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Biodiversity and seasonal abundance of Zooplankton and its relation to physico – chemical parameters of Jamunabundh, Bishnupur, India

Tapas kumar Dutta*, Bidhan C. Patra**

*Aquaculture Research Unit, Department of Zoology, Vidyasagar University, Midnapur- 721 102, West Bengal

***Abstract*:** Ponds are natural water sources that are used by man for various purposes. Zooplankton constitutes an important food item for fishes . Zooplankton also play an important role and serve as bioindicators as well as to assess the pollution status of water .In this present study, we tried to asses the zooplankton species richness, diversity and evenness and to state the condition of a freshwater tropical perennial pond , Jamunabundh, of Bishnupur Bankura. The plankton density and physicochemical parameters were recorded during the period of January 2012 to December 2012 . A total of 20 taxa were recorded in which 6 were rotifers , 3 copepoda , 4 cladocera , 3 of ostracoda and 4 larva and protozoa were recorded . Cladocera constituted the main dominant group in this pond contributing 45.2% of the total zooplanktons followed by Rotifera 43.3%, Copepoda 8.3% and Ostracoda 1.7% during January being 360 No/l and February being 347 No/l . Lowest density was observed during June and July 234 No/l and 246 No/l respectively. These data are in accordance with the negative significant correlation between Zooplankton and temperature (r = -0.593) . Highest species diversity was observed during December, January and February being 2.96, 2.99 and 2.92 respectively. Highest evenness was also observed during January and February being 0.99 in both the months while the richness being 3.28,, 3.22 and 3.07 in these three months during December, January and February respectively.

Index Term: Jamunabundh, Perrenial pond; Physico-chemical characteristics of the water,. species diversity, richness.

I. INTRODUCTION

Water is the prime necessity of life , without it , there would be no life. Most of the biological reactions uses water as the medium . So, the study of water bodies is equivalent to the study of life .Water is the habitat for a large number of aquatic organisms ranging from microscopic plankton to large aquatic animals and macrophytes. .But nowadays due to unplanned urbanisation, rapid industrialisation and unjustified use of chemical fertilisers in the fields is leading to the deterioration of the water quality both qualitatively and quantitatively and depleting the aquatic fauna (Sati and Paliwal, 2008). Moreover, there is a very close relationship between the metabolism of aquatic organisms and hydrobiological parameters in a freshwater body (Desmukh and Ambore , 2006).

The plankton community is a heterogenous group of tiny plants (phytoplankton) and animals (Zooplanktons) adapted to float in the sea and fresh waters. Their intrinsic movements are so feeble that they remain essentially at the mercy of every water current.

In freshwater ecosystem zooplanktonic organisms are important food sources for many aquatic animals specially fishes. The main for major carps like rui , catla and their hybrids were found to be plankton in origin (Mozumder, P.K.and Naser,M.N., 2009) .

Zooplankton plays an important role in indicating the water quality, eutrophication status and productivity of a freshwater body. (Mikschi E, 1989). The planktons not only increases fish production but also helps in bioremediation of heavy metals and other toxic material. Plankton can also act as biomarker for water quality assessment for fish production (Arunava Pradhan, et al 2008) .

Thus, in order to find out the status of a freshwater body it is necessary to observe seasonal diversity and abundance of zooplankton . The present investigation is an attempt to study the biodiversity and seasonal abundance of zooplankton in a perennial freshwater pond , Jamunabundh of Bishnupur,West Bengal .

II. STUDY AREA

The Jamunabundh is a major perennial pond of the Bankura district and located at Bishnupur which falls under latitude $23^{o}04'$ and longitude $87^{o}20'$. This 'bundh' had been artificially dug out by the rulers (Mallaraj) of this town to solve the problem of drinking , bathing and irrigation . This is a perennial pond with an average depth of about 25-30 feet.

III. MATERIALS AND METHODS

Monthly zooplankton samples were obtained from each of these sites for the period January 2012 to December2012. Concurrently, water samples were taken for measuring selected physico-chemical variables. For zooplankton samples, we filtered 40 l of water using plankton net of 50 µm mesh size. Samples were collected from the surface (0.5 m) during the morning hours. Although we collected the samples for some

months at fortnightly intervals, for presentation we pooled the data and expressed it on a monthly basis. Zooplankton samples were preserved in 10%formalin at the site itself.

At the time of sampling, we measured the surface water temperature and pH. A Celsius thermometer(scale ranging from 0ºC to 100ºC) was used to measure surface water temperature. pH of water was measured directly in a digital electronic pH meter (Systronics,Model SYS - 335). Turbidity was measured with the help of a Turbiditmeter. Dissolved oxygen (DO), free carbon dioxide, total alkalinity, hardness and salinity was determined by titrimatric method (APHA, 2008).

For quantitative analysis, we counted the number of individuals for each species present in aliquot of 1ml from the concentrate (to 100 ml) of field collected zooplankton. The data were later converted to the actual quantity of water filtered from the lake. We used 3–4 aliquots for each sample. Density of zooplankton was expressed as number of individuals per liter.

IV. RESULT AND DISCUSSION

. Eight physicochemical parameters were recorded from the study area during the study period.(**Table 1).**
In summer highest temperature was observed as 25^0C and lowest in the winter months 14^0C. Water temperature in the range between 13.5^0C and 32^0C is found to be suitable for the development of the planktonic organisms (Kamat, 2000; Gaikwad et al., 2008). In this pond the zooplankton show negative correlation (-0.593) with the surface temperature of water . Similar observation has been made by Ahmad et al,(2012). **(Fig 1).**
Turbidity values ranges from 2.0 NTU in winter to 8.0 NTU, maximum in monsoon period. Water turbidity is negatively correlated (-.0551) wuith Zooplankton abundance in the study period.

pH ranged from 6.5 in the month of july to 7.9 in the month of May . This high pH in summer may be due to low level of water and high photosynthesis of micro-, macro - organism resulting in high production of free carbon dioxide which make the water a little alkaline (Trivedy, 1989; Shiddamallayya and Pratima, 2008). The pH range between 6.0 and 8.5 indicates medium productive nature of a reservoir.(Kurbatova,2005). Since the average value of pH is 7.1 the pond seems to be of medium productive in nature for Zooplankton production .

Dissolved oxygen (DO) is very important aquatic parameter whose measurement is vital in the context of culture of any aquatic animal. Oxygen plays a crucial role in its life processes the main dominant group in this pond contributing 45.2% of the total zooplankton followed by Rotifera 43.3%, Copepoda 8.3% and Ostracoda 1.7% **.(Fig2).** A distinct seasonal fluctuations and composition of the zooplankton has been obseved in the Jamunabundh reservoir. It is productive during post monsoon and winter months (October to February), retardation during summer and monsoon months (March to September) . Highest density of Zooplankton were observed of all organisms. Dissolved oxygen ranges from 2.4mg/l during the post monsoon to 10.4 mg/l during the winter. This may be due to difference in water temperature. In high temperature the solubility of oxygen is lowered and also the organic substances are degraded. Concentration of D.O is inversely proportional to temperature at a given time.. DO value show significant positive correlation with zooplankton. Similar conclusion has been drawn by (Ahmad and Krishnamurthy, 1990; Singh and Singh, 1993)

Free carbon dioxide is also one of the important factor in aquatic habitat. It is highly soluble in water and is the main source of carbon path way in the nature. Plants absorb the free carbon dioxide present in both atmosphere and water. Carbon dioxide in water bodies is contributed by the respiratory activity of animals. Carbon dioxide content ranges from 8mg/l to 20 mg/l. Carbon dioxide content of water has been found to be negatively correlated (r= -0.385) with zooplankton abundance .

Highest salinity 204 mg/l and lowest salinity 114 mg/l was observed. Salinity content of water has been found to be negatively correlated (r= -0.085) with zooplankton abundance.

Total alkalinity in the pond ranged from 22 mg/l to 68 mg/l. High alkalinity value was recorded during summer months, which is probably due to reduction of water. Such observation has been made by (Singh and saha ,1987). Alkalinity of water has been found to be positively correlated (r= 0.209) with zooplankton abundance. This suggests that high total alkalinity is related to high yield of zooplankton. (Singh et al., 2002; Sachidanandamurthy and Yajurvedi, 2006; Kiran et al., 2007).

The hardness of water is not a pollution parameter but indicates water quality. Waters are often categorized according to degrees of hardness as follows:
0 – 75 mg/L = soft, 75 – 150 mg/L= moderately hard , 150 – 300 mg/L= hard, above 300 mg/L= very hard . In the present investigation, total hardness level varied from 39.6 mg/l to 77.8 mg/L. Total hardness of water has been found to be positively correlated (r= 0.040) with zooplankton abundance . Similar observations have been made by (Ratushnyak et al., 2006).

Monthly and seasonal abundance of zooplankton for one year of investigation has been presented in **Table 2**. The Zooplankton of Jamunabundh reservoir consists of Rotifers, Cladocera, Copepoda and Ostracoda. . A total of 20 taxa were recorded in which 6 were rotifers , 3 copepoda , 4 cladocera , 3 of ostracoda and 4 larva and protozoa were recorded . Cladocera constituted during January being 360 No/l and February being 347 No/l . Lowest density was observed during June and July 234 No/l and 246 No/l respectively.
Rotifera comprises of the second most abundant group of zooplankton The rotifera group was represented by 6 genera. The most dominant being *Brachionus sp.*, represented by 3 species viz., *Brachionus bidentata, B. qudridentata.and B.*

diversicornis. The others were, *Keratella tropica*, *Asplanchna* sp and *Filinia* sp..

Presence of *Brachionus* sp is the indication that the pond is organically polluted. .This is in also agreed by (Ahmed ert al , 2012.). The density of rotifers ranged from 80 No/l in the month of June to 165 No./l in the month of January.

Among Zooplankton, cladocera was the dominant group. . This group is represented by *Daphnia* sp., *Moina* sp., *Ceriodaphnia* sp. and *Bosmina* sp. Their density ranged from 115 No./l in the month of April to 150 No./l in the month of September. Cladocerans are important food source for fry; fingerlins and adult of many economically important fish species. Cladocerans are also reported to be the indicators of eutrophic nature of water bodies.(Sharma,2001) .

Copepoda comprises of the third most abundant group of zooplankton . This group is represented by *Cyclops* sp., *Mesocyclops* sp., and *Diaptomus* sp Their density ranged from 14 No./l in the month of July to 38 No./l in the month of January.

Ostracoda comprises of the least abundant group of zooplankton. This group is represented by *Cypris* sp., and *Heterocypris* sp Their density ranged from 2 No./l in the month of July to 8 No./l in the winter months.

In addition Nauplius larva, Zoea larva, *Paramoecium* sp and *Euglena* sp. has also been found.

To relate the effect of environmental factors on zooplankton abundance, correlation were made between zooplankton and other physicochemical parameters.(**Table 3)** . Zooplankton showed negative significant correlation with water temperature (r = -0.593). Also negative correlation has been observed between zooplankton and turbidity (-0.551), , Free CO_2 (-0.385), and salinity (-0.085). A positive correlation has been observed between DO (0.102) ,pH(0.434), Total alkalinity (0.209) and Total hardness (0.040) .

Highest species diversity was observed during December, January and February being 2.96, 2.99 and 2.92 respectively . Highest evenness was also observed during January and February being 0.99 in both the months while the richness being 3.28,, 3.22 and 3.07 in these three months during December, January and February respectively**.(Table4).**

Table 1. Monthly variation in Physicochemical factors of jamunabundh

Parameters	Jan-12	Feb-12	Mar 12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Temp(^{0}C)	16	14	24	24	25	24	21.6	21	25	22	20	18
Turbidity(NTU)	4.0	3.0	4.0	5.0	3.0	4.0	7.0	8.0	6.0	5.0	2.0	2.0
pH	7.0	7.8	7.5	7.8	7.9	6.7	6.5	6.5	6.7	6.8	7.1	7.1
D.O.(mg/l)	8.0	10.4	8.0	7.2	6.0	5.2	5.8	8.0	4.0	2.4	3.2	4.4
Free CO_2.(mg/l)	10.0	12.0	8.0	8.6	10.0	18.0	20.0	18.0	20.0	20.0	16.0	16.0
Salinity.(mg/l)	125.0	130.0	116.0	141.9	204.0	191.0	114.0	114.0	131.0	134.6	178.4	163.5
Alkalinity (mg/l)	35.0	24.0	24.0	35.0	24.0	60.0	64.0	68.0	26.0	24.0	22.0	28.0
Total Hardness (mg/l)	49.5	59.5	39.6	46.2	77.8	67.6	46.2	45.2	48.1	62.0	56.4	56.5

Table 2.Monthly and seasonal abundance of zooplankton of Jamunabundh

Sl No.	Months/ Genera	Jan-12	Feb-12	Mar-12	Apr-12	May-12	June 12	July 12	Aug 12	Sep12	Oct 12	Nov 12	Dec 12
	Cladocera												
1	*Daphnia* sp	55	57	60	65	76	80	75	70	75	70	65	65
2	Bosmina sp	45	42	20	15	30	20	31	30	35	30	35	45
3	Moina sp	35	37	25	20	16	25	23	25	26	39	35	25
4	Ceriodaphnia sp	10	8	15	15	4	5	2	10	14	10	7	10
	Total	**145**	**144**	**120**	**115**	**126**	**130**	**131**	**135**	**150**	**149**	**142**	**145**
	Copepoda												
5	Cyclops sp	12	8	3	4	7	3	2	5	6	5	8	9
6	Mesocyclops Sp	4	3	3	4	1	2	2	2	4	3	4	4
7	Diaptomus sp	22	21	14	10	10	15	10	18	18	14	20	20
	Total	**38**	**32**	**20**	**18**	**18**	**20**	**14**	**25**	**28**	**22**	**32**	**33**
	Rotifera												

8	Brachionus bidentata	53	45	48	40	40	30	35	30	38	45	35	40
9	Brachionus quadridentata	38	38	30	38	40	20	25	21	30	26	31	34
	Brachionus diversicornis	25	29	20	12	20	10	-	-	16	20	20	22
10	Keratella tropica	30	25	28	33	35	18	30	20	20	26	26	25
l11	Filinia sp	12	15	12	10	10	-	-	13	12	15	13	9
12	Asplanchna sp	7	8	10	12	-	2	5	6	9	8	10	5
	Total	**165**	**160**	**148**	**145**	**145**	**80**	**95**	**90**	**125**	**140**	**135**	**135**
	Ostracoda												
13	Cypris sp	4	5	5	5	4	1	2	1	3	3	2	4
	Stenocypris sp.	2	1	2	2	2	-	-	-	-	1	2	1
	Total	**8**	**8**	**9**	**7**	**8**	**1**	**2**	**1**	**3**	**5**	**6**	**6**
15	Nauplius larva	1	1	1	1	1	1	1	1	2	1	1	1
16	Zoea	1	1	1	1	-	-	1	1	-	1	1	1
17	Paramoecium Sp.	1	1	1	2	1	1	1	1	2	1	1	1
18	Euglena Sp.	1	-	-	-	1	1	1	1	1	1	1	1
	Total	**4**	**3**	**3**	**4**	**3**	**3**	**4**	**4**	**5**	**4**	**4**	**4**
	Grand Total	**360**	**347**	**300**	**289**	**300**	**234**	**246**	**255**	**311**	**320**	**319**	**323**

Table 3. Corelation between zooplankton abundance and physicochemical parameters

	Temperature	**Turbidity**	**pH**	**Dissolved Oxygen**	**Free CO2**	**Salinity**	**Alkalinity**	**Total Hardness**

Zooplankton	-0.593	-0.551	0.434	0.102	-0.385	-0.085	0.209	0.04

Table 3. Total zooplankton,diversity index, richness and evenness in Jamunabundh during 2012

Months	Diversity Index	Species Richness	Species Evenness
Jan-12	2.99	3.22	0.99
Feb-12	2.92	3.07	0.99
Mar-12	2.84	3.15	0.96
Apr-12	2.81	3.00	0.97
May-12	2.79	2.98	0.96
June-12	2.67	2.74	0.96
July-12	2.64	2.72	0.95
Aug-12	2.77	2.88	0.97
Sep-12	2.84	2.96	0.98
Oct—12	2.77	3.29	0.92
Nov-12	2.95	3.29	0.98
Dec-12	2.96	3.28	0.99

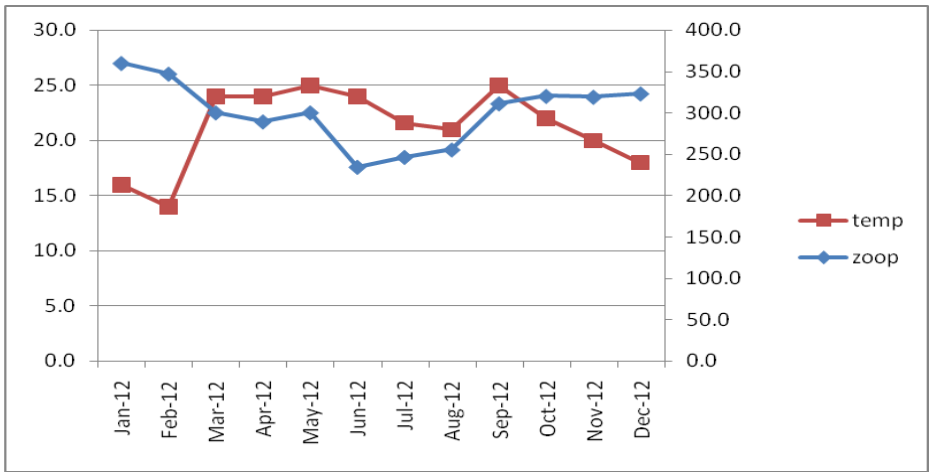

Figure 1 Graphical representation of Temperature vs. Zooplankton abundance

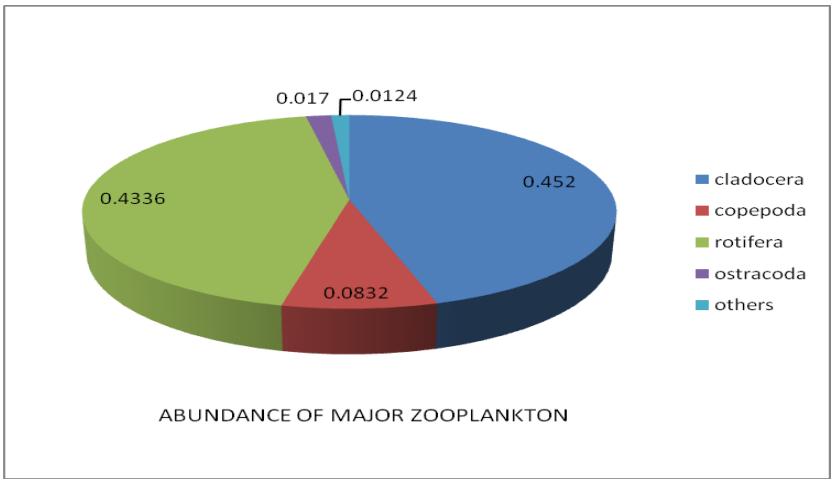

Figure 2. Percentage abundance of major zooplankton groups

V. CONCLUSION

Zooplankton may exist in a wide range of environmental conditions. But dissolved oxygen, temperature, salinity,pH and other physicochemical parameters are limiting factors . At the same time they are also very good bioindicators to assess the pollution of any freshwater body. The presence of three species of *Brachionus* sp reveals that the the pond is being eutrophicated and is organically polluted . Various anthropogenic activities such as entry of agricultural run offs like pesticides , insecticides from surrounding agricultural fields seems to be the major cause of eutrophication. Further, the water level of this pond must be maintained by desilting . From the above study we can make the overall conclusion that a strict vigilance and general awareness is required so that proper conservation of this old perennial water body can be done, which support a rich biodiversity of flora and fauna.

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AUTHORS

First Author – Tapas Kumar Dutta, Research scholar, Aquaculture Research Unit, Department of Zoology, Vidyasagar University. Midnapore - 721102. West Bengal, India. *e-mail: tdutta98@gmail.com

Second Author – Prof. Bidhan C. Patra, Aquaculture Research Unit, Department of Zoology, Vidyasagar University. Midnapore - 721102. West Bengal, India.

(*Corresponding author : Tapas Kumar Dutta , e-mail address : tdutta98@gmail.com, contact No. 9474723798)