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ON THE WATER QUALITY OF SELECTED ENVIRONMENTS ALONG BOMBAY COAST

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ABSTRACT

Water quality of three stations representing polluted (Sts. B & S) and relatively unpolluted (St. M) areas along the coast of Bombay was studied during March 1981 to May 1982. Stations B & S were characterised by relatively wider fluctuations in salinity, low range of dissolved oxygen and higher BOD, phosphate and nitrate levels. At St. M higher range of dissolved oxygen coupled with low values of BOD and nutrients suggest the prevailing good water quality. The deteriorating water quality of the polluted station probably lead to retarded growth of *Saccostrea cucullata and Cerithium rubus* living in the shallow intertidal region.

INTRODUCTION

Recent studies around Bombay has indicated the presence of deteriorating water quality at confined areas due to indeterminate discharge of waste (Bal & Pradhan, 1945; Jayaraman & Gogate, 1957; Jayaraman, Vishwanathan & Gogate, 1961; Zingde, Trivedi & Desai, 1979; Nair, Gajbhiye & Desai, 1981; Nair, Gajbhiye & Sayed, 1983). Water quality of an environment plays an important role in the distribution, growth and physiological functions of the organisms inhabiting the area. Hence the ecology of a few molluscs living under varying conditions along the coast of Bombay was taken up to evaluate the pollution stress (Krishnakumari, 1985) and as a part of the programme information on the water quality of the very shallow intertidal flats were studied. For comparison stations were selected which are representative of polluted and relatively unpolluted environments. Most of the relevant physico-chemical parameters were considered for evaluating the growth and related aspects of *Saccostrea cucullata, Cerithium rubus* and *Tellina angulata.*

MATERIALS AND METHODS

Water quality at three stations (Fig. 1) along the coast of Bombay was monitored during low and high tide for a period of fifteen months (March 81-May 82). Station Bandra (B) represents a polluted rocky shore where as

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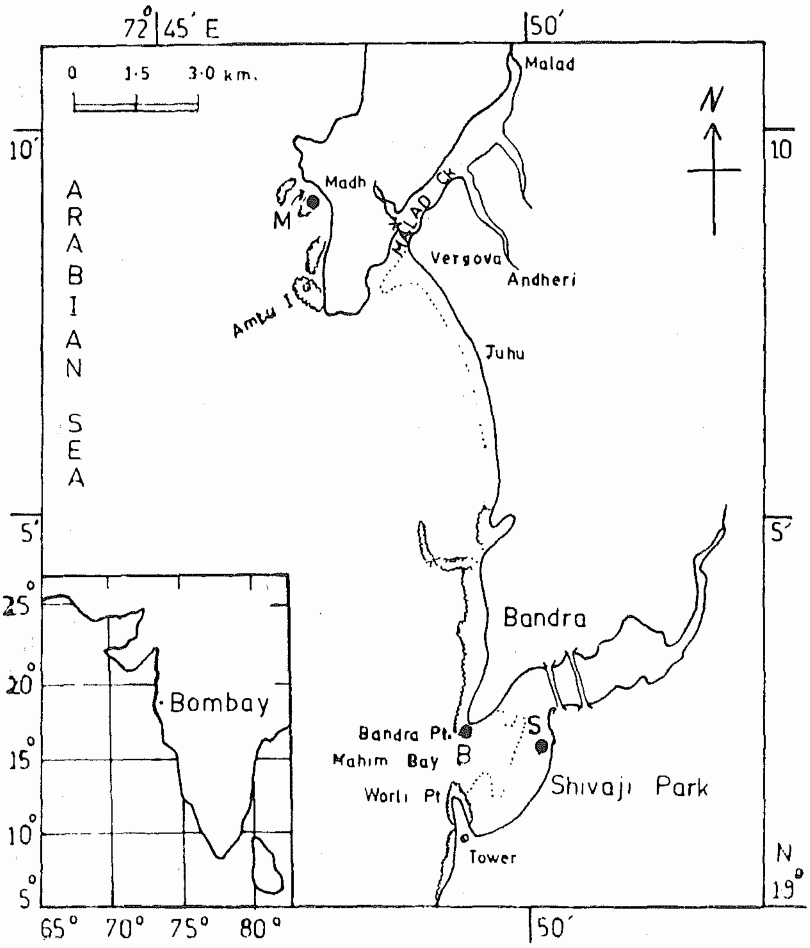

Fig. 1 Station locations

station selected at Mudh (M) is a similar habitat with less contamination. Eventhough station at Sivaji park (S) is a sandy shore, it is located close to St. B having a deteriorating water quality. Salinity and dissolved oxygen were determined by titration following the method given in Strictland and Parson (1972). pH was determined on a digital Philips model pH meter. The direct undilution method was adopted for BOD estimation. Methods of Murphy and Riley (1962) and morris and Riley (1963) with the modification of Grasshoff (1976) were used respectively for phosphate and nitrate estimation.

RESULTS AND DISCUSSION

Monthly variations in different environmental parameters during low and high tide are given in Figs. 2&3. There was no appreciable difference in temperature between the stations. Invariably at all the three stations highest and lowest temperatures were recorded respectively in May and January. Seasonally premonsoon period indicated the maximum value (Table I).

Table I. Average value of various physico-chemical parameters at different stations for the monsoon (June-Sept.), postmonsoon (Oct.-Jan.) and premonsoon (Feb-May) periods.

Seasons	St B	St M	St S
		Temperature °C	
Monsoon	29.84	29.94	30.13
Postmonsoon	28.56	28.57	28.63
Premonsoon	30.50	30.68	30.51
		Salinity (‰)	
Monsoon	26.97	28.43	27.32
Postmonsoon	33.66	34.68	32.78
Premonsoon	35.02	35.75	33.60
		pH (Units)	
Monsoon	7.67	8.21	7.28
Postmonsoon	7.92	8.05	7.89
Premonsoon	7.89	8.05	7.89
		Dissolved Oxygen (ml/l)	
Monsoon	4.63	5.59	4.38
Postmonsoon	4.19	5.74	3.38
Premonsoon	3.66	4.52	3.41
		BOD (ml/l)	
Monsoon	2.51	1.30	4.48
Postmonsoon	3.32	2.09	2.89
Premonsoon	3.14	1.63	3.63
		Phosphate (μg at/l)	
Monsoon	4.85	4.90	7.86
Postmonsoon	8.16	3.87	6.20
Premonsoon	5.44	1.94	3.05
		Nitrate (μg at/l)	
Monsoon	30.52	21.05	28.31
Postmonsoon	10.13	9.65	11.61
Premonsoon	4.25	5.62	4.82
		N:P ratio	
Monsoon	13.48	5.41	3.58
Postmonsoon	1.32	2.99	2.01
Premonsoon	5.62	16.81	3.74

Fluctuation in salinity was more at Sts. B & S than at St M. Higher salinity has been noticed during premonsoon period at all the three stations (Tabble I). Tidal effect on salinity was well marked with higher values for high tide (av: 33.19‰ at St B; 34.54‰ at St. M and 32.46‰ at St. S) than low tide (av: 30.84‰ at St B; 32.69‰ at St. M and 29.86‰ at St. S).

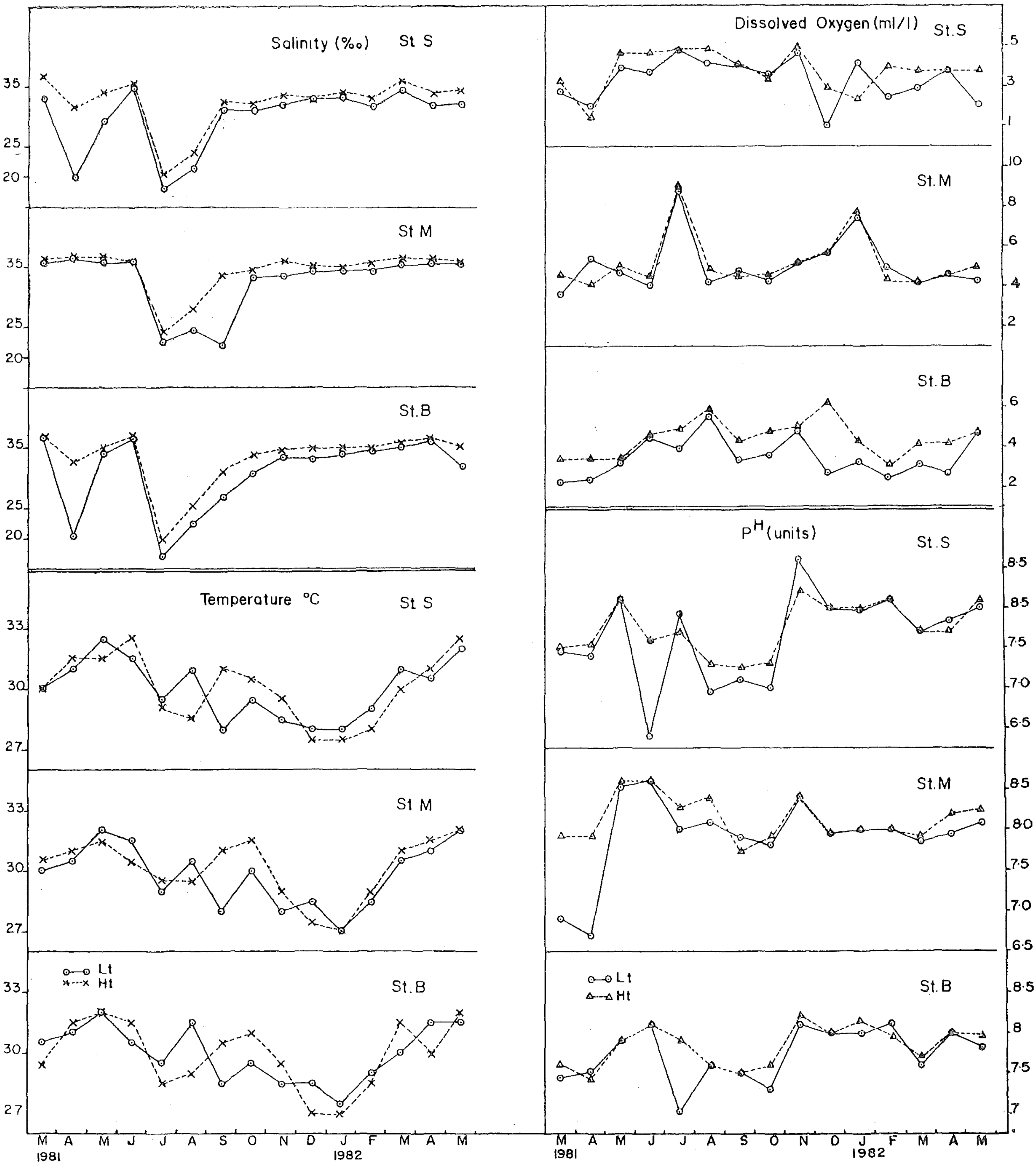

Fig. 2. Monthly fluctuations in temperature, salinity pH & dissolved oxygen for high and low tides at different stations.

In general, pH showed limited variation with relatively higher values for high tide than low tide. Mean value was high at St. M. Seasonal variation was not well marked at any of the stations studied. However, decrease in pH was noticed during June at St M and July at St B.

Dissolved oxygen values were high at St M when compared to Sts. B & S and the recorded mean values for high and low tide were respectively 4.36 & 3.49 ml/l (St. B), 5.19 & 5.09 ml/l (St. M) and 3.74 & 3.37 ml/l (St. S). Invariably high tide showed higher DO than low tide. Stations B&S indicated maximum value during monsoon, whereas at relatively unpolluted station peak value has been observed during postmonsoon (Table I).

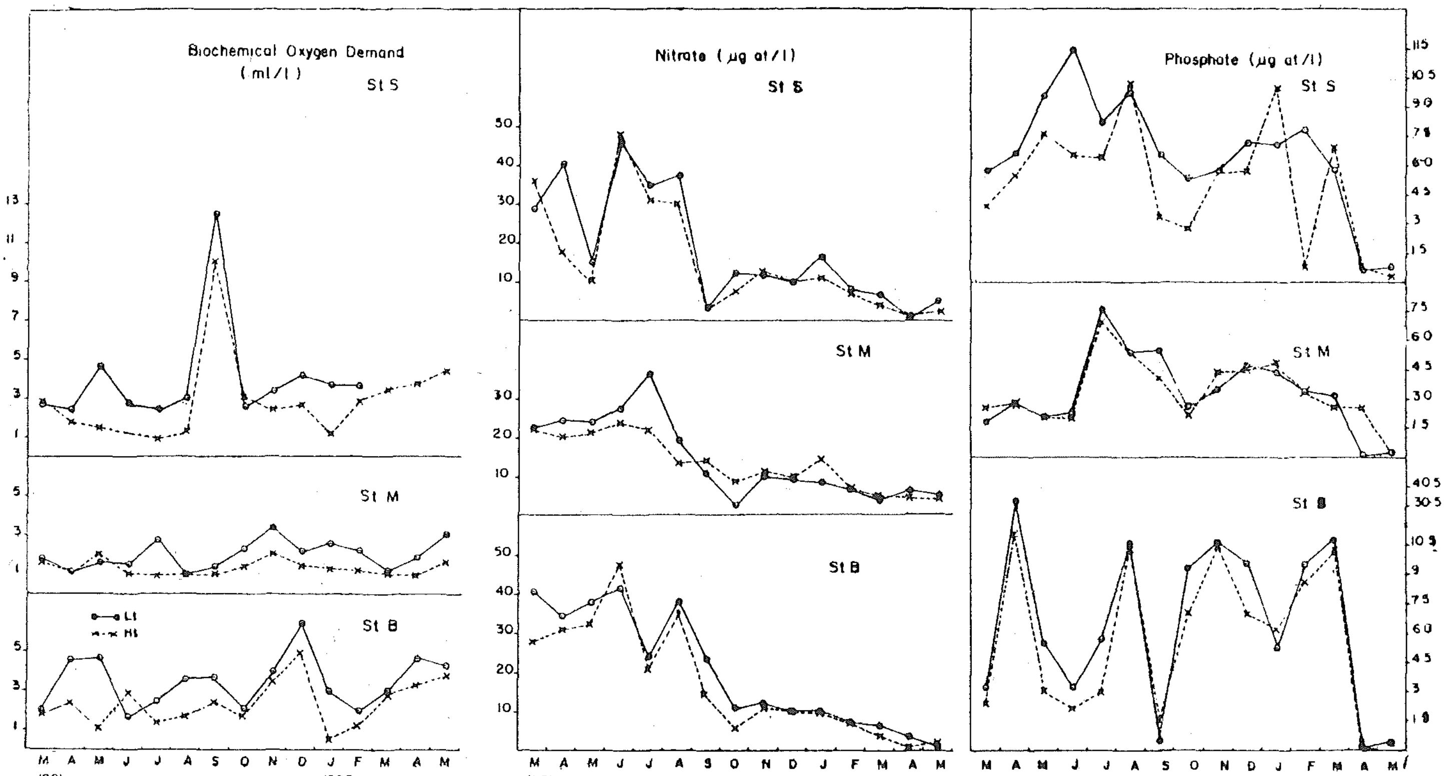

Fig. 3. Monthly variations in biochemical oxygen demand, nitrate and phosphate content for high and low tides at different stations.

Variation in BOD value was more at Sts. B & S than at St. M. Slight increase in BOD was observed during low tide. Mean recorded for low and high tide at different stations was respectively 3.49 & 2.4 ml/l (St. B.), 1.99 & 1.3 ml/l (St. M) and 3.99 and 3.01 ml/l (St. S). In general low BOD values were noticed during monsoon at stations B & M.

Average values for phosphate during ebb & flood period at Sts. B, M & S were respectively 8.19 & 5.98 µg at 1; 3.3 & 3.36 µg at/l and6.57 & 5.14 µg at/l. Compared to St. M. phosphate concentration was about two times high at Sts. B & S. Seasonal maximum was recorded during monsoon at Sts. M & S (Table I). and postmonsoon period at St. B (Table I). The observed high values of phosphate for low tide were more prevalent at Sts. B & S.

Mean value of nitrate was relatively low at St. M (14.85 μg at/l for low tide and 13.57 μg at/l for high tide) than at Sts. B (20.26 μg at/l for low and 17.40 μg at/l for high tide) and St. S (18.62 μg at/l for low and 15.68 μg at/l for high tide) Seasonal peak for nitrate was during monsoon at all the three stations. Tidal variation was well defined with higher values during low tide than high tide.

Temperature variations at all the three stations followed the same pattern with peak values in May and low values in December-January. This is the normal pattern observed along the nearshore waters of Bombay (Nair, Gajbhiye & Desai 1981). Even though salinity fluctuations were well defined at all the three stations, a wider variation in salinity was recorded at St. B than the other two places. Invariably high tide sustained higher salinity. Dissolved oxygen values were higher at St. M as compared to the other two. In general, low levels of DO were recorded in the polluted creek regions of Bombay (Zingde, Trivedi & Desai 1979; Nair, Gajbhiye & Syed 1983). Off Thal, an unpolluted coastal area, south of Bombay DO concentration ranged from 3.8-9.4 mg/l (Nair, Gajbhiye, Krishnakumari & Desai, 1983). The solubility of oxygen increases as the salinity decreases. This high solubility of oxygen during monsoon due to low salinity might be one of the reason for the increase in oxygen during monsoon (Zingde & Desai 1980). BOD at coastal waters of Bombay has been reported to vary from 0.2 to 2.3 mg/l (Zingde, Trivedi & Desai, 1979). At the creek regions of Bombay, especially Mahim, Thana and Worli Bay, BOD range has been reported respectively as 5.3 to 8.2; 2.1 to 6.3 and 0.8 to 8.3 mg/l (Zingde, Trivedi & Desai, 1979). In the present study average BOD value at Sts. B & S was higher than what has been reported for Thana Creek and Worli Bay and lower than Mahim Creek. In the coastal region of Bombay the phosphate and nitrate values Seldom exceed 3 μg at/l and 4 μg at/l respectively (Zingde & Desai, 1980). However phosphate and nitrate concentrations at Mahim Bay ranged respectively from 8 to 65 μg at/l and 6 to 46 μg at/l (Zingde & Desai 1980). Phosphate value recorded at stations Off Versova and Mahim varied respectively at the rate of 0.66-2.99 and 1.38-4.71 μg at/l while at the polluted creek regions of Versova and Thana the range was respectively 1.64 to 30.43 and 2.27 to 5.52 μg at/l Nair, Gajbhiye & Sayed 1983). In the present investigation Sts. B&S indicated higher phosphate content of about two times higher than that recorded at St. M. An earlier report (Nair, Gajbhiye & Sayed, 1983) shows that mean value for nitrate of two polluted stations off Bombay is more (11.2 and 19.41 μg at/l) than the relatively unpollected stations (5.03 and 7.78 μg at/l). Enrichment of coastal waters by nutrients during monsoon due to land drainage with heavy rainfall has been reported (Reddy & Sankaranarayanan, 1968; Sankarayanan & Qasim, 1969; D'Souza, Sen Gupta, Sanzgiri & Rajagopal, 1981). Phosphate and nitrogen concentration in the surface waters of the sea decreases as a result of utilization by phytoplankton but are replenished by decomposition of organic matter *in situ* by mixing which brings back nutrients to the surface waters from richer deeper waters. The worked out nitrogen to phosphate ratio indicated that the value during high tide was more at St. B (0.48-21.99) than at Sts. M (1.9-17.5) and S (0.63-9.58). Discharge of sewage, industrial waste and land drainage during monsoon resulted in an increase in nutrient concentration at polluted St. B. Eventhough nutrients are rich, photoplankton production and their assimilation capacity may be less at this region leading to a hihger N.P. ratio.

Even though St. M & B are comparable because of the rocky shore and similar faunal assemblage, there are well defined differences in the environmental characters studied. St. B was characterised by the relatively wider fluctuation in salinity, low range of dissolved oxygen, higher BOD and nutrient levels. At St. M higher range of dissolved oxygen coupled with low values of BOD and nutrient, suggest the prevailing good water quality. Even though St S is a sandy shore, the physico-chemical parameters of the area is comparable with St. B indicating the deteriorating water quality.

The Mahim area receives massive pollution loads to the extent of about 175 mld of sewage, of which the major fraction is untreated. During flood tide the movement of current is towards the northeast and during ebb tide towards southwest (NIO, 1978). The movement of water showed an elliptical pattern. This pattern of circulation of water would result in the accumulation of contaminated sea water released through the Mahim creek and Bay. Hence, the expected deterioration in the water quality is reflected at Sts. B & S located in the Mahim Bay.

The general trend in the pattern of different biological parameters studied in *S. cucullata* and *C. rubus* collected from pollured and relatively unpolluted areas indicated distinct variations (Krishnakumari, 1985). It appears that the prevailing good water quality at St. M results in enhanced growth, percentage edibility and condition index of these molluscs (Krishnakumari, 1985). The average growth rates observed for *C. rubus* and *S. cucullata* at St. M were found to be respectively 1.6 and 1.2 times more than that recorded at St. B. Pollution imposes additional stress on these organisms which results in additional energy requirement to withstand the adverse conditions. This may lead to retarded growth of these molluscs as observed at St. B. However, the adverse water quality in the polluted area has not reached an alarming state and the recovery to normal stage is possible by effective management and making more stringent norms on pollution control.

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