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Research Article

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SEASONAL VARIATION IN PRIMARY PRODUCTIVITY AND MACROPHYTES OF GUTHIA TAAL, BAHRAICH (U.P.)

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Abstract: Seasonal variations in primary productivity, respiration rate, chlorophyll content and macrophytes biomass were carried out during July, 2019 to June, 2020. Grass primary productivity (GPP) and net primary productivity (NPP) ranged from 54.27 to 92.36 mgC/m³/3hr and 34.95 to 59.59 mgC/m³/3hr, respectively. The respiration (R) value and chlorophyll concentration varied between 15.32 and 34.16 mgC/m³/3hr and 0.0047 and 0.149 mg pig/m³ in respectively. The primary productivity rate was maximum during summer season denote the peak of phytoplankton, macrophytes, higher values of light intensity, temperature and chlorophyll concentration. The minimum rate of primary productivity was observed during monsoon season.

Keywords: Guthia taal, Macrophytes, Primary productivity, Respiration, Wetland.

INTRODUCTION

According to Cowardin *et al.* (1979) wetlands are defined as lands transitional between terrestrial and aquatic ecosystem, where the water level is usually at or near the surface or the land is covered by shallow water. They are rich source of primary producers. Wetlands are very productive ecosystems, which help in the regulation of biological cycles, maintenance of water quality, nutrient movement and support for food chains. Wetlands are areas where water is the primary factor controlling the environment and the associated plants and animal life (Kumar *et al.*, 2015). Wetlands are important components of watersheds and provide many valuable functions to the environment and society.

Wetlands support vast the biodiversity that has different values, necessary for ecological balance and human survival (Verma, 2015, 2017, 2018). The wetlands also influence the overall climate. The climate change has a huge impact on biodiversity (Prakash and Srivastava, 2019). The biodiversity conservation is required for sustainable development (Verma, 2019) and survival of plants and animals because biodiversity is the foundation of human life (Verma and Prakash, 2020). The wetlands occur where the water table is at or near the surface of the land, or where the land is covered by water. Wetlands are among the world's most productive environments (Verma and Prakash, 2018) and provide food and shelter to organisms that thrive

in. The wetlands like lake etc. are of utmost importance for several reasons. They represent only a part of our land bases but they provide shelter to a great number of plant and animal species including mammals, birds, reptiles, amphibians, fishes and invertebrate species. Now-a-days wetlands and other deep water habitats is globally a subject of great ecological interest due to their socio-economic values and ecosystem services which has necessitated the need for reliable broad based information on their ecological status. The ecological functioning of these ecosystems has been greatly affected by the growing anthropogenic activities.

Primary productivity is defined as the rate at which organic matter is created dry producer in an ecosystem whereby low energy inorganic carbon is converted to high energy organic carbon form. Primary productivity of an ecosystem is the radiation energy stored by photosynthetic activity of phytoplankton (Odum, 1977). The entire diverse life depends on this phenomenon either directly or indirectly. Thus primary productivity is a mass of new organic matter synthesized through carbon assimilation by chlorophyll bearing aquatic plants which serve as primary producers in an aquatic food chain and thus act as keystone species in the ecosystem.

Primary productivity of a particular water body gives quantitative information about the amount of energy available to support bioactivity of the system. In India, contributions to the productivity and diversity of macrophytes were made by Sreenivasan (1965), Pandey and Singh (1978), Bhargava and Saxena (1987), Deka (2017) and Singh and Singh (2020). Due to urbanization and anthropogenic pressure most of the wetlands are succumbed to greater degree of biologically active nutrient accumulation.

MATERIAL AND METHODS

Study area: Guthia Taal (fig) is a large shallow perennial horse shoe shaped lentic water body. The total catchment area of wetland is about 75.9 ha. Out of 75.9 ha, 25.3 ha is situated in Guthia, 25.3 ha in Rucknapur, 22.77 ha in Dihawa Sher Bahadur Singh and 2.53 ha in Nawgeya villages, of Kaiserganj Tahsil of district Bahraich, Uttar Pradesh, India. But in summer season its water spread area becomes reduced up to 37.95 ha. It is situated between the latitude 27.2537°N - 81.54313°E . The Taal is enriched with several type of vegetation such as *Nymphaea*, *Nelumbo* and *Nympha* as well as aquatic birds like Duck, Saras and Bagula. The water of Taal is used for agriculture and fish culture.



Fig.: Satellite image showing Guthia Taal, a wetland and its surroundings.

Sampling Sites: To study the primary productivity of Guthia taal, three sampling sites (*i.e.* S-1 at Ruknapur, S-2 at Guthia and S-3 at Dihawa Sher Bhadur Si villages) were selected. The primary productivity was measured with well known light and dark bottle method of Gaarder and Gran (1927). Initial dissolved oxygen values were recorded from each site by Winkler method. Light and dark bottles were submerged for three hours, after which they were withdrawn and the final dissolved oxygen in each was measured on spot. The oxygen production values were converted into its carbon equivalents using a factor of 0.375.

RESULTS AND DISCUSSION:

The seasonal values of productivity, respiration rate, chlorophyll contents and biomass of macrophytes of Guthia Taal are given in the Table 1.

Productivity: The primary productivity of an aquatic system is the rate of radiation energy, which is stored by photosynthetic activities of phytoplankton (Odum, 1971). The primary productivity of a water body is function of

autotrophs associated with utilization of radiant energy. The solar energy that required for biological activities is finally converted to chemical energy by the process of photosynthesis primarily executed by phytoplankton and macrophytes. In the present study, the GPP varied from 54.27 to 65.45 mgC/ m³/3hr in monsoon, 87.24 to 90.14 mgC/ m³/3hr in winter and 91.35 to 92.36 mgC/ m³/3hr in summer seasons. NPP varied from 34.35 to 47.28 mgC/ m³/3hr in monsoon, 54.28 to 59.14 mgC/ m³/3hr in winter and 56.28 to 59.51 mgC/ m³/3hr in summer seasons.

Respiration rate and Chlorophyll content: The respiration (R) which is a heterotrophic activity of phytoplankton, zooplankton, bacteria and fungi etc. inhabiting the pond water (community respiration) ranged from 15.32 to 17.44 mgC/ m³/3hr in monsoon, 28.35 to 33.96 mgC/ m³/3hr in winter and 31.12 to 32.79 mgC/ m³/3hr in summer seasons. In the present study, the chlorophyll concentration varied from 0.0045 to 0.0057 mg pig/m³ in monsoon, 0.0056 to 0.091 mg pig/m³ in winter and 0.128 to 0.149 mg pig/m³ in summer seasons.

Table 1: Seasonal variations in Primary GPP, NPP, Respiration rate, Chlorophyll and Macrophytes biomass of Guthia Taal.

Location	Season	GPP (mgC/m ³ /3hr)	NPP (mgC/m ³ /3hr)	Respiration (mgC/m ³ /3hr)	Chlorophyll (mg pig/m ³)	Macrophytes biomass (kg / m ²)
S-1	Monsoon	54.27	34.95	15.32	0.0047	3.114
	Winter	87.52	59.14	28.35	0.0056	1.868
	Summer	91.35	56.28	31.12	0.128	1.194
S-2	Monsoon	65.45	41.55	23.95	0.0045	2.797
	Winter	90.14	54.28	32.05	0.0086	2.147
	Summer	91.53	57.38	34.15	0.131	1.491
S-3	Monsoon	62.65	47.28	17.44	0.0057	2.918
	Winter	87.24	56.09	33.96	0.0091	1.885
	Summer	92.36	59.51	32.79	0.149	1.517

GPP= Gross Primary Productivity; NPP= Net Primary Productivity

The GPP and NPP were maximum in summer season, moderate in winter season and minimum in monsoon season in all the three sites. During the present study, the maximum value of GPP and NPP was observed during summer season and subsequently the lower values during monsoon

season which corresponds to the intensity of light energy. Lower rate of primary production during monsoon season is the result of limitation of sunshine period and low light energy due to interruption of clouds. Subsequently, the dilution effect of rain on phytoplankton density

and as well as the increased in allochthonous turbidity from nearby area are prime causes of lowering the primary productivity in monsoon season. Thus, in the present study high productivity was due to high temperature (Shukla and Pawar, 2001) and low in spite of high concentration of nutrients in monsoon season (Saijo and Kawashima, 1964). Similar observations were made by Bhargava and Saxena (1987), and Shukla and Pawar (2001). The maximum rate of production in summer months coincided with the peak of phytoplankton and macrophytes, higher values of light intensity, higher temperature and high value of chlorophyll concentration. The steep fall of phytoplankton population, biomass, low values of transparency and light intensity during monsoon months were reflected in the minimum rate of primary production (Shukla and Pawar, 2001). Higher respiration values (R) were observed during the summer season and low values were recorded in the monsoon season. The maximum chlorophyll concentration was observed in summer season and minimum in rainy season. After monsoon, with the increase in phytoplankton concentration the rate of production is also increased. Higher growth of algal biomass results in higher primary productivity (Deka, 2017). On the basis of primary productivity it can be concluded that Guthia Taal shows the mesosaprobic status.

Macrophytes: The present study revealed that the presence of 15 aquatic macrophytes belonging to four groups namely free floating (*Eichhornia* sp., *Salvinia* sp., *Wolffia* sp. and *Lemna* sp.), emergent (*Ipomoea* sp., *Polygonum* sp., and *Typha* sp.), submerged (*Hydrilla*, *Vallisneria*, *Ceratophyllum* and *Najas* sp.) and rooted with floating leaves (*Potamogeton*, *Nelumbo*, *Nymphaea* and *Najas*). The *Salvinia* sp., *Lemna* sp., *Ipomoea* sp., *Hydrilla*, *Vallisneria*, and *Potamogeton* species have been recorded as prominent species of macrophytes and found all the three sites (S1, S2 and S3). The average biomass varied from 2.797 to 3.114 kg/m² in monsoon, 1.868 to 2.147 kg/m² in winter and 1.194 to 1.885 kg/m² in summer seasons. In general average biomass found to be in declined trend as the season changes from

monsoon to winter to summer. Aquatic vascular plants are an important indicator of water pollution. Aquatic plants are important as they serve as a substratum to different micro and macro fauna (Ramesh and Kiran, 2015).

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