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Study of the Seasonal variation of Zooplankton in a fish pond near Roorkee, Distt. Hardwar

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Abstract

Zooplankton has been used as an indicator for monitoring the water quality, trophic status and pollution level. The purpose of this study was to assess the zooplankton abundance and their monthly variation in a fresh water fish pond near Roorkee. In the present study the total Zooplankton density exhibited a single peak during March. Though, a sudden increase was noticed in the month of September and October which sustained till March. This increase is endorsed to the settling of rain water return of favorable conditions in post monsoon period. Total number of zooplankton is high during winter season when the temperature is relatively low. In the present study total Zooplankton comprises of 5 groups: ***Protozoa***, ***Rotifera, Cladocera, Copepod***, and ***Ostracods.*** Out of this group ***Protozoa*** is the dominant group and the order of dominance is as ***Protozoa*** > ***Rotifera*** > ***Copepod*** > ***Cladocera*** > ***Ostracods.***

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Introduction

A pond is referred to as a man-made or natural water body which is between 1 m^2 and 2 ha (~5 acres or 20,000 m^2) in area, which holds water for four months of the year or more (Biggs *et al*., 2005). Ponds are an essential freshwater habitat for plants and animals, and they play a central role in maintaining high regional biodiversity. The important component of the ecological pyramid of the freshwater ecosystem is plankton. Planktonic communities have long been recognized in natural aquatic ecosystems as being a keystone group for energy (Alikuhi *et al*., 1955; Mitra & Mohapatra, 1956). All aquatic animals depend directly or indirectly on the plankton, which make them of prime importance. Similarly, a healthy zooplankton community in many aquaculture systems is also recognized as necessary for good final production from the system (Estudillo *et al*., 1998), and these communities have potential value as indicators of changing trophic condition (Kundari and Kanamadi, 2008). Zooplankton form an intermediate step in grazing food chain in aquatic bio-loop and an ecosystem (Rao 1993). Zooplankton

organisms occupy a central position in the food webs of aquatic ecosystem. The importance of the Zooplankton is well recognized as these have vital part in food chain and play a key role in cycling of organic matter in an aquatic ecosystem. The larvae of carps feed mostly on zooplankton, they constitutes important food item of many omnivorous and carnivorous fish. With the thrust on rural aquaculture in the country, it is generally seen that ponds in rural areas adopted for fish farming are largely unkept and unmanaged. As such it becomes imperative to study such representative pond ecosystems on a comparative basis. For effective maintenance of water quality through appropriate control measures, continuous monitoring of large number of quality parameters is essential (Khanna *et al*., 2009).

Material and Methods

The present investigation was carried out for one year (January, 08 to December, 08) in a fresh water fish pond with 2, 92,500 square meter water area at village Paniyala near Roorkee (29° 51' N; 77° 53' E). The depth of pond was (0.6-2.8 m) mean depth was 1.7 meter. Water samples from the surface water column were collected on monthly basis for a period of one year. Four sampling points (S_1, S_2, S_3 and S_4) were selected from the four sides of the pond with an approximate distance of 2m along the edge from the places of human activities such as washing, bathing and fishing, etc. Samples from the predetermined points were collected between 7.00 A.M. to 9.30 A.M. For studying the quantitative analysis of zooplankton at each collection site separately 100 liters of water was passed through the plankton net. The plankton samples were preserved in 4 % formaldehyde and brought in the laboratory for quantitative and qualitative analysis. With the help of broad mouth dropper the sample was transferred to the Sedgwick Rafter cell and the plankton were counted. The identification of zooplankton was done according to Needham and Needham (1972), Ward and Whipple (1959), APHA (2005) and Khanna and Bhutiani (2008). Counting of the organisms was done by applying the following formula-

$$\text{Plankton/ l} = \frac{(a \times 1000)C}{l}$$

Where,

a = average no. of plankton in one small counting chamber of Sedgwick Rafter counting cell.

c = ml of plankton concentrate

l = Volume of original water filtered in liter

Results and Discussion

The zooplankton in Indian subcontinent consists of miscellaneous assemblage of major taxonomic groups. The number, type and distribution of these organisms present in any aquatic habitat provide a clue on the environmental conditions existing in that particular habitat. The density of zooplankton showed distinct seasonal variations. In the present study it has been noted that the maximum average number of zooplankton were (597 unit/l ±163.71) in the month of March and minimum number were (57.17 unit/l ±18.71) found in the month of August. Observing the monthly variation in the number of zooplankton the maximum number observed was (856.62 unit/l ±132.00) in the month of March at site I and minimum was present at site II (29.69 unit/l ±15.11) in the month of July. Bhuiyan & Nessa (1998a, b) and Islam *et al*. (2000) recorded highest

density of total zooplankton in winter and minimum during rainy season. Variation in the numbers of zooplankton at different site during the study period is tabulated in Table-1 and graphically shown in Fig. 1.

The results indicated that the zooplankton were maximum in the winter month perhaps due to low temperature and high content of DO. Similar study was made by Khanna and Bhutiani (2003) and Khanna *et. al. (*2000).

During the study each group of zooplankton showed their own maximal and minimal peaks. In the present study the protozoan was maximum during (182.63 unit/l ±37.08) in January at site I and minimum was (6.57±2.03) in the month of July in the same site. Highest average number (148.32 unit/l ±40.98) was observed in January month and minimum (12.49 unit/l ±6.30) in the month of July (Table-2 and Fig. 2). Rotifers are considered opportunists due to their highest intrinsic rates of natural increase among the major zooplankton groups (Allan, 1977). Rotifera was maximum (192.30 unit/l ±16.24) in April at site IV and minimum was observed (5.85 unit/l ±4.62) during July at the same site. Highest average number (127.78 unit/l ±18.01) was studied in April and minimum was observed (11.15 unit/l ±5.64) in the month of August (Table-3 and Fig.3). Cladoceran (Table-4 and Fig. 4) was maximum (190 unit/l ±32.61) in the month of March found at site I and minimum (1.08 unit/l ±0.24) was during in August at site IV.

Highest average number (101.75 unit/l ±15.50) was observed in the month of March and minimum average number (6.88 unit/l ±2.33) was found during August. Govind (1969) reported Cladoceran peak in March to May in the shallow zone of Tungabhadra reservoir. Copepods are relatives of crabs and shrimp. They have a hard shell-like cover on their bodies and jointed appendages. Most copepod in ponds are 4 mm or less. Copepod feed on tiny green cells (algae) that are also present in the pond. Copepod (Table-5 and Fig. 5) was maximum (135.27 unit/l ±42.31) in March at site I and site IV shown the number (3.24 unit/l ±1.67) in the month of July. The highest average number (107.56 unit/l ±35.13) were found in March and minimum average number (5.18 unit/l ±3.36) observed during July. Ostracods are bivalve crustaceans found in both freshwater and marine water. There are over 1700 species of known ostracods of which about one-third are fresh water forms. They inhibit a wide variety of freshwaters like lakes, pools, swamps, streams and heavily polluted areas (Edmondson, 1959). Ostracods were totally absent at site II during the study period. Ostracods was maximum (152.61 unit/l ±35.49) in the month of March found at site I and minimum (4.05 unit/l ±0.82) were observed during July at site IV (Table-6 and Fig. 6). The highest average number (84.66 unit/l ±33.36) was observed in March and the minimum average number (4.05 unit/l ±0.82) was found in the month of July. The quantitative analysis of zooplankton revealed that the total concentration was highest in the month of January to March from where onwards it decreases continuously up to August.

Zooplankton population was found to be low during rainy season, but it was higher during summer and winter months. Though there was no clear trend to suggest that which of the two seasons could be considered as the best. It appears that the nutrient status of the pond is moderate and it is more or less environmentally least populated. Kohli *et al.* (1998) in Powai lake, Mumbai observed that

zooplankton population increased during post monsoon months. These findings are similar to those as recorded in case of this fish pond.

Month	Site-1	Site-2	Site-3	Site-4	Average
January	436.52±35.60	434.78±156.67	189.48±44.51	627.30±162.82	422.02±99.9
February	320.00±160.00	390.89±141.65	334.50±50.52	647.65±186.00	423.26±134.54
March	856.62±132.00	503.56±244.84	229.54±37.22	799.53±240.81	597.31±163.71
April	621.34±158.62	507.89±74.74	352.67±112.68	558.71±67.79	510.15±103.45
May	526.10±127.80	279.55±132.74	357.62±54.34	311.74±190.71	368.75±126.39
June	196.25±72.36	100.36±43.77	214.72±41.98	89.08±31.12	150.10±47.30
July	84.60±35.00	29.69±15.11	92.06±27.68	34.21±11.55	60.14±22.33
August	87.21±18.24	37.64±21.04	49.11±20.81	54.75±12.51	57.17±18.15
September	95.27±31.00	120.08±45.21	58.14±18.50	115.92±25.25	97.35±29.99
October	132.16±56.06	162.38±39.39	70.77±27.86	166.60±33.01	132.97±39.08
November	125.00±7.86	197.83±56.74	73.66±20.94	257.07±43.90	163.39±32.36
December	362.00±54.67	317.60±83.31	137.77±30.01	389.27±130.83	301.66±74.70

Table-1: Monthly variation in the number of total zooplankton at different sampling sites (Unit/l)

Month	Site-1	Site-2	Site-3	Site-4	Average
January	182.63±37.08	149.65±56.30	145.00±14.26	116.00±56.31	148.32±40.98
February	157.00±42.00	119.50±70.25	62.14±12.50	76.84±29.82	103.87±38.64
March	172.65±41.38	114.62±17.20	104.32±36.20	112.67±39.82	126.06±33.65
April	110.36±10.53	112.40±27.80	106.05±15.04	105.00±16.08	108.45±17.36
May	74.21±50.24	72.00±13.21	62.05±12.30	97.42±18.86	76.42±23.65
June	14.00±6.28	30.02±17.29	42.24±15.20	46.65±23.50	33.22±15.56
July	6.57±2.03	10.61±7.21	16.08±8.59	16.70±7.40	12.49±6.30
August	10.16±3.53	32.51±3.82	35.14±6.20	20.86±6.36	24.66±4.97
September	32.62±7.28	32.51±7.24	25.00±5.10	25.62±8.82	28.61±7.11
October	34.00±8.05	40.00±25.21	20.10±3.16	20.35±4.29	28.61±10.17
November	52.62±12.39	45.62±7.14	35.52±2.50	37.49±8.50	42.81±7.63
December	94.00±17.52	85.73±3.50	50.10±10.15	63.70±15.70	73.38±11.71

Table-2: Monthly variation in the number of Protozoa at different sampling sites (Unit/l)

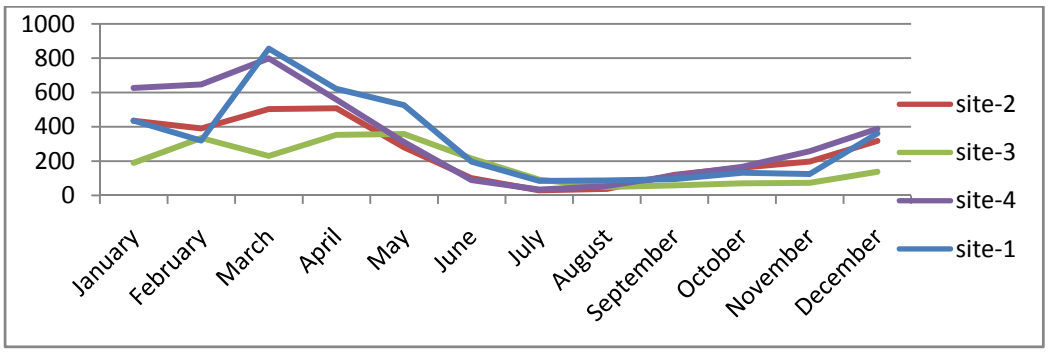

Fig. 1: Monthly variation in the number of total zooplankton at different sampling site

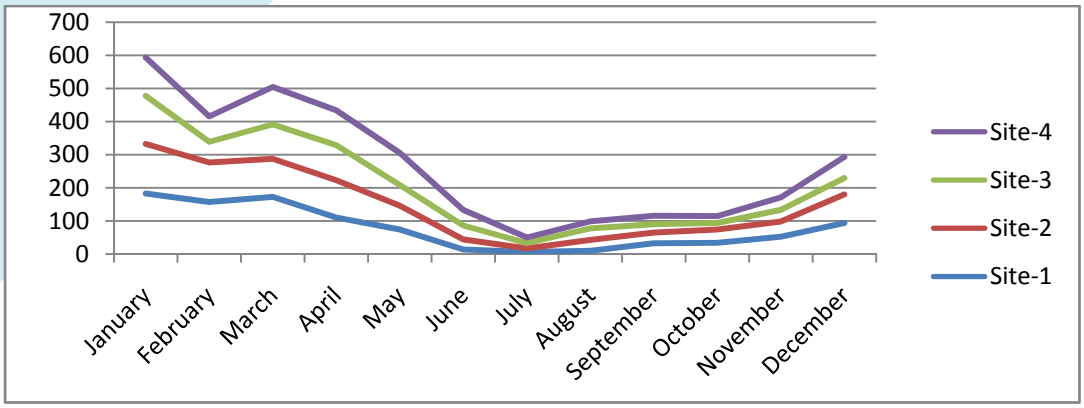

Fig. 2: Variation in the number of Protozoa at different sampling sites.

Month	Site-1	Site-2	Site-3	Site-4	Average
January	106.00±32.71	112.61±18.31	68.20±12.00	116.60±28.26	100.85±22.82
February	115.64±61.00	137.25±58.82	50.10±5.24	106.92±56.81	102.47±45.46
March	149±89.02	107.82±17.82	66.00±14.21	112.84±88.92	108.91±52.49
April	107.2±12.86	125.64±27.84	86.00±15.10	192.30±16.24	127.78±18.01
May	78.35±42.79	32.62±9.81	65.00±10.14	53.00±30.24	57.24±23.24
June	21.71±6.28	15.20±9.83	25.62±2.60	17.00±4.90	19.88±5.90
July	12±8.20	12.33±7.24	16.81±2.50	5.85±4.62	11.74±5.64
August	15.52±3.42	15.24±6.89	5.14±3.00	8.70±7.00	11.15±5.07
September	30.25±7.18	37.81±9.80	12.00±12.10	52.50±17.24	33.14±11.58
October	42.8±5.24	56.72±17.81	12.00±11.40	65.00±13.86	44.13±12.07
November	68.4±8.13	84.00±7.24	52.10±11.30	85.02±23.46	72.38±12.53
December	37.24±52.64	28.54±7.21	46.12±11.00	97.22±37.25	52.28±27.02

Table-3: Monthly variation in the number of Rotifera at different sampling sites (Unit/l)

Month	Site-1	Site-2	Site-3	Site-4	Average
January	137±38.51	21.05±75.16	12.10±3.10	17.56±8.64	46.92±31.35
February	189.68±42.80	15.64±72.80	16.20±2.16	37.70±8.12	64.84±31.47
March	190±32.61	150.00±19.37	22.00±5.00	45.00±5.04	101.75±15.50
April	172.53±32.06	16.72±37.84	15.01±2.20	25.62±8.20	57.47±20.07
May	52.62±28.40	64.71±32.61	10.65±1.10	16.00±5.20	35.99±16.82
June	14.68±2.98	35.40±7.86	3.10±1.04	3.25±1.86	14.10±3.43
July	2.93±0.24	11.00±4.62	5.00±2.00	1.80±0.02	5.18±1.72
August	10.26±0.09	14.20±8.00	2.00±0.01	**1.08**±0.24	6.88±2.33
September	7.16±1.20	25.67±17.82	6.60±3.50	**6.70**±3.25	11.53±6.44
October	32.8±13.42	30.27±27.00	12.30±2.12	16.20±8.24	22.89±12.69
November	49.63±17.68	48.16±2.15	2.15±0.21	4.32±1.50	26.06±5.38
December	64.32±32.65	85.60±7.14	5.16±1.00	9.40±6.00	41.12±11.69

Table-4: Monthly variation in the number of Cladocera at different sampling sites (Unit/l)

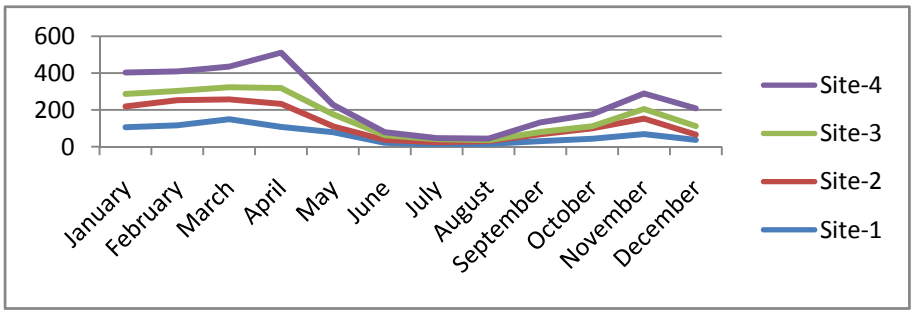

Fig. 3: Monthly variation in the number of Rotifera at different sampling sites

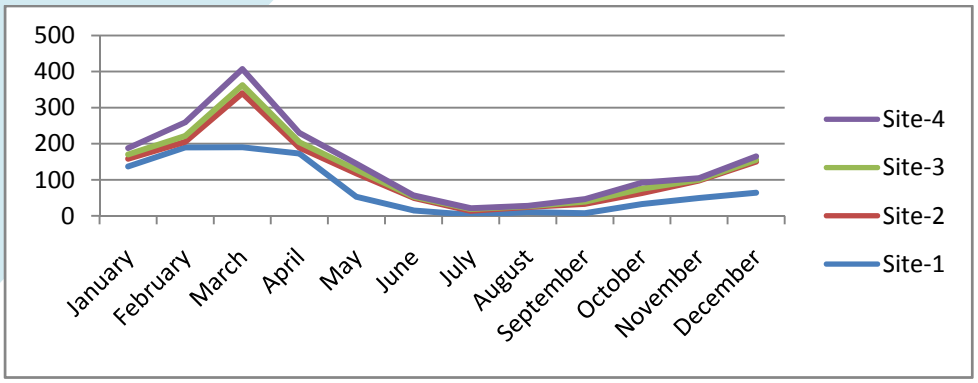

Fig. 4: Monthly variation in the number of Cladocera at different sampling sites

Month	Site-1	Site-2	Site-3	Site-4	Average
January	86±12.37	40.25±17.35	55.00±10.00	106.00±37.84	71.81±19.39
February	64.3±16.20	90.10±15.60	86.00±12.21	115.26±28.30	88.91±18.07
March	135.27±42.31	87.63±27.84	92.35±35.12	115.00±35.26	107.56±35.13
April	85.62±5.82	65.36±17.82	68.00±16.14	100.62±27.80	79.9±16.89
May	53.71±28.80	15.42±8.89	52.02±12.24	55.65±27.84	44.2±19.44
June	14.39±5.26	12.31±3.42	10.00±2.64	15.60±7.23	13.07±4.63
July	3.71±0.06	7.66±6.10	6.12±5.62	3.24±1.67	5.18±3.36
August	5.28±1.35	15.92±8.34	11.36±5.10	14.00±6.10	11.64±5.22
September	17.87±6.24	0.40±37.80	14.61±3.76	15.26±7.28	22.03±13.77
October	28.35±4.20	56.71±8.21	14.20±2.10	28.12±4.16	31.84±4.66
November	36.42±4.89	63.21±7.22	26.00±11.00	35.00±15.28	40.15±9.59
December	72.82±15.63	5.80±32.80	52.10±11.26	95.28±13.36	74±18.26

Table-5: Monthly variation in the number of Copepod at different sampling sites (Unit/l)

Month	Site-1	Site-2	Site-3	Site-4	Average
January	115.67±42.15	–	54.20±11.16	78.62±25.62	62.12±19.73
February	121.03±24.00	–	15.10±5.11	54.17±18.60	47.57±11.92
March	152.61±35.49	–	68.00±22.15	118.05±75.80	84.66±33.36
April	83±6.52	–	82.56±5.86	84.35±6.42	62.47±4.7
May	52.85±40.48	–	25.00±6.20	57.48±50.60	33.83±24.32
June	24.3±10.32	–	11.10±6.20	17.86±6.30	13.31±5.70
July	9±1.02	–	5.10±2.10	2.10±0.18	4.05±0.82
August	13.53±4.12	–	4.50±4.20	3.00±1.56	5.25±2.47
September	28.02±3.35	–	12.56±3.40	20.00±8.62	15.14±3.84
October	28.65±2.10	–	15.06±2.16	32.71±8.84	19.10±3.27
November	50±0.81	–	22.00±5.00	36.00±8.00	27±3.45
December	60.89±12.39	–	36.00±11.10	52.00±11.00	37.22±8.62

Table-6: Monthly variation in the number of Ostracods at different sampling sites Unit/l)

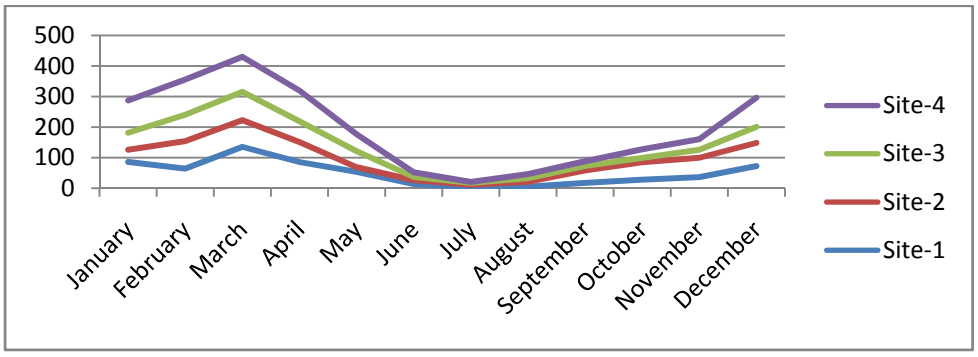

Fig. 5: Monthly variation in the number of Copepod at different sampling sites (Unit/l)

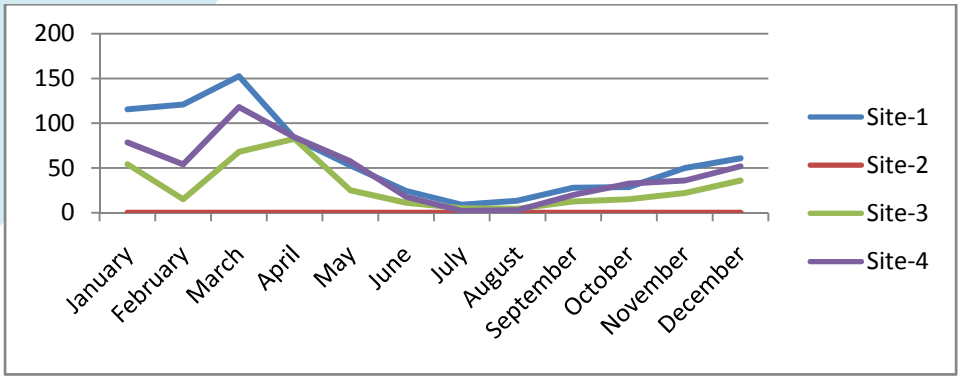

Fig. 6: Monthly variation in the number of Ostracods at different sampling sites (Unit/l)

References:

Alikuhi, K. H., Chaudhuri, H. & Ramachandran, V. (1955). On the mortality of carp fry in nursery ponds and the role of plankton in their survival and growth. Indian J. Fish. 2: 257-313.

Allan, J. D. (1977). An analysis of seasonal dynamics of a mixed population of *Daphnia* and the associated cladoceran community.

APHA, (2005). Standard methods of examination of water and waste water. 21st Ed., American Public Health Association, New York, USA.

Bhuiyan, A.S. & Nessa, Q. (1998a). Seasonal variation in the occurrence of some zooplankton in a fish pond. *Bangladesh J.Fish. Res*.**2**(2):201-203.

Bhuiyan, A.S. & Nessa, Q. (1998b).A quantitative study of zooplankton in relation to the physico-chemical conditions of a freshwater fishpond of Rajshahi. *Univ. J. Zool.Rajshahi Univ*. **17**:29-37.

Biggs J, Williams P, Whitfield M, Nicolet P, Weatherby A (2005). 15 years of pond assessment in Britain: results and lessons learned from the work of pond conservation. Aquatic conservation; Marine Freshwater Ecosyst. 15: 693-714.

Edmondson, W.T. (1959). Freshwater Biology. 2nd edition. John wiley and Sons, New York, USA.

Estudillo, C.B., Duray, M.N. & Marasigan, E.T. (1998) Growth and survival of milkfish (*Chanos chanos*), seabass (*Lates calcarifer*) and rabbitfish (*Siganus guttatus*) larvae reared at the same density in different sized containers. The Israel J. Aquacult. – Bamidgeh 50: 20-24.

Govind, B. V. (1969). Bottom fauna and macrovegetation in the Tugabhadra reservoirand their role in the food chain of fish communities. *Proc. Sem Ecol. Fish.*, pp 27-29.

Islam, M.N., Khan, T.A. & Bhuiyan, A.S. (2000). Ecology and Seasonal abundance of some zooplankton of a pond in Rajshahi. *Univ.J. Zool.Rajshahi Univ*. **19**:25-32.

Khanna D.R., Bhutiani R., Matta Gagan, Kumar Dheeraj, Singh V. and Ashraf J., (2009). A Study of Zooplankton diversity with special reference to their concentration in River Ganga at Haridwar. Environment Conservation Journal, 10(3): 15-20.

Khanna, D.R.,Gautam,A.,Chug,T. and Sarkar,P. (2000). Impact of abiotic factors on the planktonic population of a pond. Env. Cons. J., 1(1):41-46.

Khanna, D.R. and Bhutiani, R. (2003). Ecological status of Sitapur Pond at Hardwar (Uttaranchal), India. Indian J. Env. And Eco. Pl., 4(1-3):109-122.

Khanna, D.R. and Bhutiani, R., (2008). Water analysis at a glance. ASEA Publication, pp: 1-115.

Kohli, M.P.S., Dubey, K., Prakash, C., Chaturvedi, C. S. and Jadhav, R.J. (1998). Observation on some Hydrobiological feature of lake Powai near Mumbai (Maharashtra*) J. inland finish Soc.* India, **30**(2):37-49.

Kudari, V. A. and Kanamadi, R. D. (2008). Impact of changed tropic status on the zooplankton composition in six water bodies of Dharwad district, Karnataka state (South India). Environ. Monit. Assess., 144: 301 – 313.

Mitra, G.N. & Mohapatra, P. (1956) On the role of zooplankton in the nutrition of carp fry. Indian J. Fish. 3: 299-310.

Needham J. G., Needham R. R., (1972). A guide to the study of freshwater biology. Holden Day Inc. San Francisco Constable & Comp. Ltd. 5th Edit. p.108.

Rao, K.S. (1993) "Recent advancement in Fresh water biology", Anmol Publishing Pvt. Ltd. New Delhi.

Ward H. B., Whipple G. C., (1963). Freshwater biology 2nd Edit. (Edmondson W.T. Ed.) New York London John Wiley & Sons Inc. pp. 1248.