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Research Article

Random biological activities in relation to physico-chemical parameter of shallow water in catchment area of Bhopal's upper lake

Shweta Deshmukh*, Sadhna Tamot

Sadhu Vaswani College, Bairagarh, Bhopal (M.P.)

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ABSTRACT

Freshwater resources are considered to be the wealth of Nation. Urbanization, agricultural and uncontrolled anthropogenic activities leads to the nutrient accumulation, silt and sediment deposition, and addition of organic matter in the lake from the catchment area in the aquatic ecosystems causing their deterioration and caused them to lose their importance. As the biological activities of lakes or any water body is largely depending upon its water quality in varied aspects, thus, present investigation is aimed at instantaneous existence of interdependent physico-chemical hydrological quality to various life forms of Bhopal's upper lake to understand the level pollution due to anthropogenic regions. Temperature, pH, transparency, total hardness, nitrates, phosphates, biological oxygen demand were measured for water samples collected from four sites, Boat club, Koh-e-Fiza, Karbala and Bairagarh region designated as S-1, S-2, S-3 and S-4 respectively. Occurrence of aquatic plants *Eichhornia crassipes, Pistia stratiotes, Ceratophyllum demersum, Eleodea Canadensis* and *Azolla spp.*; algal species *Anabaena sp., Microcystis aeroginosa, Oscillatoria tenuis and Chlorella spp.*;ornamental fishes *Trichogaster lalius*, *Trichogaster fasciata,* and *Badis badis*; and snails were noticed at random in relation to the current physico-chemical conditions of water that were supporting the flourishing of such biological forms in the sites. Upon further studies, these biological forms could be explored in socio-economic development of some communities that rely aquaculture based economy.

Keywords: Physico-chemical parameters, Upper lake, Phytoplankton, Ichthyofauna, socio-economy.

INTRODUCTION:

Optimum physico-chemical parameters are of any water body is an important prerequisite for flourishing aquatic life forms whether floral, faunal or micro bodies. Fresh water resources are considered to be the wealth of Nation, but our indiscriminate exploitation of these resources have led to their deterioration and caused them to lose their importance (Kumar and Chaudhary, 2013). The physico-chemical parameters and biological activities of any aquatic system are complementary to each other, as one describes the type of constituents while other reflects the consequences of the first one (Bhat, *et al*., 2012).

Urbanization, agricultural and uncontrolled anthropogenic activities leads to the nutrient accumulation, silt and sediment deposition, and addition of organic matter in the lake from the catchment area in the aquatic ecosystems causing eutrophication that signifies the aging of lake.(Dhote and Dixit, 2007;Lone, *et al*.,2014).The shallow regions of lakes and water bodies are the biologically active zones comprising of several different species of aquatic plant diversity, macrophytes, mollusks and fish diversity and are sensitive to changes (Abobi, *et al*., 2015).Kant and Vohra (1989) suggested the management of any aquatic ecosystem is conservation of freshwater habitat with an aim to maintain the quality or to rehabilitate the physico-chemical and biological quantity of water (Chouhan, *et al*., 2009).

With reference to the articles Upper lake of Bhopal is the oldest manmade reservoirs, in India, along with its catchment area, as comprehensive systems constitute the extent of the Bhoj Wetland and was created by Raja Bhoj in the 11th century by constructing an earthen dam across the Kolans River. The Kolans was originally a tributary of the Halali River, which in turn joins Betwa River near Vidisha. The upper lake is a major source of portable water for the city of Bhopal, Madhya Pradesh, India. Latitude 23" 12' (23.2000) and

*Corresponding author: Shweta Deshmukh | E-mail: shwetara10@gmail.com

Longitude 77" 18' (77.3000). The basin has a maximum depth of 11.7m and storage capacity 101.5m, cm and the surface area is 32.29 sq. km.Outflow from the Upper Lake which receives water mainly through the Kolans River drains into Kaliasot River and finds its way to Yamuna River through the Betwa River. The Upper Lake, in a linear east-west alignment, has a catchment area of 361 sq. km. The Upper Lake has a partial urban component in its catchment on the eastern end while the remainder is Rural.(Bhat, *et al*., 2012; Sharma, *et al*., 2014). As the biological activities of lakes or any water body is largely depending upon its water quality in varied aspects, thus, present investigation is aimed at instantaneous existence of interdependent physico-chemical hydrological quality to various life forms of Bhopal's upper lake to understand the level pollution due to anthropogenic regions.

Materials and Methods

Sample Collection

The site for the collection of water samples was the catchment area near Boat club, Koh-e-Fiza, Karbala and Bairagarh region designated as S-1, S-2, S-3 and S-4 respectively. Water samples were randomly collected using open water grab sampler (1 liter capacity) from shallow regions of selected sites in February 2015 and taken to the laboratory of department.

Physico-chemical Parameters

Temperature, pH, transparency, total hardness, nitrates, phosphates and biological oxygen demand were studied according to the standard methods of APHA (1995)

Biological Activities:

Both microscopic and macroscopic biological activities were observed which includes the enlistment of phytoplankton, fish population and total microbial load in the water bodies of the shallow regions of upper lake catchment area. The characterization of aquatic life forms was referred from "Workbook on Limnology" by Adoni (1985).

Results and Discussion

The physic-chemical parameter studied for shallow water collected from the both the sites under investigation are as follows:

Table 1: Physico-chemical parameters studied for water quality at 4 sites under investigation in February 2015.

S.N	Parameter	S-1 (Boat Club)	S-2 (Koh-e-fiza)	S-3 (Karbala)	S-4 (Bairagarh)
1.	Temperature (^{o}C)	26-30	28-30	25-29	27-31
2.	pH	7-8.1	6.9-7.1	7 -7.1	7-7.8
3.	Transparency (cm)	18-20	20-22	6-7	18-20
4.	Total Hardness	65-93	66-91	61-89	64-98
5.	Nitrates (mg/l)	0.676	2.114	3.016	4.331
6.	Phosphates (mg/l)	0.20	0.20	0.22	0.26
7.	Biological Oxygen Demand (mg/l)	7.2	4.1	3.8	2.1

At instance, the biological activities in relation to anthropogenic activity on four sites under study were Boat club, Koh-e-fiza, Karbala and Bairagharah stretch of the upper lake. With reference to table 1, it was observed a great difference in the physico-chemical parameters taken under present study. The site S-1 is highly affected by the anthropogenic activities due to large number of visitors to enjoy the lake beauty. The temperature and pH of this region were recorded in the range of 26-30^{o}C and 7-8.1 respectively and the total hardness range was 65-93 those are slightly coincides with early investigations made Bhat *et al*., (2012). The temperature of S-2, S-3 and S4, sites are in the range of 28-30 ^{o}C, 25-29 ^{o}C and 27-31 ^{o}C respectively, while that of the pH ranges 6.9-7.1, 7 -7.1 and 7-7.8 respectively. The lake catchment area Site S-4 (Bairagarh) is with slight higher temperature and alkaline pH range may be due to agricultural activity nearby. May be the leaching of fertilizers and salts responsible for such notes.

The transparency of Karbala site (S-3) is recorded as the least (6-7 cm) due to the heavy growth of phytoplankton species that forms a green mat

over the lake surface in shallow regions, on the other hand the other sites under study fall in the range of 18-22 cm due to phytoplankton and algal population of cyanophyceae mainly. The biological oxygen demand value (BOD) in present investigation was in the range between 2 to 8 mg/l (table 1).

In regards to water quality criteria, the threshold limit of BOD for inland surface water is 3 mg/l, according to CPCB (2009), for class B water, when such waters are used as raw water for public water supplies and bathing purposes. The BOD value more than 6 mg/l in surface water are classified as polluted according to ICMR (1975). Site S-1 illustrates the exceeding limit of BOD values with 7.1 mg/L that clearly indicates that this area is being influenced by organic pollution due to anthropogenic activity. Upadhyay *et al*., (2013) notified the similar type or results in their investigation with an average value of 7.7 mg/l. BOD was recorded maximum at the bottom and minimum at the surface water samples. The BOD at Bairagarh site was 2.1 mg/l while that of karbala and Koh-e-fiza were 3.8 and 4.1 respectively which is due the natural growth of excess algae phytoplankton and zooplankton on those sites while the S-4 site is affected by the disturbances of agricultural activity.

As per the standards the average concentration of nitrates must be 1 mg/l in any water body but again here the nitrate concentration were recorded higher than the normal limits at S-2, S-3 and S-4 but may be due to different reasons. S-2, and S-3 were the areas with decomposing organic matters containing nitrogenous content while S-4 being possibly polluted with fertilizers due to agricultural activities. Phosphorous is considered to be the most significant component among the nutrients responsible for eutrophication of a water body, as it is the primary initiating factor. Phosphorus is rarely found in high concentrations in freshwaters as it is actively taken up by plants (Muralidharan, and Waghode, 2014).

The Biological activity at a random marking records the presence of various types of algal species phytoplankton, zooplanktons and molluscs at the shallow water zone of catchment area of selected sites. Mainly the *Anabaena sp., Microcystis aeroginosa Chlorella spp., Oscillatoria tenuis Azolla* spp., *Eichhornia crassipes, Pistia stratiotes.,* and snails were the predominant species in all the sites under investigation the list of biological members of the lake are depicted in table.2 The sites S-2 and S-3 are predominantly covered with the green mat of *Microcystis aeroginosa Eichhornia crassipes,* and *Azolla* spp. because to the nutrient and environment that supports the growth of such biological water bodies macroscopically.S-3 sites were also observed to the rich in *Ceratophyllum demersum,* and *Eleodea Canadensis* population. The greenish tinge of water at S-1 was due to presence of *Chlorella spp.,*and *Scenedesmus dimorphus.* The S-4 area was observed to be covered with large number of algal blooms in addition the presence of water hyacinth (*Eichhornia crassipes*) all along the margins of catchment area. Macrophytes colonize many different types of aquatic ecosystems, generally shallow ecosystems with adaptive strategies, where they become important components, influencing ecological processes (e.g., nutrient cycling) and attributes of other aquatic attached assemblages (e.g., species diversity) so is here (Thomaz and Cunha 2010).Primary production of macrophytes can surpass that of other aquatic primary producers (Wetzel, 2001; Kalff, 2002). Out of the ichthyofounal population near the shallow regions of catchment area *Trichogaster lalius*, *Trichogaster fasciata,* and *Badis badis* were the common fishes that can be seen easily at S-2 and S-3 regions and upto some extent at S-4 region in present investigation. These are considered to be the ornamental fishes of upper lake. Sharma *et al*., (2014) also recorded the presence of these fishes while studying biodiversity of ornamental fishes of upper lakes.

The present physic-chemical parameters of shallow regions of upper lake catchment area on the selected sites of present investigation allow the adaptive and supportive conditions for the interdependent present of the organisms found in there. Macrophytes have primarily been characterized as an important resource of food for aquatic organisms, due to their high rate of biomass production, providing both living (grazing food webs) and dead organic matter (Thomaz and Cunha 2010). The areas need attention to be improved further and required to monitoring

uncontrolled addition of public garbage and pollutants.

Table 2:

S.N.	Site	Aquatic Plants	Molluscs	Micro alga	Fishes
1.	**S-1**	*Eichhornia crassipes,*		*Chlorella spp., Scenedesmus dimorphus,*	*Trichogaster lalius*, *Trichogaster fasciata,* and *Badis badis*
2.	**S-2**	*Eichhornia crassipes, Pistia stratiotes, Ceratophyllum demersum, Eleodea Canadensis* and *Azolla spp.*	Snails	*Anabaena sp., Microcystis aeroginosa* and *Chlorella spp.,*	*Trichogaster lalius*, *Trichogaster fasciata,* and *Badis badis*
3.	**S-3**	*Ceratophyllum demersum,*and *Eleodea Canadensis*	Snails	*Anabaena sp., Microcystis aeroginosa*	*Trichogaster lalius*, *Trichogaster fasciata,* and *Badis badis*
4.	**S-4**	*Eichhornia crassipes, Pistia stratiotes, Ceratophyllum demersum, Eleodea Canadensis* and *Azolla spp.*	Snails	*Anabaena sp., Microcystis aeroginosa, Oscillatoria tenuis*	*Trichogaster lalius*, *Trichogaster fasciata,* and *Badis badis*

Conclusions

From the investigations it is clear that the quality of water in the shallow regions of sites under investigation is largely affected by the agricultural and anthropogenic activities. The physico-chemical parameters are slightly above the optimum in the shallow region near the catchment area of upper lake and could not be immobilized to the standards. But the investigation of such aquatic condition could be made and explored to utilize the condition in variety of aquaculture activities to open new opportunities and methods of socio-economic development and lake conservation respectively. Upon further studies, these biological forms could be explored in socio-economic development of some communities those rely aquaculture based economy.

Figure 1:(A) S-2 site at Koh-e-fiza, presence of *Eichhorniacrassipes,Azolla spp.,* and*Microcystisaeroginosa*; (B) S-3 site at Karbala area, shows frenzied anthropogenic activities; (C) S-4 site near Bairagarh, with agricultural activities; (D) S-4near Bairagarh, occurrence of algal blooms and *Eichhorniacrassipes* representing mess at the margin of catchment area

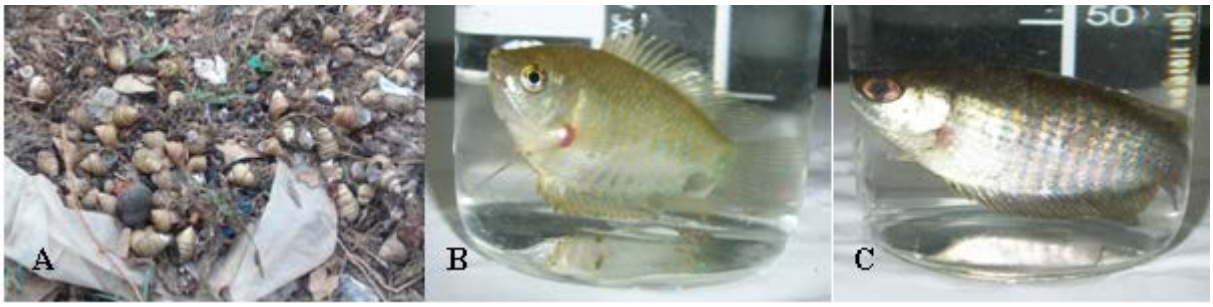

Figure 1:(A)Shells of Snails thrive in upper lake(B)Ornamental fish *Trichogasterlalius*from shallow region of upper lake catchment areas; (C)Ornamental fish *Badisbadis* from shallow region of upper lake catchment areas.

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