Journal of Life Sciences

(A Quarterly, Refereed, & Peer Reviewed Journal of Life Sciences)
Published by: AASTEMER, Mumbai, (MS) India
Journal homepage: https://jls.aastemer.org/
ISSN (Online): xxxx-xxxx
Volume 1, Issue 1, December 2025; Pages 33 – 37
DOI: 10.5281/zenodo.17459256

Seasonal Variation of Productivity of Lonar Meteoritic Lake (Maharashtra) India

Pedge Sudarshan Sambhajirao

Department of Zoology, Kai. Rasika Mahavidyalaya, Deoni Dist. Latur 413519 Maharashtra, India

Article history:
Received 07 August 2025
Received in revised form
03 October 2025
Accepted 10 October 2025
Available online 17 October 2025

Corresponding author Email:
sspedge@krmd.ac.in

Abstract

The quantity of energy available to sustain the biological activity of aquatic habitats is correlated with primary productivity. The goal of the current study is to evaluate Lonar Lake's productivity level. As recommended by APHA (1991) and Trivedy and Goel (1987), it was ascertained using monthly Light and Dark bottle tests with the ^{14}C method, carried out during study period (April 2009 to March 2010). Between January and June, productivity rose, but between July and December, it fell once more. The months of May and June had the greatest productivity figures.

Keywords: Lonar, Meteorie, Lake, Meteoritic Lake, Maharashtra, India.

Introduction

The rate at which producers (phytoplankton, algae, and microphytes in water) are store solar radiation through photosynthetic and chemosynthetic processes in the form of organic materials is known as primary productivity. Odum (1971). Any aquatic body's physicochemical state and potential for fishery resources are directly correlated with its biological production. Studies of primary production are crucial for comprehending how pollution affects the effectiveness of systems. When physicochemical conditions are favorable, elevated production levels occur in the both natural and cultural environments. Sultan and associates (2003).

The net primary productivity of phytoplankton may represent account for 50% of the total biosphere (Behrenfeld et al., 2006), acting as the base energy transfer in the food web of environments. Recent research on phytoplankton primary productivity has focused on tropical, subtropical, and temperate water bodies. Earlier research indicates the main primary productivity of phytoplankton is affected by inorganic turbidity, the joint effect of heavy metals and nutrients, along with the location and depth of the monitoring site (Schagerl and Oduor, 2003; Jia et al., 2020; Westernhagen et al., 2010). Nonetheless, there are quite limited investigations regarding the primary productivity of phytoplankton in cold and dry areas. Its prevalence among various species and ecosystems has intrigued successive generations of biologists and sparked numerous efforts to offer a universal clarification, frequently necessitating novel perspectives on biological systems (López-Urrutia et al., 2006). Recent findings suggest that this metabolic principle influencing individual organisms is also rapplicable to overall ecosystem traits, such as predator–prey ratios (Hatton et al., 2015) and productivity in esturies (Nidzieko, 2018), implying a wider relevance and that ecosystems in certain respects, self regulate to operate as super organisms.

Materials and Methods

The samples were gathered each month from the chosen 3 locations between from April- 2009 and March 2011. The productivity of the lake was assessed using the Light and Dark bottle experiments along with 14C method proposed by APHA (1991), Trivedy and Goel (1887), Walker, (1975), Nair, (1970). In this method, the sample was enclosed in a bottle and suspended at under water for 5-6 hrs. After that the dissolved oxygen concentration was estimated from the bottles by Wrinklers method and observations were recorded. It was expected that the oxygen concentration would be increased in the light bottle due to photosynthesis, while it would be decline in the dark bottle due to the consumption of oxygen. Other process, oxygen consumption like photorespiration were absent, then difference in oxygen content of the light and initial bottle was Net photosynthesis or productivity. The initial bottle and the dark bottle differed in total photosynthesis or total Primary Productivity.

GPP, NPP, and community respiration were the main metrics of productivity measures. Productivity was assessed based on the assumption that one atom is absorbed for each molecule of oxygen (32g) emitted for each molecule of carbon (12g) captured (APHA, 1991). The duration of the experiment was six hours, ranging from 9:00 am to 3:30 pm. The factor 0.375 (12/32) was utilized hourly to change the DO values to g C/m3/h. The productivity values per day were then calculated by multiplying the hourly values by 12 (Nair, 1970).

Result and Discussion

Venugopalan, (1969) studied on the main production of the estuarine and nearshore waters of Porto Novo and reported that productivity rates of 35.5 and 45.99 mg C/m3/hr. Krishnamurthy et al., (1973) have studied the environmental features of the estuarine system and observed that the average gross production rate of the Pichavaram has been 7.56 g C/m3/day with a net average rate of 6.29 g C/m3/day. Walker (1975) studied on seasonal phytoplankton patterns in saline lakes of central Washington and observed that the 1,622 mg cm-2 day-1 with minimal 650 on October and maximal 2919 on September this estimate was sufficiently reliable to show that Soap Lake is highly productive. Mohamed, et al., (1976) studied on primary productivity of lake Manzalah, Egypt using C14 technique and observed the mean productivity 182.5 mg C/m3/h, with standard deviation ± 98.70 indicating this lake is a highly productive lake. Nair, et al., (1983) studied on main productivity in tropical wetlands of the southern coast of India and reveled that annual average net production has been 84.28 mg C/m3/hr and gross production 152.33 mg C/m3/hr and also stated that the backwater has proven to be the most fruitful during the monsoon season and least productive in the post- monsoon season. Usha, et.al., (2006) have studied on freshwater lakes- a potential source of aquaculture activities of Perumal Lake, Cuddalore, Tamilnadu and observed that the net productivity (NP) values ranged from 140 to 10225 mg/O2/m2/day and gross productivity values ranged from 1100 to 12440. Meera and Nandan, (2010) has worked on primary productivity of Valanthkad Backwater in Kerala and observed that the maximum gross production was observed 3 g C/m3/day during November. Koli and Ranga, (2011) studied the primary productivity of Ana Sagar Lake, Ajmer (RJ), India and reveled that Community respiration varied between 0.26 and 3.6 g C/m2/day, while NPP varied from 0.72 to 4.99 g C/m2/day, GPP values varied between 1.93 and 6.24 g C/m2/day. This study examined GPP, NPP, and Community respiration. The Gross Primary Productivity (GPP) varies between 0.684 and 2.110 g C/m3/day at station A. The Gross Primary Productivity values are presented in Table 01 and depicted in Fig. 01. The Net Primary Productivity (NPP) varies between 0.272 and 1.950 g C/m3/day at station-A. The Net Primary Productivity values are presented in Table 01 and shown in Fig. 01. The Community Respiration (CR) varies from 0.160 to 0.618 g C/m3/day at station-A. The Community Respiration values are presented in Table 01 and depicted in Fig. 1. Productivity rose from January to June but then declines again by December.

Table 1: Monthly Variation of GPP, NPP and CR g C/m2/day

Months	GPP (g C/m2/day)	NPP (g C/m2/day)	CR (g C/m2/day)
April	1.623	1.296	0.321
May	2.110	1.950	0.160
June	1.462	1.053	0.404
July	0.825	0.548	0.272
August	0.825	0.412	0.412
September	**0.684**	0.272	0.412
October	0.825	0.548	0.272
November	0.754	0.478	0.272
December	0.961	0.342	0.618
January	0.754	0.272	0.478
February	1.296	0.809	0.487
March	1.623	1.379	0.243
Mean	1.145	0.779	0.362

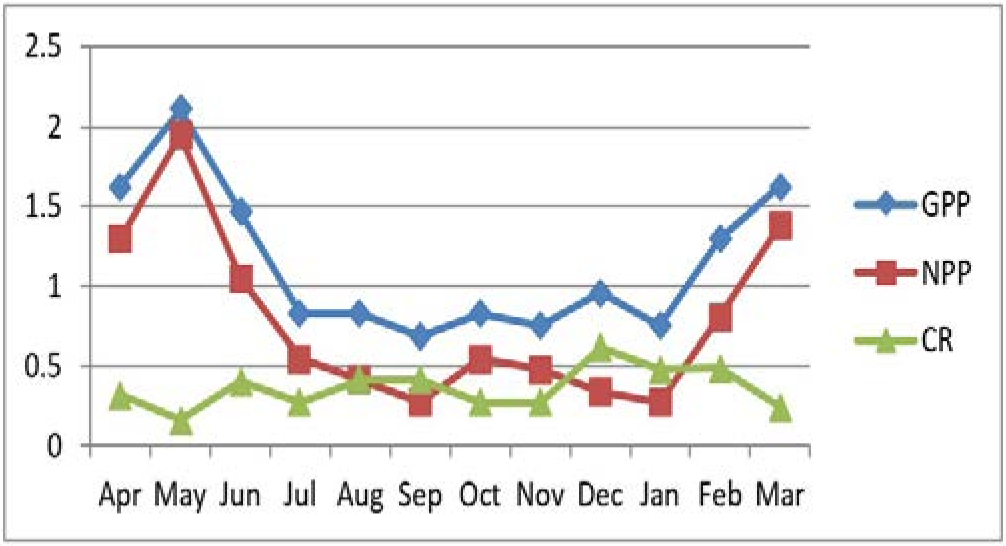
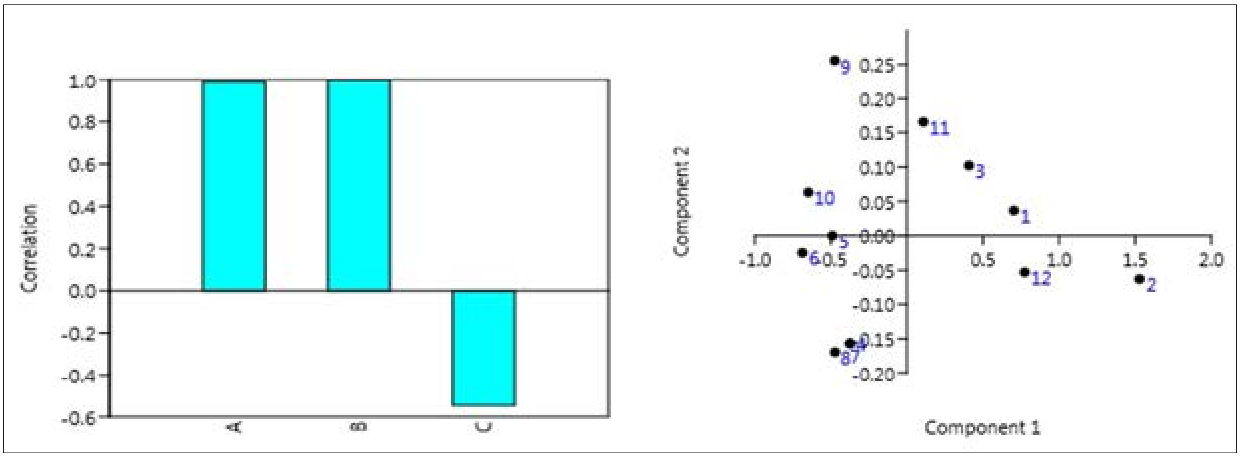


Fig. 1: Monthly Variation of Gross Primary Productivity (GPP) g C/m2/day

Table No. 2: Principal Component Analysis GPP, NPP and CR g C/m2/day

	PC 1	PC 2	PC 3
1	0.7036	0.036639	-0.0022001
2	1.5287	-0.062943	0.00139
3	0.4077	0.10224	-0.0017621
4	-0.37402	-0.15685	-0.00076777
5	-0.49021	-3.0664E-05	0.0010739
6	-0.68737	-0.024703	0.0017739
7	-0.37402	-0.15685	-0.00076777
8	-0.47293	-0.16943	-0.00012827
9	-0.47471	0.25608	0.00026334
10	-0.64832	0.063184	-0.00082137
11	0.10779	0.1657	0.00099293
12	0.77377	-0.053024	0.00095325



A: Loadings Plot **B: Scatter Plot**

Fig. 2. Principal Component Analysis Plot

References

1. Odum, E.P., (1971). Fundamental of ecology. W.B. Sunders, Toppan Co. Ltd., Tokyo, Japan.
2. Sultan, S., Chauhan, M. and Sharma, V.I., (2003). Physicochemical status and primary productivity of Pahunj reservoir, Uttar Pradesh. J. Inland Fish. Soc. India, 35, 73- 80.
3. APHA., (1991). Standard Methods for the examination of water and waste waters. 15th edition. APHA, AWWA and WPCF, Washington D.C.
4. Trivedy, R.K and Goel, P.K., (1987). Practical Methods in Ecology and Environmental Science. Enviro Media Publications Karad India.
5. Walker, K.F., (1975). The seasonal phytoplankton cycles of two saline lakes in central Washington. Limnology and Oceanography, Vol. 20 (1), 40-53.
6. Nair, P.V.R., (1970). Primary productivity in the Indian seas; Bull. cent. mar. Fish. Res. Inst. 22 56pp.

7. Venugopalan, V.K., (1969). Primary production in the estuarine and inshore waters of Porto Novo; Bull. Natn. Inst. Sci. India. 38, 743-746.

8. Krishnamurthy, K. and Sudarraj, V., (1973). A survey of environmental features in section of the Vellar-Coleroon estuarine system; Mar. Biol. 23, 229-237.

9. Mohamed A. Ibrahim and El-Reheim, H.A., (1976). Primary productivity of Lake Manzalah, Egypt, using C14 technique. 145-152 (online).

10. Nair, N. Balakrishnan., Dharmaraj, K., Azis, Abdul .P.K., Arunachalam, M., Kumar, Krishna. K. and Balasubramanian., (1983). Nature of primary production in tropical backwater of the southwest coast of India. Proc. Indian Natn. Sci. Acad. B49 No 6, 581-597.

11. Usha, R., Ramalingam, K. and Rajan Bharathi, U.D., (2006). Freshwater lakes- a potential source of aquaculture activities of Perumal Lake, Cuddalore, Tamilnadu. Journal of Environmental Biology 27 (4), 713-722.

12. Meera, S and Nandan Bijoy, S., (2010). Water quality status and Primary Productivity of Valanthkad Backwater in Kerala. Indian Journal of Marine Sciences Col. 39 (1), 105-113.

13. Koli. Vijay Kumar and Ranga, Madhur Mohan., (2011). Physicochemical status and primary productivity of Ana Sagar Lake, Ajmer (Rajasthan), India. Universal journal of Environmental Research and Technology. Vol. 1 (3), 286-292.

14. M.J. Behrenfeld, R.T. O'Malley, D.A. Siegel, C.R. McClain, J.L. Sarmiento, G.C. Feldman, A.J. Milligan, P.G. Falkowski, R.M. Letelier, E.S. Boss., (2006). Climate-driven trends in contemporary ocean productivity. Nature, 444 (7120), pp. 752-755.

15. M. Schagerl, S.O. Oduor., (2003). On the limnology of Lake Baringo (Kenya): II. Pelagic primary production and algal composition of Lake Baringo, Kenya drobiologia, 506 (1–3), pp. 297-303.

16. J. Jia, Y. Gao, Y. Lu, K. Shi, Z. Li, S. Wang., (2020). Trace metal effects on gross primary productivity and its associative environmental risk assessment in a subtropical lake, China. Environ. Pollut., 259, Article 113848.

17. N. Westernhagen, D.P. Hamilton, C.A. Pilditch., (2010). Temporal and spatial variations in phytoplankton productivity in surface waters of a warm-temperate, monomictic lake in New Zealand. Hydrobiologia, 652 (1), pp. 57-70.

18. Lopez-Urrutia, A., San Martin, E., Harris, R. P., and Irigoien, X., (2006). Scaling the Metabolic balance of the oceans. Proc. Natl. Acad. Sci. 103, 8739-8744. doi:10.1073/pnas.0601137103.

19. Hatton, I. A., McCann, K. S., Fryxell, J. M., Davies, T. J., Smerlak, M., Sinclair, A. R., et al. (2015). The predator-prey power law: Biomass scaling across terrestrial and aquatic biomes. Science 349, aac6284. doi:10.1126/science.aac6284.

20. Nidzieko, N. J. (2018). Allometric scaling of estuarine ecosystem metabolism. Proc. Natl. Acad. Sci. 115, 6733–6738. doi:10.1073/pnas.1719963115.