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Research Paper

DIVERSITY OF PLANKTON AND THEIR SEASONALVARIATION OF DENSITY IN THE YAMUNA RIVER AT KALPI, DISTRICT JALAUN (U.P.) INDIA

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Abstract

Present paper deals with the analysis of diversity of Plankton (i.e., Phytoplankton and Zooplankton) and their seasonal variation of density in the Yamuna river at Kalpi, district Jalaun, U.P.. Four sampling stations were selected on the Yamuna river for sampling purpose. Samples were collected for a period of one year (October 2013 to September 2014) at each month of every season. Collected samples were evaluated for study of diversity of Plankton (i.e., Phytoplankton and Zooplankton) and their seasonal variation of density. Registered Phytoplankton were belong to 35 species of 25 genera of different groups like as Chlorophyceae (12 species of 11 genera), Euglenophyceae (3 species of 2 genera), Bacillariophyceae (5 species of 5 genera) and Cyanophyceae (15 species of 7 genera). In the study period group Chlorophyceae was dominated over rest of the phytoplankton population. Registered Zooplankton were belong to 22 species of 16 genera of different groups like as Protozoa (3 species of 3 genera), Rotifera (12 species of 6 genera), Cladocera (5 species of 5 genera) and Copepoda (2 species of 2 genera). Among recorded Zooplankton Rotifer's population was dominant during entire study span. It was noticed that density of Plankton was maximum in summer, minimum in rainy season and intermediate in winter season.

Key words: *Plankton diversity, Phytoplankton, Zooplankton, Yamuna River and Kalpi*.

INTRODUCTION

The term 'Plankton' is used for assemblage of microscopic, free floating organisms in water which wander at the mercy of winds and currents. Depends upon the nature plankton can be divided in two major groups, named as phytoplankton and zooplankton.

Phytoplankton are chlorophyll bearing suspended microscopic organisms consisting mainly of algae. The majority of the members of phytoplankton belongs to Chlorophyceae, Cyanophyceae and Bacillariophyceae group of algae. Phytoplankton are the basic members of aquatic ecosystems and hence change in phytoplankton population has a direct link with the change of water quality in any aquatic medium. The number and species of Phytoplankton serves to determine the quality of a water body (Bahura, 1991).Phytoplankton, being the primary producer, forms the lowest trophic level in the food chain of fresh water ecosystem. In water bodies, seasonal qualitative and quantitative fluctuations occur in plankton communities. Their

density varies according to the nature of water.
Zooplankton are the microscopic animal components of aquatic system which move at the mercy of the water movements (current). Protozoans, Rotifers, Cladocerans and Copepods constitute the major groups of Zooplankton. Zooplankton constitute an important link between primary producers (mostly phytoplankton) and higher consumers (mostly fishes) in aquatic food webs. They occupy in intermediate position in the food web and mediate the transfer of energy from lower to higher trophic level (Water, 1977). Zooplankton diversity is one of the most important ecological parameter in water quality assessment. Considering the importance of plankton diversity and variation in their density, several studies have been made in this field (Battish, 1992; Pandey *et al*., 1993; Dhanapathi, 2000; Sampaio *et al*., 2002; Rajshekhar, 2010; Khanna *et al*., 2012; Shinde, 2012 and Kadam *et al*., 2014).

AIMS AND OBJECTIVES

Objectives of the study was to analysis of diversity of Plankton (Phytoplankton and Zooplankton) and to analysis of their seasonal variation of density in the Yamuna river at Kalpi stretch.

MATERIAL AND METHODS

Study area The study was carried out at Kalpi stretch of the Yamuna river. Kalpi is a historical city of district Jalaun of Uttar Pradesh. It lies to the south east bank of Yamuna and falls under 26^0 7' 14" N latitude to 79^0 44' 59" E longitude with an average elevation of 112 meters. 5 Km. length of Yamuna at Kalpi from vicinity of Vyas mandir (u/s) to Raid drain opening (d/s) was under study programme (Fig. – 1, 2 &3).
Sampling and Analysis Four sampling stations named as S1- vicinity and in front of Vyas Mandir, S2- Kila Ghat, S3- Peela Ghat and S4- near Raid drain opening were selected for the sampling purpose (fig.-3). The samples were collected monthly till one year (October 2013 to September 2014) from selected sampling stations.

Plankton samples were collected between 8.0 AM to 9.30 AM, at every selected sampling stations. Plankton net of bolting silk no. 25 was used for sampling purpose. Samples were taken at mid stream 0.5 to 1m below the surface of water. Collected concentrated plankton samples (10 ml) were fixed and preserved in 5% formalin. Plankton samples were examined under high power microscope and identified up to genus and species level with the help of standard books and monographs (Prescott, 1962; Adoni, 1985 for plankton and Battish, 1992 for Zooplankton).

RESULTS AND DISCUSSION

Phytoplankton Registered Phytoplankton were belong to 35 species of 25 genera of different groups like as Chlorophyceae (12 species of 11 genera), Euglenophyceae (3 species of 2 genera), Bacillariophyceae (5 species of 5 genera) and Cyanophyceae (15 species of 7 genera). Alam, 2013 reported 30 species of different group of Phytoplankton from the Yamuna river at Kalpi stretch. In the study period group Chlorophyceae was dominated over rest of the phytoplankton population. Data has given in table No.- 1.
Mean value of density of recorded genera of Chlorophyceae was varied from 9 org/L to 193 org./L during observation period. *Spirogya* was most abundant genera among Chlorophyceae group. Population of Chlorophyceae gradually rised from February on words and touched peak level in May and June. Shinde *et al*., (2012) have noticed maximum number of Chlorophyceae in summer and minimum during monsoon season. This finding is coinciding with the present work. Seasonal variation in density of Chlorophyceae genera is represented by diagram No. 1.
Mean value of density of recorded genera of Euglenophyceae was in range of 3 org./L to 37 org./L. Lowest density was observed in rainy season and highest density was noticed in summer season. Present work is in conformity with the observation made by other researchers. Shinde *et al*., (2012) recorded maximum genera of Euglenophyceae in summer and minimum during monsoon. Seasonal fluctuation in density of recorded members of Euglenophyceae is expressed by diagram No. 2.

Fig. No. 1: Map of U. P. express location of district Jalaun

Fig. No. 2: Map of district Jalaun.

Fig.– 3 Satellite photograph of whole Study Area (Yamuna river at Kalpi).

Mean value of density of members of Bacillariophyceae(diatoms) was in the range between 4 org./L to 78 org./L. *Navicula* was most dominant and *Synedra* was second dominant genera during study period. Minimum density was noticed in rainy season whereas maximum density of this group was recorded in summer season. The present observation is similar to those observation made by other workers. Shinde *et al*., (2012) recorded maximum genera of Bacillariophyceae during summer and minimum during monsoon. Seasonal fluctuation in density of this group is showed by diagram no. 3.

Mean value of density of recorded genera of Cyanophyceae (Blue Green Algae) was noticed in the range between 9 org./L to 123 org./L. *Microcystis* was the most dominant genus. Highest density of this group was observed during summer (May and June) while lowest density was noticed in rainy season (August). The present work is in conformity with the work of other researchers. Thirugnanamoorthy and Selvaraju, (2009) has reported that maximum density of Cyanophycean members occurred from April to June and density was gradually decreased during winter and rainy seasons. Shinde *et al*., (2012) have recorded maximum member of Cyanophyceae in summer and minimum during monsoon season. Seasonal fluctuation in density of this group is showed by diagram No.4.

It was noticed that density of phytoplankton was maximum in summer, minimum in rainy season and intermediate in winter season. Data of average value of seasonal density of recorded Phytoplankton in the Yamuna river at study area (Kalpi) has given in table No.- 2.

Present findings are in accordance with the finding of other workers. Singh, (1990) reported that plankton population showed bimodal, pattern of fluctuation with one peak in pre winter and other in summer. Hassan *et al*., (2010) observed minimum density of phytoplankton during monsoon and maximum during summer.

Zooplankton Registered zooplankton were belong to 22 species of 16 genera of different groups like as Protozoa (3 species of 3 genera), Rotifera (12 species of 6 genera), Cladocera (5 species of 5 genera) and Copepoda (2 species of 2 genera). Alam, 2013 reported 15 species of different group of Zooplankton from the Yamuna river at Kalpi stretch. Among recorded Zooplankton Rotifer's population was dominant during entire study span. Data has given in table No.- 3. Mean value of density of recorded Protozoans was varied from 3 org./L to 31 org./L at different sampling stations. Highest density of Protozoans was noticed in the month of June while lowest density of Protozoans was recorded in the month of August (rainy season). Seasonal fluctuation in the density of Protozoans has given in diagram No. 5.

Table No.-1 List of recorded Phytoplankton in the Yamuna river at study area (Kalpi).

Chlorophyceae

	Genera	Species
1.	*Ankistrodesmus*	*falcatus*
2.	*Chlorella*	*vulgaris*
3.	*Chlorococcum*	*infusionum*
4.	*Cladophora*	*fracta*
5.	*Cosmarium*	*tenue*
6.	*Closterium*	sp.
7.	*Hydrodictyon*	*reticulatum*
8.	*Pediastrum*	*simplex*
	Pediastrum	*tetras*
9.	*Scenedesmus*	*quadricauda*
10.	*Spirogyra*	*condensata*
11.	*Stigeoclonium*	*tenue*

Euglenophyceae

	Genera	Species
1.	*Eugelna*	*acus*
	Euglena	*viridis*
2.	*Phacus*	*caudatus*

Bacillariophyceae

	Genera	Species
1.	*Cyclotella*	*meneghiniana*
2.	*Melosira*	sp.
3.	*Navicula*	*viridula*
4.	*Nitzschia*	*angustata*
5.	*Synedra*	*ulna*

Cyanophyceae

	Genera	Species
1.	*Anabaena*	*fertilissima*
2.	*Lyngbya*	*gracilis*
	Lyngbya	*magnifica*
	Lyngbya	*spirulinoidus*
3.	*Merismopedia*	*elegans*
	Merismopedia	*punctata*
	Merismopedia	*glauca*
4.	*Microcystis*	*aeruginosa*
5.	*Nostoc*	sp.
6.	*Oscillatoria*	*clorina*
	Oscillatoria	*limosa*
	Oscillatoria	*subbrevis*
	Oscillatoria	*tenuis*
7.	*Phormidium*	*calciola*
	Phormidium	*uncinatum*

Mean value of recorded density of Rotiferans was in the range of 8 org./L to 110 org./L. Maximum density of Rotifers was recorded in the month of June while their minimum density was recorded in the month of August (rainy season) The finding is similar to those observed by Michael, (1964). Seasonal fluctuation in the density of Rotifers has given in diagram No. 6.

Mean value of noticed density of Cladocerans was varied from 4 org./L to 84 org./L during entire study period. Their highest density was recorded in the month of May (Summer season) and their lowest density was recorded in the month August (rainy season). Seasonal fluctuation in the density of Cladocera has given in diagram No. 7.

Table No. 2: Average value of seasonal density of recorded *Phytoplankton* in the Yamuna river at study area (Kalpi).

Period Oct. 2013 to Sept. 2014 Months		**Chlorophyceae (org./l)**	**Euglenophyceae (org./l)**	**Bacillariophyceae (org./l)**	**Cyanophyceae (org./l)**
Winter Season	Oct.	83	17	43	64
	Nov.	99	26	62	72
	Dec.	74	14	53	46
	Jan.	65	6	49	36
Total		**321**	**63**	**207**	**218**
Summer Season	Feb.	82	12	48	58
	Mar.	129	15	56	78
	Apr.	147	24	64	90
	May	183	31	70	115
Total		**541**	**82**	**238**	**341**
Rainy Season	Jun.	193	37	78	123
	Jul.	32	5	14	29
	Aug.	9	3	4	9
	Sep.	25	5	14	19
Total		**257**	**50**	**110**	**180**
Grand Total		**1119**	**195**	**555**	**739**
Percentage (%) contribution		**42.91%**	**7.48%**	**21.28%**	**28.34%**

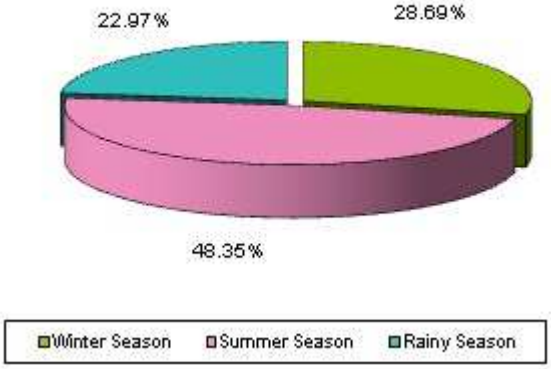

Diagram No. 1: Express seasonal fluctuation in density of Phytoplankton (*Chlorophyceae*).

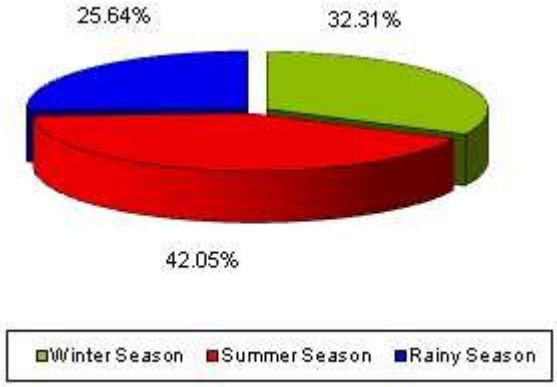

Diagram No. 2: Express Seasonal fluctuation in density of Phytoplankton(*Euglenophyceae*).

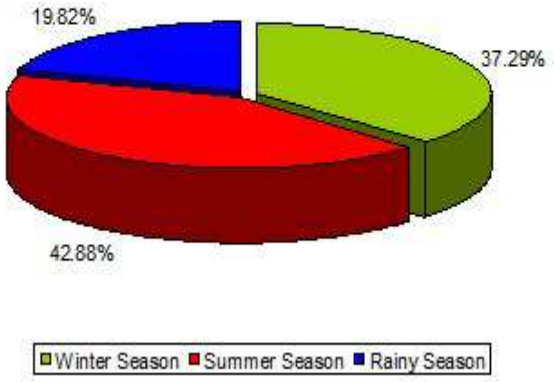

Diagram No. 3: Express Seasonal fluctuation in density of Phytoplankton (*Bacillariophyceae*).

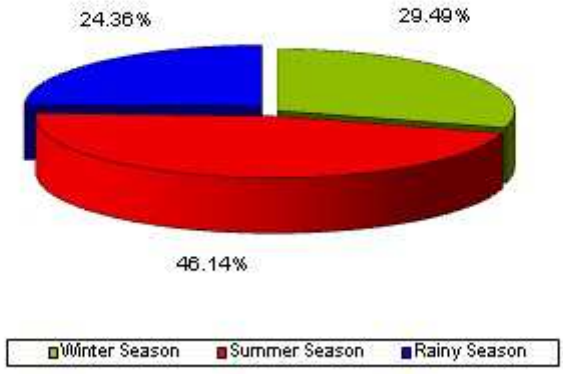

Diagram No. 4: Express Seasonal fluctuation in density of Phytoplankton (*Cyanophyceae*).

The mean value of recorded density of Copepods during study period was varied from 6 org./L to 42 org./L. Maximum density of this group was recorded in the month of May (summer) and Lower density of this group was noticed in the month of August (Rainy season). Seasonal fluctuation in the density of Copepoda has given in diagram no. 8.

It was noticed that density of Zooplankton was maximum in summer, intermediate in winter and minimum in rainy season. Data of average value of seasonal density of recorded Zooplankton in the Yamuna river at study area (Kalpi) has given in table No.- 4.

Table No.-3 List of recorded Zooplankton in the Yamuna river at study area (Kalpi).

Protozoa

	Genera	Species
1.	*Arcella*	*dentata*
2.	*Paramecium*	*caudatum*
3.	*Vorticella*	*campanula*

Cladocera

	Genera	Species
1.	*Alona*	*rectangula*
2.	*Bosmina*	*longirostris*
3.	*Ceriodaphnia*	*reticulata*
4.	*Daphnia*	*carinata*
5.	*Moina*	*brachiata*

Copepoda

	Genera	Species
1.	*Cyclops*	*bicuspidatus*
2.	*Macrocylops*	*albidus*

Rotifera

	Genera	Species
1.	*Asplanchna*	*intermedia*
2.	*Brachionus*	*calyciflorus*
	Brachionus	*caudatus*
	Brachionus	*falcatus*
	Brachionus	*plicatilis*
	Brachionus	*quadridentatus*
	Brachionus	*rubens*
3.	*Filinia*	*longiseta*
4.	*Keratella*	*cochlearis*
	Keratella	*tropica*
5.	*Philodina*	*citrina*
6.	*Polyarthra*	sp.

Table No.4: Average value of seasonal density of recorded *Zooplankton* in the Yamuna river at study area (Kalpi).

Period Oct. 2013 to Sept. 2014 Months		**Protozoa (org./l)**	**Rotifera (org./l)**	**Cladocera (org./l)**	**Copepoda (org./l)**
Winter Season	Oct.	12	52	30	22
	Nov.	17	51	40	37
	Dec.	9	31	26	38
	Jan.	8	28	31	11
Total		**46**	**162**	**127**	**108**
Summer Season	Feb.	10	32	44	14
	Mar.	16	41	60	20
	Apr.	20	60	74	35
	May	26	100	84	42
Total		**72**	**233**	**262**	**111**
Rainy Season	Jun.	31	110	74	33
	Jul.	4	17	6	24
	Aug.	3	8	4	6
	Sep.	6	25	10	10
Total		**44**	**160**	**94**	**73**
Grand Total		**162**	**555**	**483**	**292**
Percentage (%) contribution		**10.86%**	**37.19%**	**32.37%**	**19.57%**

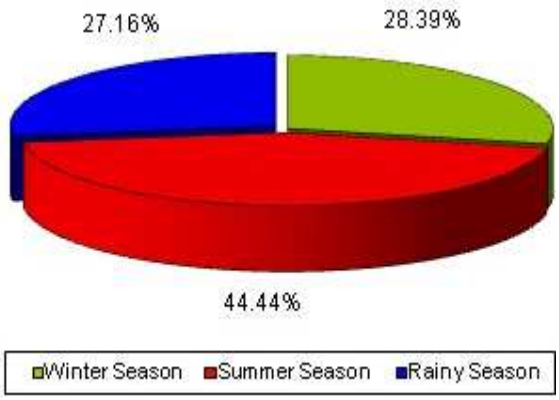

Diagram No. 5: Express seasonal fluctuation in density of Zooplankton (*Protozoa*).

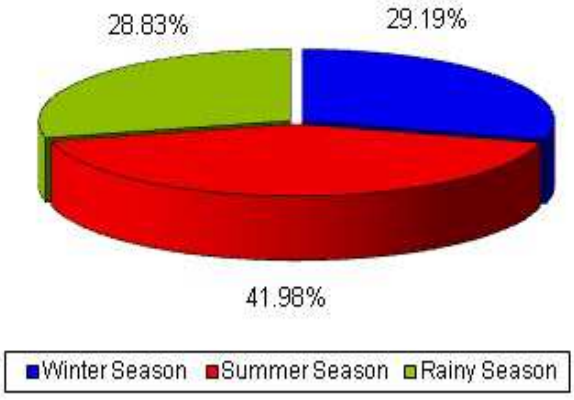

Diagram No. 6: Express seasonal fluctuation in density of Zooplankton (*Rotifera*).

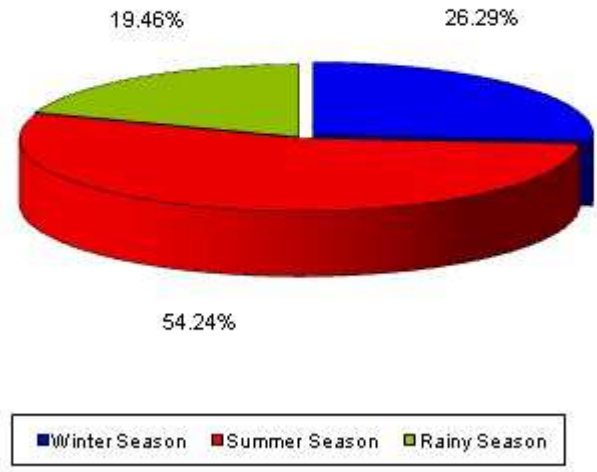

Diagram No. 7: Express seasonal fluctuation in density of Zooplankton (*Cladocera*).

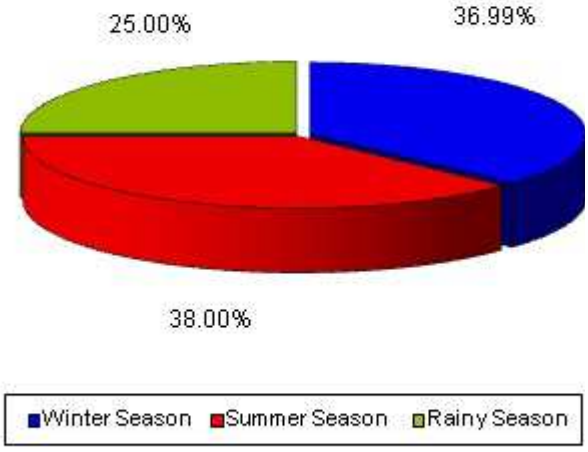

Diagram No. 8: Express seasonal fluctuation in density of Zooplankton (*Copepoda*).

CONCLUSION

Yamuna river was rich in diversity of Plankton. Registered Phytoplankton were belong to 35 species of 25 genera of different groups like as Chlorophyceae (12 species of 11 genera), Euglenophyceae (3 species of 2 genera), Bacillariophyceae (5 species of 5 genera) and Cyanophyceae (15 species of 7 genera). In the study period group Chlorophyceae was dominated over rest of the phytoplankton population. Registered Zooplankton were belong to 22 species of 16 genera of different groups like as Protozoa (3 species of 3 genera), Rotifera (12 species of 6 genera), Cladocera (5 species of 5 genera) and Copepoda (2 species of 2 genera). Among recorded Zooplankton Rotifer's population was dominant during entire study span. It was noticed that density of Plankton was maximum in summer, minimum in rainy season and intermediate in winter season.

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