Chapter 4

Penaeus

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Shrimps and prawns constitute a large group of crustaceans varying in size and are widely distributed in marine, brackish, and freshwater regions from the equator to the Polar Regions. Although the majority of the commercial marine species occupy shallow or moderately deep water areas along the continental shelves at depths of less than 100 m, some are found at depths of nearly 5700 m. Many shrimps are pelagic but the majority by far is benthic, living on a large variety of bottoms such as rock, mud, peat, and sand, fragments of shells or mixtures of these materials. Although there are about 4048 species of prawns known to date, they are subdivided into four major groups, namely Dendrobranchiata (68 species, 533 species), Stenopodidea (12 genera, 71 species), Caridea (389 genera, 3438 species) and Procarididea (2 genera, 6 species) (De Grave and Fransen, 2011). Although the carideans are a majority only a few are abundant enough to be of interest to fisheries. Most of the commercial prawns belong to the Penaeoidea; at present, only less than 300 species of prawns are of economic interest worldwide and of these only about 100 comprise the principal share of the annual world catch (Chan, 1998). The record of 418 species of prawns is a testimony to the high diversity of prawn fauna in Indian waters. The Carideans with 7 superfamilies and 11 families underneath has numerologically large number of species with only few with commercial potential (Radhakrishnan and Josileen, 2013). Most of the commercial species of prawns belong to the superfamily penaeoidea. Studies on penaeoids are more comprehensive and at present 5 families, 23 genera and 121 species (including the introduced species) are known to occur along the Indian coast including the Lakshadweep and Andaman and Nicobar Islands, with the penaeidae being the most important family (Radhakrishnan *et al*., 2011).

The terms “shrimp” and “prawn” have no definite reference to any known taxonomic groups. Although the term “shrimp” is sometimes applied to smaller species, while “prawn” is more often used for larger forms, there is no clear distinction between both terms and their usages is often confused or even reverse in different countries or regions (Chan, 1998). However, for uniformity the term **“prawn”** will be used throughout this text.

Systematic Position

Penaeoid prawn belongs to the largest phylum in the Animal Kingdom, the Arthropoda, characterized by jointed appendages and an exoskeleton or cuticle which is periodically molted. There are thousands of terrestrial species in this phylum, and large, predominately aquatic subphylum, the Crustacea. The more highly evolved crustaceans (Class Malacostraca) include the penaeid prawns (Order Decapoda). The class Malacostraca contains about three-fourths of the known species and includes crayfish, lobsters, shrimps and crabs (Bailey-Brock & Moss, 1992).

Prawns are included in the decapod suborder Dendrobranchiata, which are distinguished from other prawn-like Crustacea (the Caridea) and the remainder of the Decapoda by their gill structure and by not carrying the developing eggs on the pleopods of the abdomen. Decapods can be distinguished from other higher crustaceans by examining differences in the thoracic appendages. The first three pairs of thoracic appendages, the maxillipeds, are modified for feeding and the remaining five pairs are the walking legs, hence the name Decapoda or "ten-legs". Penaeid appendages typically consist of two branches (biramous), the exopodite and endopodite. These structures are variously developed for feeding, locomotion or burrowing; or they bear feathery gills (modified epipodites) contained beneath the carapace, or sensory structures on the antennae and antennules (Bailey-Brock & Moss, 1992). To study the different genera and species of the prawns, one must have knowledge on fundamentals of morphology, based on these characters, species are separated.

Classification

Phylum: Arthropoda
Sub phylum: Crustacea
Class: Malacostraca
Subclass: Eumalacostraca
Superorder: Eucarida
Order: Decapoda
Suborden: Dendrobranchiata
Superfamily: Penaeoidea

Most of the commercial species of prawns belong to the **superfamily Penaeoidea**, which is divided into families Solenoceridae, Benthescymidae, Aristeidae, Penaeidae and Sicyoniidae. Among them family **Penaeidae** comprises more species of commercial value prawns.

Superfamily PENAEOIDEA

Penaeoid shrimps

Diagnostic characters: Small to large sized, with a body length from 2.5 to about 35 cm. All 5 pairs of legs well developed, with **first 3 pairs of legs forming a pincer**, none of the pincers particularly large. Abdomen with **posterior part of pleura (lateral plates) covering anterior part of succeeding pleura**. **With large copulatory organ, on first pair of pleopods in males (petasma), and on posterior thoracic sternites in females (thelycum)**.Eggs are released directly into the water and not retained by the females on the abdomen.

Caridea:

Third leg always without pincer; **pleuron of second abdominal segment greatly expanded and overlapping those of first and third segments**; males and females without large copulatory organ on first pair of pleopods or posterior thoracic sternites, respectively; females carry the eggs on the abdomen until hatching.

Key to the families of Penaeoidea occurring in the area

1a. Either rostrum very short and armed with 1 or 2 upper teeth only, or upper antennular flagellum very short and attached to the base of distal antennular segment . . . . **Aristeidae**

1b. Rostrum always armed with more than 3 upper teeth, and both upper and lower antennular flagella of similar length and attached to the tip of antennular peduncle . .. . →

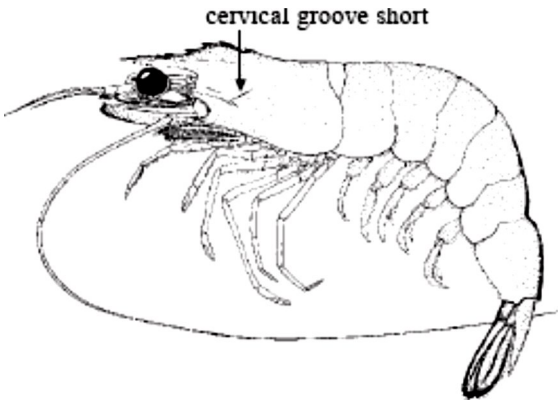
2a. Pleopods (abdominal appendages) with 1 branch only; abdomen often with many distinct furrows and grooves . . . . . **Sicyoniidae**

2b. Pleopods (abdominal appendages) with 2 branches; abdomen without or with very few distinct grooves . . . . . → ***3***

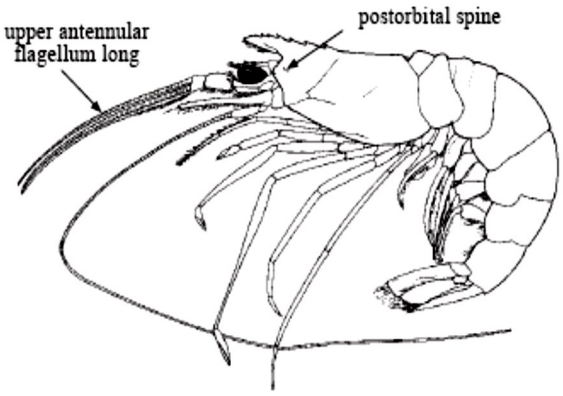
3a. Cervical groove prominent and extending to about dorsal carapace; either postorbital or postantennal spine present . . . . . **Solenoceridae**

3b. Distinct part of cervical groove far from dorsal carapace; postorbital and postantennal

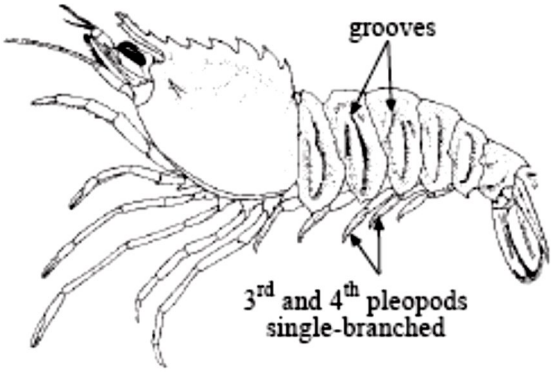
spine absent . . . . . **Penaeidae**



Penaeidae



Solenoceridae



Sicyoniidae

Aristeidae

Some of the important penaeid shrimps that support commercial fisheries along the Indian seas are *Fenneropenaeus indicus* (Indian white prawn), *Penaeus semisulcatus* (Green tiger prawn), *P. monodon* (Giant tiger prawn), *F. merguiensis* (Banana prawn), *Marsupenaeus japonicus* (Kuruma shrimp), *F. penicillatus* (Red-tail prawn), *Melicertus canaliculatus* (Witch Prawn), *M. latisulcatus* (Western king prawn), *Metapenaeus dobsoni* (flower-tail prawn), *M. monoceros* (Speckled prawn), *M. affinis* (Jinga prawn), *M. kutchensis* (Ginger shrimp), *M. brevicornis* (Yellow prawn), *Parapenaeopsis stylifera* (Kiddi prawn), *P. hardwickii* (Spear prawn), *P. sculptilis* (Rainbow prawn), *P. uncta* (Uncta prawn), *Trachysalambria curvirostris*

(Rough prawn), *Metapenaeopsis stridulans* (Fiddler shrimp), *Parapenaeus longipes* (Flaming prawn), *Solenocera crassicornis* (Coastal mud prawn) and *S. choprai* (Coastal mud prawn).

Penaeus general characters

- Body integument always glabrous.
- Rostrum toothed dorsally and ventrally
- Adrostral carina extending well back on to the carapace
- Carapace without longitudinal or transverse sutures
- Cervical and orbito-antennal sulci, antennal carina, hepatic and antennal spines, well defined and pterygostomial angle rounded.
- Antennular flagella shorter than the carapace.
- Petasma pod-like and flexible with thin median lobes, usually with small thickened distal protuberances and forming a posterior tube-like projection; lateral lobes usually with thickened distal rounded margins.
- Thelycum with anterior plate between the coxae of the 4th pereiopods variable in shape and smaller than the posterior part of the thelycum; seminal receptacle occupying the ventral surface of the last thoracic somite, usually closed by two flaps, or sometimes a single pocket, or sometimes open.

Revision of the genus *Penaeus*

Within the genus *Penaeus* there were 27 species and from the Table-1, it can be seen that 17 of the species names pre-dated the 20th century and 10 more were named thereafter, the most recent in 1967. During 1969-1972 the genus *Penaeus* was divided into sub-genera (Perez Fartante, 1969; Tirmizi, 1971; Burukovsky, 1972) based on few common morphological features (Fig.A). This had little effect on practitioners of shrimp industry or on the shrmp scientific community, since sub-genus names are rarely used in the commerce. However, in more recent monograph published in 1997 (Perez Fartante and Kensley, 1997) the generally accepted sub-genus names were elevated to the rank of genus. Flegel (2007), proposed a transitional, that included the sub-genus names in brackets between the genus *Penaeus* and the relevant species names, as recommended by the rules of the zoological nomenclature [e.g., *Penaeus*

(*Fenneropenaeus*) *chinensis*]. The reverse can not be done because *Penaeus* is not a sub-genus name and only viable option is to include a statement in brackets after the new binomial the first time it is mentioned [e.g., *Fenneropenaeus chinensis* (also called *Penaeus chinensis*].

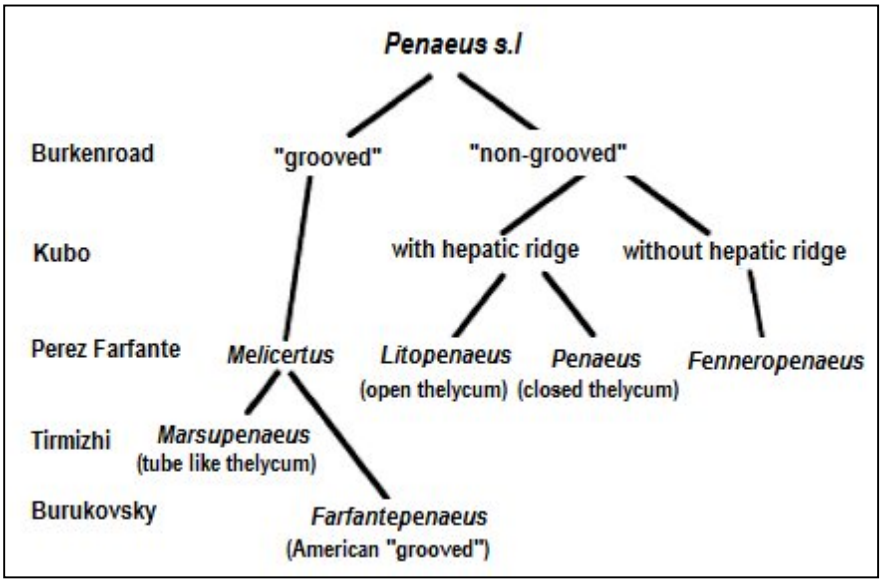


Figure A. History of penaeid shrimp division into sub-genera (after Lavery et al., 2004)

Table 1.Traditional species names for the penaeid shrimp together with their date of naming (Holthuis, 1980)

Genus	Sub-genus	Species	Authority	Year
Penaeus	*Farfantepenaeus*	*aztecus*	Ives	1891
		brasiliensis	Latreille	1817
		brevirostris	Kingsley	1878
		californiensis	Holmes	1900
		duorarum	Burkenroad	1939
		notialis	Pérez-Farfante	1967
		paulensis	Pérez-Farfante	1967
		subtilis	Pérez-Farfante	1967
	Fenneropenaeus	*chinensis*	(Osbeck)	1765
		indicus	H. Milne Edwards	1837
		merguiensis	De Man	1888
		penicillatus	Alcock	1905
	Litopenaeus	*occidentalis*	Streets	1871
		schmitti	Burkenroad	1936
		setiferus	(Linnaeus)	1767
		stylirostris	Stimpson	1874
		vannamei	Boone	1931
	Marsupenaeus	*japonicus*	Bate	1888
	Melicertus	*canaliculatus*	(Olivier)	1811
		kerathurus	(Forskål)	1775
		latisulcatus	Kishinouye	1896
		longistylus	Kubo	1943
		marginatus	Randall	1840
		plebejus	Hess	1865
	Penaeus	*esculentus*	Haswell	1879
		monodon	Fabricius	1798
		semisulcatus	De Haan	1844

Important species

***Penaeus* (*Fenneropenaeus*)** Pêrez Farfante, 1969

Penaeus (*Fenneropenaeus*) *indicus* (H. Milne Edwards, 1837 in Milne Edwards, 1834-1840)©

Penaeus (*Fenneropenaeus*) *merguiensis* (De Man, 1888a)©

Penaeus (*Fenneropenaeus*) *penicillatus* (Alcock, 1905)©

Penaeus (*Fenneropenaeus*) *silasi* (Muthu & Motoh, 1979 a)*

***Penaeus* (*Litopenaeus*)** Pérez Farfante, 1969

Penaeus (*Litopenaeus*) *vannamei* (Boone, 1931)®

***Penaeus* (*Marsupenaeus*)** Tirmizi, 1971

Penaeus (*Marsupenaeus*) *japonicus* (Bate, 1888)©

***Penaeus* (*Melicertus*)** Rafinesque, 1814

Penaeus (*Melicertus*) *canaliculatus* (Olivier, 1811)©

Penaeus (*Melicertus*) *latisulcatus* (Kishinouye, 1896)©

Penaeus Fabricius, 1798

Penaeus monodon Fabricius, 1798©

Penaeus semisulcatus De Haan, 1844©

© - Commercial; * - not common ® - Introduced for aquaculture

Key for commercially important *Penaeid* species

1. Rostrum with dorsal and ventral teeth Adrostral carina reaching almost to posterior margin of carapace; gastrofrontal carina present ……..….. 2
   Adrostral carina not reaching behind middle of carapace; gastrofrontal carina absent …4

2. Telson usually with 3 pairs of spinules ……..……3
   Telson without movable spines; rostrum with 1 ventral tooth and body with cross bands
   ……..……. ***Melicertus canaliculatus***

3. Adrostral sulcus narrower than post-rostral carina; Thelycum of females a well developed pouch, opened anteriorly, anterior plate rounded at the apex, anterior and posterior processes fused, forming a subtriangular concave plate. ……***Marsupenaeus japonicus***

   Adrostral sulcus as wide as post-rostral carina; anterior plate of thelycum bifid at the apex
   …… ***Melicertus latisulcatus***

4. Hepatic carina present ……..…… 5
   Hepatic carina absent …….. 6

5. Hepatic carina horizontally straight; fifth pereopod without exopodite……
   ……..…..***Penaeus monodon***

   Hepatic carina inclined at an angle of 20^0 anteroventrally; fifth pereopod with small exopodite ……..***Penaeus semisulcatus***

6. Gastro-orbital carina occupying posterior 2/3 distance between hepatic spine and orbital angle; rostral crest may be elevated but not triangular in profile

…… ***Fenneropenaeus indicus***

Gastro-orbital carina absent or not reaching hepatic spine, and occupying middle 1/3rd distance between hepatic spine and orbital angle…….. 7

7. Dactyl of third maxilliped of adult male ½ propodus; adrostral carina not reaching as far as epigastric tooth; rostral crest triangular in profile.

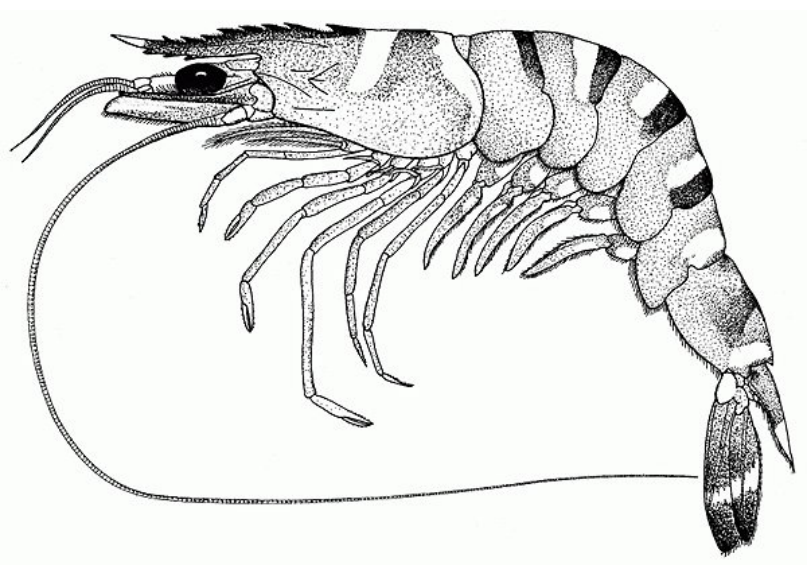
……. ***Fenneropenaeus merguiensis***

Dactyl of third maxilliped of adult male much longer than propodus; adostral carina Reaching just beyond epigastric tooth; rostral crest markedly elevated.

…… ***Fenneropenaeus penicillatus***

Description of the species

Penaeus monodon (Giant tiger prawn/ Black Tiger prawn)



Rostrum generally armed with 6 to 8 upper teeth (including those on carapace) and 3 lower teeth; postrostral crest well developed and reaching nearly to posterior margin of carapace, with or without a feeble median groove; adrostral crest extending to just before last postrostral tooth;

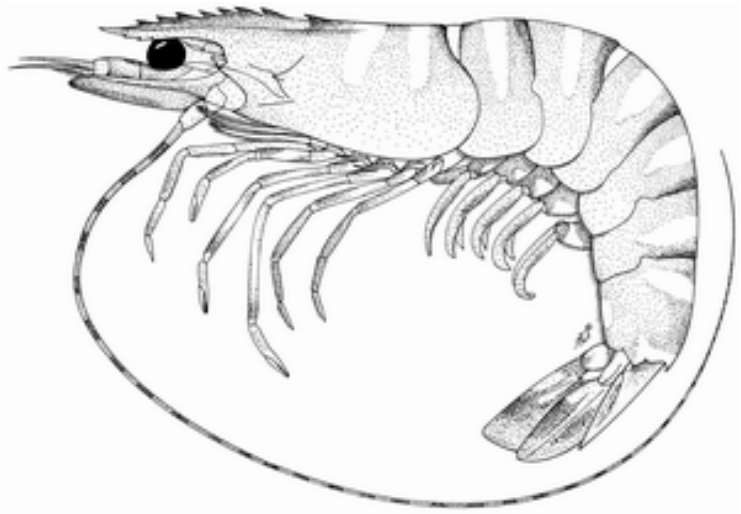
gastrofrontal crest absent; **hepatic crest almost horizontal** and extending far behind antennal crest. **Fifth pereiopod without exopod**.

Colour: body grayish greenish or dark greenish blue; becoming reddish brown in large adults; carapace covered with mud-yellow transverse bands, while abdomen bears dark brown and mud-yellow cross bands.

Distribution and fishery: Both east and west coasts of India and Andaman waters; depth upto 150m (usually less than 30 m); maximum size (TL) in females, 35cm; males 26.8 cm.

Penaeus semisulcatus *Penaeus monodon*

Penaeus semisulcatus (Green tiger prawn)

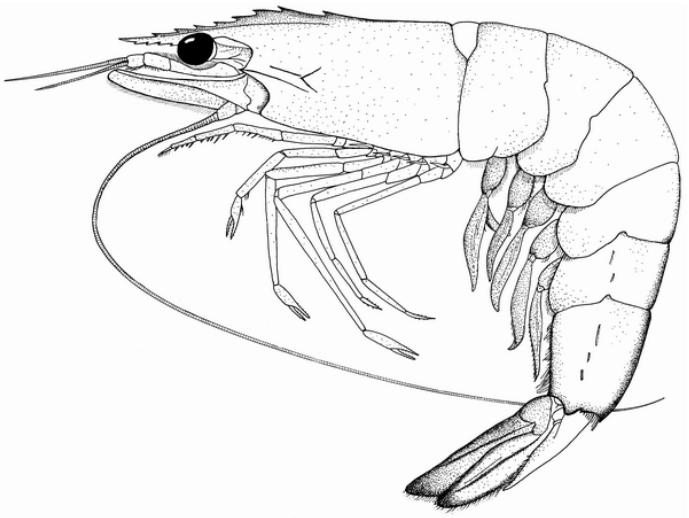


Rostrum generally armed with 6 to 8 upper teeth (including those on carapace) and 3 lower teeth; postrostral crest well developed and reaching nearly to posterior margin of carapace, with a distinct median groove; adrostral crest extending beyond last postrostral tooth; gastrofrontal crest absent; **hepatic crest long and extending behind antennal crest, straight but distinctly sloping antero- ventrally. Fifth leg with exopod (somewhat hidden beneath carapace).**

Colour: body reddish brown to pale brown or dark green, carapace covered with mud-yellow transverse bands while abdomen including tail fan bears grayish brown and mud- yellow cross bands.

Distribution and fishery: Both east and west coasts of India and Andaman waters; depth upto 130m; maximum size (TL) in females, 25cm; males 18cm (commonly between 13& 18 cm).

Penaeus (Fenneropenaeus) indicus (Indian white prawn)

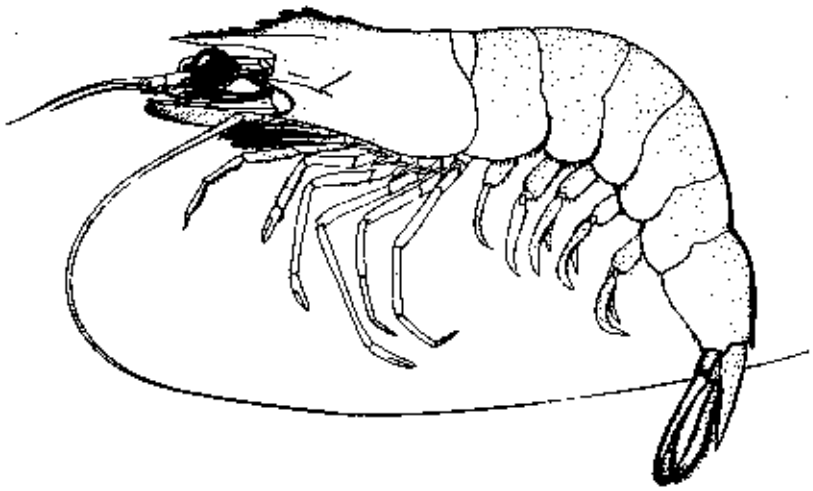


Carapace rather smooth, lacking gastrofrontal and hepatic crests; adrostral crest extending as far as or just before epigastric tooth; **rostrum slightly cruved at tip and sigmoidal-shaped,** usually bearing 7 to 9 upper teeth (including those on carapace) and 3 to 6 lower teeth. **Postrostral crest extending near to posterior margin of carapace**

Colour: Body semi-translucent, Somewhat yellowish white (small specimens) or grayish green and covered with numerous minute dark brown dots.

Distribution and fishery: Both east and west coasts of India and Andaman Islands; depth up to 9 0m (usually less than 30); maximum size (TL) in females, 23 cm; males, 18.4 cm.

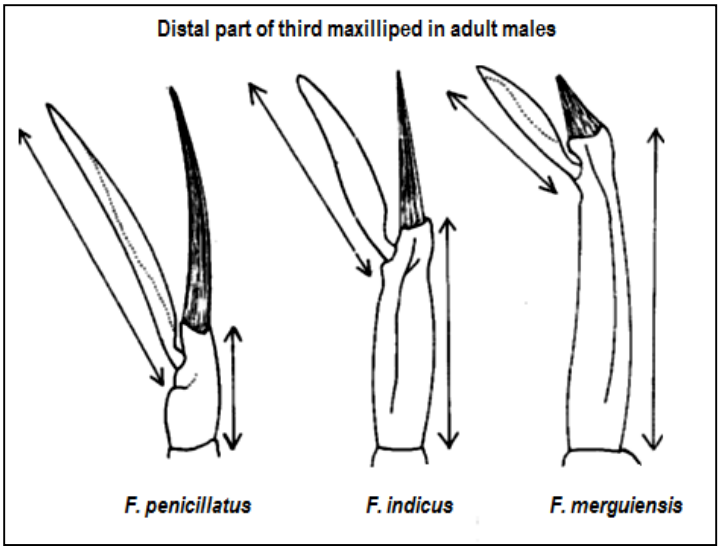
Penaeus (Fenneropenaeus) merguiensis (Banana prawn)



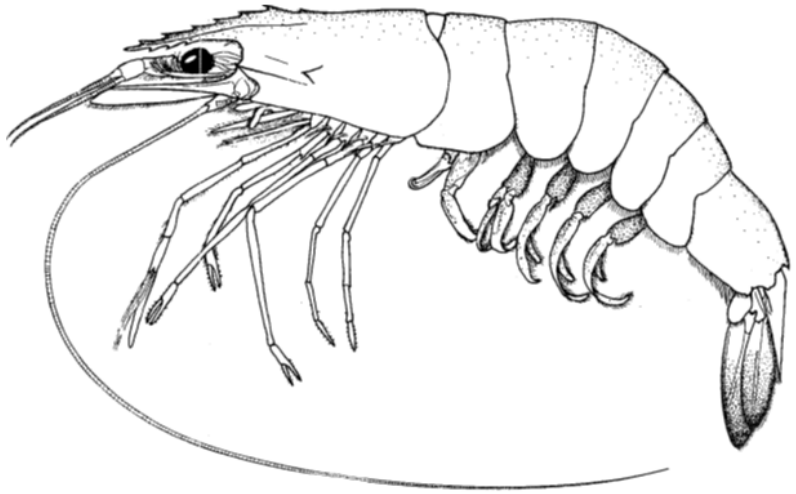
Carapace rather smooth, lacking gastrofrontal and hepatic crests; adrostral crest extending to, or just before, epigastric tooth; tip of rostrum horizontally straight, and **rostral crest becoming very high and broadly triangular in large specimens (even stronger in females),** generally bearing 6 to 9 upper teeth (including those on carapace) and mostly 3 to 5 lower teeth; postrostral rest extending near to posterior margin of carapace. In adult males, third maxilliped with distal segment only about half as long as second segment this bears **a tuft of dense short hairs** (slightly shorter than distal segment) at tip.

Colour: body semi- translucent, some- what yellowish to greenish (in very large specimens) and covered with numerous minute dark brown dots; distal part of uropods yellowish green with red margins; young specimens often with many longitudinal black broken lines on abdomen.

Distribution and fishery: Both east and west coasts of India; depth up to 150m (usually less than 30); maximum size (TL) in females, 35 cm; males, 26.3 cm.



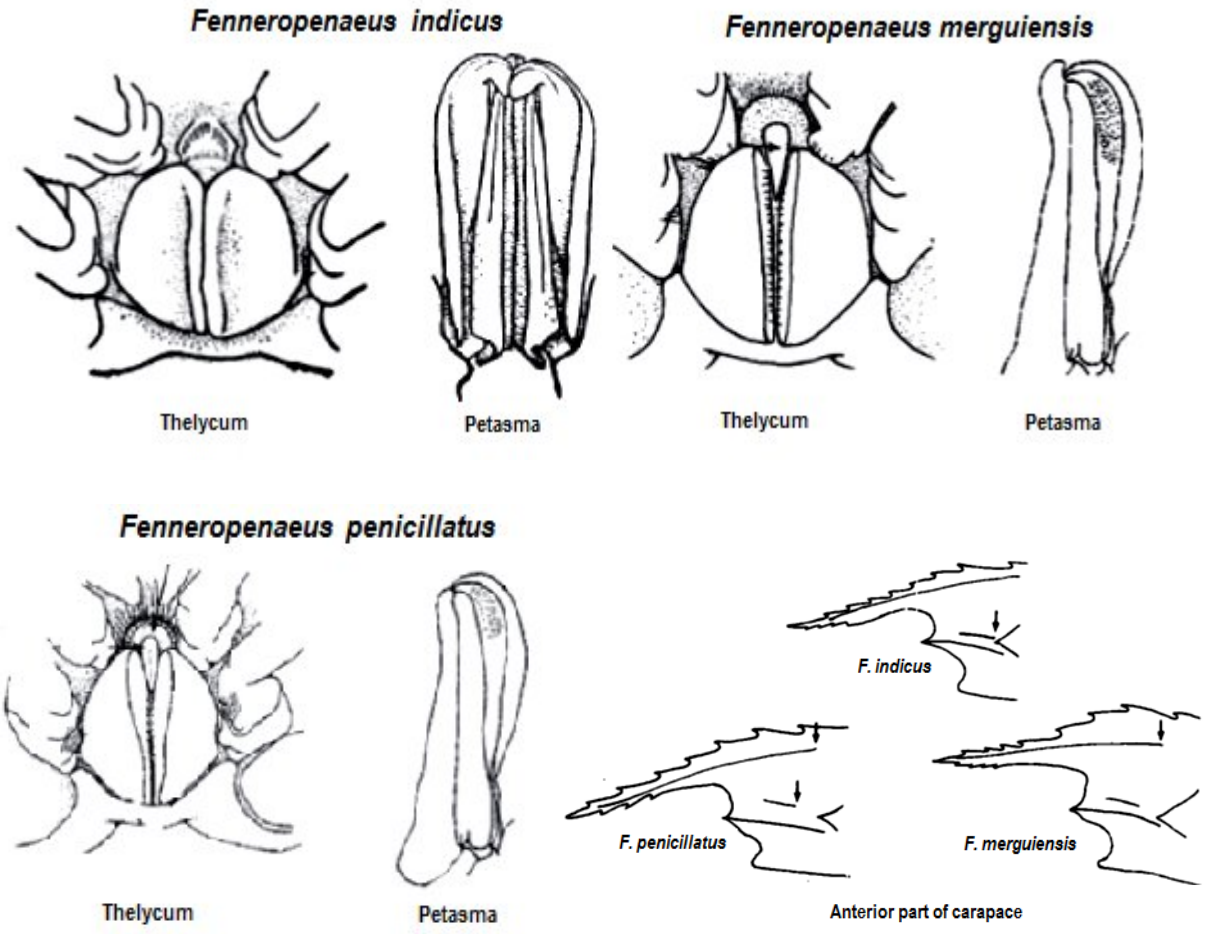
Penaeus (Fenneropenaeus) penicillatus (Red tail prawn)



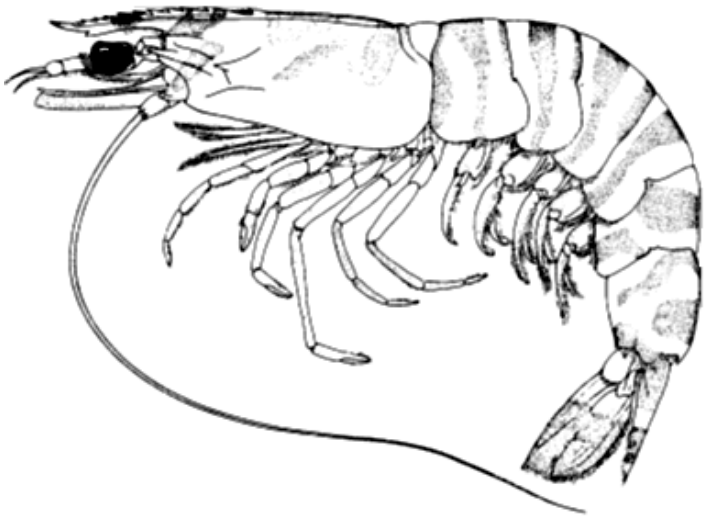
Carapace rather smooth, **lacking gastrofrontal and hepatic crests**; adrostral crest extending just beyond epigastric tooth; **tip of rostrum horizontally straight, and rostral crest generally slightly elevated in youngs and adult males, to moderately high in large females**; In **adult males,** third maxilliped with distal segment much longer than second segment which bears **a tuft of dense long hairs** (as long as distal segment) at tip.

Colour: body semi-translucent, slightly greenish and covered with numerous minute dark brown dots; rostral and abdominal dorsal crests reddish brown to dark brown; **antennal flagella reddish brown**; legs translucent and somewhat whitish; pleopods rather reddish; **distal half of uropods yellowish to greenish but always with reddish tips.**

Distribution and fishery: Gujarat,Maharashtra, Orissa and West Bengal,; depth upto 90 m; maximum size (TL) in females, 21.2 cm; males, 16.3 cm (commonly between 10 & 16cm).



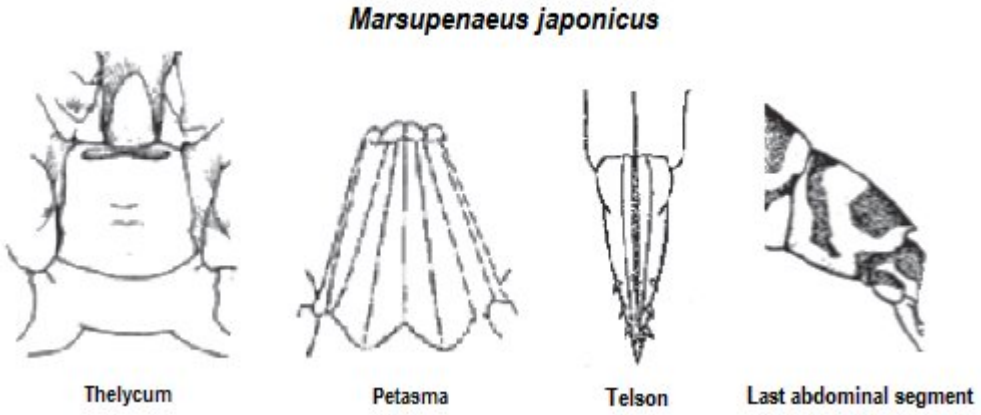
Penaeus (Marsupenaeus) japonicus (Kuruma prawn)



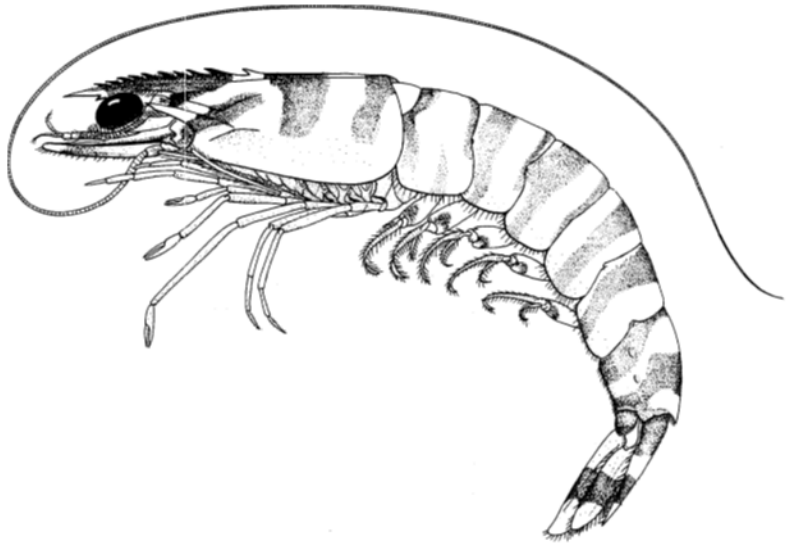
Carapace with grooves and crests very distinct, bearing both gastrofrontal and hepatic crests; **rostrum generally armed with 9 or 10 upper teeth (including those on carapace) and 1 lower tooth,** postrostral crest well developed and with a deep median groove throughout its length; adrostral groove extending near to posterior margin of carapace and almost as wide as postrostral crest; **Telson with 3 pairs of movable lateral spines.**

Colour: body pale yellowish and crossed with dark brown transverse bands; those on carapace generally extending to lower half of carapace, **last abdominal band interrupted**.

Distribution and fishery: Gujarat, Tamil Nadu, West Bengal, Maharashtra; depth upto 90m (usually less than 50); maximum size (TL) in females, 30 cm; males, 20 cm.



Penaeus (Melicertus) canaliculatus (Witch Prawn)

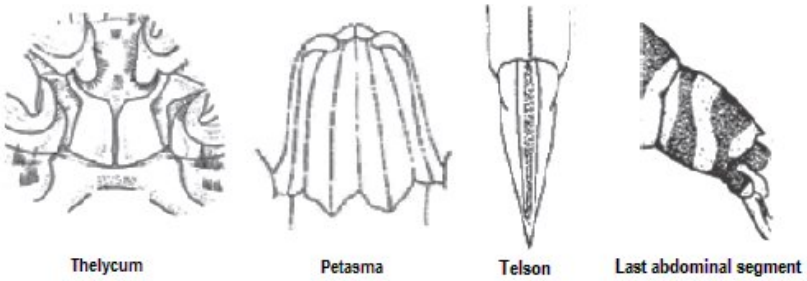


Carapace with grooves and crests very distinct, bearing both gastrofrontal and hepatic crests; rostrum armed with 10 or 11 upper teeth (including those on carapace) and 1 lower tooth; postrosral crest well developed and with a deep median groove throughout its length; adrostral groove extending almost to posterior margin of carapace and slightly wider than postrostral crest; First leg without ischial spine. **Telson without lateral spines**.

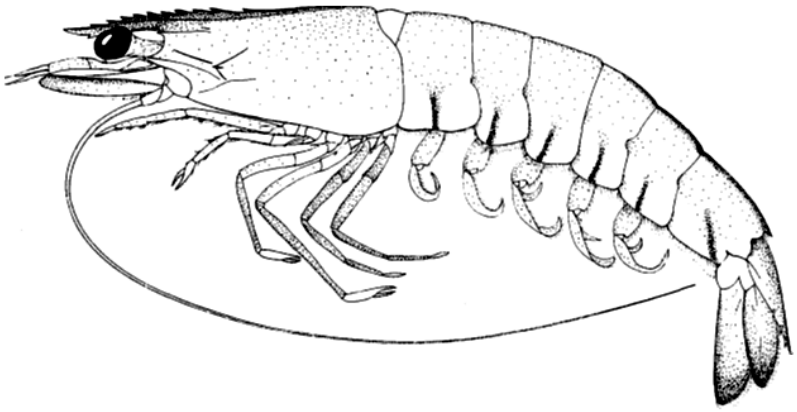
Colour: body pale yellowish and crossed with dark brown **transverse bands**; those on carapace note extending over lower half of carapace **while those on last abdominal segment usually continuous to the ventral margin.**

Distribution and fishery: Gujarat, Orissa, West Bengal, Maharashtra, Tamil Nadu, Kerala, Andaman and Nicobar Islands & Lakshadweep; depth upto 50 m; maximum size (TL) in females, 18.2 cm; males, 14.5 cm.

Melicertus canaliculatus



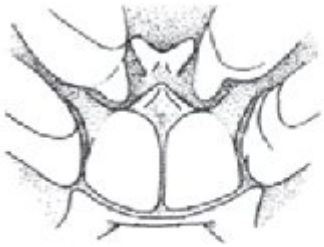
Penaeus (Melicertus) latisulcatus **(**Western king prawn)



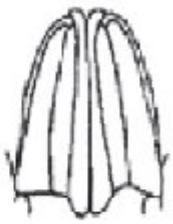
Carapace with grooves and crests very distinct, bearing both gastrofrontal and hepatic crests; rostrum generally armed with 10 or 11 upper teeth (including those on carapace) and 1 lower tooth, lacking distinct accessory crest on the blade; postrostral crest well developed and with a deep median groove throughout its length; adrostral groove extending almost to posterior margin of carapace and distinctly wider than postrostral crest; posterior end of gastrofrontal groove divided into 2. **Telson with 3 pairs of movable lateral spines.**

Colour: body generally yellowish green, becoming slightly reddish inlarge adults; **abdominal segments each with a short vertical black bar on pleuron; hinges on abdomen often bearing dark brown spots** and posterolateral part of carapace also sometimes with 2 black stripes positioned at a right angle.; uropods bright yellow, with distal half and outer margins of exopods bright blue, other margins reddish.

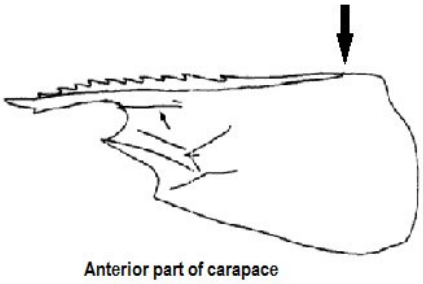
Distribution and fishery: Gujarat, tamil Nadu, Kerala, Andaman and Nicobar Islands & Lakshadweep; depth upto 90m; maximum size (TL) in females, 20.2 cm; males, 16.2 cm (commonly between 10&16 cm).



Thelycum

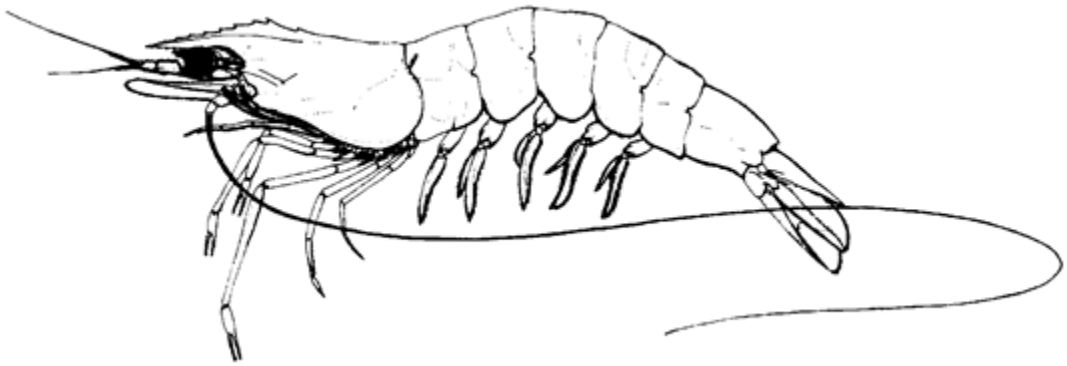


Petasma

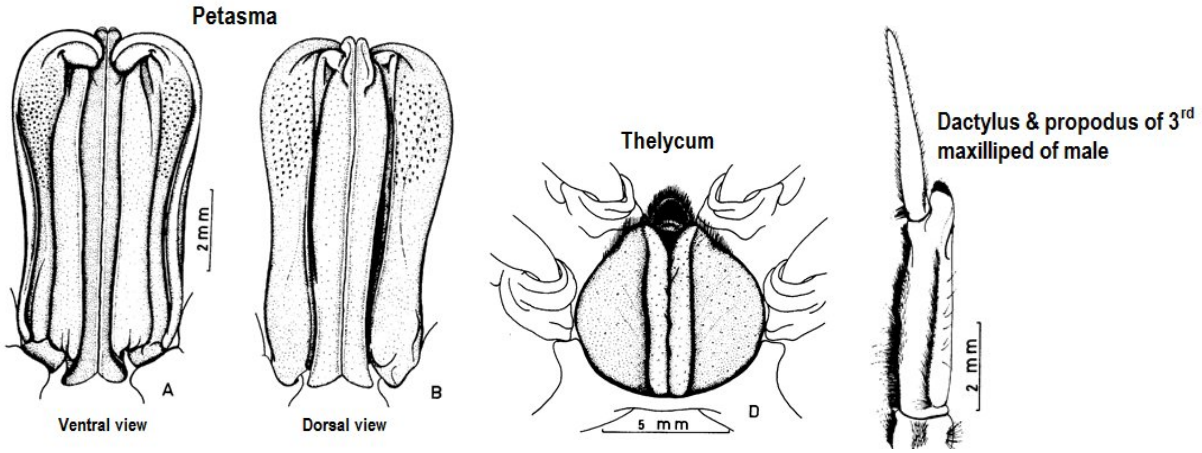


Anterior part of carapace

Penaeus (Fenneropenaeus) silasi



Rostrum almost straight, reaching or slightly exceeding tip of antennular peduncle, sometimes reaching only tip of second segment, with low rostral creast in males and higher crest in large females almost approaching the condition in *P.(F). merguiensis*. Rostral teeth 1+ 6-8/4-5. Adrostral carina and sulcus reaching just behind epigastric. Carapace glabrous. Gastrorbital carina well defined occupying posterior 2/3rd distance between hepatic spine and the postorbital margin; hepatic carina absent. Petasma with median distal projections not overhanging lateral lobes when seen from side. Distal margin of the lateral laobe minutely serrae, outer surface of lateral lobe with a patch of minute conical teeth.



The species is closely related with *P.(F). indicus, P .(F).merguiensis* and *P.(F). penicillatus* and characterized by features in the 3rd maxilliped and thelycum. The 3rd maxilliped

in adult male has dactylus as long as or slightly shorter than the propodus, dactylus narrower than propodus which has only a rudimentary (conical) tuft of hairs instead of a long tuft of bristles as in *P.(F). indicus*. In females the anterior plate of the thelycum is triangular with rounded apex and relatively prominent (Muthu and Motoh, 1979).

LIFE CYCLE

Based on their mode of life, penaeid shrimps can be grouped into wandering and burrowing groups.

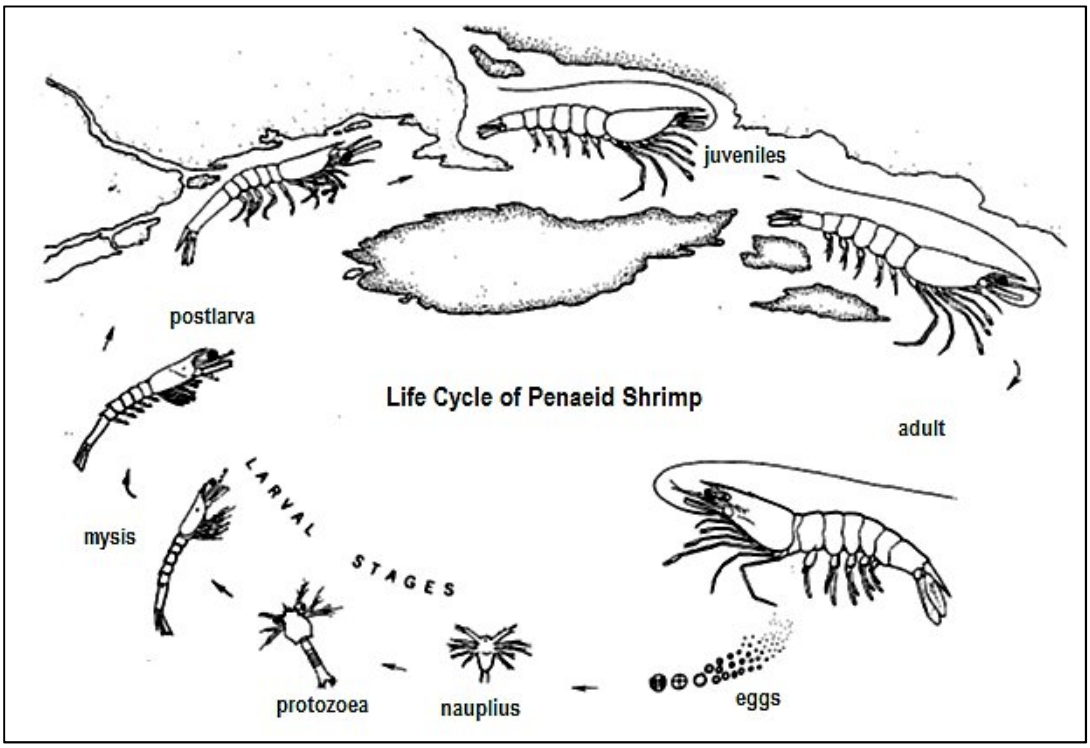
Wandering group

Species belonging to this category have pronounced age groups, from dense schools and are always on the move and active day and night. They prefer turbid waters with soft mud bottom, burrowing slightly or not at all into the substrates. A typical wandering species, *P. orientalis* in the Yellow Sea migrates southward for over wintering and northward in spring to its spawning ground. The distance between the areas for overwintering and spawning is approximately 700–1300 km. Other species belonging to this group are *P. setiferus* of the Atlantic coast, *Fenneropenaeus merguiensis* and *F. indicus* of the Southeast Asian region. These tropical species however, do not need overwintering. *F. merguiensis* and *F. indicus* generally spawn at a depth of 7–30 meters in offshore waters, usually near the nursery ground. The larvae spend part of their life cycle in nursery ground until adolescent stage when they start migrating to deeper and more saline waters. Since *F. merguiensis, F. indicus* and other wandering type of penaeid shrimps from dense schools, fishermen can easily collect large number of spawners during peak seasons.

Burrowing groups

This group prefers certain habitats with sandy bottom. They do not have pronounced age groups. They show marked nocturnal activity, burrowing into the bottom substratum during the day and emerging at night to search for food. This diurnal activity is closely associated with changes in light intensity but may also be due to other factors. Examples of this group are *Marsupenaeus japonicus* in the Japanese coast, *P. dourarum* off Florida and *P. monodon* in Southeast Asia.

Life cycle of the shrimps is completed after passing through two distinct environments - the sea and the estuary. The larval development takes place in the sea, and the migration into the estuaries, lakes and backwaters commences when they are in late mysis or early postlarval stages. They then migrate to deeper water when they become adolescent and finally move to spawning grounds upon becoming adults.



Sexuality

Shrimps are Bisexual. Sexes can be distinguished by external characters such as the presence of morphologically differentiated male and female sex organs. While the male sex organ, petasma, is abdominal in position, being the endopodite of the first pleopod, the female sex organ, thelycum, is a modification of the thoracic sternite. The presence of an appendix masculina on the endopod of the second pair of pleopods is another male character. While the genital openings of the male are situated on the coxa of the fifth pair of pereiopods those of the female are on the coxa of the third pair of pereiopods.

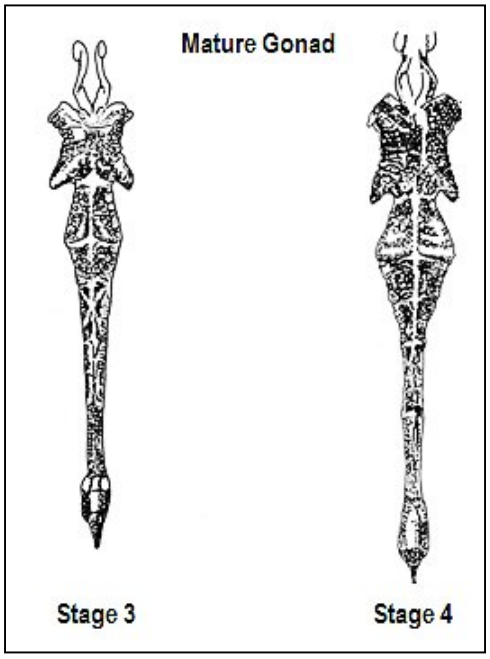
The thelycum is on the ventral side of the cephalothorax and between 4th and 5th walking legs and oviducts open at the base of the 3rd pair of walking legs. The ovary is found on the

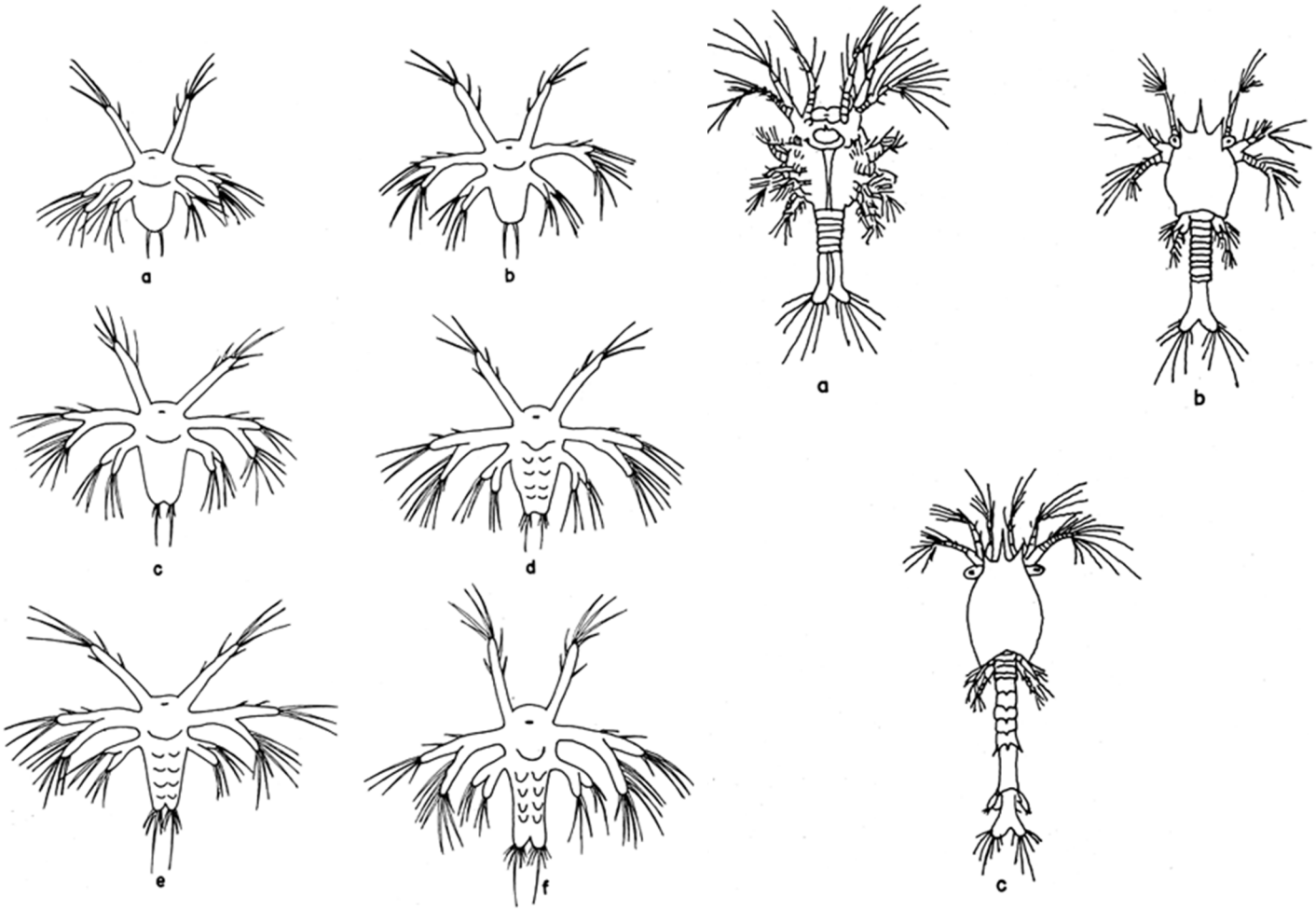
dorsal side of the animal along the entire length. In a fully ripe female ready to spawn, the ovary is dark oive green in colour ans has a lateral expansion in the first abdominal segment.

In males, the petasma is attached to the ventral side of the first pair of swimming legs, which is a modified part of first pair of swimming legs. The two sperm ducts from the testis open at the base of the 5th pair of walking legs. The terminal portion of the sperm duct is enlarged to form the terminal ampoule in which the the spermatophore or sperm packet is stored. It is visible as a white mass at the base of the 5th pair of walking legs in mature males. Females attain relatively larger sizes than males.

Mating and Fertilization

Mating takes place soon after the female moults, when it is still in the soft condition. During mating the sperm packs known as spermatheca are deposited by the male in the external genitalia of the female. In mated females it can be seen as a whitish mass below the translucent cuticle of the thelycum. The females carry the spermatheca during the entire intermoult period and sperms remain viable throughout the period. The sperms are dispensed at the time of spawning. Fertilization is external. As the eggs are extruded from the genital openings of the female the sperms are dispensed from the spermatheca.





NAUPLIUS STAGES

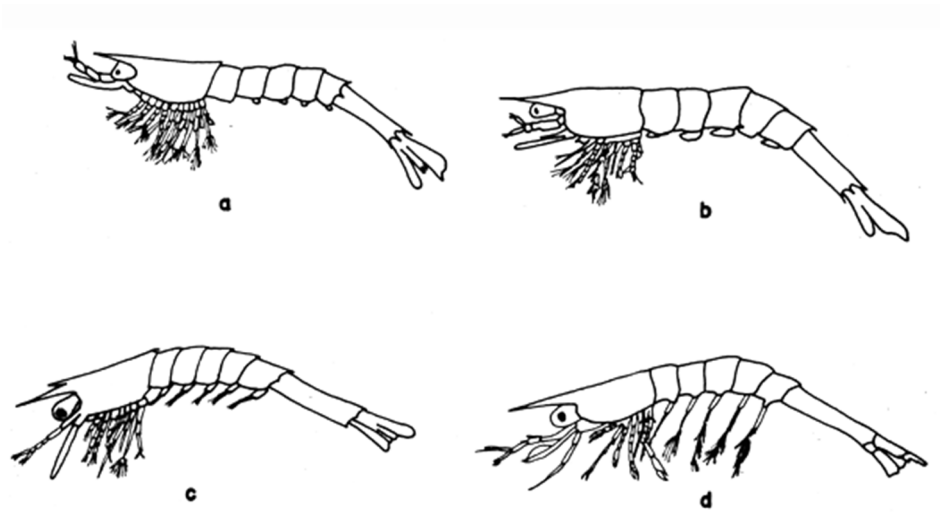
PROTOZOEAL STAGES

a. Nauplius I b. Nauplius II

c. Nauplius III d. Nauplius IV

e. Nauplius V f. Nauplius VI

a. Protozoea 1
b. Protozoea 2
c. Protozoea 3



Mysis and post larval stages

a. Mysis 1
b. Mysis 2
c. Mysis 3
d. Postlarvae 1

At post larval stages the pleopods become fully developed and functional. The animals grow very fast in terms of size and are able to swim freely although early postlarvae are still planktonic in offshore waters. At a body size of 0.8–1 cm in body length, they enter estuaries and inshore shore waters where they first adopt a benthic existence. The shrimps spend their juvenile, adolescent and sub-adult stages in estuarine waters and then gradually move toward deeper water as they grow and eventually returning to offshore water when they attain sexual maturity.

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Editorial

Use of the generic name *Penaeus*

The editors wish to draw to the attention of authors to the publication in this issue of Aquaculture of a paper by T.W. Flegel entitled "The right to refuse revision in the genus *Penaeus*". This paper discusses the effects of the publication by Pérez Farfante and Kensley (1997) of a monograph of shrimps and prawns of the world which included a proposed taxonomic revision raising former sub-genera in the genus *Penaeus* to generic rank.

The editors of Aquaculture have for some time felt that this revision had resulted in some confusion with some authors and journals using the new binomials of Pérez Farfante and Kensley (1997) and others remaining with the traditional *Penaeus* binomials.

The editors are in agreement with the arguments put forward in T.W. Flegel's paper and have agreed that Aquaculture will prefer that authors of future submissions to this journal that concern species of Penaeid shrimp use the generic epithet *Penaeus*, preferably qualified at the first mention by Flegel's proposal, namely to follow the rules of zoological nomenclature by placing the sub-genus names in brackets between the traditional genus name *Penaeus* and the relevant species name at first mention [e.g., *Penaeus* (*Fenneropenaeus*) *chinensis*].

The editors do not however wish to be "coercive" in this matter and so authors who feel strongly supportive of the revised Pérez Farfante and Kensley (1997) generic names should use Flegel's alternative at the first mention of the genus to indicate that another name is also used [e.g., *Fenneropenaeus chinensis* (also called *Penaeus chinensis*)].

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