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RESEARCH ARTICLE

Monthly variation of physico-chemical parameters and zooplankton density in Kangsabati Reservoir, West Bengal, India

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Abstract

The present investigation provides information about physico-chemical parameters and zooplankton density which was carried out on monthly basis for the period of one year from march- 2010 to February -2011 at three different stations of Kangsabati Reservoir which is a freshwater ecosystem. Various parameters including temperature, conductivity, transparency, pH, dissolve oxygen, free CO_2, total alkalinity, chloride, phosphate, total inorganic nitrogen, total hardness were analyzed. Phosphorus and total inorganic nitrogen were at peak in rainy season. Water temperature varies with air temperature ranging 2.26 ^{0}C to 11.41 ^{0}C. Chlorinity, salinity, alkalinity were high in summer season and low in winter month. Transparency was maximum in winter season and minimum in rainy season.

The result envisages that there were wide fluctuations in some physico-chemical parameters where as few parameters were in the normal range throughout the study period and indicated better water quality of the reservoir.

During study period total 39 genera of zooplankton were identified in five groups such as Rotifera (12 genera),Copepoda (12 genera), Cladocera (10 genera), Ostracoda (2 genera) and Protozoa(3 genera).The highest number of zooplankton was recorded in May-2010 months (743 Ind./L) and lowest in July-2010 months (169 Ind./L).

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Introduction

Aquatic ecosystem is considered as diverse ecosystem in the nature. The physico-chemical characteristics of the aquatic environment either directly or indirectly influence the life inhabiting it. And zooplankton plays a critical role not only in converting plant food to animal food but also they themselves serve as source of food for higher organisms. Zooplanktons provide the main food source for fishes and can be used as indicators of trophic status of water bodies (Verma &Munshi, 1987). Zooplankton densities are sensitive to physical and chemical changes in the water comprising the qualitative and quantitative fluctuation as well as biological productivity.

Interrelationship of physico-chemical and biological conditions have been investigated in various aquatic habitat by a number of workers like Sukumaran and Das (1999); Pandey, B.N., Hussain, S., Jha, A.K., and Shyamanand, (2004) ; Altaff, K.(2003)., Chandrasekhar, S.V.A.(2002)., Kumar, A. and Tripathi, S. (2004)., Srivastava, N., Harit, G. and Srivastava, R. (2009)., Sharma, L.L. and Sarang, N. (2004) ; Dhanapathi, M.V.S.S.S. (2000). The present study deals with various physico-chemical factors and abundance of zooplankton in Kangsabati reservoir.

Materials And Methods:-

Kangsabati, a man made reservoir comprising 7400 ha. average water spread area, has been set up during the year 1965-1966 on the river of Kansai and Kumari at Mukutmanipur, West Bengal , India. The reservoir is located about 67 Km southwest from the Bankura Town, West Bengal. Geographically it is situated in between 22° 55'16.53" N - 23°2' 30.41"N latitude and 86° 37' 55.30" E - 86° 47' 23.35" E longitude. Reservoir is used for different purposes like irrigation, drinking water supply, pisciculture etc. Generally, Kangsabati reservoir is lentic water body but in monsoon it becomes lotic when water level exceeds maximum limit of water holding capacity. The map of Kangsabati reservoir has been depicted in figure – 1.

Water samples were collected from the three stations viz. Sadarghat, Aparajitaghat and Peerless ghat called by local people. Monthly samples of subsurface water were collected during last week of each month from March, 2010 to February, 2011 at 8 A.M - 9.30 A.M in clean plastic air tight bottles. The water and air temperature were recorded by minimum-maximum hydro-thermometer and thermometer respectively; pH by pH meter (Cystronics model – 335); dissolved oxygen by Winkler's method; photic depth by Secchi disc method; free Co_2, alkalinity, chlorinity, phosphorus, total inorganic nitrogen, Calcium, Magnesium and hardness by APHA (2008).

Qualitative and quantitative Zooplankton analysis of the reservoir was done for the same period. From each spot 75L of water samples was filtered through plankton net of bolting silk No.25 (mesh size 64 micrometer). All the filtered content was then transferred to 100 ml container. 4% formalin and few drops of glycerin were added to it. Supernatant plankton free water was removed and sedimentary zooplankton was counted by Sedgewick-Rafter cell method (Adoni,1985). Identification of zooplankton was done under microscope using keys and monographs of Edmondson (1959), Battish (1992), Needham & Needham (1978), Sharma(1998) and with the help of experts of Zoological Survey of India, Kolkata.

Results And Discussion :-

Fig. 1 - Kangsabati Reservoir (Blue Shaded Area) Map.

Fig. 2 - Open view of Kangsabati Reservoir.

Water transparency: It was higher in between end of winter and beginning of dry season as a result of reduced rain. Similar type of observation was reported in Kangsabati reservoir (Kundu et al, 2005).The mean values of transparency were ranged between 40.83 $\pm$ 7.16 cm (May-2010) to 308.5 $\pm$ 13.93 cm (February -2011) during the present study (Table – 1). Factors affecting transparency of water are siltation, microscopic organisms and organic matter (Mishra and Saksena.,1991). The water of the Kangsabati reservoir became turbid due to suspended solids being washed off with rain water.

Temperature: It is very important for its role in chemical and biological activities of organisms in the aquatic media. The mean values of atmospheric temperature were found to vary 25.0 $\pm$ 1.00 ^{0}C in December-2010 to 36.83 $\pm$ 0.67^{0}C in April-2010 (Table – 1). The maximum air temperature was recorded in summer, while the minimum was recorded in the winter. Similar result was observed in Satak Reservoir, Madhyapradesh (Yadav et al., 2013). Water temperature followed closely with the air temperature and fluctuated between 31.66 $\pm$ 0.78 ^{0}C in July-2010 to 18.33 $\pm$ 1.52 ^{0}C in December -2010 (Table – 1). The water temperature was always less than air temperature and it was recorded to be lower than air temperature 2.26 ^{0}C to 11.41 ^{0}C.

Dissolved oxygen: It is very important parameter in water quality assessment .Its presence is highly effective for maintenance of biological life of aquatic ecosystem. The mean values of D.O. content were to vary in between 7.2 ± 0.6 to 12.4 ± 0.4 ppm during study period (Table – 1). D.O. showed inverse relationship with temperature which was also reported by several workers (Rani et al, 2004.,Chattopadhyay, 2007). Higher D.O. during winter might also be due to photosynthetic activities of aquatic plants and specific types of algae at upper level of the water body.

Conductivity: Electrical conductivity is a tool to asses the purity of water (Murugesan et al, 2006). Electrical conductivity of water depends upon the concentration of ions dissolved in it. The trend of conductivity value was higher in summer months than lower in the month of rainy season(Table – 1). Similar pattern was recorded by Figueredo and Giani (2001).

Free Co_2 : Carbon di oxide is produced as a result of respiration of aquatic organisms . Due to respiration of organisms, carbon di oxide increases in water which subsequently change the proportion of carbonate and bicarbonate ion (Boyd, 1981). In the present study, Co_2 values were observed in between 3.33 ± 0.56 in July-2010 to 9.66 ± 1.52 mg/l in January-2011(Table – 1). In 2005, Kundu et al, reported free Co_2 range 5 to 12 mg/l in the Kangsabati reservoir. Generally, during winter season free Co_2 remain high in the water due to low temperature. Chattopadhyay (2007) also reported a negative co-relation of temperature with Co_2 in Krishna Sayar lake at Burdwan.

Alkalinity: Alkalinity of water is a measure of its capacity to neutralize acids. Presence of hydroxides, carbonate and bicarbonate are usually considered for determination of alkalinity. The mean values of total alkalinity ranged between 40.67 ± 1.14 mg/l in September-2010 to 94.0 ± **1.0mg/l** in May-2010 (Table – 1). Kedar, Patil and Yeole (2008) recorded maximum alkalinity in summer and minimum in monsoon probably due to rainfall in Rishi lake, Maharastra. Similar results also expressed by Islam (2002) in a pond of Rajshahi University, Bangladesh.

Salinity : It plays an important role in the growth of culture organisms through osmoregulation of body minerals from that of the surrounding water and acts as a dynamic indicator of the nature of the exchange system. It expressed maximum in summer season 0.57 ± 0.07 inJune-2010 & minimum in winter season 0.22 ± 0.01 in February-2011(Table – 1).

Chloride: The mean values of chloride were found to vary between 110.91 ± 8.40 mg/l inFebruary-2011 to 305.30 ± 43.04 mg/l in June-2010 (Table – 1). During present investigation, it has been observed that the chloride content was higher in the month of summer. Similar type of observation had been found in Ranjitsagar reservoir by Kumar, Parasharand and Patiyal(2006). It has been reported by many worker about high chloride content during summer. It is due to evaporation as well as reduction of water volume which helps to increase concentration of salts.

Hardness : In most of the fresh water , total hardness is mainly occupied by calcium and magnesium ions. Hardness varied from 112.62 ± 4.35 ppm in January-2011 to 195.36 ±3.08 ppm in August-2010 (Table – 1). In few cases during rainy season (July to Sept) hardness of water abruptly increase due to addition of Ca & Mg ions through surface runoff from soil and sedimentary rocks. These findings suggest that the water body is hard mainly in the transitional period of summer and rainy season.

p^H : It is the scale of intensity of acidity and alkalinity of water and measures the concentration of hydrogen ions .Sreenivasan (1976) observed that a large variation in p^H of water is an indicator of a highly productive nature of the water body. The variation of p^H ranged between 7.32 ± 0.12 in March-2010 to 8.45 ± 0.34 in December-2010 (Table – 1).Water quality is slightly alkaline throughout the year. In winter season p^H range increased but in other season minute differences were observed. Kundu et al, (2005)., Mukherjee and Praharaj (2009) also exhibited similar results and considered as a safe range for aquatic life. A positive correlation was found between zooplankton density with respect to p^H .Similar result had been seen in Ramgarh lake, Joypur, Rajasthan by Paulose and Maheshwari (2008).

Phosphorus: The most critical single element in maintaining aquatic productivity is phosphorus, through it is one of the most limiting factors of production in Indian reservoirs (Das, 2000). The mean values of phosphorus ranged

between 0.014 to 0.199 mg/l. Observed values was maximum in the month of August-2010 & minimum in March-2010 (Table – 1). According to Sreenivasan (1964) normal range of phosphate concentration in water is 0.1 to 0.2 mg/l. Finding result remained within the normal range during the present study. Many worker (Sunkad and Patil, 2004) suggested during monsoon phosphorus range become greater than other season either due to phosphate rich agricultural runoff reaching the reservoir or prevalence of low temperature in winter reduces its utilization by phytoplankton .

Total inorganic nitrogen: Nitrogen is a vital composition of protein. Nitrate is plant nutrient which impacts on algal population. Total inorganic nitrogen(ammonia, nitrate and nitrite) were ranged between 0.5 to 1.96 mg/l. The values were very low all over the study period except monsoon. Similar observation was seen by Das (2000).

Photic depth: Light penetration range within the water was maximum in February-2011 i.e. 287 ± 15.13 cm & minimum in May-2010 i.e. 32.66 ±5.50cm (Table – 1). It was observed that it became due to turbidity and rainfall during study period.

Water level: Maximum water level was 432.8 ft during September-2010 and minimum was 396.0 ft during April-2010 (Table – 1) due to heavy rainfall and minimum rainfall respectively

Zooplankton:- The zooplankton of Kangsabati Reservoir consists of Rotifera, Copepoda, Cladocera, Protozoa and Ostracoda. Total 39 genera were recorded which were available in the reservoir during the present study. Of which 12 genera of Rotiera, 12 genera of Copepoda,10 genera of Cladocera,3 genera of Protozoa and 2 genera of Ostracoda contributed to zooplankton density. It was observed monthly wide fluctuation among zooplankton population. The total zooplankton population was occupied by Rotifera(31.65%), Copepoda (29.38%), Cladocera (21.52%), Protozoa (10.57%) and Ostracoda (6.88%) annually.

Among zooplankton, Rotifera was the dominant group. The highest number of Rotifer was observed in the month of March - 2010 (266ind./L), whereas lowest number recorded in October-2010 (44 ind./L).Among Rotifera *Brachionus sp., Keratella sp., Asplanchna sp. and Anuraeopsis sp.* were the dominant genera. The high incidence of Rotifer population in between winter and summer month show negative co-relation with temperature. Similar trends were found by Sharma (2009), Salve and Hiware (2010). Schindler and Noven (1971) reported enormous growth of rotifers in lakes and reservoirs indicating eutrophic condition.

High incidence of Copepoda was recorded in the month of May-2010 i.e. 364 ind./L, while low density was noticed in the month of March-2010 i.e. 22 ind./L (Table – 2). Nauplii, *Paracyclops sp., Pseudodiaptomus sp., Microcyclops sp., Diacyclops sp.* were the dominant genera. Similar type of observation was suggested by Paulose & Maheswari (2006) in Ramgarh lake. Cladocera was the third dominant group during the study period. *Daphnia sp., Ceriodaphnia sp., Bosmina sp., Simocephalus sp.* were the dominant genera. Maximum density were noticed in the end of winter season, Feb-2011 i.e.161 ind./L and low density in the month of rainy season, Aug-2010 i.e.19 ind./L (Table – 2). The presence of Daphnia sp. Indicates that reservoir water was clear and indication of absence of organic pollution . On other hands chemical variables are also within the permissible limit (Vijay Kumar et al; 2006).

Ostracoda comprising *Cypris sp., Cyprinotus sp.* showed their maximum population during the month of winter season, January-2011 i.e. 96 ind./L which indicate that it prefers low temperature & minimum during the month of rainy season, July-2010 i.e.7 ind./L(Table – 2). Similar observation was made by Kiran et al. (2007) in the pond of Bhadra Fish Farm, Karnataka. Shivashankar and Venkataramana (2013**)** in Bhadra Reservoir reported high abundance and diversity of ostracods in hard water.

The density of protozoan was highest during the month of December -2010 i.e. 88 ind./L & lowest at the end of winter &onset of summer months i.e. 12 ind./L (Table – 2). *Amoeba sp. & Difflugia sp.* were the dominant genera during study. The available species of zooplankton found in reservoir were enlisted in the table – 4.

Numerous studies have been conducted indicating the importance of phosphates and nitrates in controlling the abundance of phytoplankton and there by zooplankton (Schindler,1974; Barica,1990). Plankton population was low in the month of rainy season due to high temperature, high conductivity, low dissolved oxygen. Similar results were obtained by Pathani and Mahar (2006) in some lotic waters of Uttaranchal Himalayas.

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TABLE – 1: MONTHLY VALUES OF PHYSICO-CHEMICAL PARAMETERS OF KANGSABATI

RESERVOIR (MARCH, 2010 – FEBRUARY, 2011)

PARAMETER(UNIT)	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.
Air Temp.^{0} C	33.58 ±0.92	36.83±0 .67	34.33± 1.17	34.3 3±1. 03	35.83 ±2.36	34.50 ±0.50	35.67 ±0.7 5	31.0 6±0. 90	31.2 5±0. 90	25.0 ±1.0 0	32.16 ±1.0 4	35.25± 1.51
Water Temp.^{0} C	28.16 ±0.84	30.41±1 .09	29.66± 0.33	31.5 0±0. 5	31.66 ±0.78	30.75 ±0.24	30.86 ±0.3 1	28.8 0±1. 06	23.7 3±0. 64	18.3 3±1. 52	20.75 ±1.0 8	27.83± 4.53
Transparency(cm)	181.6 6±6.3 4	93.50±2 5.5	40.83± 7.16	105. 83± 21.0 9	133.0 ±23.0 1	188.3 4±27. 12	174.1 6±5. 10	193. 66± 12.4 7	189. 66± 14.0 2	188. 16± 15.0 5	239.5 ±55. 60	308.5± 13.93
Conductivity(µS/ cm)	15.73 ±0.09	17.11±0 .37	16.77± 0.18	17.0 4±0. 104	16.43 ±0.17	15.88 ±0.1	12.26 ±0.2 4	12.1 4±0. 24	12.3 2±0. 09	11.9 5±0. 09	28.39 ±0.4 7	13.98± 0.3
$_P$H	7.32± 0.12	7.65±0. 23	7.72±0 .21	7.71 ±0.2 6	7.98± 0.07	7.38± 0.13	7.56 ±0.2 4	7.50 ±0.1 5	7.42 ±2.7 2	8.45 ±0.3 4	8.05 ±0.4 2	7.58±0 .09
D.O(mg /l)	9.0±0 .20	7.2±0.6	7.46±0 .26	8.6± 0.34	7.6±0 .63	8.8±0. 26	10.8 ±0.2 0	11.0 6±0. 22	12.0 0±0. 4	11.6 ±0.4 0	10.8 ±0.8 4	10.4±0 .21
Alkalinity(mg/l))	54.33 ±1.52	71.00±1 .0	94.0±1 .0	79.0 ±1.0	79.66 ±2.07	60.34 ±1.52	40.67 ±1.1 4	68.6 7±0. 56	80.3 4±1. 52	60.3 3±0. 57	62.33 ±3.2 1	68.66± 1.15
Chloride (mg/l)	270.4 1±23. 84	175.98± 30.43	132.91 ±3.66	305. 30± 43.0 4	160.9 3±20. 98	150.3 2±12. 99	143.9 2±4. 19	127. 41± 8.83	157. 66± 4.19	131. 08± 5.82	160.4 1±22 .22	110.91 ±8.40
Phosphate (mg/l)	0.014	0.026	0.029	0.04 1	0.185	0.199	0.106	0.09 8	0.06 2	0.05 5	0.046	0.037
Total Inorganic Nitrogen (mg/l	0.90	0.80	0.50	1.08	1.40	1.96	1.64	1.06	1.02	0.92	0.74	0.85
Hardness(ppm)	118.2 9± 7.71	115.18± 14.11	137.40 ±6.46	178. 62± 0.12	186.2 4±4.0 8	195.3 6±3.0 8	168.0 4±5. 15	137. 07± 10.5 2	170. 61± 5.22	145. 33± 2.64	112.6 2±4. 35	113.49 ±3.24
Salinity(ppt)	0.51± 0.04	0.347±0 .05	0.26±0 .01	0.57 ±0.0 7	0.31± 0.03	0.29± 0.02	0.28 ±0.0 2	0.25 ±0.0 1	0.31 ±0.0 1	0.26 ±0.0 5	0.31 ±0.2 0	0.22±0 .01
Photic Depth(cm)	170± 8.0	81±18.6 8	32.66± 5.50	95.3 3±1 8.58	117± 25.51	174.3 5±29. 93	157.0 ±3.0 0	176. 66± 10.4 0	175. 50± 17.5 1	163 ±6.5 5	216.6 6±48 .75	287.00 ±15.13
Free Co_2 (ppm)	3.66± 0.34	3.66±0. 34	3.66±0 .34	4.00 ±1.0	3.33± 0.56	3.66± 0.56	5.34 ±0.5 7	7.00 ±1.0 0	5.00 ±1.0 0	3.66 ±1.9 0	9.66 ±1.5 2	6.00±1 .732

Water level(ft)	399.0	396.0	397.40	397.40	405.0	427.4	432.8	417.0	415.8	415.6	409.40	409.2
Ca (mg/l)	26.29 ±2.13	21.09	27.65	41.06	35.05	40.83	30.85	35.33±1.88	51.21	25.36	18.63	27.71
Mg (mg/l)	12.06 ±1.24	14.46	16.55	55.40	23.96	22.52	21.81	11.87±1.13	10.35	19.91	16.04	10.74
GPP $g^c/m^2/day$	0.468	0.156	0.562	0.984	0.656	0.542	1.80	0.562	0.900	1.26	0.703	1.406
NPP $g^c/m^2/day$	0.187	0.093	0.375	0.281	0.468	0.384	0.337	0.337	0.562	0.140	0.562	0.937
Rainfall(mm)	4.3	14.6	106.8	138.2	131.6	213.6	90.8	95.6	5.4	34.8	14.0	0.0

TABLE – 2 : MONTHLY VARIATION IN ZOOPLANKTON GROUPS (NUMBER OF INDIVIDUALS/L) IN KANGSABATI RESERVOIR FROM MARCH, 2010 – FEB, 2011

	Zooplankton					
March-10	266	22	45	44	11	388
April-10	86	97	101	12	08	304
May-10	220	364	131	28	00	743
June-10	137	204	136	30	39	546
July-10	53	44	27	38	07	169
Aug-10	103	62	19	74	09	267
Sept-10	187	54	27	40	39	347
Oct-10	44	80	27	54	09	214
Nov-10	57	251	137	45	43	533
Dec-10	123	52	134	88	30	427
Jan-11	113	127	136	57	96	529
Feb-11	201	119	161	21	55	557
Total	1590	1476	1081	531	346	5024
Percent Value (%)	(31.65%)	(29.38%)	(21.52%)	(10.57%)	(6.88%)	

TABLE – 3 : POPULATION DENSITY (NO. OF IND./L) AND PERCENTAGE CONTRIBUTION OF DIFFERENT GROUP OF ZOOPLANKTON IN KANGSABATI RESERVOIR DURING FROM MARCH, 2010 – FEB, 2011.

Serial No.	Group	No. of Ind/L	Percentage (%)
1	Rotiera	1590	31.65%
2	Copepoda	1476	29.38%
3	Cladocera	1081	21.52%
4	Protozoa	531	10.57%
5	Ostracoda	346	6.88%

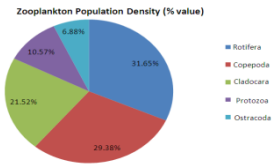


TABLE – 4 : LIST OF ZOOPLANKTON SPECIES AVAILABLE IN KANGSABATI RESERVOIR (MARCH, 2010 – FEBRUARY,2011)

ROTIFERA

1 *Brachionus caudatus* (Barrois and Daday,1894)
2 .*Brachionus quadridentatus* (Hermann, 1783)
3.*Brachionus angularis* (Gosse,1851)
4.*Brachionus falcatus* (Zacharias, 1898)
5.*Brachionus bidentata* (Anderson, 1889)
6.*Asplanchna priodonta* (Gosse,1850)
7.*Keratella valgatropica* (Apstein,1907)
8.*Synchaeta oblonga* (Ehrenberg, 1832)
9.*Notholca labis*(Gosse, 1887)
10.*Anuraeopsis fissa*(Gosse,1851)
11.*Lecane spp.(*Nitzsch, 1827)
12.*Monostyla lunaris*(Ehrenberg, 1832)

COPEPODA

1. Nauplii larvae
2. *Diaptomus denticornis* (Wierzejski, 1887)
3. *Paracyclops fimbriatus* (Fischer, 1853)
4. *Diacyclops sp.*
5. *Thermocyclops sp.*
6. *Microcyclops varicans* (Sars, 1863)
7. *Mesocyclops leuckarti* (Claus, 1857)
8. *Eucyclops serrulatus* (Fischer, 1851)
9. *Acanthocyclops sp.*
10. *Mesocyclops hyalinus* (Rehberg, 1880)
11 *Diaptomas pallidus* (Herrick, 1879)
12. *Pseudodiaptomus smithi* (Wright S., 1928)

CLADOCERA

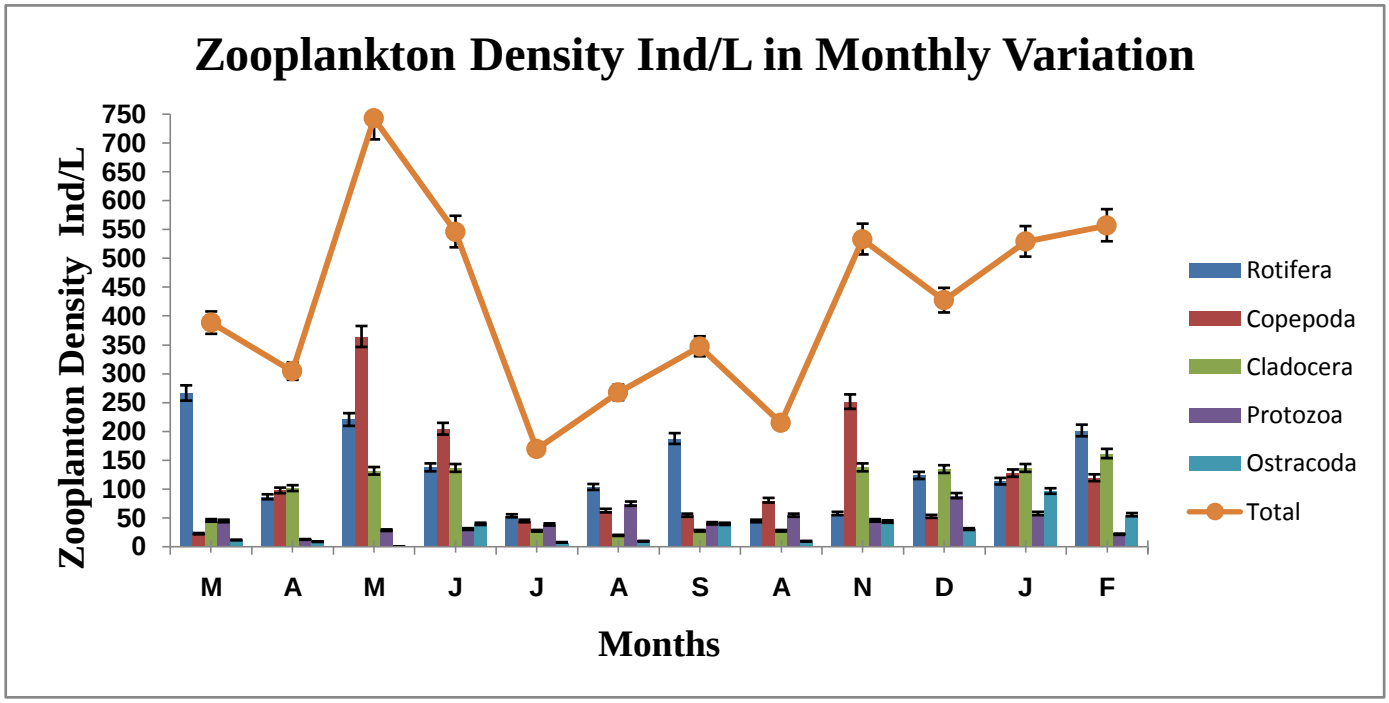
1. *Daphnia longiremis*(Sars, 1862)
2. *Daphnia retrocurva*(Forbes, 1882)
3. *Ceriodaphnia reticulate*((Jurine, 1820)
4. *Ceriodaphnia cornuta*(Sars, 1885)
5. *Simocephalus serrulatus*(Koch,1841)
6. *Bosmina longirostris((*O. F. Müller, 1776)
7. *Alona affinis*((Leydig, 1860)
8. *Eubosmina sp.*
9. *Diaphanosoma tropicum* (Korovchinsky, 1998)
10. *Pleuroxus aduncus*(Jurine, 1820)

PROTOZOA

1. *Difflugia corona* (Wallich)
2. *Amoeba proteus* (Leidy)
3. *Paramecium caudatum* (Ehrenberg,1833)

OSTRACODA

1 *Cypris subglobosa* (Swerby, 1840)
2 *Cyprinotus sp.*



Conclusion:-

The zooplankton density was maximum in winter and minimum in monsoon season. water temperature, transparency, D.O., p^H have positive relationship with zooplankton richness which were observed in winter months and these provide favourable environment for the growth of plankton. This has been confirmed by Agarwal et al (2005).

In Kangsabati reservoir, zooplankton density was greatly concerned at consumer level of reservoir ecosystem. In this reservoir summer peak was chiefly contributed by rotifera; copepod peak in May; cladocera peak in November; protozoa peak in August and ostracoda peak in January during the study period. According to the Kurasawa (1975) followed by the observation in Kangsabati reservoir now remain in oligotrophic condition. The dominance of zooplankton were rotifera> copepod >cladocera> protozoa>ostracoda respectively

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REERENCES:-

APHA (2008): Standard Methods for Examination of Water and Waste Water, 15th edn., American Public Health Association, Washington, DC.

Verma, P.K. and Munshi, D. (1987): Plankton community structure of Badua reservoir, Bhagalpur (India). Tropical Ecology, 28 : 200 – 207.

Sukumaran, P.K. and Das, A.K. (1999): Plankton abundance in relation to physico-chemical features in a peninsular manmade lake. Environment and Ecology, 20(4): 873-879.

Pandey, B.N., Hussain, S., Jha, A.K., and Shyamanand. (2004): Seasonal fluctuation of zooplankton community in relation to certain parameters of river Ramzan of kishanganj, Bihar. Nature, Environment and Pollution Technology, 3(3): 325-330.

Altaff, K.(2003): A manual of Zooplankton. Department of Zoology, The New College, Chennai.

Chandrasekhar, S.V.A. (2002): Cladoceran Fauna of Malda district, West Bengal, Journal of Bombay Natural History Society, 99(3): 467-470.

Kumar, A. and Tripathi, S.(2004): Zooplanktonic diversity in relation to aquaculture in some ponds of Durg-Bhillai
city, Chhattisgarh state. Nature, Environment and Pollution Technology, 3(2): 175-178.

Srivastava, N., Harit, G. and Srivastava, R. (2009): A study of physico-chemical characteristics of lakes around
Jaipur, Inida, Journal of environmental biology,30(5): 889-894.

Sharma, L.L., and Sarang, N.(2004): Physico-chemical limnology and productivity of Jaisamand lake, Udaipur, Rajasthan. Poll.Res. ,23(1): 87-92.

Dhanapathi, M.V.S.S.S.(2000): Taxonomic notes on the rotifers from India (from 1889-2000). Indian Association of Aquatic Biologists (IAAB), Hyderabad.

Trivedy, R.K. and Goel, P.K.(1987): Practical methods in ecology and environmental science. Environmental publications, Karad, India.

Adoni, A., Joshi,D.G., Ghosh, K., Chourasia, S.K., Vaishya, A.K.,Yadav,M. and Verma,H.G. (1985): A work book on limnology (Pratibha publisher), Sagar.

Edmondson, W.T.(1959): Freshwater Biology, 2 nd edition. John Wiley & Sons, Inc., New York.

. Battish, S.K.(1992): Freshwater Zooplankton of India. Oxford and IBH Publications, New Delhi.

Needham, J.G. and Needham, P.R. (1962) : A guide to the study of fresh water biology 5th edn. Liolden-day, Inc., San Francisco.

Mishra, S.R. and D.N. Saksena(1991): Pollution ecology with reference to physico-chemical characteristics of Morar (Kalpi) river, Gwalior (M.P.).In current trend in limnology (Ed,: Nalin K. Shastree).Narendra Publishing House Delhi,India.159 – 184.

Yadav, J., Pathak, R.K. and Khan, E.(2013): Analysis of Water Quality using Physico-Chemical Parameters, Satak Reservoir in Khargone District, MP, India. International Research Journal of Environment Sciences. 2(1): 9-11.

Rani, R., Gupta, B.K. and Srivastava, K.B.I. (2004): Studies on water quality assessment in Satna city(M.P.): Seasonal parametric variations. Nat. Env. Poll. Tech., 3(4):563 – 565.

Chattopadhyay, C. and Barik, A (2009): The composition and diversity of net zooplankton species in a tropical fresh water lake. International journal of lakes and rivers, 2 (1): 21 – 30.

Boyd, C.E. (1981): Water quality in warm water fish ponds. Anbum University of Agriculture experimental station. Craf master printers, Inc. U.S.A. second edition.

Kedar,G.T., Patil,G.P. and Yeole, S.M. (2008): Effect of physico-chemical factors on the seasonal abundance of zooplankton population of Rishi Lake. Proceedings of Taal2007:The 12th World Lake Conference :88-91.

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

Kumar, A., Qureshi, T.A., Parashar, A. and Patiyal, R.S.(2006) : Seasonal variation in physico- chemical characteristics of Ranjit Sagar reservoir, Jammu & Kashmir. J. Ecophysiol. Occup. Hlth., 6 .

Kundu, P., Roy Chowdhury, M., Panja, U and Mukherjee M. (2005): Past, Present and Future of Kangsabati Reservoir of West Bengal. A National Workshop on Development of Reservoir Fisheries Strategies to meet its fish seed requirements, 122 – 137.

Mukherjee, M. and Praharaj, A. (2009): Kangsabati Reservoir fisheries development new Policy approaches through multidisplinary field demonstration to rural people. Fishing Chimes, 29 (1):112 – 121.

Paulose, P.V. and Maheshwari, K. (2008) : Seasonal variation in zooplankton community structure of Ramgarh lake, Jaipur, Rajasthan. Proceeding of Taal 2007: The 12th World Lake Conference: 82 – 87.

Das, A.K.(2000): Limno-Chemistry of some Andhra Pradesh reservoirs. J.Inland. Fish. Soc. India. 32(2): 37 – 44.

Sreenivasan, A. (1964): Limnological studies of tropical impoundment II : Hydrological features and planktons of Bhavanisagar Reservoir (Madras State) for 1961-1962. Proc.Ind.Acad.Sci., 59 (B): 53-71.

Sunkad, B.N., and Patil, H.S.(2004): Water quality assessment of fort lake of Belgaum (Karnataka) with special reference to zooplankton. J.Environ.Biol. ,25(1): 99-102.

Sharma, B.K. (2009): Diversity of rotifers (Rotifera: Eurotatoria) of Loktak lake, Manipur, North-eastern India. Tropicl Ecology, 50 (2), 277 – 285. Salve, B. and Hiware, C. (2010): Zooplankton diversity of Wan Reservoir, Nagpur (MS),India. Trends Research in Science and Technology, 2 (1): 39 – 48.

Vijoykumar, K., Paul, R. and Kadadevaru, G.(2006): Physicochemical features of Attikolla pond during pre-monsoon period.J. of Environ.Ecol., 9: 393 - 395.

Kiran, B.R., E.T. Puttaiah and D.Kamath (2007): Diversity and seasonal fluctuation of zooplankton in fish pond of Bhadra fish farm, Karnataka. Zoos Print J.,22: 2935 – 2936.

Shivashankar, P. and Venkataramana, G.V.(2013): Zooplankton Diversity and their Seasonal Variations of Bhadra Reservoir, Karnataka, India. International Research Journal of Environment Sciences, 2(5): 87 - 91.

Pathani, S.S. and Mahar, S. (2006): A studie of population of plankton in the river Suyal of Uttaranchal, India. Flora
and Fauna, 11(2): 250-256.

Schindler, D.W.(1974). Eutrophication and recovery in experimental lakes: implications for lake management science
184 : 897 - 899.

Agarwal, N.K., B.L., Thapliyal (2005): Preimpoundment hydrological study of Bhilangana River from Tehri Dam reservoir area in Uttaranchal. Enviromental Geochemistry 8: 143 - 148.

Kurasawa, H. (1975) : Productivity of communities in Japanese inland water, part 9, Zooplankton JIBP, Synthesis, 10, (Mori S. and Yamamoto Eds.), 436, Tokyo University Press.