

On Indian species of *Nanosesarma* Tweedie, 1950 (Decapoda: Brachyura: Sesarmidae)

Vinay P. Padate¹  orcid.org/0000-0002-2244-8338

Krupal J Patel^{2,4}  orcid.org/0000-0003-0810-4210

Chandrashekher U. Rivonker³  orcid.org/0000-0002-5828-5032

Jigneshkumar N. Trivedi⁴  orcid.org/0000-0002-1308-7104

1 Government of India, Ministry of Earth Sciences, Centre for Marine Living Resources & Ecology. Atal Bhavan, LNG Terminus Road, Puthuvype, Cochin, Kerala, India.
VPP E-mail: vinaypadate@gmail.com

2 The Maharaja Sayajirao University of Baroda, Department of Zoology, Marine Biodiversity and Ecology Laboratory. Vadodara-390002, Gujarat, India.
KP E-mail: kjpatel8460@gmail.com

3 Goa University, School of Earth, Ocean and Atmospheric Sciences. Taleigao, Goa, India.
CR E-mail: curivonker@gmail.com

4 Hemchandracharya North Gujarat University, Department of Life Science, Animal Taxonomy and Ecology Laboratory. Patan-384265, Gujarat, India.
JT Email: jntrivedi26@yahoo.co.in

ZOOBANK: <http://zoobank.org/urn:lsid:zoobank.org:pub:38D424BA-8675-4A80-88DD-0ADBA8407698>

ABSTRACT

Four species of sesarmid crabs of the genus *Nanosesarma* Tweedie, 1950, have been reported from India: *Nanosesarma andersoni* (De Man, 1888), *Nanosesarma batavicum* (Moreira, 1903), *Nanosesarma jousseaumei* (Nobili, 1906), and *Nanosesarma minutum* (De Man, 1887). In the present study, one more species, *Nanosesarma sarii* Naderloo and Türkay, 2009 is reported for the first time from India along with the diagnosis and illustrations of the five Indian *Nanosesarma* species.

KEYWORDS

Brachyura, Goa, Gujarat, intertidal area, new record, West coast of India

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Shane Ahyong

Corresponding Author
Jigneshkumar N. Trivedi
jntrivedi26@yahoo.co.in

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INTRODUCTION

Tweedie (1950) proposed a new genus, *Nanosesarma* Tweedie, 1950, characterized by “distal part of the hind border of the ambulatory meri being spinate or denticulate”, for seven species: *Nanosesarma andersoni* (De Man, 1888), *Nanosesarma batavicum* (Moreira, 1903), *Nanosesarma edamense* (De Man, 1887), *Nanosesarma gordonii* (Shen, 1935), *Nanosesarma minutum* (De Man, 1887), *Nanosesarma nunongi* Tweedie, 1950, and *Nanosesarma vestitum* (Stimpson, 1858). Serène (1967) described *Nanosesarma tweediei* Serène, 1967 from Mersing, Malaysia, with a “densely setose, elongate carapace and setose outer surface of chelipeds”, and suggested a morphological affinity with *N. minutum*.

Serène and Soh (1970) proposed to divide *Nanosesarma* into two subgenera: *Nanosesarma* (*Nanosesarma*) (type species *N. minutum*) and *Nanosesarma* (*Beanium*) Serène and Soh, 1970 (type species *N. batavicum*). In the same study, they synonymized *Sesarma jousseaumei* Nobili, 1906 and *N. gordonii* with *N. minutum*. They also transferred *Sesarma pontianacense* De Man, 1895 to *Nanosesarma* and synonymized *N. tweediei* with the former species. However, they were unable to determine the subgeneric position of *N. vestitum*.

Subsequently, Holthuis (1977) provided a short introduction to the genus *Nanosesarma* wherein he disapproved of the division of *Nanosesarma* into two subgenera by Serène and Soh (1970) stating that “the differences given by Serène and Soh (1970) for their two subgeneric taxa are rather vague and not too clear cut”. Moreover, he believed that the division of the genus into two subgenera on the basis of the male pleon was inadequate, since this character was neither included in original descriptions (e.g., *N. edamense*; *N. batavicum*) nor clearly described (e.g., *N. andersoni*; *N. nunongi*).

Recently, Ng et al. (2008) treated *Beanium* Serène and Soh, 1970 [as *Nanosesarma* (*Beanium*)] as a junior subjective synonym of *Nanosesarma* Tweedie, 1950. Subsequently they listed nine extant species of *Nanosesarma*, and treated *Sesarma gordonii* and *Sesarma barbimana* Cano, 1889 as synonyms under *N. minutum*, and rejected the subgeneric classification

of Serène and Soh (1970). Currently, *Nanosesarma* comprises 10 valid species (Ng et al., 2008; Naderloo and Türkay, 2009) inhabiting intertidal habitats across the Indo-Pacific regions (Serène and Soh, 1970), of which four species: *N. andersoni*, *N. batavicum*, *N. jousseaumei* and *N. minutum* have been reported from India (Trivedi et al., 2018). In the present study, we record the presence of one more species, *Nanosesarma sarii* Naderloo and Türkay, 2009, for the first time from India. Further, a detailed diagnosis of all five species of *Nanosesarma* occurring in India, along with their illustrations and morphological comparisons, is provided here to facilitate proper identification.

MATERIAL AND METHODS

The specimens were collected from the coastal regions of Gujarat and Goa States of India. The specimens examined were stored in a 5 % formalin solution and deposited in the Marine Biology Laboratory, Department of Marine Sciences, Goa University, Goa, India (GUMSIS) and Zoological Reference Collection, Department of Life Sciences, Hemchandracharya North Gujarat University, Patan, Gujarat, India (LFSC.ZRC). The terminology used in the description follows Davie et al. (2015). The following abbreviations are used: CL = carapace length; CW = carapace width; P2–5 = second to fifth walking legs respectively; PW = pleonal width; G1 = male first gonopod; coll. = collector. All the measurements are expressed in millimeters (mm).

SYSTEMATICS

Family Sesarmidae Dana, 1851

Genus *Nanosesarma* Tweedie, 1950

Nanosesarma andersoni (De Man, 1888)

(Figs. 1A, 2, 7A, B)

Sesarma andersoni De Man, 1888: 172, pl. 12, figs. 1–4. — Alcock, 1900: 418.

Sesarma (*Parasesarma*) *andersoni* — Tesch, 1917: 129.
Nanosesarma andersoni — Tweedie, 1950: 312, fig. 1d, e.

Nanosesarma (*Beanium*) *andersoni* — Serène and Soh, 1970: 394.

Material examined. 10 males (CL: 4.4–4.8 mm, CW: 5.9–6.5 mm), 7 females (CL: 2.9–4.3 mm, CW: 4.0–5.8 mm), LFSC.ZRC-185, India, Goa, Chapora Estuary (15°37'21"N 73°44'45"E), coll. Mithila Bhat, 13 April 2016.

Diagnosis. Carapace quadrangular, glabrous, 1.34 times wider than long; lateral margins slightly concave, subparallel posteriorly; dorsal surface covered with

scattered pits, setal tufts and sparsely placed setae; protogastric and mesogastric regions delimited by inconspicuous grooves. External orbital tooth broadly triangular followed by rudimentary epibranchial tooth. Several oblique, low, setose granulated striations extending across branchial regions (Figs. 1A, 2A). Frontal margin wide, indistinctly bilobed, frontal lobes separated by shallow depression; 4 inconspicuous postfrontal lobes covered with setose patches, separated by longitudinal grooves (Fig. 2A). Basal antennal article long (Fig. 2B), reaching distal margin of first article.

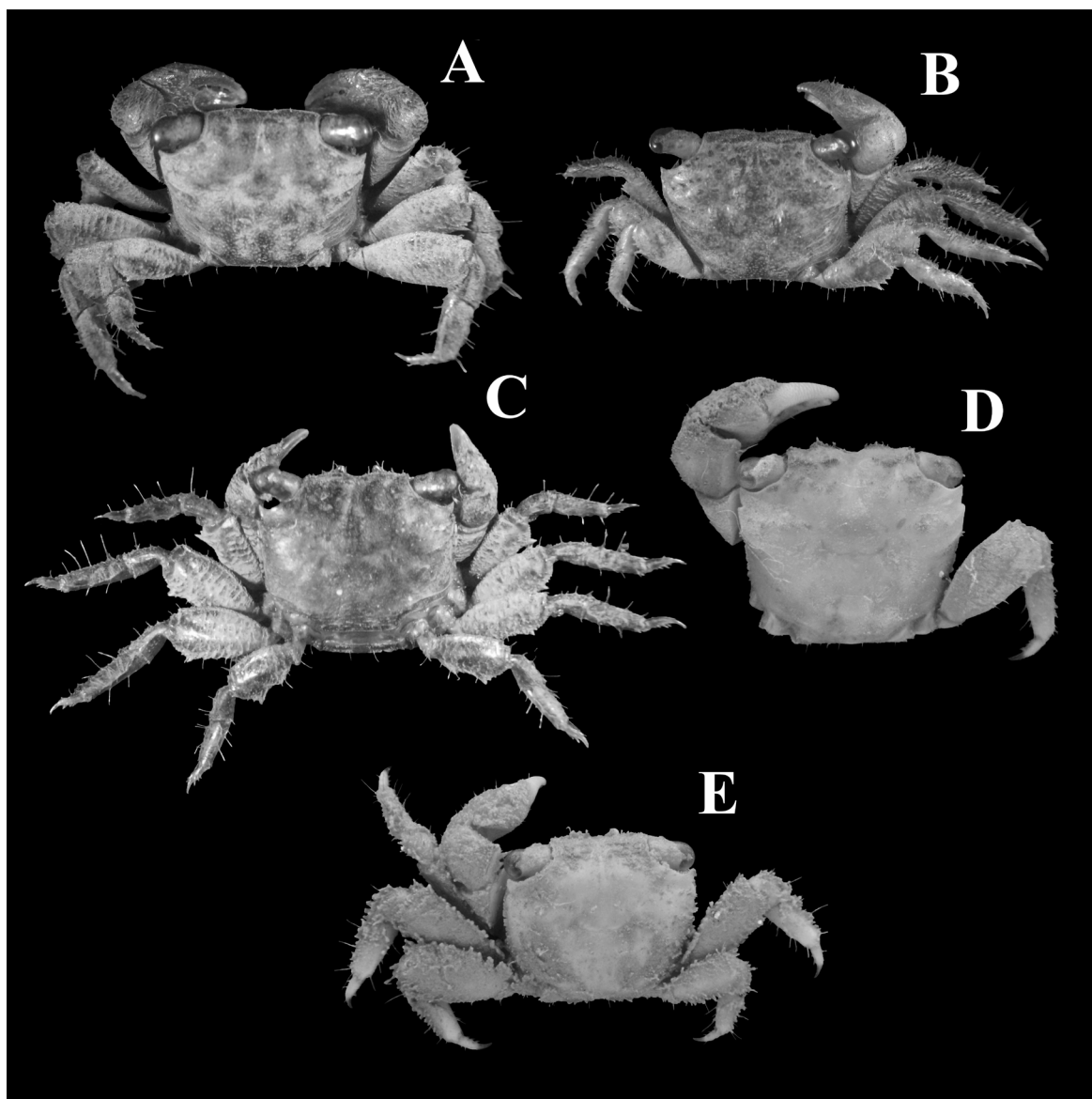


Figure 1. Dorsal habitus of *Nanosesarma* species. (A) *N. andersoni* (De Man, 1888), male (LFSC.ZRC-185) CL: 6.2 mm; CW: 8.4 mm; (B) *N. batavicum* (Moreira, 1903), male (GUMSIS1), CL: 4.8 mm; CW: 6.6 mm; (C) *N. minutum* (de Man, 1887), male (LFSC.ZRC-186), CL: 4.8 mm; CW: 5.9 mm; (D) *N. sarii* Naderloo and Türkay, 2009, male (LFSC.ZRC-188), CL: 5.6 mm; CW: 6.6 mm; (E) *N. jousseaumei* (Nobili, 1906), male (LFSC.ZRC-187), CL: 4.8 mm; CW: 5.5 mm.

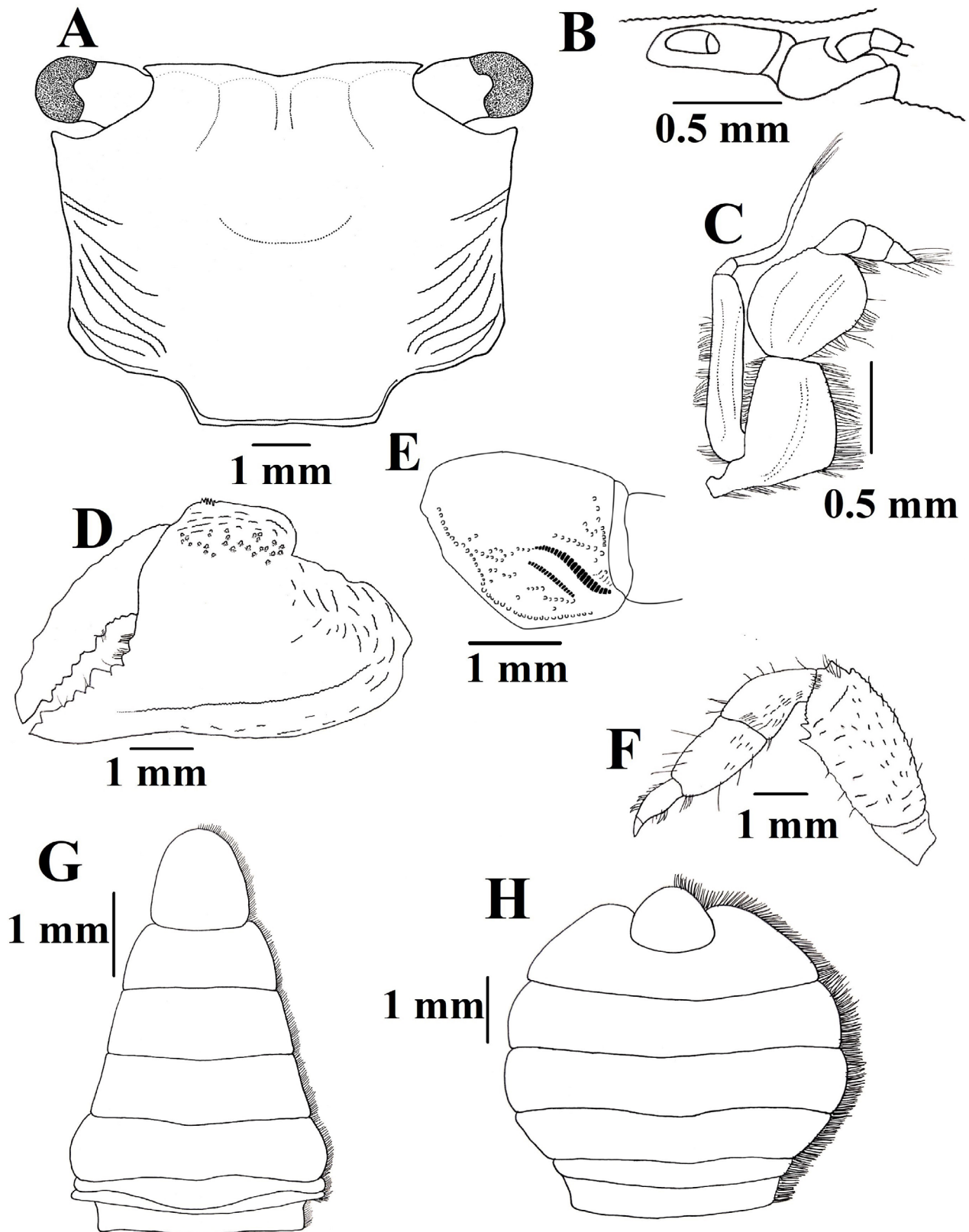


Figure 2. *Nanosesarma andersoni* (De Man, 1888). **A–G**, Male (LFSC.ZRC-185) (CL: 4.8 mm; CW: 6.5 mm), Chapora Estuary, Goa, India; **H**, female (LFSC.ZRC-185) (CL: 4.3 mm; CW: 5.8 mm), Chapora Estuary, Goa, India. (**A**) Carapace; (**B**) basal antennular and antennal articles; (**C**) right third maxilliped; (**D**) palm of left cheliped (outer face); (**E**) dorsal view of left cheliped palm; (**F**) left PS (dorsal view); (**G**) male pleon; (**H**) female pleon.

Third maxillipeds with distinct rhomboidal gap when closed; ischium subrectangular, slightly longer than wide, 1.27 times longer than merus, with oblique setose ridge; merus subovate, 1.01 times as wide as long, with oblique setose ridge. Exopod slender, flattened, with long flagellum (Fig. 2C).

Chelipeds subequal, massive; palm massive (Fig. 2D), surfaces rugose, dorsal surface with two oblique pectinate crests and 4 or 5 oblique granular ridges (Fig. 2E); outer surface pitted, covered with discreet granular striations on posterior half and scattered granules anteriorly, thin granular line on lower half commencing on pollex and extending posteriorly to carpal junction; inner surface sparsely granulated. Fingers (dactylus and pollex) massive, curved, with rounded spatulate tips, gaping when closed. Male cheliped dactylus short, with row of 13 or 14 small smooth transverse tubercles and proximal granules on dorsal surface; inner surface with proximal granular patch. Cutting edge of dactylus with 3 large and 2 small teeth, and large subdistal tooth, pollex with large subdistal tooth, followed by 3 small, 1 large median teeth and 4 proximal teeth (Fig. 2D).

P2–5, compressed, shorter than chelipeds. P2 short, P3 and P4 subequal, P5 short. P4 and P5 meri flattened, wider distally. Carpi ventral surfaces with median longitudinal granular ridge. P4 and P5 carpi and propodi without dense setae. Propodi about twice as long as wide, posterior margins with distal spine and few long bristles, ventral surface with inconspicuous oblique groove. Dactyli smooth, tip corneous, slightly curved, dorsal margin with 2 pairs of slender subdistal spines and ventral margin with 1 pair of subdistal spines (Fig. 2F).

Male pleon narrow, bluntly triangular, surface pitted; lateral margins finely granulated, densely setose; telson 1.03 times as long as wide, 1.69 times as long as pleomere 6 (Fig. 2G). Female pleon wide, rounded, pleomere 6 with concave distal margin; telson pentagonal, wider than long, partially sunken into distal margin of pleomere 6 (Fig. 2H).

G1 long, straight, distal part corneous, flattened, slightly curved, medially notched, flanked by thick bristles, groove at base of tip extends along ventral surface to G1 (Fig. 7A, B).

Remarks. The specimens examined in the present study resemble De Man's (1888) description of his *Sesarma andersoni*, differing in the presence of a distinct subdistal spine on the anterior margin of P2–P5 meri. Morphological comparison with other Indian congeneric species is provided in Tab. 1.

Distribution. *Nanosesarma andersoni* was originally described from Mergui Archipelago (De Man, 1888; Alcock, 1900), and later reported from Malaysia, Singapore (Tweedie, 1950), Japan (Komai *et al.*, 2004), and India (Trivedi *et al.*, 2018). In India, it is known from Goa (Dev Roy and Bhadra, 2008; present study), Kerala (Devi *et al.*, 2015), Tamil Nadu (Ravichandran and Kannupandi, 2007), and Andaman and Nicobar Islands (Dev Roy and Das, 2000).

***Nanosesarma batavicum* (Moreira, 1903)**
(Figs. 1B, 3, 7C, D)

Sesarma barbimana — De Man, 1890: 104, pl. 6, fig. 13.

Sesarma batavica Moreira, 1903: 117 (nom. nov.). — Tweedie, 1940: 90, fig. 1.

Sesarma batavicum — Kemp, 1915: 238, pl. 12, fig. 7.

Sesarma (*Parasesarma*) *batavica* — Tweedie, 1936: 62.

Nanosesarma batavica — Tweedie, 1950: 311.

Nanosesarma (*Beanium*) *batavicum* — Serène and Soh, 1970: 394.

Material examined. 1 male (CL: 4.8 mm, CW: 6.6 mm), GUMSIS1, India, Goa, Verem (15°29'74"N 73°48'20"E), coll. Mithila Bhat, 9 April 2014.

Description. Carapace quadrangular, 1.35 times wider than long, with slightly concave, converging lateral margins; dorsal surface covered with scattered pits, prominent setal tufts on post-frontal lobes, protogastric and anterior branchial regions, and sparsely placed setae on posterior half of carapace. External orbital tooth triangular. Several oblique, low, setose granulated striations extending across branchial regions (Figs. 1B, 3A). Frontal lobes separated by shallow depression; 4 inconspicuous post-frontal lobes covered with setose patches, separated by longitudinal grooves (Fig. 3A).

Table 1. Morphological comparison of different species of *Nanosesarma* reported from India.

Species characters	<i>Nanosesarma andersoni</i> (De Man, 1888)	<i>Nanosesarma batavicum</i> (Moreira, 1903)	<i>Nanosesarma minutum</i> (De Man, 1887)	<i>Nanosesarma sarii</i> Naderloo and Türkay, 2009	<i>Nanosesarma jousseau mei</i> (Nobili, 1906)
	CW/CL = 1.34	CW/CL = 1.35	CW/CL = 1.26	CW/CL = 1.13–1.17	CW/CL = 1.1–1.15
	lateral margins slightly concave, subparallel posteriorly	lateral margins concave posteriorly, gently converging	lateral margins almost straight, gradually diverging posteriorly	lateral margins slightly concave, slightly converging posteriorly	lateral margins almost straight, converging posteriorly
Carapace	dorsal surface covered with scattered pits, setal tufts and sparsely placed setae	dorsal surface covered with setal tufts (those on anterior third larger) and sparsely placed setae	dorsal surface covered with scattered pits, sparsely placed setae only on front	dorsal surface covered with setal tufts and sparsely placed short and thin plumose setae	dorsal surface covered with setal tufts and long setae sparsely set among shorter plumose setae
	external orbital tooth broadly triangular, followed by rudimentary tooth	external orbital tooth triangular	external orbital tooth truncate triangular, followed by sharp, triangular epibranchial tooth	external orbital tooth sharply triangular, followed by small, slightly pointed epibranchial tooth	external orbital tooth triangular, followed by small, blunt epibranchial tooth
Third maxilliped	ischium 1.27 times longer than merus	ischium 1.59 times longer than merus	ischium 1.18 times longer than merus	ischium 1.37 times longer than merus	ischium 1.33 times longer than merus
	merus 1.01 times as wide as long	merus 0.89 times as wide as long	merus 1.01 times as wide as long	merus 1.18 times longer than wide	merus 1.26 times longer than wide
	palm outer surface without setose patch	palm outer surface without setose patch	palm outer surface with densely setose patch extending anteriorly to proximal portion of fingers	palm outer surface with densely setose patch extending anteriorly to mid-length of fingers	palm outer surface with densely setose patch extending anteriorly to proximal portion of fingers
	palm dorsal surface with 2 oblique pectinated crests and 4 or 5 oblique granular ridges	palm dorsal surface with 2 oblique pectinated crests and 5 or 6 oblique granular ridges	palm dorsal surface without oblique pectinated crest; 3 oblique granulated ridges present	palm dorsal surface without oblique pectinated crest or granulated ridges	palm dorsal surface without oblique pectinated crest or granulated ridges
Chelipeds	dorsal surface of male dactylus with row of 13 or 14 small smooth transverse tubercles and proximal granules	dorsal surface of male dactylus with row of 12 prominent transverse ridges, proximal granules and scattered setae	dorsal surface of male dactylus without transverse ridges; proximal granules and scattered setae present	dorsal surface of male dactylus completely tuberculated, densely set small tubercles on proximal part with 6 large granules	dorsal surface of male dactylus without transverse ridges, small proximal granules with a large distinct tubercle on outer surface
	dactylus dorsal surface not granulated	dactylus dorsal surface granulated proximally with scattered setae	dactylus dorsal surface relatively less granulated proximally	dactylus dorsal surface relatively more granulated proximally, completely covered with small tubercles on dorsal surface, 6 prominent granules proximally on the dorsal surface	dactylus dorsal surface relatively less granulated proximally
	cutting edge of dactylus with 3 large and 2 small teeth, and 1 large subdistal tooth	cutting edge of dactylus with 4 subequal blunt teeth	cutting edge of dactylus with large subdistal tooth, followed by 2 small teeth in middle portion and 2 large proximal teeth	cutting edge of dactylus with small teeth	distal half of cutting edge of dactylus with 6 or 7 low tubercles, distalmost larger
	cutting edge of pollex with one large subdistal tooth, followed by 3 small, 1 large median tooth, and 4 small proximal teeth	cutting edge of pollex with 4 subequal blunt teeth	cutting edge of pollex with large subdistal tooth, followed by 2 small teeth, large tooth in middle portion and 3 or 4 small teeth	cutting edge of pollex with several small teeth and a large prominent tooth in middle portion	cutting edge of pollex with large prominent tubercle in middle portion

Table 1. Cont.

Species characters	<i>Nanosesarma andersoni</i> (De Man, 1888)	<i>Nanosesarma batavicum</i> (Moreira, 1903)	<i>Nanosesarma minutum</i> (De Man, 1887)	<i>Nanosesarma sarii</i> Naderloo and Türkay, 2009	<i>Nanosesarma jousseau mei</i> (Nobili, 1906)
	propodus about twice as long as wide	propodus about twice as long as wide	propodus about twice as long as wide	propodus about twice as long as wide	propodus 1.5 times as long as wide
Pereopods	dactylus slightly curved, with 2 pairs of slender subdistal spines	dactylus smooth, tip corneous, slightly curved, with pair of slender subdistal spines	dactylus smooth, tip corneous, slightly curved, with 4 slender subdistal spines	dactylus with 8–10 spines in 2 rows on posterior margin	dactylus ending in large spine, 6 spines in 2 rows along posterior margin
Male pleon	telson 1.03 times as long as wide	telson 1.04 times as long as wide	telson 1.17 times as long as wide	telson about 1.60 times as long as wide	telson about 0.97 times as long as wide
G1	corneous distal part, flattened, slightly curved, medially notched, flanked by thick bristles	corneous distal part, slender, flattened, slightly bent, flanked by thick bristles	corneous distal part curved, long scoop-shaped, flanked by stiff bristles	corneous distal part curved outwards, with long, stiff setae around it, some setae along lateral margin	long corneous distal part, gently bending outwards, covered with long setae, posterior surface concave

Third maxillipeds with distinct rhomboidal gap when closed; ischium subrectangular, 1.17 times longer than wide, 1.59 times longer than merus, with oblique setose ridge; merus subovate, 0.89 times longer than wide, with oblique setose ridge. Exopod slender, flattened, with long flagellum (Fig. 3B).

Right cheliped massive, longer than carapace; palm massive (Fig. 3C), surfaces rugose, dorsal surface with 2 oblique pectinate crests and 5 or 6 oblique granular ridges (Fig. 3D); outer surface smooth, slightly pitted, thin granular line on lower half commencing on pollex and extending posteriorly to carpal junction; inner surface sparsely granulated. Fingers massive, curved, with rounded spatulate tips, gaping when closed, outer surface with dense setose patch. Male dactylus with row of 12 prominent transverse ridges, proximal granules and scattered setae on dorsal surface; inner surface with proximal granular, setose patch. Cutting edges of dactylus and pollex with 4 subequal blunt teeth each (Fig. 3C).

P2–5, compressed, shorter than chelipeds. P2 and P5 short, P3 and P4 subequal. P2 and P3 propodi and carpi densely setose on anterior surface, P4–P5 propodi and carpi without dense setae. P2–P5 propodi posterior margins with one distal spine, ventral surface with inconspicuous oblique groove. P5 dactylus smooth, tip corneous, slightly curved,

dorsal margin with six spines, ventral margin with three pairs of spines (Fig. 3E).

Male pleon bluntly triangular ($AW/CW = 0.38$), surface pitted, sutures with sparsely setose patches; lateral margins finely granulated, densely setose; telson 1.04 times as long as wide, 1.88 times as long as pleomere 6 (Fig. 3F).

G1 long, straight, distal part corneous, slender, flattened, slightly bent, lined by thick bristles, groove at base of tip extends along ventral surface to proximal portion of G1 (Fig. 7C, D).

Remarks. The specimen examined in the present study agrees with the description by De Man (1890) but differs in having 6 oblique granular ridges on dorsal surface of male cheliped propodus (vs. 7 or 8 in the holotype), and 4 occlusal teeth on pollex (vs. 3 in the holotype). Morphological comparison with other Indian species is provided in Tab. 1.

Geographical distribution. *Nanosesarma batavicum* was originally described from Batavia, Indonesia and later reported from Java, Malaysia, Singapore, (Tweedie, 1950) and India (Trivedi *et al.*, 2018). In India, it is known from Goa (present study), Kerala (Devi *et al.*, 2015), Tamil Nadu (Varadharajan and Soundarapandian, 2014), and Odisha (Dev Roy and Rath, 2017).

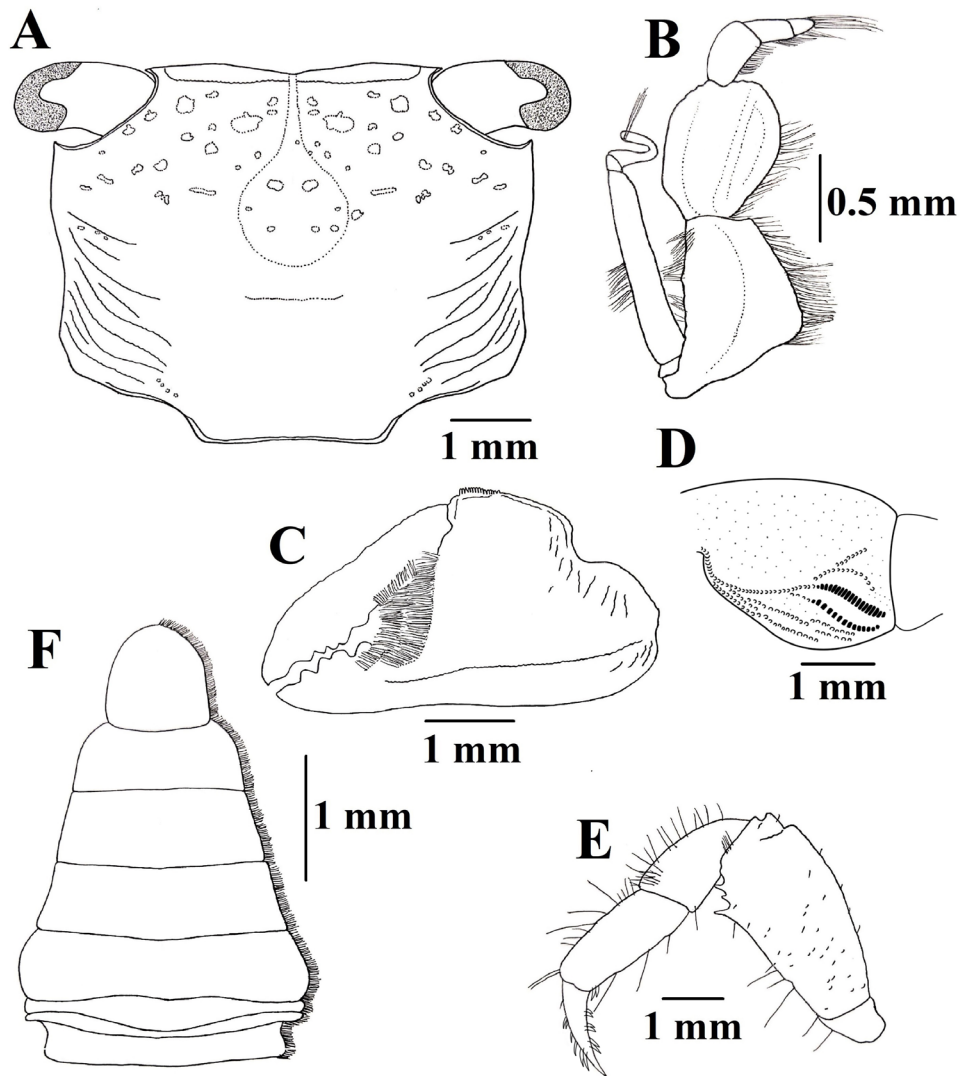


Figure 3. *Nanosesarma batavicum* (Moreira, 1903). Male, (GUMSIS1) (CL: 4.8 mm; CW: 6.6 mm), Verem, Goa, India. (A) Carapace; (B) right third maxilliped; (C) palm of left cheliped (outer face); (D) dorsal view of left cheliped palm; (E) left P5 (dorsal view); (F) male pleon.

***Nanosesarma minutum* (De Man, 1887)**

(Figs. 1C, 4, 7E, F)

Sesarma minuta De Man, 1887: 650.

Sesarma barbimana — Cano, 1889 (nec De Man, 1888): 245.

Sesarma (Sesarma) minutum — Rathbun, 1910: 327.

Sesarma (Sesarma) minuta — Tesch, 1917: 174. — Tweedie, 1936: 52. — Chhapgar, 1957: 522, pl. 16, figs. k–m.

Sesarma (Sesarma) gordonii — Shen, 1935: 27, figs. 7A–D.

Nanosesarma minuta — Tweedie, 1950: 311.

Nanosesarma cf. *minutum* — Crosnier, 1965: 70, text-figs. 89, 109–115, pl. 6, fig. 1.

Nanosesarma minutum — Serène and Soh, 1970: 393.

Material examined. 10 males (CL: 2.4–4.6 mm, CW: 3.1–5.9 mm), 7 females (CL: 2.6–4.9 mm, CW: 3.3–6.2 mm), LFSC.ZRC-186, India, Goa, Chapora Estuary (15°37'21"N 73°44'45"E), coll. Mithila Bhat, 13 May 2016.

Diagnosis. Carapace quadrangular, 1.26 wider than long; lateral margins almost straight, gradually diverging posteriorly; dorsal surface, strongly rugose,

slightly convex, covered with scattered pits and sparsely placed setae only on front, protogastric, mesogastric and branchial regions delimited by conspicuous depressions. External orbital tooth truncate and triangular, followed by sharp epibranchial tooth. Several oblique, low, setose granulated striations extending across branchial regions (Figs. 1C, 4A). Frontal margin bilobed, strongly declivous, thickly setose, at level of eyes, frontal lobes separated by shallow depression; 4 inconspicuous postfrontal lobes covered with setose patches, separated by longitudinal grooves. Ocular peduncle well-developed, slightly setose, cornea terminal (Fig. 4A).

Third maxillipeds with distinct rhomboidal gap when closed; ischium subrectangular, 1.38 ± 0.19 times longer than wide, 1.18 ± 0.10 times longer than merus, with oblique setose ridge; merus 1.01 ± 0.11 times longer than wide, with oblique setose ridge. Exopod slender, flattened, with long flagellum (Fig. 4B).

Male chelipeds subequal, massive, longer than carapace; palm massive, surfaces rugose, dorsal surface without oblique pectinated crest, 3 inconspicuous oblique granulated ridges; outer surface with densely setose patch extending anteriorly to proximal portion of fingers, pitted, prominent granular ridge on lower half commencing on pollex and extending posteriorly up to carpal junction, 4 rows of closely spaced granules above granular ridge; inner surface sparsely granulated. Fingers massive, curved, with rounded spatulate tips, gaping when closed. Cheliped dactylus of male short with proximal setose granular patch on dorsal surface, transverse ridges absent; inner and outer surfaces with proximal setose granular patch. Cutting edge of dactylus with large subdistal tooth, followed by 2 small median and 2 large proximal teeth, that of pollex with large subdistal tooth, followed by 2 small teeth, large median tooth and 3 or 4 small teeth (Fig. 4C).

Pereopods compressed, shorter than chelipeds. P2 and P5 short, P3 and P4 subequal. P4 and P5 meri flattened, anterior margin terminating in blunt angle followed by subdistal spine; postero-distal margin with minute distal tooth-shaped granules followed by one spinule. P2–P5 propodi and carpi with long bristles on anterior margins. Propodi about twice as long as

wide, posterior margins with 2 distal spines and few long bristles. Dactyli smooth, tip corneous, slightly curved, with 4 slender subdistal spines (Fig. 4D).

Male pleon narrow ($PW/CW = 0.40 \pm 0.04$), bluntly triangular, surface pitted; lateral margins finely granulated, densely setose; telson 1.17 times as long as wide, 2.00 times as long as pleomere 6 (Fig. 4E). Female pleon wide ($AW/CW = 0.72 \pm 0.10$), rounded, pleomere 6 with rounded distal margin, margins densely setose; telson wider than long, almost completely sunken into distal margin of pleomere 6 (Fig. 4F).

G1 long, straight, corneous distal part curved, long scoop-shaped, flanked by stiff bristles, groove at base of tip extends along ventral surface to G1 base (Fig. 7E, F).

Remarks. The morphology of the present specimens agree with that reported by De Man (1887), Rathbun (1910), Tweedie (1950), and Crosnier (1965). However, it differs in having the presence of stiff distal setae on the G1 tip, which was probably omitted in the earlier reports. Morphological comparison with other Indian congeneric species is provided in Tab. 1.

Distribution. *Nanosesarma minutum* was originally described from Edam Island near Jakarta, Indonesia and later reported from Malaysia, Singapore, Gulf of Thailand, South China Sea (Tweedie, 1936, 1950), Madagascar (Crosnier, 1965), Tanzania (Hartnoll, 1975), and India (Trivedi et al., 2018). In India, it is known from Gujarat (Saravanakumar et al., 2007), Maharashtra (Pati et al., 2012), Goa (present study), and Tamil Nadu (Kathirvel and Gokul, 2010).

***Nanosesarma sarii* Naderloo and Türkay, 2009**
(Figs. 1D, 5, 7G, H)

Nanosesarma (*Nanosesarma*) *minutum* — Tirmizi and Ghani, 1996: 159, fig. 61A–D [not *Sesarma minutum* De Man, 1887].

Nanosesarma minutum — Jones, 1986: 160, pl. 46. [not *Sesarma minutum* De Man, 1887].

Nanosesarma sarii Naderloo and Türkay, 2009: 9212–9218, figs. 1A, B, 2, 3.

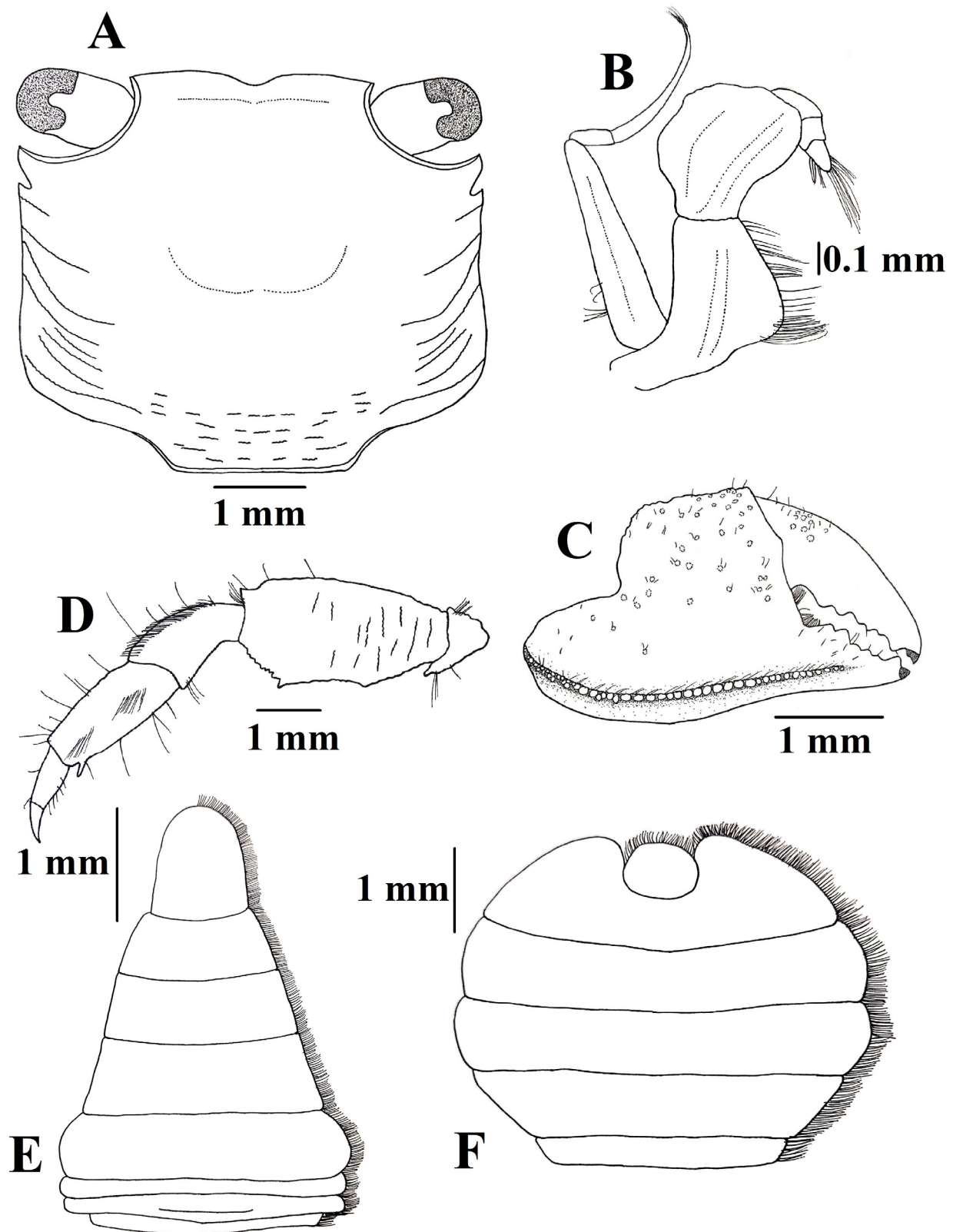


Figure 4. *Nanosesarma minutum* (De Man, 1887). **A–E**, Male, (LFSC.ZRC-186) (CL: 4.8 mm; CW: 5.9 mm), Chapora Estuary, Goa, India; **F**, female (LFSC.ZRC-186) (CL: 4.8 mm; CW: 6.1 mm), Chapora Estuary, Goa, India. **(A)** Carapace; **(B)** right third maxilliped; **(C)** palm of right cheliped (outer face); **(D)** left PS (dorsal view); **(E)** male pleon; **(F)** female pleon.

Material examined. 3 males (CL: 4.6–5.6 mm, CW: 5.4–6.6 mm), LFSC.ZRC-188, India, Gujarat, Shivrajpur (21°19'55"N 68°57'02"E), coll. Jigneshkumar Trivedi, 3 February 2016.

Diagnosis. Carapace quadrangular, 1.13–1.17 times wider than long, widest at the level of second anterolateral teeth, evenly convex, sparsely plumose; lateral margins slightly concave, slightly converging posteriorly, dorsal surface covered with setal tufts and sparsely placed short and thin plumose setae, well-defined gastric region contained by deep groove, cardiac region with shallow groove. External orbital tooth sharply triangular, followed by smaller, slightly pointed epibranchial tooth. Dorsal surface finely granulated, 2 transverse granulated ridges originating from lateral margin, almost parallel to posterolateral margin, first ridge emerging just after epibranchial tooth, extending towards central region of carapace, second ridge originating near end of lateral margin, terminating at posterolateral edge, further 2 less-prominent, short ridges present, one emerging almost from the V-shaped notch between the anterolateral teeth, moving subparallel to first prominent ridge, other below first prominent one, nearly parallel to it (Figs. 1D, 5A). Basal antennal article long (Fig. 5B), reaching to about half of second article, antennae flagellum short, reaching cornea.

Third maxillipeds with distinct rhomboidal gap when closed, ischium subrectangular, 1.37 times longer than merus, internal margin crenulated, with long setae; merus subovate 1.18 times longer than wide, with longitudinal furrow on outer surface, margins crenulated, internal margin with long setae. Exopod slender, with long flagellum (Fig. 5C).

Chelipeds subequal; palm with entire outer surface covered with dense setae above lower row of granules, extending anteriorly to midlength of fingers (Fig. 5D), 3 rows of granules, lowermost regularly granulated, extending to centre of pollex, middle one short, irregularly granulated, subparallel to lower one, uppermost short, irregularly granulated, upcurving, upper margin with crenulated longitudinal line, dorsal surface without oblique pectinate crest or granulated ridges. Dactylus (except tip) with dorsal

surface completely tuberculated, densely set small tubercles on proximal part with 6 comparatively large granules, all covered by tufts of setae, cutting edge with small teeth. Pollex short, smooth, cutting edge with several small teeth and large prominent one medially, finger-tips spatulate (Fig. 5E).

Pereopods medium-sized, P2 and P5 short, P3 and P4 longest, anterior meral margins weakly crenulated, bearing pointed subdistal tooth, posterior margins crenulated, posterodistal lobe denticulate. Propodi usually longer, about twice as long as wide with oblique carina on posterior face, 2 rows of long setae along propodus on anterior and posterior margins, P2–P4 with small brown setae on anterior margin of propodus, setae prominent and dense on P2. Dactyli distinctly more than half as long as propodus, with 8–10 spines, in 2 rows on posterior margin, 2 or 3 spines on anterior margin of P5, female P5 without any spine on anterior margin (Fig. 5F).

Male pleon elongated, triangular, smooth, pleomere 6 almost twice as broad as long, telson markedly elongate, about 1.60 times as long as broad (Fig. 5G).

G1 long, nearly straight, corneous distal part curved outwards with long stiff setae, groove at proximal part, with terminal opening on lateral side (Fig. 7G–H).

Remarks. The specimens examined in the present study agree with the holotype description of *N. sarii* provided by Naderloo and Türkay (2009). The morphological comparison of *N. sarii* with other species of *Nanosesarma* reported from India is provided in Tab. 1.

Distribution. *Nanosesarma sarii* is previously known from Persian Gulf, Gulf of Oman, and Pakistan (Naderloo and Türkay, 2009). The present specimens represent the first record from India.

***Nanosesarma jousseaumei* (Nobili, 1906)**

(Figs. 1E, 6, 7I, J)

Sesarma (*Sesarma*) *jousseaumei* Nobili, 1906: 411. — Nobili, 1906: 323, pl. 8, fig. 9.

Sesarma (*Sesarma*) *jousseaumei* — Laurie, 1915: 416. — Guinot, 1976: 283.

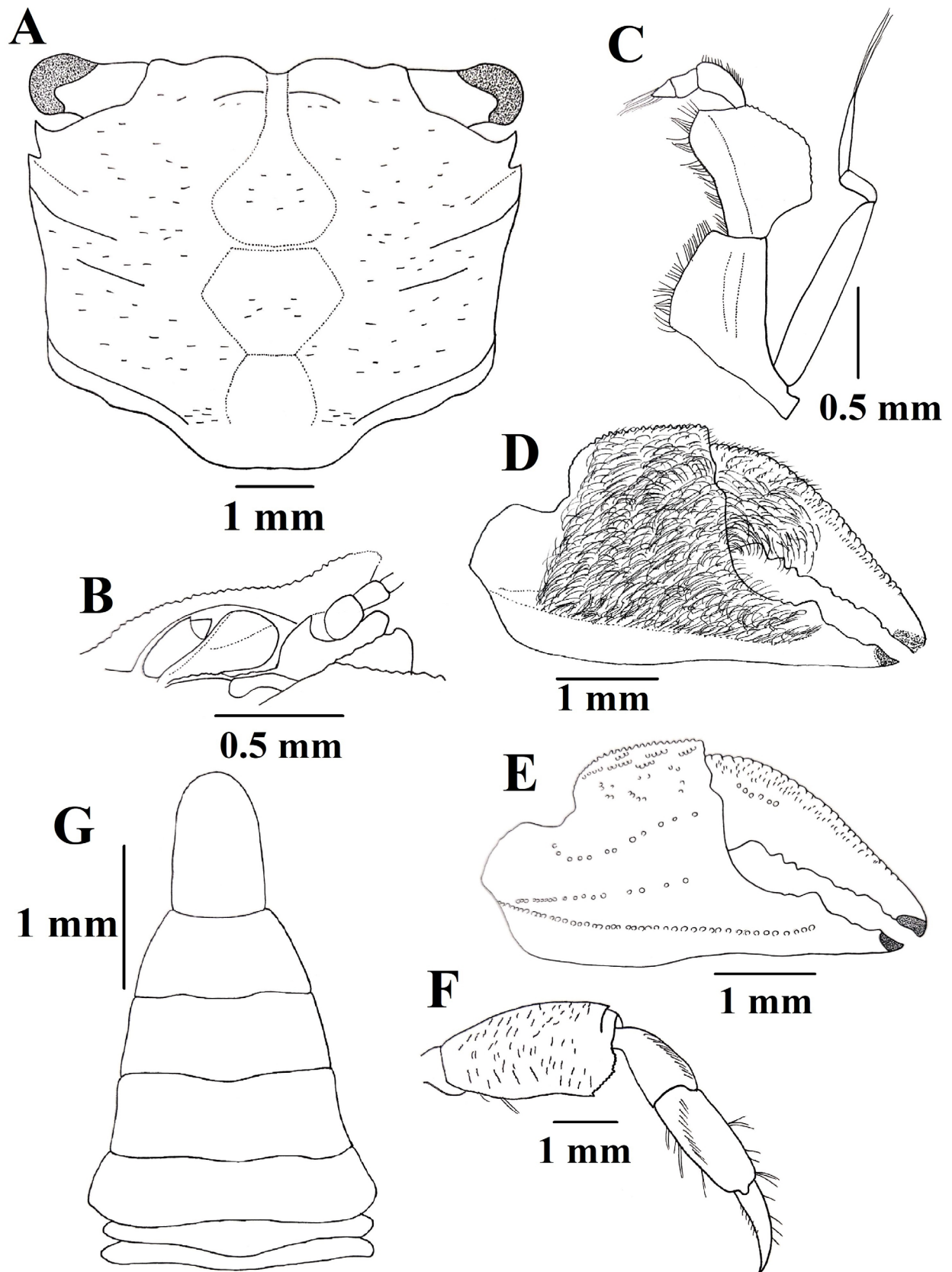


Figure 5. *Nanosesarma sarii* Naderloo and Türkay, 2009, male (LFSC.ZRC-188) (CL: 5.6 mm; CW: 6.6 mm), Shivrajpur, Gujarat, India. (A) Carapace; (B) basal antennular and antennal articles; (C) left third maxilliped; (D) palm of right cheliped (with setae); (E) palm of right cheliped (outer face without setae); (F) right PS (dorsal view); (G) male pleon.

Nanosesarma jousseaumei — Holthuis, 1977: 172–174.
— Ng et al., 2008: 221. — Poupin et al., 2018: 71,
fig. 19G.

Material examined. 5 males (CL: 2.71–4.82 mm, CW: 3.12–5.55 mm), 12 females (CL: 5.43–5.41 mm, CW: 4.08–6.24 mm), LFSC.ZRC-187, India, Gujarat, Shivrajpur (21°19'55"N 68°57'02"E), coll. Jigneshkumar Trivedi, 3 February, 2016.

Diagnosis. Carapace quadrangular, 1.1–1.15 times wider than long, lateral margins almost straight, converging posteriorly; dorsal surface smooth, covered with setal tufts and long setae sparsely set among shorter plumose setae, regions well defined, front slightly protruded, bilobed with a shallow depression, extending to gastric region, straight depression separating gastric and cardiac regions, cardiac region with 2 small elevations, separated from intestinal region by a shallow depression, weakly granulated oblique ridge on posterior surface of carapace, extending from lateral margin to posterior edge. External orbital tooth triangular, followed by small, blunt epibranchial tooth (Figs. 1E, 6A). Basal antennal article (Fig. 6B) long, reaching to base of flagellum.

Third maxilliped morphology identical to that of *N. sarii*; ischium 1.33 times longer than merus, internal margin crenulated, possess long setae, merus 1.26 times longer than wide, with crenulated longitudinal margins, internal margin with long setae. exopod slender, with long flagellum (Fig. 6C).

Chelipeds distinctly unequal, palm relatively large, dorsal surface without oblique pectinate crest or granulated ridges, outer surface bearing 3 rows of tubercles fully covered with dense setae extending anteriorly to proximal portion of fingers (Fig. 6D), lower one with small tubercles, extending to basal third length of pollex, middle one shortest, oblique, with relatively large tubercles, upper row of granules short, nearly parallel to median one. Upper margin with sparse tubercles, some tubercles present on upper part. Fingers shorter than palm, with a large gap in proximal half, dactylus straight, dorsal surface completely

smooth, small proximal granules with a large distinct tubercle on outer surface, distal half of cutting edge with 6 or 7 low tubercles, distalmost larger, pollex cutting edge with large prominent tubercle in middle part, tips of fingers spatulated (Fig. 6E).

Pereopods medium-sized, all articles except dactylus, densely covered with short plumose setae, long bristles between them. Meral posterior margins with distinct tooth-shaped granules, posterodistal margin with spiniform teeth, proximal one largest. Carpal anterior and posterior margins with longitudinal line of small tubercles, P5 without such line on posterior surface of carpus. Propodi smooth, 1.5 times as long as wide, posterodistal end with 2 groups of 3 small spines. Dactylus ending in large spine; 6 spines in 2 rows along posterior margin (Fig. 6F).

Male pleon bluntly triangular, pleomere 6 about 3.5 times as broad as long, lateral margins gently converging distally, telson 0.97 times as long as wide, rounded distally (Fig. 6G). Female pleon large, round, pleomere 6 longer than others, telson small, inserted into pleomere 6 (Fig. 6H).

G1 long, straight, distal part long, gently bending outwards, covered with long setae, posterior surface concave, groove nearly straight, terminal opening in posterior apical part. Some plumose setae along lateral margin (Fig. 7I–J).

Remarks. The specimens examined in the present study agree with the descriptions and illustrations of *N. jousseaumei* and *N. sarii* as discussed in Naderloo and Türkay (2009). The morphological comparison of *N. jousseaumei* with other species of *Nanosesarma* reported from India is provided in Tab. 1.

Distribution. *Nanosesarma jousseaumei* was originally described from Gulf of Aden (Nobili, 1906), and later reported from Madagascar, Dar es Salaam, Persian Gulf (Naderloo and Türkay, 2009), Mayotte (Poupin et al., 2018), and India (Trivedi et al., 2018). In India, it is known only from Gujarat (Ghosh, 2004; Dev Roy, 2013; present study).

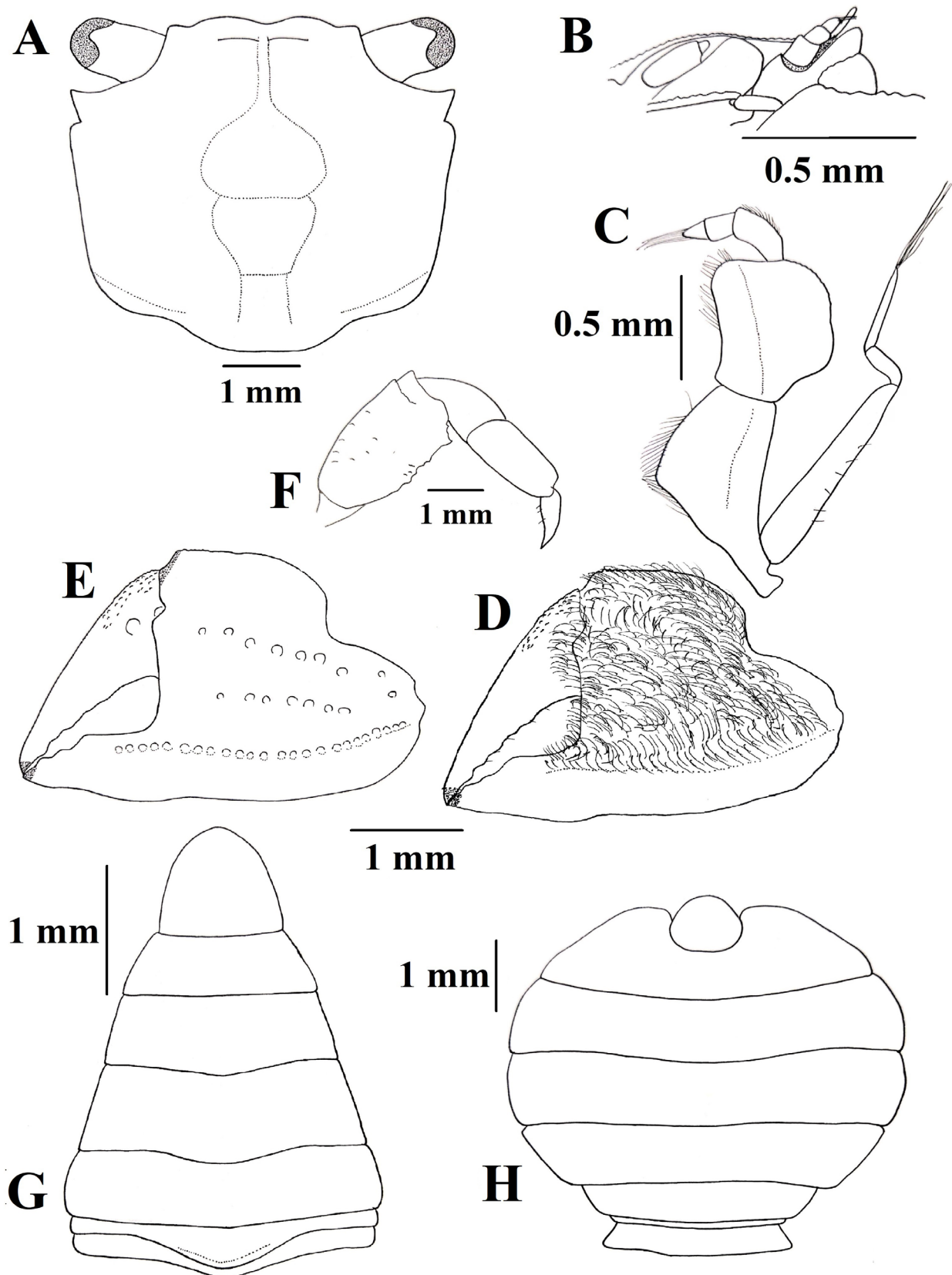


Figure 6. *Nanosesarma jousseaumei* (Nobili, 1906). **A–F**, Male (LFSC.ZRC-187) (CL: 4.8 mm; CW: 5.5 mm), Shivrajpur, Gujarat, India; **G**, female (LFSC.ZRC-187) (CL: 5.4 mm; CW: 6.2 mm), Shivrajpur, Gujarat, India. **(A)** Carapace; **(B)** basal antennular and antennal articles; **(C)** left third maxilliped; **(D)** palm of left cheliped (outer face with setae); **(E)** palm of left cheliped (outer face without setae); **(F)** right PS (dorsal view); **(G)** male pleon; **(H)** female pleon.

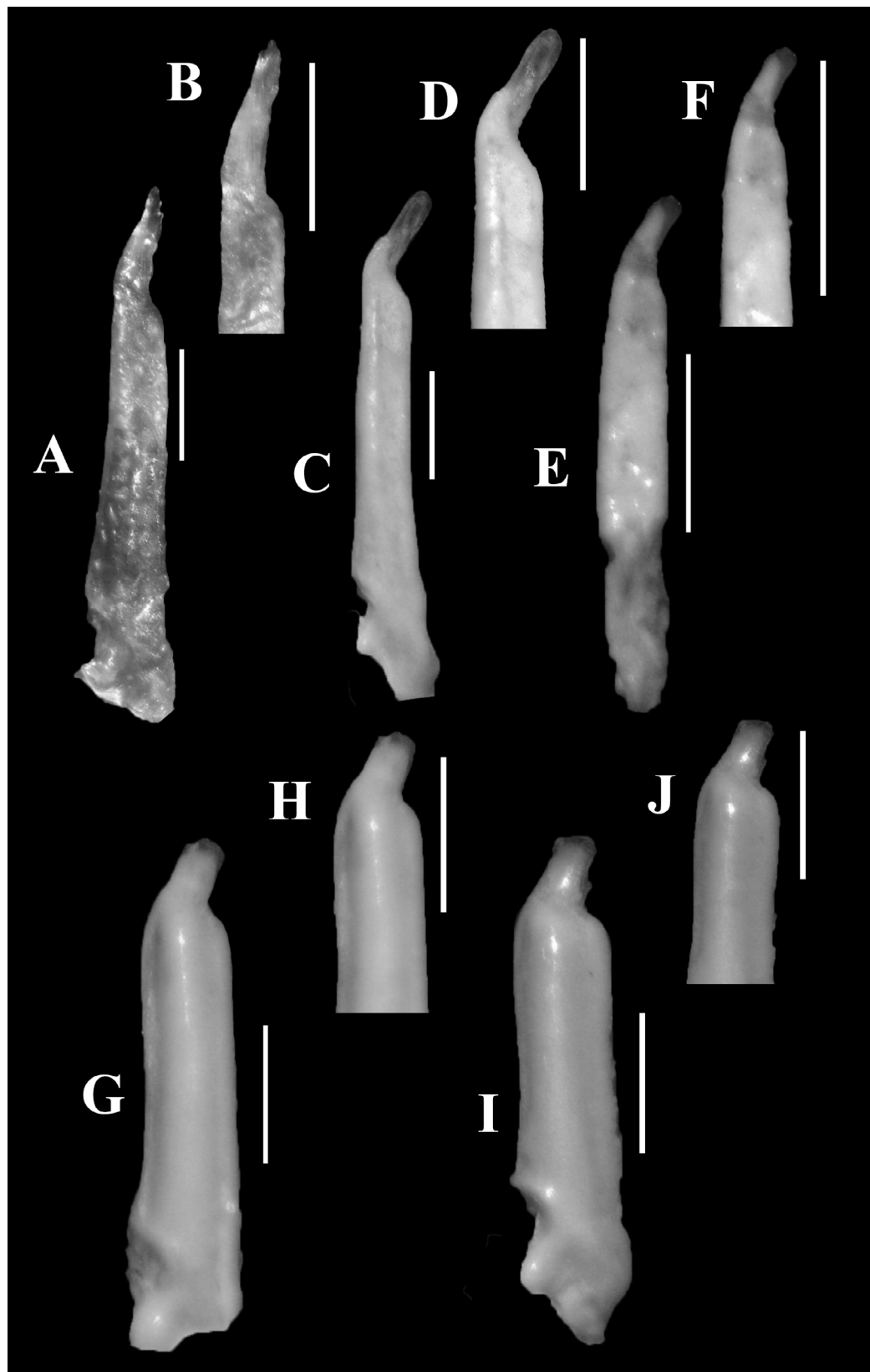


Figure 7. *Nanosesarma* G1 ventral view. (A, B) *N. andersoni* (De Man, 1888), male (CL: 4.8 mm; CW: 6.5 mm), (LFSC.ZRC-185); (C, D) *N. batavicum* (Moreira, 1903), male (CL: 4.8 mm; CW: 6.6 mm) (GUMSIS1); (E, F) *N. minutum* (De Man, 1887), male (CL: 4.8 mm; CW: 5.9 mm) (LFSC.ZRC-186); (G, H) *N. sarii* Naderloo and Türkay, 2009, male (CL: 5.6 mm; CW: 6.6 mm) (LFSC.ZRC-188); (I, J) *N. jousseaumei* (Nobili, 1906), male (CL: 4.8 mm; CW: 5.5 mm) (LFSC.ZRC-187); (A, C, E, G, I) ventral view of left G1; (B, D, F, H, J) ventral view of distal part of left G1 (setae removed). Scale bars = 1 mm.

Key to *Nanosesarma* species from India

1. Cheliped palm dorsal surface with pectinate crest2
 - Cheliped palm dorsal surface without pectinate crest3
2. Cheliped palm dorsal surface with 2 oblique pectinate crests and 4 or 5 oblique granular ridges; dactylus dorsal surface with row of 13 or 14 tubercles*N. andersoni*
 - Chelipeds palm dorsal surface with 2 oblique pectinate crests and 5 or 6 oblique granular ridges; dactylus dorsal surface with row of 12 prominent transverse ridges*N. batavicum*
3. Male cheliped palm dorsal surface with 3 oblique granulated ridges; dactylus dorsal surface with proximal granular patch*N. minutum*
 - Male cheliped palm dorsal surface unarmed; dactylus dorsal surface either tuberculate or smooth.....4
4. Male chelipeds with thick setose patch on entire outer surface of palm extending up to midlength of fingers; dactylus dorsal surface completely tuberculated; telson about 1.60 times as long as wide*N. sarrii*
 - Male chelipeds with thick setose patch on entire outer surface of palm extending to proximal portion of fingers; dactylus dorsal surface completely smooth; telson about 0.97 times as long as wide ...*N. jousseumei*

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Competing interests

The authors declare no competing interest.

ADDITIONAL INFORMATION AND DECLARATION**Authors Contribution**

Conceptualization: VPP, CUR, JNT. Performed research: VPP, KJP, CUR, JNT. Acquisition of data: VPP, KJP, CUR, JNT. Analysis and interpretation of data: VPP, KJP, CUR, JNT. Preparation of figures/tables/maps: KJP and JNT. Writing - original draft: VPP, KJP, CUR, JNT. Writing - critical review & editing: VPP, KJP, CUR, JNT.

Consent for Publication

All authors declare that they have reviewed the content of the manuscript and give their consent to submit the document.

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