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TAXONOMY OF INDIAN PRAWNS (PENAEIDAE, CRUSTACEA, DECAPODA)

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ABSTRACT

In the light of the various systematic revisions of penaeid prawns published in recent years from the Indo-Pacific and other regions, a general revision of Indian prawns of the family Penaeidae is attempted. Out of a total of 62 species present in the collection, 48 species included in 9 genera belong to the subfamily Penaeidae. The genera represented in this subfamily are *Penaeus* Fabricius (8 species), *Metapenaeopsis* Bouvier (9 species), *Parapenaeus* Smith (3 species), *Penaeopsis* Bate (1 species) *Trachypenaeopsis* Burkenroad (1 species), *Metapenaeus* Wood-Mason & Alcock (11 species), *Atypopenaeus* Alcock (1 species), *Trachypenaeus* Alcock (3 species) and *Parapenaeopsis* Alcock (11 species). The rest of the species belong to the other subfamilies namely, Solenocerinae (2 genera, *Solenocera* Lucas (8 species) and *Hymenopenaeus* Smith (1 species), Aristaeinae (2 genera, *Aristeus* Duvernoy (3 species) and *Aristaeomorpha* Wood-Mason (1 species) and Sicyoninae (1 species of genus *Sicyonia* H. Milne Edwards). The zoogeographical distribution of these prawns in this region is discussed.

INTRODUCTION

IN view of the increasingly prominent role played by prawns and prawn products in the economy of the country, in the present contribution it is attempted to bring together all the Indian species of prawns belonging to the family Penaeidae, excepting a few genera of oceanic nature, occurring in the littoral zone at different regions of the coasts, in the light of various revisions of different genera and groups of species available in recent literature. The pioneering works of Alcock (1901, 1905, 1906) are the most significant contributions to the systematics of penaeid prawns of Indian region. While describing the various aspects of the prawn fishery of particular regions along the coastline of India, lists of constituent species in these regions have been given by several authors such as Rai (1933), Panikkar (1937), Chopra (1939), Nataraj (1942), Srivastava (1953), Chacko (1955), Kurien and Sebastian (1975) and others. Descriptions of certain new records and new species (Nataraj, 1945; Menon 1956; Kunju, 1960; Ramamurthy, 1964; George, 1964, 1966, 1969a; George *et al.*, 1963; George and Rao, 1966; George and Muthu, 1968a; Thomas, 1969, 1970, 1972; Muthu, 1971, 1972a, 1972b; Silas and Muthu, 1974) are also available. However, a comprehensive study of penaeid prawns after Alcock's work is lacking. Moreover several groups of species needed revision in the light of the various systematic studies of recent years (Burkenroad, 1934a, 1934b, 1936; Kubo, 1949; Barnard 1950; Dall, 1957; Hall, 1956, 1961, 1962, 1966; Racek and Dall, 1965; De Bruin, 1965; Racek, 1968; Starobogatov, 1972). So the taxonomic position of these Indian prawns are considered and a revision attempted.

To maintain uniformity in the spelling of penaeid generic names, as suggested by Holthuis (1962) and followed by Racek & Dall (1965) the diphthong "ae" is now used in the root word *Penaeus* for all genera, deviating from previously adopted procedure of following the spellings given by the various original authors of the names. The word "pereopod" is spelt as such following the suggestions by Racek & Dall (1965, p. 8).

For help in identifying, a key for all the species and figures of the carapaces are also given.

Family PENAEIDAE Rafinesque 1815

Subfamily *Solenocerinae* Wood-Mason & Alcock 1891

Genus *Hymenopenaeus* Smith 1882

Hymenopenaeus aequalis (Bate 1888) (Fig. 1. a)

Hymenopenaeus aequalis Kubo, 1949: 219-222 (with synonymy); George, 1966: 339; 1969a:19

Material: Several specimens from south-west coast of India off Quilon to Ponnani —depth 250 to 450 m.

Examination of several specimens of the species in the present collection confirms the fact that the difference in length of the rostrum recorded by de Man (1911) and Kubo (1949) is, as doubted by George (1966), a difference according to sexes, the rostrum of males being slightly shorter than that of females. The rostral teeth formula varies from 7 to 8 + 2. In the thelycum, the median, flattened and shield-shaped sternal plate between the 5th pereopods has the posterior edge slightly raised into two knobs.

Genus *Solenocera* Lucas 1850 (Fig. 1. b-i)

Solenocera crassicornis (H. Milne Edwards 1837)

Solenocera crassicornis Muthu and George, 1971: 142-44 (with synonymy); Starobogatov, 1972: 360 *(non. S. subnuda)*

Material: Several specimens from Bombay coast as well as from east coast near Kakinada area—depth 5 to 40 m.

Muthu and George (1971) and Starobogatov (1972) considered *S. indica* synonymous to S. *crassicornis* based on the important features like absence of pterygostomian spine and absence of lateral spines on the telson shared by the two. Since Milne Edwards' type specimen of *S. crassicornis* is considered lost by Burkenroad (1934a) neotypes may have to be designated for the species. It is suggested that the type specimens of *S. indica* (as *S. indicus)* may be designated as the neotypes of *S. crassicornis.*

Although Cheung (1960) suggested the possible synonymy of *S. indica* and *S. subnuda* and Kunju (1968, 1970) and Starobogatov (1972) synonymised them in view of the differences in thelycal features according to the descriptions of the two species, the synonymy cannot be established unless the type specimens are re-examined. Hence they are treated separately.

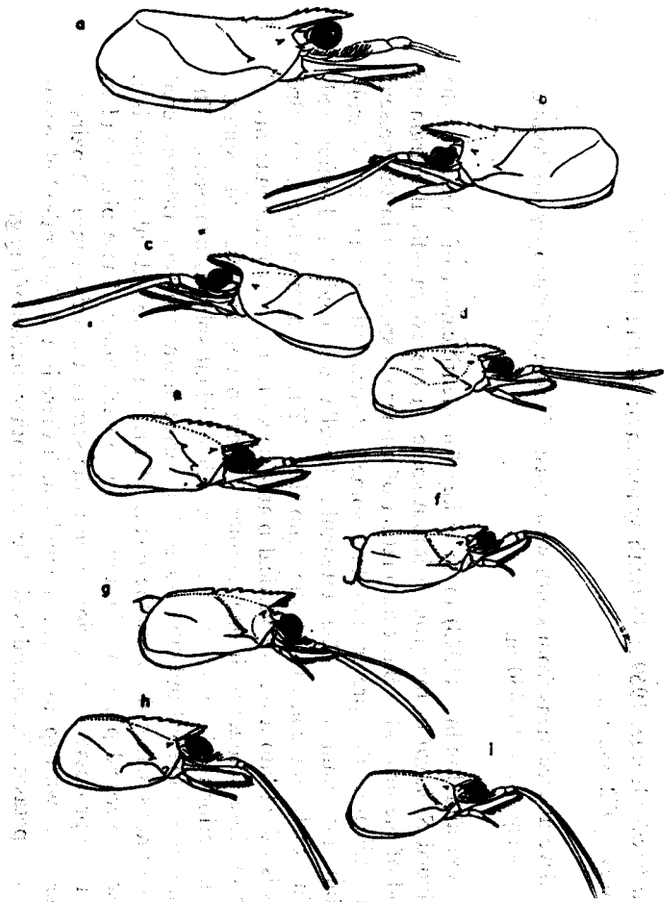


Fig. 1. Carapace with anterior appendages of: a. *Hymenopenaeus aequalis* (Bate) b. *Solenocera crassicornis Milne* Edwards c. *Solenocera waltairensis* George and Muthu d. *Solenocera pectinata* (Bate) e. *Solenocera hextii* Wood Mason f. *Solenocera melantho* de Man g. *Solenocera alticarinata* Kubo h. *Solenocera choprai* Nataraj i. *Solenocera koel beli* de Man.

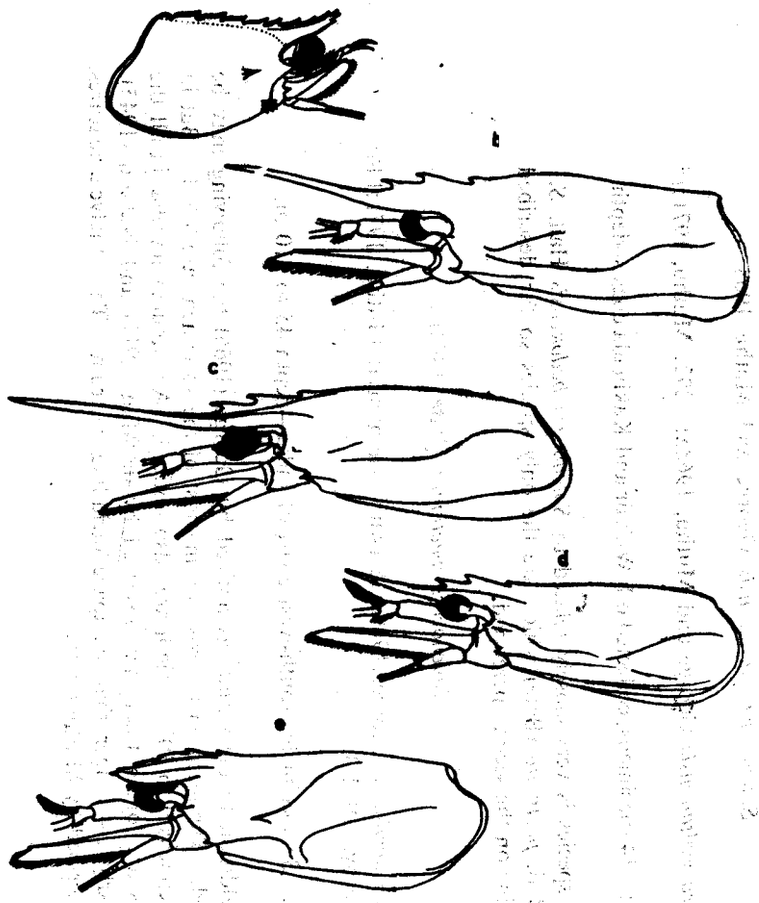


Fig. 2. Carapace with anterior appendages of: a. *Sicyonia lancifer* (Olivier) b. *Aristeus semidentatus* (Bate)–Female c. *Aristeus alcocki* Ramadan–Female d. *Aristeus virilis* (Bate) Male e. *Aristaeomorpha woodmasoni* Calman-Male.

Solenocera waltairensis George and Muthu 1968

Solenocera waltairensis George and Muthu, 1968a: 292; Muthu, 1971:154

Material: 14 specimens, collected off Waltair and Kakinada coasts–depth 5 to 40 m

The species is very closely related to *Solenocera bedokensis* Hall, *S. spinajugo* Hall and *S. pectinata* (Bate) which are the only species so far described without basial spine on the second pereopod.

Solenocera pectinata (Bate 1888)

Solenocera pectinata George, 1969a:18 (with synonymy); Muthu, 1971:146; Starobogatov, 1972:364.

Material: 35 specimens, south-west coast of India—depth 45 to 110 m.

In addition to the variations noticed by George (1966) the following may be mentioned. The teeth on the rostrum in most of the specimens are 8+ 1. But in some specimens 9 to 10+ 1 teeth are also noticed. Antennular flagella in all the specimens are longer than that observed by de Man (1911) and Nataraj (1945), being nearly 1/4 longer than carapace including rostrum. The thelycal features are as described by Muthu (1971).

Solenocera hextii Wood-Mason 1891

Solenocera hextii George, 1969a: 18 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:382 (key).

Material: Several specimens from south-west coast of India off Alleppey to Ponnani —depth 150 to 450 m.

Anderson and Lindner (1943) in their key for identification of species of the genus included *S. hextii* in the group without spine on the externo-distal margin of the exopod of the uropod. But examination of numerous specimens in the present collection indicates the presence of this spine. Postrostral carina is sharply defined, but not laminose. The antennular flagella are banded red/white, red/white. The thelycum consists of the following. The sternum between the 3rd pereopods is raised into a pair of vertical plate-like structures, the inner margins of which are in close contact with one another. These plates are beset with spinous setae and posterior to these plates there is a pair of blunt spinous processes. The sternum in between the 3rd and 4th pereopods is raised into a transverse ridge covered with small spinous setae. Between the coxae of the 4th pereopods also there is a pair of narrow vertical plates put in apposition to each other. These plates end in blunt teeth-like processes. Posterior to these the sternum is raised into 2 pairs of short ridges beset with spinous setae, behind which there is a slightly raised glabrous portion. The petasma in general is similar to the other species of the group.

Solenocera alticarinata Kubo 1949

Solenocera alticarinata Kubo, 1949:227-31; Hall, 1961:79-80; 1962:12-13; Starobogatov, 1972:382 (key).

Material: 10 specimens, south-west coast of India off Trivandrum to Cochin—depth 150 to 250 m.

The specimens on hand agree in most details with Kubo's description. As mentioned by Hall (1961) the rostral teeth vary from 8 to 9 and in confirmation of Hall's observation, in most of the specimens in the present material from the south-west coast of India the number of rostral teeth on the carapace is only 4 as against 6 mentioned by Kubo (1949). The important differences from *S. hextii* recorded by Hall (1961) are clearly noticeable in the present material also. In the thelycum the vertical plates in between the 3rd pereopods are less spinous and the pair of blunt spinous processes posterior to these plates present in *S. hextii* is lacking in this species. The ridge on the sternum in between the 3rd and 4th pereopods is more conspicuous. The plates in between the 4th pereopods also possess spinous setae and lack the blunt teeth-like processes. The 4 ridges posterior to these plates are in the form of round tubercles beset with long spinous setae. Behind these tubercles the sternum is excavated into a rectangular area bounded posteriorly by the considerably elevated posterior edge of the last thoracic sternite.

Solenocera melantho de Man 1907

Solenocera melantho George 1969a:19 (with synonymy); Muthu, 1971:145; Starobogatov, 1972:384 (key).

Material: 5 specimens, south-west coast of India off Alleppey—depth 175 to 200 m.

This species resembles very closely *S. alticarinata,* the most important difference being the presence of laminose postrostral carina in the latter. The slight difference in thelycum depicted in the figures by Hall (1962) is more imaginary than real as he himself mentions. However, differences in lengths of all the pereopods are noticed in the material on hand when compared to the descriptions of de Man (1911). The Ist pereopod reaches only to a little less than the middle of the antennal scale. The 2nd pereopod reaches upto the tip of the antennal scale. The 3rd pereopod extends with more than 1/3 of their carpal joints beyond the antennal scales. The pereopods of the 4th pair reach only to the middle of the antennal scale. 5th pereopod extends beyond the antennal scale by 1/2 of propodus and dactyl.

Solenocera koelbeli de Man 1885

Solenocera koelbeli George, 1969a: 19 (with synonymy); Starobogatov, 1972; 384 (key)

Material: 6 specimens, Arabian Sea, north-west of Cochin off Ponnani—depth 65 to 75 m.

Apart from the remarks made by George (1966) it may be mentioned that the species closely resembles *S. choprai*. The diagnostic feature of *S. koelbeli* is that the postrostral carina is uninterrupted by cervical groove. Another difference mentioned by Nataraj (1945) is in the length of the antennular flagellum. In the present material it is longer than the carapace including the rostrum. In the mandibular palp the distal width of the proximal joint is more or less equal to the proximal width of the distal segment.

Solenocera choprai Nataraj 1945

Solenocera choprai Nataraj 1945:91; George 1969a: 18; Starobogatov, 1972:382 (key)

Material: 8 specimens obtained from north-west of Cochin off Ponnani 10°35'N and 75°20'E—depth 60 to 75 m.

The specimens on hand agree well with the excellent description of Nataraj (1945). The rostral teeth are, however, found to vary from 7 to 9. In the thelycum the rounded medium sternal prominance between the 3rd and 4th pereopods described by him is more or less in the form of a transverse ridge and covered by spinous setae as in *S. hextii* and *S. alticarinata*. The pair of vertical plates in between the 3rd as well as 4th pereopods are also beset with spinous setae as in above mentioned species. Maximum size is about 10 cm (carapace 3.3 cm).

Subfamily *Sicyoninae* Ortmann 1890

Genus *Sicyonia* H. Milne Edwards 1830

Sicyonia lancifer (Olivier 1811) (Fig. 2.a)

Sicyonia lancifer George, 1969a: 19 (with synonymy); Muthu, 1971:151; Starobogatov, 1972:376

Material: I male specimen (3.6 cm), Arabian Sea off Cochin (9°55'N and 75°55'E) depth 30 m.

In addition to the remarks made by George (1966) it may be mentioned that the teeth on the postrostral carina vary from 4 to 5. The petasma is exactly the same as depicted by Hall (1962, fig. 124a). The last thoracic sternite of male has the pair of papillary projections as in *S. lancifer japonica* and *S. cristata*. The tooth on the 5th abdominal somite is directed posteriorly.

Subfamily *Aristaeinae* Alcock 1901

Genus *Aristeus* Duvernoy 1841 (Fig. 2.b–d)

Aristeus semidentatus (Bate 1888)

Aristeus semidentatus George, 1966:339-340 (with synonymy); 1969a:20.

Material: Several specimens, south-west coast of India off Quilon to Mangalore—depth 250 to 440 m.

To the observations of George (1966) the lengths of the pereopods may be added here. The 1st pereopod slightly overreaches half the length of the scaphocerite and its carpus is 1/5 shorter than the chela. The 2nd pereopod reaches the tip of the anterolateral spine on the antennal scale and its carpus is almost the same length as the chela. 3rd pereopod overreaches the antennal scale by 1/3 length of the dactyl and its chela is 3/4 length of carpus. 4th and 5th pereopods reach the tip of the antennal scale. The thelycum consists mainly of a heart shaped plate beset with spinous setae in between the 4th pereopods. Dorsally the posterior border of the abdominal segments are banded red.

Aristeus alcocki Ramadan 1938

Aristeus alcocki George, 1969a: 20 (with synonymy).

Material: 1 specimen-female 14.1 cm total length, Arabian Sea south-west of Cochin off Alleppey (9°23′N and 75°40′E)—depth 340 m.

As observed by Ramadan (1938) and George (1966) the chelae of the pereopods of the species are larger in proportion to the carpus than in *A. semidentatus*. The 1st pereopod reaches 3/4 length of the scaphocerite and its chela is 1/4 longer than the carpus. 2nd pereopod exceeds the tip of the anterolateral spine of the scaphocerite. The 3rd pereopod overreaches the antennal scale by 3/4 dactyl and the 4th and the 5th overreach the same by the length of the dactyl.

Aristeus virilis (Bate 1881)

Aristeus virilis George, 1969a: 20 (with synonymy).

General distribution of the species in the Indo-Pacific extends from the Andaman Sea through the East Indian Archipelago to Japan. In the Andaman Sea it is found in depths of 345 to 740 m. It is of the same size as other species.

Genus *Aristaeomorpha* Wood-Mason 1891

Aristaeomorpha woodmasoni Calman 1925 (Fig. 2.e.)

Aristaeomorpha woodmasoni George, 1969a: 21 (with synonymy).

Material: 25 specimens, Arabian Sea south-west of Cochin off Alleppey to Ponnani-depth 330 to 375 m.

To the observations made by George (1966) it should be added that in the female the rostrum is armed with 10 teeth. It is almost the length of the carapace and curved upwards. The dorsal carinae of 3rd to 6th abdominal segments end in spines, the carinae on the 3rd segment being present only in the posterior half.

Subfamily *Penaeinae* Rafinesque 1815

Genus *Penaeus* Fabricius 1798 (Fig. 3. a-h)

Penaeus canaliculatus Olivier 1811

Penaeus canaliculatus Olivier, 1811, George, 1969 a : 21 (with Synonymy); Starobogatov, 1972:388 (key).

Material: Few specimens, south-west coast of India—depth 10 to 40 m.

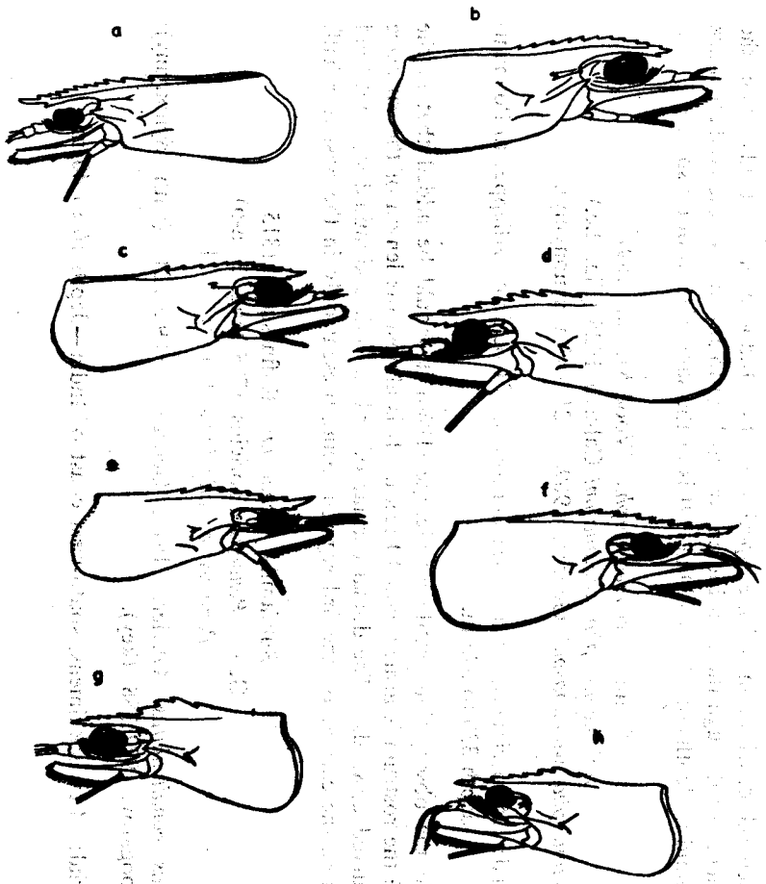


Fig. 3. Carapace with anterior appendages of: a. *Penaeus japonicus* Bate. b. *Penaeus canaliculatus* Olivier c. *Penaeus latisulcatus* Kishinouye d. *Penaeus monodon* Fabricius e. *Penaeus semisulcatus* de Haan. f. *Penaeus indicus* Milne Edwards g. *Penaeus merguiensis* de Man h. *Peaneus penicillatus* Alcock.

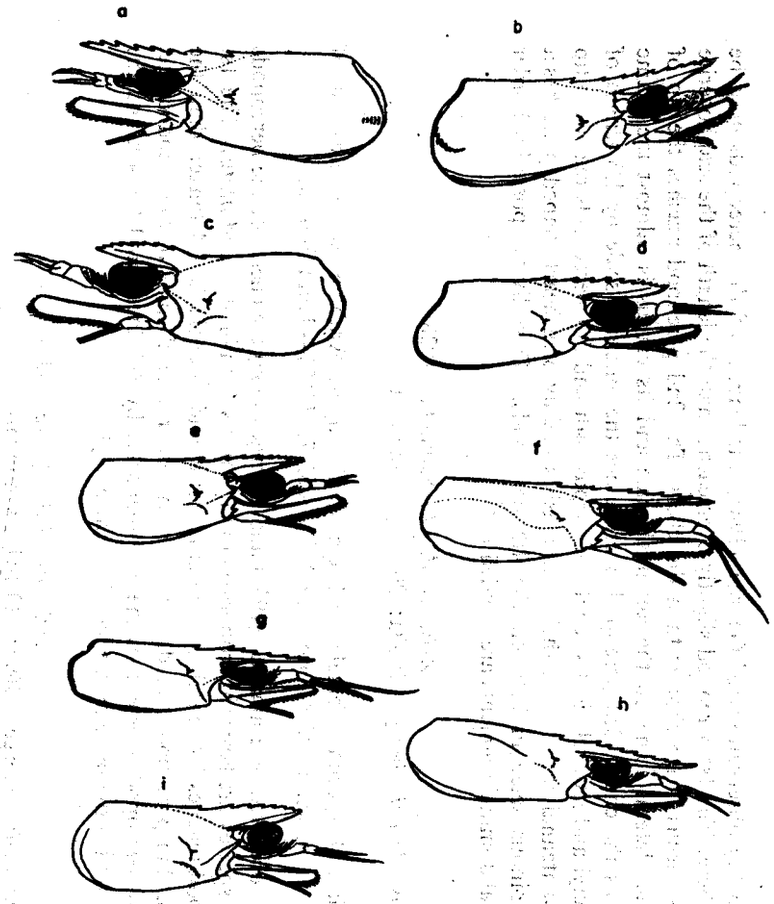


Fig. 4. Carapace with anterior appendages of: a. *Metapenaeopsis stridulans* (Alcock) b. *Metapenaeopsis barbata* (de Haan) c. *Metapenaeopsis mogiensis* (Rathbun) d. *Metapenaeopsis borradaili* (de Man) e. *Metapenaeopsis hilarula* (de Man) f. *Metapenaeopsis andamanensis* (Wood Mason) g. *Metapenaeopsis coniger* (Wood Mason) h. *Metapenaeopsis philippi* (Bate) i. *Metapenaeopsis gallensis* (Pearson)

The material on hand agrees well with the earlier descriptions of the typical species characterised by the telson without lateral spinules. The rostrum is generally 10/1 dentate. As described earlier 4 of the rostral teeth are on the carapace, but unlike in the specimens described by de Man (1911) the ventral tooth is situated just opposite or slightly anterior to the anteriormost dorsal tooth in some of the present specimens. In females the external maxillipeds and the 3rd pereopods both extend slightly short of the tip of the basal segment of the antennular peduncle. In males they are a bit shorter.

Penaeus canaliculatus of Alcock (1906) being later synonymised as *P. japonicus* Bate, most of the records of *P. canaliculatus* from Indian waters may be referred to *P. japonicus*. However, *P. canaliculatus* auct. has recently been obtained in few numbers among the prawn collections from south-west coast of India, although it does not contribute to a fishery. Juveniles occur in Cochin backwaters during certain season.

Penaeus japonicus Bate 1888

Penaeus japonicus George, 1969a: 21 (with synonymy); Muthu, 1971 : 154; Starobogatov, 1972:367.

Material 15 specimens, from inshore catches of Bombay, south-west coast and east coast, Madras region—depth 10 to 30 m.

There is close agreement between the detailed descriptions of Alcock (1906) in the name of *Penaeus canaliculatus*, de Man (1911) and Kubo (1949) and the specimens in the present collection. In Singapore specimens Hall (1956) noted that the 2nd, 4th and 5th pereopods attain the same point anteriorly and expressed the opinion that in the observation of Kubo (1949) about the 1st, 4th and 5th pereopods attaining the same point anteriorly "possibly there has been a misprint in Kubo's text as the illustration by both Kishinouye (1900) and Alcock (1906) agree with the specimens to hand." However, it is of interest to note that the specimens in the present collection exhibit the condition noticed by Kubo (1949).

Penaeus latisulcatus Kishinouye 1900

Penaeus latisulcatus George, 1969a: 22 (with synonymy); Starobogatov, 1972:367.

Material: 1 female specimen 8.9 cm in total length, south-west coast off Cochin—depth 20 m.

The single specimen which is female agrees well with the descriptions of the species in previous literature. The 4th and 5th pereopods are shorter than those of the Singapore specimens (Hall, 1956), more in agreement with Kubo's specimens. Slight differences in lengths of the pereopods of specimens from widely separated localities have been mentioned by Racek & Dall (1965) also. In the thelycum the bifurcate apical projection of the apical plate lying on the sternite between the 4th pereopods are clearly visible.

Penaeus monodon Fabricius 1798

Penaeus monodon George, 1969a:22 (with synonymy); Mohamed, 1970a: 1258; Muthu, 1971:154; Racek & Yaldwyn, 1971:209; Starobogatov, 1972:388 (key).

Material: Several specimens from various parts of the coast of India—depth 10 to 60 m.

From the present material nothing of importance can be added to the descriptions of this species extensively dealt with in previous literature. Racek and Dall (1965) mentions about a single female from Brisbane river with some difference in colouration, having 'a dull-red dorsal strip, width of body, running from rostrum to 6th abdominal somite, rest of animal an inky blue." A few specimens of the same colouration, in the length range 100–125 mm have been obtained from Cochin backwaters also. The dorsal strips in these specimens are noticed to be more brownish than red. As mentioned by Racek and Dall (1965) apart from this colouration all other criteria are fully comparable with those of typical *P. monodon*.

Penaeus semisulcatus de Haan 1850

Penaeus semisulcatus George, 1969a:23 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:368.

Material: Few specimens from south-west coast—detph 20 to 40 m.

This species has been adequately described in the name of *P. monodon* by Alcock (1906), Kubo (1949) and others. Unlike in Kubo's specimens the length of the 3rd pereopod of the present specimens agrees with the descriptions of Alcock (1906) and Dall (1957). Ischial spine is present only in 1st pereopod as pointed out by Dall (1957).

Penaeus indicus H. Milne Edwards 1837

Penaeus indicus George, 1969a: 23 (with synonymy); Mohamed, 1970b: 1274; Muthu, 1971:154; Starobogatov, 1972:368.

Material: Numerous specimens from different parts of the coast—depth 5 to 60 m.

The specimens examined show all the typical features described in previous literature. The adrostral sulci extend upto the epigastric tooth as described by Alcock (1906), although Racek and Dall (1965) found these sulci slightly exceeding the epigastric tooth. The gastro-orbital carina is well defined. The length of the 3rd pereopod is quite variable as pointed out by Hall (1956).

Penaeus merguiensis de Man 1888

Penaeus merguiensis George, 1969a:24 (with synonymy); Muthu, 1971:154; Racek & Yaldwyn, 1971:210; Starobogatov, 1972:368.

Material: Few specimens from south-west coast and from east coast off Kakinada area—depth 15 to 40 m.

Dall (1957) and Racek & Dall (1965) drew attention to the feature of absence of gastro-orbital carina in the specimens from Australia and New Guinea while the carina is present in specimens from Karachi, Malaysia, Indonesia and the Philippines. The material on hand from the west coast of India also shows the presence of this carina occupying middle 1/3 portion between the hepatic spine and the post-orbital margin of carapace. Distinction of this species from *P. indicus* especially in the juvenile stages is very difficult. Muthu & Rao (1973) have described some useful characters for distinguishing the juveniles of these two species.

Penaeus penicillatus Alcock 1905

Penaeus penicillatus George, 1969a: 24 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:390.

Material: 4 specimens, north-west coast of India, Veraval region—Depth 25 m.

Although Kubo (1949) and Hall (1956) recorded the length of the rostrum surpassing the tip of the antennal scale, in adults in the present collection the rostrum does not reach tip of antennal scale. In adult males on hand the length of the 3rd maxilliped agrees with that depicted in the figures of Alcock (1906), a condition longer than that observed by both Kubo (1949) and Hall (1956). In adult females the external maxillipeds are shorter, extending to the 2nd segment of the antennular peduncle. There exists slight variations in the lengths of the pereopods also.

Penaeus barmerensis Tiwari 1963 and
Penaeus glaessneri Tiwari 1963

In order to make the list of Indian species of the genus *Penaeus* complete, the names of *P. barmerensis* and *P. glaessneri* may also be mentioned here. The two fossil species have been described from Kapurdi in Rajasthan, India by Tiwari (1963).

Genus *Metapenaeopsis* Bouvier 1905 (Fig. 4 a-i)
Metapenaeopsis stridulans Alcock 1905

Metapenaeopsis stridulans George, 1969a:25 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:375

Material: 8 specimens from Visakhapatnam coast and Bombay coast—depth 20 to 50 m.

Nothing of importance can be added in the general features of the species to the description of Racek and Dall (1965) and others except some details regarding the petasma and thelycum which are described by George and Muthu (1968 b).

Metapenaeopsis barbata (de Haan 1850)

Metapenaeopsis barbata George & Muthu, 1968 b:286-91 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:374.

Material: 4 females and 5 males obtained from Visakhapatnam coast (17°40′N 83°20′E)—depth 24 to 48 m.

Rostrum straight and reaches tip of antennular peduncle. Kubo (1949) noticed a variation of rostral teeth from 6 to 7 excluding epigastric spine. In the present collection specimens with 5 teeth were also present. The short subcarinae on the 4th abdominal somite noted by de Man (1911) on re-examination of the type specimen in a dried condition and suggested by him as the effect of dessication and later found to occur in Kubo's specimens as well as Singapore specimens (Hall, 1961) are found to occur in the Indian specimens also. According to Kubo (1949) the telson may or may not surpass the uropods. In the present material the telson, although reaching to the tip in some specimens, does not surpass the uropods. The ratio of length to width measured near the posterior end of the 6th abdominal segment varies from 1.85 to 2.30 in Kubo's specimens while Hall reported a higher ratio in his material. The specimens on hand show that the length is almost twice the width. Detailed descriptions of petasma and thelycum are given by George & Muthu (1968b).

Metapenaeopsis mogiensis (Rathbun 1902)

Metapenaeopsis mogiensis George, 1969 a:25 (with synonymy); Muthu, 1971:149; Starobogatov, 1972:376.

Material: 3 specimens, south-west coast—depth 50 to 60 m.

Considering the differences noticed between Australian and Indian specimens of this species recorded in previous literature, Racek & Dall (1965) remarked that *M. mogiensis* Auctorum might consist of more than one species. This has since been proved correct and with the material available in Ceylon De Bruin (1965) separated *P. hilarulus* of de Man (1911) and Barnard (1950) and *M. mogiensis of* Hall (1962) to include them in *Metapenaeopsis hilarulus* (de Man). The present material shows that the specimens belong to *M. mogiensis* auct.

Metapenaeopsis borradaili (de Man 1911)

Penaeopsis borradailei de Man, 1911:73-75
Metapenaeopsis borradailei Dall, 1957:174-56; Starobogatov, 1972:405 (key)
Metapenaeopsis borradaili Racek and Dall, 1965:20 (key); Thomas, 1970: 213-216.

This is a small species, the maximum size recorded being only 56 mm. In the genus the possession of a distal segment on appendix masculina and the hepatic sulcus descending to ventral edge of branchiostegite are distinctive features of the species.

Metapenaeopsis hilarula (de Man 1911)

Penaeopsis sp. *(hilarulus)* de Man, 1911:70-71.
Penaeopsis hilarulus Barnard, 1950:595
Metapenaeopsis mogiensis Hall, 1962:35; Racek and Dall, 1965:42 (part synonymy)

Metapenaeopsis hilarulus Muthu, 1971:150
Metapenaeopsis hilarula Racek and Yaldwyn, 1971:210; Starobogatov, 1972:406 (key); Kathirvel *et al.*, 1976:236

Although Racek and Dall (1965) considered this species synonymous to *M. mogiensis*, the distinguishing characters between the two species are very convincingly brought out by De Bruin (1965) and Muthu (1971) that there is no hesitation to treat *M. hilarula* as a distinct species. Starobogatov (1972) considered *M. hilarulus* described by De Bruin (1965) as a separate species and named it *M. ceylonica*.

Metapenaeopsis gallensis (Pearson 1905)

Parapenaeus gallensis Pearson, 1905:52-73
Metapenaeopsis gallensis Starobogatov, 1972:404 (key); Muthu, 1972b:564-67.

The species belong to the *mogiensis* group of *Metapenaeopsis*. The differences between this species and *M. mogiensis* and *M. hilarula* have been clearly brought out by Muthu (1972b). The other species to which *M. gallensis* has affinities as mentioned by Racek and Yaldwyn (1971) are *M. assimilis* and *M. mannarensis*, the differences from which are pointed out by Muthu (1972 b).

Metapenaeopsis andamanensis (Wood-Mason 1891)

Metapenaeopsis andamanensis George, 1969a: 25 (with synonymy); Starobogatov, 1972:404 (key).

Material: Several specimens from deep water trawl catches in the south-west coast off Quilon to Malpe—depth 100 to 400 m.

In the antennular flagella, as observed by Hall (1961) the lower flagella are longer and almost the same length as the entire antennular peduncle. On examination of a large number of specimens the small basial spines reported to be present on the 2nd legs of the "Siboga" (de Man, 1911) and Malayan specimens (Hall, 1961) and observed to be absent in specimens from south-west coast of India (George, 1966) are found to be present as very minute spinules in a few specimens. As in Malayan specimens in some animals in the present collection the 3rd pereopod surpasses the tip of the rostrum by the entire chela. The posterior extension of the median thelycal plate, although medially concave, does not appear to be made of two distinct lobes.

Metapenaeopsis coniger (Wood-Mason 1891)

Metapenaeus coniger Wood-Mason, 1891:272; Alcock, 1901:16
Metapeneus coniger Alcock, 1906:25-26
Penaeopsis (Metapenaeopsis) coniger: Ramadan, 1938:69-70
Metapenaeopsis coniger Dall, 1957:168 (key); Racek & Dall, 1965:21 (key); Starobogatov, 1972:404 (key).

Material: Numerous specimens collected from trawl catches off south west coast—100-250 m.

The description of petasma and thelycum of this species given by Alcock (1906) is meagre. The availability of large numbers of specimens from the trawl catches made it possible to give a more detailed description as follows:

Petasma has subequal lobes, the left distoventral projection larger than right, distally carrying 2 minute spinules, right distoventral projection narrower and distally carrying 4 minute spinules; distoventral flap moderately large, striated, ribbon-like and convoluted; right distodorsal lobule and the inner and outer intermediate strips are fused; the left distodorsal lobule is elongated with the distal end cup-like and tuberculated; distomedian lobule proximally narrow and with semi-circular distinctly crenulated apical plate covered by the right distoventral projection.

Appendix masculina typical for the genus, one segmented with truncated concave distal end; the rim of the distal surface is oval in shape, the outer side having a small semi-circular process beset with 6-8 small setae.

Thelycum has the following structure; sternum between the 2nd pereopods possess 2 very short spinous processes; that of the 3rd with an anterior and posterior pair of low bosses, the latter pair being slightly larger and bounded posteriorly by the conspicuous lateral extensions of the coxae of the 3rd pereopods. The thelycal plate lying between the 4th pair of pereopods is T shaped, the horizontal limb of the T is narrow, vertically placed plate with the anterior surface convex; the vertical limb is narrow and short, with short setae at its posterior margin; a deep transverse sulcus with posterior extension on the vertical limb is present on this plate, the edges of this sulcus are setose. The sternum posterior to the thelycal plate broad and concave with the anterolateral margin slightly raised and abutting the rounded posterolateral margin of the thelycal plate. Minute setae present on the concave surface of the plate, those on the posterior margin being longer.

Metapenaeopsis philippii (Bate 1881)

Metapenaeopsis philippii George, 1969a: 26 (with synonymy); Starobogatov, 1972:404 (key).

Material: 10 specimens, south-west coast off Alleppey and Cochin—depth 150 to 350 m.

The antennular flagella are shorter than that of *M. andamanensis*. The posterior extension of the median thelycal plate has a distinct longitudinal median groove, giving the appearance of the midplate being formed of two distinct lobes. The petasma is more than half as long as the carapace without the rostrum.

Genus Parapenaeus Smith 1886 (Fig. 5. a-c)

Parapenaeus longipes Alcock 1905

Parapenaeus longipes George, 1969a:26 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:374.

Material: 8 specimens, Arabian Sea, north-west Cochin—Depth 20 to 60 m.

In addition to the remarks made by George (1966), the following needs mention. The antennular flagella are almost equal in length in males while the lower flagellum is longer than the upper in females. The inconspicuous and flat carina of the 3rd abdominal segment mentioned by Racek & Dall (1965) is not at all clear in the present specimens. 4th to 6th somites are sharply carinated mid-dorsally, the carinae ending in distinct teeth. Petasma and thelycum agree well with the figures given by Racek & Dall (1965).

Parapenaeus fissurus (Bate 1888)

Parapenaeus fissurus George 1969a: 26 (with synonymy), Starobogatov, 1972:375.

Starobogatov (1972) has synonymised *P. fissurus* recorded by Hall (1961, 1962) with *P. sextuberculatus* described by Kubo (1949). As Racek and Dall (1965) pointed out Hall's (1962) Malaysian specimens are fully comparable with those described by previous authors as *P. fissurus* in the nature of petasmata. But considerable difference is noticed in the thelycum which is similar to that of *P. Sextuberculatus*. So it is possible that the two species are mixed up in Hall's collections.

Parapenaeus investigatoris Alcock & Anderson 1899

Parapenaeus investigatoris George, 1969a:27 (with synonymy); Starobogatov, 1972:401 (key)

Material: Several specimens, south-west coast off Quilon to Mangalore—depth 100 to 400 m.

There is nothing of importance to be added to the descriptions in previous literature. Slight variations in the lengths of the pereopods are noticed in the present material. In the thelycum the transverse semicircular plate between the 4th pereopods is beset with the long setae anteriorly.

Genus Penaeopsis Bate 1881 (Fig. 5d)
Penaeopsis rectacuta (Bate 1888)

Penaeopsis rectacuta George, 1969a:27 (with synonymy); Starobogatov, 1972:390 (key).

Material: Several specimens, south-west coast off Quilon to Malpe—depth 100 to 400 m.

As observed by Kubo (1949) the rostral teeth range in number from 8 to 13 + epigastric. The antennular flagella of male agrees well with the description and figures of Alcock (1906). Unlike the observations of Kubo (1949) the lower flagellum which has a semicircular loop in male is shorter than the upper. Basial spine is absent on 2nd pereopod in confirmity with the observation of Ramadan (1938) and Kubo. In the lengths of the 3rd maxilliped and pereopods there are some variations. While 'Siboga' (de Man, 1911) specimens and Kubo's specimens had only 2 pairs of movable spines on the telson in addition to the fixed pair, the present specimens

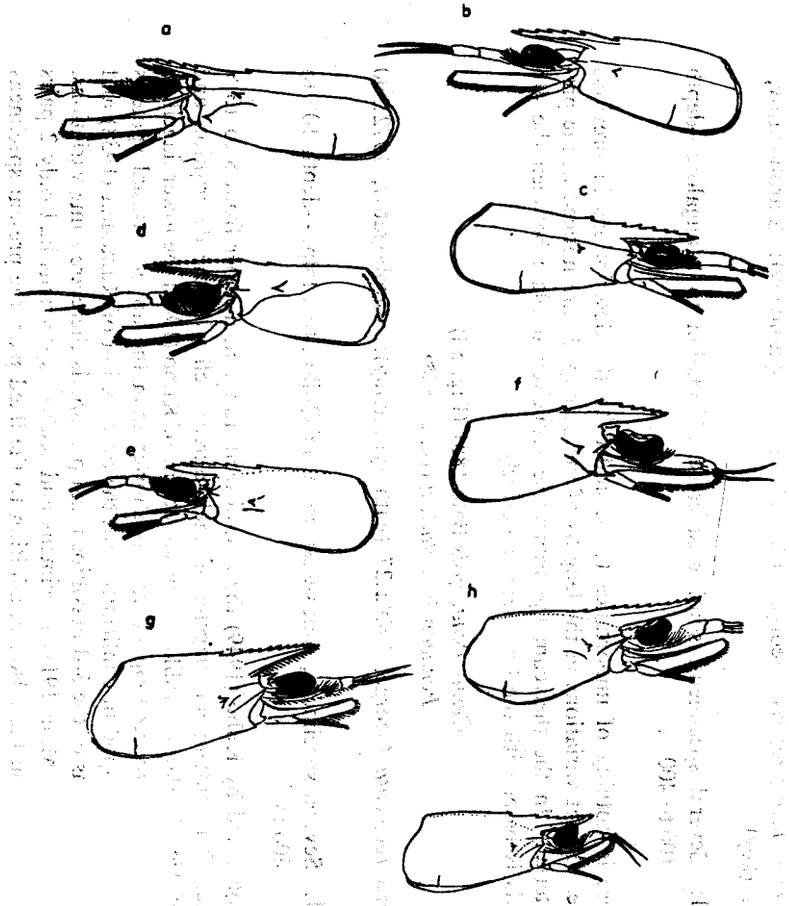
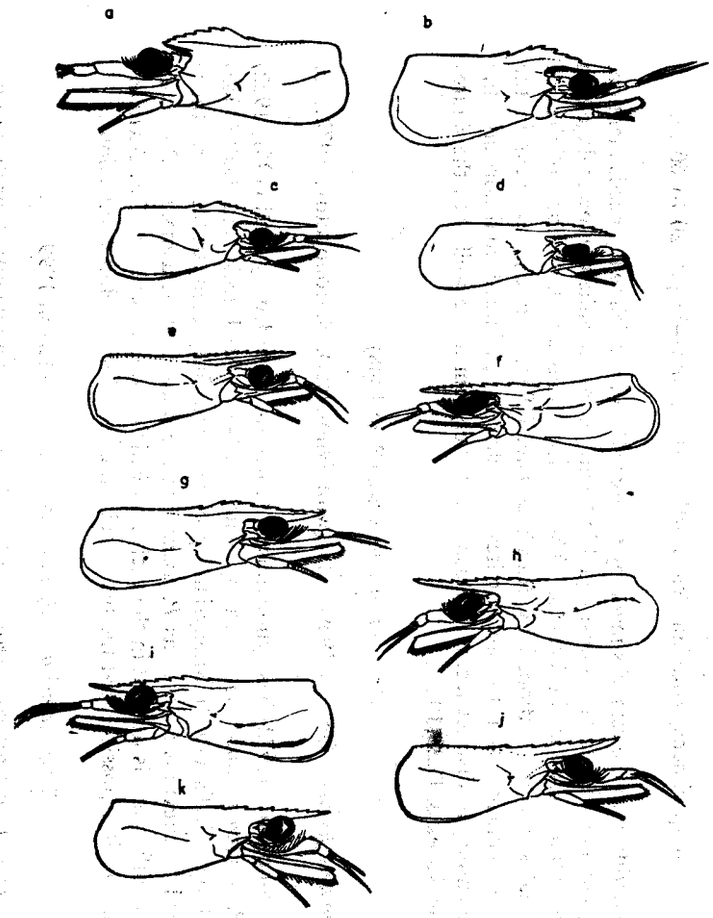


Fig. 6. Carapace with anterior appendages of: a. *Parapenaeus investigatoris* Alcock and Anderson b. *Parapenaeus longipes* Alcock c. *Parapenaeus fissurus* (Bate) d. *Penaeopsis rectacuta* (Bate) e. *Atypopenaeus stenodactylus* (Stimpson) f. *Trachypenaeopsis minicoyensis* Thomas g. *Trachypenaeus curvirostris* (Stimpson) h. *Trachypenaeus sedili* Hall i. *Trachypenaeus pescadoreensis* Schmitt.



Carapace with anterior appendages of: a. *Metapenaeus lysianassa* (de Man) b. *Metapenaeus brevicornis* (Milne Edwards) c. *Metapenaeus dobsoni* (Miers) d. *Metapenaeus stebbingi* (Nobill) e. *Metapenaeus ensis* (de Haan) f. *Metapenaeus monoceros* (Fabricius) g. *Metapenaeus kutchensis* George, George and Rao h. *Metapenaeus alcocki* George and Rao i. *Metapenaeus affinis* (Milne Edwards) j. *Metapenaeus burkenroadi* Kubo k. *Metapenaeus krishnatrii* Silas and Muthu.

agree with the observations of Alcock (1906) and Hall (1962) in having 3 pairs of movable spines in addition to the fixed pair. The spine on the distolateral lobe of the petasma figured by de Man and Kubo is found to be lacking in the material studied.

Genus Trachypenaeopsis Burkenroad 1934 (Fig. 5f)
Trachypenaeopsis minicoyensis Thomas, 1972

Trachypenaeopsis minicoyensis Thomas, 1972:116-121.

This is known only from the type locality of Minicoy Island, Lakshadweep—depth 3 m.

Burkenroad (1934b) created the genus and out of three species known so far two are from the Indo-Pacific region and the other from the Antilles. *T. minicoyensis* can be distinguished from *T. richtersii*, the other species recorded from the Indo-Pacific by the presence of 3 pairs of distal projections visible in the dorsal view of petasma as against 2 pairs in the latter.

Genus Metapenaeus Wood-Mason & Alcock 1891 (Fig. 6. a-k).
Metapenaeus lysianassa (de Man 1888)

Metapenaeus lysianassa George, 1969a:28 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:392 (key).

Material: 9 specimens from Gulf of Mannar—depth 20 to 25 m.

Hall (1962) suggested the erection of a variety *M. lysianassa malaccaensis* based on consistent differences in petasmal structure in specimens collected from the area between Penang and Sumatra. While getting similar male specimens from North Borneo and establishing their identity with Hall's 'variety' Racek & Dall (1965) remarked the possibility of the species being split into two subspecies *M. lysianassa lysianassa* and *M. lysianassa malaccaensis* at a future date as a result of further research. The material on hand in the present collection has the petasma similiar to that of the *forma typica* as depicted by de Man (1888) and Alock (1906). The possible inclusion of this species in a group having the distomedian projection of the petasma with a paired free filament or auxiliary lobe was indicated by Racek & Dall (1965). In the material of the species from North Borneo on close examination of the petasma they found a stumpy prominence on the ventral posteromedian corner of the distomedian projections and felt that those might be the rudiments of the above mentioned paired outgrowth. The petasmata of the present specimens are also found to possess similar prominences.

Metapenaeus brevicornis (H. Milne Edwards 1837)

Metapenaeus brevicornis George, 1969a:28 (with synonymy); 1970d:1564; Muthu, 1971:154; Starobogatov, 1972:390 (key).

Material: Few specimens from Bombay coast and Kakinada area on the east coast—depth 15 to 40 m.

The species is adequately described and the present material confirms to the various features. The ischial spine is present on the 1st pereopod. Although Kubo (1949) described the telson as devoid of lateral spines Racek and Dall (1965) observed

a pair of clearly perceptible distal spines in addition to minute spinules in most of the specimens in their collection, a condition described by de Man (1924) and Burkenroad (1934b). Several of the specimens in the present collection were found to possess a smaller pair of spines in addition to the distal pair. White conjoined pads are present on the thelycum in impregnated females.

Metapenaeus dobsoni (Miers 1878)

Metapenaeus dobsoni George, 1969a:28–77; 1970a, 1342 (with synonymy); Muthu, 1971:154;Racek & Yaldwyn, 1971:212;Starobogatov, 1972:394 (key).

Material: Innumerable specimens from south-west coast—depth 5 to 40 m.

The numerous specimens examined agree well with the previous descriptions. The free filament of the petasmal distomedian projection about which attention was drawn by Racek & Dall (1965) as a result of Burkenroad's suggestion and pointed out by them to be present in Hall's (1962) figure 98a also, is clearly seen in the adult petasma examined. This is another species coming under the group with conjoined white pads on the thelycum in impregnated females.

Metapenaeus stebbingi (Nobili 1904)

Metapenaeus stebbingi George, 1969a:29 (with synonymy); Starobogatov, 1972:394 (key).

Material: 4 specimens, Gulf of Kutch on the north west coast—depth 15 to 25 m.

The specimens to hand agree well with the descriptions by previous authors, especially the petasma and thelycum described by Tirmizi (1962). To the detailed description of the petasma may be added the presence of an upturned spinous projection on either side of the posterior edge of the lateral sides a little above the joint with the pleopod, as also pointed out by Ramamurthy (1964).

Metapenaeus ensis (de Haan 1850)

Metapenaeus ensis George, 1969a:29 (with synonymy); Racek & Yaldwyn, 1971:212; Starobogatov, 1972:369.

Material: 14 specimens, north of Visakhapatnam on the east coast—depth 35 to 50 m.

Nothing of importance could be added to the previous descriptions of this species. As pointed out by Muthu (1965) the record of this species from Indian waters is of great interest in view of Hall's (1958 & 1962) hypothesis regarding the distribution of the Penaeidae in the Indo-Pacific. According to him the distribution of *M. ensis* was restricted to the east of Malayan Peninsula/Sumatra land mass. De Bruin's (1965) record of the species from Ceylon in addition to the report from Indian waters establishes the fact that it is also distributed in areas west of the barrier suggested by Hall.

Metapenaeus monoceros (Fabricius 1798)

Metapenaeus monoceros George, 1969a:30 (with synonymy); 1970c:1547; Tirmizi, 1969:760; Muthu, 1971:154; Racek & Yaldwyn, 1971:212; Starobogatov, 1972:391 (key).

Material: Numerous specimens from west coast and south-east coast—depth 5 to 60 m.

The numerous specimens examined, both juveniles and adults, confirms the descriptions in previous literature. According to Hall (1958 & 1962) the eastern limit of the distribution of this species is Malacca Strait, a view endorsed by Racek & Dall (1965) also.

Metapenaeus alcocki George and Rao 1966

Metapenaeus alcocki George and Vedavyasa Rao, 1966;146-151; George, 1969a:31.

Material: 5 specimens, Gulf of Kutch, north west coast of India (22°48′N and 70°03′E) and east coast near Kakinada area–depth 3 to 15 m.

The species is considered adequately by George and Rao (1966).

Metapenaeus kutchensis George, George & Rao 1963

Metapenaeus kutchensis George, George & Vedavyasa Rao, 1963:284-288; George, 1969a:31; Starobogatov, 1972:392 (key).

Material: Several specimens, Gulf of Kutch, north-west India—depth 3 to 12 m. Known only from type locality.

Metapenaeus affinis (H. Milne Edwards 1837)

Metapenaeus affinis George, 1969a:31;1970b:1366 (with synonymy); Muthu, 1971: 154; Racek & Yaldwyn, 1971:211; Starobogatov, 1972:368.

Material: Numerous specimens from different parts of the coast-depth 5 to 50 m.

The confusion created by Hall's re-examination of type material of the species and his comments has since been cleared (ref: Racek and Dall, 1965, p. 54). Still considerable differences of opinion were expressed on the taxonomic status of this species from India in the World Scientific Conference on the Biology and Culture of Shrimps and Prawns held at Mexico city (Mistakidis, 1968). However, pending final decision about the matter, I am more inclined to follow the views expressed by Racek and Dall (1965) and hence Hall's new species *M. necopinans* and *M. mutatus* are given as synonyms of *M. affinis* here,.

Metapenaeus burkenroadi Kubo 1954

Metapenaeus burkenroadi George, 1969a:32 (with synonymy); Starobogatov, 1972:394 (key); Muthu & Sampson Manickam, 1973:214.

Material: 15 specimens, collected from south-west coast and south-east coast depth 10 to 20 m.

The material on hand agrees well with the descriptions of the species by Kubo (1954), Racek (1957) and others. However, De Bruin (1965) mentioned a few variable features in Ceylon specimens. In comparison with his remarks the present specimens show that the dorsal pubescence is much less strong in males than in females as in Ceylon specimens. The first four abdominal somites are mostly glabrous while the last two somites are more pubescent.

Metapenaeus krishnatrii Silas and Muthu 1974

Metapenaeus krishnatrii Silas and Muthu, 1974:645-648.

This species has been recently described from the Andamans and is only known from the type locality.

Genus Atypopenaeus Alcock 1905 (Fig. 5e)
Atypopenaeus stenodactylus (Stimpson, 1860)

Atypopenaeus stenodactylus George, 1969 a:32 (with synonymy); Starobogatov, 1972:369–70.

Material: 4 specimens from Bombay coast—depth 10 to 20 m.

According to Hall (1961) the three characters, namely, length of the postrostral carina, granulated nature of the dorsum of the carapace and the length of the third maxillipeds by which *A. stenodactylus* and *A. compressipes* are separated, are quite variable and he relegated the latter species to a synonym of the former, an arrangement followed by De Bruin (1965) also. Without seeing Hall's arguments Racek and Dall (1965) preferred to keep the two species separate. Both of these authors had only single specimen for study. Based on examination of present specimens I have no hesitation in agreeing with Hall (1961 & 1962) and *A. compressipes* is here treated as a synonym of *A. stenodactylus*.

Starobogatov (1972) considers *Miyadiella pedunculata* Kubo (1949) also as a synonym of *A. stenodactylus*.

Genus *Trachypenaeus* Alcock 1901 (Fig. 5g-i)
Trachypenaeus curvirostris (Stimpson 1860)

Trachypenaeus curvirostris George, 1966:343; 1969a:33 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:370.

Material: Several specimens from south-west coast—depth 40 to 75 m.

The species is adequately described in previous literature and the material examined does not show anything of importance to be added. In Ceylon specimens De Bruin (1965) found that the rostrum is straight and not curved as illustrated by Dall (1957). Large numbers of specimens examined in the present collection show much variation in this character as noticed by Hall (1961) also.

Trachypenaeus sedili Hall 1961

Trachypenaeus sedili Thomas, 1969: 192–195; George, 1969a:33 (with synonymy); Muthu, 1971: 148; Starobogatov, 1972:372.

Material: 5 specimens (4 females and 1 male) obtained from a shrimp trawl catch off Trivandrum—depth 50 m.

The original description was that of a female specimen by Hall (1961). Although De Bruin (1965) reported about males for the first time he did not describe the male except figuring the petasma and appendix masculina. In the present collection 4 females and 1 male were obtained in a shrimp trawl catch off Trivandrum. In general characters, the male specimen to hand agrees well with the description of the female given by Hall. The body is heavily setose. Unlike in the female, the rostrum is straight instead of upcurved and possesses 9+1 teeth dorsally as against 8+1 described by Thomas (1969). The 3rd maxilliped exceeds the carpocerite by the dactylus and 1/2 of the propodus. The 1st pereopod attains the middle of the carpocerite; the 2nd surpasses the carpocerite by 3/4 of the chela; the 3rd is slightly short of the distal end of the scaphocerite; the 4th reaches the middle of the carpocerite and the 5th attains the same length as the 3rd pereopod. The first three pairs of pereopods possess epipodites. The petasma as shown by De Bruin (1965) has the distolateral projections narrower than in other species of the genus and these projections get narrower towards the tips which curve anteriorly. Anterior projections on the median plate overhang the opening by about 3/4 its diameter. Appendix masculina is similar to that of *T. curvirostris*. While describing the new species *T. gonospinifer* Racek & Dall (1965) expressed the opinion that the male of *T. sedili* when obtained might prove to be quite similar to that of *T. gonospinifer*. Contrary to their expectation the male of *T. sedili* shows a petasma quite different, further strengthening the validity of their new species.

Trachypenaeus Pescadoreensis Schmitt 1931

Trachypenaeus pescadoreensis Thomas, 1969:192; George, 1969a:33 (with synonymy) Starobogatov, 1972:372.
Trachypenaeus granulosus Muthu, 1971:148.

Material: 2 male specimens, one from Arabian Sea off Trivandrum–depth 50 m and one from Gulf of Mannar—depth 25 m.

The petasma of the specimen to hand is quite characteristic of the species as described by Hall (1961 and 1962) and the differences from *T. salaco* de Man are clearly noticeable so that I have no hesitation in treating this as a separate species from *T. granulosus* as well as *T. salaco* to which *T. pescadoreensis* was synonymised by De Bruin (1965). As Racek and Dall (1965) mentioned, collection of many more specimens of these would be necessary before a revision of this group of species could be attempted.

Genus *Parapenaeopsis* Alcock 1901 (Fig. 7. a–k)

Parapenaeopsis uncta (Alcock 1905)

Parapenaeopsis uncta Thomas, 1969:195; George, 1969a:34 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:395 (key).

Material: 10 specimens, Arabian Sea off Colachel—depth 20 m.

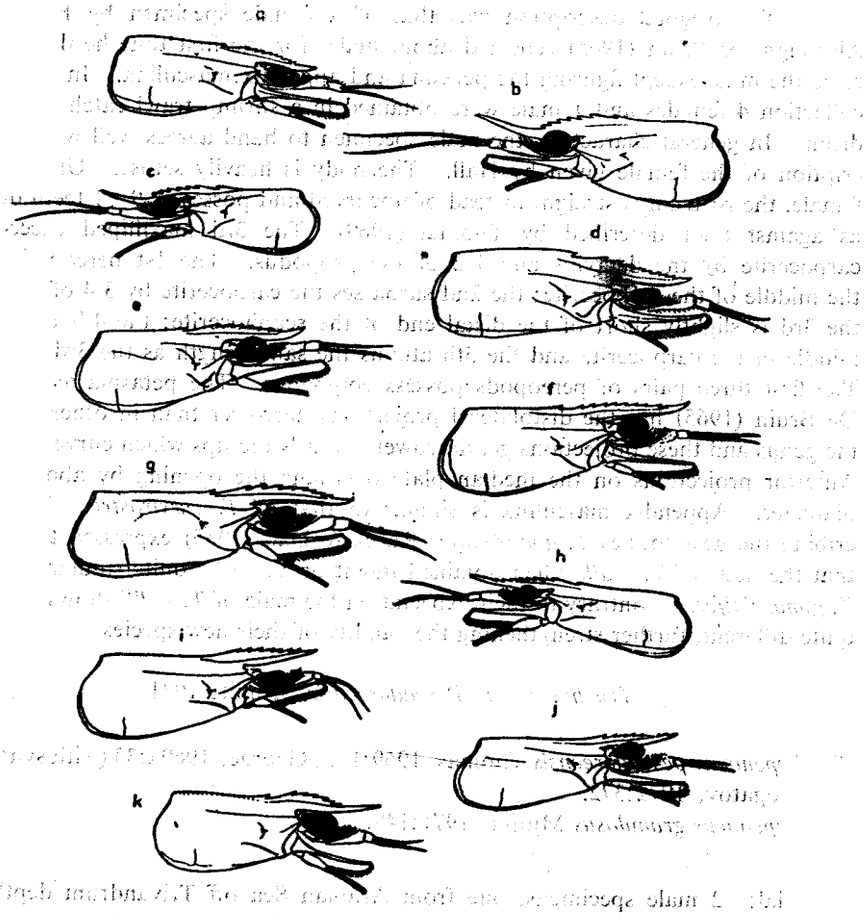


Fig. 7. Carapace with anterior appendages of: a. *Parapenaeopsis uncta* Alcock b. *Parapenaeopsis stylifera* (Milne Edwards) c. *Parapenaeopsis stylifera* var. *cochinensis* George d *Parapenaeopsis maxillipedo* Alcock e. *Parapenaeopsis cornuta* (Kishinouye) f. *Parapenaeopsis nana* (Alcock) g. *Parapenaeopsis hardwickii* (Miers) h. *Parapenaeopsis sculptilis* (Heller) i. *Parapenaeopsis tenella* (Bate) j. *Parapenaeopsis acclivirostris* (Alcock) k. *Parapenaeopsis indica* Muthu.

Noticing extreme variation in the characteristics used by Hall (1961) to separate *P. probata* from *P. uncta*, De Bruin (1965) suggested that the two species are synonymous. Examining the material on hand I have no hesitation in agreeing with De Bruin's view that *P. probata* should be treated as a synonym of *P. uncta* as pointed out by Thomas (1969) also. Only in the case of the basial spine on the 2nd leg does the present specimen show difference, being minute and sometimes absent.

Parapenaeopsis stylifera (H. Milne Edwards 1837)

Parapenaeopsis stylifera George, 1969a :34 (with synonymy); Muthu, 1971:154; Rao, 1970:1580; Starobogatov, 1972:395 (key).

Material: Numerous specimens from different parts of the coast of India—depth 5 to 50 m.

Based on telsonic armature and geographic distribution Hall (1962) raised Alcock's variety *P. stylifera coromandelica* to specific rank, a view followed by De Bruin (1965) also. But Racek and Dall (1965) were of opinion that since all the morphological criteria except telsonic armature in both the forms were in complete agreement, specific separation of Alcock's variety from Milne Edwards' species could not be attempted. However, they felt that it is necessary to retain their taxonomic distinction at an intra-specific level in view of their geographic separation and proposed two sub species *P. stylifera stylifera* (Milne Edwards) and *P. stylifera coromandelica* (Alcock). Examination of innumerable specimens in the fishery of the species on the south west coast of India showed that both the forms exist together here, contrary to the record of one form on the west coast and the other on the east coast by Alcock (1906). In view of this as well as the various gradations noticed in the telsonic armature varying between the two forms it is quite evident that the two are only synonyms and they are treated as such.

Parapenaeopsis stylifera var *cochinensis* George 1975

Parapenaeopsis stylifera var *cochinensis* George, 1975:420–23.

Material: 15 male specimens. Detailed descriptions are given by George (1975).

Parapenaeopsis maxillipedo Alcock 1906

Parapenaeopsis maxillipedo George, 1969a: 35 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:396 (key).

Material: 15 specimens, north-west and south-west coast of India—depth 10 to 30 m.

Although Hall (1961) suggested that Alcock's *P. maxillipedo* might be considered as geographical variety of *P. cornuta* (Kishinouye), De Bruin (1965) felt that the two are distinct species, based on comparison of the features in Ceylon specimens. At the same time Racek and Dall (1965) treated the two as belonging to two sub species *P. cornuta cornuta* (Kishinouye) and *P. cornuta maxillipedo* (Alcock). After critical examination of the present material I have no hesitation in agreeing with De Bruin's view and the two are here treated as distinct species.

In the present material of *P. maxillipedo* the postrostral carina is faintly grooved for a short distance, after which it is bluntly rounded, extending to the posterior margin of the carapace as described by de Man (1911) and Hall (1961). The basial spine on the 3rd pereopod of female is quite conspicuous in the specimens to hand.

Parapenaeopsis cornuta (Kishinouye 1900)

Parapenaeopsis cornuta Racek & Dall, 1965:98–99 (with synonymy).

Parapenaeopsis cornuta de Man, 1911:93; Muthu, 1971:147; Starobogatov, 1972:396 (key).

Material: 3 female specimens (3.3–4.8 cm total length and 0.8–1.2 cm carapace length), south-west coast off Mangalore—depth 20 m.

In agreement with De Bruin's (1965) observation about the size of this species being smaller than *P. maxillipedo* the specimens to hand are also small. The 3rd pereopod does not possess a basial spine. Although Dall (1957) stated that the telson is unarmed, as in Ceylon specimens the present material shows 2 or 3 pairs of minute spines on the distolateral margins of the telson. As observed by De Bruin median tuft of setae is not present behind the posterior thelycal plate.

Parapenaeopsis nana (Alcock 1905)

Parapenaeopsis nana George, 1969a:35 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:396 (key).

Material: 18 specimens, off Kakinada on the east coast—depth 25 m.

The present specimens agree well with Alcock's (1905 and 1906) descriptions. The rostral teeth vary from 7 to 10 excluding epigastric. Slight variations are noticed in the lengths of the thoracic legs. 1st pereopod reaches only base of the basicerite and the 2nd pereopod extends to the tip of the basicerite. 3rd and 5th pereopods reach the tip of the carpocerite (slightly shorter than Alcock's specimens) and 4th pereopod extends to the base of the carpocerite. The large leaf-shaped median thelycal plate lying between the 4th pereopods possess rows of setae on the anterior ventral margin.

Parapenaeopsis sculptilis (Heller 1862)

Parapenaeopsis sculptilis George, 1969a: 35 (with synonymy); Muthu, 1971: 154; Starobogatov, 1972:296 (key).

Material: 20 specimens, Bombay coast as well as Kakinada area on the east coast—depth 10 to 40 m.

The species is adequately described and the material to hand agrees well with the descriptions in the previous literature. In comparison with *P. hardwickii* the differences noticed by Kubo (1949) are clearly noticed in the specimens of the collection, especially the presence of shallowly canaliculated dorsomedian carinae on the 1st and 2nd abdominal somites and the longer carpocerite reaching to distal end of basal antennular segment. Minor variations are noticed in the lengths of the pereopods from the observations of Kubo (1949) and Dall (1957). Telson is unarmed, unlike in *P. hardwickii*.

Parapenaeopsis hardwickii (Miers 1878)

Parapenaeopsis hardwickii George, 1969a:36 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:370.

Material: Several specimens from Bombay coast and Kakinada coast—depth 10 to 30 m.

Numerous specimens examined fully agree with the detailed descriptions and also differences noticed from *P. sculptilis* by Burkenroad (1934b), Kubo (1949),

Kunju (1960) and Racek & Dall (1965). The first two abdominal segments are without median carination. The telson is armed with 3 pairs of small lateral spines. The cultrate rostrum of adult males is a feature shared by both *P. hardwickii* and *P. sculptilis*.

Parapenaeopsis indica Muthu, 1972

Parapenaeopsis indica Muthu, 1972a: 174–80.

This is known only from the type locality in the east coast of India off Godavari river mouth and Kakinada Bay.

The species is closely allied to *P. sculptilis*, *P. hardwickii* and *P. uncta*. The lesser number of rostral teeth, nature of distomedian projections of petasma, absence of basial spines on 2nd leg in male and rounded anterolateral corners of posterior sternal plate overlapping the anterior thelycal plate are important features which distinguish *P. indica* from these species.

Parapenaeopsis tenella (Bate 1888)

Parapenaeopsis tenella George, 1969a : 36 (with synonymy); Thomas 1969:166; Muthu, 1971:147; Starobogatov, 1972:370.

Material: 4 specimens, Palk Strait on the south-east coast–depth 20 m.

Although the specimens to hand agree well with most of the features described earlier, they exhibit slight differences in certain features. While Dall (1957) described the length of the rostrum as reaching the tip of the 2nd segment of the antennular peduncle, De Bruin (1965) found the rostrum extending to or exceeding the 3rd segment of the peduncle. The present specimens agree with Dall's specimens. Adrostral carina ends at 1/8 distance from anterior border of the carapace. The 2nd pereopod extends to the middle of the carpocerite and the 3rd pereopod extends to the base of the dactyl of 3rd maxilliped. The 4th pereopod reaches the middle of the 2nd segment of the antennular peduncle. 5th pereopod slightly exceeds the tip of the antennular peduncle. In the length of the 2nd and 3rd pereopods the present specimens agree with Australian specimens whereas in the length of the posterior legs they agree with Ceylon specimens. The petasma and thelycum closely agree with earlier descriptions and figures.

Parapenaeopsis acclivirostris (Alcock 1905)

Parapenaeopsis acclivirostris George, 1969a:37 (with synonymy); Muthu, 1971:154; Starobogatov, 1972:398 (key).

Material: 25 specimens, south-west coast off Alleppey to Ponnani—depth 25 to 70 m.

The differences of the species from *P. tenella* especially in the secondary sexual characters described by Kunju (1960) and Racek & Dall (1965) are clearly evident

in the present material examined. Alcock's (1906) record of *P. acclivirostris* from Madras and Visakhapatnam on the east coast of India renders it difficult to accept the suggestion by Racek & Dall (1965) that the vicinity of Palk Strait could be considered the zoogeographic boundary separating the eastern species *P. tenella* from its western congener *P. acclivirostris*, although it may be admitted that *P. tenella* is so far not recorded west of Palk Strait, the present material of that species also being from Palk Strait.

KEY FOR IDENTIFICATION OF INDIAN PRAWNS OF THE FAMILY PENAEIDAE

A revision of the key given by George (1969a) and Kurian and Sebastian (1975) including all the species mentioned in this account is given below:

1 Postorbital spine present.....subfamily *Solenocerinae*.....4
Postorbital spine absent 2

2(1) Carapace with a median dentate crest extending nearly or quite to the posterior margin.....subfamily *Sicyoninae*.....12
Carapace without a median dentate crest except occasionally over the eyes 3

3(2) Distinct median tubercle on occular peduncle; upper antennular flagellum inserted near posterior border of third antennular segment, strikingly shorter than lower.....subfamily *Aristaeinae*.....13
No distinct median tubercle on occular peduncle; upper antennular flagellum subequal to the lower one, attached to apex of third antennular segment.....subfamily *Penaeinae*.....16

4(1) Antennular flagella foliaceous.....*Solenocera*.....5
Antennular flagella cylindrical or subcylindrical..*Hymenopenaeus*
Rostrum straight, inclined upwards at an angle of 20° with 7—8 + 2 teeth dorsally.....*Hymenopenaeus aequalis* (Bate)

5(4) Telson trifurcate 6
Telson simple and devoid of any spine on lateral margin.....
.....*Solenocera crassicornis* H. Milne Edwards

6(5) Externo-distal margin of the exopod of the uropod without spine
.....7
Externo-distal margin of the exopod of the uropod with spine.....8

7(6) Postrostral carina present in posterior half of the carapace; cervical groove indents the carapace mid-dorsally.....
.....*Solenocera waltairensis* George & Muthu

Postrostral carina absent in posterior half of the carapace; cervical groove does not indent the carapace mid-dorsally.....
.....*Solenocera pectinata* (Bate)

8(6) Spine on the cervical groove ventral to the posterior-most spine of the rostral series present; 'L' shaped groove on either branchiostegal region present.....*Solenocera hextii* Wood Mason.

Spine on the cervical groove ventral to the posterior-most spine of the rostral series absent; 'L' shaped groove on either branchiostegal region absent 9

9(8) Post-rostral carina markedly elevated, laminose.....
.....*Solenocera alticarinata* Kubo

Post rostral carina not markedly elevated, not laminose.....10

10(9) Cervical groove indents the post-rostral carina deeply.....11

Cervical groove does not indent the post-rostral carina.....
.....*Solenocera melantho* de Man

11(10) Antennular flagellum longer than the carapace including rostrum and it gradually tapers to a point...*Solenocera koelbeli* de Man

Antennular flagellum as long as the carapace including rostrum and tapers abruptly towards the broadly rounded apex.....
.....*Solenocera choprai* Nataraj

12(2) Post-rostral carina armed with 5 teeth; abdominal pleura of 1st and 2nd segments unispinose and 3rd, 4th and 5th with 3 spines
.....*Sicyonia lancifer* (Olivier)

13(3) Rostrum three-toothed dorsally; hepatic spine absent.....
.....*Aristeus* 14

Rostrum with many teeth on upper border; hepatic spine present; length of pterygostomian region more than 2.5 times its greatest breadth.....*Aristaeomorpha woodmasoni* Calman

14(13) Integument glabrous 15

Integument pubescent.....*Aristeus virilis* (Bate)

15(14) Pleurobranchiae on somites X-XIII on distinct filaments provided with pinnules.....*Aristeus semidentatus* (Bate)

Pleurobranchiae on somites X-XIII reduced to mere papillae.....
.....*Aristeus alcocki* Ramadan

16(3) Rostrum without ventral teeth 17
Rostrum with ventral teeth.....*Penaeus*.....24

17(16) A distal fixed pair of spines on the telson and 1-3 pairs of mobile spines 18
No distal fixed pair of spines on the telson; lateral mobile spines may be present 21

18(17) Petasma symmetrical; 3rd maxilliped without basial spine.....19
Petasma asymmetrical; 3rd maxilliped with basial spine.....
.....*Metapenaeopsis* 31

19(18) Carapace with longitudinal sutures extending from post-orbital margin to almost posterior margin.....*Parapenaeus*.....39
Carapace without longitudinal sutures 20

20(19) Branchiostegal spine present.....*Penaeopsis*
Telson with 3 pairs of movable marginal spines in addition to the fixed pair.....*Penaeopsis rectacuta* (Bate)

Branchiostegal spine absent.....*Trachypenaeopsis*
3 pairs of distal projections on petasma, the distolateral being the shortest; anterior plate of thelycum as long as wide.....
.....*Trachypenaeopsis minicoyensis* Thomas

21(17) No exopod on 5th pereopod; pleurobranch on 7th thoracic somite present.....*Metapenaeus*.....41
Exopod on 5th pereopod present; pleurobranch on 7th thoracic somite absent 22

22(21) Carapace with longitudinal sutures; ischial spine on 2nd pereopod absent.....23
Carapace without longitudinal suture; ischial spine on 2nd pereopod present.....*Atypopenaeus*.....
Hepatic spine present; petasma not constricted distally; anterior plate of thelycum rounded posteriorly.....
.....*Atypopenaeus stenodactylus* (Stimpson)

23(22) 3rd pereopod with epipodite.....*Trachypenaeus* 51
3rd pereopod without epipodite.....*Parapenaeopsis*.....53

24(16) Adrostral carina reaching almost to posterior border of carapace; gastrofrontal carina present 25
Adrostral carina not reaching behind middle of carapace; gastrofrontal carina absent 27

25(24) Telson armed usually with 3 pairs of spinules 26
Telson unarmed; rostrum with 1 ventral tooth .....
.....*Penaeus canaliculatus* Olivier

26(15) Adrostral sulcus narrower than post-rostral carina; anterior plate of thelycum rounded at the apex.....*Penaeus japonicus* Bate
Adrostral sulcus as wide as post-rostral carina; anterior plate of thelycum bifid at the apex.....*Penaeus latisulcatus* Kishinouye

27(24) Hepatic carina present.....28
Hepatic carina absent.....29

28(27) Hepatic carina horizontally straight; 5th pereopod without exopodite.....*Penaeus monodon* Fabricius
Hepatic carina inclined at an angle of 20° anteroventrally; 5th pereopod with small exopodite.....*Penaeus semisulcatus* de Haan

29(27) Gastro-orbital carina occupying the posterior 2/3 distance between hepatic spine and orbital angle; rostral crest may be elevated but not triangular in profile.....
.....*Penaeus indicus* H. Milne Edwards

Gastro-orbital carina absent or not reaching hepatic spine and occupying the middle 1/3 distance between hepatic spine and orbital angle.....30

30(29) Dactyl of 3rd maxilliped of adult male 1/2 propodus; adrostral carina not reaching as far as epigastric tooth; rostral crest triangular in profile.....*Penaeus merguiensis* de Man
Dactyl of 3rd maxilliped of adult male much longer than propodus; adrostral carina reaching just beyond epigastric tooth; rostral crest markedly elevated.....*Penaeus penicillatus* Alcock

31(18) Stridulating organ present on posterior branchiostegite.....32
Stridulating organ absent from posterior branchiostegite.....33

32(31) Dorsal carina of 3rd pleonic somite sulcate; stridulating organ almost straight; anterior edge of thelycal plate entire, left petasmal lobe sharply pointed and triangular.....
.....*Metapenaeopsis stridulans* (Alcock)
Dorsal carina of 3rd pleonic somite flat or hardly sulcate; thelycal plate about as wide as long; left petasmal lobe with processes arranged in a semicircular manner; inner intermediate strip much longer than outer.....*Metapenaeopsis barbata* (de Man)

33(31) Hepatic sulcus descending almost vertically to ventral edge of branchiostegite.....*Metapenaeopsis borradaili* (de Man)
Hepatic sulcus absent or not reaching to ventral edge of branchiostegite.....34

34(33) A pair of tooth-like platelets immediately posterior to thelycal plate.....35

No tooth-like platelets immediately posterior to thelycal plate 37

35(34) A distinct groove present on 3rd abdominal carina 36

3rd abdominal carina without groove.....
.....*Metapenaeopsis hilarula* (de Man)

36(35) Anterior edge of anterior sternal plate between 5th pair of legs in female almost straight with flat triangular spine at anterolateral corners; distomedian lobule of petasma distally broad.....
.....*Metapenaeopsis gallensis* (Pearson)

Anterior edge of anterior sternal plate between 5th pair of legs in female with 4 rounded teeth, 2 median ones being incurved; distomedian lobule of petasma small...*Metapenaeopsis mogiensis* (Rathbun)

37(34) Rostrum as long as or longer than antennular peduncle 38

Rostrum not reaching tip of antennular peduncle; centre of the thelycal plate non-sulcate.....*Metapenaeopsis coniger* (Wood-Mason)

38(37) Posterior extension of thelycal plate with indistinct median sulcus and angular posterolateral corners.....
.....*Metapenaeopsis andamanensis* (Wood-Mason)

Posterior extension of thelycal plate with distinct medium sulcus and evenly rounded posterolateral corners.....
.....*Metapenaeopsis philippii* (Bate)

39(19) Branchiostegal spine present; 5th pereopods not reaching tip of antennal scale.....40

Branchostegal spine absent; 5th pereopods exceeding antennal scale by dactyl.....*Parapenaeus longipes* Alcock

40(39) Branchiostegal spine on anterior margin of carapace; 6th abdominal somite less than twice length of 5th; process 'a' of petasma bifurcate, directed laterally, thelycum with anterior, intermediate and posterior plates.....*Parapenaeus fissurus* (Bate)

Branchiostegal spine a little behind anterior margin of carapace; 6th abdominal somite more than twice length of 5th; rostrum reaching distal end of 1st segment of antennular peduncle.....
.....*Parapenaeus investigatoris* Alcock & Anderson

41(21) Distomedian petasmal projection with fully developed or vestigial apical filament; thelycum of impregnated females usually with white conjoined pads.....42

Distomedian petasmal projection without apical filament; thelycum of impregnated females without white conjoined pads.....44

42(41) Rostrum wide and short, not reaching to distal end of basal antennular segment; thelycum with ovoid anterior and lateral plates of subequal size; conjoined pads usually set askew; apical filaments of petasma vestigial, represented by a pair of rounded bosses.....
.....*Metapenaeus lysianassa* (de Man)

Rostrum projecting beyond basal antennular segments, with a marked edentate distal portion.....43

43(42) Posterior part of rostrum with distinctly elevated crest; basial spine on male 3rd pereopod simple; apical petasmal filaments slender, slightly converging; thelycum with a large anterior and small lateral plates.....
.....*Metapenaeus brevicornis* (H. Milne Edwards)

Posterior part of rostrum without distinctly elevated crest; basial spine on male 3rd pereopod long and barbed; apical petasmal filaments not readily visible; anterior thelycal plate tongue-like
.....*Metapenaeus dobsoni* (Miers)

44(41) Branchiocardiac sulcus distinct in at least posterior 1/3 carapace; distomedian petasmal projections flap-like.....45

Branchiocardiac sulcus almost completely absent; distomedian petasmal projections anteriorly filiform, each with a serrate ventral margin.....*Metapenaeus stebbingi* (Nobili)

45(44) Ischial spine on 1st pereopod distinct.....46

Ischial spine on 1st pereopod small or absent.....50

46(45) Ischial spine subequal to basial spine; distomedian lobes having bluntly triangular apices with median margins parallel to each other; anterior thelycal plate tongue-like with raised lateral margins parallel; lateral plates flat.....*Metapenaeus krishnatrii* Silas & Muthu

Ischial spine much smaller than basial spine; anterior thelycal plate tongue-like.....47

47(46) Distomedian petasmal projections directed anteriorly; lateral thelycal plates with raised lateral ridges, each with a posterior inwardly curved triangular plate.....*Metapenaeus ensis* (de Haan)

Distomedian petasmal projections directed anterolaterally; anterior thelycal plate tongue-like.....48

48(47) Lateral thelycal plates with salient and parallel ear-shaped lateral ridges; distomedian petasmal projections hood-like.....
.....*Metapenaeus monoceros* (Fabricius)

Lateral thelycal plates without lateral raised ridges; distomedian petasmal projections not hood-like.....49

49(48) Posterior extension of the anterior median thelycal plate bound laterally by an oval flat plate on each side; distomedian petasmal projections overlying lateral projections and distally trilobed..... .....*Metapenaeus alcocki* George & Rao

Posterior extension of the anterior median thelycal plate not bound laterally by oval plate on either side; distomedian petasmal projections not overlying lateral projections..... .....*Metapenaeus kutchensis* George, George & Rao

50(45) Branchiocardiac carina feeble or ill-defined, anterior end not exceeding posterior 1/3 of carapace; distal margin of anterior thelycal plate convex to indistinctly triangular; petasma with laminose and strongly diverging distomedian projections..... .....*Metapenaeus burkenroadi* Kubo

Branchiocardiac carina distinct, extending from posterior margin of carapace almost to hepatic spine; anterior thelycal plate longitudinally grooved, wider posteriorly than anteriorly; distomedian petasmal projections crescent-shaped..... .....*Metapenaeus affinis* (Milne Edwards)

51(23) Epipodites present on 1st and 2nd pereopods.....52

Epipodites absent on 1st and 2nd pereopods; distolateral projections of petasma with sharp tips reaching coxae of 4th pereopods, anterolaterally with large wing-like flaps on outer curvature..... .....*Trachypenaeus pescadoreensis* Schmitt

52(51) The plates of thelycum with raised anterior and lateral margins... .....*Trachypenaeus sedili* Hall

The anterior plate of the thelycum may have a raised anterior margin but laterally the margins are not raised; an excavation present between the anterior plate and the transverse sternal ridge .....*Trachypenaeus curvirostris* (Stimpson)

53(23) Epipodites present on 1st and 2nd pereopods.....54
Epipodities absent on 1st and 2nd pereopods.....62

54(53) 2nd pereopods with basial spines.....55
2nd pereopods without basial spines..... .....*Parapenaeopsis uncta* Alcock

55(54) Telson with pair of fixed subapical spines; at least distal 1/2 free portion of rostrum unarmed.....56

Telson without fixed subapical spines, with or without lateral movable spines; 1/3 or less free portion of rostrum unarmed.....57

56(55) Petasma long with distolateral projections divergent; appendix masculina with distolateral projection.....
.....*Parapenaeopsis stylifera* (Milne Edwards)

Petasma smaller with distolateral projection less divergent; appendix masculina without distolateral projection.....
.....*Parapenaeopsis stylifera* var. *cochinensis* George

57(55) Petasma with a pair of long slender caliper-like distolateral projections directed forwards 58

Petasma with a pair of distolateral projections directed laterally or distolaterally, usually short and spout-like 59

58(57) 3rd pereopod of female with basial spine.....
.....*Parapenaeopsis maxillipedo* Alcock

3rd pereopod of female without basial spine.....
.....*Parapenaeopsis cornuta* (Kishinouye)

59(57) Postrostral carina reaching almost to posterior border of carapace; petasma with pair of short spout-like distolateral projections and pair of cap-like distal projections.....60

Postrostral carina reaching 3/4 carapace; petasma with pair of distolateral projections directed laterally, cap-like distal projections absent.....*Parapenaeopsis nana* (Alcock)

60(59) Antennular flagella 0.5-0.6 length of carapace; movable lateral spines absent on telson 61

Antennular flagella 0.7 length of carapace or longer; movable lateral spines present on telson.....
.....*Parapenaeopsis hardwickii* (Miers)

61(60) Distomedian projections of petasma small and parallel, directed anteriorly; anterior thelycal plate overlapped by posterior sternal plate.....*Parapenaeopsis indica* Muthu

Distomedian projections large and flare out laterally; anterior thelycal plate separated from the posterior sternal plate by a short intervening space.....*Parapenaeopsis sculptilis* (Heller)

62(53) Anterior plate of thelycum with V-shaped posterior edge and 2 accessory ridges on anterior edge of posterior plate; rostrum with proximal 1/3 rising from carapace; remainder more or less horizontal ..... *Parapenaeopsis tenella* (Bate)

..... b

Anterior plate of thelycum with a more or less straight transverse posterior edge; no accessory ridges on anterior edge of posterior plate; rostrum inclined upwards at an angle to carapace for whole of its length ..... *Parapenaeopsis acclivirostris* (Alcock)

ZOOGEOGRAPHY

In the distribution of the different species along the coasts of India, out of a total of 62 species only 4 are found in all parts of the coastline. Five species are reported from all regions except Andaman Sea. All the other species have restricted distribution in some region or the other which is dealt with in detail by George (1972).

A study of the Indo-Pacific distribution of the species reveals that the distribution of several of them has been extended in the Indo-Australian Archipelago. In the case of a number of species the areas which were suggested as areas of probable occurrence by Dall (1957) have been proved to be correct. It is found that *Penaeus monodon* is the most widely distributed species in the Indo-Pacific. A few other species belonging to this genus are also distributed in most of the areas.

Carrying out an analysis of the zoogeographic distribution of these prawns, George (1972) came to the conclusion that the Indian species are probably a western extension of the Indonesian fauna, based on the fact that more of the Indian species have an eastern distribution in the Indonesian waters than a western distribution in East African waters. But an examination of the paleogeographical aspects renders it difficult to accept this point of view. It is well known that during the glacial ages of the Pleistocene there was a lowering of the sea level and the Sunda shelf for something like one million years separated the littoral faunas of the eastern and western Indo-west Pacific. There existed a broad and solid barrier from Malaya almost to Australia, separating the faunas of the Indian Ocean and the Pacific. So if at all any extension of the Indonesian fauna has been brought about it must have been recent, probabaly of postglacial origin.

It is clear that no barrier exists at present in this region. Hall (1962) suggested the existence of a barrier at the Malaya Peninsula/Sumatra land mass restricting the distribution of Penaeidae. Based on the distribution of Ceylon Penaeidae De Bruin (1965) expressed doubt on the validity of Hall's hypothesis. In the distribution of brachyuran fauna in the Indo-Pacific region Chhapgar (1957) also did not come across any barriers between interconnecting oceans. Hall's hypothesis was mainly based on restricted distribution of a few species of prawns on either side of the Malacca Strait. The report of these species, considered by Hall to be of restricted distribution in the Malayan side of the barrier, from Indian waters (George, 1969a) points to the absence of such a barrier. Johnson (1967) studying

the biogeography of Malaysian marine decapoda as a whole did not come across the barrier suggested by Hall. However, he was of the opinion that there is an indication of a sub-regional boundary between the western Indian Ocean and the central Indo-west Pacific, with the west coast of India forming a transition zone between the two. On the ichthyofauna of the Indian Ocean and Red Sea, Klausewitz (1972) commented "for the classical descriptive zoogeography the faunal distinctions of the different parts of the Indian Ocean are not easily understandable as there does not seem to exist real geographical or ecological barriers along the coastlines." However, he found the ichthyofauna of the littoral zone of the Indian Ocean anything but a homogeneous zoogeographical unit, the eastern part till India and the Maldives being different from the western part. Jones and Kumaran (1971) also came to the same conclusion with reference to the ichthyofauna. It is interesting to note that in the distribution of penaeid prawn also the east and west coasts of India show some differences in the composition of species, probably brought about by the existence of the transition zone as envisaged by Johnson (1967) and others. The results of the geological studies carried out during the International Indian Ocean Expedition might throw more light on this problem.

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