brachyuran

species, including new records and new species (e.g., Lin et al. 2014; Ng and Lin 2015; Ng et al. 2016; Lin and Ng 2017).

Acknowledgments: The authors are most grateful to Daisy Wowor (MZB) for allowing us to examine the holotype male of *Heteropilumnus satriai*. This work is a contribution resulting from research grants to the second author from the National Museum of Marine Biology and Aquarium and Ministry of Science and Technology, Taiwan. We are grateful to Paul Clark and Benny Chan for their kind reading of the manuscript and various suggestions.

Authors' contributions: Ng PKL conceived this study, performed part of the examination of morphological characters and drafted the manuscript. Lin CW collected and processed the samples, helped with the morphological description and discussion, and submitted the manuscript. Ho PH provided a specimen and worked closely with the first author on the taxonomy of two of the three species. All authors read and approved the final manuscript.

Competing interests: Ng PKL, Lin CW and Ho PH declare that they have no conflicts of interest.

Availability of data and materials: Specimens in the study have been deposited in the National Museum of Marine Biology and Aquarium (NMMBA), Taiwan; National Museum of Natural Science, Taichung (NMNST), Taiwan; Muzium Zoologicum Bogoriense (MZB), Indonesia; and Zoological Reference Collection (ZRC), Singapore.

Consent for publication: Not applicable.

Ethics approval consent to participate: Not applicable.

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