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REPRODUCTIVE BIOLOGY AND SETTING OF SPAT OF *CRASSOSTREA MADRASENSIS* (PRESTON) IN MUTTUKADU BACKWATER*

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ABSTRACT

The spawning in *Crassostrea madrasensis* of Muttukadu Backwater is prolonged from January to November with peaks in February-March and September-October. Female oysters were dominant in several months of the year and males outnumbered females in August and September 1986, February and May 1987. Among the four stations, where oyster spat settlement was studied, Muttukadu Bridge yielded good settlement of spat especially in October. A maximum of 109 oyster spat set on a lime-coated tile. The fouling organisms and their intensity of settlement on the clutch was recorded. Maturation and spawning of oysters and spatfall were correlated with salinity and temperature.

INTRODUCTION

THE EDIBLE OYSTER *Crassostrea madrasensis* is distributed on the eastern and western sides of road bridge of the Muttukadu Backwater. The natural bed consists of six patches spread over a wide area of 3.6 hectares. The density of oysters in this bed varied between 60 and 372 number per m^2 with a biomass of 545 tonnes (Sarvesan *et al.*, 1987). Several tonnes of oysters are exploited from this area once in four years exclusively for lime-burning. Small quantities are collected to supply the same to hotels in Madras. Studies on the biology of the oyster are a prerequisite to propagate oyster culture and several workers gave information from different locations (Hornell, 1908, 1910; Devanesan and Chacko, 1955; Rao, 1956; Rajapandian and Rajan, 1983; Rao *et al.*, 1983). Experiments on the spat collection of oysters have been attempted by several workers (Hornell, 1908; Devanesan and Chacko, 1955; Sundaram and Ramadoss, 1978; Reuben *et al.*, 1983; Thangavelu and Sundaram, 1983; Purushan *et al.*, 1981). In the present investigation, the reproductive biology, rate of spat settlement, seasonal variations and hydrological conditions which may have influence on the settlement of spat in the Muttukadu Backwater are given.

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MATERIAL AND METHODS

Samples of *C. madrasensis* for biological studies were collected once in a month in all the four stations (Muttukadu Bridge, Sluice Gate, Kunnukadu and Kovalam Bridge) during September 1986 to August 1987 in Muttukadu Backwater and pooled. They were washed and

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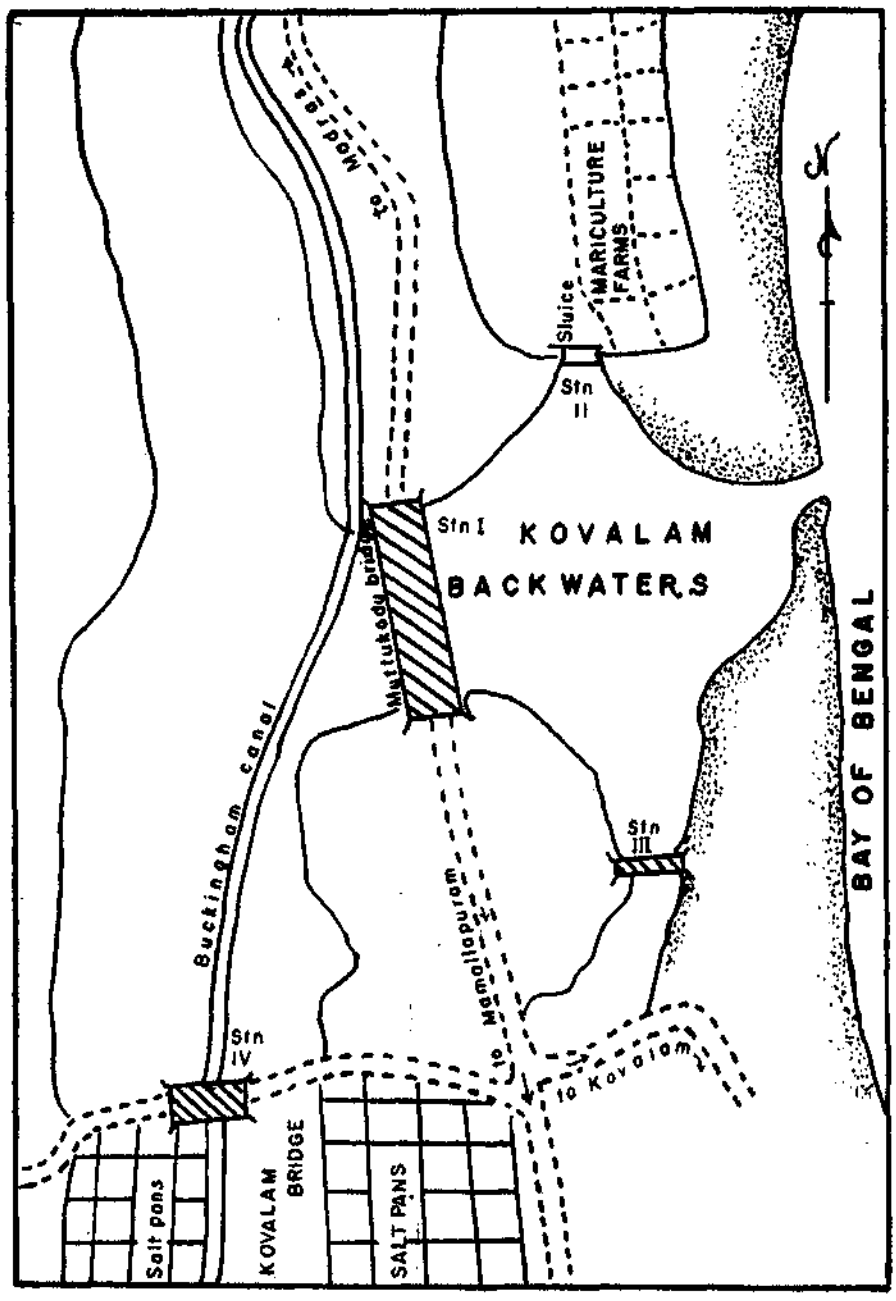

Fig. 1. Diagrammatic representation of Muttukadu backwater showing four stations selected for oyster spat collection experiment.

cleared off epifauna and epiflora prior to examination. Length of the oyster was measured to the nearest 0.1 mm and the weight taken nearest to 0.01 g. Sex and maturity stage were determined by microscopic examination of gonad smears of 50 individuals in each month. Five categories of maturity stages, namely stage I (maturing), stage II (ripe), stage III (partially spawned), stage IV (spent) and stage V (resorbing) were recognised following Ropes (1968) and Narasimham (1987). The monthly sex-ratio data subjected to Chi-square test to see whether male : female ratio was different from 1 : 1.

Semicylindrical roofing tiles were used as spat collectors. Lime-coating and drying of tiles were carried out as explained by Thangavelu and Sundaram (1983). The lime-coated tiles were arranged in the form of a crate containing 12 tiles and tightly tied with 4 mm nylon rope. Four stations were fixed (Fig. 1) for laying the spat collectors. The tiles were arranged near the platform of the bridge or on the hard substratum. Two to six crates were laid in each station and they were examined once in a month for the number of spat settled. Fouling organisms were also noted.

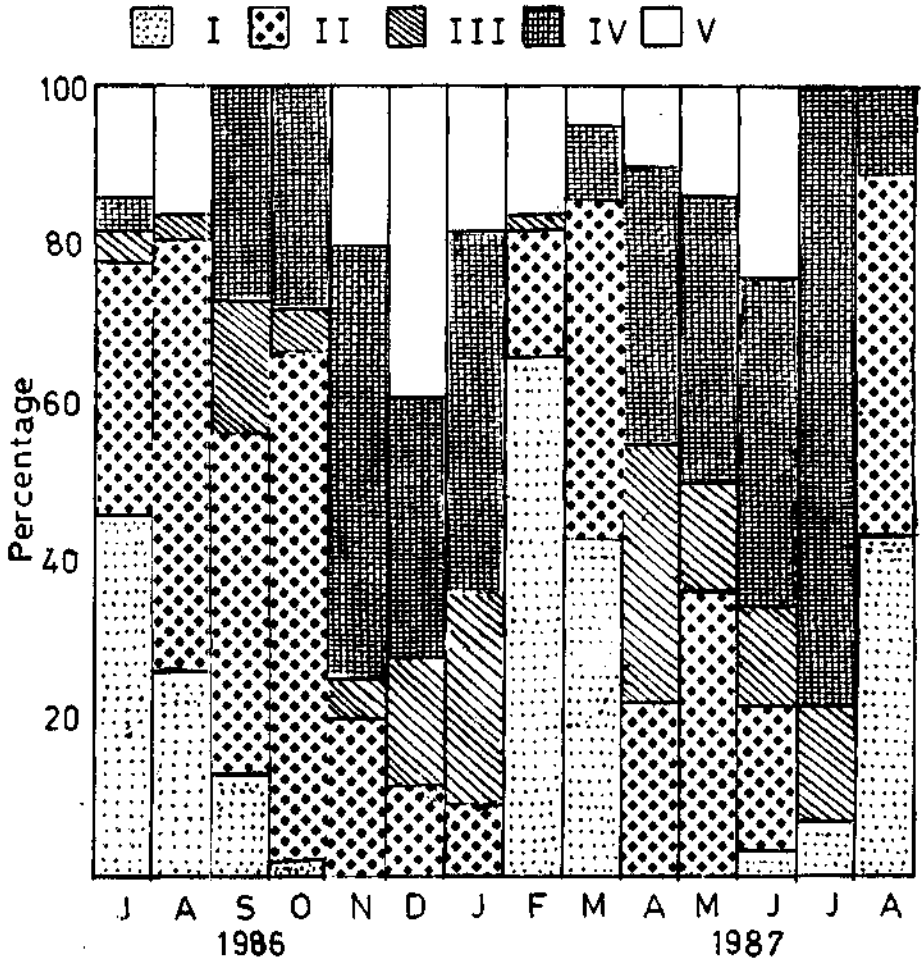

Fig 2. Monthwise percentage composition of different stages of maturity among male *C. madrasensis*.

Observations and Results

Distribution of maturity stages

Males : Maturing and ripe individuals were more common from July to October and again in February-March (Fig. 2). Partially spawned individuals were recorded in large numbers in September, December, January and April-July. Spent and resorptive stages were dominant in November-January and April-July.

Females : Maturing and ripe individuals were dominant from July - October and February - March, partially spawned ones in October, November, January and April ; and spent and resorptive in November-January and April-July (Fig. 3).

Ripe and partially spawned individuals occurred in high percentages during July-November and January-April period. Since these two stages of maturity stages bear direct relationship with the spawning activity, it can be inferred that their presence in large numbers indicate the period of active spawning. Occurrence of spent and resorptive individuals were

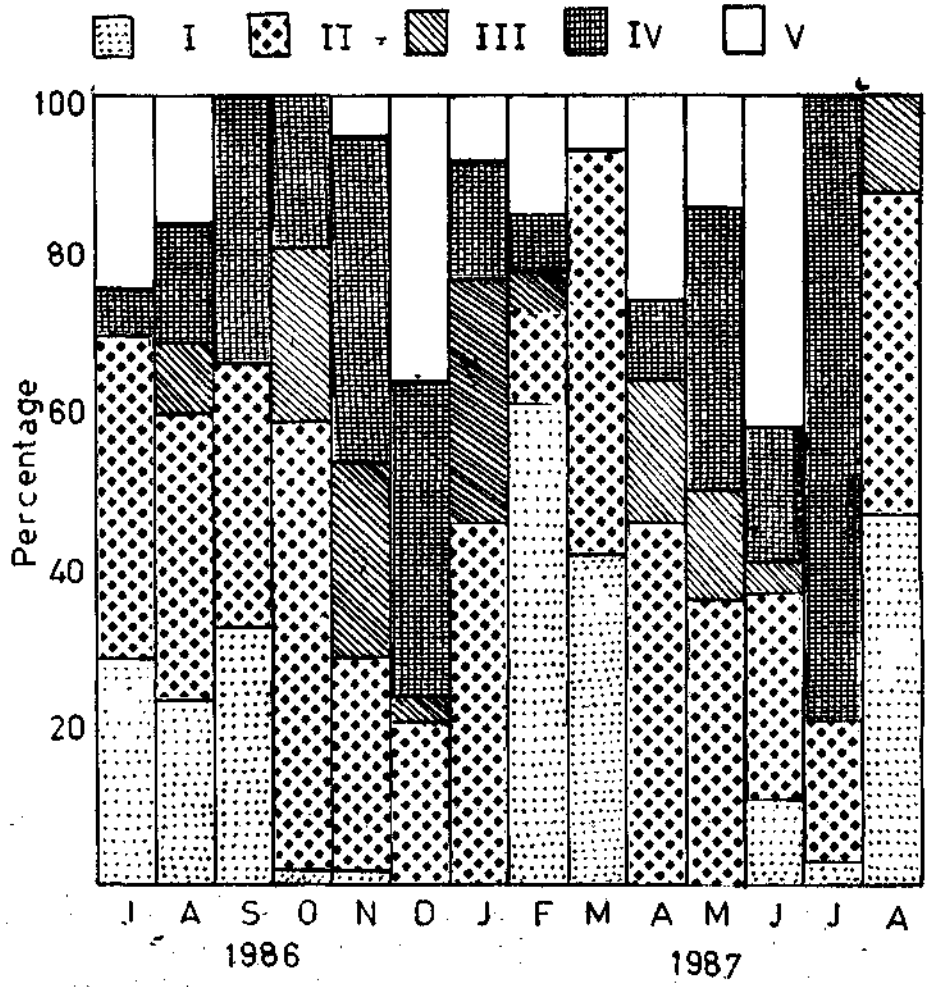

Fig. 3. Monthwise percentage composition of different stages of maturity among C Madras female *C. madrasensis*.

common in November, December, May and June, indicating the slackening of the spawning activity.

It is evident from the above data, that spawning in *C. madrasensis* is prolonged in Muttukadu Backwater from January to November with peak activity in February-March and September-October. Spawning activity was almost nil in December and very low in May-June. These two periods coincide with lowest and highest temperatures respectively in Muttukadu Backwater.

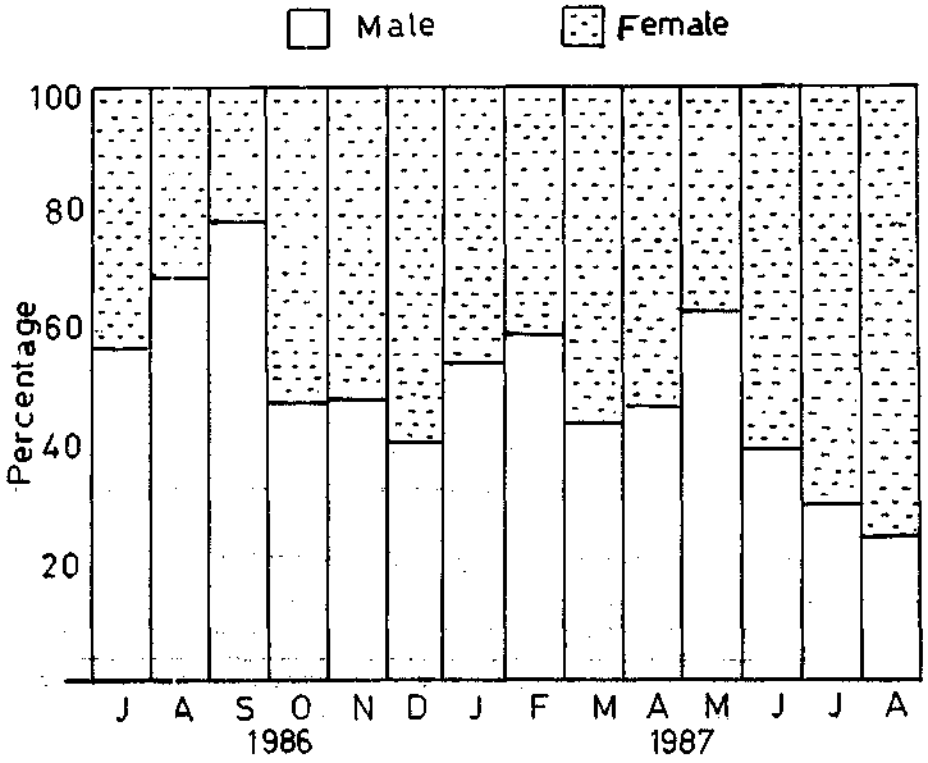

Fig. 4. Sex ratio in *C. madrasensis* at Muttukadu backwater.

Sex-Ratio

Males outnumbered females in July-September, January, February and May, while females were dominant in other months (Fig. 4). The test for homogeneity gave a Chi-square value of 2.5997 which was not significant at 5% probability.

Indeterminates were recorded from nil to 15% in different months. Instances of hermaphroditism were not observed.

During the study period, males formed 46%, females 50% and indeterminates 4%. The male and female sex-ratio recorded for the whole period was 1 : 1.1.

Setting of Oyster Spat

The average number of spat settled and range of spat on tiles in different stations have been given in Table 1 and 2.

Station I (Muttukadu Bridge): The high settlement of oyster spat was observed during

September 1986. The settlement ranged between 8 and 109 numbers with an average of 55 in each tile. It was found to decrease in the subsequent two months to reach an average of 32 and 4 per tile. There was no settlement and February 1987 respectively. The settlement appeared in September and February extended till the end of October and April respectively. There was no spat settlement in the remaining months.

TABLE 1. *The average number and range of spat settled in the four stations of Muttukadu Backwater*

Period	Muttukadu Bridge		Sluice Gate		Kunnukadu		Kovalam Bridge	
	Average	Range	Average	Range	Average	Range	Average	Range
September 1986 ..	55	8-109	11	3-22	—	—	—	—
October ..	32	11-87	21	8-83	—	—	7	0-14
November ..	4	0-37	—	—	—	—	—	—
December ..	—	—	—	—	—	—	—	—
January 1987 ..	—	—	—	—	—	—	—	—
February ..	3	0-14	4	0-12	1	0-7	2	0-11
March ..	9	0-31	2	0-6	3	0-31	—	—
April ..	1	0-6	3	0-11	2	0-21	—	—
May ..	—	—	—	—	—	—	—	—
June ..	—	—	—	—	—	—	—	—
July ..	—	—	—	—	—	—	—	—
August ..	—	—	—	—	—	—	—	—

TABLE 2. *The percentage of settlement of oyster spat on the concave and convex side of the tiles*

Period	Muttukadu Bridge		Sluice Gate		Kunnukadu		Kovalam Bridge	
	concave	convex	concave	convex	concave	convex	concave	convex
September 1986 ..	74.8	25.2	95.3	4.7	—	—	—	—
October ..	80.7	19.3	86.0	14.0	—	—	79.3	20.7
November ..	86.9	13.1	—	—	—	—	—	—
February 1987 ..	68.6	31.4	43.9	56.1	90.0	10.0	79.3	20.7
March ..	39.8	60.2	76.5	23.5	—	—	—	—
April ..	75.0	25.0	88.9	11.1	84.2	15.8	89.7	10.3

of spat from December 1986 to January 1987 and May-August 1987. Again there was settlement in February, attaining a peak in March and its intensity was reduced in April.

Station II (Sluice Gate): An average of 21 spats with a range of 8-83 and 4 spats with a range of 0-12 were noted during October 1986

Station III (Kunnukadu): There was only one peak of spat settlement during February-April and with no settlement of spat in all other months. It varied between 0-7 with an average of 1 spat per tile.

Station IV (Kovalam Bridge): The Kovalam Bridge is about 4 km from the bar-mouth on the

southern side, influenced by high saline conditions during summer months and freshwater influx during the monsoon season. In this station spat settlement was observed in October 1986 and February 1987. An average spat settlement of 7 per tile (range 0-14) in October and an average of 2 spat (range 0-11) were noted in February 1987.

Site Preference on Tiles

The tiles were arranged in the form of a crate one above the other and the uppermost tiles always collect silt and thereby there was no spat settlement. The pediveliger larvae of oysters usually prefer the concave side and select the darker area. At Muttukadu Bridge, maximum settlement of oyster spat was observed on the concave side (71%) and the settlement on the convex side was limited to 29%.

Settlement of Other Fouling Organisms

Sessile organisms such as barnacles, serpulids, bryozoans, anomids, simple and compound ascidians, sponge colony, bivalves such as mussel and pecten spat, modiolids and *Trapezium* were found to settle on tiles. The algal settlement was also common on the clutch material. The young barnacles were abundant in August-September 1986 and February-March 1987. *Hydroides lunulifera* was found to settle throughout the year with peak during February-March in all the four stations. The fouling intensity was low in Kunnukadu and Kovalam Bridge. Crabs, Alphids, amphipods, isopods and polychaetes were found to take shelter temporary on the tiles.

Hydrology in Relation to Spat Settlement

The salinity, temperature and dissolved oxygen varied between 14.9 ppt and 49.38 ppt, 28.1°C and 34°C and 2.46-4.45 ml/l respectively (Fig. 5). The Sluice Gate station is influenced by both tidal effect and movement of high saline water from Muttukadu Lagoon and as a result high saline conditions prevailed in April-May. Due to excess of evaporation, the salinity rose to 44.3 ppt during September and dissolved oxygen was reduced to 1.92 ml/l in summer season. The water in Kovalam Bridge area is influenced by freshwater influx during the monsoon season and mixing of high saline water from the salt pans during the summer months. The maximum settlement of spat was noted in September-October and February-March. In these months, the salinity and temperature ranged between 19.6 ppt and 34.12 ppt and 30°C and 34°C at Muttukadu Bridge. The spat settlement was poor at a salinity of 40 ppt at Sluice Gate station and it was completely absent at Kunnukadu and Kovalam Bridge where the salinity was 44.3 ppt and 48.7 ppt respectively. The settlement of spat during February-April was poor at the Sluice Gate, Kunnukadu and Kovalam Bridge and the salinity was found to range 39.5-44.2 ppt.

Discussion

Sastry (1955) has reported the spawning of *Placuna placenta* with the dilution of sea water by monsoonal rains. Lowering salinity with the onset of the Northeast Monsoon has been reported to be the stimulus for spawning in a number of bivalves from the Indian Coast (Hornell, 1908 ; Panikkar and Aiyar, 1939 ; Paul, 1942 ; Rao, 1951 ; Sastry, 1955 ; Nair and Saraswathy, 1970). In most of the bivalves, temperature plays a major role in maturation of gametes and spawning during summer season (Orton, 1920 ; Loosanoff, 1953 ; Sastry, 1963). The present study on the oysters of Muttukadu Backwater indicates prolonged spawning with biannual peak in March-April and September-October. It synchronises with heavy rainfall during the Northeast Monsoon and with increasing temperature during the summer months which is in agreement with the works of Hornell

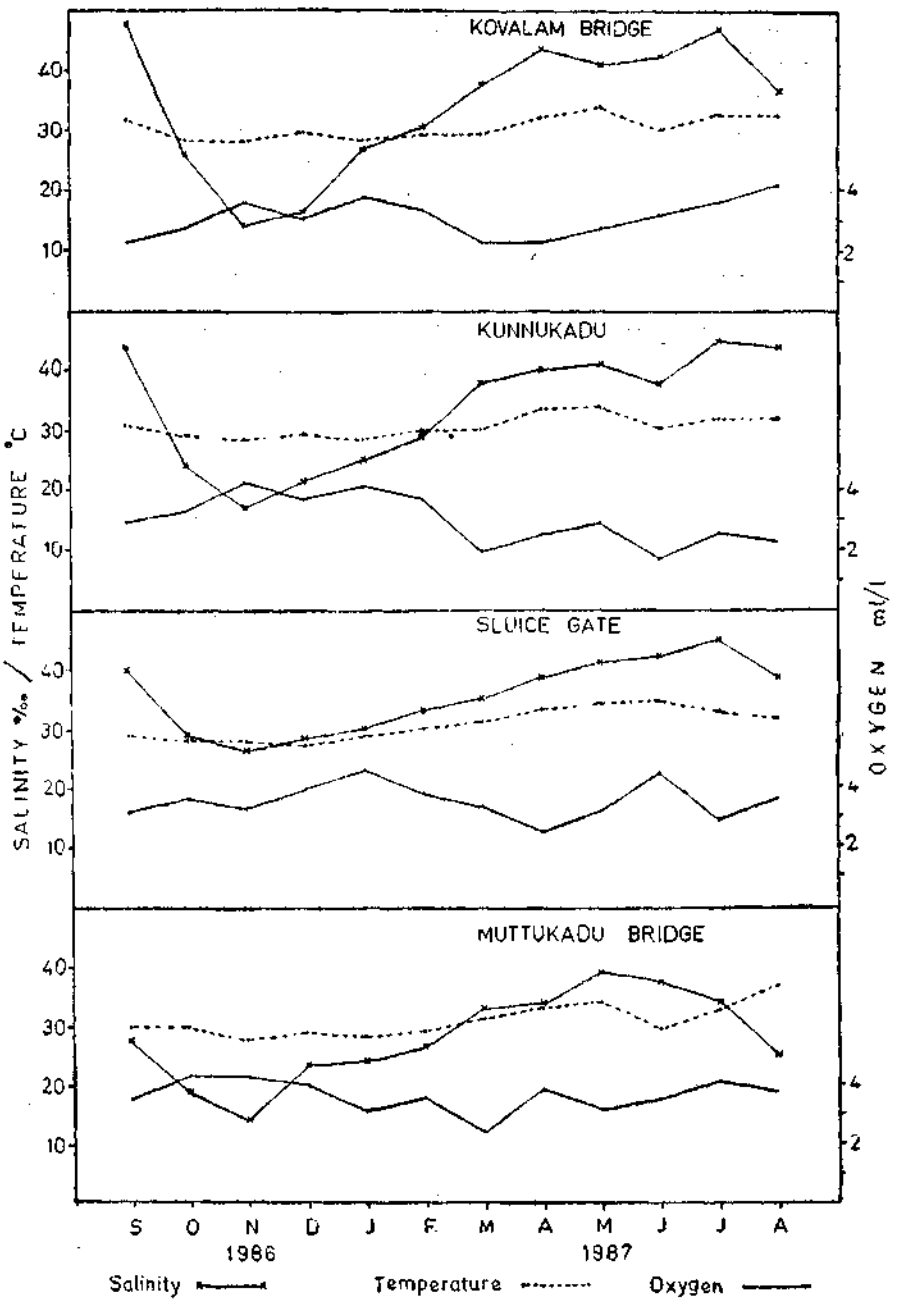

Fig. 5. Fluctuations in Salinity, Temperature and dissolved oxygen in four stations of Muttukadu backwater.

(1910), Sunder Raj (1930), Rao (1956) and Stephen (1980).

The peak settlement of spat was observed in September 1986 and March 1987. An average of 55 spat / tile was observed in September on lime-coated tiles. Among the four stations, Muttukadu Bridge showed maximum spatfall, where the tidal current is felt and the water is replenished constantly. The spat settlement is moderate in the Sluice Gate. The spat settlement was very poor in Kunnukadu and Kovalam Bridge where the freshwater influx is heavy during monsoon and excess of evaporation during the summer months.

The settlement of fouling organisms is abundant in August-September and February-March when there is a hike in the regime of salinity and temperature. The fouling organisms were found to be abundant in the Muttukadu Backwater and Sluice Gate and this may be due to heavy flushing of sea water which is not the case at Kovalam Bridge and Kunnukadu.

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