

**SYNOPSIS OF BIOLOGICAL DATA ON THE PRAWN PRAWN
Metapenaeus affinis (H. Milne Edwards, 1837)**

by

M.J. GEORGE

Reprinted from: **FAO Fish. Rep.** (57) Vol. 4, 1970

SYNOPSIS OF BIOLOGICAL DATA ON THE PENAEID PRAWN
Metapenaeus affinis (H. Milne Edwards, 1837)

Exposé synoptique sur la biologie de
Metapenaeus affinis (H. Milne Edwards, 1837)

Sínosis sobre la biología del
Metapenaeus affinis (H. Milne Edwards, 1837)

prepared by

M.J. GEORGE
Central Marine Fisheries Research Institute ^{1/}
Mandapam Camp, India

^{1/} Present address: Indian Ocean Biological Centre (National Institute of Oceanography),
Pullepady Cross Road, Ernakulam, Cochin-18, Kerala.

CONTENTS

| | Page No. |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1 | 1:1 |
| 1.1 <u>Taxonomy</u> | 1 |
| 1.1.1 Definition | 1 |
| 1.1.2 Description | 1 |
| 1.2 <u>Nomenclature</u> | 1 |
| 1.2.1 Valid scientific names | 3 |
| 1.2.2 Synonyms | 1 |
| 1.2.3 Standard common names, vernacular names | 3 |
| 1.3 <u>General variability</u> | 3 |
| 1.3.1 Subspecific fragmentation (races, varieties, hybrids) | 3 |
| 1.3.2 Genetic data (chromosome number, protein specificity) * | 3 |
| 2 | 2:1 |
| 2.1 <u>Delimitation of the total area of distribution and ecological characterisation of this area</u> | 1 |
| 2.2 <u>Differential distribution</u> | 1 |
| 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 | 1 |
| 2.2.2 Areas occupied by adult stages: seasonal and annual variations of these | 1 |
| 2.3 <u>Behaviouristic and ecological determinants of the general limits of distribution and of the variations of these limits and of differential distribution *</u> | 1 |
| 3 | 3:1 |
| 3.1 <u>Reproduction</u> | 1 |
| 3.1.1 Sexuality (hermaphroditism, heterosexuality, intersexuality) | 1 |
| 3.1.2 Maturity (age and size) | 1 |
| 3.1.3 Mating (monogamous, polygamous, promiscuous) * | 1 |
| 3.1.4 Fertilization (internal, external) | 1 |
| 3.1.5 Fecundity | 1 |
| 3.1.6 Spawning | 1 |
| 3.1.7 Spawning grounds | 1 |
| 3.1.8 Eggs: structure, size, hatching type, parasites and predators | 1 |
| 3.2 <u>Larval history</u> | 1 |
| 3.2.1 Account of embryonic and juvenile life (prelarva, larva, postlarva, juvenile) | 1 |

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

| | <u>Page No.</u> |
|----------------------------------------------------------------------------------------------------|-----------------|
| 3.3 <u>Adult history</u> | 312 |
| 3.3.1 Longevity | 2 |
| 3.3.2 Hardiness | 2 |
| 3.3.3 Competitors | 2 |
| 3.3.4 Predators | 2 |
| 3.3.5 Parasites and diseases | 2 |
| 3.3.6 Greatest size | 2 |
| 3.4 <u>Nutrition and growth</u> | 2 |
| 3.4.1 Feeding (time, place, manner, season) | 2 |
| 3.4.2 Food (type, volume) | 2 |
| 3.4.3 Relative and absolute growth patterns and rates | 2 |
| 3.4.4 Relation of growth to feeding, to other activities, and to environmental factors * | |
| 3.5 <u>Behaviour</u> | 2 |
| 3.5.1 Migration and local movements | 2 |
| 3.5.2 Schooling | 3 |
| 3.5.3 Reproductive habits | 3 |
| POPULATION (STOCK) | 411 |
| 4.1 <u>Structure</u> | 1 |
| 4.1.1 Sex ratio | 1 |
| 4.1.2 Age composition | 1 |
| 4.1.3 Size composition | 1 |
| 4.2 <u>Size and density *</u> | |
| 4.2.1 Average size | |
| 4.2.2 Change in size | |
| 4.2.3 Average density | |
| 4.2.4 Changes in density | |
| 4.3 <u>Natality and recruitment</u> | 1 |
| 4.3.1 Natality * | |
| 4.3.2 Natality rates * | |
| 4.4 <u>Mortality, morbidity *</u> | |
| 4.4.1 Rates of mortality | |
| 4.4.2 Factors or conditions affecting mortality | |
| 4.4.3 Factors or conditions affecting morbidity | |
| 4.4.4 Relation of morbidity to mortality rates | |
| 4.5 <u>Dynamics of population *</u> | |
| 4.6 <u>Relation of population to community and ecosystem, biological production, etc. *</u> | |
| EXPLOITATION | 511 |
| 5.1 <u>Fishing equipment</u> | 1 |
| 5.1.1 Fishing gear | 1 |
| 5.1.2 Fishing boats | 1 |

| | <u>Page</u> |
|-----------------------------------------------------------------------|-------------|
| 5.2 <u>Fishing areas</u> | 5:1 |
| 5.2.1 General geographic distribution | |
| 5.2.2 Geographical ranges (latitudes, distances from coast, etc.)* | |
| 5.2.3 Depth ranges | |
| 5.3 <u>Fishing seasons</u> | |
| 5.3.1 General pattern of fishing season | |
| 5.3.2 Duration of fishing season | |
| 5.3.3 Dates of beginning, peak and end of season | |
| 5.3.4 Variation in time or duration of fishing season * | |
| 5.3.5 Factors affecting fishing season | |
| 5.4 <u>Fishing operations and results</u> | |
| 5.4.1 Effort and intensity | |
| 5.4.2 Selectivity | |
| 5.4.3 Catches | |
| 5.5 <u>Fisheries management and regulations</u> | |
| 5.6 <u>Fish farming, transplanting and other intervention</u> | |
| 6 REFERENCES | 6:1 |

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

Penaeus *H. affinis*

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 affinis* (H. Milne Edwards, 1837)

1.1.2 Description

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.

Rostrum dorsally toothed only; carapace without sutures; orbital angle usually sharp; postocular sulcus present; cervical sulcus well defined; hepatic sulcus not well defined behind level of hepatic spine, but pronounced in front with well defined postero-inferior border, usually descending vertically from hepatic spine, then turning towards the pterygostomial angle; antennal and hepatic spines pronounced; pterygostomial angle blunt. Telson with deep dorsomedian sulcus, without fixed subapical spines, and with movable dorsolateral spines which may be microscopic and very numerous. First antennular segment without spine on ventral distomedian border. Antennular flagella usually shorter than carapace. Maxillulary palp with 2 segments, distal small, basal with convex, foliaceous projections on inner and outer edges, and long spine on inner edge. First to 3rd pereopods with basal spines; 5th pereopod without exopod; ischium and merus often modified in adult male. Petasma tubular with thickened median lobes; lateral lobes thicker than median, forming distolateral spout-like projections, each with dorsal lobule produced posteriorly into expanded, plate-like projection; median lobes with dorsal lobule produced into thin recurved plate-like or hood-like structure. Appendix masculina with knob-like distal piece bearing deep posterodistal depression or is sculptured in some way. Telycum composed of anterior median plate, 2 posterior lateral plates more or less enclosing posterior end of median plate; posterior plates often

continuous across sternite. Zygoocardiac ocellus with 2 rows of teeth which get progressively smaller. Pleurobranchs on 3rd to 7th thoracic somites, rudimentary arthrobranch on 1st somite, anterior and posterior arthrobranchs on 2nd to 6th, vestigial anterior and fully developed posterior arthrobranchs on 7th somite; mastigobranchs on 1st, 2nd, 4th to 6th somites. Body usually with some dorsal setose depressed areas, remainder of body surface varying from completely glabrous to covered with clove irregular setose depressed areas. (Dall, 1957).

Metapenaeus affinis (H. Milne Edwards, 1837)

The type specimens of the species are in the Paris Museum and were examined there in 1938 by Burkenroad (see Burkenroad, 1963), who found them to be identical with the present species. Hall (1958) mistakenly took a specimen of *Parapenaeopsis sculptilis* in the Paris collection to be the type of *Penaeus affinis* and concluded that the name *affinis* could not be used for the present form. This question was put straight by Burkenroad (1963) and the name *affinis* can be continued to be used in the sense it had always been considered.

Type locality. "Côte de Malabar" (=S.W. coast of Indian peninsula, Kerala, India).

The species is illustrated in Fig. 1.

Body tomentose; rostrum more curved, less uptilted, slightly larger than that of *M. monogeros*; not less than 9 dorsal teeth; postrostral crest does not extend to posterior part of carapace; anterolateral angles of carapace rounded; antennal spine strong, produced as salient ridge to small hepatic spine; ridge bounding well marked postantennular groove which meets cervical groove. Anterior abdominal tergite indistinctly carinated; 5th abdominal somite 2/3 length of 6th; 6th somite little shorter than telson. Telson without marginal spines shorter than endopod of uropod.

Eyes very large, slightly surpassed by antennular scale. Upper antennular flagellum at least 3/4 length of peduncle. 3rd maxilliped barely reaches middle of antennal scale, dactylus of male not modified. Strong spines present on bases of all 3 pairs of chelipeds. Last pair of thoracic legs usually surpassing tip of antennal scale, sometimes by whole length of dactylus; no lobule on posterior edge of ischium in male, notch in the merus bounded by twisted tooth, edge of merus entire beyond tooth.

Petasma (Fig. 2) symmetrical. In adult, 2 halves form compressed tube ending in pair of 2-lipped spouts like short horns.

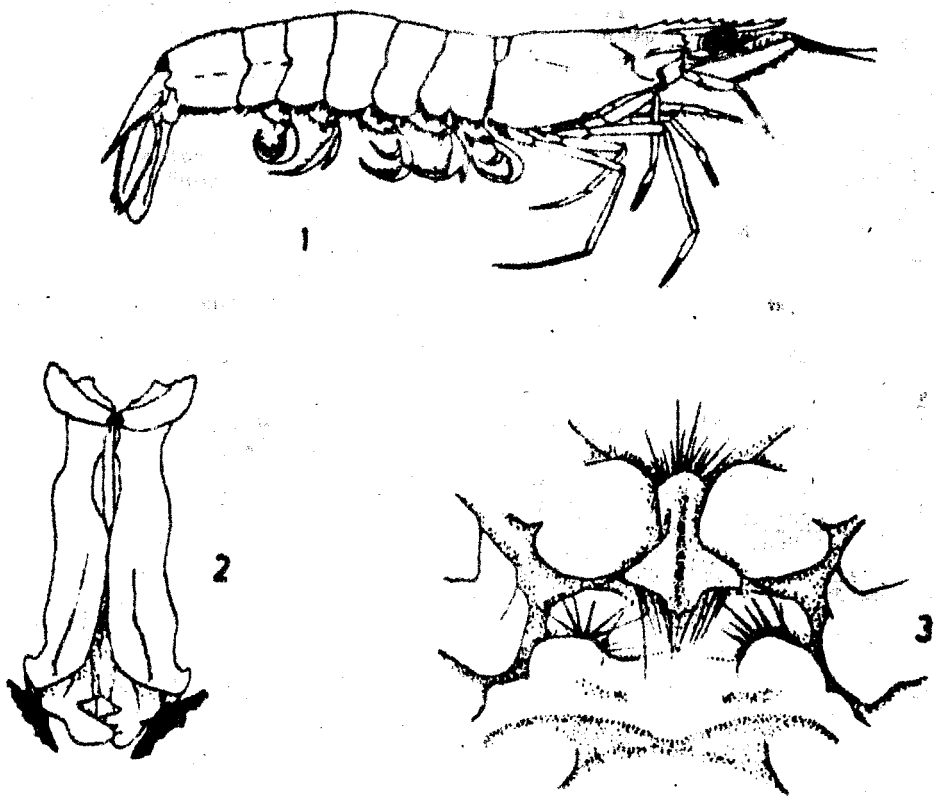


Fig. 1 Metapenaeus affinis.

Fig. 2 Petasma.

Fig. 3 Thelycum.

(from Hall, 1962).

Fm/898 H. affinis

Thelyoum (Fig. 3) concave, setose. Lateral lobes fairly flat, transversely out into unequal segments, median plate projects between 2 lobes of sternum between 4th pair of legs.

Body translucent green, uropods tipped with conspicuous green. Maximum length about 180 mm.

For artificial key to the species of Metapenaeus see section 1.1.2 of the synopsis on Metapenaeus monoceros by George (1970), or Paock and Dall (1965).

1.2 Nomenclature

1.2.1 Valid scientific names

Metapenaeus affinis (H. Milne Edwards, 1837).

1.2.2 Synonyms

Objective synonymy

Penaeus affinis H. Milne Edwards, 1837, Hist.nat.Crust., 2: 416. (original combination).

Parapenaeus affinis (H. Milne Edwards) Rathbun, 1902, Proc.U.S.Nat.Mus., 26:23-55.

Metapenaeus affinis (H. Milne Edwards) Nobili, 1903, Boll.Mus.Zool.Anat.comp.Torino, 18(447).

Penaeopsis affinis (H. Milne Edwards) De Man, 1911, Siboga Exped., 39a:57.

Subjective synonymy

Penaeus mutatus Lancheester, 1901, Proc.zool.Soc. London, 1901:572.

Metapenaeus necopinans Hall, 1956, Bull. Raffles Mus., 27:82.

Metapenaeus mutatus (Lancheester) Hall, 1952, Fish.Publ., London, 17:76.

1.2.3 Standard common names, vernacular names

In Kerala, on the southwest coast of India, the species is locally known as "Kas-hanthan chemen". In Bombay, on the northwest coast, it is locally called "Jinga", and in Bengal, on the east coast, the name "Chingri" is applied to this and related species.

1.3 General variability

1.3.1 Subspecific fragmentation (races, varieties, hybrids)

No subspecies or varieties are known for the species.

2 DISTRIBUTION

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

General distribution of the species in Indian seas through Malaysia and part of Indonesia to Hong Kong and Japan. Under the FAO distribution code (see Holthuis and Rosa, 1965) it occurs in land areas 421, 423, 433, 434 and 437, and water areas ISW and ISEW, in marine and brackish waters.

In Indian waters, the juveniles of the species are found in very small numbers in the backwaters and estuaries, and adults occur in the inshore waters to a depth of about 25 fm (45 m). In Ceylon, it is found on mud banks in the sea at a depth of 8 to 12 fm (14 to 22 m) (De Bruin, 1965). In Malaysian waters the juveniles are found in the Singapore pond fishery in small numbers and the adults in larger numbers in the seas around Malaysia (Hall, 1962).

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

So far no work has been reported on the eggs and larvae of the species. According to Subrahmanyam (1967) the species may breed in inshore waters of the southwest coast of India.

There does not seem to be such large-scale migration of the postlarval stages into nearby estuaries as in *M. dohsoni* (Niers) and the species never accounts for more than 20 percent of the catch in the fishery for juvenile prawns in the backwaters of Cochin. In the Singapore pond fishery, according to Hall (1962), juveniles of *M. affinis* occur sporadically from February to September but never exceed 6.5 percent of the prawn population. The species is present in small numbers in estuaries almost throughout the year and is most common from January to June. In the Chilka Lake, on the east coast of India, Kemp (1915) recorded the species in February and March and concluded that it may be present there at all seasons.

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

On the inshore fishery grounds of the west coast of India, adults of the species are most common in November and December (George, 1961), and on the offshore grounds they are most abundant from November to January (George, Raman and Nair, 1968a). In Penang, according to Hall (1962), there is some indication that the adults are most abundant in August-September.

3 BIONOMICS AND LIFE HISTORY

3.1 Reproduction

3.1.1 Sexuality (hermaphroditism, heterosexuality, intersexuality)

M. affinis is heterosexual, as are all penaeid prawns.

Hall (1962) recorded one hermaphrodite in a total of 77 specimens, from a Singapore prawn pond.

3.1.2 Maturity (age and size)

Menon (1957) and Subrahmanyas (1967) mentioned that sexual maturity is reached at a length of about 120 mm. Rao (1968) recorded the minimum length at maturity as 88.6 mm, corresponding to the late 0 year class. By ova diameter and other studies he classified the different maturity stages of the female as 'immature', 'early maturing', 'late maturing', 'mature' and 'spent-recovering'. Shaikhmahmud and Tembe (1960) classified specimens from Bombay waters into only 3 stages, namely, immature, maturing and mature.

3.1.4 Fertilisation (internal, external)

As in other penaeid prawns, fertilisation is external, taking place at the time of spawning. Hudinaga (1941) made some observations on the fertilisation, the number of entrance cones, etc.

3.1.5 Fecundity

Fecundity of the species, as estimated by Rao (1968), ranges between 88,000 to 363,000 eggs. According to him there is a linear logarithmic relationship between the number of eggs produced and the size of the prawn. The formula is

$$\text{Log } F = -0.4306 + 2.7179 \text{ Log } L$$

where *F* is the number of mature eggs and *L* is the total length in mm.

3.1.6 Spawning

From a study of the inshore fishery of the southwest coast of India, George (1961) reported the breeding time of the species to be from October to December. Later, from the study of the trawl catches of the species off Cochin, George *et al.* (1968a) concluded that the active breeding season of the species is from November to February. Rao (1968), using the maturity conditions of the catches off Cochin, also arrived at a similar conclusion, the breeding season being October to March

with peak in November to December. January to March is the spawning period in Calicut waters according to Subrahmanyas (1967). In Bombay waters, Shaikhmahmud and Tembe (1960) found most mature and maturing females in October and April to June. Similarly, Hall (1962) reported 2 peak breeding seasons for the species in Malaysian waters, namely, May to June and October to December.

Hudinaga (1942) has found that the species spawns while swimming about or vigorously moving the pleopods when spawning at the bottom. Under other conditions, eggs failed to hatch.

Utilising the data on the monthly distribution of late maturing and mature females in 10 mm length groups in the catches off Cochin, Rao (1968) concluded that the species spawns more than once during its growth from 91-100 mm to 151-160 mm.

3.1.7 Spawning grounds

Subrahmanyas (1967) studying the breeding of the species in Calicut, and on the southwest coast of India, observed that the species moves to offshore areas for spawning. Studies at Cochin, on the same coast, indicated that the species may be breeding in the 15 to 25 fm (27 to 45 m) areas. In Malaysian waters Hall (1962) observed the species breeding very close inshore. In Bombay waters, Shaikhmahmud and Tembe (1960) observed that there are indications that the species prefers areas of soft mud, rich plankton and shallow coastal waters for mating and spawning.

3.1.8 Egg: structure, size, hatching type, parasites and predators

The most highly developed ovarian eggs measure 0.352 mm according to Rao (1968). He has given measurements of various stages of maturing eggs. No information is available on the spawned eggs, hatching, etc.

3.2 Larval history

3.2.1 Account of embryonic and juvenile life (prelarva, postlarva, juvenile)

In the embryonic development of the species, Hudinaga (1942) observed the segmentation to be quite similar to that of *Penaeus japonicus*, which he described in considerable detail.

The larval development of the species is described by Hudinaga (1941). There are 6 moultings in the nauplius stage, 3 in the protozoa, and 3 in the mysis stage, after which the larva passes into the postlarva. The nauplius stages do not feed.

Hudnaga (1941) obtained good results by rearing the zoea of the species on *Skeletonema costatum* in the laboratory.

Mohamed, Rao and George (1968) described the first postlarva.

3.3 Adult history

3.3.1 Longevity

Subrahmanyam (1967) recorded that the species may live for 3 years or slightly more. According to George *et al.* (1968a) from a study of the trawl catches off Cochin only 2 year classes of the species contribute to the fishery.

3.3.2 Hardiness

Like most other penaeids, the species can withstand only a minimum of handling.

3.3.3 Competitors

The species occurs on the fishing grounds off the coasts of India along with other species, and undoubtedly there will be competitors with them for food.

3.3.4 Predators

Penaeids in general are preyed upon by the demersal fishes of the area where they exist. There are records of 'penaeids' 'prawns', etc., as forming major portion of food of several species of demersal fishes.

3.3.5 Parasites and diseases

There are no reports of parasites or diseases of *M. affinis*.

3.3.6 Greatest size

The maximum size of the species according to Alcock (1906) and Menon (1957) is 6 1/2 in (165 mm). George *et al.* (1968a) report a maximum size of 170 mm.

● 3.4 Nutrition and growth

3.4.1 Feeding (time, place, manner, season)

By analysis of the stomach contents of 30 specimens caught during daylight from the Straits of Malacca, Hall (1962) classified the species in a group feeding mainly on vegetable matter. No information is available on feeding time, season, etc.

3.4.2 Food (type, volume)

The items of food, in their order of abundance in the stomachs of the 30 specimens, are vegetable matter (mainly angiosperm tissue),

small crustaceans (copepods and ostracods), Polychaeta, echinurid setae, molluscan shell pieces and fish remains. Except for 1 empty stomach, sand grains were always present, some of the grains being large, but the quantity was not great (Hall, 1962). According to Subrahmanyam (1967) the species is an omnivorous feeder and larger prawns show a preference to a molluscan diet.

3.4.3 Relative and absolute growth patterns and rates

George *et al.* (1968a), studying the fishery of the species in Cochin trawl catches, recorded a growth of specimens in the 1st year of 20 mm among males and 25 mm among females in about 6 mo.

Differential rates of growth in the sexes, females showing a faster growth rate, has been recorded by George (1961), Subrahmanyam (1967) and George *et al.* (1968a).

In the Seto Inland Sea of Japan, Yasuda (1956) classified this species in a group in which the young shrimps do not grow for a limited period and thereafter grow very rapidly before the spawning season.

Hall (1962) related weight and carapace length by the formula $W = 0.7079C^{2.770}$, based on 183 observations. The formula according to Subrahmanyam (1967) is

$$W = .0000495L^{2.7867},$$

where L refers to total length.

3.5 Behaviour

3.5.1 Migration and local movements

Juveniles migrate from the sea to backwaters and estuaries, but not to the same extent as some other species like *M. dobsoni* and *Penaeus indicus*. In the Cochin backwaters, juveniles of this species are present in very small numbers in most months, but it is probable that most of the postlarvae do not leave the sea.

In the offshore shrimping grounds off Cochin, George, Banerji and Mohamed (1968) recorded some movements. According to them this species and others move to deeper waters during the monsoon period and return after the monsoon.

Subrahmanyam (1965) studying the migration of the species in the Godavari estuarine system on the east coast of India, found more emigration of the species during the night. According to him, intense emigration was in April, May and early June. Immigration was noticed to be most marked at dawn.

3.5.2 Schooling

Large concentrations of this species are known to occur in shoals, along with other species, in the mud bank areas off the southwest coast of India and also in the shrimping grounds of the coast.

3.5.3 Reproductive habits

Observations have been made by Hudinaga (1942) on spawning behaviour in captivity (see section 3.1.6) but there are no other accounts of reproductive habits.

4 POPULATION (STOCK)

4.1 Structure

4.1.1 Sex ratio

Menon (1957) has described in detail the sex ratio of the species from the inshore catches of the southwest coast of India. The sex ratios according to him are shown in Table I.

TABLE I

Percentage of males in total catch and the same for specimens of over 120 mm

| Year | Total catch | Over 120 mm |
|------|-------------|-------------|
| 1952 | 52.2 | 47.2 |
| 1953 | 50.4 | 47.5 |
| 1954 | 52.0 | 39.0 |
| 1955 | 44.2 | 44.2 |

According to him, the population of immature prawns (up to 120 mm) contains similar numbers of each sex. Among older prawns (above 120 mm), however, there is considerable disparity, females outnumbering males by 11.6 percent. Subrahmanyam (1967) found females dominating in the catches from Calicut waters.

George and Rao (1967) statistically analysed the data on sex ratios of the species in the offshore trawl fishery off Cochin, and found that, unlike 3 other co-existing species, the two sexes were present in similar numbers throughout the year. Any migration from these grounds must therefore involve similar numbers of each sex. In Bombay waters, Shaikhmahmud and Tembe (1960) recorded more females throughout the year, especially during the months of October, November and December.

4.1.2 Age composition

George (1961) and George et al. (1968a) have mentioned the age composition of the species in catches of both the inshore and offshore fisheries off Cochin. In both cases the fishery is sustained by the 1st and 2nd year classes. In the trawl fishery, the 2nd year classes generally enter the fishery in the earlier half of the season and the 1st year

classes make their appearance in the latter half. The late 0 year class is also represented in the inshore fishery in some months. In the backwater fishery only the 0 year class is represented. 3 year classes are represented in the coastal waters of Calicut (Subrahmanyam 1967). Males and females grow up to 105 mm, 135 mm, 155 mm and 115, 155 mm, 175 mm during the 3 years respectively.

4.1.3 Size composition

In the inshore fishery of the southwest coast of India (George, 1961), the prominent length groups are 71 to 75 mm and 81 to 85 mm in February to April. In November and December the prominent groups are 121 to 125 mm and 126 to 130 mm. In some years the mode reaches 136 to 140 mm in January or February.

In the trawl fishery (George et al., 1968a) from October to January larger sizes, with lengths between 121 and 140 mm, are represented in larger numbers than in the inshore fishery. Towards the middle of the season, i.e. after February, smaller sizes between 111 and 115 mm come into the fishery. In the Bombay fishery (Shaikhmahmud and Tembe, 1960) the species ranges in size from 45 to 156 mm in length.

4.3 Natality and recruitment

In the inshore fishery (George, 1961), recruitment of bigger specimens into the fishery commences in October. After December to January the smaller specimens get recruited into the fishery. In the offshore trawl fishery off Cochin also more or less the same pattern is observed (George et al., 1968a). Recruitment of postlarvae into the backwaters is on a small scale compared to other species.

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 details of the 'dol' nets and its operation have 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.

Powered boats use shrimp trawls of various sizes.

5.1.2 Fishing boats

The inshore fisheries are mainly operated from dugout canoes and plank-built boats with out-rigger. Powered fishing vessels are generally medium sized 7 to 11 m pablo boats, having 10 to 30 bhp engines.

5.2 Fishing areas

5.2.1 General geographic distribution

The species is fished in Indian waters, particularly on the west coast, and round the coasts of Ceylon and Malaysia.

5.2.3 Depth ranges

Juveniles are fished in small numbers in the backwaters and estuaries, including paddy fields, of the west coast of India in shallow waters ranging from 1 to 5 m.

Young adults and adults are caught from depths up to about 30 fm (54 m) from the sea. In the trawl fishery off Cochin, George et al. (1968a) reported a concentration of the species in the 10 to 11 fm (18 to 20 m) depth region.

In Bombay (Shaikhshahud and Tembe, 1950), the depth from which these prawns are caught ranges from 4 to 7 fm (7 to 13 m).

The Singapore pond, from which Hall (1962) recorded this species, had an average depth of 4 ft (1.2 m) at high tide.

In Ceylon, *M. affinis* is found in 8 to 12 fm (14 to 22 m) (De Bruin, 1965).

5.3 Fishing seasons

5.3.1 General pattern of season

The fishery for *M. affinis* tends to be seasonal in all areas where it occurs, but the periods of peak abundance vary between the different fisheries.

5.3.2 Duration of fishing season

See section 5.3.3

5.3.3 Dates of beginning, peak and end of season

In the Singapore pond fishery this species is represented sporadically by juveniles in April, May and June (Hall, 1962).

In the backwater fishery of Cochin the species is most abundant from January to June. The percentage contribution of the species, given by Menon and Raman (1961), is shown in Table II.

George (1961) gave the percentage contribution of the species to the inshore fishery of the southwest coast of India for 1956

TABLE II

Showing percentage values (numerical and weight) of *M. affinis* in the monthly catches in the stake net catches at Cochin from February 1957 to January 1958

| Months | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. |
|-----------|------|------|------|------|------|------|------|-------|------|------|------|------|
| By weight | 9.5 | 10.3 | 9.9 | 5.9 | 12.7 | 0.5 | - | - | 2.5 | 1.4 | 5.9 | 13.4 |
| By number | 11.4 | 15.3 | 15.3 | 11.4 | 16.9 | 2.1 | 2.1 | 0.4 | 1.6 | 5.2 | 6.9 | 15.8 |

through 1960. Its highest percentage is recorded in the post-monsoon months, November and December, and it is fished from October to May.

The peak season for the species in the trawl fishery off Cochin (George *et al.*, 1968a) is from December to February. Detailed distribution of the species from 1958 through 1963 is given by them. In Bombay waters (Shaikhmahsud and Teabe, 1960), although the species is available throughout the year it is more plentiful from January to March. In 1952 to 1954 the species formed 12.3 percent of the Bombay prawn catch. In Calicut inshore waters the fishing season is January to August (Subrahmanyam, 1967).

5.3.5 Factors affecting fishing season

The inshore fishery on the Malabar coast intensifies after the annual formation of mud banks, on which the prawns concentrate. The fishery in the backwaters of Kerala is probably influenced by rainfall and lunar periodicity (Nenon and Raman, 1961). Subrahmanyam (1967) found a positive relationship between bottom salinity and abundance of the species.

5.4 Fishing operations and results

5.4.1 Effort and intensity

George (1961), studying the prawn fishery of three centres of the Kerala coast for the years 1956 through 1960, used the total effort and intensity of fishing and established a relationship between catch-per-man-hour and recruit sizes. *M. affinis*, however, makes only a minor contribution to this fishery.

In the trawl catches of Cochin, George *et al.* (1968a) studied the effort and intensity of fishing through the years 1958 to 1963 and concluded that there is no overfishing in the area. In Table III the catch and effort for one season is shown.

TABLE III

Total catch and catch per hour of *Metapenaeus affinis* in the trawl catches for the season 1959-60

| Year | Month | Percentage by weight | Total catch of prawns (kg) | Total effort in hrs | Catch of <i>M.affinis</i> | Catch per hour for all prawns (kg) | Catch per hour for <i>M.affinis</i> (kg) |
|------|----------|----------------------|----------------------------|---------------------|---------------------------|------------------------------------|------------------------------------------|
| 1959 | November | 20.8 | 2306 | 301.17 | 479 | 8.0 | 1.6 |
| | December | 28.9 | 10027 | 430.00 | 2898 | 23.0 | 6.7 |
| 1960 | January | 49.6 | 22725 | 491.25 | 11272 | 46.0 | 22.9 |
| | February | 28.3 | 50113 | 692.68 | 14182 | 72.0 | 20.5 |
| | March | 55.8 | 14119 | 608.75 | 7878 | 23.0 | 12.9 |
| | April | 20.8 | 18944 | 660.42 | 3940 | 29.0 | 6.0 |
| | May | 29.2 | 20712 | 387.33 | 6048 | 54.0 | 15.6 |

5.4.2 Selectivity

None of the fishery as it exists at present is very selective as regards size or species.

5.4.3 Catches

Tham Ah Kow (1954) gave the total prawn catch (including this species) from a 20 acre prawn pond in Singapore, and Hall (1962) gave the weight of prawns (again including *M. affinis*) passing through Singapore markets in 1952 to 1954.

George (1961) and George *et al.* (1968a) gave the total catches of prawns, including this species, for certain Indian areas. Nenon and Raman (1961) gave total catches of prawns at two centres in the backwaters of Cochin.

Subrahmanyam (1965) gave the total catches of this and other species for the new moon and full moon periods in the Godavari estuarine system, on the east coast of India. He also gave high tide and low tide catches of the prawns.

5.5 Fisheries management and regulations

In southwest India, the paddy field fishery is legally restricted to the period from the middle of November to the middle of April. This regulation is imposed in the interests of rice cultivation, and not to protect the prawn stocks.

5.6 Fish farming, transplanting and other intervention

In the paddy fields of Kerala, prawns may be held in the fields for a few days before trapping, but this is mainly to wait for a convenient tide. A few decades ago, young prawns were allowed to grow in the paddy fields for 2 or 3 mo before trapping, but this practice is no longer followed.

6 REFERENCES

- Alcock, A., The prawns of the *Penaeus* group. In Catalogue of the Indian decapod Crustacea in the collection of the Indian Museum. Calcutta, Part 3, Maorura, Fasc. 1, 55 p.
1906
- Burkenroad, N.D., Comments on the petition concerning penaeid names (Crustacea, Decapoda)
1963 (2.N(S.)962). Bull.zool.Nomencl., 20(3):169-74
- Dall, W., A revision of the Australian species of Penaeinae (Crustacea, Decapoda: Penaeidae). Aust.J.mar.freshwat.Res., 8(2):136-231
1957
- De Bruin, O.H.P., Penaeid prawns of Ceylon (Crustacea, Decapoda, Penaeidae). Zool. Meded., Leiden, 41(4):73-104
1965
- de Man, J.G., The Decapoda of the Siboga expedition. Part 1. Family Penaeidae.
1911 Siboga Exped., 39a:131 p.
- George, M.J., Studies on the prawn fishery of Cochin and Alleppey coast. Indian J. Fish., 8(1):75-95
1961
- _____, Synopsis of biological data on *Metapenaeus monoceros* (Fabricius). FAO Fish.Rep., (57)Vol.4:1539-57
1970
- George, M.J. and P.V. Rao, Distribution of sex ratios of penaeid prawns in the trawl fishery of Cochin. Symp.Ser.mar.biol.Ass.India, 2(2):698-700
1967
- George, M.J., S. K. Banerji and K. H. Mohamed, Size distribution and movement of the commercial prawns of the southwest coast of India. FAO Fish.Rep., (57) Vol.2:265-84
1968
- George, M.J., R. Raman and P.K. Nair, Observations on the offshore prawn fishery of 1968a Cochin. Indian J.Fish., (1963),10A(2):460-99
- Hall, D.N.F., The Malayan Penaeidae (Crustacea, Decapoda). Part 1. Introductory notes on the species of the genera *Solenocera*, *Penaeus* and *Metapenaeus*. Bull. Raffles Mus., 27:68-90
1956
- _____, Distinctions between *Metapenaeus monoceros* (Fabr.) and *Metapenaeus ensis* (de Man) (Crustacea, Decapoda). Ann.Mag.nat.Hist., 1(8):537-44
1958
- _____, Observations on the taxonomy and biology of some Indo-West Pacific Penaeidae (Crustacea, Decapoda). Fish.Publs.colon.Off., 17:229 p.
1962
- Holthuis, L.B. and H. Rosa, Jr., List of species of shrimps and prawns of economic value. FAO Fish.tech.Pap., (52):21 p.
1965
- Hudinaga, M., On the nauplius stages of *Penaeopsis monoceros* and *Penaeopsis affinis*.
1941 Proc.scient.Fishery Ass.,Tokyo, 8(3-4)
- _____, Reproduction, development and rearing of *Penaeus japonicus* Bate. Jan.J. Zool., 10(2):305-93
1942
- Kemp, S., Fauna of the Chilka Lake. Crustacea Decapoda. Mem.Indian Mus., 5(3):201-325
1915
- Lantheater, W.F., On the Crustacea collected during the Skeat Expedition to the Malay Peninsula, together with a note on the genus *Actaeopsis*. Part 1. Brachyura, Stomatopoda, and Maorura. Proc.zool.Soc.London, 1901:534-74
1901
- Menon, M.K., Contributions to the biology of penaeid prawns of the southwest coast of India. 1. Sex ratio and movements. Indian J.Fish., 4(1):62-74
1957

- Menon, M.K. and K. Raman, Observations on the prawn fishery of the Cochin backwaters
1961 with special reference to the stake net catches. Indian J.Fish., 8(1):1-23
- Milne Edwards, H., Histoire naturelle des crustacés, comprenant l'anatomie, le physiologie et le classification de ces animaux. Paris, Vol.2, 532 p.
1837
- Mohamed, K.H., P. V. Rao and M. J. Georg, Postlarvae of penaeid prawns of southwest
1968 coast of India with a key to their identification. FAO Fish.Rep., (57)
Vol.2: 487-503
- Pradhan, L.B., Mackerel fishery of Karwar. Indian J.Fish., 3(1):141-85
1956
- Racek, A.A. and W. Dall, Littoral Penaeinae (Crustacea Decapoda) from northern Australia,
1965 New Guinea and adjacent waters. Verh.K.ned.Akad.Wet., 56(3):1-119
- Rao, P.V., Maturation and spawning of the penaeid prawns of the southwest coast of India.
1968 FAO Fish.Rep., (57)Vol.2:285-302
- Setna, S.B., Bombay fishermen's ingenuity. J.Bombay nat.Hist.Soc., 36:887-97, 40(3):
1949 444-9
- Shaikhmahmud, F.S. and V.B. Tenbe, Study of Bombay prawns: the seasonal fluctuation
1960 and variation in abundance of the commercially important species of
Bombay prawns with a brief note on their size, state of maturity and sex
ratio. Indian J.Fish., 7(1):69-81
- Subrahmanyam, C.B., Notes on the bionomics of the penaeid prawn Metapenaeus affinis
1967 (Milne Edwards) of the Malabar coast. Indian J.Fish., (1963), 10A(1):11-22
- Subrahmanyam, M., Lunar, diurnal and tidal periodicity in relation to the prawn abundance
1965 and migration in the Odavari estuarine systems. Fishery Technol., Ernakulam,
2(1):26-33
- Thao Ah Kow, The shrimp industry of Singapore. Proc.Indo-Pacif.Fish.Coun., 5(2-3):145-55
1955
- Wood-Mason, J. and A. Alcock, Natural history notes from H.M. Indian marine survey
1891 steamer INVESTIGATOR. Ann.Mag.nat.Hist., 8(6):268-86
- Yasuda, J., Shrimps of the Seto Inland Sea of Japan. Proc.Indo-Pacif.Fish.Coun., 6(3):
1956 378-86