

**GEOSESARMA HEDNON, A NEW SPECIES OF TERRESTRIAL CRAB
(CRUSTACEA: DECAPODA: BRACHYURA: SESARMIDAE)
FROM TAIWAN AND THE PHILIPPINES**

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ABSTRACT. – A new species of *Geosesarma*, *G. hednon*, is described from Taiwan and the Philippines. The new species represents the northernmost record of this genus. *Geosesarma hednon* is morphologically closest to *G. maculatum* (De Man, 1892) and *G. ternatense* (Serène, 1968) (both from Indonesia), but can be distinguished from them by outer margin of the external orbital tooth being subparallel to the rest of the lateral carapace margin, a short flagellum of the third maxilliped, the shape of the male abdomen, and the structure of the male first pleopods. *Geosesarma hednon* has small eggs and marine planktonic larval development, which distinguishes it from many other species of *Geosesarma* that are known to have abbreviated or direct development. This supports current doubts about the homogeneity and monophyly of the genus *Geosesarma*.

KEY WORDS. – Sesarmidae, new terrestrial crab, *Geosesarma*, taxonomy.

INTRODUCTION

Of the over 40 species of sesarmid crabs of the genus *Geosesarma* De Man, 1892, known from Southeast Asia and neighbouring areas (Ng, 1988), the most northerly record has been *G. vicentense* (Rathbun, 1914) from Port San Vicente in Luzon. The genus has not been previously reported from Taiwan. In the Philippines, there are two other known species of *Geosesarma*, viz. *G. rathbunae* (Serène, 1968) [Culasi, Panay Island] and *G. protos* Ng & Takeda, 1992 [Mindanao]. In this paper, we describe a new species from the central Philippines and Taiwan.

The terminology follows Ng (1988). The abbreviations G1 and G2 are for the male first and second pleopods respectively. All measurements, in millimetres, are of the carapace width and length respectively. Specimens are deposited in the Taiwan National Museum, Taipei, Taiwan (TMCD); Institute of Zoology, Academia Sinica (ASIZ), Nankang, Taipei, Taiwan; Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research, National

University of Singapore; The Naturalis (ex-Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands (RMNH); and the Senckenberg Museum (SMF), Frankfurt a. M., Germany.

TAXONOMY

Geosesarma De Man 1892

Remarks. – The genus *Geosesarma* De Man 1892 (sensu Serène & Soh, 1970) is clearly not homogeneous, and Ng (1988: 119) recognised three separate groups for convenience. As has been discussed by some authors (see Ng, 1988: 118), the genus *Geosesarma* is not well defined, and is characterised mainly by their wholly freshwater habits, swollen basal antennular segment and large eggs (ca. 1.0 mm in diameter or larger). Many other sesarmid genera, however, also have representatives living in fresh water habitats, sometimes great distances from the sea. The swollen antennular segment is a useful character, but is not always reliable as it is also evident in members of other genera (e.g. *Labuanium*) (unpublished

data). The egg sizes of many species currently referred to *Geosesarma* are still not known, and it is doubtful if this character alone is sufficient to diagnose a genus. The development of only two species is known for certain, *G. peraccae* and *G. notophorum*. *Geosesarma peraccae* has an abbreviated development, with the advanced zoeae possessing their own food reserves and developing rapidly in the burrows (Soh, 1969), while *G. notophorum* has direct development with the young crabs staying on the mother's back for a short time (Ng & Tan, 1995). Large eggs and abbreviated development have also been reported for other inland and coastal sesarimid taxa (Hartnoll, 1964; Schubart & Cuesta, 1998; Cuesta et al., 1999; Schubart & Ng, in prep.).

The present description of a new species, *G. hednon*, from the central Philippines and Taiwan is noteworthy as the two sites are some distance apart. However, many ovigerous females of *G. hednon* had been obtained and the eggs are small, much smaller than those known for other *Geosesarma* species (see Ng 1988: 118). The eggs from some of these ovigerous females hatched into normal planktonic zoeae and they will be described at a later date. As such, this species has a rather wide distribution compared to more typical

Geosesarma species. *Geosesarma hednon* thus lacks one of the key attributes of the genus, i.e. the possession of large eggs with abbreviated or direct development. The authors have on hand, ovigerous females of *G. nemesis* Ng, 1986, *G. cataracta* Ng, 1986, *G. tiomanicum* Ng, 1986, *G. penangense* Tweedie, 1940, *G. malayanum* Ng & Lim, in Ng, 1986, *G. aurantium* Ng, 1995, and *G. noduliferum* (De Man, 1892), all of which have large eggs. We expect some of the other *Geosesarma* species (e.g. *G. maculatum*) to also have small eggs like *G. hednon*. While we have seriously considered establishing a new genus for *G. hednon* and its close allies (the type species of *Geosesarma* is *G. noduliferum*), we have deferred from doing so as the affinities of too many of the species in the genus are still poorly understood. Most of the species have not even been reported or redescribed since their original discovery.

***Geosesarma hednon*, new species**
(Figs. 9-14)

Material examined. – Holotype – male (13.4 by 12.3 mm) (TMCD), mouth of Kangkou stream Manchow, Pingtung County, Taiwan, 21°59'26" N 120°50'09"E, coll. H.-C. Liu, 7 Jan.2000.

Paratypes – **Taiwan:** 3 males (13.9 by 13.3 mm, 11.4 by 11.0 mm, 11.0 by 10.4 mm) (ZRC), mouth of Kangkou stream, Manchow, Pingtung County, 21°59'26" N 120°50'09"E, coll. H.-C. Liu, 13 Dec.1999 ;1 female (12.6 by 11.4 mm) (SMF 28101) (DNA voucher), mouth of Kangkou Stream, Pingtung County, 21°59'26" N 120°50'09"E, coll. H.-C. Liu, 1 Sep.1999 ;1 male (13.1 by 12.1 mm) (TMCD), mouth of Kangkou stream, Manchow, Pingtung County, 21°59'26" N 120°50'09"E, coll. H.-C. Liu, 17 Dec.1999 ;2

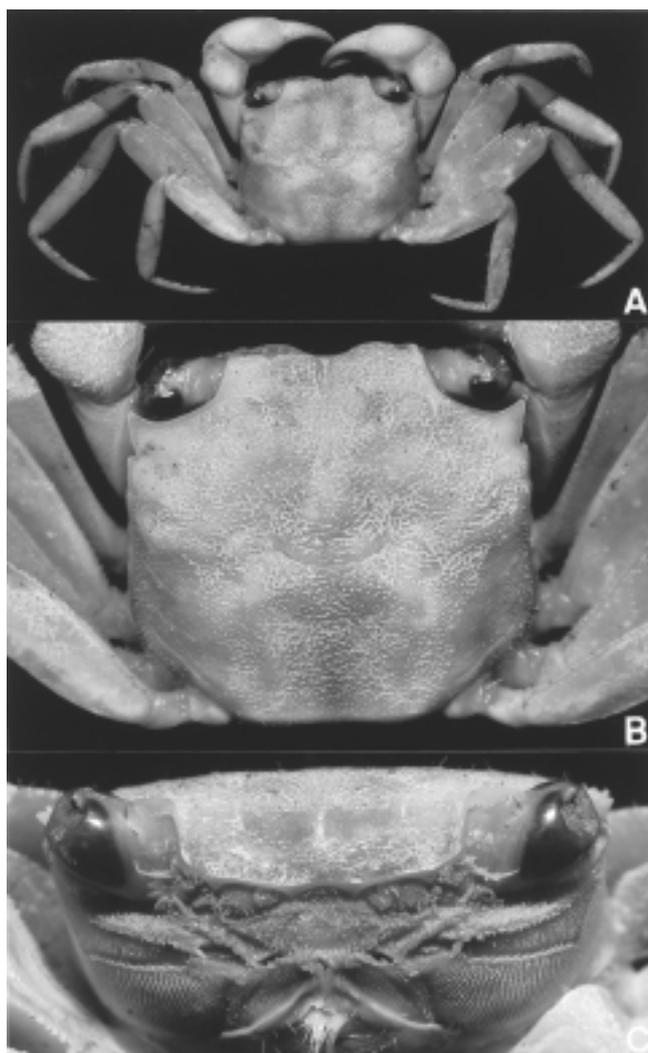


Fig. 1. *Geosesarma maculatum* (De Man, 1892). Male (12.8 by 12.2 mm) (RMNH D30584), Sumba. A, overall view; B, carapace; C, frontal view.

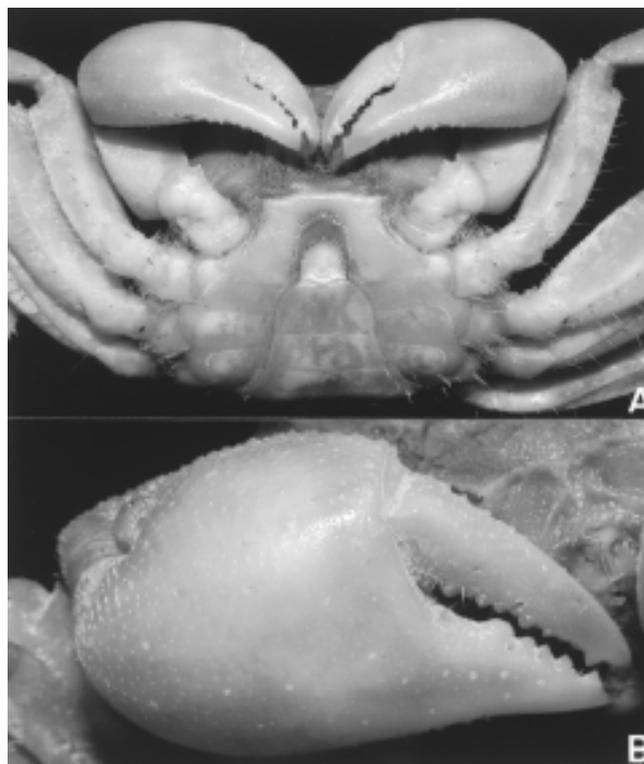


Fig. 2. *Geosesarma maculatum* (De Man, 1892). Male (12.8 by 12.2 mm) (RMNH D30584), Sumba. A, ventral view; B, right chela, outer view.

males (10.1 by 9.4 mm, 8.8 by 8.5 mm), 2 females (8.0 by 7.1 mm, 7.0 by 6.4 mm) (TMCD), 2 males (9.9 by 9.4 mm, 6.8 by 6.4 mm), 1 female (10.9 by 9.9 mm) (ZRC), mouth of Meilun stream, Hualien City, Hualien County, 23°58'54"N 121°36'37"E, coll. H.-C. Liu, 18 Jun.2000 ;2 females (10.3 by 9.6 mm, ovigerous; 8.3 by 7.3 mm) (TMCD), mouth of Meilun stream, Hualien City, Hualien County, 23°58'54"N 121°36'37"E, coll. H.-C. Liu, 12 Jul.2000 ;1 female (12.3 by 11.1 mm, with larvae) (TMCD), mouth of Meilun stream, Hualien City, Hualien County, 23°58'54"N 121°36'37"E, coll. H.-C. Liu, 21 Sep.2000 ;1 female (13.7 by 12.2 mm, with larvae) (TMCD), mouth of Meilun stream, Hualien City, Hualien County, 23°58'54"N 121°36'37"E, coll. H.-C. Liu, 19 Jun.2000 ;1 female (9.5 by 8.5 mm, ovigerous), mouth of Meilun stream, Hualien City, Hualien County, 23°58'54"N 121°36'37"E, coll. H.-C. Liu, 3 Oct.2000 ;1 male (12.6 by 11.5 mm), 1 female (12.4 by 11.3 mm), 2 juveniles (ZRC 2002.416), mouth of Meilun stream, Hualien City, Hualien County, 23°58'54"N 121°36'37"E, coll. P. K. L. Ng & H.-C. Liu, 22 Jun.2002.

Other material – **Philippines**: 2 males (17.7 by 16.0 mm, 11.6 by 10.7 mm), 2 females (17.7 by 15.6 mm, 12.7 by 11.1 mm) (ZRC), 1 male (13.7 by 13.0 mm) (TMCD), 1 female (13.2 by 11.7 mm) (ASIZ), Kawasan Falls, Matutinao River, western Cebu, Philippines, coll. H.-C. Liu, 4 Dec.2001.



Fig. 3. *Geosesarma maculatum* (De Man, 1892). Male (12.8 by 12.2 mm) (RMNH D30584), Sumba. Ambulatory legs. A, ventral view of first propodus and dactylus; B, dorsal view of second (top) and third (below) propodi and dactyli; C, dorsal view of fourth propodus and dactylus.

Diagnosis. – Carapace squarish, dorsal surfaces finely granular; external orbital tooth with outer margin almost straight and flush with rest of lateral margin, separated from rest of margin by narrow cleft; lateral carapace margins subparallel; exopod of third maxilliped slender, with short flagellum (sometimes absent); dactylus of male chela with numerous unevenly arranged simple sharp granules on dorsal margin; meri of ambulatory legs relatively broad, ventral margins of first dactylus and propodus usually with brush-like setae in adults; thoracic sternites 3 and 4 separated by gently curved ridge, with anterior and posterior surfaces depressed; abdomen triangular; G1 relatively slender, distal chitinous part very elongate, ca. half length of basal segment, tip forked.

Description of male. – Carapace squarish, slightly broader than long, broadest at posterior part of carapace, dorsal surfaces finely granular, regions not prominently swollen, with distinct grooves separating them; transverse groove separating cardiac and intestinal regions distinct; posterolateral regions with well developed oblique striae. Frontal margin strongly deflexed, slightly sinuous from dorsal view, vaguely divided into 2 low, subtruncate lobes; postfrontal cristae distinct, sharp, almost straight, separated into 4 parts, median parts separated by deep fissure, lateral parts separated by short, narrow fissure; frontal region concave. Antero- and posterolateral margins not discernible; external orbital tooth low, directed anteriorly, outer margin usually almost straight and flush with rest of lateral margin, separated by small, relatively narrow cleft; lateral carapace margins gently convex to almost straight, subparallel, no other lateral teeth discernible. Merus of third maxilliped longitudinally ovate, widest part much wider than length of proximal margin; ischium with shallow median sulcus; exopod slender, with short, slender flagellum that does not extend across width of merus, sometimes vestigial or absent.

Male chelipeds subequal; outer surface with numerous rounded granules singly or in small clumps. Merus with numerous rounded granules on outer surface; outer and inner margins serrated, without subdistal spines; inner margin with distal part dilated, sublamelliform. Carpus with outer surface granulated; longer than broad; inner distal angle with several sharper tubercles but without distinct tooth or spine. Palm inflated, especially on inner surface; dorsal and inner surfaces with numerous rounded granules; outer surface of larger males with median part almost smooth to pitted; fingers slightly longer than palm, forming small gape proximally when closed; dactylus with numerous unevenly arranged simple sharp granules on dorsal margin, cutting margin with several teeth and denticles; pollex with several low teeth, may be eroded in larger specimens.

Second and third ambulatory legs longest, meri of all legs relatively broad (cf. Ng, 1988). Upper margin weakly but unevenly serrated, with a low, but not spiniform subdistal tooth; dorsal and ventral margins of merus and carpus with scattered long setae. Dorsal and ventral margins of propodus and dactylus with numerous long, stiff setae, but not obscuring margins. Ventral margins of first dactylus and propodus with

densely packed short setae forming brush-like structures in smaller specimens, absent or sparser in larger specimens; brush-like setae usually present on second dactylus and propodus but sparser; absent on dactylus and propodus of third and fourth legs.

Thoracic sternites with smooth surface; sternites 3 and 4 separated by gently curved ridge, surfaces anterior and posterior to this ridge depressed; abdominal cavity reaching slightly beyond midpoint of sternite 4. Abdomen triangular. Telson with lateral margins convex, slightly longer than broad, tip rounded. Segment 6 with lateral margins convex, much broader than long. Segments 3-5 increasingly trapezoidal; lateral margins of segments 4 and 5 gently concave, that of segment 3 gently convex. Segments 1 and 2 transversely very narrow.

G1 relatively slender; basal segment gently sinuous; distal chitinous part very elongate, ca. half length of basal segment, gently sinuous from dorsal view and subspatuliform from marginal view; tip gently forked. G2 short, without distal segment.

Variation. – The female specimens agree with the male in almost all non-sexual characters, although in a few females, the carapace regions are slightly more inflated. The relative

length of the male telson compared to segment 6 varies somewhat. In smaller males, the telson is usually slightly longer or subequal to the length of segment 6 (Fig. 13A), becoming relatively shorter in larger specimens (Fig. 14A). Similarly, the lateral margins of male abdominal segment 6 are more prominently convex in larger specimens. *Geosesarma hednon* is sexually dimorphic in the size of the chelae (larger chelae with higher palms in males) and in the brush-like pubescence at the ventral side of the first two ambulatory legs, which is absent in females, suggesting a possible role during mating.

Colour. – Dorsal surface mostly brown to yellowish-brown, sometimes with dark-purple streaks which are bilaterally positioned; frontal region distinctly dark purple to almost black, stopping sharply at postfrontal cristae; posterolateral surface and margin with prominent broad dark purple to black band which is sharply demarcated, even in juveniles. Dorsal surfaces of ambulatory legs light brown, ventral surfaces of merus yellowish to dirty white. Ocular peduncle bright yellowish-green on dorsal surface, lateral and ventral surfaces purplish; cornea black with numerous small iridescent green spots. Third maxillipeds purple; oblique median ridge of merus and adjacent areas yellowish-green to yellow. Merus and carpus of chelipeds purplish, with yellowish patches. Outer surface of chela mostly light purple to purple, with

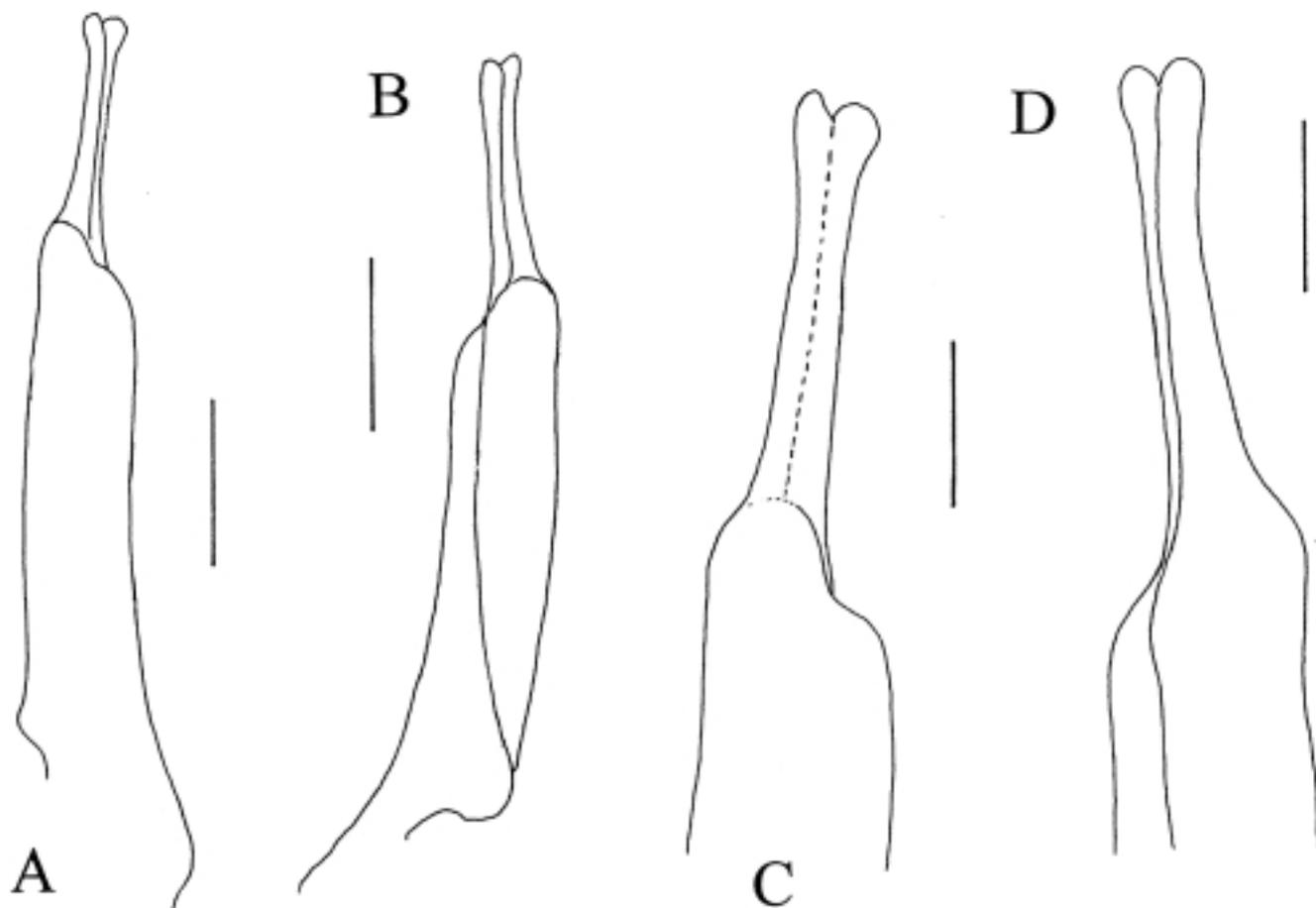


Fig. 4. *Geosesarma maculatum* (De Man, 1892). Male (12.8 by 12.2 mm) (RMNH D30584), Sumba. A-D, left G1 (setae denuded). Scales: A, B = 1.0 mm, C, D = 0.5 mm.

median parts sometimes somewhat yellowish; fingers dull red with dorsal surface of dactylus purplish, distal one-quarter or one-fifth yellowish orange to yellow, tips corneous. Thoracic sternum dirty to brownish-white.

Etymology. – The name is derived from the Greek “hednon” for wedding gift. This alludes to the circumstances during which the species was discovered. The species was first identified as a new *Geosesarma* species by the third author from among the second author’s material during the second author’s engagement. The species name represents a gift by the second author to his wife; and a wedding gift to the couple from the first and third authors. The name is used here as a noun in apposition.

Remarks. – *Geosesarma hednon*, new species, is closest to *G. maculatum* (De Man, 1892) and *G. ternatense* (Serène, 1968). The identity of *G. maculatum* s. str. is not very clear.

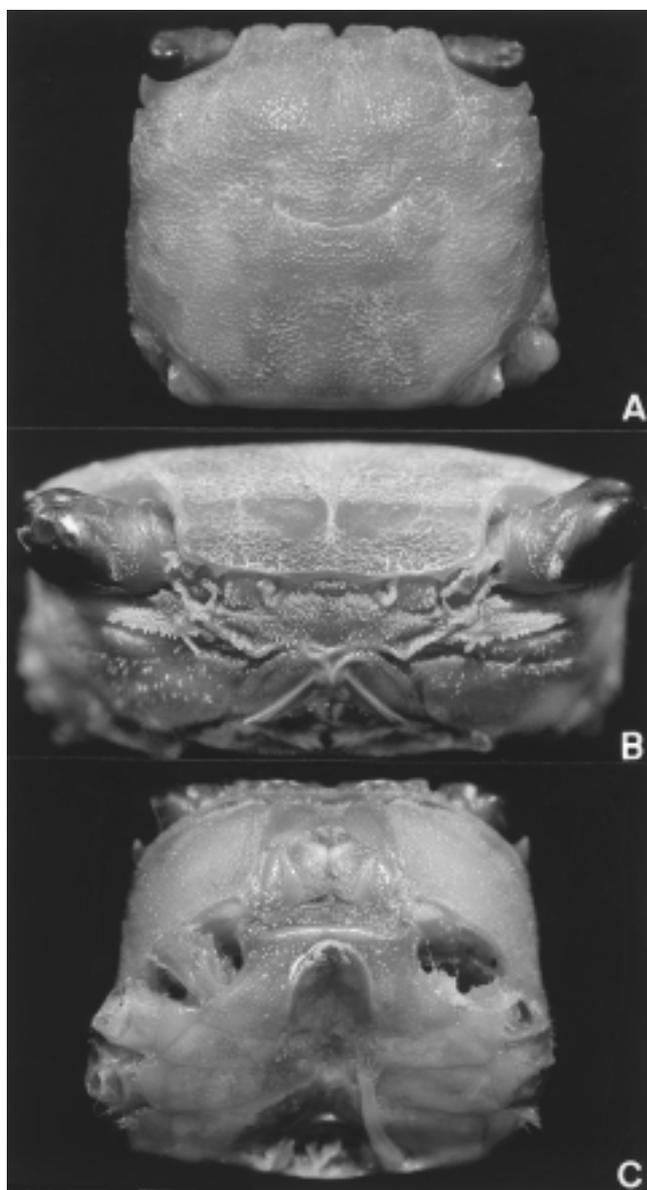


Fig. 5. *Geosesarma ternatense* (Serène, 1968). Holotype male (13.9 by 12.9 mm) (RMNH D1205a), Ternate. A, overall view; B, frontal view; C, ventral view.

The species was described from Flores (Lesser Sunda Islands) (as a *Sesarma*, De Man, 1892: 347, Pl. 21 Fig. 19), and was subsequently reported from Ternate, Batjan and Halmahera in eastern Indonesia by De Man (1902: 517). Gordon (1937) examined the Ternate specimen and argued that it was not conspecific with real *G. maculata* but she did not apply a new name. Serène (1968: 1092) stated that *G. maculatum* s. str. could be distinguished by the presence of brush-like setae on the first and second ambulatory propodus and dactylus; by the telson being as broad as long, with segment 6 being proportionately less broad, the male abdominal cavity not reaching as far forwards to the ridge between thoracic sternites 2 and 3, and the tip of the G1 being somewhat flared and distinctly bilobed (Figs. 1-4, 8A) (see also Gordon, 1937: 150, Figs. 1, 2c, d, 3a-c). On this basis, he argued that the specimens of *G. maculatum* reported from Ternate (see also Gordon, 1937) should be referred to a new species, *G. ternatense* (Serène, 1968) (see present Figs. 5-7, 8B). The identity of the Batjan and Halmahera specimens will need to be verified (see Cai & Ng, 2000). We have examined specimens of *G. maculatum* and *G. ternatense*, including the holotype of the latter species (see also Fransen et al., 1997: 123) and we concur with Serène’s (1968) observations and conclusions.

From both *G. maculatum* and *G. ternatense*, *G. hednon* can be distinguished by the outer margin of the external orbital



Fig. 6. *Geosesarma ternatense* (Serène, 1968). Holotype male (13.9 by 12.9 mm) (RMNH D1205a), Ternate. Ambulatory legs. A, left second or third leg; B, right fourth leg; C, right first or second leg.

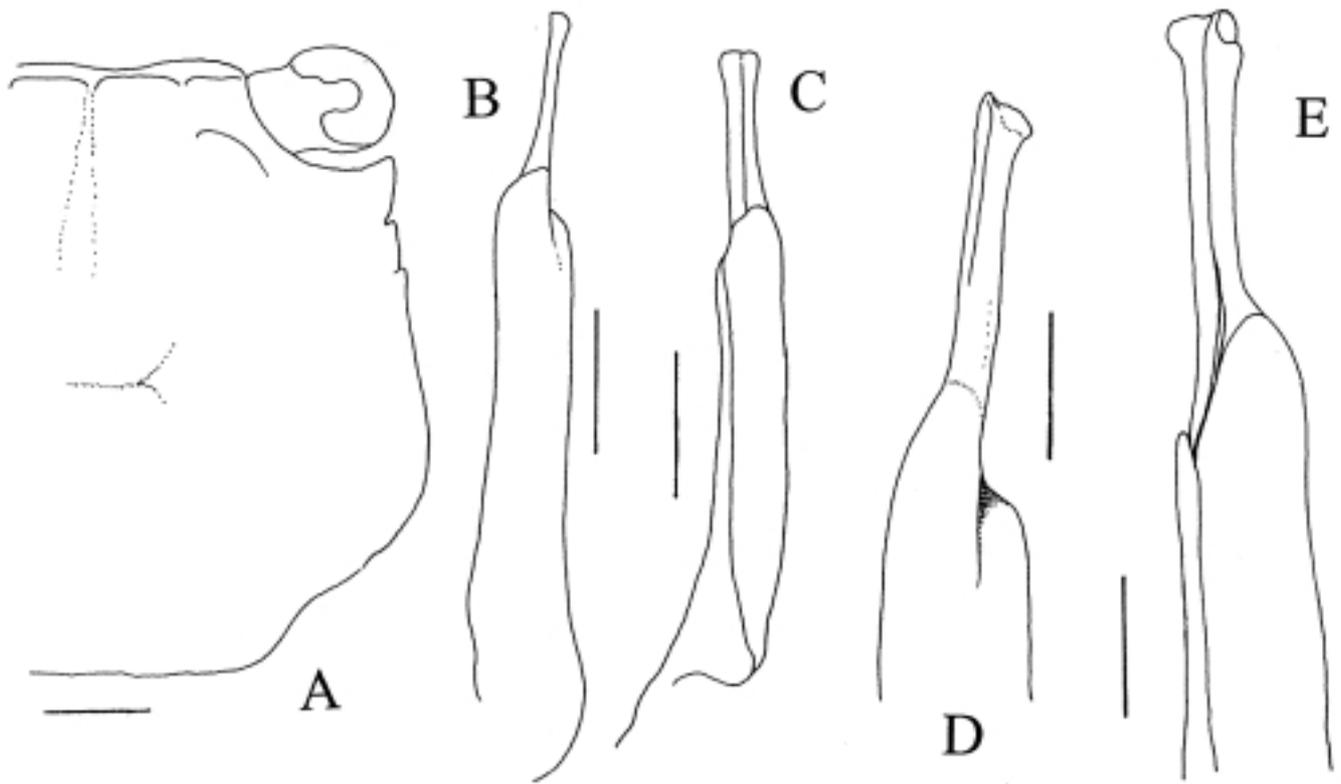


Fig. 7. *Geosesarma ternatense* (Serène, 1968). Holotype male (13.9 by 12.9 mm) (RMNH D1205a), Ternate. A, right side of carapace (schematic); B-E, left G1 (setae denuded). Scales: A = 2.0 mm, B, C = 1.0 mm, D, E = 0.5 mm.

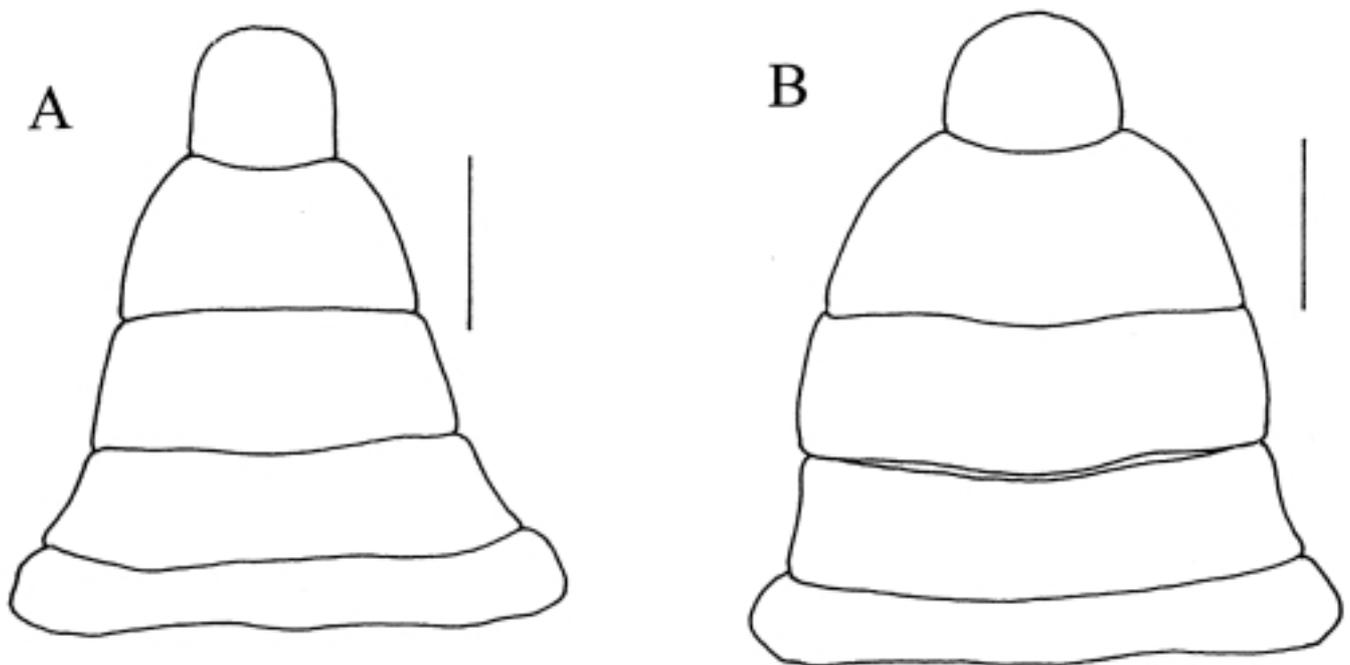


Fig. 8. Male abdomen (segments 3-6 and telson). A, *Geosesarma maculatum* (De Man, 1892), male (12.8 by 12.2 mm) (RMNH D30584), Sumba; B, *G. ternatense* (Serène, 1968), holotype male (13.9 by 12.9 mm) (RMNH D1205a), Ternate. Scales = 2.0 mm.

tooth being subparallel to the rest of the lateral carapace, and separated from it by a small or narrow cleft (Figs. 9B, 11B) (vs. outer margin sharply sloping inwards towards the carapace centre and the cleft with the lateral carapace margin distinctly V-shaped, Figs. 1B, 5A, 7A); the flagellum of the exopod of the third maxilliped being not longer than the width of the merus (sometimes vestigial) (vs. flagellum long, longer than width of merus); the elongate distal chitinous part of the G1 being proportionately longer (Figs. 13C-G, 14C-H vs. Figs. 4A-D, 7B-E) and the basal part being more sinuous (Figs. 13C-G, 14C-H vs. Figs. 4A-D, 7B-E). *Geosesarma hednon* can be distinguished from *G. ternatense* in possessing brush-like setae on the first and second ambulatory propodi and dactyli (completely absent in *G. ternatense*). The male abdomen of *G. ternatense* is remarkably broad and very diagnostic (Fig. 8B) and easily distinguishes this species from the other two. The male abdomen of *G. hednon* (Figs. 13A, 14A) is also relatively more transversely narrow than that of *G. maculatum* (Fig. 8A).

The taxonomic value of the presence or absence of brush-like setae on the ventral margins of the first and second ambulatory propodus and dactylus depends to some degree

on the size of the specimen. It has been used as a taxonomic character to separate various sesarimid species (e.g. by Gordon, 1937; Serène, 1968; for *Geosesarma* species) but is known to be variable to some degree and is always absent in females (see Ng, 2002). In the present series of *G. hednon* from Taiwan, this character varies somewhat. In males, the brush-like setae on the first and second ambulatory dactylus are short but distinct; on the propodus, they are arranged in small tufts and are neither as dense or fully continuous (Figs. 10B, 13I). In a large male of *G. hednon* from the Philippines (17.7 by 16.0 mm, ZRC), the brush-like setae of the first ambulatory dactylus are markedly more ragged and sparser compared to the smaller males, and in this specimen, they are also not discernible on the first ambulatory propodus as well as second ambulatory propodus and dactylus. Male specimens of *G. hednon* from Taiwan and Philippines smaller than the holotype invariably have more prominent brush-like setae. In the male specimen of *G. maculatum* examined, these brush-like setae are very dense and distinctly longer (Figs. 3A, B) compared to those of *G. hednon* (Figs. 10B, 13I).

Three other *Geosesarma* species have G1 structures which are similar to the three species discussed above, viz. *G. sylvicum* (De Man, 1892), *G. gordonae* (Serène, 1968) and



Fig. 9. *Geosesarma hednon*, new species. Holotype male (13.4 by 12.3 mm) (TMCD), Taiwan. A, overall view; B, carapace; C, frontal view.

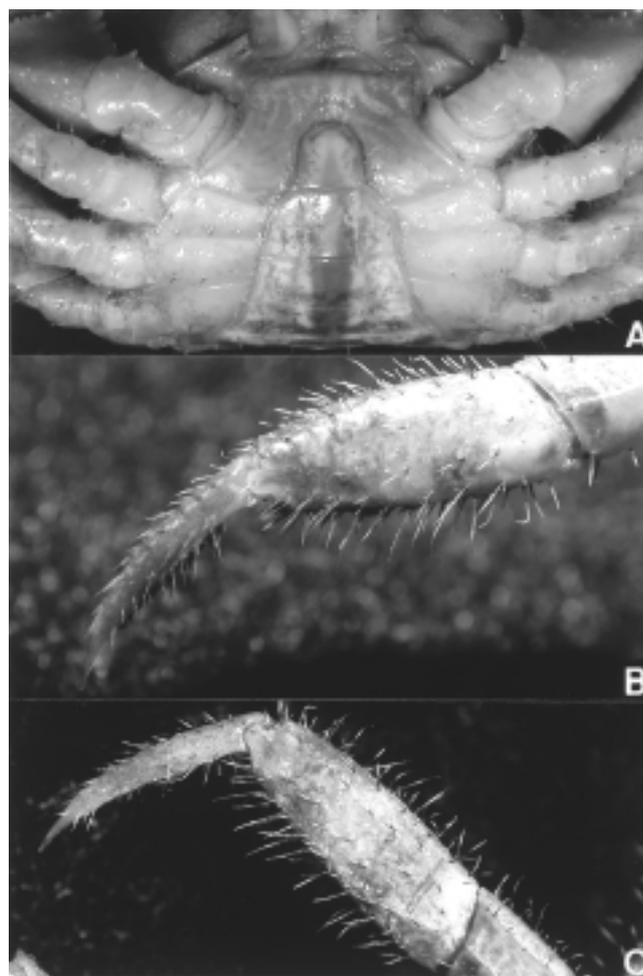


Fig. 10. *Geosesarma hednon*, new species. Holotype male (13.4 by 12.3 mm) (TMCD), Taiwan. A, ventral view; B, left first ambulatory propodus and dactylus; C, left second ambulatory propodus and dactylus.

G. johnsoni (Serène, 1968) (see Gordon, 1937; Serène, 1968), and all are probably related. Compared to *G. hednon*, their carapace and G1 structures are different. When a full revision of the genus is eventually done, hopefully supported by molecular data, these species, together with *G. maculatum*, *G. ternatense* and *G. hednon*, will probably have to be referred to their own genus.

Ecological notes. – *Geosesarma hednon* occurs on the side of river banks, under forest cover or in burrows. It has been collected from burrows that it apparently digs itself, as well as from under stones or in crevices. In Taiwan, *G. hednon* occurs sympatrically with *Sesarmops intermedium*, *S. impressum*, *Chiromantes haematocheir* and *Neosarmatium rotundifrons* (all Sesarmidae); and in the Philippines, it has been collected with *Sesarmops weberi* and *Bresedium philippinense* (both Sesarmidae). The preferred habitats are usually close to fresh water pools or streams (often within a 10 m radius). In Taiwan, the species was collected less than 300 m away from the sea, but in the Philippines, it was obtained slightly further away (ca. 500 m). This species has

secretive habits and does not wander far from cover. The only exceptions are ovigerous females which need to migrate to the sea to release their larvae. Of the 38 ovigerous females from Taiwan that were examined (not all preserved), the smallest specimen measured 9.5 mm in carapace width. Ovigerous females were found all year round. Ovigerous females have small eggs that hatch out into pelagic, free-swimming larvae. The release of larvae does not appear to be associated with lunar or semilunar cycles, with many ovigerous females also observed during other periods.

Comparative material. – *G. maculatum* (De Man, 1892): 1 male (12.8 by 12.2 mm), 1 female (11.0 by 10.3 mm) (RMNH D30584), Bondokodi River, 2-3 km from river, west Sumba, Indonesia, coll. E. Sutter, 10 Aug. 1949; 1 female (RMNH D38588), Roti, Timor, Indonesia, coll. H. Ten Kate, 1891. *G. ternatense* (Serène, 1968): Holotype male (13.9 by 12.9 mm) (RMNH D1205a), Ternate, coll. Kükenthal Expedition; 1 female (14.0 by 12.8 mm) (RMNH D1205b), same data as holotype.

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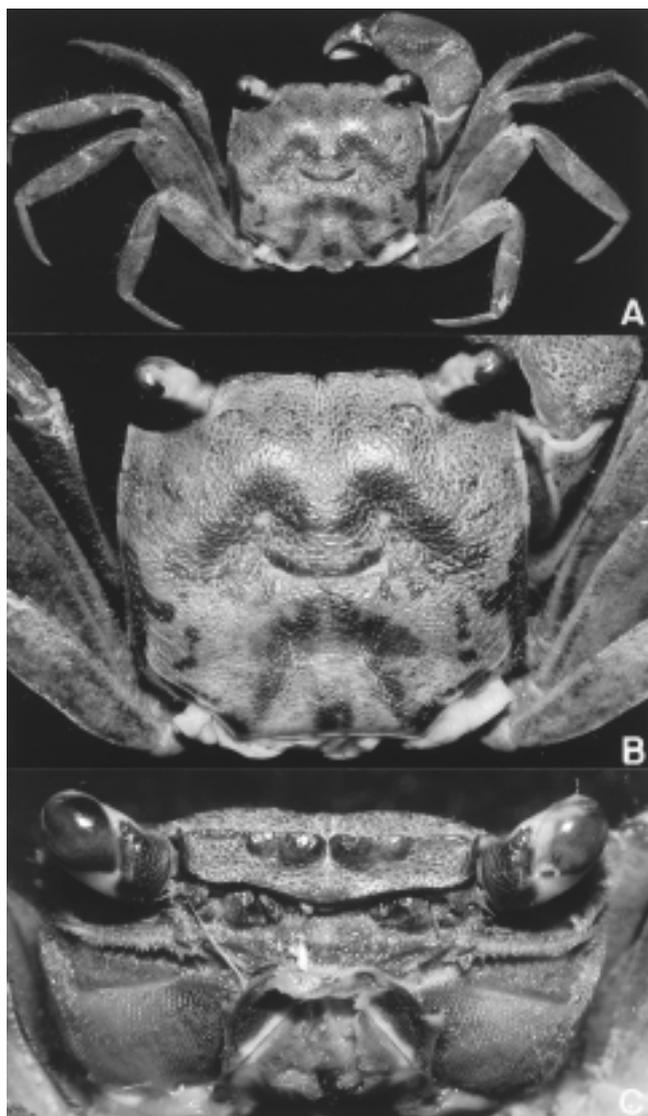


Fig. 11. *Geosesarma hednon*, new species. Male (17.7 by 16.0 mm) (ZRC), Philippines. A, overall view; B, carapace; C, frontal view.

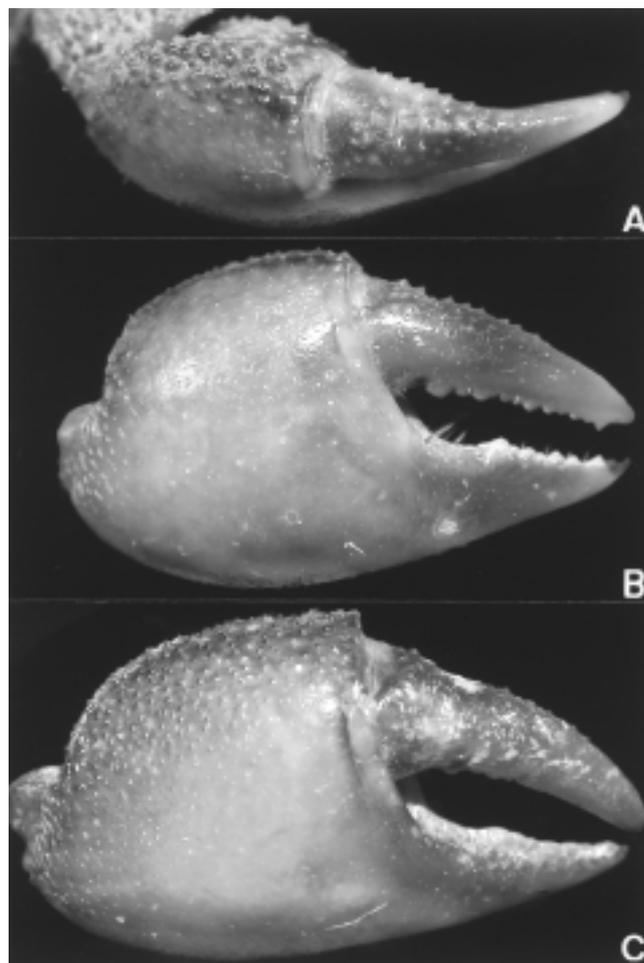


Fig. 12. *Geosesarma hednon*, new species. Chelae. A, B, holotype male (13.4 by 12.3 mm) (TMCD), Taiwan; C, male (17.7 by 16.0 mm) (ZRC), Philippines.

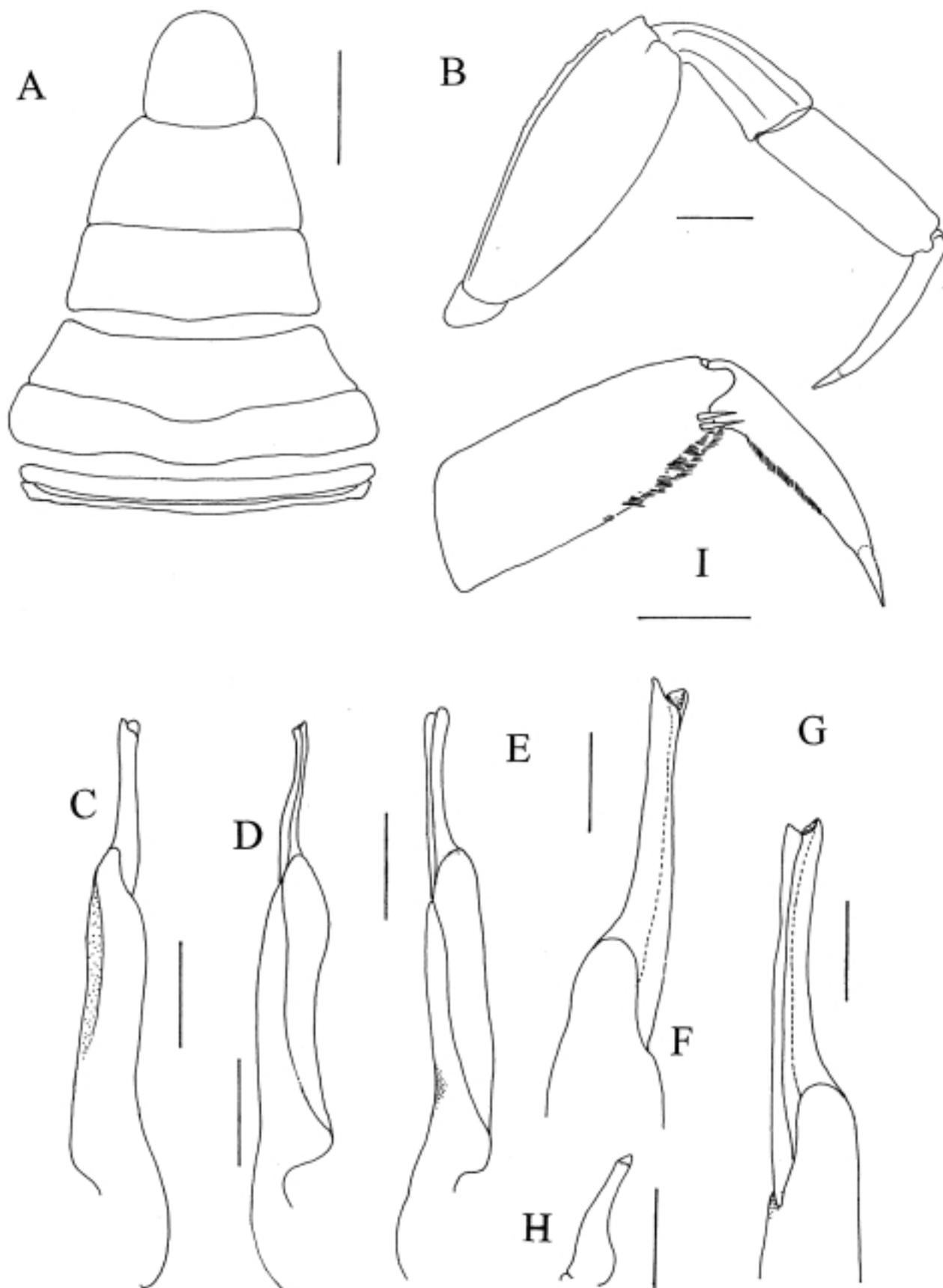


Fig. 13. *Geosesarma hednon*, new species. Holotype male (13.4 by 12.3 mm) (TMCD), Taiwan. A, abdomen; B, right fourth ambulatory leg; C-G, left G1 (setae denuded); H, left G2 (setae denuded); I, right first ambulatory propodus and dactylus. Scales: A, B = 2.0 mm, C-E, H = 1.0 mm, E, G = 0.5 mm.

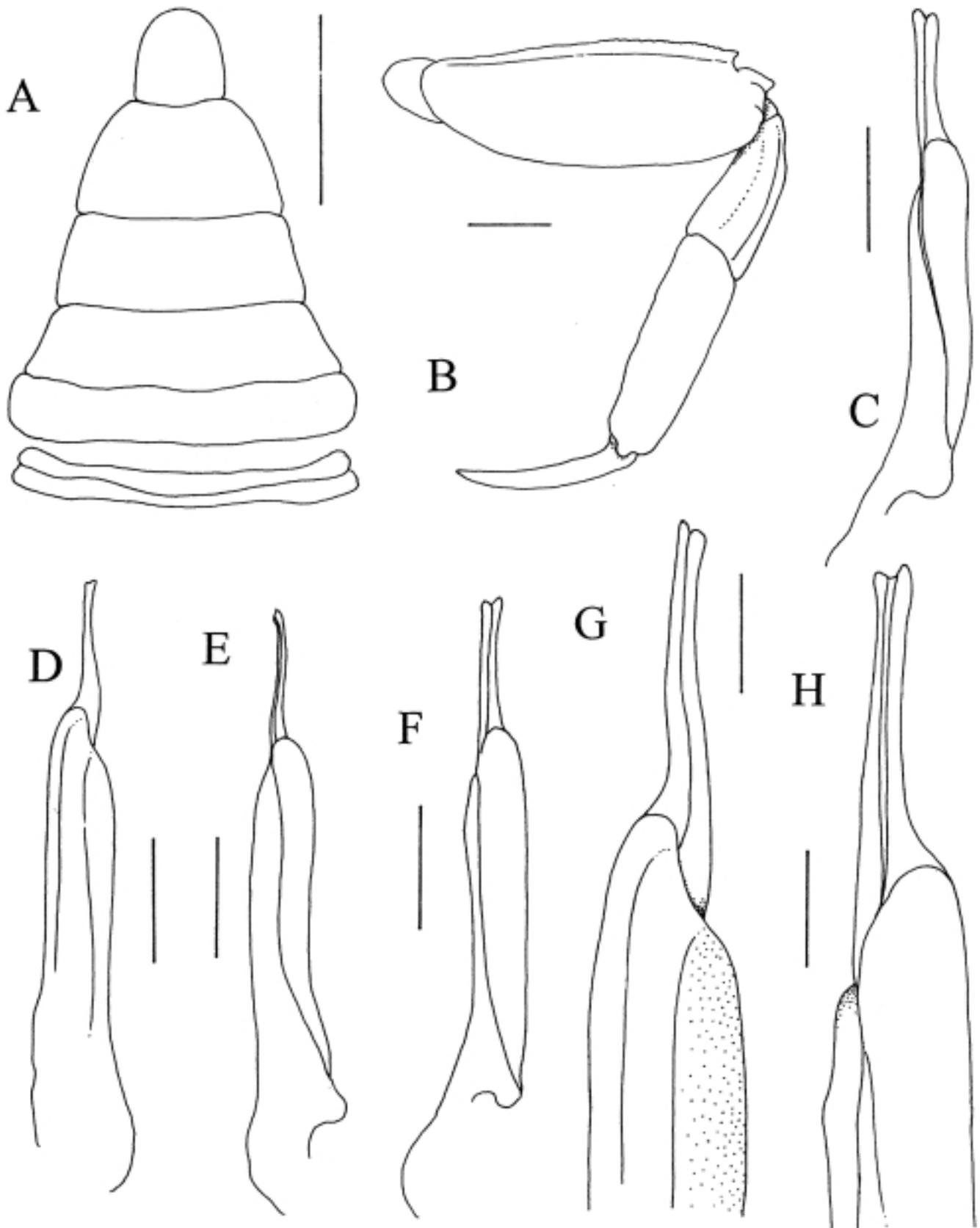


Fig. 14. *Geosesarma hednon*, new species. A, D-H, male (17.7 by 16.0 mm) (ZRC), Philippines; B, C, male (11.6 by 10.7 mm) (ZRC), Philippines. A, abdomen; B, right fourth ambulatory leg; C-H, left G1s (setae denuded). Scales: A = 5.0 mm, B = 2.0 mm, C-F = 1.0 mm, G, H = 0.5 mm.

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LITERATURE CITED

- Cai, Y. & P. K. L. Ng, 2001. The freshwater decapod crustaceans of Halmahera, Indonesia. *Journal of Crustacean Biology*, **21**(3): 665-695.
- Cuesta, J. A., M. Schuh, R. Diesel & C. D. Schubart, 1999. Abbreviated larval development of *Armases miersii* (Grapsidae: Sesarminae), a crab that breeds in supralittoral rock pools. *Journal of Crustacean Biology*, **19**(1): 26-41.
- Franssen, C. H. J. M., L. B. Holthuis & J. P. H. M. Adema, 1997. Type-catalogue of the Decapod Crustacea in the collections of the Nationaal Natuurhistorisch Museum, with appendices of pre-1900 collectors and material. *Zoologische Verhandelingen*, Leiden, **311**: i-xvi, 1-344.
- Gordon, I., 1937. Notes on several Indo-Pacific species of *Sesarma* (Crustacea Brachyura). *Proceedings of the Linnaean Society, London*, **1936-1937**(3): 150-156, fig. 1-5.
- Hartnoll, R. G., 1964. The freshwater grapsid crabs of Jamaica. *Proceedings of the Linnaean Society, London*, **175**: 145-169.
- Man, J. G., De, 1892. Decapoden des Indischen Archipels. In: Weber, M. (ed.), *Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien*, **2**: 265-527, pls. 15-29.
- Man, J. G., De, 1902. Die von Herrn Professor Kükenthal in Indischen Archipel gesammelten Dekapoden und Stomatopoden. In: Kükenthal, W. (ed.), *Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, **25**(3): 467-929, pls. 18-20.
- Ng, P. K. L., 1986. Preliminary descriptions of 17 new freshwater crabs of the genera *Geosesarma*, *Parathelphusa*, *Johora* and *Stoliczia* (Crustacea Decapoda, Brachyura) from South East Asia. *Journal of the Singapore National Academy of Science*, **15**: 36-44.
- Ng, P. K. L., 1988. *The Freshwater Crabs of Peninsular Malaysia and Singapore*. Department of Zoology, National University of Singapore, Shinglee Press, Singapore, pp. i-viii, 1-156, 4 colour pls.
- Ng, P. K. L., 1995. *Geosesarma aurantium*, a new sesarminae land crab (Crustacea: Decapoda: Brachyura: Grapsidae) from Sabah. *Malayan Nature Journal*, **49**: 65-70.
- Ng, P. K. L., 2002. New species of cavernicolous crabs of the genus *Sesarmoides* from the western Pacific, with a key to the genus (Crustacea: Decapoda: Brachyura: Sesarminidae). *Raffles Bulletin of Zoology*, **50**(2): 419-435.
- Ng, P. K. L. & M. Takeda, 1992. A new freshwater crab of the genus *Geosesarma* De Man, 1892, from the Philippines (Crustacea, Brachyura, Grapsidae). *Proceedings of the Systematic Society of Japan*, **47**: 29-32.
- Ng, P. K. L. & C. G. S. Tan, 1995. *Geosesarma notophorum* sp. nov. (Decapoda, Brachyura, Grapsidae, Sesarminae), a terrestrial crab from Sumatra, with novel brooding behaviour. *Crustaceana*, **68**(3): 390-395.
- Rathbun, M. J., 1914. New species of crabs of the families Grapsidae and Ocypodidae. *Proceedings of the U.S. National Museum*, **47**(2044): 69-85.
- Schubart, C. D. & J. A. Cuesta, 1998. The first zoeal stages of four *Sesarma* species from Panama, with identification keys and remarks on the American Sesarminae (Crustacea: Brachyura: Grapsidae). *Journal of Plankton Research*, **20**(1): 61-84.
- Serène, R., 1968. Note préliminaire sur de nouvelles espèces de *Sesarma* (Decapoda Brachyura). *Bulletin du Muséum d'Histoire naturelle*, Paris, (2)**39**(5): 1084-1095, pls. 1, 2.
- Serène, R. & C. L. Soh, 1970. New Indo-Pacific genera allied to *Sesarma* Say 1877 (Brachyura, Decapoda, Crustacea). *Treubia*, Bogor, **27**(4): 387-416.
- Soh, C. L., 1969. Abbreviated development of a non-marine crab, *Sesarma* (*Geosesarma*) *perracae* (Brachyura; Grapsidae) from Singapore. *Journal of Zoology*, **158**: 357-370.
- Tweedie, M. W. F., 1940. New and interesting Malaysian species of *Sesarma* and *Utica* (Crustacea Brachyura). *Bulletin of the Raffles Museum*, Singapore, **16**: 88-113, pl. 14.