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Hydrography and Plankton Productivity of the Surf Zone of Moplah Bay, North Kerala

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Abstract

The study is based on hydrographic and plankton data collected at intervals of two hours during 0630-1830 hours from a fixed station in the surf zone of Moplah Bay during April, July, August, December 1991 and March 1992. Water temperature ranged from 25.1 to 32.0°C, salinity 18.9-35.8 ppt, dissolved oxygen 1.9-4.3 ml/l and net primary productivity 0.01-1.26 g.C/m³/day. Monthwise mean values of temperature, salinity and dissolved oxygen in water exhibited almost the same trend of rise and fall during high and low tide periods. Seasonal average values of temperature were 30.3, 26.0 and 27.5°C, salinity 33.7, 28.5 and 34.5 ppt, dissolved oxygen 3.5, 3.2 and 3.1 ml/l and net primary productivity 610, 447 and 573 mg.C/m³/day during March- April (premonsoon), July-August (southwest monsoon) and December (postmonsoon) respectively, with an average primary production of 543 mg.C/m³/day in the bay. Wet displacement volumes of zooplankton biomass during these periods were 13.5, 20.3 and 22.9 ml respectively with an average of 18.9 ml per 100 m³ water which would amount to 2.82 mg.C/m³/day. The estimated mean turn-over from primary to secondary production level was less than 1% in the bay. Results of the experiments pertaining to the production potential and microbiochemical oxygen demand indicated that the shallow intertidal water zone in the Moplah Bay provides a self replenishing autotrophic environment.

Introduction

With the establishment of a prawn hatchery at Moplah Bay, Cannanore during January 1990 (Muthu and Pillai, 1991), the present study was initiated during 1991-'92 to collect seasonal data on hydrography and plankton productivity since there was no published information on the fertility and seasonal variation of the water quality of the Moplah Bay; and the results are presented here.

Materials and Methods

Data on sea surface temperature, salinity, dissolved oxygen, primary productivity and zooplankton were collected from the intertidal surf zone at a fixed station having 1 m depth in the Moplah Bay during diurnal observation on a day fixed in the third week of April, July, August, December 1991 and March 1992 at two hourly intervals from 0630 to 1830 hours covering high and low tides. The data thus obtained during high and low tide periods were treated separately to study the influence of tides on hydrography and plankton productivity. The data for March and April were treated for the premonsoon (summer), July and August for the southwest monsoon and December for the postmonsoon seasons in the present study.

Light and Dark bottle (L and D) oxygen technique (Strickland and Parsons, 1968) was adopted to determine the daily rate of net primary productivity giving an incubation time of two hours in the field. To determine the daily rate of net production and loss by consumption of oxygen, the difference in the oxygen values of Light bottle and Initial bottle (L-I) extrapolated for 12 hours was considered to indicate the net rate of oxygen production (+ value) or loss by consumption (- value) for the day time; and that of the Dark bottle and Initial bottle (D-I) extrapolated for 12 hours was considered to indicate the net rate of oxygen production (+ value) or loss by consumption (- value) for the night time. Commutation of the oxygen values thus obtained for the day time and night time would give the net rate of oxygen production (+ value)/loss by consumption (- value) in the water sample per day (Selvaraj, 1997).

Zooplankton samples were collected by filtering 1000 litres (1 m³) of water from the surf region manually and preserved in 5% formalin. Displacement volumes of the samples were taken after removing dust particles. The entire samples were analysed group-wise for numerical counts and the values were extrapolated per 100 m³ water. The mean wet displacement volumes obtained for the three seasons were used to estimate the rate of secondary production adopting the formula: 1 ml wet volume= 78.5 mg dry wt; and 38% of dry wt = mg organic carbon (Dalal and Parulekar, 1986); and 50% of the wet volume of plankton was considered as the daily rate of zooplankton production (Qasim and Ansari, 1981).

Results and Discussion

Environmental features

Diurnal variations in sea surface temperature, salinity, dissolved oxygen, net primary production and the rate of net production /consumption of dissolved oxygen for April, July, August, December '91 and March '92 are depicted in Figs. 1 and 2. In the Moplah Bay, sea surface temperature ranged from 25.1-32.0°C, salinity 18.9°-35.8 ppt and dissolved oxygen 1.9-4.3 ml/l. The monthly difference in salinity values observed between the minimum and maximum was 0.9 ppt during March and April (summer/premonsoon) and 1.1 ppt in December (postmonsoon). During southwest monsoon period, while July recorded the highest difference of 8.4 (18.9-27.3) ppt, August average productivity was 2.82 mg.C/m^3/d when 50% of the zooplankton biomass was considered as the daily rate of production (Qasim and Ansari, 1981).

Phytoplankton - Zooplankton relationship

The net primary production and zooplankton biomass values generally showed an inverse relationship within the bay. During premonsoon period, when the mean primary production value was higher in the high tide water, zooplankton biomass showed a low value (8.6 ml/100 m^3) as compared to that of the low tide water (16.4 ml/100 m^3. During southwest monsoon period, the mean primary production value was more in the low tide water when the zooplankton biomass value was relatively low (16.7 ml/100 m^3) as compared to that of the high tide water (23.8 ml/100 m^3). December (postmonsoon) data also showed the same trend as that of southwest monsoon period. The very low primary productivity value (0.201 g.C/m^3/d) observed at high tide as compared to that of the low tide water (0.598 g.C/m^3/d) during August corresponding to the very high zooplankton number (41,750/100m^3) observed in the high tide water than that of the low tide water (28,900 nos/100m^3) might be attributed to the productive potential of the upwelled waters entering and mixing in the bay as well as subsequent grazing by zooplankters.

The conversion efficiency values from primary to secondary production level were estimated as 0.33, 0.68 and 0.60% for the three seasons respectively, contributing to an average of 0.52% in the Moplah Bay. The ranges in the transfer efficiency observed in the present study of the year fall below the mean turn-over of 3.3% as estimated by Cushing (1973) for the open sea; and according to Qasim and Ansari (1981), it was about 10% for the Indian seas. In the Mandovi-Zuari estuarine system, the turn-over from primary to secondary production level was 6.6% (Selvakumar *et al.*, 1980); and according to Qasim (1977) it was about 7%. In contrast to the above values, the mean turn-over of 0.52% from primary to secondary production level observed in the Moplah Bay is very low.

Environmental stability

The experiments conducted to determine the productive potential and microbial consumption of oxygen revealed that the rate of net production/loss by consumption of oxygen was showing wide fluctuation from sample to sample in the diurnal bihourly observations and the fluctuation reached the highest in April (premonsoon) and the lowest during July (peak southwest monsoon). The hydrographic data indicated that the water quality, in general, was continuously changing from time to time in the diurnal observation due to tide rise and tide fall and associated circulation and mixing processes within the bay. However, the fluctuations in salinity (difference between the minimum and maximum values) observed in different months indicate that the premonsoon and postmonsoon months might provide a relatively stable environment in the bay.

The results of the experiments on the rate of oxygen production/consumption (Table 1) revealed that, although photosynthetic production of oxygen was considerably more, especially during March-April (premonsoon months), the shallow waters of the bay appeared to provide an oxidising environment (with more of microbial consumption of oxygen) especially during December-March, indicating high microbiochemical oxygen demand in this ecosystem. Commutation of the overal net production and consumption of oxygen values revealed that the net production was relatively more than consumption (Table 1); and the average net production potential of dissolved oxygen in the bay was estimated as 0.0295 ml/l/hr amounting to 0.708 ml/l/d (24 hours). This indicates that the Moplah Bay provides a self replenishing autotrophic environment along the Kerala coast.

Table 1. Diurnal variation and productive potential of oxygen (ml/l/hr)

Time	April		July		August		December		March	
(hrs)	Prod.	Cons.	Prod.	Cons.	Prod.	Cons.	Prod.	Cons.	Prod.	Cons.
0630	0 1617	0.0	0.0517	0.0	0.0341	0.0226	0.0010	0.1054	0.0010	0.1190
0830	0.0911	0.0	0.0333	0.02	0.1062	0.0	0.0739	0.0141	0.0651	0.0887
1030	0.0545	0.0542	0.0517	0.0	0.1825	0.0	0.0	0.1732	0.0010	0.0377
1230	0.0545	0.0542	0.0867	0.0	0.0357	0.0113	0.1135	0.0485	0.0987	0.0985
1430	0.2039	0.0137	0.0767	0.0	0.0120	0.0117	0.0505	0.0505	0.1230	0.0
1630	0.0009	0.1823	0.0933	0.0	0.0009	0.0158	0.0941	0.0462	0.1184	0.0196
Average	0.0945	0.0507	0.0655	0.0033	0.0619	0.0102	0.0555	0.0730	0.0679	0.0606
Net gain/ loss per hour	+0.0438		+0.0622		+0.0517		-0.0175		+0.0073	

Average of 5 values + +0.0295 ml O_2/l/hr. (i.e) +0.708 ml O_2/l/d

+ = production (gain)

- = consumption (loss)

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