

The vampire crabs of Java, with descriptions of five new species from Mount Halimun Salak National Park, West Java, Indonesia (Crustacea: Brachyura: Sesarmidae: *Geosesarma*)

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Abstract. Six species of vampire crabs, *Geosesarma noduliferum* (De Man, 1892), *G. confertum* (Ortmann, 1894), *G. rouxi* (Serène, 1968a), *G. bicolor* Ng & Davie, 1995, *G. dennerle* Ng, Schubart & Lukhaup, 2015, and *G. hagen* Ng, Schubart & Lukhaup, 2015, are known thus far from Java, Indonesia. All are endemic to the island. Surveys in and around Mount Halimun Salak National Park in West Java showed that the sesarmid crab fauna for the island is much richer, and five new species are described. The new taxa are described, figured, and compared with their closest congeners. Two poorly known species, *G. confertum* and *G. rouxi* are also re-diagnosed and figured. A key to the known species of *Geosesarma* from Java is also provided.

Key words. semiterrestrial crab, Indonesia, Java, taxonomy, new species, protected areas

INTRODUCTION

The freshwater sesarmid crab fauna of Java has been increasingly studied in recent years, and six species of *Geosesarma* De Man, 1892, and two species of *Karstarma* Davie & Ng, 2007, are now known (cf. Ng et al., 2015; Wowor & Ng, 2018). The diversity of *Geosesarma* in particular, popularly known as vampire crabs, is especially high, and some 59 species are now known from the Andamans, Thailand, Malaysia, Indonesia, Papua New Guinea, Philippines, and Taiwan (Ng, 2017). As most of these species practice direct development (i.e., their large eggs hatch into very advanced non-feeding zoeae or as juvenile crabs (cf. Ng, 1988; Ng & Tan, 1995; Soh, 1969), many *Geosesarma* species have very restricted distributions, with different species sometimes occurring just 10 km from each site (see Ng et al., 2015), compounding the challenge for taxonomists.

From West Java, three species are known at present: *G. noduliferum* (De Man, 1892) [Bogor], *G. confertum* (Ortmann, 1894) [Tjibodas or Gunung Gede], and *G. bicolor* Ng & Davie, 1995 [Ujung Kulon], with two species from Central Java: *G. dennerle* Ng, Schubart & Lukhaup, 2015

[Cilacap], and *G. hagen* Ng, Schubart & Lukhaup, 2015 [Cilacap]; and one species from East Java: *G. rouxi* (Serène, 1968a) [Poedjon].

Collections in and around Mount Halimun Salak National Park (or Taman Nasional Gunung Halimun Salak) in West Java and Banten Provinces in 2015 and 2016 as part of the Indonesia-German *INDOBIOSYS* (Indonesian Biodiversity and Information System) project resulted in a good collection of *Geosesarma* specimens. Additional collections were subsequently made in 2017. A joint study of this material and other specimens obtained from several previous surveys around Bogor and Cipanas of Banten Province by the second author showed that five species are represented, all of which are new to science. These new species, as well as the current taxa, are diagnosed, figured and compared with their closest species. A new genus and new species of gecarcinucid crab has already been described from near the summit of Mount Halimun (Ng & Wowor, 2018).

MATERIAL AND METHODS

Material examined is deposited in the Museum Zoologicum Bogoriense (MZB), Cibinong, Bogor, Indonesia; and the Zoological Reference Collection (ZRC) of the Lee Kong Chian Natural History Museum (ex-Raffles Museum of Biodiversity Research), National University of Singapore. Indonesian words use in the text are S. or Sungai for river or stream; Gunung for mountain; Ds. or Desa for village; Kp. or Kampung for hamlet. The collectors were D. Wowor, U. Nurhaman, and S. Sauri, which is written as D. Wowor et al., unless otherwise stated.

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The terminology used mostly follows that in Ng (1988) with recent changes in Davie et al. (2015). Measurements provided in millimetres are of the carapace width and length, respectively. The following abbreviations are used: m asl = metres above sea level; coll. = collected by; G1 = male first gonopod; G2 = male second gonopod. The position was obtained by using GPS (Garmin eTrex Vista C), while the elevation was acquired by the software GPS Geoplaner – GeoConverter (<https://www.geoplaner.com/>).

TAXONOMY

Family Sesarmidae Dana, 1851

Geosesarma De Man, 1892

Type species. *Sesarma* (*Geosesarma*) *nodulifera* De Man, 1892, subsequent designation by Serène & Soh (1970).

Remarks. The genus continues to grow as more areas are surveyed and new taxa discovered; with the total now standing at 59 (Ng, 2017). The number of *Geosesarma* species known from Indonesia is certain to grow, and the authors are aware of more populations, some with distinctive colours, which will need to be studied. From Java, six species are known at present: *G. noduliferum* (De Man, 1892) [Bogor, west Java], *G. confertum* (Ortmann, 1894) [Tjibodas, west Java], *G. rouxi* (Serène, 1968a) [Poedjon, east Java], *G. bicolor* Ng & Davie, 1995 [Ujung Kulon, Banten], *G. dennerle* Ng, Schubart & Lukhaup, 2015 [Cilacap, central Java], and *G. hagen* Ng, Schubart & Lukhaup, 2015 [Cilacap, central Java]. In this paper, we redescribe the first three species as well as describe five new species from forests surrounding Mount Halimun Salak National Park in West Java.

Geosesarma noduliferum (De Man, 1892)

(Figs. 1–4)

Sesarma (*Geosesarma*) *nodulifera* De Man, 1892: 342, pl. 20, fig. 16; Nobili, 1900: 512 (part).

Sesarma (*Geosesarma*) *nodulifera* – Ortmann, 1894: 56; Serène, 1968b: 106.

Sesarma (*Geosesarma*) *noduliferum* – Rathbun, 1910: 309.

Sesarma (*Sesarma*) *nodulifera* – De Man, 1902: 519; Tesch, 1917: 178.

Geosesarma noduliferum – Serène & Soh, 1970: 402, 407; Ng, 1988: 119; Ng et al., 2008: 221; Ng et al., 2015: 3, figs. 1A, B, 2A–E, 5A, B.

(not *Sesarma* (*Geosesarma*) *noduliferum* – Serène 1968a: 1094, figs. 19, 20 = *Geosesarma confertum* [Ortmann, 1892]).

Material examined. West Java Province, Bogor City: 1 male (12.0 × 11.0 mm) (MZB Cru 4888), Bogor Timur District, Ds. Tajur, coll. M. Djajasmita, 24 December 1977; 2 males (10.8 × 9.4 mm, 11.2 × 9.9 mm), 7 females (7.4 × 6.6 mm – 11.8 × 10.4 mm), 1 ovigerous female (12.0 × 10.9 mm, eggs 1.8 mm diameter) (MZB Cru 4889), Bogor Barat District, Ds. Cilendek Barat, S. Cisadane, 06°34'54.8"S 106°46'30.7"E, 202 m asl, 21 December 2017. Bogor Regency: 3 males (9.3 × 8.9 mm – 10.9 × 9.9 mm),

1 male (poorly preserved, 10.7 × 9.5 mm), 1 female (7.2 × 6.5 mm) (MZB Cru 4448), Tenjolaya District, Ds. Tapos 1, Kp. Sinar Wangi, S. Ciampea at the border of Gunung Bunder Resort, 06°40'46.6"S 106°41'39.6"E, 775 m asl, coll. D. Wowor et al., 2 October 2015; 2 males (8.5 × 7.6 mm, 9.3 × 8.9 mm), 3 females (9.9 × 8.5 mm – 10.9 × 10.4 mm) (MZB Cru 3403), Taman Sari District, Ds. Sukajadi, Kp. Gadog Sisi, S. Cihideung, 06°39'03.7"S 106°43'15.3"E, 562 m asl, coll. D. Wowor et al., 26 September 2011; 1 male (9.9 × 9.1 mm) (MZB Cru 3407), 1 male (10.9 × 10.4 mm) (ZRC 2018.0282 ex-MZB Cru 3407), Tenjolaya District, Ds. Gunung Malang, Kp. Cibitung, S. Cibitung, 06°39'01.5"S 106°43'09.3"E, 551 m asl, coll. D. Wowor et al., 27 September 2011; 2 males (10.1 × 9.2 mm, 11.3 × 10.5 mm), 2 females (8.2 × 7.2 mm, 8.3 × 7.3 mm) (MZB Cru 3014), 2 males (12.1 × 11.4 mm, 12.7 × 11.7 mm), 2 females (10.0 × 8.6 mm, 10.5 × 8.9 mm) (ZRC 2018.0283 ex-MZB Cru 3014), Megamendung District, Ds. Sukaresmi, S. Cisukabirus, 06°42'09.7"S 106°54'43.7"E, 800 m asl, coll. D. Wowor et al., 10 May 2010; 2 males (8.4 × 7.8 mm, 12.3 × 10.9 mm), 1 female (10.1 × 9.3 mm) (MZB Cru 4644), Bogor Selatan District, Ds. Katulampa 2, S. Ciliwung, 06°38'03.6"S 106°50'24.9"E, 370 m asl, coll. D. Wowor et al., 26 July 2009; 2 males (11.1 × 10.2 mm, 11.8 × 10.4 mm), 1 ovigerous female (10.9 × 10.5 mm, eggs 1.5 mm diameter) (MZB Cru 4645), Megamendung District, Ds. Sukamanah, S. Cisukabirus, 06°41'12.8"S 106°54'08.0"E, 703 m asl, coll. D. Wowor et al., 24 July 2009. Cianjur Regency: 8 males (10.5 × 9.5 mm – 14.5 × 13.5 mm), 2 females (12.3 × 11.3 mm, 12.6 × 11.4 mm) (MZB Cru 4646), 4 males (12.9 × 11.5 mm – 13.7 × 12.8 mm) (ZRC 2018.0284 ex-MZB Cru 4646), Sukaresmi District, Ds. Cibadak, Kp. Rawa Benceh, S. Ciwalen at rice field, coll. U. Komarudin, 24 July 2009; 19 males (8.0 × 7.4 mm – 13.9 × 12.2 mm), 12 females (9.4 × 8.1 mm – 12.7 × 11.7 mm), 5 ovigerous females (9.6 × 8.6 mm – 11.3 × 10.6 mm, 1 female with juveniles in pouch (11.4 × 9.9 mm) (MZB Cru 4643), Cipanas District, Ds. Sindanglaya, at vegetable garden, coll. U. Komarudin, 24 July 2009. Banten Province, Lebak Regency: 3 males (8.8 × 8.4 mm, 10.9 × 10.2 mm, 11.3 × 10.6 mm), 5 females (8.4 × 7.3 mm – 10.9 × 10.2 mm) (MZB Cru 4796), 3 males (9.6 × 8.9 mm, 10.4 × 9.5 mm, 13.3 × 12.4 mm), 2 females (9.6 × 9.3 mm, 10.9 × 9.6 mm) (ZRC 2018.0294 ex-MZB Cru 4796), Banten Province, Lebak Regency, Cipanas District, Ds. Cipanas, 06°32'54.9"S 106°23'55.7"E, 184 m asl, coll. D. Wowor, I. Rachmatika & A. Mun'im, 30 August 2005.

Revised diagnosis of male. Carapace squarish, wider than long, lateral margins gently concave, subparallel (Figs. 1A, B, 2A, C, E, 3A, B); dorsal surface with distinct regions, anterior regions with numerous small rounded granules (Figs. 1B, C, 2E, 3A, B); front deflexed, frontal lobes very broad with almost truncate margins, separated by broad median concavity; postfrontal cristae sharp (Figs. 1B, C, 2E, 3A, B); external orbital tooth triangular, directed obliquely outwards, tip reaching anterior part of lateral carapace margin, first epibranchial tooth triangular, well defined, separated from margin by distinct cleft (Figs. 1B, 2E). Ischium of third maxilliped ovate, wide; exopod relatively slender, with long flagellum that extends beyond merus width (Fig. 4A).

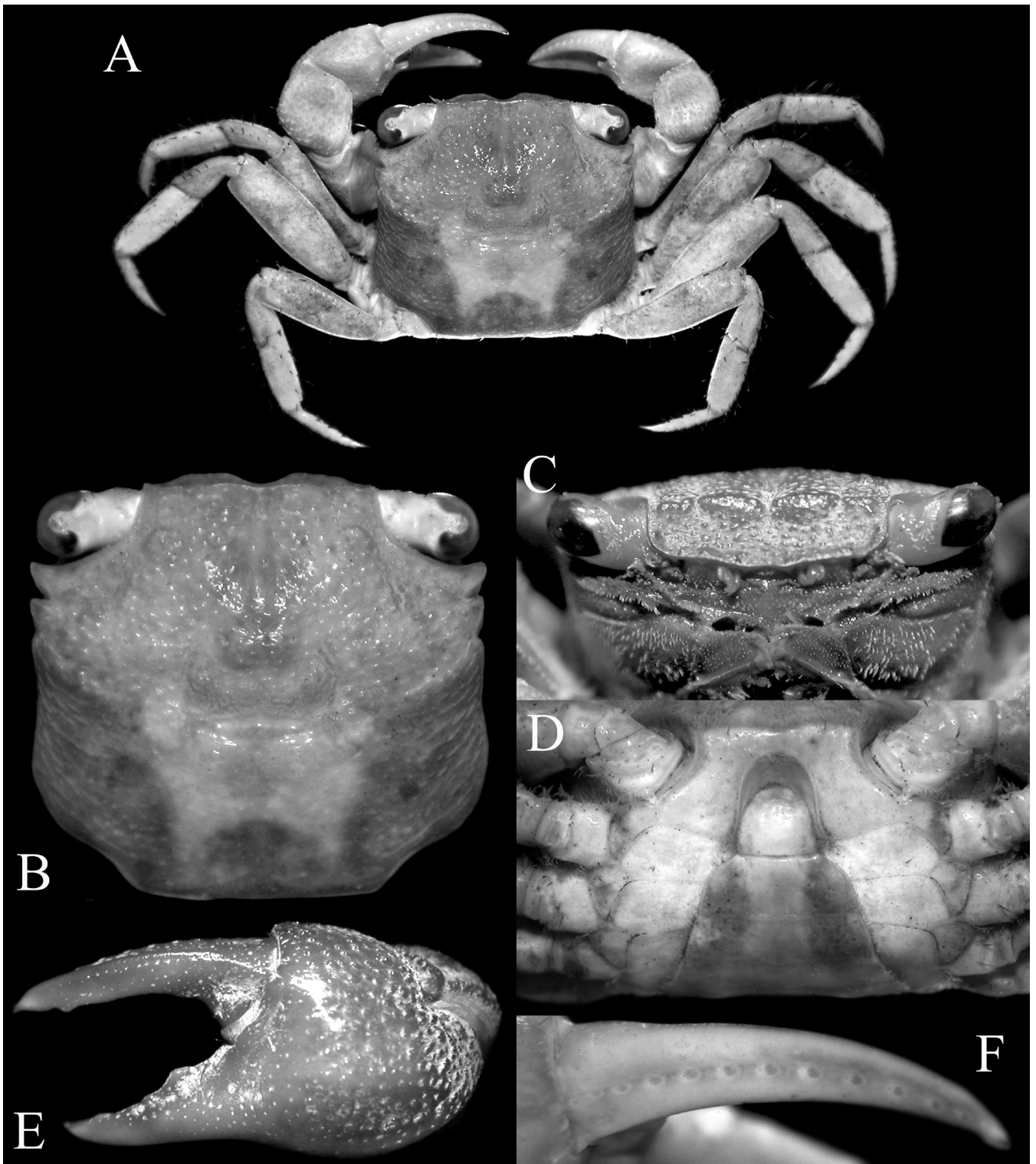


Fig. 1. *Geosesarma noduliferum* (De Man, 1892), male (10.9 × 10.4 mm) (ZRC 2018.0282). A, overall dorsal view; B, dorsal view of carapace; C, frontal view of cephalothorax; D, anterior thoracic sternum, telson and pleonal somites 4–6; E, outer view of left chela; F, dorsal view of dactylus of left chela.



Fig. 2. *Geosesarma noduliferum* (De Man, 1892). A, B, male (12.1 × 11.4 mm) (ZRC 2018.0283); C–G, male (12.7 × 11.7 mm) (ZRC 2018.0283). A, C, overall dorsal view; B, D, anterior thoracic sternum, telson and pleonal somites 4–6; E, dorsal view of carapace; F, outer view of left chela; G, dorsal view of dactylus of left chela.

Outer surface of palm of adult male chelae granulate; inner surface granulated but without prominent transverse comb-like ridge; dorsal margin of dactylus with 11–13 (usually 10 or 11) evenly spaced small tubercles (last one near tip often very small), each with chitinous tip (Figs. 1E, F, 2F, G). Ambulatory legs with relatively broad meri, with sharp subdistal spine on dorsal margin, surfaces gently rugose; ventral margins of propodus and dactylus of adult first ambulatory leg with scattered stiff setae (Figs. 1A, 2A, C,

3A, B). Male pleon triangular; telson triangular with rounded tip, slightly longer than broad; somite 6 with convex lateral margins (Figs. 1D, 2B, D, 4B, C). G1 relatively slender, subdistal part of outer margin before chitinous distal part rounded with inner dorsal section relatively slender; chitinous distal part bent about 40° along longitudinal axis, elongate, tapering, slender in lateral view, subspatuliform in mesial view; tip clefted when viewed dorsally (Figs. 4D–F, H–J, 6D–F).

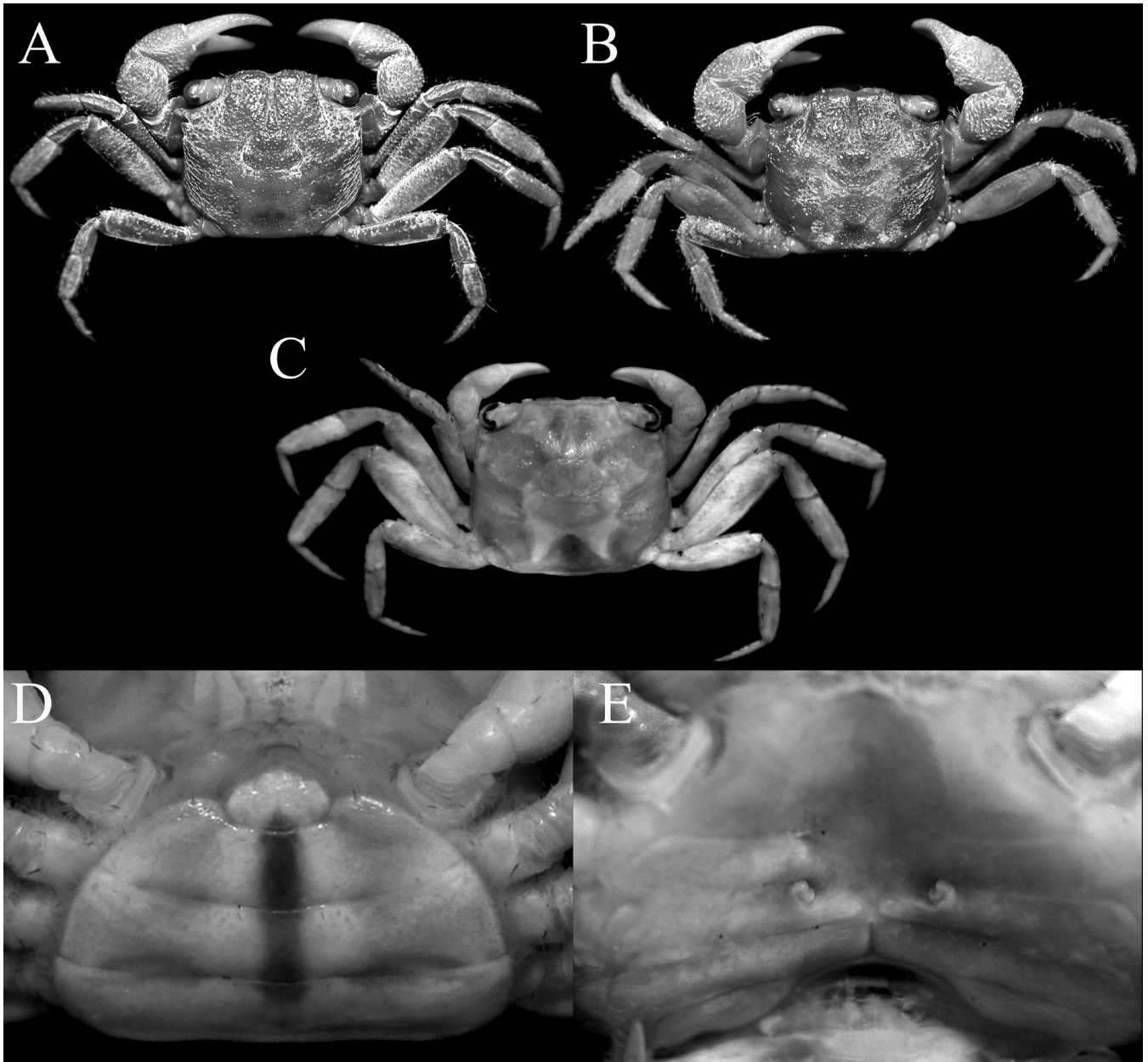


Fig. 3. *Geosesarma noduliferum* (De Man, 1892). A, male (10.9 × 10.4 mm) (ZRC 2018.0282); B, male (12.7 × 11.7 mm) (ZRC 2018.0283); C–E, female (10.5 × 8.9 mm) (ZRC 2018.0283). A–C, overall dorsal view; B, anterior thoracic sternum, telson and pleonal somites 4–6; C, sternopleonal cavity showing vulvae.

Females. The adult female carapace is relatively broader and more trapezoidal in general shape (Fig. 3C). The vulvae are on the anterior half of sternite 6, raised, directed obliquely inwards towards the median line of the sternum, the margin is indented medially and without a sternal opercular cover (Fig. 3E). The eggs of ovigerous females were between 1.8 mm (MZB Cru 4889) and 1.5 mm in diameter (MZB Cru 4645).

Remarks. Examination of the good series of specimens of *G. noduliferum* obtained by the second author from the lower slopes of Mount Salak requires a revised diagnosis for this species which is common in the habitats outside Bogor, especially in view of the new allied species recognised here (*G. lebak*, new species). The present study augments and updates the description and figures of the type by Ng et al. (2015). The form of the male pleon, notably the general

proportions and the shape of somite 6, varies to some degree. Some of the smaller specimens tend to have a slightly wider male somite 6 with the lateral margins slightly more convex (Fig. 1D) compared to larger ones (Figs. 2B, D, 4B, C); and the chitinous distal part of the G1 varies slightly in length as well (Fig. 4F, J).

See General Discussion for comparisons with allied Javan species.

Notes on habitat. It is found mainly at the side of moderate-fast current streams, under the stones nearby human settlement, rice field and tea plantation (Fig. 25A). Sometimes it can be encountered in holes at the moist wall of a river. Besides that, the species also inhabits edge of secondary forest with soft ground, in holes among dense

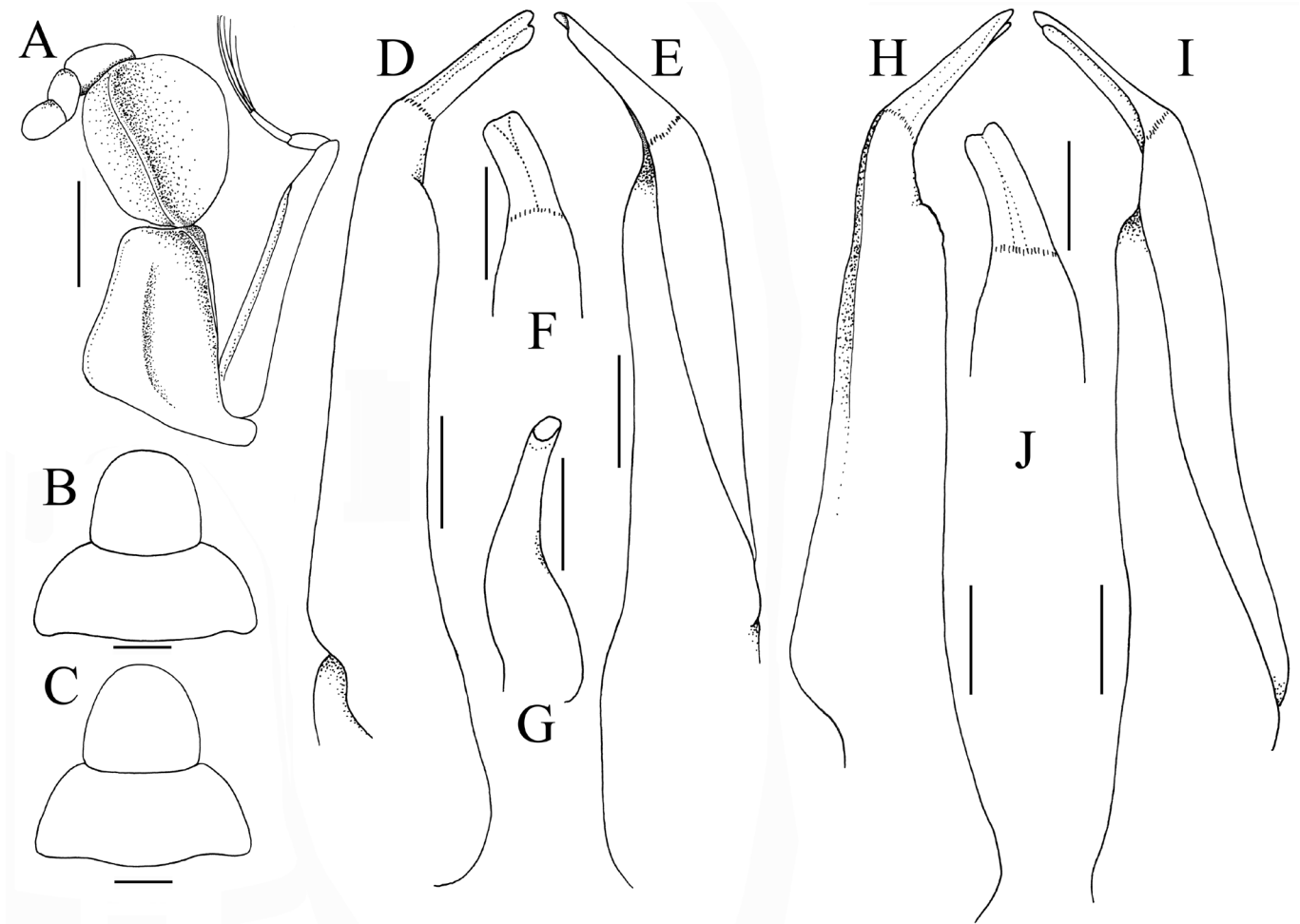


Fig. 4. *Geosesarma noduliferum* (De Man, 1892). A, D–G, male (10.9 × 10.4 mm) (ZRC 2018.0282); B, male (12.1 × 11.4 mm) (ZRC 2018.0283); C, H–J, male (12.7 × 11.7 mm) (ZRC 2018.0283). A, left third maxilliped; B, C, male pleonal somite 6 and telson; D, H, left G1 (dorsal view); E, I, left G1 (ventral view); F, J, left G1 (dorso-mesial view); G, left G2. All structures denuded. Scales: A–C = 1.0 mm; D–J = 0.5 mm.

weed. Those places are open area with very little canopy coverage. *Geosesarma noduliferum* is a middle stretch stream species live between 170 to 800 m asl.

Life colouration. The carapace is reddish dark brown to dark blue with yellow eyes and bright maroon chelae.

Distribution. Widespread in Bogor and Cianjur Regencies, West Java Province, and Lebak Regency, Banten Province.

***Geosesarma lebak*, new species**
(Figs. 5, 6A–C, 7)

Material examined. Banten Province, Lebak Regency: holotype: male (11.7 × 11.3 mm) (MZB Cru 4563), Sobang District, Ds. Majasari, S. Cimaok, ca. 06°38'35.5"S 106°22'22.0"E, 685 m asl, coll. Ibu Warung, 28 May 2016. Paratypes: 10 males (9.9 × 9.0 mm – 11.7 × 11.1 mm), 1 female (9.7 × 9.4 mm) 1 female (damaged, 10.9 mm carapace width) (MZB Cru 4648), 2 males (11.0 × 10.7 mm, 11.2 × 10.8 mm) (ZRC 2018.0285 ex-MZB Cru 4648), data same as holotype; 7 males (7.6 × 7.0 mm – 11.3 × 10.5 mm), 6 females (8.6 × 7.6 mm – 12.9 × 11.5 mm), 2 juveniles (MZB Cru 4553), Sobang District, Ds. Majasari, Kp. Maja,

S. Cimaja, 06°39'15.7"S 106°21'43.7"E, 536 m asl, coll. D. Wowor et al., 26 May 2016; 6 males (8.2 × 7.4 mm – 11.7 × 11.1 mm), 5 females (7.9 × 7.0 mm – 11.2 × 10.3 mm) (MZB Cru 4551), 1 male (10.8 × 9.6 mm), 2 females (11.8 × 10.4 mm, 12.2 × 10.6 mm) (ZRC 2018.0286 ex-MZB Cru 4551), Sobang District, Ds. Majasari, Kp. Majaharja, S. Cigehong, a small tributary at the back of Jaro M. Yunus (head of village) home, 06°39'07.4"S 106°22'05.5"E, 588 m asl, coll. D. Wowor et al., 28 May 2016.

Diagnosis of male. Carapace squarish, wider than long, lateral margins gently concave, subparallel (Fig. 5A, B); dorsal surface with distinct regions, anterior regions with numerous small rounded granules (Fig. 5B, C); front deflexed, frontal lobes very broad with almost truncate margins, separated by broad median concavity; postfrontal cristae sharp (Fig. 5B, C); external orbital tooth triangular, directed obliquely outwards, tip slightly extending beyond anterior part of lateral carapace margin, first epibranchial tooth triangular, well defined, separated from margin by distinct cleft (Fig. 5B). Ischium of third maxilliped ovate, wide; exopod relatively slender, with long flagellum that extends beyond merus width (Fig. 7A). Outer surface of palm of adult male chelae granulate; inner surface granulated but without distinct transverse comb-

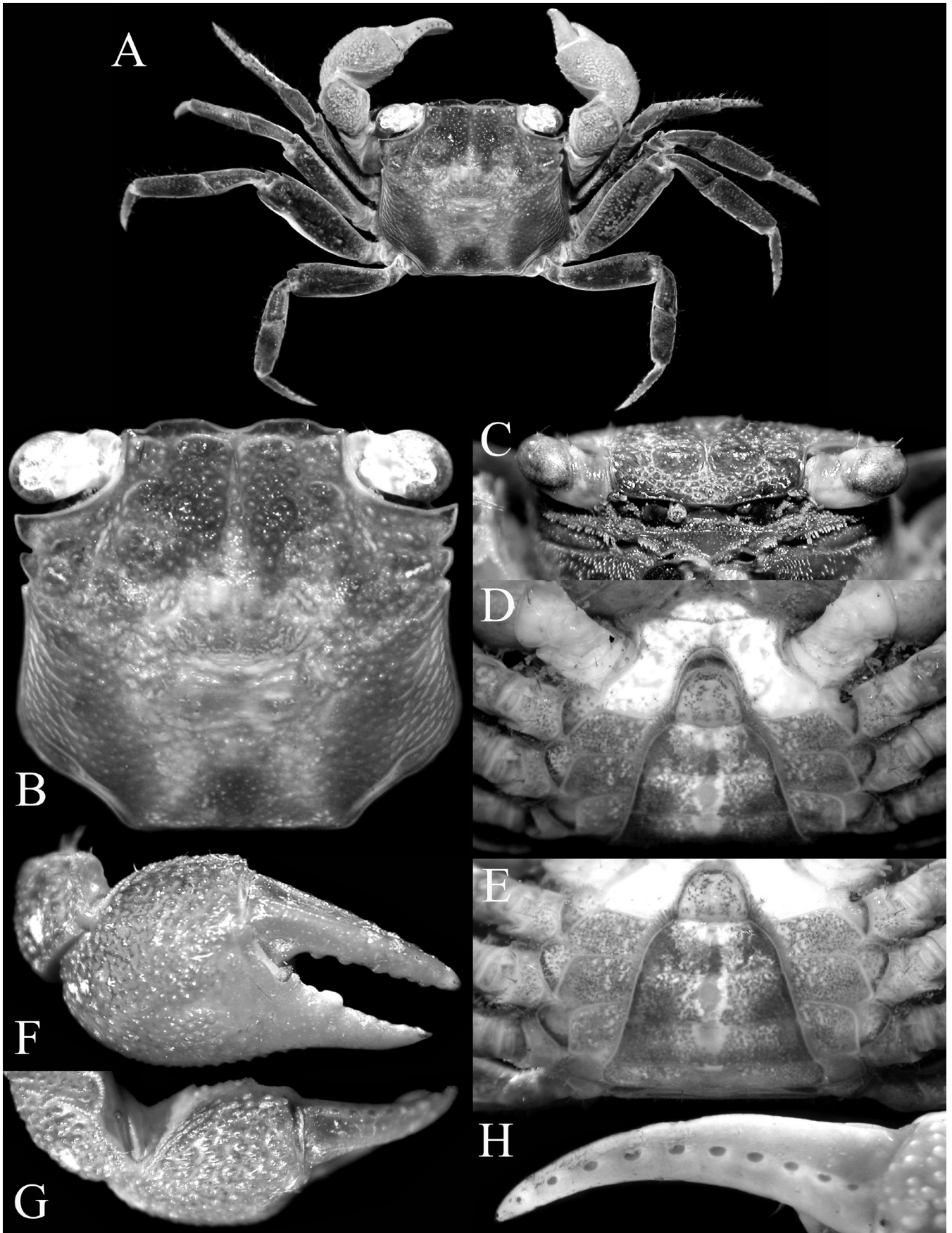


Fig. 5. *Geosesarma lebak*, new species, holotype male (11.7 × 11.3 mm) (MZB Cru 4563). A, overall dorsal view; B, dorsal view of carapace; C, frontal view of cephalothorax; D, anterior thoracic sternum, telson and pleonal somites 4–6; E, thoracic sternum, telson and pleonal somites 3–6; F, outer view of right chela; G, dorsal view of right chela; H, dorsal view of dactylus of right chela.

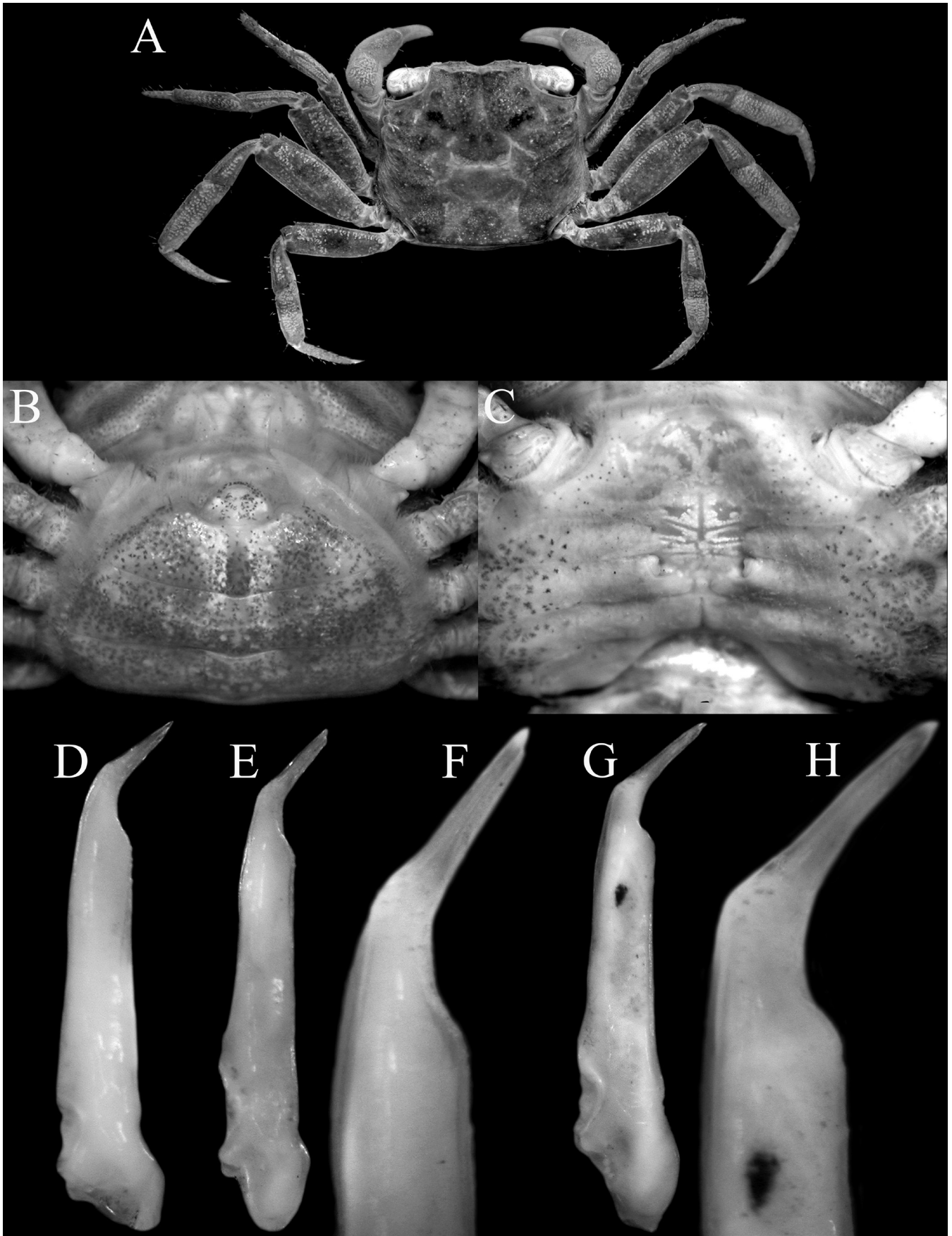


Fig. 6. A–C, *Geosesarma lebak*, new species, paratype female (12.2 × 10.6 mm) (ZRC 2018.0286); D, *G. noduliferum* (De Man, 1892), male (11.3 × 10.6 mm) (MZB Cru 4796); E, F, *G. noduliferum* (De Man, 1892), male (10.9 × 10.2 mm) (MZB Cru 4796); G, H, *G. lebak*, new species, paratype male (11.2 × 10.8 mm) (ZRC 2018.0285). A, overall dorsal view; B, anterior thoracic sternum, telson and pleonal somites 4–6; C, sternopleonal cavity showing vulvae; D, E, G, left G1 (dorsal view); F, H, distal part of left G1 (dorsal view).

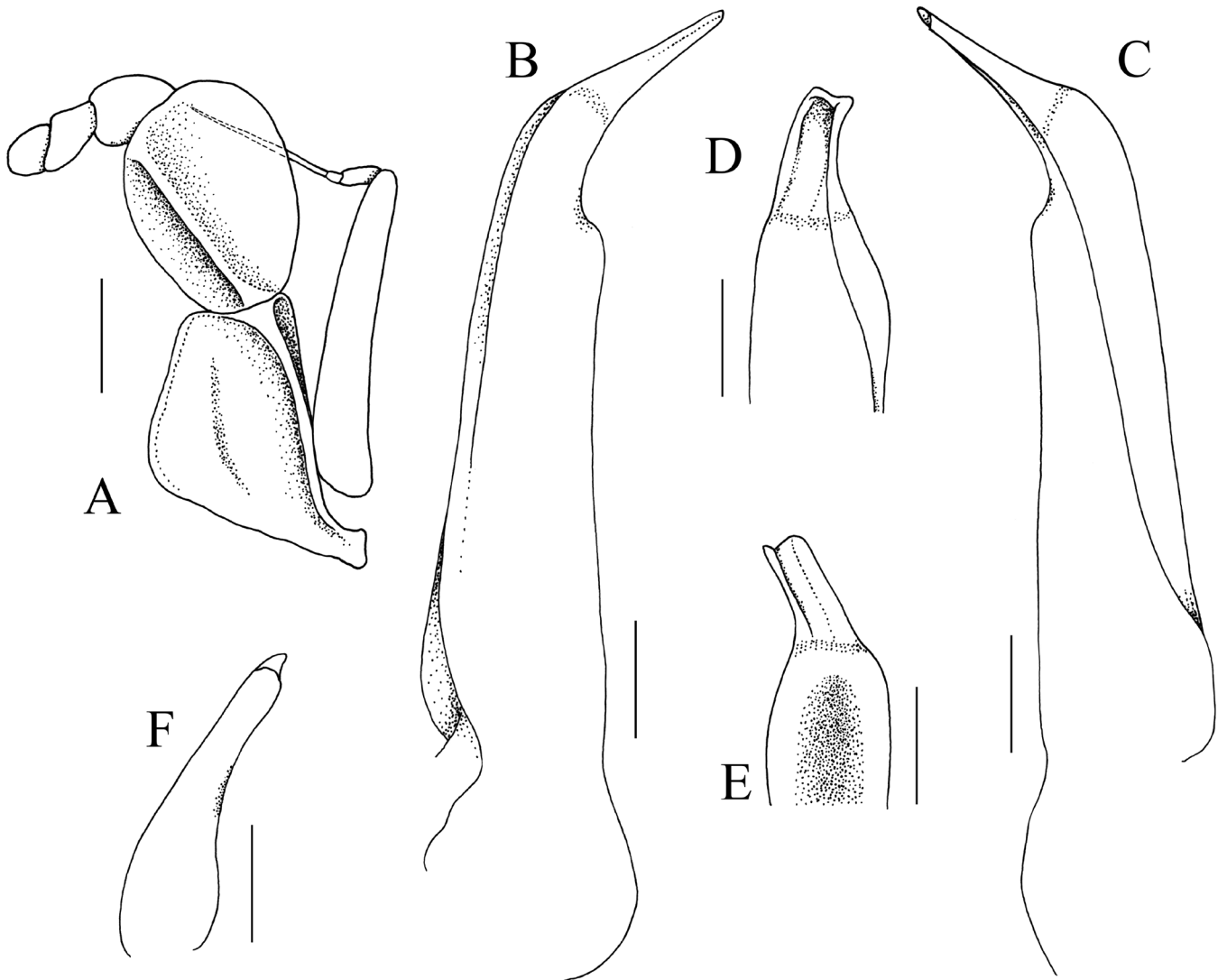


Fig. 7. *Geosesarma lebak*, new species, holotype male (11.7 × 11.3 mm) (MZB Cru 4563). A, left third maxilliped; B, left G1 (dorsal view); C, left G1 (ventral view); D, left G1 (ventro-mesial view); E, left G1 (dorso-mesial view); F, left G2. All structures denuded. Scales: A = 1.0 mm; B–F = 0.5 mm.

like ridge; dorsal margin of dactylus with 10 or 11 evenly spaced small tubercles (last one near tip may be very small), each with chitinous tip (Fig. 5F–H). Ambulatory legs with relatively broad meri, with sharp subdistal spine on dorsal margin, surfaces gently rugose; ventral margins of propodus and dactylus of adult first ambulatory leg with scattered stiff setae (Fig. 5A). Male pleon triangular; telson triangular with rounded tip, longer than broad; somite 6 with convex lateral margins (Fig. 5D, E). G1 relatively slender, subdistal part of outer margin before chitinous distal part angular with inner dorsal section strongly developed; chitinous distal part bent about 45° along longitudinal axis, elongate, tapering, slender in lateral view, subspatuliform in mesial view; tip clefted when viewed dorsally (Figs. 6G, H, 7B–E).

Females. The adult female carapace is slightly broader and more trapezoidal in form (Fig. 6A). The vulvae are on the anterior half of sternite 6, raised, directed obliquely inwards towards the median line of the sternum, the margin is indented medially and without a sternal opercular cover (Fig. 6C).

Etymology. The species is named after the locality where the holotype of the new species was found. The name is used as a noun in apposition.

Remarks. See General Discussion for comparisons with allied Javan species.

Notes on habitat. This species inhabits side of slow-moderate current streams, under the cobbles nearby human settlement and rice field. It can be also found under the cobbles of dried tributaries but with the substrate still moist (Fig. 25B). The habitat is open area with little canopy coverage. *Geosesarma lebak*, new species, lives between 500 to 700 m asl.

Life colouration. It has reddish dark brown carapace, yellow eyes and bright red chelae (Fig. 26A).

Distribution. Lebak Regency in Banten Province, in Gunung Bongkok Resort of Mount Halimun Salak National Park.

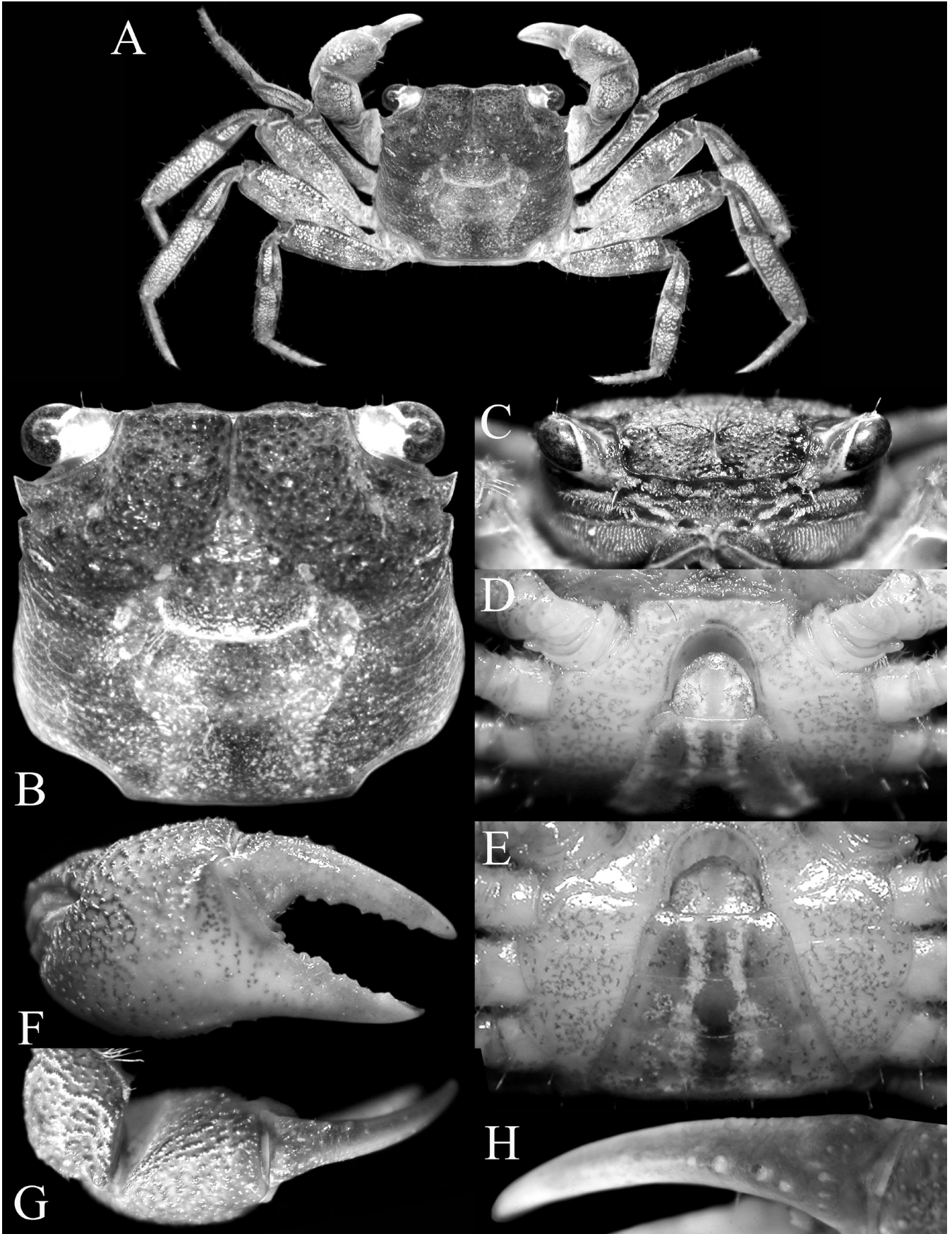


Fig. 8. *Geosesarma sukabumi*, new species, holotype male (11.5 × 10.3 mm) (MZB Cru 4555). A, overall dorsal view; B, dorsal view of carapace; C, frontal view of cephalothorax; D, anterior thoracic sternum, telson and pleonal somites 5 and 6; E, anterior thoracic sternum, telson and pleonal somites 3–6; F, outer view of right chela; G, dorsal view of right chela; H, dorsal view of dactylus of right chela.



Fig. 9. *Geosesarma sukabumi*, new species, paratype female (10.3 × 9.2 mm) (MZB Cru 4647). A, overall dorsal view; B, anterior thoracic sternum, telson and pleonal somites 4–6; C, sternopleonal cavity showing vulvae.

***Geosesarma sukabumi*, new species**
(Figs. 8–10)

Material examined. West Java Province, Sukabumi Regency: holotype: male (11.5 × 10.3 mm) (MZB Cru 4555), Cikakak District, Ds. Cirendang, Kp. Paniisan, cliff nearby S. Cirendang, 06°53'57.0"S 106°33'11.1"E, 587 m asl, coll. D. Wowor et al., 18 May 2016. Paratypes: 13 males (6.3 × 5.5 mm – 10.5 × 9.1 mm), 8 females (5.2 × 4.7 mm – 10.4 × 9.9 mm), 2 juveniles (MZB Cru 4647), 1 male (10.3 × 9.0 mm), 1 female (9.2 × 8.0 mm) (ZRC 2018.0287 ex-MZB Cru 4647), same data as holotype.

Diagnosis of male. Carapace subquadrate, slightly wider than long, lateral margins sinuous, gently divergent (Fig. 8A, B); dorsal surface with clear regions, anterior regions with numerous small rounded granules (Fig. 8B, C); front deflexed, frontal lobes broad with convex margins, separated by broad, shallow median concavity; postfrontal cristae sharp (Fig. 8B, C); external orbital tooth triangular, directed obliquely outwards, tip extending slightly beyond anterior part

of lateral carapace margin, first epibranchial tooth truncate, well defined, separated from margin by small cleft (Fig. 8B). Ischium of third maxilliped ovate; exopod relatively slender, with long flagellum that extends just beyond merus width (Fig. 10A). Outer surface of palm of adult male chelae with low granules and rugae; inner surface granulated but without transverse comb-like ridge; dorsal margin of dactylus with 3 or 4 distinct large tubercles on proximal third, each with chitinous tip (Fig. 8F–H). Ambulatory legs with relatively broad meri, with sharp subdistal spine on dorsal margin, surfaces rugose; ventral margins of propodus and dactylus of adult first ambulatory leg with dense comb-like setae. Male pleon triangular; telson triangular with rounded tip, as long as broad; somite 6 wide, with convex lateral margins (Fig. 8D, E). G1 relatively stout, subdistal part of outer margin before chitinous distal part gently curved with inner dorsal section strongly developed; chitinous distal part bent about 80° along longitudinal axis, tapering, relatively slender in lateral view, spatuliform in mesial view; tip rounded when viewed dorsally (Fig. 10B–E).

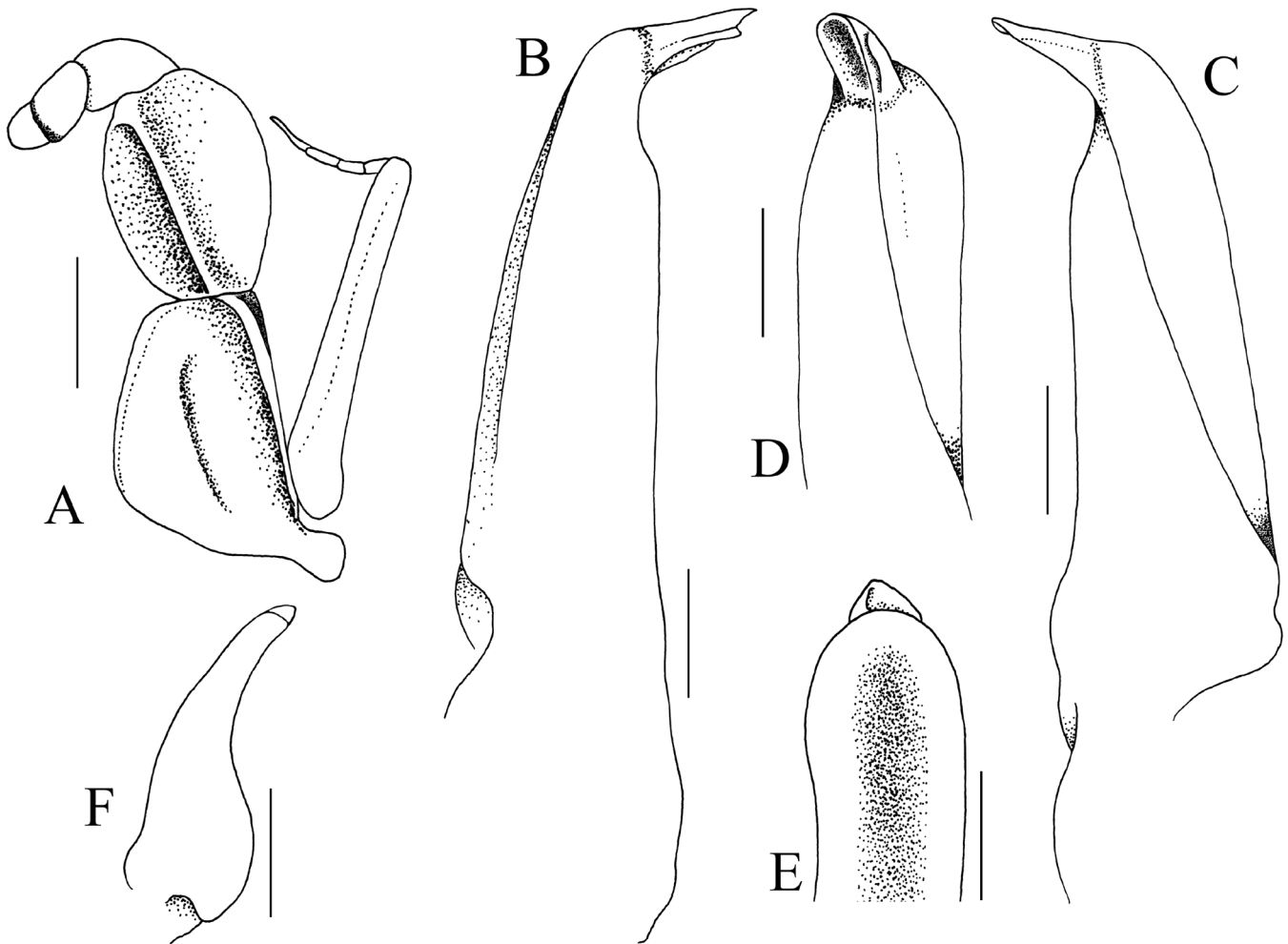


Fig. 10. *Geosesarma sukabumi*, new species, holotype male (11.5 × 10.3 mm) (MZB Cru 4555). A, left third maxilliped; B, left G1 (dorsal view); C, left G1 (ventral view); D, left G1 (ventro-mesial view); E, left G1 (dorso-mesial view); F, left G2. All structures denuded. Scales: A = 1.0 mm; B–F = 0.5 mm.

Females. The adult female carapace is more trapezoidal in form (Fig. 9A). The vulvae are on the anterior half of sternite 6, slightly raised, directed obliquely inwards towards the median line of the sternum, the margin is indented medially and without a sternal opercular cover (Fig. 9C).

Etymology. The species is named after the region where it was found, Sukabumi Regency. The name is used as a noun in apposition.

Remarks. See General Discussion for comparisons with allied Javan species.

Notes on habitat. The species was found under wet leaf litter, with water seeping from the base of a cliff, not far from a stream at the edge of a small hamlet. The ground is a mixture of gravel and coarse sand. The habitat is about 12.6 m above the stream, shadowed by trees grow on the cliff at around 580 m asl (Fig. 25C).

Life colouration. The carapace and chelae are dark brown with black eyes.

Distribution. Sukabumi Regency in West Java Province, in Gunung Koneng Resort of Mount Halimun Salak National Park.

***Geosesarma robustum*, new species**
(Figs. 11, 12)

Material examined. West Java Province, Bogor Regency: holotype: male (9.6 × 9.2 mm) (MZB Cru 4452), Tenjolaya District, Ds. Tapos 1, Kp. Sinar Wangi, near dam at headwaters of S. Ciampea, in middle of primary forest, 06°41'36.0"S 106°42'23.7"E, 1,032 m asl, coll. D. Wowor et al., 2 October 2015.

Diagnosis of male. Carapace quadrate, slightly wider than long, lateral margins almost straight, slightly divergent (Fig. 11A, B); dorsal surface with clear regions, anterior regions with numerous small granules (Fig. 11B, C); front deflexed, frontal lobes broad with gently convex margins, separated by shallow median concavity; postfrontal cristae sharp (Fig. 11B, C); external orbital tooth triangular, directed obliquely outwards, tip extending just beyond anterior part of lateral carapace margin, first epibranchial tooth truncate, barely separated from margin by small cleft (Fig. 11B). Ischium of third maxilliped ovate; exopod relatively slender, with

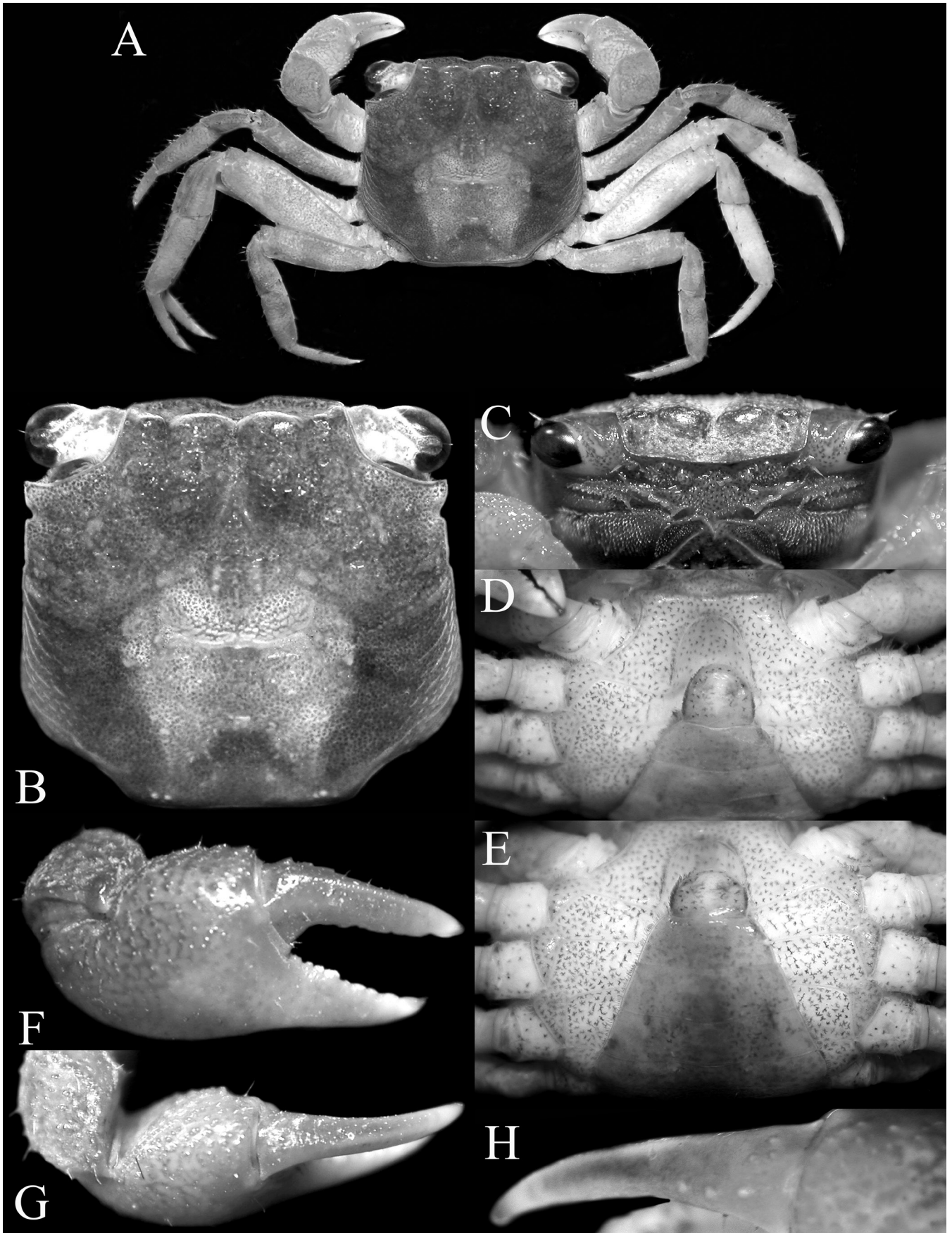


Fig. 11. *Geosesarma robustum*, new species, holotype male (9.6 × 9.2 mm) (MZB Cru 4452). A, overall dorsal view; B, dorsal view of carapace; C, frontal view of cephalothorax; D, anterior thoracic sternum, telson and pleonal somites 5 and 6; E, anterior thoracic sternum, telson and pleonal somites 3–6; F, outer view of right chela; G, dorsal view of right chela; H, dorsal view of dactylus of right chela.

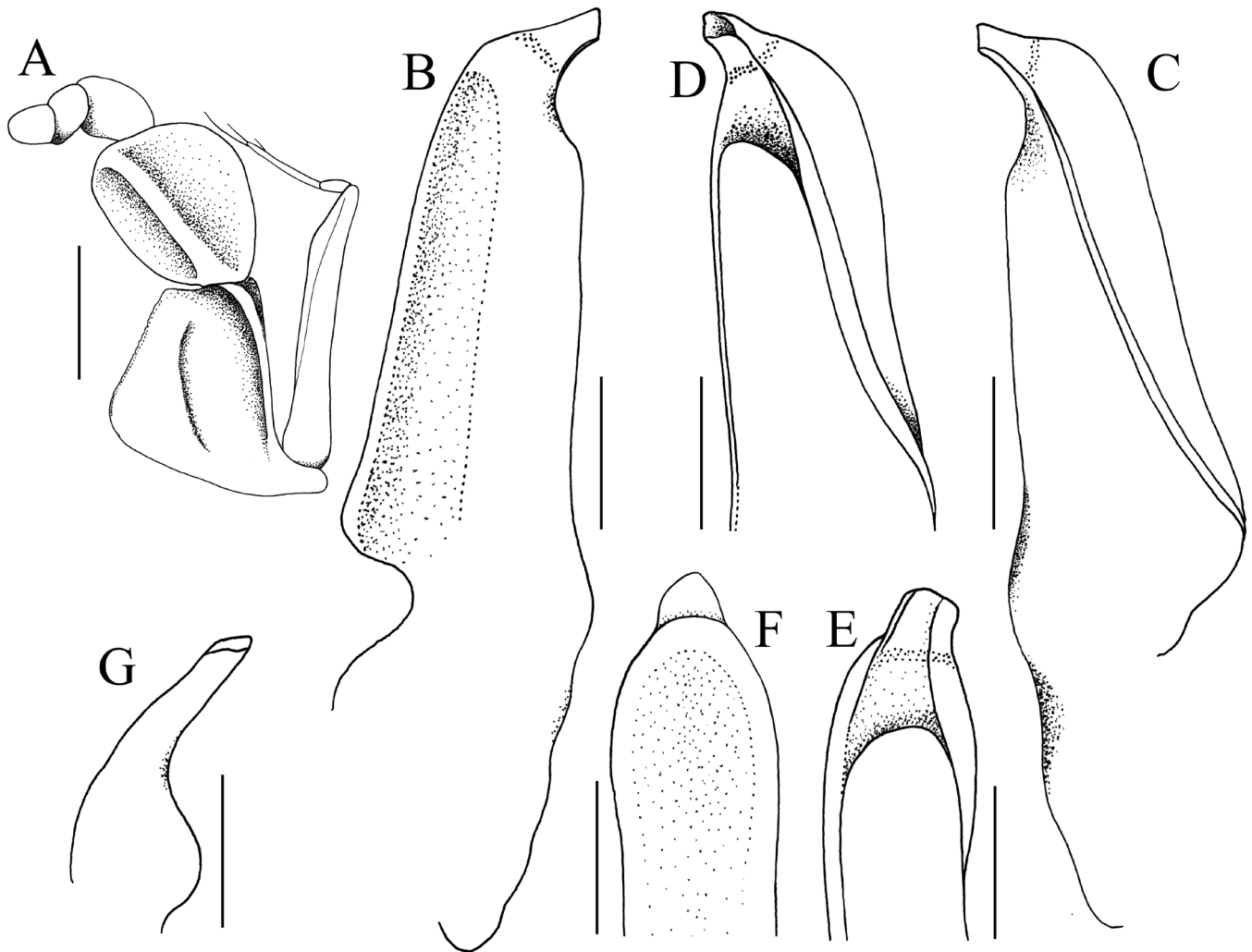


Fig. 12. *Geosesarma robustum*, new species, holotype male (9.6 × 9.2 mm) (MZB Cru 4452). A, left third maxilliped; B, left G1 (dorsal view); C, left G1 (ventral view); D, E, left G1 (ventro-mesial view); F, left G1 (dorso-mesial view); G, left G2. All structures denuded. Scales: A = 1.0 mm; B–G = 0.5 mm.

long flagellum that extends just beyond merus width (Fig. 12A). Outer surface of palm of adult male chelae with low granules; inner surface granulated but without transverse comb-like ridge; dorsal margin of dactylus with 3 distinct large tubercles on proximal third, each with chitinous tip (Fig. 11F–H). Ambulatory legs with relatively broad meri, with sharp subdistal spine on dorsal margin, surfaces rugose; ventral margins of propodus and dactylus of adult first ambulatory leg with dense comb-like setae. Male pleon triangular; telson triangular with rounded tip, as long as broad; somite 6 trapezoidal, with gently convex to almost straight lateral margins (Fig. 11D, E). G1 very stout, short, subdistal part of outer margin before chitinous distal part gently angular with inner dorsal section strongly developed; chitinous distal part bent about 45° along longitudinal axis, short, truncate in lateral view, spatuliform in mesial view; tip truncate when viewed dorsally (Fig. 12B–F).

Females. Not known.

Etymology. The name alludes to the stout structure of the G1.

Remarks. See General Discussion for comparisons with allied Javan species.

Notes on habitat. It was found at the side of head water stream, under cobbles of 10 to 20 m diameter with a bit of water (Fig. 25D). It is in an open area far from human settlement, surrounded by forest. It is a highland species that lives above 1,000 m asl.

Life colouration. The carapace is purplish dark brown with black eyes and dark brown chelae.

Distribution. Bogor Regency in Jawa Barat Province, in Gunung Bunder Resort of Mount Halimun Salak National Park.

***Geosesarma confertum* (Ortmann, 1894)**
(Figs. 13–15)

Sesarma (*Geosesarma*) sp. De Man, 1892: 345.

Sesarma (*Geosesarma*) *nodulifera* var. *conferta* Ortmann, 1894: 56.

Sesarma (*Geosesarma*) *noduliferum* – Serène, 1968a: 1093, text figs. 19, 20.

Sesarma (*Geosesarma*) *noduliferum confertum* – Serène, 1968b: 106.

Geosesarma confertum – Ng et al., 2008: 220; Ng et al., 2015: 6, fig. 1E, F.

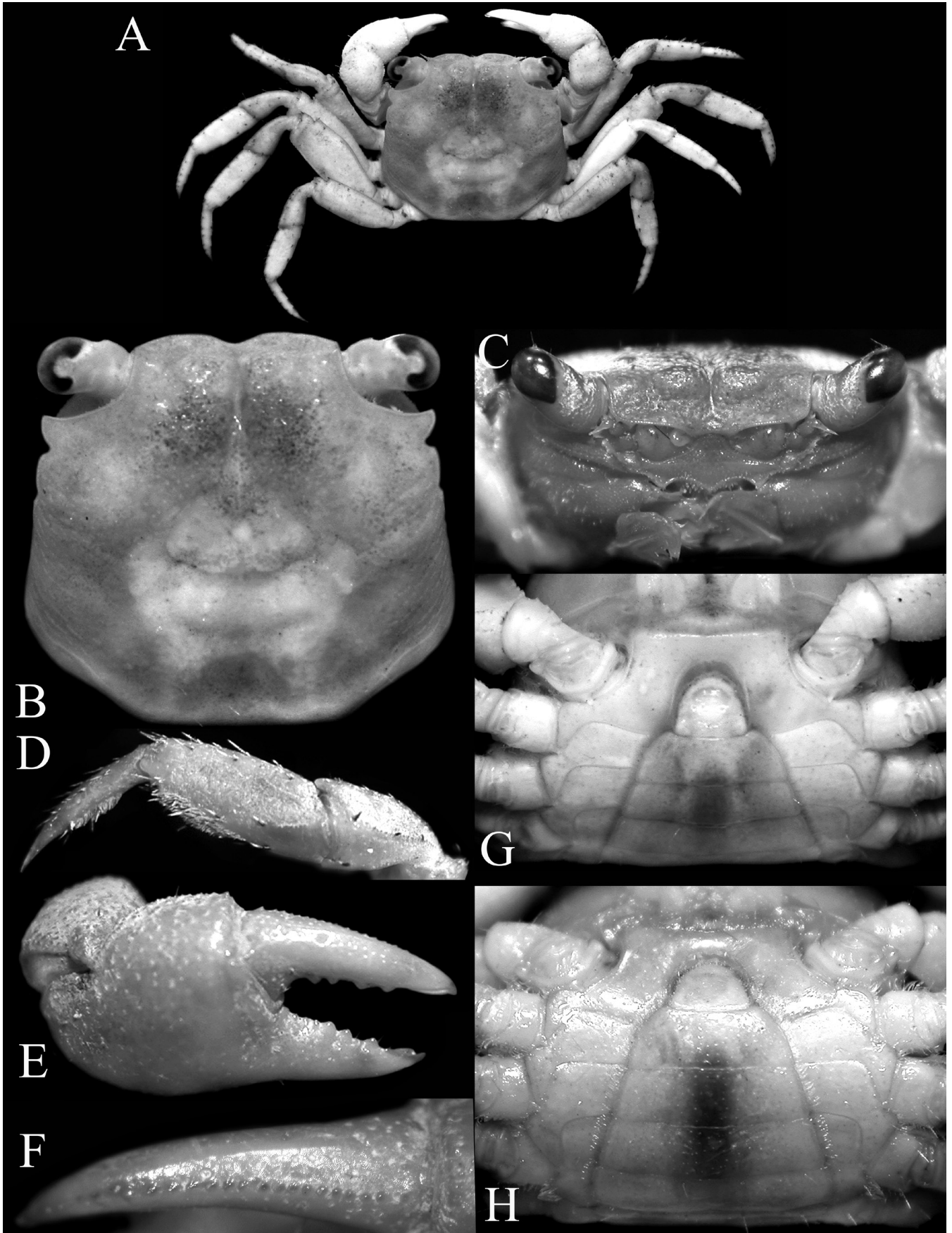


Fig. 13. *Geosesarma confertum* (Ortmann, 1894), male (9.3 × 8.6 mm) (MZB Cru 4797). A, overall dorsal view; B, dorsal view of carapace; C, frontal view of cephalothorax; D, propodus and dactylus of left first ambulatory leg; E, outer view of right chela; F, dorsal view of dactylus right chela; G, anterior thoracic sternum, telson and pleonal somites 4–6; H, posterior thoracic sternum and pleonal somites 2–6.

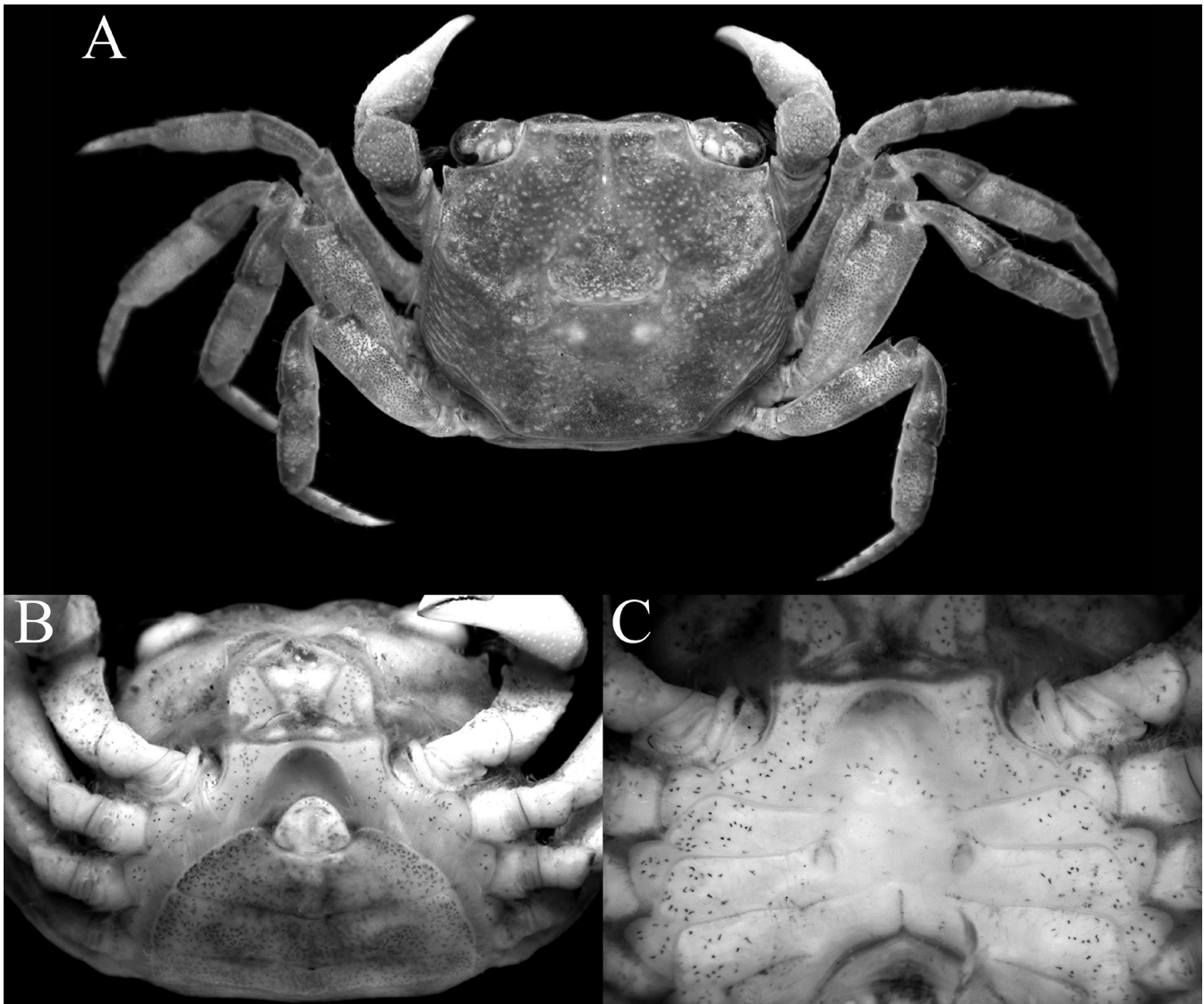


Fig. 14. *Geosesarma confertum* (Ortmann, 1894), female (11.5 × 10.0 mm) (MZB Cru 4797). A, overall dorsal view; B, anterior thoracic sternum, telson and pleonal somites 4–6; C, sternopleonal cavity showing vulvae.

Material examined. West Java Province, Cianjur Regency: 2 males (9.4 × 8.5 mm, 10.7 × 9.7 mm) (ZRC 1970.3.7.11–12), Tjibodas (= Cibodas or Gunung Gede), west Java, don. Museum Zoologicum Bogoriense, 1960s; 5 juveniles, 20 males (6.9 × 6.6 mm – 9.8 × 9.0 mm), 21 females (8.3 × 7.3 mm – 11.5 × 10.0 mm), 5 ovigerous females (9.9 × 8.9 – 10.1 × 8.9 mm) (MZB Cru 4797), 2 males (9.0 × 8.2 mm, 11.1 × 10.9 mm), 1 female (10.5 × 9.6 mm) (ZRC 2018.0292 ex-MZB Cru 4797), among watercress, at nursery, on edge of cliff, near Cibogo Waterfall, Kebun Raya Cibodas (= Cibodas Botanical Garden), 06°44'16.0"S 107°00'38.3"E, 1,286 m asl, Ds. Sindanglaya, Cipanas District, coll. D. Wowor & U. Nurhaman, 29 Mar 2011; 1 male (11.9 × 11.1 mm, badly damaged) (MZB Cru 4798), S. Cibogo, walled stream with slow-moderate flow with rock and gravel substrate, canopy coverage 90%, pH 6.0, Kebun Raya Cibodas (= Cibodas Botanical Garden), 06°44'18.7"S 107°00'33.7"E, 1,303 m asl, Ds. Sindanglaya, Cipanas District, coll. D. Wowor et al., 22 July 2009; 1 male (9.6 × 9.0 mm), 2 females (8.8 × 7.7 mm, 13.1 × 10.9 mm), 1 ovigerous female (10.2 × 9.4 mm, eggs 1.2 mm diameter) (MZB Cru 4799), 1 male (9.8

× 9.0 mm) (ZRC 2018.0293 ex-MZB Cru 4799), in grass-covered holes at water edge, small gutter, near pond, not far from entrance gate, Kebun Raya Cibodas (= Cibodas Botanical Garden), Ds. Sindanglaya, Cipanas District, coll. D. Wowor et al., 23 July 2009; 18 males (7.9 × 7.4 mm – 10.6 × 9.6 mm), 14 females (7.8 × 7.3 mm – 11.3 × 10.1 mm), 1 ovigerous female (10.3 × 9.3 mm, eggs 1.3 mm diameter), 8 juveniles (MZB Cru 4961), on cliff covered with wet moss, Kebun Raya Cibodas (= Cibodas Botanical Garden), Ds. Sindanglaya, Cipanas District, coll. S. Klaus, P. Koller & D. Wowor, 31 March 2006.

Diagnosis of male. Carapace subquadrate, wider than long, lateral margins gently sinuous, divergent (Figs. 13A, B); dorsal surface with regions, anterior regions with very small granules (Fig. 13B, C); front deflexed, frontal lobes broad with convex margins, separated by shallow median concavity; postfrontal cristae relatively sharp (Fig. 13B, C); external orbital tooth triangular, directed obliquely outwards, tip just reaching or extending slightly beyond anterior part of lateral carapace margin, first epibranchial tooth subtruncate,

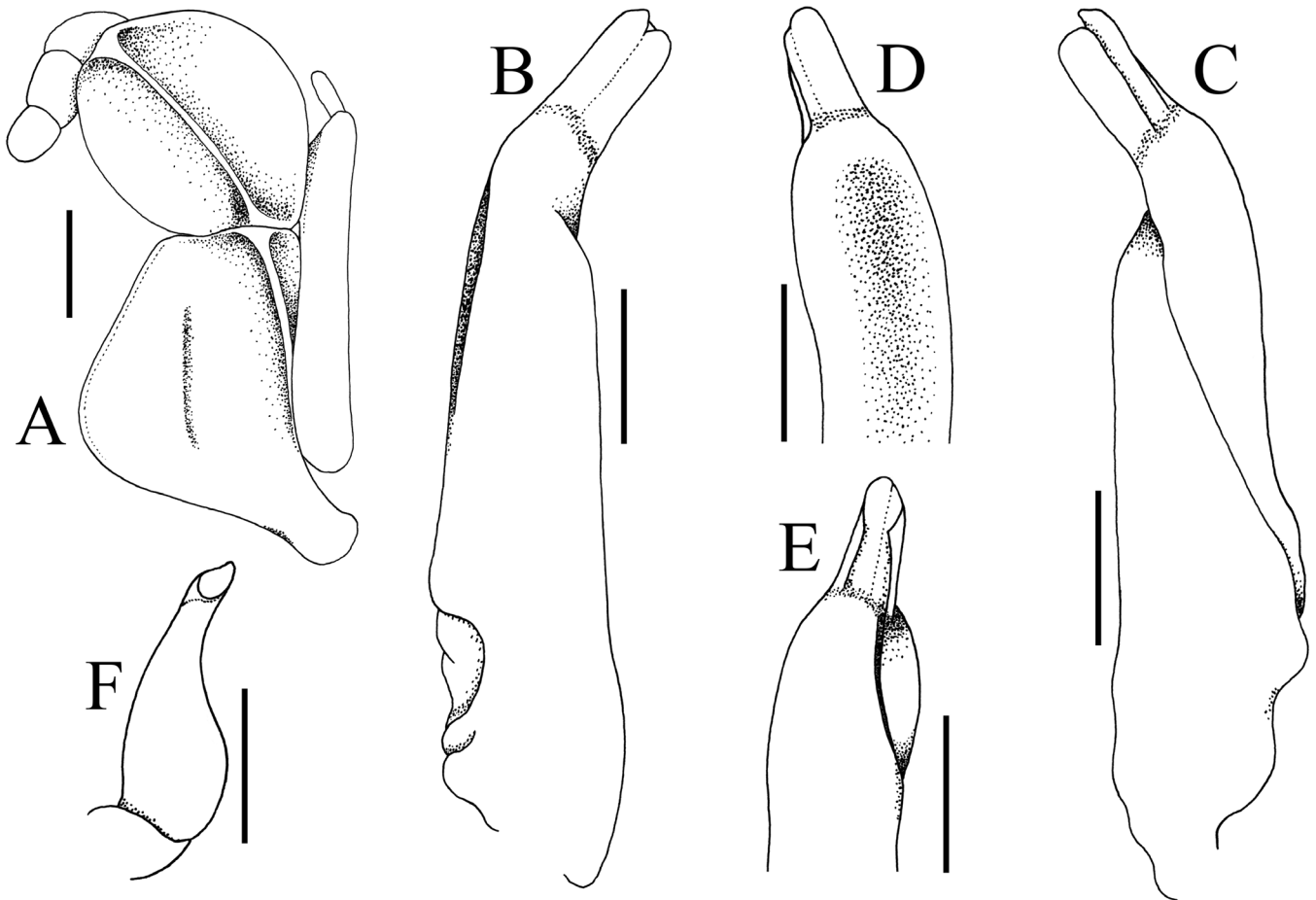


Fig. 15. *Geosesarma confertum* (Ortmann, 1894), male (9.3 × 8.6 mm) (MZB Cru 4797). A, left third maxilliped (distal part of flagellum broken off); B, left G1 (dorsal view); C, left G1 (ventral view); D, left G1 (dorso-mesial view); E, left G1 (ventro-mesial view); F, left G2. All structures denuded. Scales = 0.5 mm.

separated from margin by small cleft (Fig. 13B). Ischium of third maxilliped short, ovate, wide; exopod relatively slender, with long flagellum that extends just beyond merus width (Fig. 15A). Outer surface of palm of adult male chelae with scattered low granules; inner surface granulated but without transverse comb-like ridge; dorsal margin of dactylus with 16–19 small tubercles, each with chitinous tip along length (Figs. 13E, F). Ambulatory legs with relatively broader, shorter meri, with sharp subdistal spine on dorsal margin, surfaces rugose; ventral margins of propodus and dactylus of adult first ambulatory leg with dense comb-like setae (Figs. 13D). Male pleon triangular; telson triangular with rounded tip, slightly wider than long; somite 6 with convex lateral margins (Figs. 13G, H). G1 relatively slender, short, gently curved, subdistal part of outer margin before chitinous distal part with low convexity, inner dorsal section strongly developed; chitinous distal part bent about 40° along longitudinal axis, relatively long, spatulate in lateral view, subcylindrical in mesial view; tip subtruncate when viewed dorsally (Fig. 15B–E).

Females. The adult female carapace is more trapezoidal in form (Fig. 14A). The vulvae are without a sternal opercular cover, ovate and are level with the surface of the anterior half of sternite 6, and relatively widely separated (Fig. 14C). The egg diameter of ovigerous females is 1.2 mm (MZB Cru 4799).

Remarks. De Man (1892: 345) recorded several small specimens from “Tjipanas” and Tjibodas from Java as “*Sesarma (Geosesarma) sp.*”, noting that it was possibly *G. noduliferum* except that the dactylus of the male has more and closely packed tubercles. Ortmann (1894: 56) had more material from the same area, observed the same differences with *G. noduliferum* s. str. and decided to recognise a new variety, *G. noduliferum confertum*, for this material (see review in Ng et al., 2015: 6). There is a town called Tjipanas (= Cipanas) further to the west in Lebak Regency, but the “Tjipanas” cited by De Man (1892) almost certainly refers to the district of Tjipanas (= Cipanas District) which includes the highlands of Tjibodas on the slopes of Mount Gede.

See General Discussion for comparisons with allied Javan species.

Notes on habitat. It is found in holes at the edge of water of small gutter and among roots of watercress in wetland. The water is clear with a slow-moderate current. The habitat is also shadowed by trees. Sometimes it is also occurs under wet moss on cliff sides. *Geosesarma confertum* is a highland species, occurring above 1,280 m asl.

Life colouration. The carapace is dark brown with black eyes. The chelae are yellowish brown and the ambulatory legs are with dark brown and yellowish-brown stripes.

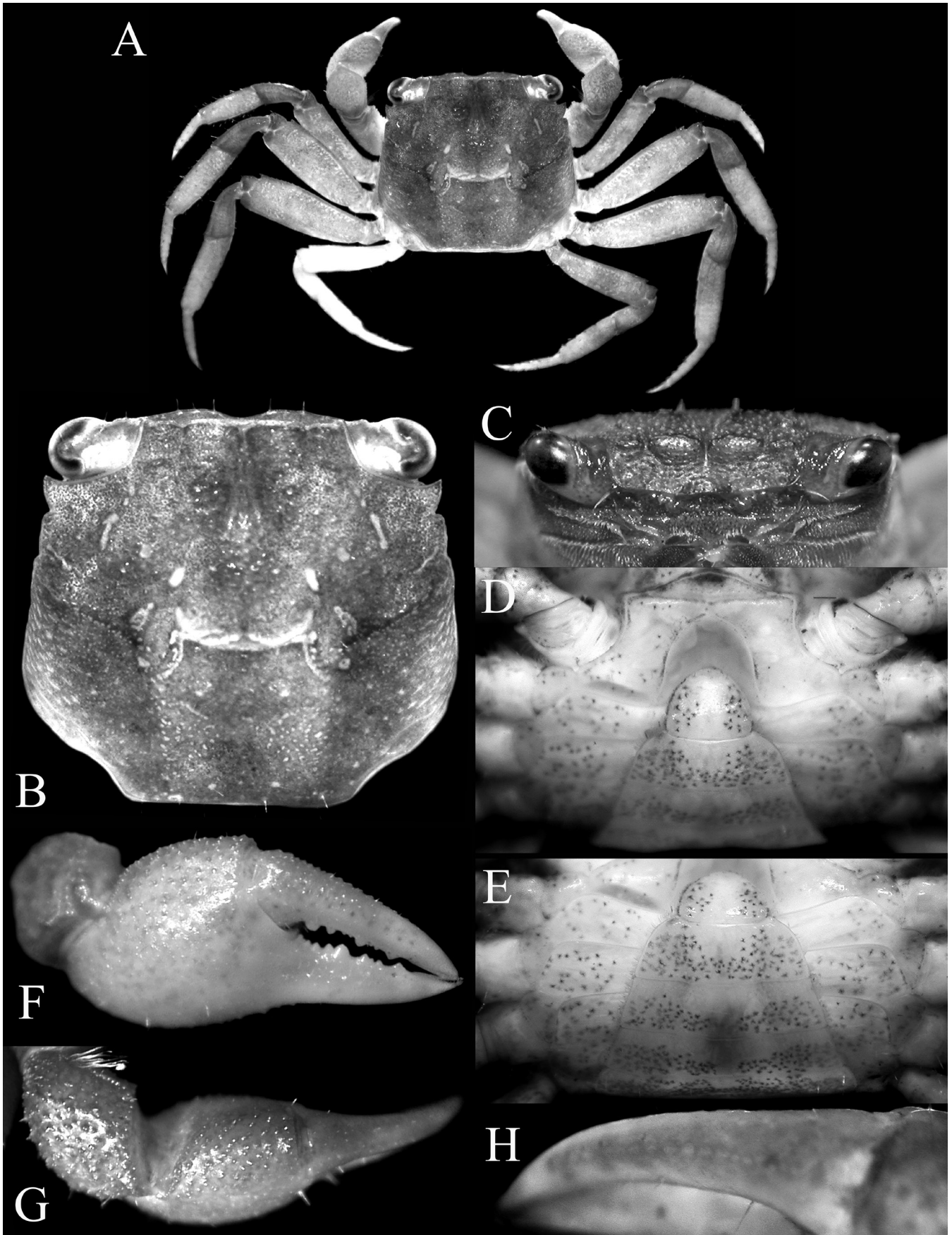


Fig. 16. *Geosesarma sekop*, new species, holotype male (10.5 × 9.4 mm) (MZB Cru 4455). A, overall dorsal view; B, dorsal view of carapace; C, frontal view of cephalothorax; D, anterior thoracic sternum, telson and pleonal somites 4–6; E, anterior thoracic sternum, telson and pleonal somites 3–6; F, outer view of right chela; G, dorsal view of right chela; H, dorsal view of dactylus of right chela.

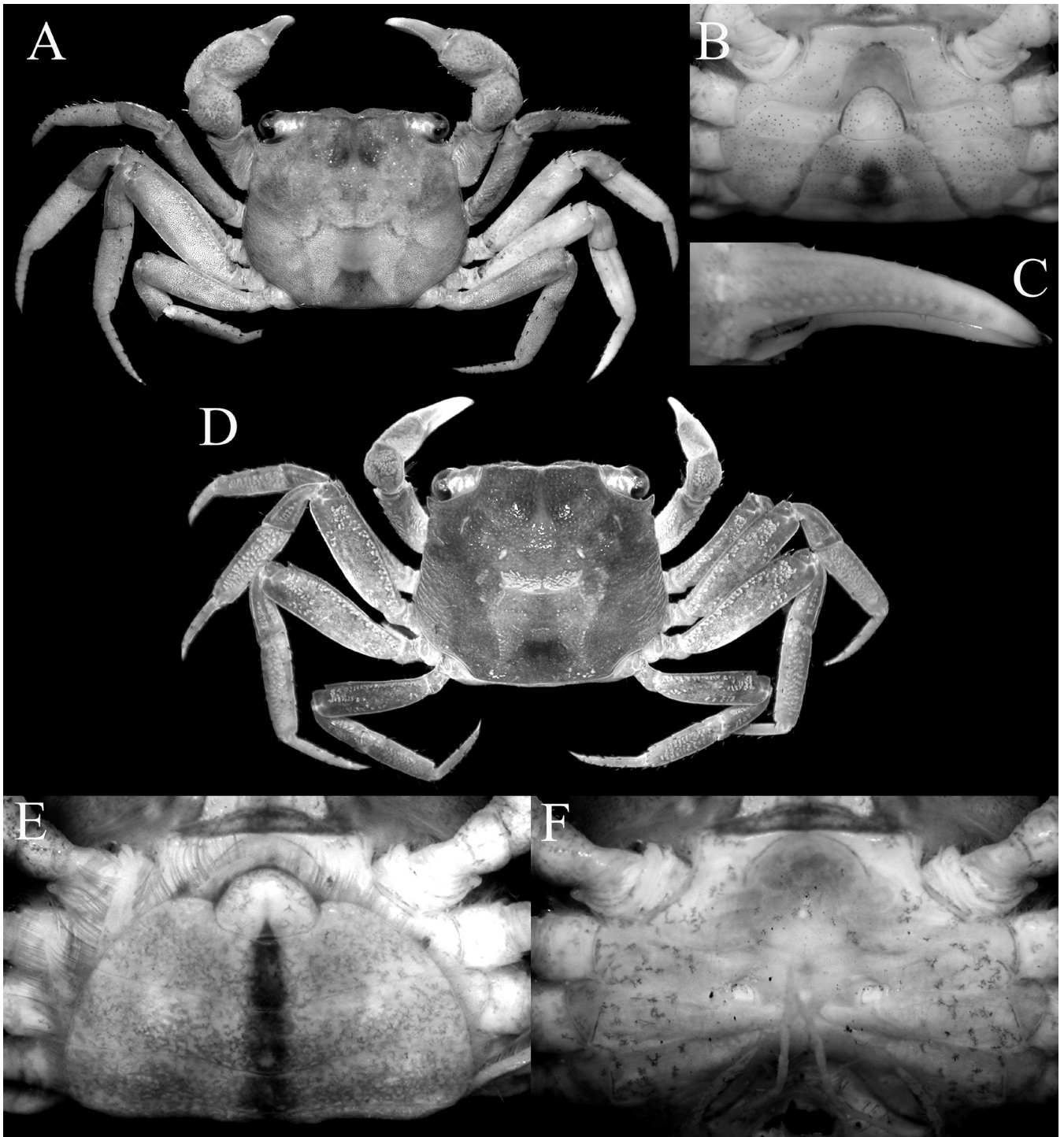


Fig. 17. *Geosesarma sekop*, new species. A–C, paratype male (12.1 × 10.8 mm) (MZB Cru 4466); D–F, paratype female (11.9 × 10.4 mm) (ZRC 2018.0288); A, D, overall dorsal view; B, E, anterior thoracic sternum, telson and pleonal somites 4–6; C, dorsal margin of dactylus of left chela; F, sternopleonal cavity showing vulvae.

Distribution. The species is known only from and around the highlands of Cibodas in Cianjur Regency at the border of Mount Gede Pangrango National Park.

Geosesarma sekop, new species
(Figs. 16–18)

Material examined. West Java Province, Bogor Regency: holotype: male (10.5 × 9.4 mm) (MZB Cru 4455), Pamijahan District, Ds. Gunung Sari, Kp. Rawa Lega, on moist cliff

of S. Cimua Herang at Curug Muara Herang in Gunung Bunder Resort, 06°42'40.8"S 106°41'03.2"E, 1,015 m asl, coll. D. Wowor et al., 3 October 2015. Paratypes: 12 males (8.2 × 7.5 mm – 11.2 × 10.5 mm), 15 females (8.3 × 7.5 mm – 10.9 × 9.7 mm), 1 ovigerous female (9.0 × 8.6 mm, eggs 1.8 mm diameter), 15 juveniles (MZB Cru 4654), 1 male (10.2 × 9.2 mm), 1 female (11.9 × 10.4 mm) (ZRC 2018.0288 ex-MZB Cru 4654), same data as holotype. Sukabumi Regency: paratypes: 14 males (8.1 × 7.3 mm – 12.1 × 10.8 mm), 3 females (6.6 × 6.0 mm – 12.6 ×

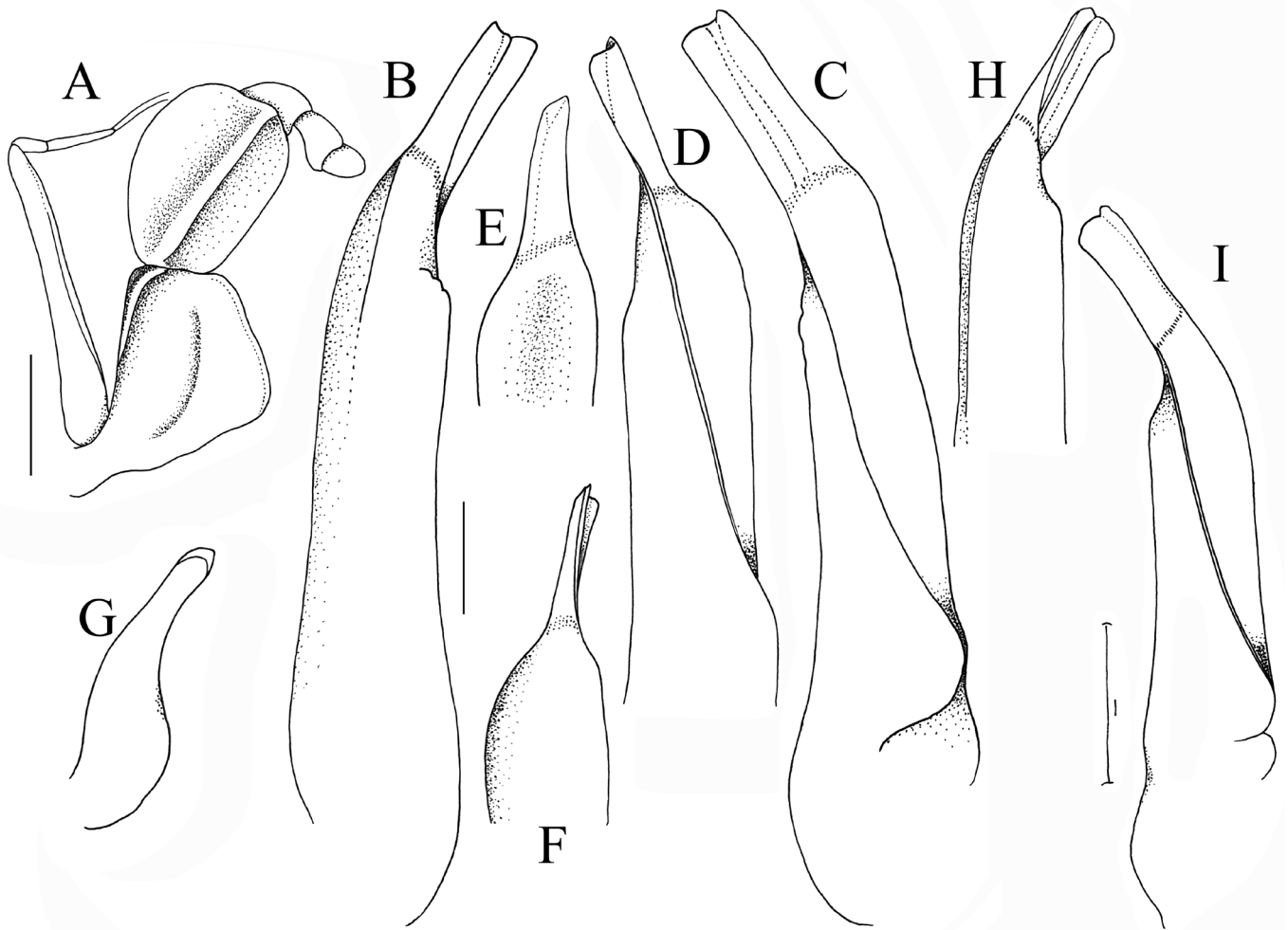


Fig. 18. *Geosesarma sekop*, new species. A–G, holotype male (10.5 × 9.4 mm) (MZB Cru 4455); H, I, male (12.1 × 10.8 mm) (MZB Cru 4466). A, right third maxilliped; B, H, left G1 (dorsal view); C, I, left G1 (ventral view); D, E, left G1 (ventro-mesial view); F, left G1 (dorso-mesial views); G, right G2. All structures denuded. Scales: A, H, I = 1.0 mm; B–G = 0.5 mm.

11.8 mm), 1 ovigerous female (10.6 × 9.5 mm, eggs 1.7 mm diameter) (MZB Cru Cru 4466), Cidahu District, Ds. Cidahu, on moist cliff at hiking gate to Kawah Ratu Salak 1, 06°44'19.1"S 106°42'52.9"E, 1,214 m asl, coll. D. Wowor et al., 30 September 2015.

Diagnosis of male. Carapace subquadrate, slightly wider than long, lateral margins gently sinuous, divergent (Figs. 16A, B, 17A); dorsal surface with regions, anterior regions with numerous small granules (Fig. 16B, C); front deflexed, frontal lobes broad with convex margins, separated by short, shallow median concavity; postfrontal cristae sharp (Fig. 16B, C); external orbital tooth triangular, directed obliquely outwards, tip not extending beyond anterior part of lateral carapace margin, first epibranchial tooth subtruncate, separated from margin by small cleft (Fig. 16B). Ischium of third maxilliped ovate, wide; exopod relatively slender, with long flagellum that extends just beyond merus width (Fig. 18A). Outer surface of palm of adult male chelae with scattered low granules; inner surface granulated but without transverse comb-like ridge; dorsal margin of dactylus with 15–18 small tubercles, each with chitinous tip along length (Figs. 16F–H, 17C). Ambulatory legs with relatively broad meri, with sharp subdistal spine on dorsal margin, surfaces

rugose; ventral margins of propodus and dactylus of first ambulatory leg with scattered stiff setae. Male pleon triangular; telson triangular with rounded tip, as long as broad; somite 6 with convex lateral margins (Figs. 16D, E, 17B). G1 relatively slender, subdistal part of outer margin before chitinous distal part gently curved, may be crenulate, with inner dorsal section strongly developed; chitinous distal part bent about 30° along longitudinal axis, elongate, spatulate in lateral view, narrow in mesial view; tip subtruncate when viewed dorsally (Fig. 18B–F, H, I).

Females. The adult female carapace is distinctly more trapezoidal in form (Fig. 17D). The vulvae are without a sternal opercular cover, ovate and are level with the surface of the anterior half of sternite 6, and relatively more widely separated (Fig. 17F). The eggs were between 1.8 mm (MZB Cru 4654) and 1.7 mm in diameter (MZB Cru Cru 4466).

Etymology. The name is derived from the Indonesian word “sekop” for spade, alluding to the structure of the G1. The name is used as a noun in apposition.

Remarks. See General Discussion for comparisons with allied Javan species.

Notes on habitat. Moist cliffs with water seepage and moss are the preferred habitats of this species; and these are usually not far from streams. The area has canopy coverage between 70 and 80%. *Geosesarma sekop*, new species, lives above 1,000 m asl.

Life colouration. The carapace is dark brown with black eyes and light brown chelae (Fig. 26B).

Distribution. Bogor and Sukabumi Regencies in West Java Province, in Gunung Bunder and Kawahratu Resorts of Mount Halimun Salak National Park, respectively.

***Geosesarma cikaniki*, new species**

(Figs. 19–21)

Material examined. West Java Province, Bogor Regency: holotype: male (8.9 × 8.7 mm) (MZB Cru 4649), Nanggung District, Ds. Malasari, 4th tributary from Cikaniki Research Station, at trail between Cikaniki Research station and Kp. Citalahap Sentral, in the forest, above 1,108 m asl, coll. D. Wowor et al., 5 July 2017. Paratypes: 5 males (11.9 × 11.0 mm [post molt], 9.0 × 8.2 mm – 9.5 × 9.2 mm), 2 females (8.4 × 7.6 mm, 10.4 × 9.3 mm), 1 ovigerous female (10.1 × 9.2 mm, eggs 1.5 mm diameter), 12 juveniles (MZB Cru 4650), same data as holotype; 5 females (6.8 × 6.2 mm – 10.7 × 8.9 mm), 1 juvenile (MZB Cru 4619), Nanggung District, Ds. Malasari, 4th tributary from Cikaniki Research Station, at trail between Cikaniki Research station and Kp. Citalahap Sentral, in the forest, above 1,108 m asl, coll. D. Wowor et al., 11 May 2016; 8 males (6.7 × 6.3 mm – 10.0 × 9.3 mm), 2 females (6.6 × 6.4 mm, 10.2 × 9.2 mm), 7 juveniles (MZB Cru 4651), Nanggung District, Ds. Malasari, 5th tributary from Cikaniki Research Station, at loop trail between Cikaniki Research Station and Kp. Citalahap Sentral, in the forest, above 1,108 m asl, coll. D. Wowor et al., 5 July 2017; 1 young (5.9 × 5.3 mm) (MZB Cru 4652), 1 male (11.1 × 9.1 mm) (ZRC 2018.0289 ex-MZB Cru 4652), Nanggung District, Ds. Malasari, about 30 m down of the 4th tributary from Cikaniki Research Station, coll. D. Wowor et al., 5 July 2017; 3 males (6.9 × 6.6 mm – 7.4 × 6.9 mm), 2 females (5.9 × 5.4 mm, 7.3 × 6.7 mm), 1 juvenile (MZB Cru 4653), 2 males (9.2 × 7.9 mm, 11.6 × 10.2 mm), 1 female (10.2 × 9.2 mm) (ZRC 2018.0290 ex-MZB Cru 4653), Nanggung District, Ds. Malasari, a tributary (= S. Malajegang), on the road to Cikaniki Research Station, 6°44'55.4"S 106°32'26.1"E, 1,093 m, coll. D. Wowor et al., 5 July 2017.

Diagnosis of male. Carapace subquadrate, slightly wider than long, lateral margins gently sinuous, slightly divergent (Figs. 19A, B, 20A); dorsal surface with regions, anterior regions with numerous small granules (Figs. 19B, C, 20A);

front deflexed, frontal lobes broad with convex to subtruncate margins, separated by short, shallow median concavity; postfrontal cristae sharp (Figs. 19B, C, 20A); external orbital tooth triangular, directed obliquely outwards, tip not extending beyond anterior part of lateral carapace margin, first epibranchial tooth subtruncate, separated from margin by distinct cleft (Figs. 19B, 20A). Ischium of third maxilliped ovate, wide; exopod relatively slender, with long flagellum that extends just beyond merus width (Fig. 21A). Outer surface of palm of adult male chelae with small granules; inner surface granulated but without transverse comb-like ridge; dorsal margin of dactylus with 15–18 small tubercles, each with chitinous tip along most of length except distal part (Figs. 19E, F, 20C). Ambulatory legs with relatively broader, shorter meri, with sharp subdistal spine on dorsal margin, surfaces rugose; ventral margins of propodus and dactylus of adult first ambulatory leg with dense comb-like setae. Male pleon triangular; telson triangular with rounded tip, as long as broad; somite 6 with convex lateral margins (Figs. 19D, 20B). G1 relatively slender, short, gently curved, subdistal part of outer margin before chitinous distal part very low with inner dorsal section strongly developed; chitinous distal part bent about 40° along longitudinal axis, short, spatulate in lateral view, narrow in mesial view; tip subtruncate when viewed dorsally (Fig. 21B–D).

Females. The adult female carapace is distinctly more trapezoidal in form (Fig. 20D). The vulvae are without a sternal opercular cover, ovate and are level with the surface of the anterior half of sternite 6, and relatively more widely separated (Fig. 20F). The egg diameter is 1.5 mm (MZB Cru 4650).

Etymology. The species is named after the site where it was first collected, Cikaniki. The name is used as a noun in apposition.

Remarks. See General Discussion for comparisons with allied Javan species.

Notes on habitat. It lives under pebbles with coarse sand substrate. The substrate is always wet due to water seepage. The habitat is in the middle of highland rain forest with almost totally under canopy coverage (Fig. 25E). *Geosesarma cikaniki*, new species, lives above 1,000 m asl. A new genus and new species of gecarcinucid, *Occulthusa halimun* Ng & Wowor, 2018, was recently described from the same area as this *Geosesarma* species (Ng & Wowor, 2018).

Life colouration. The carapace is dark brown with black eyes and purplish brown chelae.

Distribution. Bogor Regency in West Java Province, in Cikaniki Resort of Mount Halimun Salak National Park.

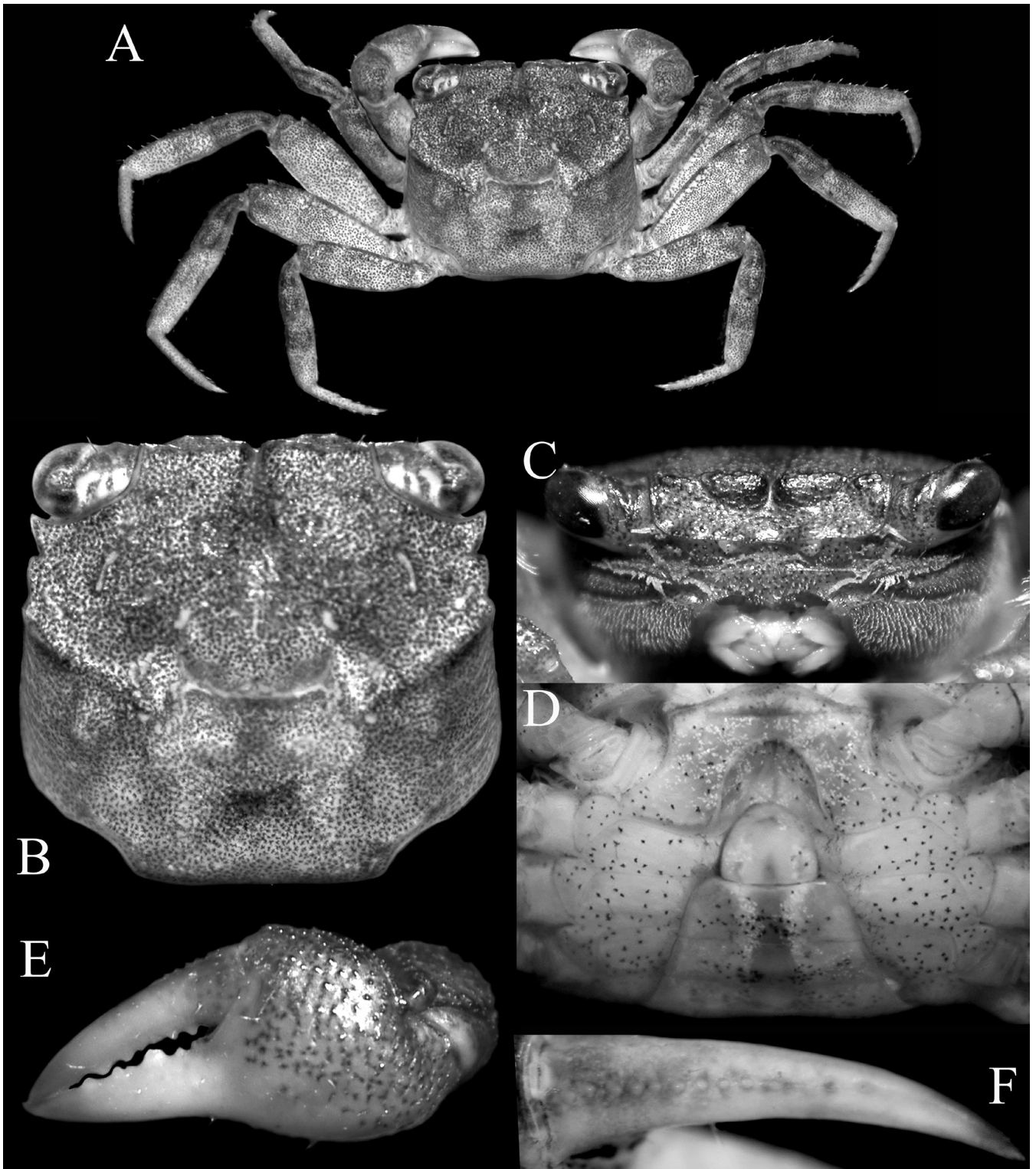


Fig. 19. *Geosesarma cikaniki*, new species, holotype male (8.9 × 8.7 mm) (MZB Cru 4649). A, overall dorsal view; B, dorsal view of carapace; C, frontal view of cephalothorax; D, anterior thoracic sternum, telson and pleonal somites 4-6; E, outer view of left chela; F, dorsal view of dactylus of left chela.

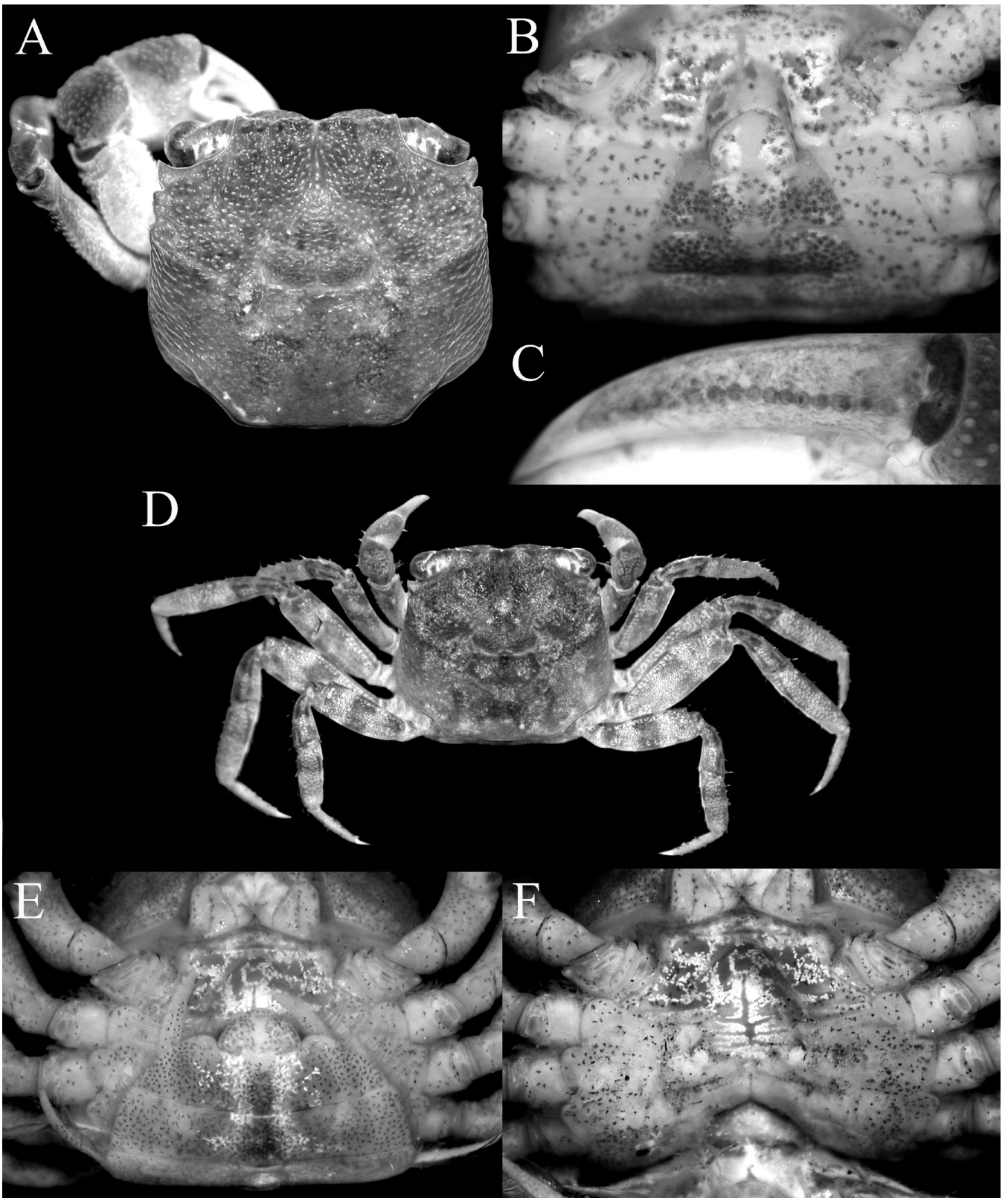


Fig. 20. *Geosesarma cikaniki*, new species. A–C, paratype male (11.9 × 11.0 mm) (MZB Cru 4650); D–F, paratype female (9.9 × 8.9 mm) (MZB Cru 4619). A, D, overall dorsal view; B, E, anterior thoracic sternum, telson and pleonal somites 4–6; C, dorsal margin of dactylus of right chela; F, sternopleonal cavity showing vulvae

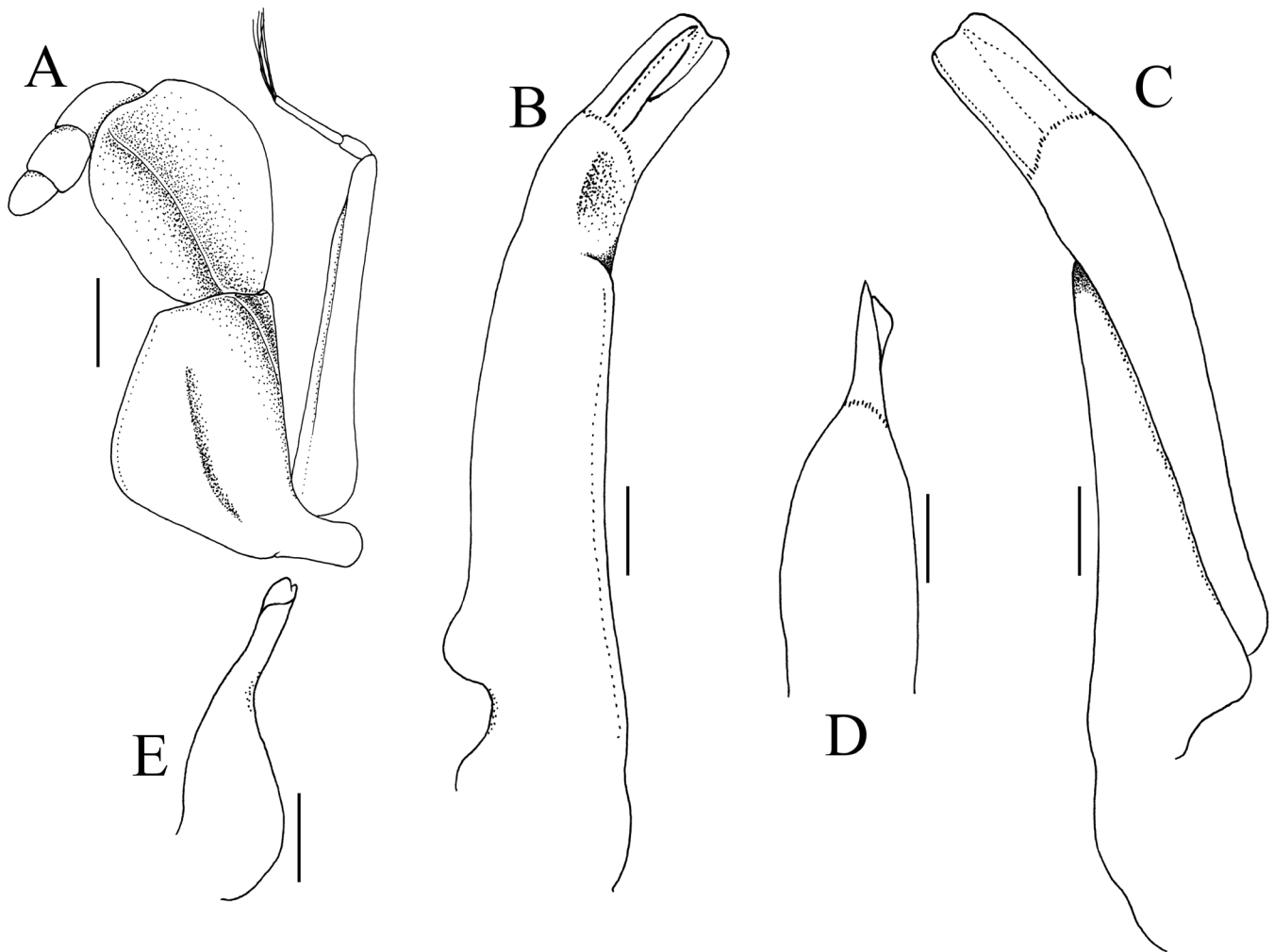


Fig. 21. *Geosesarma cikaniki*, new species, holotype male (8.9 × 8.7 mm) (MZB Cru 4649). A, left third maxilliped; B, left G1 (dorsal view); C, left G1 (ventral view); D, left G1 (dorso-mesial views); E, left G2. All structures denuded. Scales = 0.5 mm.

***Geosesarma rouxi* (Serène, 1968a)**
(Figs. 22, 23)

Sesarma (*Sesarma*) *sylvicola* – Roux, 1933: 11. (not *Sesarma sylvicola* De Man, 1892)

Sesarma (*Geosesarma*) *rouxi* Serène, 1968a: 1092, text fig. 15, 16, pl. 2 fig. 4; Serène, 1968b: 107.

Geosesarma rouxi – Ng et al., 2008: 221.

Material examined. East Java Province, Malang Regency: paratypes: 2 males (10.0 × 9.5 mm, 12.6 × 12.3 mm) (ZRC 2014.0358), Poedjon (= present day Pujon), cascades, ca. 7°50'37"S 112°28'08"E, Pujon District, East Java, Indonesia, coll. J. Roux, 16 January 1929.

Diagnosis of male. Carapace quadrate, slightly wider than long, lateral margins gently convex, subparallel (Figs. 22A, B); dorsal surface with regions, anterior regions with small flattened granules (Figs. 22B); front deflexed, frontal lobes broad with convex margins, separated by median concavity; postfrontal cristae relatively sharp (Figs. 22B, C); external orbital tooth triangular, directed obliquely anteriorly, tip not extending beyond anterior part of lateral carapace margin, first epibranchial tooth low but distinct, separated from margin by distinct cleft (Figs. 22B). Ischium of third maxilliped short,

ovate, wide; exopod relatively slender, with long flagellum that extends across width of merus (Fig. 23A). Outer surface of palm of adult male chelae with spaced out granules; inner surface granulated but without transverse comb-like ridge; dorsal margin of dactylus with 6 or 7 large tubercles, each with chitinous tip along most of length except distal part (Figs. 22F–H). Ambulatory legs with relatively broad meri, with sharp subdistal spine on dorsal margin, surfaces rugose; ventral margins of propodus and dactylus of adult first ambulatory leg with dense comb-like setae. Male pleon broadly triangular; telson triangular with rounded tip, as long as broad; somite 6 wide with convex lateral margins (Figs. 22D, E). G1 short, stout, subdistal part of outer margin before chitinous distal part angular; chitinous distal part bent, short, round, subtruncate in lateral view, spatulate in mesial and dorsal views (Fig. 23B–F).

Females. Not known.

Remarks. Roux (1933: 11) had reported this taxon as *Sesarma sylvicola* De Man, 1892, listing 22 males and 11 females among his collection. Serène (1968a: 1092) argued it was not De Man's species and described it as new from seven males he had on hand: the holotype (11.0 × 11.5 mm), four males which he labelled A–D (10.0 × 10.5 mm, 11.5 ×

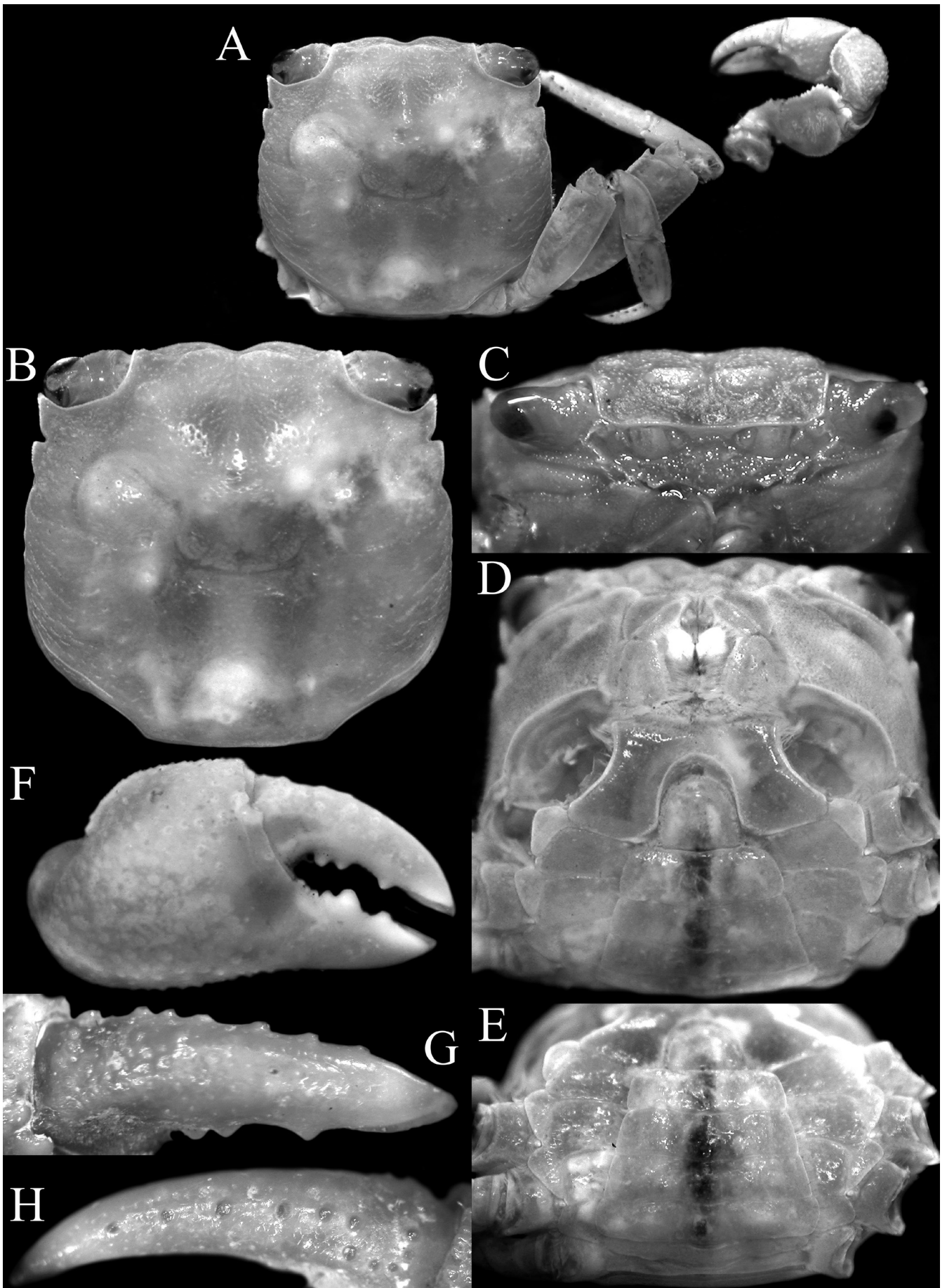


Fig. 22. *Geosesarma rouxi* (Serène, 1968a), male (12.6 × 12.3 mm) (ZRC 2014.358). A, overall dorsal view; B, dorsal view of carapace; C, frontal view of cephalothorax; D, anterior thoracic sternum, telson and pleonal somites 4–6; E, posterior thoracic sternum and pleonal somites 1–6; F, outer view of right chela; G, H, dorsal view of dactylus of right chela (different angles).

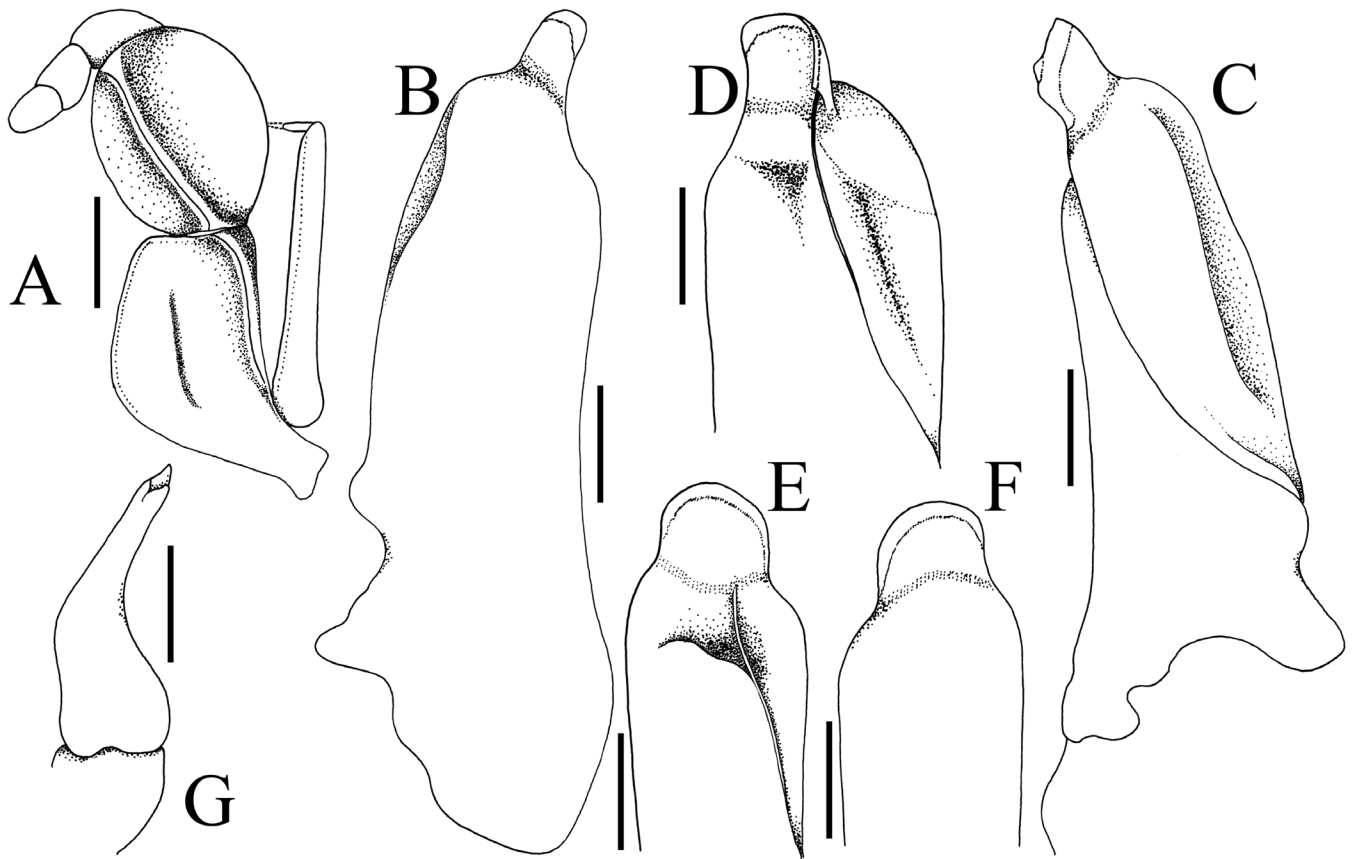


Fig. 23. *Geosesarma rouxi* (Serène, 1968a), male (12.6 × 12.3 mm) (ZRC 2014.358). A, left third maxilliped; B, left G1 (dorsal view); C, left G1 (ventral view); D, E, left G1 (ventro-mesial views); F, left G1 (dorso-mesial view); G, left G2. All structures denuded. Scales: A = 1.0 mm; B–G = 0.5 mm.

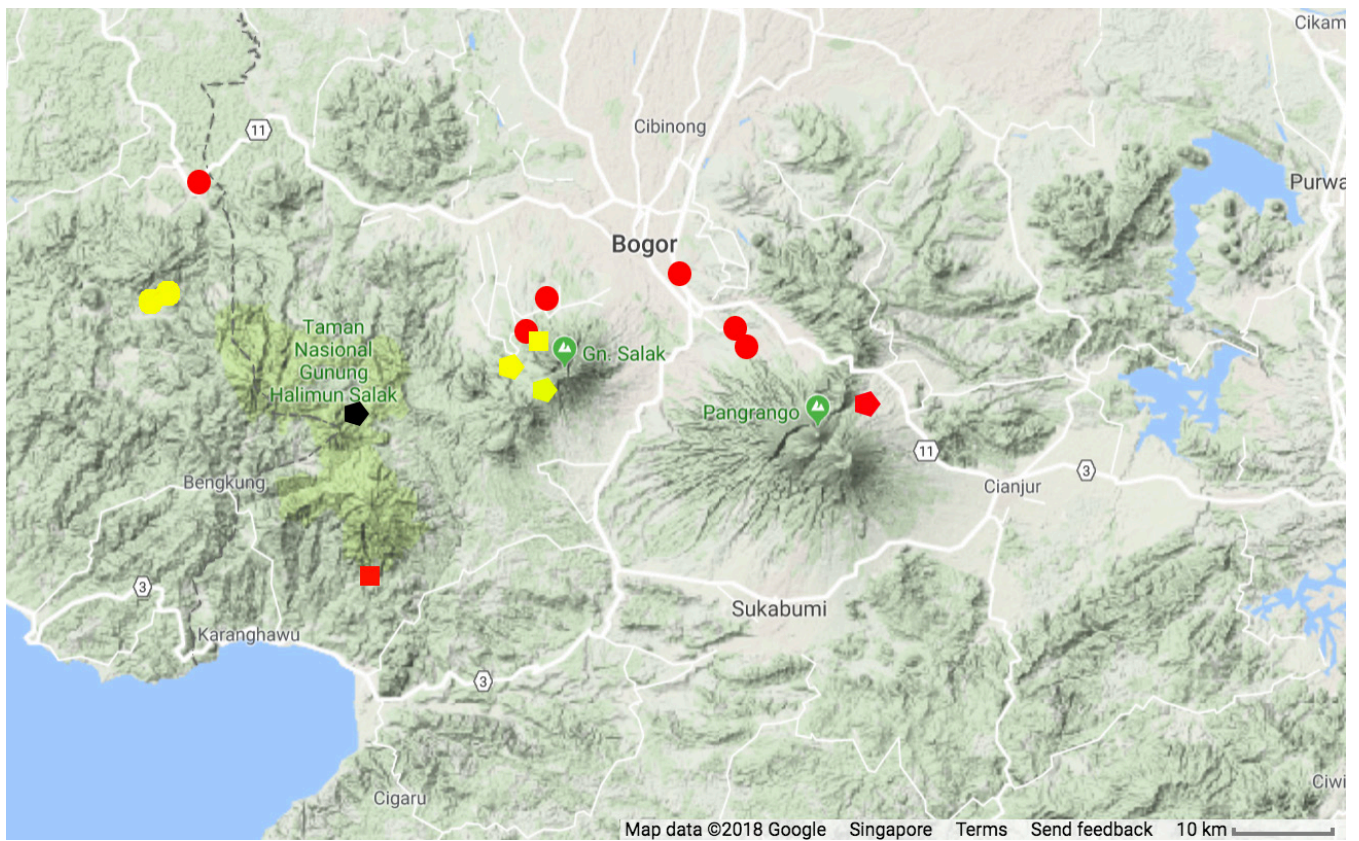


Fig. 24. Distribution of species in and around Mount Halimun Salak National Park. *Geosesarma noduliferum* (De Man, 1892) (red circles); *G. lebak*, new species (yellow circles); *G. sukabumi*, new species (red square); *G. robustum*, new species (yellow square); *G. confertum* (Ortmann, 1894) (red polygon); *G. sekop*, new species (yellow polygon); *G. cikaniki*, new species (black polygon). Google Map.



Fig. 25. Habitats. A, *Geosesarma noduliferum* habitat, stream at Tenjolaya District, Bogor Regency; B, *G. lebak*, new species, edge of S. Cimaja in Banten Province; C, *G. sukabumi*, new species, cliff face above S. Cirendang, Sukabumi Regency; D, *G. robustum*, new species, head water of S. Ciampea, Bogor Regency; E, *G. cikaniki*, new species, moist forest in Cikaniki Research Station, Bogor Regency.

12.0 m, 9.0 × 9.5 mm, 12.0 × 12.5 mm, respectively) and two juveniles. The present two specimens in the ZRC have a small label C and D each, respectively, and are clearly the two paratypes listed by him. The type locality was stated to be “Poedjon (Cascade), (Centre Java, Indonesia)” (Serène, 1968a: 1093), but this is not correct as this location is actually in East Java, in the highlands northwest of Malang. The altitude of Pujon is around 1,100 m asl.

See General Discussion for comparisons with allied Javan species.

Notes on habitat. Not known.

Life colouration. Not known.

Distribution. Known only from the type locality.

GENERAL DISCUSSION

The 11 species of *Geosesarma* now known from Java can be separated into four species groups. One group (*G. noduliferum*, *G. bicolor*, *G. dennerle*, *G. hagen*, *G. lebak*) has a more or less quadrate carapace with the lateral margins parallel, the dorsal margin of the adult male cheliped dactylus has 7–11 small tubercles, the G1 is relatively slender with the chitinous distal part slender in lateral view, and the



Fig. 26. Colour in life. A, *Geosesarma lebak*, new species, male (11.3 × 10.5 mm) (MZB Cru 4553), S. Cimaja, Banten Province; B, *G. sekop*, new species, holotype male (10.5 × 9.4 mm) (MZB Cru 4455), Curug Muara Herang, Bogor Regency. A, photograph by R.M. Marwoto; B, photograph by R.K. Hadiaty.

vulvae (when known) are directed obliquely towards the median part of the sternopleonal cavity. The second group (*G. sukabumi*, *G. robustum*) has a quadrate to subquadrate carapace with the lateral margins slightly diverging, the dorsal margin of the adult male cheliped dactylus has 3 or 4 clear large tubercles, the G1 is stout with the chitinous distal part tapering in lateral view, and the vulvae (when known) are directed obliquely towards the median part of the sternopleonal cavity. The third group (*G. confertum*, *G. sekop*, *G. cikaniki*) has a subquadrate carapace which is usually trapezoidal in shape with the lateral margins diverging, the dorsal margin of the adult male cheliped dactylus has 15–19 small tubercles, the G1 is relatively slender with the chitinous distal part appearing more spatulate in lateral view, and the vulvae are positioned further apart on the sternopleonal cavity and are almost flat on the surface. The last group has only one species *G. rouxi* (Serène, 1968a), and is characterised by its trapezoidal carapace, the dorsal margin of the adult male cheliped dactylus possessing 5 or 6 large tubercles, and a short and stout G1 with a very short and almost rounded chitinous distal part.

For the new species described in this paper, only *G. lebak* is in the *G. noduliferum* group. *Geosesarma lebak* is very close to *G. noduliferum* in the general carapace features but is most effectively separated by its G1, with the general structure relatively stouter and the subdistal part of outer margin more angular in shape (Figs. 6G, H, 7B, C) (versus G1 more slender with the subdistal part of outer margin more rounded and curved in *G. noduliferum* [Figs. 4D, E, H, I, 6D–F]); the dorsal distal section of the G1 just before the chitinous part is more strongly developed (Figs. 6G, H, 7B, C) (versus G1 dorsal section is proportionately more slender in *G. noduliferum* [Figs. 4D, E, H, I, 6D–F]); the chitinous distal part is bent at a slightly greater angle from the longitudinal axis at 45° (Fig. 6G, H) (versus chitinous distal part bent at 40° angle in *G. noduliferum* [Fig. 6D–F]); and the tip of the chitinous part of the G1 is more acute in lateral view (Figs. 6G, H, 7B, C) (versus tip of G1 is more rounded in *G. noduliferum* [Figs. 4D, E, H, I, 6D–F]). The male pleon

of *G. lebak* is also proportionately more slender (Fig. 5D) than that of *G. noduliferum* (Fig. 1D) when specimens of similar sizes are compared. The first lateral carapace tooth of *G. lebak* is also usually more distinctly acute (Fig. 5B) (versus usually relatively broader and usually more truncate in *G. noduliferum*; Fig. 1B, 2E); but this character is not reliable for smaller specimens and does vary a bit.

Two of the new species, *G. sukabumi* and *G. robustum*, are unusual among West Javan *Geosesarma* in that the dorsal margin of the dactylus of the adult male chela only has 3 or 4 distinct tubercles which are just on the proximal part. In addition, the G1s of these two species are proportionately much stouter and broader than those of other *Geosesarma* species in west Java. *Geosesarma sukabumi* can be separated from *G. robustum* by the form of its male pleon, which is distinctly more triangular in *G. robustum* with somite 6 more trapezoidal in form (Fig. 11D, E) compared to *G. sukabumi*, which is broader with somite 6 more subrectangular (Fig. 8D, E). The most diagnostic difference is in their G1 structures; in *G. sukabumi*, the chitinous distal part is bent about 80° along the longitudinal axis and relatively elongate (Fig. 10B–D) whereas in *G. robustum*, the G1 is proportionately much stouter and wider with the chitinous part very short and bent at only about 45° along the longitudinal axis (Fig. 12B–F).

For the third group of species whose members have a large number of tubercles on the adult male cheliped dactylus, the G1 of *G. cikaniki* is most similar to that of *G. confertum* except that the G1 is relatively more slender and the chitinous distal part is more slender in mesial view (Fig. 21B, C) (versus G1 proportionately stouter with the chitinous distal part wider in mesial view in *G. confertum*; cf. Fig. 15A, C). In any case, *G. confertum* is known only from Cibodas (Gunung Gede), a separate mountain range over 20 km to the east of Mounts Salak and Halimun. *Geosesarma sekop* can easily be distinguished from *G. confertum* and *G. cikaniki* by its proportionately longer and more slender ambulatory meri (Fig. 16A versus Figs. 13A, 19A). While the G1 structure of *G. sekop* is superficially similar to *G. cikaniki*, it is less

curved, with the chitinous part is relatively longer and bent at only about 30° along the longitudinal axis (Fig. 18B, C, H, I) (versus G1 proportionately shorter with the chitinous part shorter and bent at about 40° in *G. cikaniki*; Fig. 21B, C).

The presence of comb-like setae on the ventral margins of the dactylus and propodus of the adult male first ambulatory leg in some species is an interesting character. Females and juveniles lack this feature. In *G. noduliferum* and *G. lebak*, the ventral surfaces only have scattered stiff setae and the comb-like setae (Fig. 13D) are never present. It is also absent in *G. bicolor* (unpublished data). It is distinct in *G. sukabumi*, *G. robustum*, *G. confertum*, *G. cikaniki*, and *G. rouxi*. In *G. sekop*, the males do not have the comb-like setae, but it is possible they are all still subadult; smaller males of *G. cikaniki* examined also lack the comb-like setae and it is possible the discovery of larger males will show this character is present. The function of these setae is not known but is a useful feature to separate adults of these species.

The distribution of the seven species occurring in and around Mount Halimun Salak National Park are distinct and reflect the taxonomic groups they belong to (Fig. 24), with species occurring in the same area always belonging to different groups. For the first group, *G. noduliferum* occurs east of Mount Halimun Salak, in the Bogor and Cianjur Regencies, while *G. lebak* is found 30 km to the west of the mountain range in the Lebak Regency. For the second group, *G. sukabumi* is found south of Mount Halimun Salak whereas *G. robustum* is found 30 km to the northeast, nearer Bogor. The three montane species in the third group occur in habitats from above 900 m asl, with *G. confertum* occurring in Tjibodas, *G. sekop* living on Mount Salak to the east of the national park whereas the closely allied *G. cikaniki* is present 20 km to the west on the top of Mount Halimun.

With regards to the conservation status for the five new species, all occur in a nationally protected area and are thus not faced by any immediate threats. In any case, most *Geosesarma* species have not been subjected to a more detailed conservation assessment as has been done for the primary crabs (cf. Cumberlidge et al., 2009). This should be done eventually considering their similar habits and high degree of endemism.

Key to Species of Javan *Geosesarma*

- 1. Dorsal margin of dactylus of male chela with 3 or 4 tubercles; G1 relatively stout.....2
- Dorsal margin of dactylus of male chela with more than 5 tubercles; G1 relatively slender3
- 2. Male pleon with somite 6 trapezoidal (Fig. 11D, E); G1 proportionately very stout, wide, chitinous part very short, bent about 45° along longitudinal axis (Fig. 12B–F) [Bogor Regency, West Java].....*G. robustum*, new species
- Male pleon with somite 6 subrectangular (Fig. 8D, E); G1 proportionately less stout, more narrow, chitinous distal part relatively elongate, bent about 80° along longitudinal axis (Fig. 10B–D) [Sukabumi Regency, West Java].....*G. sukabumi*, new species

- 3. Dorsal margin of dactylus of male chela with 6 or 7 large tubercles (Fig. 22F–H); G1 very short, stout with short, rounded chitinous distal part (Fig. 23B–F) [Malang Regency, East Java] *G. rouxi* (Serène, 1968a)
- Dorsal margin of dactylus of male chela with 7–19 small tubercles along almost entire length; G1 slender, chitinous distal part long, slender to spatulate.....4
- 4. Dorsal margin of dactylus of male chela with 7–13 small tubercles (including small one near tip) along almost entire length; species living from lowlands to about 700 m asl.....5
- Dorsal margin of dactylus of male chela with 15–19 small tubercles (including small one near tip) along almost entire length; montane species, from 900 m asl and above.....9
- 5. Carapace in life distinctly with anterior and posterior halves differently coloured6
- In life, carapace evenly coloured grey, brown, orange or purple, the anterior and posterior halves not distinctly separated.....7
- 6. Anterior half of carapace purple to purplish-brown, posterior half cream to yellowish-white (Ng et al., 2015: fig. 6A–C); dorsal margin of dactylus of male chela with 7–9 small tubercles (Ng et al., 2015: fig. 5D) [Cilacap Regency, Central Java].....*G. dennerle* Ng, Schubart & Lukhau, 2015
- Anterior half of carapace bright purple on anterior half, posterior half bluish-grey (Ng & Davie, 1995: 32); dorsal margin of dactylus of male chela with 10 or 11 small tubercles (Ng & Davie, 1995: fig. 2D, E; Ng et al., 2015: fig. 5C) [Ujung Kulon, Lebak Regency, Banten] *G. bicolor* Ng & Davie, 1995
- 7. Carapace evenly orange throughout in life (Ng et al., 2015: fig. 6D–F); dorsal margin of dactylus of male chela with 7–9 small tubercles (Ng et al., 2015: figs. 5E) [Cilacap Regency, Central Java].....*G. hagen* Ng, Schubart & Lukhau, 2015
- Carapace otherwise coloured in life; dorsal margin of dactylus of male chela with 11–13 or small tubercles (last one often very small)8
- 8. Male pleon proportionately broader (Fig. 1D); G1 more slender with subdistal part of outer margin more rounded, curved, dorsal section proportionately more slender; chitinous distal part bent 40° along longitudinal axis (Figs. 4D, E, H, I, 6D–F) [Bogor and Lebak Regencies; West Java and Banten]*G. noduliferum* (De Man, 1892)
- Male pleon proportionately more slender (Fig. 5D); G1 relatively stouter, subdistal part of outer margin more angular, dorsal distal section more strongly developed, chitinous distal part bent 45° along longitudinal axis (Figs. 6G, H, 7B, C) [Lebak Regency; Banten] *G. lebak*, new species
- 9. Ambulatory meri proportionately longer and more slender (Fig. 16A); G1 with chitinous part relatively longer, gently bent 30° along longitudinal axis (Fig. 18B, C, H, I) [Bogor and Sukabumi Regencies; West Java].....*G. sekop*, new species
- Ambulatory meri proportionately shorter and stouter; G1 with chitinous part relatively shorter, bent 40° along longitudinal axis.....10
- 10. Margin of frontal lobe distinctly convex (Fig. 13B); G1 proportionately stouter, chitinous distal part wider in mesial view (Fig. 15B, C) [Cibodas, Cianjur Regency, West Java]...*G. confertum* (Ortmann, 1894)
- Margin of frontal lobe gently convex to almost truncate (Figs. 19B, 20A); G1 relatively more slender, chitinous distal part more slender in mesial view (Fig. 21B, C) [Mount Halimun, Bogor Regency, West Java].....*G. cikaniki*, new species

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