

PROCEEDINGS OF THE WORLD SCIENTIFIC CONFERENCE  
ON THE BIOLOGY AND CULTURE OF SHRIMPS AND PRAWNS

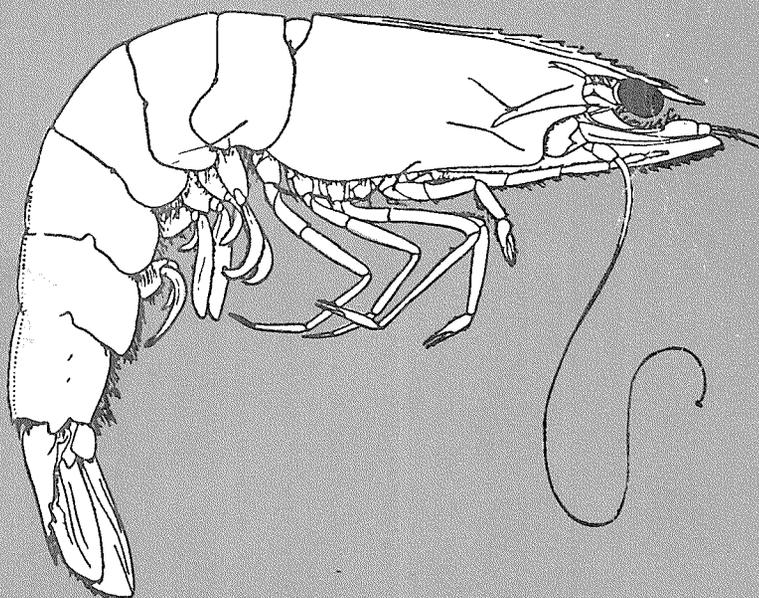
ACTES DE LA CONFÉRENCE SCIENTIFIQUE MONDIALE  
SUR LA BIOLOGIE ET L'ÉLEVAGE DES CREVETTES

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SYNOPSIS OF BIOLOGICAL DATA ON THE PENAEID PRAWN

Metapenaeus monoceros (Fabricius, 1798)

Exposé synoptique sur la biologie de  
Metapenaeus monoceros (Fabricius, 1798)

Sinopsis sobre la biología del  
Metapenaeus monoceros (Fabricius, 1798)

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<sup>1/</sup> This synopsis has been prepared according to Outline Version No. 1 (H. Rosa, Jr., FAO Fish. Synops., (1) Rev.1, 1965).

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\* As no information was available to the author, these items have been omitted from the text.

1 IDENTITY

1.1 Taxonomy

1.1.1 Definition

Phylum Arthropoda  
 Class Crustacea  
 Subclass Malacostraca  
 Series Eumalacostraca  
 Superorder Eucarida  
 Order Decapoda  
 Suborder Natantia  
 Section Penaeidea  
 Family Penaeidae  
 Subfamily Penaeinae  
 Genus Metapenaeus Wood-Mason,  
 1891  
 Species Metapenaeus monoceros  
 (Fabricius, 1798)

1.1.2 Description

Generic

Genus Metapenaeus Wood-Mason, in Wood-Mason and Alcock, 1891, Ann.Mag.nat.Hist., (6) 8:271. Type species by original designation: Penaeus affinis H. Milne Edwards, 1837. Gender: masculine.

A detailed description of the genus is given in the Species Synopsis on Metapenaeus affinis by George (1970). The following characters distinguish it from other genera of the Penaeinae.

Rostrum with dorsal teeth only. Carapace without longitudinal or transverse sutures or lateral keels. Dorsal keel on 4th-6th abdominal segments; lateral keels on 6th segment discontinuous and inconspicuous. Telson grooved, not trifid. No exopod on 3rd maxilliped or 5th pereopod.

Specific

Metapenaeus monoceros (Fabricius, 1798)

The type material cannot be traced and must be considered lost.

Type locality: "In Oceano Indico", (probably near Tranquebar, S. India).

The following description is adapted from Alcock (1906).

Body covered with stiff, very short tomentum. Rostrum nearly straight, uptilted, reaching nearly to, or a little beyond, tip of antennular peduncle; armed dorsally with 9 to 12 teeth. Postrostral crest continued to, or almost to, posterior border of carapace. Anterolateral angles of carapace broadly rounded off. Very small postocular (orbital) tooth. Postantennular (antennal) spine strong, produced as ridge to base of small hepatic spine; ridge bounding well marked postantennular groove which meets cervical groove. Gastric region defined anteriorly by short oblique

postorbital groove. Branchial region defined (i) anteriorly, by deep and narrow crescentic groove (anterior part of cervical groove) which embraces base of postantennular ridge and meets postantennular groove, (ii) superiorly, by sinuous ridge which is most distinct in posterior half and runs from hepatic spine almost to posterior border of carapace.

Dorsal carina on 2nd to 6th abdominal terga, usually 1st also, blunt and inconspicuous on (1st) 2nd and 3rd, very sharp on 4th to 6th. Fifth abdominal somite about two-thirds length of 6th, 6th a little shorter than telson. Telson shorter than endopod of uropod; without marginal spines.

Eyes very large, slightly surpassed by antennal scale. Outer (upper) antennular flagellum slightly longer than inner, not much more than half length of peduncle.

Third maxillipeds barely reach middle of antennal scale: dactylus in male not modified, consists of slender, setose, tapering joint, about four-fifths length of propodus. Strong anterior spine on basis of each cheliped. Last pair of thoracic legs of adult male with proximal end of merus notched on outer side, notch deepened anteriorly by large hook-like spine, and posteriorly by subterminal lobule on posterior border of ischium. Edge of merus finely denticulate beyond spine. Three terminal joints of 5th legs slender in both sexes, the dactylus rarely reaches much beyond middle of antennal scale. No exopods on the 5th legs. (Fig. 1).

Petasma symmetrical, consists of 2 rigid segments tightly folded longitudinally, interlocked all along anterior margins, in close apposition along most of posterior margins, forming compressed tube; tube ends distally in pair of large gargoyles with posterior lips convoluted like mouth of personate corolla (Fig. 2).

Thelycum concave, bounded laterally by pair of ear-like lobes with free edge often incurved, bounded anteriorly by median projecting tongue embedded between 2 lobes of sternum corresponding with penultimate pair of legs (Fig.3).

Semitransparent, closely covered with small red chromatophores; dorsal carina of carapace, rostrum, bases of eyestalks, dorsal abdominal carinae and carinae of telson and uropods dull red; antennae bright red; first 2 legs colourless; last 3 legs with numerous red chromatophores; setae of uropods golden red; outer uropod bright red along external margin (Kemp, 1915). According to Ahmad (1957), body is flesh-coloured with pigment sparsely distributed, thickly covered with brown dots; spots also present on flagella

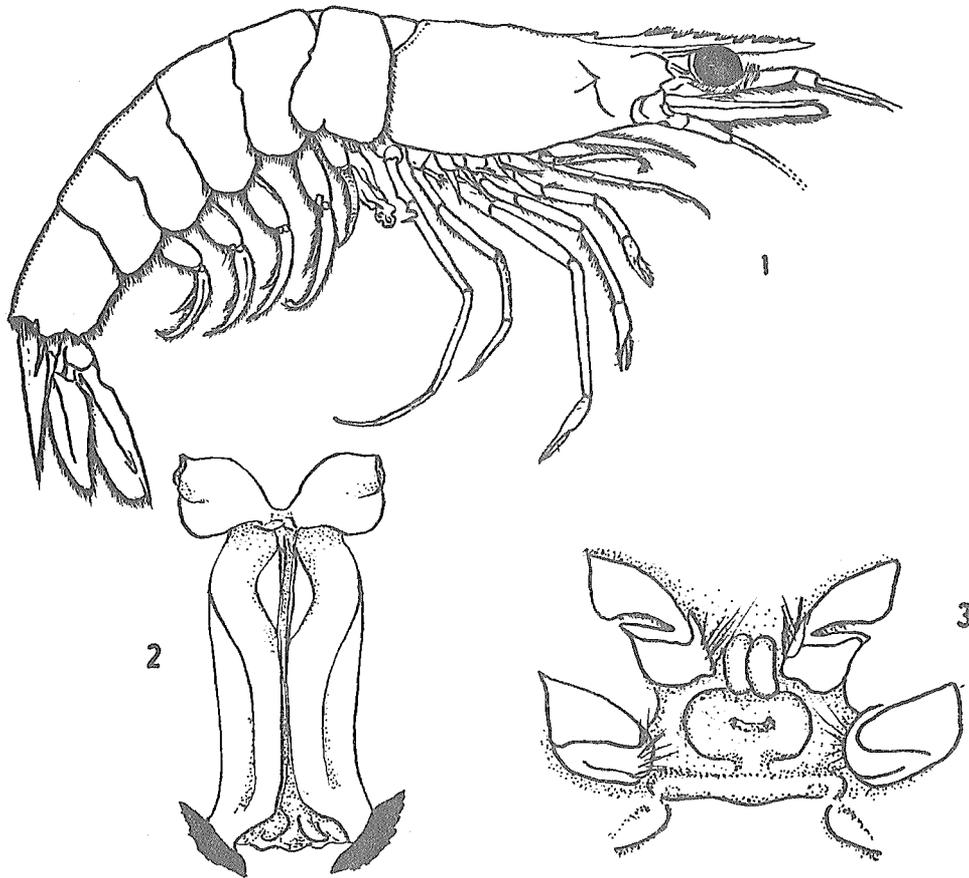


Fig. 1 *Metapenaeus monoceros*, adult male, lateral view.

Fig. 2 Petasma of adult male.

Fig. 3 Thelycum of adult female.

and thoracic legs. Joubert (1965) described body as white, covered with dark brown speckles.

Artificial key to the species of Meta-peneaus. (Modified from Racek and Dall (1965))

- 1 Telson armed with 3 or 4 pairs of conspicuous spines.....2
- Telson armed with a single row of very minute mobile spinules, with or without 1-2 pairs of somewhat larger distal spines.....4
- 2 (1) Three pairs of subequal telsonic spines; rostrum straight, teeth extending to its apex.....3
- Four pairs of telsonic spines, progressively increasing in size posteriorly; rostrum sigmoidal, anterior half edentate, styliform.....M.macleayi (Haswell)
- 3 (2) Branchial region with small pubescent areas; coxal projection of Q 4th pereopod long and curved, dagger-like; thelycum with rounded median boss posterior to lateral plates; distomedian petasmal projections without an anterolateral spinous process.....
- .....M.intermedius (Kishinouye)
- Branchial region with 2 large pubescent areas; coxal projection of Q 4th pereopod a straight conical spine; thelycum without a rounded boss posterior to lateral plates; distomedian petasmal projections with a distinct anterolateral spinous process...M.endeavouri (Schmitt)
- 4 (1) Distomedian petasmal projection with fully developed or vestigial apical filament; thelycum of impregnated females usually with white conjoined pads.....5
- Distomedian petasmal projection without apical filament; thelycum of impregnated females without white conjoined pads...9
- 5 (4) 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 petasme vestigial, represented by a pair of rounded bosses...M.lysianassa (de Man)
- Rostrum projecting beyond basal antennular segment, with a marked edentate distal portion.....6
- 6 (5) Posterior part of rostrum with distinctly elevated crest; basal spine on Q 3rd pereopod simple.....7
- Posterior part of rostrum without distinctly elevated crest; basal spine on Q 3rd pereopod long and barbed.....8
- 7 (6) Ischial spine on 1st pereopod subequal to basal spine; telson usually with 1

- distal pair of slightly larger spinules; distolateral petasmal projections directed outwards; apical filaments of distomedian projections slender, slightly converging; thelycum with a large anterior and small lateral plates.....
- .....M.brevicornis (H.Milne Edwards)
- Ischial spine on 1st pereopod much smaller than basal spine; telson usually with 2 distal pairs of slightly larger spinules; distolateral petasmal projections pointing anteriorly; apical filaments of distomedian projections lobe-like; thelycum with a small anterior and very large lateral plates.....
- .....M.tenuipes Kubo(M.spinulatus Kubo)
- 8 (6) Apical petasmal filaments not readily visible; anterior thelycal plate tongue-like.....M.dobsoni (Miers)
- Apical petasmal filaments large and lobe-like, curved dorsally; anterior thelycal plate styliform.....M.joyneri (Miers)
- 9 (4) Branchiocardiac sulcus distinct in at least posterior 1/3 carapace; distomedian petasmal projections flap-like.....10
- Branchiocardiac sulcus almost completely absent; distomedian petasmal projections anteriorly filiform, each with a serrate ventral margin.....M.stebbingi (Nobili)
- 10 (9) Ischial spine on 1st pereopod distinct .....11
- Ischial spine on 1st pereopod small or absent.....15
- 11(10) Ischial spine subequal to basal spine; petasmal apices turned at 30° towards midline, semicircular; anterior thelycal plate spoon-like; lateral plates with raised ventral ridges, each with anterolateral and posteromedian spinous process.....M.suluensis Racek and Dall
- Ischial spine much smaller than basal spine; lateral thelycal plates without spinous processes.....12
- 12(11) Distomedian petasmal projections directed anteriorly; lateral thelycal plates with raised lateral ridges, each with a posterior inwardly-curved triangular plate.....M.ensis(de Haan)(=M.mastersii(Haswell) = M.incisipes(Bate))
- Distomedian petasmal projections directed anterolaterally; anterior thelycal plate tongue-like.....13
- 13(12) Lateral thelycal plates with salient and parallel earshaped lateral ridges; distomedian petasmal projections hood-like .....M.monoceros (Fabricius)
- Lateral thelycal plates without lateral raised ridges; distomedian petasmal projections not hood-like.....14

- 14 (13) Posterior extension of anterior median thelycal plate bound laterally by an oval flat plate on each side; distomedian petasmal projections overlying lateral projections and distally trilobed.....M.alcocki George and Rao  
Posterior extension of anterior median thelycal plate not bound laterally by oval plate on either side; distomedian petasmal projections not overlying lateral projections.....  
...M.kutchensis George, George and Rao
- 15 (10) Ischial spine minute and blunt.....16  
Ischial spine absent.....19
- 16 (15) Rostral teeth more or less evenly spaced; thelycal structure posteriorly open.....17  
Rostral teeth unevenly spaced, anterior 2 teeth separated from each other and from the rostral apex by a much wider space; thelycal structure posteriorly closed.....M.demani (Roux)
- 17 (16) Distomedian petasmal projections not superficially separated into 2 lobes, almost completely overlying distolateral projections; lateral thelycal plates kidney-shaped, with strongly raised ventrolateral ridges.....  
.....M.conjunctus Racek and Dall  
Distomedian petasmal projections more or less superficially separated into 2 lobes, not overlying distolateral projections, lateral thelycal plates ear-shaped, with salient lateral ridges.....18
- 18 (17) Distomedian petasmal projections parallel and directed anteriorly, longitudinal sulcus ill-defined; posterior end of salient ridges on lateral thelycal plates curved outwards; spine on merus of ♂ 5th pereopod slightly bent inwards.....M.papuensis Racek and Dall  
Distomedian petasmal projections diverging and directed anterolaterally, longitudinal sulcus distinct; posterior end of salient ridges on lateral thelycal plates curved inwards; spine on merus of ♂ 5th pereopod slightly bent outwards  
.....M.eligans (de Man)(= M.singaporensis Hall)
- 19 (15) Rostrum with a marked edentate distal portion; anterior thelycal plate bluntly pointed, lateral plates large, separated by a narrow fissure.....  
.....M.eboracensis Dall  
Rostrum without edentate distal portion.....20
- 20 (19) Branchiocardiac carina distinct, extending from posterior margin of cara-

- pace almost to hepatic spine; anterior thelycal plate longitudinally grooved, wider posteriorly than anteriorly; distomedian petasmal projections crescent-shaped.....  
..M.affinis (H.Milne Edwards)(= M.mutatus (Lanchester) = M.necopinans Hall)  
Branchiocardiac carina feeble or ill-defined, anterior end not exceeding posterior 1/3 of carapace.....21
- 21 (20) Anterior thelycal plate tongue-like, with a pair of anterolateral rounded tubercles; lateral plates with characteristic patch of dense setae; distomedian petasmal projections strongly diverging, each forming a broad outwardly-curved tooth.....  
.....M.insolitus Racek and Dall  
Anterior thelycal plate flask-shaped, with a longitudinal median ridge; distomedian petasmal projections finger-shaped.....22
- 22 (21) Anterior margin of anterior thelycal plate with 3 tubercles.....23  
Anterior margin of anterior thelycal plate with 2 fang-like teeth and a median indistinct tubercle; petasma with slightly diverging tubular distomedian projections.....M.dalli Racek
- 23 (22) Median tubercle more prominent than lateral ones; distal margin of anterior thelycal plate distinctly triangular; petasma with almost parallel tubular distomedian projections, their distal half twisted dorsoventrally.....  
.....M.bennettiae Racek and Dall  
All tubercles of equal size; distal margin of anterior thelycal plate convex to indistinctly triangular; petasma with laminae and strongly diverging distomedian projections.....  
.....M.burkenroadi Kubo

1.2 Nomenclature

1.2.1 Valid scientific names

Metapenaeus monoceros (Fabricius, 1798)

1.2.2 Synonyms

Objective synonymy

Penaeus monoceros Fabricius, 1798, Suppl. Entomol.syst.:409.

Metapenaeus monoceros (Fabricius, 1798) Nobili, 1903, Boll.Mus.Zool.Anat.comp.Torino, 18(447):3.

Penaeopsis monoceros (Fabricius, 1798) De Man, 1911, Siboga Exped., 39a:55.

Subjective synonymy

*Penaeopsis spinulicauda* Stebbing, 1914,  
*Ann.S.Afr.Mus.*, 15:17.

1.2.3 Standard common names, vernacular names

India: Kerala coast - Choodan chemmeen;  
Bangal coast - Koraney chingdi,  
Nonya chingdi;  
Bombay coast - Jinga;  
Gulf of Kutch - Sonayya jacha;

East Pakistan - Kucho chingdi;  
West Pakistan - Kiddi

South Africa: Durban Bay - Speckled  
prawn, Ginger  
prawn

1.3 General variability

1.3.1 Subspecific fragmentation  
(races, varieties, hybrids)

No subspecies, races or varieties are  
known for the species.

## 2 DISTRIBUTION

### 2.1 Delimitation of the total area of distribution and ecological characterization of this area

M. monoceros is recorded from the eastern Mediterranean, the east coast of Africa, Madagascar, the Red Sea, all coasts of India, Pakistan and Ceylon, and Malaysia as far as the Straits of Malacca. Hall (1962) gives the Straits of Malacca as its eastern limit. Crosnier (1965) also includes Indonesia, Australia and Japan in the distribution of the species, but these records probably apply to M. ensis (De Haan) (Rasek and Dall, 1965). Under the FAO distribution code (Holthuis and Rosa, 1965), the species is found in sea areas ASE and ISW, and in coastal and estuarine waters of land areas 122, 136, 154, 413, 421, 423, 424, 425, and 556. (Distribution data from the 3 works just cited and from De Bruin, 1965).

Juveniles are found in estuaries and backwaters of reduced salinity (India) and in lagoons (Ceylon); adults occur in the sea, usually in shallow water, but to a depth of 50 to 60 m on the Cochin coast of India (George et al., 1968) and to 70 m off Durban, South Africa (Joubert, 1965). Both juveniles and adults are usually found on substrates of mud, silt or muddy sand (George and George, 1964; De Bruin, 1965).

### 2.2 Differential distribution

#### 2.2.1 Areas occupied by eggs, larvae and other junior stages; annual variations in these patterns, and seasonal variations for stages persisting over two or more seasons

There is no information on eggs and early larvae of this species.

Late mysis and postlarval stages migrate into backwaters and estuaries all along the coastline of India, and the juveniles contribute to a fishery in these waters. The occurrence of large numbers of postlarvae of the species in the Adyar estuary has been recorded by Panikkar and Aiyar (1939).

Large quantities of this species, both juveniles and medium sized specimens, are present in the Gangetic deltaic area. In Bombay waters juveniles are present in the inshore catches.

#### 2.2.2 Areas occupied by adult stages; seasonal and annual variations of these

In India, the adults are found in the sea in slightly deeper waters than other species of Metapenaeus. George and George (1964) recorded a breeding population in 50 to 60 m depth off Cochin.

Adults occur from the intertidal zone to a depth of 40 m off Madagascar, but they are most common at depths between 6 and 15 m (Crosnier, 1965).

### 3 BIONOMICS AND LIFE HISTORY

#### 3.1 Reproduction

##### 3.1.1 Sexuality (hermaphroditism, heterosexuality, intersexuality)

The species is heterosexual. Although not a case of hermaphroditism, George (1963) recorded a specimen with both thelyoum and petasma, the latter not fully developed.

##### 3.1.2 Maturity (age and size)

No maturity studies have been carried out on the species. George (1959) gave indirect evidence that it does not mature before attaining a length of 120 mm.

##### 3.1.4 Fertilization (internal, external)

Fertilization is external, taking place at the time of spawning.

##### 3.1.6 Spawning

According to George (1959) the spawning season of the species in Cochin waters is from October to December with a peak in November and December. However, George (1962), studying the post-larval abundance of the species in the backwaters of Cochin, recorded that the species breeds throughout the year with two peaks, the first in July and August and the second in November and December. George and George (1964) recorded a catch consisting mostly of mature specimens from a depth of 50 to 60 m off Cochin in August. In the Gulf of Kutch area, the spawning season is from February to April (Srivatsa, 1953).

##### 3.1.7 Spawning grounds

Panikkar and Aiyar (1939) found early post-larvae in the brackish waters of Adyar and suggested that the species may breed there. Similar early postlarvae occur in Cochin backwaters, but the absence of young larvae indicates that this is not a breeding area (George, 1959, 1962). The presence of mature adults in a sandy area at a depth of 50 to 60 m off Cochin points to this as a possible spawning ground (George and George, 1964)

#### 3.2 Larval history

##### 3.2.1 Account of embryonic and juvenile life

The larval development of the species has not been described.

The postlarval recruitment of the species into the backwaters of Cochin was studied by George (1962). George (1959) reared the

postlarvae from about 3.0 mm (total length). The biology of the juveniles in the fishery of Cochin was also studied by him.

#### 3.3 Adult history

##### 3.3.1 Longevity

Srivatsa (1953), studying the fishery in the Gulf of Kutch, calculated the life span of the species to be 12 to 14 mo. According to George (1959) 3 distinct year classes are recognizable, indicating a life span of 3 yr.

##### 3.3.2 Hardiness

According to Chopra (1939) this penaeid is a hardy creature, a fact to which it owes its local name in the Calcutta markets, "koraney chingdi". Generally this species arrives in the market alive. Another local name for the species in Bengal is "honye chingdi" or mad prawn, which probably refers to the fact that even long after capture it jumps about like a mad creature.

Active regulation of chloride and osmotic behaviour of this species has been extensively studied by various authors in India. Panikkar (1948) studied this prawn in comparison with other penaeids and found that it can survive the greatest extremes of salinity, low as well as high. The distribution of the species in relation to this osmoregulatory behaviour has been discussed by him. Panikkar and Viswanathan (1948) experimented on the changes in the chloride content of the blood of this species.

Oxygen consumption as a function of size and salinity in this species, from marine and brackish water populations, was the topic of study of Rao (1958). He noticed that oxygen consumption increased with increasing hypertonicity or hypotonicity of the medium. Comparing two natural populations in media of different salinities, he suggested that the osmotic stress, as shown by oxygen consumption, depends on the salinity of the medium to which the animal is naturally adapted.

Reddy (1963) showed that, after transfer to anisotonic media of between 5‰ and 35‰ salinity, the chloride concentration of the blood, and the rates of heart beat, respiration and urine production attained a steady level after 8 to 10 days. The prawns then appeared to be fully acclimatized to the new medium. Gnanamuthu (1966) correlated adaptation to different salinities with changes in body volume of the prawn, and considered the gut wall to be the site of osmoregulation.

##### 3.3.6 Greatest size

According to Alcock (1906) and Menon (1956), the species attains a length of 6½ in (165 mm). Chopra (1939) gave the maximum length as a little over 5 in (127 mm). In the trawl fishery off

Cochin, a maximum length of about 180 mm has been recorded by George (1959). Grosnier (1965) gave the largest males and females, obtained from Madagascar, as 133 and 162 mm respectively.

### 3.4 Nutrition and growth

#### 3.4.2 Food (type, volume)

By the analysis of the stomach contents of 1,173 specimens, ranging in length from 20 to 100 mm, George (1959) has recorded an omnivorous feeding habit for the species. The main items found in the stomach contents were remains of crustaceans (amphipods, isopods and copepods), polychaete remains, vegetable matter (angiosperm tissues and diatoms), foraminifera, mollusc shell pieces and sand particles.

#### 3.4.3 Relative and absolute growth patterns and rates

Growth rates of the species in the laboratory, as recorded by George (1959), are reproduced in Table I. The rate of growth varied between 6.25 and 10.25 mm per month and the average growth rate was 7.98 mm per month. The same paper also recorded growth of the species in a paddy field as 10 to 14 mm in about 3 mo. This relates to larger specimens than those used in the laboratory experiments. Srivatsa (1953) was of the opinion that, in the Gulf of Kutch area, growth is rapid and prawns attain a length of about 4 in (102 mm) in 5 mo.

Differential rate of growth in the sexes, females showing the faster growth rate, has been recorded by George (1959) and George *et al.* (1968).

George (1959) recorded the number of moults in laboratory reared animals and es-

timated the number for larger specimens from the fishery. According to him, growth from 3 mm to about 100 mm is achieved in 32 moults.

George (1959) recorded the relationship between weight and total length, based on 175 observations on individuals ranging from 25 to 105 mm total length, as

$$W = 0.01989 L^{2.7603}$$

### 3.5 Behaviour

#### 3.5.1 Migration and movements

The migration of the postlarval stages to backwaters and estuaries takes place all along the coastline of India. The migration from the sea into the Cochin backwaters takes place in the early postlarval stages, and the movement back to the sea commences within a year, after a length of about 100 mm has been reached.

In the offshore trawling grounds off Cochin, George *et al.* (1968) observed some movements of the bigger sizes into the grounds from deeper waters in the early half of the season, in November.

In the Gulf of Kutch area, the prawns are found to move to deeper waters and open areas from August to November. Srivatsa (1953) did not consider this to be a feeding migration.

In the Godavari estuary on the east coast of India, Subramanyam (1965) observed migration out of the estuary to be mostly nocturnal and immigration was greatest at dawn. He noticed more emigrants than immigrants. The outward migration of the species was intense in December, May and June.

TABLE I

Growth rate of Metapenaeus monoceros in the laboratory  
(after George, 1959)

| Period of experiment (mo) | Initial size (mm) | Final size (mm) | Increase in size (mm) | Rate of growth (mm/mo) |
|---------------------------|-------------------|-----------------|-----------------------|------------------------|
| 4                         | 3.0               | 33.5            | 30.5                  | 7.63                   |
| 4                         | 3.0               | 33.0            | 30.0                  | 7.50                   |
| 4                         | 3.0               | 34.0            | 31.0                  | 7.75                   |
| 4                         | 3.0               | 28.0            | 25.0                  | 6.25                   |
| 8                         | 3.0               | 60.0            | 57.0                  | 7.13                   |
| 4                         | 3.5               | 36.0            | 32.5                  | 8.13                   |
| 6                         | 3.0               | 46.0            | 43.0                  | 7.17                   |
| 4                         | 3.5               | 44.5            | 41.0                  | 10.25                  |
| 4                         | 3.5               | 43.5            | 40.0                  | 10.00                  |

4 POPULATION (STOCK)

4.1 Structure

4.1.1 Sex ratio

George (1959) studied the sex ratio of the juveniles in the backwater catches of Cochin during 1952 to 1955 and recorded a slightly higher percentage of females in each year, the respective percentage of females for the 3 years being 51.76, 51.08 and 51.31. In catches of juveniles of the species from the inshore waters of Bombay, Shaikhmahmud and Tembe (1960) also recorded a predominance of females except in the month of June. Crosnier (1965) observed 93 females in a trawl net catch of 153 specimens off Madagascar.

4.1.2 Age composition

George (1959) observed that only the 0 year-class contributed to the backwater fishery of Cochin. In the trawl catches he recorded three year-classes with modal lengths 100 to 110 mm, 131 to 135 mm and 156 to 160 mm.

4.1.3 Size composition

The juveniles contribute to the paddy field and backwater fisheries of Cochin and also to the estuarine prawn fishery along most of the Indian coast. In the Cochin backwaters,

according to George (1959), prawns of this species measuring more than about 100 mm in length are very scarce, and the modal lengths vary from about 58 to about 88 mm. In the inshore fishery of Bombay this species is represented by specimens ranging in length from 40 to 120 mm (Shaikhmahmud and Tembe, 1960).

The adults of the species are represented in the trawl fishery off Cochin in the months of November and December, when specimens with modes varying from about 128 to about 148 mm are caught (George et al., 1968).

4.3 Natality and recruitment

4.3.1 Natality

George (1962) studied the recruitment of postlarvae into the backwaters of Cochin and suggested the possibility of using this index for predicting the subsequent fishery of the backwaters as well as the outside sea. In the trawl fishery off Cochin, the recruitment of bigger sizes early in the season and smaller sizes in the latter half of the season was observed by George et al. (1968).

## 5 EXPLOITATION

### 5.1 Fishing equipment

#### 5.1.1 Fishing gear

In the Bombay area, the 'dol' net or bag net is the gear used for catching prawns, the operation of which has been described by Setna (1949). On the north Kanara coast, the prawns are caught by shore seines (yendi bale), the details of which are given by Pradhan (1956).

On the southwest coast of India, various types of boat-seines (locally called 'thangu vala', 'vatta vala', 'koru vala'), shore seines ('kamba vala', 'nona vala'), drag nets (vadi vala) and cast nets are employed. In mechanized fishing for prawns, shrimp trawls of various sizes are used.

#### 5.1.2 Fishing boats

The indigenous gears are operated mainly from dug-out canoes and plank-built boats with out-rigger. The mechanized fishing vessels are generally the medium sized 7 to 11 m long pablo boats, having 10 to 30 bhp engines.

### 5.2 Fishing areas

#### 5.2.1 General geographic distribution

The species is fished in India (Panikkar and Menon, 1956), East and West Pakistan (Qureshi, 1956) and Ceylon (De Bruin, 1965). Small numbers are caught on the east African coast (Hall, 1967).

#### 5.2.2 Geographical ranges (latitudes, distances from coast, etc.)

The fishery is largely in enclosed or partly enclosed waters, such as paddy fields, estuaries and lagoons, but the species is also fished in the open sea, in inshore waters off Bombay (Shaikhmahmud and Tembe, 1960) and up to several km offshore on the Cochin coast of India (George *et al.*, 1968).

#### 5.2.3 Depth ranges

The fishery for juvenile prawns is generally in water of less than 5 m, but they are fished in depths of 13 m off Bombay (Shaikhmahmud and Tembe, 1960). Adults are fished to a maximum depth of 60 m off Cochin, (George *et al.*, 1968).

### 5.3 Fishing seasons

#### 5.3.1 General pattern of season

The species is fished throughout the year in the backwaters of the southwest coast of India, and in the Godavari estuary on the east

coast. The inshore fishery on the northwest coast of India is in the middle of the year. The trawl fishery off the Indian southwest coast and much of the estuarine fishery on the east coast are pursued in winter. Prawns, including *M. monoceros*, are fished in all seasons in some creeks and inlets of West Pakistan. In general, however, prawn fisheries in both East and West Pakistan are mostly carried out in winter (Qureshi, 1956).

Data on fishing seasons in other countries are not available.

#### 5.3.3 Dates of beginning, peak and end of season

In the backwater fishery of Cochin, although represented throughout the year, the species is most abundant in the months March to June and November (Menon and Raman, 1961). The percentage contribution of the species given by them is reproduced in Table II. The peak season for the species in the trawl fishery off Cochin (George *et al.*, 1968), is November and December; detailed records of the species from 1958 through 1963 are given by them. Usually the species appears in the catches in small numbers by October, reaches a peak in November and disappears by the end of December. Smaller sizes are represented again in the fishery in small numbers in March and April. In Bombay waters, although present throughout the year, the peak fishery is during the rainy season, in July and August (Shaikhmahmud and Tembe, 1960).

Kemp (1915) observed the presence of this species in the Chilka Lake all through the year. In the Godavari estuary (Subramanyam, 1965), although present in the catches throughout the year, it is more abundant in May to June and in November to December.

#### 5.3.4 Variations in date or duration of season

Variation in the season of the species in the same locality is recorded by George *et al.* (1968), in the trawl fishery off Cochin. November and December are usually the months of peak occurrence of the species in this fishery, but in certain years the species fails to appear in the catches in these months. The reason for this is not yet known.

#### 5.3.5 Factors affecting fishing season

The formation of mud banks, locally called 'chaakara' is noticed to influence the inshore fishery for prawns on the Malabar coast. Menon and Raman (1961) have recorded a direct relationship between rainfall and prawn catches in the backwaters of Kerala, and they also noticed highest catches at new or full moon or a day or

TABLE II

Percentage values (numerical and weight) of M. monoceros in the monthly catches in the stake net at Cochin in 1957-1958

|           | Jan. | Feb. | Mar. | Apr. | May  | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|-----------|------|------|------|------|------|------|------|------|-------|------|------|------|
| By number | 10.5 | 9.6  | 18.9 | 22.3 | 12.3 | 16.5 | 14.2 | 9.0  | 12.3  | 11.9 | 35.8 | 5.4  |
| By weight | 21.2 | 21.6 | 32.0 | 36.7 | 33.2 | 35.8 | 29.2 | 27.9 | 36.3  | 28.9 | 63.4 | 17.7 |

two later. Subramanyam (1965) observed more of the species at new moon than at full moon in catches from the Godavari estuary.

#### 5.4 Fishing operations and results

##### 5.4.1 Effort and intensity

George et al. (1968) studied the trawl fishery for prawns off Cochin in the years 1958-63. The total catches of M. monoceros in the months in which they were significant are shown in relation to the fishing effort in Table III.

##### 5.4.3 Catches

Apart from the data given in Table III, Indian records of prawn catches do not list M. monoceros separately. Menon and Raman (1961) gave the total catch of prawns from Azhikode and Thevara, in the backwaters of Kerala, as 1198.5 kg in 1957 and 1388.7 in 1958. Subramanyam (1965) recorded a total of 48.6 t of prawns (including M. monoceros) from the Godavari estuary, on the east coast of India, in 1961-62.

#### 5.5 Fisheries management and regulations

On the southwest coast of India the only regulation now in existence is in respect of the paddy field prawn fishery, in which M. monoceros is one of the more important species. The fishery is allowed to operate from the middle of November to the middle of April only, but this is done not in the interest of the fishery but in the interest of rice cultivation which is carried out in these fields during the monsoon months. According to Panikkar and Menon (1956) "the methods of fishing now in

vogue do not involve the destruction on any appreciable scale of prawn fry and leave sufficient numbers of breeding females to replenish the stock. The fear of depletion has not therefore arisen anywhere and thus no serious problem in management, requiring regulation of the fishery, has confronted the Governments of the various States". In the paddy field fishery, as well as the cast net, stake net and Chinese dip net fishery of the backwaters of Kerala, a licensing system is prevalent.

#### 5.6 Fish farming, transplanting and other intervention

Farming or culture practices are not carried out anywhere in the case of this species. But trapping of juvenile stages of the species along with others is extensively practiced in the rice fields bordering the backwaters of the southwest coast of India (Panikkar, 1937; Menon, 1955; Gopinath, 1956; Panikkar and Menon, 1956; Kesteven and Job, 1957). About 11,000 acres (about 4,500 ha) of single crop rice fields, which are not utilized for paddy cultivation during the period when the water is saline, are used for this fishery. The fishing practice is restricted to admitting juvenile prawns to the paddy fields with the incoming tides and fishing them during favourable low tides at night. Prawns are caught in a conical bag net attached to a rectangular frame which fits into the mouth of the sluice gate provided for the field. In this process of fishing, very little attention to the stock is called for, although during the variable interval that the trapped prawns remain in the fields they utilize the food organisms within the field and grow to a certain extent.

TABLE III

Total catch and catch per hour of *Metapenaeus monoceros* in the trawl fishery off Cochin in months in which there was a significant catch of the species in 1958-1962 (George *et al.*, 1968)

| Year | Month     | Percentage by weight | Total catch of prawns (kg) | Total effort (h) | Catch of <i>M.monoceros</i> (kg) | Catch per hour for all prawns | Catch per hour for <i>M.monoceros</i> |
|------|-----------|----------------------|----------------------------|------------------|----------------------------------|-------------------------------|---------------------------------------|
| 1958 | November  | 12.9                 | 11607                      | 339.92           | 1497                             | 34.0                          | 4.4                                   |
|      | December  | 12.5                 | 15861                      | 535.63           | 1983                             | 30.0                          | 3.7                                   |
| 1959 | November  | 39.6                 | 2306                       | 301.17           | 913                              | 8.0                           | 3.0                                   |
|      | December  | 19.5                 | 10027                      | 430.00           | 1955                             | 23.0                          | 4.6                                   |
| 1960 | February  | 7.9                  | 50113                      | 692.68           | 3959                             | 72.0                          | 5.7                                   |
|      | November  | 42.5                 | 1536                       | 207.18           | 653                              | 7.0                           | 3.2                                   |
| 1961 | November  | 11.1                 | 21462                      | 442.00           | 2382                             | 49.0                          | 5.4                                   |
| 1962 | September | 25.6                 | 7664                       | 91.92            | 1962                             | 83.4                          | 21.3                                  |
|      | October   | 3.6                  | 24023                      | 372.75           | 865                              | 64.4                          | 2.3                                   |

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