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Review of Palaemoninae (Crustacea: Decapoda: Caridea) from Vietnam, *Macrobrachium* excepted

Nguyễn Văn Xuân

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Key words: Palaemoninae; *Leandrites*; *Leptocarpus*; *Exopalaemon*; *Palaemon*; new species; Vietnam.

An account is presented of the species of Palaemoninae known from Vietnam, the genus *Macrobrachium* excluded. Of each species a description or descriptive notes are provided, and the habitat and economic importance are discussed. Illustrations of each species, two of which are new to science, are given.

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Introduction

Very little has been published so far on the Palaemoninae of Vietnam, and most of the species from the area mentioned in the literature belong to the genus *Macrobrachium* Bate, 1868. Still Palaemoninae are not rare there, and some are even of economic interest.

The present paper is the result of about 20 years of collecting and studying the Palaemonid prawns of Vietnam by the author, and deals with the Palaemoninae, with the exception of the genus *Macrobrachium*, to which a special study will be devoted. It intends to give an annotated catalogue of all the species known from the area with a description and illustration of their characters, and the variability of these. Apart from an enumeration of the material examined, a discussion is provided of occurrence, ecology, biology and economic importance of the species. Fig. 1 gives a schematic impression of the habitats of the species dealt with here.

The references as far as listed under the species described bear exclusively on Vietnamese material. Reference material of all species, including the holo- and allotypes of two new species, is deposited in the collections of the Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie - RMNH), Leiden, The Netherlands.

The abbreviation tl. is used for total length (= tip of rostrum to tip of telson), while tl.-r. signifies the length from the posterior margin of the orbit to the tip of the telson; cl. is used for carapace length.

Descriptive part

Leandrites Holthuis, 1950
Leandrites indicus Holthuis, 1950
(fig. 2)

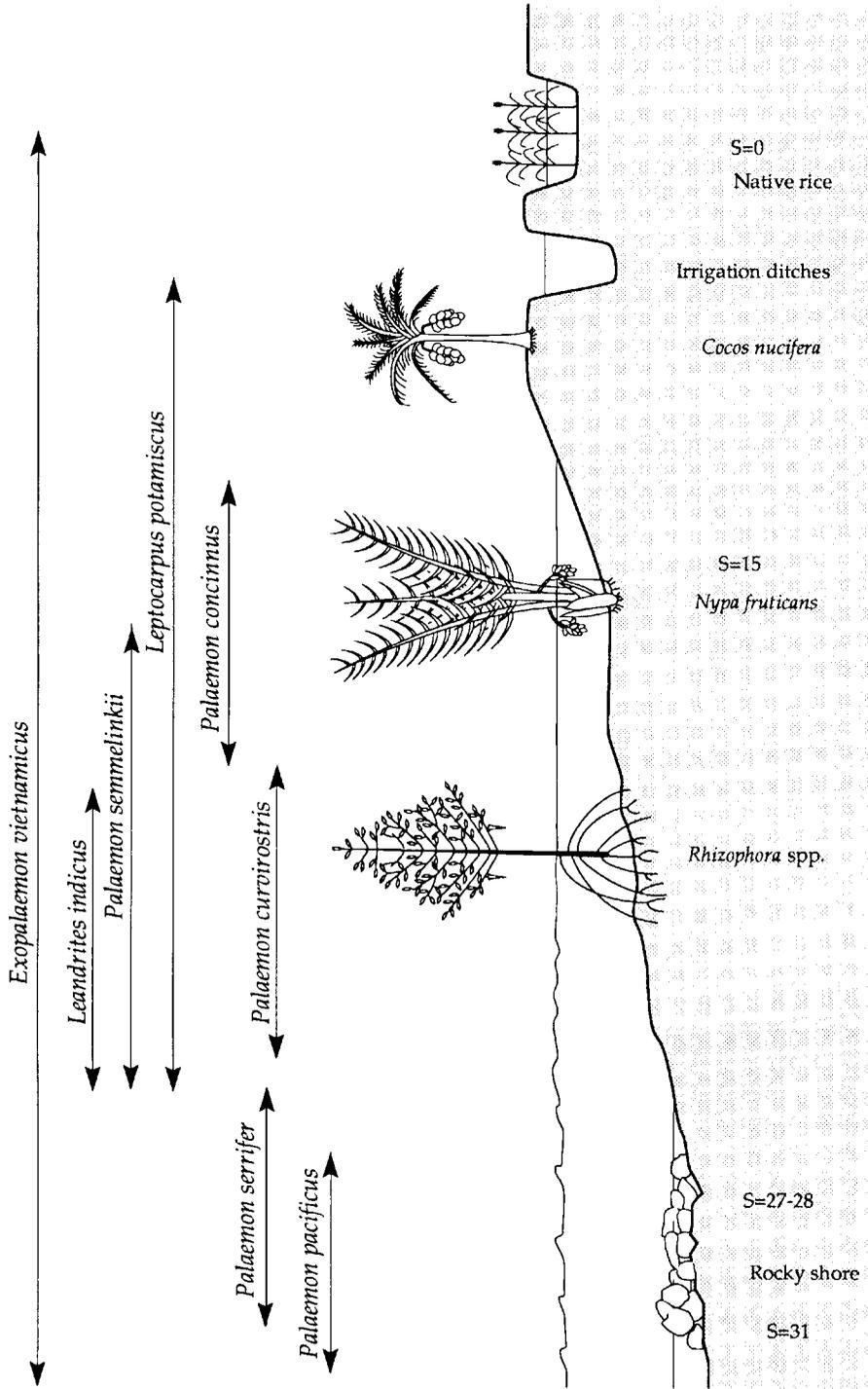


Fig. 1. Schematic impression of the habitats of the Vietnamese Palaemoninae dealt with here. S = salinity.

Leandrites deschampsii; Nguyễn Văn Xuân & Trinh Truong Giang, 1979: 200.

Leandrites indicus; Nguyễn Văn Xuân, 1981: 146.

Material.— Purchased in market of Ba-ria, 22 km north-east of Vung Tàu (= Cap St. Jacques), Vietnam, from mangrove area, v.1972, 25 ♂♂ (tl. 21-28 mm) and 20 ovigerous ♀♀ (tl. 21-30 mm); Phuóc Co, a village 17 km north-east of Vung Tàu, from shrimp ponds in mangroves, 1.iv.1979, 6 ♂♂ (tl. 26-29 mm), 12 ovigerous ♀♀ (tl. 26-28 mm); purchased in local market 3 km from Vung Tàu, 5.v.1987, 10 ♂♂ (tl. 21-28 mm), 25 ♀♀ (tl. 21-30 mm).

Description.— The rostrum is straight, with the tip, or even the distal half, turned up. In males it reaches with one third of its length beyond the scaphocerite, in females with one fourth or less (figs. 2a, b). The dorsal margin bears 9-14 teeth (generally 11-13). The first tooth is distinctly more remote from the second tooth than the second is from the third. The first and second teeth are placed on the carapace behind the orbital margin (sometimes the second is just over the orbital margin). The other teeth are regularly spaced over the rest of the length of the rostrum, except the two or three distal teeth that are placed close together near the apex; sometimes the distal tooth is very small and placed very close to the apex, thus making the rostrum somewhat bifid. In males, generally two or three teeth of the distal third are more spaced than those in the middle. The lower margin has a double fringe of setae and bears 5-7 (generally 6) teeth. The carapace is smooth, the antennal spine is strong; the branchiostegal spine, as strong as the antennal spine, is placed some distance behind the anterior margin of the carapace.

In males a minute median spine is present on the first and second abdominal sternites.

The posterior margin of the telson (fig. 2r) ends in a sharp median point and bears two pairs of spinules and one pair of strong feathered setae.

The eye is well developed and reaches nearly to the end of the basal segment of the antennular peduncle. The antennular peduncle (fig. 2c) has the second segment slightly shorter than the third. In the male (fig. 2d), the scaphocerite reaches somewhat beyond the antennular peduncle, in the female one fifth to one fourth beyond this peduncle. The mandible (fig. 2e) has no palp. The third maxilliped (fig. 2j) reaches to the end of the basal segment of the antennular peduncle.

The first legs (fig. 2k) are slender and the distal border of the carpus reaches to, or almost to, the end of the scaphocerite; in the ovigerous female the carpus surpasses the scaphocerite with one fifth of its length. The second legs (fig. 2l) are long and slender, but distinctly stouter than the first. The fingers are elongate and somewhat longer than the palm, they have the tips curved inward. Near the basal part of the cutting edge, both fingers are provided with some minute teeth; the palm is a little swollen. The carpus is equal to or somewhat longer than the chela and widens distally; the distal portion of the carpus extends beyond the scaphocerite (two thirds to four fifths in ovigerous females; one third to one half in non-ovigerous females and males).

The last three pereopods are slender (fig. 2m, n). The third and fifth legs extend with one half to two thirds of the propodus beyond the scaphocerite. The posterior margin of the propodus bears no spinules or transverse rows of setae; the dactyli are slender and simple.

The endopod of the first male pleopod (fig. 2o) is provided with a well developed appendix interna, that reaches as far as or beyond the tip of the endopod. The appen-

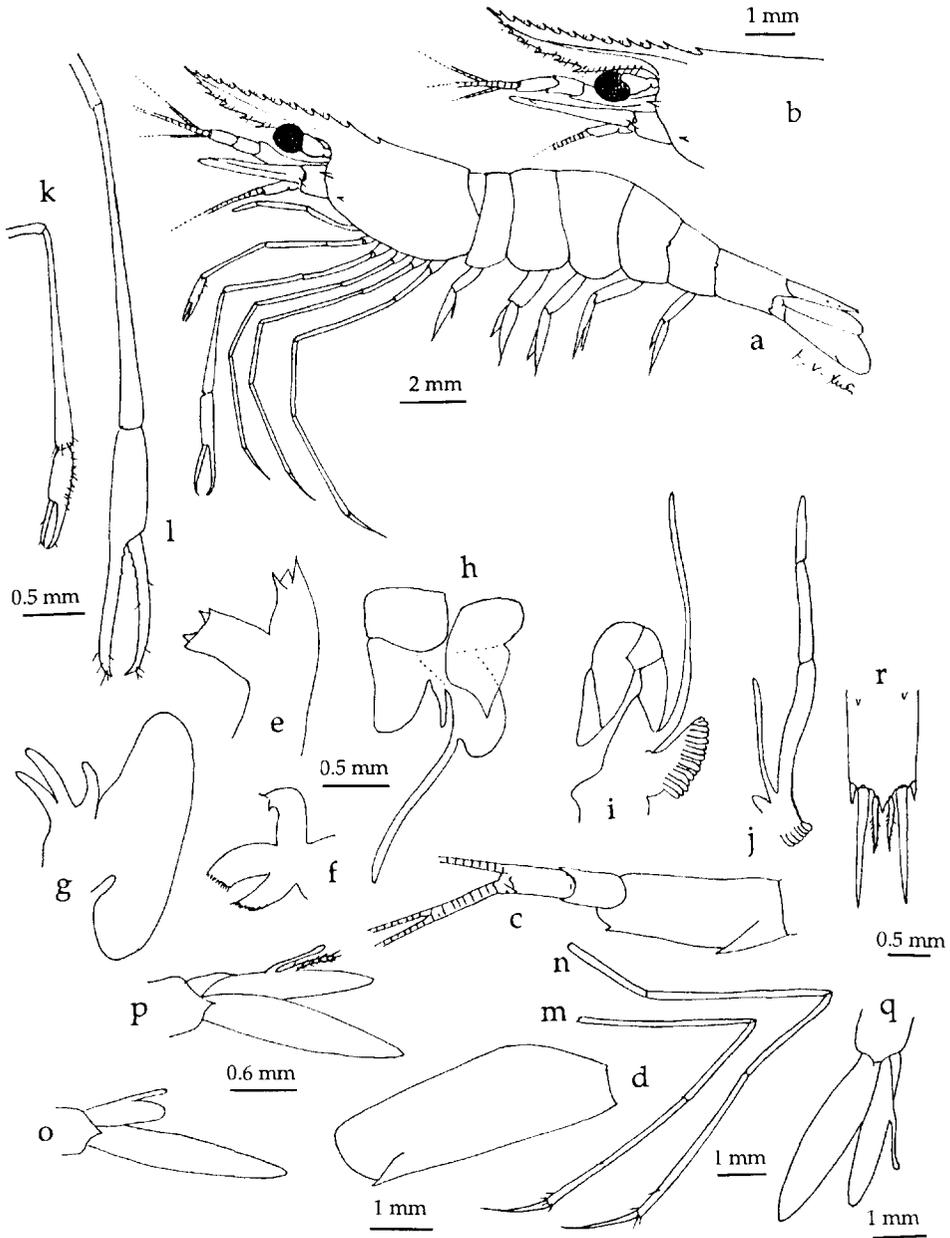


Fig. 2. *Leandrites indicus* Holthuis, 1950. a, male (cl. 3.8 mm) in lateral view; b, rostrum and anterior appendages of female; c, antennula; d, scaphocerite; e, mandible; f, maxillula; g, maxilla; h, first maxilliped; i, second maxilliped; j, third maxilliped; k, distal part of first pereiopod; l, distal part of second pereiopod; m, third pereiopod; n, fifth pereiopod; o, first male pleopod; p, second male pleopod; q, second female pleopod; r, tip of telson.

dices interna and masculina are present on the endopod of the second pleopod of the male (fig. 2p). The second pleopod of the female has an appendix interna (fig. 2q).

Colour.— The ripe eggs are orange in colour.

Size.— The diameter of the eggs is 0.6×0.8 mm.

Remarks.— The rostrum of the male is relatively longer and more tapering than that of the female.

The teeth on the lower margin of the rostrum of the present specimens are fewer than in the specimens described by Holthuis (1950), but higher than in those described by Nobili (1903) for *Leandrites deschampsii*. Johnson (1961) confirmed that *Leandrites deschampsii* (Nobili, 1903) is close to *Leandrites indicus* Holthuis, 1950. Despite the smaller number (5-7) of teeth on the lower margin, I think that all the specimens here examined should be assigned to *Leandrites indicus* Holthuis, 1950, where this number is described to be 8 or 9.

Habitat.— *Leandrites indicus* is very common in creeks and rivers in the mangrove area of Vung Tàu, and is also taken in culture ponds. This agrees with the observations made by Johnson (1965).

Distribution.— The present records from Vietnam extend the known geographical distribution much farther to the north.

Economic importance.— *Leandrites indicus* is not listed by Holthuis (1980) as a species of interest to fisheries. But in the Vung Tàu - Ba-ria area of Vietnam it can provide a good food supply for local consumption. The species is caught in mangrove creeks throughout the year with conical set-nets or with push nets worked from motor-boats. It is sold fresh in quantities, mixed with *Acetes indicus* H. Milne Edwards, 1830, *A. japonicus* Kishinouye, 1905, and *A. vulgaris* Hansen, 1919. It is also used in the processing of "Mam ruoc", a Vietnamese native shrimp paste, made mainly from the above three *Acetes* species and juvenile penaeid shrimps. *Leandrites*, being collected with the *Acetes*, is not discarded, but forms part of the mixture used for making the paste, be it only a small part.

Leptocarpus Holthuis, 1950
Leptocarpus potamiscus (Kemp, 1917)
 (fig. 3)

Leptocarpus potamiscus; Nguyễn Văn Xuân & Trinh Trương Giang, 1979: 199; Nguyễn Văn Xuân, 1981: 147.

Material.— Tân Thủy, a village on a sheltered bay 22 km north of Nhatrang, in shrimp ponds, 2.xii.1973, 4 ♂♂ (tl. 33-37 mm), 5 ovigerous ♀♀ (tl. 39-52 mm); purchased in a local market 3 km north of Nhatrang, 15.x.1989, 1 juvenile ♀ (tl. 49 mm), 3 ovigerous ♀♀ (tl. 49-56 mm); Phước Co, a village 17 km north-east of Vung Tàu (= Cap St. Jacques), in shrimp pond in mangroves, 1.iv.1979, 10 ♂♂ (tl. 35-40 mm), 12 ovigerous ♀♀ (tl. 40-45 mm); Thu Đức district, 10 km north of Saigon, irrigation ditches, iii.1983, 3 post-ovigerous ♀♀ (tl. 38-42 mm); Can Giuộc, 25 km south of Saigon, irrigation ditches, ix.1987, 1 ♂ (tl. 38 mm); Hoà Dinh, a village 12 km from My Tho, irrigation ditches at 4 km from the Mekong River, 28.i.1989, 1 ♂ (tl. 43 mm), 10 ♀♀ (tl. 48-60 mm).

Description.— The rostrum is long and more or less upcurved (fig. 3a, b), reaching with one third to less than half its length beyond the scaphocerite. In large ovigerous or post-ovigerous females (tl. 56-60 mm) the distal half of the rostrum is more strongly

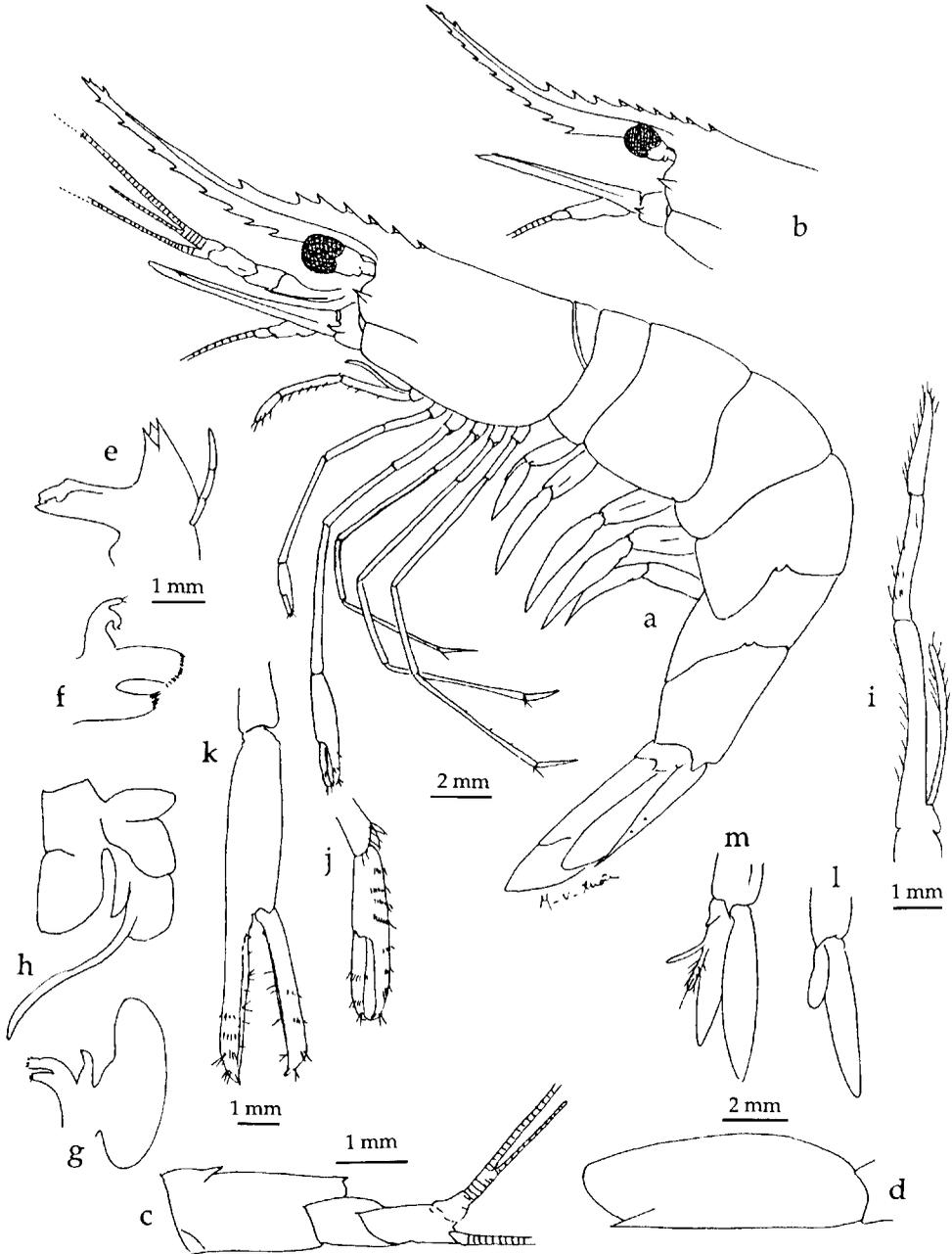


Fig. 3. *Leptocarpus potamiscus* (Kemp, 1917). a, male (cl. 6.5 mm) in lateral view; b, rostrum and anterior part of body; c, antennula; d, scaphocerite; e, mandible; f, maxillula; g, maxilla; h, first maxilliped; i, third maxilliped; j, chela of first pereiopod; k, chela of second pereiopod; l, first male pleopod; m, second male pleopod.

upturned than in smaller specimens. The upper margin does not present an appreciable elevated basal crest; it bears a series of 7-9 teeth in the basal one third to one half of its length; 5 or 6 of these teeth are movable. There are 2 or 3 subapical teeth, separated from the basal teeth by a long unarmed interval, which occasionally bears a single tooth. The first tooth is not farther from the second tooth than the second is from the third. The lower margin of the rostrum bears 7-9 teeth, placed in the distal two thirds. The carapace is provided with an antennal spine only.

The mandibular palp is three-segmented (fig. 3e).

The tip of the dactylus or the distal end of the propodus of the first pereiopod reaches to the end of the scaphocerite. The second pereiopod is slender, reaching with one sixth to one third of the length of the carpus beyond the scaphocerite. The carpus is three times as long as the palm, and about one and a half times as long as the merus. The cutting-edge of the movable finger of the chela is provided with one small tooth near the base; the cutting-edge of the immovable finger bears two small teeth near its base. The third pereiopod reaches with half or the entire dactylus beyond the scaphocerite; the carpus is a little shorter than, or half as long as, the merus. The fifth pereiopod is longer than the others; it reaches with one third to one half of the propodus beyond the scaphocerite; the carpus is about two thirds as long as the merus.

The endopod of the first male pleopod is ovate and without appendix interna (fig. 3l); the endopod of the second male pleopod has the appendix masculina as long as the appendix interna (fig. 3m).

The telson is a little longer than the sixth abdominal somite; of the two pairs of dorsal spines, the posterior pair is generally located closer to the anterior pair than to the posterior margin.

Colour.— The ripe eggs are of a green olive colour.

Size.— The largest male collected has tl. 45 mm, the largest female tl. 60 mm. The diameter of the eggs is 0.7×0.8 mm.

Habitat.— This species tolerates a wide salinity range, from almost fresh water to 33 ‰. It is found in shrimp ponds along the coast, in mangroves and in freshwater irrigation ditches both in the outskirts of Saigon and in the Mekong delta; all these localities are subject to tidal influence.

Economic importance.— Great quantities of males and females with a maximal tl. of 45 mm and 60 mm, respectively, are collected in irrigation ditches after 8 months stocking. The species is most abundant in irrigation ditches 12 km from My Tho in the Mekong delta. These ditches are designed for culture of *Macrobrachium rosenbergii* (De Man, 1879) with natural seeding. Here the annual salinity varies from 0-15 ‰. *Leptocarpus potamiscus* is a valuable species for local fisheries.

Distribution.— The species is known from India to Thailand and Indonesia. It is now reported for the first time from Vietnam.

Exopalaemon Holthuis, 1950
Exopalaemon vietnamicus spec. nov.
 (figs. 4, 12)

Palaemon (*Exopalaemon*) *styliferus*; Nguyễn Văn Xuân, 1978: 171; Nguyễn Văn Xuân, 1981: 146 (as *Exopalaemon*).

Material.— Can Giuộc, near Saigon, ii.1974, 11 paratypes, ♂♂ and ♀♀ (tl. 30-40 mm); Tam Thon Hiep, 40 km south east of Saigon, conical set net, iii.1979, 19 paratypes, ♂♂ and ♀♀ (tl. 67-90 mm); Can Giò, 15 km west of Vung Tàu (= Cap St. Jacques), shrimp pond, x.1987, 14 ♂♂ paratypes (tl. 72-86 mm), 8 ♀♀ paratypes (tl. 77-115 mm); Can Giò, 15 km west of Vung Tàu, conical set nets, xi.1989, holotype ♂ (RMNH, Crust. D 41190) tl. 85 mm, allotype ♀ (RMNH, Crust. D 41191), tl. 100 mm; Tra Vinh, coastal area south of Mekong delta, rice fields, vii.1989, 8 ♂♂ paratypes (tl. 32-80 mm), 11 ♀♀ paratypes (tl. 62-112 mm); east coast near Ca Mau, vi.1988, 1 ♂ paratype (tl. 53 mm), 1 ♀ paratype (tl. 90 mm).

Description.— The rostrum (fig. 4a) is very long; it reaches beyond the apex of the scaphocerite with more than one half to three fifths of its length. The proximal portion is elevated dorsally, forming a basal crest which bears 5-7 teeth (one of which is on the carapace behind the orbital margin). In front of this crest the rostrum is slender and up-turned. Its dorsal margin is provided with 5-7 (seldom 8) teeth in the terminal half. The lower margin bears 12-15 teeth (generally 13 or 14).

The carapace is smooth. In large specimens the antennal spine is small; the branchiostegal spine is larger and stronger than the antennal spine and is situated on the anterior margin of the carapace. The branchiostegal groove reaches the anterior margin of the carapace a short distance above the branchiostegal spine (about at one fourth of the length of the margin that separates the branchiostegal and the antennal spines).

In males the thoracic sternum usually shows a conspicuous median spine between the bases of the fifth pereopods. A compressed median protuberance is present on the first and second abdominal sternites. In the females these abdominal protuberances are totally absent.

The abdomen is normal in shape. The pleura of the fifth and sixth abdominal somites end posteriorly in a rounded angle. The sixth abdominal somite, when measured dorsally, is about 1.25 to 1.5 times as long as the fifth. The abdomen is smoothly rounded in small specimens but in large specimens a blunt dorsal ridge extends from the posterior two thirds of the third somite to the end of the sixth.

The telson (fig. 4m) has dorsally two pairs of minute spinules; the anterior pair is situated slightly behind the middle of the telson; the posterior pair is somewhat closer to the anterior pair than to the tip of the telson. In young specimens the posterior margin of the telson bears two pairs of spinules that do not reach the apex of the telson. In large specimens the apex is simply pointed, without spines; it reaches a little more than three fourth of the length of the exopods of the uropods. The telson is about 1.25 to 1.5 times as long as the sixth abdominal somite.

The eyes are well developed and reach three fourths of the length of the basal segment of the antennular peduncle.

The basal segment of the antennular peduncle (fig. 4b) is provided with a small spine on the lower margin; the outer border is sinuous and terminates in a tooth which extends as far as, or a little beyond, the rounded antero-external margin of the segment. The unbranched part of the upper antennular flagellum is composed of 7-10 segments and measures 1-1.5 mm; the shorter ramus is serrate at its outer margin and composed of 25-36 segments; it measures 4-6 mm; the width of the shorter ramus may be equal to, or smaller than, that of the longer. When measured mid-dorsally the basal segment is a little shorter than the second and third segments taken together; the third segment is more than twice as long as (but less than 3 times) the second segment. The stylocerite is pointed; it reaches or almost reaches the mid-

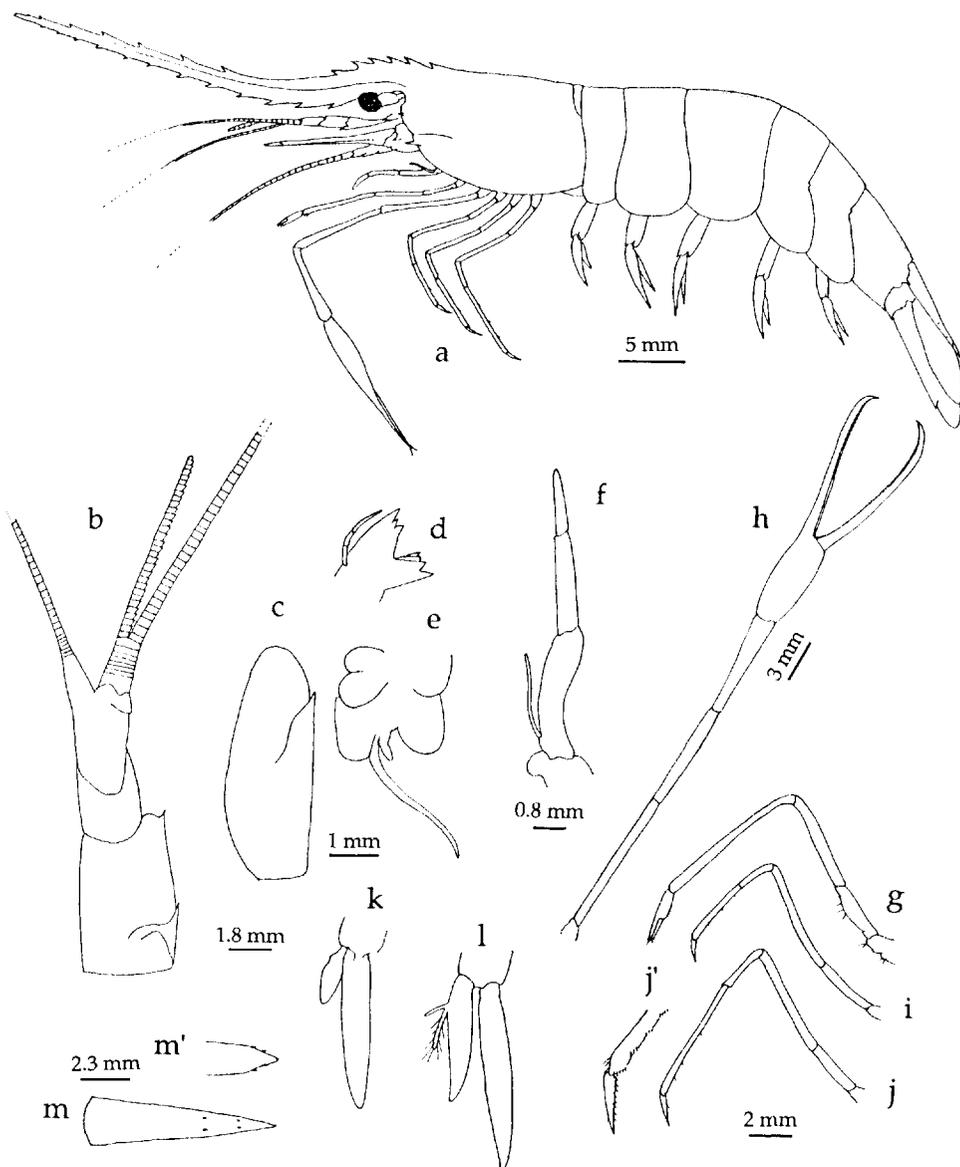


Fig. 4. *Exopalaemon vietnamicus* spec. nov. a, male (cl. 13.5 mm) in lateral view; b, antenna; c, scaphocerite; d, mandible; e, first maxilliped; f, third maxilliped; g, first pereiopod; h, second pereiopod; i, third pereiopod; j, fifth pereiopod; j', distal part of fifth pereiopod; k, first male pleopod; l, second male pleopod; m, telson; m', tip of telson of young specimen.

length of the basal segment of the antennular peduncle; the surface of the stylocerite is provided with a V-shaped carina.

The scaphocerite (fig. 4c) is broad and slightly less than 3 times as long as wide; in old specimens the outer margin is somewhat concave or sinuous and ends in a strong tooth which is overreached by the rather sharply rounded distal end of the lamella.

The oral parts are typical: the mandible (fig. 4d) has the palp three-segmented. The maxillula and the maxilla are of the usual form. The endite of the first maxilliped (fig. 4e) is composed of two rounded lobes. The second maxilliped is of the usual form. The third maxilliped (fig. 4f) reaches to the end of the basal or the second segment of the antennular peduncle; the antepenultimate segment is somewhat expanded distally; the exopod reaches to the distal quarter of the antepenultimate segment.

The first pereopod (fig. 4g) fails to reach beyond the scaphocerite (in young specimens) or reach beyond it by half the length of the dactylus (in old specimens). The dactylus is slightly longer than the merus; the merus measures about 0.8-0.88 the length of the carpus; the carpus is about twice as long as the ischium, and about twice as long as the chela, or slightly longer; the ischium is very slightly longer than, or as long as, the chela.

The second pereopods (fig. 4h) are equal in size. The dactylus generally fails to reach the tip of the rostrum. The legs extend beyond the tip of the scaphocerite by one third the length of the carpus (in young specimens) to four fifths (in large specimens). In some small specimens (ovigerous females or young males) the second leg overreaches the tip of the rostrum with one fifth to one third the length of its dactylus. The ischium, merus, carpus and palm decrease successively in length; the carpus, always shorter than the chela, is about 0.75-0.9 the length of the dactylus and about 0.86-0.9 the length of the merus. The ischium is slightly longer than, or about as long as, the dactylus. The fingers are long with an acute and slightly curved terminal claw; the cutting-edges are entire. The palm is swollen and about two thirds to three fifths the length of the dactylus.

The last three pereopods are slender and usually bear a few short setae on the posterior margin of ischium, merus, carpus and propodus. In the third pereopod (fig. 4i) the distal end of the dactylus reaches to the middle or, in old specimens, to the distal end of the third segment of the antennular peduncle. The propodus is more than twice to less than 3 times as long as the dactylus; it is about two thirds to three fourths as long as the merus. The carpus is about one third to one half as long as the merus. In the fourth pereopod the distal end of the dactylus reaches to the end of the scaphocerite, or almost so; the dactylus is about one third the length of the propodus; the carpus is slightly more than one third to less than one half the length of the merus. In the fifth pereopod (fig. 4j) the dactylus reaches, or nearly reaches, as far as the end of the scaphocerite; in old specimens the posterior margin of ischium, merus, carpus and propodus bear many short setae; generally the propodus is somewhat more than 3 times (seldom 4 times) as long as the dactylus; the propodus is a little longer than the merus (1.13-1.17 times); the carpus is generally a little less than half as long as the merus. The posterior margin of the propodus bears the usual transverse rows of setae distally.

The endopod of the first male pleopod (fig. 4k) is short and ovate. The second male pleopod (fig. 4l) has an appendix interna and an appendix masculina.

Colour (fig. 12).— Freshly collected males and young females are transparent whitish; the rostrum is red, except for the basal crest. Ovigerous females show the same red colour on the rostrum, but furthermore there are four prominent oval bluish green spots on the abdominal pleura, one on the first pleuron, two on the second and again one on the third. These green spots disappear after the eggs are released. The colour of the eggs initially is yellow, to change later to greyish brown or light brown.

Size.— In ovigerous females tl. varies from 56 to 128 mm, tl.-r from 40 to 77 mm. The young (yellow) eggs are 0.6-0.9 mm in diameter, the ripe (brown) eggs 0.9-1.0 mm.

Habitat.— The species seems to be restricted to river estuaries and the flat and shallow muddy coast nearby. It is a littoral species tolerating both brackish and fresh water; it does not migrate far inland.

Economic importance.— Of the eight palaemonine species dealt with in this paper, *E. vietnamicus* is the most important economically. It is fished for with conical set nets and push nets. In the coastal rice shrimp farming area of Tra Vinh Province, it plays an important role in the shrimp industry, together with *Metapenaeus lysianassa* (De Man, 1888) and *M. tenuipes* Kubo, 1949. There, at the end of the rainy season, the species forms 40-50 % of the total shrimp yield, the shrimps then having attained a tl. of up to 70 mm. In the semi-extensive shrimp pond culture of the Can Giò area and in Ganh Hào, *E. vietnamicus* is plentiful during the rainy season and forms an important food competitor for *Penaeus silasi* Muthu & Motoh and *P. merguensis* De Man. In the crop of the two last-named species, specimens of *E. vietnamicus* are found with an average tl. of 105 mm, forming some 30-40 % of the yield. The species is not much appreciated by the freezing industry working for export. It is usually sold dried or fresh, mixed with *Metapenaeus monoceros* (Fabricius, 1798) or *M. ensis* (De Haan, 1844) and juveniles of *Parapenaeopsis hardwickii* (Miers, 1878) or *P. sculptilis* (Heller, 1862). It is, however, an important food for local consumption.

Distribution.— So far the species seems to be restricted to the south-eastern part of Vietnam, from the extreme southern tip north to the vicinity of Saigon.

Remarks.— The specimens examined agree well with *Exopalaemon styliferus* (H. Milne Edwards, 1840) as described by Kunju (1969) on the basis of material from the Bay of Bengal. The following differences are noted between the two species:

1. Number of teeth on rostrum.— In *E. styliferus* the dorsal margin in front of the basal crest bears only 1-3 subapical teeth, while the lower margin has 6-10 teeth. In *E. vietnamicus* the distal half of the upper margin bears 5-8 widely spaced teeth, and the lower margin has 12-15 teeth.

2. Size.— *E. vietnamicus* is larger: the maximal tl. of *E. styliferus* is 90 mm (86 mm for ovigerous females), of *E. vietnamicus* 128 mm.

Palaemon Weber, 1795

Palaemon semmelinkii (De Man, 1881)

(fig. 5)

Palaemon (Palaander) semmelinkii; Nguyễn Văn Xuân & Trinh Truong Giang, 1979: 199; Nguyễn Văn Xuân, 1981: 146.

Material.— Tân Thuy, a village on a sheltered bay 22 km north of Nhatrang, in shrimp pond, 17.x.1974, 5 ♂♂ (tl. 32-35 mm), 2 ovigerous ♀♀ (tl. 34-41 mm), 1 post-ovigerous ♀ (tl. 35 mm); Phước Co, a village 17 km north-east of Vung Tàu (= Cap St. Jacques), from shrimp pond in mangrove, iv.1979, 3 ♂♂ (tl. 32-38 mm), 5 ovigerous ♀♀ (tl. 38-42 mm); purchased in market of Can Giò, xi.1989, 4 ovigerous ♀♀ (tl. 40-42 mm).

Description.— The rostrum (fig. 5a, b) is directed down, with the tip curved up. It reaches with at most one third of its length beyond the antennal scale. The upper

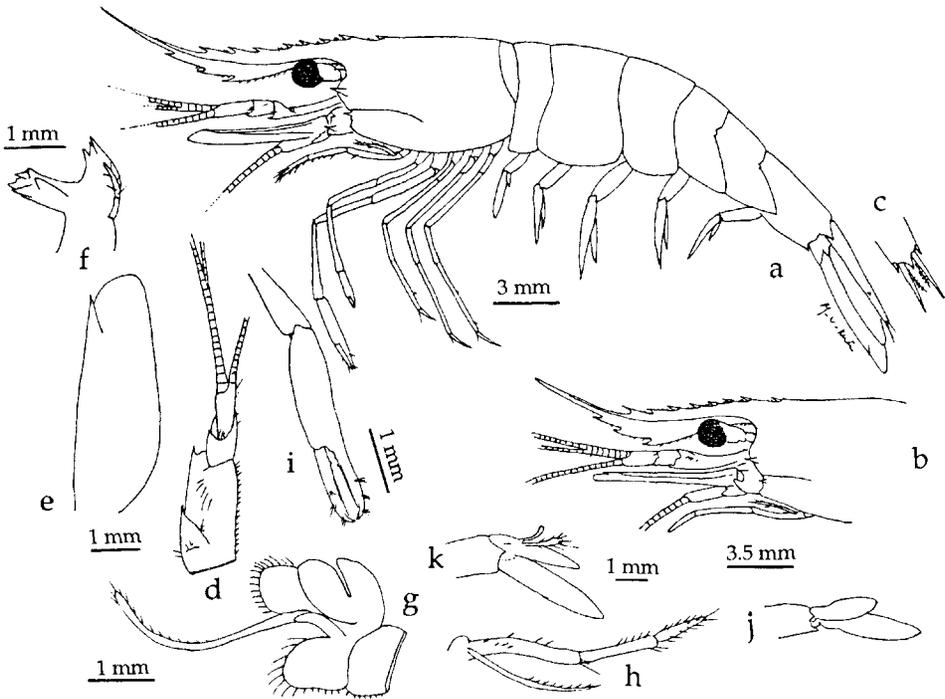


Fig. 5. *Palaemon semmelinkii* (De Man, 1881). a, male (cl. 5.5 mm) in lateral view; b, anterior part of body of female in lateral view; c, tip of telson; d, antennula; e, scaphocerite; f, mandible; g, first maxilliped; h, third maxilliped; i, chela of second pereiopod; j, first male pleopod; k, second male pleopod.

margin bears 8-10 teeth; the first of these is placed on the carapace behind the orbital margin, and is more remote from the second tooth than the third is. The second tooth is situated slightly behind, or just over the posterior margin of the orbit. The proximal dorsal teeth (5 or 6) of the rostrum are movable, the ultimate 2 or 3 are immovable. The teeth are placed only in the proximal two thirds of the rostrum, the remaining distal third is entire and bears no subapical tooth. The lower margin bears 3 teeth; here, too, the distal part is entire. In the males the rostrum is more slender than in the females; especially the distal teeth are longer and more appressed. The carapace has a branchiostegal and an antennal spine.

The telson (fig. 5c) is longer than the sixth abdominal somite. Of the two dorsal pairs of spines the anterior pair is situated in the middle of the telson; the place of the posterior pair is rather variable.

The outer margin of the basal segment of the antennular peduncle (fig. 5d) is more or less straight and ends in a strong antero-lateral spine which reaches beyond the middle of the second segment and distinctly overreaches the convex anterior margin of the basal segment.

The mandibular palp is two-segmented (fig. 5f).

The second pereiopod (fig. 5i) reaches with the fingers as far as the antennal scale. The third pereiopod reaches to the end of the antennular peduncle; the fifth pereiopod reaches almost to the end of the antennal scale. The endopod of the first

male pleopod is ovate and bears no appendix interna (fig. 5j). The second male pleopod (fig. 5k) has an appendix interna and an appendix masculina.

Habitat and economic importance.— This species is common in ponds used for shrimp-culture in the mangroves, but is not specially fished for.

***Palaemon concinnus* Dana, 1852**
(fig. 6)

Palaemon (Palaemon) concinnus; Nguyễn Văn Xuân, 1981: 147.

Material.— Cai River, north of Nhatrang, bottom sandy, salinity never more than 18‰, purchased in local market 3 km north of Nhatrang, 15.x.1989, 8 ovigerous ♀♀ (tl. 49-70 mm); Bè River, south of Nhatrang, purchased in a local market 5 km south of Nhatrang, xii.1973, 8 ♂♂ (tl. 48-60 mm), 9 ♀♀ (tl. 54-70 mm); river in outskirts of Saigon, turbid muddy water, salinity 16‰ or less; purchased in a local market, v.1973, 2 ♂♂ and 5 ♀♀ (tl. 54-58 mm).

Description.— The rostrum (fig. 6a, b) is well developed, longer than the carapace, rarely equal to it. It is straight or directed downward in the basal part and slightly or more strongly curved upward beyond the middle or the distal third. It reaches past the end of the scaphocerite by 0.05 to 0.25 of its length. The upper margin bears 6-8 (mostly 6 or 7) teeth which are placed in the proximal half or two thirds; the distal portion (about one third) is entire, except for one small subapical tooth very close to the apex. The first tooth (seldom the first two) is placed behind the posterior margin of the orbit; it is generally slightly more remote from the second tooth than the second is from the third. All the dorsal teeth are immovable (except the first or the first two in small specimens, which are semi-movable). The lower margin of the rostrum bears 4-7 (mostly 5 or 6) teeth which are placed usually in the distal two thirds of that margin. The proximal teeth are generally placed more closely together than the distal; in some specimens the teeth are more regularly spaced, or the distal teeth may be closer together than the proximal (fig. 6b). Both upper and lower margins of the rostrum are provided with a single row of setae.

The branchiostegal spine on the anterior margin of the carapace is about as strong as the antennal spine in young specimens, somewhat larger in older specimens. The branchiostegal groove reaches the anterior margin of the carapace above the branchiostegal spine. The distance between it and the spine is about one third to less than one half the length of the distance between the antennal and branchiostegal spines.

The abdomen is normal in shape. The pleura of the fifth and sixth abdominal somites end posteriorly in an acute point. The fifth abdominal somite measures one half to three fifths the length of the sixth.

The telson is slightly less than 1.3 times as long as the sixth abdominal somite. The dorsal surface of the telson is provided with the normal two pairs of spines. The anterior pair is situated halfway the length of the telson; the posterior pair is placed more closely to the anterior pair than to the posterior margin of the telson. The posterior margin of the telson is provided with the usual two pairs of spines and two feathered setae; the inner pair of spines reaches with about half its length beyond the median tooth of the posterior margin.

The cornea of the eye is about as long as the stalk but is distinctly broader. A dis-

tinct ocellus is present. The eyes reach nearly to the distal end of the basal segment of the antennular peduncle.

The antennular peduncle (fig. 6c) fails to reach the end of the scaphocerite. The stylocerite is well developed and sharply pointed; it reaches about halfway the basal segment. Its dorsal surface is provided with a distinct longitudinal carina. The outer margin of the basal segment of the peduncle is sinuous and ends in a strong spine which reaches far beyond the middle of the second segment and overreaches the convex anterior margin of the basal segment. The second segment, when measured dorsally, is distinctly shorter than the third. The basal segment is about as long as, or slightly longer than, the third and second segments taken together. The upper antennular flagellum has the two rami fused for 6-11 segments. This unbranched portion measures about 1.3-1.8 mm. The free part of the shorter ramus has the outer margin serrate and consists of 26-42 segments. It measures 6-9.8 mm, so that it is 4.5-5.5 times as long as the fused portion.

The scaphocerite (fig. 6d) is less than 3 times as long as wide. Its outer margin is slightly convex and ends in a distinct final tooth which is overreached by the broad anterior margin of the lamella.

The first pereiopod (fig. 6j) reaches with the dactylus almost to, or beyond, the end of the scaphocerite; the fingers are blunt and distinctly longer than the palm. The carpus is 2.5 to slightly more than 3 times as long as the chela. The merus measures about three fourths of the length of the carpus. The ischium is about half or slightly more than half as long as the merus.

The second pereiopod (fig. 6k) is slender and reaches with one tenth to two thirds (mostly one half) the length of the carpus beyond the scaphocerite. The fingers are 0.13-0.65 times as long as the palm; the fixed finger bears a small but distinct tooth in the proximal third; the cutting-edge of the dactylus bears a series of 5 or 6 minute teeth. The palm is cylindrical in young specimens but somewhat broadened distally in older specimens. The carpus measures about 1.25-1.50 the length of the chela and is slightly broadened distally. The merus is longer than the ischium and about as long as the chela. All segments are smooth in young specimens but in older specimens the palm and carpus are rough.

The third pereiopod (fig. 6l) reaches beyond the end of the antennular peduncle, usually as far as the end of the scaphocerite, or overreaches it by half the length of the dactylus at most. The propodus is about 3 times as long as the dactylus. The carpus has about half the length of the merus and is about as long as the ischium.

The fourth pereiopod reaches beyond the scaphocerite by one fifteenth to one third of the length of the propodus. The propodus is about 4 times as long as the dactylus.

The fifth pereiopod (fig. 6m) is more slender than the third. The propodus is about 4-5 times as long as the dactylus. The carpus is a little more than one half to about two thirds the length of the merus. The merus is about 0.75-0.82 the length of the propodus. The ischium is about three fifths to three fourths the length of the carpus.

The first male pleopod (fig. 6o) has a rudimentary appendix interna on the endopod. The second male pleopod (fig. 6p) has the appendix masculina longer and broader than the appendix interna. The first pleopod of the female (fig. 6n) has no appendix interna.

The uropods are normal in shape.

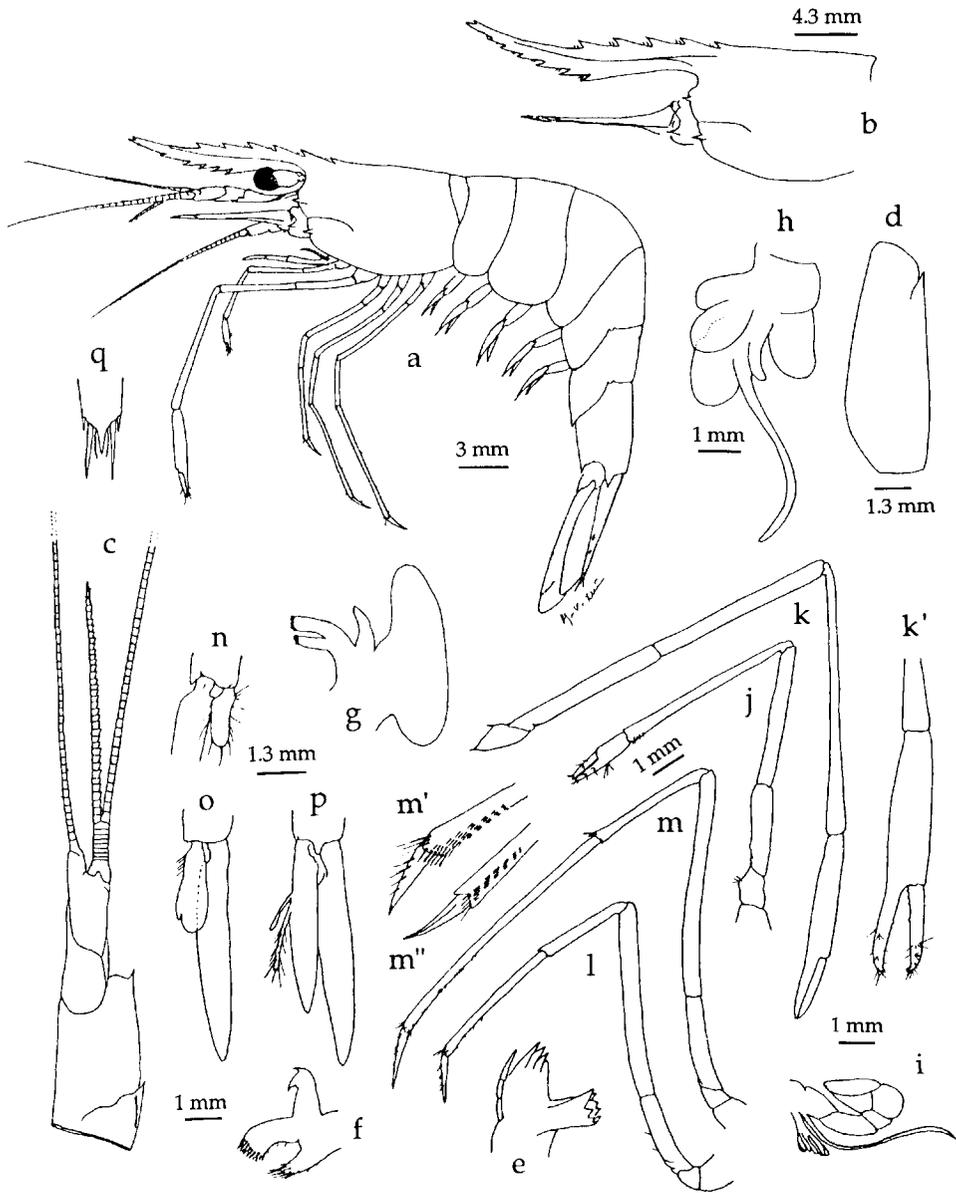


Fig. 6. *Palaemon concinnus* Dana, 1852. a, male (cl. 10.5 mm) in lateral view; b, carapace and antenna of female; c, antennula; d, scaphocerite; e, mandible; f, maxillula; g, maxilla; h, first maxilliped; i, second maxilliped; j, first pereopod; k, second pereopod; l, third pereopod; m, fifth pereopod; m', m'', tip of fifth pereopod; n, first female pleopod; o, first male pleopod; p, second male pleopod; q, tip of telson.

Colour.— In the living prawn a brown spot is visible in the postero-median part of the sixth abdominal segment. The ripe eggs are light green.

Size.— The smallest ovigerous female collected measured 49 mm tl., the largest 70 mm. The eggs measure 0.7×0.8 mm.

Remarks.— The specimens examined agree with the description given by Holthuis (1950). The length of the part of the rostrum that extends beyond the end of the scaphocerite seems not to be related to the age of the individual. The present material contains (a) 3 ovigerous females which have the rostrum relatively short (only 0.05-0.10 of its length extending beyond the scaphocerite), (b) 3 young males, tl. 48-50 mm, that have a long rostrum (extending with one fourth to one fifth of its length beyond the end of scaphocerite) and (c) 2 other young males, tl. 45-50 mm, that have a short rostrum (one tenth the length beyond the scaphocerite).

The palm of the second pereopod is cylindrical in juveniles but somewhat widened distally in adults.

Apart from the fact that the rostrum of 5 females is well up-turned (fig. 6b), more so than in the other specimens, our material is quite homogeneous.

The branchiostegal groove reaches to anterior margin of the carapace distinctly above the branchiostegal spine (one third to less than one half the length of the distance which separates the branchiostegal and the antennal spines).

The free part of the shorter ramus of the upper flagellum of the antennula is at least 4 times as long as the fused part.

The rather closely related *Palaemon (P.) debilis* Dana, 1852, does not figure in the author's collections.

Habitat.— The species has not been found in brackish water of shrimp culture areas. In central Vietnam it seems to be concentrated in two rivers: the Cai River, situated at 2 to 5 km north of Nhatrang, and the Bé River, 5 to 7 km south of Nhatrang. In the Cai River the annual salinity does not exceed 18‰; it has a sandy bottom and the estuary is rather shallow by the deposit of sand, while urbanisation also influences this habitat. The Bé River has the estuary larger and the arms deeper; the salinity is higher and extends deeper inland (especially at high tide and in the dry season). In the area near Saigon the rivers have muddy bottoms and turbid water; here the species is scarcer than in the Nhatrang area.

Economic importance.— The species is offered for sale at the local markets both of the Nhatrang and the Saigon areas, being more plentiful in the former. In the Bé River it is often caught together with *Macrobrachium latidactylus* (Thallwitz, 1891) and *M. formosense* Bate, 1868. It is used almost exclusively for local consumption.

Palaemon curvirostris spec. nov.

(figs. 7, 8, 12)

Material.— Small fishery centre near Thanh An, a village 20 km north-west of Vung Tàu (= Cap St. Jacques), taken with conical set net in mangroves, 21.iii.1988, holotype ♂ (RMNH Crust. D 41198) (tl. 54 mm), allotype ♀ (RMNH Crust. D 41199) (tl. 50 mm), 16 paratypes (tl. 38-54 mm, ♂♂; tl. 40-54.5 mm, ♀♀); near Thien Lien, a village in Can Giò district, 10 km north-west of Vung Tàu, taken with conical set net in mangroves, 3.iii.1990, 1 paratype ♂ (tl. 56 mm), 2 ovigerous paratype ♀♀ (both tl. 56 mm); near Thien Lien, taken with conical set net in mangroves, 3.i.1991, 27 paratype ♂♂ (tl. 34-55 mm), 11 ovigerous paratype ♀♀ (tl. 40-58 mm), 1 post-ovigerous paratype ♀ (tl. 48 mm), 1 juvenile paratype ♀ (tl. 38 mm); purchased in a local market 7 km west of Vung Tàu, iii.1974, 2 paratype ♀♀ (tl. 54.5 and 50 mm).

Description.— The rostrum (fig. 7a, b, c) is long with the basal part directed down and the distal one half to two thirds strongly upcurved. It reaches with about one third to two thirds of its length beyond the scaphocerite. In old females it is gen-

erally more strongly curved than in males (fig. 7b). The upper margin consists of two parts. The basal half bears a series of 8-10 movable teeth, two or three of which are on the carapace behind the orbital margin; the first as a rule is distinctly more remote from the second tooth than the second is from the third. The distal portion of the rostrum is smooth (seldom with a single tooth), except for 2 (rarely 1) immovable small subapical teeth. Between the teeth is a single row of setae. The lower margin of the rostrum bears 10-14 teeth which are covered by a double row of setae.

The carapace has the branchiostegal spine smaller (in old specimens) or as strong as the antennal spine (in the young); it is placed on the anterior margin of the carapace just below the branchiostegal groove.

The thoracic sternum of the males shows a prominent boss between the bases of the fourth pereopods and a conspicuous, slightly bifid, median spine between those of the fifth legs.

A median spine is present on the first and second abdominal sternites; a longitudinal, median, ridge-like protuberance is present before the bases of the fifth pleopods. In the ovigerous females the spines are absent, but the boss between the bases of the fourth pereopods and the ridge on the fifth abdominal sternite remain visible.

The abdomen is normal in shape. The sixth abdominal somite is about 1.5 times as long as the fifth. The pleura of the fourth abdominal somite ends posteriorly in a rounded angle, while those of the fifth somite end in an acute apex.

The telson (fig. 8u, u') is about 1.5 times as long as the sixth abdominal somite. It is elongate in shape and provided with the usual two pairs of dorsal spinules: the anterior pair is generally situated somewhat behind the middle, the posterior pair about halfway between the anterior pair and the posterior margin of the telson. The posterior margin of the telson bears the usual two pairs of spines and two feathered setae; the inner spines are about 6-7 times as long as the outer.

The eyes are well pigmented; they fail to reach the end of the basal segment of the antennular peduncle.

The antennule (fig. 8d, e) has the basal segment as long as the second and third segments taken together. The interior lower margin of the basal segment is provided with a spine which is situated at the end of the basal third. The stylocerite is pointed and reaches two-thirds of the basal segment; a faint carina is present on the upper surface of the stylocerite. The outer margin of the basal segment is somewhat sigmoid and ends in a strong antero-lateral tooth which is directed somewhat outward and reaches about two thirds of the second segment. The third segment is twice as long as the second. The two rami of the upper antennular flagellum are fused for 5-7 segments (usually 6); this unbranched portion measures 0.9-1.5 mm (0.9 mm in juveniles; 1-1.5 mm in the older). The free part of the shorter ramus is somewhat depressed and consists of 18-31 segments (18-21 in the young and generally 27-29, seldom 31, in the older); it measures 3.5-6 mm (3.5 mm in young specimens and generally 5-6 mm in the older). The segments of this free portion have the outer margin sinuous (fig. 8e).

The saphocerite (fig. 8f) reaches beyond the end of the antennular peduncle; it is somewhat less than 3 times as long as broad. The outer margin is slightly concave and ends in a final tooth which is distinctly overreached by the lamella. The lamella has the inner antero-lateral angle rather rounded.

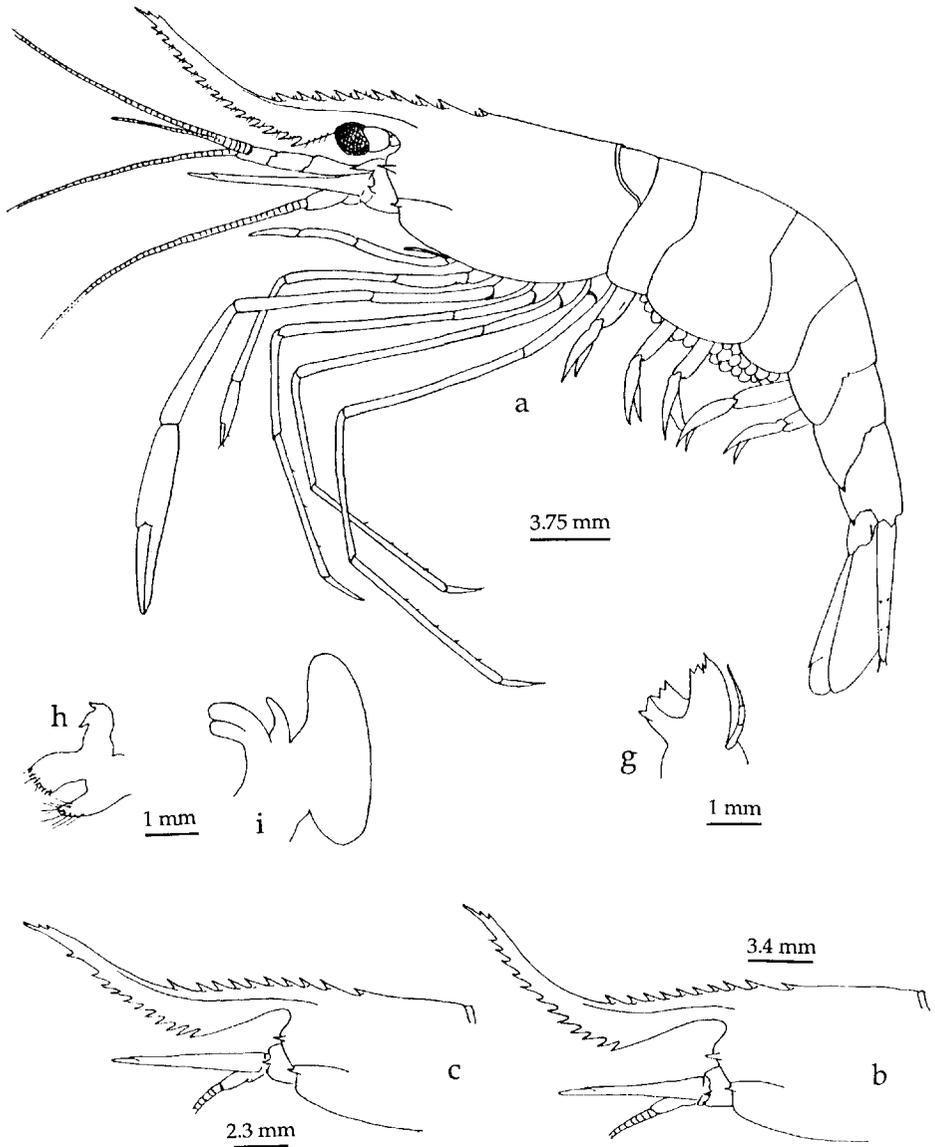


Fig. 7. *Palaemon curvirostris* spec. nov. a, ovigerous female (cl. 11 mm) in lateral view; b, carapace and antenna of old female; c, same of male; g, mandible; h, maxillula; i, maxilla.

The oral parts are quite typical for the genus. The mandible (fig. 7g) has the molar and incisor processes well-developed; the palp is three-segmented. The maxillula and the maxilla (fig. 7h, i) are of the usual shape. The epipod of the first maxilliped (fig. 8j) is divided into two rounded lobes. The second maxilliped (fig. 8k) is of the usual form. The third maxilliped (fig. 8l) reaches as far as the end of the second segment of the antennular peduncle in young specimens; in old specimens it reaches

the third segment. The antepenultimate segment is somewhat shorter than the last two segments taken together; the penultimate segment is less than 1.5 times as long as the ultimate segment.

In young specimens the first pereopod (fig. 8m) reaches with the tip or the middle of the dactylus to the end of scaphocerite. In old specimens it extends with 0.3 to 1.0 times of the length of the palm beyond the scaphocerite. The dactylus is as long as the palm. The carpus is about 3 times as long as the palm, and as long as the merus; it is slightly broadened anteriorly.

The pereopods of the second pair (fig. 8n) are fairly stout, and of equal length. In young specimens about one fourth (or less) of the carpus reaches beyond the scaphocerite. In old specimens the carpus extends beyond the end of scaphocerite with one third to two thirds of its length. The dactylus is about as long as the palm (sometimes slightly longer or slightly shorter). The carpus is slender and widens distally; it is about 1.5 to 1.7 times the length of the palm, but equal to, or very slightly shorter than, the merus. The fingers, when closed, touch each other over the full length, except for the tips which are curved inward and are crossing. The cutting-edges are entire, but in old specimens a small tooth is present near the base of the movable finger. The palm is somewhat depressed; all segments are unarmed.

The last three pereopods are long and slender; the dactyli are short, curved inward and end in an acute point. The third pereopod (fig. 8o) reaches with one third to five sixths of the length of the propodus beyond the scaphocerite. The propodus is about 3 times (but less than 4 times) as long as the dactylus; it is longer than the carpus but shorter than the merus. The propodus is provided at its posterior margin with some very small spinules. The ischium is shorter than the carpus.

The fourth pereopod (fig. 8p) reaches with two thirds to four fifths (or somewhat more) of the length of the propodus beyond the scaphocerite. The propodus is about 3-4 times as long as the dactylus, and longer than the carpus. The ischium is shorter than the carpus.

The fifth pereopod (fig. 8q) is the longest. It reaches with two thirds to eight ninths of the length of the propodus beyond the scaphocerite. The propodus is about 3-4 times (but always less than 5 times) as long as the dactylus; it is longer than the carpus but equal to, or somewhat longer than, the merus. The posterior margin of the propodus of the male bears the usual transverse rows of setae in the distal part (fig. 8q).

The first male pleopod (fig. 8r) has no appendix interna; the endopod is ovate in shape. In the second male pleopod the appendix masculina (fig. 8s) is relatively weak and equal to or somewhat shorter than the appendix interna.

The uropods are normal in shape.

Colour (fig. 12).— The distal half of the upper margin of the rostrum is red, the proximal half brownish purple; the lower margin is light-purple or brown. The carapace has sparse light-purple spots or bands on the surface of the gastric, cardiac and branchial regions; the irregular band on the gastric region is the most conspicuous. The terga of the abdominal somites show irregular bands and spots of a light-purple colour. The tergum of the first abdominal somite has one irregular band; that of the second somite shows four or five irregular spots or bands, the one in the dorsal region being the most conspicuous; the tergum of the third somite has an irregularly shaped band which extends on to the lateral surface; the remaining terga have irreg-

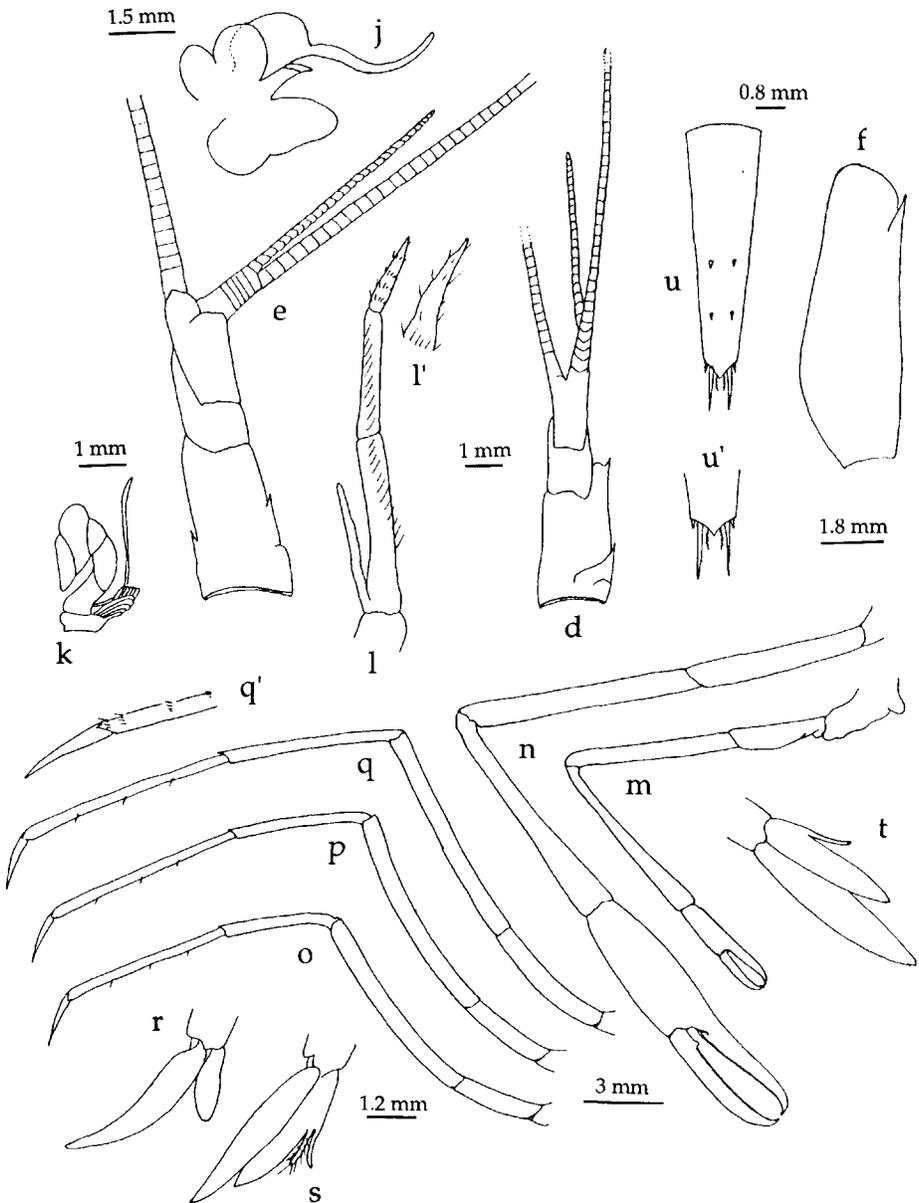


Fig. 8. *Palaemon curvirostris* spec. nov., continued. d, e, antenna; f, scaphocerite; j, first maxilliped; k, second maxilliped; l, third maxilliped; l', apex of third maxilliped; m, first pereiopod; n, second pereiopod; o, third pereiopod; p, fourth pereiopod; q, fifth pereiopod; q', distal part of fifth pereiopod; r, first male pleopod; s, second male pleopod; t, second female pleopod; u, telson; u', tip of telson.

ular streaks in the dorsal region. The first five abdominal pleura are provided with eight light-purple distal spots: one on the first pleuron, two on the second (one at either end), one on the third (placed posteriorly), and two (placed one above the other) on both the fourth and fifth somites. The posterior margin of the sixth abdominal somite is purple. The distal end of the telson is pink. The endo- and exopod of the uropods are red or pink with a brown spot in the centre. The exopods and endopods of the pleopods are pink.

The flagella of the antennula and antenna are pink. The second pereopod is pink with the distal ends of the fingers, carpus, merus and ischium of a darker, almost brown colour. The last three pereopods are pink. The ripe eggs are orange brown to light grey.

Size.— The maximal size found for the males is tl. 56 mm, for the females 58 mm. Ovigerous females with tl. 40-58 mm were observed. The eggs are numerous and 0.8-1.1 mm in diameter.

Habitat.— The species seems restricted to mangrove areas. It is rather plentiful both at the beginning of the rainy season and at that of the dry season. It was found together with the penaeid shrimps *Parapenaeopsis hardwickii* (Miers, 1878), *P. sculptilis* (Heller, 1862), *Penaeus silasi* Muthu & Motoh, 1979, *P. merguiensis* De Man, 1888, *Metapenaeus brevicornis* (H. Milne Edwards, 1837), *M. lysianassa* (De Man, 1888), *M. tenuipes* Kubo, 1949, the sergestid shrimp *Acetes indicus* H. Milne Edwards, 1830, the carideans *Macrobrachium equidens* (Dana, 1852), *M. mirabile* (Kemp, 1917), *Periclimenes grandis* (Stimpson, 1860), *Alpheus* sp., the stomatopod *Cloridopsis scorpio* (Latreille, 1825) and the horseshoe crab *Tachypleus gigas* (O.F. Müller, 1785), as well as numerous species of brackish water fishes, like *Plotosius canius* Hamilton Buchanan, 1822, *Lates calcarifer* (Bloch, 1790) and *Scatophagus argus* (Linnaeus, 1766).

Economic importance.— The species has not been found among the fishery products obtained with conical set nets placed near the coast. Due to its restricted distribution (mangroves in the Vung Tàu area) it is rarely seen on the markets and evidently is of negligible economic importance.

Distribution.— So far the species has only been found in the Vung Tàu (= Cap St. Jacques) area of Vietnam, where, however, it can be plentiful.

***Palaemon serrifer* (Stimpson, 1860)**

(fig. 9)

Material.— Dá Chong, 12 km north of Nhatrang, central Vietnam, shore with boulders, 11.vii.1990, 6 ♂♂ (tl. 16 mm), 6 ovigerous ♀♀ (tl. 24-27.5 mm), 1 non-ovigerous ♀ (tl. 17 mm); Luong Son, 7 km north of Nhatrang, central Vietnam, shore with boulders, 18.x.1989, 2 ovigerous ♀♀ (tl. 30 mm), 6 non-ovigerous ♀♀ (tl. 20-22 mm); front beach of Vung Tàu (= Cap St. Jacques), Vietnam, shore with boulders, 8.iv.1985, 6 ♂♂ (tl. 24-27 mm), 1 non-ovigerous ♀ (tl. 22 mm), 12 ovigerous ♀♀ (tl. 31-34.5 mm).

Description.— In males the rostrum (fig. 9b) is generally straight with the upper margin horizontal or somewhat convex; in females it is rather variable and has the distal third more or less upturned (fig. 9a, c). The rostrum reaches slightly (0.15-0.17 of its length) beyond the end of the scaphocerite; rarely it reaches as far as the scaphocerite. The dorsal margin bears 10-14 (generally 12 or 13) teeth, of which 2 or 3 are placed on the carapace behind the orbital margin. As a rule, the first tooth is more remote from

the second than the second is from the third. The distance between the dorsal teeth increases distally; the last and the penultimate teeth are often widely separated. One or two subapical teeth (generally one) are present; in some specimens the subapical tooth may be far removed from the apex. The teeth of the dorsal margin are semi-movable, except for the two or three distal ones, which are fixed. The lower margin of the rostrum bears 3-5 (generally 4) teeth. Between the dorsal teeth there is a single row of setae; the ventral teeth bear a double row of setae, one on either side.

The carapace is about as long as the rostrum; it is smooth and shows an antennal and a branchiostegal spine. The branchiostegal groove reaches to the branchiostegal spine, which may be situated very slightly behind the anterior margin of the carapace. The branchiostegal spine of the male is sometimes directed down.

In males and juvenile females the thoracic sternum shows a conspicuous median spine between the bases of the fifth pereopods; a median spine is also present on the first and second abdominal sternites of both males and juvenile females. In adult females these spines are entirely absent.

The sixth abdominal segment is 1.4-1.8 times (usually 1.6 times) as long as the fifth.

The telson is 1.1-1.3 times (usually 1.2 times) as long as the sixth abdominal segment. The dorsal surface of the telson is provided with the two usual pairs of spines; the anterior pair is situated somewhat behind the middle of the telson; the posterior pair halfway between the anterior pair and the posterior margin (sometimes slightly closer to the anterior pair). The posterior margin of the telson ends in a median point and is provided with two pairs of spines and a pair of long feathered setae. The outer of the two pairs of spines is very short and just fails to reach the tip of the telson; the inner pair is about 8-9 times as long as the outer.

The eyes are well pigmented.

In the antennule (fig. 9d) the stylocerite is long and reaches to or beyond the middle of the basal segment. The outer margin of the basal segment is about straight and ends in a forward directed antero-lateral spine which reaches beyond the convex anterior margin of the segment. The third segment is slightly longer (1.1-1.2 times) than the second. If taken together the second and third segment are equal to, or somewhat shorter than, the basal segment. The two rami of the upper antennular flagellum are fused for 5-8 segments; this unbranched portion measures 0.8-1.2 mm. The free part of the shorter ramus is slightly serrate at its outer margin and consists of 14-22 articles; it measures 2.3-3.5 mm (in 1 specimen the free ramus is relatively short and consists of 11-13 articles). The free part is 3 times as long as the fused portion. The width of the shorter ramus is somewhat more (1.2 times) than that of the longer ramus.

The scaphocerite (fig. 9e) is about 2.7-3.4 times as long as wide; the outer margin is about straight.

The oral parts are quite typical. The mandibular palp is three-segmented. The third maxilliped reaches to the distal end of the first or second segment of the antennular peduncle.

The first pereopods (fig. 9f) reach with the tip of the dactylus as far as the end of the scaphocerite (in young specimens) or reach beyond it with one half to the entire length of the dactylus (in old specimens). The fingers are somewhat shorter than the palm. The ischium is 0.46-0.82 times as long as the merus. The merus is somewhat

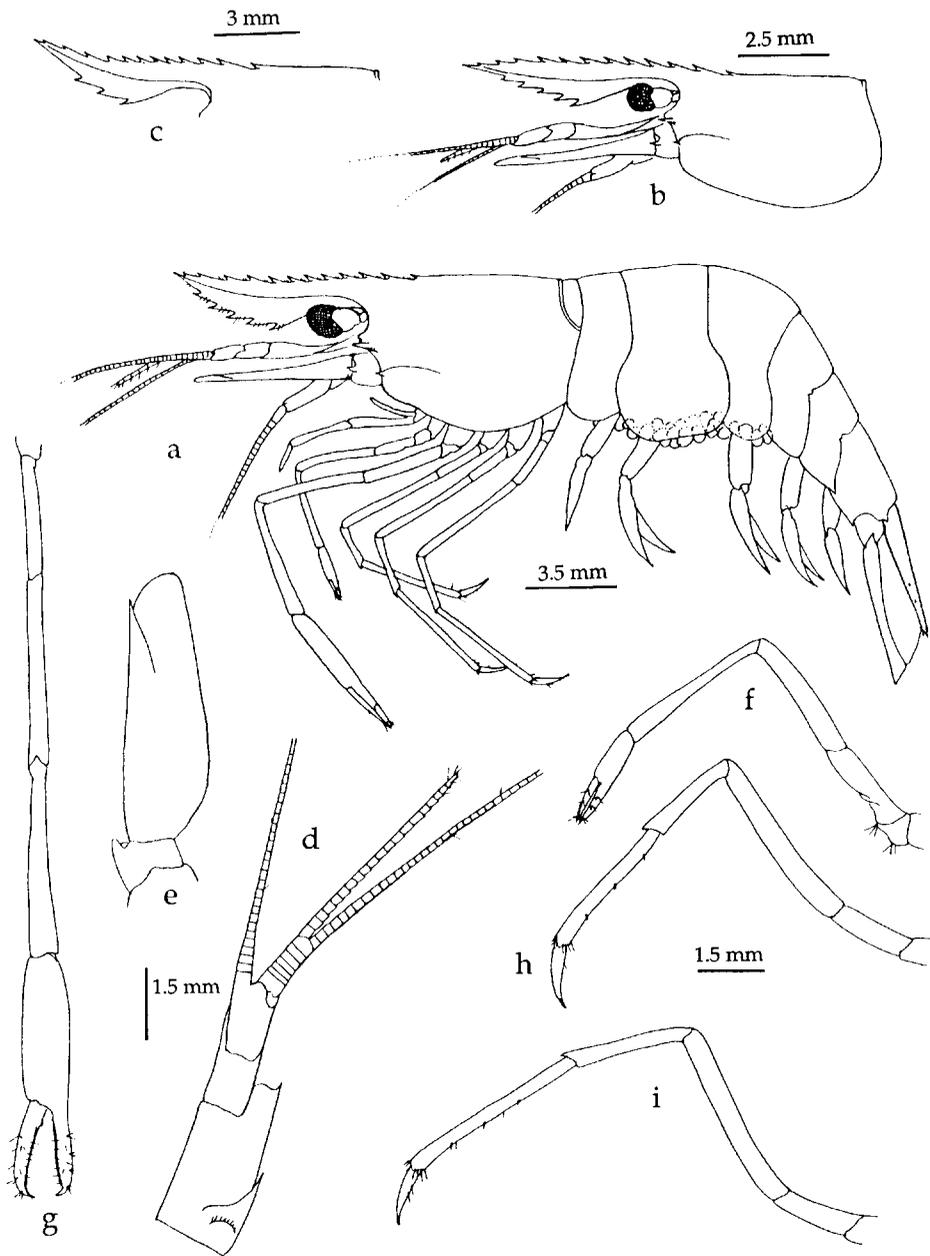


Fig. 9. *Palaemon serrifer* (Stimpson, 1860). a, ovigerous female (cl. 6.5 mm) in lateral view; b, carapace and anterior appendages of male (cl. 5 mm) in lateral view; c, rostrum; d, antennula; e, scaphocerite; f, first pereiopod; g, second pereiopod; h, third pereiopod; i, fifth pereiopod.

shorter than the carpus.

The second pereiopods (fig. 9g) are equal in size; only in old ovigerous females one of these legs may be slightly larger than the other. In small specimens the second pereiopod extends with one seventh of the length of the palm, or with the entire palm, beyond the scaphocerite, but in ovigerous females it may reach beyond that scale with the entire chela or with one seventh of the length of the carpus. The fingers are 0.63-0.8 times as long as the palm. The two very small teeth in the proximal part of the cutting-edge of the dactylus are usually inconspicuous. The fingers are directed somewhat inwards at the top. The palm is somewhat depressed. The merus usually is about as long as the carpus. The ischium is 0.7-0.9 times as long as the merus. The carpus is shorter than the chela.

The last three pereiopods are about equal in length and shape; the dactyli are short, simple and curved. In small specimens the third pereiopod (fig. 9h) reaches to the end of the scaphocerite with the tip of its dactylus. In older individuals it overreaches the scaphocerite by the whole length of its dactylus. The propodus is 2.5-3.2 times as long as the dactylus. The merus is slightly longer than the propodus. The fourth pereiopod overreaches the end of the scaphocerite by half to the full length of its dactylus. The propodus is about 3 to almost 4 times as long as the dactylus. The fifth pereiopod (fig. 9i) overreaches the scaphocerite at most with one third the length of its dactylus. The propodus is more than 3 times to slightly less than 4 times as long as the dactylus and bears the usual transverse rows of setae.

The endopod of the first male pleopod is ovate and lacks any trace of an appendix interna. The endopod of the second male pleopod is provided with an appendix masculina as well as with an appendix interna.

Colour.— Ripe eggs are light olive green to light grey.

Size.— Examination of more than 100 specimens showed the maximal tl. of males not to exceed 28 mm. Ovigerous females were found to have a tl. of 29.5-35 mm. Ripe eggs are 0.6-0.9 mm in diameter.

Habitat.— The species was found in the intertidal zone of flat sandy, sometimes slightly muddy, beaches with many rounded boulders, in a sheltered bay. So far it has not been found on pure sandy beaches or on rocky shores. It lives in pools among the boulders. The bottom of these pools generally consists of coarse sand, shells, coral, and occasionally some mud. The shrimp population of these pools may be very dense: in a pool near Tung Vau, measuring about $60 \times 50 \times 6$ cm, no less than 15 specimens of *Palaemon serrifer* of over 12 mm tl. were collected. Two hours of fishing with three scoop nets in an area of ca $400 \times 10 \times 0.1$ m yielded 1.2 kg of this shrimp species. The salinity of the water varies between 32 and 5‰. The salinity can be considerably lowered by the rains (especially in the rainy season), by the run off from nearby mountains, by rivers in the mangrove area nearby, and by waste water from human settlements.

Economic importance.— The small size of the species and the fact that it lives well hidden in crevices among boulders, evidently are the cause that it is not exploited commercially, notwithstanding being quite common.

Distribution.— The species is known from India to Indonesia and north to Japan and southern Siberia. It is here reported for the first time from Vietnam.

Remarks.— The Vietnamese specimens agree with the description of *Palaemon serrifer* (Stimpson, 1860) given by Holthuis (1950). The following characters may be

added: the first dorsal tooth as a rule is situated farther from the second tooth than the second is from the third. The rostrum of the male is invariably straight. The rostrum of the females shows some variation: it may be straight with the distal third slightly to distinctly curved upward, which agrees with the observations by Holthuis (1950) concerning *Leander fagei* of Yu (1930). In the males the branchiostegal spine sometimes is directed slightly downward.

***Palaemon pacificus* (Stimpson, 1860)**
(figs. 10, 11)

Material.— Hòn Chong beach, 5 km north of Nhatrang, central Vietnam, rocky shore, 16.x.1989, 19 ♂♂ (tl. 22.5-43 mm), 5 non-ovigerous ♀♀ (tl. 37.5-40 mm), 4 ovigerous or post-ovigerous ♀♀ (tl. 43-50 mm); back beach of Vung Tàu (= Cap St. Jacques), Vietnam, rocky shore, 20.v.1989, 10 ♂♂ (tl. 32-36 mm), 22 ovigerous ♀♀ (tl. 40-46 mm), 1 juvenile ♀ (tl. 30 mm).

Description.— The rostrum (fig. 10a, b, c) is well developed; the basal part is directed down and in the distal half or three fifths it is slightly or more strongly curved upward. It reaches beyond the end of the scaphocerite for one fifth to one third (generally one fourth) of its length. The upper margin bears 8-11 (mostly 8-10) teeth, which are placed in the proximal two thirds to three fourths. The distal one fourth to one third is entire, except for one or two small subapical teeth, placed very close to the apex. The first two or three teeth are placed behind the posterior margin of the orbit; the first tooth sometimes is more remote from the second tooth than the second is from the third. Five or six dorsal teeth are semi-movable. The lower margin of the rostrum bears 3-5 (mostly 4) teeth, which are usually placed in the distal half or two-thirds. The intervals between the teeth may increase distally. Both upper and lower margin of the rostrum are provided with a single row of setae. The branchiostegal spine is placed on the anterior margin of the carapace and usually is not stronger than the antennal spine. The branchiostegal groove reaches to the anterior margin of the carapace at the branchiostegal spine.

In the males and juvenile females the thoracic sternum shows a median, spini-form protuberance between the bases of the fifth pereopods. The abdominal sternites have a median spine between the first, second and third pairs of pleopods; between the fourth pair of pleopods there may be a spine or a protuberance. The first abdominal spine is always bifid; the second is generally also bifid, but in some specimens it may be simple. In ovigerous females these spines are entirely absent.

The abdomen is normal in shape. The pleura of the fifth and sixth abdominal somites end posteriorly in an acute point. The sixth abdominal somite is 1.6-1.9 times the length of the fifth.

The telson is 1.12-1.22 times as long as the sixth abdominal somite. The dorsal surface of the telson is provided with the usual two pairs of spines. The anterior pair is situated behind the middle of the telson; the posterior pair usually is closer to the anterior pair than to the tip of the telson. The posterior margin of the telson is provided with the usual two pairs of spines and two feathered setae. The outer pair of spines fails to reach the apex of the median tooth of the posterior margin of the telson, the inner pair is 5-7 times as long as the outer.

The eyes are well pigmented.

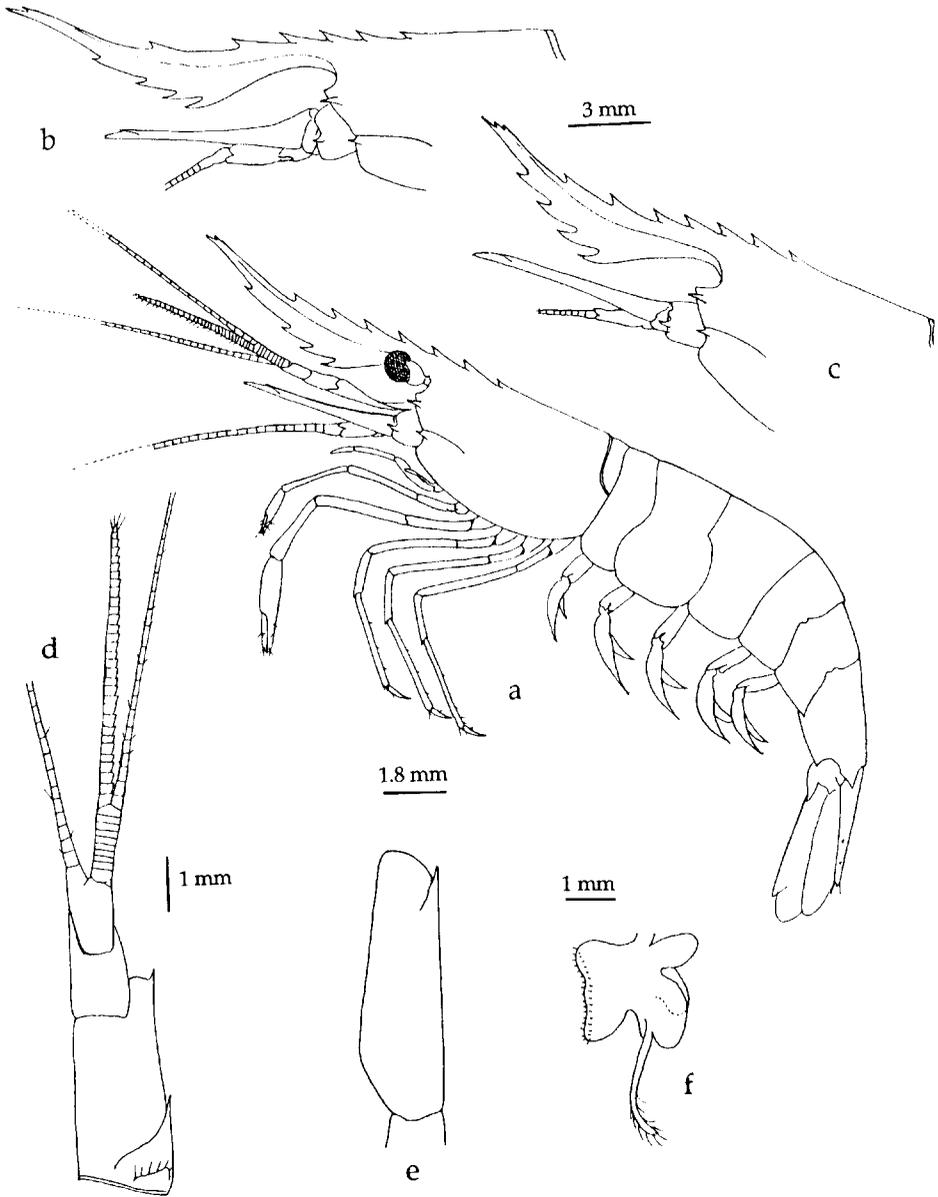


Fig. 10. *Palaemon pacificus* (Stimpson, 1860). a, male (cl. 6.5 mm) in lateral view; b, c, carapace and antenna in lateral view; d, antennula; e, scaphocerite; f, first maxilliped.

The antennular peduncle (fig. 10d) fails to reach the end of the scaphocerite. The stylocerite is well developed and sharply pointed; it reaches usually somewhat beyond the middle of the basal segment. Its dorsal surface is provided with a sinuous carina. The outer margin of the basal segment is somewhat sinuous in juveniles and straight in adults; it ends in a strong spine which reaches far beyond the middle of

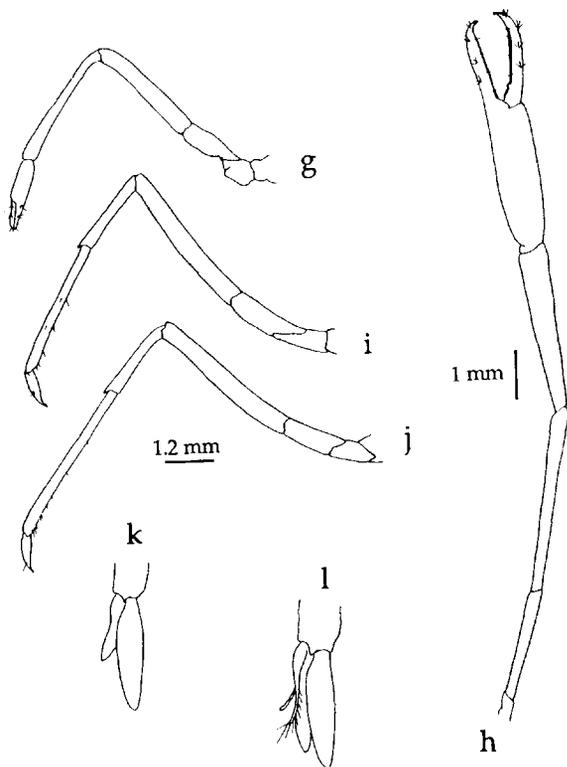


Fig. 11. *Palaemon pacificus* (Stimpson, 1860). continued. g, first pereiopod; h, second pereiopod; i, third pereiopod; j, fifth pereiopod; k, first male pleopod; l, second male pleopod.

the second segment and also overreaches the convex anterior margin of the basal segment. The second segment, when measured dorsally, is distinctly shorter than the third. The basal segment is longer than the third and second segments taken together. The upper antennular flagellum has the two rami fused for 7-11 segments; this unbranched portion measures about 1.2-1.8 mm. The free part of the shorter ramus has the outer margin serrate and consists of 20-33 segments (mostly 20-27); it measures 3.5-6 mm, and is 3-3.2 times as long as the fused portion. In juveniles the shorter ramus is about twice as wide as the longer, but less so in old females.

The scaphocerite (fig. 10e) is about 3 times as long as wide. The outer margin is straight and ends in a final tooth which is somewhat overreached by the lamella.

The oral parts are quite typical. The mandibular palp is three-segmented. The epipod of the first maxilliped (fig. 10f) is divided into two rounded lobes. The third maxilliped reaches as far as the proximal third or to the end of the second segment of the antennular peduncle.

The first pereiopod (fig. 11g) usually reaches to the end of the scaphocerite, or almost so, but in old specimens the first pereiopod may overreach the antennal scale by half the length of its dactylus. The dactylus is equal to, or somewhat shorter than, the palm. The ischium is 0.48-0.66 times as long as the merus. The carpus is 2.8-3.5 times as long as the palm; it is longer than the chela. The merus is shorter than the carpus.

The second pereiopods (fig. 11h) are equal in size and fairly stout. In young specimens they reach beyond the tip of the scaphocerite by one half to four fifths the length of the dactylus, but in old specimens they may overreach that scale by two thirds of the length of the palm. The ischium is 0.66-0.79 times as long as the merus. The carpus is slender and widens distally; it is 1.14-1.43 times as long as the palm but equal to or slightly shorter than the merus. The carpus is shorter than the chela. The palm is somewhat depressed. The fingers, when closed, touch each other over their full length, except for the tips, which are curved inwards and crossing. The cutting-edges are entire, but in old specimens a small tooth is present near the base of the movable finger. The fingers are directed slightly inwards and are shorter than the palm.

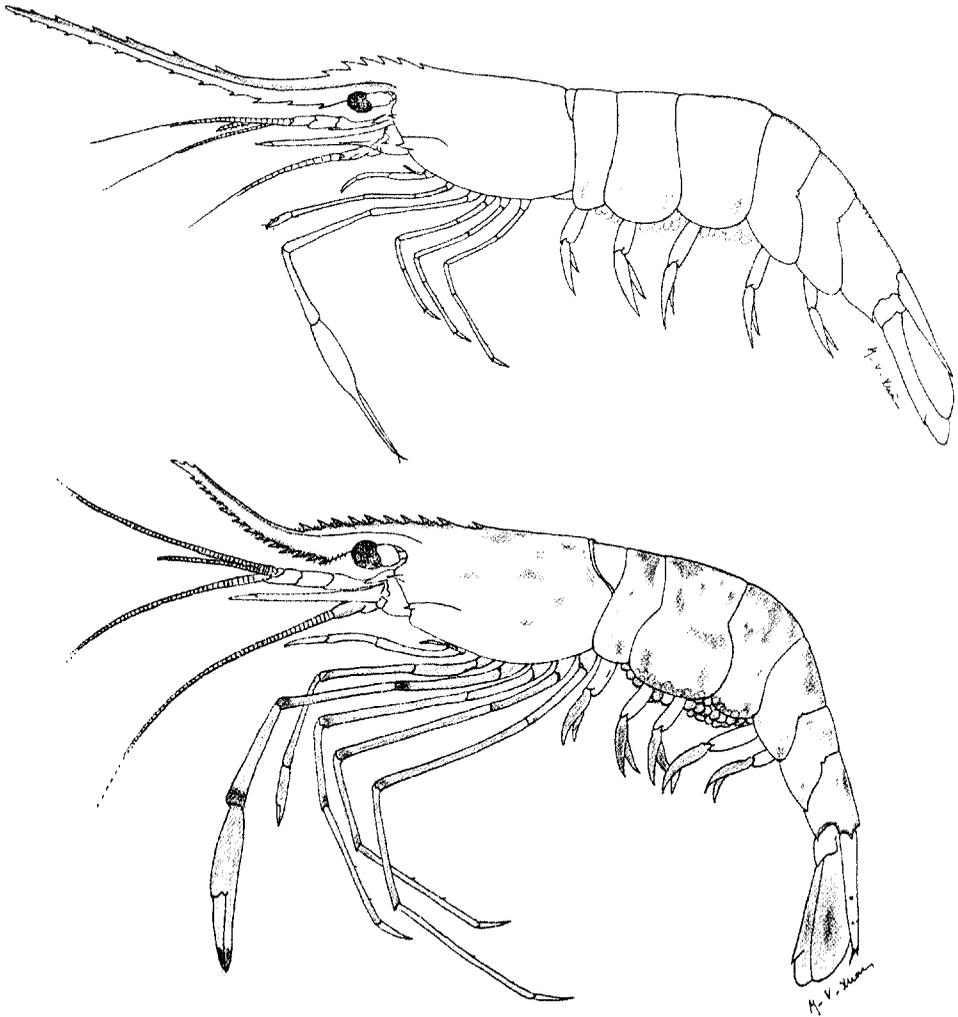


Fig. 12. Colour pattern of *Exopalaemon vietnamicus* spec. nov. (upper figure), and *Palaemon curvirostris* spec. nov. (lower figure).

The last three pereiopods are slender; the dactyli are short and curved inwards. In the third pereiopod (fig. 11i) the distal end of the dactylus fails to reach the end of the scaphocerite, or just reaches the tip. The ischium is 0.37-0.48 times as long as the merus. The merus is 1.64-2.69 times as long as the carpus. The carpus is 0.39-0.59 times as long as the propodus. The propodus is 2.53-3.46 times as long as the dactylus. In the fourth pereiopod the end of the dactylus usually reaches to the end of the antennular peduncle, but sometimes it may reach to the apex of the scaphocerite. The merus is 1.68 to 2.66 times as long as the carpus. The carpus is 0.39-0.60 times as long as the propodus. The propodus is 2.33-3.84 times as long as the dactylus. In the fifth pereiopod (fig. 11j), the distal end of the dactylus reaches to the middle or to the

end of the third segment of the antennular peduncle. The merus is 1.58-2.53 times as long as the carpus. The carpus is 0.38-0.58 times as long as the propodus. The propodus is 3 to 5 times as long as the dactylus; the posterior margin of the propodus is provided with the usual transverse rows of setae.

In the first male pleopod (fig. 11k) the endopod is ovate and has no trace of an appendix interna. The second pleopod of the male (fig. 11l), as usual, has both an appendix interna and an appendix masculina.

Colour.— The ripe eggs are green olive.

Size.— The maximal tl. observed is 43 mm for males and 50 mm for ovigerous females. In the smallest ovigerous female tl. is 37 mm, in the largest non-ovigerous female 40 mm. The eggs are numerous, they measure $0.8-0.9 \times 0.9-1.0$ mm.

Habitat.— The species was found only in two rock pools at Vung Tàu. Both pools occupy an area of about 0.7 m² and are 0.2-0.3 m deep. The bottom is sandy and the water very clear. They are situated in a rocky area without the rounded boulders that are so characteristic of the habitat of *Palaemon serrifer*. At the time of collecting, the animals were quite plentiful, but a visit to the locality at Vung Tau in October 1989 did not yield a single specimen.

Economic importance.— The species has not been observed on the local markets, and possibly is too uncommon to be of any economic value.

Distribution.— *Palaemon pacificus* inhabits a large part of the Indo-West Pacific region (Red Sea to Japan and Polynesia).

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