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Short Communication

Plankton dynamics in a backwater estuarine canal (T.S. Canal, Thottapally), Kerala, India

S. Jaishinimol Bharghavan* and Tresa Radhakrishnan
Department of Aquatic Biology and Fisheries, University of Kerala, India
jaishini@rediffmail.com

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Abstract

Plankton is of great ecological importance and are the primary producers in aquatic food web and the number and quality of these determine the quality of water bodies. Diversity and abundance of planktonic organisms are useful indicators of the trophic state of various water bodies. Spatial and temporal variation the diversity and abundance of plankton in the T.S. Canal, Thottapally - Alappuzha and its relation to the physicochemical parameters was studied in detail from February 2004 to January 2005. This study was thus envisaged detailed analyses through the yearly cycle, of the plankton. In T.S. Canal Chlorophyceae was the dominant phytoplankton indicating eutrophication. In T.S. Canal Oscillatoria was a dominant genus of Myxophyceae confirming organic pollution in the water body. The zooplankton in the T.S. Canal was represented by 13 groups, the dominant ones being copepods, nematodes and rotifers.

Keywords: Phytoplankton, zooplankton, eutrophication, T.S. canal, Thottapally.

Introduction

Aquatic organisms are especially important as they form the most sensitive component of the ecosystem and signal environmental disturbances[1]. Of these plankton is of great ecological and economic importance and is the base of aquatic food web and the number and quality of these determine the quality of water bodies. Species of plankton vary in their dominance and diversity due to changes in physicochemical and biological factors. Phytoplankton study provides a relevant and convenient point of focus research on the mechanism of eutrophication and its adverse impact on an aquatic ecosystem[2]. Zooplankton forms a major link in the energy transfer at secondary level in aquatic food webs between autotrophs and heterotrophs[3]. Plankton responds quickly to environmental changes and hence their standing crop and species composition are more likely to indicate the quality of the aquatic habitat they live. Successful fishery management, aquaculture operation and natural resource management warrant a thorough knowledge of the abundance and composition of plankton in any water body. The main objectives of the research was to determine and conduct a detailed study on spatial and temporal variation the diversity and abundance of plankton in the T.S. Canal, Thottapally, in Alleppey district of Kerala, India and its relation to the physicochemical parameters.

Materials and methods

Area selected for the study is a man-made canal equipped with a spillway, constructed in 1953 in Alleppey district, Kerala, India (9º17'30"N lat. and 76º25'30"E long.) for diverting flood waters of 3 major rivers of the state Pampa, Manimala and Achankoil rivers directly into the Arabian Sea, is one of the connections of the Vembanad backwaters with the sea. It is a bar-built estuarine zone gets connected seasonally to the sea through the opening of the sand-bar, especially during monsoon season.In principle the solution was correct, but in practice the scheme turned out to be a failure partly because the spillway's performance fell short of the requirements infiltration of salt water into the freshwater side of the canal and thence into the adjoining paddy fields, thus adversely affecting paddy cultivation.

Figure-1: Map of the study area.

The investigation was carried out from February 2004 to January 2005. Five stations were selected for the study along the canal and sampled twice a month every second and fourth week

- between 8 a.m. and 10 a.m. Surface and bottom water samples were collected using a Niskin bottle sampler for quantitative study. For the qualitative analysis phytoplankton was concentrated by filtering 50L of water by towing a simple conical tow net (No. 25, mesh size = 64µm) from country boat - uniform speed for about 5 minutes. Samples were fixed in 4% neutral formaldehyde and transported to laboratory in polythene bottles. Fixed samples were enumerated using a Sedgwick-Rafter counting slide on a Inverted Phase-contrast microscope Model CK2, Olympus, Japan. Biomass of plankton was estimated as per standard method APHA[4] and values were expressed in No./ml. The qualitative and quantitative analysis of plankton was estimated using semi-quantitative method - Sedgwick- Rafter's plankton counting chamber and abundance was expressed in No.ml^{-1}. The systematic identification of plankton was made by using wet mounts and standard Identification keys used were Needham and Needham[5], Ward and Whipple[6], Tomas[7].

Results and discussion

The abundance of plankton in T.S. Canal varied monthly, seasonally and among the stations. The total plankton density in T.S. Canal registered an irregular pattern of monthly variation at all the five stations and ranged between 35 cells/mL at station 5 (July 04) to 1,840 cells/ mL at station 3 (June 04). The plankton density in T.S. Canal was high during pre monsoon and low during monsoon season. Vikram and Jha[8] in the estuarine part of Pamba river (*i.e*., Thottapally) have noted low abundance of plankton during the monsoon season and attributed it to the relatively high turbidity and lowering of some of the chemical constituents consequent on the entrance of rain water. In T.S. Canal the plankton biomass was high during pre- and post monsoon season and low during monsoon season. The average biomass of plankton as volume in T.S. Canal was between 0.65 and 4.15 ml. The more or less stagnant nature of water during post monsoon season favours the proliferation of plankton, which increases its biomass. According to Pillai[9] and Thompson[10], in Cochin backwater and Vembanad Lake there are two peaks for plankton, one during pre monsoon season and the other during post monsoon, which is similar to that noted in T.S. Canal. Rainfall has significant effect on plankton volume. Factors like turbidity and fast current of water results diminution of plankton biomass during southwest monsoon season.

Statistical analysis indicated that biomass and numerical abundance of plankton in T.S. Canal were not correlated. Naturally, occurrence of larger forms will increase the volume without any substantial increase in number. The actual number of animals present in a plankton sample is considered more realistic and reliable than the settling volume, since the settling volume can be seriously affected by the presence of suspended particles in water[11].

The diversity of plankton was high towards the marine region and low at the freshwater region, which suggests that the plankton in T.S. Canal is mostly euryhaline. The higher plankton diversity at the marine region is in conformity with the usual distribution pattern of plankton in estuaries. Thus the number of phytoplankton genera (62) indicates that T.S. Canal is rich in phytoplankton. The closed nature of T.S. Canal during most part of the year coupled with availability of nutrients and also the incursion of marine plankton into the backwater during certain periods might have resulted in sharp fluctuation and high abundance of plankton in the estuary.

Phytoplankton in T.S. Canal was represented mainly by 3 groups viz; Chlorophyceae, Myxophyceae, Bacillariophyceae. The highest number of genera of phytoplankton was seen during monsoon season at station 4 (42 genera), which comprised 23 genera of Chlorophyceae, 6 Myxophyceae and 13 of Bacillariophyceae. The lowest generic diversity was noted during the postmonsoon season at station 2 (20 genera), which consisted of 9 genera of Chlorophyceae, 5 of Myxophyceae and 6 of Bacillariophyceae. In T.S. Canal Chlorophyceae was the dominant phytoplankton group. The density of Chlorophyceae in the three monsoon seasons showed that at stations 1, 2 and 3 it was the highest during monsoon season and at stations 4 and 5 during postmonsoon season. Abundance and dominance of chlorophytes in phytoplankton is indicative of eutrophication[12]. Reduction of salinity accompanied by elevated nutrient supplies provides both osmotic and nutritional stimulus favouring predominance of Chlorophyceae over diatoms and dinoflagellates[13].

The high density of Chlorophyceae especially at the freshwater zone of T.S. Canal during monsoon season may be due to the very low salinity and high nutrient concentration due to rainfall. Myxophyceae in the T.S. Canal was represented by eleven genera; Highest number of genera was noted during monsoon season at station 2 (7 genera) and the lowest during postmonsoon season at station 3 (1 genus). At station 5 four genera of Myxophyceae were represented during all the three monsoon seasons. The highest number of genera was represented during monsoon season at station 1 (26 genera), and the lowest at station 2 during postmonsoon season (9 genera). In T.S. Canal *Oscillatoria* was a dominant genus of the group Myxophyceae. According to Palmer[14], *Oscillatoria* is an indicator of organic pollution. Thus the high occurrence of *Oscillatoria* in T.S. Canal suggests that there is organic pollution in this canal though the visual appearance of its water deceives this. During post monsoon season when the nutrient contents were very low, Myxophyceae was a dominant phytoplankton in T.S. Canal. Bacillariophyceae in the T.S. Canal was represented by 23 genera. Earlier studies noted Chlorophyceae as the dominant group by George Thomas[15] and Berman *et al*.[16] in Veli backwaters and Lake Kinneret respectively. In T.S. Canal peaks of diatoms occurred during monsoon and postmonsoon periods. The progressive increase in salinity and transparency during the postmonsoon season accounts for the repopulation of diatoms and dinoflagellates. Abundance of pollution tolerant genera like *Melosira,*

Closterium, Navicula, Anacystis and *Scenedesmus* is an indication of enrichment of water with organic wastes inputs in T.S. Canal.

Zooplankton: In relation to the monsoon seasons, zooplankton density was the highest during premonsoon at all stations. The zooplankton in the T.S. Canal was represented by 13 groups, the dominant ones being copepods, nematodes and rotifers Annually, the zooplankton groups was the maximum at station 5 (13 groups) and the minimum at stations 1 and 4 (7 groups) Copepod was the abundant group in T.S.Canal. In the seasonal distribution of zooplankton, salinity has a crucial role. Apart from salinity, strong currents and turbidity make the environment severe for many organisms during monsoon, which lowers the zooplankton abundance. According to Haridas[17] the backwaters of Veli and Thottapally had a mixed assemblage of high- and low-saline fauna with high abundance of copepods especially during premonsoon. Poor water quality lowers the abundance and diversity of zooplankton Unnithan *et al*.[18].

Statistical analysis suggested that the distribution of plankton along the T.S. Canal was not uniform particularly in the freshwater zone; at the region most proximal to the freshwater confluence the plankton was dominated by Bacillariophyceae and zooplankton, whereas at the marine end plankton appeared to be more homogeneous with no one group influencing the composition. ANOVA results comparing abundance and distribution of plankton among stations, seasons and months within observed variations in phytoplankton were generally not significant but for total zooplankton the observed differences were significant between seasons and between months within seasons ($P< 0.01$). Results of multiple correlation analyses comparing distribution of plankton did not reveal any consistent and meaningful correlations between the two. Analysis of correlation between plankton biomass, total density of plankton of phyto- and zooplankton and of the three families of phytoplankton showed that at station 1 plankton biomass and total density of plankton were significantly positively correlated with that of Bacillariophyceae as also with that of total zooplankton ($P< 0.01$).

Conclusion

The closed nature of T.S. Canal during most part of the year coupled with availability of nutrients and also the incursion of marine plankton into the backwater during certain periods might have resulted in sharp fluctuation and high abundance of plankton in the estuary.the distribution of plankton along the T.S. Canal was not uniform particularly in the freshwater zone; at the region most proximal to the freshwater confluence the plankton was dominated by Bacillariophyceae and zooplankton, whereas at the marine end plankton appeared to be more homogeneous with no one group influencing the composition. The diversity of plankton was high towards the marine region and low at the freshwater region, which suggests that the plankton in T.S. Canal is mostly euryhaline. The high density of Chlorophyceae especially at the freshwater zone of T.S. Canal during monsoon season may be due to the very low salinity prevailing in these areas accompanied by elevated nutrient supplies provides both osmotic and nutritional stimulus favouring predominance of Chlorophyceae over diatoms and dinoflagellates.In T.S. Canal *Oscillatoria* was a dominant genus of Myxophyceae which indicatedthat the water body has organic pollution.

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