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Seasonal Changes in Primary Productivity at Water Reservoirs of Ajara Tahsil from Kolhapur District, M. S., India

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Abstract:

Present study deals with seasonal changes in primary productivity of water reservoirs from Ajara tahsil of Kolhapur district, Maharashtra. During the study period Gavase, Dhangarmola, Yarandol, Khanapur and Ningudage water reservoirs were explored so as to study the seasonal variation in Gross Primary Productivity, Net Primary Productivity and Community respiration. The study revealed that GPP, NPP and CR were higher during summer season while lower during monsoon season. During study period it has also been observed that the GPP, NPP and CR values varied from site to site but the fluctuation is negligible.

Key words: Primary productivity, GPP, NPP, CR, Water reservoirs, Ajara Tahsil

Introduction:

Primary productivity is an important biological phenomenon in nature upon which the entire diverse array of life depends,

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directly or indirectly. The importance of primary productivity in an aquatic ecosystem is realized for estimating the productive capacity. It shows nature of ecosystem, its tropic level and availability of energy for secondary producers (Patil, 2012). Primary productivity is the major component for the fish production and the potential of fish production can be estimated by primary production. Primary production is influenced by biotic as well as abiotic interactions.

Enrichment of nutrients and dissolved matter in the water bodies affect diversity of plankton and physico-chemical characters of water. Diversity in the distribution, abundance and variations in the biotic factors provide information of energy earned over in an aquatic ecosystem. Productivity of lakes depends on the presence of planktonic biomass. Plankton is considered as an index of fertility of the water quality (Fraser, 1962). Planktonic organisms have short life cycle with high metabolic activity, which facilitates them to respond to any pollution stress quickly and significantly compared to benthic or nektonic organisms (Parkins, 1976).

In an aquatic body, primary productivity gives information relating to the amount of energy available to support bioactivity of the system (Vollenweider, 1969). Estimation of primary productivity of the aquatic systems, which are adversely affected by anthropogenic activities, serves as an important tool in studying the effect of those activities on the system. High and low productivity values of water bodies might be due to low nutrient status of water (Radheyshyam *et al.,* 1988). Primary productivity is a biological phenomenon in freshwater ecosystem. Physiological activities are controlled by physico-chemical properties of the water body. Phytoplankton plays an important role in the food chain of aquatic animals by balancing the oxygen and carbon-dioxide balance and quality of the water. The pH, phosphate and nitrogen are main factors controlling the productivity of aquatic ecosystem (Cabecuds and Broqueira, 1987). In India, some natural and man-made

reservoirs have been estimated for their primary productivity. The workers like Sreenivasan (1964), Singh (1998), Synudeen Sahib (2002) and Hujare *et al.* (2007) have attempted for the estimation of primary productivity.

Materials and Methods:

Study Area:

Ajara is one of the important tahsil of Kolhapur district, located at southern region with N 16^0 12' and E 74^0 2'. Total population of the tahsil is about 1,21, 430 residing in 74 villages. The total area of the tahsil is about 54, 853 ha. The climate is moderate subtropical with an average annual rainfall of 2000 mm. The people residing here depend on two important rivers for their domestic, agricultural and drinking water needs, viz. Hiranyakeshi River and Chitri River. On the other hand, villages away from these rivers depend on bore-wells, dug-wells, small and large freshwater water bodies for their daily use. The present study deals with major wetlands from this tahsil. Gavase freshwater water body is situated south-west to the Ajara city at N 16^0 05' 761" and E 74^0 07' 596". The submergence area of this reservoir is 37.04 ha during monsoon season and 3.79 ha during summer season (Patil *et al.* 2014). Dhangarmola freshwater water body is situated at south-west to the Ajara city with longitude and latitude of 16^0 03' 687" and 74^0 05' 647". The actual submergence area is 55.17 ha. The submergence area during summer season is 7.32 ha (Patil *et al.* 2014). The location of Yarandol freshwater body is N 16^0 03' 629" and E 74^0 10' 539", situated to the south of Ajara city. The submergence area of this water body at present is 71.48 ha during monsoon season (Patil *et al.* 2014). According to Patil *et al.* (2014), Khanapur freshwater water body is situated at south-west of Ajara city with the location of N 16^0 05' 352" and E 74^0 18' 132". The actual submergence area is 20.71 ha. Ningudage freshwater body is situated at north-east of the

Ajara city with the location of N 16^0 09' 325" and E 74^0 18' 132" with submergence area of 4.28 ha (Patil *et al.* 2014).

Analysis of Primary Productivity:

Present study was carried out from July 2011 to June 2013 so as to analyze the primary productivity of five major wetlands from Ajara Tahsil of Maharashtra. Primary productivity was determined by Gaarder and Gran (1927) using light and dark bottle method seasonally. The water samples were analyzed by Wirnkler's method. The gross and net primary productivity was determined along with community respiration or respiration rate.

Result and Discussion:

The seasonal values of GPP, NPP and CR for 2011-12 and 2012-13 at all study sites are depicted in Table 1.1 to Table 1.5.

The seasonal variations in GPP, NPP and CR values at Gavase water body during 2011-12 fluctuated from 0.19 gC/m^3/hr, 0.11 gC/m^3/hr and 0.08 gC/m^3/hr to 0.91 gC/m^3/hr, 0.76 gC/m^3/hr and 0.15 gC/m^3/hr respectively. The values during 2012-13 ranged from 0.23 gC/m^3/hr, 0.15 gC/m^3/hr and 0.08 gC/m^3/hr to 1.07 gC/m^3/hr, 0.91 gC/m^3/hr and 0.15 gC/m^3/hr respectively. It was noted minimum during monsoon season while maximum during summer season for both the years.

	2011-12			2012-13		
Season	GPP	NPP	RR	GPP	NPP	RR
Monsoon	0.19	0.11	0.08	0.23	0.15	0.08
Winter	0.75	0.6	0.15	0.91	0.6	0.3
Summer	0.91	0.76	0.15	1.07	0.91	0.15

Table 1.1: Seasonal variation in Primary productivity (gC/m3/hr) at Gavase water body

The seasonal variations in GPP, NPP and CR values at Dhangarmola water body during 2011-12 fluctuated from 0.15 gC/m^3/hr, 0.08 gC/m^3/hr and 0.07 gC/m^3/hr to 0.91 gC/m^3/hr, 0.61 gC/m^3/hr and 0.30 gC/m^3/hr respectively. The values during 2012-13 ranged from 0.26 gC/m^3/hr, 0.19 gC/m^3/hr and 0.08 gC/m^3/hr to 0.91 gC/m^3/hr, 0.76 gC/m^3/hr and 0.15 gC/m^3/hr respectively. It was noted minimum during monsoon season while maximum during summer season for both the years.

	2011-12			2012-13		
Season	GPP	NPP	RR	GPP	NPP	RR
Monsoon	0.15	0.08	0.07	0.26	0.19	0.08
Winter	0.61	0.46	0.15	0.61	0.46	0.15
Summer	0.91	0.61	0.3	0.91	0.76	0.15

Table 1.2: Seasonal variation in Primary productivity (gC/m3/hr) at Dhangarmola water body

The seasonal variations in GPP, NPP and CR values at Yarandol water body during 2011-12 fluctuated from 0.23 gC/m^3/hr, 0.15 gC/m^3/hr and 0.08 gC/m^3/hr to 1.21 gC/m^3/hr, 0.91 gC/m^3/hr and 0.30 gC/m^3/hr respectively. The values during 2012-13 ranged from 0.26 gC/m^3/hr, 0.19 gC/m^3/hr and 0.08 gC/m^3/hr to 1.36 gC/m^3/hr, 1.06 gC/m^3/hr and 0.30 gC/m^3/hr respectively. It was noted minimum during monsoon season while maximum during summer season for both the years.

	2011-12			2012-13		
Season	GPP	NPP	RR	GPP	NPP	RR
Monsoon	0.23	0.15	0.08	0.26	0.19	0.08
Winter	0.91	0.61	0.3	0.91	0.76	0.15
Summer	1.21	0.91	0.3	1.36	1.06	0.3

Table 1.3: Seasonal variation in Primary productivity (gC/m3/hr) at Yarandol water body

The seasonal variations in GPP, NPP and CR values at Khanapur water body during 2011-12 fluctuated from 0.23

gC/m^3/hr, 0.15 gC/m^3/hr and 0.08 gC/m^3/hr to 1.06 gC/m^3/hr, 0.76 gC/m^3/hr and 0.30 gC/m^3/hr respectively. The values during 2012-13 ranged from 0.28 gC/m^3/hr, 0.19 gC/m^3/hr and 0.09 gC/m^3/hr to 0.91 gC/m^3/hr, 0.60 gC/m^3/hr and 0.30 gC/m^3/hr respectively. It was noted minimum during monsoon season for both the years while maximum during summer season for 2011-12 and winter and summer for 2012-13.

	2011-12			2012-13		
Season	GPP	NPP	RR	GPP	NPP	RR
Monsoon	0.23	0.15	0.08	0.28	0.19	0.09
Winter	0.76	0.61	0.15	0.91	0.61	0.3
Summer	1.06	0.76	0.3	0.91	0.61	0.3

Table 1.4: Seasonal variation in Primary productivity (gC/m3/hr) at Khanapur water body

The seasonal variations in GPP, NPP and CR values at Ningudage water body during 2011-12 fluctuated from 0.45 gC/m^3/hr, 0.30 gC/m^3/hr and 0.15 gC/m^3/hr to 1.67 gC/m^3/hr, 1.36 gC/m^3/hr and 0.30 gC/m^3/hr respectively. The values during 2012-13 ranged from 0.26 gC/m^3/hr, 0.19 gC/m^3/hr and 0.08 gC/m^3/hr to 1.52 gC/m^3/hr, 1.22 gC/m^3/hr and 0.30 gC/m^3/hr respectively. It was noted minimum during monsoon season while maximum during summer season for both the years.

	2011-12			2012-13		
Season	GPP	NPP	RR	GPP	NPP	RR
Monsoon	0.45	0.3	0.15	0.26	0.19	0.08
Winter	1.06	0.76	0.3	1.06	0.91	0.15
Summer	1.67	1.36	0.3	1.52	1.22	0.3

Table 1.5: Seasonal variation in Primary productivity (gC/m3/hr) at Ningudage water body

The present study revealed that GPP, NPP and CR values were lower during monsoon season while higher during summer season at all study sites. This might be due to cloudy atmosphere, lower temperature, dilution of water and

decreased nutrient status. On the other hand, maximum primary productivity during summer season might be due to intense sunlight, increased ambient temperature, decreased water level and increased nutrient status influence the productivity. Similar type of justification was also given by Parasd and Nair (1963), Sreenivasan (1964), Singh (1998), Hujare (2007), Umavati *et al.* (2007), Baruah *et al.* (2009), Patil and Chavan (2010) and Sarma and Dutta (2012).

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