Primary Production Studies in Muthupet Mangroves

Suganthi A., Venkatraman C. and Ezhumalai P*

Marine Biology Regional Centre, Zoological Survey of India, Chennai *Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai suganthi_emelda@yahoo.co.in

ABSTRACT

The seasonal variations of primary and net production were studied during July 2013 to June 2014 in the Muthupet mangroves (Lat. 10° 46' N; Long. 79° 51'E) south east coast of India. The primary productivity values ranged between 26.65 and 152.35 mg C/m³/hr. The minimum values of 26.65 mg C/m³/hr was observed in November 2013 and the maximum values of 152.35 mg C/m³/hr was observed in May 2014 at Muthupet mangroves. The seasonal average of gross and net primary production showed maximum values in summer and gradually decreases during pre-monsoon and post-monsoon and attained minimum values during monsoon periods.

Key words: Muthupet mangroves, Gross and net Primary production

INTRODUCTION

Primary production in an estuary is very important not only for the dynamics of nutrients in its ecosystem but also for the marine biological resources. The fishery resources of any area are mainly dependent on the magnitude of primary and secondary productions which in turn are influenced by various physical, chemical and biological factors. Since all organic matter available in the estuary is primarily synthesized by the primary producers and their products are transferred to consumers through tropic levels, the amount of primary production is the most significant factor which determines whether or not a particular body of water is important from the point of view fisheries.

An extensive work was carried out on the primary productivity of estuarine waters of India. Rajagopalan *et al.*(1992) made a detailed study on the productivity of the Arabian sea. The seasonal variations of primary productivity in relation to phytoplankton diversity were studied by Purvaja and Ramesh (2000) in Pichavaram managrove, Ennore creek and Adayar estuary. Ajith Kumar *et al.* (2006) worked on primary production and biological properties of Muthupet mangrove, south east coast of India. Phytoplankton pigments and primary productivity of inshore waters of

Tuticorin were discussed by Gopinathan et al. (1994). Diversity of phytoplankton species and productivity in Cochin backwaters were investigated by Selvaraj et al. (2003). A study on net and gross primary productivity and in relation to some physico-chemical factors of Valanthakad backwater in Kerala was undertaken by Meera and Bijoy Nandan (2010). Primary production in relation to fishery potential of the Panangad region in the Cochin estuary was studied by Renjith et al. (2004). Gandiappan et al. (2001) reported phytoplankton diversity and productivity of Paravanar estuary in Cuddalore coast. Redekar and Wagh (2000) investigated relationship of fouling diatoms and chlorophyll value from Zuari estuary, Goa. Selvaraj et al. (2003) studied the seasonal fluctuations of phytoplankton chlorophyll pigments and primary productivity in the surf zone and backwater of Cochin. Krishnakumari et al. (2002) documented primary productivity in Mandovi-Zuari estuaries in Goa. Considerable works on primary productivity of Vellar estuary are available (Venugopalan 1969; Sundarajraj and Krishnamurthy, 1974; Vijayalakshmi and Venugopalan, 1975; Chandramohan and Bhatnagar, 1976; Sundararaj 1978; Chandran 1982; Sivakumar, 1982 and Kawabata et al., 1993). Although many studies have been undertaken to evaluate the productivity of Indian estuaries, no scientific studies have hitherto been carried out on the productivity of the mangrove and estuarine waters of Muthupet. The present study aims to get an insight in to the productivity of this mangrove environment.

MATERIALS AND METHODS

Study area

Muthupet mangroves (Lat. 10° 46' N; Long. 79° 51' E) is located at the southern end of the Cauvery river delta of Tamil Nadu on the Bay of Bengal, covering an area of approximately 6,803.01 ha of which only 4% is occupied by well-grown mangroves. The rivers Paminiyar, Koraiyar, Kilaithankiyar, Marakkakoraiyar and other tributaries of the river Cauvery flow through Muthupet and adjacent villages. At the tail end, they form an estuary before meeting the sea.

Estimation of primary and net productivity

Primary productivity was estimated on the basis of changes in dissolved oxygen using light and dark bottle method as described by Strickland and Parsons (1972). The term 'Primary Production' refers to the rate of formation of organic matter by the Phytoplankters. In other words, it is the rate at which new organic matter is added to the existing phytoplankton standing crop. It is expressed in terms of mg, carbon, per cubic metre per hour. The studies of primary productivity was carried out for 3 hrs in Muthupet mangroves water during day time. Primary production was measured in the surface water following the light and dark bottle method (Strickland and Parsons, 1972).

Water samples were collected in three glass stoppered reagent bottles, from the Muthupet mangroves at a depth of 1.5 mtr. The dissolved oxygen in one of the three bottles was determined by Winkler's method (Strickland and Parsons, 1972). This is called Initial Bottle (IB). Out of the remaining two bottles, one bottle was completely

covered with a black cloth so as to prevent the entry of light. This was being the dark bottle (D.B). The remaining one which was uncovered was being the light bottle (L.B). Both the light and dark bottle were lowered to the original depth 1.5 metre from where the samples were collected.

In the light bottle, both respiration and photosynthesis took place. But respiration alone took place in the dark bottle. The difference between the value of dissolved oxygen in light and dark bottles would give the amount of oxygen released during photosynthesis. From the values of oxygen obtained from the IB, LB and DB the productivity was calculated using the following formula:

Gross primary productivity (Mgc/M³/hr)

$$= \frac{\Phi_2 L.B - \Phi_2 D.B}{\Phi Q G_3} x 1000$$

Net Primary Productivity (Mgc/M³/hr) = $\frac{\Phi_2 L.B \Phi_2 L.B}{\Phi_2 L.B} x 1000$

Where

O_2	=	Oxygen ml/lit	
$1 m l \ of \ O_2$	=	0.536 mg carbon	
$O_2 LB$	=	Oxygen dissolved in light bottle	
O ₂ DB	=	Oxygen dissolved in dark bottle	
O ₂ IB	=	Oxygen dissolved in Initial bottle	
PQ	=	Photosynthetic Quotient (1.2)	
t	=	Hours of incubation (3 hours)	

During the study period primary productivity and net productivity were calculated and the values were tabulated.

RESULTS AND DISCUSSION

The rate of gross primary production was maximum during summer followed by pre monsoon and post monsoon and minimum during monsoon period. The primary productivity values ranged between 26.65 and 152.35 mg $C/m^3/hr$. The minimum values of 26.65 mg $C/m^3/hr$ was observed in November 2013 and the maximum values of 152.35 mg C/m³/hr was observed in May 2014 at Muthupet mangroves water (Table 1 and Graph 1). The low values of primary productivity recorded during monsoon could be due to the cloudy weather, low values of salinity and low water temperature. The advent monsoon tilts the whole picture of the flora, it inactivates the marine species by fresh water species in this season. The high productivity in summer season could be attributed to the high light intensity, high salinity and high density of phytoplankton, clear water condition and availability of nutrients. This findings is in agreement with the earlier observations of Dehadrai and Bharagava (1972) in Mandovi and Zuari estuaries; Pillai et al. (1975), Purushothaman and Bhatnagar (1976) and Sivakumar (1982) in Vellar estuary; Prabha Devi (1986) and Tillai Rajsekar et al. (2005) in Coleroon estuary; Nair et al. (1984) in Ashtamudi estuary and Rajesh et al. (2002) in Nethravathi estuary, Mangolare.

In the present investigation the peak primary productivity during summer period coincides with the amount of solar energy reaching the surface of the water (Nair and Tampi, 1980). Statistical analysis revealed that a positive correlation for gross and net primary production with light penetration. Similar observations were made by Chandran (1982) from Vellar estuary and Prabha Devi (1986) in Coleroon estuary. In the present investigation, the net primary production is followed the pattern of gross primary production throughout the study period. Similar observations were made by Qasim and Gopinathan (1969); Nair *et al.* (1983); Sivadasan and Joseph (1998); Rasheed *et al.* (2000), Selvaraj *et al.* (2003) and Renjith *et al.* (2004) from Cochin backwaters, Meera and Bijoy Nandan (2010) from Valanthakad backwater in Kerala, from Ashtamudi estuary (Nair *et al.*, 1984) and from Mangroves at Porto Novo (Krishnamurthy and Sundararaj, 1972).

Table: 1. Seasonal variations of Primary Production (mg C/m³/hr) IN Muthupet Mangroves

Month	Gross Primary Production	Net Primary Production
July 2013	149.60	125.62
August	64.35	38.65
September	33.40	27.62
October	28.32	28.62
November	26.65	24.32
December	32.35	28.15
January 2014	35.40	38.35
February	34.10	36.40
March	38.45	42.18
April	84.50	65.32
May	152.35	145.6
June	95.32	82.50

86



Graph 1: Shows the Seasonal variations of Primary Production (mg C/m³/hr) IN Muthupet Mangroves

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