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A REVISION OF THE CAMPTANDRIINE GENUS *BARUNA* STEBBING, 1904 (CRUSTACEA: BRACHYURA: DECAPODA: OCYPODIDAE), WITH DESCRIPTIONS OF TWO NEW SPECIES FROM THE INDO - WEST PACIFIC

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ABSTRACT. - The genus *Baruna* Stebbing, 1904 is shown to be a senior synonym of *Leipocten* Kemp, 1915 after examination of their respective type species. *Baruna socialis* Stebbing, 1904 proves to be a senior subjective synonym of *Leipocten sordidulum* Kemp, 1915. Specimens which have been reported from various parts of the Indo-West Pacific as *Leipocten sordidulum* are shown to belong to an undescribed species instead, here named *Baruna mangromurphia*. A separate *Baruna* species from laterite and coral rock, *B. minuta*, new species, is also described. The genus *Mortensenella* Rathbun, 1909, previously classified in the Pinnotheridae, is also transferred to the subfamily Camptandriinae.

INTRODUCTION

The genus *Baruna* was established by Stebbing (1904) for a new species, *B. socialis* from Sri Lanka (= Ceylon) which has not been reported since. Stebbing placed *Baruna* in the Grapsidae on the basis of the form of its third maxilliped and believed it to be close to *Varuna* and *Pseudograpsus*. This classification was followed by Balss (1957) in his synopsis of the world Brachyura.

In 1915, Kemp established *Leipocten* for a new species, *L. sordidulum*, from India. Crabs attributed to *L. sordidulum* have been widely reported from many areas in the Indo-West Pacific region (see Manning & Holthuis, 1981). Kemp (1915) placed *Leipocten* in the Xanthidae on the basis of its carapaee shape, but Balss (1935) suggested transferring it to the Ocypodidae, subfamily Macrophthalminae, because of similarities in the shapes of the chelae, third maxillipeds and male abdomina to *Paracleistostoma*.

Stimpson (1858) had established a new family, Camptandriidae, for his new genus *Camptandrium*. Following views expressed by Serène & Kumar (1971), Serène (1974) formally defined Camptandriinae as a subfamily of Ocypodidae, in which both *Leipocten* and *Paracleistostoma*

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were included. The main diagnostic character of this family is the strongly recurved male first pleopod. Neither Stebbing nor Kemp described the male first gonopod of *B. socialis* and *L. sordidulum* respectively. The male first pleopod of what was believed to be *L. sordidulum* from Singapore (= present *B. mangromurphia*, new species) was first figured by Tweedie (1937). Manning & Holthuis (1981: 193, 348) subsequently provided a key to the 13 genera (including *Leipocten*) they recognised in the Camptandriinae,

Serène (1974) indicated that he had examined the type of *Baruna socialis* Stebbing and found it identical with *Leipocten sordidulum* Kemp as he understood it. He however, took no formal action to synonymise the two genera. Manning & Holthuis (1981) also suggested that *Baruna* and *Leipocten* were probably synonyms but prefered to wait for descriptions of the male first pleopods of *Baruna* before formally synonymising them. On the basis of the original descriptions, differences in the form of the carapace and male abdominal structure were apparent. This especially the case for *Baruna*, which was described as having seven free male abdominal segments. In *Leipocten*, the second and third male abdominal segments are fused.

In this paper, the types of both *Baruna socialis* Stebbing and *Leipocten sordidulum* Kemp have been examined. We can now confidently state that both genera are synonymous, with *Baruna* having seniority. Both are also shown to belong to the Camptandriinae sensu Serène (1974). *Baruna socialis* and *Leipocten sordidulum* are very close and are here regarded as conspecific. Examination of large numbers of specimens from various parts of the Indo-West Pacific showed that those referred to "*Leipocten sordidulum*" by most workers since Kemp (1915) in fact belong to a separate undescribed species, *B. mangromurphia*, new species. Specimens from rocks in coral reefs and rocky shores also proved to belong to another undescribed species, *B. minuta*, new species.

Serène (1974) and Manning & Holthuis (1981) emphasise the unusual strongly recurved male first pleopod and the form of the third maxilliped (merus as long as or longer than ischium, the last two segments slender) as important characters for the subfamily Camptandriinae. All known male camptandriines (with the exception of *Ilyogynis* Manning & Holthuis, 1981) also have a distinct molariform tooth on the proximal part of the cutting edge of the chelal dactylus. The genus *Mortensenella* Rathbun, 1909, classified at present in the Pinnotheridae, must also be transferred to the Camptandriinae. Its male first pleopods, chelae and male abdomen (see Dai *et al.*, 1980; Manning & Morton, 1987) are clearly camptandriine in structure. One of the authors (PKLN) has examined several specimens of the type species, *Mortensenella forceps* Rathbun, 1909, in the Zoological Reference Collection (former Raffles Museum and National Museum collections), Department of Zoology, National University of Singapore, and they are typical camptandriines with regards to all the key characters. Its unusual carapace form is very likely to be due to its specialised association with sipunculan worms (see Manning & Morton, 1987). Interestingly, a recent study of the setae of pinnotherid gill-grooming appendages and associated mouthparts by Pohle (1989) also suggests that *Mortensenella* is not a true pinnotherid.

There are indications that the late Dr. Raoul Serène was attempting to revise the genus *Baruna*/ *Leipocten*. There are specimens from the Philippines in the Zoological Reference Collection (and possibly other museums as well), which carry one of his unpublished manuscript names - "*Leipocten quezonensis*". Yang (1979: ix, 39) listed this name in her catalogue to the material

in the Zoological Reference Collection, but it is a nomen nudum (see later). His "*L. quezonensis*" is almost certainly conspecific with the present *B. minuta*, new species. There are also specimens from Peninsular Malaysia which have been labelled as "*Leipocten squalidulum*". This name has never appeared in the literature. We believe that this species is identical to *B. socialis*. We have opted not to use Serène's new names as our understanding of the genus differs somewhat from his (see *Remarks* for *Baruna socialis* and *B. minuta*).

MATERIALS AND METHODS

As the type specimens of *B. socialis* and *L. sordidulum* have already been scraped and cleaned, they were examined in glycerol without further treatment. More recent as well as freshly collected specimens were subjected to various treatments as and when required. Specimens of *Baruna* are often covered with mud or other detritus. Two to six minutes exposure of alcohol-preserved material in a ultrasonic cleaner was found to remove most of this fouling without apparent damage. Pretreatment with potassium hydroxide and chlorox for preserved specimens helped clean the stains and loosen detritus. This treatment was generally unnecessary for fresh material. Some permanent preparations of detached gonopods and male abdomina of recent specimens were made in chloral gum or resinous mounting agents.

The abbreviation G1 is used for the male first pleopod. All measurements (in millimetres) are of the carapace width and length respectively. Specimens are deposited in the AM (Australian Museum, Sydney, Australia); PMBC (Phuket Marine Biological Center, Phuket, Thailand); QM (Queensland Museum, Brisbane, Australia); NHM (Natural History Museum, London, United Kingdom); MNHN (Muséum nationale d'Histoire naturelle, Paris, France); RMNH (Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands); USNM (National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A.); ZSI (Zoological Survey of India, Calcutta, India); and the ZRC (Zoological Reference Collection, National University of Singapore).

SYSTEMATICS

Camptandriinae Stimpson, 1858

Baruna Stebbing, 1904

Baruna Stebbing, 1904: 3
Baruna - Balss, 1957: 1668; Serène, 1974: 62, 64, 66; Manning & Holthuis, 1981: 207
Leipocten Kemp, 1915: 243
Leipocten - Tweedie, 1937: 162; Sakai, 1939: 635; Barnes, 1967: 249; Serène, 1974: 62, 64, 66; Sakai, 1976: 619; Manning & Holthuis, 1981: 207
Leiopocten (sic) - Balss, 1957: 1665; Serène, 1965: 30

Diagnosis. - Carapace subquadrangular, slightly broader than long, relatively convex both longitudinally and transversely; upper surface with regions poorly or fully indicated, bearing granules, woolly hairs and/or small bristles. Anterolateral margin slightly shorter than postero-

lateral margin, with or without crenulate lobes. Frontal margin less than a third breadth of carapace, front slightly depressed. Antenna as long as width of frontal margin. Orbits large, upper margin slightly sinuous, occasionally obscurely crenulate; inferior margin evenly curved and crenulate, meeting upper margin externally without any emargination. Buccal cavern broader than long, opening transversely oval; third maxilliped large, ischium quadrate, merus as long as broad, larger than ischium.

Chelae equal to subequal for each sex, larger, more swollen in males. Outer surface of male chela mostly smooth or granulose, cutting edges with numerous blunt denticles, dactylus with one molariform tooth near proximal end. Outer surface of female chela with bristles and/or woolly hairs, with rows of sharp to blunt granules along its length, fingers without cutting teeth or with very low, obscure denticles.

Ambulatory legs short, stout, with shaggy hair, meral segments somewhat dilated with large spinules and sharp granules on lower margins and surface, arranged in an approximately U-shaped structure, last pair of ambulatory legs shortest.

Male abdomen with six free somites, second and third segments fused, separated by indistinct median suture. Female abdomen with seven free somites, broad with densely hirsute margins.

G1 strongly recurved, distal part with stiff spines and a well developed subapical process.

Remarks. - See *Remarks* for *Baruna socialis* for taxonomic details. The camptandriine genus most closely allied to *Baruna* appears to be the monotypic *Lillyanella* Manning & Holthuis, 1981 (in addendum, p. 348) from West Africa. The carapace shape of the single species, *L. plumipes* Manning & Holthuis, 1981 however, is different, being armed with distinct antero-lateral spines. *Lillyanella plumipes* also has the tubercles and spines on the ventral margins of the ambulatory meri less well developed, the second to fourth segments fused, and the G1 lacks a long subapical process.

The spines and granules on the ventral surface of the ambulatory merus of *Baruna* are very characteristic, and has been described in some detail by Kemp (1915). The approximately U-shaped groups of spines and granules are used to help the animal clamp down on its substrate when it is disturbed or splashed by water. It normally moves using the tips of its curved dactyli.

Of the three species of *Baruna* recognised in this revision, *B. minuta* is the most marine, occuring predominantly on rocky shores and coral reefs. *Baruna socialis* is known to occur in waters of widely fluctuating salinities, even fresh water. *Baruna mangromurphia* is predominantly a mangal species, occuring mainly in more brackish waters. It can also be found on substrates in waters not subject to tidal influence.

Although both *B. socialis* and *B. mangromurphia* are occur along the Trengganu coast of Peninsular Malaysia, they have not been collected from the same locality. All the Malaysian specimens of *B. socialis* have come from one locality only - Dungun.

***Baruna socialis* Stebbing, 1904**
(Figs. 1-3)

Baruna socialis Stebbing, 1904: 3, Pl. 1A
Leipocten sordidulum Kemp, 1915: 244, Text figs. 16-20, Pl. 12 fig. 8
Baruna socialis - Serène, 1974: 64, 66; Manning & Holthuis, 1981: 207.
Leipocten sordidulum - Balss, 1935: 47; Tweedie, 1937: 162 (part), Fig. 7; Sakai, 1939: 635 (part), Fig. 105; Barnes, 1967: 249 (part); Serène, 1968: 101 (part); Serène, 1974: 64, 66 (part); Sakai, 1976: 619 (part), Fig. 339; Manning & Holthuis, 1981: 207 (part) Text fig. 52a-f
Leipocten sp. - Yang, 1979: 39 (part)

Material examined. - Lectotype (*Baruna socialis*) - male (6.9 by 5.0 mm) (NMH), Lake Negombo, Sri Lanka, leg. A. Willey. — lectotype (*Leipocten sordidulum*) - male (6.4 by 4.9 mm) (ZSI 9164/10), Ennur backwater, near Madras, India, leg. N. Annandale, i.1915.

Paralectotype (*Leipocten sordidulum*) - 1 female (8.2 by 6.4 mm), same data as lectotype.

Others - 1 male (4.7 by 3.5 mm) (ZRC 1965.7.19.336), Dungun, Trengganu, Peninsular Malaysia, leg. Forestry Department, xii.1950. — 1 male (5.3 by 3.5 mm) (ZRC 1970.1.9.1), Dungun, Trengganu, Malaysia, leg. M. W. F. Tweedie, 12.1950. — 5 males, 8 females (ZRC 1965.12.8.92-101), Dungun, Trengganu, Malaysia, leg. M. W. F. Tweedie, xii.1950. — 1 female (ZRC 1970.1.9.3), Dungun, Trengganu, Malaysia, leg. M. W. F. Tweedie, 12.1950.

Diagnosis. - Carapace subquadrilateral, broader than long, evenly low convex both longitudinally and transversely. Upper surface of carapace granulose and punctate, regions scarcely areolated, with tracts of short bristles and long woolly hairs posteriorly. Epigastric cristae weak but visible. Anterolateral margin shorter than posterolateral margin, usually divided into three lobes, that nearest the orbit being the largest with six or seven small marginal granules, the second with three or four marginal granules, the last produced into a blunt tooth, with or without distinct marginal granules. Posterolateral margins converging, gently granulose in males, strongly granulose in females; with group of larger, laterally flattened granules just before meeting posterior margin, more distinct in females than males. Posterior margin straight, gently granulose; parallel ridge of small granules just before posterior margin. Frontal margin about a third of carapace breadth, appearing slightly depressed, pubescent, margin smooth or granulose. Supraorbital and infraorbital margins obscurely crenulate, granulose, meeting frontal margin gradually. Antennae as long as front. Orbits large, eyestalks stout. Buccal cavern very large, broader than long, somewhat transversely oval.

Male chelae swollen large, equal to subequal; outer surface with small granules on upper surfaces, without hairs or bristles; cutting edge of fingers with numerous denticles, dactylus with a prominent stout tooth near proximal end; inner distal margin of carpus serrated, with submarginal row of granules. Female chelae equal to subequal, not swollen, outer surface with numerous bristles and hairs, with numerous cone-shaped granules, dorsal margin of dactylus with many sharp granules and tubercles, cutting edge of fingers without teeth or denticles.

Ambulatory legs short, stout, hirsute; last pair shortest; ischio-basis with several well developed granules on ventral margin; merus with short, stout ventral spines, granules and tubercles arranged in a U-shaped structure, dorsal margin unevenly serrated, outer surfaces

distinctly granulose; upper margin of carpus uneven; lower distal margin of propodus with one to three small teeth and one to two strong spines on edge of dorsal margin.

G1 tip lobiform, with several spines on one subapical edge and a long, gradually tapering subapical process on the other, the tip of which is pointed.

Distribution. - Sri Lanka, Chilka Lake, Madras (India) and Trengganu (Peninsular Malaysia).

Habitat and Biology. - Occurs among decaying timber in brackish water or salt water lakes (Stebbing, 1904), cavities of marine laterite blocks and among shells in mangrove oyster-bed (Kemp, 1915). Stebbing's (1904) and Kemp's (1915) notes provides what little we know about the biology of this species. Stebbing's specimens were collected from some piles of coconut trunks driven into the water by fishermen in a salt water lake with freshwater and marine connections. Kemp records the Chilka Lake specimens as occuring in waters ranging from fresh to salt. The geography and hydrography of the lake was described in detail by Annandale & Kemp (1915) The Ennur specimens were "... found in cavities in laterite blocks forming a sea-wall, submerged at high water. The specific gravity of the water was 1.0025" (p. 247).

Remarks. - The similarity between *B. socialis* and *L. sordidulum* has already been noted by several workers (see Serène, 1974; Manning & Holthuis, 1981). Direct comparisons of the type males of both species reveal only two differences - the carapace of *L. sordidulum* lacks the long hairs on the back and the posterior lobe of the anterolateral margin in *L. sordidulum* is granular, whereas in *B. socialis* it is smoother. The carapace of the type male of *L. sordidulum* is almost completely denuded. Kemp (1915) had described the "... entire upper surface of the animal is densely covered with a fine woolly hair ... Interspersed among the hairs are numerous large black bristles." (p. 247). The form of the last anterolateral lobe is a very minor difference at best, can easily be accounted for by variation, as is obvious in the series of specimens from Trengganu, Malaysia. The G1s of both the type males are very similar. There is thus no reason why both species should be regarded as separate and are synonymised accordingly.

Stebbing (1904) described *B. socialis* on the basis of two males and two females but did not state where his types were deposited. A syntypic specimen was located in the NHM and kindly loaned to us by Dr. Paul Clark. This is the only specimen of this species whose whereabouts is known, and is here designated the lectotype. There are no type specimens of this species in the Colombo Museum, Sri Lanka (R. Pethiyagoda, pers. comm.). Stebbing (1904) described the male abdomen of *B. socialis* as having seven distinct segments. In his Pl. 1A however, he figures the male abdomen with eight distinct segments. The male abdomen of the lectotype male we have examined has only six free somites, with a small and faint incomplete suture separating the fused second and third segments. Stebbing thus seems to have been mistaken about the condition the male abdomen.

The descriptions of Kemp (1915) are excellent, and agree with the pair of syntypes we examined through the kind courtesy of Dr. Maya Deb (ZSI). One discrepancy concerns his Pl. 12 fig. 8. The female specimen featured has a more squarish carapace, the anterolateral margin being almost entire, and without the three lobes of the allotype female. Kemp himself comments that the variation in the anterolateral margin of his species was great but the specimen featured in Pl. 12 fig. 8 "... is extreme in this respect" (p. 245). In fact, the female figured bears a strong resemblance to females of *B. mangromurphia*, new species. This has probably misled many workers as to the real identity of *L. sordidulum/B. socialis*. Kemp records five females from

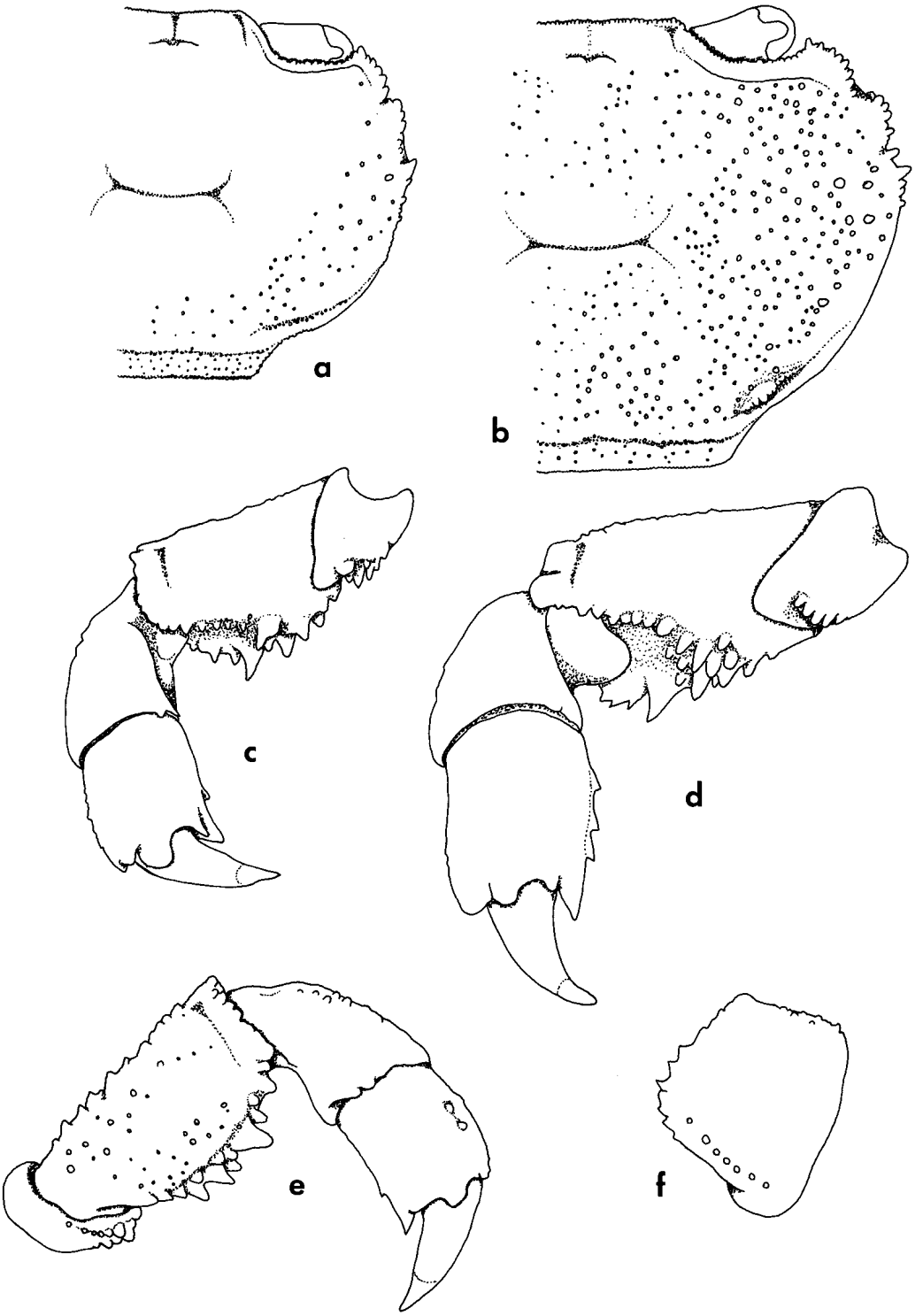

Fig. 1. *Baruna socialis* Stebbing. a, c-f, lectotype, b, allotype, *Leipocten sordidulum* Kemp. a, b, carapace (denuded); c, right fourth ambulatory leg (inner surface view); d, right third ambulatory leg (inner surface view); e, right fourth ambulatory leg (outer lateral view); f, right cheliped carpus (dorsal view).

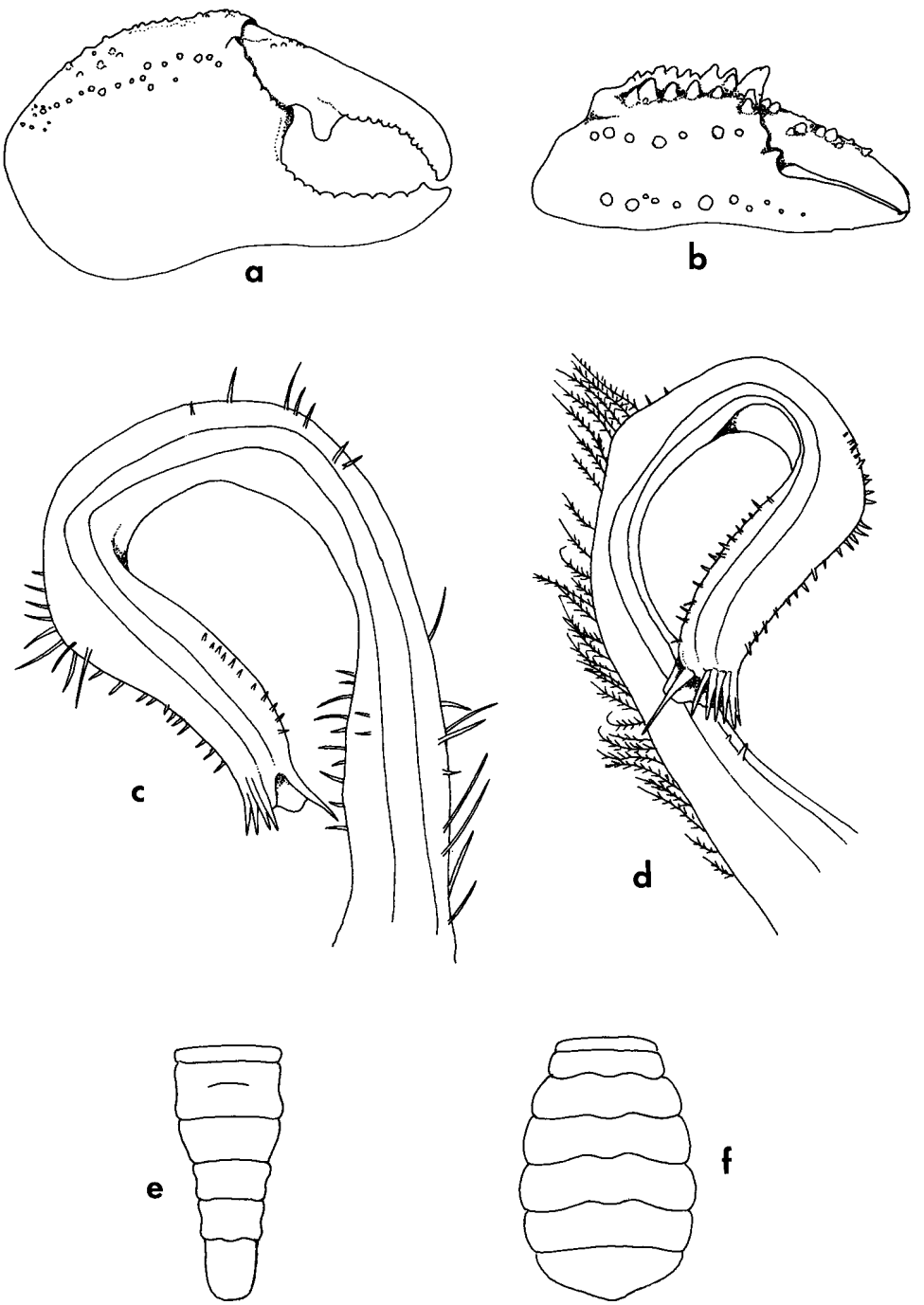

Fig. 2. *Baruna socialis* Stebbing. a, c, e, lectotype, b, allotype, *Leipocten sordidulum* Kemp; d, male (5.3 by 3.5 mm) (ZRC 1970.1.9.1), Trengganu, Malaysia. a, b, right chelae; c, d, left G1s; e, male abdomen (denuded); f, female abdomen (denuded).

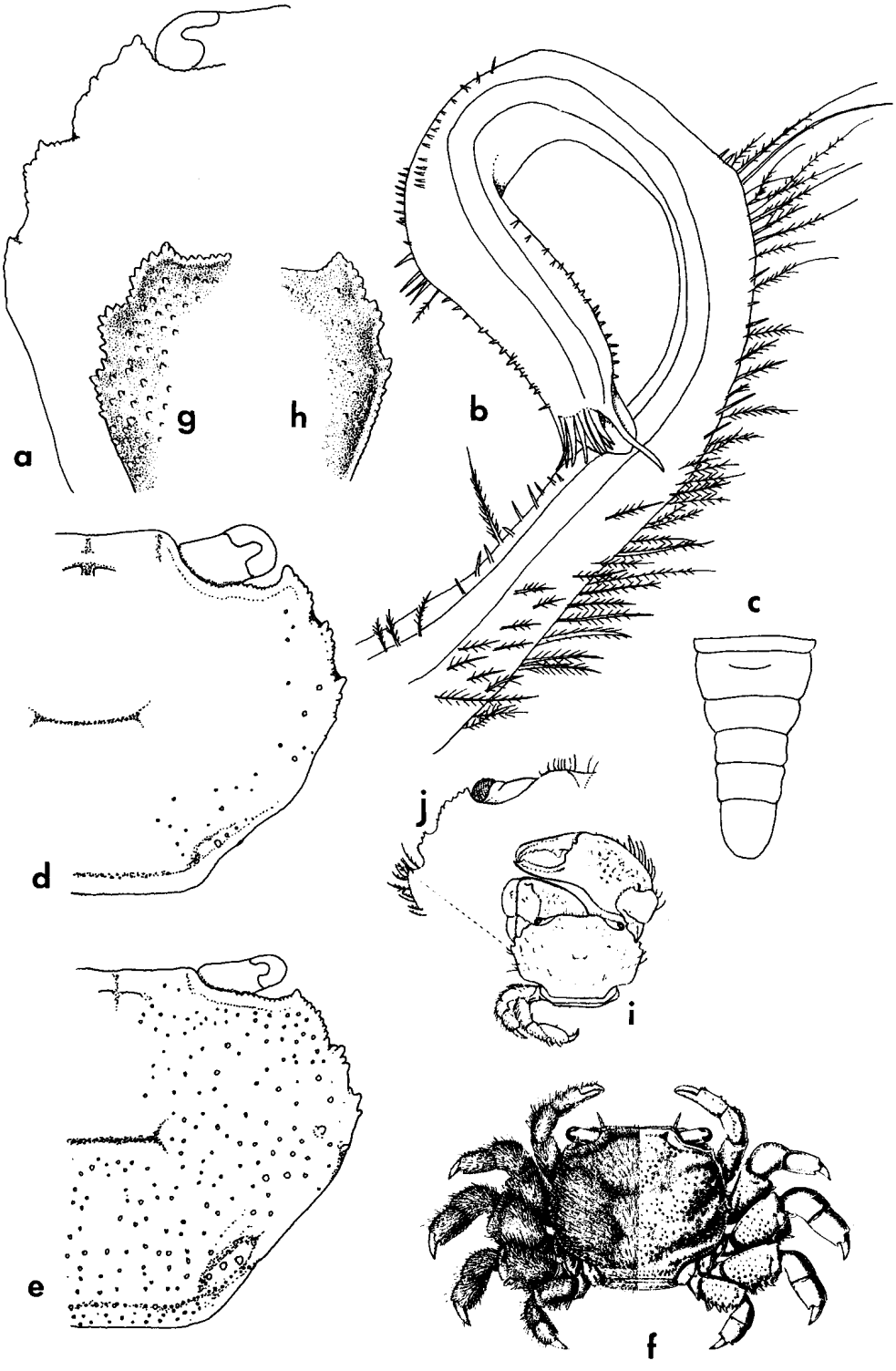

Fig. 3. *Baruna socialis* Stebbing. a-c, lectotype male; d, male (5.3 by 3.5 mm) (ZRC 1970.1.9.1), Trengganu, Malaysia; e, female (6.7 by 4.7 mm) (ZRC 1965.12.8.93), Trengganu, Malaysia; f-h, *Leipocten sordidulum* (after Kemp, 1915); i, j, *Baruna socialis* (after Stebbing, 1904). a, carapace (denuded, granules omitted); b, left G1; c, male abdomen (denuded); d, e, carapaces (denuded).

Chilka Lake and 10 males and 27 females from Ennur backwater. All the specimens were listed as types. It is uncertain if the unusual female featured in his Pl. 12 was from Chilka or Ennur. The good series of specimens of *B. socialis* from Dungun, Trengganu (Peninsular Malaysia) contain many females, none of which have an anterolateral margin like that figured in Kemp's Pl. 12. There is however, a tendency for the carapace to become more transverse (distinctly broader than long). The specimen Kemp figured however, differs from typical *B. mangromurphia* in the degree of granulation on the carapace (reaching the front half), presence of numerous granules just before the posterior carapace margin, presence of sharp granules on the upper margin of the dactylus of the chela, and very granulose outer surface and and serrated upper margin of the ambulatory merus. In these respects, it seems to be closer to *L. sordidulum*/ *B. socialis*. The degree of variation noted by Kemp for his specimens has not been observed for *B. mangromurphia* or *B. minuta*. Whether all of Kemp's material is in fact conspecific can only be determined after all the specimens are reexamined. As the Chilka Lake specimens were all female, and in the interests of stabilising the taxonomy of the genus, the larger series from Ennur should be regarded as representative of *B. sordidulum* s. str. The male from Ennur which is refigured here is hereby designated the lectotype, the female the allotype.

The basis-ischia of the ambulatory legs figured by Kemp (1915: Text fig. 19) and Stebbing (1904: Pl. 1A) appear smooth, without any granules. All the specimens of *B. socialis*/*L. sordidulum* we have examined however, have well developed granules on the ventral margins of the basis-ischia. In fact, this character is one of those which easily distinguishes *B. socialis* from the other two congeners.

Serène had identified specimens from Dungun, Trengganu, Malaysia to a new species "*Leipocten squalidulum*", a name which he never published. In the ZRC are three bottles carrying specimens (designated as holo- and paratypes) with this name. Serène's specimens (including several males) agree with the types of both *L. sordidulum* and *B. socialis* so well that the authors do not hesitate to regard them as conspecific. The record of this species in Trengganu, northeastern Peninsular Malaysia represents a substantial increase in the range of *Baruna socialis*.

***Baruna mangromurphia*, new species**
(Figs. 4-6)

Leipocten sordidulum - Tweedie, 1937: 162 (part), Fig. 7; Sakai, 1939: 635 (part), Fig. 105; Snelling, 1959: 70; Barnes, 1967: 249 (part); Serène, 1968: 101 (part); Lundoer, 1974: 8; Serène, 1974: 62, 64, 66 (part); Sakai, 1976: 619 (part), Fig. 339; Frith *et al.*, 1976: 13, 18; Yang, 1979: 39; Naiyanetr, 1980: 44; Manning & Holthuis, 1981: 207 (part); Davie, 1982: 206 (nec Kemp, 1915: 244)

Leipocten sp. - Yang, 1979: 39 (part)

Diagnosis. - Carapace subquadrangular, rather broader than long, regions clearly demarcated, mostly covered with numerous small stiff, short hairs and scattered long hairs. Outer edge of supraorbital margin smooth in males, gently granulated in females. Anterolateral border usually entire, not divided into lobes, rarely with with a very low epibranchial lobe, margin with row of small granules. Posterolateral margin smooth or with very small granules in males, covered with numerous large and small granules in females. Outer surface of third maxilliped with short hairs.

Male chelae swollen, equal to subequal, outer surface smooth, with scattered granules in smaller specimens, without bristles of hairs, dactylus with a molariform tooth near proximal end, with row of granules adjacent to cutting edge of pollex; inner distal margin of carpus gently crenulated, edges rounded, with two or three small submarginal granules. Female chelae equal, not swollen, outer surface with three rows of sharp granules and tubercles, with numerous stiff bristles and hairs, especially around granules, dorsal margin of dactylus entire, not granulated or distinctly serrated, cutting edges of fingers without distinct teeth, inner surface of distal part broadly concave.

Ambulatory legs short, stout, with short bristles and woolly hairs; ischio-basis smooth or with several very small, rounded granules on ventral surfaces; lower surface of merus with short, stout spines, granules and tubercles arranged in a U-shaped structure, dorsal margin entire or gently uneven but never serrated, outer surfaces almost smooth in males, with scattered small granules in females.

G1 tip rounded, with several long stiff subapical spines on one edge and a single long subapical process on the other, the tip of which is dilated, appearing slightly flared and dichotomous.

Material examined. - Holotype - 1 male (6.0 by 5.1 mm) (ZRC 1991.111), in rotten log, floor of mangroves, Mandai, Singapore, leg. P. K. L. Ng & L. W. H. Tan, 1980. — Allotype - 1 female (6.6 by 5.4 mm) (ZRC 1991.112), same data as holotype.

Paratypes - 8 males (5.2-6.5 by 4.4-5.1 mm), 3 females (6.3-7.0 by 4.8-5.8 mm) (ZRC 1991.113-123), same data as holotype. —2 females (ZRC 1991.134-135), under muddy rocks, Mandai mangroves, Singapore, leg. P. K. L. Ng, 24.vi.1987. — 6 females (3 ovigerous) (ZRC 1991.128-133), Mandai mangroves, leg. P. K. L. Ng, viii.1986. 1 female (with one vial of zoea 1) (ZRC 1988.793), Mandai, leg. P. K. L. Ng, 18.v.1984. — 6 females (ZRC 1991.136-141), Mandai, leg. S. Harminto & D. H. Murphy, 9.ix.1987. — 4 males (ZRC 1991.124-127), 1 male, 1 female (USNM), 1 male, 1 female (MNHN), 1 male, 1 female (NHM), 1 male, 1 female (QM), 1 male, 1 female (PMBC), 1 male, 1 female (RMNH), 1 male, 1 female (AM), Mandai mangroves, in log, leg. P. K. L. Ng, 18.v.1984. — 2 males, 3 females (ZRC 1985.1733-1737), in clump of *Mytilopsis sallei* mussels, mouth of Jurong River, leg. J. B. Sigurdsson, iii.1985. — 21 males (ZRC 1991.156-176), Kranji mangroves, Singapore, leg. D. H. Murphy, 19.vi.1986. — 5 males, 14 females (11 ovig.) (ZRC 1988.2107-2125), Kranji, Singapore, leg. D. H. Murphy, 19.vi.1986. — 1 male, 1 female (ZRC 1991.154-155), Kranji mangroves, leg. P. K. L. Ng, v.1987. — 5 males, 7 females (ZRC 1991.142-153), Sungei Buloh mangroves, leg. P. K. L. Ng, 3.iv.1991. All type localities in Singapore.

Others - 1 male, 1 female (ZRC 1991.177-178), Mandai mangroves, Singapore, leg. P. K. L. Ng, 1988. — 3 males, 2 females (ZRC 1991.186-190), Lim Chu Kang mangroves, leg. D. H. Murphy, 1987. — 1 male, 2 females (ZRC 1988.2130-2132), Lim Chu Kang mangroves, Singapore, leg. D. H. Murphy, 30.vii.1987. — 2 males (ZRC 1988.2128-2129), Lim Chu Kang mangroves, Singapore, leg. S. Harminto, 10.ix.1986. — 1 male, 2 females (ZRC 1991.183-185), Lim Chu Kang mangroves, Singapore, leg. S. Harminto, 10.ix.1986. — 3 males, 7 females (1 ovig.) (ZRC 1988.2133-2142), Lim Chu Kang mangroves, Singapore, leg. S. Harminto, 6.viii.1987. — 1 female (ZRC 1985.1600), West Coast, in dead wood, Singapore, leg. P. K. L. Ng, 16.vi.1983. — 2 females (ovigerous) (ZRC 1988.2126-2127), Pandan mangroves, leg. P. Y. Ow, 14.vii.1986. — 1 male, 1 female (ZRC 1991.179-180), Pandan river mangroves,

Singapore, leg. S. Harminto, 1987. — 1 male, 3 females (ZRC 1965.7.19.351-353), Pandan Forest Reserve (mangroves), Singapore, leg. M. W. F. Tweedie, viii.1934. — 2 males (ZRC 1970.1.10.30-31), Singapore, leg. R. Serène, 23.vi.1967. — 1 female (one vial of zoeae 1) (ZRC 1988.791), Pandan mangroves, Singapore, leg. S. Harminto, 3.x.1986. — 3 males, 15 females (ZRC 1965.7.19.326-335), Serangoon, Singapore, leg. M. W. F. Tweedie, x.1934. — 1 male, 1 female (ZRC 1991.181-182), Pulau Ubin, Singapore, leg. P. K. L. Ng, iv.1987. 2 males, 7 females (6 ovigerous) (ZRC 1988.2143-2151), Pulau Ubin, Singapore, leg. P. K. L. Ng, ix.1987. — 1 female (ZRC 1988.593), Changi, Singapore, leg. D. S. Johnson, 25.ii.1952. — 1 female (ZRC 1965.7.19.337), Sungei Buloh, Johor, Peninsular Malaysia, leg. M. W. F. Tweedie, viii.1934. — 3 males, 5 females (ZRC 1965.71.9.338-347), Johor Strait, Peninsular Malaysia, leg. M. W. F. Tweedie, x.1934. — 2 females (ZRC 1991.191-192), Lumut, Perak, Peninsular Malaysia, leg. H. Singh, 1988. — 1 female (?) (ZRC 1965.7.19.354), Sungei Patani, Kedah, Peninsular Malaysia, leg. ii.1951. — 1 male, 2 females (ZRC 1970.1.10.29), Trengganu, Peninsular Malaysia, leg. 23.vi.1970. — 4 males, 7 females (ZRC 1965.7.19.315-325), Kuala Ibai, Trengganu, Peninsular Malaysia, leg. M. W. F. Tweedie, viii.1950. — 2 males, 1 female (ZRC 1965.7.19.348-350), Prai, Province Wellesley, Peninsular Malaysia, leg. xii.1938. — 11 males, 7 females (ZRC 1988.634-651), Ranong (Thailand), leg. D. H. Murphy, 14.xi.1987. — 1 male, 1 female (PMBC 2226), Phuket, Thailand, leg. R. Serène & S. Lundoer, 8.xi.1972. — 4 males, 9 females (ZRC 1988.621-633), Phuket, Thailand, leg. D. H. Murphy, 12.xi.1987. — 1 male (AM P3 841), Brisbane River, Australia, leg. A. R. McCulloch, viii.1915. — 1 male, 3 females (1 ovig.) (QM W.8226), Murray River, Australia, leg. R. Timmins, 22.v.1978. — 1 female (ovig.) (QM W.14391), Darwin, Australia, leg. P. Davie & P. Shanco, 29.vi.1982.

Etymology. - The authors take great pleasure in dedicating this species to Associate Professor "Paddy" Murphy on the occasion of his 60th birthday. The name "mangromurphia" is a composite of the words mangrove and his name (Murphy), and seeks both to acknowledge his love for the mangrove biotope as well as to give credit to the many contributions he has made to mangrove biology over the years. The name is to be used as a noun.

Distribution. - Phuket and southwestern Thailand (Lundoer, 1974; Frith *et al.*, 1976; present study); Andaman Sea (Naiyanetr, 1980); Peninsular Malaysia and Singapore (Tweedie, 1937); northern Australia (Snelling, 1959; Barnes, 1967); and Taiwan (Sakai, 1939, 1976).

Habitat and Biology. - *Baruna mangromurphia*, new species, is very common in or under rotten wood, under loose bark of prop roots and crevices, as well as among clumps of clams (*Isognomon*) or mussels (*Perna viridis*, *Mytilopsis sallei*) growing on mangrove roots, rocks, on the floor of mangrove swamps or other substrates. It can also be found among clumps of mangrove barnacles. It has been found in large numbers among clumps of the green mussel (*Perna viridis*) rope-cultured in floating farms near mangroves in Singapore, a habitat continually submerged and not affected by tides. *Baruna mangromurphia* occurs both in well shaded and more open mangrove areas, and appears to be closely associated with the mangal biotope.

Remarks. - The well demarcated regions of the carapace surface, numerous short stiff hairs on the carapace and legs, and the flared, dichotomous tip of the subapical process of the G1 of *B. mangromurphia* are very characteristic and serve to distinguish this species from all congeners. *Baruna mangromurphia* can be easily distinguished from *B. socialis* by the form of the G1 and that the anterolateral margin of the males is entire. In *B. socialis*, the G1 subapical

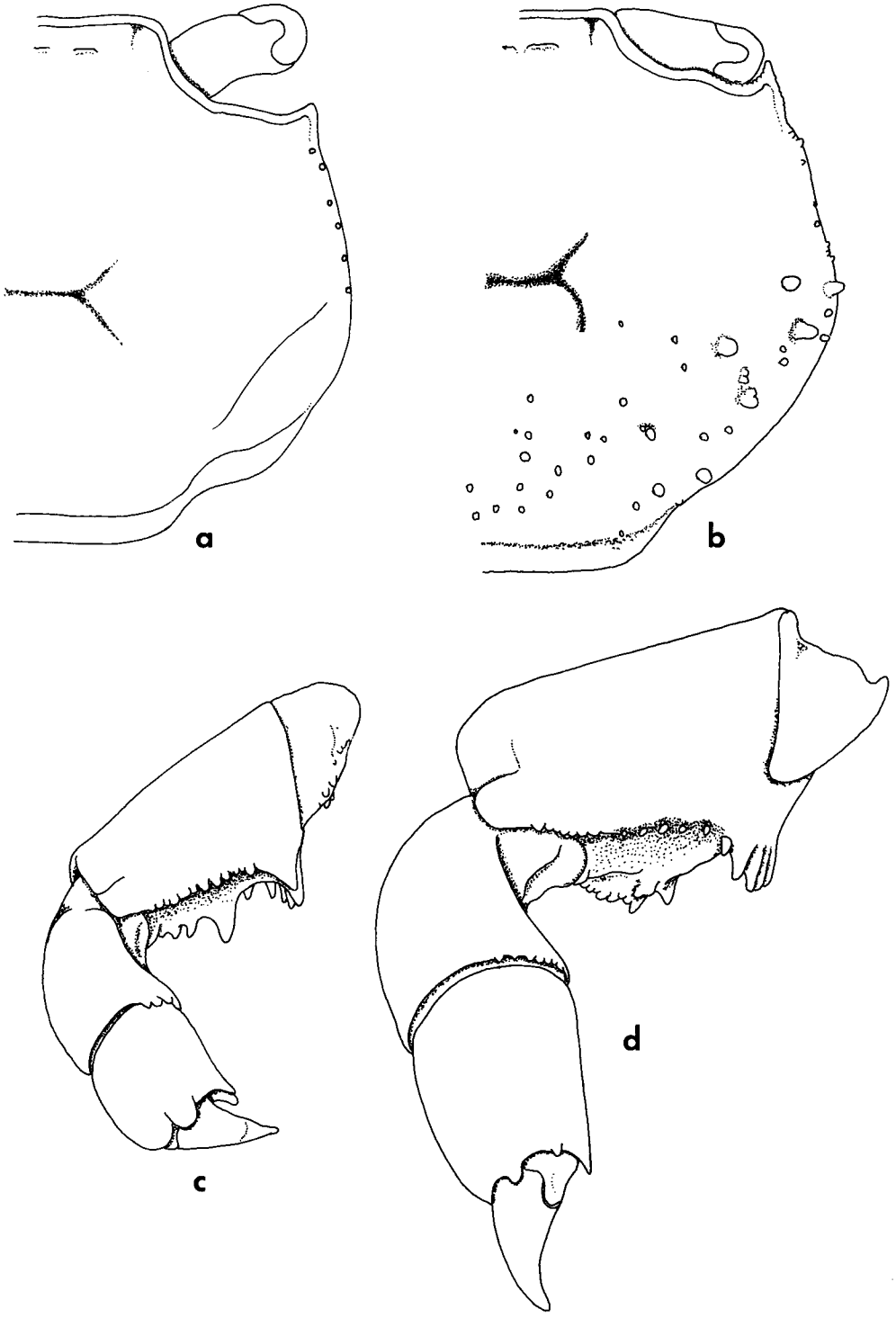

Fig. 4. *Baruna mangromurphia*, new species. a, c, d, holotype male; b, allotype female. a, b, carapace (denuded); c, right fourth ambulatory leg (inner surface view); d, left third ambulatory leg (inner surface view).

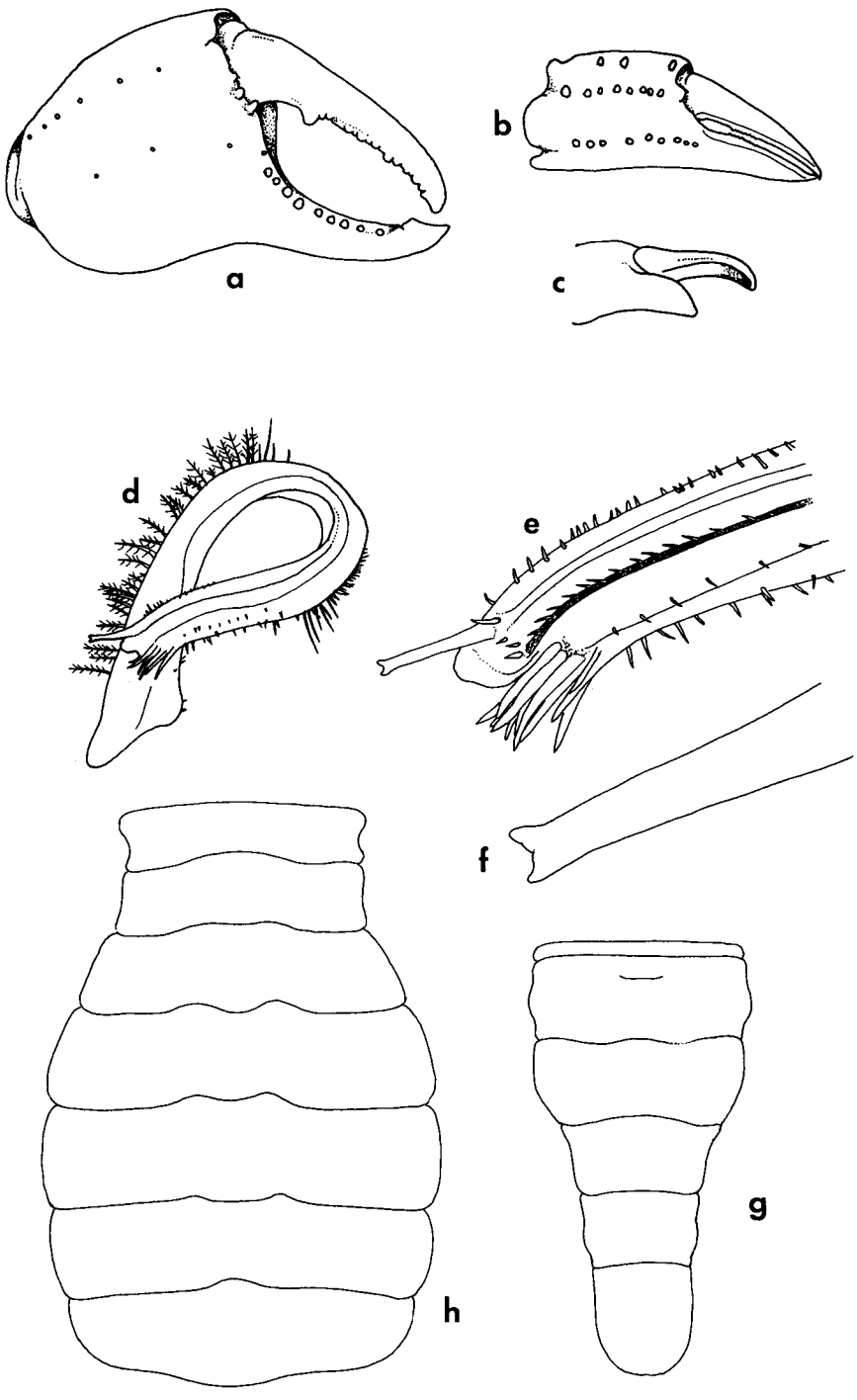

Fig. 5. *Baruna mangromurphia*, new species. a, d-g, holotype male; b, c, h, allotype female. a, right male chela (denuded); b, right female chela (denuded); c, right female chela showing concavity of fingers; d, left G1; e, distal part of G1; f, G1 subapical process; g, male abdomen (denuded); h, female abdomen (denuded).

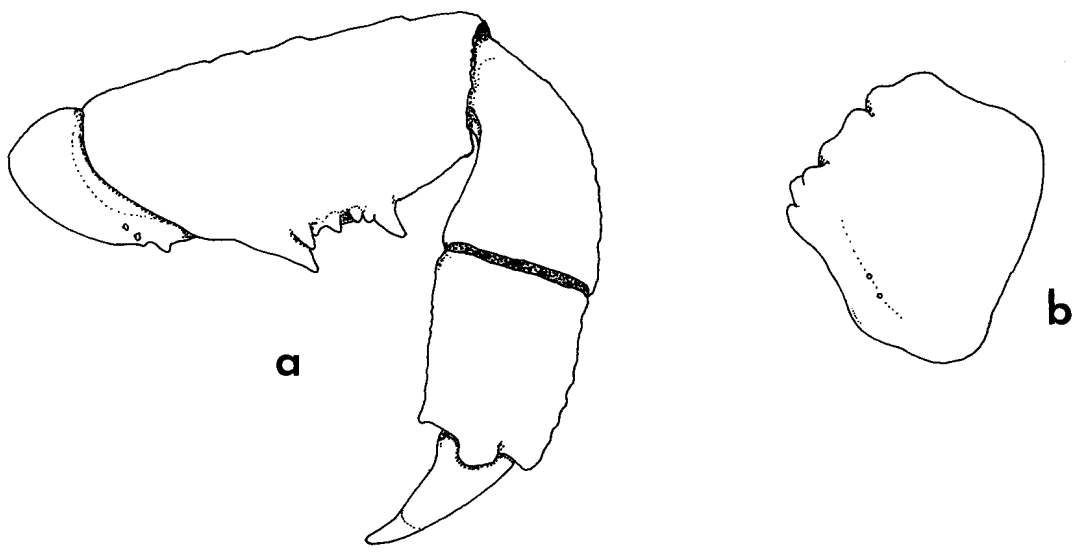

Fig. 6. *Baruna mangromurphia*, new species. Holotype male. a, right fourth ambulatory leg (outer lateral view); b, right cheliped carpus (dorsal view).

process tapers to a sharp tip and the anterolateral margin is demarcated by three broad lobes. The lobed anterolateral margin of *B. socialis* also serves to distinguish females. In addition, the dorsal surface of the carapace of female *B. socialis* is very granulose throughout, whereas in *B. mangromurphia*, granules occur predominantly (if not wholly) on the posterior half. The large granules on the posterolateral region of female *B. mangromurphia* are very distinctive, and in larger specimens, this feature is very useful in distinguishing the species.

Baruna mangromurphia appears to be the most widely distributed and common species of *Baruna*. The form of the male chela is subject to some variation. In smaller males, chela is less inflated and the surfaces of more granulated. Although the shape of the tip of the G1 subapical process (dichotomous) seems minor, we have found the character to be constant for all the specimens (including small males) from Singapore, Malaysia, Thailand and Australia we have examined. The figures of the G1 by Tweedie (1939) and Sakai (1939, 1976) show the distinctly flared tip of the subapical process.

A single female from Kedah, Malaysia (ZRC 1965.7.19.354) is unsual in having the dorsal surface of the carapace and outer surface of the ambulatory merus more granulose than typical *B. mangromurphia*. There are also several larger granules on the anterolateral margin. It is tentatively referred to *B. mangromurphia*.

Baruna minuta, new species
(Figs. 7, 8)

Leipocten quezonensis Serène, in Yang, 1979: ix (nomen nudum)
Leipocten quezonensis - Yang, 1979: 39 (nomen nudum)
Leipocten sp. - Yang, 1979: 39 (part)

Diagnosis. - Carapace subquadrangular, slightly broader than long, regions poorly defined, numerous long hairs, especially on frontal and anterolateral regions legs, short stiff hairs absent. Outer edge of supraorbital margin smooth in males, gently granulated in females. Anterolateral border occasionally with single epibranchial lobe, often entire, not lobulated. Anterolateral and posterolateral regions smooth in males, covered with numerous granules in females. Outer surface of third maxilliped with short hairs.

Male chelae equal to subequal, swollen, outer surface without hairs, with median longitudinal row of granules, upper surfaces granulose, finger with a large blunt tooth near proximal end, cutting edges of pollex with numerous blunt granules; inner distal margin of carpus serrated, with row of submarginal granules. Female chelae not swollen, equal, outer surface of chelae with numerous long woolly hairs, with three indistinct rows of low granules, row of granules and tubercles on upper margin of dactylus, cutting edges of fingers almost blade-like, without distinct teeth, inner surface of distal part broadly concave.

Ambulatory legs short, stout, with long woolly hairs but no bristles; ischio-basis smooth or with several very small, rounded granules on ventral surface; ventral surface of merus with ventral spines, granules and tubercles arranged in U-shaped structure, dorsal margin smooth to gently uneven, never serrated; carpi, propodi, and dactyli sometimes lined with small marginal or submarginal granules, dorsal margins not serrated; outer surfaces of all segments almost smooth.

G1 tip cone-shaped, with two or three stiff large subapical spines on one edge and a long, gradually tapering subapical process on the other, of which the tip is pointed.

Material examined. - Holotype - 1 male (2.9 by 2.4 mm) (ZRC 1991.193), in laterite rocks, Sentosa island, Singapore, leg. P. K. L. Ng, 21.xi.1987. — Allotype - 1 female (4.3 by 3.5 mm) (ZRC 1991.194), same data as holotype.

Paratypes - 6 females (ZRC 1991.195-200), same data as holotype. — 1 male (2.8 by 2.2 mm), 8 females (3.5-5.5 by 2.9-4.7 mm), 8 females (ovig.) (3.4-5.4 by 2.8-4.7 mm) (ZRC 1991.201-217), same locality as holotype, leg. S. Harminto, P. K. L. Ng & L. Tan, 24.x.1987. — 4 males, 4 females (ZRC 1991.223-230), 1 male, 1 female (USNM), 1 male, 1 female (MNHN), 1 male, 1 female (NHM), 1 male, 1 female (QM), 1 male, 1 female (PMBC), 1 male, 1 female (RMNH), 1 male, 1 female (AM), Sentosa island, leg. S. Harminto, 6.xii.1987. — 3 females (ZRC 1988.794-796), Sentosa island, leg. S. Harminto, 24.x.1987. — 1 male (3.0 by 2.4 mm), 2 females (4.4-4.9 by 3.4-3.7 mm), 2 females (ovig.) (3.8-4.4 by 3.0-3.4 mm) (ZRC 1991.218-222), same locality as holotype, leg. S. Harminto, 22.xi.1987. All type localities in Singapore.

Others - 3 males, 10 females (4 ovig.) (ZRC 1988.2163-2178), Labrador, Singapore, leg. P.

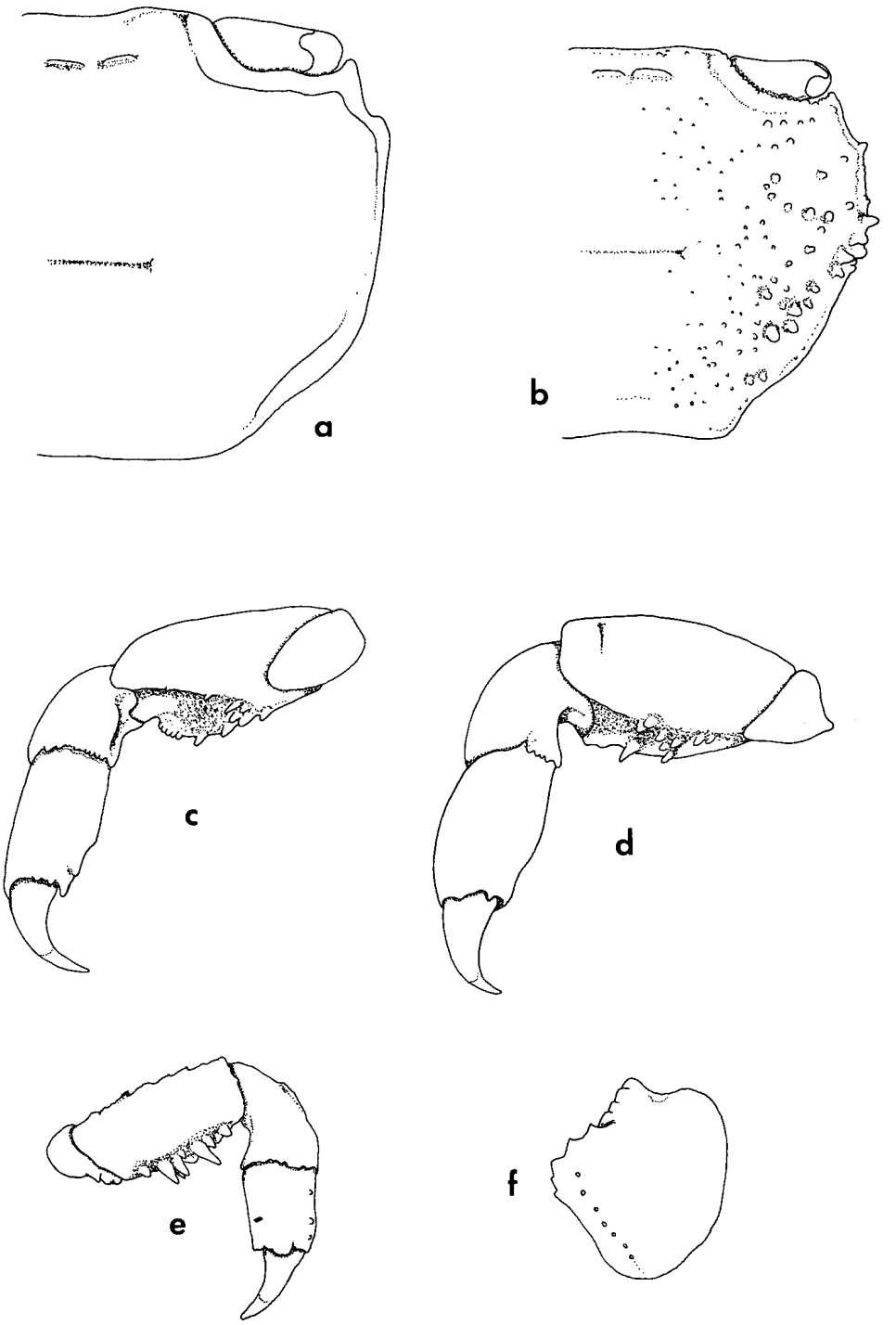

Fig. 7. *Baruna minuta*, new species. a, c, d-f, holotype male; b, allotype female. a, b, carapace (denuded); c, right fourth ambulatory leg (inner surface view); d, left third ambulatory leg (inner surface view); e, right fourth ambulatory leg (outer lateral view); f, right cheliped carpus (dorsal view).

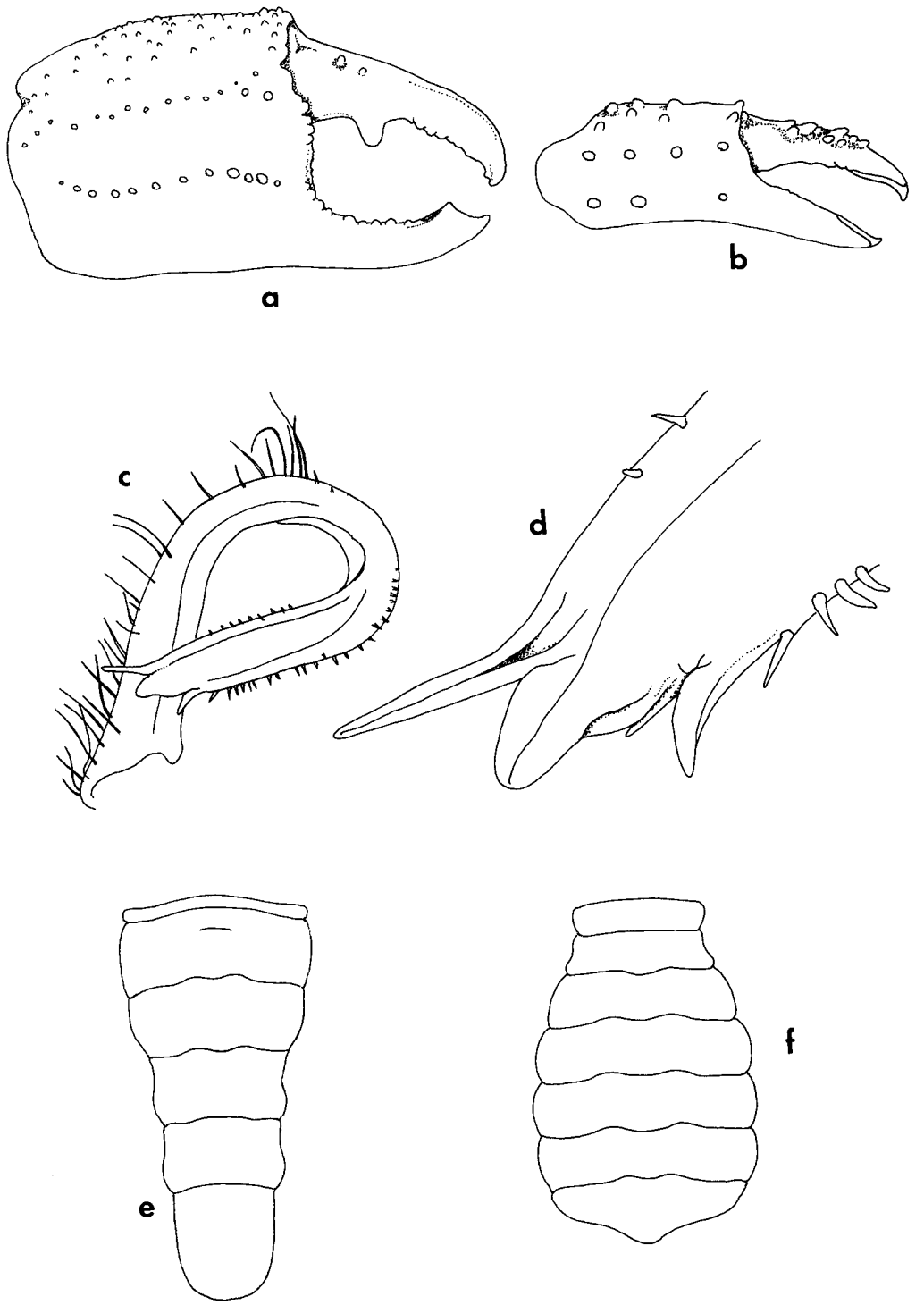

Fig. 8. *Baruna minuta*, new species. a, c, d, e, holotype male; b, f, allotype female. a, right male chela (denuded); b, right female chela (denuded); c, left G1; d, distal part of G1; e, male abdomen (denuded); f, female abdomen (denuded).

K. L. Ng, 22.xii.1987. — 1 female (ovigerous) (ZRC 1988.2152), Labrador, Singapore, leg. P. K. L. Ng, 1986. — 1 female (ZRC 1991.232), Labrador, Singapore, leg. P. K. L. Ng, 1982. — 2 females (ZRC 1991.233-234), Labrador, Singapore, xii.1983. — 1 female (ZRC 1991.235), Labrador beach, Singapore, leg. P. K. L. Ng, 1988. — 114 males, 84 females (41 gravid) (ZRC 1984.5153-5343), East Coast, in clumps of barnacles and algae on concrete wall, Singapore, leg. P. K. L. Ng, 12.v.1983. — 1 female (with two vials of zoeae 1) (ZRC 1985.1890-1892), East Coast, in clumps of barnacles on concrete wall, Singapore, leg. P. K. L. Ng, 1983. — 2 females (1 ovigerous) (ZRC 1988.2161-2162), West Coast, Singapore, leg. S. Harminto, 27.viii.1987. — 1 female (ZRC 1984.7849), Sentosa island, Singapore, leg. P. K. L. Ng, 19.v.1983. — 1 male (ZRC 1991.231), Sentosa island, Singapore, leg. S. Harminto, 22.xi.1987. — 1 male (ZRC 1989.3631), Sentosa, Singapore, leg. P. K. L. Ng, 13.xii.1989. — 8 females (6 ovigerous) (ZRC 1988.2153-2160), Pulau Kukor, southern Singapore, leg. P. K. L. Ng & S. Harminto, 30.xii.1986. — 3 males, 9 females (ZRC 1988.2209-2220), Pulau Kukor, southern Singapore, leg. S. Harminto, 17.iii.1988. — 2 males, 2 females (ZRC 1985.1738-1741), on soft mud clump on rock, Tanjong Bidara, Camp Terendak, Malacca, leg. P. K. L. Ng, 16.ii.1985. — 2 males (ZRC 1991.243-244), Lumut, Perak, Peninsular Malaysia, leg. H. Singh, 1988. — 7 females (ZRC 1991.236-242), Lumut, Perak, Peninsular Malaysia, leg. H. Singh, 1988. — 1 male, 2 females (ZRC 1970.1.22.31-34), Quezon, Palawan, Philippines, leg. R. Serène, 1963. — 3 females (ZRC 1970.1.10.44-46), Quezon, Palawan, Philippines, leg. R. Serène, 1963. — 3 males, 2 females (ZRC 1070.1.10.47-52), Quezon, Palawan, Philippines, leg. R. Serène, 1963.

Etymology. - The specific name is derived from the Latin "minutus" for small, alluding to the small size of the species.

Distribution. - Singapore, Johor, Malacca, Perak (Peninsular Malaysia) and Palawan (Philippines).

Habitat and Biology. - *Baruna minuta*, new species occurs in cavities of marine laterite blocks, soft and coralline rocks. It has also been found in large numbers in clumps of mud on rocks, as well as among barnacles and algal growths on rocks and concrete walls. It is very common in the holes and crevices of dead coral rock. Although *B. mangromurphia* sometimes also occurs among barnacle clumps, they always do so in areas in or near mangroves. *Baruna minuta* on the other hand, is not known to occur in or near mangroves. Both species have yet to be found together.

Remarks. - The anterolateral margin of *B. minuta* is almost entire or with one blunt lobe, the regions of the carapace poorly demarcated, absence of short stiff hairs, having much more long hairs, the male chelae more granulose with a median longitudinal row of granules, the tip of the G1 is cone-shaped (not rounded) and the subapical process of the G1 is pointed and entire. The granules on the ventral surfaces of the merus of *B. minuta* are also weaker and less well developed compared to those of *B. mangromurphia*. Compared to *B. mangromurphia*, the ambulatory dactyli of *B. minuta* are also proportionately longer and more hooked. *Baruna minuta* appears to be the smallest of the three known species of *Baruna*, with males less than 4.0 mm and females less than 5.5 mm in carapace width.

The specimens from Palawan, Philippines (ZRC 1970.1.22.31-34, 44-46, 47-52) collected by R. Serène were identified by him as a new species "*Leipocten quezonensis*". This name was

never published but appeared in Yang's (1979) catalogue of the ZRC Brachyura as a nomen nudum. They are clearly conspecific with what is here identified as *B. minuta*, their G1 features and other morphological characters being almost identical. We have opted to use another name for this species as it appears to be widely distributed in Southeast Asia and possibly in other parts of the Indo-West Pacific as well. Serène's specimens of *L. quezonensis* are almost identical with those of *B. minuta*, and the present authors regard them as conspecific.

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