БІОГЕОЦЕНОЛОГІЧНІ ДОСЛІДЖЕННЯ

UDC 574.5/6

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PHYTOPLANKTON PRODUCTIVITY OF A TROPICAL ESTUARINE WATER BODY, KERALA, INDIA

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Paravur Canal is a connecting link between Paravur Lake and Edava-Nadayara backwater, Kerala, India. This paper deals with primary productivity of Paravur canal during the period from January 1999 to June 1999, and their correlation with physico-chemical parameters. Present study revealed that primary production was influenced by pollution, high respiratory rate of secondary producers and nutrients. To assess the effect of pollution on primary productivity from various sources such as factory effluents, domestic waters, husk retting etc., a control site was also selected near bar mouth where Ithikkara river joins, is one of the major area for fishing showed high productivity rate. The biological characteristic of Paravur canal was highly influenced by pollution.

Keywords: Paravur canal, Primary productivity, Phytoplankton, pollution.

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Відділення вивчення оточуючого середовища університету штату Керала, Індія

ПРОДУКТИВНІСТЬ ФІТОПЛАНКТОНУ УСТЯ ВОДНОЇ СИСТЕМИ ТРОПІКІВ

Стаття присвячена вивченню первинної продуктивності фітопланктону устєвої частини водної системи тропіків штату Керала (Індія). Установлено, що на первинну продукцію впливають такі фактори, як забруднення, вторинні продуценти і склад поживної речовини у воді.

Ключові слова: Паравур канал, первинна продукція, фітопланктон, забруднення.

Primary productivity is a prime factor in an aquatic ecosystem, which determines the health of water body and assesses the impact of anthropogenic activities on fisheries angle. The studies on primary production evaluate the capacity of an ecosystem and the magnitude and dynamics of primary production has become an essential parameter to estimate the state of pollution in an aquatic system. The radiant energy is stored by photosynthetic and chemosynthetic activity of producer organism (chiefly green plants) in the form of organic substance, which can be used as food materials (Odum, 1959) and it control the whole aquatic food chain. All biotic components of an ecosystem are interdependent and inter related with each other through various kinds of trophic and non-trophic links. These close interactions with the environment constitute a balanced ecosystem.

Present studies give information about the primary productivity of Paravur canal system. The study is quite relevant in the context of the ever-increasing threat to the estuarine ecosystem of Kerala from various sources of pollution such as factory effluents, domestic waste, husk retting etc. and it is intended as a base line study, which would be helpful to plan out programmes of fish culture in the state.

MATERIALS AND METHODS

The study area, Paravur canal which is situated in Kollam district has a length of 2,41 km. It is located between $8^0 45'–8^0 50' N$ latitude and $76^0 35'–76^0 41' E$ longitude (Fig. 1). It is a connecting link between the Paravur Lake and the Edava Nadayara backwater situated south of Paravur town. Four sampling stations were selected for monthly investigation for a period of six months from January 1999 to June 1999. Staion I is situated at the end of Paravur canal, which is adjacent to Edava Nadayara Back water. This region is polluted with wastewater from the municipality and the domestic waste flowing from the neighboring area. The average depth

of the region is 1,94 m. Station II, this region is near a coir-dying factory, from which the waste of dye materials are directly discharged. The average depth of this station is 1,5 m. Station III, this portion of the back water system is highly polluted by husk retting. It has a depth of 1,84 m and is being used for fish catching. Station IV, is near bar mouth where the Ithikkara river joins. The water is highly saline in nature and is one of the major areas for fishing.

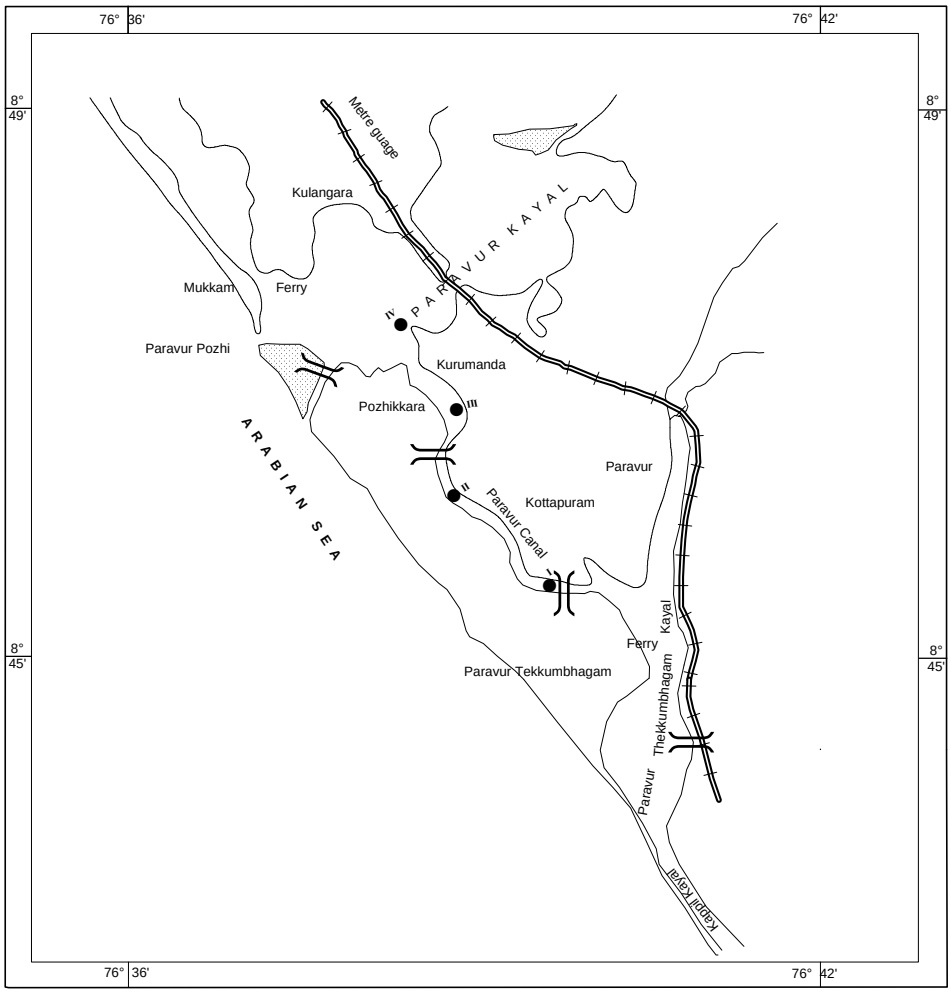


Fig. 1. **Map of the Paravur Canal indicating study area**

Net and gross primary productivity of water was analyzed following light and dark bottle techniques (Strickland and Parsons, 1968) and modified by Qasim et al. (1969). All precautions suggested by Vollenweider (1969) have been strictly followed in conducting the experiments. The value of net and gross primary productivity was expressed as mgC/m^3/hr. Physico Chemical parameters were measured by standard analytical methods (Grasshoff, 1976). Simple correlation between the various water quality parameters and primary productivity was worked out (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSIONS

The monthly variation in gross productivity and net productivity values in the present study ranged from 50,7 to 456,1 gmC/m^3/hr (Table 1). When the four stations were compared,

net primary productivity and gross primary productivity were found to be low in certain months at all stations. At the same time high gross primary productivity and net primary productivity were recorded at station I, during May and at station IV, during April. In station II, III average

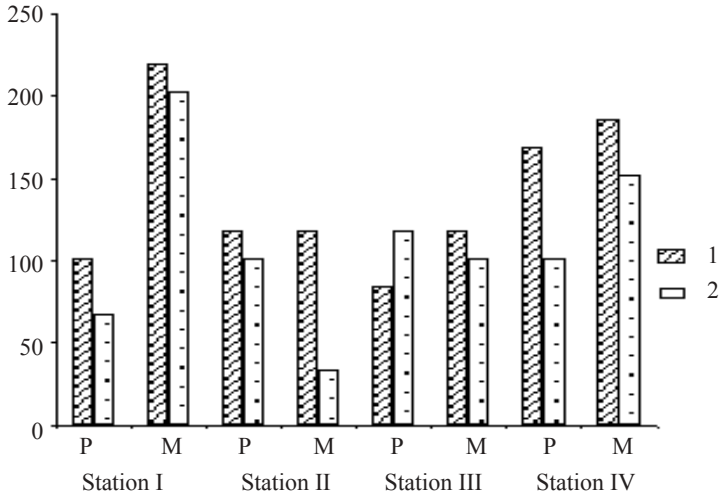
Table 1

Monthly and average values of the gross and net primary productivity of four different stations in Paravur canal, mgC/m^3/hr

Month	Station							
	I		II		III		IV	
	GPP	NPP	GPP	NPP	GPP	NPP	GPP	NPP
January	152	101,40	152	202,70	50,70	UD	304,10	202,70
February	50,70	101,40	101,40	101,40	101,40	152,03	101,40	101,40
March	101,40	UD	101,40	UD	101,40	202,70	101,40	UD
April	101,40	50,70	202,70	UD	152,03	50,70	456,10	304,10
May	456,10	456,10	50,70	50,70	152,03	152,03	50,70	50,70
June	101,40	101,40	101,40	50,70	50,70	101,40	50,70	101,40
Average	160,50	135,16	118,26	67,59	101,37	109,81	177,39	126,71

GPP – Gross Primary Productivity; NPP – Net Primary Productivity.

gross primary productivity values and I remained low when compared to station IV which may be due to the pollution effects. Srivastava et al. (1996) in his study on Rapti River stated that industrial effluents and city sewage adversely affect the rate of primary productivity; the present study also confirmed this view. The seasonal average values of gross primary productivity remained high at all the four stations during the monsoon period (Fig. 2) may be



P – Pre-monsoon; M – Monsoon

Fig. 2. **Seasonal average values of gross** (*1*) **and net primary** (*2*) **productivity values of four different stations at Paravur canal,** mg C/mi/hr

due to high amount of nutrients brought from the river and land run off during southwest monsoon. The backwater remained most productive during monsoon season and least productive during post monsoon season. The seasonal average values of net primary productivity remained high during monsoon period at station IV and I. At station II and III

net primary productivity values were maximum during pre-monsoon period. Average values (Table 1) showed that gross primary productivity was high in station IV, is a control site near the bar mouth where Ithikkara joins, is one of the major area for fishing. The producers primarily synthesize the organic matter available in our estuary and the products are transferred to consumers through different trophic levels. Primary productivity has close relationship between fish production. Boyd (1979) and Smith and Swingle (1938) have emphasized the relationship between phytoplankton and fish production. At all stations during certain month no net primary productivity was noticed, which can be attributed to high respiratory rates of secondary producers (zooplankton). Dugdalle and Wallace (1960) explained the depletion of oxygen in light bottle as the result of photochemical oxidation of humid materials. Observation of Wetzel (1975) revealed that decomposition of autochthonous oxidizable material takes place in the upper euphotic zone and that the rate is higher, when the temperature is heightened further reason for the reduction in oxygen. Prakasam and Joseph (1989) in their studies on Sasthamcotta Lake also confirmed these views.

The simple correlation coefficients between gross and net primary production and the different physico chemical parameters showed in Table 2. In station I, the correlation of net primary productivity with phosphate was found to be highly significant at 5 % level. But gross primary productivity showed no correlation among any parameters. In Station II, the correlation between the net primary productivity and silicate was significant at 1 % level and the correlation between gross primary productivity with dissolved oxygen was significant at 5 % level. In station III, there is no significant relation between rate of primary productivity and physico chemical parameters. In station IV, net primary productivity showed a correlation with dissolved oxygen at 5 % level. Temperature, salinity, nitrite and nitrate showed no significant relation with the rate of primary production in any of the station.

Table 2

Correlation coefficients between the rates of primary productivity and physico-chemical parameters in water at four different stations in Paravur canal

Parameters	Tempera-ture	pH	Salinity	Dissolved O_2	Phosphate	Silicate	Nitrite	Nitrate
Station I								
GPP	0,5310	0,28	–0,386	0,466	0,698	0,140	–0,032	0,028
NPP	0,5720	0,15	–0,381	–0,422	0,870*	0,148	–0,217	–0,029
Station II								
GPP	0,2163	0,20	0,277	0,837*	–0,634	–0,189	–0,498	0,002
NPP	–0,0001	0,67	0,656	0,631	–0,484	–0,932**	–0,478	–0,588
Station III								
GPP	0,1198	0,62	0,511	–0,214	–0,050	–0,422	0,486	–0,328
NPP	–0,1172	–0,36	0,231	0,653	0,769	–0,447	–0,217	–0,602
Station IV								
GPP	–0,4736	0,61	0,462	0,808	0,250	–0,519	–0,378	–0,294
NPP	–0,5591	0,55	–0,532	0,868*	–0,150	–0,524	–0,559	–0,385

Significant: * $\alpha < 0,05$; ** $\alpha < 0,01$. GPP – Gross Primary Productivity, NPP – Net Primary Productivity.

Steemann and Jenson (1957) have pointed out that in shallow region where the bottom is in direct contact with the overlying water, and indirect influence of temperature would cause an enhancement in the regulation process to some extent, which would reflect in the rate of primary production. In the present study at station IV maximum gross primary productivity and I coincided with higher surface water temperature. The seasonal variations in pH seemed to have an inverse effect on the productivity during the present study. This is an agreement with the studies on productivity in the Kadinamkulam Lake (Anuradha Ram Mohan, 1995). Salinity

was also found to have an inverse effect on the seasonal variations of the productivity. During the present study the month wise value of gross primary productivity showed significant correlation with dissolved oxygen at station II, III and IV. Dugdalle and Wallace (1960) Wetzel (1975) and Prakasam and Joseph (1989) revealed that there is a remarkable relation between productivity and dissolved oxygen. Atkins (1923) suggested that nutrients play a significant role in phytoplankton productivity. Bruno et al. (1980) observed that organic nitrogen and silica regulate primary productivity in the Peconic Bay Estuary. In the present study also phosphate and silicate have significant relationship with phytoplankton productivity.

CONCLUSION

Paravur canal, which acts as a connecting link between Edava- Nadayara and Paravur backwater is subjected to a constant sea water-fresh water interaction. Certain areas of this canal were exploited for fish capturing by the local people. In the present study, the most polluted sites like station II and III showed low productivity rate. Where as, station IV, which is comparatively a non-polluted site with influx of riverside water and intrusion of salinity showed high productivity rate. The rate of primary production is important for assessing the fisheries yield. Today because of pollution and other anthropogenic activities, the qualities of water bodies are getting deteriorated. Hence it is highly essential to save them, so that people can exploit these resources for domestic as well as recreational purposes.

Acknowledgement

Financial assistance from university of Kerala is gratefully acknowledged.

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Надійшла до редколеії 07.01.04