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RESEARCH ARTICLE

Evaluation of BOD, *E.coli* and *Pseudomonas* spp. in Shallow Water of Bhopal's Upper Lake at Catchment Areas Sheltering Some Ornamental Fishes in a Year

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Abstract:

Bhopal's Upper Lake is not only the source of water but also the habitat of several aquatic life forms including variety of fish species. The present study aims to evaluate the BOD, *E.coli* and *Pseudomonas* spp. in shallow water of Bhopal's upper lake at catchment areas sheltering some ornamental fishes on collective basis.Water samples were collected and ornamental fishes were observed from shallow water body of catchment area of the lake covering 4 sites near Boat club, Koh-e-Fiza, Karbala and Bairagarh region designated as S-1, S-2, S-3 and S-4 respectively. BOD, total microbial count, *E.coli*, and *Pseudomonas* spp. count were made in triplicates for 3 seasons. All the sites have highest BOD values in rainy season followed by summers then winters. Seasonal variation in occurrence of these fishes suggesting the increased and decreased presence in winter and rainy seasons respectively that could be correlated with microbial contamination and unsuitable aquatic environment for these fishes.

Key words: BOD, *E.coli*, *Pseudomonas* spp. ornamental fishes, Upper Lake.

INTRODUCTION:

The rising concern for water quality appropriate for human and animal use is the chief issue of present scenario.[1] Urbanization, agricultural and uncontrolled anthropogenic activities are the sources of extensive variety of pollutant discharge in rivers and lakes that results into significant assimilation of contaminants and pollution loads in water bodies. [2,3] Upper lake of Bhopal situated in latitude 23" 12' (23.2000) and longitude 77" 18' (77.3000) is a manmade water reservoirs, in India,created by Raja Bhoj in the 11th century by constructing an earthen dam across the Kolans Riveralong with its catchment area, as comprehensive systems constitute the extent of the Bhoj Wetland. The upper lake is a major source of potable water for the city of Bhopal, Madhya Pradesh, India. The basin has a maximum depth of 11.7m and storage capacity 101.5m, cm and the surface area is 32.29 sq. km.The Upper Lake has a partial urban component in its catchment on the eastern end while the remainder is Rural.[4,5]

Upper Lake is not only the source of water but also the habitat of several aquatic life forms including variety of fish species.Addition of organic matter in the lake from the catchment area in the aquatic ecosystems causing eutrophication that signifies the aging of lake. [6,7] Catchment area of upper Lake Bhopal has been witnessing change in land use and land cover.[8] Successful habitat of any fish species in a water body mostly rely on the physical, chemical and biological characteristics of the water and requires monitoring to avoid contamination and/or degradation of the environment.[9] Affecting several factors of water quality, such as pH, dissolved oxygen, ammonia etc., microorganisms play significant role in water bodies with their involvement in the conversion of nutrients, the nutrition of animals and disease control.[10] The present study aims to evaluate the BOD, *E.coli* and *Pseudomonas* spp. in shallow water of Bhopal's upper lake at catchment areas sheltering some ornamental fishes on collective basis.

Materials and Methods

Sampling Collection

With reference to the objective the study, sampling sites chosen for the study must be a shallow water body and should be at the line of catchment area of the lake. Thus 4 sites were observed are near Boat club, Koh-e-Fiza, Karbala and Bairagarh region designated as S-1, S-2, S-3 and S-4 respectively. Water samples and fish samples were collected during 3 successive seasons of the year 2014 and taken to the laboratory of department. The fish

samples were collected using gill nets of different mesh sizes (10 to 100 mm) with the help of local fishermen. The fishes were identification of fishes was done with the help of taxonomic keys of Jayaram (1981), Jhingran (1991) and Qureshi and Qureshi (1983).[11,12,13]

Microbiological Analysis of Water

Specifically biologicaloxygen demand (BOD) of the collected water samples were analyzed as per the standard methods of APHA (1995)and also total microbial count, *E.coli*, and *Pseudomonas* spp. count on nutrient agar plate, McConky's agar plate and Cetrimide agar plate respective from each water sample collected in all the 3 seasons of year 2014. All the experiments were done in triplicates and average values considered as results in present study.

Results and Discussion

BOD analysis of water samples collected from the four regions of Bhopal's upper lake during the 3 successive seasons which were under investigation in year 2014 are discussed in table 1 which suggest that there are notable variations in the BOD of water samples from particular site with reference the change the season.

Table 1: Average reading of seasonal BOD analysis of water samples from shallow zones from sites under investigation.

S.N	Sampling Site	BOD in Season(mg/l)		
		Winter	**Summer**	**Rainy**
1.	**S-1**	6.8	6.5	7.3
2.	**S-2**	4.3	4.1	5.7
3.	**S-3**	4.1	3.7	5.3
4.	**S-4**	2.4	2.2	3.8

***S-1 = Boat club; S-2 = Koh-e-Fiza;S-3 = Karbala; S-4= Bairagarh region.**

The values of BOD at all the sited under study were in the standard range of 3-20 mg/l recommended by Boyd (2003).In some study, Gupta (2008) observed the BOD of upper lake in the range of 2.8 to 4 mg/l with reference to algal flora in rainy season.Bajpai*et al.*,

(2008)[14] also described a great variation in various water quality parameters including BOD during a decade from 1994 to 2004 in their case study. Compare to the four samples sites under investigation the BOD values of Site S-4 (Bairagarh region) is shows the lowest BOD values in all the three seasons and that of the site S-1 (Boat club) was with higher BOD values than other sites in all seasons in a year. Since Site S-4 (Bairagarh region) is far from the urban zone and anthropological activities hence may be less affected.

With the help of standard plat method the total microbial count, *E.coli*, and *Pseudomonas* spp. count on respective mediums from each water samples have came up with undoubted results regarding the presence of these microbes in a sufficient amount in those water samples collected from the shallow regions of catchment area. The results of microbial count at 10 fold dilutionsare descried in table 2. This clearly indicates the discharge of wastes, garbage and sewage are adding the coliforms and pathogenic microbial species to the water body, but it has seasonal variations due differences in environmental and nutritional conditions in 3 different seasons.Figure 1 describes the differences in total microbial count obtained from standard plat count method.

Table 2: Microbial count analysis of upper lake waters of shallow regions of catchment area in three difference season of year 2014.

S.N	Sample Site	Seasonal Microbial Count per ml								
		Winter			Summer			Rainy		
		Total count	*E.coli*	*Pseudomonas spp*	*Total count*	*E.coli*	*Pseudomonas spp*	*Total count*	*E.coli*	*Pseudomonas spp*
1.	**S-1**	***2240***	***232***	***228***	***3614***	***280***	***311***	***4136***	***528***	***481***
2.	**S-2**	***2508***	***293***	***117***	***3021***	***331***	***137***	***7082***	***693***	***457***
3.	**S-3**	***2554***	***167***	***235***	***3348***	***107***	***244***	***8542***	***547***	***524***
4.	**S-4**	***1936***	***119***	***127***	***2206***	***92***	***196***	***6936***	***363***	***276***

***S-1 = Boat club; S-2 = Koh-e-Fiza; S-3 = Karbala; S-4 = Bairagarh region.**

Rainy season is reported to be high water contamination in the range of $41.36\times 10^2$to 69.36×10^2CFU per ml followed by summer ranging from $22.06\times10^2$to 36.14×10^2CFU per ml than

winter ranging from 19.36× $10^2$to 25.54 × 10^2 CFU per ml. From table 2 and figure 2 the standard plat count of *E.coli* on McConky's agar plat at 10 fold dilution is again reported to be highest in rainy season followed by summers then winters. Out of the four sites, S-1 and S-2 were relatively higher in *E.coli* counts in all seasons of the year, may be due to being closest contact to city and large anthropological activates, garbage and sewage disposals.From table 1 and 2, though the BOD values of S-3 and S-4 sites were higher than the other sites but their *E.coli* count were lower than S-1 and S-2, since they were distant from urban activity. With reference to table 2 and figure 3, similar styles of effects were observed in *Pseudomonas* spp. count. Prasad *et al*., (2015) [15] estimated *E.Coli* , *Staphylococcus, Pseudomonas* and *Bacillus* Species in winter, summer and rainy season of Bhopal's upper lake while studying its microbial diversity. Byragi Reddy, *et al*., (2014) [16] reported 0.69 × 10^4CFU/100ml to 2.01 ×10^4CFU /100 ml, faecal coliform counts on Eosin Methylene Blue agar plate In Water Samples From Tribal Areas Of ChintapalliMandal,Visakhapatnam District, Andhra Pradesh, Indiaexceeding the standard limit. [17]

Absence of fecal microorganisms in water bodies has been considered safe for human and animal use in general.[18] Detection of indicator microorganism that is coliforms and *E. coli* in water samples is the best method of microbiological water quality monitoring.[19] The usability of water from any source is determined by its bacteriological analysis and with reference to Indian standards [17] there must be no detectable coliform per 100 ml samples in 95% of waters throughout the year.[20]

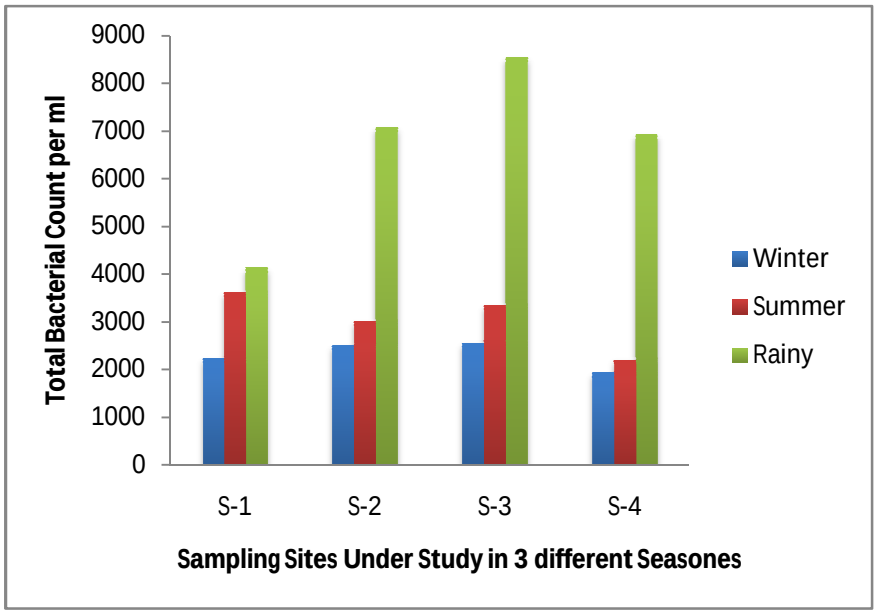

Figure 1: Graphical description of seasonal variations in total microbial count in shallow region water samples of upper lake catchment areas of Bhopal; where, sites S-1 = Boat club; S-2 = Koh-e-Fiza; S-3 = Karbala; S-4 = Bairagarh region.

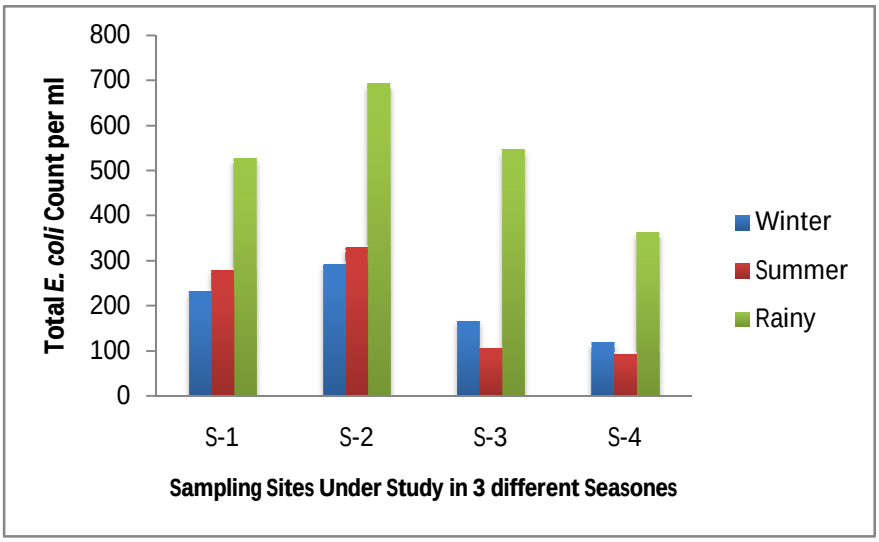

Figure 2: Graphical description of seasonal variations in *E. coli* count in shallow region water samples of upper lake catchment areas of Bhopal; where, sites S-1 = Boat club; S-2 = Koh-e-Fiza; S-3 = Karbala; S-4 = Bairagarh region.

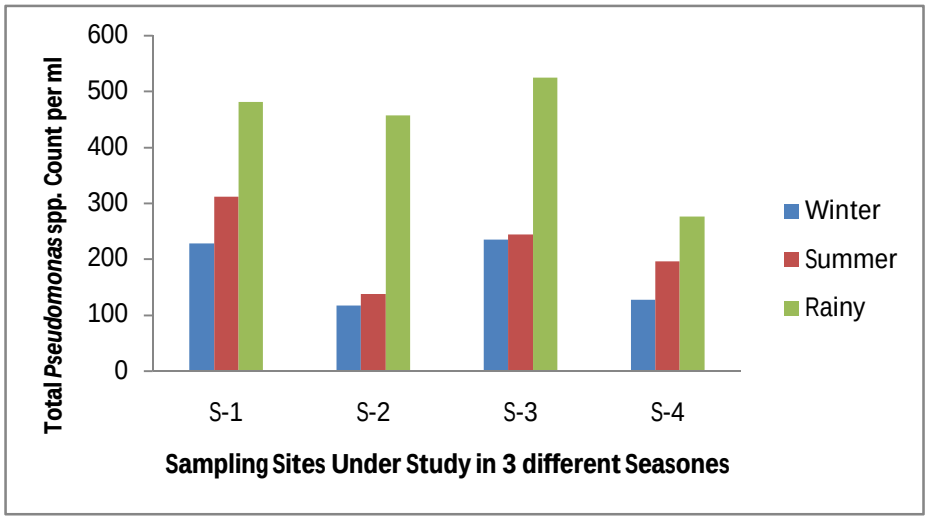

Figure 3: Graphical description of seasonal variations in *Pseudomonas* spp. count in shallow region water samples of upper lake catchment areas of Bhopal; where, sites S-1 = Boat club; S-2 = Koh-e-Fiza; S-3 = Karbala; S-4 = Bairagarh region.

The fish species of ornamental variety in the shallow regions of all the sites taken in study were mainly *Trichogasterlalius*, *Trichogasterfasciata*, *Badisbadis*, *Puntiussophore*, *Systomussarana*, *Glossogobiusgiuris*, *Channagachua*, and *Clariasbatrachus* (table 3). Sharma, *et al.*, (2014) [5] also reported these ornamental fishes in Upper Lake of Bhopaland all of them are eatable varieties. These fishes were almost commonly seen throughout the year in the shallow regions. But it was observed on the collective basis, that the occurrence of these species was increases in winter while decreases greatly in numbers in rainy season from shallow regions of all the sites of study. During summers the shallow water regions were having varied fish verities but in few numbers. The occurrence of fishes in particular region is dependent on water environment, also the presence of microbes on in and on the fishes is the indicator of water pollution, and consequently microbial contamination may affect the presence or absence of fishes in water body. [3,21] Thus with reference to table 1 and 2 the seasonal variation in microbial count and aquatic environment, the occurrence of these fishes in shallow region could be related.

Table 3:Occurrence of ornamental fishes observed in the shallow water region Catchment areas of Bhopal Upper lake at four sites under study on collective basis during winter summer and rainy season of year 2014 (sites S-1 = Boat club; S-2 = Koh-e-Fiza; S-3 = Karbala; S-4 = Bairagarh region)

S.N	Fish Species	Common name	Family
1	*Trichogasterlalius*	Dwarf gourami	Osphronemidae
2	*Trichogasterfasciata*	Banded gourami	Osphronemidae
3	*Badisbadis*	Badis	Badidae
4	*Puntiussophore*	Pool barb	Cyprinidae
5	*Systomussarana*	Olive barb	Cyprinidae
6	*Glossogobiusgiuris*	Tank goby	Gobiidae
7	*Channagachua*	Gachua	Channidae
8	*Clariasbatrachus*	Philippine catfish	Clariidae

Conclusions

Microbial contamination of water significantly affects the health of animals. The seasonal variegation number of microorganisms especially coliforms, *E.coli* and *Pseudomonas* largely depends on the amount of nutritional components and supportive aquatic environment of any aquatic system. The over count of indicator as well as pathogenic microbial community in aquatic system also affects the fish fauna either due to pathological condition or by generating an environment unsuitable for their life. Thus, in present study seasonal variation in BOD and microbial count was observed on the site taken in study that could be related to seasonal variation in the occurrence of number of ornamental fish species on collective basis. Such results should further be subjected to extensive investigations to generation strong scientific data in future studies that could be used in conservation of lake and biodiversity of fish fauna in the direction of socio-economic development.

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