

## STUDIES ON THE ENVIRONMENTAL CONDITIONS OF TIDAL PONDS IN THE RAMANTHURUTH ISLAND (COCHIN)

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### ABSTRACT

Environmental characteristics of certain enclosures and tidal ponds in Ramanthuruth Island where prawns grow in abundance were studied. Various parameters such as temperature, salinity, pH, Eh, dissolved oxygen, nutrients, chlorophyll 'a', particulate organic carbon, etc. were analysed from four different ponds in the island. These studies showed that the environment is subjected to seasonal variations due to the monsoons. It is observed that the ponds are highly productive during the whole year ( $>70 \mu\text{g/l}$  Chlorophyll 'a') with a high amount of particulate organic matter. Since these ponds are tidal, there was no depletion of oxygen in the overlying water as a result of oxidation. The results indicate that these ponds are highly suited for the culture of prawns.

### INTRODUCTION

ABIOTIC FACTORS particularly chemical characteristics of the environment can exert profound influence on the growth and survival of aquatic organisms. There are a number of reports on the prawn culture practices in Kerala (Panikkar, 1937; Menon, 1954; Gopinath, 1956; Kesteven and Job, 1957; George *et al.*, 1968; George, 1974), but they are mainly concentrated on the biological aspects of their culture. The culture ponds are mostly extensions of the estuary and backwaters and are therefore subjected to wider variations in the environmental conditions as compared to the sea. A regular monitoring of the environmental conditions therefore becomes essential to understand optimum environmental conditions for the culture of prawns.

The tidal ponds in the Ramanthuruth Island in the Cochin Backwater afford an excellent opportunity to study the different environ-

mental conditions that can be met in certain culture ponds in this region. They were therefore regularly monitored at fortnightly intervals for various physico-chemical factors, such as temperature, salinity, dissolved oxygen, pH, Eh and nutrient concentration of the waters. The study was conducted for 12 months from September 1978 to August 1979.

Ramanthuruth is a small island with an area of 18 ha. roughly, in the Cochin Backwater near the harbour entrance, of which 12 ha. is formed by a tidal pond regularly leased out by the Government for harvesting prawns (Fig. 1). Connected to this pond there are three other small tidal ponds in the area selected for the present study. These ponds are not leased out and hence regular fishing is carried out.

The hydrography of the ponds in the Ramanthuruth Island is largely influenced by the tides and the changes caused by the seasonal

monsoons. As these ponds are connected with the backwater the changes are brought about by the influence of the inshore waters

were made within 2 hours after the collections. Standard procedures were used for the analyses of samples.

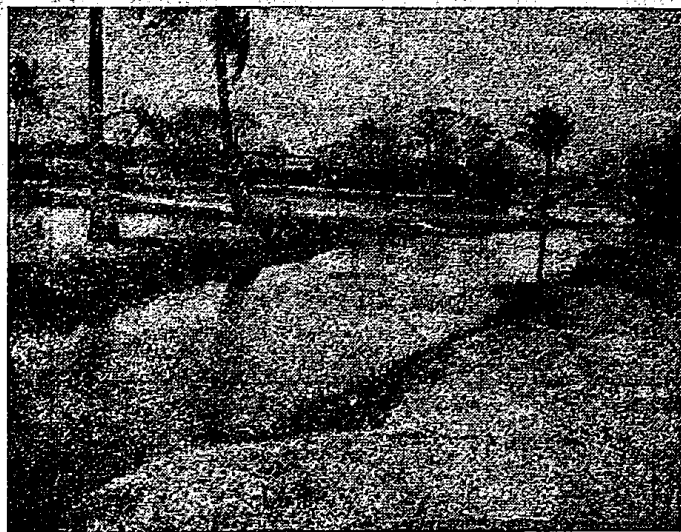


Fig. 1. Ramanthuruth Island showing various ponds.

as well as the river system in the upper reaches of the backwater. The tide in this area is semidiurnal with an average amplitude of about 1 m.

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#### MATERIAL AND METHODS

Water samples were collected at fortnightly intervals from the surface. As there was no difference in the surface and subsurface water characteristics, the subsurface samples were collected only at frequent intervals. After the collections of samples they were brought to the laboratory and the analyses

#### RESULTS AND DISCUSSION

##### *Temperature*

The temperature of the water in ponds varied between 27.5 and 34.0°C. During the SW monsoon season the temperatures were low. The minimum temperature was recorded during December-January. The low temperature observed during these months was due to the winter effect. In general higher temperature was recorded during the pre-monsoon season (March-May) and also during the postmonsoon season.

Higher temperature observed in ponds 2 and 3 in the month of July may be due to the shallow nature of the pond.

##### *Salinity*

The salinity of the pond water showed wide seasonal variation (Fig. 2). The values were low ( $S < 5\text{‰}$ ) during June to November, when the SW monsoon was active. During

this period freshwater flow predominated over the tidal flow in the surface layers of the backwater. The salinity values started increasing from December and the higher value ( $S > 25\text{‰}$ ) were observed in February

*pH*

The results showed that the pH of the water in the ponds were lower than the usual 8.0 to 8.3 of sea water. The values varied between 7 and 8.2. Higher values

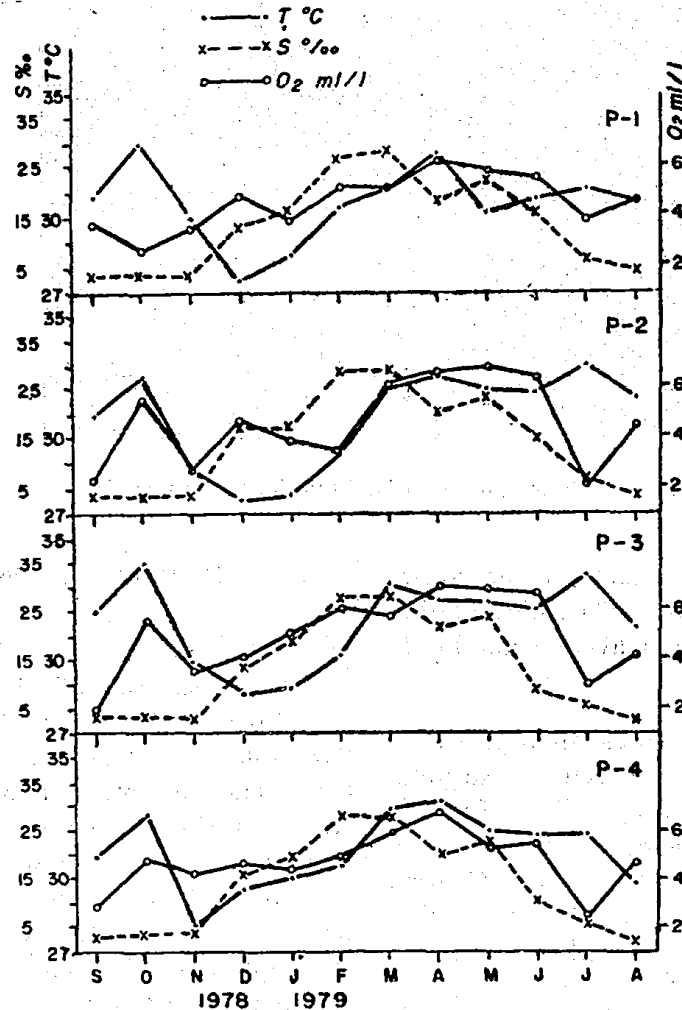


Fig. 2. Seasonal distribution of temperature, salinity and dissolved oxygen in ponds 1 to 4 of Ramanthuruth Island.

and March. However, there was a slight drop in salinity during April and May. This may perhaps be due to the effect of the pre-monsoon showers, which is common during this period.

were recorded during the premonsoon season when the salinity values are high. Low pH values were confined to the SW monsoon period when the system was dominated with freshwater. The pH at bottom was

approximately the same as that near the surface.

#### *Eh*

The oxidation reduction potential exhibited only a narrow range of +100 to +140 mV throughout the surface layer. The bottom water Eh also did not show much variation and was similar to that of the surface. However, the bottom sediments in these ponds exhibited a variation from -245 to -120 mV indicating reducing conditions in the mud. But there was no smell of hydrogen sulphide excepting on a few occasions in the bottom sediments of pond 2.

#### *Dissolved oxygen*

The water in the ponds was well oxygenated with values varying between 2 and 7 ml/l (Fig. 2). High oxygen values were noticed during the premonsoon months (March to May). The dissolved oxygen content was relatively low (< 4 ml) during the SW monsoon period (June to October). The values steadily increased in the following months. As the system was relatively shallow the vertical variation in the dissolved oxygen concentration was negligible.

#### *Nutrients in organic phosphate*

Inorganic phosphate in the waters of all the ponds showed very high values (>2 $\mu$ g at/l) throughout the year (Fig. 3). Highest value was observed in pond 2. The phosphate levels showed a general increase during the SW monsoon period (June to October), excepting a fall in the concentration during the month of August in ponds 1, 2 and 3. The phosphate concentration in pond 2 was exceptionally high during these months. In pond 4 the seasonal variation in the phosphate levels showed a general decrease from the month of March to September unlike in other ponds. Afterwards the levels showed an increase during the

following months, except in November and December.

#### *Nitrate*

Nitrate values in all the ponds varied between <1 and 15  $\mu$ g at/l (Fig. 3). The annual distribution in the nitrate levels showed a general decrease during the months March to May and during September and October. Highest nitrate values were recorded during June and August and the values showed a decrease and afterwards an increase in the following months. The general pattern of monthly variation in all the ponds are similar.

#### *Chlorophyll 'a'*

While all the ponds in Ramanthuruth Island were highly productive the pond 2 appeared to be exceptionally rich in chlorophyll with values exceeding 300  $\mu$ g/l. The chlorophyll 'a' values showed a maximum concentration during June to September, in all the ponds excepting the pond 2, where the chlorophyll was high throughout the year. In all the other ponds the minimum amount of chlorophyll 'a' was observed in May. High chlorophyll concentrations were usually observed with dense phytoplankton bloom of a single species like *Nitzschia*, *Skeletonema*, *Peridinium*, at different months of the year.

#### *Organic matter*

The organic matter in the ponds varied between 1 and 4%. Many of the bottom samples from the pond contained leaves and twigs of plants. The organic matter in the sediment was due to the incomplete oxidation of debris from plants, the leaves of which were blown into these ponds, apart from the contribution from the overlying water. The population living in the island is also contributing for fertilizing the pond by feeding the ducks in the pond.

Retting the coconut husks leads to reducing conditions in the water and in the bottom sediments. But at no time of the year reducing condition of the water was observed.

REMARKS

The foregoing account clearly indicates that the cycle of events in the tidal ponds of

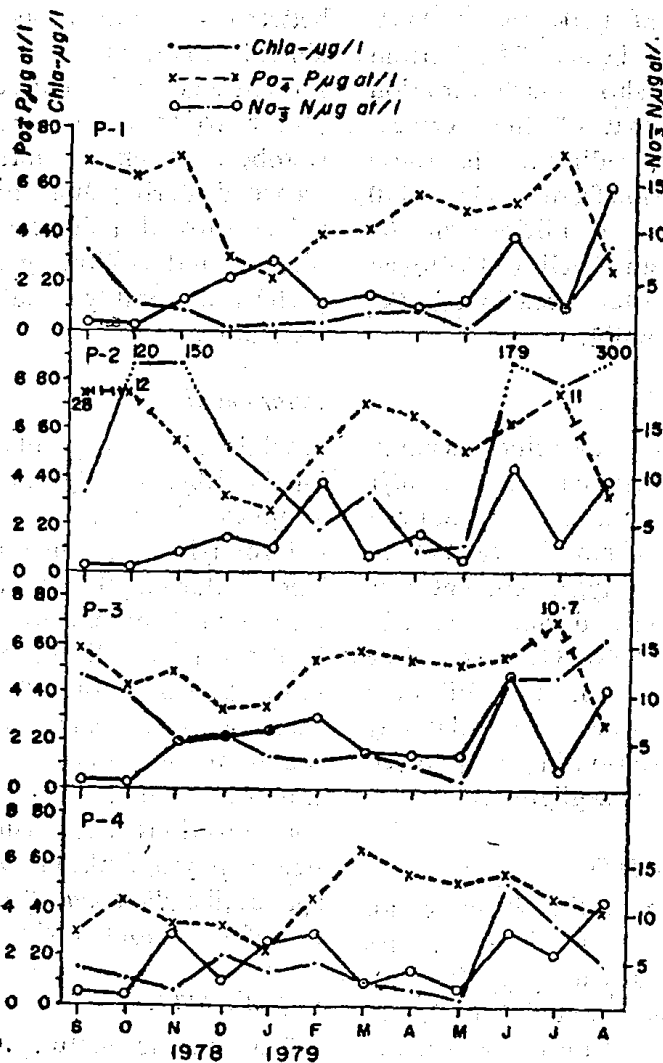


Fig. 3. Seasonal distribution of inorganic phosphate, nitrate-nitrogen and Chlorophyll 'a' in ponds 1 to 4 of Ramanthuruth Island.

As described earlier the smell of hydrogen sulphide in the mud was noticed at a few occasions in pond 2 but in other ponds it was absent.

Ramanthuruth Island was fairly regular. The temperature of the water was relatively low during the SW monsoon season when the rain was maximum and also during winter.

Several workers (Williams, 1960; Zein-Eldin and Griffith, 1969; Venkataramaiah *et al.*, 1974; Sreekumaran Nair and Krishnan Kutty, 1975) have stressed the importance of temperature and salinity in the survival and growth of prawns. Although Rao (1973) did not observe the relationship between the distribution of larvae and the temperature conditions in the inshore and backwater regions, the peak abundance of larvae was noticed at temperatures between 28° and 30°C. During July to November the salinity of the water in these ponds were low (< 5‰) as a result of large influx of freshwater due to the monsoonal rains. But the salinity increased during the following months to values > 10‰ and it maintained till the month of June when the freshwater flow began. Williams (1960) has found that the juveniles of certain species of *Penaeus* survived better in higher salinities. Nair and Krishnan Kutty (1975) based on laboratory studies have found that the growth rate of *Penaeus indicus* is significantly high in salinity of 10‰ for postlarval stages and in salinity of 30‰ for juvenile prawns. In the Ramanthuruth area, when the season for impounding the postlarvae in the fields begin the salinity is relatively low which gradually increases as the season progresses which also suits the increasing salinity optima of the growing prawns.

The dissolved oxygen of the water in all the ponds was never below 30% saturation during different months of the year. Relatively lower oxygen saturation values (< 3 ml/l) were observed when the system was freshwater dominated and during rest of the months the oxygen content was more than 4 ml/l indicating well oxygenated condition of the environment. The waters in the pond were rich in nutrients with inorganic phosphate values greater than 2 µg at/l throughout the year and of nitrate values more than 1 µg at/l. The distribution of nutrients therefore

indicated that the primary production in these ponds were not nutrient limited. The nutrient concentration in these waters were mainly influenced by the marine waters and by the freshwater discharge as suggested by Sankaranarayanan and Qasim (1969). As the system was shallow the regeneration and the cycling of nutrients was also largely reflected by the high values in the overlying waters. The phytoplankton production in these ponds was also high throughout the year (Fig. 3). The zooplankton population in these ponds was low during most of the months of the year (Haridas, per. comm.). Therefore the high phytoplankton production may be going waste in the overlying water and getting deposited in the bottom. Relatively high organic matter (> 4%) of the mud with a calorific content > 200 cal/g dry wt lends support to this. The low redox potential of the bottom mud also indicated the high organic content of the mud. Qasim *et al.* (1969) have also noticed a large surplus of primary production which falls to the bottom as detritus in the Cochin Backwater. The calorific content of the detritus has been estimated by Qasim and Sankaranarayanan (1972), to be from 200 to 500 cal/g dry wt. Qasim and Easterson (1974) have determined the nutritive value of the estuarine detritus and the energy conversion of a penaeid prawn *Metapenaeus monoceros* based on experiments conducted in the laboratory. They found a gross growth efficiency of 10.5 to 35.2% and the assimilation efficiency in the order of 93%. These ponds can therefore support a rich bottom fauna, an important source of food for prawn, besides detritus.

The present observations clearly indicate that these ponds are highly productive and suitable for culturing prawns. The environmental conditions and the high organic production are conducive for their fast growth and for maintaining a high biomass.

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