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Stress of Environmental Pollution on Zooplanktons and theirComparative Studies in Dal Lake, Wular lake Ancharlake and Manasbal Lake, inSrinagar, Kashmir.

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----------**ABSTRACT**----------

Comparison of Zooplanktons at the selected sites of Dal Lake, Wular lake, Anchar lake and Manasbal lake were carried out (July 2000 to Aug 2002 and March 2013 to Apr 2014) to find the changes in the water quality over the years. For physico-chemical analysis of water, sampling was done once in a month and samples were collected from both surface and bottom of the Lake in polyethylene bottles of 1 L capacity from pre-selected sites with the help of Ruttner type water sampler. The water temperature in general ranged from 4-27^{o}C respectively with usual trend maximum in summer and minimum in winter. The pH values fluctuated between 7.1 and 9.3 respectively indicating the Lakes to be on alkaline side. A total of 40 taxa of Zooplankton were recorded during both the periods of study. Previous studies were carried out from July 2000 to Aug 2002, a total of 27 rotifer and 13 crustaceans and from March 2013 to Apr 2014, 8 rotifer and 5 crustacean taxa were recorded respectively. Due to anthropogenic activities the number of zooplanktons has been decreased from last decade in said lakes.

Keywords:*Zooplankton, Dal Lake, Wular lake, Anchar lake and Manasballake , water quality, physico-chemical analysis, rotifer, crustaceans.anthropogenic*

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I. INTRODUCTION

Kashmir, being predominantly an agricultural economy and having water and land as its most valuable natural resources, has lakes as the main sources of water, followed by rivers, streams and springs. These water bodies have a bearing on the economy of the state besides providing us the source of portable water, fish, vegetable foods and fodder. The freshwater bodies of Kashmir have not remained immune to anthropogenic pressures as a result of which many water bodies have got deteriorated during the last 50 years. As a result of degraded water quality, aquatic biodiversity has also got severely affected.

In an aquatic ecosystem the life of aquatic biota is closely dependent on the physical, chemical and biological characteristics of water, each of which directly acts as a controlling factor. Therefore, for understanding the dynamics of an organism, a population or a community, knowledge of both the organism and its environment is required. It is in this backdrop of the rich biodiversity of the world famous Wular lake, a Wetland of International Importance (Ramsar site) confronting a number of ecological stresses, the present study on crustaceans, an important component of zooplankton community in terms of its diversity and abundance has been undertaken during 2013-2014 with a view to obtain the baseline data on such an important group of animals serving as an important link in theaquatic food chain and being very good and sensitive bio indicators to monitor the trophic status of the water body. The importance of zooplankton in other studies has also been highlighted by many workers. The occurrence and abundance of zooplankton depends on the productivity of the lake, which in turn is influenced by abiotic factors and the level of nutrients in the water body. Further, zooplankton occupies a key position in ecological pyramids and their role in trophic-dynamics is noteworthy (Pandit, 1980, 99). The physico-chemical parameters and nutrient status of water body play an important role in governing the production of plankton (especially zooplankton) which is the natural food of many species of fishes and also support the necessary amount of protein for the rapid growth of larval carps (Rahman and Hussain, 2008). Major zooplankton forms vary in their relative abundance and they belong to three groups: (i) Phylum Protozoa, (ii) Phylum Rotifera and (iii) Class Crustacea which is itself composed of orders like Cladocera, Copepoda, and Ostracoda.

Kashmir Valley situated in the northern part of Indiawithin the Himalayan region has a number of fresh waterbodies. These water bodies have a great diversity due totheir differences in origin and altitude. Increasingpopulation on the other hand has been responsible forintroducing many undesirable changes to these waterbodies. Among these, the Dal Lake, WularLake, AncharLake and Manasbal Lakeover the years, havebeen subjected to over exploitation for economicpurposes. Open water areas of the Dal Lake, WularLake, AncharLake and Manasballake have beenconverted into floating gardens to enhance agriculturalproduction while lake peripheries have been encroachedupon to construct residential houses and hotels. A largenumber of houseboats have encroached within the lakearea. Household wastes and sewage are drained into thelake indiscriminately at several sites. Agricultural run-offfrom the surrounding fields, especially the fertilizer andpesticide wastes from the floating gardens enter into thelake water. The excessive load of nutrients in the Lakewater has resulted into luxuriant growth of aquatic plants. This indiscrimination has led to the pollution and encroachment in certain areas mostly in littoral and limnetic zones from which the aquatic life have been totally vanished or vulnerable. This leads to environmental stress on limnetic water bodies and aquatic life.

1.1Literature Survey

However, due to multiple of problems the lakes isheading towards its destruction. With this background,the present study was carried out at the selected sites ofDal Lake, Wular lake, Anchar lake and Manasballake ,at two different periods of time to find out thechanges in the water quality over the years and itsimpact on Zooplanktons especially crustaceans like calanoids, , coyclopoids, cladocerans, copepoda, rotifera and other organisms. The present study will alsoreveal the impact of de-weeding and the magnitude ofthreat imposed by discharges from urban humansettlements to the ecology of the lake, so that possibleconservative measures could be undertaken to restorethe aquatic life.

1.2 Materials and Methods

The present study would prove useful in understanding the conservative planning and management of polluting factors.

1. ***Water sample:***Water samples were collected from foursites of the Dal Lake, Wular lake, Anchar lake and Manasballake for a period of two seasons extendingfrom March -April 2014and June - July 2014(Fig. 1a-c).

Fig. 1a. De-weeder in Dal Lake, Wular lake, Anchar lake and Manasballake .

Fig. 1b.Encroachment of Dal Lake, Wular lake, Anchar lake and Manasbal lake , Kashmir.

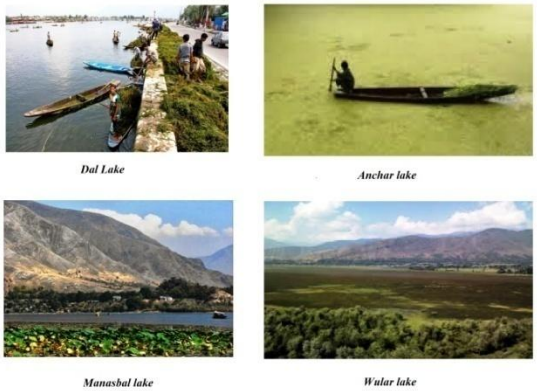

Fig. 1c.Aquatic plants at the periphery after removalfrom the Dal Lake, Wular lake, Anchar lake and Manasballake.

2. Physico-chemical analysis: Sampling was done once in amonth and samples were collected from both surfaceand bottom of the Lakes in polyethylene bottles of1 L capacity from pre-selected sites with the help ofRuttner type water sampler (Ruttner, 1968). Samplingwas done between 10 am to 12 noon. For thephysico-chemical analysis, standard methods assuggested by Welch (1948), Murphy and Riley (1962),Mackereth (1963), Golterman and Clymo (1969), TrivedyandGoel (1986) and APHA (1989) were followed.

3. Zooplankton sampling: Zooplankton sampling was carriedout on monthly basis from March 2013 to Apr 2014. However, the sampling fromMarch 2013 to Apr 2014 was done on seasonal basis(2 seasons) from the open water areas of the Lake almostdevoid of aquatic plants. The study of zooplankton wasdivided into two parts, viz., qualitative and quantitativeanalysis. For Qualitative analysis, standard planktonicnet (64 nm pore dia) was hauled through vertical andhorizontal planes of the lake at selected sites.The plankton collected in the 50 mL polyethylene bottleconnected at the lower end of the net was preserved in5% formalin. Then, 1 mL of this sample was taken at atime in a Sedgwick Rafter chamber and studied underthe phase contrast inverted microscope (Nikon) andsimple microscope. The identification was done with thehelp of keys given by Ward and Whipple (1959),Mellanby (1963), Pennak (1978) and Tonapi (1980).To collect sample for quantitative analysis of zooplanktonpopulation, 10 L of water was filtered through theplankton net and the water was allowed to filter throughthe net, the planktons were concentrated in the 50 mLpolyethylene bottle connected at the lower end of the net.The sample thus, obtained was preserved in 5% formalinand further reduced in volume to 5 mL by centrifugation.About 1 mL of concentrated preserved sample was takenat a time in a Sedgwick Rafter Chamber (Whipple et al.,1927) and counting was done for each zooplanktontaxon. The entire 5 mL of the concentrated sample wasstudied under phase contrast inverted microscope(Nikon) and other microscope. The results are expressedas individuals per litre.

Parameters Range	Parameters Range			
	Dal lake	Wular lake	Anchar lake	Manasbal lake
Temperature (^oC)	27.00 ± 5.00	18.87±0.93	3.1-25.6	20.0±1.00
pH	8.14 ± 0.45	7.44±0.19	7.96-8.39	8.18±0.10
Conductivity (µS/cm)	136.00 ±27.13		296.4-461.10	307.83±12.77
Dissolved oxygen (mg/L)	9.05 ± 2.04	4.3±1.28	2.0-06.9	5.83±0.28
Calcium (mg/L)	17.6-55.3	34.02±9.33	13.8-58.6	38.66±0.91
Magnesium (mg/L)	2.4-20.4	18.89±4.23	3.7-16.8	9.50±0.95
Total alkalinity (mg/L)	110.25 ±20.55	82.37±11.65	236.4-381.	98.16-108
Chloride (mg/L)	141.60 ±52.09	20.81±1.18	20.2-52.8	5.33±0.42
Nitrate-nitrogen (µg/L)	280.00 ±80.00	28.4±42.2	137.3-323.4	88.83±2.13
Total phosphorus (µg/L)	92.25 ±19.34	1.00±0.83	287.7-512.4	58.50±3.75

Table 1.Physico-chemical characteristics of Dal Lake, Wular lake, Anchar lake and Manasballake.

II. RESULTS AND DISCUSSION

The physico-chemical features of water are summarizedin Table 1. The water temperature in general rangedfrom 4-27^oC of four lakes respectively, with usual trend with maximum in summerand minimum in spring. The pH values fluctuatedbetween 7.1 and 9.3 indicating the Lakes to be on alkaline. The conductivity values put the Lake water underβ-mesotrophic. The calcium and magnesium valuesfollow the progression as Ca>Mg. The total alkalinityshowing that the water is moderately hard. The richchloride contents in these Lakes indicate the presenceof organic pollution. Overall, the Dal Lake, Wularlake, Anchar lake and Manasbal lake water is alkaline, moderately hard and nutrient rich in NO_3-N andP-PO_4.

Zooplankton in the Dal Lake, Wular lake, Ancharlake and Manasbal lake is represented by rotifersand crustacean (Jeelani*et al.*, 2005). A total of 40 taxa ofZooplankton of Dal lake were recorded during both the periods ofstudy. In the past studies carried out from July 2000 to Aug 2002, a total of 27 rotifer and 13 crustaceansand fromMarch 2013 to Apr 2014, 8 rotifer and 5 crustacean taxawere recorded respectively (Table 1,2 3 and 4; Fig. 4). Therotifer fauna shows single peak in population densityduring summer at all the sites in both the studies. Thesite-I is open water area of these Lakes which does notreceive domestic water directly. The site-II is shallow anddensely vegetated with macrophytes and at this site,species diversity and population was highest of all thesites. Both site-III and site-IV receive direct discharge ofdomestic sewages. The species composition has beenfound to be almost similar except *Brachionusangularis*Pallus which is found at site-IV. However, over a periodof one decade, there has been a decline in the number oftaxa of rotifer in the Lakes evident from the studies carriedout from March 2013 to Apr 2014 in which only 8 rotifertaxa were recorded. Crustacean population in both theperiods of study increased during summer with a singlepeak. In all, 13 crustaceans belonging to cladoceraandcopepod were recorded during July 2000 to Aug 2002.Out of these, 12 were present at site-I and 13 each at allother sites of the Lake. However, during the studiedperiod from March 2013 to Apr 2014, the crustaceandiversity has shown a considerable decrease over aperiod of time.

	Site-I	Site-II		Site-III		Site-IV	
		(S)	(B)	(S)	(B)	(S)	(B)
March							
Rotifera	78	48	42	42	36	48	36
Cladocera	18	24	36	24	30	42	18
Copepoda	12	12	24	24	18	18	06
April							
Rotifera	48	42	36	36	24	18	12
Cladocera	24	18	18	24	12	12	06
Copepoda	12	06	12	12	06	06	06
May							
Rotifera	42	30	24	42	12	18	18
Cladocera	36	18	12	24	06	12	06
Copepoda	12	06	06	12	06	06	06
June							
Rotifera	72	78	36	30	24	18	24
Cladocera	24	12	18	24	06	12	12
Copepoda	18	06	12	06	06	06	06

Table 1.Zooplankton Enumertation for the month of March-June 2014 for the open water expanse of the Dal lake

	Site-I	Site-II		Site-III		Site-IV	
		(S)	(B)	(S)	(B)	(S)	(B)
March							
Rotifera	82	52	43	43	37	51	37
Cladocera	19	28	38	26	36	46	21
Copepoda	15	11	27	25	20	21	10
April							
Rotifera	54	44	38	35	28	20	13
Cladocera	26	19	20	27	15	23	11
Copepoda	12	09	18	13	08	08	07
May							
Rotifera	48	32	26	43	11	19	19
Cladocera	37	20	16	27	05	17	05
Copepoda	15	10	09	16	07	06	08
June							
Rotifera	73	81	38	32	26	20	26
Cladocera	28	16	22	28	10	15	16
Copepoda	16	07	14	09	08	10	09

Table 2Zooplankton Enumertation for the month of March-June 2014 for the open water expanse of the Walurlake

	Site-I	Site-II		Site-III		Site-IV	
		(S)	(B)	(S)	(B)	(S)	(B)
March							
Rotifera	72	44	39	38	39	40	34
Cladocera	14	18	30	19	24	35	15
Copepoda	10	11	20	21	16	15	04
April							
Rotifera	42	35	35	35	21	18	11
Cladocera	17	15	14	20	10	08	05
Copepoda	10	04	10	11	09	04	04
May							
Rotifera	44	28	20	40	11	15	16
Cladocera	30	12	07	20	07	11	07
Copepoda	11	03	05	10	04	02	06
June							
Rotifera	65	70	30	24	20	16	20
Cladocera	24	10	18	10	04	11	11
Copepoda	17	04	10	06	07	05	05

Table 3 Zooplankton Enumertation for the month of March-June 2014 for the open water expanse of the Ancharlake

	Site-I	Site-II		Site-III		Site-IV	
		(S)	(B)	(S)	(B)	(S)	(B)
March							
Rotifera	72	41	37	36	36	41	36
Cladocera	15	17	34	22	20	35	14
Copepoda	11	14	22	20	16	17	06
April							
Rotifera	41	35	38	31	20	21	12
Cladocera	18	19	12	21	11	10	05
Copepoda	13	06	11	09	11	04	05
May							
Rotifera	41	23	21	44	12	14	17
Cladocera	31	15	10	21	07	13	09
Copepoda	14	03	07	12	06	03	05
June							
Rotifera	64	70	32	21	19	17	21
Cladocera	24	14	13	11	06	12	10
Copepoda	18	06	11	05	06	06	05

Table 4 Zooplankton Enumertation for the month of March-June 2014 for the open water expanse of the Manasballake

Findings:-Rotifera>Cladocera>Copepoda>

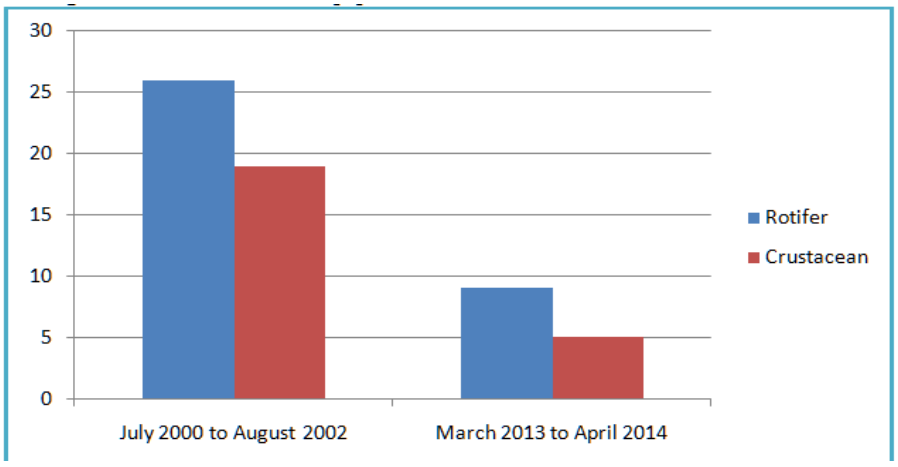

Fig. 4. Zooplankton diversity in Dal Lake, Wular lake, Anchar lake and Manasballake.

The excessive load of nutrients in the Lakes has resultedinto excessive growth of aquatic vegetation. In the recentpast, a large scale mechanical de-weeding in the Lakeshas resulted into loss of crustacean as the aquaticvegetation provides food and shelter to them.

III. CONCLUSION

Several measures are being taken to restore the pristine glory of the Dal Lake, Wularlake, Anchar lake and Manasbal lake back. However, few measuresadversely affect the Lake ecology in general.The machines in place for the removal of nutrient richsediments and aquatic plants from the Lakes resulted intoloss of biodiversity as is evident from this study.

The use of mechanical de-weeder has also resulted intothe loss of species diversity of Zooplankton in the Lakeover a period of time. The entry of untreated sewage,agricultural run-off from the floating gardens and solidwaste within and outside into the Lake water has resultedin nutrient enrichment of the water that has led toluxuriant growth of aquatic plants. In the recent pastreduction/erratic precipitation levels has led to decreaseof fresh water entry into the Lakes. At present, there is avery little control over point and non-point source ofpollution and the lack of public participation have alsoresulted into deterioration of the Dal Lake, Wularlake, Anchar lake and Manasbal lake waters.Concept of polythene recycling machine named (polyrecyler) designed by Ar.Taha Mughal under the supervision and guidance of Author Urfan Ali.This project was presented in 15th national children science congress 2007 at department of science and technology, vidhiyaprathisthanBaramatipune.(India)The machine was highly appreciated by jury from different professional universities and colleges.Schememattic representation of this machine is given below.For experiment yarinumbal site of Dal Lake was taken.

IV. DESIGN

This machine is made up of rotter blades and used on sites where polythene bags and other non-disposable items are thrown .By the help of rotter these materials is extracted from weeds(azolla)and the allow to shift into oil chambers where oil and other impurities was allow to absorb by any absorbent or hair could be used as substitute. Now from oil chamber polythene would be shifted to burning incinerator,which was a connected burning outlet. It is of two types one. Used for emitting gases and the gas were treated and made it suitable for extinguishers. While as other one outlet contains residue matter which would be set into steel mould and mixed with the material which could be used to make sanitary tiles

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