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## On the taxonomy of two poorly known species of *Geosesarma* De Man, 1892 (Crustacea: Brachyura: Sesarmidae) from the Philippines

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### Abstract

The identities of two poorly-known species of semiterrestrial crabs of the genus *Geosesarma* De Man, 1892, from the Philippines, are clarified. The types of *Sesarma* (*Sesarma*) *vicentense* Rathbun, 1914 (from Luzon), and *Sesarma* (*Geosesarma*) *rathbunae* Serène, 1968 (from Panay), are examined and both species are rediagnosed with detailed figures. Comparisons with allied congeners are also provided.

**Key words:** Philippines, redescription, types, Sesarmidae, *Geosesarma*, systematics

### Introduction

The genus *Geosesarma* De Man, 1892, of the family Sesarmidae Dana, 1851, includes a group of semi-terrestrial crabs widely distributed in Southeast Asia, eastern Indian Ocean, and western Pacific. Currently this genus contains 58 recognized species (cf. Ng *et al.* 2008; Ng 2015; Ng *et al.* 2015; Schubart & Ng 2014; Manuel-Santos *et al.* 2016). Of these, seven occur in the Philippines: *G. hednon* Ng, Liu & Schubart, 2004 [Cebu, Philippines; Taiwan], *G. vicentense* (Rathbun, 1914) [Luzon], *G. rathbunae* (Serène, 1968a) [Panay], *G. protos* Ng & Takeda, 1992 [Mindanao], *G. lawrencei* Manuel-Santos & Yeo, 2007 [Palawan], *G. batak* Manuel-Santos, Ng & Freitag, 2016 [Palawan], and *G. tagbanua* Manuel-Santos, Ng & Freitag, 2016 [Palawan] (see Serène 1968a, b; Ng & Takeda 1992; Ng *et al.* 2004; Manuel-Santos & Yeo 2007; Manuel-Santos *et al.* 2016). All except *G. hednon* are endemic to the Philippines.

Of these seven species, the earliest described were under the genus *Sesarma* Say, 1817, *S. (Sesarma) vicentense* Rathbun, 1914, and *S. (Geosesarma) rathbunae* Serène, 1968a. Both have remained taxonomically poorly known. The original descriptions of Rathbun's and Serène's taxa are not up to modern standards and the types were not well illustrated. This needs to be addressed now as the *Geosesarma* fauna of the Philippines has been shown to be much richer than previously believed. There are now more species that have been observed but need to be formally reported from Luzon, Palawan, and Panay, including several that may prove to be undescribed (PKL Ng, pers. obs). Thus, updated, detailed redescriptions and taxonomic clarifications of Rathbun's and Serène's species will allow work to proceed on the fauna of *Geosesarma* from the Philippines and adjacent regions by various carcinologists.

The material used in this study is deposited in the National Museum of Natural History, Smithsonian Institution, Washington D.C. (USNM); and the Zoological Reference Collection of the Lee Kong Chian Natural History Museum, National University of Singapore (ZRC). The measurements provided (in millimetres) are of maximum carapace width and length, respectively. The abbreviation G1 is used for the male first pleopod. The terminology used essentially follows that in Ng (1988), with recent amendments recommended by Davie *et al.* (2015).

## Taxonomy

### Family SESARMIDAE Dana, 1851

#### *Geosesarma vicentense* (Rathbun, 1914)

(Figs. 1, 5A–D)

*Sesarma* (*Sesarma*) *vicentense* Rathbun, 1914: 74.

*Sesarma* (*Geosesarma*) *vicentensis*—Serène 1968b: 106.

*Geosesarma vicentensis*—Serène & Soh 1970: 402 (list); Ng 1988: 119 (list).

*Geosesarma vicentense*—Ng *et al.* 2008: 221 (list).

**Type material.** Holotype: male (9.2 × 8.5 mm), Port San Vicente (Luzon side), Palaui Island, off northern Luzon, 18°31'N 122°7'60"E, along beach, coll. 15 November 1908 (USNM 45758).

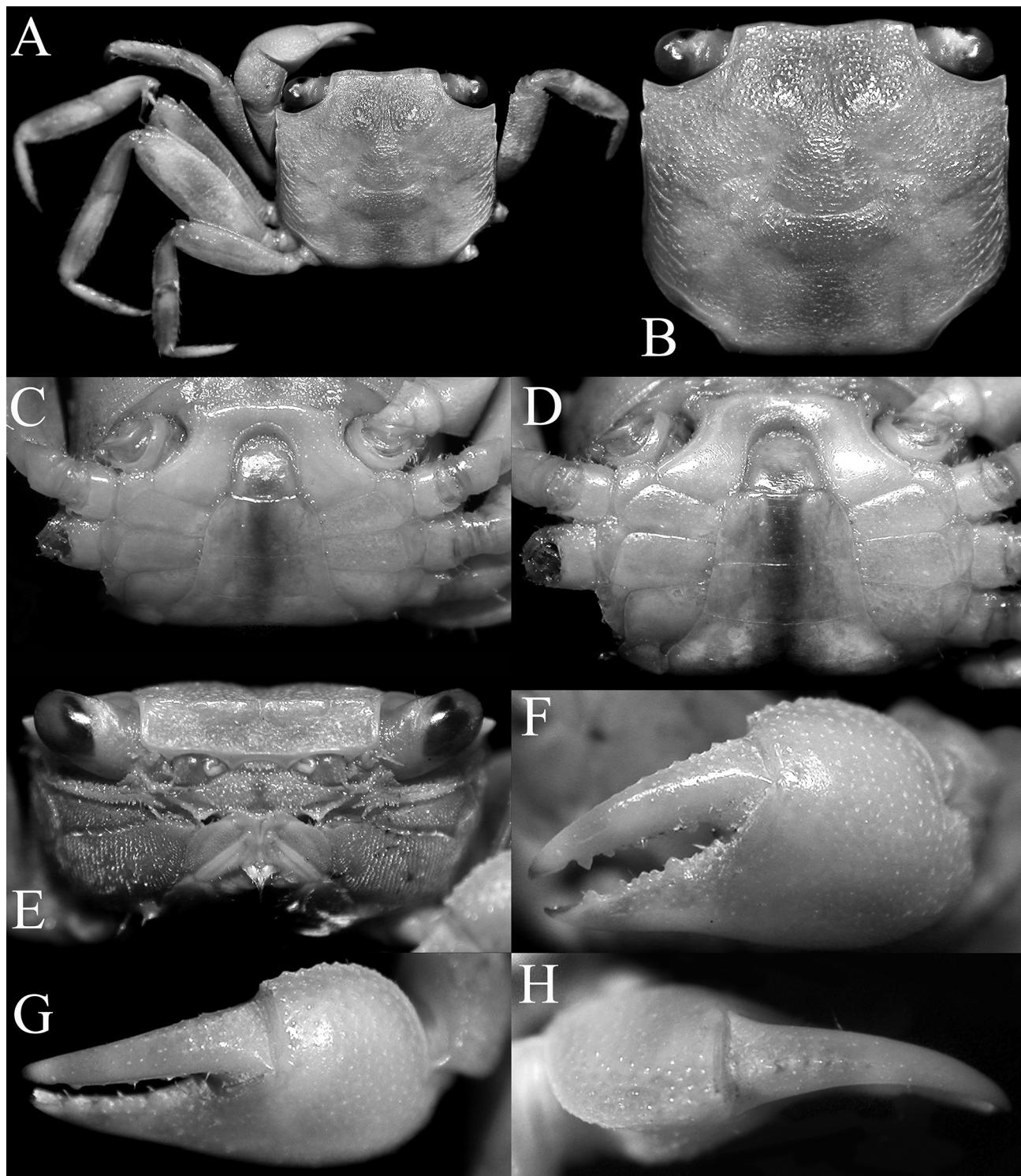
**Comparative material.** *Geosesarma maculatum* (De Man, 1892): 1 male (12.4 × 11.9 mm), station MALU 47, Halmahera, coll. MALU Expedition, L. Deharveng, July 1988 (ZRC 2017.0113).

**Diagnosis.** Carapace almost quadrate, wider than long, width to length ratio 1.1, lateral margins subparallel (Fig. 1A, B); dorsal surface with regions weakly demarcated, anterior regions densely covered with low, small rounded, flattened granules (Fig. 1A, B); front deflexed, frontal lobes broad with subtruncate margins, separated by shallow broad concavity; postfrontal, postorbital cristae moderately low, distinct (Fig. 1A, B, E); external orbital tooth acutely triangular, directed anteriorly, outer margin almost straight, first epibranchial tooth low, second epibranchial tooth barely demarcated (Fig. 1A, B). Merus of third maxilliped subovate, subequal in length to ischium; exopod slender, with long flagellum (Fig. 5A). Outer surface of palm of adult male with numerous low granules, shallow pits; inner surface granular but without distinct transverse ridge; dorsal margin of dactylus with 3–5 low conical granules on proximal part, tips not chitinous, distal half uneven but without distinct granules (Fig. 1F–H). Ambulatory legs each with relatively stout merus having sharp subdistal spine on dorsal margin and lateral, mesial surfaces gently rugose (Fig. 1A); propodus without brush-like setae on ventral margin. Male pleon triangular, relatively wide; somite 6 with convex lateral margins; telson semicircular (Fig. 1C, D). G1 slender, distal chitinous part elongated, almost straight, directed upwards, subspatuliform, tip dilated, medially clefted (Fig. 5B–D).

**Remarks.** The taxonomic position of *Geosesarma vicentense* has been uncertain, with Ng & Takeda (1992: 81) questioning its placement in *Geosesarma*, especially since the only known specimen was obtained from a beach. *Geosesarma* species are otherwise found further inland in freshwater habitats (Ng 1988). *Geosesarma vicentense*, however, belongs to the same group of species as *G. maculatum* (De Man, 1892), *G. ternatense* (Serène, 1968a), and *G. hednon* Ng, Liu & Schubart, 2004, in which the G1 is slender, straight, with the chitinous distal part subspatuliform and directed upwards. Most of the species in this group have small eggs and almost certainly have planktotrophic larvae that must be released into the sea.

Compared to *G. maculatum*, the frontal orbital lobes of *G. vicentense* are more convex (Fig. 1A, B) (lobes truncate in *G. maculatum*; Fig. 2A, B); the external orbital tooth is relatively less prominent and separated from rest of margin by a shallow cleft (Fig. 1A, B) (tooth more prominent and separated from margin by deep cleft in *G. maculatum*; Fig. 2A, B); the ambulatory meri are relatively slender (Fig. 1A) (meri broader in *G. maculatum*; Fig. 2A); and the male pleonal somite 6 is proportionately broader (Fig. 1D) (somite 6 proportionately longer in *G. maculatum*; Fig. 2C) (see also Ng *et al.* 2004: figs. 1A, B, 2A). *Geosesarma ternatense* is distinct in that the male pleonal somite 6 is proportionately very broad with strongly convex lateral margins and the telson is relatively wider (Ng *et al.* 2004 fig. 8B) (somite 6 and telson less wide in *G. vicentense*; Fig. 1D). *Geosesarma vicentense* is closest to *G. hednon* in general form, but can be distinguished by its external orbital tooth being distinct and separated from the rest of the margin by a small cleft (Fig. 1A, B) (tooth subparallel to the rest of the lateral margin and separated by a fissure in *G. hednon*; cf. Ng *et al.* 2004: figs. 9B, 11B) and the slender chitinous part of the G1 is relatively shorter (Fig. 5B–D) (chitinous part relatively longer in *G. hednon*; cf. Ng *et al.* 2004: figs. 13C–G, 14C–H).

*Geosesarma protos* Ng & Takeda, 1992, also described from Luzon, is very different from *G. vicentense* in possessing an external orbital tooth that is prominent and directed obliquely laterally, a third maxilliped in which the exopod has no flagellum and the G1 is stout with a short chitinous part (Ng & Takeda 1992: fig. 1A, B, G–I).



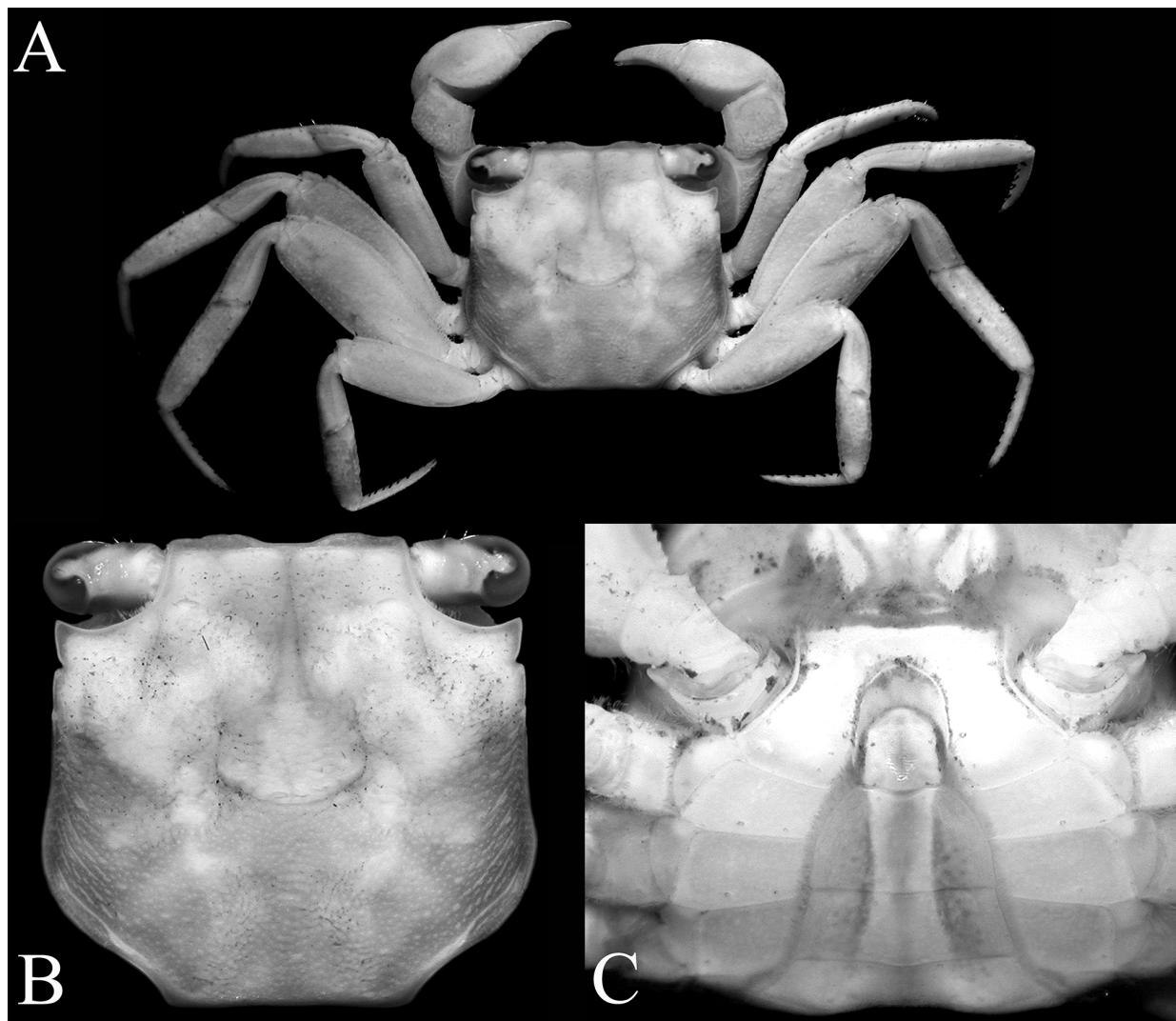
**FIGURE 1.** *Geosesarma vicentense* (Rathbun, 1914), holotype male ( $9.2 \times 8.5$  mm) (USNM 45758). A, overall habitus; B, dorsal view of carapace; C, D, ventral view of cephalothorax showing thoracic sternum and pleon; E, frontal view of cephalothorax; F, G, outer views of left chelae at different angles; H, dorsal view of left chela.

***Geosesarma rathbunae* (Serène, 1968a)**  
(Figs. 3, 4, 5E–H)

*Sesarma (Geosesarma) rathbunae* Serène, 1968a: 1086, figs. 5, 6; pl. 1 fig. 4.

*Sesarma (Geosesarma) rathbunae*—Serène 1968b: 106.

*Geosesarma rathbunae*—Serène & Soh 1970: 403; Ng 1988: 119 (list); Ng *et al.* 2008: 221 (list).

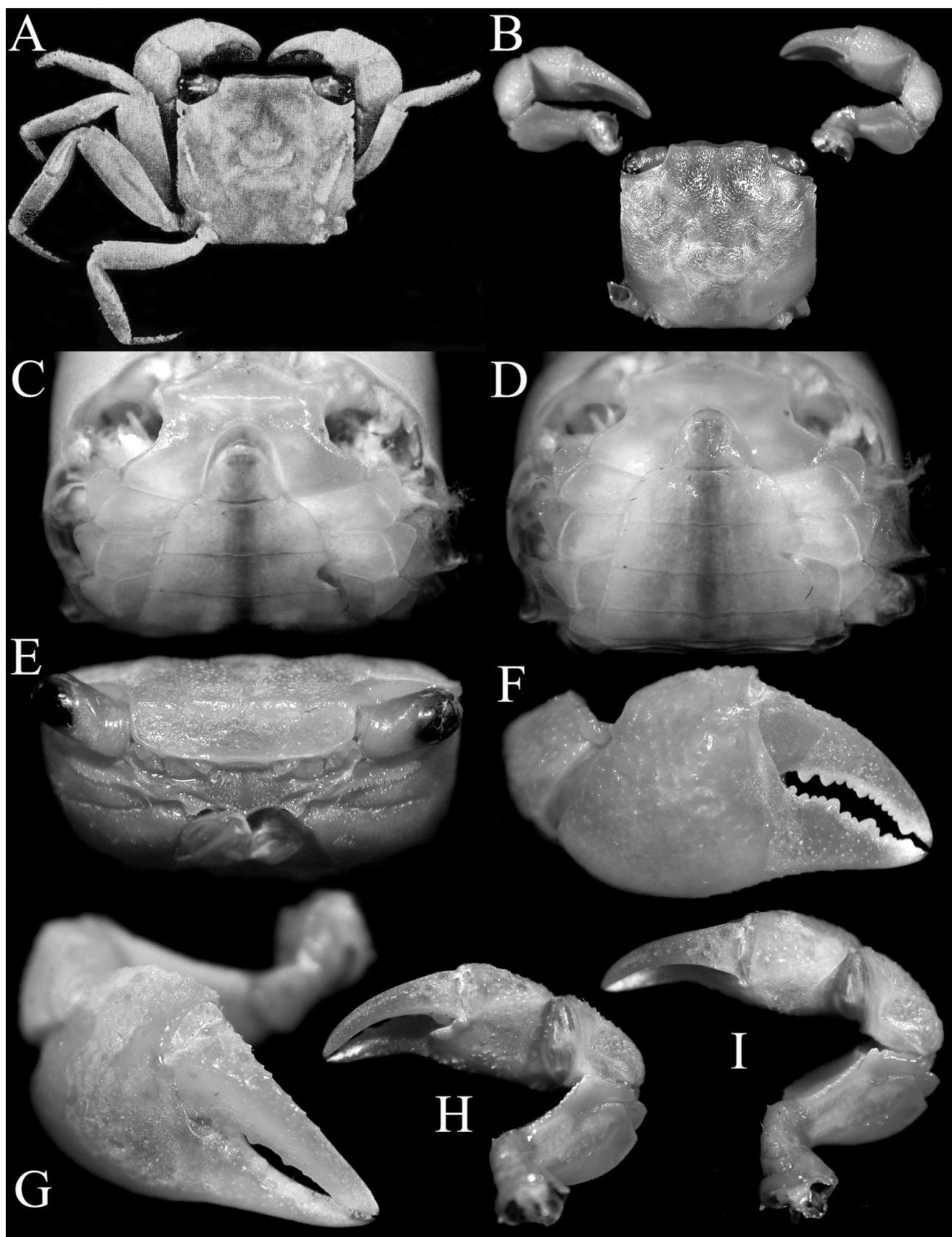


**FIGURE 2.** *Geosesarma maculatum* (De Man, 1892), male ( $12.4 \times 11.9$  mm) (ZRC 2017.0113), Halmahera. A, overall habitus; B, dorsal view of carapace; C, ventral view of cephalothorax showing thoracic sternum and pleon.

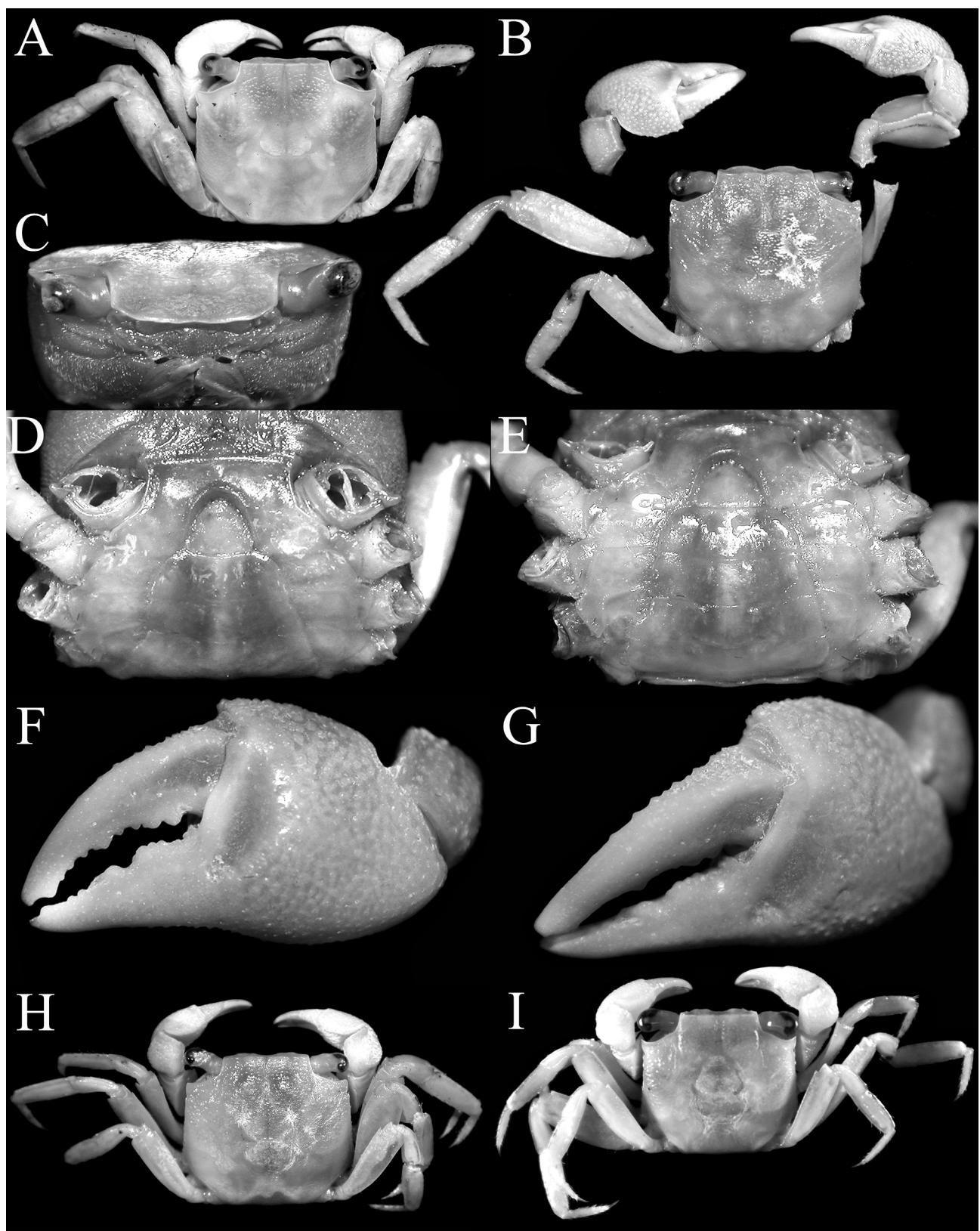
**Type material.** Holotype (missing, see Remarks): male ( $13.0 \times 12.2$  mm), on trunks of forest trees, Culasi, Panay Island, 800 m altitude, Philippines, coll. McGregor, 18 May 1918 (USNM 54315). Paratype: 1 female ( $13.3 \times 12.0$  mm), same locality and other data as holotype (USNM 1277697).

**Non-type material.** 4 males ( $14.9 \times 14.5$  mm,  $13.1 \times 12.3$  mm,  $11.1 \times 9.7$  mm,  $10.4 \times 9.4$  mm), 1 female ( $14.1 \times 12.6$  mm), 4 immature juveniles, locality and data same as holotype and paratype (USNM 123208).

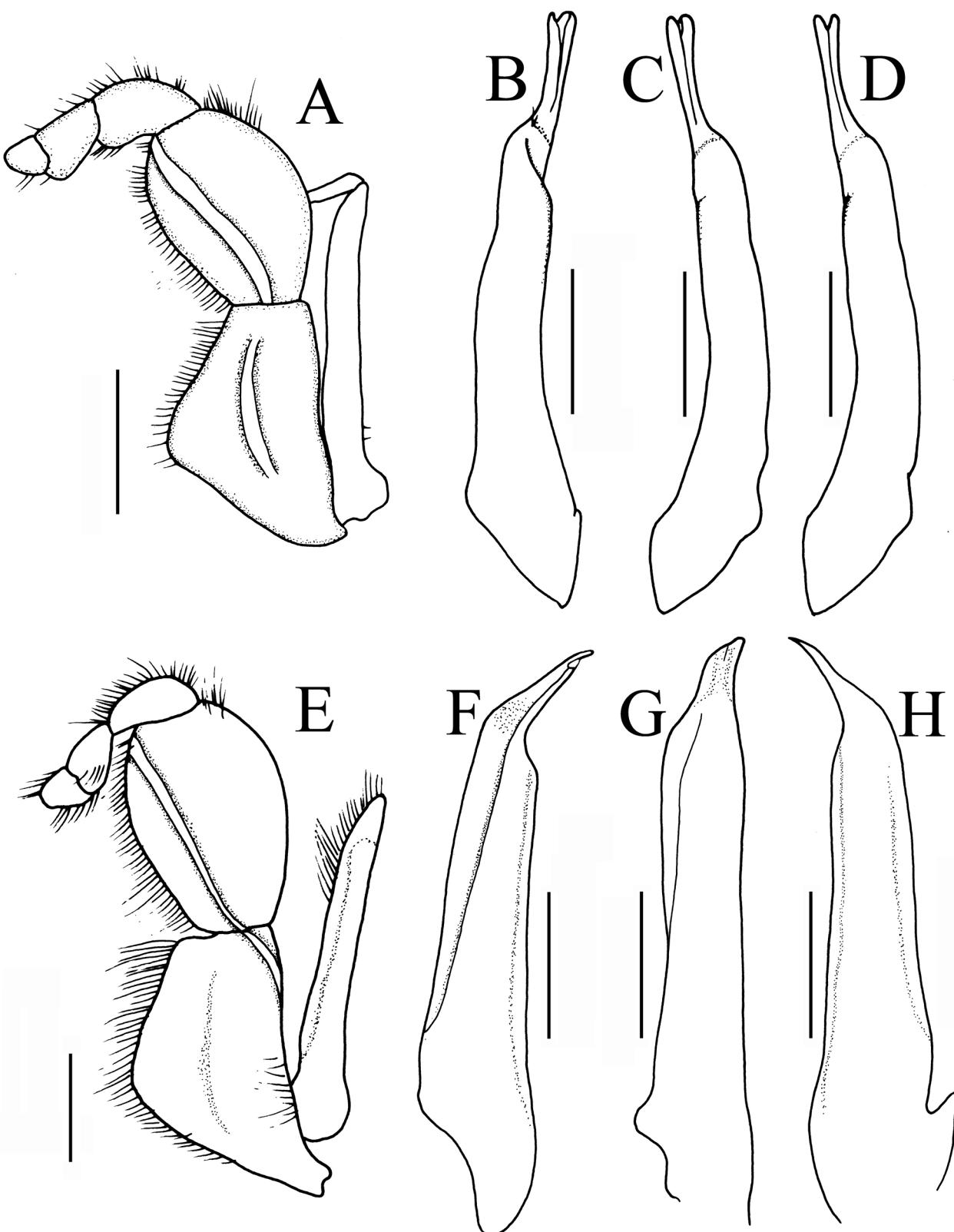
**Diagnosis.** Carapace quadrate to subquadrate, just wider than long, width to length ratio 1.0–1.1, lateral margins parallel (Figs. 3A, B, 4A, B, H, I); dorsal surface with regions just visible, anterior regions densely covered with low, small, rounded, flattened granules and rugosities (Figs. 3A, B, 4A, B, H, I); front deflexed, frontal lobes broad with subtruncate margins, separated by shallow concavity; postfrontal, postorbital cristae low but relatively sharp (Figs. 3A, B, E, 4A, B, C, H, I); external orbital tooth triangular, directed obliquely, outer margin convex, tip not distinctly extending beyond lateral margin (Figs. 3A, B, 4A, B, H, I). Merus of third maxilliped subovate, subequal in length to ischium; exopod slender without trace of flagellum (Fig. 5E). Outer surface of palm of cheliped of adult male covered with numerous low granules; inner surface granulated but without transverse ridge; dorsal margin of dactylus with 6–8 low granules on proximal half or two-thirds, granules not chitinous, unarmed on distal half (Figs. 3F–I, 4F, G). Ambulatory legs each with relatively slender merus having sharp subdistal spine on dorsal margin and lateral, mesial surfaces gently rugose (Figs. 3A, 4A, B, H, I); propodus without brush-like setae on ventral margin. Male pleon triangular, relatively broad; somite 6 wide, with convex lateral margins; telson semicircular (Figs. 3C, D, 4D, E). G1 relatively slender, distal chitinous part bent obliquely laterally, tapering to sharp tip (Fig. 5F–H).



**FIGURE 3.** *Geosesarma rathbunae* (Serène, 1968a). A, holotype male ( $13.0 \times 12.2$  mm) (USNM 54315) (after Serène, 1968a: pl. 1 fig. 4); B–I, non-type male ( $13.1 \times 12.3$  mm) (USNM 123208). A, B, overall habitus; C, D, ventral view of cephalothorax showing thoracic sternum and pleon; E, frontal view of cephalothorax; F, G, outer views of right chelae at different angles; H, I, dorsal views of right chelipeds at different angles.



**FIGURE 4.** *Geosesarma rathbunae* (Serène, 1968a). A, paratype female ( $13.5 \times 12.1$  mm) (USNM 1277697, ex USNM 123208); B–G, non-type male ( $14.9 \times 14.5$  mm) (USNM 123208); H, non-type female ( $14.1 \times 12.6$  mm) (USNM ex 54315); I, non-type male ( $10.4 \times 9.4$  mm) (USNM 123208). A, B, H, I, overall habitus; C, frontal view of cephalothorax; D, E, ventral view of cephalothorax showing thoracic sternum and pleon; F, G, outer views of left chelae at different angles.



**FIGURE 5.** A–D, *Geosesarma vicentense* (Rathbun, 1914), holotype male ( $9.2 \times 8.5$  mm) (USNM 45758); E–H, *Geosesarma rathbunae* (Serène, 1968a), male ( $13.1 \times 12.3$  mm) (USNM 123208). A, E, left third maxilliped; B, F, ventral view of left G1; C, G, mesial view of left G1; D, H, dorsal view of left G1. Scales = 1.0 mm.

**Remarks.** While examining the type material of *Geosesarma rathbunae*, some discrepancies were discovered in the contents of the jars that were supposed to contain the holotype and paratype specimens of this species. Serène (1968a: 1086, 1087) based his description on only two specimens, one male and one female, loaned to him by the USNM. His two specimens were part of a lot (USNM 54315), containing as per the labels and USNM records, a total of five males and two females collected in Culasi, on the west coast of Panay Island, Philippines. The specimens in this lot had been identified by M. J. Rathbun as “*Sesarma (Sesarma) sylvicola* (de Man), var” but never reported in the literature. Of the two specimens that Serène borrowed, he designated as holotype the male measuring 13.0 × 12.2 mm, which he illustrated and photographed (Serène 1968a: figs 5, 6, pl. 1, fig. 4), and as paratype the female measuring 13.3 × 12.0 mm. The holotype and paratype were then returned to the USNM where the holotype was assigned for itself the same original catalogue number used for all the Culasi material, USNM 54315. A new catalogue number, USNM 123208, was then issued for the female paratype.

When the two USNM jars with Serène’s (1968a) type material of *Sesarma (Geosesarma) rathbunae* were pulled from the shelves for this study, we discovered that the lot that should contain the male holotype, USNM 54315, actually contained a female specimen (Fig. 4A). Furthermore, the lot that should contain the single female paratype, USNM 123208, actually contained four males, one female, and a vial with four small and dismembered immature juveniles unaccounted for in the labels and USNM records. It should be noted that Serène (1968a) only examined and reported in his description the male and female types; thus, the rest of the Culasi material, even though it has been found to be conspecific with Serène’s species, cannot be part of the type series.

After measuring and comparing all the specimens from Culasi with Serène’s (1968a) description, we determined that the female mistakenly found in the holotype jar matches precisely Serène’s female paratype, and this female specimen has now been assigned a new catalogue number, USNM 1277697. However, none of the males found still in USNM 54315 could be matched with confidence to the size and features of the holotype photographed and illustrated by Serène (1968a) (Fig. 3A), and moreover, none was found to have the G1 dissected and Serène had a well-known practice of dissecting out the G1 for illustration. More conclusive, one of the five males in the original jar with all the Culasi material, is missing and we have concluded it must be the holotype. Given the possibility, even if remote, that Serène’s holotype may be found in the future, we prefer to be cautious and make a note in the records of the missing holotype in USNM 54315. Finally, the status of lot USNM 123208 that was originally to contain the female paratype but found during this study to contain non-paratypes from Culasi, has been adjusted to reflect that the specimens therein are non-types.

The identity of the species, however, is not in doubt as the series of remaining specimens all agree very well with the type descriptions and figures by Serène (1968a).

*Geosesarma rathbunae* is unique among known Philippine *Geosesarma* in that the exopod of the third maxilliped does not have a flagellum (Fig. 5E). All the other species have a long flagellum on the exopod (e.g., Fig. 5A). This is a character, however, present in many highland species from Peninsular Malaysia and Borneo (e.g., see Ng, 1988, 2015). These species also have G1 structures similar to that of *G. rathbunae*, with the distal chitinous part relatively shorter and laterally bent.

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