

NOTES ON THE BIONOMICS OF THE PENAEID PRAWN *METAPENAEUS AFFINIS* (MILNE EDWARDS) OF THE MALABAR COAST.

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Metapenaeus affinis (M. Edw.) is one of the three species of *Metapenaeus* represented in the fishery on the Malabar coast. This species enjoys a wide distribution in the Indo-Pacific region, occurring all along the Indian coast, Tokyo to Formosa, in waters of Hawaiian Islands (Kubo, 1949) and along Southern Africa (Barnard, 1950). The bionomics of *M. dobsoni* and *M. monoceros* are known in some detail through the publications of Menon (1951 & '55), Menon and Raman (1961) and George (1959 & '61). The available information on *M. affinis* is limited to a reference to its occurrence along the Travancore coast by Chopra (1943), an account of its fluctuations in abundance in Bombay waters by Shaikmahmud and Tembe (1960), a brief discussion of its sex ratio in Cochin waters and some observations on its fishery and biology on Cochin and Alleppey coast by George (1961). The following account of the biology of the species is based on the observations made at Calicut during the years 1957 to 1959.

Material for the study was obtained from the departmental collections twice a week. The gear employed was a boat seine, locally known as *paithu vala*, the description and mode of operation of which have been given by Bhimachar and Venkataraman (1952). Samples from commercial landings were also studied whenever available. While the departmental operations were limited to a depth of 12 metres commercial fishing extended up to a depth of 18 metres. A total of 200 to 300 prawns were collected every month, the males and females were sorted out and individual length was taken from the tip of the rostrum to the tip of the telson. The gonads were studied under a microscope to determine the stage of maturity. Percentage of mature prawns, numerical proportion, percentage by weight and sex ratio were calculated for each month.

The author is grateful to Shri P.R. Sadasivan Tampi and to Shri B. Krishnamoorti, Central Marine Fisheries Research Institute, for helpful criticism.

FISHERY AND FLUCTUATIONS IN ABUNDANCE

M. affinis starts appearing in the coastal waters in January and forms a small percentage of the commercial catches till the end of August. The proportion in the commercial landings whenever it occurred, amounted to 0.23 to 4.56% during the years 1957 and 1958. In the departmental catches the abundance varied from 0.3 to 14.36% and the ratio of the species to the total quantity of prawns was 2.52 and 2.91% respectively for the two years. January to April is the peak season and good numbers occur in August also. The fluctuations in abundance during the two years are set forth in Table I. That the numerical abundance was greater in the departmental collections suggests that the species is concentrated in shallow waters up to 12 metres during its sojourn in the coastal waters.

TABLE I

Occurrence and fluctuations in abundance of *Metapenaeus affinis* (M.-Edw.) in the Departmental collections and commercial fishery at Calicut during the years 1957-59

Year	Months	Departmental collections		Commercial Fishery	
		Percentage of prawns	Percentage of <i>M. affinis</i>	Percentage of prawns	Percentage of <i>M. affinis</i>
1957	January	4.00	1.20	0.10	..
	February	41.52	3.80	0.10	..
	March	43.23	4.60	18.10	..
	April	50.02	6.40	9.53	..
	May	46.67	..	41.65	0.52
	June	..	..	19.47	0.62
	July	60.86	1.40	25.30	1.32
	August	12.85	10.20	0.81	4.56
	September	30.04	..	0.05	..
	October	0.44	..	..	..
	November	15.62	..	..	..
	December	32.83	..	..	..
1958	January	47.05	1.94	0.24	..
	February	28.38	4.49	0.30	0.23
	March	24.37	5.75	2.29	..
	April	37.14	8.11	1.88	..
	May	43.52	2.10	1.16	..
	June	..	..	0.23	2.23
	July	9.77	0.31	17.77	..
	August	7.69	14.36	14.44	..
	September	5.60	..	11.79	..
	October	..	..	0.09	..
	November	0.11	..	0.08	..
	December	2.17	..	..	..
1959	January	3.57	28.57	..	..
	February	12.00	13.99	..	..

At Alleppey highest percentages of this species in the commercial fishery were noticed in November, December and March (George, 1961). It is of interest that this species formed as much as 66.7 to 96% by weight at these centres while the quantities caught commercially at Calicut were negligible.

An attempt has been made to study any possible relationship between the occurrence of the species and hydrological factors, such as bottom and surface salinity and temperature. The results are graphically represented in Figure 1 for the year 1958. It can be seen that the bottom salinity fluctuates only slightly while surface salinity falls considerably during the monsoon

months of May to July. Surface temperature follows the trend of salinity up to June. The fluctuations, of bottom salinity and in the abundance of the species, follow a similar pattern which suggests a positive relationship between these two factors. Temperature does not appear to have much influence.

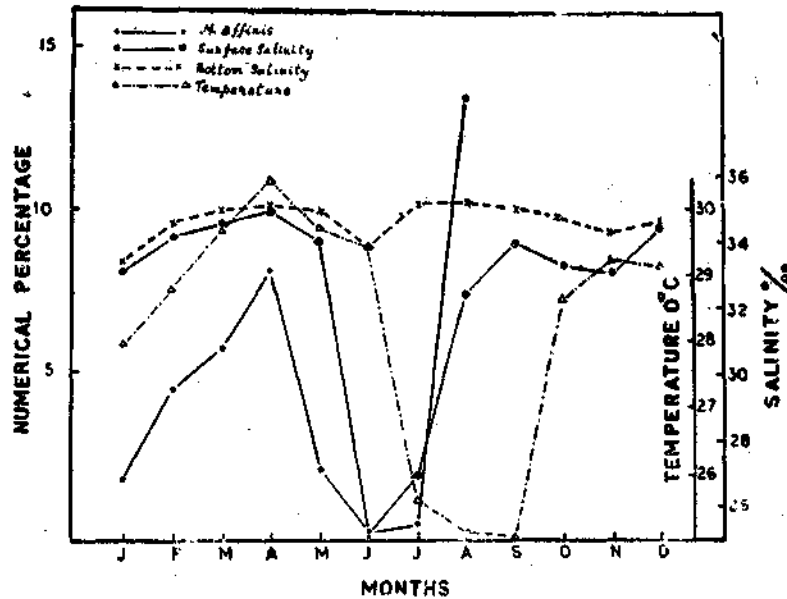


FIG. 1. Seasonal fluctuations in surface and bottom salinity, surface temperature and variations in abundance of *Metapenaeus affinis* in coastal waters off Calicut during the year 1958.

There have been diverse opinions regarding the occurrence of *M. affinis* in backwaters. Chopra (1943) reports its abundance in the backwaters of Travancore from January to May but Menon (1954) and Gopinath (1955) have not included this species among the others occurring in backwaters. However, recently Menon and Raman (1961) have reported the occurrence of this species in Cochin backwaters in small quantities, 1.0 to 20.1% by weight per month, almost throughout the year. The peak seasons appear to be November to April and June at Azhikal and January to June at Thevara. It is of interest that this species occurs throughout the year in the marine catches of Bombay (Shaikmahmud and Tembe, 1960).

LENGTH FREQUENCY STUDIES

Length frequency distribution for various months is set forth in Fig. 2. It can be seen that the prawns during the period June to August, 1957 are mostly juveniles measuring below 120 mm. The mode is at 56-60 mm. in June which shifts to 91-95 mm. in August. These prawns may belong to the brood of the same year as the breeding season of the species appear to extend from January to March (*vide infra*) and they may be 6 to 8 months old.

In January 1958, when the species reappears, more than one year class are represented in the collections in the length range of 31 to 170 mm. There are three distinct modal group (Fig. 2.) in that month, 96-100 mm. (a), 141-145 mm. (b) and 156-160mm. (c). The mode

a shifts to the right in the following months and reaches 106-110mm. in March. It is probable that this modal group and the one in August 1957 at 91-95 mm. represent the same year

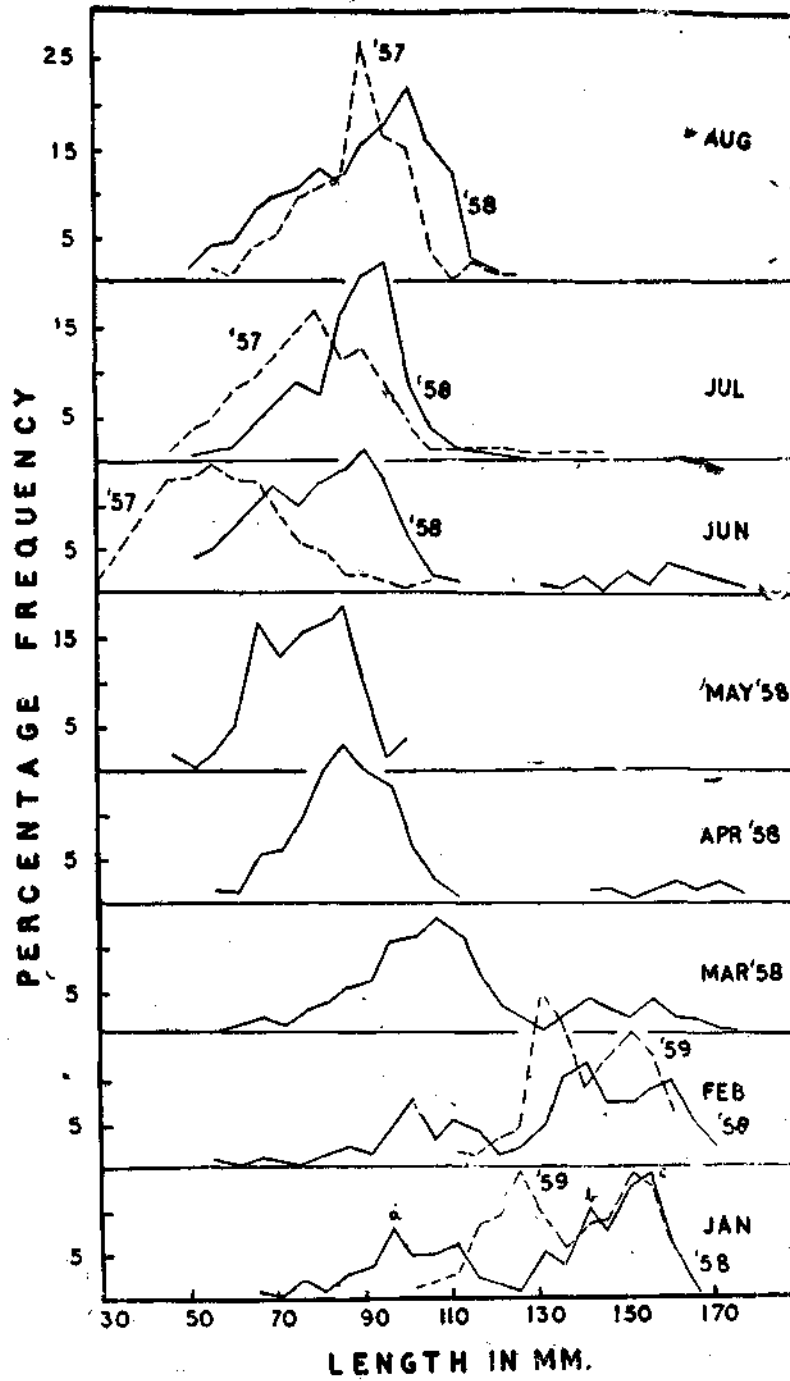


FIG. 2. Length frequency distribution of *M. affinis* for various months during the year 1957-1959.

class. The peak *b* remains stationary during the three months. Mode *c* shifts slightly to the right in February and moves back in March. It is probable that this modal group represents prawns of another year class. The difference between the modal groups *a* and *c* is 55 mm. and hence it is obvious that there should be yet another year class within this range. From April to August 1958 the juveniles are seen to dominate and the mode at 86-90 mm. in April reaches 101-105 mm. in August. The curves for June are drawn based on samples collected from commercial landings.

If the curves for 1959 are examined it can be seen that two modal groups are represented at 126-130 mm. and 151-155 mm. in January. The first mode shifts to 131-135 mm. in February. The two modes at 126-130 mm. and 131-135 mm. fit within the range of two modal groups mentioned already and hence prawns of these two size groups may belong to yet another year class. A minor mode at 131-135 mm. can also be seen in January 1958. Therefore, it can be concluded that three year classes are represented in the coastal waters of Calicut. It also appears that this species may probably live for three years or slightly more as the two other species of *Metapenaeus* (Menon, 1955 & George, 1959). In Seto Inland sea of Japan this species lives for about 16 months (Yasuda, 1955).

A comparison with the situation at Allepey and Chellanam regarding the biology of the species may be worthwhile at this context. During the year 1957-60 the modal groups were at 71-75 mm. and 81-85 mm. in February, March and during November to December the peaks were at 111-115 mm. to 136-140 mm. (George, 1961). This author designates the prawns in the size groups 136-140 mm. as 2-year class prawns. It is significant that prawns measuring above 140 mm. were not reported from these centres while they occurred at Calicut. The present study revealed that this species attains a length of 155 mm. (male) and 176 mm. (female) and therefore prawns in the modal groups of 131-135 mm. (male) and 151-155 mm. (female) belong to 1-year class and those measuring above belong to 2-year class. Therefore, it is probable that the prawns described by George as belonging to 2-year class may represent only 1-year class. Thus, in the experimental catches made at Calicut 0-year, 1-year and 2-year class prawns of *M. affinis* were available (Fig. 2).

Differential growth of sexes.

Length frequency patterns for males and females are set forth separately in Figure 3. Males show two modes during the period June to August 1957, at 76-80 mm. and 86-90 mm. There is only one mode in the corresponding period of 1958. From January to April 1958 there are two peaks at 101-105 mm. and 141-145 mm. If these two size groups represent males of two different year classes the range of 40 mm. is considerable. Hence there may be another year class. If the curve for January-February 1959 is compared it can be seen that the mode at 131-135 mm. fits into this range. Therefore, it is possible that this modal group represents prawns of another year class. From the foregoing it can be concluded that males grow up to 101-105 mm. during the first year, up to 131-135 mm. during the second year and up to 155 mm., which is the maximum length observed, during the third year of life.

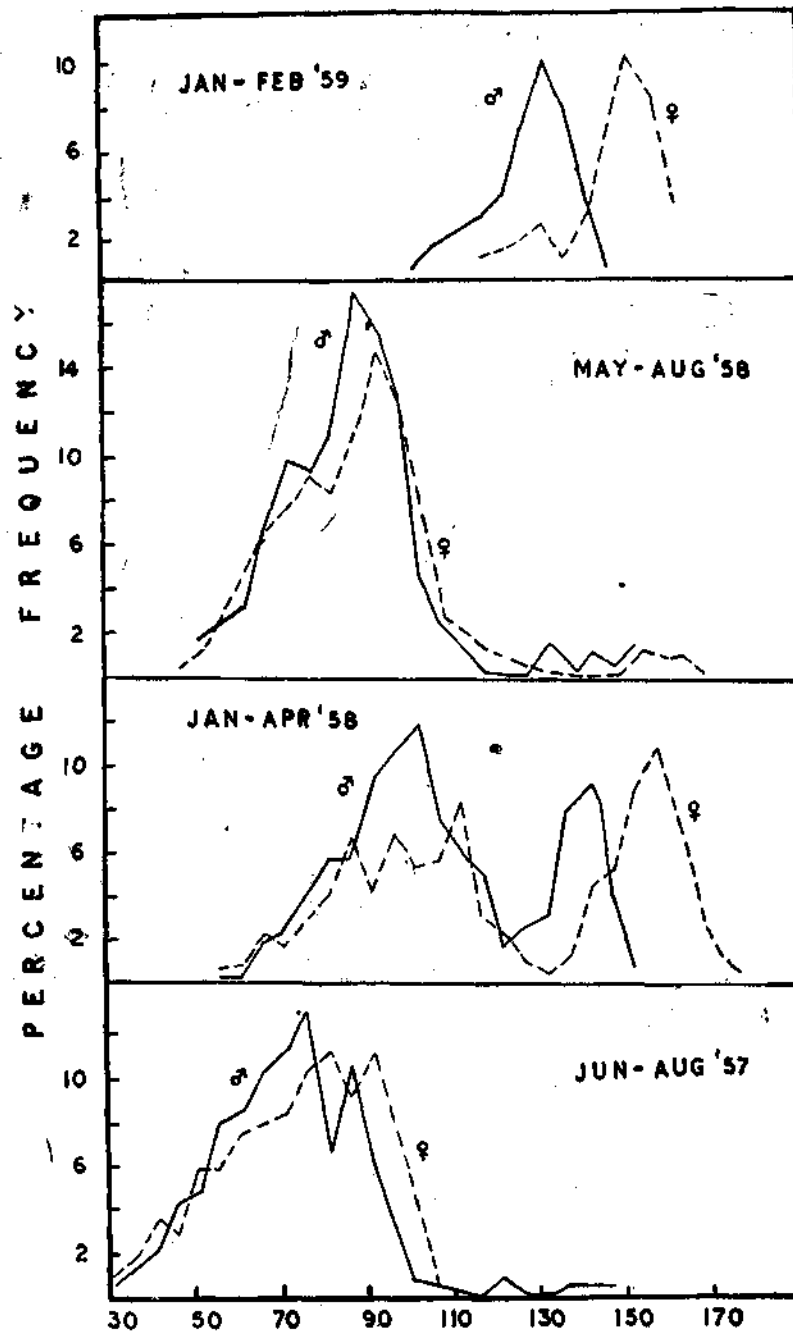


FIG. 3. Length frequency patterns of male and female *M. affinis* in different periods during the years 1957-1959.

Females show a slightly accelerated pace of growth. The modes at 81-85 mm, and 91-95 mm, during June -August 1957 are distinct. The peaks are at 111-115 mm, and 156-

160 mm. in January-April period of 1958, representing 0-year and 2-year class respectively. There is a mode at 151-155 mm. in the curve for January-February 1959 that may represent 1-year class prawns. Therefore, it can be concluded that females grow up to 111-115 mm. during the first year, up to 151-155 mm. during the second year and up to 176 mm., which is the maximum length observed, during the third year of life.

The differential growth rate and the disparity in the maximum size attained in the two sexes are observed in several other species such as *M. dohsoni* (Menon, 1955), *Parapenaeopsis stylifera* (Menon, 1953), several species in Japanese waters (Kubo, 1955) and *Crangon vulgaris*, *Leander serratus* and *Pandalus montagui* (Graham, 1959).

LENGTH WEIGHT RELATIONSHIP

The length weight relationship was established by taking the measurements of 625 specimens ranging from 31 mm. to 176 mm. in length. The total size range was divided into 30 groups with a class interval of 5 mm. The mean length and weights were calculated for each group from the observed data. The result is presented in Figure 4.

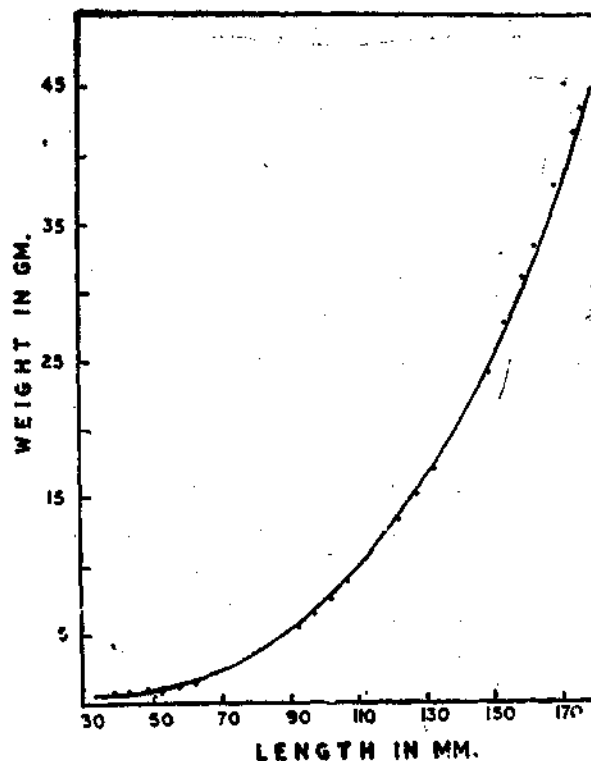


FIG. 4. Length Weight relationship of *Metapenaeus affinis*. The line represent the calculated weights and the dots represent the observed weights.

The conventional formula $W = a L^b$ has been applied to the data, where W is the weight, L the length and a and b are constants. The logarithmic relationship of length to weight is $\log W = -4.6873 + \log L 2.7867$.

From this formula the theoretical value of W for every given length was calculated. The observed and calculated values when plotted against their respective values of L are found to be in close agreement (Fig. 4). Thus, *M. affinis* shows a relationship of weight to the length slightly less than the cube value, i.e., 2.78, as found in other species such as *Leander styliferus* (2.88) (Kunju, 1955) and *M. monoceros* (2.76) (George, 1959).

FOOD

Stomach contents of several prawns ranging from 106 to 165 mm. were examined and the results are set forth in Table II. When the volume of food contents was small the entire amount was made up to 1 or 2 ml., the total recognizable organisms were counted and the percentages calculated. When the quantity of food was more it was made up to 5 ml. and an aliquot of 1 ml. was analysed.

TABLE II

The composition of the stomach contents of *M. affinis* (M. Edw.) of different sizes

Length groups (mm.)	106- 110	111- 115	116- 120	121- 125	126- 130	131- 135	136- 140	141- 145	146- 150	151- 155	156- 160	161- 165
Absolute volume of Food contents ml.	0.5	0.25	0.25	0.5	0.5	0.22	0.1	0.1	0.25	0.26	0.6	0.15
Food items	%	%	%	%	%	%	%	%	%	%	%	%
Diatoms	..	..	..	..	..	..	..	..	..	8.2	..	..
Algal filaments	12.5	..	..	5.0	13.3	10.5	..	..	..	4.2	..	..
Foraminifera	31.3	..	..	..	13.3	..	..	..	..	16.7	..	..
Nematodes	9.4	20.0	40.0	5.0	1.5	2.5	..	..	..	16.7	..	..
Bivalve shells	6.2	20.0	20.0	60.0	15.0	30.5	..	..	..	33.3	..	..
Gastropod shells	12.3	..	40.0	25.0	30.0	40.0	90.5	100	80.2	..	98.0	80.0
Copepods (remains)	9.4	..	..	..	15.0	3.0	..	..	..	4.2	..	..
Crustacean appendages	0.2	..	..	..	..	5.5	..	..	10.6	12.7	..	10.3
Amphipods (remains)	..	..	..	..	..	2.5	..	..	..	4.0	..	8.2
Debris and sand particles	..	60.0	..	5.0	0.2	5.5	9.5	..	9.2	..	2.0	1.5

It can be seen from Table II that this species is omnivorous. Algae and diatoms are found in a few specimens only and they do not form regular items of food. The diet appears to be predominantly made up of animals from the bottom such as nematodes, foraminiferans and molluscs. Copepods are also taken in certain quantities. Gastropods and bivalves form a large percentage of food, 12.5 to 98%, and in several prawns the stomachs were gorged with the shells of these animals. Older prawns appear to prefer a molluscan diet. Debris and sand particles are also found in the stomachs.

BREEDING AND MIGRATIONS

Breeding

When *M. affinis* start appearing in the coastal waters in January a sizable proportion of them are mature. In mature males the terminal ampoules of vasa deferentia appear white being packed with spermatophores. In ripe females the fully ripe ovaries, which are dark grey in colour, can be seen from the dorsal side through the cuticle. The ovaries of the spent females are whitish and devoid of any ova. Impregnated females can be identified by the whitish pads deposited by the males on the thelycum as in *M. dobsoni*. Percentages of such males and females for every month are presented in Table III. It can be seen that mature males and females form a significant proportion in the months of January to March 1958 and January and February 1959. They decline in numbers in April. The numerical abundance of spent females during the months of January to March (Table III) suggests that the species spawns during this period. A few mature specimens were also noticed in July 1957. Therefore, this species appears to breed annually like *Penaeus indicus* on the Madras coast (Subrahmanyam, 1963). However, eggs and larvae belonging to this species could not be collected from either the inshore or the offshore plankton of the coast. The breeding season of this species appears to last from October to December on the Cochin coast (George 1961).

TABLE III

The percentage of mature and immature males, ripe, unripe, impregnated and spent females and sex ratio of *M. affinis* (M.-Edw.) in various months off Calicut Coast during the years 1957-59

Year	Months	Sex Ratio		Percentage of males (By numbers)		Percentage of females			
		Males	Females	Immature	Mature	Unripe	Ripe	Impreg- nated	Spent
1957	June	47.4	52.6	100	Nil	100	Nil	Nil	Nil
	July	49.9	50.1	97.6	2.4	100	Nil	Nil	Nil
	August	42.9	57.1	97.4	2.6	100	Nil	Nil	Nil
1958	January	46.5	53.5	50.6	49.4	36.2	46.9	33.0	16.9
	February	40.0	60.0	37.3	62.7	44.3	42.6	42.5	13.1
	March	47.2	52.8	75.0	25.0	83.7	15.0	16.3	1.3
	April	43.3	56.7	96.3	3.7	88.4	6.3	5.3	2.3
	May	48.4	51.6	100	Nil	100	Nil	Nil	Nil
	June	38.7	61.3	98.2	1.8	97.6	2.4	Nil	Nil
	July	43.8	56.2	100	Nil	100	Nil	Nil	Nil
	August	46.4	53.6	100	Nil	100	Nil	Nil	Nil
1959	January	32.5	67.5	34.0	66.0	31.7	65.4	3.7	2.9
	February	47.7	52.3	11.1	88.9	12.9	48.4	54.8	38.7

Although the present data give an idea of the breeding season of *M. affinis*, evidence is lacking at present to show that it breeds in coastal waters. However, species of *Metapenaeus* off Australia (Racek, 1955) and *M. dobsoni* on the Malabar coast are reported to spawn in the inshore waters. More detailed investigations, especially on the planktotrophic larvae of the present species, are necessary to locate its breeding grounds. It is of interest that mature *M. affinis* occur during October to December and April to June in Bombay waters (Shaikmahmud and Tembe, 1960).

Attainment of maturity

The smallest mature male and female measure 120 mm. It has been shown that this species may grow up to 115 mm. during the first year of life and therefore, it appears to attain maturity during the second year of life.

Sexual union

Sexual union takes place in this species as impregnated females occur in the months of January to March. The whitish pads deposited on the thelycum distinguish such females. The smallest of such females measured 113 mm. and hence it is clear that sexual union takes place before females attain maturity. It resembles *M. dobsoni* and *Parapenaeopsis styliifera* in this respect. The smallest spent female measured 150 mm.

Sex ratio

It can be seen from Table III that females invariably dominate in the catches. Such an instance has also been reported by Menon (1957), especially in older groups. The preponderance of females appears to be a general feature in species of *Metapenaeus*.

Migrations

It has been mentioned earlier that this species occurs in backwaters also. When it appears in the coastal waters mature and spent females form a sizeable proportion from January to March. It can be seen from Fig. 1 that 1-year and 2-year class prawns occur from January to March and they disappear in April. Later on only the 0-year class prawn remain in the coastal waters till the end of August during which period they grow up to 115 mm. The absence of older prawns from April onwards might be due to fishing activity or due to their movements away from the shore. A similar phenomenon has been reported in *P. styliifera* (Menon, 1953). The juveniles also disappear in September. Although mature prawns appear in coastal waters as a regular sequence, from January to March, it cannot be said for certain whether such individuals actively migrate to the inshore waters during this period. If it performs such migrations the purpose is also not definitely understood. Further studies on this aspect are necessary to understand the migratory movements of this species. However, the minimum size-at maturity is 120 mm. and so the disappearance of the 0-year prawns in September may be due to their migration to deeper water for attainment of maturity. Similar migrations have been reported in *Crangon vulgaris*, *Leander serratus* and *Pandalus montagui* (Graham, 1959), *Penaeus setiferus* (Anderson, 1955), *M. affinis* and *M. joyneri* (Yasuda, 1955) and *Penaeus japonicus* (Kubo, 1955).

SUMMARY

Certain aspects of the biology of *Metapenaeus affinis* (M. Edw.) occurring along the Malabar coast, such as growth, length weight relationship, food, breeding and migration are presented.

The species occurs seasonally in the inshore environs and forms a small percentage of the commercial catches from January till the end of August. The fishery is constituted by the 0-year class.

The juveniles grow up to 115 mm. in the coastal waters. Males and females show different rates of growth. Males grow up to 105 mm., 135 mm. and 155 mm., and females up to 115 mm., 155 mm., and 176 mm. during the first, second and third year of their life respectively. The species may live for 3 years or slightly more.

The length weight relationship shows the normal pattern according to the formula $W = -4.6873 L^{3.7667}$.

The species is an omnivorous feeder and larger prawns show a preference to a molluscan diet.

When the species starts appearing in the coastal waters from January to March a good proportion of them are mature. From April onwards they are scarce in this area. Juveniles remain in this habitat till the end of August during which period they grow up to 115 mm. in length. Later on they disappear from the inshore area. The minimum size at maturity is 120 mm. and therefore they may migrate to deeper waters for the attainment of maturity. The breeding season extends from January to March.

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