Journal Homepage: -www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI:10.21474/IJAR01/2082
DOI URL: http://dx.doi.org/10.21474/IJAR01/2082
ISSN NO. 2320-5407

RESEARCH ARTICLE

STUDIES ON PHYTOPLANKTON RELATED DIVERSITY INDEX OF RIVER SHARDA(UTTARAKHAND).

Hem Chandra Upadhyay.
Department of Zoology, R. H. Govt. P.G. College Kashipur, Kumaun university, Uttarakhand.

Manuscript Info

Manuscript History

Received: 24 September 2016
Final Accepted: 26 October 2016
Published: November 2016

Key words: -
Phytoplankton,Sharda River,Diversity index, Simpson's dominance index.

Abstract

Phytoplankton are an integral component of the aquatic ecosystem. Being at the base of an aquatic food chain, these are responsible for almost all the primary production altered in any aquatic ecosystem. The numerical relationship among species, their communities, population often provide a better and reliable detection of pollution with compare to a single species. In the present investigation phytoplanktonic species composition,Shannon-Weiner information function of diversity and Simpson's dominance index was computed.

Introduction: -

Phytoplankton are minute, chlorophyll bearing organism, occupies the lowest level in aquatic food chain pyramid system. They form the base of a grazing food chain and work as primary producers by trapping solar energy in the aquatic ecosystems.These are the major source of dissolved oxygen in the water bodies and are a good indicator of water quality (Wetzel 1975, 2001;Lynch 1980;Pathani et. al, 2002).Presence of plankton in any aquatic media directly affects the productivity of that aquatic system.Phytoplankton are very sensitive to changes in these environment and affects dissolved oxygen levels, nutrient concentrations, light levels, and zooplankton biomass.Plankton composition and diversity estimationhave often been utilized to evaluate the overall health of riverine ecosystem.The species diversity index is a quantitative measure that help in evaluation of how much diverse theparticular aquatic community. It also indicates the number and individuals of different species present in an ecosystem at a specific time and in a unit space. Shannon-Weiner diversity index is the best indicator of water quality categorization.Recentobservations on Shannon-Weiner diversity index have been reported by several researchers such as Huang et. al, (2004), Zalocar de Domitrovic et. al, (2007),Desai et. al, (2008) etc. Plankton population and their distribution are greatly affected by pollution. Therefore, the magnitude and dynamic of phytoplankton population has become a very effective tool to assess river health. Thus the attempts have been made to assess the pollution level in the Sharda River by computing Shannon-Weiner diversity index and Simpson's dominance index.

Material and methods: -

The qualitative and quantitative estimation of phytoplankton community was done by filtering about 50 litres of water through the plankton net. Then the filtrate was collected and counting was done by a method using Sedgwick-Rafter counting cell.Standard books and manuals were followed to identify the phytoplankton taxa (Pennak 1958; Edmondson, 1959; Fitter and Manuel, 1986; APHA 1999). The data were collected for a period of one year at three sampling points S1(29º08′13.72"N, 80º10′56.73"E), S2(29º06′45.10"N, 80º09'19.36"E) and S3(29º04'39.06"N, 80º07'07.10"E) from January 2012 to December 2012 **(fig.1.2)**.

Corresponding Author: -Hem Chandra Upadhyay
Address: -Department of Zoology, R. H. Govt. P.G. College Kashipur, Kumaun university, Uttarakhand.

Shannon-Wiener species diversity index ($\overline{H}$): -

Diversity index was determined using Shannon-Wiener diversity index, which is:

$$\overline{H} = -\sum_{i=1}^{S} Pi \log_2 Pi,$$

Concentration of dominance (Simpson's index):-

It was calculated by the following formula.

$$C = \sum_{i=1}^{s} (Pi)^2$$

where:*Pi* = proportion of the abundance of species

Population density: -

$$\text{No. of phytoplankton (units/l)} = \frac{(a \times 1{,}000)C}{L}$$

where:

a = average no. of plankton in all counts in counting unit of an ml capacity

C = volume of original concentrate in ml

L = volume of original water filtered expressed in litres

Table 1.1: -List of phytoplankton taxa collected from Sharda River during the study period (January 2012 to December 2012).

S. No.	Phytoplankton taxa	S. No.	Phytoplankton taxa
	Chlorophyceae		**Bacillariophyceae**
1.	*Actinastrum*sp.	1.	*Asterionella*sp.
2.	*Ankistrodesmusfalacatus*	2.	*Cyclotella*sp.
3.	*Chlamydomonas* sp.	3.	*Cymbella*sp.
4.	*Chlorella* sp.	4.	*Diatoma* sp.
5.	*Cladophora*sp.	5.	*Fragillariacapucina*
6.	*Closteridium*sp.	6.	*Gomphonemaintericatum*
7.	*Closterium*sp.	7.	*Navicula*sp.
8.	*Coelastrummicroporum*	8.	*Synedra* sp.
9.	*Cosmarium*sp.	9.	*Tabellaria fenestrate*
10.	*Desmidium*sp.		**Cyanophyceae**
11.	*Gonatozygon*sp.	1.	*Merismopedia*sp.
12.	*Mougeotia*sp.	2.	*Microcystis* sp.
13.	*Pediastrum*sp.	3.	*Oscillatoria*sp.
14.	*Spirogyra* sp.	4.	*Spirulina* sp.
15.	*Volvox*sp.		**Xanthophyceae**
16.	*Zygnema*sp.	1.	*Tribonema*sp.
			Total number of taxa 30

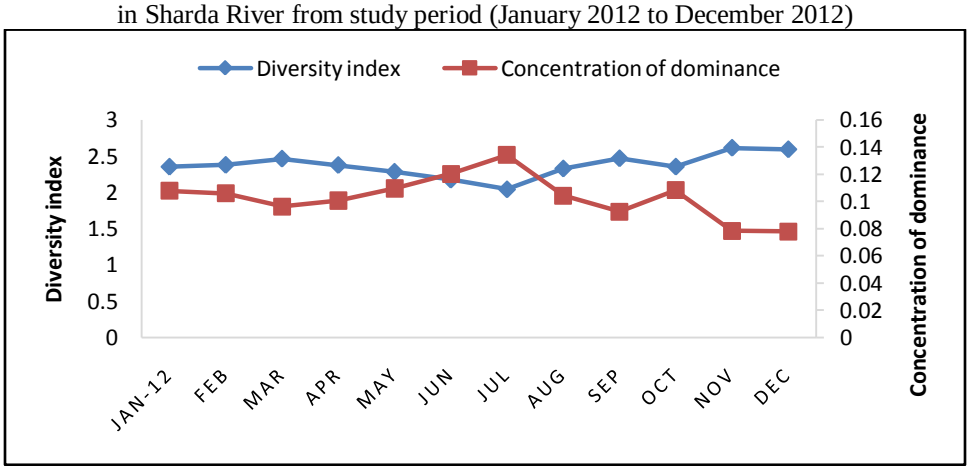
Table 1.2: -Seasonal variation in total number of species belonging to different phytoplankton groups collected during the study period (January 2012 to December 2012).

Groups	Chlorophyceae	Bacillariohyceae	Cyanophyceae	Xanthophyceae	Total
Jan 2012	7	4	1	0	12
Feb	5	5	2	0	12
Mar	6	5	3	0	14
Apr	6	4	2	0	12
May	6	3	2	0	11
Jun	3	4	2	0	9
Jul	3	3	2	0	8
Aug	5	3	3	0	11
Sep	7	3	2	1	13
Oct	5	4	2	1	12
Nov	9	4	2	0	15
Dec	7	5	2	0	14

Table 1.3: -Total Estimation of Composition of different groups of Phytoplankton in Units/liter of Sharda River Year-2012.

Months	Chlorophyceae	Bacillariophyceae	Cyanophyceae	Xanthophyceae	Total
Jan 2012	186	160	50	0	396
Feb	203	197	98	0	498
Mar	210	220	125	0	555
Apr	348	232	137	0	717
May	310	191	135	0	636
Jun	190	189	128	0	507
Jul	131	88	92	0	311
Aug	83	53	66	0	202
Sep	124	105	57	15	301
Oct	115	145	51	20	331
Nov	208	118	68	0	394
Dec	173	146	53	0	372

Fig 1.1: - Seasonal variation in Shannon-Weiner diversity index and concentration of dominance of phytoplankton in Sharda River from study period (January 2012 to December 2012)

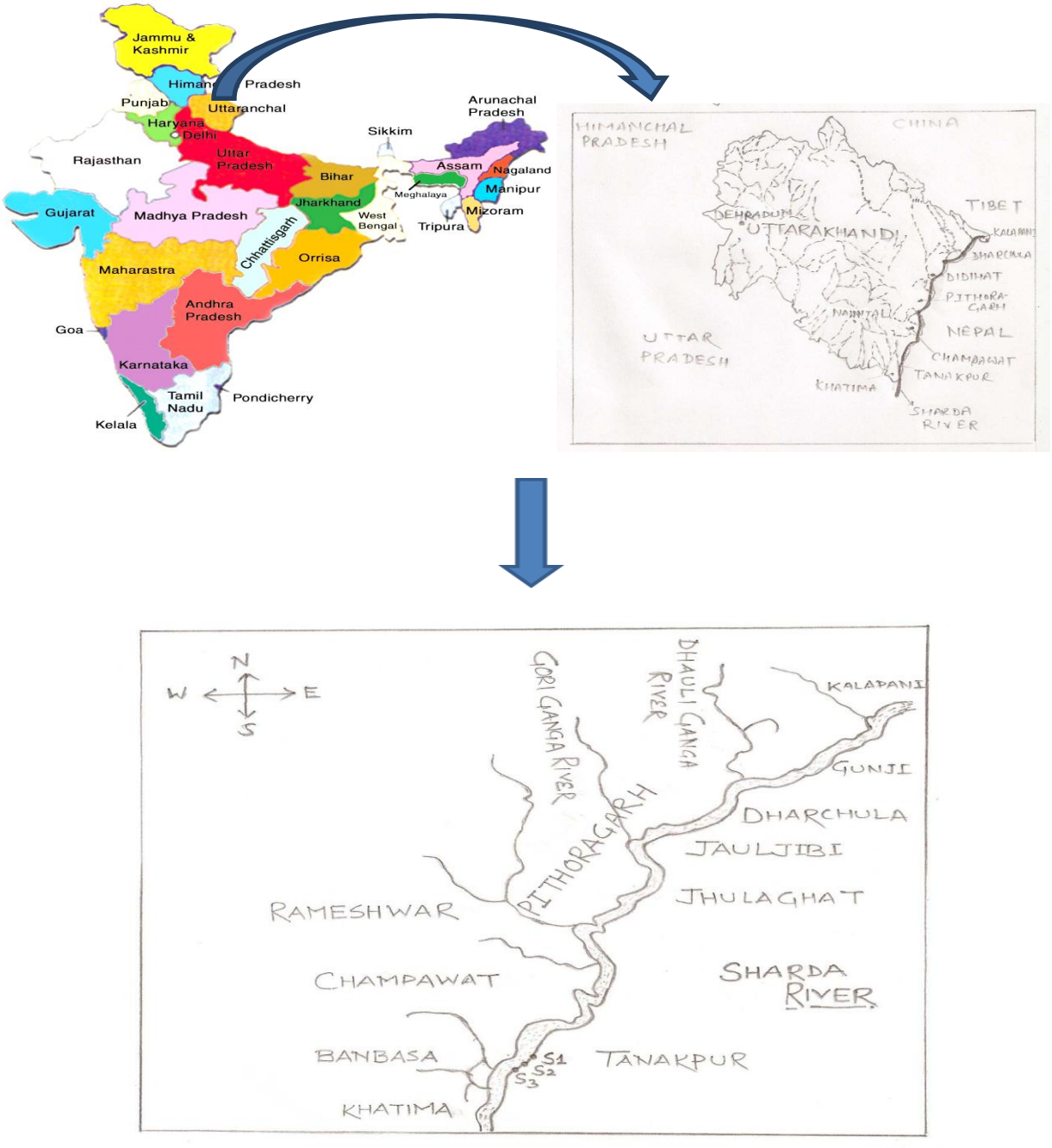


Results and Discussion: -

During the entire study period of the present investigation, thirty (30) different phytoplanktonic taxa were collected in collection **Table (1.1)**.Of these 30 species, maximum number of species were contributed by the group Chlorophyceae. A maximum number of the Chlorophycean taxa were obtained in the month of November (9).The

second dominant group in terms of species composition was Bacillariophyceae (5). Characteristically, maximum number of species of this group were collected in the months of March, February and December**Table (1.2)**.In the present investigation, in terms of species richness the group Chlorophyceae was the most dominant group. Rajagopalet. al, (2010) and Khan et. al, (2013) also reported dominancy of Chlorophyceae over other groups in their studied aquatic bodies.

Fig.1.2: -



Above maps showing the river andsampling areas (S_1- 1st sampling site(Thuligad), S_2-2nd sampling site (AdyaShaktipeeth-Boom temple) and S_3-3rd sampling site (Hanuman Gari-Tanakpur town).

(Map is not to scale)

Being the most important group in terms of percentage share of the phytoplankton standing crop, the abundance of Chlorophyceae varied from 83 units/litre (August) to 348 units/litre (April)**(Table 1.3)**.The group Bacillariophyceae was the second dominant group and most of the constituting species of this group were intermittently present in the samples, while a few species namely *Diatoma* sp. and *Synedra* sp. were almost perennial in terms of occurrence. The population size of Bacillariophyceae varied from 53 (August) to 232 (April).In the present research, Bacillariophyceae was the second dominant group. Negi and Rajput, (2011) and Negi and Rajput, (2013) also reported the same results in their studies.

Cyanophyceae was the third important group in terms of percentage share to the total phytoplankton numbers. During the present study, the abundance of this group fluctuated between 50 (January) to 137 (April). Cyanophyceae was the third dominant group in terms of number of species contributed. Maximum number of Cyanophyceae taxa (3) were collected during March and August. Group Xanthophyceae shared least number of species in the phytoplankton community. It was represented by a single species during the whole study period. Being the least abundant group of phytoplankton community of Sharda River, the group Xanthophyceae was present only in the months of September and October.

The Shannon-Weiner information function of diversity and Simpson's dominance index both are quite significance functions of the community. In the present investigation the Shannon-Weiner diversity index ranged between 2.04 (July) and 2.613 (November) during entire study period. The values of diversity indices weregreater than 2 throughout the study period.The concentration of dominance showed a distinct inverse relation to that of species diversity index. During the whole study period in Sharda River, the dominance index ranged from 0.077 (December) to 0.134 (July).Shannon-Weiner diversity index and concentration of dominance depicted in **fig 1.1**. The range of seasonal variation in concentration of dominance was much narrow and, therefore, indicates that none of the phytoplankton taxa was exclusively dominant and distributed in this river.

Conclusion: -

Overall, the findings of the present study are hopeful to categorize the Sharda River as an unpolluted water body and the density of phytoplankton species is also sufficient for the maintenance of fish fauna in the river. None of the pollution tolerant species were over-dense in the river and, therefore, the river water is suitable for drinking water treatment plants. Further studies on the structure and organisation of phytoplankton community will be effective for water managers, governmental authorities, etc. towards its sustainable management and conservation for future perspective.

Acknowledgement: -

The author expresses profound gratitude to his parents and Head, Department of Zoology, R. H. Government P.G. College, Kashipur, Kumaun University, Uttarakhand, for laboratory facilities.

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