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SOME LIMNOLOGICAL ASPECTS OF GOVERDHAN SAGAR LAKE OF UDAIPUR, RAJASTHAN TO SUGGEST ITS FISHERIES MANAGEMENT

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Abstract: The current research work was conducted to find out the fish production potential of Goverdhan Sagar, a medium class water body of Udaipur in southern Rajasthan. Goverdhan Sagar is a shallow lake with a maximum depth of 7.62 meters and a shoreline of 3888.8 meters with relatively fringed margins and an area of 30.81 ha. Physico-chemical parameters of Goverdhan Sagar were found to be congenial for productivity throughout the study period. The average water quality parameters of the lake during the study period were: air temperature-30.75 ºC, water temperature-28.57ºC, depth of visibility-96.23 cm., pH-7.18, EC-381.8 µS cm^{-1}, dissolved oxygen-5.56 mg l^{-1}, free CO_2-6.56 mg l^{-1}, carbonates-35.41 mg l^{-1} , bicarbonates-137.44 mg l^{-1}, total alkalinity-185.73 mg l^{-1} , orthophosphates-0.13 mg l^{-1} , nitrate-nitrogen-0.46 mg l^{-1} , GPP-0.42 g C m^3 h^{-1} , NPP-0.26 g C m^3 h^{-1} , CR-0.17 g C m^3 h^{-1}. The Average phytoplankton count in Goverdhan Sagar was 36.71 Nos/ml distributed in 29 genera showed the order of dominanceae–Chlorophyceae > Bacillariophyceae > Cyanophyceae > Desmidiaceae.
Keywords: Fish production, Phytoplankton, Primary productivity and Water quality.

Introduction

The growing number of man-made reservoirs and impoundments for various purposes warrant an early investigation of their water quality for aquaculture and domestic uses. The primary productivity of different water bodies has been widely investigated to assess the fish production potentialities of a water body and to formulate fishery management policies. The physico-chemical features greatly influence the primary productivity and in turn the growth of the fish in an aquatic environment.

Studies of plankton and productivity of Udaipur waters and that of Rajasthan have been carried out by several workers (Sharma and Durve, 1990; Paulose and Maheshwari, 2007 and Rajkumar, 2007). Ayyappan and Gupta (1980) studied the primary productivity of Ramasamudra Tank situated in Karnataka. Nandan and Magar, (2007) studied 16 physico-chemical parameters of the Girma dam of Nashik district from Maharashtra.

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Looking to the need of a diverse limnological application for lake management, this study was aimed for the assessment of a diversity profile of primary producers *viz.* phytoplankton in Goverdhan Sagar lake in relation to its water quality and primary productivity. Attempt has also been made to suggest appropriate stocking of the lake.

Material and Methods:

The present study was carried out during January 2012 to June 2012 at Goverdhan Sagar. Lake of Udaipur city (24º32'N latitude and 73º41'E longitude) in southern Rajasthan. Goverdhan Sagar is a shallow lake with a Catchment area of 2.56 sq.km, maximum depth (Zm) of 7.62 meters, maximum length (L) 1.97 km, maximum width (bx) 0.72 km and a shoreline of 3888.8 meters with relatively fringed margins and an area of 30.81 ha. The lake is totally rain-fed and retains water throughout the year. The over-flooded Pichhola lake and Kotra river feeds water to the Goverdhan Sagar. For the proposed study, three sampling stations (A, B and C) were fixed in Goverdhan Sagar for collection of surface water samples and phytoplankton.

Result and Discussion:

During the study period, surface water samples were collected every week to determine the water quality parameters, primary productivity and phytoplankton of Goverdhan Sagar. The analysis was made using standard methods (Trivedy *et al.,* 1987 and APHA, 1989 and standard methods of Adoni (1985).

The results indicate that the Physico-chemical parameters of Goverdhan Sagar were found to be moderate throughout the study period. The average water quality parameters of the lake during the study period were: air temperature-30.75 ºC, water temperature-28.57ºC, depth of visibility-96.23 cm., pH-7.18, EC-381.8 µS cm^{-1}, dissolved oxygen-5.56 mg l^{-1}, free CO_2-6.56 mg l^{-1}, carbonates-35.41 mg l^{-1} , bicarbonates-137.44 mg l^{-1}, total alkalinity-185.73 mg l^{-1} , orthophosphates-0.13 mg l^{-1} , nitrate-nitrogen-0.46 mg l^{-1} , GPP - 0.42 g C m^3 h^{-1} , NPP - 0.26 g C m^3 h^{-1} , CR-0.17 g C m^3 h^{-1}.

The recorded depth of visibility points out relatively moderate levels of nutrients in Goverdhan Sagar and thus can be acclaimed in the category “Moderately eutrophic”(Jain (1978; Sharma and Durve, 1990). In present investigation the observed values of water clarity might be mainly influenced by the suspended particulate matter, plankton and variations in water level.

Plankton in inland water bodies holds a key position in the metabolism of water bodies, trophic levels, food chains and energy flow as well as they also play an important role in the

transformation of energy from one trophic level to the higher trophic levels, ultimately leading to fish production. In the present investigation the average phytoplankton count was 36.71 Nos/ml distributed in 29 genera in the order of dominance – Chlorophyceae > Bacillariophyceae > Cyanophyceae > Desmidiaceae.

Rao and Durve (1987) have reported 52 genera in Jaisamand lake out of which 25 belong to Chlorophyceae, 12 from Bacillariophyceae, 2 from Euglenophyceae, 01 from Xanthophyceae and 12 from Myxophyceae. Jain (1978) reported 35 genera of phytoplankton in Goverdhan Sagar thus, indicating slight decrease in diversity of phytoplankton during the present study.

The correlation between water quality and other parameters indicated greater production of phytoplankton at higher temperature (r = 0.526) with lower solubility of gases DO (r = -0.968), low EC (r = -0.901), low visibility (r = -0.294), pH (r = -0.537), bicarbonates (r = -0.174) and total alkalinity (r = -0.115). The relationship between phytoplankton and productivity indicated a negative correlation with NPP (r = -0.291) and positive with GPP (r = 0.189) and CR (r = 0.985) in Goverdhan Sagar.

Willen (1990) and, Yusuff and Patimah (1994) considered eutrophic lakes on the basis of blue-green algae. From the results of water quality parameters and observations on phytoplankton it is appropriate to place this water body somewhere between “mild eutrophic-to-eutrophic”. For effective channelization of the energy trapped in the form of primary producers (macrophytes and phytoplankton) stocking of suitable fish species is also suggested.

The higher primary productivity found in the present study may be assigned to high concentration of nutrients, higher temperature and higher photosynthesis during the pre summer and summer months. Rajkumar (2005) also reported higher average GPP (0.45 g C m^3 h^{-1}) in Daya reservoir by adequate influx of water. Sultan *et al.* (2003) indicated that higher primary productivity creates a congenial environment for biological production.

The potential fish production of Goverdhan Sagar on the basis of GPP (0.42 g C m^3 h^{-1}) is 289.29 kg/ha/yr or 8913 kg/yr following conversion factor of (Odum, 1971).

However, the Odum's conversion does not take into account the macrophyte production which is a dominant factor in Goverdhan Sagar. Ayyappan *et al.* (2006) suggested productivity of such medium class waters to the tune of 3-35 kg/ha/yr without management and it can be raised to 70-275 kg/ha/yr with scientific management. The present fish production of the lake as reported by the contractor was only 6500 kg/yr *i.e.* 211 kg/ha/yr. Thus, stocking of phytophagous fish namely *Ctenopharyngodon idella* (grass carp) @ 125

fingerlings/ha and bottom feeder such as *Cirrhinus mrigala* (mrigal) @ 500 fingerlings/ha can be a good choice to take care of available food resources in the lake. Surface feeder *Catla catla* (catla) @ 50 and browser fishes *Labeo rohita* (rohu) @ 300 fingerlings/ha. can also be stocked. Considering all above the total number of fish suggested to be stocked are 30339 @ 985 advanced fingerlings/ha. As such, with assumed weight of 1 kg and 20 percent losses after one year, almost a fourfold increased fish production of 24032 kg/yr., can be achieved through scientific management of the lake.

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Station A

Station B

Station C

Fig. 1. Panoramic view of the lake Goverdhan Sagar indicating the locations of sampling station A, B and C.

Table 1: Average values of water quality, productivity and phytoplankton of Goverdhan Sagar lake, Udaipur (Raj.)

S.No	Parameters	Average
1	Air temperature °C	30.72
2	Water temperature °C	28.53
3	Transparency (cm)	96.19
4	pH	7.19
5	EC(µS cm^{-1})	380.41
6	Dissolved oxygen (mg l^{-1})	5.65
7	Free CO_2 (mg l^{-1})	6.56
8	Carbonates (mg l^{-1})	39.47
9	Bicarbonates (mg l^{-1})	141.00
10	Total alkalinity (mg l^{-1})	180.19
11	Orthophosphates (mg l^{-1})	0.12
12	Nitrate-nitrogen (mg l^{-1})	0.44
13	Gross primary productivity ($gC.m^{-2}.hr^{-1}$)	0.43
14	Net primary productivity($gC.m^{-2}.hr^{-1}$)	0.25
15	Community respiration($gC.m^{-2}.hr^{-1}$)	0.17
16	Phytoplanlton (Cell ml^{-1})	36.71