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Study of Abundance and Diversity of Phytoplankton at z- Minor of Gang Canal in Sriganganagar, Rajasthan, India

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Abstract

Phytoplanktons are assemblages of heterogeneous microscopic algal forms whose movement is more or less dependent upon water currents. The present study was undertaken to explore the effect of different seasons on abundance and diversity of phytoplankton in one sites i.e. z-minor of gang canal in Sriganganagar, Rajasthan, India. The present observations were made for a period of fifteen months from September, 2012 to November, 2013 and covering all the seasons. The flora was identified by following standard taxonomic keys and illustrations. The identified phytoplankton belonged to four different families of Chlorophyceae, Bacillariophyceae and Myxophyceae and Xanthophyaceae. The phytoplankton comprises of 16 species belonging to 15 genera. Out of these, 8 species belong to Bacillariophyceae, 5 to Chlorophyceae, 2 to Myxophyceae and 1 to Xanthophyceae. The family Bacillariophyceae was dominating the canal with much abundance throughout the study period. Both the number of genera and number of species belonging to each genera was maximum in case of family Bacillariophyceae followed by Chlorophyceae, Myxophyceae and Xanthophyaceae. Maximum population abundance of Phytoplakton was observed in the summer season followed by winter and rainy.

Keywords: Phytoplankton, *Z*- Minor, Gang Canal, Sriganganagar.

Introduction

The word plankton is derived from the Greek *planktos*, meaning wandering. It is used to describe the small, usually immotile, freely floating organisms living in aquatic habitats (Powell et al., 1975). So Phytoplankton are defined as microscopic drifting or wandering or passively floating autotrophic organisms which are spread uniformly and extend down to various depths of both fresh water and marine water habitat, where light is available for photosynthesis. They are able to trap radiant solar energy with the help of chlorophyll and convert it in to chemical energy i.e. complex organic substances. So they belong to first trophic level of aquatic ecosystem. Many herbivores, mostly zooplankton, graze upon the phytoplankton thus, passing the stored energy to its subsequent trophic levels. The role of phytoplankton in energy budgets of aquatic systems and their importance in establishing their states is well known. So Planktonic life is an essential part of aquatic ecosystem to maintain a healthy and productive environment (U. Anitha Devi and M.A. Singara Charya, 2007; Khangarot and Das, 2009). Shastree, 1992 identified two main advantages of the phytoplankton study. They are: (1) fish monitoring and surveillance programme, and (2) sensitivity towards foreign material and indication of contaminant stress. Phytoplankton studies and monitoring are useful for control of the physico-chemical and biological conditions of the water in any irrigation project.

Objective of the Study

The aim of this work was to study the diversity and abundance of phytoplankton in relation to change in season in *z*-minor of the site of Gang Canal, Sriganganagar, and Rajasthan, India.

Review of Literature

Bishnoi et al. (2013) ; Bishnoi and Sharma (2016) investigated the phytoplankton of Gang canal of Sriganganagar which comprises of 16 species belonging to 15 genera. Out of these, 8 species belong to Bacillariophyceae, 5 to Chlorophyceae, two to Myxophyceae and one to Xanthophyceae. In this study the largest and diverse group is Bacillariophyceae.Sharma and Srivastava (2016) revealed the

occurrence of 27 species of phytoplankton, among these 12 species of Bacillariophyceae, 9 species of chlorophyceae, 3 species of cyanophyceae and 1-1 species of zygnemataceae, myxophyceae and chaetophoraceae in their study. The total number of species was found to be in the following order Bacillariophyceae> Chlorphyceae> Cyanophyceae> Zygnemataceae, Myxophyceae and Chaetophoraceae. Therefore diversity wise Bacillariophyceae was superior with more number of species. Singh et al. (2016) studied effect of pollution on biodiversity of phytoplankton of river Gomati. The biological productivity as ecological indicator to identify the ecological quality of river Gomati. During study period the total of phytoplankton (35 sp.) were noticed during different seasons. The phytoplankton density fluctuated maximum during summer season and minimum during monsoon season. The study indicated that highest phytoplankton population in summer season due to favorable condition of growth and velocity of water. It had been monitored during the study time that the water current above the moderate speed is usually directly inhibitory to phytoplankton development. The fluctuation in occurrence of phytoplankton and abundance can be a major indicator of the environmental status of any water body like phytoplankton. The study revealed that population density of different biotic community including phytoplankton in river Gomati were affected with the variations of abiotic factors either directly or indirectly. This study concluded that seasonal differences of phytoplankton density will help in further planning of water management and their use for beneficial purpose like agricultural, drinking etc. for mankind. Taruni sarang and Kapila Manoj (2017) made quantitative estimation of Phytoplankton in relation to Physico- Chemical properties. The results show that throughout the study period Bacillariophyceae group of organisms found abundantly. While density of Chlorophyceae groups and Cyanophyceae group of organisms fluctuates. The correlation between phytoplankton population and physicochemical parameter revealed that Bacillariophyceae was statistically significantly positively correlated at 1% level of significance with pH. Alkaline pH supports the growth of Diatoms. Bacillariophyceae was also positively correlated with Nitrate. Cyanophyceae is positively correlated with Temperature. Euglenophyceae was positively correlated with pH while, Dinophyceae was negatively correlated with pH.

Material and Methods

Study Area

Sriganganagar is the North most District of Rajasthan state of India and is situated between Latitude 28.4^{o} to 30.6^{o} and Longitude 72.2^{o} to 75.3^{o}. The Ganganagar is named after Maharaja Ganga Singh, the ruler of former Bikaner State, whose continuous efforts resulted in the advent of Gang Canal in this thirsty and arid land of the district. Gang Canal and introduction of other irrigation facilities, most of the portion of the block has been reclaimed for intensive farming. Consequently, Ganganagar today bears the proud title of being the granary of Rajasthan. Gang canal is the life line of Sriganganagar District. City of Sriganganagar get canal water supplies from Z-distributary and that divides into three *a, b*, and *z*-minor. We selected *z*-minor as a study site. It is selected at origin of *z-minor* from Z-disty. near the origin of a-minor. Not much human activities is evident at this sites except for some human bathing and Utensils & cloth washing which are done by villagers. The water is comparatively clean at this point.

Study duration and Sampling Procedure

The sampling on monthly basis was done for a period of 15 months from September, 2012 to November, 2013 from the three sites by plankton net (Plankton net number 25 of mesh size 20 µm). 100 liters of water was measured in a graduated bucket and filtered through the net and concentrated in a 100 ml bottle. Samples were collected as close to the water surface as possible in the morning hours and preserved for further analysis.

Preservation of the sample

For a plankton sample to be analyzed for an extended period, commonly two preservatives are used: Lugol' s iodine using acetic acid which will stain cells brownish yellow and will maintain cell morphology and of 4% formaldehyde. But here samples were preserved with Lugol' s iodine in 10:1 ratio i.e. 10 ml water sample: 1 ml Lugol' s iodine (Trivedy et al, 1986).

Concentration Technique

The 100 ml preserved sample was allowed to settle for 24-48 hours and was further concentrated to approximately 30 ml by decanting. The concentration factor is used during the calculations.

Mounting the Slides

Concentrated samples in a bottle are mixed uniformly by gentle inversion. Then by using bore pipette 1 ml of sample was transfer on Sedgwick Rafter count cell. Now it was covered by using cover slip, avoiding any kind of air bubble. Then it was kept for 10-15 minutes so that all plankton may settle down. Now the Sedgwick rafter counting cell is placed under microscope and then plankton was identified by moving the cell horizontally and vertically. The process was repeated twice.

Phytoplankton Identification under microscope

A binocular compound microscope is used in the identification of Phytoplankton with different eyepieces such as 10X and 40X. Identification of specimen was carried out by taxonomic keys and illustrations given by Hutchinson, 1957; Desikachary, 1959; Prescott, 1962; Edmondson, 1966; Round, 1975; Chapman & Chapman, 1975 and Needham & Needham, 1975.

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Results and Discussion

Table 1 : Number of Genera and Species of Phtyoplankton (Family wise) and their percentage of species in *z*-minor of Gang Canal, Sriganganagar, Rajasthan, India.

Name of family	No. of Genera	No. of species	Percentage of species
Bacillariophyceae	7	8	50%
Chlorophyceae	5	5	31.25%
Myxophyceae	2	2	12.5%
Xanthophyceae	1	1	6.25%
Total	15	16	100%

Table 2: Distribution pattern for family of Phytoplakton in *z*-minor of Gang Canal, Sriganganagar, Rajasthan, India(September, 2012 to November 2013).

Month → / Family ↓	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
Bacillariophyceae	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
Chlorophyceae	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
Myxophyceae	_	_	_	++	++	+	+	+	+++	+++	+	_	_	_	_
Xanthophyceae	+	+	+	++	++	+	_	_	_	_	_	_	_	+	+

Table 3: Distribution pattern for family of Phytoplakton in *z*-minor of Gang Canal, Sriganganagar, Rajasthan, India (September, 2012 to November 2013). (+) Low, (++) Moderate, (+++) High. (-) absence of species.

Month → / Family ↓	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
Bacillariophyceae															
1.Achnanthes exigua	-	+	+	++	++	+	+	+	+++	+++	+	-	-	+	+
2. Cocconeis spp.	-	+	+	++	++	+	+	+	+++	+++	+	-	-	+	+
3. Gamphonema parvulum	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
4. Cymbella Cistula	-	+	+	-	-	+	+	+	+++	+++	+	-	-	+	+
5. Navicula simplex	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
6. Navicula spp.	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
7. Nitzschia spp.	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
8.Fragilaria brevistriata	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
Chlorophyceae															
1. Ulothrix zonata	-	+	+	-	-	+	+	+	+++	+++	+	-	-	+	+
2. Microspora spp.	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
3. Pithophora spp.	-	+	+	++	++	+	+	+	+++	+++	+	-	-	+	+
4.Ankistrodesmus convolutus	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
5.Scendesmus platydiscus	+	+	+	++	++	+	+	+	+++	+++	+	+	+	+	+
Myxophyceae															
1. Rivularia spp.	_	_	_	++	++	+	+	+	+++	+++	+	_	_	_	_
2. Phormidium spp.	_	_	_	++	++	+	+	+	+++	+++	+	_	_	_	_
Xanthophyceae															
1. Vaucheria spp.	-	+	+	++	++	+	_	_	_	_	_	-	-	+	+

Fig. 1: Pie chart showing percentage of species in each family of Phytoplankton in *z-minor* of Gang Canal, Sriganganagar, Rajasthan, India.

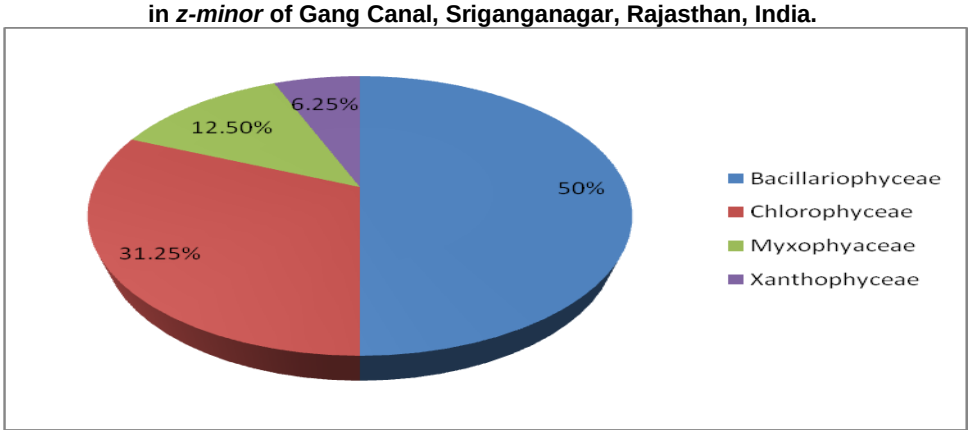
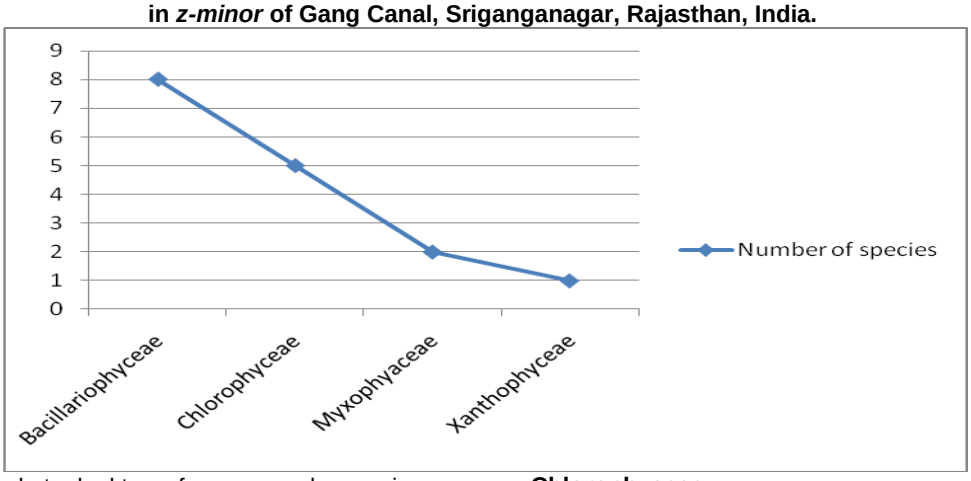


Fig. 2: Graph showing variation in number of species in each family of Phytoplankton in *z-minor* of Gang Canal, Sriganganagar, Rajasthan, India.



The phytoplankton of gang canal comprises of 16 species belonging to 15 genera belong to four families of Bacillariophyceae, Chlorophyceae, Myxophyceae and *Xanthophyceae* were identified in the water of this site of Gang canal. Number of Genera and Species of Phtyoplankton (Family wise) and their percentage of species and their distribution in all three sites of Gang Canal, Sriganganagar, and Rajasthan, India is given in Table 1, 2 and 3.

In the present investigation, the family Bacillariophyceae was dominating the river with much abundance throughout the study period. Both the number of genera with number and percentage of species belonging to each genera was maximum in case of family Bacillariophyceae (8, 50%) followed by Chlorophyceae (5, 31.25%) and Myxophyceae (2, 12.50%), *Xanthophyceae*(3, 6.25%). Number of Genera and Species of Phtyoplankton (Family wise) and their percentage of species in all three sites of Gang Canal, Sriganganagar, Rajasthan, India (fig. 1 and fig. 2). Detail of each family is given below.

Bacillariophyceae

In present study the largest and diverse group is Bacillariophyceae. Diatoms were represented by 7genera and 8 species *Achnanthes exigua, Microspora spp., Gamphonema parvulum, Cymbella cistula , Navicula simplex, Navicula spp , Nitzschia spp , Fragilaria brevistriata.*

Chlorophyceae

Chlorophyceae was the second group after Bacillariophyceae in the number of identified species observed. In this group 5 genera and 5 species were recorded which are Ulothrix *zonata, Microspora spp., Pithophora spp., Ankistrodesmus convolutes, Scendesmus platydiscus*

Myxophycaeae

Myxophycaeae was represented by 2 genera and 2 species of which. *Rivularia* spp., *Phormidium* spp.

Xanthophyceae

Only one species of Xanthophyceae were recorded that is *Vaucheria* spp.

Similar phytoplankton diversity has been observed by Bishnoi *et al.,* 2013.; Bishnoi and sharma, 2016 in Gang Canal of Sriganganagar in their studies. Similar result have been found by Kumar *et al,*2012.*;* Fouzia Ishaq *et al.,*2013; Kushwaha and Agrahari, 2015 **;**Matta, 2015; Sharma and Srivastava, 2016; Taruni Sarang and Kapila Manoj, 2017, where they observed dominance of Bacillariophyceae. According to Oritz and Cambra, 2007 phytoplankton community is generally dominated by members of Bacillariophyceae perhaps because of their capability of utilizing the nutrients. Fouzia Ishaq *et al,* 2013 evaluated both the number of genera and number of individuals belonging to each genera was maximum in case of family Bacillariophyceae followed by

Chlorophyceae and Myxophyceae. Probably, the diatoms which are typical lentic flora get continuously washed into Gang canal from Harike Barrage.

Many genera were seasonally and monthly absent at different times in the canal; however the overall diversity was found to be maximum in summer. The values of different phytoplankton groups and species fluctuated in all the samples. In the seasonality of the phytoplankton, summer had the maximum species diversity (15 species) while winter and monsoon recorded 14 and 8 species respectively. Within the three seasons, the highest phytoplankton was in summer and the lowest was in monsoon. Similar results were observed by Bhowmick and Singh 1985; Kushwaha and Agrahari, 2015; Singh *et al.*, 2016.

Bacillariophyceae or Diatoms being the dominant phytoplankton of the canal water. Their maximum number was in summer (May and June) and the minimum in monsoon season. Further, the diatoms were maximum in summer and minimum during monsoon.

Chlorophyceae were the second largest group in the phytoplankton of the Gang canal. Their minimum number was in monsoon and the maximum at summer(May and June).The *Myxophyceae* were represented only by two species. The highest was observed in summer (May and June). Blue green were absent from monsoon season (August and September) to early winter (October and November). The absence of *Myxophyceae* in post monsoon and early winter months of September to November could be due to the influx of clean freshwaters containing less of dissolved organic. The fast flowing water further discouraged their development as *Myxophyceae* are the algae of standing waters. *Xanthophyceae* was the lowest in abundance in the phytoplankton of Gang canal. It was represented only by one species (*Vaucheria* spp.) which showed its appearance only in winter and early summer month of March. The maximum number was observed in January and February. They were absent in monsoon during August and September, the plankton could not be studied due to the heavy silt laden water in the Gang canal (Bishnoi and sharma, 2016). *Xanthophyceae* showed its appearance only in winter and early summer month of March thus showing the preference for low temperature.

Their abundance in summer was because of higher values of temperature; moderate values of water current, turbidity and alkaline pH (Saravanakumar *et al*., 2008).The abundance of phytoplankton was highest during the pre-monsoon period, which could be attributed to more stable hydrographical conditions prevailing during summer months (kumar et al., 2012). During monsoon and early months of winter (Oct., Nov.), the plankton was minimum due to fast water current in the present investigation. The volume of plankton present in any lotic system is inversely proportional to the rate of the water current. Probably, during monsoon period the plankton was low in August and September owing to heavy silt laden incoming waters. The silt laden incoming water blanketed the penetration of light and the fast flow of water further discouraged plankton production owing to friction and washing off of the earlier developmental stages of the planktonic algae. Rai, 1974; Vasisht and Jindal, 1980; Sharma *et al*., 2013; Bishnoi and sharma, 2016 expressed similar views.

Conclusion

The values of different phytoplankton groups and species fluctuated in all the samples in different seasons. Both the number of genera and number of species belonging to each genera was maximum in case of family Bacillariophyceae followed by Chlorophyceae, Myxophyceae and Xanthophyaceae. Maximum population abundance was observed in the summer season followed by winter and rainy.

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