

## Studies on primary productivity with special Reference to their physico-chemical status of Govindgarh Lake Rewa (M.P.), India



### Zoology

**KEYWORDS :** Govindgarh Lake, GPP, NPP, Community respiration and Physico-chemical Factors

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### ABSTRACT

*The present investigation has been carried out in Govindgarh Lake located in Rewa district, Madhya Pradesh. Primary productivity and physico-chemical parameters were estimated from July 2011 to June 2012. Gross primary production values ranged between 450 to 3950 mg C/m<sup>3</sup>/d, Net primary production ranged between 275 to 3200 mg C/m<sup>3</sup>/d, and Community respiration ranged from 100 to 1000 mg C/m<sup>3</sup>/d. GPP, NPP and CR was higher in summer season due to favourable water temperature leading towards higher photosynthetic activity as well as metabolic rate. The primary productivity was influenced by various physico-chemical factors.*

### Introduction-

Primary production is the most important biological phenomenon in nature on which the entire diverse array of life depends, either directly or indirectly. Primary productivity can be defined as the weight of new organic matter created through carbon assimilation by plants or the energy it represents. Primary productivity is the rate at which the sun's radiant energy is stored by photosynthetic and chemosynthetic activities of producers (Phytoplankton, algae and macrophytes in water) in the form of organic substances (Odum, 1971). Productivity is defined as the rate at which inorganic carbon is converted into on organic form (APHA, 1985). This aspect of primary production and limno-chemistry of tropical Indian reservoirs have been well documented (Kannan and Jobs, 1980; Unni and Patil, 1995 and Ramakrishniah and Das, 1998 etc). Several workers have been studied lentic ecosystem in India with reference to physico-chemical status and primary productivity. Singh and Sharma (2012) research on Ecological Productivity studies of the Macrophytes in Kharungpat Lake, Manipur Northeast India. Mohapatra and Patra (2012) studies on primary productivity of Bay of Bengal at Puri Sea-Shore in Orissa. No study has been carried out with reference to primary productivity on this lake. In the present investigation an attempt has been made to study physico-chemical parameters and primary productivity of Govindgarh Lake. This study may help in optimum utilization and sustainable management of this Lake.

### Material and Method-

The study was carried out for a period from July 2011 to June 2012 at monthly intervals. For the purpose of the present investigation, the lake was marked into four stations. Water sample were collected from a selected station during morning time (7 to 9 am), in the first week of every month. The analysis of physico-chemical characteristics of water were done as per standard methods given by APHA (1985), Trivedi and Goel (1987), and Adoni (1985). Temperature, pH and conductivity were noted us-

ing Water analyser kit on the spot. Transparency was measured by secchi disc. The phytoplankton primary productivity was estimated using light and dark bottle method of Gaarder and Gran (1917).

### Result and Discussion-

The results of the present study have been presented in Table 1 and 2. The gross primary production ranged from 450 to 3950 mg C/m<sup>3</sup>/d. Three peaks were observed for GPP and NPP in July 2011, October 2011 and March 2012. The Net primary production ranged from 275 to 3200 mg C/m<sup>3</sup>/d. the lower value of GPP and NPP were recorded in November 2011. GPP and NPP gradually increased from November 2011 to March 2012 and decline after April 2012 to June 2012. As far as the seasonal variation in primary productivity is concerned, it was found that winter was least productive and summer was most productive season of the year. (Table 1). The community respiration ranged from 100 to 1000 mg C/m<sup>3</sup>/d. The minimum seasonal values of community respiration were recorded during winter and maximum in the rainy season. Highest value of productivity found in March during summer season (Fig 1, 2, 3 & 4).

Several workers reported that primary productivity in temperate water is typically bimodal (Nassar and Dutta Munshi, 1975 etc). Hanifa and Pandian (1978) reported a higher production rate during summer than during winter in several tropical fresh water ponds. The situation in Govindgarh Lake is typical of the tropical water as the summer values was more only 2-3 times higher as compared to winter values. Shukla and Pawar (2001); Sultan *et al.*, (2003); Koli and Ranga, (2011) also found same result. Probably, during summer the Temperature raised, which enhance the release of nutrients from sediment through bacterial decomposition. Sultan *et al.*, (2003) reported that temperature, solar radiation and available nutrients may be important limiting factors for primary production and contributing to seasonal variation in any aquatic ecosystem.

Table 1. Monthly Variation in primary Productivity (mg C/m<sup>3</sup>/day) of four stations at Govindgarh Lake during July 2011 to June 2012

Months	Station A			Station B			Station C			Station D		
	GPP (mg C/m <sup>3</sup> /d)	NPP (mg C/m <sup>3</sup> /d)	CR (mg C/m <sup>3</sup> /d)	GPP (mg C/m <sup>3</sup> /d)	NPP (mg C/m <sup>3</sup> /d)	CR (mg C/m <sup>3</sup> /d)	GPP (mg C/m <sup>3</sup> /d)	NPP (mg C/m <sup>3</sup> /d)	CR (mg C/m <sup>3</sup> /d)	GPP (mg C/m <sup>3</sup> /d)	NPP (mg C/m <sup>3</sup> /d)	CR (mg C/m <sup>3</sup> /d)
July	3400	2600	800	3160	2300	860	3321	2550	771	3500	2550	1000
Aug.	1300	900	400	1150	875	275	1350	950	400	1200	950	300
Sept.	1160	950	210	1050	900	150	1200	1050	150	1350	1050	225
Oct.	2900	1900	1000	2450	1725	725	2640	1800	840	2700	1800	850
Nov.	650	480	170	450	275	175	700	450	250	750	450	250
Dec.	950	725	225	750	525	225	1000	800	200	1100	800	125
Jan.	850	625	225	800	600	200	800	675	125	950	675	200

Feb.	1300	1100	200	800	650	150	1250	1050	200	1300	1050	175
Mar.	3950	3150	800	3250	2900	350	3550	3200	350	3600	3200	625
Apr.	1900	1550	350	1600	1500	100	1750	1475	275	2000	1475	375
May	1800	1550	250	1700	1475	225	1900	1600	300	1750	1600	200
Jun.	1800	1500	300	1550	1325	225	1700	1475	225	1900	1475	250
Seasonal Variation												
Rainy	2190	1587.5	602.5	1952.5	1450	502.5	2127.75	1587.5	540.25	2187.5	1593.75	593.75
Winter	937.5	732.5	205	700	512.5	187.5	937.5	743.75	193.75	1025	837.5	187.5
Summer	2362.5	1937.5	425	2025	1800	225	2225	1937.5	287.5	2312.5	1950	362.5

Table 2. Mean value of Physico-chemical features of the lake during July 2011 to June 2012

Months	Parameters												
	Air temp	Water temp	Transparency	Conductivity	pH	Free CO <sub>2</sub>	DO	Total Alkalinity	Chloride	Ca hardness	Mg <sup>++</sup>	Total hardness	TDS
July	28.25	29	21.02	195.94	8.09	2.5	6.13	91.25	24.23	96.63	7.58	125.88	87.75
Aug.	28.5	28	16.92	197.5	8.06	4.5	8.03	88.73	29.14	68.89	6.22	111.32	92.06
Sept.	29.25	29	35.27	120.74	8.23	3.5	7.45	104.13	32.22	48.82	8.51	87.29	58.83
Oct.	28	28.5	71.09	176.35	8.26	2	6.18	115.84	33.12	85.21	8.58	102.26	75.14
Nov.	25.5	27	88.23	227.71	7.88	3.5	7.03	127.91	37.53	85.05	7.39	115.94	92.47
Dec.	22.75	20	92.57	260.3	8.47	4.5	9.65	145.23	31.37	118.76	6.58	130.42	96.96
Jan.	15.63	17	65.85	276.14	8.25	5	8.5	131.33	35.31	183.68	4.95	201.42	92.56
Feb.	22.38	23.62	50.55	285.77	8.09	3	8.98	126.81	35.39	146.31	8.33	175.83	95.76
Mar.	23.25	23.37	32.57	376.82	8.01	5.5	8.58	132.14	50.86	120.75	8.93	157.83	126.18
Apr.	26.63	22.17	25.57	378.77	8.5	3.5	8.58	115.72	45.59	182.53	10.82	191.13	124.08
May	27.63	28.5	33.09	391.11	8.39	3.5	6.79	144.55	42.24	176.76	16.8	192.83	124.11
Jun.	33.87	33.12	36.07	336	8.27	1	6.95	156.37	52.69	128.62	14.3	177.88	121.81
Seasonal Variation													
Rainy	28.5	28.62	36.45	172.63	8.16	3.12	6.94	99.98	29.67	74.88	7.72	106.68	78.44
Winter	21.57	21.9	74.3	262.48	8.17	4	8.54	132.82	34.9	133.45	6.81	155.9	94.43
Summer	27.84	26.79	31.83	370.68	8.29	3.37	7.72	137.95	47.84	152.16	12.7	179.91	124.04

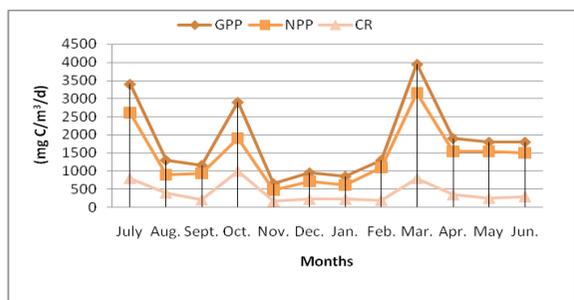


Fig. 1 Monthly Variation in primary Productivity (Station A)

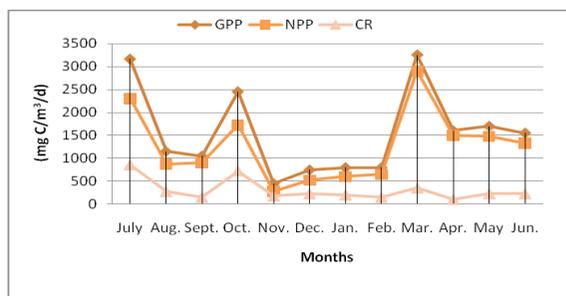


Fig. 2 Monthly Variation in primary Productivity (Station B)

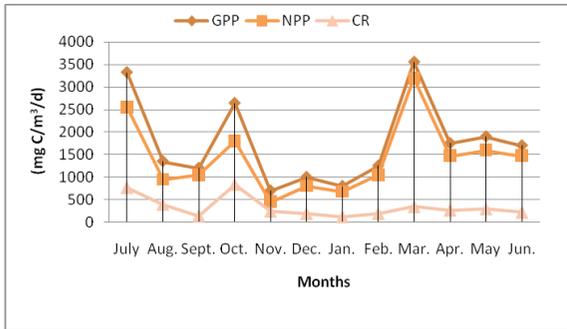


Fig. 3 Monthly Variation in primary Productivity (Station C)

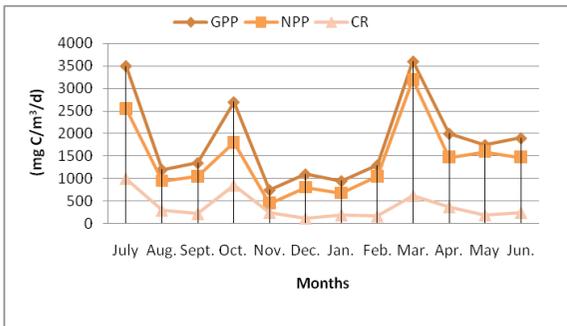


Fig. 4 Monthly Variation in primary Productivity (Station D)

The nature of water remained alkaline throughout the study period. The pH ranged from 7.88 to 8.5. pH value is very important for plankton growth (Chisty, 2002). According to Umavathi *et al.*, (2007), pH ranged of 5 to 8.5 is best for plankton growth but harmful when more than 8.8. Dissolved oxygen is regarded as one of the best indicator to assess the health of a water body (Edmondson, 1961). It varied from 6.13 to 9.65 mg/l. according to Banerjee (1967) and Tarzwell (1957) the lake is productive for fish culture when DO concentration was above 5 mg/l throughout the year.

High temperature also decreases oxygen holding capacity of water and low temperature in winter contributed rise in DO. The concentration of free carbon dioxide recorded in the reservoir water ranged between 1 to 5.5 mg/l. Total alkalinity ranged between 88.73 to 156.37 mg/l. Natural water containing 40 mg/l or more of total alkalinity is considered as more productive (Moyle 1946). Minimum content was noted during monsoon presumably due to dilution.

Chloride occurs naturally in all types of water due to its high solubility, and is one of the major inorganic anion in water and waste water. Its concentrations in freshwater is generally taken as an indicator of sewage pollution (Wetzel, 1966; Trivedi and Goel, 1986 etc). Chloride found to be high during the summer season, whereas it was low during the monsoon season. This may be assigned to the continuous evaporation of water during summer and pre monsoon season. The hardness of water is mainly due to the calcium and magnesium salts present in the water. Total hardness ranged from 87.29 to 201.42 mg/l. and values were higher during summer. These high values may be due to the addition of calcium and magnesium salts from detergents, which were used for bathing and washing by the local people. The increase in hardness can be attributed to the decrease in the rate of evaporation at high temperature (Kaur *et al.*, 1996). Seasonal values of calcium hardness were lowest during rainy season in Govindgarh Lake. During the course of investigation it was observed that the magnesium content of water was minimum in winter season while its maximum value during summer season. Magnesium is absolutely essential for chlorophyll bearing algae and plants.

Thus it can be inferred that the present lake is more productive and the primary productivity was influenced by various physico-chemical factors. Productivity was also found to be influenced by seasonal variation and was highest in summer season, because the rate of photosynthesis was peak in summer period due to high water temperature. The result of physico-chemical parameters and tropic status of the lake indicates its eutrophic nature.

## REFERENCE

- Adoni, A.D.: Workbook of limnology, Pratibha Publishers, C-10, Sagar-470003 (M.P.), India (1985) | APHA, AWWA, WPCF: Standard Methods for the examination of water and waste water. 16th Edition American Public Health Association, Washington, D.C. (1985). | Banerjee, S.M. (1967): Water quality and soil condition of fishponds in states of India in relation to fish production. Indian Journal of Fisheries, 14 (1&2): 115-144. | Chisty, N. (2002): Studies on biodiversity of fresh water zooplankton in relation to toxicity of selected heavy metals. Ph.D. Thesis submitted to Mohanlal Sukhadia University, Udaipur, India. | Efford, I.E., 1967: Temporal and spatial differences in phytoplankton productivity in Marine Lake. British Columbia. - J. Fish. Res. Bd. Can. 24. 2283-2307. | Gaarder, T and H.H. Gran: Investigations on the production of plankton in the Oslofjord. Rapp. Cons. Explor. Mer. 144, 56-60, (1927). | Hanifa, M.A., and T.J. Pandian, 1978: Morphometry, primary productivity and energy flow in a tropical pond. Hydrobiologia 59, 23-48. | Kannan, V. and Job, S.V. 1980: Diurnal, seasonal and vertical study of primary production in Sathiar reservoir. Hydrobiologia, 70: 171-178. | Kaur, H., Dhillion, S.S., Bath, K.S. and Mander, G. (1996): Abiotic and biotic components of a fresh water pond of Patiala (Punjab). Poll. Res., 15(3): 253-256. | Koli, V.K. and Ranga M.M. 2011: Physicochemical status and Primary Productivity of Ana Sagar Lake, Ajmer (Rajasthan), India. Uni. J. Env. Res and Tech., Vol.1 Issue 3: 286-292. | Lund, L.W.G. and J.F. Talling: Botanical and Limnological methods with special reference to the algae. Bot. Rev. 23, 489-583, (1957). | Meena, S. (2001): Studies on biodiversity of fresh water zooplankton in relation to organic pollution. Ph. D. thesis, Submitted to Mohanlal Sukhadia University, Udaipur, Rajasthan, India. | Mohapatra Suchismita and Patra A.K. 2012: Studies on Primary Productivity of Bay of Bengal at Puri Sea-Shore in Orissa, IJSR Pub., Vol 2, Issue 10, ISSN 2250-3153. | Moyle, J.B. (1946): Some indices of lake productivity. Transactions of the American Fishery Society, 76: 332 - 334. | Nasar, S.A. K. and J. Dutta Munshi, 1975: Studies on primary production in a fresh water pond. Jap.J. Ecol. 25, 21-23. | Odum, E.P. (1971): Fundamental of Ecology. W.B.Sunders, Toppan Co.Ltd., Tokyo, Japan. | Ramakrishniah, M. and Das A.K. 1998: Ecology and fishreis of selected reservoir of Andhra Pradesh Bull. No. 85, CIFRI Barrackpore, West Bengal. | Ranu (2001): Studies on toxicity if textile effluents to fresh water zooplankton. Ph. D. Thesis Submitted to Mohanlal Sukhadia University, Udaipur, Rajasthan, India. | Shukla, A.N. and Pawar, S. (2001): Primary productivity of Govindgarh Lake, Rewa (M.P.) India Journal of Environment and Pollution, 8(3): 249-253. | Singh, K. Khelchandra and B. Manihar Sharma 2012: Ecological productivity studies of the Macrophytes in Kharungpat Lake, Manipur North East, India, Int. J. Geo. Erth and Environ. Sci., Vol. 2 (2), pp 58-71. | Singhal, P.K. 1980. Primary productivity of some fresh waters : with special reference to macrophytes of Sagar lake. Ph.D. thesis, Deptt. of Botany, Sagar University, Sagar. | Sreenivasan, A. 1968b. Limnology of tropical impoundments. V. Studies of two upland impoundments in Nilgiris, Madras state, India. Phycos, 7(1): 144-160. | Sultan, S., Chauhan, M. and Sharma, V.I. (2003): Physico chemical status and Primary Productivity of Pahung reservoir, Uttar Pradesh. J. Inland Fish. Soc. India, 35: 73-80. | Tarzwell, C.M. (1957): Water quality criteria for aquatic life. In: Biological problems in water pollutions. U.S. Deptt. Of Health Education and Welfare, P.H.S., 246-272. | Trivedi, R.K. and P.K. Goel, 1986. Chemical and biological methods for water pollution studies, Environmental Publications, Karad, India, 250p. | Trivedi, R.K. and P.K. Goel, 1987: Practical methods in ecology and environmental science. Environmental Publication, Karad, India. | Umavathi, S., Longankumar, K. and Subhashini (2007): Studies on the nutrient content of Sulur pond in Coimbatore, Tamil Nadu. J. Ecol. Env. & Cons. 13(5): 501-504. | Unni, K.S. and Patil, M.K. 1995: Thermal stratification, eutrophication and primary production in a central Indian reservoir. pp 291-229. In Timotius, K. H. and Gotteboth, F. (ed), Tropical Limnology. | Wetzel, R.G. 1966. Variations in productivity of Goose and hypereutrophic Sylvan Lakes, Indiana. Invest. Indiana Lakes & Streams, VII: 147-184.