International Journal of Theoretical & Applied Sciences,
Special Issue onEnvironmental Contaminants and Management

10(1): 126-131(2018)

ISSN No. (Print): 0975-1718
ISSN No. (Online): 2249-3247

Assessment of Physico-chemical Parameters and rotifera of Brarinambal basin of Dal Lake, Kashmir

Sameera Siraj[1], Sualiha Tabassum[2] and Aubid Bashir[2]
[1]Department of Zoology, S.P. College Srinagar (J&K), India
[2]Hydrobiology Research Laboratory, S.P. College Srinagar (J&K), India

(Corresponding author: Sameera Siraj)
(Received 12 November, 2017 accepted 15 December, 2017)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A systematic study of physico-chemical parameters of the Brarinambal basin, an important basin of Dal lake, was carried out on monthly basis for a period of one year. The study revealed that the basin has alkaline water (pH 7.3–7.9) with water temperature ≤ 31°C, transparency 0.2m–0.8 m, DO 0.2 mg/l – 3.0 mg/l. The cation concentration was Ca > Mg >Na > K while the anion concentration was HCO_3^-> PO_4^->NO_3^- > Cl^-. The nutrient content was quite high which clearly show that the basin is hypereutrophic in nature.

I. INTRODUCTION

The Dal lake, covering an area of 11.4 sq km, is situated between 34°5 ´ and 34° 6´ N latitude and 74° 8´ and 74° 12´ E longitude at an altitude of 1584 a. s. l. It is shallow open drainage type water body divided into five basins – the Hazratbal, the Lokut Dal, the Gagribal, the Nigeen and the Brarinambal basin. In recent years the exceptionally high human interference in and around the lake has accelerated the deterioration of its water quality as a result of which the changes must have occurred in the biota as well. This work evaluates the surface water quality in terms of physio-chemical parameters for the Brarinambal basin of the Dal lake. A lot of research has been carried out on the limnology of Dal lake [4,6,7,9] yet the Brarinambal basin has not so for been exclusively studied. Consequently, the present endeavour has been made to study the Brarinambal basin which differ tremendously in nature and extent of pollution as compared to other basins of Dal lake. Dal lake particularly Brarinambal basin is undergoing fast eutrophication due to pollution caused by agricultural practices in the catchment area which has subsequently enriched the lake water with enormous inputs of fertilizers, nutrient content, organic matter from both autochthonous and allochthonous modes etc.

Study sites: Brarinambal basin is located on South Eastern corner of Dal Lake (Fig. 1). It is ecologically most degraded basin of the lake having settlements all around, which discharge their wastes directly into this basin. The macrophytic association included *Potamogeton* sp, *Ceratophyllum* sp., *Lemna* sp., *Salvinia* sp. Besides this *Typha*, *Phragmites* and *Salix* plantation have also occupied a large part of this basin.

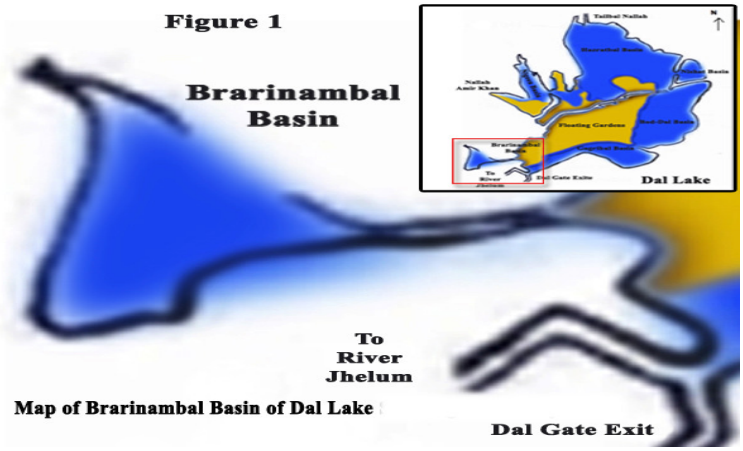

Fig. 1. Map of Dal Lake showing different basins and study sites during study period.

II. MATERIAL AND METHODS

Water samples were collected on monthly basis using Rutner type water sampler. Temperature, transparency, pH and electrical conductivity were measured in the field. In order to determine the water quality, water samples were kept in 5 L polythene cans wrapped with carbon. The samples for Dissolved oxygen were fixed on the spot as per azide modification of Winkler's method. All water samples were stored in insulated cooler containing ice and delivered on the same day to laboratory and all the samples were kept at 4°C until processing and analysis. Free CO_2, total alkalinity, chloride were determined by titrimetric method [2]. Phosphate (Stannous chloride method), Nitrate (Salicylate method), Nitrite (buffer color reagent method) and ammonia (Phenate method) were analyzed with the help of Systronics 106 Spectrophotometer in accordance with CSIR [3]. Total hardness, Ca and Mg was done by tritrimetric method. COD determined on the same day of the sampling by utilizing spectroquant photometer of Merck. While as for evaluating BOD, five day incubation time at 20°C is a must and is measured by subtracting DO on fifth day from DO on first day multiplied by appropriate dilution factor. Colour was analysed visually by comparing the water samples with colour standards made of potassiumchloroplatinate (K_2PtCl_6) and cobaltous chloride ($CoCl_2.6H_2O$) in double distilled water.

III. RESULTS AND DISCUSSION

The data on monthly fluctuations in various physico-chemical features are presented in Table 1.

Table 1: Physico-chemical parameters of Brarinambal basin of Dal Lake during study period.

PARAMETERS	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Air temperature (°C)	7.9	7.9	18	20	24	24	34	32	30	17	16	13
Water temperature (°C)	6.2	7	16	18	20	22	31	31	27	15	13	12
Transparency (m)	0.3	0.8	0.4	0.3	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4
DO (mg/l)	2.4	2.6	3.0	2.0	1.5	1.2	0.2	0.6	1.1	1.2	0.4	2.4
pH(units)	7.3	7.5	7.4	7.7	7.6	7.7	7.9	7.6	7.5	7.7	7.6	7.4
Conductivity (µS/25°C)	666	565	563	622	639	641	659	685	832	680	635	640
Chloride (mg/l)	59	68	34	86	62	56	42	56	64	74	56	63
Free CO_2 (mg/l)	42	40	40	29	17	15	16	15	25	32	49	40
Total alkalinity (mg/l)	418	432	308	329	204	138	130	158	165	132	121	350
Carbonate(mg/l)	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab	Ab
Bicarbonates (mg/l)	415	430	338	359	254	138	149	155	163	135	128	360
Total Hardness(mg/l)	238	247	202	219	238	240	225	205	249	259	257	284
Ca(mg/l)	128	125	110	97	96	96	90	75	86	101	87	114
Mg (mg/l)	36	28	24	30	34	32	31	32	39	39	39	48
Na (mg/l)	16	13	14	15	14	10	14	12	12	28	20	26
K(mg/l)	3	3	3	4	3	3	4	3	3	3	5	5
Ammonical–Nitrogen (µg/l)	1224	1261	975	1025	986	866	1075	875	975	970	1180	1072
Nitrate-Nitrogen (µg/l)	219	193	88	79	91	76	143	53	87	76	173	146
Nitrite-Nitrogen (µg/l)	68	75	96	31	26	73	109	33	44	85	106	96
Ortho-phosphate(µg/l)	233	273	259	241	524	523	404	443	223	303	414	213
Total –phosphate (µg/l)	875	1357	999	1875	1343	1198	1963	2034	2335	1986	1465	1098
COD (mg/l)	84	75	56	89	72	98	136	157	115	89	93	110
BOD(mg/l)	23	28	31	28	32	35	47	52	32	30	29	31

Note: Ab = Absent

Water temperature fluctuated in close relation with air temperature recorded peaks in July and minima in Jan and Feb. Throughout the basin the transparency was generally low being due to increased silt load and suspended matter brought in from the catchment area as well as due to rich macrovegetation. DO values were maximum (2.6 mg/l) in Feb and minimum (0.2 mg /l) in July. Relatively lower concentration of DO in spite of rich macro-vegetation can be related to hyper eutrophication condition of the basin which is the result of high rate of decomposition of organic matter throughout the year. The lower value of dissolved oxygen was also due to cumulative effect of human activities like dumping of solid wastes or other residential outlet wastes flowing into it. Depletion of dissolved oxygen in water probably is the most important indicator of certain forms of water pollution [10]. Although the water was always alkaline yet lower pH was recorded in cooler months. During this period macrophytes die partially or completely and their decomposition leads to increase in CO_2 content and decrease in pH of water. This is corroborated by high free CO_2 values during winter. The conductivity was high throughout the year with its peak in September (832 µs cm^{-1}) indicating the richness of ions in the water. This is also substantiated by the significantly high value of chloride in the basin.

According to Ometo *et al.* [8] in more urbanized areas increased concentration of chloride and sodium is due to human sewage, whereas in rural areas it is due to entry of water from agricultural fields. Total alkalinity varied from 128 mg/l (Nov) to 430 mg /l (Feb) thereby suggesting the basin to be a typical hard water. The alkalinity was mainly due to bicarbonates and the change in its concentration was directly reflected in a change in total alkalinity. Carbonates were totally absent during the whole study period. Higher values of total alkalinity in winter could be attributed to lower pH values (<7.3) as a result of which insoluble carbonates get changed into bicarbonates which are readily soluble in water. Total hardness values varied from 202mg/l (Mar) to 284 mg/l (Dec). Ca being most abundant ion in freshwater varied from 75 mg/l (Aug) to 128 mg/l (Jan) while Mg varied from 24 mg/l (Mar) to 48mg/l (Dec). Decline in the values of Ca and Mg from Mar to July might be due to utilization by phytoplankton and growing macrophytes. The concentration of Na varied from 10 mg/l (June) to 28 mg/l (Oct) while K varied from 3 mg/l to 5 mg/l showing a ratio of 3:1 between Na and K.

The mean values of NH_4-N varied from 875 µg/l during Aug to 1261µg/l during Feb. Nitrates varied from 53 µg/l in Aug to 219 µg/l in Jan, while nitrite varied from 26µg/l in May to 109 µg/l in July. The concentration of orthophosphorus fluctuated between 223 µg/l in Sep to443 µg/l in Aug, while total phosphate phosphorus fluctuated between 875 µg/l in Jan to 2335 µg/l in autumn. The higher levels of nitrogen and phosphorus, especially the latter is due to the entry of large quantities of domestic sewage and agricultural runoff in to the basin not only through drains let in to the basin but also through the Dal lake. The COD of the water varied from 56 mg/l to 157 mg/l while BOD varied from 23 mg/l to 52 mg/l. On the basis of its physico-chemical parameters the basin can be regarded as belonging to hyper eutrophic category.

Biological Features: During the present study a total of 23 taxa of rotifera were recorded from the basin showing population density varying from 1ind/l to 24ind/l (Table 2). Of the recorded rotifer 11 taxa belonged to Branchionidae, 3 to Lecanidae, 2 each to Colurellidae, Gastropidae, Filinidae and 1 to Trichocercidae, Asplanchnidae and Philodinidae. Maximum contribution to the rotifer population density (%) was made by Branchionidae and Lecanidae (Fig. 2). Dominant species recorded were *Branchionus calyciflorus, Lepedella ovalis, Monostyla bulla, M. lunaris, M. quadidentata, Filinia longiseta.* All these species have been reported to be highly pollution tolerant species [1,5,11]. Besides bdelloids were recorded throughout the study period. Because of the contraction of their body in the preserved samples the identification of *Bdelloids* was not possible and as such all the organisms belonging to this group are reported under a single heading.

Table 2: Population density of different taxa reported from Brarinambal Basin of Dal Lake during study period.

Name of the taxa	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Branchionidae												
Branchionus angularis	0	0	0	0	1	2	6	6	2	1	1	0
B. bidentata	0	3	0	3	0	4	0	0	7	0	0	0
B. plicatilis	4	5	1	4	7	2	0	4	0	0	0	3
B. calyciflorus	0	0	1	4	19	15	5	17	0	2	0	0
B. quadridentata	0	3	3	4	2	2	3	2	0	0	3	0
Keretellacochlearis	0	3	2	0	0	2	5	0	0	0	0	0
K. quadrata	0	0	0	6	4	0	2	0	2	0	0	2
K. tropica	0	0	1	0	0	1	1	0	0	0	0	0
Platiyas quadridentata	0	0	0	0	12	18	0	0	0	0	0	0
P. patulus	0	0	0	1	4	1	5	1	0	0	0	0
P. quadricornis	0	0	0	0	2	2	2	0	0	0	0	0
Colurellidae												
Lepadellaovalis	0	0	1	1	7	14	17	12	0	7	0	0
L. patella	0	0	4	2	0	2	2	2	0	0	0	0
Lecanidae												
Monostyla bulla	0	0	11	0	7	14	5	14	24	11	0	0
M. lunaris	0	0	0	1	15	12	14	5	14	11	0	0
M. quadridentata	0	0	4	5	12	14	12	2	3	14	1	1
Trichocercidae												
Trichocerca longiseta	0	0	0	0	0	0	2	0	00	0	0	0
Ascomorpha sp	0	0	1	0	4	2	1	0	0	0	0	0
Gastropidae												
Gastropus sp	0	0	1	0	1	2	0	4	2	0	0	0
Asplanchnidae												
Asplanchna priodonta	0	0	1	1	0	0	0	0	0	0	0	0
Filinidae												
Filinia longiseta	0	1	1	5	1	9	17	7	11	15	9	7
F. terminalis	0	0	2	3	1	1	0	0	4	1	0	0
Philodinidae												
Philodina sp			2	0	7	4	5	0	0	8	0	0
Bdelloids	1	2	5	1	2	7	1	2	2	1	2	1

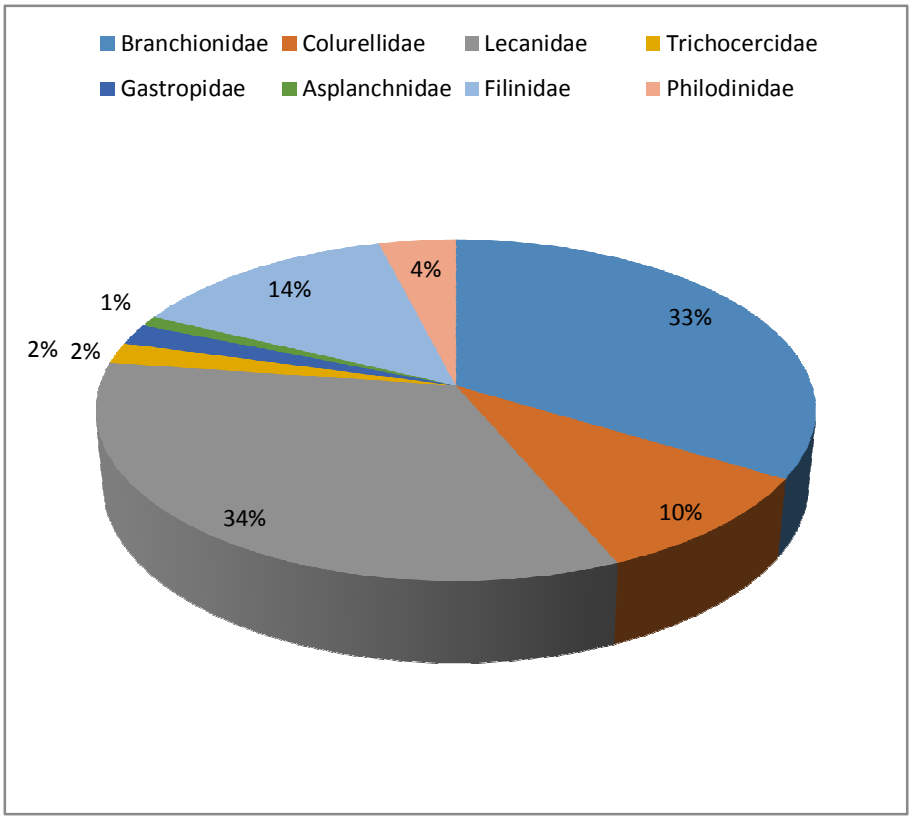

Fig. 2. Graph of population density (%) of different taxa reported from the Brarinambal Basin of Dal Lake during study period**.**

Correlation Analysis of Physico-Chemical Parameters. Correlation analysis is a preliminary descriptive technique to estimate the degree of association among the variables involved. The purpose of the correlation analysis is to measure the intensity of association between two variables. Such association is likely to lead to reasoning about the causal relationship between the variables. In this study, the relationship between various elements has been studied using Pearson correlation matrix. Most of the parameters were found to bear statistically significant correlation with each other indicating a close association of parameters with each other. The correlation analysis of water samples was analyzed and shown in Table 3.

IV. CONCLUSION

From the present study it is concluded that due to extensive anthropogenic pressure, pollution load, organic matter outcome, large quantities of raw sewage, direct drainages etc. the physico-chemical factors of the water have directly or indirectly influenced the trophic status of the Brarinambal Basin of Dal Lake. These changing factors has turned this basin into a critical stage from the ecological point of view and if proper conservation measures are not taken in future, the basin will likely deteriorate further and will soon turn into a garbage yard. Hence proper management measures are needed to be taken by Government authorities and local inhabitants to prevent the basin from rest deterioration.

Table 3: Pearson correlation matrix of Physico-Chemical parameters of Brarinambal Basin of Dal Lake.

	Air-Temp	H_2O-Temp	Transparency	Conductivity	DO	pH	Cl	Free Co_2	Total alkalinity	Total Hardness	Ca	Mg	Na	K	BOD	COD	Ammonical - N	Nitrite-N	Nitrate -N	Orthophosphorus	Total Phosphorus
Air Temp	1																				
H_2O Temp	0.972	1																			
Transparency	-0.76	-0.787	1																		
Conductivity	0.51	0.62	-0.4	1																	
DO	-0.76	-0.51	0.4	-0.4	1																
pH	0.6	0.52	-0.3	0.06	-0.7	1															
Cl	-0.34	-0.5	0.19	0.16	-0.08	0.07	1														
Free CO_2	-0.890	-0.7	0.6	-0.33	0.4	-0.6	0.04	1													
Alkalinity	-0.71	-0.6	0.49	-0.4	0.8	-0.6	0.18	0.49	1												
Total Hardness	-0.41	-0.63	0.24	0.19	0.07	-0.17	0.3	0.38	-0.0	1											
Ca	-0.8	-0.4	0.5	-0.48	0.8	-0.6	0.07	0.59	0.8	0.27	1										
Mg	-0.14	-0.2	-0.1	0.4	-0.1	-0.1	0.30	-0.22	-0.17	0.84	-0.02	1									
Na	-0.42	-0.3	0.17	-0.03	0.06	-0.09	0.28	0.49	-0.0	0.65	0.2	0.67	1								
K	.-0.12	-0.2	1.9	-0.13	-0.18	0.10	0.05	0.4	-0.0	0.45	-0.09	0.52	0.48	1							
BOD	0.8	0.7	-0.3	0.18	-0.62	0.5	-0.39	-0.7	-0.55	-0.4	-0.68	-0.17	-0.3	-0.05	1						
COD	0.6	0.8	-0.3	0.5	-0.68	0.3	-0.06	-0.5	-0.51	-0.07	-0.6	0.2	-0.09	0.17	0.94	1					
Ammonical N	-0.6	-0.8	0.5	-0.3	0.2	-0.3	0.09	0.7	0.5	0.34	0.6	0.08	0.19	0.32	0.36	0.46	1				
Nitrite N	-0.2	-0.4	0.2	-0.31	-0.01	-0.03	-0.50	0.64	0.4	0.3	0.265	0.14	0.4	0.46	-0.3	-0.49	0.84	1			
Nitrate N	-0.6	-0.8	0.4	-0.25	0.2	-0.3	-0.08	0.48	-0.08	0.38	0.65	0.178	0.15	0.31	-0.4	-0.30	0.36	-0.13	1		
Orthophosphorus	0.4	0.4	-0.4	-0.08	-0.5	0.5	-0.25	-0.6	-0.59	-0.20	-0.5	-0.18	-0.3	-0.12	-0.3	-0.22	-0.4	-0.31	-0.30	1	
Total Phosphorus	0.6	0.8	-0.16	0.6	-0.64	0.5	0.30	-0.4	-0.58	-0.11	-0.7	0.05	-0.05	-0.07	-0.54	-0.44	-0.3	-0.08	-0.49	0.81	1

ACKNOWLEDGEMENT

The first author is highly thankful to Professor A.R. Yousuf (Ex-Director, CORD) for providing laboratory facilities during research program.Thanks are also due to fellow colleagues for their support and help during lab course and field visits.

REFERENCES

[1]. AH Ismail and AA M Adnan (2016). Zooplankton Composition and Abundance of Eutrophic in Two Small Man-Made lakes. *Trop. Sci. Res*. **27**(Suppl): 31-38.

[2]. APHA (1998). *Standard Methods for the Examination of Water and Waste Water*, APHA, AWWA, WEFA. Washington, D.C.

[3]. CSIR (1975). *Analytical Guide* (*Laboratory Techniques*), CSIR, Pretoria, South Africa.

[4]. SH Dar, AA Khan, TA Shah, and QJ Shami (2016). Assessment of Physico-chemical parameters of Dal lake, Srinagar Kashmir. *International journal of Innovative Research and Advanced Studies*, **3**(11).

[5]. M Agrawar and M K Agrawal (2011). Cyanobacteria – herbivore interaction in freshwater ecosystem. *Journal of Microbiology and Biotechnology Research*. **1**(4): 52-56.

[6]. M F Mir, A.Bashir, MY Gudoo, S Tabassum, RFarooq and S Bundh (2017). Sediment chemistry and macrozoobenthos of Gagribal basin of Dal lake. *International Journal of Fauna and Biological studies*, **4**(4): 126-130.

[7]. B Mushtaq, R Raina, T Yaseen, A Wanganeo and A R Yousuf (2013). Variations in the physico-chemical properties of Dal Lake, Srinagar, Kashmir. *African Journal of Environmental Science and Technology*, **7**(7): 624-633.

[8]. JPHB Ometto, LA Martinelli, MVR Balester, AGessner, AV Krusche, RL Victoria and M Williams (2000). Effects of land use on water chemistry and macroinvertebrates in two streams of Piracicaba river basin, southeast Brazil. *Freshwater Biology,* **44**: 327-337.

[9]. M Parveen (1988). *Ecological Studies of Zooplankton of Dal lake, Kashmir*. Ph.D. thesis. Univ. of Kashmir.

[10]. N. Srivastava, G Harit, R. Srivastava, (2009). A study of physico-chemical characteristics of lakes around Jaipur, India, *Journal of environmental biology*, **30**(5): 889-894.

[11]. R.S. Virani and P.M. Makode (2011). Role of rotifer diversity in a tropical lentic ecosystem with reference to eutrophication. *Biosci. Biotech. Res. Comm*. **4**(1): 55-64.