BIOSCIENCES BIOTECHNOLOGY RESEARCH ASIA, December 2020. Vol. **17**(4), p. 853-858

Seasonal Variation of Zooplankton Density and Physicochemical Parameters of a Perennial Freshwater Body, Samudrabundh of Joypur, Bankura, West Bengal, India

Tapas Kumar Dutta and Rajendra Prasad Mondal*

Department of Zoology, Bankura Sammilani College, Bankura West Bengal, India.

http://dx.doi.org/10.13005/bbra/2890

(Received: 02 October 2020; accepted: 04 December 2020)

Water is the most essential and vital component required for the survival of all organisms in this earth. The physico-chemical and biological characteristics of a water body determine its efficacy for the production of plankton especially the zooplankton. Zooplankton are the most important primary consumer of aquatic food chain which in turn influence the productivity of finfishes in an aquatic body .The present study is primarily based on assessment of seasonal density and diversity as well as the physico-chemical condition of Samudrabundh, of Joypur block of Bankura district, West Bengal. Such type of assessment on this water body has not been done before this.. The study was carried during March.2019 to February, 2020. The water quality parameters which were used for study were temperature, P^H, Dissolved Oxygen (DO), Free carbon dioxide (CO_2),Chloride, salinity, alkalinity and total hardness. A total of 26 taxa of zooplankton were recorded. Out of which 8 sp ecies comprises of Rotifera, 05 species of Copepoda, 10 species of Cladocera and 03 species of Ostracoda. The total zooplankton density ranges from 756 (Ind/L) **to 957** (Ind/L) **which is quiet lower than the desired value required for good fish culture. The study concludes that the water body is of soft water type and medium productive in nature.**

Keywords: Physico-chemical, productive ,parameter, Zooplankton.

Water is the prime and basic necessity of life forms in this earth. It is immensely important to maintain the quality of natural ecosystem and also development of human race. The quality of water plays a major role in plankton growth as well as the biology and production of the cultured aquatic organisms and their yields[1]. Fresh water environment comprises of a combination of both biotic and abiotic factors. The important abiotic factors which are mainly used to study the water quality of a perennial aquatic body are temperature, P^H, turbidity, dissolved Oxygen (DO), Chloride, alkalinity and Total hardness[2]. Biotic factors are comprised mainly by the plankton and other aquatic flora and fauna .

Zooplanktons are tiny microscopic animals. They float freely in the surface water column. Their movement as well as distribution is determined by water waves and current. They feed on phytoplankton and smaller zooplankton. Threats for aquatic biodiversity is mainly due to human interference and mismanagement of both biotic resources and the abiotic factors which leads to deterioration of water quality[3] . Most of the

*Corresponding author E-mail: rpmondal09@gmail.com

freshwater bodies are constantly getting polluted due to domestic wastes, sewages, industrial and agricultural effluents.

In aquatic food chains, zooplankton forms a major link in the energy transfer between autotrophs and heterotrophs[4-5]. Zooplankton community are important members of aquatic food webs because they serve as an important food item for fishes and invertebrate predators [6].

The physicochemical properties and diversity of flora and fauna are two important pillars which determine the healthy status of an aquatic ecosystem. The physical, chemical and microbial characters of a water body determine its nutrient status.. It is not possible to understand the biological phenomenon fully without the knowledge of water chemistry of the aquatic ecosystem[7]. It is necessary to know the physicochemical properties of water to study the rearing practices of the fishes of water bodies[8] .

No record about the physicochemical properties and zooplankton density and diversity of the perennial water body, Samudrabundh, of Joypur block of Bankura district, West Bengal is available earlier than this study. So, this study has been conducted to fill that lacuna and to make a quantitative analysis of the water of the aquatic body so that proper utilization of such a big perennial water body can be made..

MATERIALS AND METHODS

The study was conducted by collecting water samples and zooplankton samples from the perennial pond of Samudrabundh, Joypur, Bankura. It is located in 23°2'39.81 N and 87°26'12.45 E. Approximately its water area is 25 hectors. The study was conducted during the period of March.2019 to February, 2020. For the ease of doing the job the study period was divided into four seasons viz. summer (March,2019 to May,2019), monsoon(June,2019 to August,2019), Post monsoon(Sep,2019 to Nov,2019), and Winter (December,2019 to February,2020). Random samples of water were collected between 7 A.M to 10 A.M. in the morning on any three days during each season. Instead of surface water , samples from a depth of 50 cm were collected for the study .For determination of Dissolved oxygen (DO), Free CO_2, PH, total alkalinity, hardness and salinity standard method of APHA(2008) was followed [9] . For determination of Temperature thermometer marked with 0.01 graduated centigrade (^{0}C) was used. P^H was measured using a digital PH meter (Systronics model,335).Turbidity was measured in NTU by using a Nephlometer (Systronics,338).

For zooplankton samples, 40 L of water was filtered using plankton net of 50 µm mesh size. Zooplankton samples were preserved in 10% formalin at the site itself. Sample was allowed to settle down for a day. Sedgwick Rafter plankton counting cell was used for counting of zooplankton to find out its density. The detailed study of the plankton was done by using OLYMPUS inverted stereoscopic microscope (Model MLX-B) fitted with a NIKON camera. Identification of plankton was done according to the character mentioned by Battish, 1992[10] .

RESULTS AND DISCUSSION

Temperature

Temperature is an important physical factor that affects the quality of the water and considered as controlling factor for the fluctuation of plankton and functioning of the aquatic ecosystem[11]. Water temperature in tropical waters in the range between 13.5^{0}C and 32^{0}C is found to be suitable for the development of the planktonic organisms[12]. In the study site the temperature of water varies from 19.3^{0}C in winter to 21.3^{0}C in Summer . (Table 1)

In Samudrabundh water temperature shows positive correlation with pH , turbidity , free CO_2, salinity and total alkalinity. It shows negative correlation with DO, chloride, total hardness and total zooplankton. (Table 2)

Turbidity

Maximum turbidity value 9.3 NTU has been recorded in monsoon .High turbidity values during monsoon has also been observed by Shinde et al, (2011)[13] at Harsool –Savangi dam in Aurangabad. This is due to rapid flow of water in rainy season which bring silt, clay etc along with it while low values in summer is due to low water level (Table 1).

In Samudrabundh turbidity shows positive correlation with pH, free CO_2, salinity and total alkalinity. It shows negative correlation with, DO,

chloride, total hardness and total zooplankton (Table 2).

pH

pH value ranges between 5.7 to 6.8 (Table 1). According to (Kurbatova, 2005) pH value between 6.0 and 8.5 is considered as medium productive nature of a reservoir[14] . So the reservoir under study is considered as of medium productive nature.

In Samudrabundh pH shows positive correlation with free CO_2, salinity and total alkalinity . It shows negative correlation with DO, total hardness and total zooplankton (Table 2).

Dissolved Oxygen

Dissolved oxygen (DO) is very crucial limnological parameter whose measurement is vital regarding the culture of any aquatic animal. Dissolved Oxygen (DO) in the study site varies from 3.0 mg/l in summer to 8.4 mg/l in winter .DO value less than 3.0 mg/l is considered as detrimental for fish growth[15] . So, the DO value reaches its lowest threshold value during summer in the study area (Table 1).

In Samudrabundh, DO shows positive correlation with chloride, total hardness and total zooplankton . It shows negative correlation with free CO_2 salinity and total alkalinity (Table 2).

Free CO_2

Carbon dioxide in water bodies is mainly contributed by the respiratory activites of aquatic animals. In the study area the free CO_2 ranges from 10.2 mg/l in winter to 15.8 mg/l in summer (Table 1).

In Samudrabundh, free CO_2 shows positive correlation with Salinity and Total alkalinity. It shows negative correlation with

Table 1. Seasonal variation of hydrological parameters of Samudrabundh , Joypur, Bankura

Parameters	Summer (Mar2019-May 2019)	Monsoon (June2019-Aug2019)	Post Monsoon (Sep2019-Nov2019)	Winter (Dec2019-Feb2020)
Temperature (C)	21.3	20.3	20.0	19.3
Turbidity (NTU)	8.0	9.3	4.7	4.0
pH	6.8	6.6	6.6	5.7
DO (mg/l)	3.0	3.1	5.7	8.4
Free CO_2(mg/l)	15.8	15.3	12.7	10.2
Chloride (mg/l)	36.7	50.3	44.9	54.7
Salinity(mg/l)	128.6	120.2	112.0	96.1
Alkalinity (mg/l)	35.7	39.3	29.7	26.7
Total hardness (mg/l)	30.1	33.7	41.4	47.1
Total zooplankton(Ind/L)	879	756	957	954

Table 2. Pearson Correlation matrix (r) between several hydrological parameter and total abundance of Zooplankton of Samudrabundh , Joypur, Bankura

	Temp	Turbidity	pH	D.O.	Free Co2	Chloride	Salinity	Alkalinity	Total Hardness	T.Zoop
Temp	1									
Turbidity	0.716	1.000								
pH	0.847	0.651	1.000							
DO	-0.881	-0.919	-0.894	1.000						
Free CO_2	0.907	0.916	0.885	-0.998	1.000					
Chloride	-0.900	-0.361	-0.819	0.661	-0.689	1.000				
Salinity	0.960	0.822	0.933	-0.972	0.980	-0.818	1.000			
Alkalinity	0.703	0.992	0.704	-0.937	0.927	-0.367	0.834	1.000		
T. Hardness	-0.949	-0.897	-0.853	0.977	-0.990	0.736	-0.982	-0.892	1.000	
T.Zoop	-0.418	-0.933	-0.421	0.748	-0.730	0.011	-0.580	-0.933	0.681	1

chloride, total hardness and total Zooplankton (Table 2).

According to Ellis (1937) dissolved free CO_2 should be less than 5mg/l for good fish production in water bodies. If the free CO_2 level is more than 20mg/l then it may cause hindarance with oxygen intake by fishes. In the present study the average free CO_2 varies between 10.2mg/l to 15.8mg/l which may be consider a little higher in context of fish production.

Chloride

Salts of sodium and potassium are mainly responsible for the chloride content of water. The chloride content of water in the study area ranges from 36.7mg/l in summer to 54.7mg/l in winter season (Table 1).

In Samudrabundh chloride shows positive correlation with total hardness and total zooplankton. It shows negative correlation with alkalinity (Table 2).

Salinity

In Samudrabundh salinity shows positive correlation with alkalinity. It shows negative correlation with total hardness and total zooplankton (Table 2).

Total Alkalinity

In the study area the total alkalinity ranges from 26.7mg/l in winter to 39.3mg/l in summer (Table 1).

In Samudrabundh alkalinity shows positive correlation with temperature, turbidity, pH, free CO_2 and salinity. It shows negative correlation with D.O., chloride, total hardness and total zooplankton (Table 2).

Total hardness

The hardness of water is also an important parameter which can indicates water quality. Sawyer (1960) has catagorised perennial water bodies into three groups according to their degrees of hardness [16]. It is as follows: 0 – 75 mg/L = soft, 75 – 150 mg/L= moderately hard, 150 – 300 mg/L= hard, above 300 mg/L= very hard. As the water of the study area ranges between 30.1 mg/l to 47.1 mg/l, so the water of this perennial water bodies is considered soft in biochemical nature (Table 1).

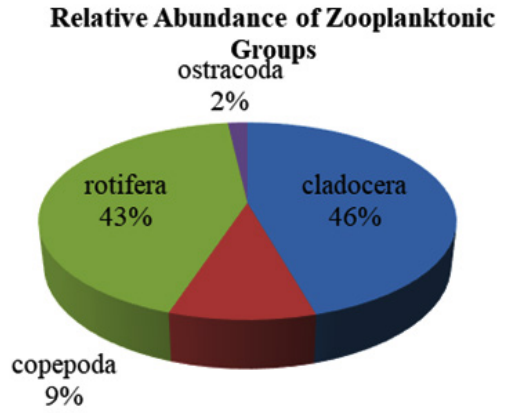

Fig. 1. Relative abundance of zooplankton groups of Samudrabundh , Joypur, Bankura

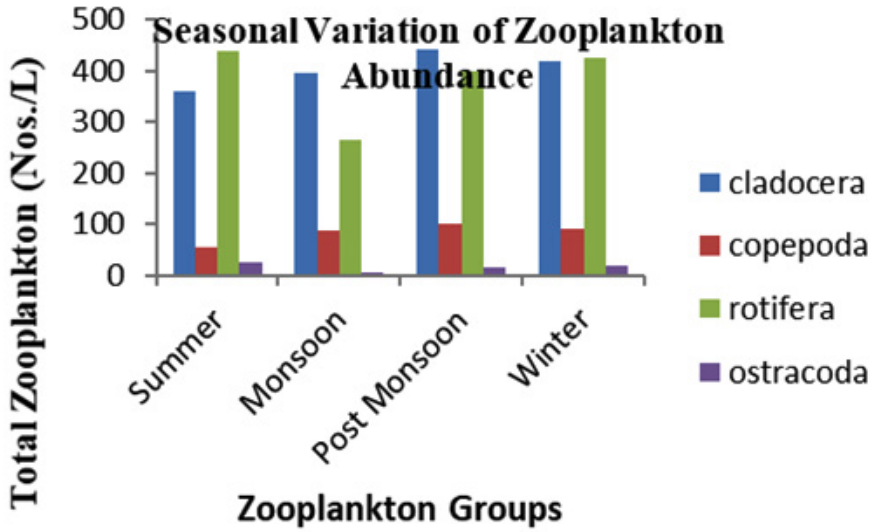

Fig. 2. Seasonal Variation of abundance of zooplankton groups of Samudrabundh , Joypur, Bankura

Table 3. List of Zooplankton Groups obtained from Samudrabundh , Joypur, Bankura during study period

Sl No	Group	Zooplankton species
1	CLADOCERA	*Daphnia carinata*
		Daphnia magma
		Daphnia retrocurva
		Ceriodaphnia regaudi
		Ceriodaphnia cornuta
		Ceriodaphnia reticulat
		Bosmina longirostris
		Moina micrura
		Moina brachiata
		Alona affinis
2	ROTIFERA	*Brachionus bidentata*
		Brachionusquadridentatus
		Brachionus caudatus
		Brachionus diversicornis
		Brachionus rubens
		Keratella tropica
		Lecane sp.
		Asplanchna sp
3	COPEPODA	*Cyclops sp*
		Mesocyclops leuckarti
		Mesocyclops hyalinus
		Diaptomus pallidus
		Diaptomus denticornis
4	OSTRACODA	*Stenocypris sp*
		Cyprinotus sp
		Cyprinotus nudus

In Samudrabundh total hardness shows positive correlation with D.O., chloride and total zooplankton. It shows negative correlation with temperature, turbidity, pH, free CO_2 and salinity (Table 2).

Zooplankton analysis

During the study period we have recorded a total of 26 taxa of zooplankton. Out of which 8 species comprises of Rotifer, 05 species of Copepoda, 10 species of Cladocera and 03 species of Ostracoda. The main dominant group in this pond is contributed by Cladocera. It constitutes 46% of the total zooplankton abundance, followed by Rotifera 43%, Copepoda 9% and Ostracoda 2% (Figure 1 and Table 3).

The density of Cladocera ranges from 361(Ind/L) in summer to 441 (Ind/L)in post monsoon. The density of Rotifera ranges from 265(Ind/L) in monsoon to 438 (Ind/L) in summer .The density of copepods ranges from 56 (Ind/L) in summer to 102 (Ind/L) in post monsoon .The density of Ostracoda ranges from 6 (Ind/L) in monsoon to 24 (Ind/L) in summer (Figure 2).

CONCLUSION

The study of the physicochemical factors of Samudrabundh reveals that its water turbidity is quite low, its pH value reveals that this water body is of medium productive in nature. The total hardness value suggests that the water body is of soft in nature. In some seasons the dissolved oxygen value remains at the critical level for fish production. Alkalinity is also quite low to support efficient fish production. Panov et al (1973) has suggested that for efficient fish production the zooplankton density of a water body must be above 1500 (Ind/L) [17]. But in the present study it has been observed that zooplankton density ranges from 756 (Ind/L) to 957 (Ind/L) which is quiet lower than the desired value. Hence it is concluded that the secondary plankton production in this water body is very less as required for high rate of fish yield. So, the study concludes that though this perennial water body bears a tremendous potentiality of fish culture the limnological features and planktonic abundance of this water body is not satisfactorily good for production of finfishes in them.

ACKNOWLEDGEMENT

We want to acknowledge Principal, Bankura Sammilani College, Bankura for his help and support for conducting the field work. We also want to acknowledge the help received from the local respondents who have actively participated in this field work..

Conflict of interest

Authors have no conflict of interest.

Funding Sources

No funding agency

REFERENCES

1. Dhawan, A. and Karu, S. Pig dung as pond manure: effect on water quality, pond productivity and growth of carps in poly culture system. The International Centre for Living Aquatic Resources Management (ICLARM) quarterly, *Manila*.,2002; **25** (1): 1-14.
2. Shaikh, N.andYegari S. G.Seasonal and temporal

changes and their influence on free carbon dioxide, Dissolved oxygen(DO) and pH in Tansa river of Thane District , Maharastra. *Journal of Aquatic Biology*., 2003; **18**(1): 73-75.

3. Sati S.C. and Paliwal, P.C..Physicochemical and bacteriological analysis of Kosi river in Central Himalaya . *Poll.Res.*, 2008; **27**(1): 79- 183.
4. Deivanai, K., Arunprasath, S., Rajan, M. K. and Baskaran, S. (2004). Biodiversity of phyto and zooplankton in relation to water quality parameters in a sewage polluted pond at Ellayirampannai, Virudhunagar district. In Proceedings of national symposium on biodiversity resources management and sustainable use, organized by the center for biodiversity and forest studies, Madurai Kamaraj University, Madurai
5. Shashikanth, M. and Vijaykumar, K.. Ecology and abundance of zooplankton in Karanja reservoir, Karnataka. *Environ. Monit.and Assess.,* 2009; **152** (1-4): 451-458.
6. Prasad, B.B. and Singh, R. B. Composition, abundance and distribution of phytoplankton and zoobenthos in a tropical water body. *Nature Environment and Pollution Technology*., 2003; **2**(3): 255-258.
7. Tiwari, T.N. (1992). Pollution of Lake Hussain sagar, Hyderabad, India: correlation and cluster analysis. In Mishra, S.R and Saksena, D.N. (Eds.) Aquatic Ecology, Ashish Publ. House, New Delhi, pp213-229.
8. Jhingran, V.G. Fish and Fisheries of India, 3rd Edn. Hindustan Publishing Corporation, Delhi, India, pp 727.1991
9. APHA. Clescerl, L, S. (Editor), Greenberg, A, E.(Editor), Eaton, A, D.(Editor) (2008). Standard Methods for Examination of Water and Wastewater (21th ed.), American Public Health Association, Washington, DC.
10. Battish, S.K. (1992).Freshwater zooplankton of India. Oxford and IBH Publishing Co., New Delhi
11. Wetzel, R.G. (1975). Limnology, W.B. Sunders Company Pub. Philadelphia, London, Toronto, p740.
12. Gaikwad, S.R., Ingle, K.N. and Thorat, S. R. Study of zooplankton pattern and resting egg diversity of recently dried water bodies in north Maharashtra region. *Journal of Environmental Biology*., 2008; **29**(3): 353-356.
13. Shinde, S.E., Pathan,T.S., Raut,K.S. and Sonawane, D.L. (2011) . Studies on the physicochemical and correlation coefficient of Harsool-Savangi Dam , district Aurangabad, India. *Middle East Journal of Scientific Research,* 2011, **8**(3) : 544-554.
14. Kurbatova, S. A. (2005). Response of microcosm zooplankton to acidification. *Izv. Akad. Nauk. Ser. Biol.*. **1**: 100-108
15. Ellis, M. M.(1937). Detection and Measurement of stream pollution. Bull 22, *US Bureau of Fish Bull.,* 1937; **48**(22): 365-425.
16. Sawyer, C.H. (1960). Chemistry for sanitary Engineers. McGraw Hill Book Co., New York
17. Panov, D. A.,Chromov, L. V. and Motenkova, L. G. Forming of the food base of ponds during rearing of phytophagous fish larvae. Biol. Resur. Vodoemov Mold., 1973;11:115-120 (in Russian).