

Primary productivity of Kumshi reservoir, Kalaburagi District, Karnataka

Shaik Fameeda, M. Rajashekhar, Zeba Parveen*, K Vijaykumar

Department of Zoology, Gulbarga University, Kalaburagi

*Department of Zoology, Bi Bi Raza Women Degree College, Kalaburagi

E-mail address: m_rajshekhar@rediffmail.com

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ABSTRACT In the present investigation, primary productivity of Kumshi reservoir of Kalaburagi District has been studied for the period of two years (2012-2014). The results reveals that, gross primary productivity of Kumshi reservoir followed an increasing trend through the northeast monsoon season towards summer season, whereas, net primary productivity of Kumshi reservoir is followed a more or less similar trend of increasing towards northeast monsoon season and summer season, while community respiration of reservoir also followed a similar trend of oscillation increasing trend towards summer and northeast monsoon season during the study period.

1. INTRODUCTION

Primary productivity is most important biological phenomenon in nature, which involves the trapping of radiant energy of the sun, and its transformation into high potential biochemical energy by the process of photosynthesis. Primary production involving chemoautotrophic process forms the base of the energy flow in a ecosystem while understanding of primary production becomes all the more essential in the evaluation of the capacity of any ecosystem, including that of standing water bodies. The primary productivity relates to the amount of organic matter synthesized in a certain space per unit term. Primary productivity have been used for potential index of productivity for many diverse ecosystem of the world (Wetzel, 2001). Primary productivity is concerned with the evolution of the capacity of an ecosystem to the synthesis of organic matter of high potential chemical. Primary production in aquatic ecosystem is mainly controlled by interaction of many factors like environmental and biotic factors and nutrient status of the water body. Thus, this aspect has drawn the attention of numerous hydro biologists. In the present investigation, an attempt has been made to analyse the primary productivity of Kumshi reservoir, Kalaburagi city.

2. MATERIALS AND METHOD

Study area: The Kumshi Reservoir a major perennial Reservoir of the Kalaburagi, which is 11 kms away from the Kalaburagi University campus which falls under 17°-22'-30" N Latitude and 76°-59'-0" E Longitude. Harnessing of the Kumshi Reservoir for irrigation purpose was considered from a long time prior to 1956 to provide facilities to the drought prone areas of Kalaburagi Town.

Primary production:

Primary production *in-situ* was estimated by Gaarder and Gran (1927) "Light and dark bottle method."

3. RESULTS

The present study has been conducted for the period of two years and all the values were presented in table 1 to 3 and figure 1 to 3 respectively.

Gross Primary Productivity

The monthly fluctuations of gross primary productivity at different stations during October 2012 to September 2014 for all the seasons are presented in Table No. 1.

During the northeast monsoon season of 2012-2013, the gross primary productivity at stations I to VII varied from 0.59 to 0.84 gC/m³/hr; 0.68 to 0.75 gC/m³/hr; 0.68 to 0.77 gC/m³/hr; 0.63 to

0.83 gC/m³/hr; 0.68 to 0.89 gC/m³/hr; 0.68 to 0.78 gC/m³/hr; and 0.63 to 0.82 gC/m³/hr respectively. While during the same season of 2013-2014, the gross primary productivity values at stations I, II, III, IV, V, VI and VII varied between 0.54 to 0.83 gC/m³/hr; 0.55 to 0.88 gC/m³/hr; 0.53 to 0.80 gC/m³/hr; 0.6 to 1.0 gC/m³/hr; 0.57 to 1.10 gC/m³/hr; 0.33 to 0.9 gC/m³/hr; and 0.48 to 0.97 gC/m³/hr respectively.

The seasonal variations during summer season of 2013 for the seven stations fluctuated between 0.74 to 1.03 gC/m³/hr; 0.79 to 1.07 gC/m³/hr; 0.82 to 1.12 gC/m³/hr; 0.84 to 1.14 gC/m³/hr; 0.85 to 1.2 gC/m³/hr; 0.82 to 1.15 gC/m³/hr; and 1.0 to 1.28 gC/m³/hr respectively. Where as, for the same season of 2014, the gross primary productivity values varied between 0.94 to 1.02 gC/m³/hr; 1.0 to 1.13 gC/m³/hr; 1.02 to 1.13 gC/m³/hr; 0.99 to 1.19 gC/m³/hr; 0.9 to 1.18 gC/m³/hr; 1.2 to 1.19 gC/m³/hr; and 1.03 to 1.28 gC/m³/hr at stations I to VII respectively.

During the southwest monsoon season of 2013 the gross primary productivity values varied 0.39 to 0.63 gC/m³/hr; 0.4 to 0.59 gC/m³/hr; 0.4 to 0.6 gC/m³/hr; 0.43 to 0.57 gC/m³/hr; 0.52 to 0.67 gC/m³/hr; 0.5 to 0.67 gC/m³/hr; and 0.4 to 0.73 gC/m³/hr at stations I to VII respectively. While for the same season of 2014, the gross primary productivity fluctuated between 0.43 to 0.8 gC/m³/hr; 0.43 to 0.58 gC/m³/hr; 0.47 to 0.62 gC/m³/hr; 0.38 to 0.62 gC/m³/hr; 0.47 to 0.78 gC/m³/hr; 0.47 to 0.75 gC/m³/hr and 0.5 to 0.83 gC/m³/hr at stations I to VII respectively.

Net Primary Productivity:

The net primary productivity values of the Kumshi reservoir from the different stations are depicted in Table No. 2.

During the northeast monsoon season of 2012-2013, the net primary productivity values varied from 0.3 to 0.45 gC/m³/hr; 0.3 to 0.39 gC/m³/hr; 0.33 to 0.37 gC/m³/hr; 0.34 to 0.47 gC/m³/hr; 0.38 to 0.45 gC/m³/hr; 0.27 to 0.43 gC/m³/hr; and 0.3 to 0.42 gC/m³/hr at stations I to VII respectively.

Meanwhile the net primary productivity values during the same season of 2002- 2014 fluctuated from 0.24 to 0.5 gC/m³/hr; 0.29 to 0.45 gC/m³/hr; 0.27 to 0.5 gC/m³/hr; 0.3 to 0.59 gC/m³/hr; 0.3 to 0.57 gC/m³/hr; 0.20 to 0.55 gC/m³/hr and 0.22 to 0.62 gC/m³/hr at stations I to VII respectively.

During summer season of 2013 the net primary productivity values fluctuated from 0.29 to 0.52 gC/m³/hr; 0.33 to 0.55 gC/m³/hr; 0.33 to 0.69 gC/m³/hr; 0.38 to 0.64 gC/m³/hr; 0.38 to 0.65 gC/m³/hr; 0.38 to 0.64 gC/m³/hr and 0.4 to 0.75 gC/m³/hr at stations I to VII respectively. While during the same season of 2014, the net primary productivity values varied between 0.43 to 0.5 gC/m³/hr; 0.47 to 0.6 gC/m³/hr; 0.53 to 0.63 gC/m³/hr; 0.49 to 0.63 gC/m³/hr; 0.38 to 0.74 gC/m³/hr; 0.63 to 0.73 gC/m³/hr and 0.53 to 0.67 gC/m³/hr at stations I to VII respectively.

However for the southwest monsoon of 2013 the net primary productivity fluctuated from 0.20 to 0.43 gC/m³/hr; 0.28 to 0.75 gC/m³/hr; 0.23 to 0.39 gC/m³/hr; 0.25 to 0.38 gC/m³/hr; 0.30 to 0.47 gC/m³/hr; 0.33 to 0.48 gC/m³/hr and 0.27 to 0.45 gC/m³/hr at stations I, II, III, IV, V, VI and VII respectively. While during the same season of 2014, the net primary productivity values ranged between 0.28 to 0.5 gC/m³/hr; 0.25 to 0.39 gC/m³/hr; 0.25 to 0.45 gC/m³/hr; 0.22 to 0.43 gC/m³/hr; 0.28 to 0.49 gC/m³/hr; 0.27 to 0.5 gC/m³/hr and 0.33 to 0.55 gC/m³/hr at stations I to VII respectively.

4. Community Respiration:

Community respiration observations at the seven stations of Kumshi reservoir are presented in Table No. 3

The community respiration during northeast monsoon season of 2012-2013 exhibited values ranging between 0.29 to 0.39 gC/m³/hr; 0.29 to 0.47 gC/m³/hr; 0.32 to 0.42 gC/m³/hr at stations I, II and III; 0.30 to 0.44 gC/m³/hr at stations IV and V; 0.3 to 0.52 gC/m³/hr at station VI and 0.33 to 0.4 gC/m³/hr at station VII respectively. While for the same season of 2013-2014, the community respiration values fluctuated between 0.3 to 0.45 gC/m³/hr; 0.27 to 0.39 gC/m³/hr; 0.27 to 0.43

gC/m³/hr; 0.3 to 0.42 gC/m³/hr; 0.29 to 0.54 gC/m³/hr; 0.32 to 0.37 gC/m³/hr and 0.27 to 0.38 gC/m³/hr at stations I to VII respectively.

The community respiration during summer of 2013 recorded high values compared to southwest monsoon season fluctuated between 0.45 to 0.53 gC/m³/hr at station I; 0.44 to 0.57 gC/m³/hr at station II and VI; 0.44 to 0.59 gC/m³/hr at station III; 0.47 to 0.55 gC/m³/hr at station IV; 0.48 to 0.55 gC/m³/hr at station V and 0.52 to 0.68 gC/m³/hr at station VII respectively. During same season of 2014, the community respiration values were in the range between 0.5 to 0.53 gC/m³/hr; 0.52 to 0.58 gC/m³/hr; 0.47 to 0.55 gC/m³/hr; 0.49 to 0.57 gC/m³/hr; 0.44 to 0.58 gC/m³/hr; 0.42 to 0.55 gC/m³/hr and 0.5 to 0.62 gC/m³/hr at stations I to VII respectively.

During southwest monsoon season of 2013 the values community respiration recorded at different stations exhibited ranges between 0.15 to 0.28 gC/m³/hr; 0.13 to 0.29 gC/m³/hr; 0.18 to 0.24 gC/m³/hr; 0.17 to 0.29 gC/m³/hr; 0.14 to 0.27 gC/m³/hr; 0.18 to 0.25 gC/m³/hr and 0.14 to 0.27 gC/m³/hr at stations I to VII respectively. While for the same season of 2014, the community respiration values from 0.13 to 0.3 gC/m³/hr; 0.17 to 0.25 gC/m³/hr; 0.14 to 0.35 gC/m³/hr; 0.13 to 0.29 gC/m³/hr; 0.18 to 0.32 gC/m³/hr; 0.18 to 0.35 gC/m³/hr and 0.18 to 0.32 gC/m³/hr at stations I, II, III, IV, V, VI and VII respectively.

Table No. 1: Seasonal variation of Gross Primary Productivity (gC/m³/hr) in Kumshi Reservoir

Months	Stations							Average
	S1	S2	S3	S4	S5	S6	S7	
Oct.2012	0.69	0.68	0.69	0.63	0.89	0.78	0.67	0.72
Nov.	0.73	0.77	0.73	0.78	0.75	0.77	0.82	0.77
Dec.	0.59	0.68	0.68	0.68	0.68	0.68	0.70	0.67
Jan.2013	0.84	0.75	0.77	0.83	0.82	0.77	0.63	0.78
Feb.	0.74	0.79	0.82	0.84	0.85	0.82	1.0	0.84
March	0.98	1.07	1.0	1.05	1.10	1.08	1.28	1.08
April	0.88	0.9	0.92	0.89	0.89	0.92	1.0	0.92
May	1.03	1.04	1.12	1.14	1.2	1.15	1.27	1.14
June	0.58	0.57	0.6	0.54	0.57	0.6	0.59	0.58
July	0.63	0.59	0.59	0.57	0.67	0.64	0.73	0.64
August	0.39	0.49	0.6	0.5	0.67	0.67	0.47	0.55
Sept.	0.45	0.4	0.4	0.43	0.52	0.5	0.49	0.46
Oct.	0.82	0.83	0.8	0.78	0.8	0.69	0.73	0.78
Nov.	0.83	0.88	0.78	1.0	1.10	0.9	0.97	0.93
Dec.	0.54	0.55	0.53	0.6	0.57	0.33	0.48	0.52
Jan.2014	0.68	0.73	0.73	0.7	0.64	0.67	0.58	0.68
Feb.	1.0	1.02	1.09	1.19	1.18	1.14	1.28	1.13
March	1.02	1.09	1.07	1.13	1.14	1.19	1.24	1.13
April	0.94	1.0	1.02	0.99	0.9	1.14	1.03	1.01
May	1.02	1.13	1.13	1.12	1.18	1.2	1.22	1.15
June	0.8	0.43	0.6	0.5	0.67	0.7	0.72	0.64
July	0.52	0.55	0.55	0.62	0.78	0.75	0.83	0.66
August	0.57	0.58	0.62	0.62	0.63	0.59	0.58	0.60
Sept.	0.43	0.5	0.47	0.38	0.47	0.47	0.5	0.46

Table No. 2: Seasonal variation of Net Primary Productivity ($\text{gC/m}^3/\text{hr}$) in Kumshi Reservoir

Months	Stations							Average
	S1	S2	S3	S4	S5	S6	S7	
Oct.2012	0.40	0.35	0.33	0.4	0.45	0.27	0.33	0.37
Nov.	0.35	0.3	0.33	0.34	0.38	0.4	0.42	0.36
Dec.	0.3	0.39	0.37	0.38	0.38	0.38	0.38	0.37
Jan.2013	0.45	0.38	0.35	0.47	0.45	0.43	0.3	0.41
Feb.	0.29	0.35	0.38	0.38	0.38	0.38	0.45	0.38
March	0.5	0.55	0.5	0.5	0.55	0.5	0.5	0.52
April	0.33	0.33	0.33	0.39	0.38	0.38	0.4	0.37
May	0.52	0.52	0.69	0.64	0.65	0.64	0.75	0.63
June	0.3	0.28	0.37	0.25	0.3	0.35	0.3	0.31
July	0.43	0.39	0.39	0.38	0.42	0.39	0.45	0.41
August	0.2	0.75	0.38	0.34	0.47	0.48	0.27	0.42
Sept.	0.3	0.28	0.23	0.25	0.38	0.33	0.35	0.31
Oct.	0.5	0.45	0.5	0.48	0.47	0.33	0.35	0.44
Nov.	0.38	0.5	0.4	0.59	0.57	0.55	0.62	0.52
Dec.	0.24	0.29	0.27	0.3	0.28	0.02	0.22	0.24
Jan.2014	0.25	0.34	0.3	0.34	0.3	0.34	0.25	0.31
Feb.	0.5	0.5	0.54	0.63	0.7	0.73	0.67	0.61
March	0.49	0.52	0.53	0.63	0.57	0.65	0.67	0.58
April	0.43	0.47	0.55	0.49	0.38	0.63	0.53	0.50
May	0.5	0.6	0.63	0.63	0.74	0.65	0.64	0.63
June	0.5	0.25	0.25	0.22	0.35	0.35	0.4	0.34
July	0.28	0.39	0.38	0.4	0.49	0.5	0.55	0.43
August	0.38	0.37	0.45	0.43	0.43	0.39	0.38	0.41
Sept.	0.3	0.33	0.33	0.25	0.28	0.27	0.33	0.30

Table No. 3: Seasonal variation of Community Respiration ($\text{gC/m}^3/\text{hr}$) in Kumshi Reservoir

Months	Stations							Average
	S1	S2	S3	S4	S5	S6	S7	
Oct.2012	0.29	0.33	0.38	0.28	0.44	0.52	0.34	0.37
Nov.	0.38	0.47	0.35	0.44	0.38	0.37	0.4	0.40
Dec.	0.29	0.29	0.32	0.3	0.3	0.3	0.33	0.31
Jan.2013	0.39	0.38	0.42	0.37	0.37	0.34	0.33	0.38
Feb.	0.45	0.44	0.44	0.47	0.48	0.44	0.55	0.47
March	0.48	0.52	0.5	0.55	0.55	0.57	0.68	0.55
April	0.53	0.57	0.59	0.53	0.5	0.53	0.55	0.55
May	0.52	0.53	0.43	0.5	0.55	0.52	0.52	0.51
June	0.28	0.29	0.24	0.29	0.27	0.25	0.29	0.28
July	0.2	0.2	0.2	0.19	0.25	0.25	0.28	0.23

August	0.19	0.24	0.2	0.17	0.2	0.19	0.2	0.2
Sept.	0.15	0.13	0.18	0.18	0.14	0.18	0.14	0.16
Oct.	0.32	0.38	0.3	0.3	0.34	0.37	0.38	0.35
Nov.	0.45	0.38	0.38	0.42	0.54	0.35	0.35	0.41
Dec.	0.3	0.27	0.27	0.3	0.29	0.32	0.27	0.29
Jan.2014	0.43	0.39	0.43	0.37	0.34	0.33	0.33	0.38
Feb.	0.5	0.52	0.55	0.57	0.53	0.42	0.62	0.53
March	0.53	0.58	0.54	0.5	0.58	0.54	0.58	0.54
April	0.52	0.54	0.47	0.5	0.5	0.52	0.5	0.52
May	0.52	0.53	0.5	0.49	0.44	0.55	0.58	0.52
June	0.3	0.25	0.35	0.29	0.32	0.35	0.32	0.32
July	0.24	0.17	0.19	0.2	0.18	0.25	0.28	0.22
August	0.19	0.18	0.17	0.19	0.2	0.2	0.2	0.19
Sept.	0.13	0.18	0.14	0.13	0.19	0.18	0.18	0.17

5. DISCUSSION

The present investigations are grass primary productivity, net primary productivity, and community respiration in the Kumshi reservoir for a period of two years i.e., October 2012 to September 2014 were aimed at understanding the productivity potential of the water body.

Grass primary productivity of Kumshi reservoir followed trimodel oscillation in all seven stations and exhibited an increasing trend through the northeast monsoon season towards summer season with distinct peaks during 2012 to 2013 and 2013 to 2014 (Table No. 1).

High primary productivity in the present during summer season and northeast monsoon season is mainly depending on the light penetration has also observed [9]. In the present study low productivity was noticed during southwest monsoon season because of the influx of the turbid water to the reservoir. In the present study the grass primary productivity showed significant correlation with water temperature ($p < 0.01$), pH ($p < 0.01$), dissolved oxygen ($p < 0.01$), total alkalinity ($p < 0.01$), chloride ($p < 0.01$), net primary productivity ($p < 0.01$), community respiration ($p < 0.01$), rotifera ($p < 0.05$), copepoda ($p < 0.01$), Cladocera ($p < 0.01$) respectively.

Net primary productivity of Kumshi reservoir is followed a more or less similar trend of fluctuations in all seven stations, exhibited an increasing trend towards northeast monsoon season and summer season with a distinct peaks while lower values of net primary productivity was observed during southwest monsoon season (Table No. 2).

The present significant correlation ship for net primary productivity observed with water temperature ($p < 0.01$), pH ($p < 0.01$), dissolved oxygen ($p < 0.01$), total alkalinity ($p < 0.01$), chloride ($p < 0.01$), net primary productivity ($p < 0.01$), and community respiration ($p < 0.01$), rotifera ($p < 0.05$), copepoda ($p < 0.01$), Ostracoda ($p < 0.01$) respectively.

Community respiration of Kumshi reservoir also followed a similar trend of oscillation in all seven stations recording lower values during southwest monsoon season of 2013 and 2014 and exhibited an increasing trend towards summer and northeast monsoon season (Table No.3).

In the present investigation community respiration showed the correlation with water temperature ($p < 0.01$), pH ($p < 0.01$), dissolved oxygen ($p < 0.01$), total alkalinity ($p < 0.01$), chloride ($p < 0.01$), gross primary productivity ($p < 0.01$), rotifera ($p < 0.01$), copepoda ($p < 0.01$), and Ostracoda ($p < 0.01$).

There are quite number of reports on primary production of standing water bodies of India to mention few, Sreenivasan (1963) reported on the primary production in three reservoir from Nilgiris and Ooty in Tamil Nadu recorded high production values and opined that primary

production correlated well with physico-chemical factors and biological parameters, even though pertaining to waters of comparatively large dimensions, such a correlation could also be observed in the present study. [11], states the water temperature is important for limiting productivity. However, [5] did not find any direct effect of temperature on productivity of ecosystem. [1] recorded high grass primary production from the tank in Dakshin Kannada and they are of the view that the higher rates during much and July coincide with the low pH, high carbon dioxide, low alkalinity and high electrical conductivity. In the present investigation such relationship is noticed. Das (2002) while reporting on primary productivity in three ponds from Andhra Pradesh observed moderate values of grass primary productivity and that low production in one of the pond could be due to excess of aquatic weeds. During the present study provide excessive growth of aquatic vegetation are encountered specially during northeast monsoon season and summer season which could have caused increased trend in primary productivity during summer months [13, 2] also observed the high primary productivity status yields the high fish productivity in the reservoir [3,4,6,11]

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