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Primary productivity of Erai river in Chandrapur district, Maharashtra, India.

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ABSTRACT

Productivity is the production capacity of a pond or any other water body. Generally, the ecosystems are self sustaining. The ecosystem productivity depends upon its physical and chemical parameters which constitutes the whole environment. Erai river is a main tributary of Wardha river in Chandrapur District. Its length is approximately 25 Km. from its origin near Kasarbodi at Khadsangi in Chimur Tahsil of Chandrapur District. Erai river supplies water to Chandrapur city and Chandrapur Super Thermal Power Station. The primary productivity was studied at three sites during the period of three months (Janauary, 2017 to March, 2017) as a project of M.Sc. In the present investigation, the gross primary production was ranged between 83.3 to 104.16 mg.C.m^3.hr^{-1}, net primary production was 41.6 to 62.5 mg.C.m^3.hr^{-1} and community respiration was 41.6 to 51.6 mg.C.m^3.hr^{-1}. The primary productivity shows the seasonal variation. From this study, it may be concluded that, Erai river is deterioted due to rural and urban wastes near the river. It is also affected with unwanted growth of Ecornia plants and domestic effluents.

Keywords: Erai river, Primary productivity, Gross primary productivity (GPP), Net primary productivity (NPP) and Community respiration (CR).

INTRODUCTION

Primary productivity is an important hydrobiological aspect of any other water body. It shows the production capacity of that water body. The measurement of primary productivity gives information regarding the photosynthetic production of organic matter in an area per unit time and the functional aspects of ecosystem (Odum, 1971). The rate of production of organic matter per unit time is called as 'Productivity'. The primary productivity is the manifestation of its biological production. It forms the base of ecosystem functioning. The ecosystem productivity depends upon its physical and chemical parameters which constitute the whole environment. The basic arrangement of an ecosystem comprises two strata. viz., (a) Autotrophic stratum and, (b) Heterotrophic stratum.

The autotrophic stratum is an upper part of the ecosystem where the light is present and contains photosynthetic organisms whereas the heterotrophic stratum is a lower part of the ecosystem where the light may or may not be present but has the consumer nutrients regenerating and decomposing organisms. On the basis of functions of ecosystem, it consists of following parts: (a) Biological flow of energy in the ecosystem, (b) Bio-geo-chemical cycles, and (c) Ecological regulation of the ecosystem. In this way, the functions of the ecosystem involve transformation, circulation, accumulation and desperation of energy and nutrients. Here, we will discuss about the primary productivity of Erai river in Chandrapur District of Maharashtra, India.

MATERIAL AND METHODS

Erai river is a main tributary of Wardha river in Chandrapur District. Its total length from its origin to meeting point at Wardha river is about 25 Kilometers. Erai river's origin is near Kasarbodi at Khadsangi in Chimur Tahsil of Chandrapur District. A dam is constructed on the Erai river in the buffer zone of Tadoba National Park for supplying water to the Chandrapur city and Chandrapur Super Thermal Power Station. Depth of the river is 3 to 8 meters. The primary productivity of the Erai river was studied at three stations for a period of three months from January, 2017 to March, 2017 as a project work of a M.Sc. student. Station-1 was in the area of Chandrapur Super Thermal Power Station, Chandrapur. Station-2 was in the Datala, Chandrapur and Station-3 at Pathanpura, Chandrapur. For the primary productivity analysis, 'Light and Dark bottle' method of Gaarder and Gran (1927), as recommended by Vollenweider (1969), was followed. Gaarder and Gran in 1927 first proposed the technique of using light and dark bottles and Winkler's titration to measure the production and consumption of Oxygen. Water samples were collected on the basis of monthly intervals in between 8.00 a.m. to 2.00 p.m. in triplicate. The samples in the first bottle were used immediately to determine the initial level of dissolved oxygen contents following modified Winkler's Volumetric method (APHA, 1998). All the values O_2 values obtained in the present study were converted into Carbon values by multiplying with the factor 0.375 (Odum, 1956). The second bottle was painted with black colour (dark bottle) to prevent light and hence serve as control to measure respiration. The third bottle (light bottle) was treated as a test to measure the net production. These two bottles were incubated under water in the euphotic zone for a period of two hours by suspending it in the water after which dissolved oxygen content of each bottle was estimated.

The Gross Primary Production (GPP), the Net Primary Production (NPP) and Community Respiration (CR) were calculated by the following way:

Gross Primary Production (GPP) O_2*/mg/l/hr. = (Dl-Di)/hr*
Net Primary Production (NPP) O_2*/mg/l/hr. = (Dl-Dd)/hr*
Community Respiration (CR) O_2*/mg/l/hr. = (Di-Dd)/hr*
Where: Di = DO (mg/l/h) in the initial bottle
Dl = DO (mg/l/hr) in the light bottle
Dd = DO (mg/l/hr) in the dark bottle
hr = Duration of exposure in hours.

The hourly rate can be converted to daily rates by multiplying with duration of sunshine on that day. Oxygen values (mg/l) were converted into carbon values by applying the equation suggested by Thomas *et al.,* in 1980. Production (mg C) = (O_2 (mg/l) x 0.375) / PQ, Where PQ = 1.25, PQ is the respiratory quotient = Respiration / Photosynthesis and a comprised value of 1.25 was used to represent the metabolism of Sugar, fat and proteins. The value 0.375 is represented as a constant to convert Oxygen value to Carbon value (Thomas *et al.,* 1980).

RESULTS AND DISCUSSION

The three months data after analysis shows the seasonal variation in gross primary productivity (GPP), net primary productivity (NPP) and community respiration (CR) of Erai river is given in the tables 1 to 3 and range of variation is given in table 4. The variation reflects a well defined seasonal pattern.

Table1: Gross Primary Production (GPP) ($mg.C.m^3.hr^{-1}$) at three stations on Erai river.

Sr. No.	Months	Station-1	Station-2	Station-3
1	January, 2017	104.16	93.3	93.3
2	February, 2017	93.3	83.3	93.3
3	March, 2017	104.16	93.3	104.16

Table 2: Net Primary Production (NPP) (mg.C.m^3.hr^{-1}) at three stations on Erai river.

Sr. No.	Months	Station-1	Station-2	Station-3
1	January, 2017	41.6	51.6	51.6
2	February, 2017	51.6	62.5	51.6
3	March, 2017	51.6	51.6	41.6

Table 3: Community Respiration (CR) (mg.C.m^3.hr^{-1}) at three stations on Erai river.

Sr. No.	Months	Station-1	Station-2	Station-3
1	January, 2017	41.6	41.6	41.6
2	February, 2017	41.6	41.6	41.6
3	March, 2017	51.6	41.6	41.6

Table 4: Range of variation in Gross Primary Production (GPP), Net Primary Production (NPP) and Community Respiration (CR) (mg.C.m^3.hr^{-1}) at three stations on Erai river.

Sr. No.	Parameters	Range of parameters (mg.C.m^3.hr^{-1})
1	Gross Primary Production (GPP)	83.3 to 104.16
2	Net Primary Production (NPP)	41.6 to 62.5
3	Community Respiration (CR)	41.6 to 51.6

The influence of environmental factors on primary productivity is well documented. Wetzel (1966) observed that high rate of primary productivity production is corresponds to an increase in solar radiation, this result corresponds to the present observation that primary productivity is always more during middle of the day (1.30 p.m. to 2.30 p.m.).

In the present investigation, the gross primary production was ranged between 83.3 to 104.16 mg.C.m^3.hr$^{-1,}$ net primary production was 41.6 to 62.5 mg.C.m^3.hr^{-1} and community respiration were 41.6 to 51.6 mg.C.m^3.hr^{-1}. Similar observations are also shown by Bhalla *et al.,* in 2006 during physic-chemical assessment of water in relation to primary production of planktons in Godavari river at Nashik. Gaidhane *et al.* (2013) studied the primary productivity of kharland (saline) ponds of Ratnagiri, Maharashtra and their results shows the gross primary production was ranged between 72.5 to 114.16 mg.C.m^3.hr$^{-1,}$ net primary production was 30.8 to 72.5 mg.C.m^3.hr^{-1} and community respiration were 30.8 to 72.5 mg.C.m^3.hr^{-1}. Jabade and Rokade (2014) was studied the primary production of the Mosam river in relation to the season and waste water discharge. Their gross production was ranged between 2.872 mgC/l/hr (Surface) and 20268 mgC/l/hr. Dash *et al.* (2011) was observed the primary productivity of Kharasrota river in Orissa. They reported maximum gross primary production during summer season and minimum in rainy season at all the six stations. Lokhande and Indulkar (2017) had made study on primary productivity of Khaire reservoir in Raigad district of Maharashtra revealed that the primary peak of productivity was observed during pre-monsoon season and the secondary peak was noticed during post-monsoon season. However, during the monsoon season low productivity values were recorded from the reservoir. Sun *et al.* (2017) has given a systematic review of studies on the estimation of net primary productivity in the three-river head water region in China. According to him, net primary productivity (NPP) is a key vegetation parameter and ecological indicator that can reflect both natural environmental changes and carbon budget levels.

CONCLUSION

From the above study, it may be concluded that:

1. The primary productivity of Erai river was very good. It is varies according to the season.
2. It is deterioted due to domestic effluents and Ecornia plants.
3. Regular cleaning of river is important for maintaining the water quality and river biota.
4. Removal of encroachment (Slum area) and restriction on bathing and washing activities along the bank of river are important.
5. Construction of a wall on the river to avoid dumping of solid wastes in the river is necessary.

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