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Zooplankton studies in relation to water parameters of Tedhi Nadi near Katahaghat of district Gonda (U.P.), India

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Abstract

In the present work during November & December,2020,January 2021 to September 2021 in Tedhi Nadi near Katahaghat of district Gonda, Uttar Pradesh, several physico-chemical parameters such as temperature (16.5to22.8.0°C), pH (7.0to8.0), DO (8.7 to12.3 ppm), FCo2(2.5to4.0ppm), Carbonate alkalinity (41 to 78 ppm), Bicarbonate alkalinity (105 to 187 ppm), Total alkalinity (82 to 221 ppm), Nitrate (0.11 to 0.37 ppm), Calcium(98 to 192 ppm), Chloride(11.0 to 71 ppm), Phosphate (0.033 to 0.068 ppm),Total organic matter (3.5 to 11.8 ppm) and Total nitrogen (1.45 to 3.04 ppm) were studied.
Zooplankton from the selected fields were examined by calculating 15 genera of three taxa-protozoan, rotifers and crustacean were recorded and showed distinct quantitative variation. During study period,number of Zooplankton increased in the summer month while decreased in the winter months. Zooplankton form very important link in aquatic ecosystem. They are at the second trophic level and constitute food for other invertebrates and fishes. They are also used as indicator of trophic status as well as the quality of water bodies.

Keywords: Zooplankton, water parameters, Tedhi Nadi, Katahaghat.

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Introduction

Water is an essential requirement for all kinds of life and the most abundant on the planet earth and among the best solvents and unique in many physico-chemical ways. It is medium of life. Every cell contains some water and all life process reactions take place in water medium. Food and nutrients move from cell to cell through this medium. Water is also the raw material in the manufacture of carbohydrates through photosynthesis in green plants.

Animals are dependent on the food prepared in the body of green plants. Two things immediately become clear, first: that water is very abundant and second : that is the very basis of that is elixir in the real sense. Because of its capacity to dissolve an extremely wide variety of substances it is both very useful in making solutes available to cellular organelles for biosynthetic activities and harmful in getting readily polluted by dissolving harmful substances toxic to organisms and man.

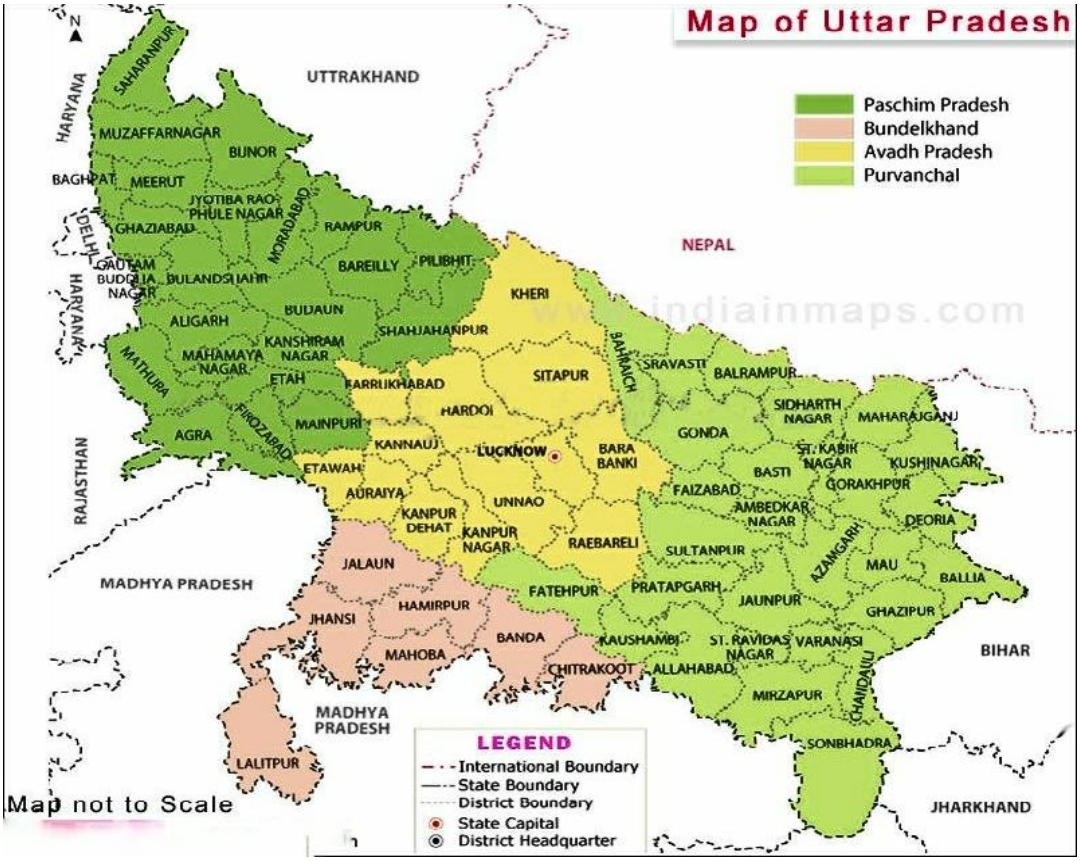
Water like air has been one of the major environmental component. It is an indispensable and the most precious natural resource on this planet, as prime necessity of life and natural water bodies are of great importance to mankind.

India is very rich in water resources and stands second in the world. Its inland water resources occupy and area of about 1.37 million hectare. The inland water resources are scattered in the form of river, dams, lakes, ponds, stream and other freshwater bodies. India is having 2,167 natural and 65,254 manmade wetlands occupying 14,58,580 hectares and 25,87,965 hectares of land respectively. Moreover the association of man and wetland in Prehistoric India also represent a rich variety of Inland and coastal wetland habitat.

Uttar Pradesh is having 125 natural and 28 manmade wetlands occupying 12,832 hectares and 2,12,470 hectares of wetlands respectively.

Location of study area: Tedhi Nadi near Katahaghat is one of the important site of the district Gonda, Uttar Pradesh state. It is situated 5 km from the district head quarter. The district Gonda lies between 26°47' and 27°20' north latitude and 81°30' and 82°46'east longitude(Map-1,2&3). Tedhi Nadi originated from Chittaura Jheel and join river Ghaghara. Flows in the range about 269 km from Chittaura Jheel to river Ghaghara (Fig.1).

Map-1: **Location of study area in India**



Map-2: Location of study area in Uttar Pradesh

Map-3: Location of study area in district Gonda

Fig.1: **Tedhi Nadi near Katahaghat of district Gonda**

Fig. 2: **Tedhi Nadi near Katahaghat, water samples collection by Investigator**

The zooplankton play an important role in the study of faunal diversity of aquatic ecosystems. They include representative of almost every taxa of the animal kingdom and occur in the pelagic environment either as adults or eggs and larvae. The zooplanktons are also utilized to assess energy transfer at secondary trophic level. They feed on phytoplankton and facilitate the conversion of plant material into animal tissues and in turn constitute the basic food for higher invertebrates and vertebrates including fishes particularly their larvae. Knowledge of abundance, composition and seasonal variation of zooplankton is an essential requirement for any successful fishery development and management programme. The zooplankton also serve as good indicator of water quality because they are influenced by environmental conditions and respond quickly changes in the quality of water.

The study of zooplankton has been a subject of a great interest among zoologists in general and hydrobiologists in particular. The zooplankton communities have been shown to respond to a wide variety of disturbances including nutrient loading. The zooplankton are susceptible to variation in a wide number of environmental factors including water parameters, food availability (algae and bacteria) and predation by fish and invertebrates are of great significance in the study of aquatic ecosystems. In Uttar Pradesh, however, little attention has been paid toward the study of zooplankton and water parameters. Quite a few workers have described zooplankton from some of the lakes, dams and reservoir of the state Tripathi(2006), Pandey (2007), Tripathi(2015,2016). The aim of the present study to deal with the zooplankton study in relation to water parameters of Tedhi Nadi near Katahaghat of district Gonda (UP), India.

Review of Literature

The available literature pertaining to the hydrobiological conditions of inland water has revealed that it was F.A. Forel (1892-1904) Swedish Professor whose researches laid down the foundation of hydrobiology.

In India, the observation of Prasad (1916), on the seasonal conditions governing the pond life in Punjab, appears to be the first hydrobiological study. Since then such studies have progressed in different parts of the country and several notable contributation have been made so far. Since then such studies progressed and noteworthy contribution were made by several workerlike Allen (1920), Atkins (1932) Hasler (1949), Singh(1955) and Srivastava (1956), Trivedi (1986). Sharma (1999) has studied limnology and distributional pattern of bottom fauna of Ban Ganga Jammu (India). Similar results other wetland have also been noted by Mohanty (1999), Chaturvedi(1999), Bhattacharya (2000), Khan And Ghosh (2001), Nath(2001), Baba (2002), Clarke (2002), Gupta (2002), Kumar (2002), Kumar and Asija (2002), Saunders (2002), Sharma (2002), Verma and Sharma (2002), Ismail and Dorgham (2003), Prasad and Singh (2003), Singh (2004), Suchi Tewari(2004), Pani and Mishra (2005), Nautiyal (2005) and Tripathi (2006).

Pandey et.al. (2007) have studied on the plankton diversity of a water body of Chittaurgarh dam in district Balrampur (U.P.), India. Subsequent contribution on this aspect were made by Latha and Thanga (2008), Kumar (2009), Kabir (2010), Mola (2011), Singh (2012), Ahmad (2012), Sharma (2013), Singh (2013). Tripathi et.al. (2015 & 2016) studies on Zoobenthos in relation to water parameters of Seetadwar lake of Shravasti district, UttarPradesh, India.

Materials and Methods

The present work was carried out for a period of 11 months from November & December 2020, January 2021 to September 2021 for completion of exhaustive work and the standard methods described for the purpose have been used, certain permissible modification and according to the local condition have also been incorporated. A short description of materials and methods applied during the present investigation has been presented below.

A - Sampling and preservation :-

(a) Sampling : The study of hydrobiological (physico-chemical and biological) condition of the water body and to assess the actual position of zooplankton diversity, the entire area of the Tedhi Nadi has been taken into account. For the purpose three sampling station namely littoral, pelagic and polluted were setout, depending upon the degree of inflow and water turbidity. At a glance station littoral and pelagic were marked non polluted. The sampling station were marked by means of a weighted plastic float.

All the sample for abiotic and biotic component (ex-water and zooplankton) of Tedhi Nadi near Katahaghat were collected during the second week of each month between 08.00A.M. to 11.00A.M. They were taken from different sampling station fixed up in littoral, pelagic and polluted region and were transported to the laboratory of P.G. Department of Zoology, M.L.K.P.G. College, Balrampur (U.P.) at the earlier for qualitative and quantitative estimations. Water samples were collected in three replicates from each of the site in clean plastic containers, using standard method of collection (APHA 2005).

(b)Preservation: The samples collected in sample containers of polyethylene. Labels on different bottles clearly indicated the name and locations of sampling station, date and time of Sampling, station number and depth.

The samples tightly cappped containers were brought to the laboratory in an ice box and kept in freezer to check the biological activity and preserve them. The physico-chemical analysis used standard method **(APHA-AWWA, WPCF 2005).**

(B)- Water sample analysis: The procedures described by Michael (1984), Trivedi (1986) have been adopted in the analysis. A brief description of the methods employed are given here.

(a) Physical Parameter

Temperature(°C) :For determination of temperature, soon after the collection of sample in the polyethylene bottle, a mercury thermometer of (0.0 – 60°C)

(b) Chemical Parameters :

pH: pH of water was determined using pH meter (HANN ,model no. -H19)

DO, FCo2, Carbonate, alkalinity, bicarbonate alkalinity, total alkalinity, nitrate, calcium, chloride, phosphate, total organic matter and total nitrogen. Rest of the parameters will be analysed using the method of Michael (1984), **APHA, AWWA and WPCF(2005)**.

(C) :Zooplankton community composition studies :-

Zooplankton samples were collected by filtering 100 Litres of subsurface water through Birge conical net made up nylon cloth (mesh size no.-20).During the course of collection of zooplankton samples, care was taken to keep as far as possible subsurface layer of water undisturbed and also not to allow spilling of water from the plankton net. The samples collected in the tube of the net were transferred into double stoppered polyethylene bottles making up their volume to 30 ml. Further the samples were preserved by adding few drops of 4% formalin and few drops of glycerine for their identification in the laboratory later on identification of zooplanktons was done by using standard literature and books Dhanapathi (2000), Edmondson (1959) and Tripathi (2006).

Results and Discussion

The Tedhi Nadi near Katahaghat of district Gonda, Uttar Pradesh on which ecological studies has been carried out represents a special type of habitat. It is a shallow, eutrophic and supports a rich aquatic zooplankton. The monthly changes of different physico-chemical and zooplankton condition of the Tedhi Nadi near Katahaghat has already been described in preceding work. The salient features of findings of all parameters have been discussed here.

Hydrology of Tedhi Nadi near Katahaghat

The various physico-chemical charactaristics of water sample of Tedhi Nadi near Katahaghat in relation to periodic changes have been described in (Table-1).

Water conditions :-

In aquatic habitat of Tedhi Nadi near Katahaghat discussed the environmental factors include various physico-chemical properties of water such as solubility, Temperature, pH, phosphate and nitrates are very important for growth and density of phytoplankton on which zooplankton and some higher consumer depend on their existence(Table 2).

The fluctuation of the water temperature in any aquatic habitat has little to do with the distribution of species but it does influence the physico-chemical characteristics of the habitat. The high temperature from march onwards initiates rapid decomposition of the organic matter in the substrate and consequently the mineral content rises in the water during the following month (Table.1).

Bose and lakra (1994) has pointed out the pH expresses the acidity or alkalinity of water which is determined by means of hydrogen ion (H+) and hydroxyl ion (OH-) in water. Higher concentration of H+ ions gives lower score on the pH scale and lower concentration of H^+ ion gives higher scores on the pH scale. Water of around pH-7 are called neutral. During

daylight, aquatic plants usually remove the CO_2 from the water quickly and pH increases. At night CO_2 accumulates and pH declines. The magnitude of daily fluctuation pH depends on the buffering. In the present study pH shown in (Table.1) . The water with pH values ranging 7.0-8.0 at day break is most suitable for fish production. This observation is in concurrence with those of Singh (1992), Shukla (1996) and Tripathi (2006).

Further an inverse correlation was found between pH and the temperature which is contrary to the observations of Kaushik and Saksena (1999), Tripathi (2006), Pandey (2007), Parveen (2010), Singh and Tripathi (2012).

The dissolved oxygen (Table.1) in the present investigation is plentiful during winter months when submerged macrophytes were luxuriant and mansoon months, when there was rich microplanktonic vegetation and addition of excess oxygen from intensive rainfall. The oxygen production during these period exceeded many a time the oxygen consumed by the organisms as have also been observed by Tripathi (2006), Pandey (2007), Singh (2012), Singh (2013) and Tripathi (2015).

The free carbondioxide (Table.1) was detected mainly from the polluted region during the winter and monsoon months. Its absence from the littoral and pelagic waters of the dam suggested that probably all the carbondioxide produced during the respiration of living oraganisms was either utilized in photosynthesis of the autotrophs or converted in the bound forms of mono and bicarbonates a features reported by Ganai (2010) and Tripathi (2015).

Tripathi (2016) has pointed out the amount of acid required titration the bases in a measures of alkalinity of water or it is the ability of water to neutralize of acids. The minerals, which dissolves in water from soil, atmosphere and waste discharge, provide the source of alkalinity. Carbonate and bicarbonate are the major constituent of Tedhi Nadi water and their concentration expressed as total alkalinity. Calcareous water with alkalinity more than 50 ppm is most productive. Water, alkalinity less than 10ppm rarely produces large crops. Water intermediate between 10ppm - 50ppm may give useful results. In highly productive water, the alkalinity is thought to be over 1000 ppm. However , the range of alkalinity as 0.00-20 ppm for low production, 20-90 ppm for medium production and 90-299 ppm for high production are considered. Since in the present Tedhi Nadi nearKatahaghat82-221is obtained during different month of the year November & December 2020, January-2021to September-2021, hence it is could classified as nutrient rich Tedhi Nadi at Katahaghat (Table.1). Similar result obtained by Singh (2012), Tripathi (2015&2021).

(Table.1) A direct link was observed between chloride content and the water temperature, Since both of them fluctuated identically. Further increase in the chloride content, the nitrate and phosphate contents also increased which is agreement with the findings of Tripathi (2006), Pandey (2007) and Singh (2012) have pointed out that the quantity of available nitrogen and phosphorus in any water is indicative of its productivity. The amount of nitrate and phosphate in the present water is relatively medium (Table.1).

The result of physico-chemical properties in Tedhi Nadi near Katahaghat include pH value ranged varied from 7.0 in the month of August to 8.0 in the month of January at site, temperature (°C) of water ranged from 16.5 in the month of January to22.8 in the month of May, DO (ppm) ranged from 8.7 in the month of April to 12.3 in the month ofAugust, FCo2(ppm) ranged from 2.5.0 in the month of November to 4.0 in the month of April, Carbonate alkalinity (ppm) ranged from 41 in the month of January to 78 in the month of June, Bicarbonate alkalinity (ppm) ranged from105 in the month of February to 187 in the month of June, Total alkalinity (ppm) ranged from 82 in the month of September to 221 in the month of May. Nitrate (ppm) ranged from 0.11in the month of December to 0.37 in the month of May, Calcium (ppm) ranged from 98 in the month of February to 192 in the month of July, Chloride (ppm) ranged from 11.0 in the month of January to 71.0 in the month of August, Phosphate (ppm) ranged from 0.033in the month of September to 0.068 in the month of May, Total organic matter (ppm) ranged from3.5 in the month of December to 11.8 in the month of June and Total nitrogen (ppm) ranged from 1.45 in the month of January to 3.04 in the month of August.

Zooplankton population in Tedhi Nadi near Katahaghat

In the present work reported that presence of 15 genera of Zooplankton belonging three group of Zooplankton viz. Protozoan Zooplankton contains Euglena sp., Amoeba sp., Arcella sp., Difflugia sp., Loxodes sp. And Trichodina sp., Rotifers Zooplankton

contains Brachionus sp., Euchlanis sp., Filinia sp., Lecane sp. and Trichocerca sp., Crustacean Zooplankton contains Bosmina sp.,Diaptomus sp., Moina sp. And Sida sp. were identified and recorded in Tedhi Nadi near Katahaghat of district Gonda,Uttar Pradesh (Table-2).The result is quite clear that protozoan Zooplankton were the most dominating Zooplankton and maximum in the month of May and Minimum in the month of February. Similar results were observed earlier Tripathi (2006), Pandey (2007), Singh (2013), Tripathi (2015), Tripathi & Shukla (2021) and Tripathi (2021).

During the investigation presence of zooplankton was maximum in the summer month (May) and minimum in the spring month (February). This is not conformity to the finding of Eggleton (1931) and Devey (1945) who observed the maximum zooplankton in April and minimum in September in American lake, while Srivastava (1956) and Tripathi (2006) observed maximum in the month of May and June and minimum in the month of February from a lake of Lucknow and Seetadwar lake of Shravasti district (U.P.), India. Michael (1969) concluded the peak period in the month of January and April but Mandal and Moitra (1975), Singh (2013), found maximum peak during summer months which is quite in conformity to the finding of this investigation. The differences in the occurrence of peak in zooplankton might be due to the different nature of the water bodies, different in nature of the abiotic factors of water and soil and variation in the productivity of different water bodies. Some worker such as Tripathi (2006), Pandey (2007), Singh (2012) and Tripathi (2015) correlated bottom community with the fish productivity and accordingly this water body is most suitable for the pisciculture.

Table :1-Monthly fluctuation of physico-chemical parameaters in water of Tedhi Nadi near Katahaghat of district Gonda (U.P.), India
(Data of November & December 2020, January 2021 to September 2021)

S.No.	Parameters	Nov	Dec		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	Temerature(0°C)	19.5	18.4		16.5.2	18.2	19.3	19.4	22.9	20.1	21.0	22.2	22.4
2	pH	7.4	7.2		8.0	7.8	7.6	7.7	7.5	7.6	7.4	7.0	7.2
3	DO (ppm)	14.6	12.4		12.2	12.2	11.3	8.7	11.4	11.8	11.8	12.3	12.6
4	FCO2 (ppm)	2.5	3.1		3.7	3.2	3.5	4.0	-	-	-	-	3.0
5	Carbonate alkalinity (ppm)	44	42		41	44	46	58	65	78	55	57	62
6	Bicarbonate alkalinity (ppm)	121	106		112	105	130	148	184	187	180	172	122
7	Total alkalinity (ppm)	85	89		141	146	145	201	212	200	122	89	82
8	Nitrate (ppm)	0.18	0.11		0.14	0.13	0.25	0.30	0.37	0.34	0.28	0.23	0.12
9	Calcium(ppm)	115	102		108	98	125	120	175	180	192	159	112
10	Chloride(ppm)	25.4	14.5		11.0	14.5	12.0	66.0	67.0	70.0	69.0	71.0	25.0
11	Phosphate (ppm)	0.041	0.050		0.050	0.050	0.060	0.058	0.068	0.048	0.035	0.041	0.033
12	Total organic matter (ppm)	5.9	3.5		4.2	3.8	8.4	9.8	10.7	11.8	11.0	11.5	6.7
13	Total nitrogen	1.87	1.46		1.45	1.55	1.60	2.05	2.12	1.95	2.68	3.04	2.95

Table-2 Zooplankton population in Tedhi Nadi near Katahaghat of District Gonda, U.P., India (Data of November & December 2020, January 2021 to September 2021)

S.N.	Zooplankton	Months										
	Genera	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
	Protozoa											
1	Euglena sp.	+	+	+	+	+	++	++++	+++	++	++	++
2	Amoeba sp.	+	+	+	+	+	++	+++	++	++	+	+
3	Arcella sp.	+	+	+	-	+	++	+++	++	+	+	+
4	Difflugia sp.	++	+	+	+	++	+++	++++	++	+	+	++
5	Loxodessp.	+	-	-	-	++	+++	++++	+++	+	+	+
6	Trichodina sp.	+	-	+	-	++	+++	++++	+++	+	-	+
	Rotifera											
7	Brachionus sp.	+	-	-	-	+	++	+++	++	++	+	++
8	Euchlanis sp.	+	-	+	-	++	+++	++++	+++	++	+++	++
9	Filinia sp.	+	-	+	-	++	+++	++++	++++	++	+++	++
10	Lecane sp.	-	-	-	-	++	+++	++++	++++	++	++	++
11	Trichocerca sp.	-	-	-	-	++	+++	++++	+++	++	+	++
	Crustacea											
12	Bosminasp.	-	+	-	+	++	+++	++++	++++	++	+	+
13	Diaptomus sp.	+	+	-	-	++	++	+++	++	+	+	++
14	Moina sp.	++	+	+	-	++	+++	++++	++	++	++	++
15	Sidasp.	+	-	-	-	+++	++	++++	+++	+++	++	++

Note :-
++++ = Abundant (51-100%)
+++ = Common (26-50%)
++ = Frequent (11-25%)
+ = Rare (0-10%)
- = Absent (Nil)

Conclusion

In the present study, several physico-chemical parameters such as temperature (16.5-22.8.0°C), pH (7.0-8.0), DO (8.7-12.3 ppm), FCo_2 (2.5-4.0 ppm), Carbonate alkalinity (41-78ppm), Bicarbonate alkalinity (105-187 ppm), Total alkalinity (82-221ppm), Nitrate (0.11-0.37ppm), Calcium (98-192 ppm), Chloride (11.0-71.0ppm), Phosphate (0.033-0.068ppm), Total organic matter (3.5-11.8ppm) and Total nitrogen (1.45-3.04 ppm) were studied.

Zooplankton diversity from the selected fields were examined by calculating15 genera of three taxa– protozoan, rotifers and crustacean, Zooplankton form a very important link in aquatic ecosystem. They are at the second trophic level and constitute food for other invertebrates and fishes. They are also used as indicator of trophic status as well as the quality of water body.

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