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Original Research Paper

Zooplankton Community in A Through Flow System of Kashmir Himalayan Wetland

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Key Words:
Zooplankton community
Wular wetland
Eutrophication
Physicochemical status
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Species diversity

ABSTRACT

Study on zooplankton community in through flow 'Wular' wetland revealed that Rotifera were dominant in diversity while Cladocerans in density. Among Rotifera *Keratella* sp., *Monostyla* sp. and *Polyarthra vulgaris* were perennial, and remaining seasonal. Among Cladocerans *Alona rectangula, Alona intermediata, Alonella exisa, Alonella nana, Chydorus sphaericus, Chydorus faviformis, Graptolebris testudanaria, Macrothrix spinosa, Macrothrix laticornis* and *Moina* sp. were perennial, and remaining seasonal. The reason for their seasonal variation has been correlated with different physicochemical parameters.

INTRODUCTION

A detailed investigation and documentation of Wular freshwater wetland is of utmost need in order to identify the problematic areas so that the proper steps could be taken for conserving its biodiversity. Since plankton community, especially zooplankton fluctuation, gives quick information about the changing trophic status of a water body, present study was thus conducted on Wular wetland in order to assess the change in its zooplankton community. Reports of zooplankton are available from several freshwater bodies of Kashmir, viz., Moza (1992), Raina (1981), Wanganeo (1980), Wanganeo & Wanganeo (2006), Yousuf & Qadiri (1975, 1983), but no detailed study has been reported on Wular wetland which has been declared as Ramsar site.

MATERIALS AND METHODS

Five sampling sites were selected in Wular wetland, through which River Jhelum traverses (Fig. 1). The sampling was done over the period of two years from March 2002 to February 2004. For this purpose monthly samples were collected by filtering 10-20 litres of water through the plankton net made up of bolting silk No. 25 (64 µm mesh size) with the help of plankton sampler (1-L capacity). The filtered sample was preserved in 4% formalin and the samples were reduced to 15 to 30 mL in centrifuge. Enumeration of plankton was done by counting the entire contents of 1 mL of subsample in Sedgwick Rafter chamber to obtain statistical accuracy and the results were expressed as individuals/litre.

Identification of zooplankton was carried out following Edmondson (1959), Penak (1988) and Michael & Sharma (1988). Species diversity index has been calculated following the equation given by Shanon & Weiner (1964) and Pielou (1975).

RESULTS AND DISCUSSION

Eighty five zooplankton species were reported in Wular wetland which belonged to Class Rotifera, Cladocera and Copepoda (Table 1). The selected sites showed maximum variation in zooplankton community. The total zooplankton density was high at Site-1 (13700 inds/L) in comparison to other four sites. Site-5 recorded least population density (6490 inds/L). The significant variation in the sites is because of high population pressure, shallow nature of water and proximity to habitation at Site-1 and comparatively less influence of human habitation and lotic nature of the Site-5 (Table2). Zooplankton population density exhibited increasing trend from March to August, thus, showing the unimodal peak (Fig 2). The zooplankton population at a time is a result of complex variations in numerous factors, the most important being the quality and quantity of available food, temperature and the chemical factors.

Among all the zooplankton, Cladocera constituted the major group in population density followed by Rotifera and Copepoda (Table 2). Rotifera as a group (47 species) depicted increasing trend from March to August, while August onwards the trend gets reversed (Fig. 3 and Table 1).

Among the Rotifera, *Keratella* sp., *Monostyla* sp. and *Polyarthra vulgaris* were perennial while the others were seasonal (Table 3). Hutchinson (1967) and Vasisht & Dhir (1970) observed *Keratella*

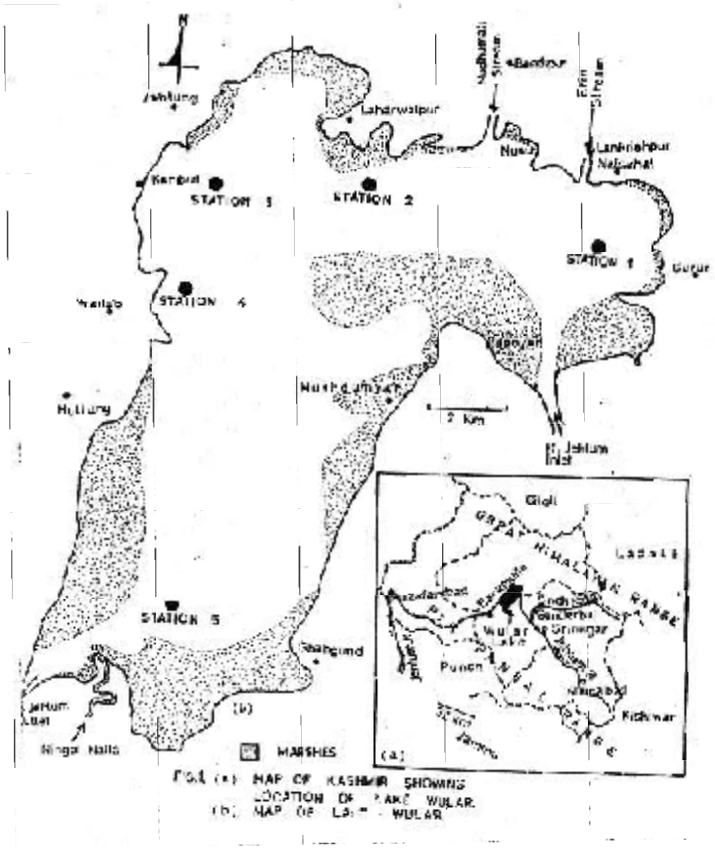

Fig. 1: Location of the study area.

Table 1. Classification of zooplankton recorded in Wular lake.

ROTIFERA	
Class	**Monogononta**
Order	**Ploima**
Family	**Asplanachnidae**
	Asplanchna priodonta Gosse
Family	**Branchioidae**
	Anuraeopsis fissa Gosse
	Brachionus angularis Gosse
	B. bidentata
	B. calyciflorus Pallas
	B. plicatilis
	B. quadridentatus
	B. patulus
	Colurella sp.
	Platyias patulus
	P. quadricornis
	Keratella cochlearis Gosse
	K. *himalis*
	K. quadrata Muller
	K. serrulata
	K. tropica Apstein
	Notholca accuminata Ehrn.
	N. caudata
	N. cornuta
	N. squamula
	Sqatinella mutica
Family	**Callothecidae**
	Colotheca sp.
Family	**Gastropidae**
	Ascomorpha saltans
	Gastropus minor
	Gastropus stylifer
Family	**Lecanidae**
	Lepadella ovalis
	L. patella
	L. princisi
	Lecane angulata
	Lophocharis salpina
	Monostyla bulla
	M. lunaris
	M. quadridentata
Family	**Mytililinidae**
	Mytilina bisulcata Ehrn.
Family	**Notommatidae**
	Cephalodella gibba
Family	**Synchaetidae**
	Euclanus dilatata
	Polyartha vulgaris
	Synchaeta pectinata
Family	**Tricercidae**
	Trichocerca longisetta
	T. similes
	T. taurocephala
	T. weberi
Order	**Floscularisiacea**
Family	**Hexathridae**
	Filinia longisetta Ehrn.
	F. opoliensis Zarcharias
	F. terminalis Plate
Family	**Testudinellidae**
	Testudinella patina
Class	**Bdelloidea**
Order	**Bdelloida**
Family	**Philodinidae**
	Bdelloid sp.
CLADOCERA	
Family:	**Sididae**
	Diaphnosoma exisum
	Pseudosida bidentata
	Sida crystallina
Family:	**Daphnidae**
	C. cornuta
	C. reticulata
	C. quadriangula
	D. carniata
	D. longispina
	D. haline
	D. magma
	D. obtusa
	D. pulex
	Scapholebris kingi
	Simocephalus expinosus
	S. ventulus
Family:	**Bosminideae**
	Bosmina coregoni
	B. longirostris
Family:	**Moinidae:**
	Moina daphnia
	M. micrura
Family:	**Microthricideae:**
	Macrothrix laticornis
	M. spinosa
Family:	**Chydoridae**
	Chydorus faviformis
	C. sphaericus
	Pleoroxus denticulatus
	P. laevis
	P. similis
	P. trigonella
	Graptolebris testudinaria.
	Alona davidi
	A. intermediata
	A. rectangula
	Alonella exisa
	A. nana
	Leydigia sp.
Family:	**Leptodorideae**
	Leptodora sp.
COPEPODA:	*Diaptomus* sp.
	Cyclops sp.
	Eucyclops
	Nauplius larvae

Table 2: Seasonal average density of zooplankton in Wular lake.

~	Zooplankton	Spring	Summer	Autumn	Winter	Total
	Rotifera	1210	3355	875	870	6310
Site-1	Cladocera	2725	1950	1010	700	6385
~	Copepoda	260	235	170	340	1005
Total	~	4195	5540	2055	1910	13700
	Rotifera	680	1810	420	735	3645
Site-2	Cladocera	1765	1535	575	555	4430
~	Copepoda	335	170	195	455	1155
Total	~	2780	3515	1190	1745	9230
	Rotifera	585	1790	320	730	3425
Site-3	Cladocera	1951	1685	675	295	4606
~	Copepoda	485	115	240	480	1320
Total	~	3021	3590	1235	1505	9351
	Rotifera	770	2595	435	850	4650
Site-4	Cladocera	1902	1985	695	425	5007
~	Copepoda	435	160	220	395	1210
Total	~	3107	4740	1350	1670	10867
	Rotifera	390	1055	245	485	2175
Site-5	Cladocera	1405	1255	475	310	3445
~	Copepoda	225	145	160	340	870
Total	~	2020	2455	880	1135	6490

quadrata as perennial plankton form determining the eutrophic nature of the water body, while Kumar & Tripathi (2004) reported *B. calciflorus, B. falcatus, B . rubens, B. plicatlis* and *Testudinella* sp. as indicator species of eutrophy. However, peak value of the group during summer may be due to increase in anthropogenic impact as most area of the lake has been converted into the agricultural fields. Shukla et al. (2001) also recorded the enhancement of Rotifera population on addition of nutrients.

Among the Cladocera, 35 species were reported and the population density exhibited increasing trend towards late spring (Fig. 4). Site-1 recorded dominance of Cladocera in comparison to other sites (Table 2). Among the Cladocerans *Alona davidi, Alona rectangula, Alona intermediate, Alonella exisa, Alonella nana, Chydorus sphericus, Cydorus faviformis, Graptolebris testudanaira, Macrothrix spinosa, Macrothrix laticornis* and *Moina* sp. were perennial, while the remaining were seasonal (Table 3).

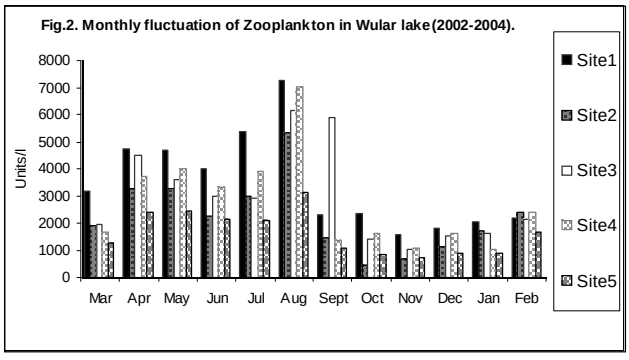

Fig. 2: Monthly fluctuation of zooplanton in Wular lake (2002-2004).

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Table 3: Seasonal succession of zooplanktpon in Wular lake (2002-2004).

Zooplankton	Spring	Summer	Autumn	Winter
Rotifera				
Aneuropsis fissa	+	+	+	-
Ascomorpha saltans	-	+	+	-
Asplanchna periodonta	-	+	+	-
Bdelloides	+	-	-	+
Branchionus angularis	-	+	+	-
B. bidentata	-	+	+	-
B. calciflorus	-	+	+	-
B. palicatlis	-	+	+	-
B. patulus	-	+	+	-
B. quadridentatus	-	+	+	-
Calotheca sp.	-	+	-	-
Cephalodella gibba	-	+	-	-
Collurella sp.	-	+	-	-
Euclanus dilatata	-	+	+	-
Filinia longisetta	+	-	-	+
F. opoleinsis	+	-	-	+
F. terminalis	+	-	-	+
Gastropus minor	-	+	-	-
G. stylifer	-	+	-	-
Karetella cochlearis	+	+	+	+
K. himalis	+	+	+	+
K. quadrata	+	+	+	+
K. serrulata	+	+	+	+
K. tropica	+	+	+	+
Lapodella ovalis	-	+	-	-
L. patella	-	+	-	-
Lapodella princisi	-	+	-	-
Lecane angulata	-	+	-	-
Lophocharis salpina	-	+	-	-
Monostyla bulla	+	+	+	+
M. lunaris	+	+	+	+
M. quadridentata	+	+	+	+
Mytilinia bisulcata	-	+	-	-
Notholca squamula	+	-	-	+
N. accuminata	+	-	-	+
N. caudata	+	-	-	+
N. cornuta	+	-	-	+
Platyas patulus	-	+	-	-
Platyas quadricornis	-	+	-	-
Polyartha vulgaris	+	+	+	+
Squitenella mutica	-	+	-	-
Synchaeta pectinata	-	+	-	-
Testudinella patina	-	+	-	-
Trichocerca longisetta	-	+	-	-
Trichocerca similis	-	+	-	-
Trichocerca taurocephala	-	+	-	-
Trichocerca weberi	-	+	-	-
Cladocera	~	~	~	~
Alona davidi	+	+	+	+
Alona intermedia	+	+	+	+
Alona rectangula	+	+	+	+

Table cont....

...Cont Table 3

Alonella exisa	+	+	+	+
Alonella nana	+	+	+	+
Bosmina coregoni	+	+	+	+
Bosmina longirostris	+	+	+	+
Ceriodaphnia cornuta	-	+	+	-
Ceriodaphnia quadriangula	-	+	+	-
Ceriodaphnia reticulata	+	-	-	-
Chydorus faviformis	+	-	-	-
Chydorus spharricus	+	-	-	-
Daphnia carniata	+	-	-	-
Daphnia haline	+	-	-	-
Daphnia longispina	+	-	-	-
Daphnia magma	+	-	-	-
Daphnia obtusa	+	-	-	-
Daphnia pulex	+	-	-	-
Diaphnosoma exisum	+	-	-	-
Graptolebris testudinaria	+	-	-	-
Leptodora sp.	+	-	-	-
Leydigia acathocercoides	+	+	+	+
Macrothrix laticornis	+	-	-	-
Macrothrix spinosa	+	-	-	-
Moina daphnia	+	+	+	+
Moina micrura	+	+	+	+
Pleurox denticulatus	+	-	-	-
Pleurox similis	+	-	-	-
Pleuroxis laevis	-	+	+	-
Pleuroxis trigonella	-	+	+	-
Pseudosida bidentata	+	-	-	+
Scapholebris kingi	+	-	-	-
Sida crystallina	+	-	-	+
Simocephalus exspinosus	+	-	-	-
Simocephalus ventulus	+	-	-	-
Copepoda	~	~	~	~
Cyclops sp.	+	+	+	+
Diaptomus sp.	+	-	+	+
Eucyclops sp.	+	+	+	+
Naplius larvae	+	+	+	+

Table 4: Monthly variation in species doiversity (H) and eveness of species (J) in Wular lake.

Species	~Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Diversity (H)												
Site-1	-0.66	-0.55	-0.56	-0.65	-0.65	-0.56	-0.63	-0.64	-0.65	-0.60	-0.65	-0.53
Site-2	-0.51	-0.46	-0.46	-0.41	-0.45	-0.47	-0.50	-0.51	-0.27	-0.47	-0.59	-0.57
Site-3	-0.52	-0.48	-0.50	-0.39	-0.43	-0.52	-0.47	-0.48	-0.54	-0.54	-0.57	-0.53
Site-4	-0.48	-0.49	-0.53	-0.52	-0.53	-0.52	-0.49	-0.52	-0.55	-0.56	-0.43	-0.56
Site-5	-0.40	-0.37	-0.36	-0.39	-0.37	-0.34	-0.42	-0.35	-0.43	-0.39	-0.38	-0.45
Evenness of Species (J)	~	~	~	~	~	~	~	~	~	~	~	Site-1
-0.16	-0.01	-0.02	-0.03	-0.01.	-0.01	-0.01	-0.03	-0.05	-0.07	-0.01	-0.02	
Site-2	-0.06	-0.02	-0.02	-0.03	-0.04	-0.02	-0.03	-0.06	-0.11	-0.03	-0.02	-0.01
Site-3	-0.02	-0.01	-0.01	-0.01	-0.08	0.01	-0.12	-0.03	-0.03	-0.02	-0.02	-0.01
Site-4	-0.02	-0.02	-0.02	-0.01	-0.05	-0.01	-0.03	-0.03	-0.02	-0.02	-0.03	-0.03
Site-5	-0.03	-0.03	-0.04	-0.01	-0.04	-0.16	-0.04	-0.03	-0.17	-0.04	-0.04	-0.02

Table 5: Correlation of zooplanktons with respect to physicochemical parameters.

Parameters	Rotifera	Cladocera	Copepoda
Air Temperature	0.520	0.376	-0.371
Water temperature	0.510	0.406	-0.399
Transparency	-0.17	-0.122	-0.244
Depth	-0.18	0.23	-0.18
pH	-0.32	-0.014	0.51
Conductivity	0.25	-0.28	0.43
Dissolved oxygen	-0.52	-0.29	0.35
Free carbon dioxide	0.33	0.40	-0.23
Total Alkalinity	-0.16	-0.19	0.22
Total hardness	0.15	0.22	0.23
Nitrate nitrogen	0.65	0.33	0.24
Ammonical nitrogen	0.43	0.16	-0.26
Total phosphorus	0.43	0.37	0.25

Among the seasonal forms *Daphnia* species were recorded during spring up to temperature range of 18-26°C. The results are in agreement with Hall (1964) who recorded the presence of *Daphnia pulex* up to 22°C. However, the disappearance of *Daphnia* sp. during summer can be correlated with increased presence of blue green algae. The blue green algae have been found to interfere with the filtration process of *Daphnia* sp. (Gliwicz 1977). However, Parveen & Yousuf (1999) recorded the *Moina daphnia* and *Daphnia longispina* in polluted waters of Brari nambal basin of Dal lake. The presence of *Chydorus* sp. throughout the study period may be correlated to trophic status of the lake. Patalas (1970) related the occurrence of *Chydorus sphaericus* to the high trophic status.

Among the Copepoda *Cyclops* sp., *Eucyclops* sp., *Dioptomus* sp. and *Nauplius* larvae have been reported (Table 3). Yousuf (1988) has reported abundance of *Cyclops vicinus* in limnetic zone and that of *Cyclops scutifer* in littoral zone of Manasbal lake.

The species diversity (H) and evenness index (J) are given in Table 4. The Wular wetland is considered as highly polluted wetland on the basis of its species diversity index. This is further

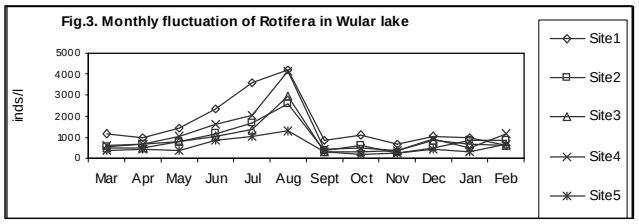

Fig. 3: Monthly fluctuation of Rotifera in Wular lake (2002-2004).

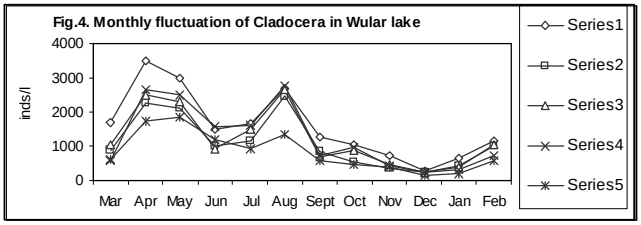

Fig. 4: Monthly fluctuation of Cladocera in Wular lake (2002-2004).

supported by the fact that the whole sewage and the domestic wastes enter the lake through River Jhelum, which is the main feeding channel of Wular wetland.

The Rotifera depicted positive correlation with temperature (0.520), phosphorus (0.43), nitrate-N (0.65) and negative correlation with transparency, depth, pH, dissolved oxygen and total alkalinity. Cladocera exhibited the positive correlation with temperature (0.406), depth (0.23), nitrate-N (0.33) and phosphorus (0.37) (Table 5). The negative correlation was recorded with transparency (-0.122) and dissolved oxygen (-0.29). This statistical description supported the fact that the India's largest freshwater wetland is moving towards the extinction, so necessary management strategies should be employed in order to preserve this world's one of the largest freshwater body.

REFERENCES

Edmondson, W.T. 1959. Freshwater Biology, John Wiley, N.Y.

Gliwicz, Z.M. 1977. Food size selection and seasonal succession of filter feeding zooplankton in a eutrophic lake. Ecol. Mongr., 22: 179-225.

Hall, D. J. 1964. An experimental approach to the dynamics of a natural population of *Daphnia palchaella*. Ecol. Syst., 7: 177-208.

Hutchinson, G.E. 1967. Treatise on Limnology, Vol. 2, Introduction to Lake Biology and Limnoplankton. Wiley, New York.

Moza, Usha 1992. Zooplankton composition and fluctuation in Wular lake, Kashmir. In: Current Trends in Fish and Fishery Biology and Aquatic Ecology (Ed. Yousuf et al.), Kashmir, 239-244.

Kumar, A. and Tripathi, S. 2004. Zooplanktonic diversity in relation to aquaculture in some ponds of Durg Bhilai city, Chattisgarh State. Nat. Env. and Pollution Tech., 3(2): 175-178.

Michael, R.G. and Sharma, B.K. 1988. Fauna of India and Adjacent Countries. Indian Cladocera (Crustacean: Branchiopoda: Gladocera). Zool. Survey of India.

Parveen, M. and Yousuf, A.R. 1999. Cladocera population in Dal lake, Kashmir. Abs., 5th National Seminar on Fish and Their Env., Univ. of Kashmir. 34-35 pp.

Patalas, K. 1970. Primary and secondary production in a lake heated by a thermal power plant. Proc. Annual Tech. Meeting, Inst. Environ. Sci., Boston, 267-271.

Peilou, E.C. 1975. Ecological Diversity. Wiley Interscience Publication, John Wiley & Sons, New York, London.

Penak, R.W. 1978. Freshwater Invertebrates of United States, John Wiley and Sons, New York.

Raina, R. 1981. Plankton dynamics and hydrobiology of Bod-Sar Lake, Kashmir. PhD. Thesis, Univ. of Kashmir.

Shanon, C.E. and Weiner, W. 1964. The Mathematical Theory of Communication. Univ. Illinois Press, Urbana, USA.

Shukla, A.N., Shrivastava, S. and Rao, K.S. 2001. Zooplankton community trends in Gandhi Sagar reservoir with relation to its eutrophication. Int. Jour. Ecol., 8(1): 77-85.

Vasisht, H.S. and Dhir, S.C. 1970. Seasonal distribution of freshwater zooplankton of four tanks, Chandigarh. Ichthyologica, 10(1-2): 44-56.

Wanganeo, A. 1980. Phytoplankton Photosynthesis, Nutrient Dynamics and Trophic Status of Mansbal Lake, Kashmir. Ph.D. Thesis, Univ. of Kashmir.

Wanganeo, A. and Wanganeo, S. 2006. Variation in zooplankton population in two morphometrically dissimilar rural lakes of Kashmir Himalayas. Proc. Nat. Acad. Sci., India, 76(B) 111: 222-239.

Yousuf, A.R. and Qadri, M.Y. 1975. Cladoceran of Malpursar, Kashmir. J. Sci. Univ. Kash., 3(1-2): 87-92.

Yousuf, A.R. and Qadri, M.Y. 1983. Seasonal distribution of the families Sididae, Daphniae, Bosminidae, Macrothricidae (Cladocera: Crustacea in Mansbal lake, Kashmir). J. Inland Fish. Soc., India. 15(1-2): 13-20.

Yousuf, A.R. 1988. Copepod plankton of Mansbal lake, Kashmir. J. Indian Inst. of Sci., 68: 303-313.