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Seasonal Variation and Species Composition of Crustacean Zooplankton (Order : Cladocera) in Manchhar Lake, Sindh, Pakistan

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Abstract.- Qualitative and quantitative studies of crustacean zooplankton were carried out during 2001, when drought conditions prevailed. Ten species belonging to 9 genera and 4 families of order Cladocera were identified. Out of 10 species, 01 species *Dunhevedia crassa* is a new record from Pakistan. Enumeration of zooplankton indicated that the population of *Alona rectangula* and *Dunhevedia crassa* increased gradually during colder months (December-March). *Alona rectangula* peaked in February, while *Dunhevedia crassa* had two peaks, in December and March. *Bosmina longirostris* and *Ceriodaphnia reticulata* did not show any remarkable changes during the year. *Chydorus poppei* and *Simocephalus exspinosus* increased during warmer months. *Chydorus poppei* had a peak in May, while the peak of *Simocephalus exspinosus* was observed in July. Highest population of *Macrothrix rosea* was found in August, and then it decreased gradually during colder months. Population of *Scapholeberis kingi* remained low throughout the year, but exhibited peaks in September and March. Seasonal fluctuation of cladocerans can be correlated with the temperature and salinity of water. As the temperature and salinity decreased in colder months, the over all population of Cladocerans increased with a peak in February.

Key words: Cladocera, Manchhar lake, seasonal fluctuations, zooplankton.

INTRODUCTION

Zooplanktons are at the most important level of food chain in aquatic ecosystem as they transfer energy from primary producers to higher levels. Their population fluctuations are influenced by various factors such as temperature, phytoplankton, density and the grazing pressure of predators specially the fishes (Fernando, 1980).

The zooplanktons occur in almost all the type of freshwater bodies, but their density and number of species varies. Lim *et al.* (1984) studied the Cladocera growing in rice fields of Malaysia. Zooplanktons were also found in a hyper saline water body in Hyderabad, Sindh (Baloch *et al.*, 2004). The dispersal and colonization of zooplankton is effected by such agents as water flow, wind, birds, insects, fishes and anthropogenic activities (Havel and Shurin, 2004). This results into cosmopolitanism in distribution of many species of freshwater zooplankton (Buchan and Padilla, 1999).

The previous information on the cladocerans has been provided by different workers in Pakistan (Baqai *et al*., 1974; Iqbal and Baqai, 1976; Siddiqui *et al*., 1973, Iqbal and Kazmi, 1990; Jafri *et al*., 1999; Baloch, 2000). In general the qualitative and quantitative studies on cladoceran zooplankton are a neglected area of study but these are important indicators of the ecological status of the water body.

The present study provides information about the species composition, abundance and new record of cladocerans from Manchhar lake, Sindh, Pakistan.

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MATERIALS AND METHODS

For taxonomic studies monthly surface plankton samples were collected by plankton net (mesh 55µ) for a period of one year. Samples were preserved in 5% formalin and brought to the laboratory. Taxonomic identification of cladocerans was carried out with the help of taxonomic keys (Ward and Whipple, 1959; Battish, 1992; Pennak, 2001).

For quantitative studies 50 l of surface water was strained through plankton net (mesh size 55 µm). In laboratory, specimens were counted with the help of counting tray under binocular microscope.

RESULTS

In the present study 10 species of Cladocerans have been recorded these include *Alona guttata, Alona rectangula, Bosmina longirostris, Ceriodaphnia reticulata, Chydorus poppi, Daphnia lumholtzi, Dunhevedia crassa, Macrothrix rosea, Simocephalus exspinosus* and *Scapholeberis kingi.* Out of these *Dunhevedia crassa* is a new record from Pakistan.

Population of genus *Alona* was present throughout the year in Manchhar lake. It was comparatively higher with a peak in February, but was low during remaining part of the year (Table I). Low population of *Bosmina longirostris* was recorded in January and February, while it increased from March to September. High population of *Ceriodaphnia reticulata* was found in January, and then there was a sharp decline (February-March). However, noticeable increase was observed during the period of April–September. Maximum population of *Chydorus poppei* was recorded in May. Its population was apparently absent in June but low number was recorded in July. *Dunhevedia crassa* occurred throughout the year except the month of June. Higher population was found in December, January and March. Low population of *Macrothrix rosea* was observed from January-June, while it increased from August to December. During June-September, the population of *Simocephalus exspinosus* was high (peak in July), but during remaining part of the year their number was considerably low. The population of *Scapholeberis kingi* remained low during most of months, but a peak was observed in March.

In the seasonal pattern, the population of cladocerans shows three maxima (July, February), while low density was found in the middle of summer and spring. The low population density of *Bosmina longirostris, Ceriodaphnia reticulata, Chydorus poppei, Dunhevedia crassa, Macrothrix rosea, Simocephalus exspinosus* and *Scapholeberis kingi* was observed, while genus *Alona* was present in comparatively larger numbers throughout the year, due to presence of two species, *A. guttata* and *A. rectangula*.

DISCUSSION

Water temperature is important in terms of its affects on aquatic life. Its influence upon the limnological phenomenon such as stratification, solubility of gases, pH, conductivity and planktonic distribution are well known (Singh, 1990).

Majority of freshwater plants and animals have a low tolerance to any changes in salinity (Kumar *et al.,* 2002). Kubly (1982) observed that considerable change in salinity occurred between winter and summer seasons. The present study follows this pattern, as comparatively higher salt concentration was found in summer. Lakes are considered as saline when the salinity is more than 3 ppt (Williams, 1981). In Manchhar lake the number of species is small due to increased salinity.

A total of 10 cladoceran species have been recorded from subtropical Manchhar lake, out of these one species *Dunehevedia crassa* is recorded for the first time. Earlier studies on Manchhar lake (Baig and Khan, 1976) described four genera of Cladocerans. According to Swarup and Singh (1979) the composition of freshwater zooplankton of south east Asia (Oriental Region) is typically tropical in the southern portion but gradually changes to temperate species in its northern region. The only species of family Daphnidae *Daphnia lumholtzi* found in Manchhar lake is of small size. It is a native of tropical and subtropical regions of Africa, Asia and Australia (Benzic, 1988). This species has also spread in North America as exotic species (Havel *et al*., 2002). The absence of larger temperate species such as *Daphnia magana, Daphnia longispina and Daphnia hyalina* is due to constant higher temperature of subtropical environment of Sindh. Another reason for abundance of other species of *Daphnia* in Manchhar lake is the higher salinity and abundance of blue green algae (Cyanophyta) (Jafri *et al*., 1999) which is not a favoured food item of filter feeding

cladocerans. All other cladoceran species found in Manchhar lake are of small size. *Bosmina longirostris* is cosmopolitan like *D. lumholtzi.*

Table I.- Monthly density distribution of cladoceran genera (No. per 50L) collected from Manchhar lake during 2001.

Months	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature (^oC)	14	17	22	24	26	30	29	29	28	24	23	17
Salinity (ppt)	3.3	2.7	6.2	5.72	5.4	6.36	3.88	3.24	3.8	3.46	3.28	3.24
Alona	235	305	187	90	116	115	164	36	43	74	110	101
Bosmina	3	1	22	8	12	8	16	14	16	3	6	14
Ceriodaphnia	53	6	3	27	22	53	39	12	31	17	21	25
Chydorus	13	24	10	20	42	0	4	14	15	17	26	23
Dunhevedia	33	42	55	33	25	0	23	4	27	23	25	52
Macrothrix	9	9	10	6	5	10	24	44	21	34	21	19
Scapholeberis	13	6	48	3	23	3	3	3	32	3	3	3
Simocephalus	3	3	6	7	3	23	42	28	13	3	6	3
Total	**362**	**396**	**341**	**194**	**248**	**212**	**315**	**155**	**198**	**174**	**218**	**240**

Littoral species such as *Alona guttata* and *A. rectangula* were dominant through out the year as it is a shallow lake (Depth < 3m).

Various species show their higher population at different times of the year but no two species co-exist at the same time with higher population. This situation was observed in lake Ikeda (Baloch, 1995). One species dominated the other for a given time period but sooner or later another species replaced it and no two species were found to be alike in their seasonal behavior. The population of genus *Alona* dominated throughout the year, which indicates that the lake is loosing the limnetic zone, since *Alona* is a creeping type and lives in weedy and shallow water. This shows its preference to winter season. *Bosmina longirostris* showed highest population in March. Generally its number was higher in summer, while it was lower in winter. This species is common in oligo to eutrophic lakes in most of Japanese lakes and is also found abundantly in Ikeda lake (Baloch, 1995). Similar observations were recorded for Rawal lake, Islamabad (Baloch *et al*, 2005). *Ceriodaphnia reticulata* did not follow temperature changes and occurred with higher populations in summer and winter. In June, however it was totally absent. Lower population of this species during spring and summer is probably due to predation by fish larvae, as most of the fish breed from spring to summer. *Macrothrix rosea* exhibited highest population in August while *Scapholeberis kingi* showed highest population in July. Both of these species show inter- species competition. *Simocephalus exspinosus* contributed low population except in September and highest abundance in March. This observation agrees with the finding of Choubey (1992) in Ghandisager reservoir where *Simocephalus exspinosus* exhibited highest abundance in April. The *Daphnia lumholtzi* appeared rarely and did not contribute much to the community.

Zooplankton community at any given time is determined by vertical and horizontal distribution. Occurrence of littoral and limnatic species is due to food availability and inter-specific competition (Urabe, 1990). The spring-summer peak of herbivore cladocerans such as *Daphnia* and *Bosmina* follows the earlier peak of phytoplankton in lakes. This grazing pressure creates patchiness in distribution (Lampart, 1985).

As the Manchhar lake was studied during draught season (2000 – 2001), the only source of water was that of MNVD (Main Nara Valley Drain) bringing saline water (Mahar *et al.*, 2005). The diversity and density of cladoceran species was low. Both, the warm water and higher salinity contributed in seasonal variation and species composition of cladocerans which are of tropical and subtropical origin. It would be interesting to see if the monsoon rains starting after 2005 have changed the environment and the plankton of Manchhar lake. It is expected that the water of MNVD will be diverted into RBOD (Right Bank

Out fall Drain) soon and the Manchhar will again become a typical fresh water lake.

REFERENCES

BAIG, N.A. AND KHAN, M.Y., 1976. Biological and chemical conditions of Manchhar lake (Distt. Dadu). *Pakistan J. Sci*., **28**: 33-40.

BALOCH, W.A., 1995. *Species composition, abundance and seasonal variation of zooplankton in lake Ikeda, Japan*. M.S. thesis, University of Kagoshima, Kagoshima, pp. 87-91.

BALOCH, W.A., 2000. Occurrence of planktonic communities in River Indus at Kotri Barrage, Sindh, Pakistan. *Proc. Pakistan Congr. Zool*., **20**: 77-83.

BALOCH, W.A., SOOMRO, A. N. AND JAFRI, S.I.H., 2004. Zooplankton of highly saline water body near Hyderabad, Sindh. *Sindh Univ. Res. J.* (*Sci. Ser.)* **36**: 25–28.

BALOCH, W.A., JAFRI, S.I H. AND SOOMRO, A.N., 2005. Spring zooplankton composition of Rawal lake, Islamabad. *Sindh Univ. Res. J.* (*Sci. Ser.)* **37**: 41–46.

BAQAI, I.U., ZUBERI, V.A. AND IQBAL, M., 1974. Limnological studies of Kalri lake. *Agric. Pak.,* **25**: 119-135.

BATTISH, S.K., 1992. *Zooplankton of India*. IBHP Publishing Co., 66 Janpath, New Delhi, pp. 233.

BELL, R. L. AND WARD, F. J., 1970. Incorporation of organic carbon by *Daphnia pulx. Limnol. Oceanogr.,* **15**: 713-726.

BENZIE, J.A.H., 1988. The systematic of Australian *Daphnia* (Cladocera: Daphnidae): species description and keys. *Hydrobiologia*, **166**: 95–161.

BUCHAN, L.A.J. AND PADILLA, D.K., 1999. Estimating the probability of long distance over land dispersal of invading aquatic species. *Ecolog. Appl.,* **9**: 254–265.

FERNANDO, C. H., 1980. The species and size composition of tropical fresh water zooplankton with refrence to oriental region. *Int. Rev. ges. Hydrobiol*. **65**: 411–426.

HAVEL, J. E. AND SHURIN, J.B., 2004. Mechanism, effects and scales of dispersal in fresh water zooplankton. *Limnol. Oceanogr*., **49**: 1229 – 1238.

HAVEL, J.E., SHURIN, J.B. AND JONES, J.R., 2002. Estimating dispersal from patterns of spread: spatial and local control of invasion by *Daphnia lumholtzi* in Missouri lakes. *Ecology*, **83**: 3306–3318.

KUBLEY, D.M., 1982. Physical and chemical features of Playa lakes in Southeastern California U.S.A. *Arch. Hydrobiol. Suppl*., **26**: 491-525.

IQBAL, M. AND KAZMI, A., 1990. Cladocera of Hub lake with notes on species and size composition. *Sarhad J. Agric*., **6**: 85-88.

IQBAL, M. AND BAQAI, I.U., 1976. Seasonal abundance of cladoceran genera in Keenjhar (Kalri) lake. *Pakistan J. Sci*., **3**: 74-77.

JAFRI, S.I.H., MAHAR, M.A. AND LEGHARI, S.M., 1999. Diversity of fish and plankton in Manchhar lake (Distt.Dadu) Sindh, Pakistan. *Proc. Semi. Aq. Biodiv. Pakistan* (eds. Q.B. Kazmi and M.A. Kazmi), pp. 63-70. MRC and Department of Zoology, University of Karachi.

KUMAR A., BOHRA, C. AND SINGH, A.K., 2002. Ecotechnology for limnological project of Kawar lake with special reference to biogeochemical cycles. In: *Ecology and ethology of aquatic biota*, vol. 1, pp. 149-199. Daya Publishing House, Delhi, India.

LAMPART, W., 1985. Food limitation and the structure of zooplankton communities. *Arch. Hydrobiol*., **21**: 497.

LIM, R.P., ABDULLAH, M. F. AND FERNANDO, C.H., 1984. Ecological studies of Cladocera in the rice fields of Tanjung Karang, Malaysia, subjected to pesticides treatment. *Hydrobiologia*, **113**: 99–103.

MAHAR, M.A., JAFRI, S.I.H., LEGHARI, S.M. AND KHUHAWAR, M.Y., 2000. Studies on water chemistry and fish production of Manchhar lake, Dadu, Sindh. Pakistan. *Pakistan J. biol. Sci*., **3**: 2151-2153.

MAHAR, M.A., JAFRI, S.I.H., LEGHARI, S.M. AND KHUHAWAR, M.Y., 2005. Studies on the physico – chemical parameters and pollution indicator algal flora of Main Nara Valley Drain (MNVD) water entering Manchhar lake. *Sindh Univ. Res. J. (Sci. Ser.)*. **37**: 1–8.

PENNAK, R.W., 2001. *Freshwater invertebrates of the United State*. 2nd Ed., John Wiley and Sons, New York, U.S.A., pp. 803.

SIDDIQUI, P.A., BAQAI, I.U. AND IQBAL, M., 1973. Check list of fishes of Keenjhar (Kalri) lake with notes on environment conditions and fisheries potentional. *Agric. Pak.,* **24**: 201-220.

SINGH, C.S., SHARMA, A.P. AND DEORANI, B.P., 1990. Limnological studies for bioenergetic transformation in a tarai reservoir, Nanak Sagar (UP). In: *Advances in limnology* (ed. H.R. Singh), pp. 356-362.

SWARUP, K. AND SINGH, S.R., 1979. Limnology of Suraha lake (Ballia) I. Variations in the water quality. *J. Inland Fish.Soc., India,* **11**: 22-33.

URABE, J., 1990. Stable horizontal variation in the zooplankton community structure of a reservoir maintained by predation and competition. *Limnol. Oceanogr.*, **35**: 1703-1717.

WARD, H.B. AND WHIPPLE, G.C., 1959. *Fresh water biology*. 2nd Ed., John Wiley and Sons, London, pp. 587-655.

WILLIAMS, W.D., 1981. Inland salt lakes: An introduction. In: *Salt lakes*: *Proc. of an introductional Symposium on Athalassic (Inland) salt lakes* (ed. W.D. Williams), Junk, The Hague, Netherlands.

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