Environment Conservation Journal 10(1&2) 9-14, 2009
(ISSN 0972-3099)

ASEA

Zooplankton diversity in relation to certain physico-chemical parameters of swamp of Kishanganj District, Bihar

B.N. Pandey[1], O.P. Ambasta[2], A.K.Thakur,[3] Sanjay Kumar[4] and Ritu Kumari[3]

Received on : 12-12-2008 Revised on : 15-01-2009 Accepted on : 30-02-2009

Abstract

The zooplankton fauna of Kishanganj swamps in relation to certain physico-chemical parameter was studied. Out of 28 species recorded, 18 belong to *Rotifera*, 6 to *Cladocera* and 4 to *Copepoda*. The total zooplankton density was more in summer and least in rainy season. The quantitative relationship amongst the group of zooplankton was *Rotifera> Cladocera> Copepoda*. Zooplankton also comprised of some pollution tolerant species like *Brachionus, Keratella* and *Mesocyclops etc.* The Rotifers showed negative correlation with pH, sulphate and dissolved oxygen Cladocerans showed negative correlation with pH, sulphate and phosphate while Copepods revealed negative correlation with pH, sulphate and water temperature.

Keywords:- *Zooplankton, Rotifera, Cladocera, Copepoda, Physico-chemical*

Introduction

Zooplankton are the microscopic free swimming animals. They are found almost universally in all the aquatic environment comprising the first trophic level of heterotrophic food chains and form a link between phytoplankton and aquatic animals. They provide main food to fishes and can be used as indicators of trophic level of water body. Zooplankton play an integrated role in transfering energy to consumer, hence they make a higher trophic level in energy flow after phytoplankton. They respond to change in water quality (Holland *et al.*, 1983). Zooplankton play an important role in the trophic dynamic of aquatic ecosytems (Venkataraman, 1981). The occurrence and diversity of planktonic organisms are almost universal in all aquatic habitats and the greatest concentration of zooplankton occurs in upper layers of water (Cable, 1966). The extent of degradation of water bodies can be reliably evaluated with plankton (Vareethiah and Haniffa, 1998).

Author's Address
[1] P.G. Deptt. of Zoology, Purnia College, Purnia ✉
[2] Deptt. of Botony, R.L.College Madhav Nagar
[3] Deptt of Zoology, M.A.M, College, Naugachia
[4] P.S.Rahua School, Madhepura

Investigation of biological diversity and primary productivity rates are of great importance to determine the potential for organic production and subsequent exploitation. The need for knowledge of zooplankton diversity is often stressed as a reliable indicator for the integrity of aquatic ecosystem (Barbosa *et al.*, 1995). The occurrence and physiological condition of zooplankton can be an indicator of environmental conditions. Hence in the present paper an attempt has been made to study the population density of zooplankton of Kishanganj swamps in relation to certain physico-chemical factors.

Materials and Method

The monthly observation of physico-chemical factors and zooplankton population was made. Surface water and zooplankton were collected on every 15th day of the month at a fixed time. Water temperature was recorded with ordinary thermometer and free CO_2 was measured on the spot. The pH, dissolved oxygen, carbonate, bicarbonate, chloride, notrate, sulphate and phosphate were analyzed according to methods of APHA (1975) and Trivedy and Goel (1984).

Zooplankton were collected by filtering 50.00 liters of water through a plankton net made up of bolting silk (No. 21) and preserved in 5% formalin. Quantitative and qualitative analysis of zooplankton were made by Lackey (1938), as modified by Edmondson (1974). Correlation between zooplankton and certain physico-chemical parameters were computed.

Results and Discussion

The physico-chemical characteristics of the swamps water and zooplankton populations are shown in the Table. 1 and 2 respectively. The zooplankton taxa collected from the swamps water belong to three dominant groups *viz. Rotifera*, *Cladocera* and *Copepoda*. There were 28 zooplankton species identified from which 18 belong to *Rotifera*, 6 belong to *Cladocera* and 4 belong to *Copepoda*. Rotifers were the most dominant and abundant group showing highest percentage (56.85%) composition and diversity followed by *Cladocera* (27.47%) and *Copepoda* (15.68%).

Following zooplankton were found in the swamps:

Rotifera : *Branchionus angularis, B, rubens, B. caudatum, B. calyciflorus, B. forticula, B. falcatus, B. bicenata, Keratella tropica, K. vulga, Filinia longiseta, F. terminalis, Monostyla lunaris, M. bulla, Hordelia sp., Lepadella sp., B. plicatilis, Rotaria sp., Polyarthra sp.*

Cladocera : *Moina micrura, M. dubia, Alonella sp., Daphnia sp., Ceriodaphnia, sp., Chdorus gibba.*

Copepoda : *Cyclops sp., Nauplius sp., Diaptomus, Cyclops sp.*

The quantitative zooplankton analysis shows that total plankton density is more in summer and least in rainy (Table 2; Fig. 1 and 2). The quantitative relationship amongst the groups of zooplankton is

Table 1: Physico-chemical characteristics of swamps water

Month	Temp.		pH	DO	Free CO_2	CO_3^{2-}	HCO_3^-	NO_3^-	PO_4^{2-}	Cl	SO_4^{2-}
	Atm.	Water									
January	20.90	19.10	7.50	8.20	8.50	0.00	125.00	0.36	0.50	14.90	49.60
February	23.80	21.10	7.40	7.80	6.70	0.00	122.00	0.37	0.52	16.50	60.40
March	25.50	22.40	7.20	7.30	9.80	0.00	126.00	0.38	0.60	20.40	72.20
April	30.10	26.80	7.10	7.10	9.60	0.00	130.00	0.42	0.84	22.20	75.60
May	33.90	31.70	7.90	6.80	8.80	0.00	135.00	0.49	0.94	28.70	71.80
June	32.80	31.90	6.80	6.10	7.20	0.00	118.00	0.52	0.72	26.20	70.90
July	33.50	30.80	6.60	5.80	9.90	0.00	105.00	0.58	0.74	19.90	78.50
August	30.80	29.40	6.70	5.10	12.80	0.00	98.60	0.62	0.72	16.40	73.20
September	29.20	28.60	6.40	4.80	11.40	0.00	106.70	0.56	0.70	12.40	80.50
October	29.30	26.20	6.90	5.20	10.50	0.00	110.20	0.52	0.73	15.10	63.80
November	26.80	25.40	7.10	5.90	9.60	0.00	112.40	0.49	0.71	16.20	57.40
December	21.40	22.10	7.30	7.80	8.10	0.00	114.20	0.41	0.68	17.10	60.50

Table 2: Monthly variation of zooplankton groups in swamps water (Unit/l)

Month	Rotifera	Cladocera	Copepoda
January	390.00	95.00	90.00
February	450.00	125.00	95.00
March	475.00	230.00	130.00
April	460.00	240.00	120.00
May	470.00	695.00	105.00
June	395.00	205.00	75.00
July	78.00	125.00	135.00
August	210.00	90.00	70.00
September	295.00	55.00	88.00
October	395.00	80.00	72.00
November	398.00	130.00	120.00
December	442.00	85.00	130.00

Rotifera > *Cladocera* > *Copepoda*. *Rotifers* showed superiority over other groups both in terms of number of species, genera and population density. Dominance of *Rotifera* in seasonal data of zooplankton in the present study is in accordance with the earlier finding of Ferneska and Lewkowiez, 1966; Schindler and Noven, 1971; Pandey *et al.*, 1994, 2004. Dominance of Rotifers over other groups is an indication of congenial conditions of the system (Arora, 1966). Daggett and Davis (1974) suggested that a rich Rotifer community requires a stable medium as they depend upon certain species of phytoplankton, whereas cladocerans and copepods due to their vast adaptability can withstand a wide range of environmental stress and utilize generally the phytoplanktonic cells as their natural food items. The rotifers communities have some association with water quality and any variation in the dissolved oxygen, organic matter, suspended solids would immediately affect their distribution (Holland *et al.*, 1983). The observed rotifers- *Branchionus calyciflorus*, *B. rubens*, *B. forticula*, *B. falcatus* can be considered to indicate the eutrophicated nature of the water body under

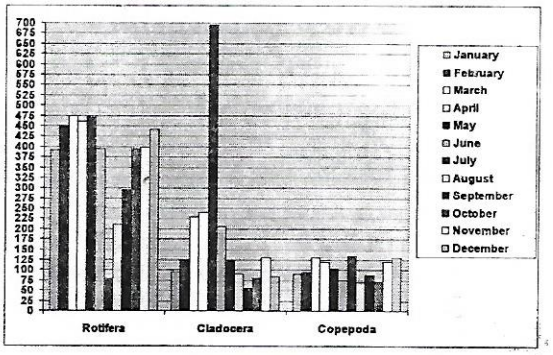

Fig 1: Showing month-wise distribution of zooplankton groups in swamp water

the present investigation as they are most abundant in the present study. George (1966) and Bansei (1976) have reported summer peak of rotifers while Nasar (1977), Baker (1979) and Edmondson (1996) have shown winter peak of rotifers. But in the present investigation peak of rotifers was observed in summer season. The abundance of rotifers in any ecosystem as compared to other groups is an indication of eutrophication (George, 1966). Laal and Karthikeyan (1993) have reported the maximum rotifers at polluted zone of different rivers. Biswas and Konar (2000) have reported more rotifers at station of mixing zone of waters in Damodar river water. However, in the present investigation no such correlation was observed.

The seasonal occurrence and abundance of different species of rotifers showed that *B. angularis* was dominant in number over other species. Such result has been reported by Pandey *et al.* (1992). *B. calyciflorus* and *Keratella tropica* were observed throughout the year while other species showed fluctuations, *Keratella sp.* was regarded as an indicator of eutrophication. *Polyarthra* was abundant during winter indicating its preference for clear water. Seasonality was not shown by any other species.

The cladoceran population was less scanty in comparison to the rotifers. The cladoceran peak was observed during winter followed by summer

and rainy seasons. Prasadam (1977) has reported the abundance of cladocerans in the month of May. Copepods were abundant during rainy season. Rainy peak of copepods has been also reported by Maruthanyagam *et al.* (2003) and Pandey *et al.* (2004). *Mesocyclops* were mainly represented by *Mesocyclops* sp. They indicate presence of particular matter in water and form primary food of planktivorous fish (Ivlev, 1961), Presence of copepods indicate rich trophic status of the water body (Pejler, 1983).

Presence of maximum zooplankton population in summer (Fig. 2) might be due to the presence of higher population of bacteria. The lowest number recorded during rainy season may be related to the flood and fast currents. This finding support to Bilgrami and Datta Munshi (1985) and Yousuf (1989). Seasonal fluctuation was observed in zooplanktonic community during the course of present investigation. Patra and Dutta (2004) have noted the seasonal fluctuation of zooplankton which is governed by abiotic and biotic factors. To assess the importance of abiotic interaction an attempt was made to analyze the data statistically (Table 3). Rotifers showed positive correlation with all the studied parameters except pH sulphate and dissolved oxygen, cladocerans showed negative correlation with pH and phosphate while copepods revealed negative correlation with water temperature, pH and sulphate.

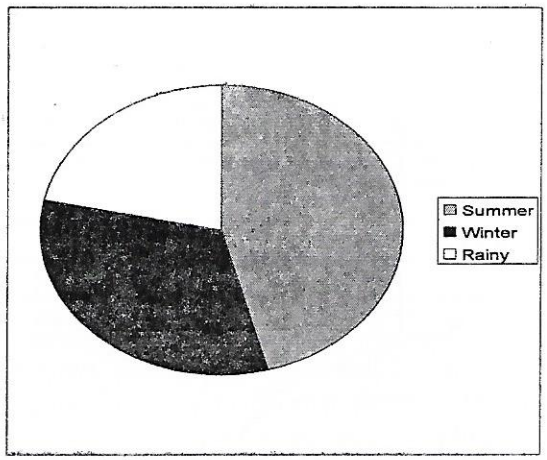

Fig. 2 : Seasonal variation of zooplankton

Table 3: Karl Pearsons's correlation coeficient (r)

Variables	Rotifera		Cladocera		Copepoda	
	r	r^2	r	r^2	r	r^2
Water Temp. (°C)	0.22	0.494	0.053	0.0028	-0.094	0.0089
pH	-0.075	0.0057	-0.323	0.1045	-0.079	0.00062
DO (mg/l)	-0.349	0.0057	0.149	0.0223	0.527	0.2774
Free CO_2 (mg/l)	0.327	0.1070	0.620	0.3846	0.495	0.2455
Bicarbonate (mg/l)	0.124	0.248	0.434	0.1887	0.223	0.0499
NO_3^- (mg/l)	0.183	0.336	0.519	0.2693	0.432	0.1866
PO_4^{3-} (mg/l)	0.198	0.0393	-0.009	0.001	0.079	0.0063
Cl^- (mg/l)	0.078	0.006	0.454	0.206	0.530	0.2806
SO_4^{2-} (mg/l)	-0.233	0.0543	0.278	0.00775	-0.287	0.0824

References

APHA, 1975. Standard methods for examination of water and waste water 14th edition. American Public Health Association, Washington, D.C.

Arora, H.C., 1966. Rotifers as indicators of trophic nature of environment. ***Hydrobiol.***, 27: 146-159.

Baker, R.L., 1979. Specific status of *Keratella cochlearis* (Goose) and *K. Eurlinare* Ahlaofrom (*Rotifera* and *Brachionidae*) morphological and ecological consideration. ***Can. J. Zool.***, 57: 1719-1722.

Bansei, I., 1976. Zooplankton investigation on the dammed river. Tisza Reaches, Tiscia (Szeged), XI : 119-124.

Barbosa, F.A.R., Breudo, C.E.M. and Huszer, V.L.M., 1995. Phytoplankton studies in Brazil community structure, variation and diversity. In : (eds. Tundisi, J.S., Bicudo, C.E.M. and Matstmura Tundisi, T) : Limnology in Brazil. 18-36. Brazilian Limnological Society, Sao Paulo.

Bilgrami, K.S. and Datta Munshi, J.S., 1985. Ecology of River Ganges. Impact of human activities and conservation of aquatic biota (Patna to Farakka). Allied Press, Bhagalpur, India.

Biswas, B.K. and Konar, S.K., 2000. Influence of Nunia Nallah (canal) discharge on plankton abundance and diversity in the river Damodar at Narankuri (Raniganj) in west Bengal. Indian. ***J. Environ and Ecoplan.***, 3: 209-217.

Cable, I.E., 1966. Plankton United States Department of Interior Fish and Wildlife Service. Bureau of Commercial Fishes. Fishery Leaflet. pp: 583.

Dagget, R.F. and Davis, C.C., 1974. A seasonal quantitative study of littoral cladocera and copepoda in a big pond an acid marsh in Newfoundland. ***Int. Rev. ges. Hydrobiol.***, 59(5): 667-683.

Edmondson, W.T., 1974. A manual on methods for measuring primary production in aquatic environment. Acad. Press, N.Y., U.S.A.

Edmondson, W.T., 1996. Fresh Water Biology. John Willey and Sons. Inc. New York.

Ferneska, M. and Lewkowiez, S., 1966. Zooplankton in pond in relation to certain chemical factors. ***Acta. Hydrobiol.***, 8: 127-153.

George, M.C., 1996. Comparative plankton ecology of five fish tank in Delhi, India. ***Hydrobiol.***, 32: 47-60.

Holland, C.E., Brayan, C.F. and Neman, Jr. J.P., 1983. Water quality and the rotifer populations in the Alchafalaya river basin, Louisiana. ***Hydrobiol.***, 98: 55-69.

Ivlev, V.S., 1961. Experimental ecology of the feeding of fishes. Translated from Russian by D. Scott, Val. University Press, New Haven.

Laal, A.K. and Karthikeyan, M., 1993. Rotifer population or productivity indicators. ***Curr.Sci.***, 5: 874-875.

Lackey, J.B., 1938. The manipulation and counting of river plankton and changes in some organism due to formation preservation. Publ. Health Deptt., 53:2080

Maruthanayagam, M. Sasikumar, M. and Senthikumar, C., 2003. Studies on zooplankton population in Thirukkulum pond during summer and rainy seasons. ***Nat. Env. & Poll. Tech.***, 2(1): 13-19.

Nasar, S.A.K., 1977. Investigations the seasonal periodicity of zooplankton fresh water pond in Bhagalpur India. Acta Hydrochem. ***Hydrobiol.***, 5(6): 577-584.

Pandey, B.N., Mishra, A.K., Jha, A.K., and Lal, R.N., 1992. Studies on qualitative composition and seasonal fluctuation in plankton composition of river Mahananda, Katihar (Bihar). ***J. Ecotoxicol. Environ. Mont.***, 2(2): 93-97.

Pandey, B.N., Jha, A.K., Das, P.K.L and Pandey, K., 1994. Zooplanktonic community in relation to certain physico-chemical features of Kosi swamps, Purnea, Bihar. ***Env. & Ecol.***, 12(3): 563-567.

Pandey, B.N., Hussain, S., Jha, A.K. and Shyamanand, 2004. Seasonal fluctuation of zooplanktonic community in relation to certain physico-chemical parameters of river Ramjan of Kishanganj, Bihar. ***Nat. Env. and Poll. Tech.***, 3(3): 325-330.

Patra, S.B. and Dutta, N.C., 2004. Seasonal fluctuations of different zooplanktonic group of a rainfed wetland in relation to some abiotic factors. ***Ind. J. Env. & Ecoplan.***, 8: 7-12.

Pejler, B., 1983. Zooplanktonic indicators of trophy and their food. ***Hydrobiol.***, 101: 111-114.

Prasadam, R.D., 1977. Observation of zooplankton population of some fresh water impoundments in Karnataka. Proc. Symp. Warm. Wat. Zooplankton. NIO, 609. pp: 214-225.

Schindler, D.W. and Noven, B., 1971. Vertical distribution and seasonal abundance of zooplankton in two shallow lakes at Ontario. ***J. Fish Res. Bd.Can.***, 28: 245-256.

Trivedy, R.K. and Goel, P.K., 1984. *Chemical and biological methods for water pollution studies.* Env. Pub. Karad., India.

Vareethiah, K. and Haniffa, M.A., 1998. Phytoplankton pollution indicators of Coir retting. ***J. Env. Poll.***, 5(2): 117-122.

Venkataraman, K., 1981. Field and laboratory studies on *Daphnia carinta* (*Cladocera*: Daphinidae) from a seasonal tropical pond. ***Hydrobiol.***, 30(1): 129-136.

Yousuf, A.R., 1989. Zooplankton study in India with special reference to North India. A critical review in management of aquatic ecosystem. Society of Biosciences, Muzaffarnagar, India. pp: 309-324.