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with my regards  
Peter Davie

REVISION OF *NEOSARMATIUM* SERÈNE AND SOH (CRUSTACEA: BRACHYURA: SESARMINAE) WITH DESCRIPTIONS OF TWO NEW SPECIES

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*Neosarmatium* Serène & Soh, 1970, is revised and re-diagnosed. Crabs of this genus are primarily characterised by a deeply vaulted, sub-quadrate, carapace, with the anterolateral margins with 0-2 teeth behind the exorbital angles; the upper surface of the palm of the chelipeds is without pectinate crests and usually defined anteriorly by a swollen longitudinal ridge; the outer surface of the palm usually with a median longitudinal row and the dorsal surface of the dactyl often bearing spines or blunt teeth; the legs are of medium length, flattened, and broad. Twelve *Neosarmatium* species are recognised as valid, including two new species: *N. fourmanoiri* Serène, 1973, *N. indicum* (A. Milne Edwards, 1868), *N. inerme* (De Man, 1887), *N. integrum* (A. Milne Edwards, 1873), *N. laeve* (A. Milne Edwards, 1869), *N. malabaricum* (Henderson, 1893), *N. meinerti* (De Man, 1887), *N. punctatum* (A. Milne Edwards, 1873), *N. rotundifrons* (A. Milne Edwards, 1869), *N. smithi* (H. Milne Edwards, 1853), *N. spinicarpus* sp. nov. and *N. trispinosum* sp. nov. Records of *Neosarmatium indicum*, *N. punctatum* and *N. malabaricum* have been confused, and the identities of these species have now been clarified after examination of the type specimens. The identity of *N. laeve* (A. Milne Edwards, 1869) as a senior synonym for *N. aequifrons* (Rathbun, 1914) and *N. ambonensis* Serène & Moosa, 1971, is clarified for the first time. *N. biroi* (Nobili, 1905) is considered a junior synonym of *N. integrum* (A. Milne Edwards, 1873). *Neosarmatium trispinosum* sp. nov. has long been confused with *N. smithi*, from which it can be easily separated by the shape and position of the teeth on the upper margin of the dactyl of the male cheliped. All records of *N. smithi* from the coast of Queensland, including published ecological studies, refer to *N. trispinosum* sp. nov. Lectotypes are designated for *Neosarmatium indicum* (A. Milne Edwards, 1868), *N. inerme* (De Man, 1887), *N. integrum* (A. Milne Edwards, 1873), and *N. punctatum* (A. Milne Edwards, 1873). □ Crustacea, Brachyura, Grapsidae, Sesarminae, *Neosarmatium*, mangroves, Indo-West Pacific, new species.

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Crabs of the genus *Neosarmatium* are among the largest of the intertidal mangrove sesarmines. The species that have so far been studied are primarily herbivorous, and along with other sesarmines, appear to be responsible for consuming a large percentage of the annual leaf fall of mangrove forests (Robertson & Daniel, 1989; Robertson, 1991; Smith et al., 1991).

The present paper is the third (see Davie, 1992, 1993) in a projected series of works intended to revise the genus *Sesarma* s.l. and clarify and correct some of the problems that have arisen from Serène & Soh's somewhat premature 1970 paper diagnosing 10 new genera, and 3 new sub-genera.

*Neosarmatium* was diagnosed by Serène & Soh (1970), to include a number of Indo-West Pacific species previously included in *Sesarma* (*Sesarma*) or *Sarmatium* Dana. Davie (1992) has revised *Sarmatium* and clearly defined its generic

limits. Six of the species that were placed in *Sarmatium* by Tesch (1917): *S. integrum* A. Milne Edwards, 1873, *S. inermis* De Man, 1887, *S. indicum* A. Milne Edwards, 1868, *S. punctatum* A. Milne Edwards, 1873, *S. biroi* Nobili, 1905 (= *integrum*) and *S. fryatti* Tesch, 1917 (= *rotundifrons* A. Milne Edwards, 1869) are now all included in *Neosarmatium*.

I have given references to non-taxonomic papers concerning some species. This listing is not meant to be exhaustive. It is primarily provided in an attempt to clarify cases where such authors have wrongly identified their study animals; and secondarily as an introduction to other biological studies.

While I have provided a full new description for most species, in several cases I have provided only a diagnosis because comprehensive and/or recent descriptions are available.

The descriptions for this paper were prepared

using the DELTA computer system for generating taxonomic descriptions (Dallwitz & Paine, 1986). Measurements given in the text are of the carapace breadth (measured at the widest point) followed by length. Leg segments were measured in a straight line to give maximum dorsal length and so are not always the maximum possible length. The exact limits of the width of the posterior margin of the carapace are also sometimes difficult to determine and in this work they were defined by the point at which the lateral carapace suture meets the posterior margin. Gonopod terminology follows that of Sakai & Yatsuzuka (1979).

ABBREVIATIONS USED: c.b., carapace breadth; Ck, Creek; BMNH, British Museum (Natural History); MNHN, Muséum national d'Histoire naturelle, Paris; ZRC, Zoological Reference Collection, Department of Zoology, National University of Singapore; NNM, National Natural History Museum, Leiden; NT, Northern Territory, Australia; ppt, parts per thousand; QLD, Queensland, Australia (ME.QLD = mid-eastern Queensland; NE.QLD = north-eastern Queensland etc.); QMW, Queensland Museum, Brisbane; SMF, Senckenberg Museum, Frankfurt; USNM, National Museum of Natural History, Washington; Z.D.U.Q., Zoology Department University of Queensland; ZMG, Zoological Museum of Goettingen (collection now housed at SMF); ZMH, Zoologisches Institut und Zoologisches Museum, Universität Hamburg; ZMK, Zoological Museum, University of Copenhagen.

## SYSTEMATICS

### *Neosarmatium* Serène & Soh, 1970

*Metagrapsus*: A. Milne Edwards, 1873: 308; De Man, 1880: 31; Kingsley, 1880: 212 [not *Metagrapsus* H. Milne Edwards, 1853: 188].

*Neosarmatium* Serène & Soh, 1970: 397, 405; Sakai, 1976: 665.

#### TYPE SPECIES

*Sesarma smithi* H. Milne Edwards, 1853, by original designation; gender is neuter.

#### DIAGNOSIS

Carapace sub-quadrate; greatest width behind exorbital angles; breadth greater than length. Carapace deeply vaulted; slightly convex laterally. Regions moderately well defined. Anterolateral margins with 0-2 teeth behind ex-

orbital angle. Front moderately to strongly deflexed; with broad median concavity. Post-frontal lobes distinct. Orbital hiatus open. Basal segment of antennal peduncle with well developed outer tongue-like lobe. Inter-antennular septum relatively narrow. Pterygostomial region with well developed reticulation of inter-crossing lines of setae. Third maxilliped merus and ischium subequal; merus longer than wide, outer margin convex; ischium sub-triangular; palp articulating near outer distal margin of merus; exopod narrow, reaching about half length of merus. Chelipeds subequal, large and robust; merus usually with distinct subdistal spine on posterior border; carpus with inner angle slightly produced; upper surface of palm usually, but not always, defined anteriorly by swollen longitudinal ridge; without pectinate crests; outer surface of palm punctate, naked, usually with median longitudinal row, without ventral ridge. Dorsal surface of dactyl usually bearing spines. Fingers pointed; curved slightly inwards; wide gape between cutting margins in adult males. Legs medium length, flattened, broad. Dactyli stout and slightly recurved; terminating in acute chitinous tip. Merus anterior margin with acute sub-distal spine; unarmed terminally. Carpus with accessory carinae on upper surface. Propodus with an accessory carina on inferior proximal portion of upper surface. Merus of last leg smooth, meri of other legs with scattering of small distally directed prickles. Male abdomen often remarkably elongate; relatively narrow; third segment widest; first segment broad, covering entire width of sternum between 4th pereopods. G1 long, reaching just past suture between sternites 3 and 4; moderately stout to slender, curved; apical process present, corneous, strongly produced, straight; gonopore terminal; seta short, simple, lying around corneous tip and apical part of stem obscuring structural detail. G2 short, evenly tapering, slightly twisted, apically rounded.

*Neosarmatium* species recognised as valid in this paper: *N. fourmanoiri* Serène, 1973, *N. indicum* (A. Milne Edwards, 1868), *N. inerme* (De Man, 1887), *N. integrum* (A. Milne Edwards, 1873), *N. laeve* (A. Milne Edwards, 1869), *N. malabaricum* (Henderson, 1893), *N. meinerti* (De Man, 1887), *N. punctatum* (A. Milne Edwards, 1873), *N. rotundifrons* (A. Milne Edwards, 1869), *N. smithi* (H. Milne Edwards, 1853), *N. spinicarpus* sp. nov. and *N. trispinosum* sp. nov.

KEY TO THE SPECIES OF *NEOSARMATIUM*

(Although the key relies heavily on male claw characters, the female chelae usually show the same features, albeit much less obviously, and can therefore usually also be identified. Features enclosed in '[ ]' are included as extra, specific diagnostic characters).

1. Side of carapace without anterolateral teeth separated by a deep notch from the rest of the margin, a single anterolateral tooth may be present as an angular projection [Exorbital breadth sub-equal to length of carapace. Outer surface of palm of cheliped punctate; inner surface with a low granular crest. Colour: purple, chelipeds, pereopods and edges of carapace reddish. Male unknown.] . . . . . *integrum* (A. Milne Edwards, 1873)
  - Side of carapace with one or two anterolateral teeth (second usually reduced to an angular projection) . . . . . 2
2. Dactyl of male cheliped with strong chitinous teeth on dorsal margin . . . . . 3
  - Dactyl of male cheliped either without strong chitinous teeth on dorsal margin, or bearing small, sharp, chitinous spinules only . . . . . 9
3. Dactyl of male cheliped with 2 teeth on dorsal margin . . . . . 4
  - Dactyl of male cheliped with 3-5 teeth on dorsal margin . . . . . 6
4. Inner surface of palm without a strongly raised, granular, vertical crest (4-5 granules may be prominent on large males but are not raised onto a crest); outer surface of male chela with a protruding basal shelf on fixed finger below gape . . . . . *N. indicum* (A. Milne Edwards, 1868)
  - Inner surface of palm with a strongly raised, granular, vertical crest; male chela normal in form, not having a protruding basal shelf on fixed finger below gape . . . . . 5
5. Distal tooth on upper surface of dactyl placed close to middle; upper surface of palm of cheliped with a strong longitudinal rim marking its outer edge; carapace 1.15-1.25 times longer than wide . . . . . *N. malabaricum* (Henderson, 1893)
  - Distal tooth on upper surface of dactyl placed clearly less than half-way to the tip; longitudinal rim present on upper surface of palm of cheliped but not strongly differentiated; carapace 1.25-1.35 times longer than wide . . . . . *N. punctatum* (A. Milne Edwards, 1873)
6. Dactyl of male cheliped with 3 teeth on dorsal margin [carapace length c.1.1 times breadth; strong vertical crest on inside of chela; sixth segment of male abdomen strongly elongated] . . . . . 7
  - Dactyl of male cheliped with 4-5 teeth on dorsal margin . . . . . 8
7. Dactylar teeth truncate, spaced evenly over proximal half . . . . . *smithi* (H. Milne Edwards, 1853)
  - Dactylar teeth acute, set close together over proximal two-fifths . . . . . *trispinosum* sp. nov.
8. Carapace sub-quadrate, maximum carapace width between tips of first anterolateral teeth; 4 evenly spaced, dactylar tubercles; frontal margin without strong median concavity; median and lateral postfrontal lobes of similar width, and not swollen; small species . . . . . *laeve* (A. Milne Edwards, 1869)
  - Carapace with lateral margins markedly convex anterolaterally, maximum carapace width behind tips of first anterolateral teeth; 4 dactylar tubercles; frontal margin with a strong median concavity; median postfrontal lobes wider than laterals, and strongly swollen; large species . . . . . *rotundifrons* (A. Milne Edwards, 1869)
9. Dactyl of cheliped smooth, unarmed [walking legs relatively slender, length of merus of third walking leg 2.6-2.7 times width; male first pleopod short, with distal portion not strongly narrowing, and not much twisted] . . . . . 10
  - Dactyl of cheliped armed with small, sharp, chitinous spinules . . . . . 11
10. Inner angle of carpus of cheliped unarmed; inner face of palm with vertical row of granules behind gape . . . . . *inerme* (De Man, 1887)
  - Inner angle of carpus of cheliped armed with acute granular projection; inner face of palm with a patch of granules ventrally but not extending as a vertical row behind gape . . . . . *spinicarpus* sp. nov.
11. Male chela c.1.7 times longer than high;

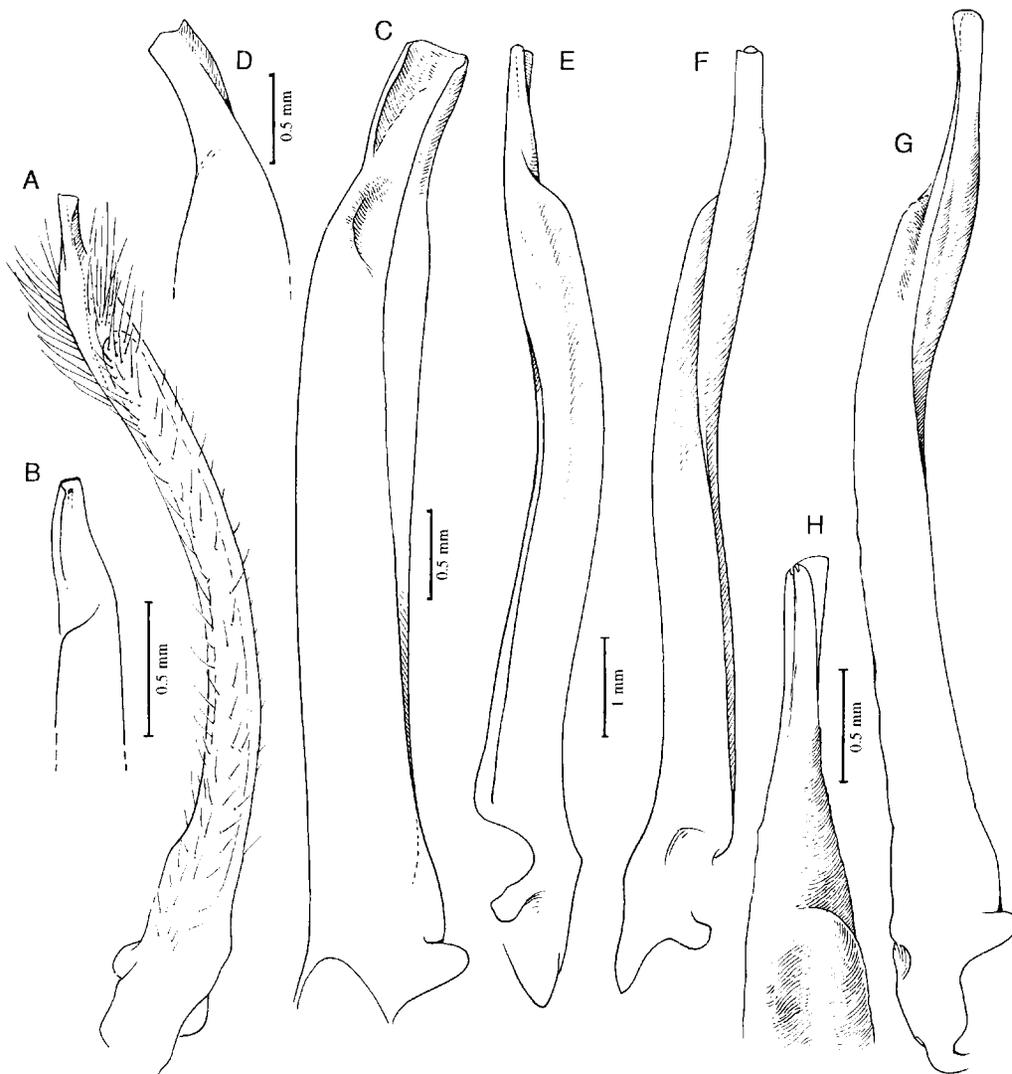


FIG. 1. Male first gonopods (setae removed except for A). A, B, *Neosarmatium laeve* (A. Milne Edwards) [specimen figured is the holotype of *N. aequifrons* (Rathbun)]; C, D, *N. inerme* (De Man), ZMH4080; E, F, *N. indicum* (A. Milne Edwards), ZRC1989.3670; G, H, *N. malabaricum* (Henderson), MNHN-B10461.

lower margin evenly convex; dactylar spinules evenly spaced in a single row, and extending only to about half length of dactyl; vertical granular row on inside of chela strongly developed . . . . .  
 . . . . . *meinerti* (De Man, 1887)

Male chela c.1.8 times longer than high; lower margin straight behind fixed finger; dactylar spinules more numerous, not confined to a single row, and extending almost to tip of dactyl; vertical granular row on inside of chela lower than in *N. meinerti* . . . . .  
 . . . . . *fourmanoiri* Scrène, 1973

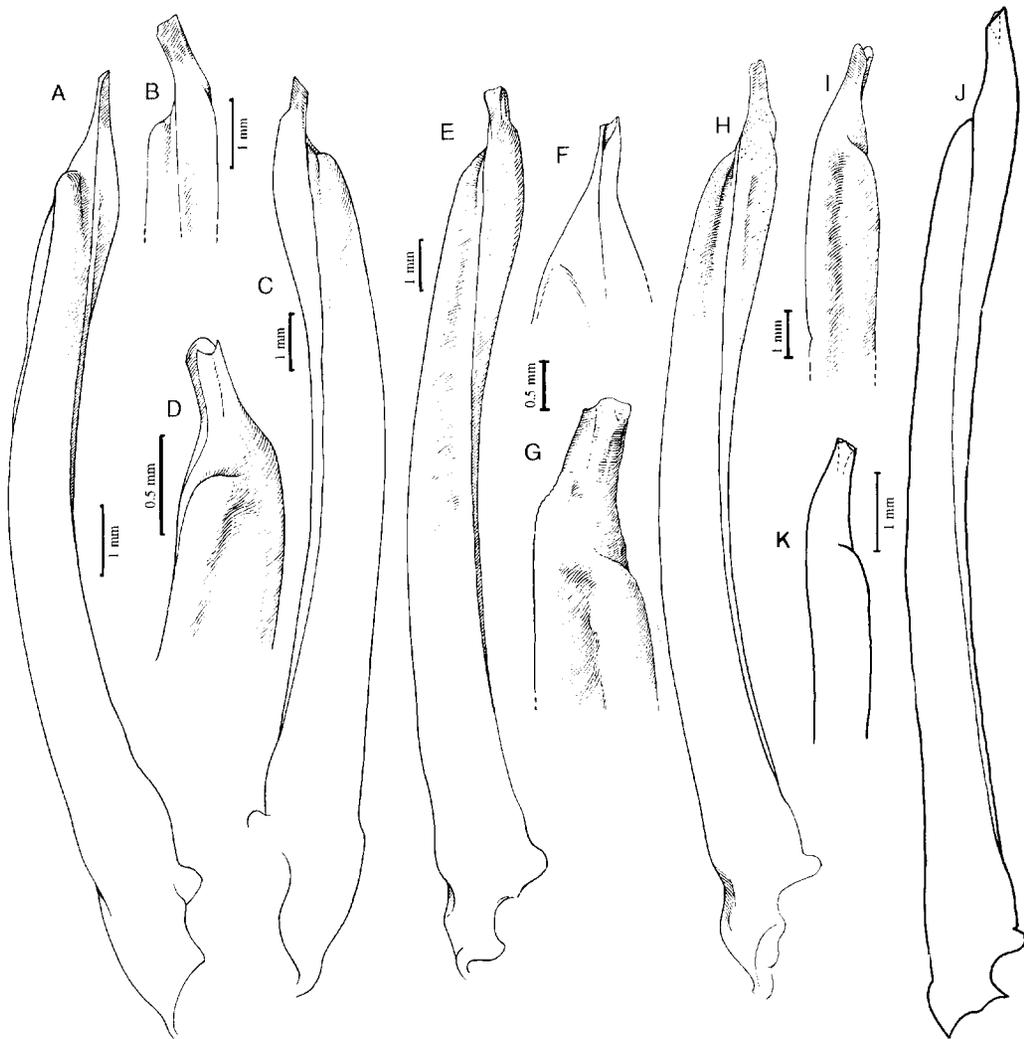


FIG. 2. Male first gonopods (setae removed). A, B, *N. roundifrons* (A. Milne Edwards) [specimen figured is the holotype of *N. fryatti* (Tesch)]; C, D, *N. fourmanoiri* Serène, holotype, MNHN-B10459; E, F, G, *N. meinerti* (De Man), MNHN-B16735; H, I, *N. trispinosum* sp. nov., MNHN unreg., New Caledonia (41.2 x 36.4 mm); J, K, *N. smithi* (H. Milne Edwards), QMW8861.

***Neosarmatium fourmanoiri* Serène, 1973**  
(Figs 2C, D; 3; 16)

*Sesarma tetragona*: A. Milne Edwards, 1873: 304, pl. 16, fig. 4 [not *Cancer tetragona* Fabricius, 1798: 341].

? *Sesarma Meinerti*: Nobili, 1907: 405 [not *Sesarma meinerti* De Man, 1887].

*Sesarma meinerti*: McCulloch, 1913: 322-23.

*Neosarmatium fourmanoiri* Serène, 1973: 126-129, pl.3 A-C.

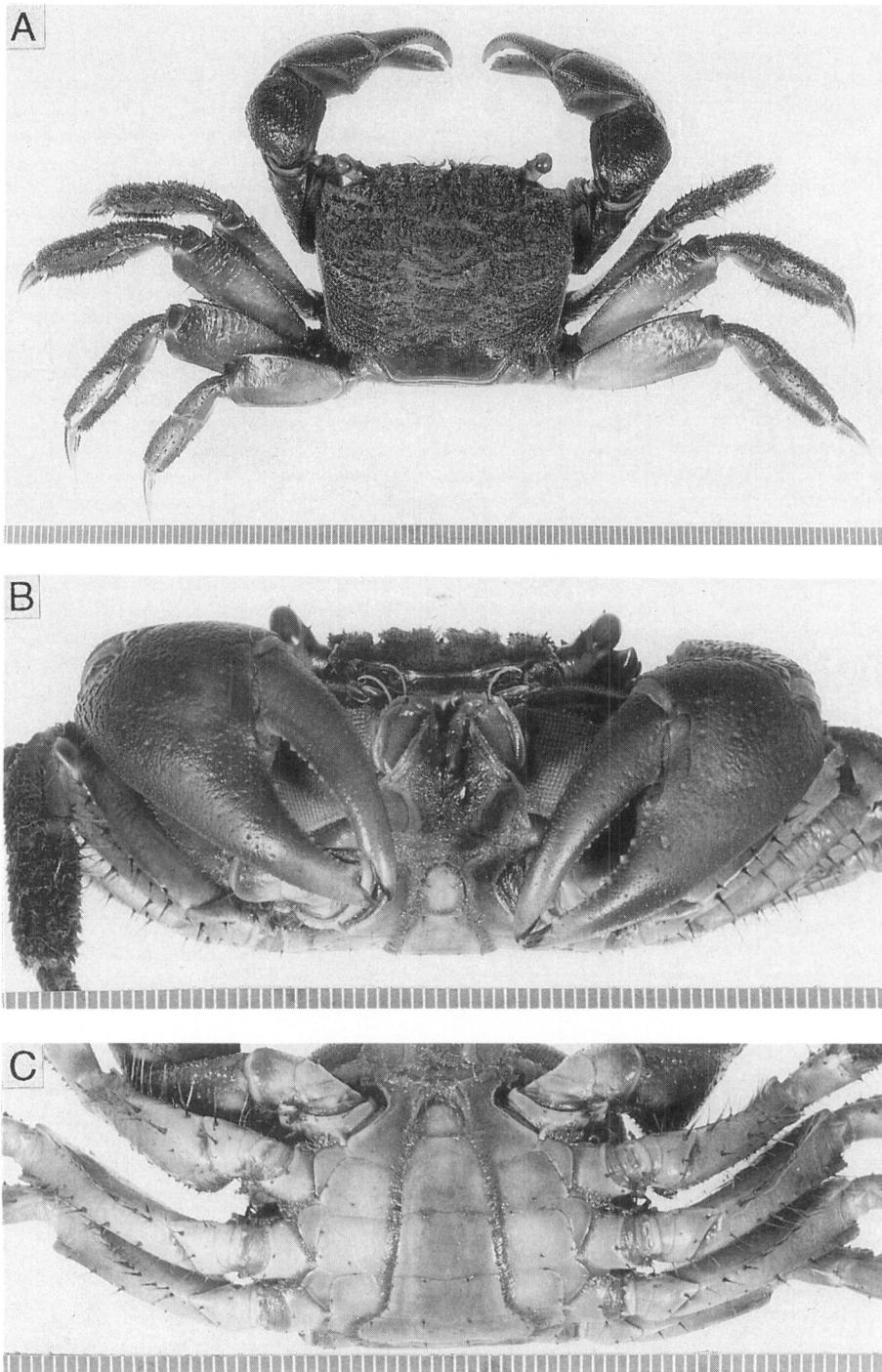


FIG. 3. *Neosarmatium fourmanoiri* Serène, 1973, ♂, QMW4598. A, dorsal view; B, frontal view; C, ventral view. Scale line in mm.

## TYPE INFORMATION

Holotype, MNHN-B10459. Type locality: New Caledonia.

## MATERIAL EXAMINED

HOLOTYPE: MNHN-B10459, ♂ (38.3 x 31.7mm), New Caledonia, R. Serène, 4.9.1971.

OTHER MATERIAL: NEW CALEDONIA: QMW-19558, ♂ (44.1 x 36.6mm), Pam, north New Caledonia, mangroves, 27.2.1992, J. Menou. VANUATU: MNHN unreg., ♂ (38.9 x 31.6mm), *Rhizophora/Xylocarpus* mangroves, in lagoon by Banana Plantation, R. Serène, 10.10.1971; MNHN unreg. (Serène coll.), ♀ (36.0 x 28.0mm), Port Stanley, tidal edge at high water, *Rhizophora/Ceriops* interface, A.G. Marshall, 2.10.1971. INDONESIA: NNMD170, ♂ (35.0 x 29.2mm), Sula Senana, E. of Sulawesi; NNMD169, ♀ (26.2 x 21.2mm), Sulawesi; NNMD1539, ♂ (41.4 x 35.4mm), ♀ (38.1 x 32.0mm), Pacific Ocean [Museum Godeffroy 1887]; NNMD40838, 4♀ (30.9 x 24.6; 30.4 x 29.0; 34.9 x 28.0; 35.5 x 28.3mm), from burrows among trees just behind beach, Holtekang, southern part of Humboldt Bay, near Buaja River, northeastern coast of Irian Jaya, New Guinea, L.B. Holthuis, 12.11.1954. AUSTRALIA: QMW8843, 2♂ (33.1 x 26.5; 30.4 x 24.7mm), Port Stewart, NE.QLD, 14°04'S, 143°41'E, B. Campbell, night collected; SMF unreg., ♀ (29.0 x 22.5mm), ♂ (37.9 x 29.4mm), upper edge of bank under stones and logs, Smith Creek, Cairns, NE.QLD, M. Türkay, 5.6.1980; QMW8841, ♂ (38.5 x 31.0mm), ♀ (30.0 x 23.4mm), Cairns side of Yorkey's Knob, NE.QLD, 5 ppt, 16°49'S, 145°43'E, 14.1.1965, B. Campbell; QMW8844, ♂ (36.8 x 29.5mm), Barron River, NE.QLD, 16°52'S, 145°42'E, Z.D.U.Q.; QMW8840, 4♂ (27.7 x 21.4 - 35.4 x 29.0mm), 5♀ (27.1 x 21.5 - 29.8 x 23.3mm), Airport Swamp, Cairns, NE.QLD, 16°53'S, 145°45'E, Z.D.U.Q.; QMW1123, (dried varnished spec.), Barron Beach, via Cairns, NE.QLD, 16°55'S, 145°46'E; QMW8842, ♂ (33.9 x 26.5mm), Trinity Inlet, Cairns, NE.QLD, 16°58'S, 145°47'E, 5.12.1975, Australian Littoral Society; QMW4598, ♂ (34.7 x 29.3mm), nth end of Admiralty Is., Trinity Inlet, Cairns, NE.QLD, 16°58'S, 145°47'E, Jan. 1975, M. Graham, found in entrance to burrows in Blady Grass on the edge of a terrestrial ridge amongst the open (4-5m) *Xylocarpus*, *Ceriops*, *Lumnitzera racemosa* and *L. littorea* mangroves; QMW8879, ♀ (31.1 x 23.7mm), Road to Lucinda, near Ingam, NE.QLD, 18°32'S, 146°2'E; QMW8845, ♂ (43.5 x 34.5mm), Townsville, NE.QLD, 19°16'S, 146°49'E, Z.D.U.Q.; QMW12901, 1♂, mangroves behind Gap Beach, Lindeman Is., ME.QLD, 20°27'S, 149°02'E, 25.3.1987, P.Davie, J.Short; QMW12902, 2♂, mangroves behind Gap Beach, Lindeman Is.,

ME.QLD, 20°27'S, 149°02'E, 27.3.1987, P.Davie, J.Short.

## DESCRIPTION

*Carapace*. c.1.2 times broader than long. Fronto-orbital width c.1.1 times carapace length. Depth c.0.7 times carapace width. Cardiac region distinct. Lateral margins slightly convergent posteriorly; slightly convex, or straight. Anterolateral margins with a single epibranchial tooth. Exorbital angle triangular and sharp. Anterolateral tooth triangular and sharp; similar in size to exorbital angle. Front c.0.55 times carapace width; c.0.6 times fronto-orbital width; pre-orbital concavity present; lateral margins parallel and convex. Post-frontal lobes with clumps of stout setae meeting over frontal furrow, and each with fringe of prominent dark setae. Short ridge medially on first epibranchial tooth. Branchial ridges prominent; first follows from typical position of second epibranchial tooth, relatively long; second arising just short of lateral margin; other ridges also arise near lateral margin; last ridge long, curved over base of last leg. Posterior margin c.0.4 times carapace width. Carapace surface smooth, shining, punctate; wrinkled posteriorly. Soft setae arranged sparsely on branchial lines and in short rows over entire surface; longest and most conspicuous over anterior half, almost lost on intestinal region. Upper orbital border smooth, slightly oblique; moderately convex mesially; inner angle rounded. Lower orbital border straight; evenly granular. Inter-antennular septum c.0.3 times width of front.

*Third maxilliped*. Suture between merus and ischium obliquely sloping inward. Ischium inner margin smooth. Exopod narrow, barely visible in frontal view; c.0.5 times width of ischium.

*Chelipeds*. Merus with posterior border bearing minute granular striations; without distinct sub-distal spine; lower border granulate; anterior border tuberculate, tubercles larger in proximal half; carpus with inner angle not produced; inner margin granular, rectangular facet more-or-less defined by two granular ridges; males (but not females) lacking brush of stiff setae on ventro-proximal end of this facet characteristic of other species; granules present on inner face of carpus just below inner angle; outer margin striated. Upper surface of palm not defined anteriorly by a longitudinal ridge. Outer surface of palm naked, microscopically granular, punctate, without median longitudinal row. Inner surface of palm minutely granular; with a low vertical band of

small granules. Immovable finger rounded on outer surface; moderately long; length cutting edge c.0.46 times length propodus. Ventral border of chela straight, or slightly convex. Dorsal surface of dactyl minutely granular. Fingers with tips, corneous, toothed, intermeshing; curved inwards; a moderate gape between cutting margins.

*Walking legs.* Second pair the longest, c.1.7 times maximum carapace width. Merus of third leg c.2.3 times as long as wide. Carpus c.2.3 times as long as wide. Propodus c.2.1 times as long as wide. Dactyli about equal to length of propodi. Meri of legs 1-3 with scattering of small distally directed prickles, arranged on transverse crests in upper part. Meri generally without setae except for some longer bristles ventrally; carpi and propodi bear a thick fur of soft setae on anterior and posterior margins, most extensive on the first two pairs where the setae also cover most of the ventral face of these segments, but reduced to a sparse, narrow, vestige on last pair; setae continue onto dactyli in narrow rows.

*Male abdomen.* Segment 1 narrow, c.0.9 times width segment 3. Width segment 3 c.4.2 times length. Segment 6 elongated; 1.1 times wider than long. Telson much shorter than segment 6; slightly shorter or subequal to segment 5; c.1.3 times longer than wide; evenly rounded.

*Gonopods.* G1 inner-dorsal margin straight and distally curved inward. Dorsal surface of stem flattened; completely calcified. Palp present, poorly developed, not separated from stem, large, narrow, rounded, calcified. Outer dorsal margin of stem convex. Distal part of the stem broad. Apical process present, corneous, moderately produced, straight. Gonopore terminal. Setae long and displaced around apex, obscuring structural detail. G2 short, straight, narrow, evenly tapering, slightly twisted.

#### COLOUR

The carapace and walking legs are a dark violet brown, nearly black. The chelipeds are a uniform bright dark red or (rarely) dark purplish.

#### REMARKS

*Neosarmatium fourmanoiri* bears a very close resemblance to *N. meinerti*. The main differences are:

1. The chelae of *N. fourmanoiri* are proportionately not as high, the mean length to height ratio being 1.81 compared to 1.70 in *N. meinerti* although there is some overlap between individual specimens; 2. The gape between the fingers of adult male *N. fourmanoiri* is compar-

tively much less than in *N. meinerti*; 3. The vertical crest on the inside of the palm of *N. meinerti* has a single even row of comparatively much larger tubercles; 4. The chitinous tubercles on the superior margin of the finger in *N. fourmanoiri* are fine, and form a broad band which extends almost to the tip. In *N. meinerti* they are coarser, uniform in size, evenly spaced in a single row, and only extend over the proximal half; 5. On the male chelae of *N. fourmanoiri* the outer edge of the articulation joint with the dactyl is oblique, and continues onto the cutting margin in a long smooth shallow continuous arc; in *N. meinerti* the edge of the joint is much more vertical and meets the fixed finger in a more angular fashion; 6. On the male chelae of *N. fourmanoiri* the lower border of the palm is more-or-less straight behind the fixed finger, whereas in *N. meinerti* it is evenly convex; 7. The carpus of the male cheliped of *N. fourmanoiri* lacks a brush of stiff setae below the inner proximal end of the rectangular facet; 8. The hirsute areas of the carapace are relatively denser in *N. fourmanoiri* than in *N. meinerti*; 9. Live colouration is different (see Descriptions).

The abdominal segments and the first male pleopod show no appreciable differences.

Female specimens of both species are difficult to distinguish. The most useful characters seem to be the development of the granular row on the inside of the palm of the chela (stronger in *N. meinerti*) and the dactylar tubercles which are more numerous on *N. fourmanoiri* and continue most of the way to the tip, whereas on *N. meinerti* they finish about half way down.

#### HABITAT

From estuaries or mangrove swamps in large burrows (about 5cm diameter). Occurs in a variety of micro-habitats and mangrove forest types - among *Sesuvium* near H.W.S.; in open, well above H.W.S.; in entrance to burrows in Blady Grass on the edge of a terrestrial ridge amongst open (4-5m) *Xylocarpus*, *Ceriops*, *Lumnitzera racemosa* and *L. littorea* mangroves; in wet *Rhizophora* zone mangroves behind sandy beach; tidal edge at high water, *Rhizophora/Ceriops* interface; upper edge of bank under stones and logs. The burrows extend through firm mud or even hard earth for about 1m to the water table. Recorded salinities cover a wide range from <1 ppt L.W.N. (21 ppt in stagnant pools) at Ross Ck., to >33 ppt in a ditch beside the road to Lucinda.

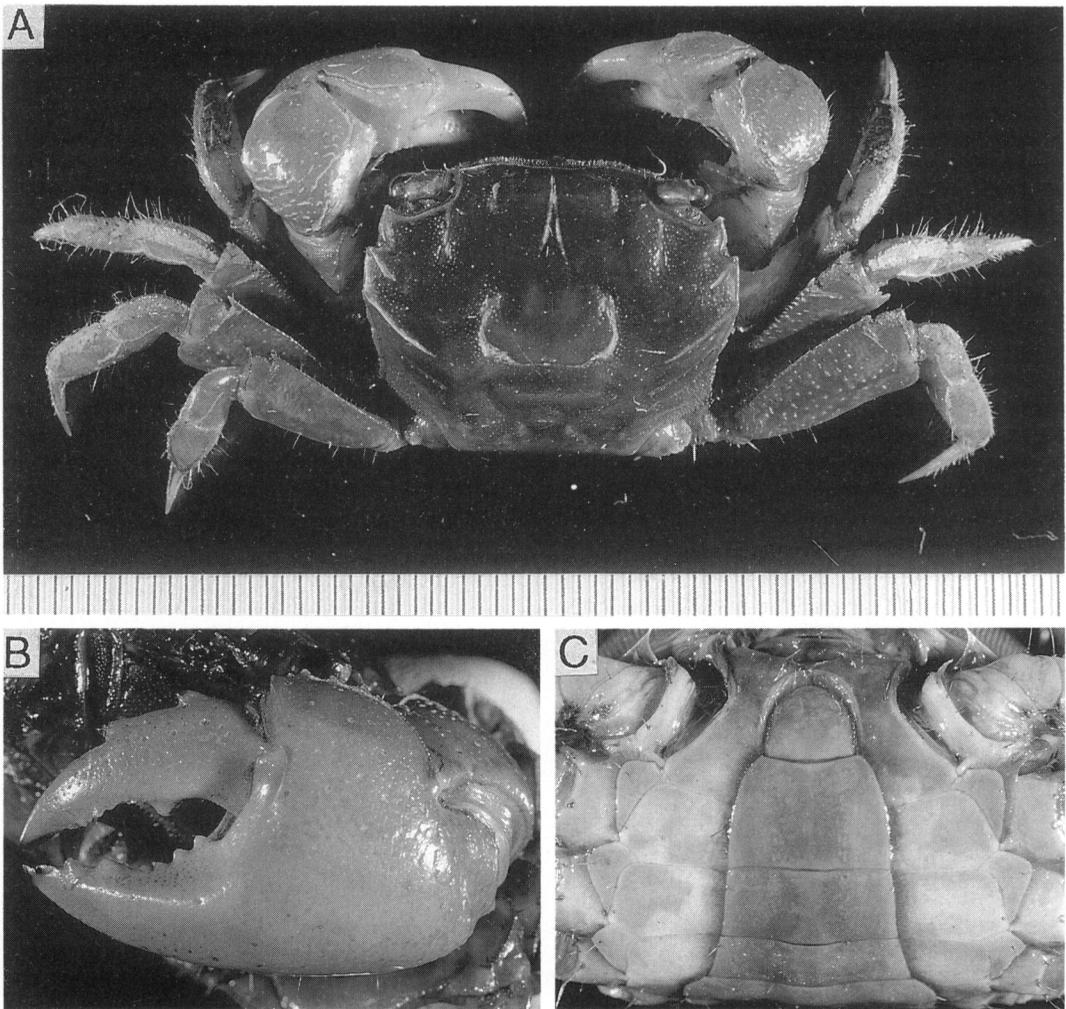


FIG. 4. *Neosarmatium indicum* (A. Milne Edwards, 1868), ♂, ZRC1975, 6.30.15. A, dorsal view; B, chela; C, sternum and male abdomen. Scale line in mm.

#### DISTRIBUTION

New Caledonia (Serène, 1973); from Lindeman Is., ME.QLD, to Port Stewart, Princess Charlotte Bay, NE.QLD; Vanuatu; northeastern coast of Irian Jaya, New Guinea, to Sulawesi, Indonesia (present records). Nobili's (1907) record of *N. meinerti* (no discussion or figure provided) from Apia, Samoa is probably also *N. fourmanoiri*.

#### *Neosarmatium indicum* (A. Milne Edwards, 1868) (Figs 1E, F; 4; 17)

*Metagrapsus indicus* A. Milne Edwards, 1868b: 174, pl. 26, figs 1-5.

? *Sesarma indica*: Heller, 1865: 64 (in part, probably the specimens from the Nicobars refer to valid *N. indicum*) [not *Sesarma indica* H. Milne Edwards, 1837 (= *Tiomanium indicum*)].

*Metagrapsus punctatus*: De Man, 1880: 31.

*Sarmatium indicum*: Kingsley, 1880: 350 (no new specimen); De Man, 1887: 660 (no new specimen); 1892: 350; Tesch, 1917: 220.

*Sarmatium punctatum*: Tesch, 1917: 221; 1918: 115.  
? *Sarmatium punctatum*: Urita, 1926: 20; Sakai, 1934: 325.

*Sesarma (Sarmatium) punctata*: Tweedie, 1940: 109; 1950b: 353.

*Sesarma punctata*: Tweedie, 1950a: 94.

*Neosarmatium punctatum*: Soh, 1978: 10, pl. 3b.

#### TYPE INFORMATION

Lectotype, here designated, MNHN-B10927.  
Type locality: Celebes (= Sulawesi), Indonesia.

#### MATERIAL EXAMINED

LECTOTYPE: MNHN-B10927, ♂ (25.9 x 20.9 mm), Celebes, Indonesia, M. Riedel.

OTHER MATERIAL: INDONESIA: NNMD187, ♂ (26.6 x 20.9mm), Padang, W. Sumatera [specimen examined by De Man (1880) and Tesch (1917) and identified as *punctatum*]. MALAYSIA: ZRC1965.8.3.38-39, 2 ♂ (16.2 x 13.0; 19.3 x 15.1 mm), Labuan, Sabah, coll. 1938; ZRC1964.9.8.14-19, ♂, 5 ♀ (not measured), Pulau Aor, M.W.F.Tweedie, 1950; ZRC1970.2.20.2, ♂ (not measured), Pulau Tioman, K. Romimohtarto, 1968; ZRC1991.351, ♀ (not measured), Tekek Bay, Pulau Tioman, P. Ng, 23.6.1983. SINGAPORE: ZRC1989 3670, ♂ (22.8 x 18.1mm), Sungei Buloh mangroves, Singapore, P.K.L. Ng, 1986. HONG KONG: ZRC1975. 6.30.15, ♂ (24.3 x 19.9 mm), Tai Tam, Hong Kong Island, C.L. Soh, 12.6.1975.

#### DESCRIPTION

*Carapace*. c.1.2-1.3 times broader than long (mean 1.25). Fronto-orbital width c.1.1 times carapace length. Depth c.0.7-0.75 times carapace width. Cardiac region distinct. Lateral margins slightly convergent posteriorly; slightly concave, with one anterolateral tooth behind the exorbital angle; second reduced to an angular projection only. Exorbital angle and first anterolateral tooth triangular and sharp; similar in size. Front c.0.52-0.55 times carapace width; c.0.59-0.64 times fronto-orbital width; moderately deflexed; weakly bilobed, almost straight; lateral angles obtuse, blunt. Post-frontal lobes without clumps of setae. Short ridge medially on first epibranchial tooth. Branchial ridges prominent; first relatively long; second arising from near lateral margin; 2-3 others also arise just inside lateral margin; last one forms strong ridge curving over base of last legs. Posterior margin c.0.47-0.51 times carapace width. Carapace surface smooth, shining, and minutely punctate. Setae arranged in scattered tufts on branchial lines, otherwise confined to posterolateral corners. Upper orbital border even-

ly microscopically granular. Lower orbital border straight; evenly granular. Inter-antennular septum c.0.31-0.36 times width of front.

*Third maxilliped*. Merus c.0.9 times length of ischium. Suture between merus and ischium obliquely sloping inward. Ischium inner margin smooth or microscopically granular.

*Chelipeds*. Merus with posterior border minutely granulate; with blunt subdistal projection; lower border granulate, with small, triangular, subdistal spine; anterior border coarsely granulate but smooth on distal third; carpus with inner angle and inner margin granular, a secondary ventral granular ridge bearing a short row of long setae proximally; tubercles present on inner face of carpus just below inner angle; outer margin with granular striations. Upper surface of palm defined anteriorly by a swollen longitudinal ridge. Outer surface of palm coarsely punctate, naked; without median longitudinal row. Inner surface of palm sparsely granular; with vertical row of 4-5 prominent granules behind gape, and 2-4 granules obliquely behind base of fixed finger. Immovable finger slightly flattened on outer surface; basally produced outward forming a prominent, elongate, triangular shelf over proximal three-quarters of finger, obliquely sloping outward. Length cutting edge c.0.41-0.44 times length propodus. Ventral border of chela convex. Dorsal surface of dactyl bearing 2 large, bluntly pointed, chitinous tipped tubercles on superior inner margin, similar size and shape, one medial, one near proximal end. Fingers pointed, lower finger with tip notched such that dactyl intermeshes; curved inwards; a moderate gape between cutting margins.

*Walking legs*. First three pairs all of similar length, c.1.5 times maximum carapace width. Merus of third leg c.1.8-2 times as long as wide. Carpus c.1.85-2.2 times as long as wide. Propodus c.1.4-1.65 times as long as wide. Dactyli c.1-1.2 times length of propodus. Carpi and propodi bear a short felt of setae on their upper halves, coverage less extensive on last legs; continues in thin rows onto dactyli.

*Male abdomen*. Width segment 3 c.4.3-4.6 times length. Segment 6 not elongated; 1.5-1.6 times wider than long. Telson slightly shorter than segment 6; 1.1-1.2 times longer than wide; evenly rounded.

*Gonopods*. G1 long, slender, curved. Inner-dorsal margin straight. Dorsal surface of stem flattened; completely calcified. Palp poorly developed, not separated from stem, large, rounded, calcified. Outer dorsal margin of stem

convex. Distal part of the stem narrow. Apical process corneous, strongly produced, straight. Gonopore terminal. Setae long, simple, lie around distal part of stem as for other species. G2 short, twisted.

*Sternum*. Sternum anterior to telson densely setose, setae continuing on the ischia of third maxillipeds.

#### COLOUR

'In life the carapace is dark purplish brown, irregularly marked with light brown near the posterior border. The legs are light brown with dark spots and the chelae bright red' (Tweedie, 1940: 109). 'In colour this species much resembles *Sesarmabidens* ... the walking legs are, however, mottled with much larger and rounded reddish-violet blotches' (Tesch, 1918: 115, as *Sarmatium punctatum*). 'The chelae are bright red all over, the carpus and merus are red with dorsal patches of purple, and the carapace and legs are a dull purplish brown' (P. Ng, in litt.). A colour photograph of the specimen ZRC1991.351 has been published (Ng, 1986).

#### REMARKS

The dry specimen that I have designated the lectotype was not noted as a type in the Paris Museum, but it did have a label identifying it as coming from the Celebes, and collected by M. Riedel. It is the only specimen now in the Paris Museum that could be the type, however it also does not agree with the size of the specimen given by A. Milne Edwards (27 x 26 mm) which I consider to be in error as both the figure and all other specimens examined are considerably more broad than long. The possibility therefore must exist that A. Milne Edwards had several specimens at his disposal and that the specimen still existing is not the one specifically mentioned by A. Milne Edwards (1868). Because of this I am following ICZN Article 74b which notes that in cases where no original holotype was designated, and the amount of syntype material is uncertain, that a lectotype should be designated.

*Neosarmatium indicum*, *N. punctatum* and *N. malabaricum* have been very confused, and it is difficult to separate the records with certainty without examining all the material. *N. indicum*, although close to the latter two species, is very easily separated on the form of the claw, with its protruding basal shelf on the fixed finger of the cheliped of the male; and the lack of a strong tubercular vertical ridge on the inner face of the palm of the cheliped. It seems certain then that all

the material identified by Tweedie (1940, 1950 a,b) as *N. punctata* is referable to *N. indicum* as the specimens of his examined for this study are all *N. indicum*. He stated in his 1940 paper that he identified his specimens from sketches of the type made by Dr I. Gordon, but these must not have shown the characteristic chela shape clearly. Soh's (1978) record of *N. punctatum* from Hong Kong was examined and it is certainly *N. indicum*. This is thus the northern-most confirmed record of any of these three species. There is an obscure record of *N. punctatum* from Kagoshima Prefecture in southern Japan, by Urita (1926) and re-cited in Sakai (1934) but not mentioned in Sakai's (1976) 'Crabs of Japan and the adjacent seas', and therefore its status must remain in doubt.

Thallwitz (1891) recorded *N. punctatum* from Manado in northern Celebes (Sulawesi) which is the type locality for *N. indicum*. He particularly noted the row of granules on the inside of the palm of the cheliped which is a characteristic of *N. punctatum*, and this suggests that his identification was correct, however there is still some doubt as one large male of *N. indicum* examined (NNMD187) has a distinct row of granules on the inner face of the palm which, although not nearly as strong as on *N. punctatum*, may have been what Thallwitz described.

#### HABITAT

'In deep holes in the banks of a small stream near its entry into the sea and could only be collected at night; even then they were wary and difficult to catch' (Tweedie, 1940: 109). From a brackish swamp (Tweedie, 1950b). 'In a freshwater stream not subjected to any tidal influence and without real mangroves about. It looked typically freshwater' (P. Ng, in litt.)

#### DISTRIBUTION

Only confirmed from the following localities. Celebes (Sulawesi) (type locality: A. Milne Edwards, 1868b) - Aor and Tioman Islands, Malaysia, South China Sea (Tweedie, 1940; present record) - Labuan, Sabah, Borneo (Tweedie, 1950a) - Hong Kong (Soh, 1978; present identification) - Singapore (present record) - Padang on the southwestern coast of Sumatera, Indian Ocean (Tesch, 1917, 1918, as *S. punctatum*).

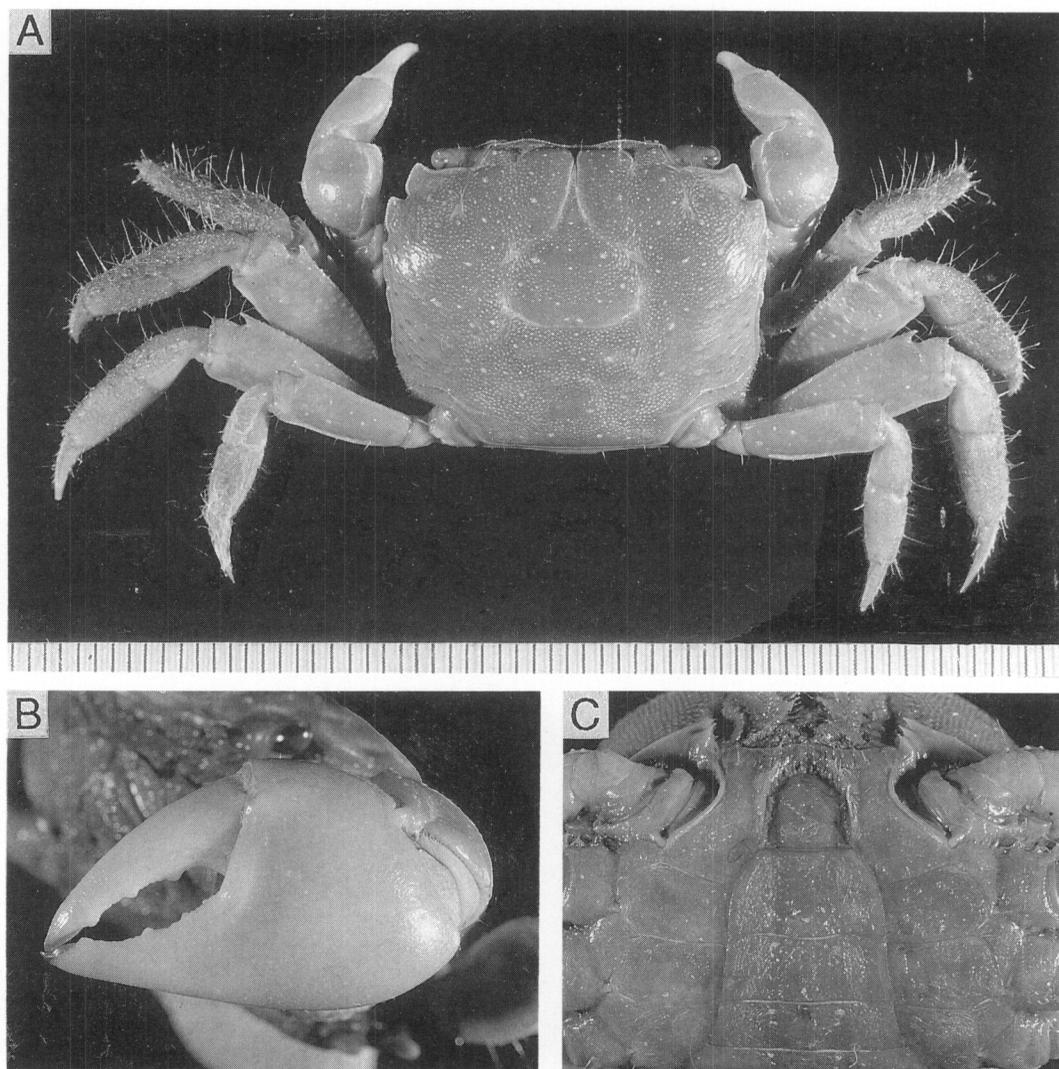


FIG. 5. *Neosarmatium inerme* (De Man, 1887), ♂, ZMH4080. A, dorsal view; B, chela; C, sternum and male abdomen. Scale line in mm.

***Neosarmatium inerme* (De Man, 1887)**  
(Figs 1C, D; 5; 15A, C, E; 16)

*Sarmatium inerme* De Man, 1887: 660, 687; Tesch, 1917: 221.

*Neosarmatium inermis*: Serène & Soh, 1970: 398, 405.

**TYPE INFORMATION**

Lectotype, here designated, ♂ (20.6 x 17.9 mm), MNHN-B3629; paralectotype, ♂ (20.6 x

18.9 mm), same registration. Type locality: Paulo [=Pulau] Condor [now Con Son], Vietnam.

**MATERIAL EXAMINED**

SYNTYPES: MNHN-B3629, 2♂ (20.6 x 17.9; 20.6 x 18.9 mm), Con Son, Vietnam, South China Sea.

OTHER MATERIAL: ZMH-K4080, 8♀ (17.5 x 14.2; 16.9 x 13.6; 17.8 x 14.5mm; 17.7 x 14.7; 19.1 x 15.5; 18.6 x 15.1; 20.3 x 16.4mm), 3♂ (13.9 x 11.8; 18.5 x 15.0mm; one unmeasured), Saigon River, Saigon, Vietnam, Capt. W. Schwinghammer, 18.10.1908.

## DESCRIPTION

*Carapace.* 1.1-1.24 (mean 1.22) times broader than long. Fronto-orbital width c.1-1.1 times carapace length. Depth c.0.75-0.8 times carapace width in adults, less in small specimens. Cardiac region distinct. Lateral margins subparallel or slightly divergent; almost straight, or slightly concave. Anterolateral margins with two teeth behind the exorbital angle. Exorbital angle and first anterolateral tooth triangular and pointed; similar in size. Second anterolateral tooth blunt; much smaller than first. Front c.0.5 times carapace width; 0.53-0.59 times fronto-orbital width (mean 0.56); moderately deflexed; with deep, broad median emargination; lateral margins slightly diverging posteriorly. Post-frontal lobes without clumps of setae. Ridge medially on first anterolateral tooth. Branchial ridges more-or-less prominent; first follows from posterior edge of last epibranchial tooth, relatively short; followed by a series of short broken granular striations, except for last which forms strong ridge continuing over base of last legs. Posterior margin c.0.5 times carapace width (one specimen aberrant at 0.6). Carapace surface smooth, shining, punctate; setae arranged sparsely on branchial lines, mainly confined to posterolateral branchial regions. Upper orbital border evenly, minutely, granular. Lower orbital border straight; evenly granular. Inter-antennular septum c.0.29-0.33 times width of front.

*Third maxilliped.* Suture between merus and ischium obliquely sloping slightly inward. Ischium inner margin smooth or microscopically granular.

*Chelipeds.* Merus with posterior border minutely finely striated; with blunt subdistal projection; lower border granulate, without subdistal spine; anterior border coarsely granulate, but smooth on distal third; carpus with inner angle rounded and granulate; inner margin granular, a secondary ventral granular ridge bearing a short row of long setae proximally; tubercles present on inner face of carpus just below inner angle; outer margin striated. Upper surface of palm sometimes with a longitudinal ridge slightly indicated; otherwise smooth. Outer surface of palm smooth, naked, with minute smooth flat granules; with more-or-less discernible median longitudinal row. Inner surface of palm granular mesially; with a vertical row of larger granules but not elevated into a crest. Immobile finger rounded on outer surface; moderately long, length cutting edge c.0.43-0.44 times length propodus. Ventral border of chela straight to

slightly convex. Dorsal surface of dactyl smooth, rounded. Fingers pointed, lower finger notched behind tip so that dactyl intermeshes, curved inwards, a moderate gape between cutting margins.

*Walking legs.* Second and third pairs sub-equal and slightly longer than others, c.1.8 times maximum carapace width. Merus of third leg c.2.6-2.7 times as long as wide. Carpus c.2.3-2.7 times as long as wide. Propodus c.2-2.5 times as long as wide. Dactyli c.1-1.1 times length of propodus. Upper margins of meri granular, sometimes with some sharp spinules; posterior margins finely granular. Carpi and propodi bear a short felt of setae on upper and lower faces, more-or-less covering anterior face of first two pairs, less so on last two pairs.

*Male abdomen.* Male abdomen not remarkably elongate; moderately broad; segment 3 the widest, first three segments of similar width. Width segment 3 c.5.1-5.5 times length. Segment 6 not elongated, 1.75-1.85 times wider than long. Telson longer than preceding segments; 1.1-1.15 times longer than wide; evenly rounded.

*Gonopods.* G1 moderately stout; slightly curved. Inner-dorsal margin slightly curved. Dorsal surface of stem flattened; completely calcified. Palp absent, position indicated by a slight expansion of inner dorsal margin. Outer dorsal margin of stem moderately convex. Distal part of the stem broad. G1 apical process corneous; moderately produced; straight. Gonopore terminal. Setae long; feathered. G2 short, slender, tapering, moderately twisted.

*Sternum.* Sternum anterior to telson densely setose, setae continuing on the ischia of third maxillipeds.

## REMARKS

*Neosarmatium inerme* and the closely related *N. spinicarpus* sp. nov. are aberrant within *Neosarmatium* by having more slender walking legs and by the much shorter, stockier male first pleopod, which has the distal portion short, not strongly narrowed, and only slightly twisted compared with other *Neosarmatium* species. These characters are possibly sufficient to warrant removal from *Neosarmatium* but as the allied genera remain to be revised no action is being taken at this time.

## HABITAT

Not recorded.

## DISTRIBUTION

Known from Con Son (type locality), and