CMFRI
bulletin 42
Part Two

DECEMBER 1988

NATIONAL SEMINAR ON SHELLFISH RESOURCES AND FARMING

TUTICORIN

19-21 January, 1987

Sessions II-VI

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
P. B. No. 2704, E. R. G. Road, Cochin-682 031, India

61. SETTLEMENT OF SPAT OF THE BACKWATER OYSTER, *CRASSOSTREA MADRASENSIS* (PRESTON) IN PULICAT LAKE

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ABSTRACT

Spawning of the backwater oyster *Crassostrea madrasensis* (Preston) and settlement of its spat on the cultch material have been observed from April 1980 to November 1982 at Pulicat Lake. The intensity of spat settlement on the cultch was correlated with the abundance of veliger larvae in the plankton. Settlement of spat was found to be high during May and low during November when the salinity was high and low respectively in the lake. The salinity of the lake during the summer months seems to be favourable for the growth and settlement of the larvae.

INTRODUCTION

The basic need in any culture practice is a steady supply of seed. Seed production in the natural beds is not always dependable and fluctuates due to various factors in the environment. In most of the industrialised countries' water pollution has wiped out large areas of natural oyster beds and even destroyed the coastal fisheries. To prevent depletion of stocks, of new methods of fish and shellfish cultivation are being developed. Some work has been carried out in India on collection of oyster spat. Hornell (1910, 1922) reported the the use of roofing tiles for spat collection in the Pulicat Lake. Devanesan and Chacko (1955) tried casuarina twigs and oyster and cockle shells at Ennore, but did not obtain encouraging results. Sundaram and Ramadoss (1978) reported on the suitability of lime-coated tiles at Tuticorin. The other important works on oyster spat are of Rao (1951) and Rao and Nayar (1956) in Adyar estuary, Dhulkhed and Ramamurthy (1980) and Stephen (1980) in the Mulki estuary, Purushan et al (1981) at Cochin backwaters, Thangavelu and Sundaram (1983), Nayar and Mahadevan (1983) in Tuticorin bay and Rao et al (1983) at Athankarai estuary.

MATERIAL AND METHODS

In order to investigate the intensity of spat settlement and frequency of larval abundance a sampling station opposite to the Estuarine Biological Laboratory was established. A small experimental rack of size of 2 m x 1.5 m was constructed by driving the casuarina poles into the muddy bottom. Poles were tied horizontally just below the surface of water and perpendicular to these poles transverse poles were tied to form a rack in such a way that the gap between them was sufficient to prevent the tiles falling from the rack. Curved roofing tiles (22 x 12 cm) were procured locally, cleaned and then coated with lime as described by Thangvelu and Sundaram (1983). After ascertaining the ripeness of the gonads of oysters by periodically examining some oysters in every season 50 tiles were arranged on the rack in the form of a crate. In addition to the tiles, weathered oyster shells (100 numbers) were also placed in a 45 x 30 cm bag made out of 2 mm synthetic twine with mesh size of 20 mm and the bag was suspended from the rack. The tiles and shells were examined after a period of 15 days and the number of spat settled on the cultch was noted.

Plankton samples were collected from the sampling station by filtering 200 l of water through a hand net made with fine shed bolting silk. Plankton collections were preserved in 2% formalin and analysed by using the plankton counting chamber and the number of bivalve veligers present in 100 l were calculated. Salinity, temperature and dissolved oxygen were also recorded from the spat collecting site regularly.

RESULTS

Relation between the ripe oysters and number of larvae in plankton

The percentage of ripe male and female oysters in the samples throughout the period of study is illustrated in Fig 1. Maximum number of fully ripe oysters of both the sexes were found during April and October during three years of study from 1980 to 1982. Immediately after the outbreak of the north east monsoon, due to freshwater influx the salinity of Pulicat Lake decreased to a low level during October/ November, which probably made the oysters to spawn. The rise in water temperature during April induces the animals to liberate their gametes into the water.

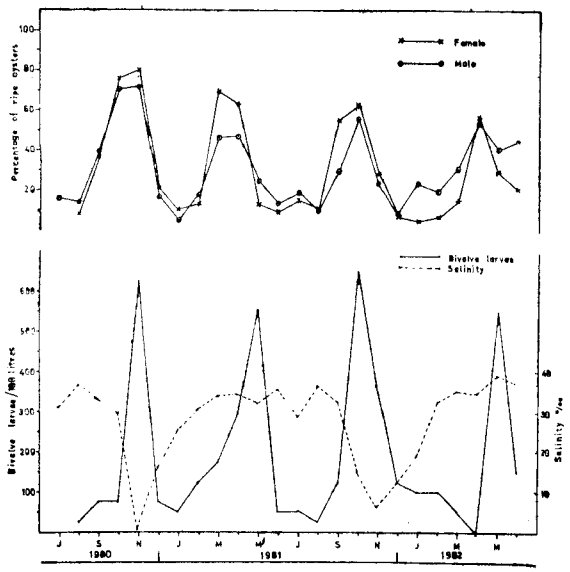

Fig. 1. Seasonal variations in the abundance of bivalve larvae/100 litres observed during July, 1980-June, 1982 and correlation with the salinity and percentage of ripe oysters.

The maximum percentage of ripe males and females during October 1980 was 75.7% and 70.5% respectively, which rose to 80% and 72% in November 1980. Since there was a delay in the onset of the monsoon during 1980 in the Pulicat Lake, spawning was also delayed and it was observed in the middle of November. Another peak of ripe ones was observed during April 1981 and it was 46.5% in females and 64.1% ih males respectively. It was found to decline during May. The same trend was observed during the corresponding months of the subsequent year also.

Immediately after spawning in November and April, there was a major peak of larval abundance in water indicating the major spawing during this period. The number of larvae was found to decline slowly during the next fortnight. In the subsequent month, the occurrence of oyster larvae was noted in the plankton samples but not in significant numbers.

The maximum occurrence of veligers in the plankton which are predominantly those of *C. madrasensis* coincided with the maximum percentage of spent oysters in the population. The peak occurrence of veliger larvae was observed in the lake during November soon after spawning which triggered by the low saline conditions as a result of northeast monsoon rain. In April, another peak of larval occurrence was observed in the lake.

Relative abundance of veligers in relation to spatting

The average number of spat collected on the tiles and shells during different periods are given in the Table 1. Oyster spat settled during April 1980 on the lime-coated tile and oyster cultch were 33 and 4 respectively. In October 1980, the average number of spat settled on a single tile was 3 whereas settlement was totally absent on shells. In April 1981, the average settlement was 19 and 2 on tiles and shells respectively. The spatfall during this period was less when compared with the previous year of the same period. In October '81, the average settlement of spat was 27 per tile and 3 per oyster shell and the number of veligers in 100 l of water was 650. Salinity was slightly higher than in the previous year. There was very good spat settlement both on the tiles and shells during April 1982. On considering the data for three years, the setting of oyster spat was considerably high during May and poor during November.

TABLE 1. *Number of spat collected in two types of spat collectors during the period April 1980 to November 1982.* (each value represents the mean (± S. D).

Type of spat Collector	Number of tiles/shells used.	Period of spat collection Apr/May, 1980	Oct/Nov 1980	Apr/May 1981	Oct/Nov 1981	Apr/May 1982	Oct/Nov 1982
Lime-coated tiles	50	33 ± 9.9	2.6 ± 2.29	19.04 ± 10.98	27 ± 20.42	51.5 ± 16.51	2.4 ± 2.37
Oyster shells	100	4.46 ± 2.23	0.0 ± 0.00	2.04 ± 1.88	2.29 ± 2.48	3.71 ± 2.90	0 0 ± 0.00

Salinity and setting of spat

Salinity is an important ecological factor in the lake which shows diurnal, seasonal and annual fluctuations in the environment. The time of spawning and the peak occurrence of oyster larvae are probably regulated by the seasonal salinity patterns. The seasonal variations in relation to the abudance of larvae in plankton are illustrated in Fig 1. Major spawning peak was observed during November '80 and relative abundance of larvae in the lake was also found to be high but the settlement of spat on the spat collectors was very poor. This may be due to poor larval development in the low saline conditions prevailing in the lake. There are changes for the mortality of veliger larvae in the lake during the low saline conditions. During the minor peak of spawning in April, the salinity was found to be 34.83 °/₀₀ and the larval abundance in the plankton was also moderately lesser than in October. Since there was no significant change in the salinity of water during April, there was no possibility of mortality of the larvae and the settlement of spat was also considerably high. In October 81, the salinity was 6.83°/₀₀ which was considerably higher than the previous year, the settlement of spat was also considerably higher during this period. It is obvious that this salinity was conducive for larval development and the settlement was on an average of 27 per tile and 3 per shell. Again in April 1982, the settlement of spat was high when compared to earlier months' but in October 1982, the settlement was very poor as it was for October/November 1980. By and large, the settlement was high during May 1982 when the salinity was moderately high.

Other factors regulating the rate of setting of oyster spat

The settlement of oyster spat on the spat collectors is greatly influenced by biological

TABLE 2. *Monthly variations in salinity, temperature and dissolved Oxygen observed over the oyster bed at Pulicate Lake*

Months		Salinity ‰	Water Temp. (°C)	Dissolved Oxygen (ml/1)
Jul	1980	31.06	30.0	4.65
Aug		36.56	29.3	4.14
Sep		32.95	30.0	4.03
Oct		29.56	29.5	7.43
Nov		0.37	29.5	4.99
Dec		16.02	25.8	4.42
Jan	1981	25.74	26.0	4.70
Feb		30.39	27.5	5.22
Mar		34.14	29.0	4.20
Apr		34.83	31.0	3.97
May		32.21	30.5	4.65
Jun		35.42	30.0	3.91
Jul		29.20	29.8	5.16
Aug		36.53	27.8	4.31
Sep		32.63	27.0	4.76
Oct		14.99	29.0	5.57
Nov		6.83	26.0	4.48
Dec		12.41	24.0	8.83
Jan	1982	18.99	23.0	3.19
Feb		32.84	23.0	5.22
Mar		35.29	29.0	3.19
Apr		35.29	29.5	3.82
May		39.24	29.0	4.71
Jun		37.19	29.0	6.49

and environmental conditions. There are favourable conditions such as extensive oyster beds, with sexually mature adult stock, a sharp fall in salinity during the northeast monsoon which triggers the rapid spawning of oysters, suitable physical factors like tides, waves and winds which contribute to the dispersal or accumulation of these larvae, suitable rise in water salinity and temperature during the summer months which facilitated a healthy growth of the larvae, suitable substratum for good settlement (Table 2). There are certain other factors which by direct or indirect means do not favour the settlement. The reason for the poor settlement is due to poor growth of the larvae in lower saline conditions, or mortality might have occurred due to silting or lack of larval food in the water. Mortality might have been due to predation, turbidity or the fast flow of water and these factors have considerably impeded the settlement after peak spawning of oyster,

DISCUSSION

Salinity, temperature and other factors are of utmost importance to induce spawning, successful development of embryos to the veliger stage and to promote setting of oyster spat (Loosanoff and Davis 1952). Based on the examination of oysters the percentage of ripe oysters in the population, the quantity of larvae produced and the number of seed collected; the efficiency of seed collection was determined. Ambient temperature does not seen to play much role in the spawning of oysters in the tropical regions. Salinity is the main factor that influences the spawning. The fall in salinity during the northeast monsoon on the contrary, is the chief stimulating factor in the spawning of the Madras oysters on the east coast backwaters of South India (Hornell 1910, 1910a, 1922 and Rao 1951). The percentage of ripe ones in October, decline considerably in November indicates the major spawning of oysters as a result of low saline conditions prevailing soon after northeast monsoon rains. The presence of early stages of oyster larvae in plankton also indicates the recent spawning, and their number will indicate whether it was a minor spawning.

In the present study on oysters of Pulicat Lake, the intensity of spawning was found to be considerably high during October/November as indicated by the presence of a large number of veliger larvae in the plankton, but mortality of veliger larvae is also moderately high due to low saline conditions (0.37%) and prevalence of heavy silting in the lake. Though the spawning intensity of oysters was low during April/May when compared with October/November in the three years of study, the setting of spat on tiles and shells was most intense. This was mainly attributed to the optimum salinity (34.83°/$_{oo}$) conditions prevailing for the larval growth and settlement. From this, it is clear that the larval development, growth and settlement of oysters are influenced by the salinity in the lake. Below the 5°/$_{oo}$, salinity level oysters cease to feed and hence the growth gets inhibited (Galtsoff 1964). The larval development, growth and settlement were moderate in salinity ranged between 32.21°/$_{oo}$ and 33.24‰ Mortality of larvae during their free swimming life is obviously high but assessing the causes for this mortality is very difficult. Predation and dispersion are probably the major causes although mortality due to disease has not been adequately evaluated. The relation between larval transportation are also poorly understood in Indian coasts.

Both roofing tiles and weathered oyster shells seem to be effective for the collection of oyster spat. Andrews (1971) mentioned that in high salinity of the eastern shores of Virginia, Carolina and Georgia there is intensive spatfall due to moderately high tidal amplitude. Hopkins (1931) found correlation between the periods of setting and the periods of high salinity in *Ostrea. (Crassostrea) virginica* of Galveston Bay, Texas and considered that this larvae depend on the salinity either directly or indirectly to develop to the setting stage. According to Pritchard (1952) both the James River and the Delaware Bay have low saline areas with high production of seed oysters but the recruitment level was poor. The findings in the precent study agree with the views of Andrews (1971).

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