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Plankton Production as Indicator of Trophic Status of Wular Lake, Kashmir

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ABSTRACT

An attempt has been made to apply production values of phytoplankton to evaluate the present trophic status of Wular, a Wetland of International Importance. The production values obtained for the lake ranged between 764.22 gC m^{-3} yr^{-1} to 903.76 gC m^{-3} yr^{-1}. It has been observed that the sites varied significantly with respect to their level of enrichment. Results of this study can be used to construct more sensible management practices for the wetland.

Keywords: Phytoplankton, production, trophic status, Wular lake, Kashmir

INTRODUCTION

Inland lakes are vital resources to provide water, food and recreation for human beings as well as habitat for many species of plants and animals. The Wular, a rural lake in the north-west of Kashmir, about 35 km from Srinagar city lies in the floodplains of River Jhelum. It is the largest freshwater lake of the Indian sub-continent and has been designated as a Ramsar site in 1990 (IUCN-Ramsar Convention, 1971).

Geographically the lake is situated at an altitude of 1580 m (a.s.l) lying between 34° 16′-34° 20′ N lat. and 74° 33′-74.44° E long. Although Wular lake is one of the largest lakes in its dimensions and now internationally recognized as a Wetland of International Importance, yet very little information is available on its ecology. The present paper, therefore, deals with the plankton production as a part of the comprehensive study carried out by the authors.

MATERIEAL AND METHODS

Hourly rates of primary production due to phytoplankton were studied from January to December, 2003 at three main selected sites of the lake (Site I- Bandipora, Site II-Watlab and Site III- Sopore). Primary productivity of phytoplankton was estimated by light and dark bottle method (Vollenweider, 1969). In this method two bottles, one transparent and another complete dark were put about 20 cm deep in the water column, by hanging them with the help of thread attached to some floats (tyre rubber tubes) at three selected sites for about four hours. The method involves measuring the amount of oxygen released in the process of photosynthesis by phytoplankton and estimating the primary productivity based on the measurement.

$$6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6O_2 + 6\ H_2O$$

RESULTS

The results of phytoplankton production are presented in Table 1. A perusal of data revealed that at Site I, the maximum values for net primary productivity (NPP), respiratory loss (R) and gross primary productivity (GPP) were 390.62 $mgCm^{-3}hr^{-1}$ (December), 437.50 $mgCm^{-3}hr^{-1}$ (February) and 781.25 $mgCm^{-3}hr^{-1}$ (February), while the minimum values were 15.62 $mgCm^{-3}hr^{-1}$ (July), 28.12 $mgCm^{-3}hr^{-1}$ (December) and 54.67 $mgCm^{-3}hr^{-1}$ (July) $mgCm^{-3}hr^{-1}$, for the three parameters respectively. However, the average monthly values of NPP, R and GPP for this site during the entire study period were found to be 174.48, 163.15 and 337.68 $mgCm^{-3}hr^{-1}$ respectively.

Table 1: Phytoplankton primary production (mgC m^{-3} hr^{-1}) of Wular lake during 2003.

Months	Bandipora (Site I)			Watlab (Site II)			Sopore (Site III)		
	NPP	R	GPP	NPP	R	GPP	NPP	R	GPP
Jan	187.50	93.75	281.25	593.75	109.37	703.12	187.50	312.50	500.00
Feb	343.75	437.50	781.25	187.50	312.50	500.00	156.25	125.00	281.25
Mar	93.75	125.00	218.75	62.50	156.25	218.75	93.75	187.50	281.25
Apr	125.00	125.00	250.00	62.50	125.00	187.50	125.00	93.75	218.75
May	93.75	109.37	203.12	93.75	125.00	218.75	93.75	125.00	218.75
Jun	93.75	250.00	343.75	250.00	93.75	343.75	218.75	156.25	375.00
Jul	15.62	39.05	54.67	23.43	70.30	93.73	15.62	78.12	93.74
Aug	281.25	312.50	593.75	312.50	203.12	515.62	281.25	421.87	703.12
Sep	62.50	156.25	218.75	93.75	281.25	375.00	62.50	312.50	375.00
Oct	93.75	125.00	218.75	62.50	101.55	164.05	62.50	62.50	125.00
Nov	312.50	156.25	468.75	405.83	281.25	687.08	834.64	187.50	1022.14
Dec	390.62	28.12	418.74	328.12	187.50	515.62	156.25	234.37	390.62
Average	**174.48**	**163.15**	**337.63**	**206.34**	**170.57**	**376.91**	**190.65**	**191.41**	**382.05**

At Site II, the maximum values of NPP, R and GPP were 593.75 (January), 312.50 (February) and 703.12 (January) as against the minimum of 23.43, 70.30 and 93.73

$mgCm^{-3}hr^{-1}$, being obtained in July 2003 respectively. The monthly average calculated for the sites were, however, 206.34, 170.57 and 376.91 $mgCm^{-3}hr^{-1}$ for the three parameters respectively.

The primary production values of phytoplankton at site III, were in the ranges of 15.62 – 834.64 $mgCm^{-3}hr^{-1}$ for NPP (averaging 190.65 $mgCm^{-3}hr^{-1}$); 62.50 – 421.87 $mgCm^{-3}hr^{-1}$ for respiratory loss (with an average of 194.41 $mgCm^{-3}hr^{-1}$) and 93.74 – 1022.14 $mgCm^{-3}hr^{-1}$ for GPP (with monthly average of 382.05 $mgCm^{-3}hr^{-1}$). In general, the figures of phytoplankton primary production were at its lowest in warm water period (July 2003) and peaked in coldwater periods coinciding with January to February and November to December (Table 1).

DISCUSSION

In the present study on Wular lake high plankton production was recorded during coldwater period coinciding with high dissolved oxygen content at all the study sites. Our study gains support from the works of Gupta *et al*. (1992) who observed more plankton production in relative lower temperature conditions of April, but seems to be in contradiction to the findings of Hickman (1971) who found primary production to be highest in spring and summer in two small ponds in N. Sommerset, UK. The less plankton production during the warm-water period i.e. in summer also gets support from the works of Hasler and Jones (1949), Moore (1952), Odum (1959); Hogetsu *et al*. (1960); and Gupta *et al*. (1992) who believe that the luxuriant submerged freshwater macrophytes lock up nutrients in the early growing season and inhibit phytoplankton production (*Kaul et al.*, 1978).

According to Vinberg (1961) lakes with annual production up to 30 $gCm^{-2}yr^{-1}$ are oligotrophic; with 30–200 $gCm^{-2}yr^{-1}$ mesotrophic and more than 300 $gCm^{-2}yr^{-1}$ are highly eutrophic. Rodhe (1969) gave some approximate values for phytoplankton production in oligotrophic lakes ranging between 7.0 and 25.0 $gCm^{-2}yr^{-1}$, naturally eutrophic lakes ranging between 75.0 and 250.0 $gCm^{-2}yr^{-1}$ and culturally polluted lakes ranging between 350.0 and 700.0 $gCm^{-2}yr^{-1}$. On the other hand, Vollenweider *et al*. (1974) reported that oligotrophic lakes have a total annual production rates upto 100.0 $gCm^{-2}yr^{-1}$, mesotrophic from 100 to 200 $gCm^{-2}yr^{-1}$ and eutrophic more than 200.0 $gCm^{-2}yr^{-1}$. Vishin (1982) recorded annual phytoplanktonic production of Pushkari lake, Kashmir to range from 650 $gCm^{-3}yr^{-1}$ to 927 $gCm^{-3}yr^{-1}$ and placed it under category of eutrophic waterbodies. On the basis of these generalizations, Wular lake falls within the eutrophic category with the annual production of 764.22 $gCm^{-3}yr^{-1}$ at the Bandipore site, 903.76 $gCm^{-3}yr^{-1}$ at Watlab site and 834.00 $gCm^{-3}yr^{-1}$ at Sopore site and with an over all average of 834 $gCm^{-3}yr^{-1}$ for the whole lake

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