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# SEASONAL VARIATIONS IN THE ABUNDANCE OF PENAEID PRAWN SEED IN RELATION TO ENVIRONMENTAL PARAMETERS IN THE SEED GROUNDS OF COCHIN BACKWATERS

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ABSTRACT

Early juveniles of *Penaeus indicus, Metapenaues dobsoni* and *M. monoceros* were collected from two centres in the shallow water areas in the Cochin backwaters where commercial seed collectors used to make their prawn seed collections. A Quantitative Seed Sampler was used during premonsoon, monsoon and postmonsoon period of 1988. The study enabled to understand the relative abundance and seasonal variations of commercially important prawn seed of the above species. Of the total seed collected *P. indicus* formed 26%, *M. dobsoni* 59% and *M. monoceros* 15%. The seed exhibited considerable fluctuations in abundance through various seasons. Seventy per cent of the total seed of *P. Indicus* were collected during premonsoon period. But in the case of *M. dobsoni*, the highest percentage of 62 was obtained during monsoon period. The seed of *M. monoceros* had the maximum of 55% during monsoon period. Seed of *P. indicus* occurred at a maximum rate of 28/m² during April-May, that of *M. dobsoni* 20/m² and *M. monoceros* 7/m² during June to August. The relationship of the seed to the environment is also discussed.

## INTRODUCTION

Relative abundance and seasonal variations of prawn seed in estuaries and backwaters have great influence on the capture and culture fishery of prawns. Among the commercially important species of prawns, *P. indicus, M. dobsoni* and *M. monoceros* whose seed are being collected in large quantities for culture purposes are the most important for the Cochin backwaters. Therefore it is necessary to monitor the seed grounds for obtaining base line information about the seed abundance which would help in fixing the level of seed exploitation in future, based on which seed management policies could be evolved.

Earlier contributions on the various aspects of prawn larval ecology include those of George (1962) on the breeding of penaeids and recruitment of their postlarvae into the backwaters of Cochin; Rao (1972) on seasonal abundance of larvae and postlarvae of the commercially important penaeid prawns in the inshore waters of Cochin; Kuttyamma (1975 and 1980) on the relative abundance and seasonal variations in the occurrence of the planktonic larvae of three species of penaeid prawns in the Cochin backwaters; Kuttyamma and Kurian (1976) on the immigration and vertical distribution of postlarvae of some penaeids in the Cochin backwaters and Jose *et al.* (1988) on the cultivable prawn and fish seed resources of Cochin barmouth area. All these workers base their studies on earlier stages of prawn larvae collected from open estuary using plankton nets. Some studies have been made in the past on the seed resources in the shallow water areas of the Cochin backwaters (Rao, 1980; Suseelan and Kathirvel, 1982; George and Suseelan, 1982; Thampy *et al.*, 1982). The present paper which attempts the quantitative seasonal abundance of seed of three important prawn species in relation to environmental parameters is based on more intensive sampling in

such areas where the commercial seed collectors look for prawn seed. Therefore, the data generated will be more useful to formulate the seed management policies.

## Material and methods

Two sampling stations were selected, one at Kannamaly, south of the Cochin barmouth and the other at Manjanakad in the north (Fig.1). The two stations were almost equidistant from the barmouth. At each station fortnightly sampling for seed was carried out from April to October, 1988 using a Quantitative Seed Sampler (Mathew *et al.*, 1980). Immediately after collection the samples were preserved in 5% formalin. In the laboratory the seed of each species were enumerated and estimates were made as number per $m^2$. Water samples were also collected from the same spot for physical and chemical analyses.

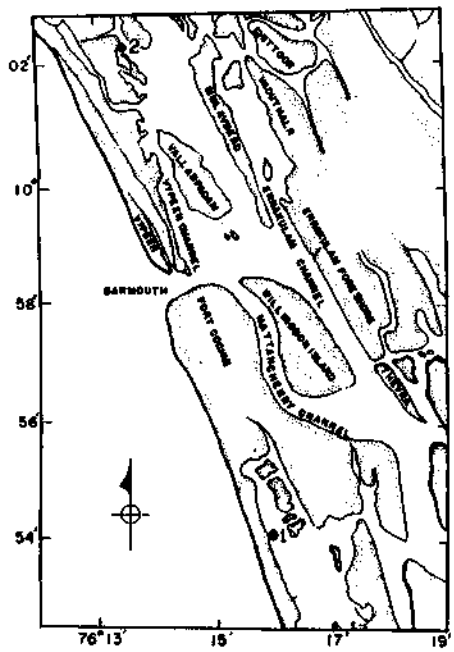


Fig. 1. Location of sampling stations on either side of the Cochin bar mouth.

## Results

### The environment

The pooled up data of environmental factors such as salinity, temperature, dissolved oxygen, pH, total alkalinity and nutrients for the two stations revealed the following. Maximum temperature (29°C) was recorded during premonsoon and minimum (25°C) during monsoon season (Fig. 2). In the case of salinity also the same pattern of variation was noticed. At station I (Kannamaly) the values of salinity fluctuated from 1.082 to 22.70‰ and at station II (Manjanakad) the variation was between 1.128 and 13.44‰. The dissolved oxygen content exhibited a variation from 2.37 to 3.60 ml/1 at S-I and 2.00 to 2.90 ml/1 at S-II. Comparatively high values were found during monsoon season. The relatively low dissolved oxygen content except

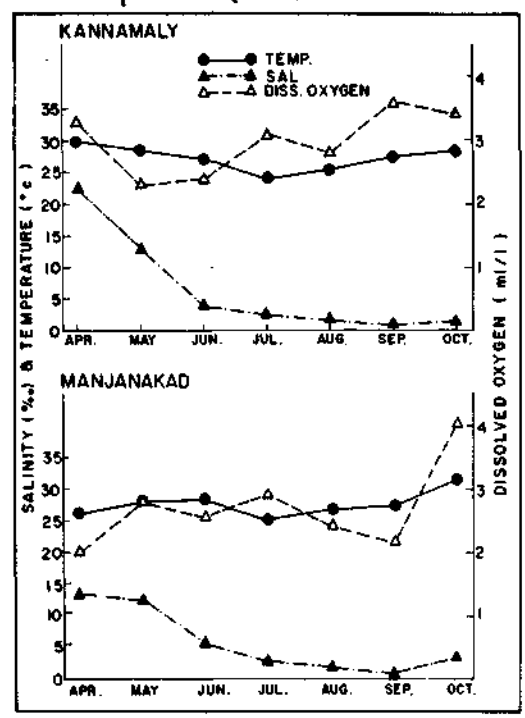


Fig. 2. Monthly variations in temperature, salinity and dissolved oxygen at the two stations.

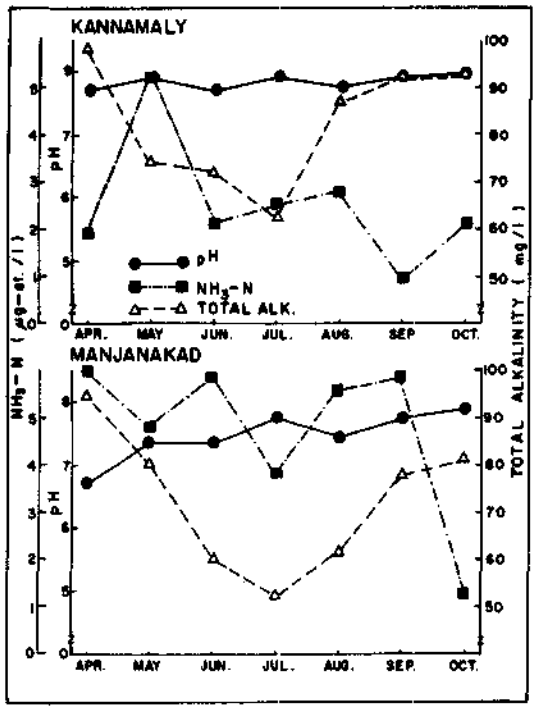


FIG. 3. Monthly variations in pH, ammonia and total alkalinity at the two stations.

during October was due to poor water quality caused by the presence of hydrogen sulphide generated on account of coconut husk retting in the nearby areas especially at Manjanakad. There was not much seasonal variation in pH value. At S - I the water was always alkaline and showed a monthly pH variation between 7.7 and 7.9. On the other hand at S - II, the pH varied from slighly acidic (6.7) to alkaline (7.7) condition (Fig.3). As in the case of low disslved oxygen values, the slightly acidic condition during April was also due to the retting of coconut husk in the nearby areas of this station. The monthly values for total alakalinity showed a variation from 63.00 to 98.00 mg/l at S-I and from 52.50 to 95.00 mg/l at S-II. Premonsoon had the highest values of total alkalinity. The lowest values at both the stations were recorded in July. During monsoon month wide fluctuatins in alkalinity were observed. The monthly ammonia-nitrogen concentration in the water ranged from 1.99 to 5.36 µg-at /l at S - I and 1.28 to 6.20 µg-at/l at S-II. The ammonia-nitrogen values showed an inverse relationship with dissolved oxygen.

The nutrient content of water is very important from the point of view of productivity. These parameters showed a common pattern of variation, *i.e.*, low values during premonsoon, maximum during monsoon season with a tendency to decrease again during postmonsoon (Fig. 4).

### Seed abundance

Numerically the seed of *M. dobsoni* dominated (average density 16/m²) closely followed by *P. indicus* (14/m²). The seed of *M. monoceros* were least represented with an

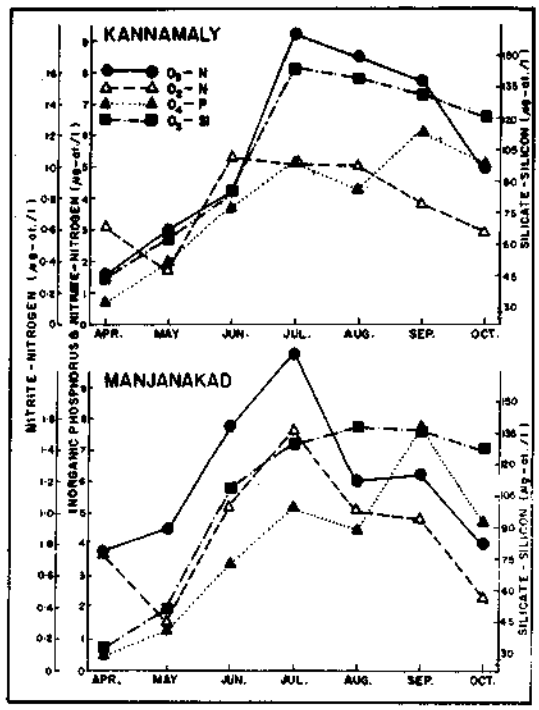


FIG. 4. Monthly variations in nitrite, nitrate, phosphate and silicate at the two stations.

average number of 6/m². Analysis of the data made for both the stations together on a seasonal basis indicated the following. During the premonsoon season (April-May) the seed of *P. indicus* occurred at the rate of 28/m², that of *M. dobsoni* occurred at the rate of 8/m² and the seed of *M. monoceros* were present at the rate of 4/m2. During monsoon season (June - August) the seed of, *P. indicus* occurred at the rate of 5/m², that of *M. dobsoni* 20/m² and the seed of *M.monoceros* occurred at the rate of 7/m². The values obtained for the postmonsoon (September-October) was 9/m² for *P. indicus*, 17/m² for *M. dobsoni* and 5/m² for *M. monoceros*.

*Penaeus indicus*

The seed of *P. indicus* were collected throughout the period of study, but in highly varying quantities. The percentage contribution of this species in the total prawn seed collected was 25% at S-I (Kannamaly) and 27% at S-II (Manjanakad).

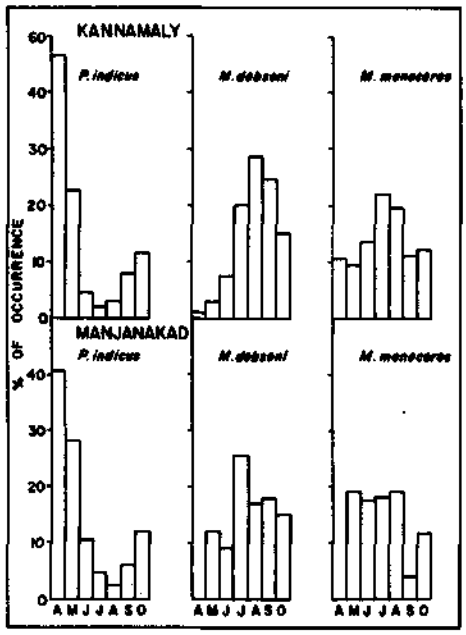


FIG. 5. Monthly variations in the abundance (in percentage) of seed of three commercially important prawn species at the two stations.

At Kannamaly (Fig. 5) of the total seed of *P. indicus*, the maximum abundance (53/m²) was noticed in April which accounted for 46.90%, followed by May (26/m²) eaqual to 22.56%. As monsoon advanced the rate of occurrence decreased and in July a mere 4/m² of the seed only was present which was equal to 2.43%. During the postmonsoon period the trend of occurrence was on the ascend and the level of abundance reached 11.5% (13/m²) in October.

At Manjanakad the trend in seasonal occurrence of the seed of this species was almost the same as at Kannamaly (Fig. 5). April, with 40.89% accounted for the maximum quantity of seed (34/m²). The least abundance of 5/m² was noticed in August which was only 2.80%. During the postmonsoon season the situation gradually improved and October claimed for 12.32% (11/m²) of the seed of *P. indicus*.

*Metapenaeus dobsoni*

The seed of *M . dobsoni* also were represented in all the collections made during the period of study. The percentage of occurrence of this species in the total prawn seed collected was 60.00 at S-I and 58.00 at S-II. At Kannamaly while the seed of *P. indicus* were relatively more during premonsoon and postmonsoon periods, that of *M. dobsoni* were especially abundant during monsoon and postmonsoon months. The least occurrence of 2/m²was in April which was only 0.98% of the total seed of *M. dobsoni* collected during the entire period of study. The trend gradually improved through monsoon and the maximum share of 28.55% was claimed by July (25/m²) followed by September (20/m² which was equal to 24.50%).

At Manjanakad also the least occurrence of seed of this species was observed in April ( 3/m²) which accounted for only 1.90% (Fig. 5). The percentage of abundance in May was 11/m² (12.38%). It once again decreased in June (7/m²). But the trend gradually improved in July when seed at the rate of 20/m² was collected followed by September (14/m² which was equal to 18.00%).

*Metapenaeus monoceros*

The seed of *M. monoceros* though present in all the months of observation, were less abundant when compared to the other two species (Fig. 5). The percentage of this species in the total prawn seed collected was 14.52 at S-I and 15.10 at S-II. At Kannamaly the seed were moderately abundant during premonsoon and monsoon seasons, with percentage of occurrence ranging from 9.69 in May to 12.33 in October 4/m² and 6/m² in the respective months. Relatively more seed were present in monsoon months. The maximum of 8/m² was collected in July which was equal to 22.46% of the total seed collected from this station.

The trend in occurrence was almost the same at Manjanakad also, but with slight variations. However, the maximum abundance of 19.47% was accounted by the premonsoon month of May ( 5/m²). The percentage of occurrence was around 18.00 during June, July and August. The least abundance was noticed in September when only 4.21% of the seed of *M. monoceros* was present, (2/m²).

## Discussion

During the period of the present study, seed of *P. indicus* eventhough occurred throughout the period of investigation, were relatively more abundant during premonsoon months of April-May. Their occurrence gradually decreased during monsoon months of June-August. But during postmonsoon, (September - October) an increasing trend was noticed. The same pattern of abundance has been reported by Subramaniyam and Rao (1969) and Gopinathan (1978) in Pulicat Lake; Rajyalakshmi (1972) in Chilka Lake, Pulicat Lake and Godavari Estuary; Victor *et al.* (1978) in Adyar Estuary; Sambandam *et al.* (1982) in Porto Novo waters, Selvakumar *et al.* (1977) and Achuthankutty and Nair (1980, 1983) in coastal waters of Goa and Mandovi Estuary for post-larvae. Panikkar and Menon 1956; George, 1962; George and Suseelan, 1982; Kuttyamma, 1975 & 1980 and Anon., 1980 reported that postlarvae and early juveniles of *P. indicus* were more abundant during summer months, (April-May) in Cochin backwaters. The present result indicate two active seasons of recruitment of this species into the estuary,the first during April-June period (April being the peak). However, since no collection could be made before April and after October, it was not possible to say anything positively for seed abundance from November to March. From the literature, it is understood that seed of *P. indicus* were encountered in good quantities during December-January also (Anon., 1980).

The seed of *M. dobsoni* were also collected throughout the period of study with peak abundance from June to August. Similar results of the presence of early postlarvae in the Cochin backwaters and also the maturity conditions of adult females in the inshore fishery led George (1962 and 1963) to conclude that this species breeds almost throughout the year with peaks in June to August and November to December. The result also agrees with the result obtained by Rao (1972) and Jose *et al.* (1988) for postlarvae and early juveniles. The periods of peak abundance of seed may denote the peak breeding season of

this species in the respective nearshore areas in Cochin backwaters.

In the case of *M. monoceros*, its seed were more abundant during monsoon months (July to August) which agrees with the findings of George (1962) and Rao (1972) and Anon. (1980) for early juveniles and postlarvae in Cochin backwaters. This peak period of abundance may indicate the peak breeding period and their larval recruitment period into the Cochin backwaters.

The environmental conditions play a vital role in the recruitment of prawn seed into the estuaries as and when there is an influx. Some minimum standards in the health of the environment are required for a successful settlement of the seed. An analysis of the ecological parameters in the areas of study revealed the following relationships.

In the case of *P. indicus*, maximum abundance was observed during April-May when the temperature ranged from 28.12 to 30.0°C at both the stations. This result is in agreement with the findings of George (1962), Rao (1972) and Kuttyamma (1975, 1980) in Cochin backwaters. Statistical analysis also proved that abundance of seed of *P. indicus* was positively correlated to temperature of water at 5% level of significance at both stations. But in the case of *M. dobsoni* the percentage of seed abundance was negatively correlated with temperature at 5% level of significance at both stations. With regard to the abundance of seed of *M. monoceros* also the temperature values were negatively correlated as it was significant at 1% level.

It has been reported that the salinity, more than temperature influenced the postlarvae of penaeids in the Cochin backwaters (Kuttyamma, 1980). In the present study, the seed of *P. indicus* were almost absent or minimum during the months of low salinity i.e. monsoon months and maximum during summer months, *i.e.*, during the period of comparatively high salinity. Statistical analysis also showed a positive relationship and it was significant at 1% level. In the case of seed of *M. dobsoni*, the peak abundant months of June to August were the months of low salinity. Statistical analysis showed a negative relationship to salinity and it was significant at 5% level. In the case of *M. monoceros* also a non-significant negative relationship between salinity and seed abundance had been noticed. These results agree with those reported earlier by George (1962) and Rao (1972) in Cochin backwaters for postlarvae of these species.

In the case of *P. indicus* the abundance of seed decreased during the monsoon months and during this period the dissolved oxygen content in the water was found to be maximum. In any case an increase in dissolved oxygen content in the water cannot be a deterrent to seed abundance. In the case of seed of *M. dobsoni* and to a certain extent that of *M. monoceros* a non-significant negative correlation betwen the seed of *M.dobsoni* and *M. monoceros* and dissolved oxygen content of water was found especially at Kannamaly. Therefore these results show that dissolved oxygen to a minimum level of 2ml/l has a non-significant role in the distribution and abundance of prawn seed in natural ecosystem or in other words the dissolved oxygen content present was optimum for the seed.

At Manjanakad, dissolved oxygen content of water had been <2ml/l during April due to the presence of hydrogen sulphide in water generated on account of coconut husk retting in the nearby areas. The low oxygen content along with the presence of hydrogen sulphide in the water was found to adversly affect the seed abundance, so that the percentage abundance of seed of penaeids was

less at Manjanakad when compared to that at Kannamaly during April. This showed that low values of dissolved oxygen in combination with low pH and presence of hydrogen sulphide in the water may be the reason for less abundance of penaeid seed during April at Manjanakad.

Statistical analysis showed that seed abundance of *P. indicus* has a non-significant positive correlation with pH values, but that of *M. dobsoni* and *M. monoceros* had a non-significant negative relationship. These results showed that pH values at the range of 7.3 - 8.2 had little effect on the seed abundance but values less than 7 had adverse effect.

Statistical analysis also showed that the seed of *P. indicus* had positive correlation with total alkalinity, but that of *M. dobsoni* and *M. monoceros* had a negative correlation. In the case of *M. dobsoni* the relationship was significant at 5% level at Manjanakad. The positive correlation in the case of *P. indicus* was also significant at 5% level at Manjanakad. The negative correlation obtained for *M. dobsoni* at Kannamaly was significant at 1% level.

Eventhough traces of ammonia normally formed in the water by bacterial action are harmless, high anhydrous ammonia concentration in the water have toxic effect on organisms resulting in their death. In the present study the abundance of seed of penaeids was negatively related to the ammonia-nitrogen concentration in the water, but at a non-significant level.

The productivity in aquatic system depend to a large extent on the nutrient concentration and its composition in the water. This suggests that probably the freshwater runoff brings in both nitrogen and phosphorus into the estuarine system. Comparatively high values of reactive phosphorus even during postmonsoon season at both stations may be due to the extended rain and freshwater runoff. High values of silicate-silicon in the water during monsoon season may be associated with the heavy silt load in the estuarine water.

Prawn seed are mainly detritivorus. The availability of detritus depends on the primary and secondary productivity of the ecosystem which in turn depends on the nutrient availability in the water. Thus the nutrient concentration in the water can have indirect effect on the abundance of prawn seed.

In conclusion, the analysis of month to month variation in the environmental parameters and corresponding abundance of prawn seed as well as statistical analysis showed that the abundance of seed of *P. indicus* had positive correlation with temperature, salinity, pH and total alkalinity of water. But in the case of *M. dobsoni* and *M. monoceros* the seed abundance was negatively correlated with the above parameters. For all the three species a negative correlation was observed with ammonia-nitrogen concentration of water.

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