SEASONAL ABUNDANCE OF LARVAE AND POST-LARVAE OF THE COMMERCIALLY IMPORTANT PENAEID PRAWNS IN THE INSHORE WATERS OF COCHIN

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ABSTRACT

Seasonal distribution of the larvae and post-larvae of five species of the commercially important penaeid prawns of the Cochin area during the years 1966-67, 1967-68 and 1968-69 showed that the larvae and post-larvae of *Metapenaeus dobsoni* formed a major component (80%) of the total larval population in the inshore waters. The larvae and post-larvae of *Parapenaeopsis stylifera* were next in the order of abundance. The annual fluctuations in the occurrence of the larvae and post-larvae of *Metapenaeus monoceros, M. affinis* and *Penaeus indicus* were very wide. The percentage reduction in the total number, from larvae to post-larvae, which was attributed as mortality rate, varied from year to year in different species. Most of these species breed throughout the year with two peaks, one during October-December which is common to all the species and the other which is less pronounced extends from May to August. The larvae of most of the species are able to withstand a wide range in salinity. The larvae of *P. stylifera* are generally absent in the inshore waters during the monsoon months. A greater abundance of the larvae in the inshore waters during the year seems to indicate a good prawn fishery in the subsequent season.

INTRODUCTION

The capture fishery for prawns is characterised by wide seasonal and annual fluctuations in the yield, caused by the changes in the biotic and abiotic factors affecting the population. Among the biotic factors, the relative abundance of larvae which determines the intensity of recruitment into the exploitable stock is by far the most important. Insufficient knowledge on the correct identification of the larval stages of these prawns has greatly hampered detailed investigations on their survival and recruitment. While studying the plankton from the Cochin Backwaters, George (1958) made a brief reference to the occurrence of penaeid larvae along with the other planktonic decapods. Later on, George (1962) determined the breeding seasons of *Metapenaeus dobsoni, M. monoceros* and *Penaeus indicus* based on the seasonal abundance of post-larvae of these species in the backwater regions of Cochin. Mohamed *et al.* (1968) described the first post-larval stage of five penaeid prawns and

provided a key for their identification. Recently, Rao (1971) studied the various larval forms of all the commercial penaeid prawns of the Cochin region. The present paper deals with the seasonal distribution of larvae and post-larvae of *Metapenaeus dobsoni* (Miers), *M. monoceros* (Fabricius), *M. affinis* (H. Milne-Edwards), *Penaeus indicus* H. Milne-Edwards and *Parapenaeopsis stylifera* (H. Milne-Edwards) of the same area.

Material and Methods

The larvae were sorted out from the plankton collections taken from a station fixed in the inshore waters of Cochin, about 3 kilometres away from the shore. The collections were made twice a week from March 1966 to February 1969. The plankton tows were of 10 minutes duration, taken with an half a metre organdy net during the early hours of the morning from sub-surface waters. The net was usually operated against the current. The temperature and salinity of the surface water at the time of plankton collection were also recorded. The plankton was immediately preserved in 5% formalin.

For quantitative studies, the plankton volume was first made up to 100 ml and then shaken to ensure an even distribution. From this, 10 ml sub-sample was taken and the penaeid eggs and larvae present in the sub-sample were picked out and counted. The total numbers of eggs and larvae in the sample were then computed for the total volume of plankton. When the volume of plankton was small, the entire sample was analysed. The total number of observations taken during the month, were combined and averaged for each month.

The Study Area

The inshore waters of Cochin remain calm during greater part of the year, except from June to August, when the south-west monsoon becomes active. The sea bottom adjacent to the shore is almost flat with a gradual seaward slope. It, however, excludes the navigational channel leading to the Cochin Harbour. The bottom sediment is composed of soft mud with shell fragments and pieces of decaying material predominantly of vegetable origin.

The environmental conditions of the inshore waters in this region is chiefly influenced by the adjoining backwater system which empties large volumes of fresh water. The average monthly salinity and temperature of the surface waters from 1966-67 to 1968-69 have been shown in Fig. 1. During the south-west monsoon (June-September), the salinity and the temperature values decline considerably. In the post-monsoon period (October-January), although wide fluctuations occur, a gradual increase in both salinity and temperature is observed. In the pre-monsoon period (February-May), typically

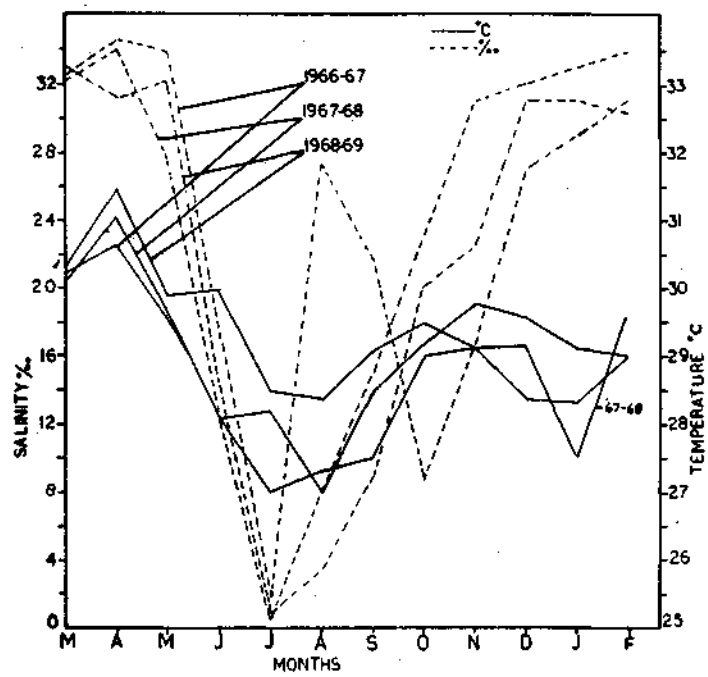

Fig. 1. Distribution of average monthly temperature and salinity of the subsurface waters of the inshore region of Cochin.

marine conditions prevail with salinity and temperature values remaining uniformly high, the maximum being in March/April. Seasonal changes in the hydrographical conditions in the coastal waters around Cochin and the distribution of nutrients in the adjoining backwaters have been recently discussed by Sankaranarayanan and Qasim (1969).

Results

Seasonal distribution of larvae and post-larvae

Metapenaeus dobsoni — Monthly distribution and abundance of eggs and different larval stages of this species are shown in Fig. 2. In the 1966-67 season, the eggs were first seen in September and their number reached the peak in November. In December they became scarce. The general trend in occurrence of the nauplii was similar to that of eggs. Only a few were collected in March, but from September to December they appeared regularly and maximum numbers were recorded in November. During the 1967-68 season, both eggs and nauplii were abundant in September and October, whereas in 1968-69, they were totally absent in September, but nauplii continued to occur till February.

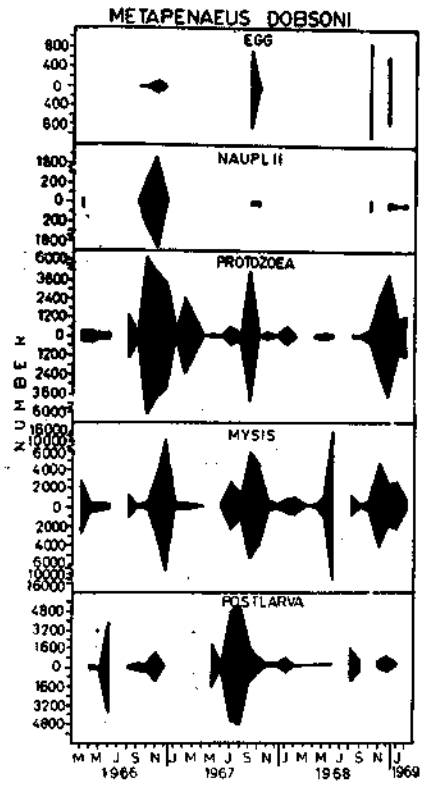

Fig. 2. Monthly distribution of larvae and post-larvae of *Metapenaeus dobsoni* in the inshore waters of Cochin.

Protozoea and mysis stages were found almost throughout the year, although their abundance varied from month to month. In the 1966-67 and 1968-69 seasons, they were completely absent in July, but were found in appreciably large numbers in the same month of the 1967-68 season. In the first year of observation, large numbers of these stages were obtained from October to December and in February, while in the second year, they were abundantly distributed from July to October. The peak period of their occurrence during the 1968-69 season was from November to February. Mysis stages occurred in large numbers in May and June.

Post-larvae of *M. dobsoni* were seen throughout the year. In the 1966-67 season, they were absent in March, but in the following month they appeared in the inshore waters and continued to occur till December. Two peaks of abundance were recorded — one in June and the other in November. In the 1967-68 season, they made their first appearance in May and their number increased considerably and reached maximum in August. Two periods of

abundance were observed again — one from July to September and other from October to January. Although, the post-larval stages were present right from March during 1968-69, their numbers were greater in August and December.

Metapenaeus monoceros — Larval stages of the species were relatively few in the inshore waters throughout the period of investigation. In the 1966-67

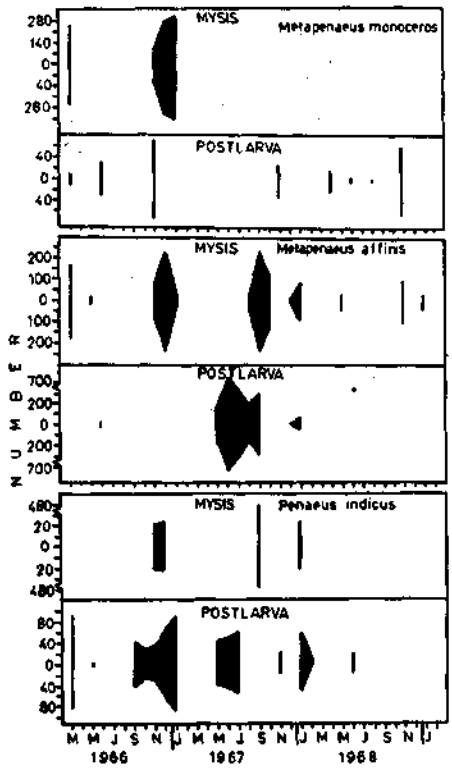

Fig. 3. Monthly distribution of larvae and post-larvae of *Metapenaeus monoceros*, *M. affinis* and *Penaeus indicus* in the inshore waters of Cochin.

season, the mysis stage appeared in March and in November-January (Fig. 3), while the post-larval stages were recorded only in March, June and November. In the 1967-68 and 1968-69 seasons, post-larvae were mainly collected in April and November. A few of them were also caught in June and August of the latter season.

Metapenaeus affinis — In 1966-67, the mysis larvae were present in March and May and more frequently from November to January (Fig. 3). Post-larvae

occurred only in June and in the other months their absence was very conspicuous. In the subsequent season, the occurrence of mysis stage was irregular; a few of them were present in April and from August to January. From May to September appreciable numbers of post-larvae were caught. They were absent in the following two months and appeared again in December and January. During the 1968-69 season, the mysis stage rarely appeared in May, November and February.

Penaeus indicus — Protozoea stage of the species was collected only once in January 1968 during the entire period of investigation, while the mysis stage was seen on three occasions in November and December of the 1966-67 season, and during September of the 1967-68 season. Post-larval stages were recorded from September to January 1967 and again from May to July 1967. In 1968-69, the post-larvae became scarce and were found only in June and February.

Parapenaeopsis stylifera — Monthly distribution and abundance of the eggs and different larval stages of the species are shown in Fig. 4. Eggs and nauplii were obtained in October and February. Protozoea and mysis stages were represented in the catches throughout the year except during the period June-August. They were most abundant from October to December and again from February to April. Post-larvae were generally scarce in the inshore

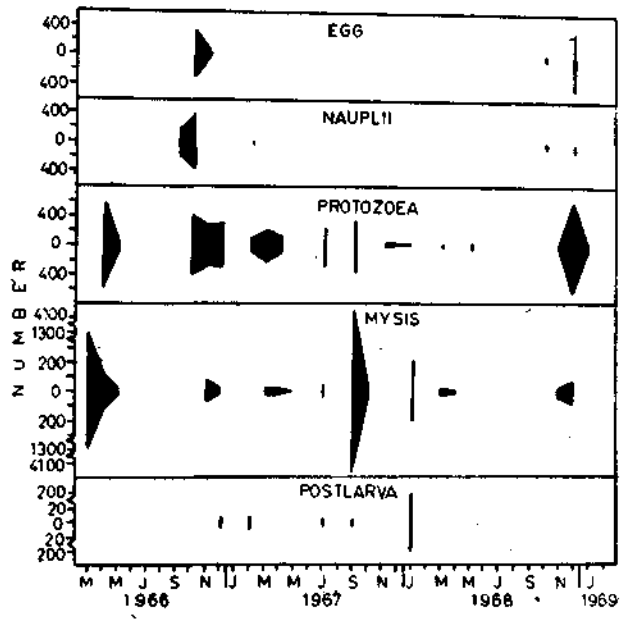

Fig. 4. Monthly distribution of larvae and post-larvae of *Parapenaeopsis stylifera* in the in the inshore waters of Cochin.

waters. In 1966-67, only a few were seen in December and also in February, but in the 1967-68 and 1968-69 seasons, large numbers were recorded only in January.

Total abundance

The total annual numbers of larval and post-larval stages of the species noted above in the inshore waters for the three seasons is given in Table 1. Of the total number of larvae in all the seasons, the larval and the post-larval stages of *M. dobsoni* formed more than 80%. The percentage contribution of *P. stylifera* in the total number varied from 2.2 to 12.0; the maximum percentage was in 1967-68 and the minimum in 1968-69. The percentage of the

TABLE 1. *Penaeid larvae and post-larvae from regular inshore samples for different years*

Species	Larvae		Post-larvae		Total	
	Number	%	Number	%	Number	%
			Year : 1966-67			
M. dobsoni	38079	88.4	6319	92.5	44398	89.0
M. monoceros	1036	2.4	118	1.7	1154	2.3
M. affinis	567	1.3	30	0.04	597	1.1
P. indicus	55	0.1	350	5.1	405	0.8
P. stylifera	3299	7.6	17	0.02	3316	6.6
			Year : 1967-68			
M. dobsoni	23797	78.3	15577	87.2	39374	81.5
M. monoceros	5	0.01	34	0.2	39	0.1
M. affinis	522	1.7	1779	9.9	2301	4.7
P. indicus	503	1.6	231	1.3	734	1.5
P. stylifera	5578	18.3	233	1.3	5811	12.0
			Year : 1968-69			
M. dobsoni	39378	97.2	3479	95.8	42857	97.0
M. monoceros	—	—	94	2.5	94	0.2
M. affinis	175	0.4	—	—	175	0.4
P. indicus	—	—	43	1.1	43	0.1
P. stylifera	962	2.2	15	0.4	977	2.2

larvae of *M. monoceros* was maximum in 1966-67, while in subsequent years they were poorly represented. During 1967-68, *M. affinis* ranked third in its percentage occurence. In *P. indicus*, increased percentage was recorded in 1967-68 and it decreased considerably in 1968-69. Considering the total

larval stages of all the species together in the inshore waters, maximum percentage was observed in 1966-67. It definitely showed a decline in the following years.

Mortality

The present data on the distribution of different larval stages of these species in the inshore waters do not permit the estimation of mortality of each developmental stage mainly because of the scarcity of larvae and their irregular occurrence in the area of collection. However, for the larvae of *M. dobsoni,* which are fairly well represented in the inshore waters, the mortality rate between the larvae and post-larvae could be roughly assessed. As it is difficult to follow the development and survival of all different stages, pooled data of larvae and post-larvae for the year were taken for calculating the mortality. Table 2 gives the numbers of larvae, post-larvae and the percentage mortality for *M. dobsoni* during the three years. In 1966-67 and 1968-69 only a small percentage of the larval population appeared to have survived to reach the post-larval stage, while in 1967-68, the survival of post-larvae was 65.5%. In the controlled culture experiments with *Penaeus japonicus,* Fujinaga (1969) recorded varying survival rates from 9.9 to 76.3% from nauplius to fry stages. Roessler *et al.* (1969) estimated that about 6% of the post-larvae of *Penaeus duorarum* survived to produce the commercial catches of South Florida in 1963.

TABLE 2. *Percentage of mortality in* M. dobsoni *from larvae to post-larvae*

Year	No. of larvae (A)	No. of post-larvae (B)	Percentage of mortality $\left[\frac{B \times 100}{A - B}\right]$
1966-67	38079	6319	83.4
1967-68	23797	15577	34.5
1968-69	39378	3479	91.2

DISCUSSION

The occurrence and abundance of eggs and the different larval forms give an indication of the breeding season of adult prawns. Most of the species dealt with here seem to be continuous breeders with two main peaks. The principal breeding season, namely, October-December, is common to all the species and the subsidiary season, which seems to vary from year to year, occurs from May to August. These deductions agree with those of George (1962), George *et al.* (1968) and Rao (1968). It must also be noted that the eggs and the early larval stages such as nauplius and protozoea of these penaeid prawns largely occur in the sea. Smaller numbers of eggs and nauplii obtained

in the inshore collections may not truly indicate their population size and mortality rates. It is reported that *M. dobsoni* and *P. stylifera* breed in shallower waters not too far from the shore (Menon, 1951, 1953), while *P. indicus* and *M. monoceros* spawn in the offshore areas probably in deeper waters (Panikkar and Menon, 1956; George and George, 1964). The distribution and occurrence of larvae of these species in the inshore waters confirm this view.

The larvae generally become less abundant during the warmer months (March-May) when the temperature of the inshore waters remains above 30°C (Fig. 1). With a decrease in temperature in June, the larvae start appearing in appreciable numbers and a greater abundance of larvae is observed when the temperature varies between 29°C and 30°C. Eldred *et al.* (1965), Christmas *et al.* (1966), Temple and Fischer (1968) and Munro *et al.* (1968) have also reported higher abundance of penaeid larvae as temperature of the water increases. That the larvae of penaeid prawns can withstand a wide range of salinity is evident from their occurrence in waters of low salinity from June to August and of high salinity from March to May. The larvae of *P. stylifera,* however, are not generally seen during the low salinity period. Moreover, their absence from the backwaters shows that the lower salinity conditions are not favourable to their larvae.

The recruitment of larval and post-larval stages of *M. dobsoni* and *M. monoceros* was maximum in 1966-67 and minimum in 1967-68. The larvae of *P. indicus* and *M. affinis* showed a greater recruitment in 1967-68, whereas, it was not so in 1968-69. Similar annual fluctuations in the recruitment of larvae were also observed by George (1962) in the backwaters of Cochin. The occurrence of larvae of *M. dobsoni* all the year round in the inshore waters and the scarcity of larval forms of larger species (*P. indicus, M. affinis* and *M. monoceros*) in the same area from February to August indicate that it might be due to some migration of larger forms from the area. George *et al.* (1968) observed that all the species of prawns except *M. dobsoni* move into deeper waters during the monsoon period and the larger species re-colonise the in-shore waters again from October to December. From January onwards, they again start their offshore movement. These movements of the adult prawns are reflected from the occurrence of their larvae in these waters.

George (1963) and Subrahmanyam (1967) have observed a relationship between the abundance of larvae and the commerical catches of the area. The former showed that the intensity of recruitment of the post-larvae of *M. dobsoni* in the backwater in a particular year is reflected from its backwater fishery during the same year and in the inshore fishery during the following year. Thus, the larval abundance in the inshore waters seems to be correlated with the prawn catches at Cochin. The total number of larvae gradually declines from 49,870 in 1966-67 to 44,146 in 1968-69. The prawn catches

landed at Cochin showed a similar decline from about 1955 tonnes in 1967-68 to 1,230 tonnes in 1969-70. Therefore, there seems some basis to believe that the relative abundance of larvae and post-larvae provides an indication to forecast a good or a bad fishery season.

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