An assessment on the influence of salinity in the growth of black clam *(Villorita cyprinoides)* in cage in Cochin estuary with a special emphasis on the impact of Thennermukkom salinity barrier

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The growth and survival of molluscs are affected by a wide variety of environmental factors including the seasons, salinity, temperature and sediment. An analysis of the growth of an organism with respect to its environment is important not only for interpreting its adaptation to environmental changes but also to understand the impact of environmental changes on the species.

Longevity and rate of growth are helpful in describing the present status and the past history of a population and to estimate the future course of the fishery. In recent years, considerable emphasis has been given in India to culture edible bivalve molluscs such as oysters, mussels and clams, since they form a subsidiary fishery in most of the coastal and estuarine regions. Though many species of commercially important bivalves occur along the Indian coast, little attention was paid by past researchers on various aspects of growth despite the fact that this field offers a large number of unanswered questions.

Thanneermukkom Bund was constructed in 1974 to prevent salt-water incursion and to permit two crops of paddy in about 50,000 ha of low lying fields in the Kuttanadu area[3]. The bund has been functional since 1976 and remains closed from January to May every year. This has resulted in drastic ecological changes in the lake, particularly south of the bund, affecting the distribution, survival and abundance of the living resources in the estuary, and causing depletion of the black clam in several localities. Dredging conducted in several parts of the estuary has aggravated this problem.

The responses of an aquatic organism to environmental change may vary with the physiological state of the organism. Alterations in growth patterns occur during definite stages of growth and different seasons, because the proportion of energy utilised by the mollusc for different activities may change with time. Hence a thorough knowledge on the growth of bivalve mollusc along with its different life stages and seasons is of interest in the successful exploitation of its fishery potential. Due to the paucity of this information in molluscs in general, and in *Villorita cyprinoides* in particular, an investigation on the influence of salinity on the growth of the black clam was conducted in cages in Cochin estuary, with particular emphasis on the impact of the Thanneermukkom salinity barrier.

Study area

Three sites were selected for cage culture experiments; one on south of Thannermukkom Bund (station II), one on north of the bund (station IV) and another in front of Cochin University Boat Jetty (station V). Regular fortnightly sampling for hydrographical parameters was carried out from stations II, IV and V for one year.

Hydrographic parameters

Among different parameters temperature was measured by ordinary thermometer, salinity by Mohr's titration method[13] and sediment texture by the method proposed by Carver [4].

Cage culture experiments

Age and growth were studied by growing clams of varying length (1-3 cm) for one year in plastic boxes (9.6 x 15 x 5 cm). Four class ranges were selected for this study (1-1.5 cm, 1.5-2 cm, 2-2.5 cm and 2.5-3 cm). Cages in triplicates were arranged at three locations (Station II, IV and V). Each cage was filled with sediment obtained from the location of each clam bed, clams of fixed length were introduced in to each cage and the cages were covered by nylon mesh of 5 mm and placed in the clam bed. Monthly measurements of the clams were taken over the course of one year.

Results

Temperature

Significant variation in temperature at different stations during different seasons was observed in this study. Being a tropical estuarine environment the variation in bottom temperature was similar in trend to that of other tropical estuaries. While comparing stations on either side of bund, the station situated south of the bund (station II) showed frequent fluctuation in temperature. At station II it was between 27°C and 33.5°C and at IV the variation of temperature was between 26°C and 32°C, whereas at station V it was between 28°C and 32°C (Figure 1). At all the stations the minimum temperature was noted during June and maximum during March except at station V. Among three stations, station II showed the highest annual average followed by station V and IV.

Salinity

The first two stations (Station II, IV) had a freshwater dominated environment with measurable salinity occurring only during pre–monsoon. At station V, the ambient salinity was high except during monsoon (Figure 2). Annual average salinity at stations II, IV and V were 0.29, 1.96 and 17.67 ppt respectively.

Sediment texture

At station II the substratum was always silty sand except in March, April and May. During March it was sandy silt but in April and May it was clayey silt (Figure 3). At station IV the dominant sediment texture was sand and at station V it was clayey silt (Figures 3, 4 and 5). At station IV the annual average value for sand was 97 %, whereas at station V the annual average value for silt and clay was 61 % and 30 % respectively.

Growth of clams in cage

At station II the annual average growth was 8.48 mm (Figure 6). It was noticed that as the size of the clams increased the growth rate decreased. Among different class ranges(1-1.5 cm, 1.5-2 cm, 2-2.5 cm and 2.5-3 cm) of clams introduced in the cage, class range 1-1.5 cm (10.2 mm) showed higher growth rate and class range 2.5-3 cm (7.3 mm) showed lower growth rate. There was a gradual decrease in the growth of clams from February to May in all class ranges.

At station IV the growth rate was comparatively higher, annual average growth rate observed was 15.15 cm (Figure 7). Here also, as the size of clams increased the growth rate decreased. The maximum growth rate observed was for 1-1.5 cm class (16.25 mm) and minimum was for 2.5-3 cm class (13.82 cm). At this station growth was more or less constant during the study period. At station V the growth of clams were low during most of the months with higher ambient salinity (Figure 8). Here the annual average growth of clams were 9.64 mm. Minimum growth was observed for larger clams ie. the 2.5-3 cm class (8.26 mm) and the maximum was for smaller clams ie., 1-1.5 cm (11.19 mm). As in the case of station II, at station V also the growth of the clams were very low during February to May. At stations IV and V, there was a significant difference in annual average growth rate between difference classes, whereas at station II the difference was negligible.

Discussion

Cage culture growth studies revealed that smaller clams grow faster than larger ones. Among the four class ranges (1-1.5 cm, 1.5 – 2 cm, 2 – 2.5 cm and 2.5 – 3 cm) selected for studies at all the stations, class range 1-1.5 cm showed the highest growth rate and class range 2.5 – 3 cm showed the lowest growth rate. Similar observations were made by Rao[9] in *Katelysia opima*, Abraham[1] in *Meretrix casta*, Nayar[7] in *Donax cuneatus*, Alagarswami[2] in *Donax fabe*, Mane[6] in *Katelysia opima* and Rao[10] and Thippeswamy and Joseph[15] in D*onax incarnatus*. Spear and Glud[11] have reported that environment and not heredity that is important in determining the growth of the soft clam *Mya arenaria*. Comparing station II and IV it was observed that the highest growth rate was at station IV rather than station II, and besides that, station II showed a decrease in growth rate from January to May in all class ranges. This may be due to the accumulation of silt and clay at station II during the closure of the bund (December to May). Swan[12] and Pratt[8] reported that linear growth of clams *Mya arenaria* and *Mercenaria mercenaria* was higher in sediment with a sandy texture than a muddy one. Another reason for better growth at station IV compared to station II may be the prevalent typical estuarine environment (saline mixed water) at station IV when compared to that at station II (freshwater). Abraham[1] compared two clam beds at Adyar and concluded that growth of clams is much more rapid in the backwater than in the river. At station IV there was a sharp decrease in the growth of clam from January to May and then it gradually increased. This was due to the higher saline condition that prevailed at that station. According to Talikhedkar *et.,al.*[14], in tropical waters, changes in temperature are relatively small and the importance of salinity as an important influence the growth of bivalves is greater. Durve[5] reported that the retardation of growth may perhaps be attributed in some way to the increase in salinity in the ambient environment especially during summer months.

In conclusion, the existence and periodical opening and closure of Thanneermukkom bund has a significant impact on the ecology of black clam beds and may threaten the very existence of clams in the estuary. The bund management should give appropriate consideration to the impact of the bund to maintain the ecology of clam beds and clam fishery of this estuary.

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Figure 1. Variation in temperature in station II, IV and V

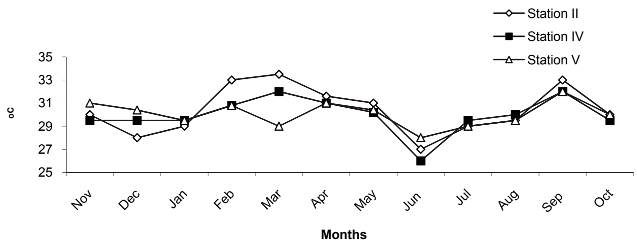

Figure 2. Variation in salinity in station II, IV and IV

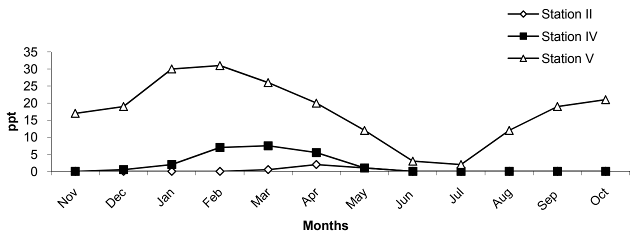

Figure 3. Variation in percentage of sand in station II, IV and V.

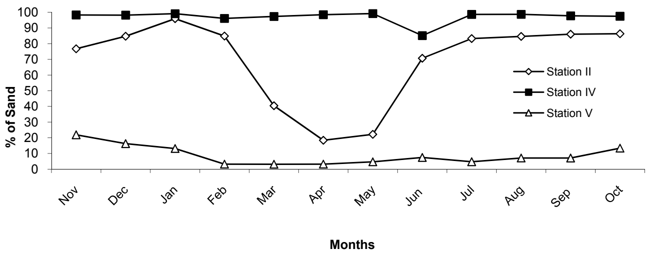

Figure 4. Variation in percentage of silt in station II, IV and V

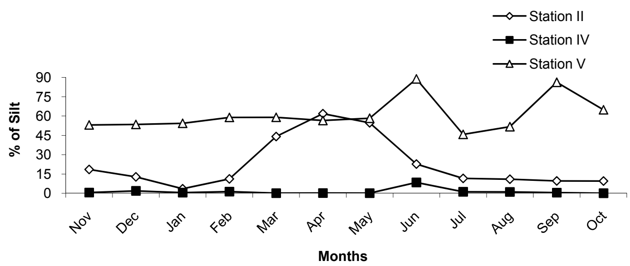

Figure 5. Variation in percentage of clay in station II, IV and V

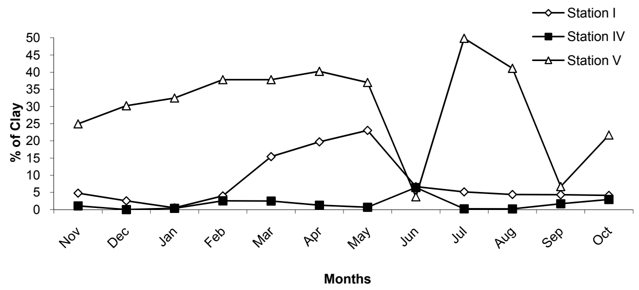

Figure 6. Growth in cage at station II

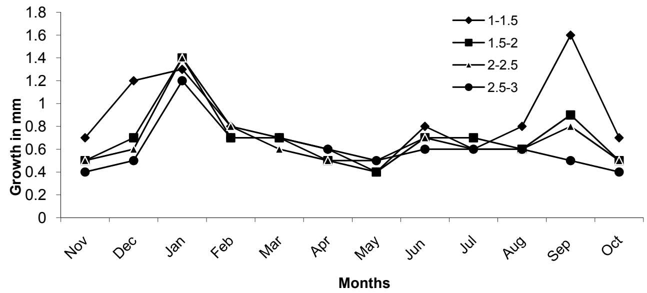

Figure 7. Growth in cage at station IV

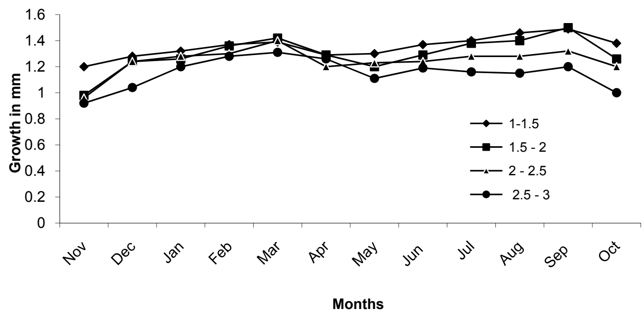

Figure 8. Growth in cage at station V