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Meiobenthic fauna of the traditional prawn culture systems around Cochin

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Abstract

The distribution and abundance of meiobenthos, hydrography and sediment characteristics of three different types of traiditonal prawn culture systems around Cochin were studied for a period of two years (1988-1990). Nematodes were the most dominant group (79.6%) of the total meiofaunal count followed by harpacticoids and polychaetes. Others like oligochaetes, bivalves, ostracods, amphipods and tanaids had only stray occurrences and together formed a meagre 0.30% of the total. The upper 0-5 cm layer harboured 79.5% of the meiofaunal population. The perennial ponds had the highest abundance of meiobenthos (69.9%) followed by canals (17.9%) and seasonal fields (12.2%). The meiobenthic biomass ranged from 0.84 mg/ 10 cm^2 to 5.7 mg/10 cm^2 in different stations. Meiofauna did not show a significant positive correlation with the different environmental parameters. However, during the southwest monsoon period, the population showed a sharp decline. Meiobenthos were found to be abundant at stations where the sand content varied from 60-78% and silt from 15-29%, and were lowest at stations with high clay content. High content organic carbon also did not favour a high abundance of meiofauna. The presence of nematodes(80%) in the gut content of the prawns indicates a trophic chain involving meibenthos.

Introduction

In Kerala about 5,200 ha of low-lying areas adjacent to the backwater system are under traditional prawn farming, with little input towards selective stocking and supplementary feeding. In the absence of supplementary feeding, prawns depend on the natural production of the pond which in turn is determined to a great extent by the quality and quantity of benthic organisms. An important group in the trophic network of benthic environment is meiobenthos (Mc Intyre, 1964; Tenore *et al.*, 1977) which are efficient recyclers of nutrients and important source of food for higher trophic levels (Sikora *et al;* 1985).

Despite the awareness about the importance of aquaculture and the role of benthic organisms in trophic relationships, studies on the benthic fauna of culture systems are scanty. There are several published accounts of benthos of Cochin backwaters (Pillai, 1978; Sing, 1987 and Ambikadevi, 1988), but only short term reports are available on the benthos of prawn forms (Sugunan, 1983, Srinivas 1982 and Gopinathan *et al.*, 1982). The present study, therefore, is an attempt to assess the spatial and temporal distribution of meiobenthic community of three different types of traditional culture systems near Cochin.

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Material and methods

Prawn culture systems in the low-lying areas adjacent to the Cochin backwaters were selected for a two-year study from November 1988 to December 1990. They included 4 perennial ponds ranging in area from 1-11.6 ha, 3 seasonal fields with 2-4 ha and 2 canals in the coconut groves which were 30-40 m long and 1.5-2 m wide. The water depth ranged between 1-1.2 m, 50-65 cm and 50-55 cm in the perennial, seasonal and canal systems respectively (Fig. 1).

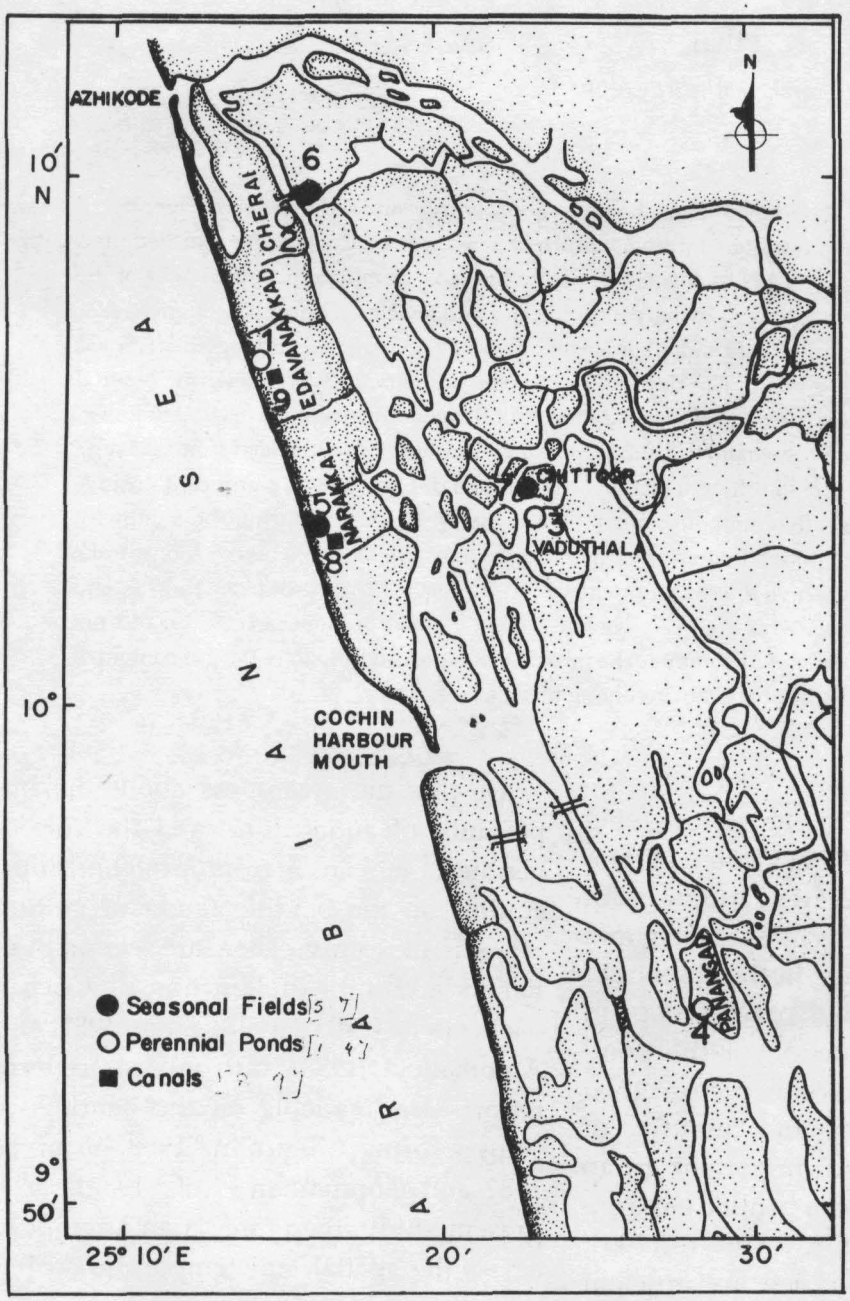

Fig. 1. *Map of Cochin backwaters showing the sampling stations*

Meiobenthos was sampled using a 10 cm long graduated glass corer with an inner diameter of 2.7 cm. Sampling was done fortnightly in the first year and monthly in the second year of study. The core sample was cut into two sections: (1) 0-5 cm layer and (2) 5-10 cm layer, and were preserved in 4% formalin. After separating the macrobenthic organisms using 500 µm sieve, the filtrate was again sieved

through a 45 µm mesh and the residue was analysed for meiobenthos. The meiobenthic organisms were identified upto the group levels. The number of animals per sample was converted into number/10 cm^2 to facilitate comparison with other studies. Hydrographic parameters, texture of sediment and organic carbon content were also studied.

Results and discussion

The important meiobenthic groups collected were nematodes, polychaetes, harpacticoids, oligochaetes, bivalves and crustaceans. The 0-5 cm layer harboured 79.5% of the total meiobenthic population (Table 1-3). The perennial ponds had the highest number of meiobenthos (69.9%), followed by the canals (17.9%) and seasonal fields (12.2%).

Nematodes were the most dominant meiobenthic group, forming 79.6%. They were present at all the stations in the 0-5 cm layer and also at stations 1, 2, 4, 5, 8 and 9 in the 5-10 cm layer. According

Table 1. *Meiobenthic biomass (mg/10 cm^2) in the 0-5 cm and 5-10 cm layers of the sediment at different stations*

		Station 1		Station 2		Station 3	
		0-5	5-10	0-5	5-10	0-5	5-10
1988	D	0.630	0.120	0.251	0.097	-	-
1989	J	0.510	0.140	0.270	0.133	-	-
	F	0.451	0.115	0.347	0.125	-	-
	M	0.428	0.086	0.347	0.125	0.649	-
	A	0.469	0.101	0.243	0.080	0.398	-
	M	0.289	0.072	-	0.035	-	-
	J	-	-	0.14	0.014	-	-
	J	-	-	-	-	0.311	-
	A	-	-	-	-	-	-
	S	-	-	-	0.018	-	-
	O	-	-	0.043	-	0.247	-
	N	0.041	-	0.043	-	-	-
	D	0.150	0.044	-	-	-	-
	J	0.137	0.062	0.257	0.098	0.335	-
	F	0.291	0.079	0.299	0.062	0.027	-
	M	0.352	0.088	0.504	0.169	0.024	-
	A	0.458	0.115	0.494	0.116	0.028	-
	M	0.398	0.097	0.349	0.089	-	-
	J	0.162	0.077	0.167	0.050	-	-
	J	0.102	0.043	-	-	-	-
	A	-	-	0.061	-	-	-
	S	-	-	-	0.029	-	-
	O	-	-	-	-	-	-
	N	-	-	-	-	-	-

to density ranking, nematodes were the most abundant at station 4, followed by stations 2, 1 and 9. Nematodes reached upto 395/10 cm^2 in the upper 5 cm layer and 152/10 cm^2 in the lower 5 cm layer. Their highest abundance was recorded at station 4, a perennial pond, where they formed 74.3% of the total meiofauna. Kurian (1973), studied the benthos of Vembanad Lake and reported that nematodes were the most abundant meiobenthos. Srinivasan (1982) also made a similar observation in the prawn culture fields of Cochin. Harpacticoids were the second dominant meiobenthic group forming 13.4% of the toal. They were collected from all the stations from the 0.5 cm layer. They were the most abundant at station 1, followed by stations 2, 3 and 4. Perennial ponds had higher abundance of harpacticoids. Their abundance was maximum during premonsoon. A sharp decline in their number was noticed at the onset of monsoon. Polychaetes ranked third in abundance, and their number was high at stations 4, 9, 1 and 8, in the descending order of abundance. Their distribution was found restricted to the upper 5 cm layer except at stations 8. Polychaetes were totally absent at stations 2 and

Table 2. *Meiobenthic biomass (mg/10cm²) In the 0-5 cm and 5-10 cm layers of the sediment at different stations.*

		Station 4		Station 5		Station 6	
		0-5	5-10	0-5	5-10	0-5	5-10
1988	D	0.343	0.098	0.1132	-	0.035	-
1989	J	0.514	0.142	0.144	-	0.125	-
	F	0.057	0.023	0.149	0.075	0.149	-
	M	0.057	0.023	0.093	0.037	0.075	-
	A	0.037	0.004	0.084	0.056	0.056	
	M	0.026	0.013	0.103	-	-	
	J	-	-	-	-	-	
	J	-	0.045	-	-	-	-
	A	-	-	-	-	-	-
	S	-	-	-	-	0.035	-
	O	-	-	-	-	-	-
	N	-	-	-	-	-	-
	D	0.226	0.039	0.036	-	0.036	-
1990	J	0.207	0.039	0.062	-	-	-
	F	0.295	0.141	0.053	0.053	0.066	-
	M	0.346	0.115	0.098	-	0.266	-
	A	0.321	0.141	0.089	0.053	0.344	-
	M	-	0.089	-	-	0.144	-
	J	0.151	0.044	0.035	-	-	-
	J	0.124	-	-	-	-	-
	A	-	-	-	-	-	-
	S	-	-	-	-	-	-
	O	-	-	-	-	0.534	-
	N	0.107	-	0.053	-	-	-

3. The highest degree of occurrence of polychaetes was recorded at station 4. This station also abounded in macrobenthic ploychaetes mainly *Dendronereis aestuarina*. In all the stations polychaetes ceased to exist during the southwest monsoon period.

The other meiofaunal organisms such as oligochaetes, bivalves, ostracods, amphipods and tanaids had only stray occurrences and they together formed a meagre 0.30% of the total meiofaunal count. These groups were observed only during peremonsson period and were found to occur only in the upper 5 cm layer.

The hydrographic parameters exhibited seasonal variations and are presented in Table 4. The soil was analysed for organic carbon and texture. Organic carbon was high in the seasonal fields due to the decomposition of paddy stem and straw. Meiofauna did not show any significant positive correlation with different environmental parameters. However, during monsoon season, when salinity values reached almost fresh water conditions (as low as 0.26 ppt), the population showed drastic decline. Srinivasan (1982), Suresh *et al.*, (1992, 1996), and Chatterji *et al.*, (1995) have also reported declining

Table 3. *Meiobenthic biomass (mg/10 cm²) in the 0-5 cm and 5-10 cm layers of the sediment at different stations*

		Station 7		Station 8		Station 9	
		0-5	5-10	0-5	5-10	0-5	5-10
1988	D	-	-	-	-	-	0.036
1989	J	-	-	0.058	-	0.053	-
	F	0.019	-	0.087	0.016	0.072	0.029
	A	0.010	-	0.036	0.036	0.058	-
	M	-	-	-	-	-	0.043
	J	0.233	-	-	-	-	-
	J	0.156	-	-	0.035	0.021	-
	A	-	-	-	-	-	-
	S	-	-	-	-	-	-
	O	-	-	-	-	-	-
	N	0.053	-	0.047	-	-	-
	D	-	-	0.070	0.070	0.028	-
1990	J	-	-	0.041	0.117	0.056	0.048
	F	0.036	-	0.236	0.118	0.295	0.221
	M	0.382	-	0.389	0.129	0.388	-
	A	0.287	-	2.271	-	0.314	-
	M	0.287	-	2.224	-	0.203	0.074
	J	-	-	2.053	-	-	-
	J	0.036	-	0.036	-	0.027	-
	A	-	-	-	-	0.035	-
	S	-	-	-	-	-	-
	O	-	-	-	-	-	-
	N	-	-	0.196	-	-	0.036

Table 4. The range of different hydrographic parameters during the 2 year study

	Perennial Ponds	Seasonal Fields	Canals
Temperature (°C)	25.2-36	24-36	26-36
Salinity - ppt	0.26-28.12	0.27-27.85	1.38-20.33
Dissolved Oxygen ml/l	2.03-8.8	1.27-6.6	1.59-4.77
pH	6.4-8.5	5.6-8.5	6.1-8.1
Alkalinity mg/l	10-10.8	14-154	19-194
Nitrate µg at/l	0.07-23.15	0.03-19.75	0.93-20.8
Nitrate µg at/l	0.001-2.56	0.01-2.05	0.003-2.05
Ammonia µg at/l	0.09-89.25	1.41-89.16	3.4-99.96
Silicate µg at/l	3-129	7-90	10-115
Phosphate µg at/l	0.001-15.6	0.01-11.8	0.01-19.03
Organic Carbon %	0.83-4.9	1.96-7.23	0.53-4.11

meiofaunal count during the monsoon season.

Many earlier workers have reported the abundance of meiobenthos on the upper 5 cm layer of the sediment (Coull, 1970; Mc Intyre and Murison, 1973; Ansari *et al.* 1977; Hirakawa and Kumada, 1986). Mc Intyre (1969) and Sarma and Wilsanand (1996) considered the availability of oxygen and food to be the main factors for the concentration of meiobenthos in the upper 5 cm layer.

The distribution and abundance of meiofauna showed wide fluctuations, which were attributed to various factors. Emberton (1981) observed that the variation in meiofaunal population of Cape Cod Bay depended on season and depth. Seasonal changes in the number of meiofauna were noticed in the present study but as the depth is low, it was not found to affect the meiofauna (Ried and Machan, 1972; Fegley, 1987), but the effects due to continuous water flow on meiobenthos is only of minor importance as the present study was carried out in confined water bodies. Even in canals the meiobenthic community is not affected by continuous water flow as the flow of water is regulated by sluice gate at the mouth of the canal.

It has been well established that the qualitative and quantitative distribution of bottom fauna has a direct relationship with the type of bottom deposits. (Sanders, 1958; Bloom *et al.*, 1972; Jonasson, 1984; Pillai, 1977, 1978). The composition of the sediment varied from station to station. In general, the perennial ponds and the canals had a predominantly sandy substratum whereas the seasonal fields had higher clay content (Table 5) At

Table 5. *Texture of soil(range) of the different culture systems*

	Perennial Ponds	Seasonal Fields	Canals
Sand %	53.28-77.65	1.07-68.34	67.11-87.88
Silt %	13.5-32.95	6.72-30.61	9.18-23.54
Clay %	1.5-21.96	4.21-91.73	2.35-10.86

station 5, a seasonal field, clay content was high as 88-92%. The meiofauna was most abundant at stations where the sand content varied from 60 to 70% and silt from 15 to 29%. But, in the canals where the sediment had a similar composition, the meiofaunal count was low. These canals had a large amount of decaying vegetation, which leaves the sediment water interface deficient in oxygen. This could be the reaons for the poor meiofaunal assemblage in the canals. The meiofauna was the least represented in the seasonal fields, which can be attributed to the very high clay content.

The diversity of meiofauna is influenced by food-resource diversity (Johnson, 1974). It was observed that, in the present study, the abundance of meiofauna which form the natural food of macrofauna was low. The meiobenthos was greatly affected by salinity changes during monsoon. At all stations they perished totally in the monsoon and recolonised during postmonsoon. Similar changes in population density were also observed by Ganapthi and Raman (1973) and Kurian (1973).

The meiobenthic biomass at the different stations is given in Tables 1-3. In all the three traditional prawn culture systems, the upper 0-5 cm layer harboured 79.5% of the meiofaunal population. The perennial fields contained the highest abundance of meiofauna (69.9%) followed by canals (17.9%) and seasonal fields (12.2%). They were abundant at stations with high sand content (60-78%) and silt (15-29%), and was the lowest at stations with high clay content. The important meiobenthic groups collected were nematodes, harpacticoids, polychaetes, oligochaetes bivalves and crustanceans. Nematodes were the most dominant group forming 79.6% of the total meiofaunal count. The abundance of meiobenthic biomass declined during the southwest monsoon in all the culture ecosystems studied. Gut content analysis of the prawns collected simultaneously from the different culture systems during the present study showed the presence of nematodes (80%) in the guts analysed, which indicates a trophic chain involving meiobenthos.

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