

## The freshwater crabs of Pulau Langkawi, Peninsular Malaysia

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**Abstract.** The freshwater crab fauna of the island of Pulau Langkawi, a large island approximately 25 km northwest of Peninsular Malaysia, is surveyed. Two new species, *Stoliczia bella* sp. nov. and *Phricotelphusa gracilipes* sp. nov., are described, whilst two other species, *Somanniathelphusa sexpunctata* (Lanchester, 1906) and *Siamthelphusa improvisa* (Lanchester, 1901) are recorded from the island for the first time. This brings to five the total number of true freshwater crabs known from the island. The taxonomy and ecology of these species are documented, and their affinities with mainland taxa discussed.

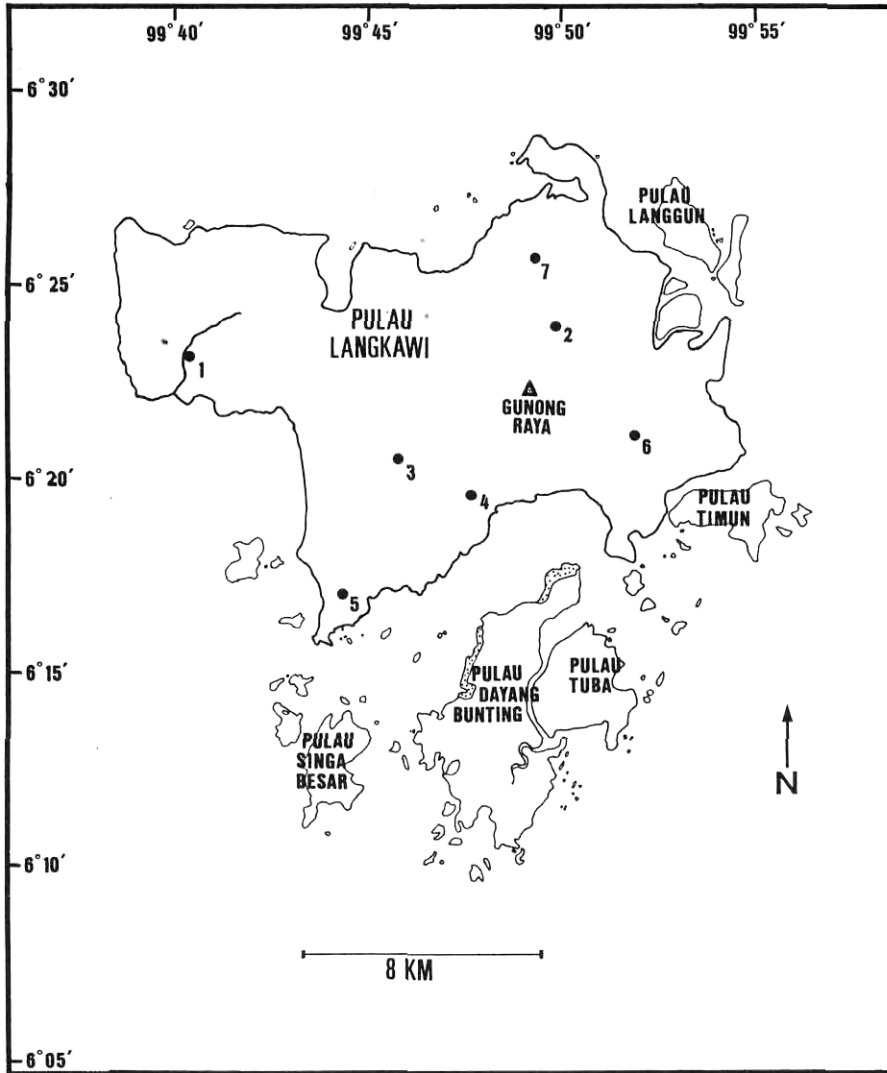
**IKHTISAR.** Fauna ketam air tawar di Pulau Langkawi, Semenanjung Malaysia telah ditinjau. Dua spesies baru, *Stoliczia bella* sp. nov. dan *Phricotelphusa gracilipes* sp. nov., adalah diuraikan, sementara dua spesies lain, *Somanniathelphusa sexpunctata* (Lanchester, 1906) dan *Siamthelphusa improvisa* (Lanchester, 1901) direkodkan untuk kali pertamanya di Pulau Langkawi. Ini menghasilkan sejumlah lima spesies ketam air tawar di Pulau Langkawi. Taksonomi dan ekologi kesemua spesies ini dicatatkan, dan pertaliannya dengan taxa semenanjung dibincangkan.

### INTRODUCTION

The island of Pulau Langkawi, located some 25 km west of the state of Kedah (Peninsular Malaysia), is one of the two largest islands in Peninsular Malaysia (Fig. 1). The only reference to the freshwater crab fauna is a paper by Kemp (1918), in which he described a new semiterrestrial sesarmine, *Sesarma foxi*, from the island. This species is currently placed in the genus *Geosesarma* De Man, 1892 (*vide* Serene & Soh 1970). There are no other known records.

Recently, the authors made intensive collections at Langkawi in an attempt to advance our knowledge of its freshwater crab fauna. As a result, a total of five freshwater crab species belonging to four families can now be listed from the island, two of which are new to science. The documentation of these taxa and the description of the new species form the basis of the present paper.

The abbreviations G1 and G2 are for the male first and second pleopods respectively. Measurements are of the carapace breadth and length respectively. Only the original references to the species previously described have been included. Specimens are deposited in the Zoological Reference Collection (ZRC), National University of Singapore; Rijksmuseum van Natuurlijke Historie (RMNH), Leiden, Netherlands;



**Figure 1.** Pulau Langkawi. Collection sites: 1. Air Telaga Tujoh Waterfall; 2. Durian Perangin Waterfall; 3. Ulu Melaka padi fields; 4. Golf Course stream; 5. Pantai Tengah padi field; 6. stream beside road from Kuah to Kisap; 7. padi field between Tanjong Rhu and Durian Perangin Waterfall.

Museum Naturhistorisches Basel (MBA), Basel, Switzerland; Museum Nationale D'Histoire Naturelle (MNHN), Paris, France; British Museum (Natural History) (BMNH), London, United Kingdom; and United States Natural History Museum (USNM), Smithsonian Institution, Washington D.C.

## FAMILY POTAMIDAE ORTMANN, 1896

Genus *Stoliczia* Bott, 1966*Stoliczia bella* sp. nov.

(Pl. 1A; Fig. 2, 3A, B)

**MATERIAL EXAMINED.** **Holotype** — 1♂ (31.0 by 23.7 mm)(ZRC), Durian Perangin Waterfall, middle stretch, under rocks, adjacent to fast flowing stream, Langkawi, Kedah, 6° 23' 58"N, 99° 50"E, leg. P.K.L. Ng and H.P. Ng, 16.vi.1987. **Paratypes** — 1♀ (ZRC), 1♀ (RMNH), same data as holotype.

**DIAGNOSIS.** Carapace rounded, swollen, broad, surfaces convex, smooth, glabrous. External orbital angle short, slightly concave. Anterolateral margin convex. Median lobe of posterior margin of epistome triangular, tip sharp. Exopod of third maxilliped with a very short flap-like flagellum. Ambulatory legs relatively long. G1 terminal segment tapered, with distinct cleft between terminal and subterminal segments.

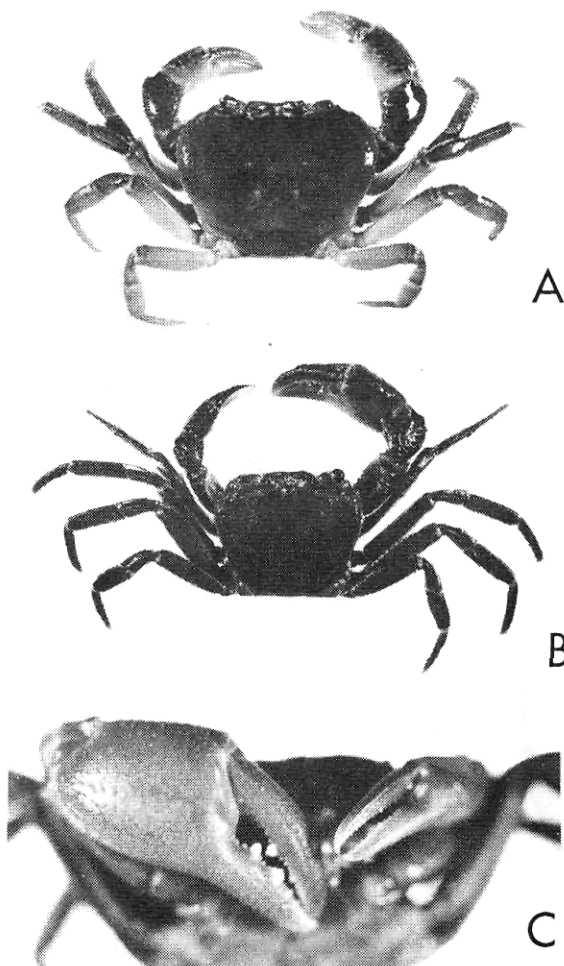


Plate 1. A, *Stoliczia bella* sp. nov., Holotype male, 31.0 by 23.7 mm; B, C, *Phricotelphusa gracilipes* sp. nov., Holotype male, 17.1 by 14.3 mm.

REMARKS. *Stoliczia bella* sp. nov. belongs to the group of *Stoliczia* which have rounded, swollen carapaces; *S. cognata* (Roux, 1936) and *S. rafflesi* (Roux, 1936). It is perhaps closest to *S. cognata*, but *S. bella* can easily be separated, viz., (1) the margin of the external orbital angle being shorter and concave (not broad, convex), (2) tip of the median triangle on the posterior margin of the epistome acute (not truncate), (3) carapace relatively broader, (4) the exopod of the third maxilliped with a very short flap-like flagellum (not absent), (5) larger adult size, females of *S. bella* the size of mature *S. cognata* are still immature, (6) G1 terminal segment more curved, (7) mesial cleft between the G1 terminal and subterminal segments more pronounced, and (8) relatively longer ambulatory legs. *Stoliczia cognata* also appears to be confined to northeastern Perak in the Yum River drainage. Compared to *S. rafflesi* described from Gunung Tahan, Pahang, *S. bella* has a much more convex carapace and anterolateral margin, concave external orbital angle margin,

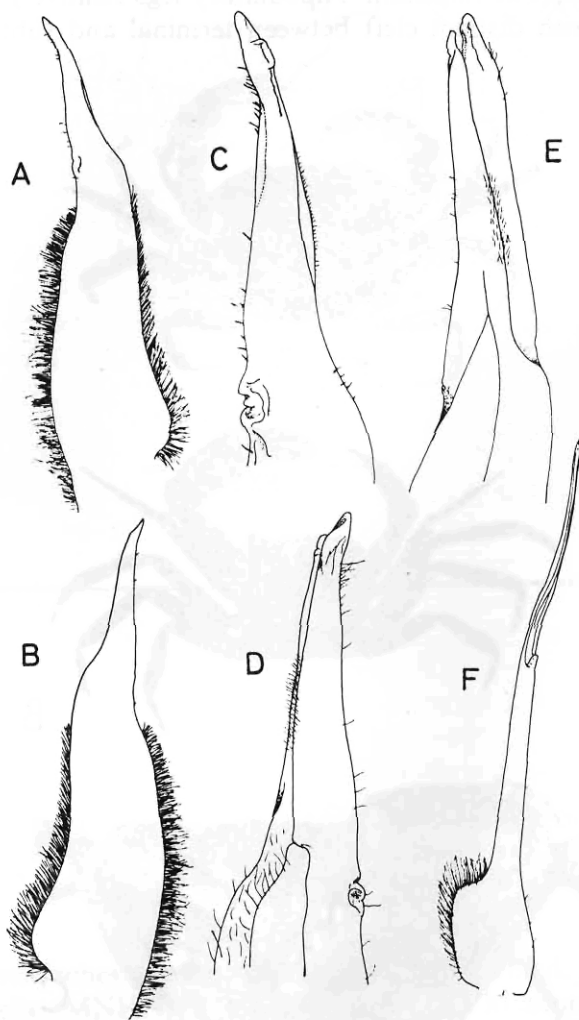


Figure 2. *Stoliczia bella* sp. nov., Holotype male, 31.0 by 23.7 mm. A-E, Left G1; F, Left G2. A, C, Dorsal view; B, D, Ventral view; E, Dorso-marginal view.

larger adult size, and very different G1 structure; the terminal segment of *S. rafflesi* being strongly bent and with a dorsal flap.

*Stoliczia bella* is extremely difficult to collect, all three specimens obtained in burrows under rocks in the moist area adjacent to the main, fast flowing stream. The substrate was mud and soil, the animals having dug gently sloping burrows at least 10 to 20 cm in length. The species appears to have semiterrestrial habits and is the first *Stoliczia* known to dig burrows. Most of the other Malaysian members in the genus (and in the related *Johora* Bott, 1966, *vide* Ng 1987) hide under rocks or leaf litter. The present observations strongly indicate that the closely related *S. cognata* may have similar habits, its swollen and rounded carapace suggesting it is also a semiterrestrial species. Ng (1986a) recorded *Terrapoton abbotti* (Rathbun, 1898) from southern Thailand as being a semiterrestrial species residing in burrows and suggested that *T. aipooae* Ng 1986a, from Pahang as doing the same. The burrows of *S. bella* are not deep, but rather, long and almost horizontal in some places, appearing to follow the areas between rocks and roots. This makes it almost impossible to dig for them, the authors obtaining them by quickly blocking the burrow after glimpsing them near the burrow entrance as the large rock adjacent to the entrance was being turned. All three specimens were collected from shaded areas, a pair (ZRC) under a large overhanging rock, and the other (RMNH) on the stream bank under a large tree. *Stoliczia bella* was only collected from Durian Perangin Waterfall, together with *Phricotelphusa gracilipes* sp. nov.. Despite an intensive search, no *Stoliczia* was found at Air Telaga Tujuh Waterfall, although they are almost certainly present there.

The live colour of this species is very spectacular. The dorsal parts of the carapace, suborbital, sub-branchial, upper part of the pterygostomial region, most of the third maxilliped merus, upper one third of the third maxilliped ischium, many parts of the ambulatory legs (especially the distal three segments), outer surface of the chelipedal carpus and upper margins of the palm are deep blue-black. All the other parts, including the infraorbital margins, posterior margin of the epistome, but with the exception of the chelipedal finger tips, rest of the third maxilliped ischium, sternum and abdomen, are bright orange. The sternal and abdominal surfaces are dirty white and pale orange, the tips of the chelipedal fingers brown, and the lower two thirds of the third maxilliped ischium dirty white. The G1 terminal segment is bright orange, the other parts white. The G1 colouration is similar to that for *S. stoliczkana stoliczkana* (Wood Mason, 1871), but the colour of the carapace and other appendages of this species is very different (unpublished data).

The specific name is derived from the Latin "bellus", for beautiful, alluding to the bright orange colour of fresh specimens.

#### FAMILY GECARCINUCIDAE RATHBUN, 1904

##### *Genus Phricotelphusa* Alcock, 1909

##### *Phricotelphusa gracilipes* sp. nov.

(Pl. 1B, C; Fig. 3 C-I)

**MATERIAL EXAMINED.** **Holotype** 1♂ (17.1 by 14.3 mm)(ZRC), bank of fast flowing stream, Durian Perangin Waterfall, upper stretch, Langkawi, Kedah, 6° 23'58"N, 99° 50'05"E, leg. P. K.L. Ng and H.P. Ng, 16.vi. 1987.

PARATYPES — 1♂, 1♀ (ZRC), same data as holotype — 7♂, 6♀, 19 juveniles from brooding female (ZRC), 1♂, 1♀ (RMNH), 1♂, 1♀ (BMNH), 1♂, 1♀ (MNHN), 1♂, 1♀, (MBA), 1♂, 1♀ (USNM), under rocks by side of fast flowing streams, same locality as holotype, middle to upper stretches, leg. P.K.L. Ng and H.P. Ng, 16.vi. 1987 — 19♂, 16♀, 1 juvenile from brooding female (ZRC), Air Telaga Tujoh (Seven Wells) Waterfall, under leaves and rocks at sides of fast flowing streams, Langkawi, Kedah, 6° 23' 09"N, 99° 40' 19"E, leg. P.K.L. Ng and H.P. Ng, 15.vi.1987.

DIAGNOSIS. Carapace quadrate, surfaces slightly rugose, granulose, regions indistinct. Frontal margin sinuous, not strongly deflexed. Postorbital cristae well developed, sharp, separated from low but distinct epigastric cristae by small notch. Epi-branchial tooth strong, acute, clearly demarcated from acutely triangular external orbital angle. Anterolateral margin slightly convex, gently serrated. Posterior margin of epistome with broadly triangular median lobe. Exopod of third maxilliped without flagellum. Chelipeds in adult males unequal, surfaces of palm and fingers of larger cheliped covered with small, sharp granules, larger cutting teeth on fingers lined with smaller denticles. Ambulatory legs long, dorsal margins of merus gently serrated. Purplish red species.

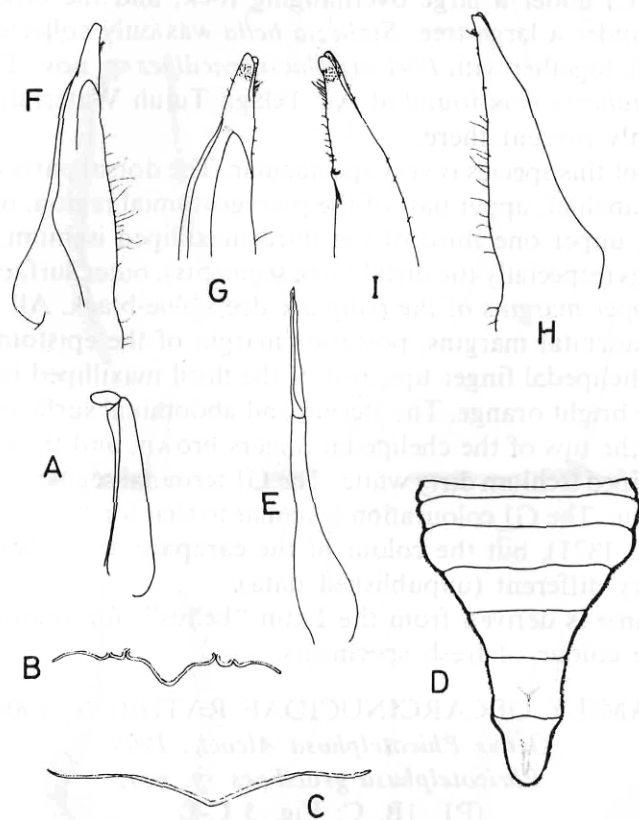


Figure 3. A, B *Stoliczia bella* sp. nov., Holotype male, 31.0 by 23.7 mm. C-I, *Phricotelphusa gracilipes* sp. nov., Holotype male, 17.1 by 14.3 mm. A, Left third maxilliped exopod; B, C, posterior margin of epistome; D, Abdomen; E, Left G2; F-I, Left G1. F, G, Ventral view; H, I, Dorsal view.

REMARKS. This species is the eighth known from the genus, and the second reported from Peninsular Malaysia, the first being *P. hockpingi* Ng, 1986c, from Maxwell Hill, Perak, northwestern Peninsular Malaysia. Three species are known from Burma, the type, *P. callianira* (De Man, 1887), *P. carinifera* (De Man, 1887) and *P. elegans* (De Man, 1898), while three others are known from Thailand, *P. limula* (Hilgendorf, 1882), *P. aedes* (Kemp, 1923) and *P. ranongi* Naiyanetr, 1982. Bott (1970) had synonymised *P. aedes* with *P. limula*, but a comparative study of specimens collected from the province of Nakon Sri Tammarat and the island of Phuket (Salanga), their respective type localities, showed them to be distinct taxa (Naiyanetr & Ng, unpublished data).

In general appearance, *P. gracilipes* is closest to *P. limula* and *P. hockpingi*. From *P. limula*, it can be separated by its smaller size, more produced and more sinuous frontal margin, more granulose carapace surfaces, the epigastric and postorbital cristae more distinctly separated, the epigastric clearly projected forwards, more serrate and less convex anterolateral margin, more prominent epibranchial tooth, less massive adult male chelipeds, more granulose cheliped surfaces, denticulated cutting teeth, and the shorter sixth and seventh male abdominal segments, the lateral sides of the seventh being much less concave. From *P. hockpingi*, *P. gracilipes* can be distinguished by its slightly more sinuous frontal margin, more granulose carapace, distinctly triangular median lobe of the posterior epistome margin, longer ambulatory legs, and a G1 which has a straighter mantel (outer) margin, with a straight and more open tip. Whereas the colour of *P. hockpingi* varies considerably between young specimens and females, that of *P. gracilipes* appears to be quite constant, even young and females are brownish-purple to purplish-red in colour.

*Phricotelphusa gracilipes* appears to be common throughout the highlands of Langkawi, preferring shaded areas under leafbeds and rocks. It is not exclusively an aquatic species, with several specimens (including the holotype male) collected from the wet terrestrial bank next to the stream. It is certainly a highland species, and was not encountered in the lower stretches of the streams. Two brooding females were collected, but most of the young crabs were not retained. Its habits and habitats thus parallel that of *P. hockpingi* (see Ng 1986c).

The specific name, *gracilipes*, is derived from the Latin, "gracilis" for slim, and "pes" for foot, in allusion to the slender ambulatory legs of the species.

#### FAMILY PARATHELPHUSIDAE ALCOCK, 1910

##### Genus *Sommaniathelphusa* Bott, 1968

##### *Sommaniathelphusa sexpunctata* (Lanchester, 1906)

(Pl. 2A; Fig. 4 A-D)

*Potamon (Parathelphusa) sexpunctatum* Lanchester, 1906

*Somanniathelphusa juliae* Bott, 1968

MATERIAL EXAMINED. 14♂, 3♀ (ZRC) 1♂, 1♀ (RMNH) 1♂ (MBA), padi (rice) field, along Ulu Melaka road, Langkawi, Kedah, 6° 20'33"N, 99° 45'41"E, leg. P.K.L. Ng and H.P. Ng, 16.vi.1987 — 1♀ (ZRC), under rock, in shallow stream, sandy substrate, junction of Empangan Malut and Golf Course, Langkawi, Kedah, 6° 19'21"N, 99° 47'44"E, leg. P.K.L. Ng and H.P. Ng, 15.vi.1987

— 1♀, 1 juv.(ZRC), padi field near Pantai Tengah, Langkawi, Kedah, 6° 17'09"N, 99° 44'19"E, leg. P.K.L. Ng and H.P. Ng, 15.vi.1987 — 14 juvs. (ZRC), padi field, along road from Tanjong Rhu to Durian Perangin Waterfall, Langkawi, Kedah, 6° 25'45"N, 99° 49'23"E, leg. P.K.L. Ng & H.P. Ng, 16.vi. 1987.

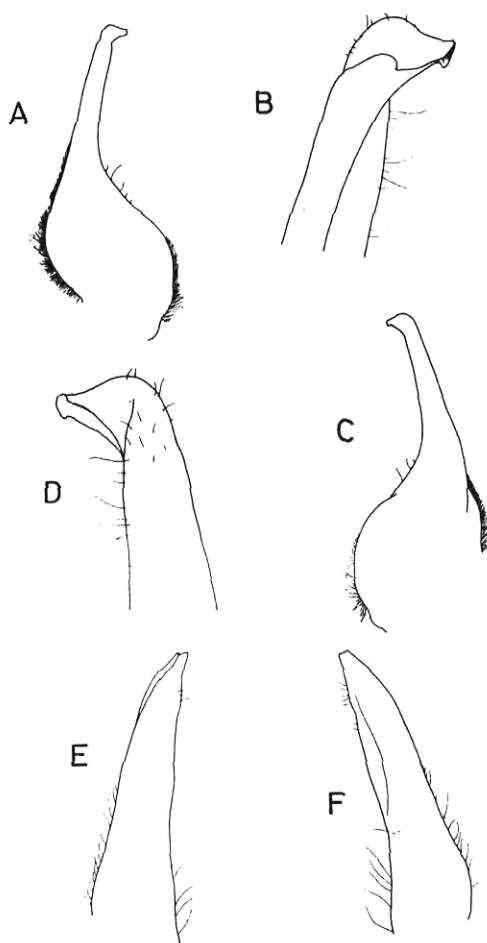
REMARKS. *Somanniathelphusa sexpunctata* is a widespread species throughout southern Thailand (Naiyanetr 1978a, b, 1980) and northern Peninsular Malaysia (Smedley 1931; Bott 1968, 1970). This is, however, the first record of the species from Pulau Langkawi. It is common in the ricefields throughout the island.

There can be little doubt that the species described as *Somanniathelphusa juliae* by Bott (1968) is identical with *Potamon (Parathelphusa) sexpunctatum*, first described from southern Thailand. Lanchester's species, without doubt, is also a *Somanniathelphusa*. The two original type localities of *S. sexpunctata*, Sai Kau and Cape Patani, are both very near the southernmost tip of Thailand, and all collections of *Somanniathelphusa* made in and around this area so far (unpublished data; Naiyanetr, personal communication) have revealed only one species, *Somanniathelphusa sexpunctata*. This is also the area cited by Bott (1968, 1970) as the range of his species, *S. juliae*. Their identical external and G1 structures leave no doubt in the authors' minds that the two species are conspecific, with Lanchester's name having priority. The first author has also examined Lanchester's (1901) specimens of "*Potamon (Parathelphusa) sinensis*" from the "Skeat Expedition" to the Malay Peninsula (presently deposited in the Cambridge University Zoology Museum) which Bott (1968, 1970) had referred to *S. juliae*. These specimens are identical with *S. sexpunctata*. According to the labels on the specimens, Dr Michael Turkay (Senckenberg Museum) had also examined these specimens in 1978, and had arrived at a similar conclusion.

*Somanniathelphusa sexpunctata* is closest to *S. germaini* (Rathbun, 1904), but can easily be separated by the form of the front and the structure of the G1. *Somanniathelphusa sexpunctata* has a clearly bilobed front, with a median cleft separating the two convex lobes whereas that of *S. germaini* is usually much straighter and though slightly sinuous, lacks a distinct cleft. Their G1 structures are very different; with the terminal segment in *S. sexpunctata* shaped like a duck's head (Bott's 1968 "*entenschnabelformig*"), whilst that of *S. germaini* is straight and simple. The easiest way to separate mature specimens of the two species, regardless of the sex, is to use the coloration of the chelipeds, a character first pointed out to the authors by Professor Phaibul Naiyanetr, for which they are most grateful. Professor Naiyanetr calls *S. sexpunctata* the "White Clawed Rice Field Crab" because the lower oblique half of its chelipeds (including the fingers) are always white. *Somanniathelphusa germaini* on the other hand, has the palm and fingers coloured a uniform dark brown or purple. This difference in colouration seems to be constant, and valid even for smaller male specimens and females in which the chelipeds are not so distinctly enlarged, and can usually be seen even in freshly preserved specimens.

They dig relatively deep burrows by the sides of the bunds, usually several centimetres (but sometimes several metres) from the water level. The base of the burrow however, is always below the water level. They are clearly nocturnal animals, and most of the large specimens were collected at night. Small specimens however, hide





**Figure 4.** Left G1s. A-D, *Somanniathelphusa sexpunctata* (Lanchester, 1906), male, 46.8 by 38.0 mm, padi field along Ulu Melaka road; E, F, *Siamthelphusa improvisa* (Lanchester, 1901), male, 17.0 by 14.3 mm, stream along road from Kuah to Kisap. A, B, E, Ventral views; C, D, F, Dorsal view.

in the submerged vegetation and can easily be caught using dip nets during the day. Freshly dug out mud at the opening is a very good indication that the burrow is occupied.

A pair of specimens were observed mating in a few centimetres of water by the edge of the padi field bund along Ulu Melaka road on the night of 16 June 1987, at approximately 2130 hours. The female was above the male which used its smaller cheliped and six of its ambulatory legs to hold onto her. The larger male cheliped was free, and although not touching the female, covered her. When disturbed by our torchlight, the male waved its large cheliped menacingly at us, but otherwise, did not move. Both the female's chelipeds were passively tucked underneath her. Mating continued for approximately ten minutes after we first noticed them.

Observations were also carried out on specimens kept in the aquaria. Several specimens moulted perfectly, but cannibalism of soft-shell postmoult crabs occurred unless these were separated. Premoult crabs were easy to detect since they refused

to feed one to two days before the moult, which lasted for only a few minutes. 24 hours after moulting, the exoskeleton was still very soft. 36 hours later, the exoskeleton became paper-thick, and after 48 hours, the carapace could still be depressed if light pressure was applied. Only after 60 hours was the exoskeleton completely hardened. Moulting always occurred in the open, outside cover, but after moulting, they retired under cover or to the corners. This agrees with field observations. In the padi fields, exuviae were frequently recovered from open areas. The present observations strongly suggest that *Somanniathelphusa* moults outside the burrow but retreats back into the burrow immediately after moulting to shelter from possible predators. Carapace and limb (including cheliped) growth and regeneration were rapid and sudden, the overall dimensions in the laboratory-held specimens increased in size by some 30%. In one large male, the regenerated larger cheliped (right) was only half the size of the original enlarged one, but interestingly, was on the opposite side. In the original specimen, the enlarged cheliped was on the left, and the moulting process would thus have seemed to have enlarged the original smaller cheliped, whilst regenerating the smaller one, which is mainly used for feeding. Specimens which had lost both chelipeds used their first two pairs of ambulatory legs to help them hold the food and aid in feeding. They are basically omnivorous, but in the wild, their main food is probably plant matter, especially the young padi plants. This species is of some economic importance since it has been reported to cause considerable damage by feeding on young padi plants and causing leaks in the bunds of the fields by their incessant digging. Sands (1930) recorded an interesting, cheap and apparently very effective method of controlling it. Wide mouthed pots were buried in corners of padi fields until their brims were level with the ground. Fried rice bran was used as bait. Crabs that crawled in were then unable to escape due to the smooth, sloping sides of the pot. Their natural enemies were believed to include otters, kingfishers, some birds of prey and waterfowl (Sands 1930). He also recorded that ducks were used to some extent to control the young, and large numbers were collected by hand by the farmers.

In life, the adult crab is a uniform dark brown to deep purple on the dorsal surface, the ventral being white. In several specimens, including females, one can make out the six yellow spots on the gastric region of the carapace, three on each side (excluding the H-shaped central depression), which gives the species its Latin name. In most specimens, only four are distinct. In young males and females, the carapace, including the chelipeds, are beige to brown in colour. The GIs of the males however, are almost identical to that of larger males. The coloration of the chelipeds of larger individuals has already been mentioned earlier.

**Genus *Siamthelphusa* Bott, 1968**

***Siamthelphusa improvisa* (Lanchester, 1900)**

(Pl. 2B; Fig. 4 E, F)

*Potamon (Parathelphusa) improvisum* Lanchester, 1901

*Siamthelphusa improvisa tweediei* Bott, 1968

**MATERIAL EXAMINED.** 1♀ (ZRC) under piece of wood, upper stretches of Durian

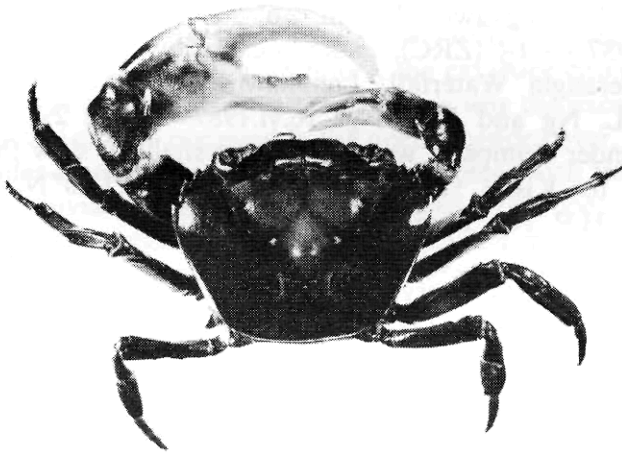
Perangin Waterfall, Langkawi, Kedah, 6° 23'58"N, 99° 50'05"E, leg. P.K.L. Ng, 16.vi.1987 — 1♂ (ZRC), under rocks, slow stream, rocky substrate, base of Durian Perangin Waterfall, Langkawi, Kedah, ca. 6° 23'58"N, 99° 50'05"E, leg. P.K.L. Ng and H.P. Ng, 16.vi.1987 — 3♂, 2♀, 3 juvs. (ZRC), 1♂, 1♀ (RMNH), under clumps of water plants, in shallow, slow flowing stream, road from Kuah to Kisap, Langkawi, Kedah, 6° 21'06"N, 99° 52'10"E, leg. P.K.L. Ng and H.P. Ng, 16.vi.1987.

REMARKS. This species has a very wide range, from most of southern Thailand and its outlying islands (Naiyanetr 1978b, 1980), down to northern Peninsular Malaysia, stretching as far south as Perak (Bott 1968, 1970; Ng & Lim 1986). The first author has even seen specimens reportedly collected from northern Selangor. Thus, the present record from Langkawi, although new, is not unexpected.

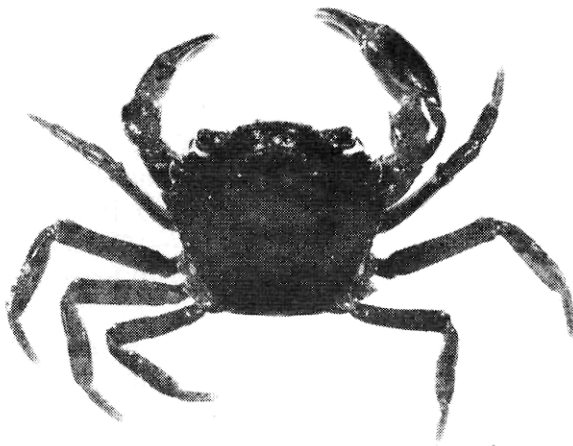
*Siamthelphusa improvisa* was first described on the basis of a brooding female by Lanchester (1901), but the exact locality where it was collected was not known, and Lanchester presumed that it was collected somewhere in the Malay Peninsula (Peninsular Malaysia and southern Thailand). In 1906, he recorded four males and a female from Mabek Hulu, Jalor (exact present locality untraceable) and described the largest male in some detail. He also figured the male abdomen. None of the specimens however, appear to be extant, being neither contained in the British Museum (Natural History) or the Zoology Museum of the University of Cambridge (Dr. Paul Clark and Dr. R. Goodhart, personal communication respectively), where many of Lanchester's specimens are known to be deposited. Bott (1968, 1970) extended the range of the species (as a subspecies) to southern Thailand, and since then, more comprehensive studies by Naiyanetr (1978b, 1980) have added details about its distribution and biology.

The status of the two subspecies of *S. improvisa* recognised by Bott (1968, 1970) is doubtful. Ng & Lim (1986) questioned the validity of these two subspecies and provisionally synonymised the two. *Siamthelphusa improvisa tweediei* Bott, 1968, which was characterised by its short fingers of the chelipeds (shorter than the palm) can only be separated from the nominate subspecies by this character. Their G1 structures are identical. Both subspecies were also collected from exactly the same locality at the same time (Sungei Chuiping, Perlis), and this makes their recognition as distinct subspecies very difficult to accept. We have examined 26 specimens of *S. improvisa* deposited in the ZRC collected from Perlis, all collected from the type locality of *S. i. tweediei*, Sungei Chuiping. They include not only representatives of both purported subspecies, but also intermediates. Five of the males have the features of *S. i. improvisa* (i.e. having the fingers of the chelipeds as long or longer than the palm), whereas one male, six females and two juveniles had the features of *S. i. tweediei*. Two specimens had missing chelipeds. The other ten specimens could not be definitely placed, their chelipedal fingers being intermediate between the conditions of *S. i. improvisa* and *S. i. tweediei*. The authors are thus of the opinion that *S. i. tweediei* cannot be a distinct subspecies since it falls into the range of variation observed for the species. It must thus be subjugated under the synonymy of *S. improvisa*.

It may be argued that the definition of species or subspecies is very subjective,



A



B

**Plate 2.** A, *Somanniathelphusa sexpunctata* (Lanchester, 1906), male, 46.8 by 38.0 mm, padi field along Ulu Melaka road; B, *Siamthelphusa improvisa* (Lanchester, 1901), male, 17.0 by 14.3 mm, stream along road from Kuah to Kisap.

and is often a very controversial matter. The same applies for the choice of characters used. There is however, a general consensus that unless minor differences (especially if they are of a quantitative nature) are shown to be really constant and/or are supported by geographical considerations, the recognition of different subspecies (or species) which are sympatric and synchronous must be discouraged. Subspecies after all, are supposed to be populations which can interbreed and produce viable offspring but are denied the opportunity to do so by geographical or ecological factors. When such factors do not exist (e.g. populations are sympatric) and/or there are intermediates, then there is no reason to differentiate between such populations (see Lopretto 1981; Serene 1973). Neither, as Bott (1968) must have realised, are there sufficient morphological grounds for differentiating the two forms into species.

There is no positive way of verifying the identity of Lanchester's (1901) original material. The type, a single female, appears to be lost, and by virtue of its sex, does not allow us to make any definite conclusions about its identity anyway. It would be difficult, if not impossible, to show that Lanchester's type may not be in fact conspecific with the present material of *S. improvisa* since the type locality of Lanchester's specimen is also unknown. Lanchester's (1906) specimens from Mabek Hulu identified by him as *Parathelphusa improvisa* however, clearly belong to *S. improvisa* since the male abdomen figured by him agrees excellently with those of the present males, with the lateral margins of the sixth segment not strongly convex. Considering that there are no records that Lanchester made or obtained specimens from Kelantan, where a related species, *Heterothelphusa insolita* Ng & Lim, 1986, is found, in any of his five papers on Malesian crustaceans (1900a, b, 1901, 1902, 1906), it may be reasonably safe to conclude that the present specimens are conspecific with Lanchester's species.

The species does not appear to dig burrows, preferring to shelter under rocks and mud at the base of water plants inhabiting relatively fast flowing shallow streams. Specimens however, were collected from high up waterfalls under rocks, together with *Phricotelphusa gracilipes* sp. nov., where there was little, if any, vegetation. It thus does not appear to have very fastidious habitat preferences. In the aquaria, it burrows underneath the substrate when cover is unavailable. It is not at all widespread on the island, and has been collected from only few localities. Large specimens were not collected, but the smaller ones are identical with the specimens in the ZRC from Perlis, and numerous specimens the authors have collected from southern Thailand, with regards to their GIs, carapaces and chelipeds. There can thus be little doubt that they are conspecific. The GIs of the present specimens, although agreeing very well with those from larger specimens from other localities, are clearly juvenile in many respects; the overall structure appearing much simpler, the hairs lining the margin being sparse, and the grooves not well developed.

The colour of the carapace of the larger specimens was dark brown, with scattered lighter flecks of beige especially on the legs. Smaller specimens tended to have much lighter colour. The upper oblique half of the surface of the cheliped palm is dark brown, the lower part being dirty white. The tips of the fingers are bright orange. Specimens collected from southern Thailand have an almost identical colour pattern (unpublished data).

FAMILY GRAPSIDAE MACLEAY, 1838  
SUBFAMILY SESARMINAE DANA, 1851

**Genus *Geosesarma* De Man, 1892**  
***Geosesarma foxi* (Kemp, 1918)**

*Sesarma foxi* Kemp, 1918

REMARKS. The species was originally described from two male specimens (9.8 by 9.8 mm, 9.8 by 9.7 mm) collected by Mr. B.H. Buxton in 1914 from 2000 feet up in Gunung Raya, the highest point on Pulau Langkawi, and for many years,

was the only freshwater crab species known from the island. This species was not encountered in the present survey. Collections from Durian Perangin Waterfall, which drains from Gunung Raya failed to obtain the species. Mr Buxton however, noted that both his specimens "were collected in moist places under stones or rotten wood at some distance from any stream" (Kemp 1918: 240). This is not unexpected as many *Geosesarma* species are known to have quite semiterrestrial habits (Ng 1986b; Ng & Lim 1987).

Tweedie (1936, 1940) had referred specimens from Maxwell Hill in northwestern Perak to *Sesarma foxi*, but Ng (1986b) established a new species, *Geosesarma serenei* for the Perak specimens, restricting *G. foxi* to Pulau Langkawi. The GIs of *G. foxi* are not known, and the species has not been collected since Kemp's description.

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