

SOME ASPECTS OF PRAWN ECOLOGY IN COCHIN BACKWATERS

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ABSTRACT

Prawn population of a large perennial tidal pond and three other connected smaller ponds in the Cochin backwaters were studied in relation to the environment occurring in these ponds. While the large pond afforded a more stable environment greater human influence in the smaller shallower ponds made their environment more fluctuating and less conducive for the growth of prawns although nutrient and primary productivity levels were generally high in these ponds. All the ponds were rich in oxygen and nutrients especially phosphorus. Primary production during the premonsoon months was considerably lower than during the monsoon months, chlorophyll *a* values often being less than 20 $\mu\text{g/l}$ whereas the monsoon values were as high as 300 $\mu\text{g/l}$ in Pond II. The monthly growth of *Penaeus indicus* in cages ranged from 12.0 - 30.4 mm during the January - February period but it decreased considerably during the second month. Smaller ponds being shallow with about 2 m depth at the deepest portion, high temperature and salinity during premonsoon months seem to have directly affected the growth. Probably, the growth was also indirectly affected by temperature particularly in Pond II by promoting decomposition of rich organic matter leading to reducing conditions.

INTRODUCTION

The long chain of backwaters of Kerala forms extensive nursery grounds for the penaeid prawns. Vast areas are being traditionally utilised to grow prawns by erecting permanent bunds for perennial ponds and seasonal bunds when the coastal wetlands are also used for paddy cultivation during the monsoon season. In fields where paddy cultivation is practised, prawn culture, till recently, was only secondary. Since the price and demand for prawn have increased enormously in recent years, in several areas prawn culture has gained primary importance. The basic information required for this is a proper understanding of the environment, and the ecosystem best suited for their better growth and survival. Environmental characteristics, nature of substratum, benthic communities, seasonal variation were studied in a highly productive area in relation to the biology and growth of prawns occurring there. In this paper the ecology of the prawn population in relation to its immediate environment is discussed.

MATERIAL AND METHODS

Fortnightly samples of prawns were collected from Pond I-III (see next section for details regarding the area of investigation) using small meshed cast net with a

stretched inner mesh size of 11-12 mm. Cast netting was not allowed in Pond IV as it was under lease and only monthly samples could be collected by arrangement with lease holders. The data, thus collected were utilized to study species composition, size-range, growth rate, sex ratio and seasonal occurrence of the juveniles of the important species of prawns. However, the survival rates of these prawns could not be studied as all the species were heavily fished in ponds I-III and the sample from Pond IV was inadequate for this purpose.

In all, 5426 specimens were collected during the course of the study, from July 1978 to June 1979. Of these, 1032 were *Penaeus indicus*, 3942 *Metapenaeus lobsoni*, 259 *M. monoceros*, 10 *Penaeus monodon* and 183 *Macrobrachium* sp. A direct study of the growth of prawn was also made in all the ponds using cages of size 50 × 50 × 30 cm. This study was done during January to March 1979.

Juveniles of *P. indicus* of nearly the same size were collected using small meshed cast net and kept in cage for few days for getting acclimatized to the conditions in the cages. Ten prawns of same size were then selected and transferred to the cages immersed in the ponds at a depth of about 1 m at low tide. In Ponds I-III three cages were immersed at different places and in Pond IV, two cages were placed at one end of the pond. In another region of this pond, 8 cages with 5, 10, 20 and 40 juveniles were kept in replicates to study the effect of density on growth. The initial size of the experimental prawns used in Ponds I-III ranged between 33.7 mm and 35.2 mm and those in Pond IV ranged between 30.0 mm and 35.4 mm. Length measurements were taken once in every fortnight. Measurements were taken from the base of the rostrum to the tip of the telson. In order to maintain the same density all the cages were checked twice a week to replace loss by mortality or escape, if any. In each pond within the region where each cage was kept, they were frequently shifted to an adjacent position to ensure fresh food supply. More details on the methodology employed in the cage study is given by Aravindakshan, Paulinose, Balasubramanian, Gopala Menon and Krishnankutty (in press).

ENVIRONMENT

The four ponds under study are located in a small Ramanthuruthu Island (Longitude 76°15.40'E, Latitude 9°58.50'N) roughly 43.6 acres in area in the Cochin backwaters near the Cochin harbour entrance. Of these Pond IV is a typical tidal pond having an area of 30 acres leased out by the Kerala Government for harvesting prawns. This pond is a traditional "Chemmeen Kettu" having connections to the back-water system. Connected to this are three smaller semitidal ponds with an average depth of 1 m to 2 m (Fig. 1). The influx of water into these ponds from the fourth pond was partially obstructed by the lease holders which gave an opportunity to study their more fluctuating environmental conditions and their impact on the growth and survival of prawns. These ponds being shallow compared to Pond IV and much less extensive the decay of the leaves, falling into the ponds from adjacent trees, duck manure added to the pond by the ducks present in the area and even occasional small scale coconut retting also made the environment somewhat distinct.

The culture ponds were mostly extensions of the estuary and the backwaters and were therefore, subjected to wider variations in the environmental conditions as com-

pared to the sea. Environmental parameters were regularly monitored at fortnightly intervals in all the four ponds but these dates have not synchronised always with periods of extreme conditions, such as near draught as well as fairly high reducing conditions that were noticed occasionally for brief periods in Ponds I-III especially during the premonsoon months. (The data collected, therefore, may not give a complete picture of the environmental fluctuations in these ponds. Nevertheless, they do provide useful information on the conditions in which these prawns were growing). Only the salient features of the environment are briefly reviewed here. For a more detailed account the paper by Sankaranarayan, Kumaran, Balasubramanian, Rosamma Stephen and Panampunnayil (in press) may be referred.

The main two hydrographic factors, temperature and salinity ranged from 27.5° to 34.0°C and < 5 to 27‰ respectively. Except in Pond IV, temperature recorded in January was less than 28°C but sharply increased to 31-33°C in the different ponds during February-March with highest values in Ponds III and IV. Salinity also showed a very similar trend steadily increasing from November to February to reach values between 25 and 27‰. The values of pH were slightly lower than those of marine conditions and varied between 7 and 8.2. The lowest values were recorded during SW monsoon months. The pond waters were well oxygenated, the values varying between 2 and 7 ml/l, high values being recorded during March to June and lower values during the SW monsoon period. The E_h values for the surface water were in the range of +100 and +140 mV, in agreement with the relatively high oxygen values, with also nearly identical values for near bottom water. The E_h values for bottom sediments however, gave a different picture during the February-March period. Negative values in the range -240 to -120 mV were

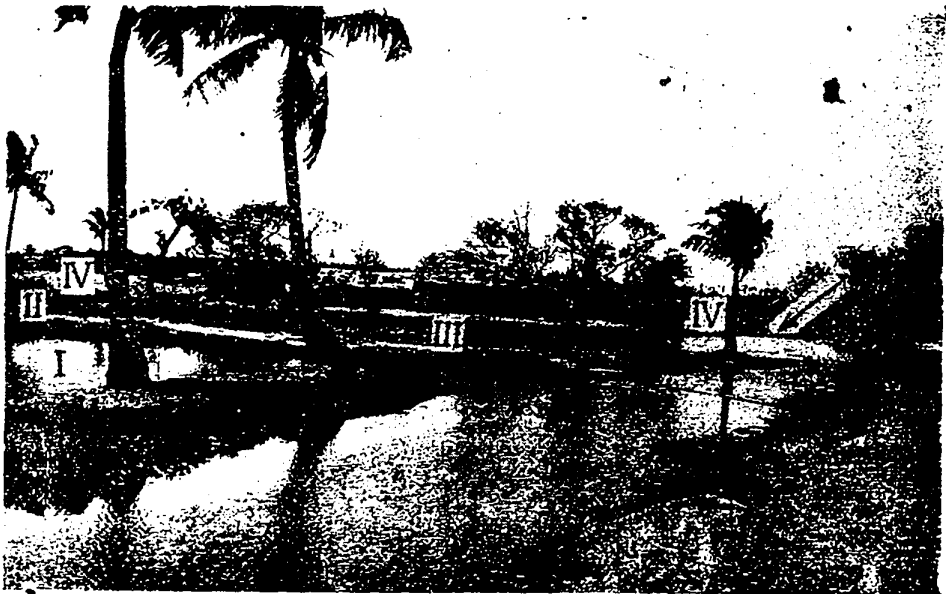


Fig. 1. The area of investigation showing the four ponds I to IV with the arrow indicating the connection from Pond IV partially closed by coconut leaf bund.

obtained, the lowest values being recorded from pond II. The water was uniformly rich in inorganic phosphates in all the ponds with monthly values often between 4 and 7 $\mu\text{g at/l}$, highest values, even as high as 28 $\mu\text{g at/l}$, being recorded from Pond II. The nitrate values in all the ponds ranged from < 1 to 15 $\mu\text{g at/l}$ with seasonal fluctuations in all the ponds. All the ponds were rich in primary production with values generally greater than 70 $\mu\text{g at/l}$ for chlorophyll *a* but production was low during the premonsoon months, January to May. Pond II was found to be the most productive with values at times exceeding 300 $\mu\text{g at/l}$. Organic matter in these ponds varied between 1 and 4% with a caloric content often exceeding 200 cal/g dry weight.

RESULTS AND DISCUSSION

Penaes indicus

Juveniles of *P. indicus* in the size range of 21–40 mm dominated the samples in the months of May, November and December. During December specimens in the size range of 51–65 mm were also common. The spawning season of this species may, therefore, extend from April to September or even October. Earlier records indicate that different spawning periods are given by different authors which suggest an extended spawning season for the species (Mohamed, 1970). By the time the juveniles enter the backwater, the postmonsoon being the peak season, the salinity level would have increased to < 10‰ which is suitable for their growth and survival. As the season advances salinity level progressively increases which also suits the growing juveniles (Nair and Krishnankutty, 1975). The larger size groups in the range 66–125 mm were more or less uniformly represented in all the months from July to March in Pond IV, but the pond could not be

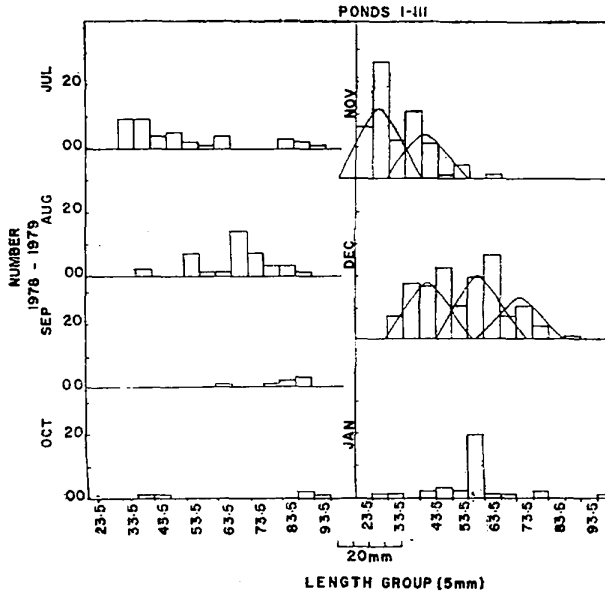


Fig. 2. *Penaes indicus*: Size frequency distribution showing the monthly progression of modal groups.

adequately sampled to trace the modal progression for studying the monthly growth. The size frequency distribution of *P. indicus* collected during November and December from Ponds I to III could, however be dissected into modal groups (Fig. 2) which suggest a monthly growth of roughly 15 mm for the juveniles. This is in agreement with the findings of George (1975).

Growth studies conducted in cages in all the four ponds (Table I) provided useful information on the growth of *P. indicus* although the data showed considerable variation. The monthly growth in the different cages in each pond showed the same trend (Table-1) except in Pond I in which it varied widely even within the same month. Maximum growth was recorded in Pond IV through out the study and the minimum in Pond II. The primary production was not high during the months from January to May with chlorophyll *a* values being well below 20 $\mu\text{g/l}$ except in Pond II where it was above 30 $\mu\text{g/l}$ during January and March. The growth of prawn in the cages were not affected by the level of primary production. In fact the growth was highest during January-February and decreased considerably only during the next 30 days (February-March). The main factors affecting the growth and survival of prawn during these months especially in the smaller ponds appear to be temperature and salinity, the latter probably affecting the growth of smaller juveniles only as shown by Nair and Krishnankutty (1975). The high temperature might have affected the growth directly and by augmenting the decomposition process of the dead and decaying plant and animal matter particularly in Pond II. The very low E_b values of the mud indicative of reducing conditions at the bottom of this pond substantiate this conclusion. The confinement of the growing prawns in cages also might have affected their growth rate. *P. indicus* in two cages with 10 individuals each kept in another region of Pond IV along with six other cages to study the effect of density registered a monthly growth of only 22 mm in the first month (Aravindakshan, Paulinose, Balasubramanian, Gopala Menon and Krishnankutty-in press) compared to the average of 27.2 mm given in Table I. This may largely be due to the cluster-effect as the 8 cages were kept more or close to one another. However, the growth in the first month was much above the normal in all cages.

Table I. Average monthly growth (in mm) of *Penaeus indicus* kept in cages in different ponds.

Pond	I				II				
	Cage	1	2	3	Mean growth	1	2	3	Mean growth
January-February		19.0	29.0	30.4	26.13	22.1	23.3	23.2	22.9
February-March		13.9	9.0	6.5	9.8	5.6	4.5	8.1	6.7

III				IV		
1	2	3	Mean growth	1	2	Mean growth
29.2	27.8	25.8	27.6	25.4	29.0	27.2
10.3	7.6	11.9	9.9	15.4	12.5	13.9

P. indicus was the most dominant species next to *Metapenaeus dobsoni*, in the sample throughout the period of study forming about 19.02 % of the total sampled. Immature juveniles were abundant during the months of November and December 1978 and May 1979. Sex ratio in the samples (Fig. 3) reveal that males in general were more dominant than females. The review of biological data by Mohamed (1970), however, shows disparity in the data by different authors.

Metapenaeus dobsoni

This was the most dominant species forming 72-65% of the total sampled and was well represented throughout the year. Juveniles in the size range of 21-35 mm dominated the samples during July and August 1978 and again in February-March and May-June 1979 suggesting that they have an extended spawning period. Menon (1955) and George (1961) suggested that their main spawning period is from May to December. The monthly size frequency distribution in the present study suggests that spawning takes place even during the earlier months of the year which supports the view held by George (1962) and George, Raman and Nair (1968) that they spawn throughout the year. The occurrence of juveniles of *M. dobsoni* in good numbers in the samples during February-March suggests that they are tolerant to higher salinities although Nair and Krishnankutty (1975) have shown that juveniles of *M. dobsoni* have an optimum

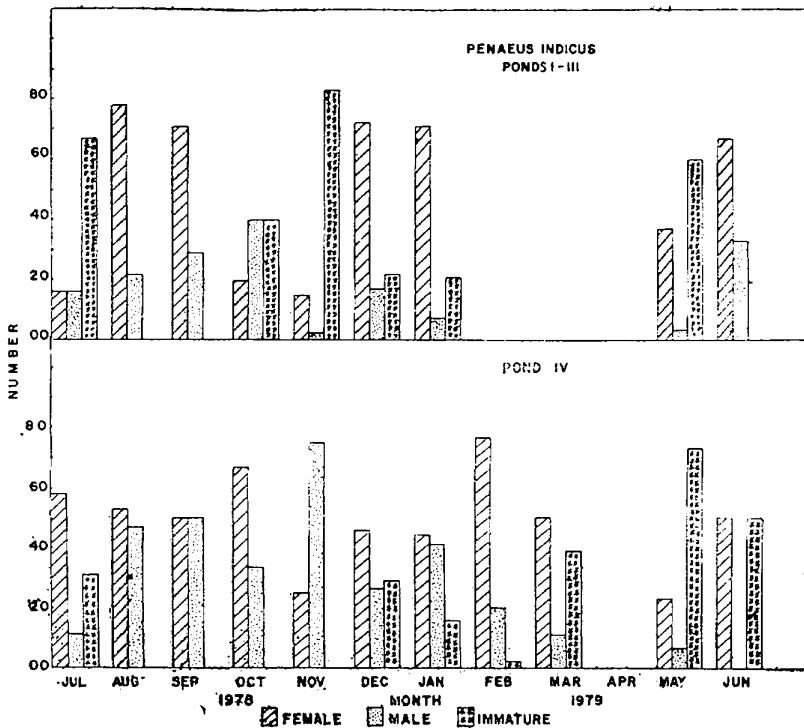


Fig. 3. *Penaeus indicus* : Monthly % distribution of male, female and immature in the sample.

salinity much lower than the values seen in natural conditions during these months when salinity estimations reach their annual peak values of over 25‰. The individuals were distributed over a size range, 16-65 mm and only seldom larger specimens were included in the sample. The size frequency distribution could be dissected into modal groups to trace the monthly modal progression to arrive at an estimate of the growth rate of the species. The fairly well defined modal groups (Fig. 4) and the narrow size range comprising them suggest that they are the result of successive monthly spawning. The monthly progression of modal groups indicate a growth of 5 to 15 mm per month in all the ponds. George (1974), George (1975), Suseelan (1975) and others have observed an average growth of 10 mm per month. Sex ratio of *M. dobsoni*

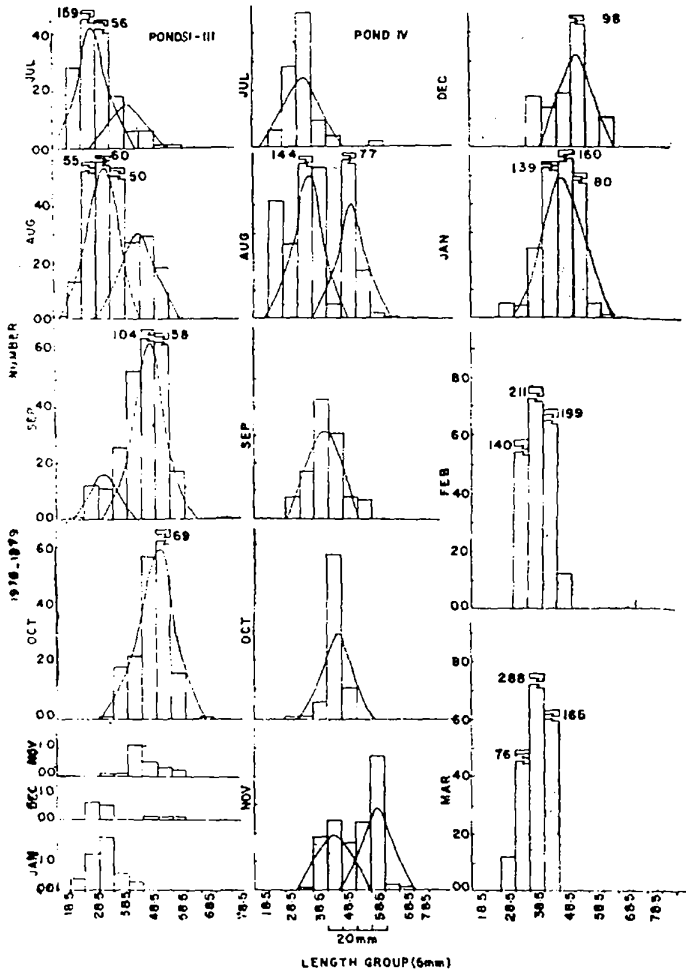


Fig. 4. *Metapenaeus dobsoni*: Size frequency distribution showing the monthly progression of modal groups.

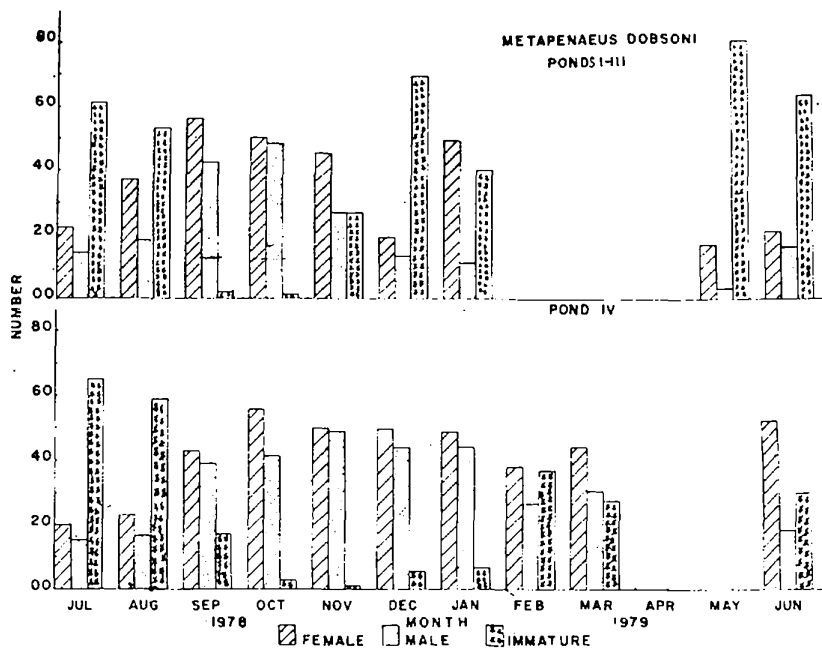


Fig. 5. *Metapenaeus dobsoni*: Monthly % distribution of male, female and immatures in the sample.

in the samples were more even (Fig. 5) than in the case of *P. indicus* although males were more dominant than the females. This is in general agreement with the findings of other authors as seen in the review by George (1970).

The lesser prawns

Metapenaeus monoceros and the fresh water prawn *Macrobrachium* sp. were the next in abundance forming 4.75% and 3.37% respectively of the sample. *Penaeus Monodon* was represented only by a few isolated specimens in the July and August samples (0.18%). Juveniles of *M. monoceros* in the size range 31-50 mm were collected in small numbers from July to October 1978 and again in May-June 1979. Specimens smaller than 30 mm were rare in the samples but those in the size range of 61 to 80 mm were more uniformly represented in the monthly samples. Since the species was not present in sufficient numbers in the sample their monthly growth could not be studied from the size frequency distribution. The occurrence of *Macrobrachium* sp. was largely restricted to the monsoon and postmonsoon months (July-December) when salinity level was fairly low. The samples were dominated by juveniles in the 26-55 mm group although prawns upto 85 mm in length were also represented. Both *M. monoceros* and *Macrobrachium* sp. were dominated by the males in the sample (Figs. 6 and 7) while immature specimens also formed a good percentage of the *Macrobrachium* sp.

Ponds I to III provided a more fluctuating environment compared to the much larger Pond IV, the three ponds being subjected to greater human influence. Decaying

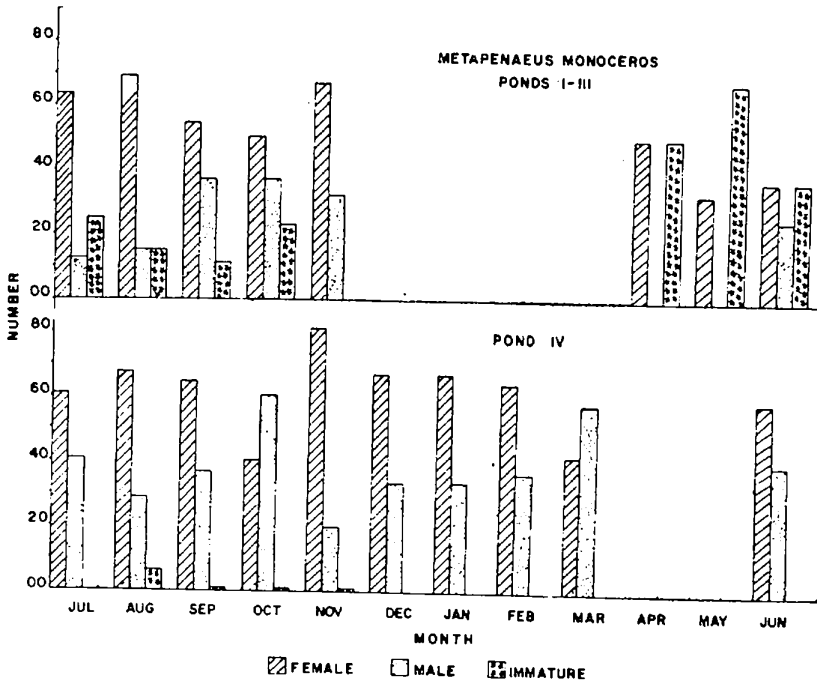


Fig. 6. *Metapenaeus monoceros*: Monthly % distribution of male, female and immatures in the sample.

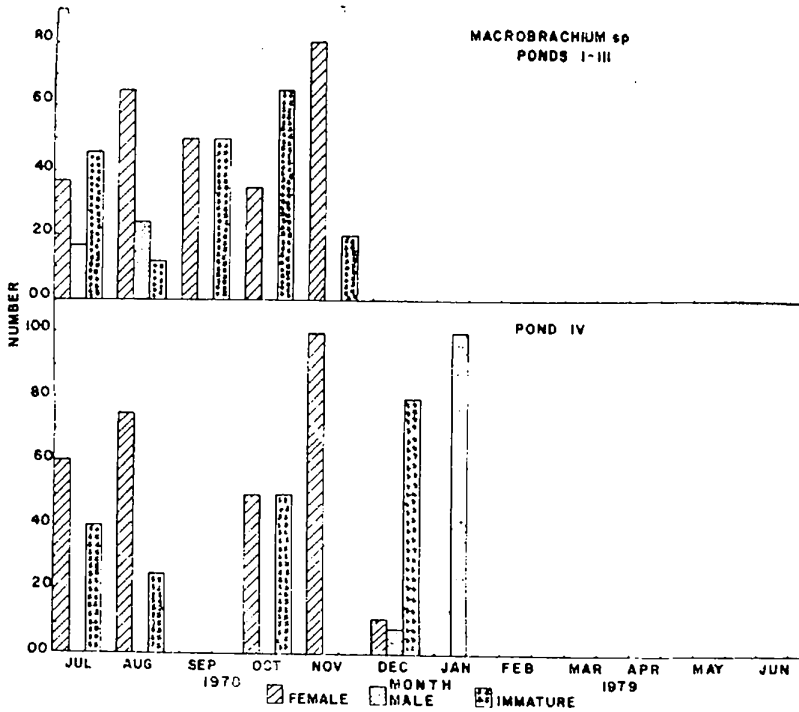


Fig. 7. *Macrobrachium* sp.: Monthly % distribution of male, female and immatures in the sample.

tree leaves, duck manure, occasional coconut retting and partial blocking of tidal flow of water from Pond IV along with effects of evaporation during the premonsoon months were the main contributing factors that made the environment less conducive for the growth of prawn than in Pond IV. There are highly productive areas of this nature scattered around the backwater system among the coconut groves, paddy fields and as small tidal pools that can, with comparatively little effort, be converted into good prawn culture ponds. Their utility for culturing prawns is at present low since tidal flushing of water is often not as complete or regular as in the traditional culture ponds, leading to stagnation of water and also decomposition of plant matter in significant quantities adversely affecting the water quality. The results of the cage studies (Table I) reveal the necessity of improving the environment for better utilization of these areas for prawn culture. The fast growth rate of prawn in cages in the initial month, high nutrient content and primary production also indicate the high potential of these areas for prawn production.

Although there is a high degree of natural enrichment in most of these areas, detailed environmental study is a prerequisite for converting them into good culture ponds. Nature of substratum is also another important factor to be considered since it must be able to support a thriving benthic community of amphipods, polychaetes and other organisms that form the main food of prawn. Balasubramanian, Devi and Krishnankutty (1979) and Devi, Balasubramanian and Krishnankutty (1980) have demonstrated the importance of the nature of substratum with respect to the preying efficiency of prawn. Their study suggests that increasing concentration of silt and clay in the substratum adversely affects the preying efficiency and that *P. indicus* is more adapted to a muddy substratum than *M. dobsoni*.

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