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Primary Productivity with Reference to Major Carps Productivity in Govindgarh Lake, Rewa (M.P.)

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Abstract: *To study the history of primary productivity in a lake ecosystem, it is crucial to consult scientific literature, research articles, and long-term monitoring data specific to the lake of interest. Additionally, consulting with environmental experts or local agencies involved in lake management can provide valuable insights into the historical trends and current state of primary productivity in the ecosystem.*
Standard deviation of primary productivity parameters gross primary productivity, net primary productivity and respiration value calculated on the basis of monthly variation were 1.19, 0.72 and 0.60 per unit area in the first year. While 1.17, 0.70, 1.61 per unit area respectively during the second year of study period.

Keywords: Gross primary productivity, net primary productivity, respiration value etc.

I. INTRODUCTION

Physico-chemical and biological properties of water make it an extraordinary substance essential for life's existence. Understanding these properties allows us to appreciate the significance of water in various aspects, from sustaining ecosystems to supporting biological functions. Its versatile nature continues to fascinate scientists and underscores the critical importance of water conservation and responsible usage for the preservation of life on our planet.

The primary productivity of a lake ecosystem refers to the rate at which plants and algae produce organic matter through photosynthesis. This process forms the basis of the food web and influences the overall health and dynamics of the ecosystem, the rate at which energy is captured and stored by autotrophic organisms, such as algae and plants, through photosynthesis. It is a vital process as it forms the base of the food chain, supporting the entire aquatic community, including fish.

To understand the history of primary productivity in a lake ecosystem, scientists usually conduct long-term studies to gather data on factors such as nutrient availability, water quality, temperature variations, and species composition. By analysing this information, they can make observations about historical trends and patterns.

Here are a few key points to consider when studying the history of primary productivity in a lake ecosystem:

1. Nutrient Levels: Nutrients like nitrogen and phosphorus play a crucial role in supporting primary productivity. Over time, the accumulation or depletion of these nutrients can affect the productivity levels in the lake. Human activities such as agriculture, urbanization, or industrial runoff can significantly impact nutrient levels in the water, leading to changes in primary productivity.
2. Climate Variability: Climate conditions, including temperature and precipitation patterns, can influence primary productivity. Changes in climate, both natural and human-induced, can have consequences on the overall productivity of the lake ecosystem. For example, warmer temperatures may stimulate increased algal growth, while extreme weather events like droughts or floods can disrupt the balance of the ecosystem.
3. Species Interactions: The composition and interactions among species within the lake ecosystem also influence primary productivity. Herbivores, such as zooplankton or herbivorous fish, can control algal populations and ultimately affect productivity levels. Additionally, the presence of top predators can impact the distribution and behaviour of other species, creating cascading effects on primary productivity.

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4. Human Influences: Human activities, such as pollution, eutrophication (excessive nutrient enrichment), habitat destruction, or introduction of non-native species, can have significant impacts on the primary productivity of a lake ecosystem. Understanding the history of human influences is essential in assessing the long-term changes and potential risks to the ecosystem's productivity.

II. MATERIALS AND METHODS

The Govindgarh lake is one of the unique water body in M.P. and located in south of Rewa district at a distance of 20 km. with a longitude 81°15'0" and latitude 24°20'25". It comes under the Rewa district and in Huzur tehsil. The lake is connected with Rewa-Shahdol and Satna-Sidhi Road. The lake was formed by impounding of small nalla originating from Kaimore hill. With a view to storing rain water, the Maharaja of Rewa at that time built a bandh across the nalla to form a tank in 1958.

Various species of fishes were bred in this lake and feed of gram and small pills of wheat flour was given to them twice a day from the budget sanctioned by Rewa head office. Fishing in the lake was totally prohibited. This practice continued till it was handed over to the M.P. Government.

Now fisheries department looks after it and exports fishes worth several thousand rupees every year.

Primary Productivity:

The present investigation of monthly variation in primary productivity will be studied at surface water of the Govindgarh Lake at four sampling sites during the study period. Primary productivity will be estimated by 'Light and Dark Bottle' method by (Garder & Gran 1927).

The primary productivity will be expressed as gross primary productivity (GPP) and net primary productivity (NPP) and community respiration (CR).

Calculation DO= Z mg/L

Light bottle DO after incubation period (3 hrs.) = X mg/L

Dark bottle DO after incubation period = Y mg/L

1. Gross photosynthesis = X – Y mg/L
2. Net photosynthesis = X – Z mg/L
3. Respiration = Z – Y mg/L

i). Gross primary productivity (mg C/L/hr) $= \frac{(X-Y)}{PQ \times N} \times 0.536$

Where, PQ = 1.2 (Photosynthetic quotient)

N = Incubation period

0.356 = Factor to convert O_2 to mg to C

ii). Net primary productivity (mg C/L/hr) = $\frac{(X-Z)}{PQ \times N} \times 0.356$

iii). Respiration Value (mg/L/hr) = GPP-NPP

III. OBSERVATION AND RESULT

Primary Productivity

Primary productivity is the sum of net primary productivity and respiration value. It is one of the best natural indicator that shows the nutrient level of a water body.

During the first year of study period gross primary productivity, net primary productivity , respiration value were ranged from 8.11 to 12.14 per unit area, 4.85 to 7.27 per unit area, 4.20 to 6.24 per unit area respectively. While these were ranged from 8.29 to 12.27 per unit area, 5.00 to 7.34 per unit area and 3.29 to 4.93 per unit area respectively during the second year of study period (Table 1 and graph 1a, 1b, 1c and 1d).

Annual average value of gross primary productivity, net primary productivity and respiration values were 9.81, 5.90, 5.06 per unit area in the first year and 10.00, 6.00 and 3.51 per unit area respectively during the second year of research period (Table 1).

Standard deviation of primary productivity parameters gross primary productivity, net primary productivity and respiration value calculated on the basis of monthly variation were 1.19, 0.72 and 0.60 per unit area in the first year. While 1.17, 0.70, 1.61 per unit area respectively during the second year of study period (Table 1).

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IV. DISCUSSION

Annual average value of gross primary productivity, net primary productivity and respiration values were 9.81, 5.90, 5.06 per unit area in the first year and 10.00, 6.00 and 3.51 per unit area respectively during the second year of research period.

Similar observations were also observed in Nagaram tank of Warangal district in Andhra Pradesh, India (Narasimha and Banerjee, 2014) and two perennial tanks of Kolhapur district (Hujare and Mulay, 2007), Parapar reservoir and Sasthamkota lake (Sinudeen, 2002) During 2013–14, average post-monsoon temperatures were higher due to cloudy climatic conditions and October heat, which may have contributed to the increase in temperatures. The increased temperatures may have released nutrients from the sediment through bacterial decomposition.

Elevated nutrient levels and high temperature values would have promoted the growth of aquatic vegetation, ultimately favoring primary productivity; specifying that temperature, solar radiation and nutrients act as limiting factors for primary production (Sultan, et al., 2003); (Koli and Ranga, 2011);(Zutshi and Khan, 1988). Clean surface water and high rates of light penetration in the present study may have supported ecological conditions to increase GPP, NPP and CR.

Table 1: Mean annual and seasonal variation of Primary Productivity in per unit area from November 2019 to October 2021 in Govindgarh Lake, Rewa (M.P.)

S. No.	November 2019 to October 2020				November 2020 to October 2021			
	Month's Name	GPP	NPP	CRV	Month's Name	GPP	NPP	CRV
1	November	9.42	5.67	4.95	November	10.06	6.03	4.65
2	December	8.73	5.23	4.52	December	8.97	5.39	4.32
3	January	8.11	4.85	4.20	January	8.29	5.00	4.86
4	February	8.72	5.21	4.45	February	8.62	5.18	3.96
5	March	9.56	5.73	4.97	March	9.87	5.94	3.29
6	April	10.04	6.04	5.20	April	10.33	6.19	4.86
7	May	11.73	7.01	5.99	May	11.60	6.98	0.47
8	June	10.54	6.49	5.44	June	10.89	6.53	0.00
9	July	12.14	7.27	6.24	July	12.27	7.34	4.21
10	August	9.72	5.83	5.06	August	10.12	6.06	3.48
11	September	9.30	5.59	4.75	September	9.28	5.56	3.89
12	October	9.74	5.85	4.97	October	9.72	5.80	4.08
Average		9.81	5.90	5.06		10.00	6.00	3.51
Min.		8.11	4.85	4.20		8.29	5.00	0.00
Max.		12.14	7.27	6.24		12.27	7.34	4.86
SD±		1.19	0.72	0.60			0.70	1.61
Seasonal Variation								
	Season's Name	GPP	NPP	CRV	Season's Name	GPP	NPP	CRV
	Rainy	10.43	6.29	5.37	Rainy	10.64	6.37	2.89
	Winter	9.00	5.40	4.66	Winter	9.26	5.56	4.48
	Summer	10.01	6.00	5.15	Summer	10.10	6.07	3.14

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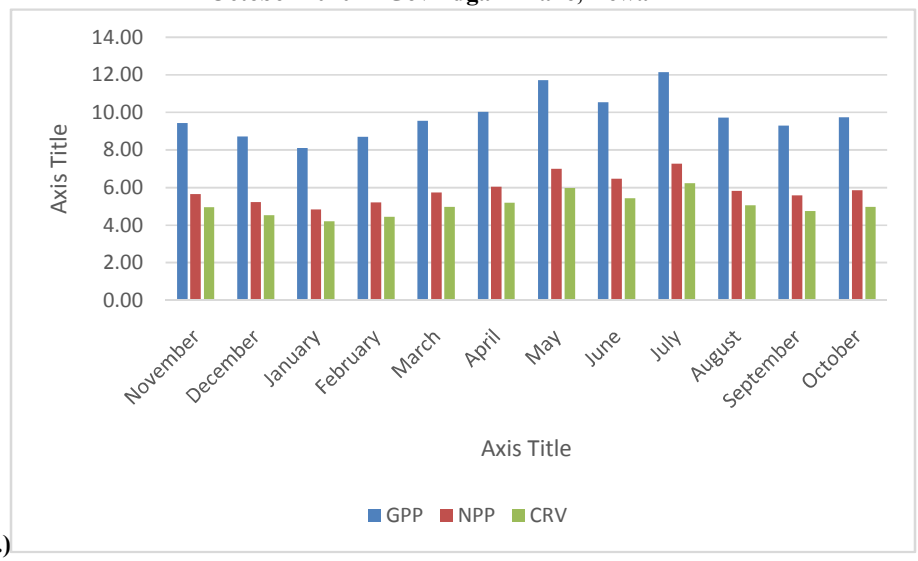
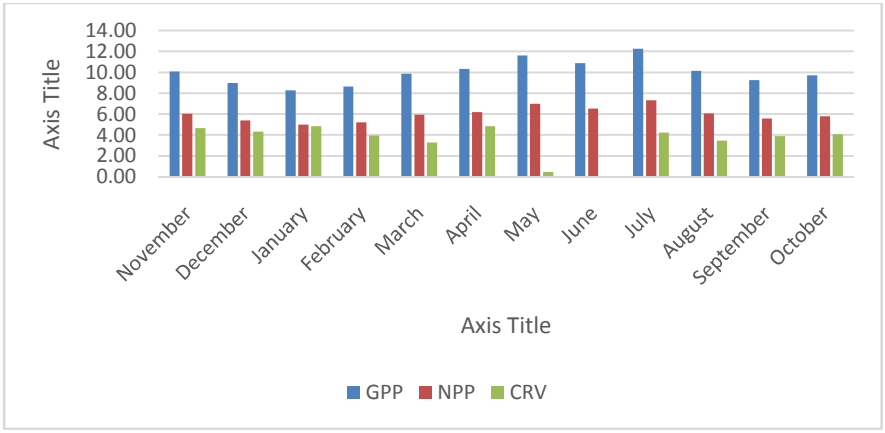
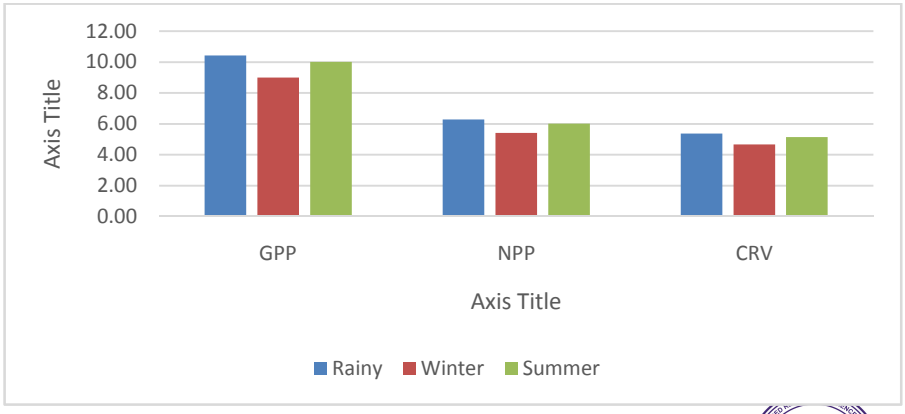
Graph 1a: Mean annual and seasonal variation of Primary Productivity in per unit area from November 2019 to October 2020 in Govindgarh Lake, Rewa (M.P.)



Graph 1b: Mean annual and seasonal variation of Primary Productivity in per unit area from November 2020 to October 2021 in Govindgarh Lake, Rewa (M.P.)



Graph 1c: Mean annual and seasonal variation of Primary Productivity in per unit area from November 2019 to October 2020 in Govindgarh Lake, Rewa (M.P.)



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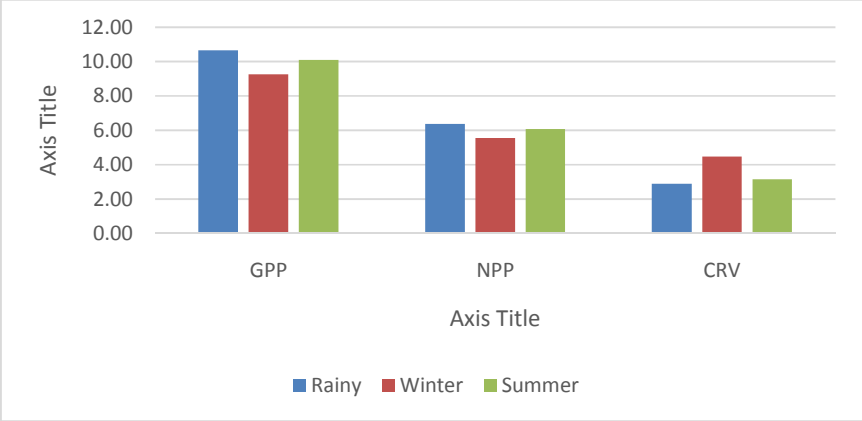
Graph 1d: Mean annual and seasonal variation of Primary Productivity in per unit area from November 2020 to October 2021 in Govindgarh Lake, Rewa (M.P.)



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