

# NOTES ON THE BIONOMICS AND FISHERY OF THE PRAWN *METAPENÆUS DOBSONI* MIERS ON THE SOUTH-WEST COAST OF INDIA

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## INTRODUCTION

IN a previous paper (1951) an attempt was made to present a detailed account of the various larval stages of the penæid prawn *Metapenæus dobsoni*, together with brief notes on some aspects of its bionomics. Since then a considerable amount of data relating to the species has accumulated in the course of the investigations at Narakkal from October 1951 with special reference to the paddy field prawn fishery. When this fishery was not in operation, *i.e.*, from about the middle of April to about the middle of November, samples of prawn catches from backwaters have been studied in order that data on the species for the whole year would be available.

Regular collections of planktonic post-larvæ were made once a week from the main canal of this place with a view, among other things, to estimating their relative abundance or scarcity from month to month. These observations have served to settle some points regarding migration of the species that had to be left in doubt in the previous paper.

In the present paper those aspects of its bionomics that were either omitted or inadequately discussed, such as growth, length of life, sex ratio and migration, are dealt with on the basis of the fuller data now available. Some remarks on its fishery have also been added in view of its great economic importance.

## GROWTH

*Rearing Experiment.*—The results of some attempts at rearing post larvæ in the laboratory have been included in the earlier paper. Another similar experiment in the rearing of a first stage post-larva, carried out at the West Hill substation, lasted from 22-6-1950 to 24-5-1951, *i.e.*, about 11 months. It measured 67 mm. finally and was a male, with the petasma completely developed and fully formed spermatozoa inside the *vas deferens*, though spermatophores had not yet developed.

*Growth in backwaters.*—The rate of growth in their natural environments in the sea and backwaters and the probable duration of life have been

approximately estimated from length frequency curves for each month (lengths were measured from the tip of the rostrum to the extremity of the telson). Some of the relevant data and the conclusions drawn in regard to growth in backwaters have been discussed in another paper (1953). It has been pointed out there how the majority group has varied in length somewhat irregularly between 46–50 mm. and 56–60 mm. during the course of the paddy field operations from November to April, possibly because of the intense fishing during the period and the comparatively quick growth of the smaller groups. Material procured from the backwater catches during the remaining months has shown the majority group to have fallen in length in certain months to 41–45 mm. and not to have exceeded 51–55 mm. in the others. It is fairly clear therefore that the vast majority of the population belonging to this species do not grow beyond 60–65 mm. in length in the backwaters. Those growing beyond 70 mm. are quite few and have seldom formed more than 2.5% in any month in 1952–53. Even those belonging to the 66–70 mm. group make up only a small proportion as is seen from the following table:

TABLE I  
Monthly percentage values of length groups 66–70 mm. and 70–80 mm.  
in 1952–53 in the backwater catches

| L. group | Nov. | Dec. | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. |
|----------|------|------|------|------|------|-------|-----|------|------|------|-------|------|
| 66–70    | 6.9  | 1.8  | 0.7  | 8.2  | 3.0  | 0.6   | 0.7 | 0.3  | 0.4  | ..   | 1.0   | 0.1  |
| 70–80    | 1.7  | 2.1  | 0.5  | 2.5  | 0.9  | ..    | ..  | 0.3  | 0.4  | ..   | ..    | ..   |

*Growth in the sea.*—Monthly length frequency curves of the inshore Departmental catches at West Hill have been prepared for both the years. As the series for the second year is incomplete owing to the very poor catches in some months, only those of the first year (1949–50) are shown in Figs. 1 and 2. Fig. 3 shows the frequencies in some months of 1950–51 of the commercial catches marketed at Kozhikode.

The curve for July 1949 shows two principal modes at 41–45 mm. (A) and 96–100 mm. (B). From what has been said above regarding growth in backwaters it is evident that the former represents individuals of only a few months' growth. The age group which the second mode at B represents can be determined after the frequencies for the following months have been studied.

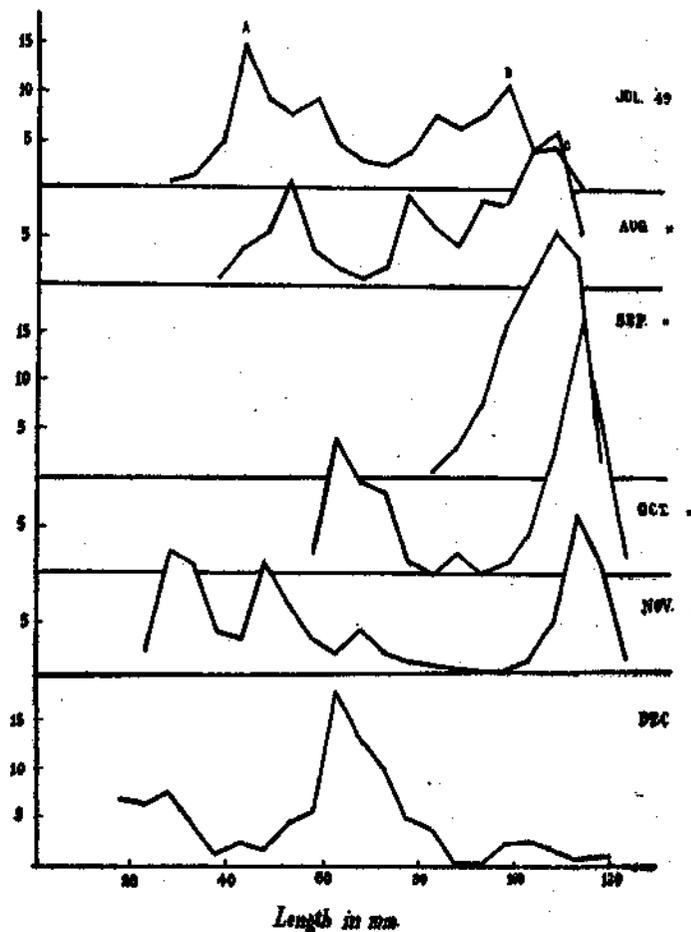


FIG. 1. Length frequencies in the Departmental catches made at West Hill substation in the year 1949-50.

In August and October mode A. has shifted to the 51-55 mm. and 61-65 mm. groups respectively, the curve for September showing no mode corresponding to it. This shift in its position may be partly due to growth and partly due probably to migration of larger individuals belonging to the same first year-class (0-year class). It shows no change in position in December, but in the following two months has moved to the 66-70 mm. group. In March it is at 71-75 mm., in the next 2 months it remains at 76-80 mm., and in June is not represented.

The breeding period of the species along the Malabar coast is fairly long, extending from September to March or April and the generation whose growth has been followed above may, in all probability, have started their

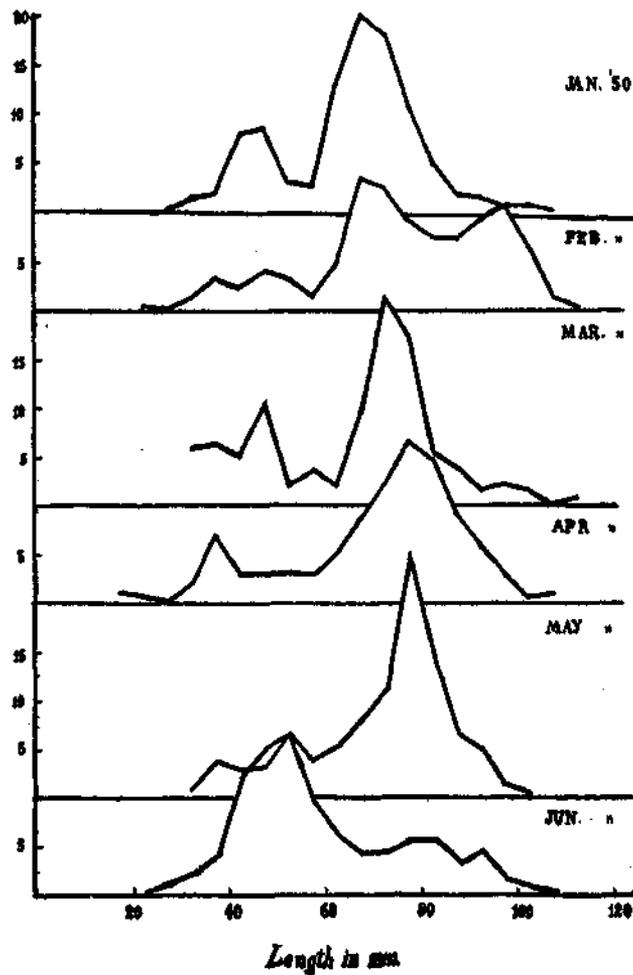


FIG. 2. Length frequencies in the Departmental catches made at West Hill substation in the year 1949-50.

development towards the close of the preceding breeding season. In the course of a year and some months a good portion among them have thus grown to a length of about 80 mm.

The mode at B in the curve for July 1949 may therefore represent prawns in the second year of their life (1-year class). The minor mode at 81-85 mm. and that at 76-80 mm. in the curve for August might also be regarded provisionally to represent groups of the same generation. In August and September there is a mode at 106-110 mm. and in the next two months a corresponding one at 111-115 mm. Whether these latter correspond to B in the curve for July 1949 and have shifted to the right as a result of growth, or

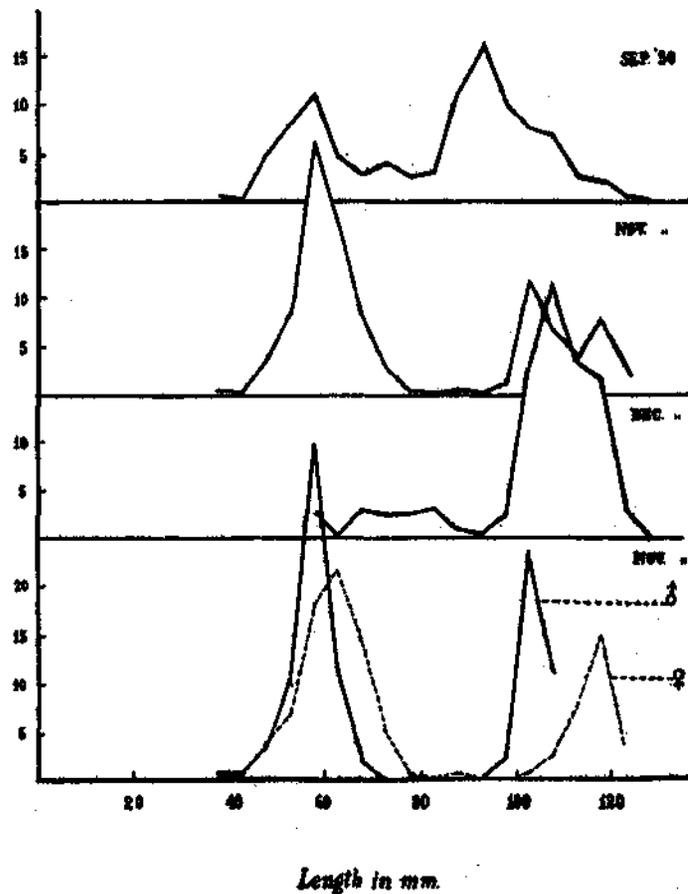


FIG. 3. Length frequencies in the commercial catches of some months in 1950-51 marketed at Kozhikode.

whether they correspond to the quite small one at C (in the same curve) is a point that has to be settled before estimating the extent of growth in the second year. It may be mentioned here that after November there is no comparable mode in the curves at any point to the right of those at 71-75 mm. and 76-80 mm. except in February, when the mode at 96-100 mm. reappears.

In Fig. 3 are shown the frequencies in the commercial catches of September, November and December 1950. As some of them come from different localities, sometimes from places quite distant from Kozhikode, the material may not be suitable for growth studies. It is interesting to note, however, that in September and November apparently two age groups are represented, one by the mode at 56-60 mm. and the other (older) by that at 91-95 mm. (September) or at 101-105 mm. and 116-120 mm. (November).

(The 2 modes at 101–105 mm. and 116–120 mm. in November represent the majority groups among males and females respectively of the same age as shown by the frequencies of the two sexes determined separately for that month.) In December there is only a single mode placed at 106–110 mm.

The curves, representing the frequencies of the two sexes for November 1950 separately, deserve special study here since they seem to have some interesting features. Each has 2 modes. They are at 56–60 mm. and 101–105 mm. in respect of the frequencies of males; but in the case of females they are at 61–65 mm. and 116–120 mm. The difference in length between the two age-groups represented by them, 45 mm. among males and 55 mm. among females, seems to be quite large so that the two age groups, which they doubtless represent, cannot possibly be successive ones. The group measuring 56–60 mm. belongs obviously to the first year-class (0-year-class). It is very likely that the other represents the third year class. If this inference proves correct then the second year class is practically unrepresented in that month's catch.

Figs. 4 and 5 show the length frequencies in the marine catches at Narakkal from May to October 1953. The frequencies in the catches of 1952 have not been taken into consideration here as the catches in certain months were extremely poor. In the curve for each month there is a mode placed at 61–65 or 56–60 mm. representing the first year class. In July it is placed at 51–55 mm. and is not very prominent. But there are 2 other modes in the curve for that month, at 81–85 mm. and 101–105 mm. Separate curves drawn for the frequencies of the two sexes in the same month also show these three modes. In respect of males they are at 51–55 mm., 81–85 mm. and 101–105 mm. When this is compared with the curves for the frequencies of the same sex in November 1950 (Fig. 3) it is seen that the modes at the left and right almost coincide and the inference that they represent the first and third year classes seems to be supported by the mode at the middle of the curve (81–85 mm.) for July 1953. This would then represent the second year class, since it has already been shown in a previous paragraph that the species grows to about 80 mm. in the course of a year and a few months. The frequencies of females also show the same three year-classes by the modes at 61–65 mm., 81–85 mm. or 86–90 mm. and 111–115 mm.

The data derived from rearing experiments and length frequency studies discussed in the foregoing paragraphs thus seem to show fairly clearly that prawns of this species live for about three years. It is also possible to indicate in a rough way the extent of growth during each year.

TABLE II

Showing growth of the two sexes during the 1st, 2nd and 3rd year of their lives

| Sex | 1st year        | 2nd year          | 3rd year      |
|-----|-----------------|-------------------|---------------|
| ♂   | About 70 mm.    | About 90-95 mm.   | About 110 mm. |
| ♀   | About 75-80 mm. | About 100-105 mm. | About 120 mm. |

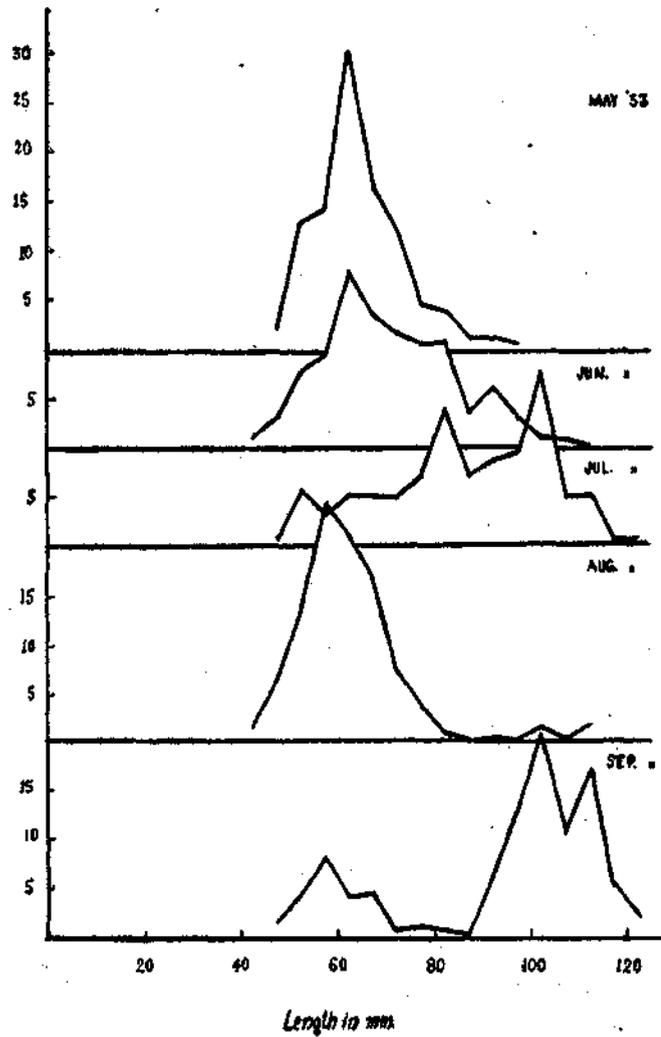


FIG. 4. Length frequencies in the marine catches at Narakkal in 1953.

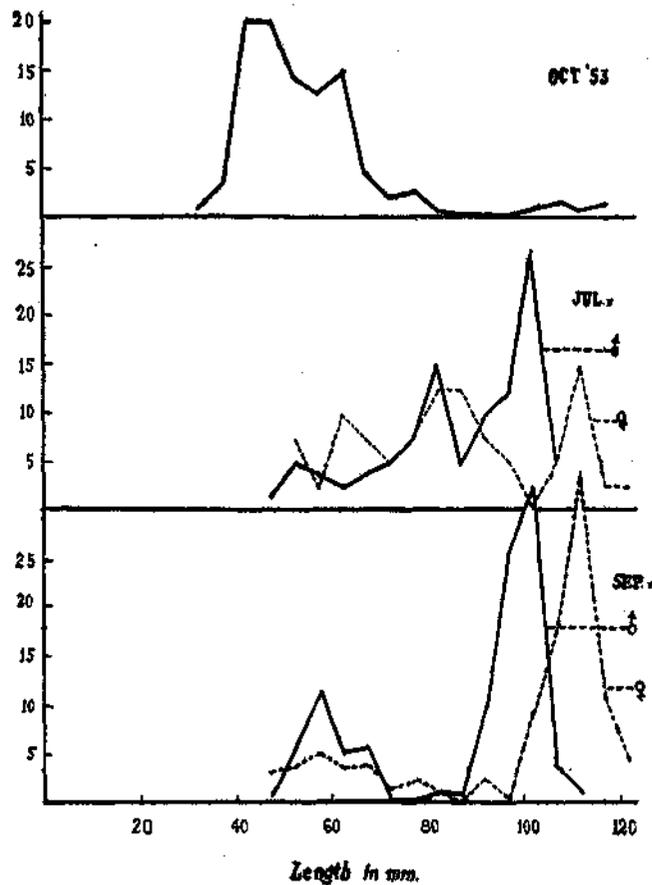


FIG. 5. Length frequencies in the marine catches at Narakkal in 1953.

*Differential growth of the sexes.*—The approximate estimates of growth during the three years of their lives make it evident that the rate of growth of females is definitely higher and it becomes apparent quite early in life, even before they have reached a length of about 50 mm., as the frequencies of the two sexes for November 1950 seem to indicate. Such growth would naturally give rise to differences in the maximum length reached by them. Differential growth rate similar to this has been recorded in *Parapenaeopsis stylifera* (Menon, 1953) among penaeids and *Crangon vulgaris* (Lloyd and Yonge, 1947) and *Crangon franciscorum* and *Crangon nigricauda* Israel (1936) among other prawns.\* The largest females obtained so far measured 124 mm.

\* In *Leand. serratus* Pennant, Forster has noted (J.M.B.A., Vol. 30, 1<sup>c</sup>) that females outstripped the males in their second summer's growth.

while males measured only 111 mm., though an exceptional specimen caught at West Hill was as much as 118 mm. in length.

The percentage of males and females measuring 100 mm. and over in the total number of each sex measured has been calculated separately for Kozhikode (only for 1950-51) and Narakkal and is shown below.

TABLES III AND IV  
Showing the percentage of females and males measuring  
100 mm. and over

| FEMALES      |                    |  |            |
|--------------|--------------------|--|------------|
| Locality     | Total No. measured | Those measuring<br>100 mm.<br>and over | Percentage |
| Kozhikode .. | 2636               | 368                                    | 12.1       |
| Narakkal ..  | 1394               | 278                                    | 20.0       |

| MALES        |                    |  |            |
|--------------|--------------------|--|------------|
| Locality     | Total No. measured | Those measuring<br>100 mm.<br>and over | Percentage |
| Kozhikode .. | 2445               | 183                                    | 7.5        |
| Narakkal ..  | 1278               | 160                                    | 12.5       |

The proportion of females of the specified size is markedly higher than that of males. It is also seen that the percentage of such individuals of both sexes is remarkably higher at Narakkal. Since the size chosen for both sexes would include almost entirely only the third year class, these percentages would also indicate that the proportion of prawns surviving to pass into the third year of their lives is quite small. It has been remarked in the previous paper (when discussing growth) that the dominant size groups in the catches examined at Kozhikode came between 60 and 80 mm. This may therefore partly explain how only a comparatively small number survives to grow to this length.

## SEX RATIO

The sex ratio in the catches from the sea at West Hill (1950-51), at Narakkal (1952 and 1953) and from the paddy field and backwaters (1951-52 and 1952-53) has been determined separately and is as follows:—

TABLE V  
*Showing sex ratio in the catches of M. dobsoni at Narakkal and West Hill*

|   | Paddy field and backwater catches |         | Marine catches |       |           |
|---|-----------------------------------|---------|----------------|-------|-----------|
|   |                                   |         | Narakkal       |       | West Hill |
|   | 1951-52                           | 1952-53 | 1952           | 1953  | 1950-51   |
| ♂ | 48.8%                             | 51.1%   | 47.1%          | 48.7% | 48.1%     |
| ♀ | 51.2%                             | 48.9%   | 52.9%          | 51.3% | 51.9%     |

The proportion of females is slightly higher than that of males except in the paddy field and backwater catches of 1952-53. These figures are for the entire catch, comprising all frequencies. The ratio among those measuring 100 mm. and over has also been calculated. In the catches of 1950-51 at West Hill the ratio of such males to females was 36.5:63.5. In the Narakkal catches the ratio was 29.3:70.9 in 1952 and 43:57 in 1953. The proportion of females of this size is thus much higher at both places and may probably be the result of the larger number belonging to that sex that survives into the third year.

## BREEDING AND MIGRATION

It was not possible to collect evidence on the breeding of the prawn at Narakkal by following the occurrence of larvæ in the marine plankton and of females with well-developed or ripe ovaries. But evidence of another type, namely the occurrence of post-larvæ, particularly the earlier stages, in the canal plankton, was available. Weekly collections, made regularly during the last two years, have revealed the occurrence of such post-larvæ practically throughout the year and in large numbers in certain months.

In Fig. 6 are shown the approximate numbers secured in each of the four samples of every month from January to December of 1953. (In order to permit quantitative studies the duration of each haul and distance covered in each haul have been made approximately constant.) In January, February

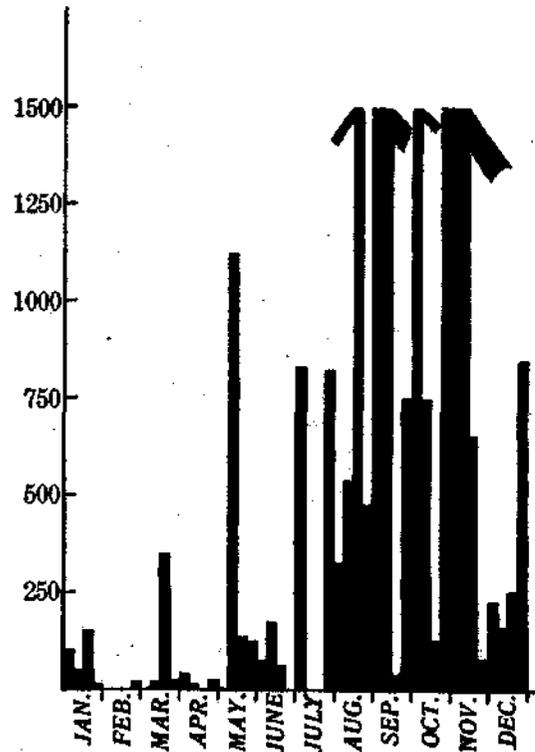


FIG. 6. Approximate numbers of the post-larvae of *M. dobsoni* collected week by week from the canal during 1953.

and April the numbers caught are few; but in all other months considerable numbers were captured, although in certain weeks the catches have been quite poor. Such fluctuations from week to week are bound to occur since the strength of the tidal flow in the canal at the time of collection varies very considerably, affecting appreciably the number of certain groups of organisms collected.

The occurrence of these fry in the canal and backwaters should necessarily imply that the species has been breeding at the time, though no evidence is yet available to indicate that it breeds anywhere within the backwaters themselves. May to December is the period when large numbers have been obtained and presumably therefore the maximum numbers breed at the time. It would thus seem that the breeding season commences somewhat earlier here than at West Hill, though its peak, August to December, coincides roughly at the two places.

Though occurring in the backwaters and canals, they should have actually migrated there from the sea, since nowhere else have they been discovered

to breed so far. The length frequencies in a sample captured on 5-3-52 are shown in Fig. 7. Over 70% of those measured were 4-6 mm. in length. The first stage post-larvæ are approximately 3-3.5 mm. in length and are

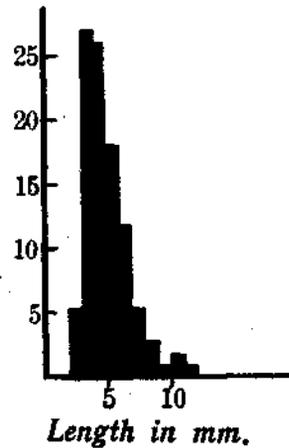


FIG. 7. Length frequencies in a collection of post-larvæ made on 5-3-52.

also represented in the collection; but they formed only about 5.5%. Migration, it would thus appear, commences when they are probably in the second stage and quite a large proportion passes into such brackish water areas before they reach a length of about 7 mm. Throughout the breeding season, therefore, immense numbers of these fry would be continuously passing into these waters from the sea. The suggestion made in the earlier paper that migration takes place when the young have reached the size of 15-25 mm. therefore requires to be corrected in the light of the observations recorded in this paragraph.

#### FISHERY

*Backwater fishery.*—*M. dobsoni* ranks high among the commercially important species of penæid prawns occurring along the south-west coast of India, contributing a good portion of the catches practically throughout the year. It is one of the two species making up the bulk of the catches from the brackish water lakes (backwaters) and canals stretching along the southern half of this coast, wherein prawn fishing is carried on all the year round. In the northern taluks of the state of Travancore-Cochin the paddy fields bordering them serve as rich prawn fishing grounds from about the middle of November to the middle of April every year, when no paddy cultivation is done. The yield per acre during this short period may vary from 700 lbs. to 1,900 lbs. according to the quality and situation of the land. A fairly full account of the paddy field fishery and the quantitative observations

carried out by the Prawn Research Unit during the years 1951-53 is in course of publication.

The proportion of the present species in the monthly catches from such a field during the two seasons 1951-52 and 1952-53 has been indicated in the paper referred to above. These and the figures for the remaining months obtained by analysing samples from the backwater catches are presented in the following table:

TABLE VI

*Showing the percentage values (numerical) of M. dobsoni in the monthly catches from paddy fields and backwaters*

| Year    | Nov. | Dec. | Jan. | Feb. | Mar. | April | May  | June | July | Aug. | Sep. | Oct. |
|---------|------|------|------|------|------|-------|------|------|------|------|------|------|
| 1951-52 | ..   | 74.6 | 81.6 | 80.8 | 79.2 | 84.5  | ..   | ..   | 47.0 | 74.8 | 75.4 | 91.3 |
| 1952-53 | 87.9 | 82.3 | 89.8 | 89.5 | 87.1 | 45.7  | 42.1 | 29.6 | 46.6 | 66.5 | 71.3 | 80.8 |

These percentage values make it quite clear that *M. dobsoni* is the dominant species in the prawn fauna of the backwaters in all but three months and its great importance in the prawn industry of this place can therefore be easily realised.

Panikkar (1937) has described some of the methods of prawn fishing generally adopted in these backwaters. The major portion of the catches is undoubtedly obtained by means of stake-nets, Chinese nets and cast nets. Stake-net fishing is carried on wherever the tidal flow is strong; the nets are usually fixed at the commencement of the ebb tide and hauled up when the high tide sets in. Though this type of fishing is not exclusively meant for the capture of prawns, they nevertheless form the bulk of the catches. The fishing goes on practically throughout the year, except when there are high floods during the monsoon period of June, July and August. At such times the swift currents and the mass of floating debris may cause damage to the nets and the operation therefore has necessarily to be stopped. A small annual licence fee of Re. 1-Rs. 3 is levied by the Travancore-Cochin Government for every net (actually for every pair of stakes).

An account of the Chinese net, with photographs to illustrate how it is worked, will be found in the paper cited above. It is only necessary to add here that it is used in the Cochin backwaters during daytime also and, like the stake-nets, is worked throughout the year.

Cast nets are used in the shallow regions of the backwaters and in the network of canals connected with them. Prawns form the major portion

of the catches. During the monsoon months, however, canal water becomes practically fresh and in consequence, prawns are quite scarce.

Another interesting method employed for catching prawns alone in shallow water is the one known as 'Pachil' locally. It has been recently described by Gopinath (1953). It is used not only in the Kayamkulam and Vembanad lakes as noted by him, but also in the backwaters and connected canals in the northern district of Travancore-Cochin.

Prawns are also caught in drag nets and by hand.

*Marine Fishery.*—The marine fishery is largely seasonal. At Kozhikode and its neighbourhood few prawns are noticed in the markets during several months, from about February to May. From a study of the departmental catches made at the West Hill substation (1949–51) and samples brought from the markets in Kozhikode it has been ascertained that in June and July and again in November and in the two following months *M. dobsoni* is relatively abundant in the commercial catches. During the warmer months of the year, especially when the sardine and mackerel fisheries are operating, fishermen seldom go for other fish, unless there is a temporary stoppage in that activity. Prawns and a variety of small fish are caught in boat seines at such times; but the former are seldom obtained in large numbers. They may not, however, be absent from the inshore waters, since the study of the fish population in such waters (2–4 fathoms) conducted at the West Hill substation has revealed the presence of considerable numbers in five months, namely, April and May (1949), January (1950) and the two following months (Bhimachar and Venkataraman, 1952).

Fishing is done usually in 8–10 fathoms of water, unless large concentrations are discovered nearer the shore. The net used is the boat seine. Cast nets may be used if the prawns occur quite close to the shore.

At Narakkal the fishery starts towards the close of April or early in May and continues till about the end of September. In September 1953 on good days the average catch per boat has been roughly estimated at about 250 lbs., and though on a few days the catches were very poor, on the whole, the prawn fishery was comparatively good during that month. After the first week of October, however, it declined abruptly and on several days thereafter, hardly any prawns have been caught, though the boat seine had been in use on most days till about the middle of January. The information collected during the two years 1952 and 1953 tends to show that the catches at this place are seldom very heavy. The monthly average percentage values (numerical) for *M. dobsoni* obtained by analysing weekly samples are shown below:

TABLE VII

Showing the monthly average percentage values for *M. dobsoni* in the marine catches at Narakkal

| Year | April | May  | June | July | Aug. | Sept. | Oct. |
|------|-------|------|------|------|------|-------|------|
| 1952 | 74.0  | 41.6 | 38.5 | 79.6 | 55.8 | 8.2   | ..   |
| 1953 | ..    | 26.3 | 55.3 | 24.0 | 33.5 | 51.0  | 16.2 |

The proportions contributed by the species in the catches of the same month in the two years show rather wide variation; but it is obvious that in no month is it low enough to be insignificant.

#### SUMMARY

The paper deals with some aspects of the bionomics of *M. dobsoni* such as growth, sex ratio and migration and also its fishery.

Estimates of the approximate extent of its growth in the backwaters and in the sea have been made by preparing length frequency curves from month to month. The duration of life and the size reached during each year by both sexes have also been arrived at by the same method. The difference in growth rates of the sexes has been elucidated and the percentage of males and females that grow to 100 mm. and over (passing into the third year of life) has been calculated. The sex ratio in the backwater catches (including paddy field catches) and marine catches (both at West Hill and Narakkal) has been worked out separately.

The importance of the species in the prawn fishery of the backwaters stretching along the south-west coast of India has been pointed out and some of the more common fishing methods have been referred to. The marine fishery has also been briefly discussed.

#### ACKNOWLEDGEMENT

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